Barriers towards the Provision of Orthodontic Treatment for Visual or Hearing Impaired Children In Saudi Arabia (Riyadh)

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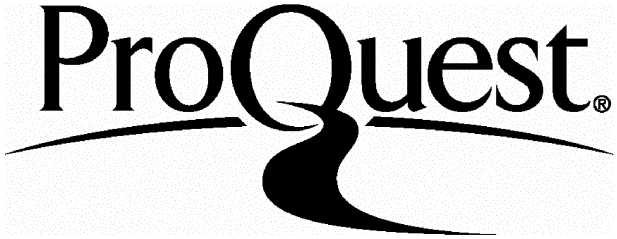

DEDICATION

WITH LOVE AND HONOUR

IN THE MEMORY OF MY PARENTS

ABSTRACT

Anecdotal evidence exists that children with sensory impairments (SI) are being disadvantaged in accessing dental care and in particular orthodontic treatment.

The aims of this dissertation were, first, to develop tools to assess, for visually impaired (VI) children, their orthodontic treatment need based on the aesthetic component (AC) of the Index of Orthodontic Treatment Need (IOTN). Second, to explore barriers to orthodontic treatment for SI children (11-16 years old) in Riyadh, by determining the oral health status, orthodontic treatment need, attitude of parents, as well as the attitudes of the dental profession and undergraduate dental students to the provision of dental treatment for these groups.

With respect to the first aim, tactile graphics were produced and approved by a panel of 9 experts and 13 VI children. With regard to oral health status, there was no difference between the SI children and control group in caries prevalence, enamel defects and malocclusion although, higher levels of gingivitis and incisor trauma existed in hearing impaired (HI) children.

No significant difference could be found between the three groups in treatment need based on the dental health component of IOTN (27.3% of VI, 30% of HI and 22.4% of control). However, for the AC, VI (55.8%) children rated a higher treatment need compared to the control (39.4%) and HI (43%) children. Control (81.3%) and HI (78.2%) children rated themselves as 1 (most attractive) more than VI (35%) children.

Overall, dentist's attitudes toward SI people were positive, but HI children were viewed more positively than VI. The general belief was HI children would be more dentally conscious, cope better with orthodontic treatment, and have better oral hygiene.

The fifth year dental students were marginal more positive toward SI people than third year students and that was related to their satisfaction to their educational curriculum.

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Thanks to God for his support and made this possible

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CHAPTER ONE

Introduction

1.1 Introduction

In recent years, the perception of an individual with disability has been slowly evolving from the "forgotten" person to one who is recognised as needing treatment. The literature suggests that, in the past, such individuals were mainly institutionalised, and their health needs largely ignored. Changes in social attitude meant that large numbers of people with a disability, now living in the community, sought treatment from a medical system which was all too often ill-equipped to deal with them.

One area that typifies this problem is dentistry and specifically orthodontic care. A child's self image is largely based on the way others treat him/her. Although numerous social factors interact to produce self-esteem, one very significant factor is a child's facial attractiveness. Orthodontic treatment effectively improves adolescent's evaluation of their own attractiveness (Albino *et al.,* 1994). Therefore, the need to quantify the degree of malocclusion has led to the promotion of a number of indices which attempt to categorise its level of severity. The Index of Orthodontic Treatment Need (IOTN) has been widely adopted for epidemiological studies (Brook and Shaw, 1989). However, it is a visual-based instrument and has little practical use for visually impaired (VI) children who may be in need of orthodontic treatment.

Dental treatment has been established and accepted as an essential aspect of everyday life. The dental management of sensory impaired children is not well documented in the medical literature. A number of studies present programmes of preventive dentistry for this group (Rapp *et al.,* 1966; Huntley and Ralston, 1977; Ball *et al.,* 1978; Ligh, 1979; O'Donnell and Crosswaite, 1999) as well as a small number of epidemiology studies have been reported (Greely *et al.,* 1976; Shaw *et al.,* 1986). There could be a number of reasons for this poor level of care, including lack of training, economic conditions, problems of patient management, lack of facilities and staff, and unfortunately, the negative attitude, barriers and beliefs of the dentists themselves.

Therefore, we have little information on the oral health needs of sensory impaired children and the provision of orthodontic care appears to be limited.

Another challenge to researchers in special care dentistry is the grouping of conditions/disabilities. The amalgamation of visually and hearing impaired people into a single sensory impaired group may in fact mask the specific needs of each group. The disability literature shows that there is a uniformity of the way different disabilities are ranked (according to the impact this has on health) by both health providers and across national boundaries (Ustun *et al.,* 1999). The disability was ranked solely on the basis of its disabling effects on health however, prognosis, pain, mood impact and public opinion may drive the effect. Ever so, blind people were ranked as 5 (most disabling) compared to deafness which scored a 10 (least disabling).

In summary, little is known on the oral health and orthodontic treatment need in children with sensory impairment especially in the Kingdom of Saudi Arabia (KSA), Riyadh.

1.2 Saudi Arabian population

The Kingdom of Saudi Arabia constitutes four fifths of the Arabian Peninsula, occupying an area of 1,960,582 sq. km. The modern state of Saudi Arabia was established in 1932 with the unification of the tribes of the Arabian peninsula by King Abdulaziz Al-Saud. The official language is Arabic, which is spoken by almost all of the population. The majority of the inhabitants are adherents of Islam, the official religion. This desert kingdom had seen little development until the discovery of oil in the areas near the Persian Gulf in the 1930s. This resulted in a development trend, which was boosted enormously by the rapid rise in oil prices in 1970s. The rapid influx of overseas currency, (the so-called petrodollar), gave tremendous impetus to the development of the country's infrastructure and to the standard of living of the population.

The size of the Saudi population is not known with any certainty, but most present estimates put it at about 22 million, with an annual growth rate of 3.28%. Forty-three percent of the population are under 14 years of age, and approximately 75% now live in the urban areas. The birth rate for the year 2000 was reported to be approximately 37.5-births/1000 population, and the death rate about 6.02 deaths/1000 population. Infant mortality was high, at 52.9 deaths/1000 live births in 2000 (www.cia.gov/cia/publications/factbook/goes/sa.html). Of the Saudi national population, 50.3% are male and 49.7% female. Currently, it is estimated that more than half the Saudi population is under the age of 20.

The capital, Riyadh, has a population of 3 million, which represent 16% of the Saudi Arabian population (www.saudinf.com). It lies in the centre of the kingdom and has a hot, dry summer and moderate winter.

1.2.1 People with a disability in the Kingdom of Saudi Arabia (KSA)

World-wide at least one child in 10 is born with or acquires a physical, mental or sensory impairment that will interfere with the capacity for development unless special assessments, support or care are provided (Ansari and Akhdar, 1998). An estimated 3.5% of the world's population affected with disability are children. Of these, 85.7% reside in developing countries (UNICEF, 1980). A large scale study of disability in children under 15 years was conducted in a representative Saudi population with accurate demographic records (Ansari and Akhdar, 1998). It was estimated that 3.76 per 1000 of the total population had a severe impairment, whilst 42.8 per 1000 had a minor impairment. Forty percent of the severe disability group could be accounted for by two conditions, cerebral palsy (10%) and epilepsy (30%). This is much less than the 79.5% for these two disabilities reported in a study from Japan (Nakada, 1993).

Three main schools were opened in KSA for children with disabilities. Children attending these schools included 4139 with visual impairments, 4024 with hearing

impairment and 3793 who had learning disabilities (Al-Hussain, 1998; Al-Sheik, 1998).

1.2.2 The sensory impaired child population in Saudi Arabia

A large-scale prevalence study has been conducted on a sample population of Saudi nationals living in a close-knit community (Ansari and Akhdar, 1998). This was based on a military complex with a total of 1120 families resident in the complex, giving a population of 8241; of these, 33% were children aged 15 years or less. Thirty-one children were identified with a disability. One hundred and forty-nine (1.8%) had problems with vision and 117 (1.4%) had hearing problems. Disabilities affecting vision occurred mainly in the 6-15 year age group, while 30 of the children under 5 years and 87 children of 6-15 year olds had hearing difficulties. The highest level of impairment was found in the 6-15 year age group, an expected finding because disabilities are easier to detect in older children. Visual impairments include squints, defects in visual aquity or both. Impairment of hearing was due to either chronic otitis media or wax in the ear.

1.3 Health care services in Saudi Arabia

The improved living standards following the discovery of oil in 1973 resulted in a significant expansion of the health sector. The total budget now allocated for health care in Saudi Arabia is approximately 6.2% of the total budget for the country; the dental health sector receiving about 5% of the nation's health budget (Annual Health Report, 1996).

The Ministry of Health (MOH) provides the highest proportion of the health services (70%). A further 18% are supplied by other government agencies, with the remainder, 12%, provided by the private sector (Annual Health Report, 1998).

It is the policy of the Saudi Arabian government to provide good primary health care to its citizens at no charge, or, for those with the ability to pay, only a nominal charge. In trying to fulfil this aim, the government has undertaken a major health-facilities construction programme and hospitals have been built in different parts of the country. In 1987, the Ministry of Health established more than 750 health centres and dispensaries across the country; this number increased gradually, to reach 1751 health centres and 182 hospitals in 1998.

1.3.1 Dental health care services

Until 1959, the practise of dentistry was not regulated. After 1959 the government issued a decree, granting a license to unregistered dentists, and stated that all future dentists must have qualified in a government-recognised university training programme and must be licensed by the Saudi government (Guile and Al-Shammary, 1987).

In 1984, Zaki and Tamimi, reported on the acute shortage of dental personnel in the Kingdom. They pointed out that in 1974 there were only 224 dentists practising in Saudi Arabia. The population at that time was approximately 7 million and growing at a rate of 2.7% per year. By 1980, there were 280 dentists giving a dentist-to-population ratio of 1:28,000. When compared to the physicians, it was clear that the shortage of dentists was particularly serious (Zaki and Tamimi, 1984). The situation improved rapidly; in 1986, the population rose to eight million, with more than 850 dentists (dentist-to-population ratio of 1:9,411) (Guile and Al-Shammary, 1987). The rapid population expansion ratio exacerbated to a dentist-to-population ratio of 1:15,609 with 3845 (923 Saudis) dentists around the kingdom by the year of 1998.

There are two dental schools in Saudi Arabia. A royal decree had established the King Saud University College of Dentistry in 1975. The women's branch of the college began in 1977. Government policy is based on a strict interpretation of Islamic values and keeps the sexes separate throughout the educational system;

the facilities are therefore in two different locations in Riyadh. In 1986, there was an enrolment capacity of 90 men and 60 women students per year. By 1996 there were 251 men and 194 women in training. The second dental college, King Abdulaziz University College of Dentistry, was founded in Jeddah in 1990. In 1998 it had the capacity to train 98 men and 138 women per year.

The urbanisation of Saudi Arabia has resulted in the transformation of a desert nomadic culture into a sedentary one residing mainly in the major cities of Riyadh, Jeddah, and Dammam. There is also a strong localisation of dental services in the two main cities (Riyadh and Jeddah) where the dental schools are located. As a consequence, there is still a shortage of dental services in the other parts of the Kingdom and comprehensive services are often not available (Guile and Al-Shammary, 1987; and Annual Health Reports, 1998).

Half of the dental practitioners in Saudi Arabia work for government dental programmes in the public sector. In principle, the government's philosophy is that high quality dental care should be available for the entire population, regardless of social background. This access policy functions effectively within the cities but not in rural areas where the distribution of personnel is more uneven (Guile and Al-Shammary, 1987; and Annual Health Reports, 1998).

1.3.2 Dental Resources

The Ministry of Health (MOH) sees dental care as an important priority and has invested large resources in facilities and materials. To date, it has equipped more than 1500 dental clinics around the Kingdom and the aim is to have 2000 dental clinics in operation by the end of the year 2000 (Pers.comm, Development Centre in MOH).

There are now 1751 MOH health centres, (214 have a dental clinic), 182 hospitals and 19 dental health centres. In 1999, there was a total of 1240 (313 Saudis) dentists working in these centres (Annual Health Reports, 1998). In addition the

Ministry of Defence and Aviation, the National Guard, and the Security Forces had a total of 39 hospitals and clinics in various parts of the Kingdom. Their staff included 599 (304 Saudis) dentists whose primary task was to provide dental services to armed services personnel and their dependants. The facilities were also made available to civilian sectors of the population in areas where there was a shortage of dental personnel (Annual Health Report, 1998).

The private sector, which often provides a wide range of dental services, is also growing rapidly. These include private clinics and polyclinics located mainly in the metropolitan regions and their surroundings. According to the last Annual Health Report for 1998, there were 622 private health care centres, 87 hospitals and 785 special clinics with 1213 dentists (Annual Health Report, 1998).

The philosophy behind dental expenditure for the last few years has changed from mainly curative to preventive care. Preventive dentistry focuses more in children than adults. As fluoridation is an important component of preventive dentistry, water fluoridation is being introduced for areas with piped water supplies (Guile and Al-Shammary, 1987; Health through century, 1999).

1.3.3 Resources in the City of Riyadh

The MOH has 29 hospitals distributed throughout areas in Riyadh to provide dental care. There are also 287 health care centres; 121 of these have dental clinics and there is a single dental centre, which provides dental care in all specialties. Patients are referred to the centre for treatment from other hospitals or dental clinics. In 1998, there were more than 216 dentists working for the MOH in Riyadh, 119 worked in the health centres which included dental services and 97 worked in the hospitals (Annual Health Report, 1998).

Each of the government agencies which provides health care for army services personnel and their dependants has its own hospital, with many different polyclinics located around Riyadh to help in developing rapid delivery of care for

all military service personnel. The staff working there are from different nationalities and the treatments provided are free of charge.

Riyadh has more private clinics in all specialities then anywhere else in the Kingdom. There are 10 private hospitals, 191 health centres, 279 private clinics and 53 dental centres. In 1998, there were estimated to be 383 dentists working full time and a small number working part time in the private sector (Annual Health Report, 1998).

CHAPTER TWO

Review of the Literature

2.1 Development of special education in Saudi Arabia

Special education significantly advanced in Saudi Arabia in 1958, when the blind Sheikh Al-Ghanem introduced the Braille system (Al-Sallom *et al.,* 1995). This private effort received government support and was widely promoted.

In 1960, two years after those initial Braille classes, the Ministry of Education started a special education programme and opened the government-supported training institute for male blind students, the Al-Noor Institute, in Riyadh. In 1964, the first school for visually impaired girls was founded. In the same year the first sensory impaired school, the Al-Amal Institute was opened also in Riyadh (Al-Sallom *et al.,* 1995). In 1974, the Ministry of Education passed resolution No. 674/36/40 to upgrade the Department of Special Education to a General Directorate.

Allowing these individuals to participate fully in society activities is one of the main standpoints of Saudi Arabia's policy towards the people with disabilities. Each ministry implements various care and service programmes. This is done within a co-ordinated framework to avoid duplication of services. The Ministry of Labour and Social Affairs implements vocational and social training and qualifying programmes for people with disabilities. The Ministry of Health implements health care services and medical rehabilitation programmes whilst the Ministry of Education implements the education and instruction programmes.

Over a number of years important organisational decisions were made by the Cabinet and the Ministry of Education to develop the present programmes. They demonstrate the amount of effort that has been exerted and is still being promoted by the state, to ensure that a high quality service is being provided to this group. The result of the studies conducted to develop the present programmes and to introduce new programmes for the education of people with disability are shown below (Page 14) (Al-Sallom *et al.,* 1995).

2.1.1 Visually Impaired people

The Al-Nour Institutes for visually impaired people provide educational training, cultural programmes in addition to full health, social and psychological care for visually impaired boys and girls (Al-Sallom *et al.,* 1995). The Institutes offer room and board for students whose families do not live within commuting distance. Visually impaired students, whose vision is between 6/24 and 6/60 in the strongest eye, or both eyes with the aid of corrective lenses, generally study in regular public schools, which provide them with special health and social services (Al-Sallom *et al.,* 1995).

The Institutes use the same grade structure and curriculum as the regular public schools for elementary, intermediate and secondary levels. Students who complete their secondary level education are encouraged to pursue further study at university level, and are eligible for government financial support and scholarships (Al-Sallom *et al.,* 1995). There are also occupational training programmes for older students, which focus on manual skills such as weaving, rug making, manual and machine knitting, constructing cleaning equipment and home economics. In addition to the general curriculum, secondary level female students also learn childcare and typing skills in Arabic and English.

2.1.2 Hearing Impaired people

The Al-Amal Institutes provide educational and health programmes for hearing impaired boys and girls. Room and board are available to all students whose families do not live near the Institutes. There are three grade levels in the programmes; nursery, elementary and intermediate. Hearing impaired students enrolled in the intermediate section specialise in two technical fields, chosen from typing, photography, printing, electrical wiring, manual and machine knitting and tailoring (Al-Sallom *et al.,* 1995).

Admission requirements for the Al-Amal Institutes specify that students must be completely or partially hearing impaired, with a hearing loss of at least 80 decibels in one or both ears after treatment or for those who use hearing aids. The best qualified graduates from intermediate level are eligible for government scholarships for specialised training courses in the UK. Further training at the post secondary level is available to some graduates at specialised institutes in Europe and USA.

Students with less severe hearing impairment (generally less than 80 decibels after treatment and use of hearing aids) are served by special classes provided by the regular public schools. Hearing, speech and literacy classes have opened for deaf adults.

2.1.3 People with learning disabilities

The Al-Tarbiyah Al-Fikriyah Institutes for people with learning disabilities offer comprehensive educational and training programmes, full health care, and room and board for boys and girls (Al-Sallom *et al.,* 1995). Special curricula are available at the nursery and elementary levels, and are carefully adapted to the abilities and needs of the students. The more severe learning disability students who are classified as "trainable" are sometimes sent by the government to special training programmes in Egypt, Syria, Lebanon and Jordan. The most severe who need complete physical care live in residential units run by the Ministry of Labour and Social Affairs, where their health, social and psychological services are provided.

Students at the Al-Tarbiyah Al-Fikriyah Institutes must be in good health and not have any other disabilities. Students must have an IQ in the range of 50-70 and be between the ages of 4-15 years.

The number of special education institutes and programmes annexed to general schools in the academic year 1998 was 77, of which 13 were schools for the blind, 35 schools for the deaf and 29 schools for the learning disabilities (Al-Hussain,

1998; Al-Sheik, 1998). The staff consisted of 1982 educational positions and 533 administratire positions.

2.2 Facilities for the people with disabilities

The Saudi Arabia government is keen to enable all people with disabilities to have the benefits of facilities and care. There has been a major development programme, in particularly housing, transport, vocational training for employment etc. The Ministry of Education has also set up special facilities, equipped with modern technology, to assist in the programmes and services for those group.

2.2.1 The Central Talking Library for the blind

This aims to integrate blind people into ordinary schools providing them with talking and Braille books. It also supplies them with general information and knowledge both while studying and after graduation from university.

2.2.2 Education Aids Production centre for the blind

The purpose of this centre is to produce the aids needed by institutes for the blind, especially material which is generally not available, or to replace the imported ones not written in Braille.

2.2.3 Hearing and Speech centre

This aims to improve the specialised service offered to those who are hearing impaired, with specialised training provided for teachers and technicians in these centres.

2.2.4 Braille Printing Presses

To keep abreast with modern technology, the printing press was modernised in order to produce textbooks and cultural books in Braille. The presses were provided with modern machines, a complete computer for Braille printing and other supporting equipment to produce drawings and relief maps.

2.3 Terminology for the study

Studies of people with disabilities show the social and psychological disadvantages associated with disability (Chamie and Mufarrij, 1986). Such conditions and states, known as handicaps, may vary in degree. The course from disability to handicap may take different pathways in different societies, and may present differently between individuals (Shaar and McCarthy, 1994). Researchers have noted, for example, that attitudes towards disabilities are inversely related to the economic status of a country (Jordan and Friesen, 1969). In addition, lack of access to education and high unemployment rates are found among the people with disabilities in some developing countries (Chamie and Mufarrij, 1986).

2.3.1 Definitions of handicap prior to 1980

Until recently, the terms "disability" and "handicap" were used interchangeably. This lack of differentiation and lack of a unifying conceptual basis for determining handicap had vast implications with regard to planning activities, policy formulation, and provision of services. Some of these definitions are: "Having difficulty meeting the requirements of current and previous jobs, and needing help with self-care and other daily activities" (Nagi, 1976), "The circumstances of the person with a disability include employment, occupational level, income and assets, housing conditions, and subjective feelings of deprivation" (Townsend, 1979).

2.3.2 Conceptual frameworks

Two major conceptual frameworks for defining handicap are explained in: the Nagi framework (Nagi, 1976) and the International Classification of Impairments, Disabilities and Handicaps (ICIDH) (WHO, 1980).

2.3.2.1 The Nagi framework

Nagi (1976) proposed four distinct but interrelated concepts: active pathology, impairment, function limitation and disability. Active pathology may result from infection, trauma, metabolic imbalance, etc. Impairment, on the other hand, indicates a loss or abnormality of an anatomical physiological, mental or emotional nature which results in functional limitations. Disability refers to social rather than physical functioning: it is an inability or limitation in performing or filling the socially defined roles and tasks expected of an individual within his or her sociocultural and physical environment. This framework does not have a classification system, but it is consistent with the concepts used in major US national surveys and with definitions of work-related disability used by the US Bureau of the Census.

2.3.2.2 The International Classification of Impairments, Disabilities and Handicaps (ICIDH)

Based on the work of Wood and his colleagues, the WHO proposed a classification system in 1980 to be used in conjunction with the Ninth Revision of the International Classification of Disease (WHO, 1977). This concept of disease is based on a continuum expressed as:

Disease→ Impairment→ Disability→ Handicap

According to this model, a pathological state is manifested as a clinical disease when the individual recognises an impairment or abnormality of body structure,

appearance and/or organ system dysfunction. Consequently, the performance or functional ability of the individual may be altered; these activity restrictions represent disabilities. Social situations may place the individual at a disadvantage. This is termed handicap: the disadvantage resulting from impairment and/or disability that limits or prevents the fulfilment of a role that would be considered normal for an individual (Patrick, 1989). A review of the Nagi framework and ICIDH shows that they propose similar concepts but give them different names. Thus, both agree on the concepts of impairment and functional limitation, but social disability in Nagi's framework is referred to as "handicap" in the ICIDH.

2.3.2.3 Revisions of International Classification of Impairments, Disabilities and Handicaps (ICIDH-2)

ICIDH aimed at unifying opinion on concepts of impairment, disability and handicap. The use of the ICIDH as an instrument tool for classification has been criticised and overviewed firstly in 1988, 1990, 1994 and finally in 2000. The ICIDH-2 reflects changes in both definitions and relationships from the 1980 version as the basis for the preparation for the final version expected in 2001.

The goals to be achieved by the revision are:

- Adaptation of the ICIDH to application not foreseen in the 1980 version;
- Adaptation of the ICIDH to new developments in health care;
- Changes based on criticisms of the 1980 version.

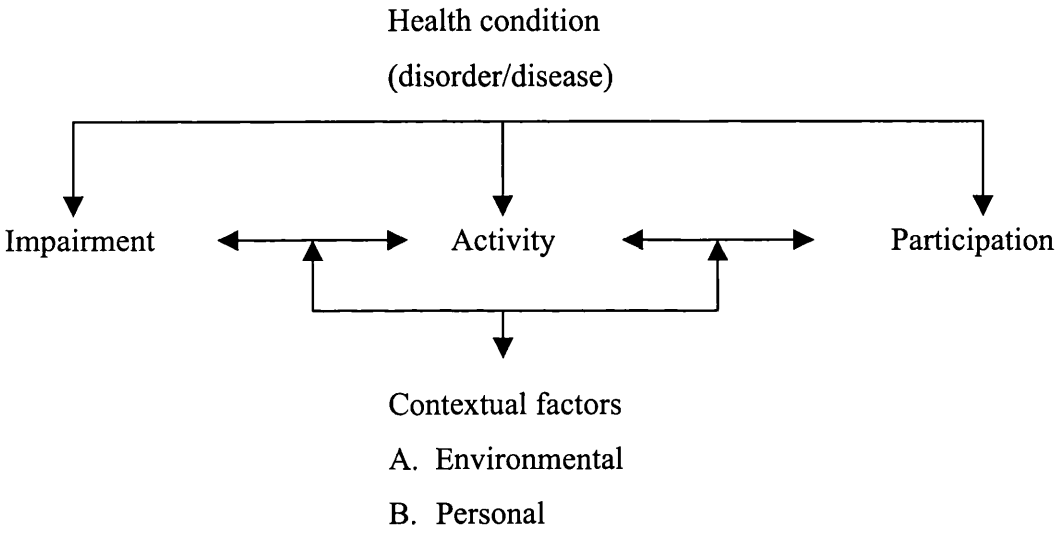
Therefore, the WHO collaborating centre for the ICIDH in the Netherlands has formulated specific goals towards revising the ICIDH since 1990 (Halbertsma *et al.,* 2000). The ICIDH-2 draft differs from the 1980 version in that the three dimensions of Impairments, Disabilities and Handicaps are re-framed as:

- Classification of impairments of function;
- Classification of impairments of structure;
- Classification of activities;

- Classification of participation;
- Contextual factors, list of environmental factors.

The current understanding of interactions within the ICIDH-2 dimensions are presented in Fig 2.1.

Fig 2.1 Interaction between ICIDH-2 dimensions



The coverage of the ICIDH emphasised conditions based on physical and motor problems with applications primarily involving adult populations. There are growing concerns in health, education and related services regarding the need for consistent classification of childhood disability (Stein *et al.*, 1997). The prevalence of disability among children varies such in Britain, it has been reported to be 3% whereas 12.2% of the US school population have been identified as students with disabilities (Hutchinson, 1995). These students have been assigned to various categories, including mental retardation and deaf-blindness as well as to categories combining the prefixes orthopaedic, visual, hearing, learning and emotional with terms impairments, conditions, disorders and disabilities. This variability and the lack of a common classification system have created persistent

problems in documenting the epidemiology of disability in children and in the provision of appropriate services.
The above issues have contributed to growing interest in the revision of the ICIDH as a classification tool.

All classifications are now formulated in neutral wordings, overlap between the three classifications has been reduced and the introduction has been changed rather drastically. In this thesis, the term disability will be used to describe the impairment of an individuals' physical abilities.

2.4 Sensory impairment

The dental literature reveals few articles specifically concerned with sensory impairments (visual and hearing) in children. However, it appears that the number of children with sensory impairments is such that the problem of their care, including their dental care, can no longer be ignored.

Before describing the few studies, a brief overall knowledge of sensory impairment will be presented.

2.4.1 Blindness (terminology, aetiology, type)

Visual impairment is the most readily recognised disability involving the loss of a sensory modality. It is estimated that between 10 and 15 million people in the world are totally blind. By the year 2000, it is estimated that this number will exceed 30 million.

2.4.1.1 Terminology

In this thesis, the term visual impairment is used. Children who are totally blind make up only a small minority of the visually impaired community. These

individuals are unable to perform any work for which eyesight is essential. A blind person (in law) is one who, with the best optical correction, can see less at 20 feet than a person with normal vision can at 200 feet (visual acuity is 20/200), or whose field of vision is limited to a narrow angle. Included in the group with visually disability, but not legally blind, are the partially sighted; these individuals are people with a permanently disability by a defective vision caused by congenital defect, illness or injury. Such children have a visual acuity of 20/70 or less in the better eye, but have a residue of useful sight that makes it possible to use their vision as the chief channel of learning and approach to the brain (Wang *et al.,* 1991).

Scott (1969), in his classic sociological study, summarised criticisms of legal blindness as a criterion of need for services. The essential point is that legal blindness refers to impairment and is used as if it were a measure of disability, (i.e. functional limitations in tasks that involve seeing) and of handicap, (i.e. limitations in performing roles).

Peterson *et al.* (1980) chose the set of terms adopted by the WHO in 1980. The problems here are that there may be a misclassification of children with regard to visual and the mental, emotional or learning disability categories.

In order to describe variations among children in terms of the severity of their condition, different variables must be considered in connection with each of the four concepts. Impairment is only one of the variables involved in disability, and it is an even smaller part of the different aspect involved in handicap (Wang *et al.,* 1991).

2.4.1.2 Prevalence

Blindness has long been recognised as a major cause of human disability and suffering in developing countries, including Saudi Arabia (Al-Faran *et al.*, 1993). The National Eye Survey, conducted in 1984, revealed that 1.5% of the

population in Saudi Arabia was blind and 7.8% visually impaired, according to WHO standards. In Saudi Arabia, the prevalence of blindness varies from region to region, the highest prevalence being 3.3% in the eastern province (Tabbara and Ross-Degnan, 1986).

2.4.1.3 Aetiology

Information is very limited concerning the causes of visual impairment. Current information on the nature and distribution of the causes of blindness are inadequate for either educational and health professional purposes; what little exists is collected and analysed almost entirely from the medical point of view. From the point of view of aetiology, prenatal influence is believed to be the major cause, mainly as a result of hereditary conditions. Infectious disease was the next largest category for the under 5 year-olds (14%). For 5-year-old children and between 5-19 years, injuries and poisoning (mainly excess oxygen) accounted for about 10%. Neoplasm accounted for about 5% in each age group, followed by various other diseases (Wang *et al.,* 1991).

Tabbara and Ross-Degnan (1986) reported that cataract is the leading cause of blindness in Saudi Arabia, accounting for 55% of cases. The second highest cause of blindness was trachoma (20.6%). Trachoma, despite its rich history dating back some 3000 years, is still a major cause of world blindness, with an estimated five hundred million people affected, of which 7 million blind have lost their sight (Tabbara and Ross-Degnan 1986). It is endemic mainly in dry areas such as Saudi Arabia, and in areas with a socio-economically-stratified society. This is a factor which promotes its transmission, and secondary bacterial infection plays an important role in the pathogenesis of scarring and blinding complications. In the Eastern province of Saudi Arabia, it was found that some 11.6% of those with impaired low vision and 14.6% causes of blindness were due to or associated with trachoma (Al-Faran *et al.*, 1993). Saudi women were also at greater risk of trachoma related blindness. Presumably their close contact with young children increases the frequency of chlamydial reinfection, the major pathway to blinding.

2.4.1.4 Type

When causes of blindness are classified by site and type of effect, conditions affecting the optic nerve and optic pathway were of nearly equal prevalence with those involving the eyeball (25% each). Within these broad categories, the most common types were optic nerve atrophy and glaucoma, respectively. Next most important were groups of conditions affecting the retina and the lens; these were of almost equal prevalence at 17% and involved mainly retrolental fibroplasia (RLF) followed by cataracts (Wang *et al.,* 1991).

When aetiology and type are combined, the three leading causes of blindness were prenatal cataract, optic nerve atrophy, and RLF respectively.

2.4.2 Deafness (terminology, aetiology, type, degree and onset of deafness)

The importance of hearing impairment, whether present in the newborn or acquired in the first few years of life, cannot be gauged only by the extent of the hearing loss. The effects that deafness have on the development of communication ability is crucial.

2.4.2.1 Terminology

The terms deafness and hearing impairment have been defined from a variety of different perspectives, including audiological, cultural and behavioural criteria. "Hearing impaired" is often used to denote the entire spectrum of hearing loss from mild to profound. In contrast, the term deaf has been restricted to the subgroup of hearing impairment persons whose hearing loss is profound (greater than approximately 90 decibels across the speech range) (Wang *et al.,* 1991). Again, the term hearing impaired will be utilised in this thesis.

2.4.2.2 Prevalence

A random sample survey of 6421 Saudi infants and children below the age of 12 years was carried out in Riyadh over a 27-month period from 1988-1990. The prevalence of hearing impairment was found to be 7.7% (Bafaqeeh *et al.,* 1994).

2.4.2.3 Aetiology

Hearing impairment may be congenital or adventitious. The former may be either endogenous or exogenous. Endogenous hearing impairment involves the hereditary transmission and may be linked with either dominant recessive or sex-linked traits. Exogenous congenital hearing impairment involves *in utero* conditions such as maternal rubella. Adventitious hearing impairment develops after the acquisition of language. It may be caused by viral infection, injury, drug toxicity or a hereditary condition (Zakzouk, 1997). Furthermore, certain causes of deafness may produce visual impairment of varying degrees in a hearing impaired child. Congenital rubella is associated with the broadest spectrum of ocular and visual problems. It appears to have a significant effect on corneal curvature as well as to be associated with anomalies of other organ systems.

Studies on the epidemiology and aetiology of hearing impaired children in Saudi Arabia indicated that the cause was limited to bacterial infections. Other major factors such as hereditary and consanguinity were predominant (Zakzouk, 1997). A representative sample of 6421 Saudi children were clinically examined and screened. Hearing impairment was detected in 494 children; 326 cases were due to chronic secretory and suppurative otitis media and in 168 (5.07%) were the result of sensorineural hearing loss (2.6%). Zakzou emphasised that consanguineous marriage, which is widely practised in Saudi Arabia, carried the danger of continued propagation of hereditary deafness. The hereditary hearing impaired were reported as 1.7% (Bafaqeeh *et al.,* 1994). Children from families of low socio-economic status tended to have a higher rate of hearing impairment

than middle and upper class children. Children whose family income was below SR 5000 (£830) per month showed relatively higher levels than other children.

2.4.2.4 Age, Type, Degree

It is important to determine the age, type, degree at onset and aetiology of deafness, in order to understand its impact on behaviour from the psychological point of view. For example, it was determined that when severe and profound hearing impairment was either congenital or had occurred prior to the age of 4-6 years, significant educational retardation was present compared with children who suffered hearing impairment after the age of 6 years (Zakzouk, 1997).

On the other hand, linguists now believe that a child's basic language skills are not established until 4-4½ years of age (McNeill, 1965). Aside from age at onset, knowing the type of hearing impairment is important in mapping out the educational future of the child. Goetzinger (1974) states that the child born with a conductive hearing loss usually has an advantage in language acquisition over one born with sensorineural hearing loss. Individuals with sensorineural deafness usually have auditory discrimination problems; this has a deleterious effect on language acquisition, especially when the hearing impairment occurred at birth. Infants with Treacher Collins syndrome are therefore very likely to have conductive hearing impairment.

The degree of hearing impairment is also significant requiring suitable rehabilitation programmes. Eagles and co-workers (1967), in their Pittsburgh study, showed the relationship between hearing level and 1) the understanding of speech; 2) the psychological impact of hearing; 3) the need for a hearing aid; and 4) the percentage of children within each classification of hearing loss. In their study, the majority of children with hearing impairment had hearing levels in the better ear in the 40-70 decibels (dB) range. In general, the primary venue for the acquisition of speech and language for children within this range is through the auditory channel. Conversely, when hearing loss exceeds the 70 dB level, the

likelihood of vision becoming the primary channel for language and education acquisition is increased. This is obviously not an either/or proposition, but rather is dependent on a multitude of variables such as intelligence, opportunity, motivation, speech lips reading ability, emotional stability etc. in conjunction with age at onset, type and degree of deafness. Nevertheless, children with hearing levels in the better ear of less than 70 dB are more likely to have and to develop functional hearing than are those with a greater loss. Children with greater than a 70 dB loss in the better ear are classified as educationally deaf.

2.5 Oral health of the visual and hearing impaired people

2.5.1 Blindness and Visual Impairment

Visual sensory limitation can vary from total blindness to limitations in the ability to visualise size, colour, distance, and shapes. Very little data is available on the oral health of this group. A project to establish a prototype community dental treatment programme for children with disability was undertaken in Sangamon County, Illinois (Horowitz *et al.,* 1965). Twelve visually impaired children were enrolled in the programme and examined to determine their dental treatment needs. They received 109 fillings, as compared with 6.3 cavities per child diagnosed on the initial examinations. Also, 10 more teeth had to be extracted than had been anticipated. Greeley *et al.* (1976) observed the caries rate, oral hygiene, occlusal classification and incidence of fractured incisor teeth in 120 visually impaired students. Oral findings for totally blind students were compared with those of the partially sighted student. Each of these groups was divided by age: 11-16 years of age and 17-23 years of age. The highest mean DMF rate (7.1) was reported for the older, partially sighted group, and the lowest (3.9) for the younger, partially-sighted group. The highest mean oral hygiene (PHP-M) score was found in the totally blind group in the older age category; the lowest (32.7) occurred in the totally blind group aged 11-16 years.

There was no significant difference in the data when both age and degree of blindness were compared with DMF rates and PHP-M scores. It was noted that PHP-M scores improved with age in the partially-sighted children, while oral hygiene became worse in the blind students; this may be related to the better perception and conceptual understanding of partially-sighted than blind youngsters.

After a period of 10 years, Shaw *et al.* (1986) assessed the caries rate, dental cleanliness and periodontal treatment requirements of children with disability, including 171 visually impaired children. When the caries experience, was analysed with respect to the main disability, it was found that the mean DMF of visually impaired children was 1.82 as compared to 1.44 in normal school children; a result that was not statistical significant. However there were highly significant differences in the oral hygiene levels between normal and visually impaired schoolchildren. "Good" oral hygiene was recorded in 60% of the visual impaired schoolchildren and in 73% of the normal schoolchildren. "Poor" oral hygiene was found in 4% of the visually impaired and 3% of normal children. There was also a highly significant difference in the presence of calculus between the two groups: 38% of visually impaired and 16% of the normal children. In terms of periodontal treatment requirements, 65% of the visually impaired children and 29% of the normal children required prophylaxis.

Caries experience in both dentitions varied across the people with disability groups, but in the sensory impaired group, it was similar. Nunn and Murray (1987) found that the mean dmf in 6-9 year olds was 2.9, compared to a mean DMF of 2.5 in 11-14 years.

Dental hypoplasia and demineralisation were reported to be high in blind children in relation to the cause of the sensory impairment (Tesini and Fenton, 1994).

2.5.2 Deafness and Hearing Impairment

Horowitz *et al.* (1965) established a community programme to determine the dental treatment needs of 11 people with disability. Because of their fear or inability to cooperate, many of the children had been difficult to examine; the extent of their dental needs had therefore been underestimated. Children with hearing impairment received 86 fillings and 15 teeth had to be extracted. Although most of the patients were treated by paedodontists, four of the hearing impaired children received care from general practitioners.

After a period of 10 years, Shaw *et al.* (1986) assessed the caries rate, dental cleanliness and periodontal treatment requirements of people with disability children including 240 with hearing impairment. When the caries experience of children with disability was analysed with respect to the main disability, the mean DMF of hearing impaired children was 1.76 compared to 1.44 in normal school children, which was not statistically significant. There were slight differences in the oral hygiene performance between normal and hearing impaired schoolchildren. "Good" oral hygiene was recorded in 69% of the hearing impaired schoolchildren and in 73% of the normal schoolchildren. "Poor" oral hygiene was found in 2% of the hearing impaired and 3% of normal children. "Fair" oral hygiene was found in 29% of hearing impaired and 24% in normal children. There was also a highly significant difference in the presence of calculus between the two groups (26% of the hearing impaired and 16% of the normal children). In terms of the periodontal treatment requirements, 36% of the hearing impaired children and 29% of the normal children required prophylaxis while 3% of the hearing impaired schoolchildren and 1% of the normal children required periodontal assessment by a dentist.

Dental hypoplasia, demineralisation and bruxism were high in children with hearing impairment and was related to the aetiology of sensory impairment (Tesini and Fenton, 1994).

Data concerning the oral health of sensory impaired children are scarce. Most reports are based on small numbers, the data being joined frequently with those of children with learning disability. An example of this is seen in a study by Gazani (1997).

2.6 Oral health of children with disability

Oral health research in children with disability passes through different sequences. The majority of the studies reported in the literature have been carried out in the period of the 1960s and 1970s. This is of relevance because following this period there has been a marked decline in the dental caries experience of many children in developed countries. Many of the studies reported were carried out in North America and European countries which accounts for 90% of the publications. However there has been a shortage of studies carried out in Middle East countries with only two studies undertaken in Saudi Arabia.

Difficulties exist in defining oral health in special groups. This has led Beck and Hunt (1985) to conclude that categorisation by the diagnostic label of developmental disability may be inappropriate, as it may not be the disability itself that influences dental disease rates, but how profound is the level of the disease. However, very few authors actually categorise their study groups in such a way that data presented gives only mean values of dental disease prevalence for each type of disability. The issue is beginning to be addressed in the dental literature with the realisation that people with disability are not a homogenous group (Nielsen, 1990; Kendall, 1992).

Increasingly, authors are moving away from the concept of a static 'label' and acknowledging that what may be an important factor for the effective delivery of dental care is the way in which the individual's disability presents (Evans *et al.*, 1991; Nunn *et al.*, 1993).

Table 2.1 summarise an overview on studies which have explored the oral health picture of children with disabilities. Through a comprehensive search, an attempt was made to identify all relevant studies irrespective of language. Papers outside the English language were considered if they could be translated.

Relevant studies were identified by searching several electronic databases from the date of inception. MEDLINE on Silver Platter was searched from the period 1966 to 05/2000, EMBASE on Silver Platter from the period 1980 to 2000, DISSERTATION ABSTRACTS on Silver Platter from the period 1861 to 11/1999, ERIC on Silver Platter from the period 1992 to 09/1998, SCISEARCH from the period 1982 to 2000 and ISTP from 1981 to 2000. The subject headings or key components used included oral health, disabled, handicapped, and malocclusion.

A manual search of key journals was undertaken, these included, Special Care Dentistry, Journal Dental Child, Paediatric Dentistry and the British Journal of Orthodontics.

Data concerning the oral health status of people with disability were often restricted to one specific type of disability or to one specific type of institute. Most reports are based on an examination of a small number of individuals with widely differing ages. In the late 70s the focus moved to deinstiutionalisation or 'normalisation' of many people with disability, particularly children (Kamen, 1986). This movement was due to awareness of the researchers that this can have a significant impact on oral health. The study outcomes were on oral hygiene, periodontal disease but with most stress being on dental caries. More recently, attention has focused on malocclusion and other treatment need measurements.

From the literature it is evident that when studying the oral health of people with disability it is important to ensure that:

1. The groups are adequately defined
2. Sufficient numbers are recruited into the study in order to allow suitable statistical analysis

3. Age should be defined and whenever possible limited to a narrow age group
4. Epidemiological studies need to broaden the oral health outcomes explored, for example, malocclusion and orthodontic treatment needs should be included.

Table 2.1 **Dental epidemiological studies on children with disabilities**

Study	Categories	Institutionalised	Age range (year)	Outcomes
Rhodes WA. The mouth in the insane. Br Dent Ass J 1884: 413-415.	Insane inmates mentally handicapped	NI	not mentioned	jaw measurements
Lyons DC. Dental problems of a spastic or athetoid child. Am J Orthod 1951; **37**: 129-131.	Cerebral palsy Spastic athetoid	NI	10-14	caries malocclusion
White RA and Sackler AM. Effect of progressive muscular dystrophy on occlusion. J Am Dent Ass 1954; **49**: 449-454.	Muscular dystrophy	NI	12-15	malocclusion
Koster SJ. The diagnosis of disorders of occlusion in children with cerebral palsy. J Dent Child 1956; **23**: 81-83.	Cerebral palsy	I	not mentioned	malocclusion
Weisman EJ. Diagnosis and treatment of the gingival and periodontal disorders in children with cerebral palsy. J Dent Child 1956; **23**: 73-80.	Cerebral palsy	NI	6-18	PD
Cohen MM *et al.* Periodontal disease in a group of mentally subnormal children. J Dent Res 1960; **39**: 745.	Mentally subnormal	I	3-18	PD

PD; periodontal disease
OH; oral hygiene
NI; Non- Institutionalised
I; Institutionalised

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (year)	Outcomes
Siegel JC. Dental findings in cerebral palsy. J Dent Child 1960; **27**: 233-238.	Cerebral palsy	Not mention	2-12	caries malocclusion dental anomalies
Tannenbaum KA and Miller JW. Oral conditions of mentally retarded patient. J Dent Child 1960; **27**: 277-280.	Mentally retarded	I	12-22	caries OH malocclusion
Johnson NP *et al.* Dental caries experience in mongoloid children. J Dent Child 1960; **27**: 292-294.	Mongoloid Nonmongoloid	I	9-11	caries
Brown RH and Cunningham WM. Some dental manifestations of Mongolism. Oral Surg Oral Med Oral Path 1961; **14**: 664-676.	Mongolism	NI	1-26	caries PD OH malocclusion
Cohen MM *et al.* Oral aspects of Mongolism. Oral Surg Oral Med Oral Path 1961; **14**: 92-107.	Mongolism	I	1-30	caries PD missing teeth malocclusion
McMillan RS and Kashgarian M. Relation of human abnormalities of structure and function to abnormalities of the condition. II. Mongolism. J Am Dent Ass 1961; **63**: 50-55.	Mongolism	I	0-40^{+}	tooth morphology

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (year)	Outcomes
Shmarak KL and Berstein KE. Caries incidence among cerebral palsy children: a preliminary study. J Dent Child 1961; **29**: 154-156.	Cerebral palsy	NI	3.5-15.5	caries
Herman SC and McDonald RE. Enamel hypoplasia in cerebral palsy. J Dent Child 1963; **30**: 46-49.	Cerebral palsy	NI	2.5-10.5	enamel hypoplasia
Johnson NP and Young MA. Periodontal disease in Mongols. J Periodont 1963; **34**: 41-47.	Mongols			PD
Magnusson B and De Val R. Oral conditions in a group of children with cerebral palsy. Odont Revy 1963; **14**: 385-402.	Cerebral palsy	NI	3-15	caries gingival status enamel hypoplasia OH trauma
Album MM *et al.* An evaluation of the dental profile of neuromuscular deficit patients: a pilot study. J Dent Child 1964; **31**: 204-227.	Cerebral palsy	I	7-10	caries PD malocclusion

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Horowitz HS *et al.* Study of the provision of dental care for handicapped children. J Am Dent Ass 1965; **71**: 1398-1411.	Mentally & physically handicapped (educable mentally retarded, trainable mentally retarded, cerebral palsy, sight, hearing mongolism and other)	NI	3-older than 18	caries dental care provision
Winer RA *et al.* Composition of human Saliva, parotid gland secretory rate, and electrolyate concentration in mentally subnormal persons. J Dent Res 1965; **44**: 632-634.	Mentally subnormal	NI	Not mention	caries
Creighton WE and Wells HB. Dental caries experience in institutionalized Mongoloid and Nonmongoloid children in North Caroline and Oregon. J Dent Res 1966; **45**: 66-75.	Mentally retarded (Mongoloid Nonmongoloid)	I	7-20	caries
Rosenbaum CH *et al.* Occlusion of cerebral-palsied children. J Dent Res 1966; **45**: 1696-1700.	Cerebral palsy	NI	6-12	malocclusion

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Smith CE *et al.* The dental health status of the mentally retarded in an institutional population. J Tenn Dent Ass 1966; **46**: 138-146.	Mentally retarded	I	3-75	caries PD OH malocclusion
Butts JE. Dental status of mentally retarded children. II. A survey of the prevalence of certain dental conditions in mentally retarded children of Georgia. J Public Health Dent 1967; **27**: 195-211.	Mentally retarded	I NI	6-20	caries OH PD
Cohen MM and Winer R. Dental and facial characteristics in Down's syndrome (Mongolism). J Dent Res 1965; **1**: 197-208.	Mongolism	I	3-30	caries PD malocclusion
Fishman SR. The status of oral health in cerebral palsy children and their siblings. J Dent Child 1967; **34**: 219-227.	Cerebral palsy	NI	4-18	caries PD OH malocclusion

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Steinberg AD and Zimmerman S. The Lincoln dental caries study; 1: The incidence of dental caries in persons with various mental disorders. J Am Dent Ass 1967; **74**:1002-1007.	Mentally subnormal	I	10-21	caries
Wolf WC. Caries incidence in Down's Syndrome (mongolism). J Wis State Dent Soc 1967; **43**: 3-7	Mongolism	I	5-14	caries
Goyings ED and Riekse DM. The periodontal condition of institutionalised children; important through oral hygiene. J Public Heath Dent 1968; **28**: 5-15.	Mentally retarded (Mongoloid, Nonmongoloid)	I	5-19	PD OH calculus
Swallow JN. Dental disease in cerebral palsied children. Dev Med Child Neur 1968; **10**: 180-189.	Cerebral palsy	NI	5-16	caries PD OH
Gullikson JS. Oral findings of mentally retarded children. J Dent Child 1969; **36**: 133-137.	Mentally retarded	Not mention	3-14	caries OH tooth and dental anomalies gingival status malocclusion

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Cohen MM *et al.* Occlusal disharmonies in trisomy G. Am J orthod 1970; **58**: 367-372.	Down's Syndrome (Mongolism)	NI	16-36	malocclusion
Kroll RG *et al.* Incidence of dental caries and periodontal disease in Down's Syndrome. NY State Dent J 1970; **36**: 151-156.	Down's Syndrome	NI	0-25	caries PD
Cutress TW. Dental caries in Trisomy 21. Arch Oral Biol 1971; **16**: 1329-1344.	Trisomy 21 Mentally retarded	I NI	5-24	caries missing teeth
Bay LM and Russell BG. Effect of chlorhexidine on dental plaque and gingivitis in mentally retarded children. Community Dent Oral Epidemiol 1975; **3**: 267-270.	Mentally retarded (mentally subnormal)	I	7-14	plaque gingival status
Gullikson JS. Oral finding in children with Down's syndrome. J Dent Child 1973; **41:** 293-297.	Down's Syndrome Mentally retarded	NI	3-10	caries gingivitis congenital missing teeth malocclusion tetracycline staining palate tongue anomalies habits

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Murray JJ and McLeod JP. The dental condition of severely subnormal children in three London borough. Br Dent J 1973; **143**:380-385.	Severely subnormal (Down's Syndrome, cerebral palsy, autistic)	NI	2-16	caries oral cleanliness gingival condition
Foster TD *et al.* The effect of cerebral palsy on the size and form of the skull. Am J Orthod 1974; **66**: 40-49.	Cerebral palsy	I inpatient	3-28	malocclusion
Sandler ES *et al.* Oral manifestations in a group of mentally retarded patients. J Dent Child 1974; **41**: 207-211.	Mentally retarded	inpatient outpatient	1-30	caries PD oral debris malocclusion
Bloxham E, Swallow JN. The dental treatment of institutionalised mentally handicapped people. A two-year report. Br Dent J 1975; **139**: 145-146	Mentally handicapped	I	3-49	caries
Orner G. Dental caries experience among children with Down's syndrome and their sibs. Arch Oral Biol 1975; **20**: 627-634.	Down's syndrome	I NI	5-20	caries

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Svatun B and Heloe LA. Dental status and treatment needs among institutionalized mentally subnormal persons in Norway. Community Dent Oral Epidemiol 1975; **3**: 208-213.	Mentally subnormal	I	5-45	caries remaining teeth
Greeley CB *et al.* Oral manifestations in a group of blind students. J Dent Child 1976; **43**: 39-41.	Blind	NI	11-23	caries OH malocclusion fractured anterior teeth
Street CM et al. Epidemiology of dental caries in relation to Streptococcus mutans on tooth surfaces in 5-year-old children. Arch Oral Biol. 1976; **21**: 273-275	Down's syndrome	NI	5	caries
Saxen L *et al.* Periodontal disease associated with Down's syndrome: An orthopantomographic evaluation. J Periodontol 1977; **48**: 337-340.	Down's Syndrome	I	9-39	PD
Brown RH. A longitudinal study of periodontal disease in Down's syndrome. NZ Dent J 1978; **74**: 137-144.	Down's Syndrome	I	1.9-16.2	PD OH

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Kreiborg S *et al.* Craniofacial growth in a case of congenital muscular dystrophy. Am J Orthod 1978; **74**: 207-215.	congenital muscular dystrophy	NI	4-13	craniofacial growth
Dever JG. Oral hygiene in mentally handicapped children. A clinical trial using a chlorhexidine spray. Aust Dent J 1979: **24**: 301-305.	Mentally handicapped	I	Not mention	OH gingival status
Tesini DA. Age, degree of mental retardation, institutionalisation and the oral hygiene status of mentally retarded individuals. Community Dent Oral Epidemiol 1980; **8**: 355-359.	Mentally retarded	I NI	4-25	caries PD OH
Ohmori I *et al.* Dental care for severely handicapped children. Int Dent J 1981; **31**: 177-184.	Severely handicapped (mentally & physically)	I	3-over 50	caries teeth present
Palin T *et al.* Dental health of 9-10 year old mentally retarded children in Eastern Finland. Community Dent Oral Epidemiol 1982; **19**: 86-90.	Mentally retarded	NI (Inpatient, outpatient)	9-10	caries OH gingival status

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Saxen L and Aula S. Periodontal bone loss in patients with Down's syndrome: A follow-up study. J Periodontol 1982; **53**: 158-162.	Down's Syndrome	I	14-43	PD
Nowak AJ. Dental disease in handicapped persons. Spec Care Dent 1984; **4**; 66-69.	Mentally handicap, Down's syndrome, cerebral palsy	NI	0 - >16	caries
Forsberg H *et al.* Dental health and dental care in severely mentally retarded children. Swed Dent J 1985; **9**: 15-28.	Severely mentally retarded	NI	3-17	caries PD
Maclaurin ET *et al.* Dental study of handicapped children attending special schools in Birmingham. Community Dent Oral Epidemiol 1985; **2**: 249-257.	Handicapped (visual, hearing, mentally retarded, epilepsy, maladjusted, physically, speech, autism)	NI (Special schools)	5-15	caries
Maclaurin ET *et al.* Dental study of handicapped children attending special schools in Birmingham Community Dent Health 1985; **2**: 259-265.	Handicapped (visual, hearing, mentally retarded, epilepsy, maladjusted, physically, speech, autism)	NI (Special schools)	2-19	PD (dental cleanliness, periodontal treatment needs)
Vigild M. Periodontal conditions in mentally retarded children. Community Dent Oral Epidemiol 1985; **13**: 180-182.	Mentally retarded (Down's syndrome)	I NI	6-19	PD OH

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Lizaire AL *et al.* Dental health status of nondependent children with handicapping conditions in Edmonton, Alberta. Spec Care Dent 1986; **6**: 74-79.	Handicapped (Learning people with disability, educable mentally handicapped, visual impaired, hearing impaired, trainable mentally handicapped	I NI	4-26	caries PD OH malocclusion
Palin-Palokas T *et al.* Relative importance of caries risk factors in Finnish mentally retarded children. Community Dent Oral Epidemiol 1986; **15**:19-23.	Mentally retarded (Down's Syndrome)	I NI	9-10	caries
Shaw L *et al.* Dental study of handicapped children attending special schools in Birmingham, UK. Community Dent Oral Epidemiol 1986; **14**: 24-27.	Handicapped (Visual, hearing, mentally retarded, epilepsy, maladusted, physically handicapped, speech, autism)	NI (Special schools)	5-15	caries OH periodontal treatment needs
Vigild M. Dental caries experience among children with Down's syndrome. J Ment Defic Res 1986; **30**: 271-276	Down's syndrome	N	6-19	caries

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Schwarz E and Vigild M. Provision of dental services for handicapped children in Denmark. Community Dent Health 1987; **4**:35-42	Mentally retarded	I NI	6-9	caries preventive programme
Mellor J and Doyle A. The evaluation of a dental treatment service for children attending special schools. Community Dent Health 1987; **4**: 43-48	Handicapped	NI (Special schools)	13-14	caries
Nunn JH and Murray JJ. The dental health of handicapped children in Newcastle and Northumberland. Br Dent J 1987;**162**: 9-14.	Handicapped (ESN, sensory, maladjusted, physical multiple)	I	2-19	caries PD OH malocclusion
Oreland A *et al.* Malocclusion in physically and/or mentally handicapped children. Swed Dent J 1987; **11**: 103-119.	Physically severely mentally retarded and their subgroups	NI	3-17	malocclusion space condition hypodontia orthodontic treatment
Storhauge K and Holst D. Caries experience of disabled school-age children. Community Dent Oral Epidemiol 1987; **15**: 144-149.	Disabled (cerebral palsy, mentally retarded, spina bifida)	NI	7-16	caries hypoplasia crowding

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Strodel BJ. The effects of spastic cerebral palsy on occlusion. J Dent Child 1987; **54**: 255-260.	Spastic cerebral palsy	NI	5 month-22	malocclusion
Lunn HD and Williams AC. The development of a toothbrushing programme at a school for children with moderate and severe learning difficulties. Community Dent Health 1990; **7**: 403-406.	Learning difficulties	NI	3-19	toothbrushing programme oral debris
Nielsen LA. Caries among children with cerebral palsy: relation to CP-diagnosis, mental and motor handicap. J Dent Child 1990; **57**: 267-273.	Handicapped (cerebral palsy, motor handicap, mental handicap, speech)	NI	14.9-15.11	caries
Evans DJ *et al.* A study of the dental health of children and young adults attending special schools in South Glamorgan. Int J Paed Dent 1991;**1**: 17-24.	Not labelled	NI (Special schools)	3-19	caries PD
Pope JEC and Curzon MEJ. The dental status of cerebral palsied children. Pediatric Dent 1991; **13**: 156-162.	Cerebral palsy	NI (Special schools)	< 6-over 11	caries tooth wear plaque gingivitis malocclusion

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Stabholz A *et al.* Caries experience, periodontal treatment needs, salivary PH, and streptococcus mutans counts in a preadolescent Down syndrome population. Spec Care Dent 1991; **11**: 203-208.	Down's Syndrome	I	8-13	dental caries periodontal treatment needs streptococcus mutans counts
Vignehsa H *et al.* Dental health of disabled children in Singapore. Aust Dent J 1991; **36**: 151-156.	Disabled (Intellectually disabled or educational subnormal, visually impaired, speech or hearing defects, neuromuscular disorders or multiple handicaps)	NI (Special schools)	6-18	caries OH PD malocclusion
Randell DM *et al.* Preventive dental health practice of non-institutionalised Down syndrome children: A controlled study. J Clin Paed Dent 1992; **16**: 225-229.	Down's Syndrome	NI	1-14	questionnaire of preventive health practice
Nunn JH *et al.* Dental disease and current treatment needs in a group of physically handicapped children. Community Dent Health 1993; **10**: 389-396.	Physical handicap	NI	3-17	caries CPITN

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Ohito FA *et al.* Dental caries, gingivitis and dental plaque in handicapped children in Nairobi, Kenya. East Afr Med J 1993; **70**:71-74.	Handicapped	Special schools	5-15	caries OH periodontal condition
Ackerman A and Wiltshire WA. The occlusal status of disabled children. J Dent Assoc S Afr 1994; **49**: 447-451	Disabled children	NI (Special schools)	6-12	malocclusion
Vittek *et al.* Analysis of orthodontic anomalies in mentally retarded developmentally disabled (MRDD) persons. Spec Care Dent 1994; **14**: 198-202.	Mentally retarded	NI	6-87	malocclusion
Bhavsar JP and Damle SG. Dental caries and oral hygiene amongst 12-14 years old handicapped children of Bombay, India. J Indian Soc Pedod Prev Dent 1995; **13**: 1-3.	Handicapped	Special schools	12-14	caries OH
Franklin DL *et al.* The prevalence of malocclusion in children with cerebral palsy. Eur J Orthod 1996; **18**: 637-643.	Cerebral palsy	NI (Special schools)	6-16	malocclusion

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Shapira J and Stabholz A. A comprehensive 30-month preventive dental health in a pre-adolescent population with Down's Syndrome: A longitudinal study. Spec Care Dent 1996; **16**: 33-37.	Down's Syndrome	I	8-13	oral cleanliness OH
Wyne A *et al.* Plaque, gingivitis, enamel defects and tooth wear among cerebral palsy children of Riyadh region. Saudi Med J 1996; **17**: 466-470.	Cerebral palsy	I	2-12	plaque gingivitis enamel defects tooth wear
Adenubi JO *et al.* Dental health care at the disabled children's Rehabilitation Centre in Riyadh. Saudi Dent J 1997; **9**: 9-13.	Disabled (Cerebral palsy, epilepsy, spina bifida)	I NI	3-14	caries PD OH malocclusion dental anomalies
Baccetti T *et al.* Craniofacial abnormalities associated with congenital fiber type disproportion myopathy. J Clin Pediatr Dent 1997; **21**: 167-171.	congenital fiber type disproportion myopathy	NI	9	craniofacial

Continued *Table 2.1*

Study	Categories	Institutionalised	Age range (years)	Outcomes
Gizani S *et al.* Oral health condition of 12-year-old handicapped children in Flanders. Community Dent Oral Epidemiol 1997; **25**: 352-357.	Handicapped (mild to severe mental retarded maladjustment physical handicap visual-hearing impaired	I NI	12	caries OH fissure sealants
Machuca G *et al.* Epidemiological study of malocclusion in patients with special needs: preliminary data. J Dent Res 1998; **77**: 702.	Special needs	NI (Special schools)	10-20	caries PD malocclusion
Shapira J *et al.* Dental health profile of a population with mental retardation in Israel. Spec Care Dentist 1998; **18**:149-155.	Mental retardation	I NI	3->40	caries periodontal condition
Martens L *et al.* Oral hygiene in 12-year-old disabled children in Flanders, Belgium, related to manual dexterity. Community Dent Oral Epidemiol 2000; **28**: 73-80.	Disabled (mentally retarded learning disabled)	I	12	OH
Shyama M *et al.* Oral hygiene and periodontal conditions in special needs children and young adults in Kuwait. J Disabil Oral Health 2000; **1**: 13-19.	Special need (visually and hearing impaired Down syndrome) Physical disabilities	Special schools	3-29	OH periodontal status

2.7 Malocclusion

Malocclusion of the teeth is not really a disease in the way that dental caries and periodontitis are diseases, it is more a reflection of the natural variation that occurs in any biological system.

2.7.1 Definition

Precise definitions of normal occlusion and malocclusion have been difficult to produce, but there is general agreement that an individual's occlusal status is described by two major characteristics: the relationship of the teeth within each arch to a smoothly curving line of occlusion, and the pattern of occlusal contacts between the upper and lower teeth. If the teeth are misplaced relative to the line of occlusion, they are malaligned; if the upper teeth are displaced relative to the lower teeth in the transverse, antero-posterior or vertical planes of space, they are maloccluded. Malocclusion, in the usual sense, includes either or both of these problems which, as will be discussed below, may have different aetiologies (Proffit *et al.,* 2000).

2.7.2 Classification

The first useful orthodontic classification was Angle's classification of malocclusion in the early 1990s. Three basic types of malocclusion were described, all of which represented deviation in an anteroposterior dimension. Lischer later termed Angle's Class I occlusion *neutro-occlusion*, his Class II relationship *disto-occlusion*, and his Class III relationship *mesio-occlusion* (Lischer, 1912).

The Angle classification was readily accepted by the dental professional, since it brought order out of what previously had been confusion regarding dental relationships. Almost immediately, however, deficiencies were recognised in the

Angle system. Two severe critics were Van Loon and Case, who pointed out that Angle's method disregarded the relationship of the teeth to the face as well as a three-dimensional problem (Van Loon, 1915 and Case, 1921). In the 1930s the German orthodontist Simon proposed a new system of classification, based on a specific recording of the vertical orientation of the jaws to the cranium by what Simon called "gnathostatic" casts. In addition, Simon included an evaluation of the anteroposterior position of the incisors by specifying canine position relative to the orbits.

In 1960, Ackerman and Proffit formalised the system of informal additions to the Angle method by identifying five major characteristics of malocclusion that should be considered and systemically described in classification (Ackerman and Proffit, 1969). The system incorporates an evaluation of crowding and asymmetry within the dental arches and includes an evaluation of incisor protrusion whilst recognising the relationship between protrusion and crowding. Also it includes the transverse and vertical as well as the antero-posterior planes of space.

2.7.3 Aetiology

Orthodontists have held quite different views at various times regarding the aetiology of malocclusion. Not surprisingly, these views affect the type of treatment offered to patients. In the early part of the twentieth century, it was generally believed that the environment had a large effect on dental and facial development. By mid-century, a combination of failures with the earlier treatment philosophy and increased knowledge of genetics had led to nearly universal adoption of the opposite view, that malocclusion was largely the result of genetically determined dental and facial proportions. Environmental influences were held to have little impact on dental and facial development (Graber and Vanarsdall, 1994). Today, most authorities agree that most malocclusions arise as a combination of genetics with superimposed environmental influences.

2.7.3.1 Genetic influences

It is widely acknowledged that most malocclusions have a genetic component; it is extremely difficult to quantify how much of a given problem is genetic and how much is due to prenatal or postnatal environment factors. Studies of twins and of triplets have shown a high concordance of dentofacial traits in monozygotic individuals, which suggests a large heritable component in the aetiology of malocclusion (Kraus *et al.,* 1959). From examination of longitudinal data from the Bolton-Bush growth study, Harris and Johnson concluded that the heritability of skeletal characteristics was high, but that of dental characteristics was low (Harris and Johnson, 1992).

2.7.3.2 Environmental influences

Although it is not uncommon for parents to believe that a child with a genetic syndrome is suffering from the effects of a birth injury, dentofacial problems related to either birth trauma or the intrauterine environment are relatively unusual. The role of the postnatal environment in the aetiology of malocclusion continues to be vigorously debated. The scientific background for more emphasis on environmental causes of malocclusion rests primarily on findings with experimental animals (McNamara, 1981; Petrovic *et al.,* 1981).

Under certain experimental conditions growth can be modified quite extensively, and in some circumstances growth can be stimulated. Some results with functional appliances in human patients support the interpretations of the animal work as directly applicable to the human (Pancherz and Fackel, 1990). Considering the amount of time this question has been under study, a surprisingly small amount of good data exist to support the hypothesis that growth can be modified in a major way.

Environmental influences may include:

- Soft tissue force such as tongue-lip pressures during resting may have a significant impact (Proffit, 1978)
- Mode of respiration may have an impact because posture influences resting pressures. It seems clear, both from animal experiments (Harvold *et al.,* 1981; Miller *et al.,* 1984) and from isolated human clinical examples (McNamara, 1981) that complete nasal obstruction may cause significant changes in the pattern of growth and lead to malocclusion.

2.8 Malocclusion in children with disability

Several authors have reported that malocclusions occur more often in children with physical and/ or mental disability than in healthy children (Koster, 1956; Gullikson, 1973 and Cecherz *et al.,* 1980). However, Swallow (1972) showed no difference between children with mental or physical disability and healthy children between 13-16 years of age in this respect. Similarly Miller and Taylor (1970) did not find any difference in the frequency of malocclusion between children with physical or mental disability and health children.

2.8.1 Children with Mental Disability

The early study by Rhodes (1884) concluded that the group of patients studied had ill-formed maxillae and more than usual overcrowding. He gave detailed measurements for intercanine widths, which he stated were much narrower than in a normal population.

Oreland *et al.* (1987) have reported that children with severe mental disability have the highest prevalence of malocclusion and hypodontia. Also they reported that the frequency of deviations in sagittal occlusion was the same as in healthy children. This view was not supported by Vigild (1985) who reported that in children with mental disability, 27% had an extreme maxillary overjet, 6% a

mandibular overjet, 17% mesial molar occlusion, 23% frontal open bite and 29% crossbite. As he compared his finding to healthy individuals he found that children with mental disability had markedly increased frequencies of some of the anomalies.

2.8.1.1 Down syndrome

One of the more striking features of the faces of children with Down syndrome is the relative under-development of the middle third of the face and the consequent tendency to a Class III skeletal base relationship (Nunn and Murray, 1987). A high vaulted palate is a common finding along with other intra-oral anomalies (McMillan and Kashgarian, 1961; Parkin *et al.,* 1970; McLever and Machen, 1979).

In contrast to the latter investigations there are several studies which suggest an increased frequency of malocclusion in specific disabled groups. Thus, in Down's syndrome, the most well-documented disabled group, all investigators, independent of the age composition of the material, state a high prevalence of prenormal occlusion (Brown *et al.,* 1961; Kisling, 1966 and Gullikson, 1973).

Rosenbaum *et al.* (1971) report a lower frequency of Class II occlusion than normal, whilst on the other hand, Cohen *et al.* (1970) report a high frequency of Class II occlusion, 32%. Other features typical of Morbus Down syndrome are frontal open bite and cross-bite (Gullikson, 1973 and Jensen *et al.* 1973; Kisling, 1976). However, the high prevalence figures of open bite (32.1%) and cross-bite (46.4%) in Gullikson's study are contradicted by Cohen and Winner (1965) where figures as low as 4.8 and 15.4% respectively have been reported.

Levinson *et al.* (1955) also found an increased prevalence of spacing as well as crowding in Morbus Down children, while Brown *et al.* (1961) only reported an increased frequency of dental frontal crowding.

2.8.2 Children with Physical Disability

Children with physical disabilities that concern the dentist include cerebral palsy, spina bifida and muscular dystrophy. Oreland *et al.* (1987) reported that children with a physical disability have a high frequency of spacing in the lower jaw.

2.8.2.1 Cerebral palsy

The muscles of the face and oral cavity play a role in facial growth and occlusal development (Houston *et al.,* 1992). As the tone and function of the orofacial muscles associated with cerebral palsy can be abnormal, the facial growth and occlusion of these children could be outside normal limits (Lyon, 1951; Leeds, 1976; Kanar, 1979).

Children with cerebral palsy have been reported to have 88% of lip incompetence due to insufficient contraction of orbicularis oris and mentalis muscle (Franklin *et al.,* 1996). Drooling of saliva, sometimes a major problem in these children, could be a manifestation of particularly poor orofacial muscle function, and it is possible that children with cerebral palsy who have a habit of drooling saliva may have increased malocclusion (Franklin *et al.,* 1996).

The majority of the malocclusions in cerebral palsy have been reported to consist of Class II malocclusions (Koster, 1956; Lyons, 1956). Koster (1956) reported Class II division 1 malocclusion in 90% of the cases in his athetoid group, usually in combination with open bite. In the spastic group, Class II division 2 malocclusions dominate (75%), usually together with unilateral cross-bite. Isshiki (1968) found both Class II and Class III occlusion frequent in the tetraplegic patients of the athetoid group, while open bite was more common in the spastic group. Anterior crowding and upper median diastema has also been reported as typical for cerebral palsy children (Lyons 1956; Album *et al.,* 1964). However, Magnusson (1964) and Rosenbaum *et al.* (1966) did not find any difference compared to healthy children, while Album *et al.* (1964) found malocclusion

twice as prevalent as in healthy children. Fishman *et al.* (1967) noted that after 6 years of age, significantly more of the cerebral palsied children had a handicapping malocclusion compared with their siblings using Draker's (1960) handicapping labio-lingual deviation index.

Foster *et al.* (1974) using cephalometry and matched controls investigated the effects of cerebral palsy in 33 patients with varying severity of the defect. They found a connection between low IQ and, among other findings, a reduced size and form of the jaws and facial bones but that the severity of the defect and age at which the lesion occurred were important variables in determining the effect.

2.8.2.2 Congenital muscular dystrophy (CMD)

Children with CMD exhibit several skeletal and oral features due to weakness of their skeletal muscles. The patient appears with a marked vertical development of the face with extreme backward rotation of the mandible and a downward-backward growth of the maxilla in relation to the anterior cranial base (Kreiborg *et al.,* 1978). Several features intra-orally were noticed; marked anterior openbite, proclination of the maxillary anterior teeth and retroclination of the mandibular anterior teeth.

2.8.2.3 Congenital fiber type disproportion myopathy (CFTD)

CFTD is a relatively rare muscular disorder due to predominance and reduction in size of type 1 fibres, with large type 2 fibres. Baccetti *et al.* (1997) have described the craniofacial defects of this disease. The low function of the masticatory muscles associated with oral breathing, lowered tongue position at rest and tongue thrust, are factors possibly responsible for a lowered position of the mandible which in turn, allow over-eruption of the posterior teeth. This mechanism is able to increase the height of the palatal vault in association with a posterior rotation of the mandible during growth.

2.9 Barriers to dental care for children with disability

Studies have shown that children with disability often have difficulty in obtaining dental care in the private sector and, in general terms dentists are reluctant to treat these patients (Steifel *et al.,* 1981; O'Donnell, 1985; Steifel *et al.,* 1987). The literature cites a number of reasons. If these reasons are looked at in terms of barriers then we find that not only are barriers erected by dentist but also by the patients themselves.

Among these barriers are:

- Severity of disabilities
- Transportation
- Access (mobility)
- Lack of suitable equipment
- Financial considerations (practitioner and patient)
- Lack of appreciation for dental treatment
- Practice image (stigma)
- Attitude (dental practitioner)
- Lack of training (under-post graduate teaching)
- Communication

2.9.1 Transportation

This may be an important barrier in big cities, which usually are extremely busy with its streets and public places crowded with people at all times. This alone can make movement difficult for persons in wheelchairs and those unsteady on their feet. For the majority of the group with disability therefore, public transport is not a feasible option. Perhaps for those with transportation problems the dentist should visit them in their home or institution, but this raises the question of portable equipment or the institution providing facilities on site (O'Donnell, 1996).

2.9.2 Access

The pace of life is very fast and the rate at which buildings appear and disappear is phenomenal. In all this frantic activity little thought has been given to those who may be in wheelchairs or who have mobility problems. New offices are built because local building codes mandate that some of the physically restrictive barriers be eliminated in new buildings (Rosenbaum, 1984). However, these changes are happening far too slowly to allow for significant access to dental offices to occur nationwide. Also, in difficult economic times dental offices are less likely to be moved to new facilities or to be extensively remodelled as it is hard to recoup the costs quickly enough. A continuous effort to improve existing facilities must be made so those disabled patients can obtain treatment. An examination of architectural barriers both inside and outside any dental facility must be made.

2.9.3 Lack of suitable equipment

Many dentists perceive that to treat patients with disability requires a large range of expensive equipment. There is an element of truth in this, in that some patients may require restraints, sedation and general anaesthesia and to provide such equipment is expensive (O'Donnell, 1996). However, the majority of patients with disability will not require these extra facilities and equipment already routinely in use will suffice. Although, once again, the question of space arises, since there may be a requirement for wheelchair access, treatment in the wheelchair and room for additional ancillary help.

2.9.4 Financial considerations

Payment for dental services is a major problem. Some patients qualify for financial aid because of the economic levels of their families. Other patients have their services paid for by a third-party carrier. Some families are financially responsible for their own fees and this presents a difficult problem because these

families frequently must spend large amounts of money for the patient's medical condition and cannot afford dental expenses. In a situation where dental treatment is unsubsidised, this is of major concern to both practitioner and patient. There is a perception that the disabled patient takes more time to treat, and that treatment is more difficult than for the normal patient (O'Donnell, 1996). However, whether the treatment of patients with disability takes longer is debatable. Many disabled patients are as easy or difficult to treat as any other person. There may be a need for a longer visit time in the initial stages of treatment, which is usually to familiarise the patient with the surroundings and achieve rapport. Therefore there is also good argument that fees should be the same as for normal patients (O'Donnell, 1996).

2.9.5 Lack of appreciation for dental treatment

Frequently there is lack of understanding by the family of the need for dental treatment. The family has been emotionally, physically and financially tied up with the patients' medical condition and often find it difficult to have dentistry at the forefront of their minds. Many of the disabling conditions are obvious at birth, at which time the family must become involved with the infant. By the time clinical dentistry becomes important, many families have expended most of their efforts on the medical condition and have reached their financial and emotional limits (Rosenbaum, 1984). It is difficult to get the family seriously interested in dental needs of the child even though for many people with disability eating becomes one of the major joys of their lives. Their ability to eat thus becomes severely restricted when dental problems develop. Lack of appreciation and awareness of the need for dental treatment may also depend on the parent's personal feelings about dentistry. Many families have not had good dental experiences nor do they have positive thoughts about dentistry. It is quite difficult to motivate them to seek quality dental care on a regular basis for their children with disability.

2.9.6 Practice image

Research studies show that people react strongly to stigmatised people, and patients with disability are stigmatised, especially those with visually apparent defects. Few people are psychologically and emotionally indifferent to abnormality. Disruption of the office routine may be a problem for many dentists. Treatment may require more auxiliary help and because of this need there can be a definite disruption to the normally smooth-running operation of an office. Some dentists believe that the presence of this type of patient in their reception rooms may be a negative influence on some of the able patients that are waiting for treatment (Rosenbaum, 1984). Putting this in the context of a dental practice, a severely cerebral palsied person in the waiting area would more than likely deter prospective patients from entering the practice. A practitioner has to consider this and may actively reject disabled patients if he or she wants to maintain a cosy family image for the practice.

2.9.7 Attitude

This follows directly from the practice image concept. Every dental practitioner sets personal and professional priorities, which are related to his individual needs and personality, and the practice is organised to achieve these goals. Therefore, each dental practitioner will treat those people whom he or she really wants to have as patients and either consciously or unconsciously rid the practice of those not wanted (O'Donnell, 1996).

All too often private dental practitioners have the right to control patient population in their practice in a way which is conducive to their own philosophy and practice ethos. However, there is also alongside the practitioners rights, the professional responsibility to ensure that all people needing dental care are provided with the opportunity to obtain it.

Few studies have determined the willingness of dentists in practice to provide care for disabled persons (Steifel *et al.,* 1981; Steifel *et al.,* 1987; Seiler and Casamassimo, 1987). A survey of southern California members of the American Society of Dentistry for Children reported a 44% positive response in 1969 (Osamu and Osamu, 1969). In 1980, Leviton reported that 20% of general practitioners and paediatric specialists who responded to a questionnaire were willing to provide care for persons with disability whilst Steifel *et al.* in 1981, reported that 40% of responding practitioners provided dental care for disabled persons. The views of community dental officers working in Northern Ireland were obtained concerning the attitudes toward providing dental care for disabled persons (Russell and Kinirons, 1993). The percentage of the dentists willing to treat the person with disability was 60-82 per cent.

As far as treatment of the disabled patient is concerned five definite groups of dental practitioner can be identified (Soble, 1974):

- The dentist who will accept the disabled patient but over identifies to the extent that he becomes ineffectual in providing adequate dental services.
- The dentist who will accept disabled patients but is disturbed to the extent of being overly cautious and fearful. Treatment becomes over slow, long and difficult.
- The dentist who tries to deny uncomfortable feelings and unconsciously employs psychological defence mechanisms which make the practitioner seem unsympathetic and unfeeling.
- The dentist who will be unable to recognise and cope with their biases and prejudices and will be totally ineffective in their professional role with disabled patients.
- The dentist who is emotionally capable and positively motivated to work with and treat disabled patients.

2.9.8 Lack of training

One of the reasons cited by practitioners for not treating patients with disability is that they have not had adequate training at undergraduate level and subsequently at postgraduate level (Bedi and O'Donnell, 1989). This is changing as most undergraduate dental curricula now include aspects of dental care for the patient with disability in their undergraduate and postgraduate programmes. Indeed some schools in the USA and UK have Masters courses devoted to this field. However some offer didactic instruction only, whilst others include the very necessary practical element (Steifel *et al.,* 1987). It is desirable for undergraduate dental students to be trained to deliver dental care for disabled patients. This training can lead to an increased willingness to treat these patients in future dental practice (Marinelli *et al.,* 1991). Dentists without any previous training or experience are more likely to look for referral centres for the dental care of disabled patients (Nunn and Murray, 1988).

However, the outcome of courses for the management of patients with disability can be unexpected. The contact of the dental student to people with disability during the undergraduate study had influenced their willingness to treat them in general practice (O'Donnell, 1985). Stiff and Phipps (1964) actually found that students who are exposed to special patients actually worsened in their attitude, and become more negative toward treating these patients. Miller and Heil (1976) reported negative results after a program of exposure to older patients. Unless the experience is positive, it can be counterproductive (Bedi *et al.,* 1986).
Because many disabled patients require the cooperation and help of several specialities and departments, frustrations and negative reinforcement will be promoted among the students if this support is not available from their instructors (Bedi *et al.,* 1986).

2.9.9 Lack of communication

Communication difficulties between patients and professionals can be a major obstacle in development of relationships. Good communication is essential for optimal care and to avoid duplication. Various models for increasing communication already exist, eg. multidisciplinary meetings, practice visits by community doctors and holding joint clinics with general practitioners (Bhrolchain *et al.*, 1993).

Recently there has been increased interest in treatment of people with disability since a reduction of patients has forced many dentists to look into new areas and opportunities. Treatment of special patients is a logical place for the dentist to find a need and interest for services. Therefore, one can look for a continued increase of emphasis in this area by practising dentists.

2.10 Barriers to orthodontic care

"It seems reasonable to anticipate that for some individuals, an attractive appearance in general and in particular, an attractive dental appearance may adversely affect normal social and emotional development" (Stricker, 1970). Social prejudices or stereotyped responses with regard to an individual's appearance are now seen to apply, often at a subconscious level, in many facets of social interaction (Adams, 1977). They may also operate in more overt and distinctly hostile ways through nicknaming, teasing and harassment, particularly during childhood.

Facial abnormality tends to evoke aesthetic aversion and consequent interference with the process of social interaction. While the defect of a man with one leg may not be noticed while seated at a dinner party, facial abnormalities cannot be hidden. Normal social interaction requires attention to the face, such that irregularities of the orafacial area are extremely distracting. Moreover, the

avoidance of noticing such defects further inhibits social interaction by dampening spontaneity. The face assumes great importance developmentally; for example, the role of the mother's face in the child's evolving perception of the world. The mouth assumes even greater importance for survival. The taking of milk from the mother or surrogate is the first emotional contact with the world. The mouth is, in fact, involved in the first prototype of the pain experience, as when food is not forth coming. With the smile, reciprocal reinforcements of mother and child facilitate the development of expectation about the human face as early as four months. During exposure to three-dimensional models of normal and disturbed faces, smiling responses occurred more often in the presence of normal faces (Kagan *et al.,* 1966). Conversely, faces rearranged in such a way as to be grotesque induced anxiety in children (Richardson, 1963).

Of particular relevance is the early importance of physical attraction as indicated by studies in which nursery school children discriminated between attractive and unattractive faces (Berscheid and Walster, 1972). Although the appearance of the body as a whole, as well as its component parts is important, the central role of the face in judgements of attractiveness has been shown in several studies. When male college students were asked to pick out the most attractive female college students, face and mouth were high on a long list of attributes (Perrin, 1921). Similar findings were obtained such that the eyes and smile were the most important factors in judgements of overall attractiveness as a part in interpersonal relationships (Berscheid and Walster, 1972).

There is increasing evidence in the cleft lip and palate literature to support the view of the effect of orofacial deformity on the person perception. Photographs of children with cleft impairments were preferred less frequently than photographs of individuals with major physical disabilities including an upper extremity amputation (Richardson, 1970). The photographs of children with clefts were rated more negatively on several measures including; boring, stupid, sad, dirty, mean and bad (Scheniederman and Harding, 1984).

Tobiason (1987) examined peer personality and ability judgements associated with cleft related impairments. Children were shown either photographically corrected versions of children with congenital facial clefts or uncorrected versions. Children and adolescents, males and females, rated individuals with cleft impairments as less popular, less friendly, less smart, and less likely to be shown as a friend. The psychological effects of cleft lip and/or palate malformation can be significant. Patients with clefts may suffer from low self-esteem as a result of looking, and sounding, different from their peers which often leads to teasing and bullying. There may be difficulties in coping with certain social situations and in forming relationships. In addition, there is trauma associated with the treatment itself and the corresponding disturbance to social, school and work routines (Turner *et al.,* 1997).

2.10.1 The Barrier Factors

The possession of an obvious malocclusion is by no means the only factor which determines whether or not an individual will receive orthodontic treatment. Malocclusion is not an acute condition requiring urgent relief, instead it is a variation from normal which may or may not predispose to disease or impairment. For the majority of prospective patients, there are barriers to the eventual decision to embark upon orthodontic treatment. These barriers reflect a combination of the consumers (patient and parent) and providers (the individual dentist or orthodontist and health system generally; Shaw, 1981).

2.10.2 Consumer Factors

Consumer factors can be summarised as; the desire to look better, self (and parental) perception of malocclusion, self-esteem, peer group norms, and social class.

2.10.2.1 The Desire to Look Better

Concern with personal appearance is a common factor of human society and is reflected in the grooming behaviour most children learn from their parents and peer groups. Not surprisingly, this desire for improvement in appearance is a common motivation for seeking orthodontic treatment.

In a study which assessed the attitude of a sample of 385 American and Welsh schoolchildren, the strongest perceived benefit of orthodontics was the opportunity for an improved appearance (35%), and although improved dental health and function (14%) were also referred to, they appeared to be secondary in the individual's personal priorities (Tulloch *et al.,* 1984). A large number of studies have confirmed the public's general agreement that the optimal occlusion "looks best" and the desirability of treatment increases with the extent of deviation from this (Tulloch *et al.,* 1984; Cons *et al.,* 1986). It is also evident, however, that the perceived acceptable or normal range of variation may be fairly wide (Shaw, 1981).

2.10.2.2 Self (and Parental) Perception of Malocclusion

In an investigation of the factors which may influence the uptake of orthodontic treatment, a positive relation between the objective severity of the visible irregularity and the uptake of orthodontic treatment was confirmed (Shaw, 1981; Burden and Pine, 1995; Birkeland *et al.,* 1996). However, it was also evident that individual subjects acted inconsistently: 48% of those with moderate or severe visible irregularities reported a high degree of satisfaction, but a similar proportion of those with minor irregularities or none at all, were dissatisfied (Shaw, 1981; Holmes, 1992).

A possible explanation for this contradiction may lie partly in the imprecise way in which individuals regard their teeth before visiting an orthodontist. It has been suggested that there is a range of malocclusions that are considered acceptable and

that this range must vary considerably between individuals and between sexes. The perception of aesthetics is dependent on an individual's aesthetic values with persons for whom dental appearance has a high priority tending to focus on seemingly minor irregularities.

Whilst it has been shown that malocclusion appears to have little bearing upon self-esteem, the effects have been shown to operate in the reverse direction, in that variation in self-esteem can influence personal judgements of the severity of malocclusion (Holmes, 1992; Albino *et al.,* 1994). This contradicts the findings of a previous study, which concluded that those having low self-esteem were found to be more critical of their dental appearance (Evan and Shaw, 1987).

Most orthodontic patients are children such that their guardians are likely to play an important role in the uptake of orthodontic care and supporting compliance. There is some evidence that parents, who desire orthodontic treatment for themselves, or who are former orthodontic patients are more likely to approve of orthodontic care in principle and to perceive a need for it in their child (Pratelli *et al.,* 1998). One interpretation of this finding is the presence of an inherited malocclusion in their offspring increases the parents' desire for their children to be treated. However, the assumption of a genetic connection may be unwarranted (Pratelli *et al.,* 1998).

Pietila and Pietila (1994) found the percentage of children with clinical need was the same both for families with and without a history of active orthodontic treatment. Other studies have shown a moderate association between clinical status and a desire for treatment (Sheats *et al.,* 1995; Birkeland *et al.,* 1996); patients and parents desired treatment when it was not indicated clinically, and vice versa.

2.10.2.3 Peer Group Norms

Reference to peers has been found to be a significant determination of the uptake of orthodontic treatment (Burden, 1995). Most children with self-perceived anomalies want to be normalised or assimilated with other children through treatment and significantly more children who had entered orthodontic treatment were aware of a friend or acquaintance who had also received orthodontic treatment (Tulloch *et al.,* 1984). Their main dilemma is the anticipation of other children's responses to conspicuous appliances, which almost entirely depend on familiarity with appliances in the school and neighbourhood. Such unfavourable responses by their peers may discourage the uptake of orthodontic care by children. Common exposure to the sight of appliances may actually stimulate demand among those who wish to ensure that they have not missed out on an opportunity for self-improvement (Burden, 1995).

2.10.2.4 Social Class

Social class, as determined by the occupation of the head of the household, is also influential in the uptake of treatment. In a study of Welsh children, for whom any form of treatment would have been available at no cost, social class had no bearing upon the uptake of treatment when a high objective need for treatment was present. However, in children with a low objective need, 19% of children in middle class families subsequently received treatment compared with 6% of those in the lower social groups (Kenealy *et al.,* 1989). It was suggested that this finding did not have its origin in actual class differences in the perception of malocclusion or treatment need. Instead it may be a reflection of the more regular pattern of dental attendance in the former group, their better organisational ability to avail themselves of any form of social service, and a facility in overcoming situational obstacles such as time off work, loss of earnings, or transport difficulties. However in England, an increased use of dental treatment has been observed in the lower social classes when the dentist/population ratio was favourable (O'Mullane and Robinson, 1977).

Most of the previous studies, which examined the influence of social class on the uptake of orthodontic treatment, have used the occupation of the head of the household to categorise families. However, such an approach has limitation in terms of gaining sufficiently precise information for classification and may misjudge the economic position of families with two earners (Morgan, 1983). A study by Burden (1995) used ACORN data, which combines 40 different variables such as demographic, housing and employment characteristics to identify the social class. He found that no social class difference could be detected in the uptake of orthodontic treatment.

Roberts *et al. (*1989) tested the hypothesis that children of lower socio-economic groups (classes III manual, IV and V) are less likely to receive necessary orthodontic care. They examined 469 14-year-olds in North Derbyshire. They concluded that girls were significantly more likely to receive orthodontic treatment, but there was no relationship with social class. However, it was noted that the results should be treated with caution, as despite a good response rate, 13% of the questionnaires sent to parents relating to such factors were not returned. It was possible that the non-responders were lower social class parents and this may have biased the results.

Searcy and Chisick (1994) in a study on 576 male United States army recruits aged from 17-39 years, concluded that demand for treatment was higher in those with higher educational levels, which may be a representation of social class.

2.10.3 Provider Factors

The second group of factors which may influence the uptake of orthodontic care are those relating to the provider (or referrer), and may be summarised as follows; the dentist's level of awareness, differences in professional and public perception of need, availability of services, cost and method of remuneration, and priority indexing.

2.10.3.1 Dentist's Awareness and Attitudes

The general dentist's crucial role in the initiation of orthodontic treatment has been demonstrated in a survey of prospective patients in which 70% of referrals to orthodontists were initiated by the dentist (Shaw *et al.,* 1980). The scale assessing dentist's attitude to the provision of orthodontic care was found to be significant in discriminating a dentist who was a provider of orthodontic services from one who was not (Lawrence *et al.,* 1995). General dental practitioners' interest in orthodontics has been found to be associated with the actual service provision (Pender, 1985). Nevertheless, remarkably little is known of the factors which influence the decision of treatment, either personally or by referral. The following possibilities may be considered;

1. Thoroughness of examination

It is self-evident that the degree of care taken in the examination of the patient must influence the level of identification of all dental disorders, and the common late referral of many teenage and adult patients with unerupted teeth and conspicuous malocclusion, speaks of a degree of negligence in previous clinical examinations (Shaw *et al.,* 1991).

2. Dentist's professional characteristics

As orthodontics is not a major part of the undergraduate dental course it can be significantly correlated with the provision of orthodontic services (Little, 1985; Lawrence *et al.,* 1995). Freer and Foster (1990) reported that 12.6% of their sample had attended an orthodontic refresher course in the last five years. In America it has been reported that between 41% and 57% of general dental practitioners have attended orthodontic continuing education courses (Jacobs *et al.,* 1991). Jacobs *et al.* (1991) also found that the number of orthodontic procedures provided increases with the number of hours of continuing education attended.

3. Judgements of objective treatment needs

A marked lack of uniformity has emerged from epidemiological surveys of orthodontic treatment need. This may partly reflect a weak scientific basis for orthodontics and inconsistencies in the available literature (Shaw *et al.,* 1980; McLain and Proffitt, 1985). Clearly, if the experts cannot agree, it is hardly surprising that individual dentists are widely inconsistent in their decision to determine an indication for orthodontic treatment.

4. Perceived reliability of treatment

Individual dentists also have varying expectations of the quality of orthodontic treatment they can provide for their patients either personally or by referral. Their general impression of the efficacy of orthodontic treatment probably arises from first-hand experience of the standards which they have achieved personally, or observed in the clinics of their teachers, or witnessed in patients referred to specialist colleagues (Shaw *et al.*, 1991).

For these reasons, the general dentist will have different "thresholds" for orthodontic treatment initiation or referral, and this variability may make the crucial difference in whether any particular child undergoes orthodontic treatment. Certainly, some intelligent uniformity, based on the best available data and definition of criteria for decision making, would be desirable.

2.10.3.2 Availability of Services

One of the most important influences upon the demand for dental care is the availability of services. Over the last two decades, most of the developed countries have seen a steady increase in the number of courses of orthodontic treatment provided annually (Shaw *et al.,* 1991). The capacity for orthodontics in any country's dental system reflects the number of dentists in the country, the proportion who undertake some orthodontics, the proportion who are in full time specialist orthodontic practice, whether or not they employ dental assistants in an

extended role, and the number of patients a single orthodontist is judged to be able to treat (Shaw *et al.,* 1991).

In an investigation into the uptake of orthodontic treatment in relation to number of orthodontists located within the schools, Wheeler *et al.* (1994) showed that demand was always higher around schools that had more orthodontists. It could be argued that orthodontists located their practice around these schools because of the higher socio-economic classes at the school, the availability of office space or both. However, it is possible that the availability of orthodontists may stimulate demand possibly by changing the prevalent local social attitudes towards orthodontics (Gravely, 1990).

2.10.3.3 Cost and Method of Dentist Remuneration

The funding of orthodontic services is also remarkably different form one country to the next, and in some, the family must meet the entire cost of treatment. More commonly, treatment is either free or partly funded by state or private insurance, which reimburse the family cost, often in proportion to the degree of severity of malocclusion (O'Brien *et al.,* 1989). It can be seen that in many countries, especially in Eastern Europe, the government pays for the majority of the orthodontic treatment (Moss, 1993). In Iceland, the government pays for 50% of the treatment in the majority of cases, 75% in severe malocclusion and 100% in cleft cases. In Norway, the government pays for 40-70% of the cost of the treatment depending on the severity of the malocclusion and 100% in cleft cases. In United Kingdom, the government pay for 90 % of the cases while 10% pay privately. For instance, some form of treatment priority index is applied and full reimbursement is given for severe irregularities, less for moderate irregularities and none for minor irregularities (Shaw *et al.,* 1991). Thus, for children with minor irregularities or those living in a setting of purely private orthodontics, uptake of treatment will simply reflect the family's ability and willingness to pay.

2.10.3.4 Priority Indexing

The development of a uniform method of epidemiological assessment and grading of malocclusion has been of interest for several decades. Due to the multiplicity of measurement methods and the difficulty in standardising criteria, Bauma (1970) expressed concerns about the lack of suitable methods of recording malocclusion.

Jago (1974), in a review of 45 studies of malocclusion in 18 countries, reported similar difficulties when comparing his findings. The inability to develop a universal occlusal index can be traced to an ever-increasing understanding of the multifactorial nature of malocclusion.

With increasing accountability of health care services, a reproducible and valid malocclusion index would be advantageous for service planning and evaluation (Shaw *et al.,* 1991). Some indices have been developed in an attempt to categorise the treatment of malocclusion into groups according to urgency and need for treatment, to facilitate comparison and objective decision and to reduce subjective bias. These indices are valuable when allocating limited resources to priority groups or as guides in an orthodontic risk/benefit analysis. In the following paragraphs, a review of different malocclusion indices will be highlighted with some of their advantages and shortcomings.

1. **Handicapping Labio-lingual Deviation Index;**

This index was proposed to complement the clinical judgement when screening subjects with handicapping anomalies (Draker, 1960). One advantage was that special equipment was unnecessary. The presence or absence of specified criteria was noted and scored. These criteria were cleft palate, trauma related malocclusions, overjet, mandibular protrusion, openbite and labiolingual spread. The sum total derived from these scores permitted differentiation between handicapping and non-handicapping malocclusions.

2. The Treatment Priority Index (TPI);

This index was designed to assess the severity of the most common types of malocclusion and to provide a means of ranking individuals according to the severity of the malocclusion, degree of handicap or priority for treatment (Grainger, 1967). This index defined seven natural groupings or manifestations of a malocclusion that tended to occur jointly and which were referred to as a "syndrome". Five grades of treatment need were developed, based on ten interrelated features of occlusion, the data was based on findings as they occurred in 375 12-year-old children from three Ontario communities. An eleventh feature was included for gross dento-facial defect.

3. The Handicapping Malocclusion Assessment Record (HMAR);

The HMAR has been endorsed and accepted as a standard by the Council of Orthodontic Health Care, the Board of Directors of the American Association of Orthodontics and by the Council of Dental Health of the American Dental Association (Salzmann, 1968). Assessment can be made from study casts, although an additional oral supplement record permits recording and scoring during clinical examination. One advantage of the HMAR system is the ability to record treatment need without the need for a millimetre gauge, thereby reducing the likelihood of clerical errors.

4. Summers Occlusal Index (SOI);

The index scored nine characteristics at different stages of dental development (Summers, 1971). Two divisions and seven syndromes can be described using the index which also ascribes five subjective classifications of occlusion to its scores. The Occlusal Index has proved to be valid and it has been used by a number of investigators (Clark and Elderton, 1987; Tang and Wei, 1990) to assess orthodontic treatment outcomes. Unfortunately, the Occlusal Index is time-consuming and cumbersome to use, involving a long, complex procedure

of scoring, thereby making research and audit difficult. So and Tang (1993) criticised the Occlusal Index for failing to score missing teeth, other than upper incisors, where pre-restorative orthodontics is needed, suggesting that this tended to underestimate treatment need. The index also penalises cases with a full unit pre-or-post-normal molar relation, the presence of which may still be compatible with static and functional occlusion (Pickering and Vig, 1975). In a field study, the Occlusal Index may be difficult to compute because it is expressed as a decimal, which is more difficult to work with than are integral values (Gray and Demirjian, 1977). Despite the criticisms of the Occlusal Index, it has been shown to be one of the most reliable and valid indices of treatment need (Grewe and Hagan, 1972).

Freer and co-workers (1968) attempted to develop a system using a similarity analysis technique, whereby a population was divided into groups containing similar malocclusions. Several multivariate techniques were used with 40 attributes measured for individuals whose occlusions varied from "near perfect" to extreme malocclusion.

In Sweden, a system was devised by the Swedish Medical Board for prescription of orthodontic treatment needs (Linder-Aronson, 1974). The system concentrated on the dental health impairment and gave subjective guidelines for measurement of aesthetic impairment. The criteria for assessment were not well defined. Ingervall and Ronnerman (1975) who incorporated a morphological index and a functional index added further criteria.

5. Dental Aesthetic Index (DAI);

Since the most common motive for seeking orthodontic treatment is dissatisfaction with the appearance of the teeth, a number of attempts have been made to measure aesthetic handicap objectively (Cons *et al.,* 1986; Evans and Shaw, 1987). One such attempt resulted in the development of the

DAI. In this index the assessment of need for orthodontic treatment is based on an evaluation of aesthetic factors and, therefore, psychosocial handicap (Cons *et al.,* 1986). The index has been used as an epidemiological tool to identify orthodontic treatment need (Estioko *et al.,* 1994) and recently it was integrated into the items of the International Collaboration Study of Oral health outcomes (ICS II) by the World Health Organisation (Howat, 1993).

6. Standardised Continuum of Aesthetic Needs (SCAN);

This index was based on the perception of dental aesthetics in the UK (Evans and Shaw, 1987). An individual's dental occlusion is matched for overall dental attractiveness against ten scaled photographs: from 1 (attractive) to 10 (unattractive). In the UK, SCAN has been found to be of value in the state-funded hospital service to assess treatment priority (Howat, 1993). The SCAN index is easy to use with a high level of reliability even when used by non-dental personnel (Evans and Shaw, 1987); however, it may be criticised for providing only a two dimensional guide and an insufficiently extensive spectrum of dental aesthetics. Phillips *et al.* (1992) has shown that, on a set of photographs, the perception of dental attractiveness is often affected by the photographic view.

7. Index of Orthodontic Treatment Need (IOTN);

Over the last 30 years many attempts have been made to devise indices to measure malocclusion and treatment need objectively, mainly in Scandinavia (Linder-Aronson, 1974) and North America (Salzmann, 1968). The index of treatment priority used by the Swedish Dental Board has been developed in the United Kingdom as an Index of Treatment Need (Brook and Shaw, 1989) into which has been incorporated the SCAN index developed by Evans and Shaw (1987). The IOTN is designed to categorise malocclusion in terms of the significance of various occlusal traits for an individual's dental health and perceived aesthetic impairment (Jones *et al.*, 1996). It is intended to identify

those individuals who would most likely benefit from orthodontic treatment (Brook and Shaw, 1989).

The lack of research data, and its contradictory nature, supporting associations between malocclusion and caries, periodontal disease, cranio-mandibular dysfunction and socio-psychological function and the fact that orthodontic treatment is usually sought by the patient for reasons of aesthetics, led Brook and Shaw to develop an aesthetic assessment "to allow appropriate weighting for this component". The resulting index incorporates a Dental Health Component (DHC) based on the Index of the Swedish Medical Board (Linder-Aronson, 1974) and an Aesthetic Component (AC) developed by Evans and Shaw (1987).

A Aesthetic component (AC);

When dealing with information related to morphology and the aesthetic significance of variability, visual stimuli as tools in communication may be more comprehensible than verbal descriptions (Stenvik *et al.,* 1997). The AC is a rating scale for dental attractiveness comprising 10 numbered dental photographs. One thousand anterior intra-oral photographs of 12-year-olds were rated by six non-dental judges and placed on a visual analogue scale (Evan and Shaw, 1987). At equidistant intervals along the judged range, sub-samples of 10 photographs were chosen to provide illustration for a 10-point scale, representing a wide variation in dental attractiveness. Accordingly, the scale may be regarded as continuous where scale point 1 represents the most and 10 the least attractive arrangement of teeth. The scale has been developed in the UK and designed to measure the aesthetic impairment of malocclusion, and hence the psychological need for orthodontic treatment. The child's dental appearance is assessed relative to the scale on the basis of comparison to dental attractiveness depicted by the photographs, rather than specific morphological similarity.

In a validation study, the photographs were re-categorised to reflect current British professional opinion regarding aesthetic treatment need (Richmond *et al.,* 1995) as shown in Table 2.2.

Table 2.2 Treatment need relative to IOTN AC score (Richmond *et al.,* 1995)

IOTN AC Score	**Orthodontic Treatment Need (on aesthetic grounds)**
Photographs 1,2,3 and 4	No need for treatment
Photographs 5,6 and 7	Possible treatment need (check against DHC)
Photographs 8,9 and 10	Definite treatment need

The proposed applications of the AC are both to assist the orthodontist in determining treatment priority and in research related to psychosocial aspects of malocclusion. Furthermore, by allowing potential patients to place themselves on the scale, it has been proposed to use AC as a tool in patient counselling when assisting subjects to gain a realistic impression of their relative dental attractiveness (Shaw *et al.*, 1991).

B Dental Health Component (DHC);

This represents an attempt at synthesis of the current evidence for the deleterious effects of malocclusion and the potential benefits of orthodontic treatment, and is loosely based on the Index of the Swedish Medical Health Board. Although the Swedish index was a basic guide, a good sense of judgement is required for its implementation while the IOTN removes subjectivity (Linder-Aronson, 1974). Each occlusal trait thought to contribute to the longevity and the satisfactory functioning of the dentition is defined and placed into five grades, with clear cut-off points between the grades.

The DHC has five categories ranging from 1 (no need for treatment) to 5 (great need), which may be applied clinically or to patient's study casts. When applied to study casts, there are minor differences in the definition of

some traits. In use, various features of the malocclusion are noted and measured with a specially designed ruler. A fundamental premise of the index is the recognition that dental diseases are site specific, (for example, severe displacement disadvantage for that site), and the most severe anomaly identified is the basis for grading the person's need for treatment on dental health grounds. Summing scores for a series of individual traits is not performed. Thus, multiple minor variations, each of which may be unimportant with respect to dental health, cannot be added together to place a person in a higher grade (Shaw *et al.,* 1995).

The following characteristics are assessed for the DHC:

- missing teeth;
- overjet;
- crossbite;
- contact point displacement; and
- overbite

The order in which these are assessed is not important. What is important however, is that the most severe trait is selected for indicating the need for treatment. Each grade has an identifying series of letters to enable the trait to be identified, if necessary, for epidemiological purposes.

General dental practitioners (GDPs) play a central role in the provision of orthodontic treatment through their referrals. A report by the British Orthodontic Standards Working Party concluded that orthodontic awareness among GDPs is commonly poor, and GDPs have difficulty in deciding which patients should be referred for orthodontic treatment (Isaacson, 1990). This situation may lead to children who need orthodontic treatment being denied the opportunity to receive it. This failure in the identification of need has been quantified in a study where 30% of 16-year-olds were found to be in need of orthodontic treatment for severe malocclusions, and over half of this group had never received orthodontic advice from their GDPs (Burden *et al.,* 1995).

In addition, children with little or no need for orthodontic treatment may be referred for active treatment. This inflates waiting lists and delays access for those with objective needs.

Traditionally, in clinical orthodontics the assessment of treatment need has involved a large measure of subjectivity and as such has been a value judgement. Numerous studies have shown that this approach to assessing treatment need is unreliable even among orthodontists (Shaw *et al.,* 1991). Clearly, if the experts cannot agree, it is hardly surprising that GDPs experience difficulty.

Any index used for surveys must accurately provide the required data. Results should be error-free and demonstrate minimal variability following examiner training and calibration. A number of studies have been carried out to demonstrate the reliability of the IOTN:

- Brook and Shaw (1989), carried out measurements on a sample of 222 referred patients, representing ideal examination conditions and 333 school children, simulating a screening programme. Their results are shown in Table 2.3. The study showed that AC had a "reasonably high" Pearson's correlation coefficient in the screening situation and "less satisfactory" in the referred group.

Table 2.3 Kappa Scores from repeat examination of 222 patients (ideal conditions) and 333 school children (screening conditions)

DHC	Kappa Score
DHC intra-examiner	0.84 "ideal conditions" 0.75 "screening conditions"
DHC inter-examiner	0.73-0.80

- Holmes (1992) showed that self-evaluation of dental aesthetics by the child demonstrated only slight agreement with the examiner's aesthetic judgement. There was a tendency for children to over rate their attractiveness compared to the professional judgement.

- Lunn *et al.* (1993), examined 24, 13-year-old children under screening conditions for training and calibration of 10 examiners. This was followed by recalibration a few months later. At the re-calibration, 22 children and 9 of the examiner returned. The results are shown in Table 2.4. Although these scores still represent a "moderate" to "substantial" level of agreement, when AC is applied to children in the field, in contrast to application of study models, the values of Kappa are reduced.

Table 2.4 Kappa scores repeat examination of 22 children by 9 examiners (Lunn *et al.*, 1993)

No. of Examiners	Weighted Kappa (Mean)
10 Examiners	AC 0.37-0.66 (0.5)
	DHC 0.35-0.91 (0.62)
9 Examiners	AC 0.38-0.76 (0.56)
(Recalibration)	DHC 0.34-0.88 (0.61)

- Richmond *et al.* (1995), trained and calibrated 21 dentists in the use of IOTN using thirty pairs of dental casts. The Kappa results for the inter-examiner calibration with the "gold standard" are shown in Table 2.5.

Table 2.5 Inter-examiner Kappa scores of 21 dentists using 30 pairs of dental casts (Richmond *et al.*, 1995)

Variables	Weighted Kappa (Mean)
AC	0.76-0.98 (0.91)
DHC	0.77-0.98 (0.90)

- Hancock and Blinkhorn (1996) carried out an examination of 246, 12-year-old children using the DHC and the AC of the IOTN, before and after training and calibration of the examiners. They compared the

examiner assessed normative needs with the subjects' perceived needs. A Kappa score of 0.29 was achieved before training and 0.79 after training, having grouped the gradings into two levels in accordance with the above recommendation of Lunn *et al.* The two groups were simply "treatment required" (DHC 3+ and AC 5+) and "no treatment required". The Kappa results achieved were consistent with the findings of Lunn *et al.* (1993)

- Birkland *et al.* (1996), found in their study on 3200, 11-year-old children in Norway, that the children's own rating of the AC scores showed a higher correlation with their normative needs than their orthodontic concern scores. The orthodontic concern score having been obtained from responses to questionnaires. The questions formulated assertions (level of agreement/disagreement with statements) and was composed of different items; perception of own occlusion, wish for treatment, negative and positive aspects of treatment, importance of occlusion and children's self-esteem.

- Mandall *et al.* (1999), found that inter-examiner and intra-examiner reliability of AC and DHC on 10% of their sample (43 children) in Manchester to be in almost perfect agreement (Table 2.6).

Table 2.6 Inter-examiner and Intra-examiner Kappa scores of 43 school-children aged 14-15-year in Manchester (Mandall *et al.*, 1999)

Variables	Weighted Kappa (Mean)
Inter-examiner	
AC	0.88
DHC	0.92
Intra-examiner	
AC	0.95
DHC	0.91

The AC when applied by the patient begins to address a problem which previous indices have displayed, that of misjudgement or insensitivity to the patient's perception of their condition. However, the AC is more subjective and less reliable than the DHC. Subjects have tended to attempt to physically match rather than compare their attractiveness with one of 10 photographs. This factor has been overcome in one study (Burden and Pine, 1995) by using a 10 point linear numerical scale, using only 2 photographs (grade 1 and 10), one at each end of the numerical scale.

It can be concluded that IOTN has been shown to be valid and reliable, easy to use and rapid to apply. It has been shown repeatedly to be simpler and less time consuming to use than other indices. Its simplicity is an advantage in studies of large population groups. High reliability for scoring across a wide range of malocclusions has been demonstrated by independent researchers.

2.11 Review of measuring attitude towards persons with disabilities

"Attitudes are regards as latent or inferred psychosocial processes that lie dormant within one's self unless evoked by specific referents" (Oskamp, 1991). Attitudes are acquired through experience, predisposing one's responses to socio-cultural events and other people, so to measure it, an index will represent the presence, strength and direction of the attitude presumed to underlie the observed behaviour (Antonak and Livneh, 1988). Attitude has three components: the cognitive component (beliefs), the affective component (feelings) and the conative component (behavioural; Speakman 1989). The cognitive component refers to the subject's belief about the attitude object. There are two types of beliefs: the first type asserts the truth or falsity of proposition, while the second type concerns a relationship between the attitude object and a favourable and unfavourable characteristic. The affective component refers to the subject's feelings toward the attitude object and they range along a bipolar dimension from negative/dislike to

positive/like. The conative component is referred to behavioural intensions and concerns how the person believes the attitude object should be treated in specific social contexts (Wrightsman, 1971).

Generally, attitudes can be measured by direct and indirect methods (Dovidio and Fazio, 1992). Direct methods are those in which the respondents are either informed that their attitudes are being measured or are made aware of it by the nature of the attitude measurement technique. Alternatives to direct measurement methods have been developed for those attitude measurement situations in which: (1) the act of measurement itself may create in the respondents an attitude towards a referent to which they were previously unaware; (2) other methods may lead the respondents to a reply that is inconsistent with their true attitude; or (3) the referent is so sensitive or so charged with emotion that the observed response may be non-purposefully distorted by unrelated but powerful personality characteristics.

2.11.1 Direct methods

Direct methods are by far the most widely used in measuring attitudes towards persons with disabilities and in which the respondents are aware that they are participating in an attitude measurement experiment (Rajecki, 1990). Opinion surveys ask respondents to express their attitudes by responding to a list of questions about the referent. A structured (closed) opinion survey asks the respondents to select one among a small set of responses, or all of those that they agree with, or those that they endorse. Unstructured surveys ask that the respondents provide not only an answer but also a justification or explanation for the answer.

2.11.1.1 Opinion Surveys

Opinion surveys ask respondents to express in writing their beliefs, attitudes, feelings or intensions toward some referent by responding to a list of questions presented in a group situation or by mail (Antonak and Livneh, 1988). The

research is not a part of the response process, although the researcher may be available to clarify a question. Because the respondent is aware of the purpose of the research, these methods are obtrusive and reactive measures. Respondents may change their responses in an effort to protect their privacy, or to provide the researcher with data they think the researcher seeks.

2.11.1.2 Interviews

Interviews require that the researcher interact directly and verbally with the respondent, although the interview may take place over the telephone or through the use of field assistants. Structured interviews use a fixed set of questions in a fixed sequence with all respondents, although branching may allow the researcher to skip over certain questions depending on the respondent's answer. In an structured interview, the researcher can ask additional questions and explore the respondent's attitudes. Interviews have been used to investigate the attitudes of employers towards the employment of persons with disabilities (Philips, 1975), and to study educators' views about the efficacy of special education (Barngrover, 1971).

2.11.1.3 Rankings

Ranking methods require the respondent to arrange a small set of items into an ordered sequence according to some specific criterion. It has been used frequently to compare various groups of respondents on their attitudes towards persons with disabilities (Orlansky, 1979).

2.11.1.4 Q methodology

This requires the respondent to sort a set of phrases or statements about the attitude referent into piles according to some criterion, such as favourability, intensity of agreement, or descriptiveness (Stephenson, 1953). The sorts of different respondents may be analyzed to derive clusters of respondents and the

content of the items in each pile for different clusters of respondents is examined in order to characterize the respondents. The researcher may then assign a respondent to a group by comparing his/her orderings with those obtained in previous research. The clusterings may also be examined before and after some event or intervention to discern changes in the respondent's attitudes. Barker (1964) used Q methodology to study similarities of views for a variety of disabilities.

2.11.1.5 Socio-metrics

This was designed to uncover how a respondent within a group behaves or intends to behave towards another person within the group when given a choice of behaviours (Antonak and Livneh, 2000). For example, the respondent may be presented with a roster of all the persons in his/her class and asked: "Which of your classmates on the list below do you most like to sit with in the lunchroom? Next most?...Least?" The resultant data can yield a pictorial sociogram illustrating the number of times a child is nominated or selected in various situations.

2.11.1.6 Paired comparisons

The researcher presents all possible pairs of the referents that he/she wishes to scale and asks the respondents to select the item in the pair that they would rate higher in terms of some criterion (Antonak and Livneh, 2000). The resultant data are analysed to yield an ordering of the items for each respondent or for a group of respondents.

2.11.1.7 Semantic differential method

A single concept is presented followed by a set of 7 to 20 scales anchored at each end by bipolar adjectives connected by a line marked in intervals (Osgood *et al.*,

1957). Respondents are asked to mark the line at a point that represents their rating of the concept on each scale.

2.11.1.8 Rating scales

Rating scales require that the respondents indicate the strength of their agreement or disagreement which each item in a collection of items concerning the attitude referent. It represents ubiquitous attitude measurement methods;

- A probabilistic rating scale assumes that the response to any item on the scale is not determined by the respondent's latent attitude, but rather the respondent's attitude is assumed to increase the probability that a particular response will be selected. The most widely known probabilistic rating scale is the summated rating scale method developed by Likert (1932).
- A deterministic rating scale assumes that the response to any item on the scale is completely determined by the latent attitude of the respondent. The most widely known deterministic scaling method is scalogram analysis (Guttman, 1944).
- A social distance scale consists of seven equal-appearing intervals that the respondent is asked to consider (Bogardus, 1933).

2.11.1.9 Adjective Checklists (ACL)

The original ACL was constructed by Gough (1960) for the investigation of personality and self-concept. A list of 300 adjectives arranged alphabetically was presented to the respondents who were asked to select those adjectives which were considered descriptive of themselves. Factor and cluster analytic investigations led other researchers to derive a variety of scales from ACL, presumably measuring various aspects of personality, such as achievement, autonomy, self-confidence and personal adjustment.

Direct methods of measuring attitudes are subject to a number of threats to the validity of the obtained data (Antonak and Livneh, 1988). The mere process of responding may transform a nonexistent attitude to an existing one, or create a transient attitude in the respondent that the researcher, quite erroneously, interprets as a meaningful, typical, or stable attitude, a validity threat known as respondent sensitization. Respondent reactivity concerns the respondent's realization that his/her attitudes, opinions, or values are being measured and the resultant attempt to modify or distort privately held attitudes when responding to an attitude instrument. One may: (1) attempt to please the researcher by providing a response that one thinks will confirm the researcher's hypothesis; (2) wish to give a good impression of oneself as open-minded, sophisticated, or enlightened; (3) grant the attitude referent the benefit of the doubt when asked to make evaluation judgments; (4) deny socially undesirable traits by endorsing only those statements that one believes represent the socially appropriate response; (5) try to sabotage the study by purposefully disclosing inaccurate attitude; (6) fail to give discerning responses because a lack of interest in the measurement task; or (7) refuse to provide responses for fear of revealing non-typical and controversial views.

Another source of invalidity of direct measurement methods, known as response style, arises from the non-purposeful attitude distorting influences of an unrelated personality attribute of the respondent. For example a midpoint response style represent one's attempt to find a place to hide on the response scale by selecting only the middle or neutral value.

2.11.2 Indirect methods

Indirect measurement methods can be organised into four classes (Livneh and Antonak, 1994). The respondents are (1) unaware that they are being observed or measured (nonobtrusive behavioral observations); (2) aware that they are being observed or measured, but are unaware of or are unclear about the purpose of the measurement situation (projective techniques); (3) purposefully deceived as to the

true purpose of the measurement situation (disguised techniques); and (4) aware of being measured but are inactive participants in the measurement process (physiological methods).

2.11.2.1 Behavioural observation

The concept of behavioural disposition is an integral part of all definitions of attitude. This is so because attitudes cannot be measures directly, but must be inferred from a variety of verbal and nonverbal behaviours which the respondent is predisposed to display. In other words, the behaviour that the respondent displays toward an attitude referent in natural settings is considered to be a direct operationalisation of his/her attitude. The behaviour observation attitude measurement requires hidden recording techniques such as video and audio recoding devices (Antonak and Livneh, 2000). A number of difficulties limit routine use of this method including the need for expensive recoding devices, that training is required and the procedure is very time consuming.

2.11.2.2 Projective techniques

This presents an ambiguous stimulus or a task for which only dim clues have been provided (Rabin, 1981). The respondents are expected to project their attitudes onto the measurement task. This projection is then interpreted and scored by a clinically trained professional.

Projective techniques are often classified into five major categories according to the type of task or stimuli presented or alternatively the type of response elicited.

- Associated techniques require the individual to respond with the first word or image that comes to mind at the presentation of a stimulus.
- Construction techniques focus on a respondent's output when requested to construct a story or a picture in response to a test stimulus.
- Completion techniques focus on a respondent's output when requested to construct a sentence in response to a test stimulus.

- Choice techniques require the respondent to select among several alternative items (e.g. Pictures, photographs, colures, designs) those that appear most relevant or correct when applied to a referent.
- Expressive techniques permit the researcher to study the projection of personal wishes, fears and conflicts by having the respondent form a product out of raw material.

The infrequent use of project techniques for the measurement of attitudes towards persons with disabilities may be due in part to (1) the specialized clinical training that is required to administer and score the instrument, and to interpret the respondent's projection; (2) the additional time and expense associated with these techniques; and (3) the lack of well-formulated hypotheses accounting for the relation between performance on a projective technique and specific manifestations of attitudes towards persons with disabilities (Antonak and Livneh, 2000).

2.11.2.3 Disguised Techniques

These provide an inherent structure to the task to be performed by the respondent in the disguised approach and attempt to direct the respondent's attention away from the attitude for which measurement is being sought (Antonak and Livneh, 2000). The disguised procedures can be classified into three categories: namely, those in which the respondent is: (1) unclear about the real purpose of the investigation; (2) led to believe that no control can be exerted over his/her response; or (3) duped into believing that the purpose of the investigation is other than what it actually is.

The researcher may provide a set of photographs or statements about individuals differing in gender, age, race, disability and other visible characteristics that belong together without stating what characteristic defines each group. The sorting of photographs is thought to reflect the salience of the various characteristics portrayed in the photos. Another approach requires that

respondents select from among individuals described in brief case vignettes those with whom they would prefer to affiliate in various social and work situations. Disguised procedures have limitations that are more difficult to counteract than those of the other types of indirect measurement methods. Task with no clear purpose require consistency of presentation or else the administration itself may become a confounding variable.

2.11.2.4 Physiological methods

These are regarded as being the most straightforward measures of attitude because they purport to measure reactions over which the respondent has no conscious or voluntary control. Physiological methods assume that the magnitude of the physiological reaction is directly and positively associated with the extent of the autonomic arousal or the intensity of the underlying attitude (Cacioppo and Tassinary, 1990). The direction of corresponding attitude (e.g. pleasurable or unpleasurable, favorable or unfavorable), on the other hand, can not be assumed with clarity, although it is often inferred that the greater the magnitude of the emotional arousal, the more favorable the attitude. The most widely used procedure to measure autonomic activation had been the electric conductiveness of the skin. It is assumed that when intense affective reactions are experienced they are accompanied by a physiological activation lowering the level of skin resistance.

Although physiological methods represent a unique and creative line of measurement, they may not always be feasible in many attitude research situations. Physiological methods require a laboratory setting, costly equipment, careful calibration and control of the measuring instrument and technical expertise to obtain and interpret the response data. There is also the attitude corresponding to a physiological response (Shapiro and Crider, 1968).

2.12 Scales for the measurement of attitudes toward persons with disabilities

Currently, there are seven scales which attempt to measure general attitudes toward people with disabilities and two scales which measure attitude toward people with sensory impairments (visually and hearing impaired).

2.12.1 Acceptance Scale (A-SCALE)

The acceptance scale was developed by Voeltz (1980) to measure the attitudes of children with no disability towards peers with disability integrated into regular classroom settings. It was intended that this instrument would provide the data needed to evaluate one aspect of the effectiveness of educational integration efforts. Beginning in 1977, the state of Hawaii began to integrate severely and multiple children with disability into regular educational settings based in neighbourhood public schools to replace institutional services. This program provided Voeltz with the impetus and opportunity for the development of the A-Scale. A prototype attitude instrument was administrated to more than 2500 public school children in grade 2 through 7 in Hawaii in the fall of 1978.
The A-Scale had been modified since early research, and consists of four versions: Lower Elementary Level (Grades 1-2); Upper Elementary Level (Grades 3-6); Secondary Level, A-Version; and Secondary Level, B-Version.

2.12.2 Attitude Toward Disabled Persons Scale (ATDP)

The ATDP scale is the most widely used of scales purporting to measure attitudes toward people with disability in general. This self-report scale was original published in 1960 as a 20-item summated rating scale named the ATDP-Forum O (Yuker *et al.,* 1960). Two equivalent 30-item forms, A and B were subsequently developed (Yuker *et al.,* 1966). The items on the scale represent statements suggesting differences between people with or without disability. The items depict two types of statements-characteristics of disabled individuals (e.g. personal, intellectual, emotional, social) and treatment modalities (e.g.

educational, vocational, social integration). The scale purports to measure both the attitudes of people without disability toward people with physically disability and attitudes of people with disability toward themselves. In the latter case, self-directed attitudes are perceived as a measure of self-acceptance or rejection of being with disability. The authors argue that the three forms are unidimensional and measure a generalised attitude.

2.12.3 Disability Factor Scales (DFS)

The Disability Factor Scales were constructed to overcome the three basic faults inherent in previously developed measures of attitudes toward people with disability (Siller *et al.,* 1967). These perceived weaknesses were: (1) the failure of previously published scales to consider the multidimensionality of attitudes toward individuals with disability, (2) the ambiguity associated with use of the term "disability" (ATDP) as a general trans-referent class which often conveys vagueness and arouses negativeness, and (3) the specificity of some attitudinal scales which only measure reactions toward a particular disabling condition.
Consequently, Siller and his colleagues developed an array of self-report summated rating scales to measure attitudes toward specific disabilities and across disabilities. The disabilities selected, which were to sample different degrees of both functionality and visibility of impairment included: amputation, blindness and cosmetic conditions (Siller *et al.,* 1967; Siller *et al.,* 1967), deafness (Ferguson, 1970), obesity (Vann, 1970) and cancer (Siller and Berden, 1976).

2.12.4 Disability Social Distance Scale (DSDS)

The Disability Social Distance Scale was developed by Tringo (1970), comparing attitudes and prejudice toward specific disability groups. Using the method of equal-appearing intervals, nine scale items were selected to represent the range of social distancing of the respondent without disability to 21 disability groups. The disabilities included physical disabilities (e.g. amputee, cerebral palsy), sensory disabilities (e.g. blindness, deafness), mental disabilities (e.g. mental retardation),

psychiatric disabilities (e.g. mental illness) and social-behavioral disabilities (e.g. alcoholism, ex-convict).

2.12.5 Rucker-Gable Educational Programming Scale (RGEPS)

Rucker and Gable (1974) developed the RGEPS with attitude operationalised as the degree of social distance which teachers and others wished to maintain between themselves and students with disability. The impetus for the development of the scale was to evaluate the success of the educational policy of mainstreaming through the investigation of the knowledge and attitudes of those professionals responsible for the implementation of the policy. The scale has been used to evaluate the effectiveness of training on the attitudes of teachers (Shaw and Gillung, 1975) and to study the attitudes of teachers and administrators in various school settings (Cline, 1981; Pfeiffer and Naglieri, 1984).

2.12.6 Scale of Attitudes toward Disabled Persons (SADP)

Research by Antonak (1979a, 1980c, 1981b) questioned the reliability and validity of the ATDP Form-O of Yuker and his associates (Yuker *et al.,* 1960). Antonak (1980c) suggested that a more contemporary, easy to use and psychometrically sound instrument was needed by researchers investigating attitudes toward people with disability as a group. The SADP was developed by Antonak (1981a, 1982) to provide an alternative to the ATDP Form-O for the investigation of questions concerning the formation, correlates and modification of these attitudes.

The specification of the scale's item content was derived from a review of the research literature on attitudes toward people with disability, from examination of previously published scales and from analyses of open-ended interviews with experts in the field of special education and rehabilitation. An initial pool of 176 items was edited to yield sets of 86 and subsequently 76 items. These 76 items were then evaluated by a panel of ten experts to identify ambiguities, to eliminate

redundant items and to determine the value of each item on a six-point scale, ranging from -3, to signify "Very unfavourable", to +3, to signify "Very favourable".

A set of 64 items were retained and randomly arranged onto a composite scale. The responses of 228 individuals were obtained and a series of item, scale and factor analyses were undertaken to reduce the number of items and create a more efficient scale with adequate general factor variance, internal consistency and sound psychometric characteristics. This iterative process yielded sets of 51, 38 and finally 30 items. These 30 items were then arranged on a second composite scale and the response of a new sample of 225 individuals were obtained. Similar scale reduction analyses yielded the final 24-item version of the SADP. Subject scores were recalculated and complete item, scale and factor analyses were performed (Antonak, 1981a).

Additional analyses of the SADP data collected from 1981 to 1983 from new samples of respondents were conducted by Antonak (1985a, 1985b) to confirm and clarify the reliability, validity and utility of the scale.

2.12.7 Interaction with Disabled Persons (IDP)

A relatively new attitude measurement scales is the IDP scale that was developed in Australia beginning 1981 and standarised in 1990 (Gething, 1992). A multidimensional scale, it is based on the theory that negative attitudes originate from the uncertainty or anxiety created by perceptions of persons as being strange or unfamiliar and integrates perspectives of health profession and lay person with various disabilities including those with visual impairment. The IDP scale was designed to measure emotions, motivations and reactions which underlie negative attitudes associated with discomfort that some people experience in actual or anticipated social interaction with a person with disability (Gething, 1992).

2.12.8 Attitudes to Blindness Scale (AB)

The Attitudes to Blindness scale was developed by Cowen *et al.* (1958) as a brief and reliable measure of verbalized attitudes toward blind people. A total of 97 propositions, which appeared to be related to the attitudes demonstrated by sighted people toward blindness and blind people, were extracted from earlier studies. Of this initial pool, 30 items were selected for the final self-report, summated rating AB Scale. The authors argue that the scale is unidemsional with scores reflecting varied degrees of favourable attitude toward blindness and blind people.

2.12.9 Attitudes to Deafness Scale (AD)

The Attitudes to Deafness scale was developed by Cowen *et al.* (1967) by rewording the 30 items of the original AB Scale (Cowen *et al.,* 1958) by substituting the terms deafness or deaf person for the terms blindness or blind person. An additional 20 items were written based on attitudinal statements regarding deaf people located in the literature. Sets of 25 items were later selected for the final self-report summated rating AD Scale. The authors argue that the scale is unidemsional and its scores purport to measure the degree of acceptance, or rejection, held by the respondent toward deafness and deaf people.

CHAPTER THREE

Aims
and
Objectives

3.1 Background

The dental management of sensory impaired children is not well documented in the literature. Also, research into the barriers in providing dental care for these children is notable by its absence.

Over the last 30 years many attempts have been made to devise indices to measure malocclusion and treatment need objectively, mainly in Scandinavia (Linder-Aronson, 1974) and North America (Salzmann, 1968). The index of treatment priority used in the United Kingdom is an index of treatment need (Brook and Shaw, 1989). The IOTN therefore has two components, one measuring dental health (DHC) and the other aesthetics (AC). The aesthetic components comprise 10 photographs, with No. 1 considered to be the most attractive and No. 10 the least attractive.

3.2 Aims of the study

The aims of the study are to document the barriers to orthodontic care for children with a sensory (visual and hearing) impairment resident in Riyadh, Saudi Arabia. Barriers to orthodontic care in terms of this study will be considered in relation to three distinct areas:

3.2.1 Normative and perceived orthodontic treatment needs of children with a sensory impairment

Normative orthodontic treatment need will be rated by an examiner while perceived treatment need will be scored by children using the AC of IOTN. Clearly a revised format for presentation of the AC would need to be developed for those children with visual impairment.

3.2.2 Attitudinal barriers of dental health professionals and parents

The views of general dental practitioners (referring source and treatment) and orthodontists in providing dental care and orthodontic treatment for children with disability as well as sensory impairments will be sought.
Furthermore, the views of the parents or care providers towards dental care and orthodontic treatment will be recorded.

3.2.3 Educational barriers

An exploration of attitudes of dental students at the beginning and end of their course towards people with sensory impairment will be undertaken. Students in the medical college will be used as a control group.

3.3 Objectives of the study

1. To develop a means of determining the AC of IOTN for visually impaired children.
2. To undertake an epidemiological dental survey of children with and without sensory impairment and who are resident in the city of Riyadh with regard to their oral health status, orthodontic treatment needs (perceived and normative need) and to determine oral health ranking between visually and hearing impaired individuals.
3. To administer a questionnaire to all parents and care providers of the children recruited into the study with regard to their attitude to dental health care and orthodontic treatment need.
4. To administer a questionnaire to general dental practitioners to determine their attitude toward sensory impaired people in society using SADP, and the provision of orthodontic treatment.
5. To administer a questionnaire to first and final year undergraduate students in the dental and medical college at King Saud University in Riyadh with regard

to their attitude to sensory impaired people in society using SADP. Also, to determine their educational and training background into carrying for people with disability need by using DSATHS.

CHAPTER FOUR

The development of tactile graphics

4.1 Introduction

Facial appearance often gives non-verbal messages about an individual's age, gender and health. It can also influence judgements about such characteristics as intelligence and personality, as well as to more generally affect how we perceive, think and feel about each other (Liggett, 1974; Alley, 1988).

Numerous studies have shown that facial attractiveness promotes positive expectation and impressions. Elovitz and Salvia (1982), demonstrated that school psychologists form more positive prognoses based on "psychological reports" when accompanying facial photographs depict more attractive children. Characteristics of oral features are an important aspect of the physiognomic basis for facial judgements (Liggett, 1974; Alley, 1988). For example, thin lips tend to make people look dominant, as well as sociable and energetic (Keating, 1985); missing or prominent incisors can promote the impression of aggressiveness (Shaw, 1981); and those with prognathic profiles or large jaws are seen as more ambitious, determined and dominating (Keating, 1985).

Studies have shown that when other facial features are held constant, normal occlusion is perceived as more attractive than various forms of malocclusion (Lucker *et al.*, 1981; Shaw, 1981). In addition, Goffman (1975) found that most school children preferred straight, evenly spaced teeth with a noticeable carious lesion to caries free, but crowded and poorly aligned teeth. Shaw (1981), reported that raters of children's photographs judged those with "ideal" dental-facial appearance as more attractive, more desirable as friends, more intelligent and less inclined to aggression than those with impaired dental-facial appearance. Therefore, the need to quantify the degree of malocclusion has led to the promotion of a number of indices which attempt to categorise its level of severity.

4.2 Development of malocclusion indices

Over the last 30 years, there have been a number of attempts to measure malocclusion and treatment need objectively, mainly in Scandinavia (Salzmann, 1968; Linder-Aronson, 1974). The Index of Orthodontics Treatment Need (IOTN) has been widely adopted for epidemiological studies (Brook and Shaw, 1989), determining use of dental services (Lunn *et al.,* 1993), determining treatment priorities, and an individual's perception of their own orthodontic need (Burden and Pine, 1995).

The IOTN has two components, the dental health component (DHC) and the aesthetic component (AC). The latter is a visual-based tool. The AC comprises ten photographs (App. 6), with the first (1) being most attractive and the last (10) being least attractive (Evans and Shaw, 1987). As a visual-based instrument, the IOTN is widely used, but has little practical use for visually impaired (VI) orthodontic patients. Therefore, the rational for this research was to produce and evaluate a modified IOTN that could be used for this group.

4.3 The blind and visually impaired population

The World Health Organization estimate that there are 40 million blind persons in the world (Valluri, 1999). The term blind is reserved for individuals with no usable sight whatsoever, while VI describes those with some usable vision. A blind person is either congenitally blind, being blind from birth, or during the first 5 years of life and possible lacking visual memory, or adventitiously blind, with blindness beginning after the age of 5 years and with the probable presence of visual memory. Visual memory means the ability to classify and remember objects in terms of visual characteristics, such as shape, size, colour, position and perspective (Sardegna and Paul, 1991).

4.4 Orthodontic treatment for VI people

In general, the provision of orthodontic care for people with special needs is poorly described in the literature. Although there are a number of reports on the prevalence of malocclusion amongst this group of patients, their practical clinical management is not described (Vigild, 1985; Oreland *et al.,* 1987). Chadwick and Asher-McDade, (1997) raised the issue of orthodontic treatment for children with learning disabilities and provided some clinical guidelines, which may allow orthodontists to gain therapeutic access to these patients. However, orthodontic care for children with VI is anecdotal. A major perceived benefit of orthodontic treatment is an improvement in appearance, and, therefore, any improvement in aesthetics for people with special needs may help to avoid stigmatisation (Khan and Horrocks, 1991).

4.5 Production of educational material for VI people

Access to visual information can widen the avenues of social interaction for VI persons. This is often accomplished through a manual process that translates a visual representation into a corresponding tactile form. One common method of representing visual images in a touchable or tactile fashion is through use of tactile graphics (Loomis and Lederman, 1986). Tactile graphics provide a raised representation of such visually useful materials as maps, graphs and other simple drawings. This material has been used widely on science courses in schools which cater specifically for VI people. A study by the Tactile Diagram Research Unit indicated that their use could help students at higher levels of education (Wild and Hinton, 1996).

4.6 Human factors

The efficacy of a method for automatically converting visual information into tactile information necessarily is dependent upon a variety of factors.

4.6.1 The human sensory system

Humans receive all their information through using one or more of five senses; gustatory sense, olfactory sense, auditory sense, visual sense and tactual sense. The tactual sense is comprised of touch and kinaesthesia, providing information about such physical qualities as temperature, perception of texture, position and motion (Coren and Ward, 1989). The bandwidth of a sense refers to the capacity of that sense to receive and perceive information. Studies show that vision, as one might intuitively expect, is our highest bandwidth sense, followed by hearing and touch (Kokjer, 1987).

The visual sense is two orders of magnitude better at carrying information than the auditory sense, which is two orders of magnitude better than the tactual sense. Visual information cannot simply be mapped directly to the auditory or tactual domains, but clearly must be reduced by some bandwidth correlated scaling factors (Kokjer, 1987). Further, this scaling must preserve the meaning of the original visual information for it to be useful.

4.6.2 Tactual perception

Tactual perception primarily refers to active exploratory and manipulative touch. For a tactile graphic to be useful, a visually impaired person must be able to explore it with the sense of touch, usually the fingers and extract some content information (Loomis and Lederman, 1986).

The basic physiology of the human skin defines limits to the ability of our sense of touch. Of particular importance to tactile graphics are the difference limen and

its relation to temporal response thresholds and masking phenomena. The difference limen is the minimum statically discernible displacement between two points such that the points are distinct. In effect, this is tactile resolution which for the skin of the fingertip is approximately 2.5mm. When statically felt, two points closer than this distance tend to feel like one point (Sherrick and Craig, 1982). This figure indicates that the resolution of the fingertip is much lower than the human eye.

4.6.3 Tactile pattern perception

The visual sense responds well to minute differences in stimulus, while the sense of touch tends to need greater variation in stimulus patterns to succeed in perceptual tasks (Klatzky *et al.,* 1987). Although touch can discriminate and recognise complex tactile patterns, such perception involves a number of complicated cognitive processes (Klatzky *et al.,* 1985) and its variation depends on the level of visual memory a visually impaired person possesses and the age of the onset of blindness (Karueger, 1982).

The exploration is performed in two stages; first: the entire image is explored as a whole in a hierarchical fashion in the brain, providing a general tactual overview, second: the details of the tactile image are explored (Hinton, 1991).

4.7 Access visual information methods

The task of accessing visual information is one of mapping information from the visual domain to that of one other sense. These fall into the general categories of static tactile graphics, auditory interfaces, dynamic tactile interfaces, haptic interfaces and tactile image creation systems (Way and Barner, 1997 Part I & II).

4.7.1 Static tactile graphics

These usually require the intervention of a sighted person in their preparation. The process of converting information can be labour-intensive and a time-consuming one.

There were three important steps in the process;

4.7.1.1 Editing step

The material should contain the least amount of information possible to convey successfully the content of the image (Klatzy *et al.,* 1987).

4.7.1.2 Transferral step

This involves placing the image onto some tactile output medium. A picture is first traced on tracing paper and then is transferred to the tactile display material using carbon paper and retracing (Way and Barner, 1997 Part I). Other methods for transferral include the pantograph, which is an instrument consisting of four arm joints in parallelogram form.

4.7.1.3 Production step

There are several methods available which all require a sighted person to translate a visual image into a tactile one (Edman, 1992);

- Raised-Line Drawing Boards: These are designed to be used by VI persons for producing raised-line drawings. This common tool is also useful for fast production of tactile versions of visual originals.
- Tactile-Experience Picture: This method is often used for young children. Pictures are constructed from a variety of materials, including wood, plastic, cloth, sandpaper, fur and metal, which are glued to a stiff cardboard backing.

- Buildup Displays: Similar in method to tactile-experience pictures, these rely on multiple layers of paper to build up a raised drawing. Additional materials, such as wire, string and even staples may be added to enhance the drawings.
- Embossed Paper Displays: This technique reproduces a drawing on heavy paper using a collection of embossing tools. A reverse view of a sketch is first transferred to the back of a sheet of embossing paper. The tools are then used to trace the sketch, embossing it as a series of raised dots.
- Braille Graphics: These are produced by using a standard braille printer connected to a computer.
- Vacuum-Forming Method: This method, also known as thermoforming, excels at producing multiple copies of tactile graphics in a very durable format.
- Microcapsule Paper: Referred to puff paper, this is a quick and economical way to produce tactile graphics. The paper coated with microscopic capsules of polystyrene, each being ≈100 μm in diameter. Organelle graphics are photocopied onto the capsule paper using a standard office copy machine. Graphics can be applied to the microcapsule paper using ink pens, markers and other drawings. Once the image is applied to the paper, it is inserted image side up into a heating machine, referred to as the tactile image enhancer, which causes the polystyrene capsules to expand and become raised.

4.7.2 Auditory interfaces

Whilst there is a wide variety of methods for producing tactile graphics, output of computer generated speech is more generic. Screen review software is used by the VI user to explore the textual material and to select the desired passage. Typically, the software sends the text it encounters to a hardware device, such as a speech-synthesis car added as an enhancement to a computer, for conversion from text to speech (Thomas, 1994).

4.7.3 Dynamic tactile interfaces

A widely used dynamic tactile display device is the Optacon. The Optacon was designed as an alternative to braille for reading printed text (Vanderheiden, 1990). It is a vibrotactile display, comprised of a fingertip-sized matrix of 144 vibrating pins, arranged in a 24-row, 6-column format. In addition to the Optacon was the tactile vision substitution system, which used a similar technique to display a vibrating representation of an image on the user's back (Beauchamp *et al.,* 1971). The image is captured by a television camera and sent to a more widely spaced array of vibrating pins. The idea of the system was to produce a system by which a VI person could wear a video camera and backpack display and actually manoeuvre through the world using the vibrating representation of what the camera saw for guidance.

4.7.4 Haptic interfaces

The term haptic refers to the proprioceptive, or positional, sense which is an extension of touch (Kennedy, 1982). Thus, a haptic interface can represent three or more dimensions whereas a tactile display provides only two dimensions. Haptic interfaces are an important display method in a virtual reality system, capable of reproducing a sense of position in space, interaction of forces, and even textures. A math-graphing package or custom graphing software often generates the original information.

4.7.5 Tactile image creation system

This system allows automatic generation of tactile graphics and involves acquiring an image through computer software, performing some simplifying processing, and displaying the result on a tactile output medium, such as capsule paper or a dynamic, real-time tactile display (Way and Barner, 1997 Part I). Thus a VI computer user could browse a CD-ROM collection of computerised images. This increased access to visual material can facilitate broader educational and

professional opportunities, particularly in areas with a strong tendency toward visual presentation of information.

4.8 Aim

There are no reports in the dental literature of the IOTN being used on people with special needs, especially for those with a visual impairment. The VI child has specific needs in this respect, which are over and above those with a sensory impairment. The visual assessment intrinsic in the IOTN index makes it inappropriate for VI children and therefore a specific format for the index was needed.

4.9 Method

After reviewing the human factors and technologies that are basic to the development of a tactile graphic, the method of producing a tactile graphic version of the IOTN had to pass through a production and evaluation stage.

4.9.1 Development of an IOTN for VI people

The new version of an AC of IOTN was developed with the collaboration of the Royal National Institute for the Blind (RNIB) at Peterborough, UK. The RNIB is a national organisation which develops and produces information and materials for the visually impaired person. It has the largest collection of Braille audio and tactile graphic facilities for this group in Europe. It is also responsible for technical testing and evaluation of such materials.

4.9.2 The production

4.9.2.1. Design

The thermoform vacuum-forming method was used in order to provide adequate thickness for the anterior-posterior dimension of incisor overjet. It also facilitated the production of several copies as required. The production passes through several stages following the general guidelines for tactile graphic production (Table 4.1).

The "teeth" were made of vinyl floor tiles equivalent to 3-layer paper thickness surrounded by rough textured papers (crepe-paper), which represented the gingivae. The "teeth" and the "gingivae" were adhered to stiff paper. The outcome design was used as a master copy (collage). The master was placed on a perforated metal tray in a vacuum-forming machine to produce the thermoforming copy (tactile graphic). A sheet of plastic of 0.006 in. to 0.010-in. thickness called braillon was placed on the top of the master and fastened in place by clamps to produce an airtight seal. The heating unit was set at 392°-572° F for approximately 6 seconds. The copy was then peeled from the master and allowed to cool for 5 seconds (Fig. 4.1).

4.9.2.2 Size

According to the RNIB print guideline, the size of the teeth was selected to be the equivalent of 18 font to increase the vision ability of children who are partially VI (RNIB, 1998).

4.9.2.3 Number

In order to avoid confusion, the number of graphics produced was limited to four, with one at least from each category of the AC of the IOTN. In this study photographs 1, 5, 8 and 10 were selected.

Graphic 1 corresponds to photograph 1 (no treatment- mild need)

Graphic 2 corresponds to photograph 5 (moderate; increased overjet with minimal crowding)

Graphic 3 corresponds to photograph 8 (severe; increased overjet with crowding)

Graphic 4 corresponds to photograph 10 (severe need)

4.9.2.4 Modification

In order to enable the individual to understand the meaning of well-aligned "straight" teeth, photograph 1 was modified by separating the upper jaw from the lower jaw.

4.9.3 Evaluation

As more and more technical aids for disabled persons are being developed in various countries, there has been a growing need to know more about the technical and functional quality of these aids. Evaluation involved an assessment by an RNIB expert consumers group at the Peterborough headquarters, followed by a school-based study undertaken in Dorton House School for the Visually Impaired (Sevenoaks, UK).

4.9.3.1 RNIB expert consumers group

The RNIB consumers group comprised four females and five males (age range 30-50 years) who were experienced in tactile products and their evaluation.

An interview evaluated the;

- quality of the graphics' design,
- conformity with guidelines,
- ease of use,

One facilitator (MS) led the groups evaluation which was essentially qualitative in nature. After the group work, each individual was asked to arrange the IOTN graphics in order of severity of malocclusion. This procedure was repeated after an interval of 30 minutes.

4.9.3.2 School-based evaluation

A sample of 13 VI children (age range 11-16 years) participated in the study. A simple interview was carried out to ensure the children understood the graphics. Each child was then asked to arrange the IOTN graphics in order of severity of malocclusion. Again the process was repeated after an interval of 30 minutes.

4.10 Results

4.10.1 RNIB expert consumers group

The general views of the consumers were interpreted as shown in Table 4.2. Whilst there was general agreement regarding the quality of design, conformity with the guidelines and ease of use, most of them were confused regarding graphic 2, and suggested an alteration.
Six (66%) consumers arranged the graphics according to the severity of malocclusion at the first attempt however, after a period of 30 minutes, only five (55%) were able to arrange the graphics correctly.

4.10.2 School-based study

The responses of the children from Dorton School are summarised in Table 4.3. Half of the children were able to identify the graphic related to teeth, which they considered similar to a diagram previously noted in their biology schoolbook. Four of those who identified the graphics lost their sight after 3-4 years of age. The children also found the graphics easy to use.

Nine (69%) arranged the graphics according to the severity of malocclusion at the first attempt. After a period of 30 minutes, only six (46%) were able to arrange the graphics correctly.

In view of the problems with graphic 2, the difficulties were discussed with the RNIB graphic designers for further modification. Several features were modified, the major being to increase the thickness of the maxillary incisors by four layers of vinyl floor tiles to enhance the anterior-posterior dimension. Mandibular incisors were also introduced to establish a reference point regarding the overjet (Fig. 4.2).

After the modification of graphic 2, a second school-based study was carried out on 15 children at Al-Nour Institute for the Visually Impaired (Saudi Arabia, Riyadh) to evaluate the modification. Fourteen children (93%) were able to arrange the graphics in the correct order at the first attempt and 13 (86%) when the procedure was repeated. Therefore the AC of IOTN for VI people were finalised.

4.11 Discussion

Based on the consumers response, the quality of the graphics appeared satisfactory and they conformed to the guidelines. Some of the children were confused as to the content of the graphics and further explanation was required.

The efficacy of a method for converting visual information into tactile information is dependent upon several important considerations (Way and Barner, 1997 Part I):

- the lower bandwidth capability of the fingertip as compared to the eye
- the hierarchical nature of spatial perception and memory
- cost-effective output of tactile graphics.

Of particular importance to tactile graphics efficacy is their ease of use and the ability of users to discriminate different structures (Way and Barner, 1997 Part II). The general design guidelines developed through years of practical application and refinement of technique was helpful in the production of the modified IOTN index, and the research team was able to adhere to these guidelines.
The visual memory of the VI person can be determined by the age of the onset of the impairment (Way and Barner, 1997 Part I). Thus, children who lose their sight after birth will invariably find it easier to identify the graphics as diagrams of teeth.

Tactile tasks may become more complex when memory is involved. Working with textual materials, Miller (1975) established that tactual features are encoded in memory separately from their corresponding phonological features. In the case of recall, the visual stimulus has first to be inspected, identified, stored and then retrieved. To retrieve a visual stimulus, children must get their knowledge in the desired category and find the item in question. Recall levels are generally found to be lower than recognition levels (Eysenck and Keane, 1990). Lansdown (1973) demonstrated that children with low vision revealed a delay in visuo-spatial competence or shape-matching ability but the effect of this delay on memory performance was unclear. On the other hand Corley and Pring (1996), reported that children with low vision named significantly fewer of the remembered pictures correctly compared to the fully sighted children. In the present study, both the consumers and children were able to recall fewer graphics at the second attempt.

The major difficulty in production was related to the representation of anterior-posterior dimension of overjet (graphic 2). Increasing the overjet by more than the four layers of vinyl floor tiles would have reduced the tactual perception of the child.

4.12 Conclusions

In conclusion, it can be stated that the tactile graphics were on the whole successful:

- They were well accepted by both the RNIB evaluators and the VI children.
- Both groups were able to use the graphics with relative ease to discern distinct oral features.
- The RNIB consumer group agreed that the graphic conformed to general guidelines
- The presentation of the overjet proved to be the most difficult feature to represent in the graphics.
- The modified graphic 2 was well accepted by the children.

Table 4.1 Guidelines for the production of tactile graphics

	Guidelines
Design	paper collages are constructed prior to the production of vacuum formed graphics clear textural differences are needed for different oral tissues e.g. gingivae and enamel vinyl floor tiles are used to develop the anterior-posterior images (to mimic increased overjet) ≈ 2.5mm minimum discernible separation of two points are required
Size	all features must be not less than a finger-tip size to allow tactual-kinaesthetic sense an 18 font size is generally recommended for partially sighted persons
Number	limit tactile tasks when complex features need to be incorporated number of graphics should be limited if comparisons are needed

Table 4.2 Examples of the RNIB consumer's response evaluation of IOTN tactile graphic

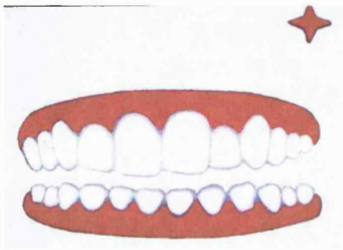
Variables	Response
Quality of design	*"I had been doing a lot of these graphic before, so it looks well produced in the sense of smoothing and raised feeling"*
Conformity with the guidelines	*"Well I had used me tongue to feel my teeth, then I looked at the graphics, I think each part of the graphic had described well the teeth and gum"*
Ease of use	*"The graphics is easily read and clear only because of experience though, but I just thought graphic with square symbol is difficult to know what make it different from graphic with star symbol"*
Need for alteration	*"Well as I'm expert in the production methods, I just have to suggest to modified the feeling of the teeth sticking out"*

Table 4.3 Examples of the children's response evaluation of IOTN tactile graphic

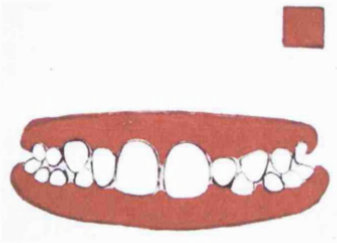
Variables	Response
Identification of the graphic	*"I think I need a time to know what in the graphic, but it looks as teeth diagram"*
Previous experience	*"He said, I thought it could be in the biology book but it could be also in other book too"*
Ease of use	*"Well I'm not an expert, but it seems okay but one graphic ... the one with square symbol is difficult at it and know what the teeth look like"*

Fig.4.1 Initial tactile graphic version of IOTN (AC) corresponding to the IOTN photographs 1, 5, 8 and 10

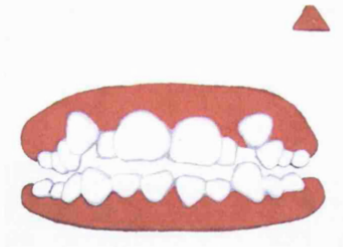
Graphic 1 (IOTN 1)



Graphic 2 (IOTN 5)

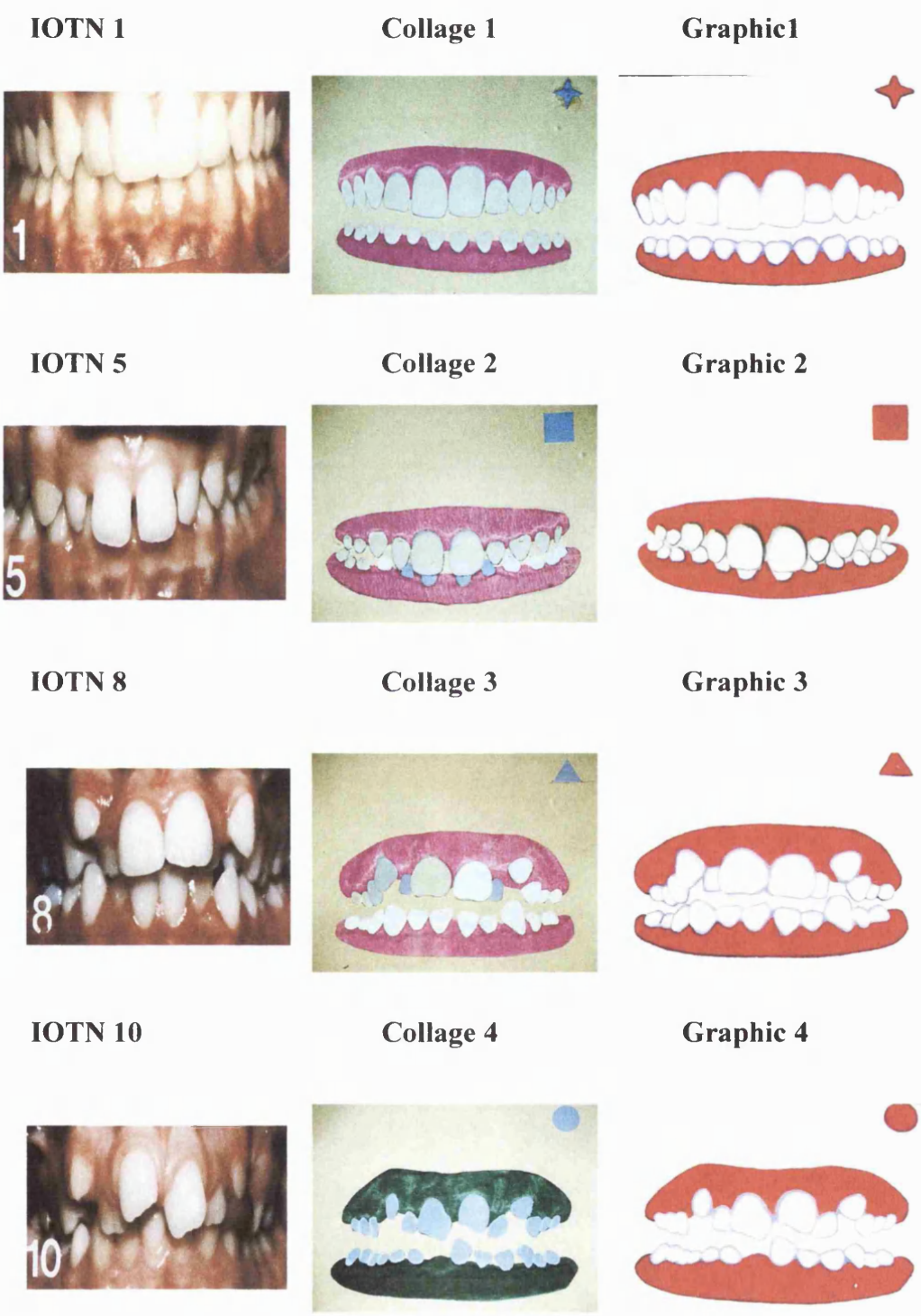


Graphic 3 (IOTN 8)



Graphic 4 (IOTN 10)

Fig 4.2 Tactile graphic version of IOTN (AC)



CHAPTER FIVE

Dental epidemiological survey

5.1 Introduction

Data concerning the oral health condition of sensory impaired children are scarce. Reports are often restricted to one specific type of disability or to one specific institute, as well as being based on an examination of a small number of individuals with widely differing ages (Table 2.1). Nation-wide surveys of the oral condition of people with disability are rare due to poor definition and limited of oral condition that had been investigated. From the literature available, the majority of the studies agree that poor oral hygiene and an increased severity of gingivitis and periodontitis are common in people with disability (Murray and McLeod, 1973; Tesini, 1981; Palin-Palokas *et al.*, 1987; Storhaug and Holst, 1987). Whilst some reports shows a high incidence of caries in children with disability, other studies describe comparable or even lower disease levels (Cutress, 1971; Shaw *et al.*, 1986).
The three socio-demographic variables which impacts upon oral health status are age, gender and socio-economic status of the parent (O'Brien 1994; Hinds and Gregory, 1995).

A most comprehensive study by Shaw *et al.* (1986) assessed the caries rate, dental cleanliness and periodontal treatment requirements of sensory impaired children, including 171 visually impaired (VI) and 240 hearing impaired (HI). When the caries experience was analysed with respect to the main disability, it was found that the mean DMF of VI (1.82) and HI (1.76) children was similar. Meanwhile for oral hygiene levels, 60% of VI and 69% of the HI schoolchildren reported to have good levels of oral cleanliness. This shows a clear but slight difference between the two sensory impaired groups in oral health terms of DMF and oral hygiene. In terms of periodontal treatment requirements, 65% of VI children and 36% of HI children required prophylaxis.

Unfortunately, there is little information on the oral health status of children with sensory impairment and the impact of different ranking order of oral health

conditions. Most reports are based on small numbers and if they are included in studies, the data are simply collected with those of children with learning disability (Gizani *et al.,* 1997). Therefore the overall aim of the study was to ascertain whether VI children had poorer oral health compared with HI children.

5.2 Aims

The aim of the study was to determine the oral health of a young (aged 11-16) Saudi Arabian population sample with sensory impairment, in comparison to children without such impairment. Also, to explore differences between VI and HI children in relation to their oral health status (DMFT, oral cleanliness, trauma, enamel defects), level of treatment needed and treatment provided (fissure sealants and FT).

5.3 Hypothesis

The following hypotheses were explored;

1. There are differences in oral health status between the sensory impaired groups as well as in comparison to control group.
2. The HI children have better prevention (fissure sealants) and more dental visits than the VI children.
3. Different in social, gender and ages have an association to the oral health conditions and prevention.

5.4 Training and calibration

A British Association for the Study of Community Dentistry (BASCD) program was undertaken in October 1998 at Barnet Health Care Unit (App. 2). The author was calibrated for four indices; dental caries (DMFT), enamel defects (DDE),

trauma and IOTN. The intra-operator variability was within the 95% confidence interval.

5.5 Formal approval

Approval for the study was sought and obtained from the Ministry of Education (Saudi Arabia), the President General for Girls Education and the Dental College (App. 3).

5.6 Method

5.6.1 Sample selection and criteria for selection of children

Children aged 11-16 years who were attending the Al-Amal Institute (for children with hearing impairment) and Al-Noor Institute (for children with visual impairment) formed the study group. The study group sample comprised of 77 VI and 210 HI children. The control group comprised all children aged 11-16 years (494) attending public schools around Riyadh selected by the Ministry of education and Girls Education office.

The Ministry of Education selected two primaries and four secondary public males schools in Riyadh, which reflected the social class of the population. A list of all female children attending primary and secondary levels was obtained from the President General for Girls Education. The Girls Education office on a similar basis as the male selected two primary and four secondary female schools.

All the female children were examined at their schools. The sensory impaired males were examined at their school while the control group at the King Saud University, Dental College. The Ministry of Education provided buses for transportation to the Dental College. The control sample size was designed to include 494 children from public schools. Letters were sent to the parents

explaining the purpose of the study, requesting consent to their child being examined and asking them to complete a questionnaire. Also, a consent form was sent to the male family asking their permission to transport the child to the dental college.

5.6.2 Clinical examination

The study children were examined at the school check-up room under standardised lighting condition using a Daray light (dental model order no. SL400/222 with "G" clamp). The control group female children were examined at the school social worker room and the male children at the paediatric clinic. Each child was examined supine with the examiner seated behind the child. The examiner worked with a trained recorder. Teeth and surfaces were examined in a standard order and their status recorded. A pair of sterile gloves and a set of sterilised instrument were used for each subject. A blunt probe was used to remove any gross debris from the teeth. The teeth were not cleaned further or dried prior to examination.

5.6.3 Method of collecting data

The methods for the clinical examination were those of the British Association for the Study of Community Dentistry (BASCD) for basic oral health surveys (Child Dental Health Surveys, 1995) (App. 4). Each surface was charted for caries, trauma, gingival conditions, and developmental defects of enamel.
The medical history for the study group was obtained from their medical record concerning their cause of disability, time of onset, degree of sensory loss and their I.Q (App. 5).

5.6.4 Measurement of social classes

Social class in western countries are often based upon the level of education of the head of household. However, in countries which are in transition such as Saudi Arabia, the classification of social class is difficult because of the dramatic changes in culture and infrastructure. Alternatively, the level of income in the

Saudi population can act as a factor in classifying the social class of the sample. According to this, the social class in this study was estimated by the father's occupation and the mother's education as utilised in the Oral Health Survey of Saudi Arabia in 1991 (Al-Shammary *et al.*, 1991). The social class according to father's occupation can be divided into 3 groups; Professionals (doctors, professors, architects) and Businessman as upper class. Governmental (military and governmental workers) as middle class, Manual (manual workers, farmers) and Unskilled (unskilled workers and others including students, the unemployed and those not indicating any occupation) as lower class.

The social class according to mother's education can be divided into 3 groups; Degree level (University and postgraduate) as upper class, Secondary level of education as middle class, and finally primary level as lower class.

5.6.5 Parents questionnaire

For each child a questionnaire was sent to the parent through the school administration. The questionnaire included questions modified from the Child Dental Health Survey (O'Brien, 1994; Q8, 9, 10, 11, 12 and 13) looks at child dental attendance (App. 9).

Information was gathered with regard to the father's occupation and mother's educational achievement. The parents were asked with regards to their views on their child's teeth, and their attitude to the child having orthodontic care.

5.6.6 Statistical Analysis

All the data were collected and entered into the SPSS program for analysis. Both descriptive and analytic approaches were used in the data analysis. Tests of the association between oral health status and single variables were carried out using the Chi square test. A p-value of ≤ 0.05 was considered statistically significant. A non-parametric test was used to compare between continuous data values.

For comparison of the sample proportions standard normal distribution (SND) was estimated together with 95% confidence intervals. Multi-variate analysis was

carried out using logistic regression analysis to test the association of various variables to the occurrence of disease. The odds ratios and 95% confidence intervals were used to compare the relative risk ratio of the studied background factors for the occurrence of caries and the periodontal condition.

5.7 Results

The results drawn from the clinical examination of 494 control children, 77 VI and 210 HI children are summarised in Tables 5.1 – 5.24

5.7.1 The sample profile

A total of 494 control children were examined (258 female and 236 male), 77 visually impaired (VI) children (38 female and 39 male) and 210 hearing impaired (HI) children (127 female and 83 male) as shown in Table 5.1. The mean age was 12.9 years in the control group, 13.4 in the VI group, and 13.5 in the HI group (Table 5.1). There were 42.1% of controls, 53.2% of VI and 51% of HI children in the primary level of education, and 57.9%, 46.8% and 49% respectively in the secondary level.

The social class of families is summarised in Tables 5.2 and 5.3. Of the total sample, 125 (25.3%) control children, 9 (11.7%) VI children and 16 (7.6%) HI children were from the upper class (professional and businessman). Three hundred and twelve (63.2%) controls, 57 (74%) VI children and 126 (60%) HI children were classified as from the middle classes; and 49 (9.9%) controls, 8 (10.4%) of VI children, and 33 (15.7%) HI children had fathers who were classified as manual to unskilled or other occupations (lower class). Eight (1.6%) controls, 3 (3.9%) VI children and 35 (16.7%) HI children were not classified by social class because of failure to respond. It was noted that the upper class contained more control children than VI or HI children.

139 (28.2%) of the control children, 28 (36.3%) VI children and 61 (29%) HI children had mothers who were educated to primary level. Two hundred and four (41.3%) controls, 20 (26%) VI children, and 45 (21.4%) HI children had mothers whose education was to secondary level. Ninety-five (19.2%) control children, 15 (19.5%) VI children and 22 (10.6%) HI children had mothers whose education included a period of college and sometimes postgraduate study. There was some missing information from mothers of 56 (11.3%) controls, 14 (18.2%) VI children, and 82 (39) HI children.

5.7.2 Caries

The findings at the clinical examination in relation to caries are summarised in Table 5.4. Caries was seen in 572 (73.3%) of the all the study children. It was found in 365 (73.9%) controls, 60 (77.9%) VI children, and 147 (70%) HI children.

5.7.2.1 Total caries prevalence

Similarity in caries prevalence was observed in the three groups. The control group mean DMFT was 2.29 compared to 2.48 for the VI group and 2.11 for the HI group. Caries experience was made up largely of decayed teeth. These made up a DT component for the control group of 1.47 (SD± 1.88) per child out of total DMFT of 64.7%. For VI children, the mean DT was 1.98 (SD± 2.45) per child out of total DMFT of 79.8%; while for the HI children, it was 1.47 (SD± 1.80) per child out of total DMFT of 69.6%.

There was a statistically significant difference (p = 0.030) when the mean DT component was compared between the control group (1.47) and the VI group (1.98), based upon the Mann-Whitney test. There was also a statistically significant difference (p = 0.038) between the VI (1.98) and the HI (1.47) children. However, the DT between the control and HI children was similar. The mean MT of the control group was 0.09 (SD± 0.44), 0.07 (SD± 0.31) of the VI

group and 0.15 (SD± 0.52) of the HI group. It was apparent more teeth had been extracted among HI children compared with the VI or control children.
The mean DMFS varied for the three groups; the control group mean DMFS was 5.10, compared to 7.02 of the VI group and 4.9 for the HI group. Caries experience was made up largely of decayed surfaces. These made up a DS component for control group of 3.39 (SD± 5.84) per child out of a total DMFS of 66.4%. For the VI children, the mean DS was 5.64 (SD± 9.44) per child out of a total DMFS of 80.3%; while for the HI children, it was 3.36 (SD± 5 .37) per child out of a total DMFS of 68.5%.

Treatment levels can be assessed by absolute number of surfaces filled (FS) and by relative treatment percentage, according to the proportion of filled surface (FS) out of total DMFS (FS/DMFS ×100). The absolute treatment level for the control group was 23.9% in comparison to the VI group (13.9%) and HI group (15.7%). A comparison of the proportion for treatment levels between the control and VI children was significant with SND 5.08 and 6%-14% differences. However, the treatment level between control and HI children, showed significant SND of 5.39 with 6.7%-9.5% differences.

The differences between DMFT and DMFS for the three groups was tested using the Kruskal-Wallis test which was confirmed not to be statistically significant between the control and study children.

5.7.2.2 Untreated active decay

Untreated decay is defined as occurring when carious lesions extend into the dentine and have not been treated. It consists of arrested dentinal caries, caries into dentine (which is restorable), and caries into pulp (requiring extraction, pulp or root canal treatment). Untreated decay is as 1, 2 and 3 of total decay measurement of DMFT (untreated decay / DMFT × 100).

The proportion of children needing treatment for decayed teeth was 63.8% in the control group, compared to 71.6% in the VI group and 64.6% in the HI group, as shown in Table 5.5. There was no statistically significant difference when the three groups were compared using the Chi-Square test ($p = 0.585$).

5.7.2.3 Decay in relation to gender, age and social class

Caries prevalence was analysed by gender, age and parents' social class level for the three groups as shown in Tables 5.6 and .5.7.

The differences between genders, age and social class in relation to caries failed to reach statistically significant levels when tested using the Chi-square test in the VI and HI children. However, there was a statistically significant difference among the control children ($p < 0.001$, $p = 0.001$, $p = 0.019$ respectively). Females control children at older age (15-16) and whose their mothers reach to school education level had experience more caries level.

There was a statistically significant difference between the control group and the HI group when caries prevalence was analysed by gender ($p = 0.040$). Control females (81%) had more caries experience than HI females (71.7%). Similarity of caries prevalence was noticed among the control females (81%) and VI females (76.3%). A comparison of the proportion of VI males (79.5%) with caries in relation to control males (66%) showed a difference of 13.5% ($p = 0.086$).

Caries prevalence in relation to age in the three groups reached a significant level of $p < 0.001$ when the Kruskal-Wallis test was used. A significant difference was found between the control and HI children aged 13-14 ($p = 0.023$). The control children (79.7%) had more caries experience than HI children (67.7%) with the difference of 12% (Table 5.7).

Caries prevalence in relation to social class (mother education) in the three groups reached a statistically significant level of $p = 0.013$ when the Kruskal-Wallis test

was used. A statistically significant difference was noted between the control and HI children (p = 0.002) and between the VI and HI children whose mother had primary education (p = 0.038). The HI children (60.7%) had less caries experience than the control children (82%) with a difference of 22.7% and VI children (82.1%) with a difference of 22.6% (Table 5.7).

5.7.2.4 Decay in relation to degree of impairment

The caries prevalence in VI and HI children was analysed by degree of impairment as shown in Tables 5.8 and 5.9.
VI Children who were partially visual impaired had more caries (65%) compared to completely blind (35%). However, 70.7% of caries incidence was found in HI children who were severely to profound hearing impaired.

5.7.2.5 Multi-variate analysis

Multi-variate analysis was carried out using a stepwise logistic regression to determine the factors which were independently related to the caries prevalence when other variables were held constant. Table 5.10 summarises the findings when the control children were included. The final model summarise in the Table showed the factors that remained as statistically significant were, being a female (OR = 2.00) and children with older age (OR = 2.06). The confidence intervals showed that in the case of being female and child aged 15-16 year the Odds Ratio in the sample might be as high as 3.04 and 4.05 respectively.

Using multi-variate analysis in sensory impaired children did not emerge as a significant variable in relation to age, gender, social class and severity of impairment.

5.7.3 Fissure sealants

Fissure sealants are applied to the surfaces of the teeth generally at least the first and second permanent molars, in order to arrest or to prevent decay. Fissure sealants were recorded simply as being present or absent. The mean number of children with fissure sealants was quite similar for the three groups (Table 5.11). In the control group there were 16 (3.2%) children with fissure sealants on any posterior teeth compared to only one (1.3%) in the VI group and 3 (1.4%) in the HI group. There was no statistically significant difference among the three groups using the Chi-square test ($p = 0.287$).

5.7.4 Trauma

Part of the survey examination was an assessment of evidence of trauma to the incisors. The examiner recorded the type of damage sustained and any treatment which had been carried out on the damage.

The proportion of children with damage to the incisors was highest among the HI group with 24 (11.4%), compared to VI children with 7 (9%) and control children with 33 (6.7%) (Table 5.12). There was a statistically significant difference between the control and HI groups ($p = 0.035$). A comparison of the proportion of children with trauma between the control and HI groups was significant with SND of 2.11 and 3%-9% differences.

The types of trauma damage recorded ranged from discoloration or fracture of enamel to the loss of one or more teeth. The proportion of children with different types of trauma for all incisors showed that by far the most common type of fracture was enamel and dentine fracture. Enamel and dentine fracture was more common among the VI and HI children compared to the control group. The control group had 3.4% enamel fractures and 1.8% enamel and dentine fractures, compared to VI children with 2.6% with enamel fractures and 6.5% of enamel and

dentine fractures. The HI children had 2.9% enamel fractures and 6% enamel and dentine fractures. Two percent of the HI children had lost one of their incisors due to trauma.

Treatment for traumatised teeth had been carried out only in the control group. Only one child had had an acid etch or permanent restoration. There was a significant difference ($p = 0.002$) between the control children and the HI children who had untreated trauma. Two percent of the control children had untreated trauma compared to 7.1% of the HI group.

The proportion of children with trauma was related to gender, in that a trend was visible in all groups with males having higher levels of trauma (Table 5.13). Thirteen percent difference was found between males (19.3%) and females (6.3%) of the HI children ($p = 0.004$). The other two groups failed to show and significant gender differences. Although, a statistical difference was observed when the sensory impaired group was compared to the children in the control group. This difference was accounted for by the high levels of trauma in the HI males (19.3%).

There was a statistically significant difference between trauma prevalence and gender among the control group and the HI group ($p = 0.005$). Trauma prevalence was highest among male HI children with 16 (19.3%), compared to males in the controls group with 19 (8.1%) out of the total trauma experience (Table 5.13).

The differences between ages and trauma prevalence failed to reach statistical significance in the VI and the HI children (Table 5.13). However, it was significant among the control children ($p = 0.022$) where older children (14.3%) had more trauma than younger children (5.7% 13-14 years, 5.2% 11-12-years).

A comparison between the control and study groups showed that 14.5% of 11-12-years-old HI children had damage to their incisors compared to 5.2% of control children ($p = 0.027$). However that was not true between control and VI children

where no statistically significant differences among 11-16-years-old VI children were noted.

5.7.5 Periodontal condition

The periodontal conditions were recorded for: the presence of gingival inflammation, plaque and calculus, for each of the six segments of the mouth (upper right, upper middle, upper left, lower right, lower middle, and lower left) (Table 5.14).

The differences between periodontal conditions for the three groups were tested using the Chi-square test which was confirmed to be statistically significant in the presence of gingivitis ($p < 0.001$).

The proportion of children with gingival inflammation was high in the HI group, with 157 (74.8%) having inflammation, in comparison to 43 (55.8%) in the VI group and 289 (58.5%) in the control group. There was a statistically significant difference when the presence of gingival inflammation was compared between the controls group and the HI group ($p < 0.001$) as well as between the HI and VI children ($p = 0.002$). The prevalence of gingivitis among HI children was more than the VI children. A comparison of the proportion for gingivitis between control and HI children showed significance with SND 4.09 and 8%-25% differences. Also, a comparison of the proportion for gingivitis between VI and HI children showed significance with SND 3.20 and 7%-30% differences.

The proportion of children with plaque was similar in the three groups, ranging from 95% to 98%. Also, the HI and the control groups had similar presence of calculus, with 20% in the control group and 19.5% in the HI group, compared to 13% in the VI group.

The proportion of children with gingivitis was related to gender and age (Table 5.15). The differences between gender in the gingivitis prevalence failed to reach statistically significant levels when tested using the Chi-square test for the VI and control children. However, it was significant among the HI children ($p = 0.008$) where males (84.3%) had more gingivitis than females (68.5%) and older children (82.1%) had more gingivitis than younger children (73.7% 13-14 years, 69.1% 11-12 years).

A comparison of gingivitis in relation to gender and age between the control and HI children showed that HI male (84.3%) had more gingivitis than control males (56.8%) ($p < 0.001$). Eleven to twelve-years old HI children ($p = 0.012$) and 13-14 years old ($p = 0.036$) had more gingivitis than the control children (50%, 61.88% for control; 69.1%, 73.7% for HI).

The differences in the gingivitis prevalence between social classes failed to reach statistically significant levels when tested using the Chi-square test in all three groups (Table 5.16). However, it was statistically significant when the HI children compared to control group based upon father's occupation. HI children from the middle and lower classes, had more gingivitis (73%, 87.9%) than the control children (58.3%, 59.2% respectively), the level of statistical significance being $p = 0.004$ in both instances. It also confirmed when the gingivitis was related to mother's education ($p = 0.010$, $p = 0.052$) where HI children from the middle and lower social classes had more gingivitis (80%, 77% respectively) than the control children (60.3%, 63.3% respectively).

5.7.5.1 Multi-variate analysis

Multi-variate analysis was carried out using a stepwise logistic regression to determine the factors which were independently related to the presence of periodontal conditions when other variables were held constant. Table 5.17 summarises the findings when the control and sensory impaired children were included. The factors that remained as statistically significant were being of older age (OR = 8.67) in relation to gingivitis, being from a lower social class (OR=

14.31) in relation to plaque deposition and being male (OR = 2.84) in relation to calculus deposition.

Analysis of periodontal condition in the control children did not emerge as a significant variable in relation to age, gender or social class.

5.7.6 Developmental defects of enamel

Alterations to the structure of enamel during development lead to changes in the appearance of the enamel which can be observed clinically. The appearance of the tooth varies from a discrete white or yellow patch confined to a small area of the tooth to pitting of the tooth surface. The examination differentiated between demarcated and diffuse opacities and note was also made of the appearance of hypoplasia. The teeth were examined for opacities, hypoplasia and their extent for upper incisors, canines and first premolars.

Overall, of the teeth examined 189 (38.3%) of the control children, 28 (36.4%) VI children and 74 (35.2%) HI children had one or more demarcated opacities of the enamel (Table 5.18). Demarcated opacities covered less than one-third of the surface of the affected tooth. There was no statistically significant difference when the three groups were compared using the Chi-square test (p = 0.094) as well as between the control and study groups.

5.7.7 Parent questionnaire

This section presents data about previous dental attendance and treatment, and parental attitudes towards treatment reported from parents. Of the 780 questionnaires distributed, the response rate was 92.9% for control, 100% for VI parents and 92.4% for HI parents.

5.7.7.1 Visiting the dentist

The overwhelming majority of the study children (37.5 % of VI, 35.2% of HI) had last visited a dentist more than two years before, but 33% of the control children had visited a dentist within the previous six months (Table 5.19). Within the previous year, 25.6% of the controls had visited a dentist which was greater than 14% of the VI and 24.1% of the HI children. Some 15-17% of all children had visited the dentist within the previous two years. The differences in parent's response were not statistically significant between the three groups.

5.7.7.2 Dental services used

Most dental treatment was provided by government hospitals (40.8% of controls, 38.6% of VI, 47% HI), while 16-19% of the children used government polyclinics and 10-14% had treatment from private hospitals (Table 5.20). Of the control group, 27% used private clinic services, compared to 20% of the VI group and 18.2% of the HI group. Among the HI children, 1% had never visited a dentist, compared to 4.3% of the VI children.

More HI children's parents than control parents reported that their children attended a government hospital for dental treatment. Far more control children attend a private clinic (27%) compared to study children (20% and 18.2% respectively), and fewer had never visited a dentist. The different dental services used by children's parents were statistically different between control and VI parents ($p = 0.001$) and between C and HI parents using the Chi-square test ($p < 0.001$).

5.7.7.3 Treatment obtained

Children in the control group had more teeth filled (28.2%) than VI (22.4%) and HI (20.2%) children, as shown in Table 5.21. In contrast, HI children had more teeth extracted (33.1%) than the controls (18.5%) and VI children (26.9%) as reported by the parents. The VI children had more scaling (11.8%) than the control (6.3%) and HI (10.4%).

2.5% of the HI and 0.5% of the control children had been treated under general anaesthesia. One percent of the HI children and 2.5% of the controls had visited the dentist for orthodontic treatment. Among the HI children, 16% had never visited a dentist in their lives, compared to 9% of the VI and 4.8% of the controls. Treatment obtained between the control and HI groups was statistically significant as revealed by using the Chi-square test ($p < 0.001$).

5.7.7.4 Parents satisfaction with children's treatment

The majority of the parents described themselves as "satisfied" with their children's dental treatment (55.3% controls, 45.3% VI group, 46.5% HI group), as shown in Table 5.22. Fewer parents of HI children (10.7%) were "unsatisfied" or "very dissatisfied" with their children's treatment, compared to 20.3% of VI parents and 15.8% of the control parents. More parents of HI children (30.2%) were very satisfied with their children's treatment, compared to 15.6% of VI parents and 20.7% of control parents.

The differences in parent's response to their satisfaction with children's treatment were statistically significant between the three groups as confirmed between control and VI parents ($p = 0.012$) and between control and HI parents using the Chi-square test ($p = 0.006$).

5.7.7.5 Reasons for the child's last visit

The majority of the children (61% controls, 80.4% of VI and 67.5% of HI) had last visited the dentist because of "tooth trouble" as shown in Table 5.23. A check-up was the reason for the last visit for 24.5% of controls, 25% of HI children, and 14.8% of VI children. Only 4.7% of the control children had attended for a dental restoration. Out of all the children, 1-3% had last seen the dentist for tooth extraction. Orthodontic treatment was the reason for 3.5% of control children, 1.6% of VI children and 2.1% of HI children. Orthodontic consultation was the reason for the last visit for only 1.6% of controls and HI children, but for 2.4% of the VI children.

The differences in the parent's response as to the reason for the last dental visit were statistically significant between the three groups when tested using the Kruskal-Wallis test ($p = 0.014$) and between the control and VI parents using the Chi-square test ($p = 0.003$).

Parents were asked whether their children had discoloured teeth, holes in the teeth, or both. Most control parents (84.4%) believed that their children had "holes" in the teeth, compared to 78.7% of VI parents and 70.7% of HI parents (Table 5.24). Few of the control parents (9.5%) thought their children had discoloured teeth, compared to 17% of VI parents and 23.3% of HI parents.

The differences in parent's response to their opinion of the children's dental problems were statistically significant between the three groups as confirmed between control and HI parents using the Chi-square test ($p = 0.001$).

5.8 Discussion

It has not been clarified previously whether sensory impaired individuals differ from 'normal' individuals with respect to their dental health. As it is difficult to include all previous studies so, those undertaken within the last 20 years will be compared and discussed to this study.

Small sample size is the key problem when comparing studies, so that it is difficult to know whether a true significant difference exists. Second, further sub-group analysis such as gender and social class differences are usually not possible.

5.8.1 Study design and methodology

The study was carried out at Al-Nour, Al-Amal Institute and four primary and eight secondary schools. The population eligible for inclusion in the study had been defined as 11-16 year olds where all children in the two institutes were included. This seemed likely to provide a reasonably representative sample of these groups. This age group was chosen as it included the standard ages for WHO and BASCAD to carry out investigation for caries and periodontal diseases.

The school setting was a convenient site to examine the children. The examination of the subjects and the data collection was quick and easy to carry out. However, interviewing hearing impaired subjects was time-consuming in that the school interpreter had to be booked a day before the examination.

Carrying out face-to-face interviews with the parents may be considered more ideal but time constraints precluded this approach, due to difficultly in access to private schools. The two institutes were governmental schools, so the social classes of the subjects were limited as upper class families invariably tend to send their children abroad or to private schools.

5.8.2 Caries

Over the past decade, a dramatic reduction in the level of dental caries has been observed in several industrialised countries, particularly among children (Sheiham, 1984). This trend parallels changing self-care practices as well as the establishment of school-based preventive programmes. Many developing countries are now facing problems of poor oral health, primarily due to changing lifestyles and lack of systemic oral health care systems. In Saudi Arabia, few oral epidemiological studies of children have been conducted and no data are available on the oral health status of children with sensory impairment.

In the present study, 73.3% of all children were found to have caries; 73.9% of controls, 77.9% of VI and 70% of HI children. Dental caries in people with disabilities have been reported and some of these studies reported similar findings to that found in control group (Brown and Cunningham 1961; Brown, 1980; Crack *et al.*, 1980) however, other reported lower prevalence (MacEntee *et al.,* 1985; Nielsen, 1990)

The high prevalence and DMFT values for the SI children reported in this study appear to be similar to estimates derived from a previous study in Riyadh city on children with disabilities. Prevalence values reported for 3-14 year old children in a Rehabilitation Centre in Riyadh have been in the order of 79% (Adenubi *et al.,* 1997). However, for VI children the picture was different when a prevalence of caries was compared to Meyer's (1980) findings where 57% of caries was found in the sample. Also for the HI children, it has been reported that the mean of DMFT equal to 1.76 was lower than the present study (MacLaurin *et al.,* 1985).

Gizani *et al.,* (1997) reported that 21% of children with different disabilities (including VI and HI children) were free of caries and that close to the present study findings.

A study by Shaw *et al.* (1986) showed a 5 unite per tooth difference in caries rate between the two sensory impaired groups (VI 1.82, HI 1.76) and that was disagreement to present study where 37 unite per tooth difference found between HI and VI groups.

The DS component from the total score is large for VI children and the FS component much smaller than in comparison to control and HI children. This points to lower restorative care in VI children. In terms of treatment provision, it showed significant differences, with VI and HI children receiving less restorative treatment. Marked differences between control and children with disabilities in treatment provision have been previously reported where treatment care was high among a control group (Holland and O'Mullane 1990; Pope and Curzon, 1991).

Although the FT and DT components for both control and HI children was close, that does not indicate that their treatment level is similar. This can be explained by the high level of teeth missing (MT) among HI children. Within the groups when the data were analysed to compare the caries prevalence between gender of the children or different age groups there was no significant difference in the study groups (VI and HI). However, it was significant among the control children with different age groups where older children tended to have a higher caries prevalence then the younger age group. Also, it was noticed that female control at older age had higher caries prevlnce than male at younger age.

Analysis of each age group and gender showed that there were statistically significant differences between the controls and HI group's children's mean DMFT which disagree the conclusions of Brown and Schodel (1976).

Assessing the level of treatment in all children showed that control (23.9%) children had more frequently obtained treatment than VI (13.9%) and HI (15.7%) children. However, marked untreated caries in the three groups showed that all children in the present study needed a preventive and treatment programme.

Caries has been shown clearly to relate to social class but that was only noticed among the control group. Control children who are from lower social classes tend to have more caries prevalence and that agreed with previous studies by O'Brien (1994) Hinds and Gregory (1995).

5.8.3 Fissure sealants

The presence of sealants reflects the prevention attitude of dentists treating children with special needs. In general, a similar and incomparable percentage of study groups and control presented with sealants. With the high prevalence of caries in the three groups, use of fissure sealant programmes on the groups should be strongly encouraged.

5.8.4 Trauma

The accumulation and comparison of and data from different studies is difficult due to differences in the sample collected, classification and indices used. Due to their vision impairment, it is often assumed that VI children are more prone to injuries such as fractures of their anterior teeth (Rapp *et al.,* 1966; Onetto *et al.*, 1994; Wei *et al.,* 1998). The present study demonstrated that the control group sustained a similar number of injuries to their anterior teeth as VI children. Trauma was more common among HI children followed by VI children and controls. The results of this study are compatible with Meyer's (1980) study who explored the oral health of visually impaired children and found 13.2% VI children in his sample to have fractured teeth. However, the figure is not as high as that shown by Greeley *et al.* (1976) in their Baltimore study where 27.2% fractures was found in their 120 VI children.

Although trauma was more common among HI children, the controls had 0.2% of permanent restoration compared to nil of HI children.

Although trauma was more common among HI children, the controls had 0.2% of permanent restoration compared to nil of HI children. A survey of VI and HI children studied at a special institute for sensory impaired children in Saudi Arabia concluded that "Braille reading" was the commonest hobby for the blind (51%), while playing football was the commonest among the deaf (62%) (Abolfotouh and Telmesani, 1993). This information may explain the high incidence of trauma among HI children.

The majority of child dental epidemiological studies have indicated that boys have more dental trauma than girls (Stokes *et al.,* 1995; Hamilton *et al.,* 1997). In this study although gender differences were apparent for sensory impaired children this only reached statistical significance in the HI group and especially HI boys.

The number, type and severity of dental injuries differ according to the patient age. Enamel and enamel-dentine fractures were the most common injury in all the children and that was in agreement to most worldwide studies where uncomplicated crown fracture was more common than other types (Hamilton *et al.,* 1997). A comparison between the control and HI groups showed that male HI aged 11-12-year old are more prone to trauma than control males of the same age.

Published studies investigating dental trauma and age, have observed that trauma frequency peaks in the 11-15 year olds (Caliskan and Turkun, 1995). Trauma was found more among control children older than 15-16 years of age however it was higher among 13-14 year old VI children. However, when comparison between the control and VI group was drawn, there was no statistically significant difference between the two groups in children ages 11-16 years.

In conclusion, sensory impaired children do have a tendency for more dental trauma. However, this was only statistically significant for HI children. A gender difference was most noticeable for the HI group, with males having higher levels of trauma.

5.8.5 Periodontal condition

Periodontal disease and oral hygiene represent as much and usually more of a problem for children with disability; however, lack of conformity in use of indices make valid comparisons difficult.

In the field of periodontal disease; plaque and calculus deposition findings were similar among all children (Table 5.14). However for gingivitis, the control and VI children came out better with significant results in their favour of the HI children. The current investigation confirmed that oral hygiene due to plaque deposition was poor in general in all children which is in disagreement to several other studies where children with special needs had poorer and a greater prevalence of periodontal disease (Bhavsar and Damle, 1995; Gizani *et al.,* 1997; Martens *et al.,* 2000).

Periodontal disease was found generally to be prevalent and poorer amongst people with mentally disability (Tesini, 1981; Evan *et al.,* 1991) and people with physical disability (pope and Curzon, 1991). By contrast, value of gingivitis have found to be similar for people with cerebral palsy and control group in spite of the difficulties sometimes experienced by the former in carrying out the necessary oral hygiene measures (Melville *et al.,* 1981).

The findings of the present study are by and large disagreement with those reported by Vignehsa *et al.* (1991). Prevalence of gingivitis was 92% in the VI children and 98% in HI sample compared to present study of 55.8% and 74.8% respectively.
However, prevalence of gingivitis among HI children were nearly close to the rate of 83.6% found in a sample of children with cerebral palsy in Riyadh region (Wyne *et al.,* 1996) and to Saudi school-children aged 12-year-olds attending normal school with 70% rate (AL-Shammary *et al.,* 1991).

The gingivitis was affected by gender and age where the HI males at younger age had more tendency than control group. There is treatment required for three groups in all age groups and that reveal a clear trend toward development of periodontal disease at the adolescent ages. In view of this, being the precursor cause of periodontitis, this gives cause for alarm that children in present study and especially HI children are heading toward dental problems in future.
The proportion of children with healthy gingiva decreases with increase age and that in agreement to Evans *et al.* (1991) and disagreement to Murray and McLeod (1973) where younger children had poorer gingival status.

5.8.6 Development defects of enamel

The prevalence of enamel defects in the three groups was similar. That was in agreement to data from the Child Dental Health Survey in UK (O'Brien, 1994), where 43% of children had a type of enamel defect. However, that was in contrast to the Saudi Oral Health Survey (AL-Shammary *et al.,* 1991) where 13% of their sample had a type of enamel defect.

5.8.7 Parent questionnaire

The questionnaire results have revealed very useful information on the knowledge profile of the three groups. There are different kinds of factors which impact on oral health status. These include values, attitude and knowledge. Knowledge is the verifiable information a person has about a subject, what the person thinks and how he/she evaluates what they know which can have different behavioural consequences.

All the control children had visited the dentist, while only 3 (4.3%) of VI children and 2 (1.1%) of HI children had never visited a dentist. Data from Child Dental Health Survey in UK (O'Brien, 1994), showed a similar pattern seen in the present study, that is approximately, 1% of 12-15-years old children had never visited a dentist. However, data from Saudi Oral Health Survey (Al-Shammary *et*

al., 1991) was in contrast to the present study where 25% of their sample claimed they never visited a dentist.

Most of the children visited a dentist in the last six months as well within 2-years and that was similar between the groups. Meanwhile, the proportion of children who had visited a dentist in last year and longer than 2-years were different between the groups. Control and HI parent's had a tendency to visit the dentist more often than the VI parent's

Children in the two sensory impaired groups tended to visit the dentist longer than 2-years ago compared the control group while less VI children had visited the dentist in last year. Data from Saudi Oral Health survey were in contrast to the present data where 13% of their sample visited a dentist in the last six months and 4% in last year.

The proportion of VI children who reported to have visited the dentist in last year was lower than HI children and control group and that may explain the high mean DT in these children.

Most of the dental treatment was provided by governmental hospitals and polyclinics. The parents of the control group children tended to obtained treatment from private clinics more often than those from the study groups. Dental services used in UK Dental Health Survey, were also mostly from General Dental Services and Community Dental Services (62%) which were comparable to Saudi governmental hospitals and polyclinics respectively. However, data from the Saudi Oral Health Survey showed that 33.6% of their sample used governmental hospitals, 27.5% used governmental polyclinics and 31% used private sector.

The treatment the children received as reported by their parents was similar in the three groups. The most common type of treatment obtained was both restoration as well as extraction. VI and HI parents reported that their children had more teeth extracted compared to the control children and that was coinciding with the mean MT in the HI children. Orthodontic treatment obtained was almost similar

between control and HI children while it was noticeable by its absence in VI children.

The mode of parent satisfaction in the three groups was satisfactory while more of control and VI parent were unsatisfied about the treatment their children obtained.

There were variations between the three groups in the treatment obtained at the last visit. More of the control and HI parents claimed that their children had visited a dentist for check-up compared to the VI parent. Only 2.1% of the control children had restoration at the last visit and that was in disagreement to data from the Saudi Oral Health Survey where 24% of the sample had restorations.

Most of the parents concerns on their child's dental problems centered upon tooth decay followed by tooth discolouration. Although parents of the control group tended to visit a dentist more often every six months (33%), less took their children for check-ups (24.5%). Also, their children had more fillings (28.2%) and they believed their children had more tooth decay. On the other hand, VI and HI parent who tended to be irregular dental attenders, that is not visiting for longer than 2-years (37.5% and 35.2% respectively), took their children more often for tooth-trouble (80.4% and 67.5% respectively) and had less teeth filled (22.4% and 20.2% respectively), believed their children had less tooth decay problems but more tooth discolouration than the control group.

5.9 Conclusion

Oral health of sensory impaired people has long been neglected in the literature. Most of the previous studies described that oral hygiene maintenance remains the most significant challenge in the care of patients with visual impairment.
Although there was no difference between the three groups in their caries prevalence, VI children had experienced more tooth decay than the other two groups.
Significantly higher levels of gingivitis and incisor trauma existed in the HI group compared with control group. However when it comes to prevention using fissure sealant and presence of enamel defects, the three groups had same levels.

In terms of dental service utitlisation, as reported by the children's parent, the control group children visited the dentist in last six months and used private clinic dental services more than the study groups. However for treatment obtained and satisfaction, HI parents reported that they were satisfied with their children's treatment and that they had more teeth extracted as reflected by the difference in a mean of MT.

5.10 Principal findings

5.10.1 Caries

- Caries prevalence among the three groups was closely similar: 73.9% of control children, 77.9% of VI children, and 70% of HI children had caries.
- The mean DMFS was 5.10 for the control group, 7.02 for the VI group, and 4.90 for the HI group. The DS component for the VI group was higher than that of the other two groups, causing the mean DMFS to be high in this group.
- Treatment levels were higher among control (23.9%) than VI children (13.9%) and HI children (15.7%).

5.10.2 Fissure sealants

Few children in any of the groups were found to have fissure sealant applications.

5.10.3 Trauma

- The proportion of children with trauma was high among the HI children (11.4%), compared to the VI children (9%) and controls (6.7%) ($p = 0.035$).

5.10.4 Periodontal condition

- The HI children (74.8%) had more gingival inflammation than the controls (58.5%), but the VI children (55.8%) were closely similar to the controls.
- Plaque deposition was nearly the same for the three groups: in the range of 95–98%.
- Control children had more calculus deposition (20%) than VI children (13%), but the HI children (19.5%) were closely similar to the controls, however, that was not statistically siginifcant.
- Male HI children aged 11-14 years had more gingivitis than male controls of the same age.
- Control children who were from lower-middle social classes had less gingivitis than HI children of the same class

5.10.5 Developmental defects of enamel

- The prevalence of enamel defects was closely similar in all three groups (38.8% of controls, 36.4% of VI group, 35.2% of HI group).

5.10.6 Parent questionnaire

- The majority of control children had last visited the dentist within the previous six months, while the majority of HI and VI children had last visited the dentist more than two years before.
- The majority of children's parents reported that their children attended a government hospital for dental treatment. Far more control children were reported to attend a private clinic.
- It had been noticed that more controls than HI or VI children had had tooth restoration. However, more HI children had had teeth extracted, and only children of the control and HI groups had had orthodontic treatment.
- There were statistically significant differences between control and HI parents in terms of satisfaction with their children's treatment ($p < 0.001$), in that less of the HI parents described themselves as "unsatisfied". However, fewer control parents described themselves as "very satisfied" as well VI parent ($p = 0.001$).
- There was a significant difference between the groups who thought their children had discoloured and decay in their teeth ($p = 0.001$).

Table 5.1 Sample profiles

Sample profile		No. (%) of children Control	VI	HI
Gender	F	258 (52.2)	38 (49.4)	127 (60.5)
	M	236 (47.8)	39 (50.6)	83 (39.5)
Age	11-12	212 (42.9)	23 (29.9)	55 (26.2)
	13-14	212 (42.9	40 (51.9)	99 (47.1)
	15-16	70 (14.2))	14 (18.2)	56 (26.7)
Education	Primary	208 (42.1)	41 (53.2)	107 (51)
	Secondary	286 (57.9)	36 (46.8)	103 (49)

Table 5.2 Social class, by father's occupation

Father's Occupation	No. (%) of children C	VI	HI
Upper class	125 (25.3)	9 (11.7)	16 (7.6)
Middle class	312 (63.2)	57 (74)	126 (60)
Lower class	49 (9.9)	8 (10.4)	33 (15.7)
Unknown	8 (1.6)	3 (3.9)	35 (16.7)

Table 5.3 Social class, by mother's education

Mother's Education	No. (%) of children Control	VI	HI
Degree level	95 (19.2)	15 (19.5)	22 (10.6)
Secondary	204 (41.3)	20 (26)	45 (21.4)
Primary	139 (28.2)	28 (36.3)	61 (29)
Unknown	56 (11.3)	14 (18.2)	82 (39)

Table 5.4 Mean (± SD) DMFT and DMFS components in relation to the study groups

Caries	No. (%) of children Control	VI	HI
No. of children	494	77	210
Mean DMFT (±) SD	2.29 (2.26)	2.48 (2.88)	2.11 (2.03)
DT	1.475 (1.88)	1.987 (2.45)	1.476 (1.80)
MT	0.099 (0.44)	0.077 (0.31)	0.152 (0.52)
FT	0.722 (1.43)	0.415 (1.01)	0.485 (1.14)
Mean DMFS (±) SD	5.10 (6.64)	7.02 (11.29)	4.90 (6.16)
DS	3.398 (5.84)	5.649 (9.44)	3.366 (5.37)
MS	0.483 (2.21)	0.389 (1.57)	0.761 (2.61)
FS	1.220 (2.56)	0.987(2.94)	0.771 (1.78)

Mann-Whitney test, $p = 0.030$, DT, C vs VI
Mann-Whitney test, $p = 0.038$, DT, VI vs HI
SND for difference in proportion = 5.08, $p < 0.05$, C vs VI
(95% confidence interval for difference = 6% to 14%)
SND for difference in proportion = 5.39, $p < 0.05$, C vs HI
(95% confidence interval for difference = 6.7% to 9.5%)

Table 5.5 Proportion of children with untreated active decay

Caries	No. (%) of children with untreated decay Control	VI	HI
No. of children	494	77	210
Mean DMFT (±) SD	2.29 (2.26)	2.48 (2.88)	2.11 (2.03)
Mean untreated (±) SD	1.91 (0.7)	2.04 (0.8)	1.9 (0.8)
Untreated caries (%)	233 (63.8)	43 (71.6)	95 (64.6)

$\chi^2 = 2.34, p = 0.585$

Table 5.6 Caries prevalence, by gender and age

Variables	No. (%) of children with caries experience Control	VI	HI
Gender			
Female	209 (81)	29 (76.3)	91 (71.7)
Male	156 (66)	31 (79.5)	56 (67.5)
Age			
11-12	139 (65.6)	17 (73.9)	38 (69.1)
13-14	169 (79.7)	33 (82.5)	67(67.7)
15-16	57 (81.4)	10 (71.4)	42 (75)

Kruskal-Wallis test, $p < 0.001$, age, for three groups
$\chi^2 = 14.19, p < 0.001$, gender, C,
$\chi^2 = 13.40, p = 0.001$, 11-12, C
$\chi^2 = 4.32, p = 0.040$, female, C vs HI,
$\chi^2 = 5.17, p = 0.023$, 13-14, C vs HI,

Table 5.7 Caries prevalence, by father's occupation and mother's education

Variables	No. (%) of children with caries experience Control	VI	HI
Father's Occupation			
Upper class	89 (71.2)	7 (77.8)	10 (62.5)
Middle class	231 (74)	46 (80.7)	86 (68.3)
Lower class	39 (79.6)	6 (75)	25 (75.8)
Mother's Education			
Upper class	63 (66.3)	12 (80)	14 (63.6)
Secondary class	147 (72.1)	16 (80)	34 (75.6)
Primary class	114 (82)	23 (82.1)	37 (60.7)

Kruskal-Wallis test, $p = 0.013$, social class by mother education, for three groups
$\chi^2 = 7.95, p = 0.019$, primary education, C
$\chi^2 = 9.95, p = 0.002$, C vs HI, Lower class, mother's education
$\chi^2 = 4.30, p = 0.038$, VI vs HI, Lower class, mother's education

Table 5.8 Caries prevalence, by degree of visual impairment

	No. (%) of children with caries experience	
Degree	**Partially**	**Complete**
No.	39	21
%	65	35

Table 5.9 Caries prevalence, by degree of hearing impairment

	No. (%) of children with caries experience		
	Mild-Moderate	**Sever-profound**	**Complete**
No.	31	104	12
%	21.1	70.7	8.2

Table 5.10 Result of logistic regression for caries prevalence when control children included: regression coefficient (b), standard error (SE), significance (*p*), Odds Ratio (OR) with 95% Confidence Interval (CI) for OR

Variables	**b**	**SE**	***p***	**OR**	**95% CI**	
Gender	0.69	0.21	0.001	2.00	1.31	3.04
Age	0.72	0.34	0.035	2.06	1.05	4.05

Table 5.11 Proportion of children with fissure sealants

	No. (%) of children with FS		
Fissure sealants	**Control**	**VI**	**HI**
No. of children	494	77	210
Mean FS (±) SD	0.03 (0.18)	0.01 (0.11)	0.01 (0.12)
No (%) of children with FS	16 (3.2)	1 (1.3)	3 (1.4)

$\chi^2 = 2.49$, $p = 0.287$, three groups

Table 5.12 Proportion of children with trauma experience

No. (%) of children with trauma experience			
Trauma	**Control**	**VI**	**HI**
No. of children	494	77	210
Mean Trauma (±) SD	0.06 (0.25)	0.09 (0.29)	0.11 (0.32)
No (%) of children with trauma	33 (6.7)	7 (9)	24 (11.4)

$\chi^2 = 4.50, p = 0.105$, three groups
$\chi^2 = 4.46, p = 0.035$, C vs HI
SND for difference in proportion = 2.11, $p < 0.01$, C vs HI
(95% confidence interval for difference = 3% to 9%)

Table 5.13 Proportion of children with trauma, by gender

No (%) of children with trauma experience			
Variables	**Control**	**VI**	**HI**
Gender			
Female	14 (5.4)	3 (7.9)	8 (6.3)
Male	19 (8.1)	4 (10.3)	16 (19.3)
Age			
11-12	11 (5.2)	2 (8.7)	8 (14.5)
13-14	12 (5.7)	4 (10)	11 (11.1)
15-16	10 (14.3)	1 (7.1)	5 (8.9)

$\chi^2 = 8.35, p = 0.004$, gender, HI
$\chi^2 = 7.60, p = 0.022$, age, C
$\chi^2 = 7.16, p = 0.005$, Male, C vs HI
$\chi^2 = 5.78, p = 0.027$, C vs HI, 11-12

Table 5.14 Periodontal conditions among the three groups

Periodontal conditions	No. (%) of children with periodontal conditions Control	VI	HI
Mean (±) SD	0.59 (0.49)	0.56 (0.11)	0.75 (0.44)
No (%) with gingival inflammation	289 (58.5)	43 (55.8)	157 (74.8)
Mean (±) SD	0.95 (0.21)	0.98 (0.11)	0.95 (0.21)
No (%) with plaque	470 (95.1)	76 (98.7)	200 (95.2)
Mean (±) SD	0.20 (0.40)	0.13 (0.34)	0.20 (0.40)
No (%) with calculus	99 (20)	10 (13)	41 (19.5)

$\chi^2 = 18.31, p < 0.001$, Gingivitis, three groups
$\chi^2 = 16.78, p < 0.001$, Gingivitis, C vs HI
SND for difference in proportion = 4.09, $p < 0.05$, C vs HI
(95% confidence interval for difference = 8% to 24%)
$\chi^2 = 9.18, p = 0.002$, Gingivitis, VI vs HI
SND for difference in proportion = 3.20, $p < 0.05$, VI vs HI
(95% confidence interval for difference = 7% to 30%)

Table 5.15 proportion of children with gingivitis, by gender and age

Variables	No. (%) of children with periodontal conditions Control	VI	HI
Gender			
Female	155 (60.1)	19 (50)	87 (68.5)
Male	134 (56.8)	24 (61.5)	70 (84.3)
Age			
11-12	107 (50)	17 (73.9)	38 (69.1)
13-14	131 (61.8)	16 (40)	73 (73.7)
15-16	51 (72.9)	10 (71.4)	46 (82.1)

$\chi^2 = 6.97, p < 0.008$, Gingivitis, HI
$\chi^2 = 22.20, p < 0.001$, Gingivitis, C vs HI, Male
$\chi^2 = 6.26, p = 0.012$, Gingivitis, C vs HI, 11-12
$\chi^2 = 4.37, p = 0.036$, Gingivitis, C vs HI, 13-14

Table 5.16 proportion of children with gingivitis, by father's occupation and mother's education

Variables	No. (%) of children with gingivitis Control	VI	HI
Father's occupation			
Upper class	70 (56)	6 (66.7)	10 (62.5)
Middle class	182 (58.3)	33 (57.9)	92 (73)
Lower class	29 (59.2)	3 (37.5)	29 (87.9)
Mother s Education			
Upper class	51 (53.7)	9 (60)	16 (72.7)
Middle class	123 (60.3)	13 (65)	36 (80)
Lower class	88 (63.3)	12 (42.9)	47 (77)

$\chi^2 = 8.51, p = 0.004$, C vs HI, Middle class, father's occupation
$\chi^2 = 8.50, p = 0.004$, C vs HI, Lower class, father's occupation
$\chi^2 = 6.68, p = 0.010$, C vs HI, Middle class, mother's education
$\chi^2 = 3.78, p = 0.052$, C vs HI, Lower class, mother's education

Table 5.17 Result of logistic regression for periodontal conditions when sensory impaired children included: regression coefficient (b), standard error (SE), significance (*p*), Odds Ratio (OR) with 95% Confidence Interval (CI) for OR

Variables	Condition	b	SE	*p*	OR	95% CI	
Age	**Gingivitis**	2.16	0.97	0.026	8.67	1.28	58.72
Social class	**Plaque**	2.66	1.11	0.017	14.31	1.60	12.76
Gender	**Calculus**	1.04	0.49	0.03	2.84	1.08	7.44

Table 5.18 Proportion of children with developmental defects of enamel

Enamel defect	Control	VI	HI
No. (%) children	189 (38.3)	28 (36.4)	74 (35.2)
Mean (±SD)	0.38 (0.49)	0.36 (0.48)	0.35 (0.48)

$\chi^2 = 4.73, p = 0.094$, Enamel defects, three groups

Table 5.19 Proportion of children's last visit to the dentist

Variables	No. (%) of the children		
	Control	VI	HI
Last six months	138 (33)	20 (31.3)	41 (25.3)
Last year	107 (25.6)	9 (14)	39 (24.1)
Within two years	67 (16)	11 (17.2)	25 (15.4)
Longer than two years	106 (25.4)	24 (37.5)	57 (35.2)

Table 5.20 Dental services named by the children's parents

Types of dental services	No. (%) of the children		
	Control	VI	HI
Government Hospital	174 (40.8)	27 (38.6)	85 (47)
Government Polyclinic	69 (16.2)	13 (18.6)	34 (18.8)
Private Hospital	60 (14.1)	10 (14.3)	19 (10.5)
Private Clinic	115 (27)	14 (20)	33 (18.2)
Never been to dentist	0.0	3 (4.3)	2 (1.1)
Don't know	8 (1.9)	3 (4.3)	8 (4.4)

$\chi^2 = 21.24, p = 0.001$, C vs VI
$\chi^2 = 26.16, p < 0.001$, C vs HI

Table 5.21 Treatment received by the children

Treatment received	No. (%) of the children		
	Control	VI	HI
Teeth filled	113 (28.2)	15 (22.4)	33 (20.2)
Teeth filled and extracted	117 (29.2)	15 (22.4)	19 (11.7)
Teeth extracted	74 (18.5)	18 (26.9)	54 (33.1)
GA	2 (0.5)	0.0	4 (2.5)
Scaling	25 (6.3)	8 (11.8)	17 (10.4)
Check-up	9 (2.3)	1 (1.5)	1 (0.6)
Orthodontic treatment	10 (2.5)	0.0	2 (1.2)
Nil	19 (4.8)	6 (9)	26 (16)

$\chi^2 = 61.67, p < 0.001$, C vs HI

Table 5.22 Parental satisfaction with children's treatment

Parental satisfaction	No. (%) of the children		
	Control	VI	HI
Very satisfied	88 (20.7)	10 (15.6)	48 (30.2)
Satisfied	235 (55.3)	29 (45.3)	74 (46.5)
Unsatisfied	56 (13.2)	8 (12.5)	10 (6.3)
Very dissatisfied	11 (2.6)	5 (7.8)	7 (4.4)
Don't know	35 (8.2)	12 (18.8)	20 (12.6)

$\chi^2 = 12.80, p = 0.012$, C vs VI
$\chi^2 = 14.55, p = 0.006$, C vs HI

Table 5.23 Reasons for last visit to the dentist

Variables	No. (%) of the children		
	Control	VI	HI
Trouble	258 (61)	49 (80.4)	100 (67.5)
Check up	104 (24.5)	9 (14.8)	37 (25)
Trouble and Check-up	15 (3.5)	1 (1.6)	2 (1.4)
Decay	11 (2.6)	0.0	0.0
Filling	9 (2.1)	0.0	0.0
Teeth taken out	12 (2.8)	1 (1.6)	3 (2)
Orthodontic treatment	15 (3.5)	1 (1.6)	3 (2.1)
Orthodontic consultation	1 (1.6)	2 (2.4)	1 (1.6)

Kruskal-Wallis test, $p = 0.014$, three groups
$\chi^2 = 17.53, p = 0.003$, C vs VI

Table 5.24 Parents' opinion of children's dental problems

Variables	No. (%) of the children		
	Control	VI	HI
Discoloured teeth	25 (9.5)	8 (17)	27 (23.3)
Holes	222 (84.4)	37 (78.7)	82 (70.7)
Holes & discoloured	16 (6.1)	2 (4.3)	7 (6)

$\chi^2 = 13.01, p = 0.001$, C vs HI

CHAPTER SIX

Malocclusion
and
Orthodontic treatment need

6.1 Introduction

Most people undergo orthodontic treatment to improve their dental appearance, indeed, their major concerns are usually related to aesthetics (Burden and Pine, 1995). In relation to facial aesthetics, Lew (1993) has shown that, from the point of view of the patient, teeth were second in importance only to facial complexion. Most individuals who have had orthodontic treatment feel that they have benefited, even through dramatic changes in facial appearance are not always evident (Ostler and Kiyak, 1991).

The eventual decision to embark upon orthodontic treatment derives from the views and attributes of both consumers (patient and parent) and providers (individual dentists, orthodontists and the health system generally) (Shaw, 1981). Examination and subsequent counselling of the child and their parents usually initiate orthodontic treatment. The aesthetic need for orthodontic treatment is well documented in the literature for a "normal" population using the IOTN. Unfortunately, there is no report of aesthetic need for children with sensory impairment.

6.2 Aims

The aim of this study was to determine the extent of malocclusion and the need for orthodontic treatment in a young (aged 11-16 years) Saudi Arabian population sample with sensory impairment in comparison to a control sample.

6.3 Training and calibration

The examiner was trained and calibrated for the IOTN in December 1997 at the Dental School of University of Wales College of Medicine. The Weighted Kappa

of the Aesthetic Component was 0.77 while for the Dental Health Component was 0.76 (App. 2).

6.4 Method

The method was carried out as mentioned in chapter 5.

6.4.1 Method of collecting data

Each child was examined for malocclusion and orthodontic treatment need using the IOTN components (App. 4). The medical history for the study group was obtained from their medical record concerning their cause of disability, time of onset, degree of sensory loss and their I.Q (App. 5).

Self-perception of malocclusion was evaluated by asking each child to rate his/her own dental attractiveness using the 4 tactile graphics for visually impaired children (VI) and the 10 point AC of IOTN for control (C) and hearing impaired (HI) children (App. 6 and 7).

6.4.2 Children interview

Each child was asked 5 questions before the examination. The questions were focused on the child's understanding for his/her teeth, whether they were crooked or protruded and whether they would like to have orthodontic treatment and be willing to wear appliances (App. 8).

6.4.3 Parent questionnaire

For each child a questionnaire was sent to the parents through the school administration (App. 9). The questionnaire included questions modified from the child dental health survey (O'Brien, 1994). The parents were asked regarding their views on the arrangement of their child's teeth, their beliefs on them having orthodontic care and the reasons for possibly not having care (Q14, 15, 16,17 All

from CDHS, 18). Also, they were asked about their beliefs as to why their children had not received orthodontic treatment and about their dentist's attitude toward providing treatment (Q19 and 20).

General information was gathered from the questionnaire regarding the father's occupation and the mother's education to classify the social classes.

6.4.4 Intra-examiner reproducibility

Intra-examiner reproducibility of the orthodontic assessment at the clinical examination was tested through repeat examination by the researcher on two occasions separated by two weeks for 30 children. This yielded a kappa value of 0.84 for AC and 0.90 for DHC of orthodontic assessment.

6.4.5 Statistical Analysis

All the data were collected and entered into the SPSS program for analysis. Both descriptive and analytic approaches were used. Tests of the association between occlusion, orthodontic treatment need and single variables were carried out using the Chi square (χ^2) test. A p-value of ≤ 0.05 was considered statistically significant. A non-parametric test was used to compare between continuous data values without normalisation consummation. A McNemar's test (producing $p \leq 0.05$) was used between examiner and children comparisons.

Multi-variate analysis was carried out using logistic regression analysis to test the association of various socio-demographic and other factors for outcomes of AC and DHC scoring. The odd ratios and 95% confidence intervals were used to compare the relative risk ratio of the studied background factors for the different scoring of AC and DHC.

6.6 Results

Results drawn from clinical examination of 494 control group, 77 visually impaired and 210 hearing impaired child are summarised in Tables 6.1-6.38 and Figures 6.1-6.6.

6.6.1 Malocclusion status of the children

The survey examination collected a range of information about the occlusal features of the children's teeth. Assessment was made of overjet and overbite, the presence of crossbite and molar relation. Three (1.4%) HI children and 11 (2.2%) controls were wearing orthodontic appliance (s) at the time of the examination and therefore were excluded from this section.

6.6.1.1 Incisor overjet

The majority of children in the three groups had an overjet measurement range 1-3/mm (control 65%, VI 61%, and HI 61.8%) as shown in Table 6.1. The VI and HI children had a greater tendency (35.1% and 32.4% respectively) to an increased overjet, defined as 4/mm or more, compared to the control children. There was no statistically significant difference when the three groups were compared using the Kruskal-Wallis test ($p = 0.283$).

The differences in overjet between genders did not reach a statistically significant level in the three groups (Table 6.2). However, among female children, there was a greater tendency to an increased overjet among the VI (34.2%) and HI (31.2%) groups than the controls (26.5%). Also for the males, VI (35.9%) and HI children (34.2%) had a greater tendency to increased overjet than the controls (30.4%).

Prevalence of overjet size in relation to different age groups is summarised in Table 6.3 and did not reach statistical significance in the three groups. Prevalence

of increased overjet tended to decrease with age among control and HI children but tended to increase among VI children. It showed a difference of 12.6% for control children, 11.6% for HI children and 5.4% for VI children aged 13-16 years.

Among the control children, 5.3% aged 11-12 years, 6.8% aged 13-14 years and 10.3% aged 15-16 years had negative to zero overjet; compared to 8.7%, 0% and 7.1% respectively of VI children and 3.7%, 8.2% and 3.6% of HI children. The prevalence showed some evidence of an increase in negative overjet with age in the control children while a decrease among VI and HI children.

6.6.1.2 Incisor overbite

The incisor overbite was measured as the vertical distance between the incisal edges of the upper and lower incisors. The measurement was made on the teeth with the largest vertical overlap. The majority of children (81% of the controls, 85.7% of the VI and 85% of the HI) had overbites in the range of 1-3/mm (Table 6.4). There was no statistically significant difference when the three groups were compared using the Kruskal-Wallis test ($p = 0.830$).

Prevalence of overbite in relation to gender is summarised in Table 6.5. The differences between genders, failed to reach significance between the three groups. Although there was no statistically significant difference, 4% of the female control group had anter openbite and 9.9% had overbite of 4/mm and above, compared to 0 and 4.8% respectively of the HI females. Excessive overbite was noticed more among the female control (9.9%) than the VI females (5.3%) and HI females (4.8%).

The differences between ages in the overbite failed to be significant between the three groups, as shown in Table 6.6. Almost 79-93% of the children aged 11 to 16 years had an overbite between 1-3/mm. The prevalence of anterior openbite among VI children aged 11-16 years was zero tendency compared to 1-5% of control children and 2 % of HI children. Thirty-three percent of control children

had an excessive overbite compared to 21.8% of VI children and 24.4% of HI children.

6.6.1.3 Crossbite

Assessment of anterior, buccal, and lingual crossbite was made. Anterior crossbite is defined as a permanent upper central or lateral incisor occluding lingually to an opposing tooth. Buccal crossbite occurs when an upper canine tooth or the buccal cusp of an upper premolar or molar occludes ligually to the buccal cusp of the opposing lower tooth. Lingual crossbite occurs when the palatal cusp of an upper premolar or molar occludes buccally to the buccal cusp of the opposing lower tooth.

The prevalence of crossbite was noticed more among the VI (22.1%) than HI (13%) and control children (14.9%). There was no statistically significant difference when the three groups were compared using the Chi-square test (p= 0.164).

It can be seen that, 12.8% of the control group children had anterior crossbite, compared to 18.2% of the VI and 11.6% of the HI children (Table 6.7). Of the control children, 8.3% had posterior crossbite, compared to 10.4% of VI children, and 6.3 of HI children. There was no statistically significant difference between control and study groups in prevalence of anterior or posterior crossbite (p = 0.334, p = 0.479 respectively).

Crossbite was related to gender as shown in Table 6.8. Again there was no statistically significant difference between the control and study group children. Female controls were more likely to have anterior (15%) and posterior (8.7%) crossbite than female HI (8%, 4% respectively). However, for the VI children, males had a greater tendency for anterior (20.5%) and posterior (15.4%) crossbite than males of the control (10.4%, 7.8% respectively).

Crossbite was also related to age, as shown in Table 6.9. Prevalence of anterior crossbite in the control (11.5% to 14.7%) and VI (17.4% to 28.6%) children tends to increase with age. However, it was the opposite for HI children (14.8% to 5.5%) where prevalence of anterior crossbite decreased in the older age groups. Prevalence of posterior crossbite in control children (5.8% to 10.3%) tended to increase with age however, it was opposite for VI (17.4% to 0.0%) and HI (7.4% to 3.6%) children were prevalence decreased in the older age groups.

6.6.1.4 Molar relation

Molar relation was recorded according to Angle classification. The molar relationship of the three groups is summarised in Table 6.10. Of all children surveyed, 55% to 59% fell into Class I. Class II was also nearly similar in the three groups, with a proportion between 22.2% and 31.2%. Almost 18.4% of the control children were diagnosed as Class III, compared to 10.4% of the VI children and 21.7% of the HI children. There was no statistically significant difference when the three groups were compared using the Kruskal-Wallis test ($p = 0.411$)

There was no significant difference between gender in the three groups (Table 6.11). Of the females, 66% of controls, 60.5% of VI children and 60% of HI children were recorded as Class I respectively. Male children in Class I included 52.2% of the control, similar to the VI group with 56.4% and the HI group with 47.6%. Children diagnosed as Class II ranged from 20.2% to 31.6% of females, and from 24.3% to 30.8% of males, in the three groups. Although there was no significant difference in Class III, it seems that the control (13.8%) and HI (19.2%) females were more likely to be in this category than VI females (7.9%). Similarly, among males, control (23.5%) and HI (25.6%) children were more likely to be in the Class III group than VI males (12.8%).

There were no significant differences between the different ages among the three groups (Table 6.12), except for 13-14 year-olds. Thirteen-fourteen years VI

children were more likely to have Class II (42.5%) than control (23.7%) children of this age but 18.4% of the control group were recorded as Class III, compared to 2.5% of VI group ($p = 0.007$).

6.5.2 Orthodontic treatment needs of children

The children were assessed for the need of orthodontic treatment by combining their condition into an index based on the IOTN. In addition, the dental examiner and the child were asked to assess the aesthetic component of orthodontic need by rating the attractiveness of each child's teeth on a scale of 1 (most attractive) to 10 (least attractive) by comparison with ten photographs for sighted and four tactile graphics for unsighted child.

6.5.2.1 Dental Health Component

The dental health component (DHC) of the IOTN is a hierarchical scale, which is divided into five grades that are related to different levels of treatment need. Five traits are recorded, the highest-scoring trait determining the overall grading of the patient.

Traits are ordered hierarchically and measured using a special designed millimetre rule:

- Missing and unerupted teeth
- Overjet
- Crossbite
- Displacement of contact points
- Overbite

The dental health of each child was rated as one of the five categories of the IOTN DHC scale. Scores of 1 and 2 are described as having no or little need for treatment, a score of 3 indicates moderate or borderline need, and scores of 4 and 5 indicate a definite need for treatment. The DHC scores are listed in Table 6.13.

A score of 1 was given to 32.3% of controls, 35% of VI children and 28% of HI children. A score of 2 was given to 45.3% of controls, 37.7% of VI children and 42% of HI children. A score of 3 was given to 13.2% of controls, 15.6% of VI children and 16.5% of HI children. A score of 5 was given to 7.3% of controls, 6.5% of VI children and 8.7% of HI children.

There was no statistically significant difference when the three groups were compared using the Kruskal-Wallis test ($p = 0.163$) and neither between the study groups.

The orthodontic treatment needs of the children were closely similar among the three groups in the category of "moderate to borderline" need (13.2% controls, 15.6% VI, 16.5% HI) ($p = 0.083$). They were different in the category of "definite need", into which category 9.2% of controls, 11.7% of VI children, and 13.5% HI children were placed but that did not reach to statistical significant level (Table 6.14).

6.5.2.2 Examiners assessment of dental attractiveness (AC)

The examiner rated the children's dental attractiveness, based on the IOTN AC score (1 to 10) and on the IOTN tactile graphics (1 to 4) for VI children. Component scores are shown in Tables 6.15 and 6.16. All ten AC classes were represented, although a rating of 10 was found among VI children only. By the examiner's rating, 60.6% of controls, 44.2% of VI children and 57% of HI children were rated 1 (most attractive); while 33.4% of controls, 39% of VI children and 37.7% of HI children were rated 5, 6% of controls, 11.6% of VI children and 5.3% of HI children were rated 8, and only 5.2% of VI children were rated 10 (least attractive). There was a statistically significant difference when the three groups were compared using the Kruskal-Wallis test ($p = 0.005$) and that differences were confirmed between controls and VI children ($p = 0.001$), controls and HI children ($p = 0.046$) and between VI and HI children ($p = 0.011$). The control children were rated as more attractive than VI children and as borderline

to HI children. A comparison between the control and HI groups showed that 27.5% of controls and 16% of HI children were rated 2.

When the data for control children were grouped into categories of need for orthodontic treatment on aesthetic grounds (Table 6.17), 60.6% were graded as having no need for treatment (AC 1–4), 33.4% as having a possible need for treatment (AC 5–7), and the remaining 6% as having a definite need for treatment (AC 8–10). Among VI children, 44.2% were graded as having no need for orthodontic treatment, 39% as possibly needing treatment, and 16.8% as definitely needing treatment. Among HI children, 57% were graded as having no need for treatment, 37.7% as possibly needing treatment, and 5.3% as definitely needing treatment. There was a statistically significant difference when the three groups were compared using the Kruskal-Wallis test ($p = 0.006$) and that differences were confirmed between controls and VI children ($p = 0.001$) and between VI and HI children ($p = 0.013$).

The difference between gender to normative child's attractiveness grouped by treatment need categories, reached a statistically significant level in the HI group ($p < 0.001$), however, failed to reach a significant level in the control and VI groups when tested using the Chi-square test (Tables 6.18). HI Males were graded for treatment needs more then females.

A comparison between the study groups and the control group showed 32% of female controls and 35.2% of female HI were rated for moderate need for treatment (AC 5-7), compared to 34.2% of female VI children. For definitive treatment need, 5.9% of female control and 0.8% of female HI were in this category compared to 18.4% of female VI. However for males; 34.8% of male control and 41.5% of HI male were rated for moderate need for treatment compared to 43.6% of male VI. For definitive treatment need, 6.1% of male control and 12.2% of male HI were in this category compared to 15.4% of male VI. There was a statistically significant difference between female and male controls in relation to VI children ($p = 0.018$, $p = 0.038$ respectively) and between female VI and HI females ($p < 0.001$).

The difference between age groups, to normative child's attractiveness grouped by treatment need categories, failed to reach statistically significant levels in the three groups when tested using the Chi-square test (Tables 6.19).

A comparison between the study groups and the control group showed 32.7% of 11-12 year-old control and 37% of HI children in the same age were rated for moderate need or treatment (AC 5-7), compared to 43.5% of VI children. For definitive treatment need (AC 8-10), 5.3% of control children and 5.6% of HI children were in this category compared to 17.4% of VI children. For children aged 13-14 years, 32.9% of control and 37.8% of HI children were rated for moderate treatment need compared to 42.5% of VI children. For definitive treatment need (AC 8-10), 5.3% of control children aged 13-14 years and 6.1% of HI children were in this category compared to 12.5% of VI children. Children aged 15-16 years, 36.8% of control children and 38.2% of HI children were rated for moderate treatment need compared to 21.4% of VI children. For definitive treatment need (AC 8-10), 10.3% of control children aged 15-16 years and 3.6% of HI children were in this category compared to 28.6% of VI children. There was a statistically significant difference between the control and VI aged 11-12 years ($p = 0.027$) and between VI and HI children aged 15-16 years ($p = 0.011$).

The difference between social classes based upon father's occupation to normative child's attractiveness grouped by treatment need categories, failed to reach statistically significant levels in the three groups when tested using Chi-square test (Tables 6.20).

A comparison between the study groups and the control group showed among children from upper class, 31.1% of controls and 31.3% of HI children were rated as moderate treatment need compared to 55.6% of VI children. For definitive treatment need, 7.6% of control children were rated for treatment need compared to 0.0% of VI children and HI children. In the middle class, 34.9% of controls, 39.5% of HI children were rated as moderate treatment need compared to 35.1% of VI children. For definitive treatment need, 4.9% of control and 6.5% of HI children needed treatment compared to 22.8% of VI children from the middle class. Among children who are classed as lower class, 30.6% of control and

36.4% of HI children rated for treatment compared to 50% of VI children. For definitive treatment need, 6.1% of control children were rated for treatment need compared to 0.0% of VI children and HI children from the lower class. There were statistically significant differences between the control and VI at middle social class ($p < 0.011$), and between VI children and HI children at middle social class ($p = 0.066$).

The difference between social classes based upon mother's education to normative child's attractiveness grouped by treatment need categories, was similar to that described above which failed to reach a statistically significant level in the three groups when tested using the Chi-square test (Table 6.21).
A comparison between the study groups and the control group showed; among children who are classified as upper class, 33.7% of controls and 36.4% of HI children were rated as moderate treatment need compared to 26.7% of VI children. For definitive treatment need, 2.2% of control children and 4.5% of HI children were rated for treatment need compared to 20% of VI children from the upper class. In the middle class, 30.2% of controls, compared to 40% of HI and VI children were rated as moderate treatment need. For definitive treatment need, 6.5% of control and 6.7% of HI children needed treatment compared to 10% of VI children from the middle class. Among children who were classed as lower class, 38% of control and 36.7% of HI children rated for treatment compared to 42.9% of VI children. For definitive treatment need, 5.8% of control children and 5% of HI children were rated for treatment need compared to 14.2% of VI children from the lower class. There were statistically significant differences between the control and VI in the upper social class ($p = 0.010$).

Multi-variate analysis

Multi-variate analysis was carried out using a stepwise logistic regression to determine the factors which were independently related to the examiner's normative child dental attractiveness AC scores according to treatment need (5-10) when other variables were held constant. Table 6.22 summarises the findings

when sensory impaired children were included. The final model summarised in the table showed the factor that remained as statistically significant was being a male (OR = 1.91). The confidence intervals showed that in the case of being male, it might be as high as 3.5.

Analysis of examiner's normative child's dental attractiveness AC scores in control children did not emerge as a significant variable in relation to age, gender and social class.

6.5.2.3 Children's perceived dental attractiveness (AC)

The distribution of children's perception of their aesthetic value using the 1-10 scale and tactile graphics are shown in Tables 6.23 - 6.24. 81.3% of the controls and 78.2% of HI children rated themselves as an IOTN score of 1 compared to 35% of the VI children. At the next level, 10.2% of control children and 16.5% of HI children rated themselves as 5 compared to 22% of VI children. Just over 8% of control children, 5.3% of HI children and 31.3% of VI children rated themselves as an IOTN of 8. At the lowest score of 10, only 0.4% of the control children and 0.0% of HI children but 11.7% of the VI children rated themselves at this level. Twenty-eight percent of the control children rated themselves as an IOTN score of 1, compared to 31.2% of HI children. At an IOTN score of 7 for example, 2.9% of controls and 5% of HI children rate themselves at this level. At a score of 8, 5.8% of controls and 3.4% of HI children rated themselves at this level. Only control children (0.4%) rated themselves at the bottom of the index with a score of 10. One of the hearing-impaired children refused to rate her aesthetic perception.

There was therefore a highly statistically significant difference between the three groups when tested using the Kruskal-Wallis test ($p < 0.001$) which was confirmed to be significant between the control and VI ($p < 0.001$) and between VI and HI children ($p < 0.001$). The VI children perceived themselves as less attractive than the control and HI children.

When the data for the control children were grouped into categories of need for orthodontic treatment on aesthetic grounds (Table 6.25), 81.3% were rated as having no need for treatment (AC 1–4), 10.2% as having a possible need for treatment (AC 5–7), and the remaining 8.5% as having a definite need for treatment (AC 8–10). Among VI children, 35% were graded as having no need for orthodontic treatment, 22% as possibly needing treatment, and 43% as definitely needing treatment. Among HI children, 78.2% were graded as having no need for treatment, 16.5% as possibly needing treatment, and 5.3% as definitely needing treatment. There was a statistically significant difference when the three groups were compared using the Kruskal-Wallis Test ($p < 0.001$) and that differences were confirmed between controls and VI children ($p < 0.001$), and between VI and HI children ($p < 0.001$).

The difference in perceived and normative need for orthodontic treatment was statistically significant in the control and HI groups ($p < 0.001$). It can be seen in Fig. 6.1 that 18.7% of control children perceived themselves as needing some orthodontic treatment (AC rating 5 or worse), but the examiner rated 39.4% as needing treatment. Of the HI children, 21.6% perceived themselves as needing some treatment, compared to 43% rated by the examiner as needing treatment. However, for VI children, 65% perceived themselves as needing some treatment, compared to 55.8% rated by the examiner as needing treatment ($p = 0.578$).

From the data, a "Tree diagram", as shown in Fig. 6.2 and Table 6.26, was constructed to test the difference in perceived and normative need for the three groups using the χ^2trend test. Numbers of children were categorised as having under-scored, agreed, or over-scored their IOTN AC category compared with the examiner (Table 6.27). A comparison between the control and study groups showed that VI children tend to over-score the examiner by 40.3% compared to 10% of controls and 12.2% of HI children ($p < 0.001$).

The difference between gender, in treatment need categories, reached a statistically significant level in VI and HI children but failed in the control group

when tested using the Chi-square test (Table 6.28). For both VI and HI children, perceived values for treatment need were high among the males ($p = 0.032$, $p = 0.014$ respectively).

A comparison between the study groups and the control group among female children showed 9.5% of control and 16.9% of HI were rated for moderate need for treatment (AC 5-7), compared to 31.6% of VI children. For definitive treatment need, 8.7% of female control and 1.6% of female HI were in this category compared to 28.9% of female VI. However for males; 10.9% of male control and 15.9% of HI males were rated for moderate need for treatment compared to 12.8% of male VI. For definitive treatment need, 8.3% of male control and 11% of male HI were in this category compared to 56.4% of male VI. There was a statistically significant difference between females and males control in relation to VI children ($p < 0.001$) and between VI children and HI children ($p < 0.001$).

Male VI children tended to rate themselves as less attractive compared to males in the control group ($p = 0.001$); fully 56.5% of VI males rated themselves as AC 8 and worse, compared to 8.3% of control males and 11% of HI males. Among female children, 81.8% of controls rated themselves as 1, compared to 39.5% of VI females and 81.5% of HI females ($p < 0.001$).

The difference between age group and children's perceived level of dental attractiveness according to treatment need, failed to reach a statistically significant level in the three groups when tested using the Chi-square test (Table 6.29).

A comparison between study groups and the control group showed 8.7% of 11-12 year old control and 20.4% of HI children in the same age were rated for moderate need for treatment (AC 5-7), compared to 17.4% of VI children. For definitive treatment need (AC 8-10), 11.5% of control children and 5.6% of HI children were in this category compared to 47.4% of VI children of the previous age. For children aged 13-14 years, 10.6% of controls and 17.5% of HI children were rated for moderate treatment need compared to 27.5% of VI children. For definitive treatment need (AC 8-10), 6.8% of control children aged 13-14 years and 4.1% of

HI children were in this category compared to 32.5% of VI children. For children aged 15-16 years, 13.2% of control children and 10.9% of HI children were rated for moderate treatment need compared to 14.3% of VI children. For definitive treatment need (AC 8-10), 4.4% of control children aged 15-16 years and 7.3% of HI children were in this category compared to 35.7% of VI children. There was a statistically significant difference between control and VI children in all ages ($p <$ 0.001), between the control and HI children at age of 11-12 years ($p = 0.030$) and between VI and HI children in all ages ($p = 0.001$, $p < 0.001$, $p = 0.014$ respectively).

The difference between children's perceived level of dental attractiveness according to treatment need and social class based upon father's occupation, failed to reach a statistically significant level in the three groups when tested using the Chi-square test (Tables 6.30).

A comparison between the study groups and the control group among children who were from the upper class showed 8.4% of controls and 31.2% of HI children were rated as moderate treatment need compared to 22.2% of VI children. For definitive treatment need, 9.2% of control children and 0.0% of HI children were rated for treatment need compared to 33.4% of VI children who were from the upper class. In the middle class, 10.7% of controls and 15.3% of HI children were rated as moderate treatment need compared to 19.3% of VI children. For definitive treatment need, 8.2% of control and 3.2% of HI children needed treatment compared to 45.6% of VI children who were from the middle class. Among children who were classed as lower class, 10.2% of control and 15.6% of HI children rated for treatment compared to 50% of VI children. For definitive treatment need, 6.1% of control children and 3.1% of HI children were rated for treatment need compared to 37.5% of VI children who were from the lower class. There were statistically significant differences between the control and VI at all social classes ($p = 0.022$, $p < 0.001$, $p < 0.001$ respectively), between control and HI children at upper social class ($p = 0.015$) and between VI children and HI children at all social classes ($p = 0.048$, $p < 0.001$, $p < 0.001$ respectively).

The difference between children's perceived level of dental attractiveness according to treatment need and social classes based upon mother's education, failed to reach a statistically significant level in the three groups when tested using the Chi-square test (Table 6.31).

A comparison between the three study groups and the control group among children who were classified as upper class showed 8.7% of controls and 4.5% of HI children were rated as moderate treatment need compared to 20% of VI children. For definitive treatment need, 5.4% of control children and 9.1% of HI children were rated compared to 33.3% of VI children who were from the upper class. In the middle class, 9% of controls and 24.4% of HI children were rated as moderate treatment need compared to 10% of VI children. For definitive treatment need, 10.6% of control and 4.4% of HI children compared to 50% of VI children who were from the middle class. Among children who were classed as lower class, 12.4% of control and 15% of HI children rated for treatment compared to 21.4% of VI children. For definitive treatment need, 6.6% of control children and 3.3% of HI children were rated for treatment need compared to 46.5% of VI children who were from the lower class. There were statistically significant differences between the control and VI children at all social classes ($p < 0.001$), between control and HI children at middle social class ($p = 0.010$) and between VI and HI children at all social classes ($p = 0.034$, $p < 0.001$, $p < 0.001$ respectively).

Multi-variate analysis

Multi-variate analysis was carried out using a stepwise logistic regression to determine the factors which were independently related to the children's AC scores according to treatment need (5-10) when other variables were held constant. Table 6.32 summarises the findings when sensory impaired children are included. The final model summarised in the table showed the factors that remained as statistically significant were being a severely impaired (OR = 2.20) and impaired since birth (OR = 2.84) tend to perceived aesthetics less than moderate to mild impairment or having lost the sense after birth. The confidence

intervals showed that in the case of being severely impaired since birth it might be as high as 4.94 and 6.79 respectively.

Analysis of AC in the control children did not emerge as a significant variable in relation to age, gender and social class.

6.5.3 Children's attitudes to their dental appearance and the need for treatment (Interview)

The children's response to the interview assessment is listed in Table 6.34. The proportion of children who believed themselves to have crooked or protruding teeth were quite similar in the three groups. Of the control children, 23% thought their teeth were crooked, compared to 20.8% of VI children and 24.8% of HI children. Also, 35% of control and VI children thought they had protruding teeth, compared to 37.2% of HI children.

The children were also asked whether they had received orthodontic treatment. Of the control children, 0.2% experienced treatment in the past and 2.2% were being treated at the time of the interview, compared to the VI children who had received no orthodontic treatment at any time, and 1.4% HI children who were having treatment at the time of the interview.

The children were also asked, "At this time, do you think your teeth are all right as they are, or would you prefer to have them straightened?" Almost 58% of control children said their teeth were either crooked or protruding, 55.3% said they would like to have treatment and 44.5% of them were willing to wear braces. However, among VI children, 55.8% said they had crooked or protruding teeth, 61% would like to have treatment, but only 36.4% would wear braces. Among HI children, 62% said they had crooked or protruding teeth, only 56.7% would like to have treatment and 45.2% were willing to wear braces.

There was no statistically significant differences in the children's response to the interview items when the three groups were compared.

A comparison was made between the children's perceived treatment need and their views on whether their teeth were crooked or protruding (Fig. 6.3 and 6.4). Among children who thought their teeth were crooked 16.4% of the control children perceived an AC 5-7 and 14.5% as 8-10; 12.5% of the VI children perceived treatment as AC 5-7 and 56.3% as 8-10; and 25.5% of the HI children perceived treatment as AC 5-7 and 15.7% as 8-10.
Among children who thought their teeth were protruding; 11.8% of control children perceived an AC 5-7 and 16% as 8-10; 29.6% of the VI children perceived treatment as 5-7 and 51.9% as 8-10; and 23.4% of the HI children perceived treatment as 5-7 and 7.8% as 8-10.

Fig.6.5 shows the extent to which the children's views on the need for treatment related to their percieved treatment need. Among those who scored for having a moderate need for treatment, 14.5% of control children, 20% of VI and HI children thought that they should have treatment. For definite need of treatment; 16.8% of control, 53.3% of VI children and 6.7% of HI children thought they should have the treatment.

Fig.6.6 shows the extent to which children's views on the need for treatment were related to the examiner's assessment of need as expressed in the DHC rating. Among those who were assessed by the examiner as having a moderate need for treatment, 17.8% of control children and 20% of VI children thought that they should have treatment; but this fell to 13.1 % of controls and 16.7% of VI children who were assessed as having a definite need for treatment. Among HI children, 14.3% of those who were assessed as having a moderate need for treatment thought that they should have treatment; this rose to 17.6% of those who were assessed as having definite need for treatment.

6.5.4 Parent questionnaire

Of the 780 questionnaires distributed, the response rate was 92.9% for control, 100% for VI parents and 92.4% for HI parents.
Nine of the control and HI children's parents, but none of the VI children's parents, had previous orthodontic treatment.

6.5.4.1 Parental attitude to the appearance of their children's teeth

Parents were asked whether their children had crooked or protruding teeth and whether they considered treatment was needed for these conditions. Those who thought their children's teeth were crooked included 27% of control parents, 17.1% of VI parents and 23.7% of HI parents. Those who thought their children had protruding teeth were 24% of control parents, 25% of VI parents, and 25.8% of HI parents.

Table 6.35 shows the proportions of parents who thought their children's teeth were crooked or protruding, in relation to the examiner's assessment of the child's dental attractiveness (AC) according to treatment need. Among the parents of the control children, the proportion who thought that their children's teeth were crooked were 37.5% of those whose children were rated by the examiner in the range AC 1–4, 54.2% of those rated AC 5-7 then fell to 8.3% of those rated AC 8-10. Among parents of VI children, those who thought their children's teeth were crooked were 23% of those whose children were rated by the examiner in the range AC 1–4, 30.8% of those rated AC 5-7, then rose to 46.2% of those rated AC 8–10. Among parents of HI children, those who thought their children's teeth were crooked were 48.9% of those whose children were rated by the examiner in the range AC 1–4, 40.4% of those rated AC 5-7, then fell to 6.7% of those rated AC 8-10.

Among the parents of the control children, the proportion who thought that their children's teeth were protruding was 36.1% of those whose children were rated by

the examiner in the range AC 1–4, 55.5% of those rated AC 5-7, then fell to 8.4% of those rated 8-10. Similarly for the parents of VI children, in which the proportion was 36.8% of those rated AC 1–4, 52.6% of those rated AC 5–7, then fell to 10.6% of those rated AC 8–10. Again, for the HI parents, the proportion was 42.9% of those rated AC 1–4, 46.9% of those rated AC 5-7, then fell to 10.2% of those rated AC 8–10.

There was a statistically significant difference between parents of control and VI children who thought their children's teeth were crooked, in relation to the examiner's assessment of definitive need for treatment (AC 8-10) of the AC (p = 0.001) and between parents of VI and HI children (p = 0.005). The proportion of control and HI parents who thought their children's teeth were crooked in relation to the examiner assessment of AC were in the most attractive end in comparison to VI parents.

6.5.4.2 Parents' views of children's need for orthodontic treatment

This section looks at whether parents would prefer their children to have orthodontic treatment, and also whether they think their children would like to be treated. They were asked, "At this time, do you think your child's teeth are all right as they are, or would you prefer him/her to have them straightened?" Among parents of the control group, 2.6% said their children were already having treatment for crooked or protruding teeth at the time of the survey, 50.5% thought their children needed treatment, 49.5% saw no need for treatment, and 44.9% thought that their children would like to have treatment. Among parents of VI children, none of the children were receiving treatment, 64.3% thought their children needed treatment, 35.7% saw no need for treatment, and 62.3% thought that their children would like to have treatment. Similarly for parents of HI children, none of the children were receiving treatment at the time of the survey, 54.4% thought their children needed treatment, 45.6% saw no need for treatment, and 66.1% thought that their children would like to have treatment.

There was a statistically significant difference between parents of control and VI children who thought their children's teeth needed treatment ($p = 0.032$). The parents of VI children believed more that their children teeth need treatment. Also, there were statistically significant difference between parents of control and VI ($p = 0.007$) and between parents of control and HI children ($p < 0.001$) who thought that their children would like to have treatment. The parents of VI and HI children believed more that their children would like to have treatment.

A comparisons was made of the parents' views on treatment and the examiner's assessment of need for treatment, based on the DHC scores (Table 6.36). Among children assessed as needing no treatment (score of 1), 22% of control parents, 37.8% of VI parents, and 23.7% of HI parents thought their children needed treatment. Among children assessed as needing little treatment (score of 2), 45.9% of control parents, 33.3% of VI parents, and 40.2% of HI parents thought their children needed treatment. However, among children assessed as being in moderate to very great need for treatment (scores of 3–5), the proportion fell in all three groups of parents who thought their children needed treatment: for controls, 32.1% of control parents, 28.9% of VI parents, and 36.1% of HI parents agreed that treatment was needed.

Of children assessed as in treatment need cateogies (3-5), 36% of control parents, 27.9% of VI parent and 35.6% of HI parents thought that their children would like to have treatment (Table 6.36).

There were statistically significant differences between the control and VI parents as well as between control and HI parents where more of the VI and HI parents believed that their children's teeth were correct in treatment categories according to the DHC compared to control parents ($p = 0.042$, $p = 0.023$).

6.5.4.3 Parents' views of children having orthodontic treatment

Questioning on a scale of five items with a simple yes-or-no response tested parents' beliefs about why their children did or did not receive orthodontic treatment. Parents were asked their opinions of whether a child was interested in his or her dental appearance, whether they could maintain necessary levels of oral hygiene, and whether they would be able to cope with the treatment, and whether the treatment is obtainable and affordable (Table 6.37). Parents were also asked what they believed their own dentist's attitude to be on the subject of providing orthodontic treatment for their children, based on the same five questions (Table 6.38).

Some 31.1% of parents of VI children believed that their children were not concerned about dental appearance, compared to 23.6% of control parents and 17.9% of parents of HI children; the proportions were less than 6% for HI group from control, but it was about 8% greater for the VI parents compared to the controls. There was a statistically significant difference between the VI parents beliefs that their children were not concerned about dental appearance and HI parents ($p = 0.044$).

On the question of hygiene, 26.2% of control parents believed it would be difficult for their children to maintain oral cleanliness during orthodontic treatment, compared to 27.4% of VI parents and 21.9% of HI parents. Of the control parents, 43.9% thought their children would find it difficult to cope with the treatment, compared to 50.8% of VI parents and 51.8% of HI parents. The opinion that orthodontic treatment is difficult to obtain was expressed by 49.5% of control parents, 52.6% of VI parents, and 54.2% of HI parents. Orthodontic treatment was thought to be expensive by 71.7% of control parents, 79.7% of VI parents, and 78.7% of HI parents.

On the subject of dentists' attitudes (Table 6.38), 21.2% of control parents said that their dentists would not provide orthodontic treatment because the child was

not concerned about his or her appearance. This compared to 29.3% of VI parents and 17.6% of HI parents. Referring to oral hygiene, 22.7% of control parents thought their dentists would refuse to provide treatment because the child would find cleanliness difficult to maintain during the treatment, compared to 24.1% of VI parents and 22% of HI parents. Of the control parents, 44.8% thought their dentists would refuse to provide treatment on the grounds that the child would find it difficult to cope, compared to 45.6% of VI parents and 44% of HI parents. The opinion that dentists would confirm that orthodontic treatment is difficult to obtain was expressed by 50.3% of control parents, 56.4% of VI parents, and 61.3% of HI parents. Finally, 69.5% of control parents, 77.6% of VI parents, and 77.2% of HI parents thought their dentists' would not offer their children the treatment because it is difficult for the parent to offer the payment.

Multi-variate analysis

Multi-variate analysis was carried out using a stepwise logistic regression to determine the factors which were independently related to parent views on treatment need for their child when other variables were held constant. Table 6.39 summarises the findings when HI children are included. The final model summarised in the table showed the factors that remained as statistically significant were being rated for treatment need by the examiner (AC 5-10) (OR = 2.04) and having crowded teeth (OR = 1.05) or protruded teeth (OR = 2.61) tend to perceived more treatment need for their child. The confidence intervals showed that in the case of having protruded teeth it might be as high as 5.46 and 29.10 respectively.

However for control children, the factors that remined statistically siginifcnat were being rated for treatment need by the examiner (AC 5-10) (OR = 2.00) and having crowded teeth (OR = 1.00) tend to perceived their child for more treatment need. The confidence intervals showed that in the case of examiner rating of treatment need it might be as high as 1.21 and 3.28 respectively.

6.6 Discussion

The aim of this part of the study was to determine the prevalence of malocclusion and orthodontic treatment need in 11-16 year old VI and HI children in Riyadh, Saudi Arabia.

6.6.1 Study design and methodology

The age group was chosen as it is a standard age for WHO and BASCAD to carry out investigation for malocclusion and orthodontic treatment needs. Also, it is a convenient time for the permanent dentition to be established and a good time for orthodontic evaluation in terms of dental development and timing for treatment.

6.6.2 Malocclusion status of the children

It has not been clarified previously whether sensory impaired individuals differ from 'normal' individuals with respect to occlusal anomalies. There are conflicting reports regarding the prevalence of malocclusion in children with disabilities even from the early study by Rhodes (1884). As it is difficult to include all previous studies and try to compare the present findings to previous reports, studies since 30 years will be compared and discussed to this study data.

6.6.2.1 Incisor Overjet

At clinical examination, 61% of VI children and 61.8% of HI had an overjet in the range of 1-3mm. It is apparent that the estimate of overjet is within the range seen in the control group (65%). Isshiki (1968), Miller and Taylor (1970) and Swallow (1972) reported that the prevalence of malocclusion for people with disability did not differ markedly from the norm.

The VI and HI children were noticeable to have deviations of overjet in range of 4/mm and above from the control children. Comparisons with the results of previous investigation are questionable, since no study has been done specifically on a sensory impaired group. Vigild (1985) estimated a four-fold increase of overjet in persons with Down's syndrome (41%) than the control (0.5%). Also, Oreland *et al.* (1987) reported that "severely mentally retarded" had larger overjets (13%) compared to a control group (8.7%).

The estimate in the present study was in disagreement to that of Pope and Curzon (1991) where a significant difference existed in the mean overjet between the cerebral palsied sample (5.1mm) and the control group (2.5mm). In addition Vittek *et al.* (1994) found that mentally disabled children had a higher prevalence of increased overjet (23.6%). A study carried out on disabled children in Riyadh (Adenubi *et al.,* 1997) showed an increased overjet (10%) among children aged 3-14 years.

Information about overjet in relation to gender and age have not been discussed in detail previously. The differences in overjet size between genders did not reach a statistically significant level. However, VI and HI females as well males are more likely than same-sex controls to have an overjet of 4mm and over.

6.6.2.2 Incisor Overbite

Eighty-five percent of the HI children had an overbite in the range of 1-3mm while this was 85.7% of VI children. It is apparent that the estimate of overbite is within the range seen in the control group (81%). About 10%-12% of the study sample had an excessive overbite (4- > 4/mm). Reverse overbite was noticeably higher in the control group compared to the VI children where it was zero.

Findings in the present study seem to disagree with the results obtained by Vigild (1985) on subjects with Down's syndrome where 3% had a deep bite compared to 19% of the controls. Meanwhile, the results of Vittek *et al.* (1994) were lower than the present study, such that 2% of mentally retarded individuals aged 6-19 years had an excessive overbite. It has been noticed that the estimate of overbite in

the sensory impaired children falls below the range seen in the Riyadh city survey on children with disability, where 20% of the examined sample had excessive overbite (Adenubi *et al.,* 1997). Also, it seems to disagree with the result obtained by Frankline *at al.* (1996) where children with cerebral palsy (mean 4.4) had a significant increased overbite than control group (mean 3.0).

3.9-4.8% of the three groups had anterior open bite. The prevalence was lower than was reported on subjects with Down's syndrome, where 38% had anterior open bite (Vigild, 1985) compared to 2% of the controls. Also it was higher in a sample of 6-19 year old who are mentally disabled, where 29% of the sample had open bite (Vittek *et al.,* 1994).

As the current study suggested that prevalence of overbite be related to gender, the female controls had a greater tendency for reversed overbite and deep bite than female VI. However, male controls had less tendency for reversed bite from the male HI. It is also of interest that VI children at the age of 13-14 years exhibited increased frequency for deep bite (17.5%) from the control children (12%).

6.6.2.3 Crossbite

At clinical examination, 14.9% of the control group children, 22.1% of the VI and 13% of the HI had signs of crossbite but this difference was not statistically significant. Comparisons with the results of previous investigations are questionable, since no study has been done specifically on sensory impaired groups.

The prevalence of crossbite in the present study was lower than in the Gullikson (1973) study, where 46.4% of a mongoloid group had a crossbite compared to 17.8% of a nonmongoloid group. In contrast of the present study, Vigild (1985) reported that people with Down's syndrome had a crossbite prevalence that was 6-times greater (69%) than the control group (12%).

Oreland *et al.* (1987) reported that crossbite was considerably more common in people with severe mental disability (12.2%) than in a control group (1.2%). Vittek *et al.* (1994) reported that children with moderate and severe mental disabilities were found to be approximately 2-times lower (14.2% and 17.1% respectively) than in persons with mild mental retardation (27%).
A study carried out on disabled children in Riyadh (Adenubi *et al.,* 1997) agrees with the present study findings, as 10% of their sample had crossbite anteriorly and posteriorly.

6.6.2.4 Molar relation

No significant differences in the occurrence of malocclusion anomalies as determined by molar relation were noted between control children and study children. The prevalence of class II and class III molar classifications among VI children, as noted in this study, were comparable to those noted in the studies of Greeley *et al.* (1976) and Meyer (1980). However, the prevalence of a Class I molar relation was low in Meyer's report compared to the present study.

Comparison of occlusal classification

Studies	Class I (%)	Class II (%)	Class III (%)
Greley *et al.,* 1973	55	21	5
Meyer, 1980	33	22	7
Present study	58.5	31.2	10.4

There is no indication that the sensory impaired groups (VI) differed significantly from the control group as reported by Meyer (1980). However other studies have confirmed that people with disability exhibited more Class III molar relation than the control group. Gullikson (1973), found that his "Mongoloid" group (50%) had a greater tendency for Class III molar relation than the controls (5.7%). Also, a study by Vigilid (1985) reported that people with "Down's syndrome" had an increase of Class III malocclusion. This was supported by Vittek *et al.* (1994) who concluded that people with "Down's syndrome" (36.5%) had a greater tendency for Class III than the control group (5%).

Parkin *et al.* (1970) reported that people with cerebral palsy have a tendency for Class II molar relation. Given that degrees of muscle tonicity and involuntary movements of structures may influence dental arches, children with cerebral palsy were found to present with a high prevalence of Class II division 1 malocclusion (Kanar, 1979).

A higher incidence of Class I and II malocclusion in people with Autism (56.3%, 18,8% respectively) when compared to a control group (20%, 5% respectively) has been reported by Vittek *et al.* (1994).
Many researches cite a tendency to Class II molar relation among people with physical disability when compared to control groups (Strodel, 1987; Pope and Curzon, 1991).

Greeley *et al.* (1976) discovered during examination that children with visual impairment had depressed orbital fossae which can be indicative of deficiency of the facial mid-third. In the present study, children who had been born with visual impairment may have some deficiency of the facial mid-third which may account for a possible Class III relation among these children (10.4%).

It is of interest that, as the prevalence of Class II molar relation was high among the VI children in comparison to control and HI children, it was equally distributed between the males and females. These findings were different to those of Vittek *et al.* (1994) who demonstrated Class II prevalence to occur more often among males (40.5%) than females (11%).

It is apparent that the estimate of Class II molar relation among VI children decreased with older age groups. This result is similar to the study published by Vittek *et al.* (1994). However, it was opposite for HI children where the prevalence increased in the older age groups.

6.6.3 Orthodontic treatment needs of the children

"Orthodontic treatment aims to improve function by correction of irregularities and to create not only greater resistance to disease, but also to improve personal appearances, which later will contribute to the mental as well as to the physical well-being of the individual" (Shaw, 1981).
Orthodontic treatment need has not been previously investigated in sensory impaired children as well as a Saudi population using IOTN. The present data permit the first comparison with other studies where a similar index has been used.

6.6.3.1 Dental Health Component

Using the IOTN (DHC) index, a calibrated examiner found that 13.2% of controls, 15.6% of VI children and 16.5% of HI children showed a moderate/borderline need for treatment while, 9.2%, 11.7% and 13.5% of the children respectively showed a definitive need. The sensory impaired children showed a greater tendency for treatment need than control children. Thirty percent of HI children and 27.3% of VI children needed treatment compared to 22.4% of controls.

Several studies based on British populations found the need for treatment to be around 30% of the population. Brook and Shaw (1989), in a cross-sectional study in Manchester, found a similar percentage of children (32.7%) in need for treatment. Holmes (1992), also reported a similar finding (32%) in a survey of Sheffield school children and Burden *et al.* (1995) assessed 15-16 year old British children, where 30% were in need of treatment. In a Finnish population (Pietila and Pietila, 1996), 20% of samples were in need for treatment based upon DHC.

However, other studies had found a higher need for treatment than in the present study. Using the Office of Population Censuses and Surveys IOTN (DHC) 1993,

data for children's dental health in the United Kingdom, it was found that 48.5% of the UK sample needed treatment (O'Brien, 1994).

The proportion of 11-12 year olds in need of orthodontic treatment in Northern Ireland was found to be 36% (Burden, 1995). The large variation in results is further exampled by a Nigerian population (Otuyemi *et al.,* 1997), where it was found that 38.5% needed treatment. In the United States, Kelly and Harvey (1977) using TPI scores to interpret the USPHS (1966-1970) data for 12-17 year old children concluded that 13% had conditions for which treatment was highly desirable and 16% for which treatment was mandatory. It is difficult to directly compare this study with the USPHS study however there is some similarity to present study sample.

The proportion of 14-15 year old children from schools of Manchester, UK, in need for treatment was found to be 52% (Mandall *et al.,* 1999).

6.6.3.2 Examiner's assessment of dental attractiveness

The examiner model score for the three groups was in the attractive end of the IOTN AC (control 2, VI 1, HI 3) as shown in Tables 6.15 and 6.16. Using the categories of treatment need (Richmond *et al.,* 1995), 60.6% of control children, 57% of HI children and 44.2% of VI children had an appearance where the treatment required was either slight or not indicated according to the AC (≤ 4). 33.4% of controls, 39% of VI children and 37.7% of HI had a moderate/borderline need for treatment (AC 5-7) while 6%, 16.8% and 5.3% respectively were considered to be in definitive need for orthodontic treatment (AC 8-10). The cross-tabulation between different groups and the examiner's aesthetic assessment showed that VI children rated the higher treatment need followed by HI children.

The study results indicated that 39.4% of control, 55.8% of VI children and 43% of HI children had an objective need for orthodontic treatment based on IOTN AC. For the study groups, this figure is high compared to previous studies. In a Nigerian population (Otuyemi *et al.,* 1997) found that 33.6% of the sample needed treatment. A group of 14-15 year old children in Manchester schools

(Mandall *et al.,* 1999) had 28% need for orthodontic treatment based on AC. Pietila and Pietila (1996), reported 22% of treatment need for their 15-16 year old Finnish group based upon the AC.

A χ^2 trend between the AC and DHC scores based on examiner's rating were highly significant in the control (p = 0.001), VI (p = 0.006) and HI groups (p = 0.006). There seems to be a discrepancy in the proportion of children needing orthodontic treatment on aesthetic and dental health grounds. Many more children had malocclusion where orthodontic need was considered definite on aesthetic grounds as compared with dental health. This is probably due to the presence of occlusal traits which have implications on facial attractiveness but do not cause any oral health effect (example, diastema). Also, the DHC score is based on a grade assigned to the worse single occlusal trait which makes it an easy and reliable index to use but ignores the cumulative effect of a number of less severe occlusal deviations (Crowther *et al.,* 1997). As a result, it may underestimate the severity of a malocclusion in some individuals (O'Brien *et al.,* 1996).

The regression analysis revealed that age groups and social class of children did not influence examiner score on AC. However, for sensory impaired group, males had a higher orthodontic treatment need on AC grounds (p = 0.033). This was in agreement to Otuyemi *et al.* (1997) where males had higher orthodontic treatment need than females.

6.6.3.3 Normative and Perceived levels of dental attractiveness using AC

Most people undergo orthodontic treatment to improve their dental appearance. Their major concerns on presentation relate to aesthetics rather dental health or function (Tulloch *et al.,* 1984; Shaw *et al.,* 1991). Thus self-perception of dental appearance is an important factor in the individual's decision to obtain orthodontic treatment and is of importance in determining the subsequent level of cooperation during treatment.

The results showed that the average scores by examiner to be lower than those control and HI children for the IOTN AC category but higher than VI children (Tables, 6.15 and 6.16, 6.23 and 6.24). When the data were analysed using the treatment need categories (Table 6.17 and 6.25) the control and HI children scored themselves as less need for treatment than did the examiner, which is consistent with the findings of Lindsay and Hodgkins (1983) and Burden and Pine (1995). However, for VI children, they scored themselves with more need for treatment than did the examiner. Overall, therefore, the examiner (Fig. 6.1), found that control and HI children perceived themselves with less need for treatment than the examiners but that was reversed for VI children. This could be due to higher clinical need for orthodontic treatment such that they tend to perceive themselves as worse off than their peers with a lower need (Mandall *et al.,* 1999). The VI children data were in agreement to Tickle *et al.* (1999), where one-quarter of their sample had a normative need for treatment and one-third a perceived need for treatment.

One of the difficulties with any such scale lies in making what is an essentially subjective interpretation. The IOTN AC represents an attempt to make the judgement more objective. The examiner had also been trained and calibrated in use of the index and had achieved substantial agreement (Weighted Kappa score of 0.77). The effect of subjectivity on behalf of the examiner is also nullified when the χ^2 trend test is used, as this compares the differences in numbers of under and over scores and agreement with the examiner, between groups. The VI group tends to over score by 4-folds to the examiner in comparison to an under score by 1-fold for the control and HI groups.

The model perceived score for both genders was in the no treatment need category ($AC \leq 4$) for controls and HI children while in the definitive treatment need for males VI (AC 8-10) (Table 6.28).

In terms of treatment need, there was no gender difference in control children but for the study groups, males perceived themselves as requiring some treatment need compared to females. This finding is similar to that of Brown *et al.* (1987)

and Otuyemi *et al.* (1997) who concluded that males were more likely to seek orthodontic treatment. However, this finding differs from that of the Roberts *et al.* (1989) and Homles (1992) where females had a higher level of subjective treatment need and demand than males.
On the other hand, as prevalence of malocclusion in control children is the same in both genders, so there is no influence on the perception of malocclusion when subjects grade their own IOTN AC (Burden and Pine, 1995).

The model perceived score of female and male (Table 6.28) with the examiner's mode (Table 6.18) again was higher for both genders among the control and HI groups but lower among the VI group. There were statistically significant differences between different genders in the control and HI groups for treatment need with the examiner's rating when McNemar test was carried out (Table 6.33). Female and male controls as well as HI children tended to under score their need for treatment compared to the examiner scoring, however, for the VI group, the children's self-perception and examiner's scoring were in close agreement.

The modal perceived score for children age groups (11-16 years) was in the no treatment need category (IOTN AC $\leq$ 4) for controls and HI children while in the definitive treatment need for VI children aged 11-14 years (Table 6.29). There was no statistically significant difference among the three groups in relation to treatment need. This was in agreement with the work of Searcy and Chisick (1994), who found no difference in perception or objective assessment of dental attractiveness between younger and older subjects. However, another study has tended to demonstrate an increasing awareness of appearance with age, peaking mid-teenage (Shaw *et al.,* 1991).

The model perceived score of children (Table 6.29) compared to the examiner's mode (Table 6.19) again showed over scoring for all age groups among the control and HI group but similar scoring for the VI group and that was statistical significant through using McNemar test (Table 6.33).

The modal perceived score for control and HI children in relation to social class was in "no treatment need" category while in "definite treatment need" for VI children except in the upper class which was in no treatment need category. As mentioned before VI children tended to perceive treatment need more than the control and HI children, and this was also true when considering social class. Meanwhile HI children from upper social class tend to perceive treatment need more than the control children.

One interesting fact revealed by this study is that there was no predominance of social class effect on the treatment uptake of the children. This was explained by using logistic regression analysis performed on normative and perceived measure of need as the dependent variable and the social class (on a 3-points scale) and whether or not a child had been in receipt of orthodontic treatment as independent variables. The result showed social class to have insignificant independent effect on treatment uptake. This was in contrast to other studies (Kenealy *et al.,* 1989; Tickle *et al.,* 1999) which have reported that the need for orthodontic treatment was more common amongst deprived children. However, it is consistent with other findings by Shaw *et al.* (1991) and Burden and Pine (1995) failed to reveal a relationship between self-perception and social class.

The model perceived score of the children (Tables 6.20 and 6.21) compared to the examiner's mode (Tables 6.30 and 6.31) again showed over scoring for control and HI children among different social classes. However, for VI children, there was no statistical significant difference through using McNemar test (Table 6.33). The VI group result was consistent with data reported from Kenealy *et al.* (1989), Shaw *et al.* (1991), Burden and Pine (1994), and Searcy and Chisick (1994) who found no difference in the perceived level of attractiveness across social class groups. Meanwhile, the Black report of 1980 and the report of its findings reviewed by Macintyre (1997) stated that there is a higher uptake, awareness, eagerness and demand with respect to health provision among middle class families. Gray *et al.* (1970) noted similar findings with respect to dental services.

The regression analysis revealed that sensory impaired children who had mild-moderate impairment and lost their sensory sense after birth (minimum 2 years), perceived dental aesthetics as more attractive than severely impaired children or those that lost the sense during birth.

6.6.4 Children's interview

"A factor that may influence the desire for orthodontic treatment, is a positive relationship between the objective severity of the visible irregularity and the desire for orthodontic treatment" (Shaw, 1981).

The VI children who thought their teeth were crooked or protruded, had a greater tendency to perceive a need for orthodontic treatment compared to the control and HI children (Fig. 3 and 4).

However, translation of IOTN (AC) categories into so called treatment need categories may be less valid in this context. For this reason, children were interviewed for their believes on needing treatment. VI children who had thought they needed treatment coincided with their perceived treatment need. However, VI children who thought their teeth were crooked or protruding had perceived greater for treatment need than the control and HI children.

VI children (61%) who thought their needed treatment was objectively rated for treatment based upon the examiner's normative (55.8%) and to their perceived (65%) treatment need (AC). However, the control (55.3%) and HI (56.7%) children over score the examiner by 2-folds (39.5% and 43%, respectively) and by 3 to 4-folds (21.8% and 18.3%, respectively) to their perceived treatment need.

Although the children had thought a greater need for treatment in their interview in relation to examiner's assessment based upon DHC, there was no difference in the three groups.

6.6.5 Parent questionnaire

"Among the factors that may influence the desire and decision to embark upon orthodontic treatment, is the parents' perception of their children's malocclusion and their views" (Shaw, 1981).

It is difficult to validate the questionnaire used in the evaluation of subjective need and demand for orthodontic treatment because differences in question wording and question response options will affect the results.

There was similarity in the control and HI parents' response who thought their children's teeth were crooked or protruded. However for VI parents, the proportion of parents who reported that their children had protruding teeth was more than crooked teeth. Data from the Child Dental Health survey (O'Brien, 1994) was in agreement to the VI parent data where parents thought their children had more crooked (67%) teeth than protruding (37%) teeth.

Parents' attitude to the appearance of children's teeth was assessed in relation to the examiner's assessment of AC scores (Table 6.345). VI parents who thought their children had crooked teeth were more in the treatment need category (AC 5-10) and especially the definitive treatment category (46.2%), as assessed by the examiner, followed by control (8.3%) than HI parents (6.7%). However, for protruded teeth, all the three groups children's parent were close in their opinion in relation to perceived dental treatment need as all the three groups parents were in the treatment need categories (C 63.9%, VI 63.2%, HI 57.1%). Only the VI parents thought their children had crooked or protruded teeth that reached the highest score of AC (10). It can be concluded that parents who thought their children had abnormal teeth alignment were in the treatment categories as assessed by the examiner.

The parents' view of their children's need for orthodontic treatment was higher among the VI parents (64.3%) followed by the HI parents (54.4%) and the control

parents (50.5%). The data from Child Dental Health survey was in contrast to the present study where over three quarters of parents (77%) of 15-year olds thought that their child's teeth were acceptable with no need for treatment, however, 29% thought they needed treatment.

Parents' views on the need for orthodontic treatment were related to the assessments of treatment need from dental examination (DHC). There was a difference between the control and VI parents to the extent assessed by the dentist as having no treatment need. Of control parents in the groups assessed as no need for treatment by the examiner, 22% felt that their children should have teeth straightened compared to 23.7% for HI parents and 37.8% for VI parents. This rose to 32.1% among control parent and 28.9% among HI parent but dropped to 36.1% for VI parent.

On the other hand, definite treatment need category, 12.8% of control parents, 24.9% of HI parent and 28% of VI parents assessed as being in the treatment need category felt that their children's teeth were acceptable. As the category of very great need for treatment includes conditions which are not visibly noticeable, such as impacted teeth, it is not surprising that many parents of children in this category saw no need for their children to undergo orthodontic treatment.

The parents expressed view that orthodontic treatment was needed more frequent than the children in the control and the HI groups which supports the finding by Lewit and Virolainen (1968) and Birkeland *et al.* (1996) that, parental concern is the most powerful single factor in the motivation for treatment.

More control parents (36%) who their children assessed as having great need for treatment felt their children would like to have the treatment compared to 28% of VI parents and 25.6% of HI parents.

From logestic regression model it can be concluded that, parents were aware of their child's teeth appearance and its relation for treatment need and that

confirmed that aesthetic had a determining role in seeking any orthodontic treatment. One interpretation of this result might be that adults are more aware of their own malocclusion if it manifests in the anterior region (Helm *et al.,* 1985; Espland and Stenvik, 1991).

Data on the parents' views of their children's concerns for reasons not to have orthodontic treatment were similar between the three groups. However for dental appearance, VI parents thought that their children would not be concerned by their dental appearance. Although government dental health services are free or require a minimum payment in Saudi Arabia, almost three-quarters of the three groups parents thought that orthodontic treatment is expensive. Almost half of the parents thought it difficult to obtain orthodontic treatment, or that their children would find it difficult to cope with the treatment.

Data on parents' views of why their dentists might not provide treatment were closely similar among the three groups except that parents of VI children were more likely to think that dentists would not provide treatment because of the child's neglect of his/her dental appearance. Almost three-quarters of parents of all three groups thought that their dentists would not provide treatment for their children due to fees being too expensive for the parent and almost half of them thought their dentist would not offer treatment due to the difficulty of the children coping with the treatment.

6.7 Conclusion

The sample included 11-16 year old children from Al-Amal, Al-Nour Institutes and 4 primary and eight secondary schools in Riyadh, Saudi Arabia. Assessment of the malocclusion and orthodontic treatment need was carried out by the examiner. The examination used the IOTN (AC and DHC) and the tactile graphic version of AC for VI individuals as an assessment of the orthodontic treatment need of study sample.

The data collected from the present study have shown that the prevalence of malocclusion for the study groups as well as the control group were similar.

It can be concluded that there was no significant difference between the three groups in treatment need based on IOTN DHC (27.3% of VI, 30% of HI and 22.4% of control). However, for examiner's AC, more VI children rated for treatment need than control and HI children. Assessing the treatment need categories, the examiner found that the VI children perceived the need for treatment need more than the control and HI groups as compared to the examiner normative treatment need assessment.

The control and HI children perceived less treatment need than VI children and that was statistically significant when related to gender, age group and social class. The orthodontic treatment need based on children's attractiveness showed a different rank between the control group and the study groups as well as between the study groups themselves. The control group was always ranked as number one followed by HI than VI children.

There was a significant difference between the perceived and normative levels of dental attractiveness and treatment need in the control and HI samples. The control and HI children consistently rated their dentitions as being more attractive and less need for treatment than the examiner had scored them. However, for VI subjects, there was consistent agreement with the examiner's scoring.

There were no statistically significant detectable differences in perception within the groups of age and social classes. However, for normative dental attractiveness, control males had normative treatment needs greater than females. Sensory impaired children with mild-moderate impairment and who had lost their sensory sense after birth, perceived themselves as attractive more than children who were severe-complete impaired and who had lost their sensory sense during birth.

Although the children's responses to the interview were similar between groups, VI who thought their teeth to be are crooked or protruded were more in the definitive need group than control and HI children. Also, children who responded that they needed treatment, VI children perceived themselves more in definitive treatment need than control or HI children.
VI children who thought they had crooked or protruding teeth, consistently related to their perceived treatment need, the normative treatment need and their views on having the treatment.

Parents who responded that their child's teeth were crooked were similar among the groups, however, control and HI children were perceived more at this attractive end of the IOTN scale compared to VI children. More parents of VI and HI children believed that their children's teeth were alright compared to control parents. More parents of the control group believed that their children were not concerned about their appearance compared to HI and VI children. The parents believed that their child did not receive treatment on the basis of being difficult to cope, difficultly in obtaining treatment and that treatment was thought to be expensive.

6.8 Principal findings

6.8.1 Malocclusion

- The majority of children in all three groups (61.8%-65%) had an overjet measurement in the range 1-3/mm.
- The majority of children (81%-85.7%) had overbites in the range of 1-3mm.
- The minority of children in all three groups (13%-22.1%%) had a crossbite tendency.
- The majority of all children (55-59%) had a Class I molar relationship. 22.2-31.2% of the three groups had tendency for Class II, while 10.4%-21.7% had tendency for Class III.

6.8.2 Orthodontic treatment need

6.8.2.1 Dental Health Component

The three groups were similar in DHC categories 1, 2, 3, and 5, but were different in category 4, which contained 1.9% of controls but 5.2% of VI children and 4.8% of HI children.

6.8.2.2 Examiner's normative assessment of dental attractiveness

- More control children were rated as 1 (most attractive) (60.6%) than VI children (44.2%). The reverse was true for the lowest ratings of 5, 8, and 10.
- More controls were rated as 2 (27.5%) than HI children (16%), more HI children were rated as 4 (16.4%) than controls (12.6%), and more HI children were rated as 6 (10.6%) than controls (8.7%).
- Comparison between the examiner's and the children's own ratings showed that VI children tended to give themselves lower ratings (into categories reflecting need for treatment) (65%) than the examiner (55.8%).

6.8.2.2 Child's perceived dental attractiveness

- More control and HI children rated themselves as 1 (most attractive) but less for VI children.
- VI children tend to over score the examiner by 4-folds while by 1-fold for control and HI children.
- More male sensory impaired children percieved a need treatment than female.
- Female and male VI children tend to score for treatment need than control and HI children.
- VI children aged 11-16 years tend to percieve a need for treatment more than control and HI children while 11-12 year HI children tend to perceive treatment need more than control.
- VI children from upper to lower social classes tend to percieve a need for treatment more than control and HI children while only HI children from upper tend to perceive treatment need more than control.
- Sensory impaired children who had mild-moderate impairement and who had lost their sense after birth, scored more towards the most attractive end of AC.
- Differences between the examiner and the children reached sigificance only in control and HI children where they under scored the exmainer rating for treatment.

6.8.3 Children's interviews

- VI children who thought their teeth were crooked or protruding, they percived themselves as having a greater need for treatment than control and HI children.
- VI children (61%) who thought their needed treatment were objectively rated for treatment based upon the examiner's normative (55.8%) and their perceiving (65%). However, the control (55.3%) and HI (56.7%) children over score the examiner by 2-folds (39.5% and 43%, respectively) and by 3-4-folds (21.8% and 18.3% respectively) with their perceived treatment need.

6.8.4 Parent questionnaire

- Among children who were rated by the examiner as having a great treatment need (in the range 8–10), more parents of VI children than parents of control and HI children thought their children's teeth were crooked.
- More of VI parents followed by HI and control parents thought their children needed treatment.
- Based upon treatment need according to DHC, more control parents thought their children's teeth were correct followed by HI and VI parent.
- VI parents tend to beliefe more that their children do not concern about their teeth apperance.
- The parents of all three groups thought that orthodontic treatment was expensive and that was confirmed in that the dentists felt the parent would not be able to pay for the treatment.

Table 6.1 Size of incisor overjet

Overjet	No. (%) of children with overjet C	VI	HI
Negtive- 0	32 (6.6)	3 (3.9)	12 (5.8)
1-3/mm	314 (65)	47 (61)	128 (61.8)
4mm-over	137 (28.4)	27 (35.1)	67 (32.4)

Kruskal-Wallis test, $p = 0.283$, three groups

Table 6.2 Size of incisor overjet, by gender

	No. (%) of children Control		VI		HI	
Gender	**F**	**M**	**F**	**M**	**F**	**M**
Negative- 0	15 (5.9)	17 (7.4)	1 (2.6)	2 (5.1)	6 (4.8)	6 (7.3)
1-3/mm	171 (67.6)	143 (62.2)	24 (63.2)	23 (59)	80 (64)	48 (58.5)
4/mm-over	67 (26.5)	70 (30.4)	13 (34.2)	14 (35.9)	39 (31.2)	28 (34.2)

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Table 6.3 Size of incisor overjet, by age

	No. (%) of Children								
	Control			VI			HI		
Overjet	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**
Negative- 0	11 (5.3)	14 (6.8)	7 (10.3)	2 (8.7)	0.0	1 (7.1)	2 (3.7)	8 (8.2)	2 (3.6)
1-3/mm	131 (63)	135 (65.2)	48 (70.6)	14 (60.9)	25 (62.5)	8 (57.1)	31 (57.4)	59 (60.2)	38 (69.1)
4/mm-over	66 (31.7)	58 (28)	13 (19.1)	7 (30.4)	15 (37.5)	5 (35.8)	21 (38.9)	31 (31.6)	15 (27.3)

Table 6.4 Size of incisor overbite

Overbite	No. (%) of children with overbite C	VI	HI
Negative	12 (2.5)	0.0	2 (1)
Zero	22 (4.6)	3 (3.9)	10 (4.8)
1-3/mm	391 (81)	66 (85.7)	176 (85)
4- > 4/mm	58 (12)	8 (10.4)	19 (9.2)

Kruskal-Wallis test, $p = 0.830$, three groups

Table 6.5 Size of incisor overbite, by gender

	No. (%) of children Control		VI		HI	
Overbite	**F**	**M**	**F**	**M**	**F**	**M**
Negative	10 (4)	2 (0.9)	0.0	0.0	0.0	2 (2.4)
Zero	6 (2.4)	16 (7)	1 (2.6)	2 (5.1)	6 (4.8)	4 (4.9)
1-3/mm	212 (83.8)	179 (77.8)	35 (92.1)	31 (79.5)	113 (90.4)	63 (76.8)
4->/4mm	25 (9.9)	33 (14.3)	2 (5.3)	6 (15.4)	6 (4.8)	13 (15.9)

Table 6.6 Size of incisor overbite, by age

	No. (%) of Children								
	Control			VI			HI		
Overbite	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**
Negative	3 (1.4)	6 (2.9)	3 (4.4)	0.0	0.0	0.0	0.0	1 (1)	1 (1.8)
Zero	10 (4.8)	8 (3.9)	4 (5.9)	2 (8.7)	0.0	1 (7.1)	2 (3.7)	7 (7.1)	1 (1.8)
1-3/mm	167 (80.3)	168 (81.2)	56 (82.4)	20 (87)	33 (82.5)	13 (92.9)	48 (88.9)	77 (78.6)	51 (92.7)
4-> 4/mm	28 (13.5)	25 (12)	5 (7.3)	1 (4.3)	7 (17.5)	0.0	4 (7.4)	13 (13.3)	2 (3.7)

Table 6.7 Presence of crossbite

Crossbite	No. (%) of children with crossbite C	VI	HI
Presence of crossbite	72 (14.9)	17 (22.1)	27 (13)
Anterior	62 (12.8)	14 (18.2)	24 (11.6)
Posterior	40 (8.3)	8 (10.4)	13 (6.3)

$\chi^2 = 3.61, p = 0.164$, for presence of crossbite, three groups
$\chi^2 = 2.19, p = 0.334$, for presence of anterior crossbite, three groups
$\chi^2 = 1.48, p = 0.475$, for presence of posterior crossbite, three groups

Table 6.8 Presence of crossbite, by gender

	No. (%) of children Control		VI		HI	
Crossbite	**F**	**M**	**F**	**M**	**F**	**M**
Anterior	38 (15)	24 (10.4)	6 (15.8)	8 (20.5)	10 (8)	14 (17.1)
Posterior	22 (8.7)	18 (7.8)	2 (5.3)	6 (15.4)	5 (4)	8 (9.8)

Table 6.9 Presence of crossbite, by age

	No. (%) of Children								
	Control			VI			HI		
Crossbite	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**
Anterior	24 (11.5)	28 (13.5)	10 (14.7)	4 (17.4)	6 (15)	4 (28.6)	8 (14.8)	13 (13.3)	3 (5.5)
Posterior	12 (5.8)	21 (10.1)	7 (10.3)	4 (17.4)	4 (10)	0.0	4 (7.4)	7 (7.1)	2 (3.6)

Table 6.10 Molar relation in the three groups

Molar relation	No. (%) of children C	VI	HI
Class I	287 (59.4)	45 (58.5)	114 (55.1)
Class II	107 (22.2)	24 (31.2)	48 (23.2)
Div 1	102 (95.3)	18 (75)	38 (79)
Div 2	2 (2)	2 (8.3)	2 (4)
Class III	89 (18.4)	8 (10.4)	45 (21.7)

Kruskal-Wallis test, $p = 0.411$, three groups

Table 6.11 Molar relation, by gender

	No. (%) of children Control		VI		HI	
Molar relation	**F**	**M**	**F**	**M**	**F**	**M**
Class I	167 (66)	120 (52.2)	23 (60.5)	22 (56.4)	75 (60)	39 (47.6)
Class II	51 (20.2)	56 (24.3)	12(31.6)	12 (30.8)	26(20.8)	22 (26.8)
Class III	35 (13.8)	54 (23.5)	3 (7.9)	5 (12.8)	24 (19.2)	21 (25.6)

Table 6.12 Molar relation, by age

	No. (%) of Children								
	Control			VI			HI		
Molar relation	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**
Class I	126 (60.6)	120 (58)	41 (60.3)	15 (65.3)	22 (55)	8 (57.1)	34 (63)	50 (51)	30 (54.5)
Class II	49 (23.6)	49 (23.7)	9 (13.2)	5 (21.7)	17 (42.5)	2 (14.3)	11 (20.4)	21 (21.4)	16 (29.1)
Class III	33 (15.8)	38 (18.4)	18 (26.5)	3 (13)	1 (2.5)	4 (28.6)	9 (16.6)	27 (27.6)	9 (16.4)

$\chi^2 = 9.83, p = 0.007$, C vs VI, 13-14

Table 6.13 DHC scores of the children

DHC	No. (%) of children		
	Control	VI	HI
1	156 (32.3)	27 (35)	58 (28)
2	219 (45.3)	29 (37.7)	87 (42)
3	64 (13.2)	12 (15.6)	34 (16.5)
4	9 (1.9)	4 (5.2)	10 (4.8)
5	35 (7.3)	5 (6.5)	18 (8.7)

Kruskal-Wallis test, $p = 0.163$, three groups

Table 6.14 DHC scores, by category of treatment need

Treatment need	DHC	No. (%) of children		
		Control	VI	HI
No need treatment	1, 2	375 (77.6)	56 (72.7)	145 (70)
Moderate/ Borderline	3	64 (13.2)	12 (15.6)	34 (16.5)
Need for treatment	4, 5	44 (9.2)	9 (11.7)	28 (13.5)

Kruskal-Wallis test, $p = 0.083$, three groups

Table 6.15 Examiner's rating level of dental attractiveness (AC) by group

AC	No. (%) of children Control (group)	VI	HI
1	293 (60.6)	34 (44.2)	118 (57)
5	161 (33.4)	30 (39)	78 (37.7)
8	29 (6)	9 (11.6)	11 (5.3)
10	0.0	4 (5.2)	0.0

Kruskal-Wallis test, $p = 0.005$, three groups
Mann-Whitney test, $p = 0.001$, C vs VI
Mann-Whitney test, $p = 0.011$, VI vs HI

Table 6.16 Examiner's rating level of dental attractiveness (AC) of control and HI children

AC	No. (%) of children Control	HI
1	1 (0.2)	1 (0.5)
2	133 (27.5)	33 (16)
3	98 (20.3)	50 (24.1)
4	61(12.6)	34 (16.4)
5	97 (20.1)	46 (22.2)
6	42 (8.7)	22 (10.6)
7	22 (4.6)	10 (4.8)
8	21 (4.4)	4 (2)
9	8 (1.6)	7 (3.4)
10	0.0	0.0

Mann-Whitney test, $p = 0.046$, C vs HI

Table 6.17 Examiner's rating level of dental attractiveness (AC) according to treatment need

AC	No. (%) of children Control (group)	VI	HI
1-4	293 (60.6)	34 (44.2)	118 (57)
5-7	161 (33.4)	30 (39)	78 (37.7)
8-10	29 (6)	13(16.8)	11 (5.3)

Kruskal-Wallis test, $p = 0.006$, for three groups
Mann-Whitney test, $p = 0.001$, C vs VI
Mann-Whitney test, $p = 0.013$ VI vs HI

Table 6.18 Examiner's rating level of dental attractiveness (AC) of children according to treatment need, by gender

	No. (%) of children					
	Control		VI		HI	
AC	**F**	**M**	**F**	**M**	**F**	**M**
1-4	157 (62.1)	136 (59.1)	18 (47.4)	16 (41)	80 (64)	38 (46.3)
5-7	81 (32)	80 (34.8)	13 (34.2)	17 (43.6)	44 (35.2)	34 (41.5)
8-10	15 (5.9)	14 (6.1)	7 (18.4)	6 (15.4)	1 (0.8)	10 (12.2)

$\chi^2 = 15.32, p < 0.001$ for HI
$\chi^2 = 8.05, p = 0.018$, Female C vs VI
$\chi^2 = 6.52, p = 0.038$, Male C vs VI
$\chi^2 = 19.78, p < 0.001$, Female VI vs HI

Table 6.19 Examiner's rating level of dental attractiveness (AC) of children according to treatment need, by age

	No. (%) of Children								
	Control			VI			HI		
AC	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**
1-4	129 (62)	128 (61.8)	36 (52.9)	9 (39.1)	18 (45)	7 (50)	31 (57.4)	55 (56.1)	32 (58.2)
5-7	68 (32.7)	68 (32.9)	25 (36.8)	10 (43.5)	17 (42.5)	3 (21.4)	20 (37)	37 (37.8)	21 (38.2)
8-10	11 (5.3)	11 (5.3)	7 (10.3)	4 (17.4)	5 (12.5)	4 (28.6)	3 (5.6)	6 (6.1)	2 (3.6)

$\chi^2 = 7.20, p = 0.027$, C vs VI, 11-12
$\chi^2 = 9.01, p = 0.011$, VI vs HI, 15-16

Table 6.20 Examiner's rating level of dental attractiveness (AC) of children according to treatment need, by father's occupation

	No. (%) of Children								
	Control			VI			HI		
AC	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**
1-4	73 (61.3)	185 (60.3)	31 (63.3)	4 (44.4)	24 (42.1)	4 (50)	11 (68.8)	67 (54)	21 (63.6)
5-7	37 (31.1)	107 (34.9)	15 (30.6)	5 (55.7)	20 (35.1)	4 (50)	5 (31.3)	49 (39.5)	12 (36.4)
8-10	9 (7.6)	15 (4.9)	3 (6.1)	0.0	13 (22.8)	0.0	0.0	8 (6.5)	0.0

$\chi^2 = 22.83, p < 0.001$, C vs VI, Middle class
$\chi^2 = 10.30, p = 0.006$, VI vs HI, Middle class

Table 6.21 Examiner's rating level of dental attractiveness (AC) of children according to treatment need, by mother's education

	No. (%) of Children								
	Control			VI			HI		
AC	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**
1-4	59 (64.1)	26 (63.3)	77 (56.2)	8 (53.3)	10 (50)	12 (42.9)	13 (59.1)	24 (53.3)	35 (58.3)
5-7	31 (33.7)	60 (30.2)	52 (38)	4 (26.7)	8 (40)	12 (42.9)	8 (36.4)	18 (40)	22 (36.7)
8-10	2 (2.2)	13 (6.5)	8 (5.8)	3 (20)	2 (10)	4 (14.2)	1 (4.5)	3 (6.7)	3 (5)

$\chi^2 = 9.20, p = 0.010$, C vs VI, Upper class

Table 6.22 Result of logistic regression of Examiner's rating level of dental attractiveness according to need or no need for treatment when sensory impaired children included: regression coefficient (b), standard error (SE), significance (*p*), Odds Ratio (OR) with 95% Confidence Interval (CI) for OR

Variable	**b**	**SE**	***p***	**OR**	**95% CI**	
Gender	0.65	0.30	0.033	1.91	1.05	3.5

Table 6.23 Children's perceived dental attractiveness (AC), comparing control, VI and HI groups

	No. (%) of children		
AC	**Control**	**VI**	**HI**
1	393 (81.3)	27 (35)	161 (78.2)
5	49 (10.2)	17 (22)	34 (16.5)
8	39 (8.1)	24 (31.3)	11 (5.3)
10	2 (0.4)	9 (11.7)	0.0

Kruskal-Wallis test, $p < 0.001$, three groups
Mann-Whitney test, $p < 0.001$, C vs VI
Mann-Whitney test, $p < 0.001$, VI vs HI

Table 6.24 Children's perceived level of dental attractiveness (AC), comparing control and HI groups

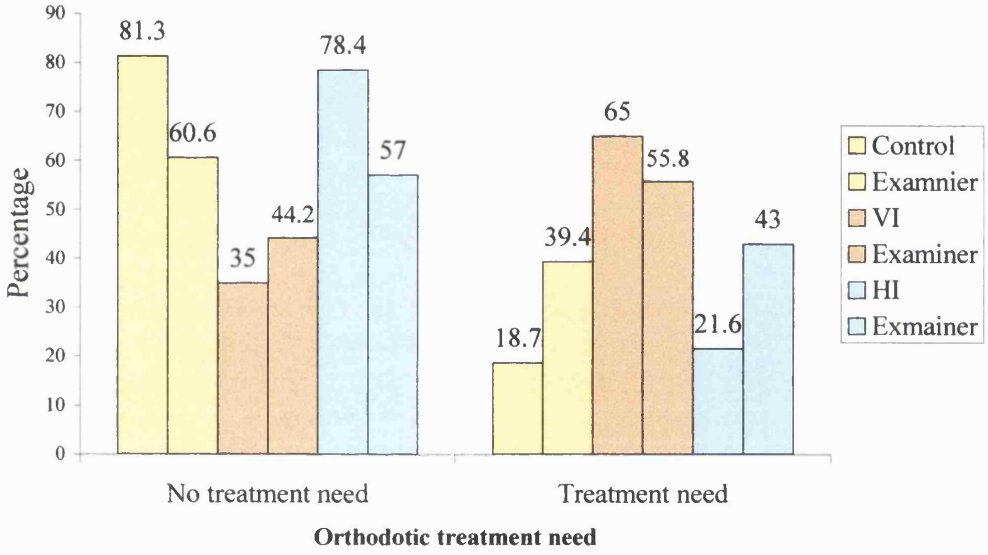
	No. (%) of children	
AC	Control	**HI**
1	134 (27.7)	64 (31.2)
2	114 (23.6)	37 (18)
3	85 (17.6)	32 (15.6)
4	60 (12.4)	28 (13.6)
5	21 (4.4)	17 (7.8)
6	14 (2.9)	7 (3.4)
7	14 (2.9)	10 (5)
8	28 (5.8)	7 (3.4)
9	11 (2.3)	4 (2)
10	2 (0.4)	0.0

Table 6.25 Children's perceived dental attractiveness (AC) according to treatment need

	No. (%) of children		
AC	**Control**	**VI**	**HI**
1-4	393 (81.3)	27 (35)	161 (78.2)
5-7	49 (10.2)	17 (22)	34 (16.5)
8-10	41 (8.5)	33 (43)	11 (5.3)

Kruskal-Wallis test, $p < 0.001$, three groups
Mann-Whitney test, $p < 0.001$, C vs VI
Mann-Whitney test, $p < 0.001$, VI vs HI

Fig. 6.1 Comparing Examiner-rated and Children Perceived levels of orthodontic treatment need



$p < 0.001$, C

$p < 0.001$, HI

Fig 6.2 Layout of the "Tree Diagram" for the χ^2 for trend test

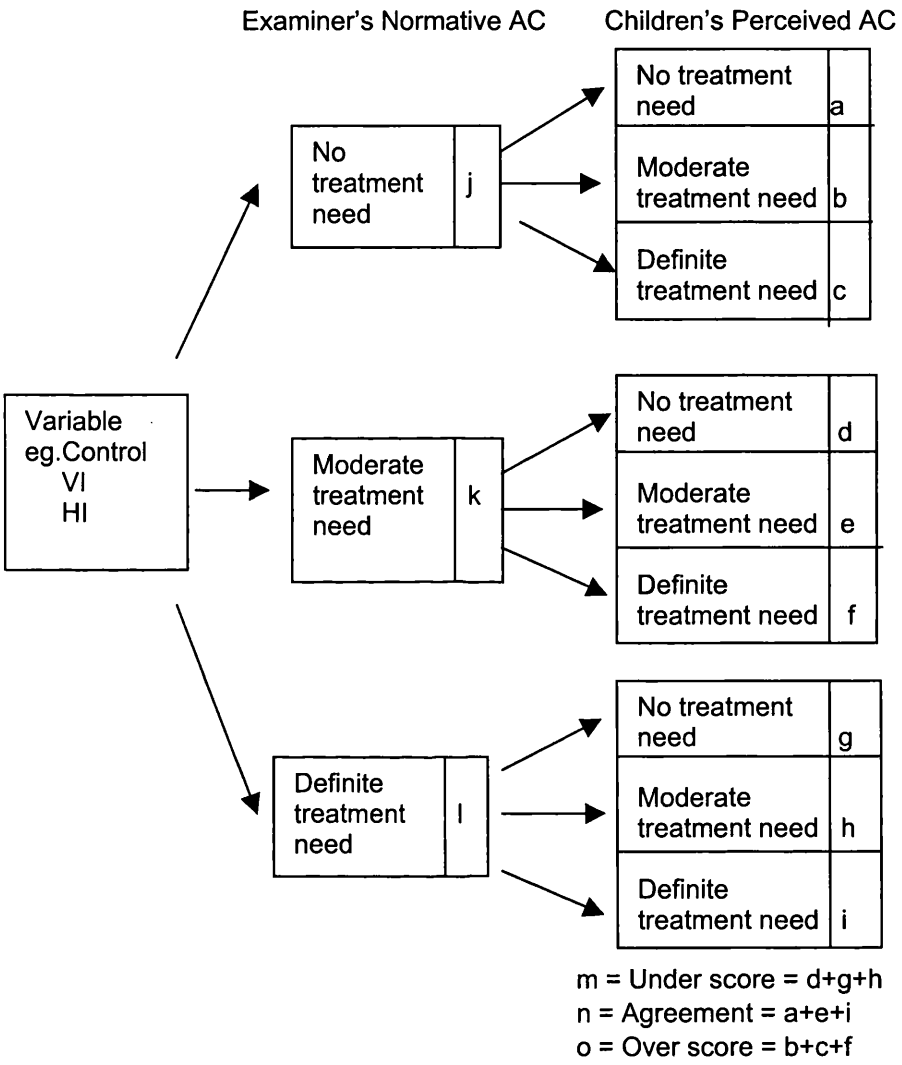


Table 6.26 Layout for χ^2 for trend Example using control and VI groups as the test variable

	Under score of IOTN AC	Agreement of IOTN AC	Over score of IOTN AC	Total
Control group	f_{11}	f_{12}	f_{13}	R_1
Test group (VI)	f_{21}	f_{22}	f_{23}	R_2
Total	C_1	C_2	C_3	n
Score for trend test	w_1	w_2	w_3	

$$\chi 2 = \frac{[\sum w_i f_{1i} - R_1 \underline{\sum w_i C_i}]^2}{\frac{R_1}{n}[1 - \frac{R_1}{n}]\{\sum C_i w_i^2 - n[\underline{\sum w_i C_i}]^2\}}$$

Table 6.27 Number of agreement between Examiner and Children in scoring for IOTN AC, comparing control and study group's children

	Under score IOTN AC (%)	Agreement IOTN AC (%)	Over score IOTN AC (%)	Total
Control	132 (27.3)	303 (62.7)	48 (10)	483
VI	13 (16.8)	33 (42.9)	31 (40.3)	77
HI	66 (32)	115 (55.8)	25 (12.2)	206

$\chi^2 = 27.49, p < 0.001$, C vs VI
$\chi^2 = 21.33, p < 0.001$, VI vs HI

Table 6.28 Children's perceived level of dental attractiveness (AC) according to treatment need, by gender

	No. (%) of children					
	Control		VI		HI	
AC	**F**	**M**	**F**	**M**	**F**	**M**
1-4	207 (81.8)	186 (80.8)	15 (39.5)	12 (30.7)	101 (81.5)	60 (73.1)
5-7	24 (9.5)	25 (10.9)	12 (31.6)	5 (12.8)	21 (16.9)	13 (15.9)
8-10	22 (8.7)	19 (8.3)	11 (28.9)	22 (56.5)	2 (1.6)	9 (11)

$\chi^2 = 6.87, p = 0.032$, VI
$\chi^2 = 8.74, p = 0.014$, HI
$\chi^2 = 32.74, p < 0.001$, Female, C vs VI
$\chi^2 = 62.20, p < 0.001$, Male, C vs VI
$\chi^2 = 37.30, p < 0.001$, Female, VI vs HI
$\chi^2 = 29.44, p < 0.001$, Male, VI vs HI

Table 6.29 Children's perceived level of dental attractiveness (AC) according to treatment need, by age

	No. (%) of Children								
	Control			VI			HI		
AC	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**	**11-12**	**13-14**	**15-16**
1-4	166 (79.8)	171 (82.6)	56 (82.4)	8 (34.8)	12 (30)	7 (50)	40 (74)	76 (78.4)	45 (81.8)
5-7	18 (8.7)	22 (10.6)	9 (13.2)	4 (17.4)	11 (27.5)	2 (14.3)	11 (20.4)	17 (17.5)	6 (10.9)
8-10	24 (11.5)	14 (6.8)	3 (4.4)	11 (47.8)	13 (32.5)	5 (35.7)	3 (5.6)	4 (4.1)	4 (7.3)

$\chi^2 = 25.23, p < 0.001$, C vs VI, 11-12
$\chi^2 = 53.77, p < 0.001$, C vs VI, 13-14
$\chi^2 = 13.25, p < 0.001$, C vs VI, 15-16
$\chi^2 = 6.98, p = 0.030$, C vs HI, 11-12
$\chi^2 = 19.92, p < 0.001$, VI vs HI, 11-12
$\chi^2 = 38.89, p < 0.001$, VI vs HI, 13-14
$\chi^2 = 8.53, p = 0.014$, VI vs HI, 15-16

Table 6.30 Children's perceived level of dental attractiveness (AC) according to treatment need, by father's occupation

	No. (%) of Children								
	Control			VI			HI		
AC	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**
1-4	98 (82.4)	249 (81.1)	41 (83.7)	4 (44.4)	20 (35.1)	1 (12.5)	11 (68.8)	101 (81.5)	26 (81.3)
5-7	10 (8.4)	33 (10.7)	5 (10.2)	2 (22.2)	11 (19.3)	4 (50)	5 (31.2)	19 (15.3)	5 (15.6)
8-10	11 (9.2)	25 (8.2)	3 (6.1)	3 (33.4)	26 (45.6)	3 (37.5)	0.0	4 (3.2)	1 (3.1)

$\chi^2 = 7.65, p = 0.022$, C vs VI, Upper class
$\chi^2 = 64.85, p < 0.001$, C vs VI, Middle class
$\chi^2 = 18.05, p < 0.001$, C vs VI, Lower class
$\chi^2 = 8.42, p = 0.015$, C vs HI, Upper class
$\chi^2 = 6.06, p = 0.048$, VI vs HI, Upper class
$\chi^2 = 55.26, p < 0.001$, VI vs HI, Middle class
$\chi^2 = 15.40, p < 0.001$, VI vs HI, Lower class

Table 6.31 Children's perceived level of dental attractiveness (AC) according to treatment need, by mother's education

	No. (%) of Children								
	Control			VI			HI		
AC	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**	**Upper**	**Middle**	**Lower**
1-4	79 (85.9)	160 (80.4)	111 (81)	7 (46.7)	8 (40)	9 (32.1)	19 (86.4)	32 (71.1)	49 (81.7)
5-7	8 (8.7)	18 (9)	17 (12.4)	3 (20)	2 (10)	6 (21.4)	1 (4.5)	11 (24.4)	9 (15)
8-10	5 (5.4)	21 (10.6)	9 (6.6)	5 (33.3)	10 (50)	13 (46.5)	2 (9.1)	2 (4.4)	2 (3.3)

$\chi^2 = 14.81, p < 0.001$, C vs VI, Upper class
$\chi^2 = 23.86, p < 0.001$, C vs VI, Middle class
$\chi^2 = 36.69, p < 0.001$, C vs VI, Lower class
$\chi^2 = 9.17, p = 0.010$, C vs HI, Middle class
$\chi^2 = 6.74, p = 0.034$, VI vs HI, Upper class
$\chi^2 = 19.18, p < 0.001$, VI vs HI, Middle class
$\chi^2 = 28.36, p < 0.001$, VI vs HI, Lower class

Table 6.32 Result of logistic regression of children's dental attractiveness (AC) according to need or no need for treatment when sensory impaired children included: regression coefficient (b), standard error (SE), significance (*p*), Odds Ration (OR) with 95% Confidence Interval (CI) for OR

Variables	**b**	**SE**	***p***	**OR**	**95% CI**	
Degree	0.79	0.41	0.050	2.20	0.98	4.94
Onset	1.04	0.44	0.018	2.84	1.19	6.79

Table 6.33 Gender, age groups and social class used for McNemar test differences in Examiner and Children scoring in relation to treatment need category

Variables	Control	VI	HI
Gender			
Female	$p < 0.001$	$p = 0.549$	$p = 0.003$
Male	$p < 0.001$	$p = 0.481$	$p < 0.001$
Age groups			
11-12	$p < 0.001$	$p = 1.000$	$p = 0.078$
13-14	$p < 0.001$	$p = 0.238$	$p = 0.002$
15-16	$p < 0.001$	$p = 1.000$	$p = 0.004$
Social classes (Father's occupation)			
Upper class	$p < 0.001$	$p = 1.000$	$p = 0.100$
Middle class	$p < 0.001$	$p = 0.541$	$p < 0.001$
Lower class	$p = 0.021$	$p = 0.250$	$p = 0.210$
Social classes (Mother's education)			
Upper class	$p < 0.001$	$p = 1.000$	$p = 0.031$
Middle class	$p < 0.001$	$p = 0.774$	$p = 0.170$
Lower class	$p < 0.001$	$p = 0.508$	$p = 0.014$

Table 6.34 Child interview results

Question items	No. (%) of children responding to the interview C	VI	HI
Crooked teeth	111 (23)	16 (20.8)	52 (24.8)
Protruded teeth	170 (35)	27 (35)	78 (37.2)
No treatment before	482 (97.6)	77 (100)	207 (98.6)
Having treatment	11 (2.2)	0.0	3 (1.4)
Had treatment before	1 (0.2)	0.0	0.0
Would like treatment	268 (55.3)	47 (61)	119 (56.7)
Wouldn't like treatment	217 (44.7)	30 (39)	91 (43.3)
Willing to wear braces	215 (44.5)	28 (36.4)	95 (45.2)
Not willing to wear brace	268 (55.5)	49 (63.6)	115(54.8)

Fig. 6.3 Child's assessment of crooked teeth appearance in relation to their perceived need for orthodontic treatment

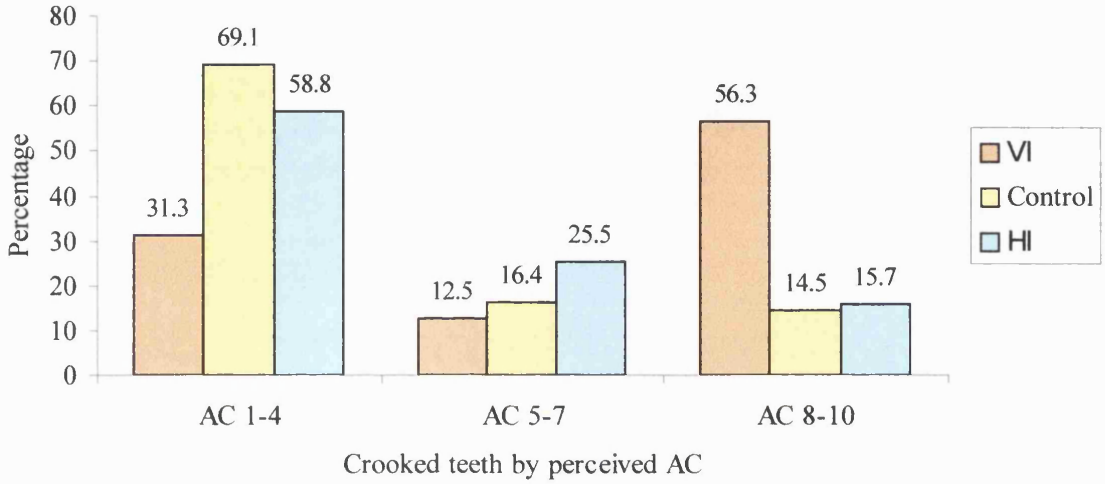


Fig. 6.4 Child's assessment of protruding teeth in relation to their perceived need orthodontic treatment

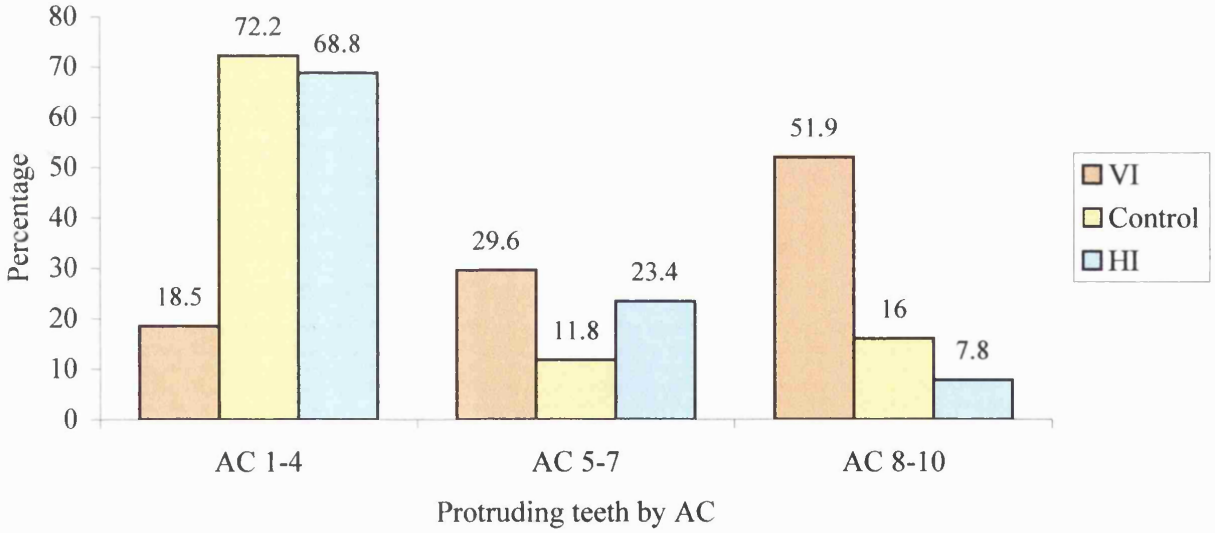


Fig. 6.5 Child's views on the need for orthodontic treatment by their perceived IOTN (AC)

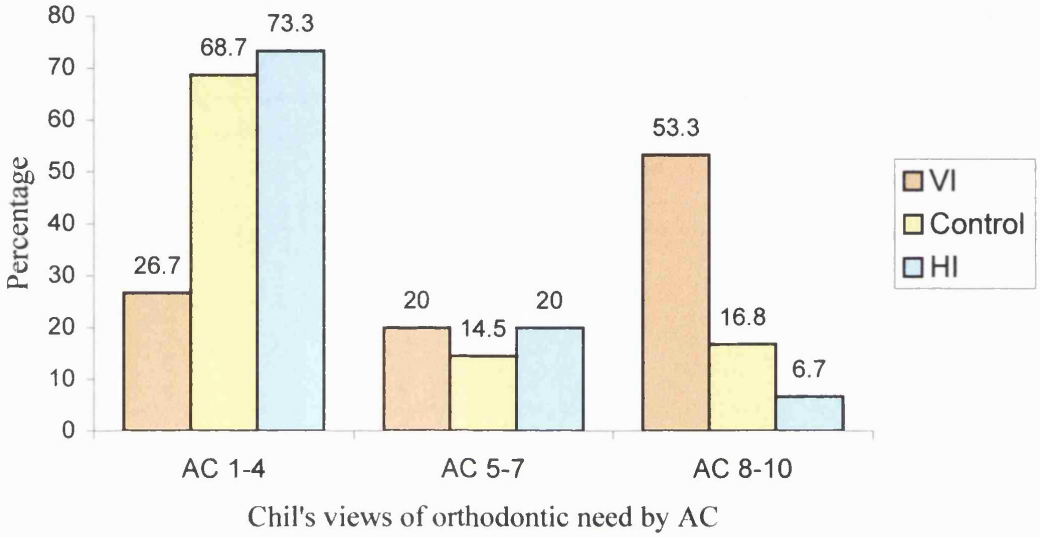


Fig. 6.6 Child' views on the need for Orthodontic treatment by Examiner' assessment of DHC

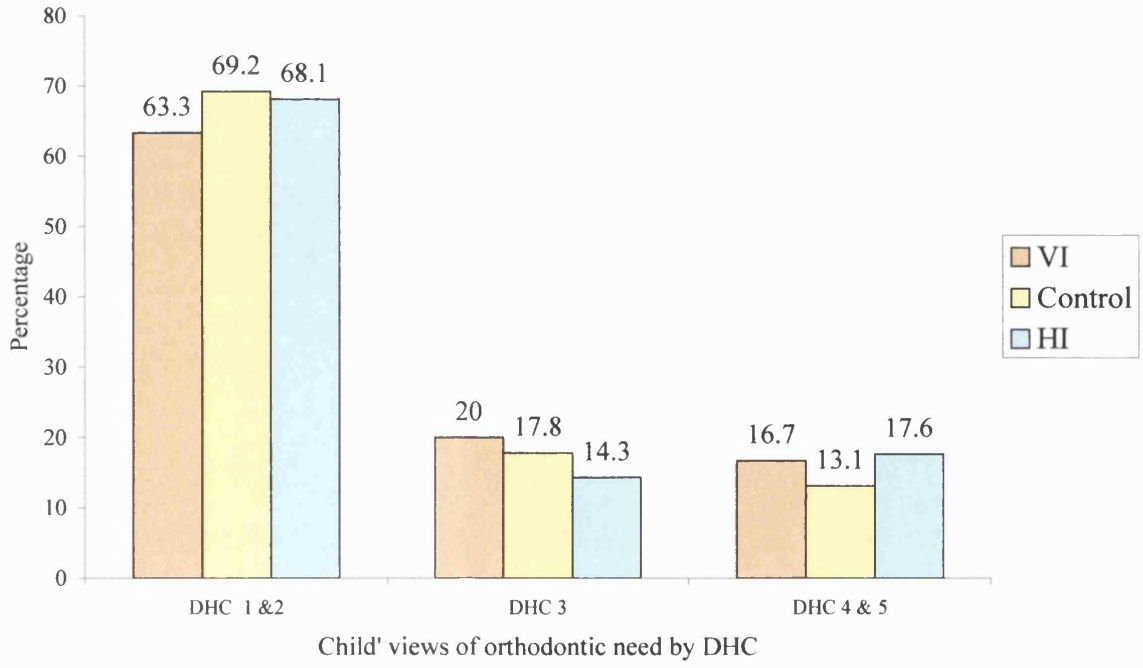


Table 6.35 Parental assessment of the appearance of control, VI and HI children's teeth, by examiner's assessment of AC

Parental Assessment	No. (%) of the parents' responses 1-4	5-7	8-10
Control			
Has crooked teeth	45 (37.5)	65 (54.2)	10 (8.3)
Has protruding teeth	39 (36.1)	60 (55.5)	9 (8.4)
VI			
Has crooked teeth	3 (23)	4 (30.8)	5 (46.2)
Has protruding teeth	7 (36.8)	10 (52.6)	1 (10.6)
HI			
Has crooked teeth	22 (48.9)	20 (44.4)	3 (6.7)
Has protruding teeth	21 (42.9)	23 (46.9)	5 (10.2)

$\chi^2 = 15.86, p = 0.001$, Crowded, C vs VI
$\chi^2 = 12.15, p = 0.005$, Crowded, VI vs HI

Table 6.36 Parental views on the need for orthodontic treatment of children's teeth, by examiner's assessment of DHC

Parental Assessment	No. (%) of control parents' responses 1	2	3	4	5
Control					
Teeth correct	89 (43.6)	89 (43.6)	13 (6.4)	2 (1)	11 (5.4)
Teeth need straightening	46 (22)	96 (45.9)	41 (19.6)	3 (1.5)	23 (11)
Child would like to have treatment	39 (21.5)	77 (42.5)	40 (22.2)	2 (1.1)	23 (12.7)
VI					
Teeth correct	8 (32)	10 (40)	4 (16)	2 (8)	1 (4)
Teeth need straightening	17 (37.8)	15 (33.3)	7 (15.6)	2 (4.4)	4 (8.9)
Child would like to have treatment	12 (27.9)	19 (44.2)	7 (16.3)	1 (2.3)	4 (9.3)
HI					
Teeth correct	23 (28)	37 (45.1)	9 (11)	3 (3.7)	10 (12.2)
Teeth need straightening	23 (23.7)	39 (40.2)	21 (21.6)	7 (7.3)	7 (7.2)
Child would like to have treatment	28 (23.7)	48 (40.7)	26 (22)	5 (4.3)	11 (9.3)

$\chi^2 = 9.92$, $p = 0.042$, Teeth correct, C vs VI
$\chi^2 = 11.35$, $p = 0.023$, Teeth correct, C vs HI

Table 6.37 Parents' views of children on having orthodontic treatment

Parent's opinion	No. (%) of parents' responses Control	VI	HI
Child not concerned about teeth appearance	88 (23.6)	19 (31.1)	29 (17.9)
Difficult to clean	100 (26.2)	17 (27.4)	37 (21.9)
Difficult to cope with treatment	163 (43.9)	31 (50.8)	87 (51.8)
Difficult to obtain the treatment	187 (49.5)	30 (52.6)	90 (54.2)
Treatment is expensive	268(71.7)	47 (79.7)	129 (78.7)

$\chi^2 = 4.36, p = 0.044$, VI vs HI, teeth appearance

Table 6.38 Parents' views of dentists' opinions of orthodontic treatment

Parent's belief of dentist's opinion	No. (%) of parents' responses Control	VI	HI
Child not concerned about teeth appearance	79 (21.2)	17 (29.3)	29 (17.6)
Difficult to clean	83 (22.7)	14 (24.1)	37 (22)
Difficult to cope with treatment	168 (44.8)	26 (45.6)	73 (44)
Difficult to obtain the treatment	187 (50.3)	31 (56.4)	100 (61.3)
Treatment is expensive	257 (69.5)	45 (77.6)	129 (77.2)

Table 6.39 Result of logistic regression of parental views on their child's possible orthodontic treatment need when HI and control children included: significance (*p*), Odds Ratio (OR) with 95% Confidence Interval (CI) for OR

Independent variable	OR	95% CI	*p*
Parent thought their child had crowded teeth	1.00	0.75 – 1.73	$p < 0.001$
Control parents	1.05	0.80 - .2.85	$p < 0.005$
HI parents			
Parent thought their child had protruded teeth	2.61	5.46 – 29.10	$p < 0.005$
HI parents			
Normative treatment based upon AC			
Control parents	2.00	1.21-3.28	$p < 0.005$
HI parents	2.04	1.25-3.32	$p < 0.005$

CHAPTER SEVEN

Dentist's questionnaire

7.1 Introduction

Dentist's attitude and willingness to provide dental care for people with disabilities have been documented in the literature (Steifel *et al.,* 1987; Bedi and O'Donnell, 1989; O'Donnell, 1993). The literature cites a number of reasons why all too often, people with disabilities do not have access to dental care. If these reasons are considered in terms of barriers then they can be divided into those erected by dentists or by the patient, or structural barriers such as access issues, payment structures, etc. Among the barriers erected by dentists are; practice image (Rosenbaum, 1984), lack of resources and training (under and post graduate teaching) (Nunn, 1984; Bedi and O'Donnell, 1989; Russell and Kinirons, 1993; O'Donnell, 1996), difficulties in communication (Bhrolchain *et al.,* 1993), and poor attitudes of dental practitioners (Bedi and O'Donnell, 1989).

Several scales have been devised that attempt to measure the attitude towards people with disabilities. One such scale is the SADP (Scale of Attitudes toward Disabled Persons) (Antonak (1982) which is a self-administered Likert-type scale (Likert, 1932) that developed from the Attitude Toward Disabled Persons Scale (ATDP) by Yuker *et al.* (1960). A more specific dental scale is the DSATHS (Dental Students Attitudes Toward the Handicapped Scale) which measures the attitudes of dental students towards people with handicapping conditions, their dental training and the role of the dentist in providing care for these patients (Lee and Sonis 1983).

The SADP consists of 24 statements or opinions with regard to people with a disability. Respondents give weighted replies (Strongly agree, Quite agree, Agree a little, Strongly disagree, Quite disagree, Disagree a Little) to each of the 24 statements. O'Donnell (1993) used the SADP in a group of dental students and

assistants in Hong Kong Dental School. He reported that dental students scored significantly lower than a group of dental assistants.

Orthodontic treatment for people with special needs has received relatively little attention and the information that is available shows that people with disabilities have difficulty in accessing orthodontic care (Olsen, 1996; Chadwick and Asher-McDade, 1997). The Saudi Institute for the Blind had expressed concern that VI children were not receiving orthodontic care, this is supported by the lack of published articles in the orthodontic literature on the subject. The reasons why general dental practitioners' either undertake orthodontic treatment themselves or refer patients to specialists have been documented and the most important factor is the availability of orthodontic services (Pender, 1985; Gorczyca *et al.,* 1989).

7.2 Aims

1. To examine the attitude towards people with sensory impairment, using a Modified version of SADP among dentists working in the capital city, Riyadh.
2. To determine the attitude of dentists towards the provision of orthodontic care for people with sensory impairment to either provide or refer sensory impaired children for orthodontic treatment. In addition, to explore factors which might affect their attitude to undertake this treatment.

7.3 Hypothesis

1. There is an association between the dentists' socio-demographic status and training in relation to their attitudes toward the sensory impaired individuals in society.

2. There is an association between the dentists' sioco-demographic status and their training in relation to provide dental and orthodontic care to the sensory impaired individuals.
3. There is a difference in the dentists attitude to provide orthodontic care for hearing impaired (HI) children as to those who are visually impaired (VI).

7.4 Method

7.4.1 The sample

There is no comprehensive dental register in Riyadh and as such a list was constructed of all dentists working in hospitals/clinics and in the local telephone directory.

7.4.2 The questionnaire design

A questionnaire was developed to assess dentists' attitudes toward the provision of dental and orthodontic care for people with a disability, their willingness to provide such care and their general attitudes toward sensory impaired children (App. 10)

The questionnaire consisted of six parts:

1. Personal details: age, gender, year of qualification and country where basic dental degree obtained (Questions, 1-4).
2. Educational information, including any undergraduate or postgraduate training in special care dentistry and if not, whether they would like to undertake such training in the future (Questions, 5-7).
3. Practice activity in treating people with disability, including whether they provide dental care for them and if so, how many patients attended or received referrals in their practice (Questions, 8-12).

4. Questions to determine their attitude in provision of orthodontic treatment for VI and HI children (Question 13 and 16).
5. VIs (VI Scale) and HIs (HI Scale) to determine the attitude of a dentist to provide orthodontic care for VI and HI children (Question 14, 15, 17 and 18).
6. The Modified Scale of Attitude toward Disabled Persons (MSADP) exploring general beliefs about sensory impaired people as persons in the society (Fig. 7.1) (O'Donnell 1993).

7.4.2.1 Pilot study and questionnaire modification

A pilot study was undertaken and 7 dentists from Saudi Arabia were asked to complete the questionnaire and comment on the overall structure and specifically on any questions which were difficult to understand. Following the comments from the respondent's certain modifications were incorported. Statements 9, 10, and 22 were removed from SADP so as not to cause offence to local customs and cultural beliefs. The statements which were removed are:

9 The disabled need only the proper environment and opportunity to develop and express criminal tendencies.

10 Disabled adults should be voluntarily committed to an institution following arrest.

22 The disabled engage in bizarre and deviant sexual activity.

Also, certain modifications were undertaken; "Disabled person" was changed throughout to "sensory impaired person (visually and hearing impaired)" the response continuum was changed to Strongly Agree, Agree, Undecided, Disagree, or Strongly Disagree so as to have a consistent response to all questions in the dentists' and dental students' questionnaires.

7.4.3 MSADP scoring

Twenty-one items were incorporated into the Modified scale and respondents had to state for each item, whether they strongly agreed, agreed, undecided, disagreed or strongly disagreed. Each response was given a numerical score of 1-5, with one being recorded for strongly agreed and 5 for strongly disagree. The scores to statements 2, 5, 6, 9, 10, 11, 13, 14, 18, 19, 20 and 21 were reversed (Table 1). The possible score for the MSADP was within a range of 21 to 105 with a score $\leq$ 63 indicating a progressively poor response.

7.4.4 VIs and HIs scoring

Attitude to provide orthodontic care for VI and HI children was tested using a small-scale (VIs and HIs). The scale consisted of four statements concerned with VI and HI children's interest in their appearance, ability to maintain oral hygiene, ability to cope with orthodontic treatment and self-perception. The respondent had to give a weighted response to each statement (Strongly Agree, Agree, Undecided, Disagree, or Strongly Disagree). Scores on individual items range from 1 to 5 (Strongly Agree =5, Agree =4, Undecided =3, Disagree =2, or Strongly Disagree =1), with a higher score indicating a greater willingness towards providing orthodontic care. The scores to statements 1 to 4 were reversed. The possible score was determined by adding the individual responses to items; the range was therefore from 4 to 20 in which a score of $\leq$ 12 indicated a poor response.

7.4.5 The survey

Permission was obtained from each hospital/clinic to circulate the questionnaire and each general dental practitioner working in a primary care setting was personally given a questionnaire and collect by the same individual (MS). The

respondents anonymity was assured. The respondents anonymity was assured. Six hundred questionnaires were sent to the dentists. Another form was sent to non-responders after a period of three weeks.

7.4.6 Data management

The data were coded and entered onto the SPSS program for statistical analysis. Both descriptive and analytic approaches were used in the data analysis. Chronobach coefficient alpha (α) was used to determine internal reliability of MSADP, VIs and HIs. Factor analysis was undertaken on the MSDAP to determine its validity. The two-sample *t*-test, one-way analysis of variance (ANOVA) and a regression analysis were used to investigate the association between socio-demographic characteristics and training of the dentists to their attitude. The wilcoxon test was used to compare the scores of the two scales. Statistical significance was set at the 5% level.

7.5 Results

7.5.1 Response rate

Of the 600 questionnaires distributed, the first response rate was 50% (300), which increased to 73.7% (442) on the second mailing.

7.5.2 Profile of the study group

The sample consisted of 235 male (53.2%) and 207 female (46.8%). Age of respondents ranged from 25-64 years, with a mean age of 37 years (SD $\pm$ 8.2).

The dentists were asked to record the date of qualification and how many years they had been in dental practice. Years of practice ranged from 1-39 years, with a mean of 13 years (SD $\pm$ 7.7). A total of 179 (41.3%) of the dentists had been qualified for 9 years or less, 180 (41.6%) for 10-19 years, 57 (13.2%) for 20-29 years and 17 (3.9%) for 30 years or more.

Respondents were asked to indicate where they had obtained their basic dental degree; a total of 50 institutions were recorded. The largest proportion (35.5%) had studied in Saudi Arabia (SA), with significant numbers from Egypt (19.7%), Syria (14%), Asian countries (12.7%), Europe/North America countries (7.9%) and African (3.2%). No other country was recorded by more than 10 respondent's (7%) (Table 7.1).

There were 240 (54.2%) general dental practitioner (GDP), 28 (6.3%) paediatric dentists, 28 (6.3%) orthodontists, 33 (7.5%) restorative dentists, 33 (7.5%) oral surgeons and a number of smaller specialities of which none was greater than 5%. (Table 7.2).

The education and training experience of those sampled was investigated. 35.5% had undertaken some training in their undergraduate course to treat people with disability and 11.3% of them considered that to be sufficient. In postgraduate training, 32.4% of them received lectures and some training for special need people and 52.5% of the sample expressed a desire for further training.

7.5.3 Attitude toward people with disability

Attitude toward people with disability was determined by asking whether dentists provided treatment for people with disability and, if so, how many they had treated in the past year.

Of the respondents, 299 (69%) said they did provide dental care for people with disability and 133 (31%) said they did not. Those who did provide dental care for people with disability were asked how many such patients had attended their practice in the past year (Table 7.3). Of the respondents, 62.7% had seen 5 or fewer patients with a disability in the past year compared to only 15.8% who had seen 6-15 patients with a disability.

Respondents were asked whether they such patients had been referred to them (Table 7.4). In response, 161 (53.5%) said they had not received any such referred patients in the past year.

Those who had received referred disabled patients were asked how many referred patients had attended their practice in the past year (Table 7.5). A total of 61 (57%) of the respondents had received 1-5 referred disabled patient during the year.

7.5.4 Attitude toward people with sensory impairment

The MSADP mean score was 68.39 (SD $\pm$ 10.94) (Fig. 7.2). The percentile curve of dentists scores showed that scores of 70 placed in percentile of 50 (Fig 7.3). Relaibility was assessed using the Chronbach's coefficient α and a value of 0.616 was obtained. Thereby, showing the scale to be a reliable tool for the population under study. The various responses to each item are listed in Table 7.6

7.5.4.1 Multi-variate analysis

Multivariate statistical analyses were carried out on the scale.

A Factor analysis

Factor analysis was carried to determine the scale validity and whether the attitude of dentists toward sensory impaired people in society (21 statements) should be considered as a single construct comprising with a single outcome score. Firstly, measures of sampling adequacy and suitability for the data set to undergo factor analysis was carried out utilising the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. Its value should be above 0.5/0.6 for satisfactory factor analysis to proceed: in this case the KMO value was 0.674. The Bartlett test of sphericity was also carried out to test if the correlation matrix was suitable for factor analysis and this was found to be highly significant ($p < 0.001$) and thus suggests that data set was amenable to factor analysis. An initial factor analysis of the principal components was performed on the scores.

Table 7.7 demonstrates the communality of each component which represents the proportion of the variance that each statement can explain in each group of factors. The higher the communality the more a particular statement can explain the variance in the group of factors. Thus, for example, statement 1 can explain 42% of the variance when the 21 statements are considered as a group of factors. Moreover, all statements appeared to be important predictors in accounting for the variance among the group factors. When the total variance was examined it was apparent that seven components-real factors emerged (Table 7.8). In reference to the eigenvalues of the components, indicators of how much variance each component can account for, it is expected that only component with eigenvalues greater than one would be extracted.

Seven components were extracted with eigenvalues of 3.12, 1.92, 1.73, 1.29, 1.19, 1.08 and 1.02. The seven components explain 54.20% of the variance. An examination of the rotated factor matrix, application of Cattell's scree test (Cattell, 1966) and the Kaiser criterion (Kaiser, 1960) to the eigenvalues of the sample supported only retention of four interpretable factors. On the principal components to the four factor groups, the combined values were 38.5% of the common variance (Table 7.9). It can be seen that the curve begins to flatten out between the third and the fourth factors (Fig. 7.4).

The statements marked with * can be grouped together in relation to the respondents' perception of the statements, such that the higher factor weight among the four factors should be selected (Table 7.9).

The statement groups are:

Factor 1 Statements 3, 4, 7, 12, 15, 16 and 17

This group was concerned with misconceptions and negative attitudes toward people with disability.

Factor 2 Statements 13, 14, 18, 19, 20 and 21

This group was concerned with moral issues and positive attitudes related to integrating people with disability into society and employment (normalisation).

Factor 3 Statements 5, 6, 8, 9 and 10

This group was concerned with misconceptions toward people with disability (Statement 8) and recognition of positive attitudes in social normalisation and employment.

Factor 4 Statements 1, 2, 11

This group was concerned with social normalisation and integration into society and (Statement 1) negative misconceptions.]

B Sample *t*-test and Analysis of variance

Variations in the Modified SADP scores were associated with the socio-demographic status and training of the dentists. A significant correlation was noted between MSADP scores and years of practise for those dentists who practiced 30 years and greater ($p = 0.003$). In addition, significant differences of the scores were found for those who held specialist degree ($p = 0.004$), those who had insufficient undergraduate training in special care dentistry ($p = 0.023$) and country of obtained undergraduate degree ($p < 0.001$) (Tables 7.10 - 7.13).

C Multiple regression

The multiple regression analysis was performed with the use of mathematical model:

$$y = \alpha + \beta\chi + \varepsilon$$

The outcome variable of the MSADP (y) was tested to determine whether it was associated with the predicator variable (χ). The χ value tested the socio-demographic status of the dentists (gender, age, holding speciality degree, year of practise since qualification and country of obtained undergraduate qualification), undergraduate training and lectures with training for special need people included in the postgraduate programme.

Using one-way ANOVA and sample *t*-test on the scale scores, showed that dentist who held specialist degree ($p = 0.004$), little or no undergraduate training for special need people ($p = 0.023$), years of practice ($p = 0.003$) and country of obtained undergraduate qualification ($p < 0.001$) were the only significant variables. These variables were then included in a multiple regression analysis. The multiple regression using the scale scores as the dependent variable showed that dentists who had qualified from Europe/North America had better attitude to

sensory impaired people in society than dentists who had qualified from Saudi Arabia ($p < 0.001$), Egypt ($p < 0.001$), Syria ($p < 0.001$), Asia ($p = 0.009$) and Africa ($p < 0.001$) (Table 7.14). Also, dentstis who held a speciality degree had a mean attitude greater thn GDPs ($p < 0.009$).

This was realated to their association with the MSADP factors and not from any relationship between themselves.

D Logistic regression

Multivariate analysis was carried out using a regression analysis to determine the variables which were independently related to the MSADP score when others were held constant. The scale scores were collapsed into binary such scores of $\leq$ 63 were value of zero and scores of > 63 were of value of one. When a forward and backward stepwise regression were applied. The only statistically significant variables in the model were whether dentists held specialist degree ($p = 0.008$), had little or no undergraduate training for special needs people ($p = 0.046$) and country of obtained undergraduate training (Table 7.15). When dentists held a specialty and had little or no undergraduate training for special needs people, the chance of being more positive toward sensory impaired people is 2 times than GDPs and who had undergraduate training. Dentists who had obtained their basic undergraduate training from Europe/North America had better attitude toward sensory impaired people in society than dentists who had qualified from Syria ($p < 0.001$), Egypt ($p < 0.001$), Saudi Arabia ($p = 0.004$) or Africa ($p < 0.001$).

7.5.5 Attitude toward provision of dental and orthodontic care for visually and hearing impaired children

Attitude toward VI and HI children were explored through dentist's attitude to provide dental and orthodontic care. Respondents were asked whether they provided dental care for VI and HI children; 129 (30.4%) and 191 (45.3%) said that they did respectively. Of those who did, 22 (22.2%) cared for one VI patient, 26 (26.3%) for two, 23 (23.3%) for three, and 28 (28.3%) for four or more (Table 7.16). However, 29 (20.3%) cared for one HI patient, 36 (25.2%) for two, 31 (21.7%) for three, and 47 (32.9%) for four or more.

Dentists who had respondent that they provided dental care for sensory impaired children were asked if they referred them for orthodontic treatment. Sixteen percent of dentist's respondent that they referred 1-5 HI children for orthodontic treatment while 8.5% of VI children (Table 7.17).

Respondents were asked whether they agreed with the statements that VI and HI children are able to receive the same orthodontic treatment as "normal" children (Table 7.18). Of the sample, 178 (41.6%) agreed that the same orthodontic care could be provided for VI children, compared to 59 (13.8%) who agreed strongly, 111 (25.9%) who disagreed and 80 (18.7%) who replied "don't know". However for HI children, 236 (54.9%) agreed that the same orthodontic care can be provided, compared to 102 (23.7%) who agreed strongly, 56 (13%) who disagreed and 36 (8.4%) who replied "don't know".

The extent to which a dentist responses to statements agreed was measured by a Weighted Kappa, its value of 0.35 indicating poor agreement between the responses for two types of impairment. More dentists (78.6%) strongly agreed or agreed that HI children are able to have the same orthodontic treatement as

"normal children" than dentists (55.4%) who strongly agreed or agreed with the statement for VI children.

Dentist's attitude toward the provision of orthodontic care for VI and HI children was determined through VIs and HIs. Chronbach's coefficient α for VIs was 0.822 and 0.877 for HIs. This shows the small-two scales have satisfactory reliability for the population under study.
Mean responses to each of the four items were in the range of 2.90-3.31 for VIs and 3.64-3.99 for HIs. The mean overall for VIs was 12.16 (CI, 11.79-12.52) and 15.43 (CI, 15.15-15.18) for HIs.

Different responses to each statement are listed in Tables 7.20. The respondents' scores between VIs and HIs were completely different. For example, statement A which concerned children interesting in their dental appearance, 27.5% of the dentist's scored 2 on VIs while 10.5% on HIs. Meanwhile, for statement B which explored children ability to maintain proper oral hygiene, 37.7% and 10.9% respectively scored 2. For coping with orthodontic treatment (statement C), 8.5% and 20.5% respectively scored 5 while for self-perception to severity of their malocclusion (statement D), 5.9% and 18.6% respectively scored 5.

The mean of the differences in the dentist's response to the two scales taken over all the statements using the paired-test was significantly different from zero ($p <$ 0.001). Dentists tend to have more favourable attitude toward HI children in the four statements than VI children (mean difference = 3.32, 95% CI = 3.68-2.96). The dentist's agreement for the four statements in the two scales gave a Kappa equal to 0.15, indicating poor agreement (Table 7.21).

Dentists who had respondent to the two scales in the same time, 73.6% of them had a greater response to HIs items than VIs, while 18.5% had no difference. Dentists tend to believe that HI children are more interested in their appearance,

ability to maintain oral hygiene, ability to cope with orthodontic treatment, and self-perception than VI children.

7.5.5.1 Analysis of variance

Taking each scale separately, each of the socio-demographic variables (all of which were categorical) was investigated to determine whether the means of the attitude scores in different categories of the variable differed. The two-sample *t*-test was used when the variable comprised two categories, and the one-way ANOVA followed by the *post-hoc* comparisons when the variable comprised more than two categories. Dentists who had qualified from Europe/North America ($p = 0.007$) and practiced dentistry for 30 years or more ($p = 0.016$) had higher score on the VIs (Tables 7.22 and 7.23) than that for other categories while only dentists who had qualified from Saudi Arabia and Europe/North America ($p = 0.001$) had higher scores on the HIs than that for other dentists who had qualified from other countries (Table 7.24).

7.5.5.2 Multivariate analysis

Multiple regression analyses were carried out to determine the variables which were independently related to each of the two scales when other variables were held constant. Table 7.25 shows the explanatory variables that were statistically significant in the model in which VIs was the dependent variable. This showed that dentists who had qualified from Europe/North America had a significantly better attitude to providing orthodontic care for VI children than dentists who had qualified from Saudi Arabia ($p = 0.04$), Egypt ($p = 0.002$), Syria ($p = 0.003$) and Asia ($p = 0.01$). Observing the upper bound of the 95% CI showed that the average score for dentists who had qualified from Europe/North America was 3.5-4.2 greater than for other dentists who had qualified from other countries. However, the difference in mean scores was only significant between dentists who

had qualified from Europe/North America and those who had qualified from Egypt ($p = 0.02$) for HI children (Table 7.26).

Each of the socio-demographic variables was investigated in a multiple regression analysis to determine whether the means of the differences in the two attitude scores of a dentist varied in the different categories of the variable.

Dentists who had qualified from Saudi Arabia ($p = 0.004$) and Asia ($p = 0.047$) had significant greater mean differences in attitude scores than dentists who had qualified from Europe/North America (Table 6.27). This was the only significant predictor in the multiple regression analysis. Observing the upper bound of 95% of CI showed that the average difference score for dentists who had qualified from Europe/North America was 3.30-4.47 greater than that for other dentists who had qualified from other countries.

7.6 Discussion

7.6.1 Response rate and Sampling

Few surveys of attitudes or practices of Saudi dentists have been published. Access to this population is difficult due to lack of a central register but the majority of the workforce live and work in the capital city and access to hosptial/clinic staff lists provide a resonable sampling frame for such survey. The personal contact with the dentists was considered important and one of the authors (MS) liased with all the respondents and ensured them of their anonymity. The high response rate (73.7%) was possibly achieved by the personal contact and ongoing follow-ups (Dillman, 1978; Oppenheim, 1992)

7.6.2 Attitude toward providing dental care for people with disabilitiy

The questionnaire had identified the views of the sampled dentists with regard to treating people with disability and their past experience and their perceived need for training. Quarter of respondents had undergraduate and postgraduate training in providing dental care for people with disability. However, half of them wished for further training and that was lower than the findings of Rojas and Cushing (1992) who had in their study reported higher proportion (70%) of dentists believing they needed such training. Although nearly three-quarter of respondents reported that they had no undergraduate or postgraduate training in providing dental care for people with disability, 69% of sample provide dental care for such people in their practice.

The literature concerning the care of people with disability frequently refers to the need for education and training for dental staff in the treatment of these patients (Ndule, 1989). Many general dental practitioners expressed the feeling that they were inadequate in the presence of the people with disability. It has been suggested that this might have been overcome if they had received guidance during their undergraduate studies (Franks and Winter, 1974). Therefore, an ongoing debate exists as to whether special care dental training should occur at undergraduate level, postgraduate or both (Levine, 1985; Ndule, 1989).

7.6.3 Attitude toward sensory impaired people in society

The SADP is a Likert scale and also an ordinal scale, and as such can compare the position of an individual in relation to others by categorising their various strengths of agreement (Likert, 1932). In Likert scaling the respondent is not just asked to decide whether he/she agrees or disagrees with an item, but rather to chose between several response categories indicating various strengths of agreement. Usually there are five response categories, but often in Likert scaling up to seven can be employed.

An important aspect in analysing the validity of the Modified scale is to use a factor analysis to find out the underlying concepts within the scale. An initial factor analysis of the Modified SADP confirmed the retention of four interpretable factors. This is not consistent with the original findings by the scale originator (Antonak, 1982). However, since the purpose of the analysis was to link statements together into factors, those statements must be related to one another and therefore the statement in the four factors were linked to each other except statement No. 1 and 8. Because of this it was decided to utilise the total score for analysis rather than the four sub scale groupings as using the sub-scale would not possible.

The confidence in the scale was strengthened by the reasonable level of reliability; Chronbach's coefficient α score of 0.616.

From the results, it was shown that 323 (73%) of the dentists responding had a positive attitude (score > 63) towards sensory impaired people. Overall, there was general agreement with all statements in the questionnaire except for statements 8 ("A sensory impaired person is like a child") and 16 ("Simple repetitive work is appropriate for the sensory impaired"); the dentists tended to have a negative attitude toward these statements.

Both the correlation and regression analyses showed dentists' attitudes to be related to years of practice, those who were specialists, those who received little or no undergraduate training in special care dentistry and the country they obtained their undergraduate training.

Dentists' attitudes can be identified by their working experience, as illustrated by the regression analysis, which showed that dentists who had 30 or more years of experience were more positive in their attitude. This finding was in contrast to Russell and Kinirons (1993), who described that dental officers who had been in practice for 10 years or more had a poorer attitude.

One reason for dentists to having a positive attitude is the provision of adequate training while obtaining their speciality programmes. Special care dentistry has chiefly been in the domain of children's dentistry, restorative dentistry, and oral surgery, all of which are postgraduate topics. It is therefore not surprising that specialists were at the high end of the scale compared to GDPs. This is changing, as most dental schools now include aspects of special care dentistry in their postgraduate programmes (Marinelli *et al.,* 1991). However, the practical results of such courses can be unexpected. Dental students' contact with people have disability during their undergraduate study has been shown to influence their attitude toward treating them in general practice (Bedi *et al.,* 1986; O'Donnell, 1993). Stiff and Phipps (1964) found that students who were exposed to "special" patients actually worsened in attitude and become more negative toward treating these patients. Miller and Heil (1976) reported similar negative results after a programme of exposure to older patients. It is not the mere exposure of students to special groups that produces favourable attitudes; unless the experience is positive, it can be counterproductive (Bedi and O'Donnell, 1989).

Different professional training can influence attitude toward sensory impaired people. As the dentists working in Saudi Arabia are of a range of nationalities, so it should not be surprising that their attitudes were influenced by the place in which they obtained their degrees. Dentists who had graduated in Europe/North America had a more favourable attitude than dentists who obtained undergraduate training from Saudi Arabia, Egypt, Syria or Africa as illustrated in the regression model. This can be due to differences in dental curriculum training and cultural background. Westbrook *et al.* demonstrated significant differences in attitudes held by health practitioners (among them dentists from China, Italy, German, Arab countries, and Australia) toward people with 20 different disabilities. People with visual impairment were less accepted by Italian, Greek, Arabic-speaking, and Chinese respondents (Westbrook *et al.,* 1993).

7.6.4 Dentist's attitude towards provision of orthodontic care for visually and hearing impaired children

Dentists on the whole were more willing to provide care for HI than for VI children, 30.4% compared to 45.3% respectively. The gender and relative professional training for special need people in their postgraduate programme could explain this finding. Sixty four percent of male dentists provided dental care for VI children and 58.6% for HI children compared to 35.6% and 41.45% of the female dentists' respectively. This differential may reflect the male/female ratios of specialists of which 63.4% are male.

Previous studies have shown that previous knowledge and experience related to special patient care gained in professional education had a substantial effect on the respondents, willingness to treat this population (Steifel, 1980; Bickley, 1990). Also, previous clinical experience can determine the willingness of dentists to include patients with a disability in their practices (Mathewson and Beaver, 1970; Robert *et al.,* 1978). These findings support the findings of the present study where dentist who had training and lectures in special dentistry included in the postgraduate programme were more likely and willing to provide the dental care for these group.

Dentist's attitude for provision orthodontic care was more positive towards HI (78.6%) than VI children (55.4%). It was noticeable that dentists who provided dental care for VI children (30.4%) tend to agree that orthodontic treatment should not provided for this group. However, this was different for dentists who provided dental care for HI children (45.3%) as they, on the whole, agreed that these children should received orthodontic treatment.

The dentists were more willing to provide dental and orthodontic care for HI children than VI children. Although there was some variation, the rankings of the disabling effect of health conditions are stable across countries and informant

groups (medical professionals, allied health professionals, caregiver etc) (Ustun *et al.,* 1999). Ranking was directed towards the extent of disabling conditions, however, prognosis, pain, mood impact and public opinion may drive the different ranks. Ustun *et al.* (1999) reported that, overall different informant groups from fourteen-countries (e.g. Egypt, Tunisia, UK), ranked people with blindness as the most disabling condition (No. 5) compared to people with deafness (No. 10).

The quality of healthcare depends in part on the quality of the education and training received at the beginning and throughout the working life of those who provide it.

It has been supported that dentists-patients referral pattern to orthodontic treatment by different practice characteristics, method of assessment and dentist's professional characteristics (Lawrence *et al.,* 1995). In the present study, it appears that dentists who had practiced dentistry for 30 years and longer and had graduated in Europe/North America were statistically significance different in their attitude to provide both VI and HI children with orthodontic treatment. These differences may be due to the differences in orthodontic training in the undergraduate curriculum.

Some universities in the world have stated that orthodontics is to be regarded as a regular part of their undergraduate courses. In the USA and European countries undergraduate dental students are taught clinical orthodontic procedures. The American Dental Association accreditation guidelines state that "graduates must be competent to recognise malocclusion in the primary, mixed and permanent dentition and treat limited developmental and acquired abnormalities (Behrents and Keim, 1991). Also, it appears that undergraduate orthodontic education is taking place in Europe countries (Adamidi *et al.,* 2000). In the 23 countries that were surveyed, respondents reported that clinical practice and theory together take up a major part of the hours allocated to the undergraduate orthodontic curriculum

and mostly devoted to recognised malocclusion, treatment planning and using appliances.

7.7 Conclusion

The purpose of this study was to determine the attitude of the dentists working in Riyadh toward people with sensory impairement.

Overall the dentist's attitude toward sensory impaired people in the society was generally positive. Absence of undergraduate special care training, speciality and country of obtained undergraduate degree was obtained as well as length years of practising dentistry were positively associated with their attitude.
People with sensory impairments cannot be considered as a homogeneous group, in that HI patients are more likely to receive dental and orthodontic care than VI children. Those individuals who had obtained undergraduate training in Europe/ North America were less likely to show a discriminatory behaviour and were more likely to provide orthodontic care for VI and HI children. Years of practising dentistry were an additional factor that appears to influence dentists' attitude towards whether orthodontic treatment should be provided to VI children. However, there is a clear need to change the attitudes of dentists with regard to VI children and ensure suitable training programmes on special care dentistry are available.

7.8 Principal findings

- Three-quarters of respondents provided dental care for people with disability.
- Dentists showed a positive attitude toward people with a sensory impairment.
- Dentists' attitudes toward people with a sensory impairement were statistically significant in relation to whether they had undergone postgraduate training, hold a specialist recognition, wether they received little or no undergraduate training in special care dentistry and the country area where they obtained their undergraduate qualification.
- Dentists were more inclined to agree that orthodontic care should be provided for HI children as "normal" children than for VI children.
- Dentists' attitude to provide orthodontic care for VI children was statistically correlated to country of obtaining the undergraduate degree and if they have practiced dentistry for 30 years and greater.
- Dentists' attitude to providing orthodontic care for HI children was statistically correlated to the country where the undergraduate qualification was obtained.
- The difference of discrimination in providing dental care for HI children from VI was statistically correlated to the country where the undergraduate training was obtained.

Fig 7.1 Modified Scale of Attitudes toward Disabled Persons (MSADP)

1. The sensory impaired should not be provided with a free public education.
2. Sensory impaired people are not more accident prone than other people.
3. A sensory impaired individual is not capable of making moral decisions.
4. The sensory impaired should be prevented from having children.
5. The sensory impaired should be allowed to live where and how they chose.
6. Adequate housing for the sensory impaired is neither too expensive nor too difficult to build.
7. Rehabilitation programmes for the sensory impaired are too expensive to operate.
8. The sensory impaired children in many ways like children.
9. Most sensory impaired people are willing to work.
10. Sensory impaired individuals are able to adjust to life outside an institutional setting.
11. The sensory impaired should not be prohibited from obtaining a driving license.
12. Sensory impaired people should live with others of similar disability.
13. Group homes for the sensory impaired should not be prohibited in residential districts.
14. The opportunity for gainful employment should be provided to sensory impaired people.
15. Sensory impaired children in regular classrooms have an adverse effect on other children
16. Simple repetitive work is appropriate for the sensory impaired.
17. The sensory impaired show a deviant personality profile.
18. Equal employment opportunities should be provided to sensory impaired people.
19. Laws to prevent employers from discriminating against the sensory impaired should be passed.
20. Sensory impaired workers should receive at least the minimum wage established for their jobs.
21. Sensory impaired individuals can be expected to fit into competitive society.

Table 7.1 Country of obtained undergraduate qualification

Country of qualification	KSA	Egypt	Syria	Asia	Europe/North America	Africa	Other
Frequency (No.)	157	87	62	56	35	14	31
%	35.5	19.7	14.0	12.7	7.9	3.2	7

Table 7.2 Number of dentists by their speciality

Specialists	Frequency (No.)	%
GDPs	240	54.2
Paediatric dentists	28	6.3
Orthodontists	28	6.3
Oral surgeon	33	7.5
Restorative dentists	33	7.5
Other	80	18.1

Table 7.3 Number of patients with a disability treated in the past year

Number	0-5	6-15	16-30	30-50	Over 50
Frequency	190	48	28	19	18
%	62.7	15.8	9.2	6.3	5.9

Table 7.4 Dentists receiving referred patients with a disability

Response	Number	%
Yes	140	46.5
No	161	53.5

Table 7.5 Number of patients with a disability referred to the dentist in the past year

Number	1-2	3-4	5	6-10	11-30	Over 50
Frequency	23	18	20	22	15	9
%	21.5	16.8	18.7	20.6	14	8.4

Fig. 7.2 Score distribution of the Dentists on the Modified Scale of Attitudes toward Disabled Persons (MSADP)

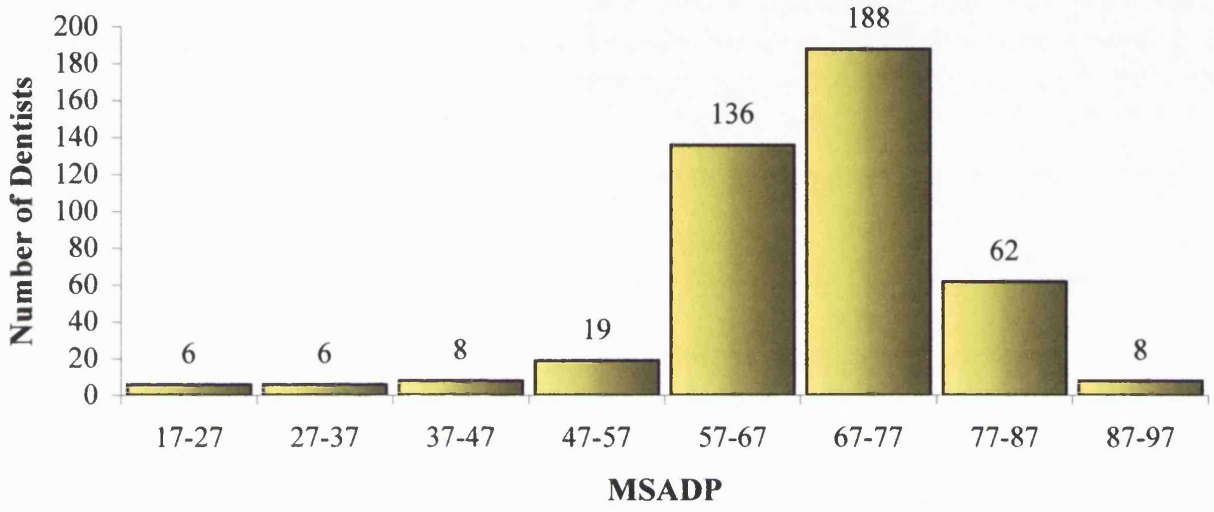


Fig 7.3 Modified Scale of Attitudes toward Disabled Persons (MSADP) Percentile score curve of the dentists

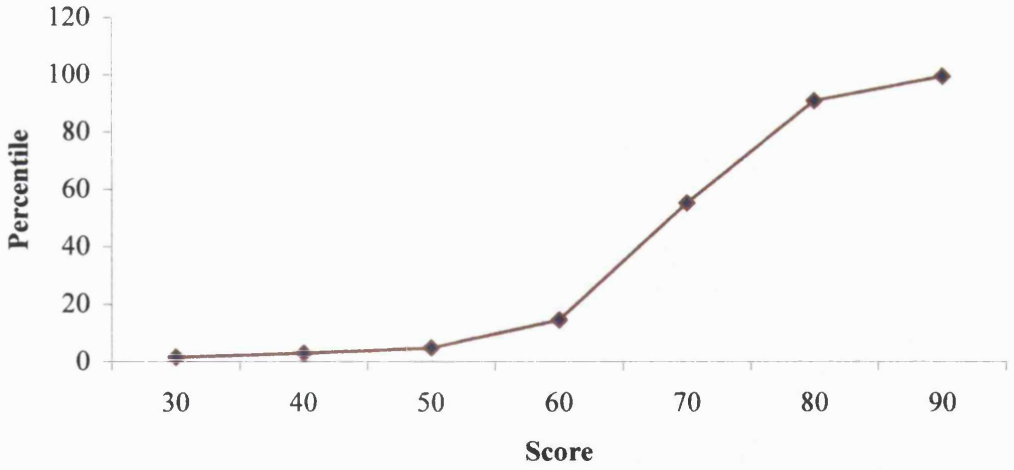


Table 7.6 Individual scoring for each statement of the Modified Scale of Attitudes toward Disabled Persons (MSADP)

	No. & % of Responses				
Statements	**1**	**2**	**3**	**4**	**5**
1	18 (4.3)	58 (13.8)	37 (8.8)	128 (30.5)	179 (42.6)
2	62 (15)	199 (48.2)	50 (12.1)	89 (21.5)	13 (3.1)
3	5 (1.2)	56 (13.6)	48 (11.7)	180 (43.7)	123 (29.9)
4	8 (1.9)	19 (4.5)	44 (10.4)	157 (36.9)	197 (46.4)
5	36 (8.5)	61 (14.4)	41 (9.6)	194 (45.5)	94 (22)
6	20 (4.7)	81 (19)	118 (28)	167 (39.5)	37 (8.7)
7	11 (2.6)	122 (28.8)	133 (31.4)	138 (32.6)	19 (4.5)
8	61 (14.8)	230 (55.8)	45 (11)	68 (16.4)	8 (1.9)
9	9 (2)	29 (7)	58 (14)	260 (62)	64 (15)
10	4 (1)	45 (10.7)	59 (14)	269 (64)	43 (10.2)
11	73 (17.5)	153 (36.7)	85 (20.4)	79 (18.9)	27 (6.5)
12	21 (5)	81 (19)	60 (14.3)	218 (51.4)	44 (10.4)
13	10 (2.5)	52 (13.2)	87 (22)	209 (53)	36 (9.3)
14	2 (0.5)	25 (6.4)	59 (15.2)	235 (60.6)	67 (17.3)
15	20 (4.8)	109 (26)	87 (20.9)	165 (39.5)	37 (8.9)
16	36 (8.7)	221 (53.5)	74 (17.9)	66 (16)	16 (3.9)
17	5 (1.3)	127 (32.9)	129 (33.4)	99 (25.6)	26 (6.7)
18	12 (2.9)	71 (17.1)	72 (17.3)	201 (48.4)	59 (14.2)
19	7 (1.7)	35 (8.5)	65 (15.8)	200 (48.5)	105 (25.5)
20	11 (2.7)	50 (12.3)	53 (13)	212 (52.1)	81 (19.9)
21	2 (0.5)	35 (8.4)	55 (13.2)	252 (60.4)	73 (17.5)

Table 7.7 Communality statements of the Modified Scale of Attitudes toward Disabled Persons (MSADP)

Statements	Extraction
1	0.421
2	0.523
3	0.639
4	0.369
5	0.506
6	0.191
7	0.125
8	0.516
9	0.499
10	0.363
11	0.282
12	0.235
13	0.248
14	0.517
15	0.368
16	0.266
17	0.447
18	0.466
19	0.362
20	0.399
21	0.341

Table 7.8 Eigenvalues of unrotated factor matrix of the Modified Scale of Attitudes toward Disabled Persons (MSADP)

Statements	Eigenvalues	Factor	% of variance	Cumulative %
1	3.12898296	1	14.900	14.900
2	1.92309218	2	9.158	24.058
3	1.73066118	3	8.241	32.299
4	1.29910024	4	6.186	38.485
5	1.19934601	5	5.711	44.196
6	1.08031278	6	5.144	49.340
7	1.02142680	7	4.864	54.204
8	0.98884495			
9	0.95980629			
10	0.87547334			
11	0.85392414			
12	0.79981571			
13	0.74950775			
14	0.69805023			
15	0.65720839			
16	0.59720391			
17	0.57156695			
18	0.55581898			
19	0.50464799			
20	0.45552705			
21	0.34968206			

Fig 7.4 Scree plot factor of the Modified Scale of Attitudes toward Disabled Persons (MSADP)

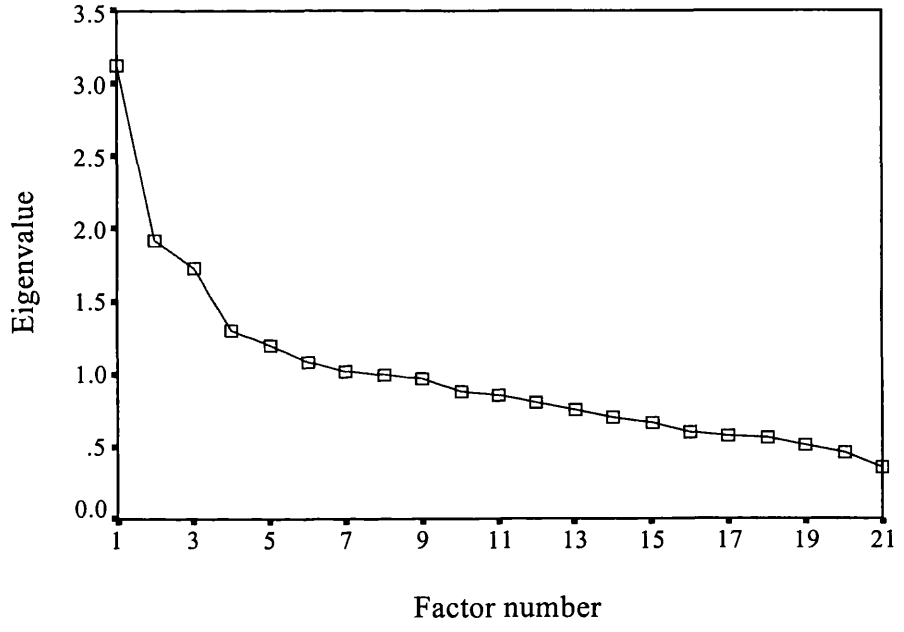


Table 7.9 Varimax rotational method of factor loadings, of the Modified Scale of Attitudes toward Disabled Persons (MSADP)

Statements	Factor 1	Factor 2	Factor 3	Factor 4
1	0.249	0.209	0.043	0.560*
2	0.202	0.255	0.208	0.611*
3	0.604*	0.093	0.326	0.399
4	0.494*	0.143	0.229	0.227
5	0.103	0.000	0.698*	0.091
6	0.248	0.238	0.360*	0.070
7	0.330*	0.094	0.078	0.025
8	0.072	0.0601	0.706*	0.088
9	0.084	0.234	0.652*	0.113
10	0.080	0.130	0.582*	0.006
11	0.011	0.235	0.057	0.472*
12	0.438*	0.120	0.137	0.099
13	0.040	0.455*	0.194	0.049
14	0.097	0.683*	0.133	0.155
15	0.606*	0.008	0.033	0.008
16	0.497*	0.055	0.071	0.105
17	0.664*	0.047	0.040	0.046
18	0.147	0.460*	0.228	0.425
19	0.113	0.587*	0.004	0.061
20	0.032	0.615*	0.124	0.064
21	0.217	0.522*	0.131	0.066

* Indicate statements that were grouped together form the factor

Table 7.10 Relationship between years of practice and outcome of the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: standard deviation (SD)

Years of practice	Number	Mean	SD
0-9	175	68.50	9.43
10-19	178	67.30	11.83
20-29	55	70.42	9.60
≥ 30	17	76.59	9.26

$p = 0.003$

Table 7.11 Relationship between specialists and outcome of the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: standard deviation (SD)

Specialty	Number	Mean	SD
Specialists*	200	70.03	8.48
GDPs*	233	66.97	12.52

* Some participants failed to complete the scale.

$t = 2.92$, $p = 0.004$, 95% CI = 5.12-1.01

Table 7.12 Relationship between those who obtained little or no undergraduate training in special care dentistry and the outcome of the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: standard deviation (SD)

Undergraduate training in special care dentistry	Number	Mean	SD
Little or no undergraduate training	379	68.80	10.48
Undergraduate training	50	65.06	13.91

$t = 2.27$, $p = 0.023$, 95% CI = 6.98-0.51

Table 7.13 Relationship between different Countries of obtained undergraduate qualification and outcome of the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: standard deviation (SD)

Country obtained undergraduate qualification	Number	Mean	SD
Europe/North America	35	78.14	12.09
Asia	56	71.71	7.42
Saudi Arabia	154	68.45	9.52
Africa	14	65.86	7.15
Egypt	83	65.75	10.88
Syria	61	63.77	12.63
Other	15	70.20	8.33

$p < 0.001$

Table 7.14 Significant exploratory variables in multiple regression of dentists' outcome of the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: regression coefficient (b), significance (p), with 95% Confidence Interval (CI) for β

Variables	b	*p*	95% CI lower bound	95% CI upper bound
Speciality	2.82	0.009	0.78	4.86
Country where basic dental degree obtained*				
Asia	-5.76	0.009	-10.09	-1.43
Saudi Arabia	-9.21	< 0.001	-12.96	-5.47
Africa	-12.28	< 0.001	-18.57	-5.99
Egypt	-12.49	< 0.001	-16.51	-8.48
Syria	-13.82	< 0.001	-18.06	-9.58

* Base line – Europe/North America

Table 7.15 Significant exploratory variables in regression analysis of dentists' outcome of the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: regression coefficient (b), Odd Ratio (OR), significance (*p*), 95% Confidence Interval (CI) for OR

Variables	b	OR	*p*	95% CI	
				lower bound	upper bound
Specialist status	0.67	1.96	0.008	1.18	3.24
Little or no undergraduate training in special care dentistry	-0.72	1.96	0.046	0.23	3.98
Country of obtaining undergraduate training *					
Saudi Arabia	-1.27	0.28	0.004	0.11	0.67
Syria	-1.91	0.14	< 0.001	0.05	0.38
Egypt	-2.20	0.11	< 0.001	0.04	0.27
Africa	-2.37	0.09	< 0.001	0.02	0.35

* Base line – Europe/North America

Table 7.16 Number of VI and HI children treated in the past year

Groups	1 (No. & %)	2 (No. & %)	3 (No. & %)	4 & over (No. & %)	Total
VI	22 (22.2)	26 (26.3)	23 (23.2)	28 (28.3)	99
HI	29 (20.3)	36 (25.2)	31 (21.7)	47 (32.9)	143

Table 7.17 Number of VI and HI children referred for orthodontic treatment

Groups	0 (No. & %)	1 (No. & %)	2-5 (No. & %)s	Over 5 (No. & %)	Total
VI	387 (91.5)	25 (5.9)	10 (2.4)	1 (0.2)	423
HI	355 (83.9)	46 (10.9)	19 (4.5)	3 (0.7)	423

Table 7.18 Response to whether VI and HI children receive orthodontic treatment in the same way as "normal" children

Groups	Disagree strongly (No. & %)	Disagree (No. & %)	Don't know (No. & %)	Agree (No. & %)	Agree strongly (No. & %)
VI	0	111 (25.9)	80 (18.7)	178 (41.6)	59 (13.8)
HI	0	56 (13)	36 (8.4)	236 (54.9)	102 (23.7)

Kappa = 0.35

Table 7.19 Mean values of the VIs (VI Scale) and HIs (HI Scale) toward attitude of a dentist for provision of orthodontic care for VI and HI children

Groups	A	B	C	D
Mean (SD ±) VIs	3.31 (1.09)	2.98 (1.17)	2.98 (1.17)	2.90 (1.03)
Mean (SD ±) HIs	3.99 (0.96)	3.92 (0.98)	3.83 (0.91)	3.64 (1.02)

Table 7.20 Difference in responses to VIs (VI Scale) and HIs (HI Scale) toward attitude of a dentist for provision of orthodontic care for VI and HI children

Statements	No. &% of Responses 1	2	3	4	5
			VIs		
A	11 (2.8)	109 (27.5)	73 (18.4)	152 (38.3)	52 (13.0)
B	30 (7.6)	150 (37.7)	49 (12.3)	135 (33.9)	34 (8.5)
C	30 (7.6)	150 (37.7)	49 (12.3)	135 (33.9)	34 (8.5)
D	18 (4.5)	154 (39.3)	94 (24.0)	103 (26.3)	23 (5.9)
			HIs		
A	5 (1.2)	43 (10.5)	30 (7.3)	205 (49.9)	128 (31.1)
B	9 (2.2)	45 (10.9)	25 (6.1)	223 (54.1)	110 (26.7)
C	4 (1.0)	43 (10.5)	56 (13.7)	222 (54.3)	84 (20.5)
D	9 (2.2)	64 (15.6)	69 (16.9)	191 (46.7)	76 (18.6)

Paired-test ($p < 0.001$)

Table 7.21 Kappa difference in dentists agreement to VIs (VI Scale) and HIs (HI Scale) comparing attitude to provide orthodontic care for VI and HI children

		No. of Response VIs			
Scores		**4-7**	**8-11**	**12-15**	**16-20**
HIs	**4-7**	4	7	3	12
	8-11	3	27	41	72
	12-15	0	3	36	85
	16-20	1	0	10	74

Kappa = 0.51 < 0.20

Table 7.22 Relationship of country of obtained undergraduate qualification to the VIs (VI Scale) toward attitude of a dentist for provision of orthodontic care for VI children included: standard deviation (SD)

Country obtained undergraduate qualification	Number	Mean	SD
Europe/North America	31	14.65	4.04
Africa	11	12.36	3.14
Saudi Arabia	141	12.16	3.31
Asia	48	11.96	3.86
Egypt	74	11.88	3.31
Syria	55	11.75	3.98

$p = 0.007$

Table 7.23 Relationship of years of practice to the VIs (VI Scale) toward attitude of a dentist for provision of orthodontic care for VI children included: standard deviation (SD)

Years of practice	Number	Mean	SD
0-9	163	11.64	3.41
10-19	158	12.28	3.73
20-20	51	13.04	3.43
30+	10	14.30	3.83

$p = 0.016$

Table 7.24 Relationship of country of obtained undergraduate qualification to the HIs (HI Scale) toward attitude of a dentist for provision of orthodontic care for HI children included: standard deviation (SD)

Country obtained undergraduate qualification	Number	Mean	SD
Saudi Arabia	145	16.27	2.81
Europe/North America	32	16.22	3.40
Asia	48	15.67	3.14
Syria	58	14.81	3.60
Africa	12	14.67	3.26
Egypt	77	14.55	3.31

$p = 0.001$

Table 7.25 Significant exploratory variables in multiple regression analysis of dentists' respondent to the VIs (VI Scale) included: regression coefficient (b), significance (*p*), with 95% Confidence Interval (CI) for β

Variables	b♠	*p*	95% CI lower bound	95% CI upper bound
Country of obtained undergraduate qualification*				
Saudi Arabia	1.79	0.037	1.11	3.47
Asia	2.23	0.011	0.52	3.94
Egypt	2.44	0.002	0.89	3.99
Syria	2.49	0.003	0.83	4.14

* Base line –Europe/North America coded as 0, each of the other variables coded as 1

♠ Represents the differences in mean scores between the specified country and Europe/North America. A positive difference implies that the mean score for the specified country is greater than that for Europe/North America.

Table 7.26 Significant exploratory variables in multiple regression analysis of dentists' respondent to the HIs (HI Scale) included: regression coefficient (b), significance (*p*), with 95% Confidence Interval (CI) for β

Variables	b	*p*	95% CI lower bound	95% CI upper bound
Country of obtained undergraduate qualification*				
Egypt	1.35	0.019	0.08	2.99

* Base line –Europe/North America

Table 7.27 Significant exploratory variables in multiple regression analysis of dentists' differences to the VIs (VI Scale) and HIs (HI Scale) scores included: regression coefficient (b), significant (*p*), with 95% Confidence Interval (CI) for β

Variables	b	*p*	95% CI lower bound	95% CI upper bound
Country of obtained undergraduate qualification*				
Asia	1.66	0.046	0.02	3.30
Saudi Arabia	2.06	0.004	0.65	3.47

* Base line –Europe/North America

CHAPTER EIGHT

Dental students questionnaire

Attitudes of the first and final year dental and medical students towards people with sensory impairments and disabilities – A survey in King Saud University, Riyadh

8.1 Introduction

Dental educators have recently become aware of the importance of developing positive attitudes among students with regard to the treatment of people with disability (O'Donnell, 1993). This emphasis stems from a concern that dentists continue to be reluctant to provide care for these patients. The reasons for this behaviour are often stated as being a lack of training, insufficient experience, poor understanding, fear and an inability to establish rapport (Bhrolchain *et al.,* 1993; O'Donnell, 1996). Lee and Sonis (1983) showed that it is the attitude of dental students which will invariably predict whether they will provide care for these groups in their own clinics.

The medical literature indicates that there is a relationship between training experience and the willingness of dental and medical students to treat patients with disabilities (O'Donnell, 1993; Paris, 1993). In addition, the attitudes of students' changes within their undergraduate careers, thus O'Donnell (1993) showed that attitudes of fourth year dental students were more favourable than third year students. The reason for this improvement was perceived to be due to an increased contact with special care patients during the fourth of the undergraduate curriculum (O'Donnell, 1993). Paris (1993), also showed that fourth year medical students in North America held significantly more positive attitudes towards people with disabilities than first year students, again citing and increase awareness of psychosocial issues in the medical education curriculum as the reason for this change. These changes in attitudes within the dental and medical curriculum can also be influenced by demographic variables such as gender and previous contact with these groups (Yuker and Block, 1986; Brillhart *et al.,* 1990; Paris, 1993).

The most widely used scale, in the dental field, to determine attitudes towards a people with disabilities is the Scale of Attitudes toward Disabled Persons (SADP). A description and background to this scale and the modifications made to the original scales are discussed in chapter 7.

The SADP is a general scale and attempts to quantify the attitudes of individuals towards people with disabilities in society in general and the roles they should play. A more specific attitude scale to determine dental students' attitudes toward dental care for patients with disabilities and their teaching experience in this field is the Dental Student Attitude Toward the Handicapped Scale (DSATHS). This scale has been shown to be reliable and valid when tested among dental students studying in the USA (Lee and Sonis, 1983) and the Hong Kong Chinese (Bedi *et al.,* 1986).

8.2 Aim

The aim of this study was to determine the attitudes of the first and final year dental and medical students toward sensory impaired people using the Modified SADP. In addition the DSATHS was administered to final year dental students.

8.3 Hypothesis

1 There is a difference in the Modified SADP scores between the first and final dental students.
2 There is a difference in the Modified SADP scores between the first and final medical students.

3 The final year dental students are more likely to produce favourable Modified SADP scores than final year medical students.
4 Final year dental students have a favourable view of their undergraduate training in special care dentistry.

8.4 Method

8.4.1 Sample

All first and final clinical dental and medical students attending King Saud University, Riyadh were included in the survey. The names of all students were obtained from the University central administration. Approval for the study was obtained from the University Central Research Committee and support was gained from the medical and dental deans. The clinical years in dentistry commence in the third year with the fifth being their final years. The same is true of the medical students except that the clinical course commences in the fourth year.

8.4.2 The questionnaire design

A questionnaire was developed to assess students' general attitudes toward sensory impaired children (App. 11 and 12)

The questionnaire consisted of three parts; personal details and two attitudinal scales (MSADP and DSATHS).

The Modified SADP has been discussed in Chapter 7.
The DSATHS scale consists of a 32-item self-administered questionnaire; respondents are asked to rate each statement according to the degree, with which they agree or disagree. The scoring consists of selecting a numerical value from

five possible alternative responses: Strongly Agree (SA=5), Agree (A=4), Undecided (U=3), Disagree (D=2), and Strongly Disagree (SD=1). The scale is designed to allow a total score to be obtained, which is a measure of the subject's general attitude toward patients with disabilities. The DSATHS allows further analysis of this attitude by grouping statements within the questionnaire into two factors. Statements 1, 3, 5, 7, 10, 12, 14, 17, 19, 21, 23, 25, 26, 27, 28, 29, 30, 31 and 32 reflect attitudes about knowledge, self-confidence, enjoyment, responsiveness and empathy when working with disabled people and the scores for these statements represent the value for factor 1. These statements were related to educational experiences and the perceptions of instructors. Statements 2, 4, 6, 8, 9, 11, 13, 15, 16, 18, 20, 22 and 24 (making up factors 2) primarily focus on attitudes toward interpersonal and future interaction with patients with disabilities.

8.4.3 The survey

A self-administered questionnaire with a covering letter was given to each student personally by a single researcher (MS). Any questions and concerns were addressed on an individual basis and anonymity was assured. MS collected the completed questionnaires and non-responders were followed up and encouraged to complete the forms.

8.4.4 Data management

The data were coded and entered onto the SPSS program for statistical analysis. Chronbach's coefficient alpha (α) was used to determine the internal reliability of the attitude scales and factor analysis was used to test the scales validity. The sample t-test was used to compare MSADP and DSATHS score differences between the groups. Statistical significance was established at the 5% level.

8.5 Results

8.5.1 Response rate

All the students completed the questionnaires (response rate 100 %).

8.5.2 Profile of the groups

Data was collected from four groups: 3 rd year dental students (No.=58), 5 th year dental students (No.=56), 4 th year medical students (No.=54), and 5th year medical students (No.=43).

For dental students, the sample consisted of 36 male (62%) and 22 female (38%) 3rd year dental, 26 male (46.4) 30 female (53.6%) 5th year dental. For medical students, the sample consisted of 33 male (61%) and 21 female (39%) 4th year medical and finally 23 male (53.5%) and 20 (46.5%) female 5th year medical.
In three of the four groups there were more males than females; the 5th dental student were the exception. There is no significant difference between the groups in their gender balance ($p = 0.093, p = 0.570$).

Participants were asked to indicate whether there were any individuals with a disability amongst their family or close friends. Both groups showed that there was very little previous contact for both dental and medical students and any differences were not significant (Table 8.1).

8.6.3 Modified SADP

8.6.3.1 Internal Reliability

8.6.3.1.1 Dental students

Chronbach's coefficient α for the Modified SADP scores for the 3rd year was 0.510 while 0.507 for the 5th year students. This shows the scale to be a relatively reliable tool for the populations under study.

8.6.3.1.2 Medical students

Chronbach's coefficient α for the Modified SADP scores was 0.622 for the 4th year while 0.715 for the 5th year students. This shows the scale to be reliable tool for the populations under study.

8.6.3.2 Factor analysis

The Kaiser-Meyer-Olkin (KMO) was 0.50 and the Bartlett test of sphericity was 0.001, indicating the adequacy of sampling and suitability for factor analysis. An initial factor analysis of the principal components was performed on the scores and the eigenvalues of the unrotated factor matrix are seen in Table 8.2. An examination of the unrotated factor matrix and the application of Cattell's scree test (Cattell, 1966) and the Kaiser Criterion (Kaiser, 1960) to the eigenvalues of the sample supported the retention of four interpretable factors (Fig. 8.1).

On the principal components to four factors groups, the combined values were 36.4% of the common variance. Rotation of the factor matrix was performed to the Varimax criterion. Factor loadings are seen in Table 8.3. In analysing the

items in each of retained factors, only those items were selected that loaded at least 0.3 or were graded in absolute value.

The statements marked with * could be grouped together in relation to the respondents' perception of the statement, such that the highest factor weight among the four factors should be selected.

The statement groups are:

Group 1 Statements 1, 3, 9, 13, 16, 17 and 18

This group was concerned with misconceptions about social normalisation and employment, and positive attitudes toward employment of sensory impaired people.

Group 2 Statements 5, 10, 14, 19 and 20

This group was concerned with positive attitudes toward social normalisation and employment.

Group 3 Statements 4, 8, 12 and 15

This group was concerned with misconceptions toward people with sensory impairment

Group 4 Statements 2, 6, 7, 11 and 21

This group was concerned with social normalisation and integrating into society, and (in Statement 7) negative misconceptions.

8.6.3.3 Modified SADP Scores

8.6.3.3.1 Dental students

The mean score for the 3rd year dental students was 65.81 (SD $\pm$ 5.15) while for 5th year was 69.84 (SD $\pm$ 6.30).

There was no significant difference between the student's gender and previous contact to person with disability in their Modified SADP score (Table 8.4).

8.6.3.3.2 Medical students

The mean score of the 4 th year medical students was 71.30 (SD $\pm$ 7.47) while for 5th year was 71.00 (SD $\pm$ 8.61).

There was no significant difference between the student's gender and previous contact to person with disability in their Modified SADP score (Table 8.5).

8.6.3.4 Comparison between the groups

When the two dental groups were compared, 5th year dental students had more favourable attitude than the 3rd year (p = 0.050) (Table 8.6). Although this difference was marginal, 95% confidence interval was as high as 4.01. A score of 75 on the MSADP scale is positioned in the 90th percentile for the 3rd year but is in the 75th percentile for the 5th year (Fig 8.3).

For medical students (control group), there was no statistically significant difference between the 4th and 5th year (p = 0.965) as shown in Table 8.6.

Comparison between 3rd year dental and 4th year medical students showed to be statistically significant difference (p = 0.005) with 95% confidence interval as high as 3.5, such medical students had more favourable attitude than dental students (Table 8.7 and Fig. 8.4). A score of 75 on the MSADP scale is positioned in the 90th percentile for the 3rd year dental but is in the 70th percentile for the 4th year medical.

Meanwhile that was not true when 5th year dental and medical students were compared such both the two group similar value of score mean (Table 8.7).

8.6.4 DSATHS

It has been shown to be reliable and valid when tested among dental students studying in United States and Hong Kong population. In the present study Chronbach's coefficient α for the DSATHS scores was 0.8577. This shows the scale to be reliable tool for the populations under study.

8.6.4.1 Factor analysis

DSATHS was shown to have good content validity. To ensure that the scale was valid in cultural values of Saudi Arabia, an attempt was made to isolate those factor in the course that were most conducive to learning and attitude change for the Saudi students. A factor analysis was preformed to explore the dimensions of the scale. A principal component analysis procedure resulted in nine factors with values greater than one which accounted for 77.46% of the total variance (Table 8.8). Rotation of the factor matrix was performed to the Varimax criterion. Factor loadings are seen in Table 8.9. In analysing the items in each of retained factors, only those items were selected that loaded at least 0.3 or were graded in absolute value.

When the number of factors was limited to two, as recommended by the original designers, all 32 items except four fell into the retrospective factor, however, when limited into three factors all items included (Fig. 8.5).

Therefore, with the high reliability of DSATHS and the method of analysis by three factors where the third factor included only statements that related to interpersonal and future interactions, the results provide supportive evidence for the validity of the scale for the Saudi students.

The statements marked with * could be grouped together in relation to the respondents' perception of the statement, such the highest factor weight between the three factors should be selected.

Group 1 Statements 1, 3, 5, 7, 10, 12, 14, 17, 19, 21, 23, 25, 26 29, 30 and 31. This group was concerned with educational experience and perception of instructors.

Group 2 Statements 2, 6, 8, 9, 11, 15, 16, 20, 22, 27, 28 and 32

This group was concerned with educational experience, perception of instructors, and interpersonal and future interaction with disabled people.

Group 3 Statements 4, 13, 18, and 24

This group was concerned with interpersonal and future interaction with disabled people.

The factor weighting for statement 15, 20, 22, 30 and 31 could be placed in group 3 as well.

8.6.4.2 Score

The scale is designed to allow a total score to be obtained that is a measure of the subject's general attitude toward people with handicapping conditions. The mean score of DSATHS was 84.91 (SD $\pm$ 10.58). The 5th year dental student score on DSATHS indicate to be positive toward people with disability (Fig 8.6) thereby confirming that the course fulfilled its primary objective in producing favourable attitude among the students. A comparison of item mean scores showed that the 5th year students had a more favourable attitude on 22-items which included the statements that related to their educational experience and perception of instructions.

All students scored higher on factor 1 statements (educational experience and perception of instructions) and lower on factor 2 statements (interpersonal and future interactions with the handicapped).

There was no statistically significant difference in DASTHS score between the students' gender and previous contact to person with disability (Table 8.10).

8.7 Discussion

The attitudes of students toward people with sensory impairment have not been explored in dental research before, and certainly not using a Saudi population.

8.7.1 Response rate

The response rate of this study was 100%. The personal contact with the students was considered important and one of the authors (MS) established contact and ensured respondents of their anonymity.
The high response rate (100%) was possibly achieved by the personal contact and ongoing follow-ups (Dillman, 1978; Oppenheim, 1992).

8.7.2 Attitude toward sensory impaired people in society using Modified SADP

Attitudes toward people with disability can be defined as learned, emotionally toned predispositions that represent values and beliefs, with components of these attitudes being knowledge, feelings and actions (Brillhart *et al.,* 1990).

To enable to test the consistency of the attitude of students from the modifed scale, relability and validity were measured. The scale was found to be reliable and internally consistent in its used on Saudi population and a four-factor analysis accounted for 36.4% of the variance. This is not consistent with the original findings by the scale originator (Antonak, 1982). However, since the purpose of the analysis was to link statements together into factors, those statements must be

related to one another and therefore the statement in the four factors were linked to each other except statement No. 7. Because of this and the small numbers involved in the dental student groups, it was decided to utilise the total score for the analysis.

The scale was used in the study since it compares result obtained from different groups. Overall, there was general agreement with all statements in the scale except for statements 1 ("sensory impaired should not be provided with a free public education"), statement 2 ("sensory impaired people are not more accidents prone than the other people") and 8 ("A sensory impaired person is like a child"); the students tended to have a negative attitude toward these statements.

The result indicated that the 5th year dental students scored marginally higher than 3rd year. Therefore, the attitudes of the 5th year dental students toward persons with a sensory impairment were more favourable than 3rd year. This could be due to the more contact to patients with disability in their undergraduate curriculum. Dentistry in Saudi Arabia has a long association with the American dental system at the undergraduate level. The dental curriculum contains lectures on special care dentistry in the third year in aiming to prepare them to clinical training in the fourth and fifth year. The special care dentistry topic is included in the paediatric course in the fourth and fifth year. The fourth and fifth year course involved six-hour clinical session each week and two hour didactic teaching. The curriculum consisted of treating children with disabilities, medical compromised and hospitalised dentistry. Also, the fifth year had a community preventive and dental education programme in their last three months before graduation which some students can chose to specialise in the dental care of a special needs group.

The positive and favourable attitude of the 5th year dental students in this study was in agreement to other studies, in which 5th year students were marginally better than the 3rd year students (O'Donnell, 1993). Also, fourth year medical

students hold significant more positive attitudes toward people with physical disabilities than do the first year (Paris, 1993). However, the study findings was in contrast to Duckworth (1988) where no difference in the attitudes held by first and fourth year medical students, and senior house officers using ATDP Scale (Attitudes Towards Disabled Persons). For medical students, there was no difference between 4th and 5th year and was in agreement to Duckworth study.

First year medical students had more favourable attitude than dental students. Studies from Nottingham (Mitchell *et al.,* 1984) and Leeds (Hordon *et al.,* 1993) were in agreement to the present study, where medical students over their years of training show increasingly positive attitudes toward people with disability. Also, O'Donnell (1993), reported that non-dental students had more favourable attitude than the dental students.

The development of a positive attitude toward people with disability in future dentists is important for several reasons. A negative attitude may not only mean less satisfactory treatment for the disabled individual, but also may have implications for the sharing out of scares resources and delivery of services. Health professionals involved in the rehabilitation of people with disability have a special responsibility, as any negative attitude may adversely affect their patients' adjustment to disability (Hordon *et al.,* 1993).

The attitude of the dental student's as well as medical students were similar regarding the gender difference. Previous research has been in contrast to this finding were females in generally and medical students in particularly have more positive attitudes toward people with disability than do their male peers (Brillhart, 1990; Paris, 1993). However, O'Donnell (1993) reported that no sex differentiation was found in their dental student's sample.

The amount of contact that dental students have with people with disability during their undergraduate study has been found to influence their willingness to treat disabled patients in general practice (O'Donnell, 1985).

Stiff and Phipps (1964) found that students who were exposed to "special" patients actually worsened in their attitude and become more negative toward treating these patients. Miller and Heil (1976) reported similar results after a program of exposure to older patients.

The present study showed that contrary to previous studies in this area, post contact with people with disability did not have any significant influence or positive effect on attitudes. Donaldson (1980) and Furnham and Pendred (1983) found that contact on an equal-status basis has been associated with positive attitudes toward people with disability. However, Paris (1993) reported that medical student attitude have not been influenced by their contact to people with a disability.

8.7.3 Attitude of dental students toward people with disability using DSATHS

An important aspect in analysing the scale is to confirm its reliability. The scale showed a reasonable level of reliability; Chronbach's coefficient α score of 0.8577.

Students enter dental school with attitudes determined by personal experience, family, culture and society in general. During their undergraduate training they are influenced by contact with patients, fellow students and teachers. Some may consider that health professionals may be the best people to teach about attitudes, as they have medical knowledge about disabilities and frequent contact with disabled people. However, health professionals are not exempt from negative attitude (Gething, 1992) perhaps acquired because they mainly come across people with disability requiring help, rather than healthy people with disabilities in the community.

The mean of the total score of DSATHS was high, thereby confirming that the course fulfilled its primary objective in producing a favourable attitude among the 5th year dental students.
The attitude of final year Saudi dental students showed to be similar to attitude of US dental (Lee and Sonis, 1983) and Chinese dental students (Bedi *et al.,* 1986), which tested by the same scale.

The students had more favourable attitude on factor 1 statements that inclined to view their education experience as positive and their instructors as self-confidence, responsiveness or knowledge of patients with disability. A comparison in the light of a US study (Lee and Sonis, 1983), students scored low on factor 1 statements. However, the Chinese students were in agreement to present study who scored high on factor 1 (Bedi *et al.,* 1986).

Although the final year dental students showed to have positive attitude toward people with sensory impairment as tested by MSADP and DSATHS, but their willingness to provide care for this group need to be follow up after post-graduation.

8.8 Conclusion

The attitudes of dental students as well as medical students were generally positive toward sensory impaired people. This attitude had no association with their socio-demographic status.
The final year dental students showed to have more positive attitude than the first year clinical. Although first medical students were more positive toward sensory impaired people than first year clinical dental students, this difference was not observed among final year dental students. A significant improvement among dental students was noted. This difference was confirmed by a positive attitude of

final year dental students towards their educational curriculum tested by DASTHS.

8.9 Principal findings

- The attitude of the 5th year dental students was more positive than 3rd year toward sensory impaired people.
- There were statistically significant differences between 3rd year dental and 4th year medical students, were medical students had more favourable attitude than dental students.
- There was no difference in attitude between 4th year and 5th year medical students.
- Gender and previous contact to people with disability were not statistically significant associated with attitude scores among dental and medical students.
- The final year dental students were positive regarding their educational curriculum.

Table 8.1 Contact with disabled people

Response	3rd dental	5th dental	4th medical	5th medical
Yes (%)	11(19.3)	11 (21.6)	8 (14.8)	4 (9.5)
No (%)	46 (80.7)	40 (78.4)	46 (85.2)	39 (0.5)

Table 8.2 Eigenvalues of unrotated factor matrix of the Modified Scale of Attitudes toward Disabled Persons (MSADP)

Statements	Eigenvalues	Factor	% of variance	Cumulative %
1	2.423	1	13.784	13.784
2	2.188	2	8.545	22.329
3	1.965	3	7.416	29.745
4	1.669	4	6.631	36.376
5	1.557	5	6.323	42.699
6	1.318	6	5.861	48.560
7	1.190	7	5.335	53.895
8	1.129	8	5.058	58.953
9	0.994			
10	0.943			
11	0.863			
12	0.784			
13	0.669			
14	0.610			
15	0.529			
16	0.517			
17	0.431			
18	0.362			
19	0.306			
20	0.300			
21	0.255			

Fig.8.1 Scree Plot factor of the Modified Scale of Attitudes toward Disabled Persons (MSADP) for Dental Students

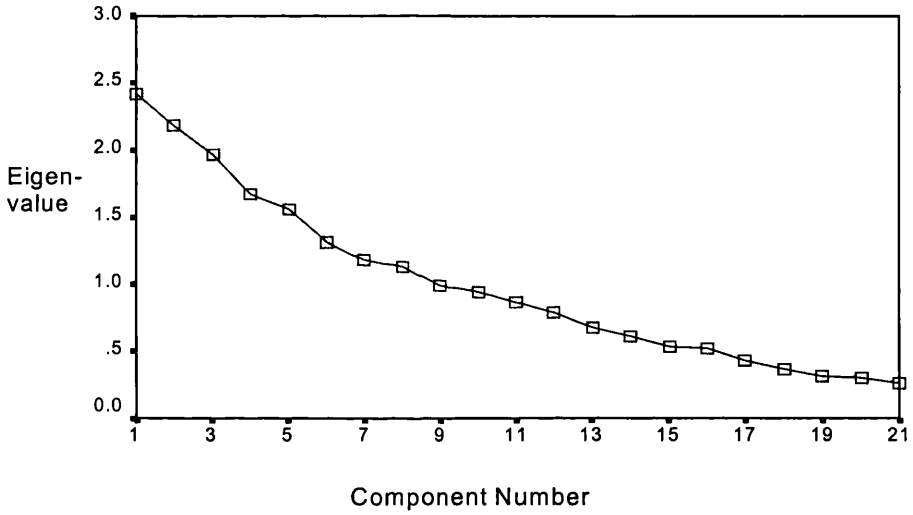


Table 8.3 Varimax rotational method of the Modified Scale of Attitudes toward Disabled Persons (MSADP), factor loadings

Statements	Factor 1	Factor 2	Factor 3	Factor 4
1	0.591*	0.233	0.193	0.119
2	0.087	0.004	0.195	0.748*
3	0.515*	0.313	0.286	0.086
4	0.133	0.106	0.703*	0.134
5	0.032	0.501*	0.392	0.237
6	0.150	0.050	0.477	0.552*
7	0.097	0.037	0.173	0.425*
8	0.043	0.213	0.244*	0.207
9	0.559*	0.177	0.041	0.023
10	0.363	0.529*	0.176	0.012
11	0.356	0.365	0.031	0.417*
12	0.139	0.334	0.449*	0.07.2
13	0.445*	0.040	0.097	0.129
14	0.081	0.523*	0.007	0.081
15	0.097	0.043	0.685*	0.212
16	0.685*	0.042	0.068	0.056
17	0.469*	0.232	0.040	0.051
18	0.428*	0.216	0.232	0.168
19	0.057	0.540*	0.152	0.272
20	0.06.2	0.572*	0.012	0.177
21	0.145	0.334	0.083	0.485*

* Statements grouped together

Fig 8.2 Difference of the Modified Scale of Attitudes toward Disabled Persons (MSADP) score between 3rd and 5th year dental students

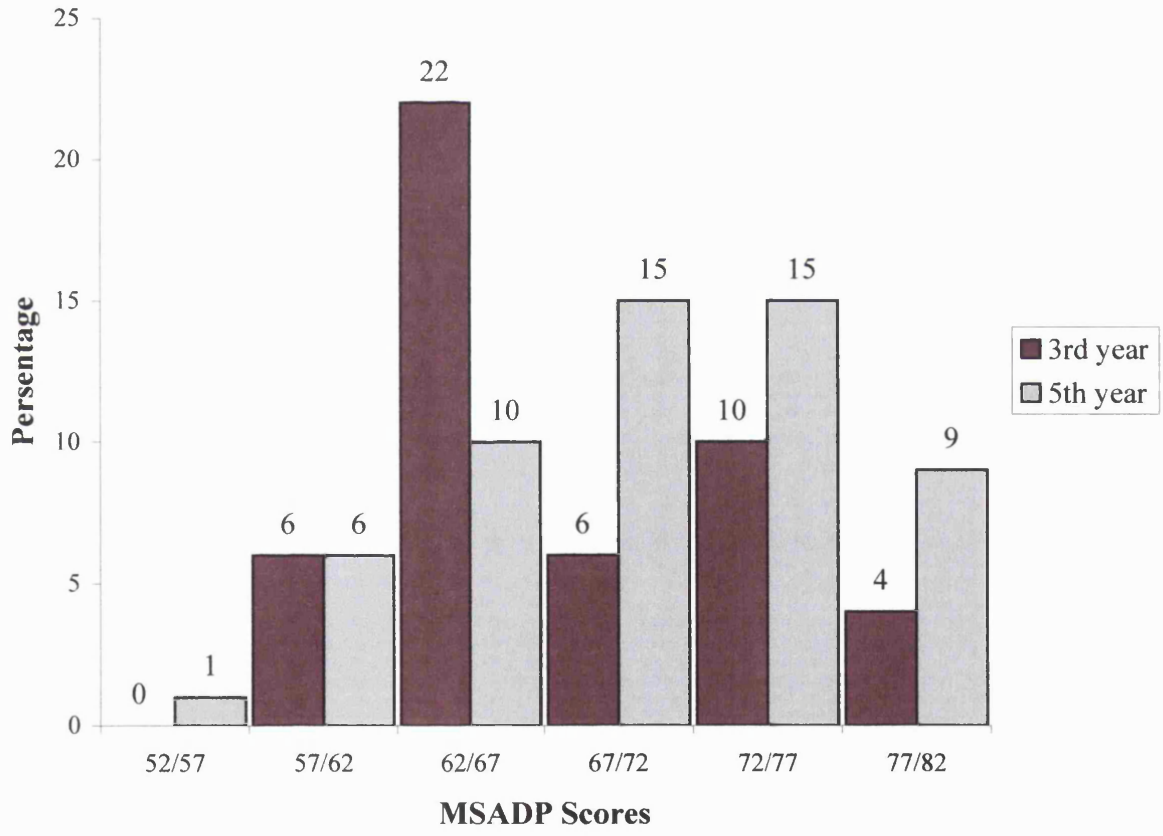


Fig 8.3 3rd/5th year Dental students, Modified Scale of Attitudes toward Disabled Persons (MSADP) Percentile Score Curves

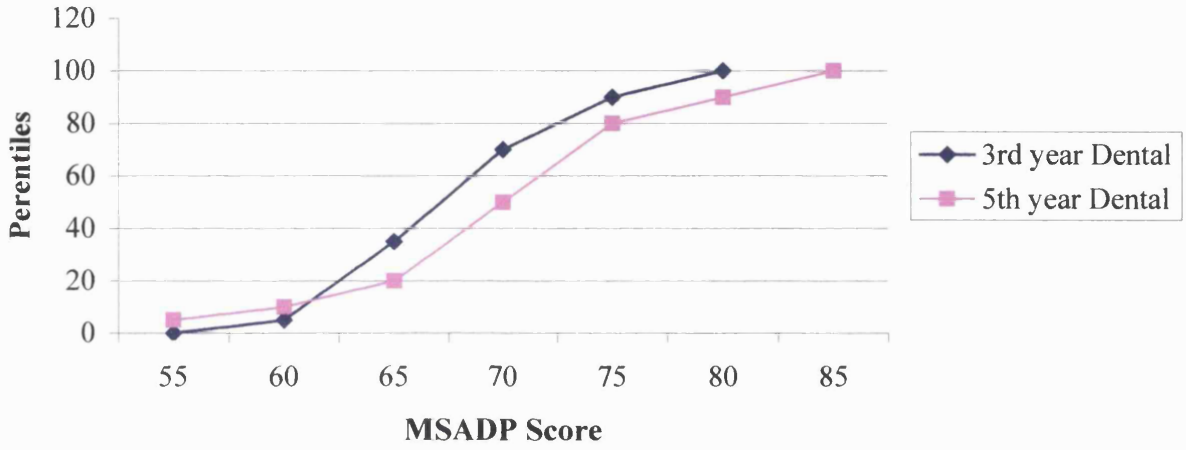


Fig 8.4 3rd year Dental/4th year Medical, Modified Scale of Attitudes toward Disabled Persons (MSADP) Percentile Score Curve

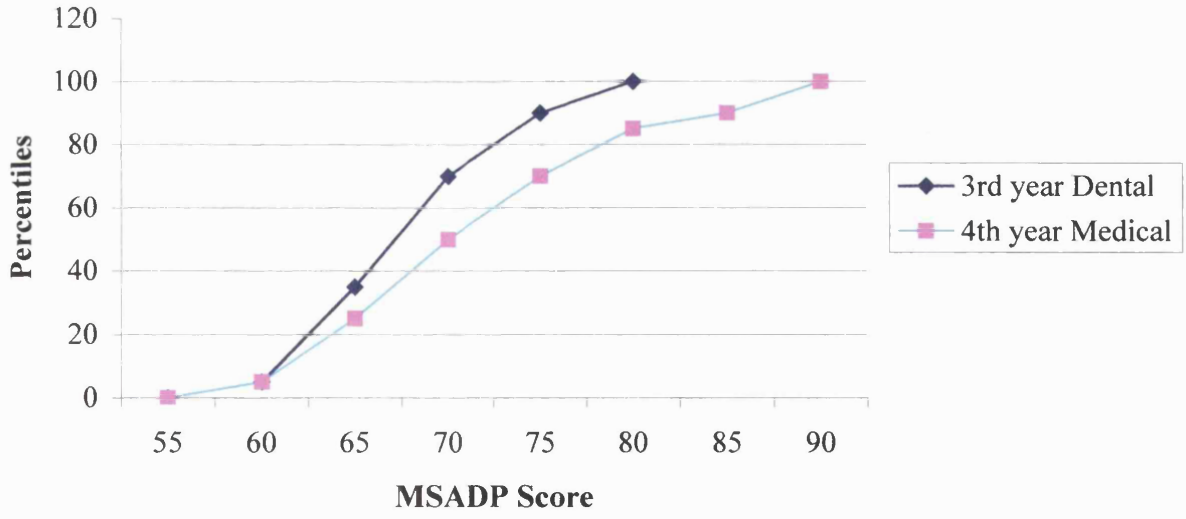


Table 8.4 Modified Scale of Attitudes toward Disabled Persons (MSADP) score of dental students in relation to gender and previous experience with disabled people included: standard deviation (SD), significance (*p*)

3rd year dental students				
Variables	**Number**	**Mean**	**SD**	***p*-value**
Gender				0.685
Female	22	67.45	6.08	
Male	36	68.03	4.58	
Previous contact to person with disability				0.822
Had	11	68.00	6.00	
Had not	46	67.61	4.94	
5th year dental students				
Variables	**Number**	**Mean**	**SD**	***p*-value**
Gender				0.745
Female	30	70.10	6.36	
Male	26	69.54	6.33	
Previous contact to person with disability				0.643
Had	11	68.91	5.15	
Had not	40	69.93	6.68	

Table 8.5 Modified Scale of Attitudes toward Disabled Persons (MSADP) score of medical students in relation to gender and previous experience with disabled people included: standard deviation (SD), significance (*p*)

4th year medical students				
Variables	**Number**	**Mean**	**SD**	***p*-value**
Gender				0.341
Female	21	72.52	7.35	
Male	33	70.52	7.56	
Previous contact to person with disability				0.663
Had	8	72.38	5.04	
Had not	46	71.11	7.85	
5th year medical students				
Variables	**Number**	**Mean**	**SD**	***p*-value**
Gender				0.093
Female	20	73.65	7.79	
Male	23	69.22	8.93	
Previous contact to person with disability				0.463
Had	4	74.50	4.80	
Had not	38	71.11	8.95	

Table 8.6 Student *t*-test for Score comparison between 3rd and 5th year dental students and between 4th and 5th year medical students for the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: significance (*p*), Standard Deviation (SD), 95% Confidence Interval (CI)

Groups	**Mean**	**SD**	**Group**	**Mean**	**SD**
3rd year dental	65.81	5.15	**4th year medical**	71.30	7.47
5th year dental	69.84	6.30	**5th year medical**	71.28	8.61

$p = 0.050$, 95% CI –4.16-0.10, 3rd Dental vs 5th year

Table 8.7 Student *t*-test for Score comparison between 3rd year dental and 4th year medical students and between 5th year dental and 5th year medical for the Modified Scale of Attitudes toward Disabled Persons (MSADP) included: significance (*p*), Standard Deviation (SD), 95% Confidence Interval (CI)

Groups	Mean	SD	Group	Mean	SD
3rd year dental	65.81	5.15	**5th year dental**	69.84	6.30
4th year medical	71.30	7.47	**5th year medical**	71.28	8.61

$p = 0.005$, 95% CI –3.5-1.21 3rd Dental vs 4th Medical

Table 8.8 Eigenvalues of unrotated factor matrix of the Dental Student Attitude Toward the Handicapped Scale (DSATHS)

Statements	Eigenvalues	Factor	% of variance	Cumulative %
1	8.409	1	26.277	26.277
2	4.377	2	13.678	39.955
3	2.881	3	9.004	48.959
4	2.146	4	6.705	55.664
5	1.753	5	5.478	61.142
6	1.443	6	4.509	65.651
7	1.392	7	4.351	70.002
8	1.272	8	3.976	73.979
9	1.115	9	3.486	77.464
10	0.975			
11	0.837			
12	0.773			
13	0.676			
14	0.563			
15	0.478			
16	0.436			
17	0.411			
18	0.344			
19	0.321			
20	0.278			
21	0.226			
22	0.192			
23	0.161			
24	0.114			
25	0.103			
26	0.080			
27	0.070			
28	0.063			
29	0.038			
30	0.036			
31	0.019			
32	0.013			

Fig 8.5 Scree Plot factor of the Dental Student Attitude Toward Handicapped Scale Score (DSATHS)

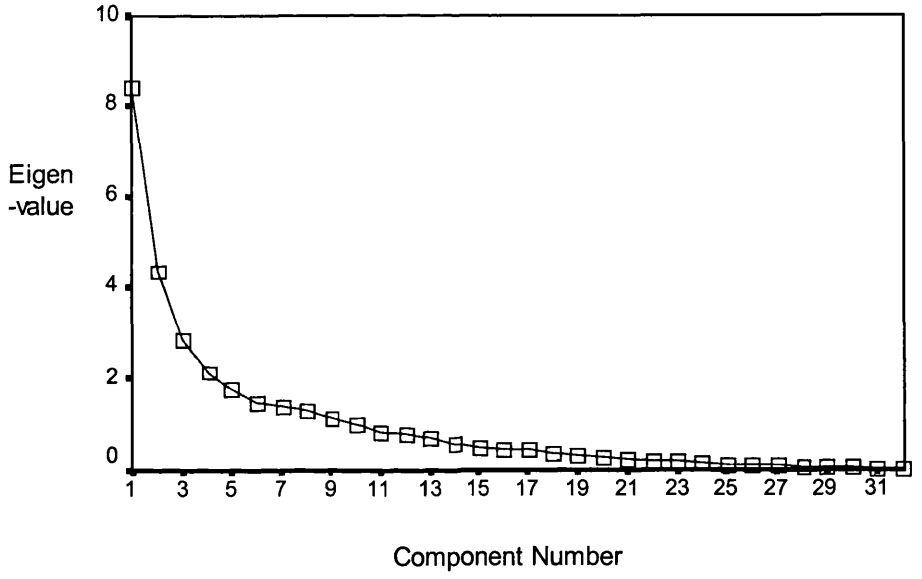


Table 8.9 Varimax rotational method, Dental Student Attitude Toward Handicapped Scale (DSATHS), factor loadings

Statements	Factor 1	Factor 2	Factor 3
1	0.705*	0.244	0.016
2	0.161	0.387*	0.168
3	0.730*	0.002	0.216
4	0.107	0.08492	0.338*
5	0.693*	0.334	0.094
6	0.068	0.564*	0.485
7	0.682*	0.105	0.034
8	0.045	0.505*	0.165
9	0.162	0.728*	0.039
10	0.791*	0.260	0.095
11	0.326	0.726*	0.081
12	0.681*	0.389	0.096
13	0.200	0.215	0.321*
14	0.736*	0.117	0.083
15	0.300	0.368*	0.425*
16	0.091	0.434*	0.058
17	0.811*	0.110	0.085
18	0.023	0.039	0.534*
19	0.813*	0.250	0.211
20	0.112	0.408*	0.682*
21	0.674*	0.183	0.093
22	0.056	0.369*	0.678*
23	0.729*	0.066	0.309
24	0.138	0.155	0.402*
25	0.795*	0.01468	0.141
26	0.706*	0.164	0.091
27	0.123	0.752*	0.158
28	0.296	0.533*	0.068
29	0.448*	0.051	0.098
30	0.468*	0.074	0.646*
31	0.369*	0.274	0.582*
32	0.321	0.632*	0.107

* Statements grouped together

Fig 8.6 Dental Student Attitude Toward Handicapped Scale (DSATHS) Score of 5th year dental students

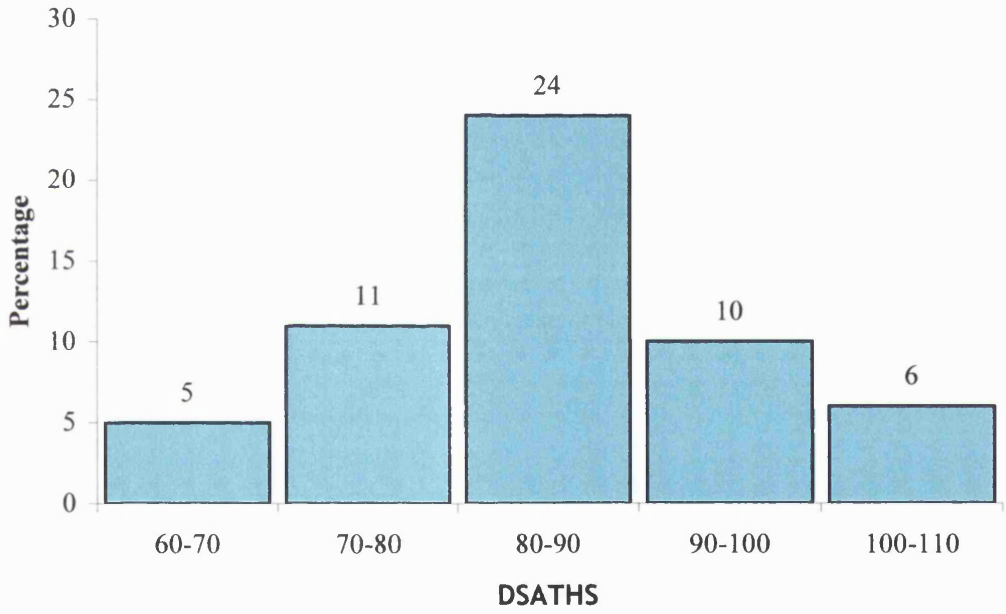


Table 8.10 Dental Student Attitude Toward the Handicapped Scale (DSATHS) score of dental students in relation to gender and previous experience with disabled people included: standard deviation (SD), significance (*p*)

5th year dental students				
Variables	**Number**	**Mean**	**SD**	***p*-value**
Gender				0.122
Female	30	82.87	11.11	
Male	26	87.27	9.60	
Previous contact to person with disability				0.271
Had	11	88.09	8.31	
Had not	40	84.15	10.87	

CHAPTER NINE

Discussion

9.1 Overview

Stigma and rejection for people with disabilities are common problems which in some cultures are exacerbated by deep rooted cultural and religious prejudices (Wang, 1992; Rogers-Dulan, 1998). Unsightly facial features also can aggravate these problems and reinforce the social exclusion of individuals (Albino *et al.*, 1994). The research theme for this thesis originated from a concern expressed by a number of voluntary groups who provide care for visually impaired children. Their concern was that VI children were not receiving orthodontic treatment and that their smiles were unattractive.

In an attempt to determine barriers to orthodontic treatment for this group, a number of new developments would be needed. First, a method assessing a VI child's perception of their malocclusion was required, since self perception of orthodontic treatment need is an important factor in determining the children who present for treatment (Brook and Shaw, 1989). The graphic modification of the IOTN was new and for the first time enabled researchers to explore the VI child's perception of their malocclusion. The development of this tool has been published in the literature (App. 13) and there has been widespread interest among researchers in this instrument.

The dental literature on the oral health status of sensory impaired children is sparse. Therefore, it was important to determine whether the oral health status especially caries prevalence and oral cleanliness was poorer. This was in order to explore whether poor oral care, expressed as high caries experience and poor oral cleanliness were the reasons for these groups not receiving orthodontic care. The assumption being that if dental disease was similar between children with sensory impairments and the control group then this could not be used as a reason for non-provision of treatment.

Orthodontic epidemiological studies of VI and HI children's malocclusion have not been reported in the medical literature. Indeed, the interview study on the child and their parents views as to their attitude for needing orthodontic treatment also appears to be unique.

Professional attitudes towards people with impairments have been well documented in the literature. The study did contribute to the literature in that this was the first time such views were documented in Saudi Arabia.

9.2 Discussion

The dental literature shows that on the whole children with special needs have a tendency for higher levels of oral health disease and malocclusion. The literature review undertaken in this thesis showed that all too often researchers have amalgamated special care groups into a single group. In this study careful consideration was given to the classification of the groups and it was shown that for there were significant variations between the two sensory impairment groups.

The present study found that 29-35% of the sample had a malocclusion due to an excessive overjet, with 40-45% of children having a tendency for Class II and Class III molar relationship. Also, 15%-22% of all children had a malocclusion that needed treatment due to presence of a crossbite or deviation. This normative orthodontic treatment is only part of the overall picture, and since much of orthodontic treatment is simply a cosmetic improvement, the child's and their parents perceptions are also important. It is generally accepted that an improved smile (occlusion) will enhance the individual's social acceptance and self-esteem (Shaw *et al.,* 1981). The patient's perception of his/her own dental appearance is therefore of considerable importance in determining orthodontic treatment demand and patient's compliance with treatment.

The study attempted to determine if a difference existed in the normative and perceived orthodontic treatment need between the three groups studied. Although there were no differences in the prevalence of malocclusion between the three groups, VI children had perceived they needed more orthodontic treatment than the other two groups and this coincided with the assessment of normative. The children in the control group were rated by the examiner as more attractive than the study groups. However, when the examiner categorised the children to different treatment needs, VI children were considered in need of more treatment than the other two groups. VI children tended to over score the examiner by a margin of 4-fold while the other two groups only over scored by 1-fold.

In an attempt to establish a degree of validation of whether the AC of IOTN actually represented the children's views on their orthodontic treatment need, an interview of each child was undertaken. VI children had concurred in their opinion with 65% perceiving and 61% for narrating treatment need. Nevertheless, control and HI children had narrated for treatment more than they had perceived a need with a 35% difference.

Most orthodontic patients are children or adolescents and according to this their guardians are likely to play an important role in initiating treatment and supporting compliance. Indeed, Pratelli *et al.* (1998) reported that the parent was the most powerful single factor in the motivation for treatment. Parents were found to have noticed occlusal defects in their children almost as frequently as dentists (Kilpelainen *et al.,* 1993). Thus, it is important that factors influencing parental attitudes and behaviours were investigated. In the present study 20% - 25% of all parent knew that their child had protruded or crowded teeth. VI parents believe that their children are not concerned about their dental appearance, also, in all the three groups parents thought that orthodontic treatment was expensive.

Determining dentists attitudes is difficult, but the widespread use of the SADP across different cultures gave the researchers confidence in its adoption. However, although attempts were made to pilot and adapt it for the cultural setting in Saudi Arabia, it is recognised that the dental profession in the country is very ethnically diverse. Therefore, it is unsure whether the scale was appropriate for all the groups. The resources available did not allow for the development of a new scale which may have been more appropriate for the wide ethnic mix of Saudi Arabia.

Using the modified SADP in the dentist's questionnaire, it was shown that 73% of the dentists who responded had a positive attitude towards sensory impaired people in society.

There is a ranking of different disabilities with regard to the level of discrimination or impact the impairment has in society. A person with visual impairment is ranked as number 5 in the degree of disabling condition but hearing impairment was ranked as number 10. By asking dentists their views in providing orthodontic care for VI and HI separately was an attempt to determine if there was a difference in their attitude to the two groups. A small scale of four statements was constructed to test the difference in dentist's attitude toward provision of orthodontic care for VI and HI children. Dentists tend to have more favourable attitudes with regard to providing orthodontic care for HI than VI children.

Dentistry in Saudi Arabia has a long association with the American dental system at the undergraduate level. The dental curriculum contains lectures on special care dentistry in the third year in aiming to prepare them to clinical training in the fourth and fifth year. Using SADP as a scale to determine people attitude toward various disabilities conditions were able to show that fifth year dental students were marginally more positive toward sensory impaired people than third year and that this possibly related to their educational curriculum which also tested using DSATHS.

9.3 Problems encountered in the study

This thesis project was unique in the Saudi Arabian context and several problems arose during this study. Gender roles are important in the Saudi culture and the provision of dental care. Dentists cannot examine members of the opposite sex unless they attend a clinic. School examinations on members of the opposite sex after primary school level are not permitted. In this study, special permission was obtained from the Ministry of Education to transport the boys to a dental clinic for the data collection and clinical examination.

The lack of a dental register in Saudi Arabia made the dentist survey difficult. Although the use of dental clinic lists and the telephone directory appeared to be comprehensive, it was difficult to know whether other dentists should have been contacted. In addition, although the response rate was reasonable for dental practitioner surveys, resources were not available for contacting non-responders to ensure that a biased sample had not been used.

9.4 Summary

In summary, this study has highlighted the need to consider VI and HI children as separate entities when dental care provision is being considered. It also showed that there is a hierarchy of discrimination for sensory impaired children, with dentists in particular having a more positive attitude to providing orthodontic treatment for HI children compared to the VI. There was no evidence to support the belief that VI children did not receive orthodontic care because they had significantly worse oral hygiene or high levels of dental decay. It is recommended that future research be undertaken to first, investigate more deeply why VI children are not receiving orthodontic care. Secondly, to determine ways to improve uptake and provision of dental care for sensory impaired children.

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Appendices

Appendix 1

Protocol of the study

Barriers towards the Provision of Orthodontic Treatment for Visual or Hearing Impaired Children In Saudi Arabia (Riyadh)

1.0 Introduction

1.1 In recent years, positive steps have been undertaken to improve the quality of life of disabled people and to sensitise society to their particular needs. These initiatives have focused on structural barriers to aid accessibility to public places; facilities for wheelchair access, disabled toilet facilities, appropriate signs, etc.. However, despite a growing awareness of the needs of disabled people, oral care and in particular orthodontic provision for this community has received little attention in the medical literature.

2.0 Understanding disability terminology

2.1 The term disability refers to any impairment that restricts or limits daily activity in some manner. Disabilities can be developmental in origin or acquired (Rehab Brief, 1993). Developmental disabilities are conditions identified in early childhood and usually persist throughout an individual's life (Tesini *et al.,* 1994). Etiologic factors of developmental disabilities are medically broad based and caused by a variety of conditions, including cerebral palsy, Down syndrome, mental retardation, autism, seizure disorders, hearing and visual impairments, congenital defects, and even social or intellectual deprivation. The acquired disabilities are caused by disability factors later in life and include neuromuscular disorders,

traumatic injuries, and psychiatric disorders producing various forms of physical and mental disabilities in the individual (Tesini *et al.,* 1994).

3.0 Oral Health Status

3.1 Tooth diseases, periodontal disease and malocclusion continue to present problems in the dental management of this patient population because the chronicity of oral diseases complicates the primary physical or mental disability (Tesini *et al.,* 1994). Research has suggested casual relationships between these oral diseases and the variables affecting them. The review of the literature for oral disease parameter associations remains controversial.

3.2 Parents and carers of children with disability frequently enquire about the possibility of orthodontic treatment. It may be tempting to dismiss the possibility of orthodontic treatment, but with a pragmatic approach to the diversity of problems presented by this group, it is possible to treat these patients successfully.

4.0 Orthodontic treatment need

4.1 The orthodontic management of patients with disability is poorly, described in the orthodontic literature. Although there are a number of papers which describe the prevalence of malocclusion amongst this group of patients (Jackson, 1967; Gullikson, 1969; Nunn, 1987; Oreland *et al.,* 1987), their practical clinical management is not described in detail. Recently Becker (1996) raised the issue of orthodontic treatment for these children and provided sidelines which may allow orthodontists to gain therapeutic access to these patients.

4.2 A major perceived benefit of orthodontic treatment is an improvement in appearance (Khan and Horrocks, 1991). If orthodontic treatment is carried out to improve aesthetics, then patients with disability are equally appropriate patients. The learning disabled represent a group who have problems with social handicap already. A poor dental appearance may lead to further negative stereotyping and rejection from their peers. Orthodontic treatment for a carefully selected group of these patients would seem to be justified.

5.0 Aim of the study

5.1 The aim of the study is to document the barriers to orthodontic care for children with a sensory (visual and hearing) impairment resident in Saudi Arabia.

5.2 Barriers to orthodontic care in terms of this study will be considered in 3 distinct areas:

a. **Educational barriers**

Exploration will be undertaken of attitudes of dental students at the beginning and end of their course. Students in the social sciences will be used as a control group.

b. **Attitudinal barriers of oral health professionals and parents**

The views of general dental practitioners (referring source and treatment) and orthodontist in providing dental care and orthodontic treatment for disabled children as well children with sensory impairments.

The views of the parents on barriers to obtaining dental care and orthodontic treatment for their children will be obtained.

c. **Normative and perceived orthodontic treatment needs of children with a sensory impairment.**

6.0 Objectives of the study

6.1 To develop a means of determining the aesthetic component of orthodontic treatment need (IOTN) for children with visually impairment.

6.2 To undertake an epidemiological dental survey of children with and without sensory impairment resident in the city of Riyadh with regard to their oral health status and orthodontic treatment needs (perceived and normative need).

6.3 To administer a self administered questionnaire to all parents and care providers of the children recruited into the study with regard to their attitude to provision of orthodontic care for their children.

6.4 To administer a self-administered questionnaire to all general dental practitioners and orthodontists working in with regard to their attitude to sensory impaired people in society using SADP. Also determine their attitude toward provision of orthodontic care for sensory impaired children.

6.5 To administer a self-administered questionnaire to first and final year undergraduate students in dentistry and medicine studying at King Saud University in Riyadh with regard to their attitude toward people with sensory impairment in

society. The questionnaire will be included the Scale of Attitude toward Disabled Persons (SADP).

6.6 To determine the view of final year dental students with regard to their undergraduate course in special needs dentistry using Dental Student Attitude Toward the Handicapped Scale (DSATHS)..

7.0 Null hypothesis

The null hypothesis of the study is that observed barriers to orthodontic treatment (educational, attitudinal or normative/perceived need) for Saudi Arabian children with or without a sensory impairment occur by chance.

8.0 Sample selection

The school students of the Al-Nour and Al-Amal for girls and boys aged 10-16 years will be included in the study. A consent form will be sent to the boys parents to have permission for their children to travel to the Dental College.

After obtaining the social classes the disabled students will be matched with the able students.

9.0 Training and calibration

The examiner will be adequately trained and familiar with the examination methods and criteria. Calibration for the IOTN was carried out in 10 th - 12th Dec 1997. The Weighted Kappa of the Aesthetic Component was 0.77 while for the Dental Health Component was 0.76 (App. 2).

A BASCD program for DMF and DDE will be carried out in 12th -14th Oct 1998 (App. 2).

9.1 Intra-examiner

Intra-examiner reproducibility for the study will be tested through repeat 10% of the sample size.

10.0 Methods Of Data Collection

10.1 Data sheet

A data sheet form had developed to obtain general information as well medical information about the child. The data include personal details, history of disability, level of their disability and their IQ. The medical information will be collected from the child medical note. The IQ level will be obtained according to the school description of their students education level. The degree of hearing impaired will be obtained form from the medical as it described according to Audiometric descriptor (British Society of Audiology recommendation, 1988). . The degree of visual impaired will be obtained form from the medical as it described according to visual acuity status (WHO, 1990).

10.2 Dental Examination

10.2.1 Dental Caries

The BASCD criteria will be used because these have been shown to be satisfactory and reproducible when assessing caries by visual examination.

The method for caries detection will be visual examination with a Daray "Versatile" light with G-clamp. The site will be cleaned using CPITN probe and cotton roll followed by visual examination. A predominantly visual method is widely used in dental surveys in the United Kingdom (O'Brien, 1994). Bitewing radiograph will not be used because of ethical, logistic and economic considerations and latterly because of the small amount of additional information it contributes (Downer 1975; Mileman *et al.,* 1983).

10.2.2 Periodontal condition

Each jaw will be divide into right, middle and left to examine the presence or absent of gingivitis, plaque and calculus using the National Health Survey codes (O'Brien, 1994).

10.2.3 Development Dental Defects

Teeth will be inspected visually using Daray light, and defective areas gently explored with a probe to determine abnormalities of surface contour. The development defects of dental enamel Index will be used (O'Brien, 1994).

10.2.4 Trauma of permanent Incisors

The teeth will be examined for the presence of enamel discoloration, fracture involving of enamel, dentine and pulp using the National Health Survey codes (O'Brien, 1994).

10.2.5 Malocclusion

The occlusion will be study from the patient mouth directly. Assessments will be made on the size of the child's overjet and overbite, incisor relationship, the presence of crossbite and crowding (O'Brien, 1994). The over jet and overbite will be measured with millimeter. The lingual and buccal crossbite will be recorded for the presence or absent of the condition. Angle classification will be used for incisors relationship.

10.2.6 Orthodontic Treatment Needs

Index of Orthodontic Treatment Needs (IOTN) will be used which designed to categorize malocclusion in terms of the significance of various traits for an individual's dental health and perceived aesthetic impairment (Jenny and Cons, 1996). It is intended to identify those individual who would most likely benefit from orthodontic treatment (Brook and Shaw, 1989). Because orthodontic treatment needs to be justified either aesthetic or dental health needs, and because there is little common ground between them, two components of assessment are required, the dental health component and the aesthetic component (McGuinness and Christopher, 1994).

a. The dental health component has five categories from 1 (no need for treatment) to 5 (great need), which may be applied clinically or to patient's study casts. A ruler has been developed to aid diagnosis. The following characteristics are assessed for the dental health component; missing teeth, overjet; crossbite, contact point displacement and overbite.

b. The aesthetic component consist of a ten-point scale illustrated by a series of photograph which were

rated for attractiveness by a lay panel and selected as being equidistantly spaced through the range of grades (Evan and Shaw, 1987). A rating is allocated for overall dental attractiveness rather than specific morphology similarity to the photographs. The final value reflects treatment need on the grounds of aesthetic impairment, and by implication the sociopsychological need for orthodontic treatment. To simplify the aesthetic component of IOTN for the visual impaired children, a Collage design of the photograph will be used.

10.3 Questionnaires

Questionnaires will be designed to determine the Knowledge and Attitude to orthodontic treatment for sensory impaired children to parents, general dental practitioners and dental students.

A questionnaire will be sent for the dental general practitioner and dental students to determine their opinion regarding their training and experience in dental care for the sensory impaired as well as their perception for orthodontic treatment needs and its provision. Another questionnaire will be sent for the parents through the head teacher to determine their perception to improve the child aesthetic through orthodontic treatment and get their consent.

11.0 EQUIPMENTS

Daray light.
Latex medical gloves
Mouth mirror
CPTIN probe.
IOTN modified Braille photographs and the original IOTN photographs
Orthodontic measuring rulers

12.0 The field

The examination for the female sample will be carried out in their school. A brief explanation of the study purpose will be given to them by the examiner and with the help of the social adviser in the schools for communication. The girls will be examined in the medical check up room one following the other.

The examination for the male sample will be carried out in the dental college. A brief explanation of the study purpose will be given to them as for the female

13.0 DATA PROCESSING

All clinical data will be entered directly onto prepared sheet suitable/designed for the database in Dental Survey 2 Program and SPSS for statistical manipulation.

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Appendix 2

Training and calibration of BASCD and IOTN

Dental Health Unit
Oak Lane Clinic
Oak Lane
East Finchley
London N2 8LT

Tel: 0181 343 2594
Answerphone: 0181 343 3930

Barnet Healthcare NHS TRUST

9 November, 1998

Dr Maha AlSarheed
11481 Riyadh
P O Box 3921
Riyadh
Saudi Arabia
FAX: 009661 464 79 37

Dear Dr AlSarheed,

Re: Calibration Exercise October 1998

I am writing to give you your individual results from the calibration exercise held in October. This letter is very similar to the letters being sent to the examiners you trained with and obviously some of the remarks will not be relevant to your situation. However I have entered all the information so that it gives you an idea of how your results relate to mine as "Gold Standard" and to those of the rest of the group. Overall your results are entirely satisfactory, your mean DMFT per child was within the 95% confidence interval for the group, and you can proceed with your surveys on that basis.

Caries: Despite screening before the calibration to identify children with caries, DDE and Ortho to train and calibrate on, we still ended up calibrating on 24 children with very few decayed or filled and no missing teeth. The group mean DMF for the 24 children examined was 0.76 teeth per child and ideally I would like it to have been a bit higher. Group mean is the mean DMFT for all the examiners *excluding* the benchmark examiner. My mean DMFT for the 24 children was 0.79. Your mean DMF was 0.75. Each dentist examined 672 teeth (24 children x 28 teeth). The average number of teeth scored as either decayed, filled or extracted was 18 and the benchmark examiner scored 19. You scored 18 teeth. The 95 % confidence interval for the group mean was 0.58 - 0.95. Ideally examiner's means should fall within the 95% confidence interval for the group mean and yours does.

Developmental Defects of Enamel: The results for DDE showed greater agreement than two years ago. I noted 6 children with one or more enamel defects and one child with a small demarcated defect of less than 1mm height and width which I therefore recorded as zero. You recorded 3 children with defects.

Orthodontic Examination: I scored 5 children with a Dental Health Component of 1 including one (borderline) child whose overjet was just about 6.5 mm. You scored 8 children as 1.

Aesthetic Component 6 were not examined orthodontically because they had a brace. Of the remaining 18 subjects there was good general agreement on 14 of them by the group when compared with the benchmark and overall. Your Aesthetic score component was 16 in general agreement with the benchmark and 2 where you differed by a slightly wider margin.

Trauma: This is the first time that we have recorded minor trauma involving enamel and there was a great difference of opinion as to how many traumatised teeth there were (Range 3 teeth to 11

teeth, benchmark scored 8 of which 6 were enamel trauma only). You scored 3 of which 1 was trauma into dentine and 3 enamel trauma.

Fissure Sealants: The average number of teeth scored as sealed was 15 and the benchmark examiner scored 16. You scored 17 sealed teeth.

General points for all: If a child has a **fixed** appliance you cannot assess for DDE so must write 9 in the DDE boxes in both type and extent. Do not leave blank and do not write a zero in the box.

There was some confusion about when to do, and when not to do the orthodontic assessments. If the child has a brace and you **see** it, either in the mouth or they pull it out of a pocket, then you do **not** do the any of the orthodontic assessment (Aesthetic and DHC). If they say that they have a brace but they haven't got it with them to show you, then you do the orthodontic assessment.

Don't forget to do both Aesthetic and Dental Health Component for each child you do assess. It is easy to forget to do the Dental Health Component at the end of the examination. Make sure that your recorder checks that the whole form is complete and prompts you if there are any blanks.

As there is such a variation of opinion on enamel trauma, record only trauma involving dentine in the dental chart to increase the level of agreement. Put a t, T, X or Y in the tooth code boxes only if there is trauma into dentine or obvious discolouration. Minor trauma which only involves enamel should not be entered in the caries chart at all but a code 2 (the code for enamel fracture) can be put in the box below the tooth chart - labelled "Additional Trauma Codes". DO NOT write the additional trauma codes into the caries chart or a code 2 for enamel trauma would get counted as caries into dentine, and a code 6 for an acid etch repair would get counted as a tooth extracted for caries. Make sure that your instructions to your recorder are completely clear and unambiguous.

My best wishes for your epidemiological work in Saudi Arabia.

Yours sincerely

(Mrs) C. J. Setchell
Senior Dental Officer

Ysgol Deintyddol
Coleg Meddygaeth Prifysgol Cymru
Division of Dental Health & Development
Head of Division: Professor Malcolm Jones

Parc y Walu
Caerdydd CF4 4XY
Tel/Ffôn: (44) (01222) 742447
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E-mail: DenHealth@cardiff.ac.uk

22nd December 1997

Maha Alsarheed
17 Northgate
Prince Albert Road
London
NW8 7RE

Dear Maha

Following the Occlusal Index Course held in Cardiff 10th – 12th December 1997, I enclose the results of the Calibration exercise.

I am pleased to inform you that you are calibrated in the use of the PAR Index and both Components of the Index of Orthodontic Treatment Need (Aesthetic and Dental Health). Congratulations!

With regard to the PAR Index the RMS was slightly higher than 5 but no statistically significant bias. With the Aesthetic Component bias was exhibited. However, the sensitivity, specificity and lower 95% confidence limits were very respectable.

I enclose the results and certificate.

You may be interested to know the collective results of the calibration exercise. The percentage of calibrated examiners were:

PAR Index – 85%
Aesthetic Component – 67%
Dental Health Component – 94%

If you have any queries do not hesitate to contact me.

It was nice meeting you and I hope you enjoyed your time in Cardiff.

All the best for the New Year.

Best wishes,

Dr Stephen Richmond
Reader in Orthodontics

Encs

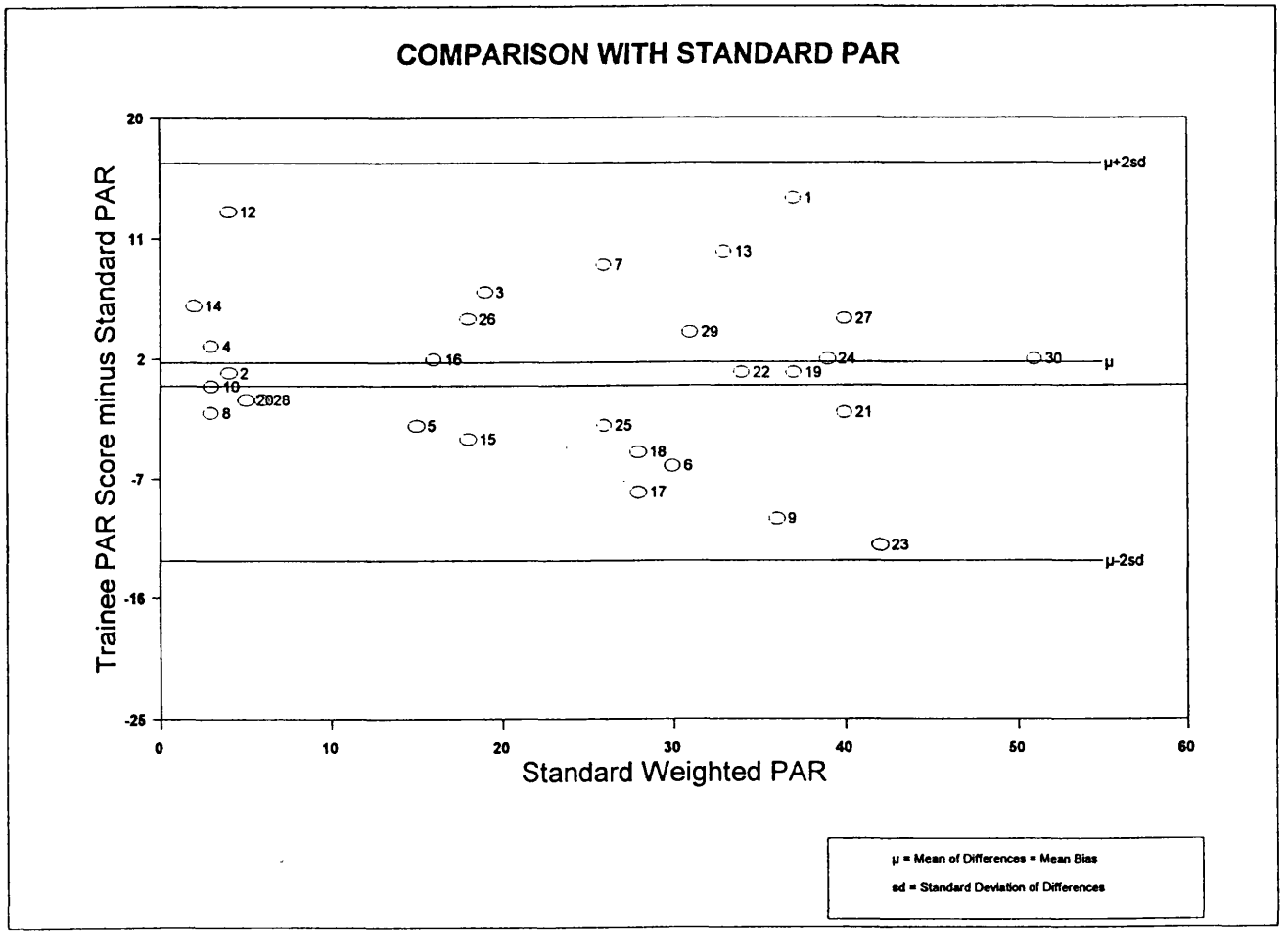
Name M Alsarheed

Mean Difference gold standard-trainee	1.73 (permitted error is less than 2 PAR points.)

Lower 95% Confidence Limit	-1.00
Upper 95% Confidence Limit	4.46

Random error	5.34 RMS (should be less than 5)

Paired t-test	1.27
Significance p	0.21



Results of Calibration Study - IOTN Aesthetic Component

Summary Table

		Standard									
		1	2	3	4	5	6	7	8	9	10
	1	-	-	-	-	-	-	-	-	-	-
	2	1	3	1	-	-	-	-	-	-	-
	3	1	-	2	-	-	-	-	-	-	-
Candidate	4	-	-	-	-	-	-	-	-	-	-
M Alsarheed	5	-	-	-	1	1	-	-	-	-	-
	6	-	-	-	1	-	3	-	-	-	-
	7	-	-	-	-	2	1	1	1	1	-
	8	-	-	-	-	-	-	1	3	-	-
	9	-	-	-	-	-	-	-	3	-	-
	10	-	-	-	-	-	-	-	1	-	2

	Correct	Under	Over	Total
Frequency	15	3	12	30

AGREEMENT

Weighted Kappa k= 0.77

Lower 95% Confidence LLCL= 0.68

Agreement with standard is acceptable if 95% LCL > 0.6

CLASSIFICATION %

Specificity : 95

Sensitivity : 82

70% or above is acceptable

BIAS

Wilcoxon sign rank test z= -2.2

p= 0.028

Bias is significant if p<0.05

Summary Table		Standard				
		1	2	3	4	5
	1	-	-	-	-	-
	2	-	6	-	-	-
Candidate	3	-	2	3	1	1
M Alsarheed	4	-	-	3	10	-
	5	-	-	-	-	4

	Correct	Under	Over	Total
Frequency	23	2	5	30

AGREEMENT

Weighted Kappa = 0.760

Lower 95% Confidence Limit = 0.613

CLASSIFICATION %

Specificity = 78.60

Sensitivity = 87.50

Agreement with standard is acceptable if 95% LCL > 0.60

70% or greater is acceptable

BIAS

Wilcoxon sign rank test z= -0.63

p= 0.53

Bias is significant when p<0.05

COURSES IN THE USE OF OCCLUSAL INDICES

This is to certify that

Maha Alsarheed

was calibrated in the use of the

THE PAR INDEX,

AESTHETIC & DENTAL HEALTH COMPONENTS OF THE INDEX OF ORTHODONTIC TREATMENT NEED.

Stephen Richmond

.....

Dr STEPHEN RICHMOND

10th - 12th December, Cardiff 1997

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة المعـــارف
شئون الطلاب

الرقم : ٢٩ / ٢٠٢٧
التاريخ : ١٢ / ١٠ / ١٤١٨هـ
المشفوعات : ١

Appendix 3

الصحة المدرسية

الموضوع : إتاحة الفرصة لعمل بحث عن صحة الفم والأسنان .

Approval letter from Ministry of education

فاكس عاجل جداً

سعادة مدير عام التعليم بمنطقة الرياض يحفظه الله

السلام عليكم ورحمة الله وبركاته

إلحاقاً لخطاب مدير عام الصحة المدرسية رقم ٢١٩٩ / ٣٢ وتاريخ ١٩ / ١٤١٨٩هـ (مرفق صورته) وإشارة إلى توجيهات معالي الوزير في الفاكس رقم ٥٣٢٧ / ١ وتاريخ ١١ / ١٠ / ١٤١٨هـ المرفق صورته من قبل مدير عام مكتب معالي الوزير بخصوص إتاحة الفرصة لعمل بحث يتعلق بصحة الفم والأسنان من قبل الباحثة / مها عبدالله السرهيد .

لذا نأمل منكم إكمال اللازم حيال توفير سيارات لنقل عدد من طلاب المرحلة الإبتدائية والمتوسطة سواء من مدارس التعليم العام أو التعليم الخاص إلى كلية طب الأسنان بالدرعية لعمل الفحص ومن ثم إعادتهم مع تواجد مشرف من المدرسة ، وإفادة مكتب معاليه بذلك .

شاكراً لكم حسن تعاونكم ، والله يرعاكم.

الوكيل المساعد لشؤون الطلاب

د . محمد بن سعد العصيمي

بحر ٢١١

377

- ص / لمكتبنا .
- ص / مع التحية لمدير عام مكتب معالي الوزير .
- ص / الصحة المدرسية [قسم طب الفم الاسنان].

0/02/98 12:03 MOE H.Q.RYD KSA 9661 4012365 NO.667 P001

المملكة العربية السعودية
الرئاسة العامة لتعليم البنات
إدارة تعليم البنات بمنطقة الرياض
التعليم الخاص

بسم الله الرحمن الرحيم

الرقم : ٩٧٨٠٧
التاريخ : ١٤٢٧/١٠/٢٤هـ
المشفوعات : ـــــ

Approval letter from President General for Girls Education Approval

المكرمه / مديرة مكتب الاشراف التربوي للتعليم الخاص المحترمه

السلام عليكم ورحمة الله وبركاته وبعد -

نرفق لكم بطية الطلب المقدم من د/ مها عبدالله السرهيد والتي تشير فيه الى موافقة مدير عام الخدمات الطبيه بالرئاسه على تطبيق دراسة عن بعض مشاكل الاسنان عند الطلبات في المدارس التابعه للرئاسه وترغب في تزويدها ببعض المعلومات المتعلقه بطالبات معاهد التعليم الخاص .

أمل بعد الاطلاع احالة طلبها الى الاخوات المختصات لديكم بالمكتب والتكرم بافادتها .

شاكرين لكم تعاونكم والله يحفظكم ،

مدير عام تعليم البنات بمنطقة الرياض
د/ عبدالله بن عبدالرحمن ال بشر

صوره مع التحيه ل د/ مها عبدالله السرهيد /ع/ط الفاكس ٤٦٤٧٩٣٧
صوره للمشرف على شئون التعليم الخاص بالاداره
صوره للملف العام مع المسوده

وزارة التعليم العالي
جامعة الملك سعود
كلية طب الأسنان
مكتب العميد

الرقم :
التاريخ : ١٤١٩/١٠/٢٣هـ
المرفقات :

الموضوع :

Letter from King Saud University, Dental College

المحترم **سعاده الدكتور وكيل الجامعه للدراسات العليا**
رئيس لمجلس العلمي

السلام عليكم ورحمه الله وبركاته وبعد

نفيد سعادتكم بان الاسئله المرفقه هي جزء من بحث رسالة الدكتوراة الخاصه بالطبيه | **مها السرهيد** وان الكليه ليس لديها أي ملاحظات على هذه الاسئله التى وردت بالاستبيانات .

آمل التكرم بالاطلاع واتخاذ ماترونه .

شاكرين ومقدرين حسن تعاونكم
وتقبلوا تحياتى وتقديري والسلام ::::::

عميد كليه طب الاسنان

١٠/٢٣

د . سليمان بن عمران العمران

جامعة الملك سعود
مكتب وكيل الجامعة للدراسات العليا
قيد الوارد
التاريخ
المشفوعات

جامعة الملك سعود
كليه طب الأسنان
قيد الوارد
التاريخ : ١٤١٩/١١/٢٨
المشفوعات :

P.O. Box 60169 Riyadh. 11545 ☎ 467-7428 Fax 4678548 Telex 401019 S.U. SJ ٤٠١٠١٩ تلكس : ٤٦٧٨٥٤٨ فاكس : ٤٦٧٧٤٢٨ ☎ ص.ب ٦٠١٦٩ الرياض ١١٥٤٥

Appendix 4

Children's examination criteria

Table 1 Caries criteria

Caries criteria	Values
Sound	0
Decayed and arrested	1
Decayed	2
Decayed and pulp involvement	3
Filled and decayed	4
Filled (no decay)	5
Extracted (caries)-	6
Extracted (ortho)	7
Unerupted	8
Missing (trauma)	T
Sealed surface	F
Restoration (crown)	C

Table 2 Trauma criteria

Trauma criteria	Values
No trauma	0
Discoloration	1
# Enamel	2
# Enamel and dentine	3
# Enamel, dentine and pulp	4
Missing due to trauma	5
Acid etch composite	6
Permanent replacement	7
Temporary restoration	8
Assessment can't made	9

Table 3 Periodontal conditions criteria

Periodontal criteria	Conditions	Values
Gingiva	Healthy	0
	Not healthy	1
	Assessment can't be made	9
Plaque	Not visible	0
	Plaque visible	1
	Assessment can't be made	9
Calculus	No calculus	0
	Calculus present	1
	Assessment can't be made	9

Table 4 Enamel opacity criteria

Criteria	Conditions	Values
Type	Normal	0
	Demarcated	1
	Diffuse	2
	Demarcated & diffuse	3
	Hypoplasia	4
	Demarcated & hypoplasia	5
	Diffuse & hypoplasia	6
	All three defects	7
	Other defects	8
	Assessment can't be made	9
Extent	Normal	0
	< 1/3 surface	1
	1/3 < 2/3 surface	2
	>2/3 surface	3
	Assessment can't be made	9

Table 5 Occlusal assessment

Occlusion assessment	Conditions	Values
Overjet	+/-	in mm
Overbite	+/-	in mm
Anterior crossbite	None of upper incisors instanding At least one upper incisor instanding	0 1
Lingual crossbite	Assessment cannot be made No crossbite Crossbite Assessment cannot be made	9 0 1 9
Buccal crossbite	No crossbite Crossbite Assessment cannot be made	0 1 9

Table 6 The Dental Health Component of The Index of Orthodontic Treatment Need (Revised sub-gradings (Lunn *et al.*, 1993)

GRADE 5	
5i	Impeded eruption of teeth (except for third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth and any pathological
5h	Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant) requiring pre-restorative orthodontics
5a	Increased overjet greater than 9mm
5m	Reverse overjet greater than 3.5mm with reported masticatory and speech difficulties
5p	Defects of cleft lip and palatal and other craniofacial anomalies
5s	Submerged deciduous teeth

GRADE 4	
4h	Less extensive hypodontia requiring pre-restorative orthodontic or orthodontic space closure to obviate need for a prosthesis
4a	Increased overjet greater than 6mm but less than or equal to 9mm
4b	Reverse overjet greater than 3.5mm with no masticatory or speech difficulties
4m	Reverse overjet greater than 1mm but less than 3.5mm with recorded masticatory and speech difficulties
4c	Anterior or posterior crossbites with greater than 2mm discrepancy between retruded contact position and intercuspal position
4l	Posterior lingual crossbite with no functional occlusal contact in one or both buccal segments
4d	Severe contact point displacements greater than 4mm
4e	Extreme lateral or anterior open bites greater than 4mm
4f	Increased and complete overbite with gingival or palatal trauma
4t	Partially erupted teeth, tipped and impacted against adjacent teeth
4x	Presence of supernumerary teeth

GRADE 3	
3a	Increased overjet greater than 3.5mm but less than or equal to 6mm with incompetent lips
3b	Reverse overjet greater than 1mm but less than or equal to 3.5mm
3c	Anterior or posterior crossbite with greater than 1mm but less than or equal to 2mm discrepancy between retruded contact position and intercuspal position
3d	Contact point displacements greater than 2mm but less than or equal to 4mm
3e	Lateral or anterior open bite greater than 2mm but less than or equal to 4mm
3f	Deep overbite complete on gingival or palatal tissues but no trauma

GRADE 2	
2a	Increased overjet greater than 3.5mm but less than or equal to 6mm with competent lips
2b	Reverse overjet greater than 0mm but less than or equal to 1mm
2c	Anterior or posterior crossbite with less than or equal to 1mm discrepancy between retruded contact position and intercuspal position
2d	Contact point displacement greater than 1mm but less than or equal to 2mm
2e	Anterior or posterior open bite greater than 1mm but less than or equal to 2mm
2f	Increased overbite greater than or equal to 3.5mm without gingival contact
2g	Pre-normal or post-normal occlusions with no other anomalies (included up to half a unit discrepancy)

GRADE 1	
1	Extremely minor malocclusion including contact point displacement less than 1mm

Appendix 5

Data collection sheets

Date

Study code

Study No D.O.B

Surname First Name

Gender M F

☐ Visually impaired Degree of visual impairment Cause

Onset of loosing vision

☐ Hearing impaired Degree of hearing impaired dB Cause

Onset of losing hearing

Other disability

Level of education

IQ%

Father occupation

Mother occupation

Other

1.Caries

Upper Left **Upper Right**

	e	d	c						c	d	e			
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
D																
O																
M																
B																
L																

Lower Left **Lower Right**

	e	d	c						c	d	e			
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
D																
O																
M																
B																
L																

2.Trauma to permanent Incisor

Grades 0-9

Upper

Right			Left
2	1	1	2

Lower

Right			Left
2	1	1	2

3.Periodontal assessment

0= Absent **1=Present**

Upper

	Right	Middle	Left
Gingiva			
Plaque			
Calculus			

Lower

	Right	Middle	Left
Gingiva			
Plaque			
Calculus			

4.Enamel opacity

Type 0-9 **Extent 0-3**

Upper

	Right							Left
	4	3	2	1	1	2	3	4
Type								
Extent								

Lower

	Right	Left
	6	6
Type		
Extent		

5.Occlusion assessment

Overjet ____ **mm** **overbite** ____ **mm** **anterior crossbite** ____ **0,1,9**

Lingual crossbite ____ **0,1,9** **Buccal crossbite** ____ **0,1,9**

Incisors relation ____

6.Orthodontic treatment need

6.1 DHC

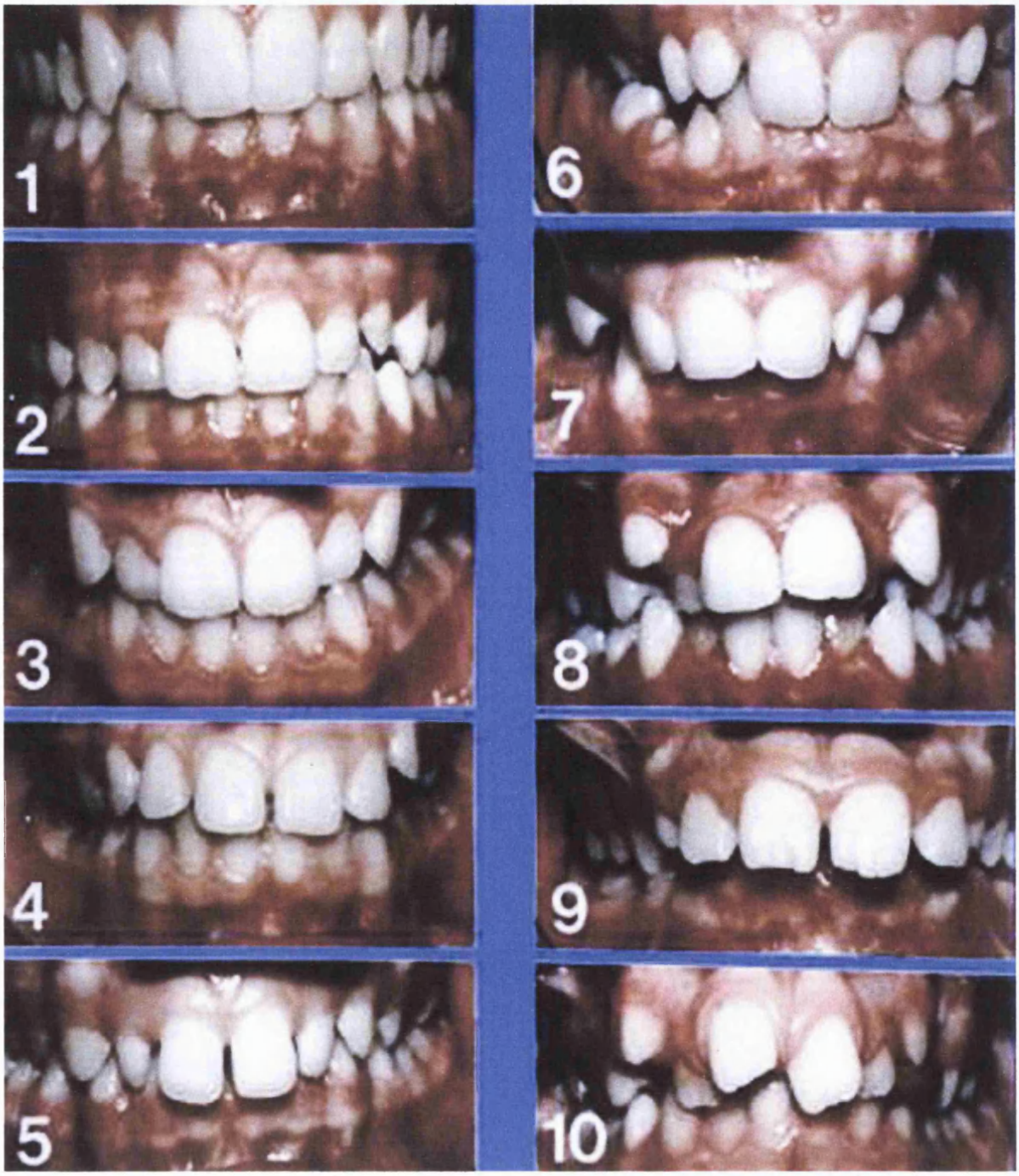
Grades 1-5 ____

6.2 AC

	Child	Examiner
Grades 1-10		

Appendix 6

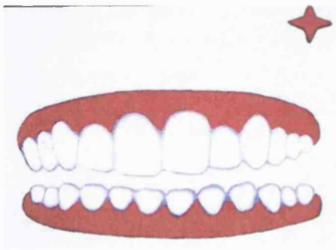
The Aesthetic Component of The Index of Orthodontic Treatment Need (IOTN)



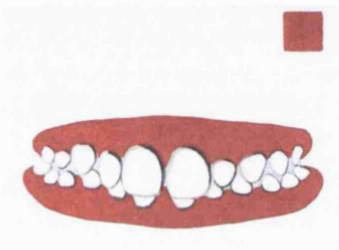
Appendix 7

Tactile Graphics version of Aesthetic Component of The Index of Orthodontic Treatment Need (IOTN)

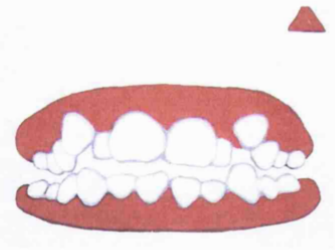
Graphic1



Graphic 2



Graphic 3



Graphic 4

Appendix 8

Children's Interview

1. Some children's teeth don't have enough room to grow and they become crooked or protruding.

   At this stage of growing up, are any of your teeth crooked at all or not? (Tick one)

   ☐ Yes ☐ No

2. At this stage of growing up, are any of your teeth protruding? (Tick one)

   ☐ Yes ☐ No

3. Have you ever had treatment for crooked or protruding teeth? (Tick one)

   ☐ Yes, having treatment now

   ☐ Yes, I had treatment in the past

   ☐ No, no treatment

At the moment, do you think your teeth are alright as they are or would you prefer to have them straightened? (Tick one)

   ☐ Alright as they are

   ☐ Prefer them to be straightened

5. If yes, would you wear a brace to have them straightened? (Tick one)

   ☐ Yes ☐ No

Eastman Dental Institute for Oral Health Care Sciences
256 Gray's Inn Road, London WC1X 8LD
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Appendix 9

Parents Questionnaire

Cover letter for parents

Date

Dear Mr and Mrs

This study is designed to look at your attitudes towards dental care and in particular orthodontic care for your child. The project involves a brief dental examination and a short questionnaire for your child to complete at school. In addition, I would be grateful if you would complete this questionnaire.

Therefore, please help me in this project by completing and returning the questionnaire in the envelope provided to the school principal.

All the information collected in this study will be treated as confidential.

Thank you for your help.

Your sincerely

Maha AlSarheed

If further information or details are required, please contact Dr. AlSarheed.

Dr. Maha AlSarheed DDS, MSc
Dental Postgraduate
11481 Riyadh, PO Box 3921, KSA, Tel 055224736

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بسم الله الرحمن الرحيم

التاريخ

عزيزي والد/والدة

Cover letter for parents (Arabic)

إن هذا البحث يتطلع لمعرفة منهجكم وموقفكم من العناية بالاسنان وخاصة علاج تقويم الاسنان لابنتكم .

إن البحث يتضمن فحص بسيط ومقابلة شخصية مع ابنتكم في المدرسة. إضافة إلى ذلك استبيان الرجاء منكم تعبئته.

لهذا الرجاء المساعدة والاجابة على الاستبيان وترجيعه إلى مديرة المدرسة.

كل المعلومات سوف تكون سرية.

شكراً لمساعدتكم
الطبيبة مها السرهيد

إذا اردتم اي معلومات الرجاء الاتصال على
هاتف ٥٥٢٢٤٧٣٦ .
الرياض ١١٤٨١
ص ب ٣٩٢١
الرياض

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Cover Letter for Control Male students Parent

Dear Mr and Mrs

This study is designed to look at your attitudes towards dental care and in particular orthodontic care for your child. The project involves a brief dental examination and a short questionnaire for your child to complete when they attend the Dental College. In addition, I would be grateful if you would complete this questionnaire.

Therefore, please help me in this project by completing and returning the questionnaire in the envelope provided to the school principal.

Your child will benefit from a check-up and will be provided with a report on their dental health. The visit to the Dental College will be arranged via the school principal.

All the information collected in this study will be treated as confidential.

If you agree for your child to participate in this study, please sign below

Your Signature----------

Thank you for your help.

Your sincerely
Maha AlSarheed
If further information or details are required, please contact Dr. AlSarheed.
Dr. Maha ALSarheed DDS, MSc
Dental Postgraduate
11481 Riyadh, PO Box 3921, KSA, Tel 05522473

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بسم الله الرحمن الرحيم

Cover Letter for Control Male students Parent (Arabic)

التاريخ

عزيزي والد / والدة :

إن هذا البحث يتطلع لمعرفة منهجكم وموقفكم من العناية بالاسنان وخاصة علاج تقويم الاسنان لابنكم.

إن البحث يتضمن فحص بسيط ومقابلة شخصية مع ابنكم في كلية طب الاسنان (الدرعية). إضافة إلى ذلك استبيان الرجاء منكم تعبئته.

لهذا الرجاء المساعدة والاجابة على الاستبيان وترجيعه الى مدير المدرسة.

إن ابنك سوف يستفيد من هذا البحث باعطائه بيان عن صحة اسنانه.

الزيارة الى الكلية سوف ترتب مع المدرسة.

كل المعلومات سوف تكون سرية.

إذا كنتم موافقين على ان يشترك ابنكم في هذا البحث ،الرجاء التوقيع

التوقيع ———————

شكراً على مساعدتكم
الطبيبة مها السرهيد

إذا ارتم اي معلومات الرجاء الاتصال على هاتف ٥٥٢٢٤٧٣٦.
الرياض ١١٤٨١
ص ب ٣٩٢١
الرياض
393

Parent questionnaire

Date ☐☐☐☐☐☐☐☐

Dental care for Sensory Impaired Children

There are only right or wrong answers to the question.

When you answer the following questions please, refer to yourself and your Wife/husband.

Personal details;

1. Are you ☐ Male ☐ Female

2. How many years did **you** spend in full time education?

☐ 6 Years ☐ 12Years

☐ 18 Years ☐ More

3. At what stage did **you** finish your full-time education?

☐ Primary ☐ Secondary ☐ Adult education

☐ Degree level ☐ Other

4. At what stage did **your wife/husband's** finish their full-time education?

☐ Primary ☐ Secondary ☐ Adult education

☐ Degree level ☐ Other

5. What is **your** occupation

☐ Student ☐ Government employed ☐ Business man

☐ Professional ☐ Farmer ☐ Manual Worker ☐ House wife

6. What is **your wife/husband** occupation

☐ Student ☐ Government employed ☐ Business man

☐ Professional ☐ Farmer ☐ Manual Worker ☐ House wife

7.Do you have children with a disability

☐Yes ☐ No

If Yes Please, specify----------

When answering the following question please, only refer to ----------

---

8. Has your child been to the dentist: (Tick one)

☐ In the last 6 months

☐ In the last year

☐ Longer ago, but within the last 2 years

☐ Longer than two years ago

9. Where does your child go for dental care? (tick any one or more)

☐ Government Hospital

☐ Government polyclinic

☐ Private clinic

☐ Other, please specify ----------

☐ Don't know

10. What kind of treatment has your child had over the whole of his/her life so far?

☐ Teeth filled

☐ Teeth taken out

☐ A general anaesthesia to have a tooth/teeth taken out

☐ Treatment to stop decaying or going bad, e.g. by painting and/or sealing the teeth

☐ Other treatment Please, specify----------

11. What are your feelings regarding the treatment obtained? (tick the appropriate answer)

☐ Very satisfied ☐ Satisfied ☐ Dissatisfied ☐ Very Dissatisfied

☐ Don't know

12. Why did your child go to the dentist last visit? (tick any one or more)

☐ He/She was having trouble with their teeth

☐ He/She went for check up

☐ For some other reason (please tick and say what below)

---

13. Does your child have: (Tick one or more)

☐ Holes in the teeth that need filling

☐ Discoloured teeth that need treatment

☐ Crocked teeth that need treatment

14. Some children's teeth don't have enough room to grow and they become crooked or protruding.

At this stage of growing up, are any of your child's teeth crooked at all or not? (Tick one)

☐ Yes

☐ No

15. At this stage of growing up, are any of your child's teeth protruding? (Tick one)

☐ Yes

☐ No

16. Is your child having, or has your child ever had, treatment for crooked or protruding teeth? (Tick one)

☐ Yes, have treatment now

☐ Yes, has had treatment in the past

☐ No, no treatment

17. At the moment, do you think your child's teeth are alright as they are, or would you prefer him/her to have them straightened? (Tick one)

☐ Alright as they are ☐ Prefer them to be straightened

18. Do you thing your child wants to have orthodontic treatment

☐ Yes ☐ No

19. Do you feel that orthodontic treatment should not be provided for your child because: (Please answer each statement)

Your child is not concerned about the appearance of their teeth

☐ Yes ☐ No

They have difficulty in keeping their teeth clean

☐ Yes ☐ No

It is difficult for them to cope with the long and complex dental treatment

☐ Yes ☐ No

It is difficult to obtain orthodontic treatment

☐ Yes ☐ No

Orthodontic treatment is too expensive

☐ Yes ☐ No

20. Do you believe that the dentist will not provide orthodontic treatment for your child because: (please answer each statement)

Your child is not concerned about the appearance of their teeth

☐ Yes ☐ No

They have difficulty in keeping their teeth clean

☐ Yes ☐ No

It is difficult for them to cope with the long and complex dental treatment

☐ Yes ☐ No

It is difficult to obtain orthodontic treatment

☐ Yes ☐ No

Orthodontic treatment is too expensive

☐ Yes ☐ No

21. Have you **yourself** been to the dentist: (Tick one)

☐ In the last 6 months

☐ In the last year

☐ Longer than two years ago

22. Have you **yourself** had any orthodontic treatment?

☐ Yes ☐ No

If Yes please specify ----------

There maybe question I need to clarify, if so, would you agree to be contacted by telephone

☐ Yes ☐ No

Thank you very much for your help

Are there any comments you wish to make about this study

التاريخ ☐☐☐

Study No. ☐☐☐☐

Parent questionnaire (Arabic)

العناية بصحة الفم للاطفال المصابين بأعاقة بصرية أو سمعية

يوجد فقط نعم أو لا للأجابة.

رجاءً، إن الاسئلة التالية س١-٦ هي عن الأب والأم

معلومات شخصية:

١- هل انت
☐ذكر ☐انثى

٢- كم سنة قضيت في دراستك حتى تنال شهادتك الاخيرة (اختار اجابة واحدة)

☐٦سنوات ☐١٢سنة
☐ ١٨ سنة ☐ أكثر

٣- ما هي المرحلة العلمية التي انتهيت اليها في دراستك (اختار اجابة واحدة)

☐ أبتدائي ☐ متوسط ☐ثانوي
☐شهادة جامعية ☐ محو الامية ☐أخرى

٤- ما هي المرحلة العلمية التي حصل عليها زوجك أو زوجتك (اختار اجابة واحدة)

☐أبتدائي ☐ متوسط ☐ ثانوي
☐شهادة جامعية ☐محو الامية ☐أخرى

٥- ما هي وظيفتك (اختار اجابة واحدة)

☐ طالب ☐ موظف حكومي ☐ رجل اعمال
☐ تعمل بتخصصك ☐ مزارع ☐ مهني
☐ ربة منزل ☐ لا تعمل

٦- ما هي وظيفة زوجك أو زوجتك (اختار اجابة واحدة)

☐ طالب ☐ موظف حكومي ☐ رجل اعمال
☐ تعمل بتخصصك ☐ مزارع ☐ مهني
☐ ربة منزل ☐ لا تعمل

٧- هل لديك اطفال معاقين

☐ نعم ☐ لا

إذا كان الجواب نعم الرجاء التوضيح كم عددهم _____

الرجاء عند اجابة على الاسئلة التالية . الاشارة إلى _____

٨- هل زار ابنك او ابنتك طبيب اسنان (اختار جواب واحد)

☐ في الاشهر الستة الماضية
☐ خلال سنة
☐ اكثر من سنة لكن اقل من سنتين
☐ اكثر من سنتين

٩- الى اين يذهب ابنك او ابنتك لعلاج اسنانه (اختار اجابة واحدة)

☐ مستشفى حكومي
☐ مستشفى خاصة
☐ مستوصف حكومي
☐ عيادة خاصة
☐ في مكان اخر ، (الرجاء التوضيح) - _____
☐ لا أعرف

١٠- ماهو العلاج الذي حصل علية ابنك او ابنتك في حياته (اختار اكثر من إجابة)

☐ حشو الاسنان
☐ خلع الاسنان
☐ تخدير كلي لخلع الاسنان
☐ علاج لتوقيف تسوس الاسنان كما هو تنظيف اللثه
☐ شيء اخر ، الرجاء التوضيح _____

١١- هل كان مستوى العلاج بالنسبه لك (اختار اجابة واحد)

☐ راضي عنه جداً ☐ راضي عنه ☐ غير راضي عنه
☐ غير راضي عنه ابداً ☐ لا اعرف

١٢- لماذا ذهب ابنك او ابنتك في المرة الاخيرة لطبيب الاسنان (اختار اجابة واحدة أو اكثر)

☐ الم في الاسنان
☐ فحص عام للاسنان
☐ اسباب اخرى ،الرجاء التوضيح _____

١٣- هل ابنك او ابنتك لديهم (اختار اجابه واحدة او اكثر)

☐ حفرة في اسنانه يجب ان تحشو
☐ اسنان ملونة
☐ اسنان متراكبة

١٤- هناك بعض الاطفال لايوجد لديهم الفراغ الملائم لظهور جميع الاسنان في الفك وهذا يؤدي الى تراكب الاسنان أو بروزهم الى الامام
هل تعتقد في هدة المرحلة من النمو ، ان اسنان ابنك أو ابنتك متراكبة أو لا ؟

☐ نعم
☐ لا

١٥- هل في هذه المرحلة من النمو لدى ابنك أو ابنتك، ان اسنانه بارزة الى الامام؟

☐ نعم
☐ لا

١٦- هل حصل ابنك أو ابنتك على علاج لتراكب اسنانه؟

☐ نعم
☐ لا
☐ نعم في الماضي

١٧- في هذا الوقت هل تعتقد أن اسنانه جيدة كما هي من ناحية المظهر ، وهل يحتاج إلى علاج تقويم ؟

☐ جيدة كما هي
☐ افضل العلاج

١٨- هل تعتقد أن أبنك أو أبنتك يفضل علاج التقويم ؟

☐ نعم
☐ لا

١٩- هل تعتقد ان علاج تقويم الاسنان يجب ان لا يعطى لابنك أو ابنتك للاسباب التالية:

-ابنك أو ابنتك لايهتم بمظهر اسنانه

☐ نعم ☐ لا

- من الصعب ان يهتم بتنظيف اسنانه

☐ نعم ☐ لا

- من الصعب ان يتكيف مع العلاج الطويل والمعقد

☐ نعم ☐ لا

- من الصعب الحصول على علاج تقويم الاسنان

☐ نعم ☐ لا

- علاج تقويم الاسنان غالي جداً

☐ نعم ☐ لا

٢٠- هل تعتقد ان طبيب الاسنان لايقدم علاج تقويم الاسنان الى ابنك أو ابنتك للاسباب التالية:

-ابنك أو ابنتك لايهتم بمظهر اسنانه
☐ نعم ☐ لا

- من الصعب ان يهتم بتنظيف اسنانه
☐ نعم ☐ لا

- من الصعب ان يتكيف مع العلاج الطويل والمعقد
☐ نعم ☐ لا

- من الصعب الحصول على علاج تقويم الاسنان
☐ نعم ☐ لا

- علاج تقويم الاسنان غالي جداً
☐ نعم ☐ لا

٢١- هل زرت انت طبيب الاسنان خلال(اختار اجابة واحدة)
☐ ٦ أشهر السابقة
☐ في السنة الماضية
☐ اكثر من سنتين

٢٢- هل انت بنفسك . حصلت على علاج تقويم الاسنان من قبل؟
☐ نعم
☐ لا
إذا كان الجواب نعم الرجاء التوضيح _____

إذا كان يوجد سؤال نريد الاستفسار عنه هل ممكن الاتصال بكم هاتفياً
☐ نعم
☐ لا

شكر على مساعدتكم
الطبيبة مها السرهيد

اذا اردت النقاش في اي موضوع في هذا البحث يمكنكم الاتصال على الهاتف ٥٥٢٢٤٧٣٦.

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Appendix 10

General Dental Practitioner Questionnaire

Cover letter

Dear Dr.

The questionnaire enclosed is part of my PhD research and it is aimed at improving dental care for children with sensory impairment (visual and hearing). Your views as a provider of dental services are essential. A questionnaire is also being sent to parents of children with a sensory impairment and undergraduate dental and medical students.

We wish to quantify the amount and scope of dental care provided for these children.

Therefore, please help us in this project by completing the questionnaire and returning in the envelope provided to senior nurse.

All the information provided will be treated in confidence by the researchers and no individual will be identified as the data will only be presented for the group as a whole.

Your sincerely
Maha AlSarheed

If further information or detail are required, please contact me.

Maha ALSarheed DDS, MSc
Dental Postgraduate
11481 Riyadh, PO Box 3921, KSA, Tel 05522473

Study No ☐☐☐☐☐☐☐

Date

Dental care for children with a Sensory Impairment

There are no right or wrong answers to the question you would rather not answer, feel free to skip that question and go on to the next.

Personal Details:

1. Are you ☐ Male ☐ Female

2. Year of birth 19☐☐

3.Year and Place of your basic dental degree 19 ☐☐
(University of----------)

4. Please specify your main specialty
   - ☐ General Dental Practitioner
   - ☐ Paediatric Dentistry
   - ☐ Orthodontics
   - ☐ Restorative Dentistry
   - ☐ Oral Surgery
   - ☐ Other (Please specify ----------)

Disabled (Physical & Learning disabled)

5. Did you receive any training in providing dental care for disabled people in your undergraduate course?
☐ Yes ☐ No

6. Did you consider this sufficient?
☐ Yes ☐ No

7. Have you attended any postgraduate lectures in providing dental care for disabled people?
☐ Yes ☐ No
If No would you like to ☐ Yes ☐ No

8. Do you provide dental care for disabled people?
☐ Yes ☐ No
If No go to question 11

9. How many disabled patients have attended your practice in the last year?
☐0-5 ☐16-30 ☐over 50 ☐6-15 ☐30-50

10.Do you received referred disabled patients?
☐ Yes ☐ No (if yes how many in any one year) ----------

Visual &Hearing impaired

11. Do you provide dental care for children with visual impaired in your clinic?
☐ Yes ☐ No (if yes how many) ----------

12.Do you provide dental care for children with hearing impaired in your clinic?
☐ Yes ☐ No (if yes how many) ----------

13.Visually impaired children can receive orthodontic treatment in the same way as 'normal' children. Do you agree with this? (tick the appropriate one)
☐ Disagree strongly ☐ disagree ☐ don't know ☐ agree
☐agree strongly

14.Have you ever referred a visually impaired child for orthodontic treatment? (tick the appropriate one)
☐ No, never ☐Yes once ☐ Yes 2-5 times ☐Yes more than 5 times

15.Visually impaired (VI) children often do not receive orthodontic care. Indicate your opinion by **circling the number** which best described your personal attitude toward each statement.

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
A.VI children are not interested in their dental appearance	1	2	3	4	5
B.VI children are not able to maintain oral hygiene levels necessary for orthodontic treatment	1	2	3	4	5
C.VI children are unable to cope with orthodontic treatment (eg. Fixed appliance)	1	2	3	4	5
D.VI children have a low self-perception with regard to the severity of their malocclusion	1	2	3	4	5

16. Hearing impaired children can receive orthodontic treatment in the same way as 'normal' children. Do you agree with this? (tick the appropriate one)
☐ Disagree strongly ☐ disagree ☐ don't know ☐ agree
☐ agree strongly

17.Have you ever referred a hearing impaired child for orthodontic treatment? (tick the appropriate one)
☐ No, ever ☐Yes once ☐ Yes 2-5 times ☐ Yes more than 5 times

18.Hearing impaired (HI) children often do not received orthodontic care. Indicate your opinion by **circling the number** which best described your personal attitude toward each statement.

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
A.HI children are not interested in their dental appearance	1	2	3	4	5
B.HI children are not able to maintain oral hygiene levels necessary for orthodontic treatment	1	2	3	4	5
C.HI children are unable to cope with orthodontic treatment (eg. Fixed appliance)	1	2	3	4	5
D.HI children have a low self-perception with regard to the severity of their malocclusion	1	2	3	4	5

The statements listed below describe different beliefs about sensory impaired people (visual and hearing impaired). You are asked to express your feelings about each statement by indicating whether you

1. strongly disagree with statement
2. disagree
3. don't know or are undecided
4. agree
5. strongly agree with the statement

Indicate your opinion by **circling the number** which best described your personal attitude toward each statement.

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
1. The sensory impaired should not be provided with a free public education.	1	2	3	4	5
2. Sensory impaired people are not more accident prone than other people.	1	2	3	4	5
3. A sensory impaired individual is not capable of making moral decisions.	1	2	3	4	5
4.The sensory impaired should be prevented from having children.	1	2	3	4	5
5.The sensory impaired should be allowed to live where and how they chose.	1	2	3	4	5

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
6. Adequate housing for the sensory impaired is neither too expensive nor too difficult to build.	1	2	3	4	5
7. Rehabilitation programmes for the sensory impaired are too expensive to operate.	1	2	3	4	5
8. The sensory impaired children in many ways like children.	1	2	3	4	5
9. Most sensory impaired people are willing to work.	1	2	3	4	5
10. Sensory impaired individuals are able to adjust to life outside an institutional setting.	1	2	3	4	5
11.The sensory impaired should not be prohibited from obtaining a driving license.	1	2	3	4	5
12. Sensory impaired people should live with others of similar impairment.	1	2	3	4	5
13. Group homes for the sensory impaired should not be prohibited in residential districts.	1	2	3	4	5
14.The opportunity for gainful sensory impaired employment should be provided to people.	1	2	3	4	5
15. Sensory impaired children in regular classrooms have an adverse effect on other children.	1	2	3	4	5
16. Simple repetitive work is appropriate for the sensory impaired.	1	2	3	4	5

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
17.The sensory impaired show a deviant personality profile.	1	2	3	4	5
18. Equal employment opportunities should be provided to sensory impaired people.	1	2	3	4	5
19. Laws to prevent employers from discriminating against the sensory impaired should be passed.	1	2	3	4	5
20. Sensory impaired workers should receive at least the minimum wage established for their jobs.	1	2	3	4	5
21. Sensory impaired individuals can be expected to fit into competitive society.	1	2	3	4	5

Thank you for your co-operation.

If you wish t to make any comment, please feel free to do so

Appendix 11

Dental (3rd year) and Medical Students Questionnaire

Study No ☐☐☐☐☐☐☐☐
Date

Dental care for Sensory Impaired Children

This study is part my PhD research and is aimed at improving dental care for sensory impaired children (visual and hearing). Your views are essential. A questionnaire is also being sent to the dentists and parents.
Therefore, please help us in this project by completing the questionnaire. There are no right or wrong answers to the question.
All information provided will be confidential to the researchers and no individual will be identified as the data will only be presented for the group as a whole.
Further information or detail please contact Dr. AlSarheed.

Thank for your help

Personal Details

Are you ☐ female ☐ male
Year of Birth? 19 ☐☐

Is there a disabled person in your family or among your close friends?
☐ Yes ☐ No
If Yes please give details ----------

The statements listed below describe different beliefs about **sensory impaired people (visual and hearing impaired).** You are asked to express your feelings about each statement by indicating whether you

1. strongly disagree with statement
2. disagree
3. don't know or are undecided
4. agree
5. strongly agree with the statement

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
1. The sensory impaired should not be provided with a free public education.	1	2	3	4	5
2. Sensory impaired people are not more accident prone than other people.	1	2	3	4	5
3. A sensory impaired individual is not capable of making moral decisions.	1	2	3	4	5
4.The sensory impaired should be prevented from having children.	1	2	3	4	5
5.The sensory impaired should be allowed to live where and how they chose.	1	2	3	4	5
6. Adequate housing for the sensory impaired is neither too expensive nor too difficult to build.	1	2	3	4	5
7. Rehabilitation programmes for the sensory impaired are too expensive to operate.	1	2	3	4	5
8. The sensory impaired children in many ways like children.	1	2	3	4	5
9. Most sensory impaired people are willing to work.	1	2	3	4	5
10. Sensory impaired individuals are able to adjust to life outside an institutional setting.	1	2	3	4	5
11.The sensory impaired should not be prohibited from obtaining a driving license.	1	2	3	4	5
12. Sensory impaired people should live with others of similar impairment.	1	2	3	4	5

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
13. Group homes for the sensory impaired should not be prohibited in residential districts.	1	2	3	4	5
14.The opportunity for gainful sensory impaired employment should be provided to people.	1	2	3	4	5
15. Sensory impaired children in regular classrooms have an adverse effect on other children.	1	2	3	4	5
16. Simple repetitive work is appropriate for the sensory impaired.	1	2	3	4	5
17.The sensory impaired show a deviant personality profile.	1	2	3	4	5
18. Equal employment opportunities should be provided to sensory impaired people.	1	2	3	4	5
19. Laws to prevent employers from discriminating against the sensory impaired should be passed.	1	2	3	4	5
20. Sensory impaired workers should receive at least the minimum wage established for their jobs.	1	2	3	4	5
21. Sensory impaired individuals can be expected to fit into competitive society.	1	2	3	4	5

Thank you for your co-operation.

If you wish t to make any comment, please feel free to do so

Appendix 12

Dental (5th year) Students Questionnaire

Study No ☐☐☐☐

Date ☐☐☐

Dental care for Sensory Impaired Children

This study is part my PhD research and is aimed at improving dental care for sensory impaired children. Your views as a provider of dental services are essential. A questionnaire is also being sent to the dentists and parents of children with a sensory impairment.
We wish to quantify the amount and scope of dental care provided for these children. **Therefore, please help us in this project by completing the questionnaire**. There are no right or wrong answers to the question.
All information provided will be confidential to the researchers and no individual will be identified as the data will only be presented for the group as a whole.
Further information or detail please contact Dr. AlSarheed.

Thank for your help

Personal Details:

Are you ☐ female ☐ male
Year of Birth? 19☐☐

Is there a sensory impaired person in your family or among your close friends?
☐ Yes ☐ No
If Yes please give details ----------

The statements listed below describe different beliefs about **sensory impaired people (visual and hearing impaired)**. You are asked to express your feelings about each statement by indicating whether you

1. strongly disagree with statement
2. disagree
3. don't know or are undecided
4. agree
5. strongly agree with the statement

Indicate your opinion by **circling the number** which best described your personal attitude toward each statement.

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
1. The sensory impaired should not be provided with a free public education.	1	2	3	4	5
2. Sensory impaired people are not more accident prone than other people.	1	2	3	4	5
3. A sensory impaired individual is not capable of making moral decisions.	1	2	3	4	5
4.The sensory impaired should be prevented from having children.	1	2	3	4	5
5.The sensory impaired should be allowed to live where and how they chose.	1	2	3	4	5
6. Adequate housing for the sensory impaired is neither too expensive nor too difficult to build.	1	2	3	4	5
7. Rehabilitation programmes for the sensory impaired are too expensive to operate.	1	2	3	4	5
8. The sensory impaired children in many ways like children.	1	2	3	4	5
9. Most sensory impaired people are willing to work.	1	2	3	4	5
10. Sensory impaired individuals are able to adjust to life outside an institutional setting.	1	2	3	4	5
11.The sensory impaired should not be prohibited from obtaining a driving license.	1	2	3	4	5
12. Sensory impaired people should live with others of similar impairment.	1	2	3	4	5

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
13. Group homes for the sensory impaired should not be prohibited in residential districts.	1	2	3	4	5
14.The opportunity for gainful sensory impaired employment should be provided to people.	1	2	3	4	5
15. Sensory impaired children in regular classrooms have an adverse effect on other children.	1	2	3	4	5
16. Simple repetitive work is appropriate for the sensory impaired.	1	2	3	4	5
17.The sensory impaired show a deviant personality profile.	1	2	3	4	5
18. Equal employment opportunities should be provided to sensory impaired people.	1	2	3	4	5
19. Laws to prevent employers from discriminating against the sensory impaired should be passed.	1	2	3	4	5
20. Sensory impaired workers should receive at least the minimum wage established for their jobs.	1	2	3	4	5
21. Sensory impaired individuals can be expected to fit into competitive society.	1	2	3	4	5

The statements listed below describe different beliefs about **people with a disability (mental and physical)**. You are asked to express your feelings about each statement by indicating whether you

1. strongly disagree with statement
2. disagree
3. undecided
4. agree
5. strongly agree with the statement

Indicate your opinion by **circling the number** which best described your personal attitude toward each statement.

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
1. My education has taught me to enjoy working with disabled people	1	2	3	4	5
2. I am not interested in learning anything else about disabled people	1	2	3	4	5
3. Educators who teach me seem to be well versed in the psychological, social and emotional characteristics of the disabled	1	2	3	4	5
4. In the private clinic, a separate waiting room should be provided for disfigured patients.	1	2	3	4	5
5. My educational experience has taught me a tremendous amount about the dental needs of the disabled.	1	2	3	4	5
6. Dental services for the disabled should only be provided in a hospital.	1	2	3	4	5
7. My educational training has helped me to better empathise with disabled people.	1	2	3	4	5
8. The more severe the disable, the lesser the need for restorative dentistry.	1	2	3	4	5

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
9. When working with the disabled, I don't care to understand what they are feeling.	1	2	3	4	5
10. My educational experiences have helped me to enjoy being with disabled patients.	1	2	3	4	5
11. I care about future dental treatment of the disabled.	1	2	3	4	5
12. The educational experiences I have received have really helped me to interact with disabled people.	1	2	3	4	5
13. Very little sensitivity is required when interacting with the disabled.	1	2	3	4	5
14. My teachers really demonstrate enthusiasm about working with disabled patients.	1	2	3	4	5
15. Working with the disabled is a very enjoyable experience.	1	2	3	4	5
16. I would not particularly desire disabled patients in my practice.	1	2	3	4	5
17. My teachers have shown me how to enjoy working with the disabled people.	1	2	3	4	5
18. Disabled people make me uneasy.	1	2	3	4	5
19. My educational training has made me confident to work with disable people.	1	2	3	4	5
20. I dislike working with disable people.	1	2	3	4	5
21. My educational training has provided me with a positive attitude toward the disabled.	1	2	3	4	5

STATMENT	strongly disagree	disagree	un-decided	agree	strongly agree
22. Dental treatment for the disabled is very discouraging. disabled at my school is really good.	1	2	3	4	5
23. The program for treatment of the	1	2	3	4	5
24. When working with disabled people, I find it hard to respond to them.	1	2	3	4	5
25. My educational training has helped me better understand how to treat the disabled.	1	2	3	4	5
26. My teachers have not shown me how to respond to the needs of the disabled.	1	2	3	4	5
27. My educational experiences have taught me to dislike the disabled.	1	2	3	4	5
28. My instructors seem nervous and reluctant to treat the disabled	1	2	3	4	5
29. My educational training has not helped me to understand disabled people.	1	2	3	4	5
30. The teachers at my school do not seem to know very much about handicapped. people.	1	2	3	4	5
31. My teachers are not very excited or interested in the treatment of the disabled.	1	2	3	4	5
32. My educational experiences have taught me very little about the dental needs of the disabled.	1	2	3	4	5

Thank you for your help
If wish to make any comment, please feel free to do so,

Appendix 13

Publiccations

1. The development of a tactile graphic version of IOTN for visually impaired patients
2. Approval letter for Attitudes of dentists, working in Riyadh, towards people with a sensory impairment

CLINICAL REPORT

The development of a tactile graphic version of IOTN for visually impaired patients

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Abstract: The Index of Orthodontic Treatment Need (IOTN) is a visual-based index and has been widely used. This paper describes the development and evaluation of tactile graphics representing the aesthetic component (AC) of IOTN for the use of visually impaired patients (VI). Four tactile graphics were produced corresponding to IOTN photographs 1 (graphic 1, no treatment – mild need), 5 (graphic 2, moderate need), 8 (graphic 3, severe need; increased overjet) and 10 (graphic 4, severe need). Nine (30–50 years) expert consumers from the Royal National Institute for the Blind (RNIB) and 13 VI schoolchildren (11–16 years) evaluated the graphics. The evaluation was in terms of design features, complexity of information and ease of use. Each individual was asked to arrange the graphics in order of severity of malocclusion. The procedure was repeated after 30 min to test individual reliability (www.clinorthodres.com/cor-c-084/).
The consumer group was able to identify the main features in each graphic and found them easy to use. Six had arranged the graphics correctly at the first attempt and five on their second. The children were able to distinguish the different oral features, except the overjet presentation in graphic 2. Nine children arranged the graphics correctly at the first attempt, but only six at the second. The confusion centred for both groups on presenting an increased overjet with graphic 2. A modification was undertaken to enhance the anterior–posterior nature of the image. Fifteen VI schoolchildren reassessed the modified graphics, 14 arranged them correctly at the first attempt and 13 at the second. The study concluded that IOTN tactile graphics were well accepted and showed a good reliability.

Key words: IOTN; tactile graphics; visually impaired

Introduction

The blind and visually impaired population

The World Health Organization estimate that there are 40 million blind and visually impaired (VI) people in the world (1). The term blind is reserved for individuals with no usable sight whatsoever, while VI describes those with some usable vision. A blind person is either congenitally blind, being blind from birth, or within the first 5 years of life, and possibly lacking visual memory, or adventitiously blind, with blindness beginning after the age of 5 years, and with the probable presence of visual memory. Visual memory means the ability to classify and remember objects we perceive in terms of visual characteristics, such as shape, size, colour, position and perspective (2).

VI is more common in older people, and as this proportion of the population increases in industrialised countries, so the proportion of VI will also increase. In the UK, the prevalence of blindness is estimated to be 0.7% of the total population, with the major cause being macular degeneration (37%) and glaucoma (13%) (3).

Orthodontic treatment for VI people

In general, the provision of orthodontic care for people with special needs is poorly described in the literature. Although there are a number of reports on the prevalence of malocclusion amongst this group of patients, their practical clinical management is not described (4–7). Chadwick and Asher-McDade (8) raised the issue of orthodontic treatment for children with learning disabilities and provided some clinical guidelines, which may allow orthodontists to gain therapeutic access to these patients. However, orthodontic care for children with VI is anecdotal.

A major perceived benefit of orthodontic treatment is an improvement in appearance, and, therefore, any improvement in aesthetics for people with special needs may help to avoid stigmatisation (9).

Development of orthodontic indices

Over the last 30 years, there have been a number of attempts to measure malocclusion and treatment need objectively (10, 11). The Index of Orthodontic Treatment Need (IOTN) has been widely adopted for epidemiological studies (12), determining use of dental services (13), determining treatment priorities, and an individual's perception of their own orthodontic need (14).

The IOTN has two components, the dental health component (DHC) and the aesthetic component (AC). The latter is a visual-based tool. The AC comprises ten photographs, with the first (1) being most attractive and the last (10) being least attractive (15). As a visual-based instrument, the IOTN is widely used, but has little practical application for VI orthodontic patients. Therefore, the rationale for this research was to produce and evaluate a modified IOTN that could be used for this group of the population.

Production of educational material for VI people

Access to visual information can widen the avenues of social interaction for VI people. This is often accomplished through a manual process that translates a visual representation into a corresponding tactile form. Tactile graphics provide a raised representation of such visually useful materials as maps, graphs and other simple drawings. This material has been used widely on science courses in schools which cater specifically for VI people (16).

Production of tactile graphics

The task of accessing visual information is one of mapping information from the visual domain to that of one other sense. These fall into the general categories of static tactile graphics, auditory interfaces, dynamic tactile interfaces, haptic interfaces and tactile image creation system (17, 18).

Static tactile graphics

Conversion of pictures, diagrams or text into a tactile graphic can be a labour-intensive and time-consuming process. There are three important steps in the process.

1. *Editing*: it should contain the least amount of information possible to convey successfully the content of the image (19).
2. *Transferral*: this involves placing the image onto some tactile output medium. A picture is first traced on tracing paper and transferred to the tactile display material using carbon paper and retracing (17). Alternatively, transferral can be achieved using a pantograph, which is an instrument consisting of four arms joints in parallelogram form.

3. *Production*: several methods are available which require a sighted person to translate a visual image into a tactile one (20). These are summarised in Table 1.

Auditory interfaces

Whilst there is a wide variety of methods for producing tactile graphics, output of computer generated speech is more generic. Screen review software is used by the VI to explore the textual material and to select the desired passage (21).

Dynamic tactile interfaces

A widely used tactile display device is the Optacon. The Optacon was designed as an alternative to braille for reading printed text (22). It is a vibrotactile display, comprised of a fingertip-sized matrix of 144 vibrating pins, arranged in a 24-row, 6-column format. In addition to the Optacon is the tactile vision substitution system, which uses a similar technique to display a vibrating representation of an image on the user's back (23), the image being captured by a television camera worn by a VI person.

Haptic interfaces

The term haptic refers to the proprioceptive, or sense, which is an extension of touch (24). Thus, a haptic interface can represent three or more dimensions, whereas a tactile display provides only two dimensions. Haptic interfaces are important display methods in virtual reality systems, capable of reproducing a sense of position in space, interaction of forces and even textures. Math-graphing packages or custom graphing software often generates the original information.

Tactile image creation system

This system allows automatic generation of tactile graphics involving the acquisition of an image through computer software, performing some simplifying processing, and displaying the result on a tactile output medium, such as capsule paper or a dynamic, real-time tactile display (18). Thus, a VI computer user could browse a CD-ROM collection of computerised images. This has increased access to visual material and can facilitate broader educational and professional opportunities, particularly in areas with a strong tendency toward visual presentation of information.

Development of an AC of IOTN for VI people

The new version of an AC of IOTN was developed with the collaboration of the Royal National Institute for the

Table 1. **Production methods of static tactile graphics**

Methods	
Raised-line drawing boards	Designed to be used by VI persons for producing raised-line drawings, this common tool is also useful for fast production of tactile versions of visual originals
Tactile-experience picture	This method is often used for young children. Pictures are constructed from a variety of materials, including wood, plastic, cloth, sandpaper, fur and metal, which are glued to a stiff cardboard backing
Buildup displays	Similar in method to tactile-experience pictures, buildup displays rely on multiple layers of paper to build up a raised drawing. Additional materials, such as wire, string and staples may be added to enhance the drawings
Embossed paper displays	This technique reproduces a drawing on heavy paper using a collection of embossing tools. A reverse view of a sketch is first transferred to the back of a sheet of embossing paper. The tools are then used to trace the sketch, embossing it as a series of raised dots
Braille graphics	These are produced by using a standard braille printer connected to a computer
Vacuum-forming method	This method, which is also known as thermoforming, excels at producing multiple copies of tactile graphic in a very durable format
Microcapsule paper	Referred to puff paper, this is a quick and economical way to produce tactile graphics. The paper, coated with microscopic capsules of polystyrene, each being $\approx$ 100 μm in diameter. Organelle graphics are photocopied onto the capsule paper. Graphics can be applied to the microcapsule paper using ink pens, markers and other drawings. Once the image is applied to the paper, it is inserted image side up into a heating machine, referred to as the tactile image enhancer, which causes the polystyrene capsules to expand and become raised

Table 2. **Guidelines for the production of tactile graphics**

Guidelines	
Design	Paper collages are constructed prior to the production of vacuum formed graphics
	Clear textural differences are needed for different oral tissues e.g. gingivae and enamel vinyl floor tiles are used to develop the anterior–posterior images (to mimic increased overjet)
	≈2.5mm minimum discernible separation of two points are required
Size	All features must be not less than a finger-tip size to allow use of the tactual-kinaesthetic sense
	An 18 font size is generally recommended for partially sighted persons
Number	Limit tactile tasks when complex features need to be incorporated
	Number of graphics should be limited if comparisons are needed

Blind (RNIB) at Peterborough, UK. The RNIB is a national organisation, which develops and produces information and materials for the VI person. It has the largest collection of braille audio and tactile graphic facilities for this group in Europe. It is also responsible for the technical testing and evaluation of such materials.

Materials and methods

The thermoform vacuum-forming method was used in order to provide adequate thickness for the anterior–posterior dimensions of overjet. It also facilitated the production of several copies, as required. The production passes through several stages following the general guidelines for tactile graphic production (Table 2).

The 'teeth' were made of vinyl floor tiles, with a 3-layer paper thickness surrounded by rough textured papers (crepe-paper), which represented the gingivae. The 'teeth' and the 'gingivae' were adhered to stiff paper. The outcome design was used as a master copy (collage). The master was placed on a perforated metal tray in a vacuum-forming machine to produce the thermoforming copy (tactile graphic). A sheet of plastic of 0.006–0.010 in. thickness called 'braillon' was placed on top of the master and fastened in place by clamps to produce an airtight seal. The heating unit was set at 392–572° F for approximately 6 s. The copy was then peeled from the master and allowed to cool for 5 s.

According to the RNIB print guideline, the size of the teeth was selected to be the equivalent of 18 font to increase the vision ability of children who are partially VI (25). In order to avoid confusion, the number of graphics produced was limited to four, with one at least from each category of the AC of the IOTN. In this study, photographs 1, 5, 8 and 10 were selected (Fig. 1).

- Graphic 1 corresponds to photograph 1 (no treatment – mild need).
- Graphic 2 corresponds to photograph 5 (moderate need; increased overjet with minimal crowding).
- Graphic 3 corresponds to photograph 8 (severe need; increased overjet with crowding).
- Graphic 4 corresponds to photograph 10 (severe need).

In order to enable the individual to understand the meaning of well aligned ('straight') teeth photograph 1 was modified by separating the upper jaw from the lower jaw.

Evaluation

As more and more technical aids for disabled persons are being developed in various countries, there has been a growing need to know more about the technical and functional quality of these aids. Evaluation involved an assessment by a RNIB expert consumers group at the Peterborough headquarters, followed by a school-based study undertaken in Dorton House School for the Visually Impaired (Sevenoaks, UK).

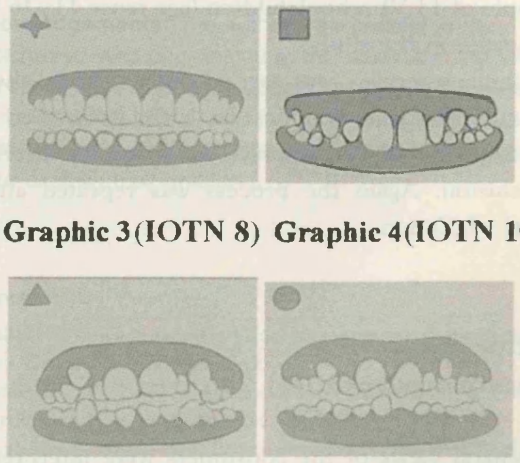

Fig. 1. Initial tactile graphic version of the IOTN AC corresponding to the IOTN photographs 1, 5, 8 and 10.

Table 3. **Examples of the RNIB consumer's evaluation of IOTN tactile graphic**

Quality of design	'I have been doing a lot of these graphics before, so it looks well produced in the sense of smoothing and raised feeling'
Conformity with the guidelines	'I used my tongue to feel my teeth, then I looked at the graphics, I think each part of the graphic had described well the teeth and gum'
Ease of use	'The graphics is easily read and clear only because of experience though, but I thought the graphic with the square symbol is difficult to know what makes it different from graphic with the star symbol'
Need for alteration	'Well as I'm expert in the production methods, I just have to suggest to modify the feeling of the teeth sticking out'

RNIB expert consumers group

The RNIB consumers group comprised four females and five males (age range 30–50 years), who were experienced in tactile products and their evaluation. An interview evaluated the

- quality of the graphics' design,
- conformity with guidelines,
- ease of use.

After the group work, each individual was asked to arrange the IOTN graphics in order of severity of malocclusion. This procedure was repeated after an interval of 30 min.

School-based evaluation

A sample of 13 VI schoolchildren (age range 11–16 years) participated in the study.

A simple interview was carried out to ensure the children understood the graphics. Each child was then asked to arrange the IOTN graphics in order of severity of malocclusion. Again the process was repeated after an interval of 30 min.

Results

RNIB expert consumers group

The general views of the consumers were interpreted as outlined in Table 3. Whilst there was general agreement regarding the quality of design, conformity with the guidelines and ease of use, most of them were confused regarding graphic 2, and suggested an alteration.

Six (66%) consumers arranged the graphics according to the severity of malocclusion at the first attempt, however, after a period of 30 min, only five (55%) were able to arrange the graphics correctly.

School-based study

The responses of the children are summarised in Table 4. Half of the children were able to identify that the graphic related to teeth, which they considered similar to a diagram represented in their biology schoolbook. Four of those who identified the graphics lost their sight after 3–4 years of age. The children also found the graphics easy to use.

Nine (69%) arranged the graphics according to the severity of malocclusion at the first attempt. After a period of 30 min, only six (46%) were able to arrange the graphics correctly.

In view of the problems regarding graphic 2, the difficulties were discussed with the RNIB graphic designers for further modification. Several features were modified the major being the increase in thickness of the maxillary incisors by four layers of vinyl floor tiles to enhance the anterior–posterior dimension. Mandibular incisors were also introduced to establish a reference point regarding the overjet (Fig. 2).

After the modification of graphic 2, a second school-based study was carried out to evaluate the modification. Fifteen VI children evaluated the modified graphic and found it easier to use. Fourteen children (93%) were able to arrange the graphics in the correct order at the first attempt, and 13 (86%) when the procedure was repeated.

Table 4. **Examples of the children's response evaluation of IOTN tactile graphic**

Identification of the graphic	'I think I need time to know what is in the graphic, but it looks like a teeth diagram'
Previous experience	'I thought it could be in the biology book but it could be also in other books too'
Ease of use	'Well I'm not an expert, but it seems okay but one graphic ... the one with the square symbol is difficult to know what the teeth look like'

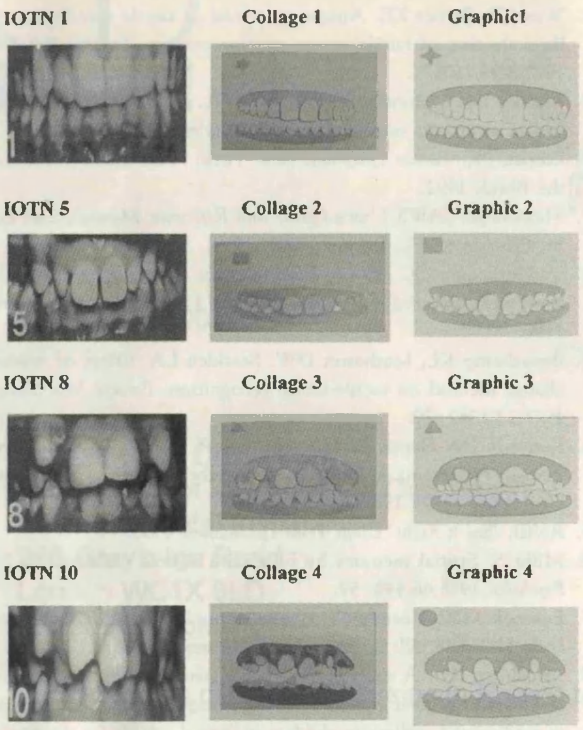

Fig. 2. Tactile graphic version of IOTN (www.clinorthodres.com/cor-c-084/).

Discussion

The responses of the consumers showed that they agreed on the good quality of the graphics and their conformity to guidelines. Some of the children were confused by the content of the graphics and required further explanation.

The efficacy of a method for converting visual information into tactile information is dependent upon several important considerations (17):

- the lower bandwidth capability of the fingertip, as compared with the eye,
- the hierarchical nature of spatial perception and memory,
- the state of the art in cost-effective output of tactile graphics.

Of particular importance to tactile graphics efficacy is their ease of use, and the ability of users to discriminate different structures (18). The general design guidelines developed through years of practical application and refinement of technique were helpful in the production of the modified IOTN index, and the research team was able to adhere to these guidelines.

The visual memory of the VI person can be determined by the age of the onset of the impairment (17). Thus, children who lose their sight after birth will invariably find it easier to identify the graphics as diagrams of teeth.

Tactile tasks may become more complex when memory is involved. Working with textual materials, Miller (26) established that tactual features are encoded in memory separately from their corresponding phonological features. In the case of recall, the visual stimulus has first to be inspected, identified, stored and then retrieved. To retrieve a visual stimulus, children must get their knowledge in the desired category and find the item in question. Recall levels are generally found to be lower than recognition levels (27). Lansdown (28) demonstrated that children with low vision revealed a delay in visuo-spatial competence or shape-matching ability, but the effect of this delay on memory performance was unclear (29).

Conclusions

In conclusion, it can be stated that the tactile graphics were on the whole successful:

- They were well accepted by both the RNIB evaluators and the VI children.
- Both groups were able to use the graphics with relative ease to discern distinct oral features.
- The RNIB consumer group agreed that the graphic conformed to general guidelines.
- The presentation of the overjet proved to be the most difficult feature to represent in the graphics.
- The modified graphic 2 was well accepted by the children.

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January 8, 2001

Raman Bedi, DDS, MSc
Department of Transcultural Oral Health
Eastman Dental Institute
256 Gray's Inn Road
London WC1X 8LD
United Kingdom

Re: "Attitudes of dentists working in Riyadh towards people with a sensory impairment"

Dear Doctor Bedi:

I am pleased to inform you we have accepted the above manuscript for publication in *Special Care in Dentistry*.

Our acceptance of the manuscript is with the understanding some changes will be made during editing. We will send an edited version to you for approval before publication. Please supply us with the academic degree(s) for the other co-authors. You may fax this information to us at 312-440-2824.

If you have any questions please do not hesitate to contact us at 312-440-2661.

Sincerely yours,

Ronald L. Ettinger, BDS, MDS, DDSc
Editor

Maha. N.P thm

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