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Title: Perceptions of Outcomes of Orthodontic Treatment in Adolescent Patients: A Qualitative Study

Short running title: Patient perspectives of treatment outcomes

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Summary

Background: The outcomes of orthodontic treatment are frequently classified as aesthetic, functional and psycho-social. However, there is limited research looking at outcomes of treatment in a qualitative manner from the patients' perspective. It is crucial to have a better understanding of these outcomes to allow management of expectations and enhance satisfaction with treatment.

Objectives: To assess the outcomes of orthodontic treatment from the adolescent patient perspective.

Subjects and Methods: This was a prospective qualitative study in which 20 adolescent patients (13-18 years), and parents, were interviewed using semi-structured in-depth interviews to assess how they felt about the outcomes of their treatment. The interviews were digitally recorded and transcribed verbatim and a content thematic analysis was undertaken using a framework approach. This publication reports on data from the patient interviews.

Results: Thematic analysis identified three main themes, and associated subthemes. The themes were (i) health related behavioural changes, including improvement in the perceived ability to maintain good oral hygiene and better diet, (ii) dental health, encompassing enhanced aesthetics, function, and reduction in plaque accumulation and (iii) psychosocial influences, for example enhanced confidence, self-esteem and better social interactions. These themes support the quality of life benefits of treatment.

Conclusion/ implications: Interviewing adolescent patients identified the important positive, and potentially long-term, benefits of orthodontic treatment. The results provide invaluable information which increases our understanding of the treatment we provide and gives important information which can be utilised when managing expectations during the informed consent stage. It is hoped that this may allow enhanced satisfaction following treatment.

INTRODUCTION

There are now a large number of publications which have studied the effects of malocclusion and those factors which motivate patients to undergo orthodontic treatment (1-4). However, the evidence regarding whether these concerns are managed at the end of a course of orthodontic treatment is less clear. The importance of identifying all potential outcomes of orthodontic treatment, in order to gain a greater insight into the treatment we provide and to establish how these outcomes may influence treatment success and patient satisfaction, should not be underestimated.

When studying outcomes of orthodontic treatment, quality of life (QoL) and psycho-social aspects have received the most interest, but the evidence is sometimes equivocal (6-8). This may be due to the heterogeneous approaches in measuring some of these factors; additionally the subjective nature of QoL makes it difficult to compare studies.

Zhang et al. (6) carried out a systematic review of the impact of orthodontic treatment on QoL, with QoL categorised into 3 sections: physical, social and psychosocial. With regards to physical impact, there was limited evidence of masticatory efficacy and speech changes as a result of orthodontic treatment. Additionally there was no convincing evidence of a relationship between orthodontic treatment and TMD, but early reduction of an increased overjet did potentially reduce the risk of trauma to the incisors. Psychologically, it was concluded that although patients were satisfied with post treatment aesthetics, they did not appear to report an increased level of self-confidence in the long-term and thus there was no strong evidence to suggest that orthodontics increases self-confidence and self-esteem. Similar conflicting evidence was found for social well-being. However, it was noted that there was marked variation in the methodologies used in the studies which were included in the review.

A subsequent review of the literature by Zhou et al. (7) found a modest association between QoL and orthodontic treatment, however, a meta-analysis could not be conducted due to the lack of standardized methodology and the heterogeneity of study designs. It was also noted that the studies included were mainly observational studies which may lead to significant bias. However, a more recent systematic review and meta-analysis, published in 2017, concluded that orthodontic treatment has a moderate effect on oral health related quality of life (OHRQoL) in young patients, particularly in the social and emotional well-being domains (9). Again, the authors noted that the evidence was of relatively low or moderate quality though.

The majority of the publications in this field of research are quantitative, questionnaire-based studies which clearly provide important information but may not allow full explorations of patients' perceptions. There are still few qualitative publications looking at outcomes of orthodontic treatment which would allow these perceptions to be considered in depth. These findings also need to be considered in the context of an increasing emphasis on the importance of patients reporting about their own treatment outcomes. Patient centred qualitative studies are therefore important in allowing us to understand treatment outcomes more fully.

This study, therefore, aimed to identify the perceived outcomes of orthodontic treatment from the adolescent patient perspective using a qualitative approach.

SUBJECTS AND METHODS

Research and development approval was obtained and ethical approval was granted by the Camden and Kings Cross Research Ethics Committee through the Proportionate Ethics Review Committee (REC reference number: 16/LO/0870).

This was a two-part prospective qualitative study; Part 1 looked at the outcomes of treatment from the adolescent orthodontic patient perspective and Part 2 (10) from the perspective of the parents. Interviews used a semi-structured, one-to-one approach to explore the perceived outcomes associated with orthodontic treatment. All patient and parent interviews were undertaken in a private non-clinical area by two members of the research team (NAQ and RS) who had been trained in the techniques of in-depth interviewing and qualitative analysis. The patients were treated by a number of different clinicians working in the department and this allowed multiple treatment experiences to be explored. A topic guide was used to aid the interviews; however, participants were free to deviate from this and discuss any aspects of relevance. Any new topics which arose were subsequently added to the updated topic guide. This publication will discuss the findings of the adolescent patient interviews and further details regarding the parent interviews will be included in Part 2 of the paper.

Patients who had completed orthodontic treatment at the Eastman Dental Hospital, UCLH NHS Foundation Trust were recruited to the study, based on the following inclusion criteria: they had completed a course of fixed appliance orthodontic treatment and were between 13 and 18 years of age at the end of treatment. All of the patients were eligible for treatment under the National Health Service, based on the Index of Orthodontic Treatment Need (IOTN). Patients receiving treatment in association with craniofacial syndromes, as part of orthognathic treatment, for malocclusions due to pathology/trauma or those with severe hypodontia were excluded from the study.

Patients who agreed to participate signed a consent form prior to the in-depth interview and, if they were under 16 years of age, their parents also signed a consent form. Confidentiality and anonymity were stressed and patients were advised that there were no right or wrong answers, it was their personal opinions which were being sought. Interviewees were also

reminded that participation was voluntary and that they were free to withdraw from the study at any stage without it affecting their care.

Purposive sampling was used during the recruitment phase to provide a sample that was representative of a typical cohort of patients treated within the department and this ensured that a broad-spectrum of ideas were explored and enhanced the generalisability of the results as much as is feasible within the constraints of qualitative research. Characteristics considered for the sampling included: age, gender, ethnicity, malocclusion type and time since removal of the orthodontic appliances. It was not possible to include all malocclusion characteristics in an initial exploratory study of this type and there was heterogeneity in the sample, but the purposive sampling strategy allowed key aspects to be explored.

In keeping with the qualitative nature of this study, no sample size calculation was undertaken and no statistical testing was undertaken. Interviews were conducted until no new themes were arising, a point at which “theoretical saturation” is sometimes said to have been achieved. It is important to note that qualitative samples are frequently small in size. This is partly because incidence and prevalence are not important in qualitative research and there is no necessity to have sample sizes which allow robust statistical analysis; an opinion needs to appear only once for it to be an important finding. Additionally, the type of information obtained is rich in detail and in order to analyse the data fully is extremely time consuming and means that small sample are a necessity (11).

Participants were initially encouraged to talk about their presenting malocclusion and any effects it may have had on them and this then led to discussion regarding the outcomes of treatment from their personal perspective. Interviews were digitally recorded and then transcribed verbatim. Data was analysed using a content thematic analysis using a framework approach as developed by the National Centre for Social Research (12). This approach initially involved all three members of the research team (NAQ, RS and SJC)

reading each transcript thoroughly several times in order to familiarise themselves with the raw data. Major themes were identified and highlighted in a specific colour and this classification was then agreed by all members of the research team. When all three researchers had agreed the main themes, quotes were extracted from the transcripts and inserted into a Microsoft Excel© spreadsheet to allow easy management of the data. Each theme was assigned a separate worksheet which was subsequently divided into the subthemes identified and the subthemes were allocated columns in the worksheet. Each participant was assigned a row, and the data identified from the transcripts were inputted into the appropriate cell. For each comment added from the transcripts, the line numbers in the transcripts was included to allow easy identification and referencing.

RESULTS

Twenty patients were interviewed, eight males and twelve females, ranging from 13 to 18 years of age. The patients had a variety of malocclusions, with all skeletal classifications represented, and also hypodontia and impacted canines. All patients had completed fixed appliance treatment and the duration since removal of the fixed appliances ranged from 1 week to 10 months. The interviews were up to 30 minutes in duration.

Three main themes identified in relation to the outcomes of treatment were:

1. Health related behavioural change
2. Dental health
3. Psychosocial influences

Each main theme had several subthemes and these are shown in Table 1. Themes and subthemes are described in this section, supported by quotes from the interview transcripts. These quotes are identified using participant numbers and line numbers; clinical details are also included where required to clarify the context behind the quote. In keeping with the reporting of qualitative data, where a comment needs to occur only once to be an important

part of the findings, numbers of respondents who made specific comments are not included within the results section.

Theme 1: Health Related behavioural change

Oral hygiene awareness

The majority of patients reported an improved awareness of the importance of oral hygiene and discussed an improvement in their wish to maintain a high level of oral hygiene, and also in their ability to do so. A number of reasons were given for this; some patients felt that the relief of crowding facilitated easier cleaning, while others discussed the effects that the dental education and regular reinforcement of oral hygiene during their treatment had, and felt that this made them much more focused on the importance of maintaining good oral hygiene. Patients also talked about their improved dental appearance and how that had increased their motivation to maintain good levels of hygiene.

"I'm more aware of cleaning and the hygiene of teeth now that I've been through treatment. Like, because my teeth are more straight I feel I need to take care of them. I've been through years of treatment, I shouldn't let it go to waste." ***(Pt 7; 98-102)***

"…so I started brushing more because it just got stuck in my brain so now I just do it." ***(Pt 8; 209)***

Dietary changes

The need to improve their diet and focus on a reduced sugar intake were also among the treatment benefits discussed by patients. This was usually related to the education and regular reinforcement which they received during their orthodontic treatment, but also due to a fear of compromising the treatment results which had been achieved.

"The treatment definitely made me more aware of what I'm eating...stuff that's too sugary or got too much citrus in is not good for me. Now that my teeth are in a good position, I don't want to do anything to spoil the result."

(Pt 11; 109-313)

Theme 2: Dental health

Improved aesthetics

Enhanced dental and facial aesthetics were discussed throughout the interviewing process, and it was noticeable that there was significant overlap between aesthetic improvements and psychosocial effects. Comments included in this section are those which focused purely on aesthetic changes and other comments are presented in the psychosocial section of this research.

"I'm really happy now that I've got them done, they look so much better ……imagine if I had to go the rest of my life with my teeth how they looked before, I really hated them."
(Pt 9; 161-164)

Functional changes

Functional changes were discussed by a relatively small number of participants but, for those who did note these changes, this was in relation to masticatory and speech related changes.

"Yeah, it's definitely more comfortable…….it feels physically more comfortable, eating is more comfortable" ***(Pt 4; 313-314)***

"I couldn't say some words properly and now I can say them properly" [Patient who initially presented with a missing lower incisor]
(Pt 6; 171)

Food trapping and plaque retention

Reduction in food trapping was noted by a number of the participants and this was generally related to ease of brushing as a result of improved alignment of the teeth.

"Food doesn't get stuck in between my teeth anymore, because they're all straight and they're close together. Before I used to get food stuck everywhere."
(Pt 18; 198-200)

Avoidance of future complex treatment

Some patients discussed satisfaction with the outcomes of treatment because it meant that they could avoid future complex dental care; examples given in this subtheme included

orthodontic space closure to obviate the need for restorative treatment in hypodontia patients, and the avoidance of complex aesthetic restorative treatment to enhance the alignment of the teeth.

"I would have been left with a baby tooth that would slowly become unstable, so I would have had quite a few teeth missing. Then I would have had to get tooth implants and it just wasn't something that I really wanted." ***(Pt 11; 279-286)***

"I would probably have paid for veneers or something, I would have definitely got them done...I'm not a shallow person but I do care about what I look like and I wouldn't have liked to have my teeth how they were before for ever." ***(Pt 9; 168-175)***

Avoidance of future dental health problems

Several interviewees discussed the benefits of treatment in relation to avoidance of future dental health problems which could arise if treatment had not been undertaken. The prevention or cessation of root resorption as a result of impacted canine teeth was one example of these beneficial effects discussed.

"They were my adult ones [impacted canine teeth], but they were underneath my two adult front teeth, and they were destroying all the nerves and they were like growing through... I would have ruined the front teeth if I had not had braces… " ***(Pt 19; 143-164)***

Theme 3: Psychosocial influences

Self-image and perceptions of self

This subtheme is closely related to the aesthetic subtheme in Theme 2, however, it also takes into consideration the psychosocial influence of these aesthetic changes. This was noted as being especially important when smiling; participants talked about avoiding smiling and actively trying to hide their smile prior to treatment and one of the major benefits of treatment was not having to be conscious of these concerns and being able to smile naturally afterwards. Additionally, participants discussed feeling more comfortable looking in the mirror and having photographs taken; the importance of photographs and social media was highlighted in a number of interviews. Participants discussed how an improvement in

their smile resulted in them generally feeling more comfortable, thinking less about their teeth and generally feeling better about themselves.

"I look like my smile is more genuine and I notice the difference more than other people do. People obviously notice that my teeth are way straighter than before…..I'm happy, I'm very content and feel better." ***(Pt 11; 292-300)***

"When I look at myself in the mirror, I always like looking at my new teeth…..it just makes me feel better……they're all straight now…." ***(Pt 18, 135-139)***

"I used to smile with my mouth closed most of the time...Yeah, my friends also told me that once I got my braces off I started smiling more with my teeth…..when I take photos I smile all the time in them, like on Instagram and stuff and most of my photos are with my mouth open" ***(Pt 8, 69-70 and 280-282)***

Self-esteem and confidence

Self-consciousness and insecurity were issues which were commonly discussed when participants talked about the effects of their malocclusion pre-treatment and, when asked about the outcomes of treatment, interviewees felt strongly about improvements in their self-confidence. Patients frequently discussed not having to consciously think about how they look when socialising and how this made them feel more relaxed and more confident in social situations. Participants also discussed some of the specific situations where they had noticed increased self-confidence.

"The best thing is more confidence…I don't have to be ashamed of my teeth. It makes me feel better about myself." ***(Pt 13; 211-212)***

"When I'm talking, when I'm laughing and just smiling…..any time that I show teeth, I feel more confident." ***(Pt 12; 114-115)***

Social-norms and acceptance

Patients discussed how they felt that the changes as a result of orthodontic treatment had an impact on their social "acceptance" and the way that people perceive them. This was discussed in relation to many situations, such as university applications, career implications or simply talking to friends. Participants stressed that they did not want perfection from

treatment but they did not want to feel “different” and treatment had made them feel like they fitted in better. There is clearly a close relationship between social acceptance, social-norms and self-confidence and these factors often appeared simultaneously during the interview process.

"It makes me feel like I fit in now. I feel more comfortable and confident I guess." ***(Pt 12; 85-86)***

"I’m just happy that I got it done because I like my teeth now…… it’s important to have nice teeth because you don’t really see people these days with bad teeth, like everybody has really nice white straight teeth. " ***(Pt 9, 333-356)***

Social interactions

A further subtheme related to feeling better in social interactions and interviewees experienced this in a number of different situations, including school. They similarly discussed feeling more confident about possible future interactions, such as university or job interviews. Patients discussed how they felt more at ease and less guarded when talking to colleagues and friends.

"Yeah, in school they do interviews and workshops and I probably wouldn’t look them in the face before or I wouldn’t smile - but now I can do that." ***(Pt 8; 107-109)***

"I will be better at interacting with people and I will smile a lot more because I don't mind the way my teeth look." ***(Pt 19, 110-***

Alleviation of dental anxiety

Interestingly, one interviewee described how undergoing orthodontic treatment had resulted in their fear of dentists being resolved, they felt that the regular appointments and the approach to treatment had allowed this fear to be alleviated.

"I had a fear of the dentist...because I had a lot of teeth taken out. But now I don’t worry because I've been here so many times. It's kind of helped take away my fear of them." ***(Pt 19; 118-122)***

DISCUSSION

This study followed standard qualitative methodology. The key strengths of the study were that two researchers conducted all of the interviews in Parts 1 and 2 of the study (10) which allowed for consistency. In-depth interviews were selected rather than focus groups, partly because this allowed interviews to be undertaken at the same time as a routine appointment with no additional visits, but additionally because it was felt that children and adolescents may talk more freely and openly in this setting rather than in a larger group. Undertaking interviews in this way allowed for a vast amount of information to be collected and explored in detail. Both interviewers were also trained in qualitative interview methods in order to reduce interviewer bias. Importantly, the thematic analysis was undertaken by all three researchers, which allowed for multiple views to be considered and this added to the integrity of the coding of the themes/ subthemes.

It is acknowledged that there are also limitations to the study. There is debate regarding generalisation in qualitative research and when wider inferences can be drawn. Whilst it is acknowledged that the sample recruited showed heterogeneity with regards to age, malocclusion, gender, time since debond etc., it may also be said to exhibit representational generalisation compared with the population of patients from which the interviewees were recruited (11). This does not necessarily mean that the results are generalisable but they do provide an important basis from which to undertake further work in this area; for example, there may be benefit in the future in focussing on specific occlusal traits in studies such as this.

The interview period was also relatively broad (1 month to 10 months post-debond) but this range was deliberately selected to explore whether there were any temporal effects; for

example some benefits may be perceived soon after debond, whereas others may become evident later in the follow up period and it was important to allow for this.

It is also important to note that both interviewers were orthodontists and there is a risk that participants felt they had to give the answers that the researchers expected to hear. This was minimised by introducing the interviewers as researchers rather than as orthodontists and by conducting all interviews away from the clinical area. It was also reiterated to the patients that there were no right or wrong answers and it was their personal opinions which were being sought. Some patients may have remembered the potential benefits that were discussed prior to commencing treatment and may have discussed them because they felt that was the right thing to do. However, some of the themes and subthemes which arose during the interviews would not have been routinely discussed as benefits of treatment; therefore the interview process appears to have been sufficiently robust to identify all of the benefits experienced. Finally, it is difficult to know if the changes discussed in the interviews were purely as a result of orthodontic treatment, were related to maturation or indeed were a combination of the two, and this is difficult to control for in a study such as this. When interpreting the findings of this study this is important to consider as it is likely there is a combination of maturation and treatment related effects.

Three themes were identified from the thematic content analysis. The health related behavioural change theme was an interesting finding as there is little research looking at this area. However, these issues were discussed multiple times during the interview process, leading to the conclusion that improved oral hygiene and dietary changes are perceived by patients as a direct or indirect benefit of their treatment. It would be interesting to undertake further research to ascertain whether this perception is something which is relatively short-term or whether it is perceived as a long-term benefit also. It is important to note that, just because a patient perceives this is a benefit, it may not translate into actual clinical improvements and this would also be an interesting topic for future research.

Patients generally felt that their diet was healthier than prior to treatment and this was often related to the patients' fear of compromising the results of their treatment or needing further conservative treatment. In addition, patients spoke about the effects that the regular dental health reinforcement had on them. It is important to see that the repetitive reinforcement of this type of information by orthodontic practitioners acts as a form of "behavioural therapy" and it is therefore vitally important to regularly reinforce oral hygiene and dietary instructions at every visit throughout treatment as this may result in behavioural changes in both the short and the longer term (13,14). Participants also noted an improvement in their perceived ability to maintain good oral hygiene and the personal wish to maintain good oral health. This is something which has received little attention in previous research, which highlights the importance and the benefits of qualitative research. Participants gave reasons as to why they thought these beneficial changes had occurred; some felt it was easier to clean due to the better alignment of the teeth, although the evidence regarding this in the literature is equivocal. It is also possible that there is a combined orthodontic/ age related effect, and some participants mentioned that they were "*less lazy*" and now understood the importance of good dental health since undergoing orthodontic treatment. Interestingly a study by Artun and Osterberg (15) found no difference between a treatment and no-treatment group when looking at plaque accumulation and gingival inflammation. In contrast, there is some evidence that patients who undergo orthodontic treatment have a greater reduction in plaque and gingival scores, although the change was felt to be more related to behavioural factors rather than to improved alignment (16,17).

Improved aesthetics was another factor which motivated participants to maintain good oral hygiene and adhere to good dietary practices. This was supported by the study done by Klages *et al.* (18) who found that patients who had undergone previous orthodontic treatment showed lower plaque scores, more rigorous oral hygiene regimes and better dental health awareness when compared with individuals with no history of orthodontic treatment. However, strong evidence to support this is lacking. It may be that improving

dental aesthetics can influence patient attitudes and result in better dental health and this should be investigated in future longitudinal studies.

The second theme related to dental health and the first subtheme, aesthetic improvement, was one of the notable outcomes, with the relationship between aesthetic improvement and psychosocial effects also being evident. Recent research supports the current findings and concluded that patients who had undergone orthodontic treatment were more satisfied with their dental appearance than an untreated group (19). In future studies, it would be interesting to compare different malocclusions to investigate whether some patients benefit more from treatment than others.

It is known that functional concerns are one of the motivating factors for undergoing orthodontic treatment (3). However, when compared with other themes in this study only a small number of patients discussed functional benefits. A small number of patients felt that their pronunciation of certain words was better after dental alignment was achieved. Speech is a complex process and research looking at the relationship between occlusion and speech is sparse and the relationship is not well understood, although certain malocclusions have been found to play a role in the articulation of specific sounds (20-22). Some patients also expressed discomfort when chewing prior to orthodontic treatment due to teeth "*sliding*" against one another or "*scraping together*" and this also appeared to be alleviated on completion of treatment.

Reduction in plaque accumulation and food trapping was another of the dental health subthemes. A participant's inability to maintain oral hygiene and remove plaque in a crowded dentition may be expected, however, there is no strong association between dental irregularities and periodontal disease (23, 24). There may, however, be a beneficial effect when treatment is undertaken due to the concomitant oral health related behavioural changes as mentioned previously.

The results also demonstrate that, from the patient's perspective, undergoing orthodontic treatment may mean that future complex dental treatment and future dental health problems are avoided. This was discussed by patients who had impacted teeth which could potentially cause damage to adjacent teeth. Other examples given were the avoidance of prosthetic replacement for missing teeth by undertaking orthodontic space closure and avoiding cosmetic restorative treatment for alignment concerns. These examples clearly illustrate situations where the risks of such restorations can be avoided; the long-term maintenance and cost implications of removing this a long-term restorative burden should also be considered.

The third theme focused on psychosocial benefits; enhanced self-confidence, self-image and perceptions of self were all discussed throughout the interview process. This is in accordance with the quality of life model described by Inglehart and Bagramian (25) and supports the quality of life benefits of orthodontic treatment. Participants noted these changes in a number of situations; for example when having photographs taken, especially when they were being placed on social media. Patients generally felt more comfortable showing their teeth post-treatment and felt more confident when smiling. One participant also spoke about the effects on her self-image when looking in the mirror and noted an improvement in this after treatment. It is therefore appropriate for orthodontists to consider the potential psycho-social benefits as part of the treatment aims.

The subthemes in the third theme also demonstrate the potential relationship between orthodontics and social acceptance, and this may lead to enhanced social and career related aspects of life. Participants expressed that they now felt like they '*fitted in*' and were more confident within themselves as well as socially. Malocclusions that deviate from the norm can result in negative stereotyping and affect actual or perceived peer group acceptance and people who have better dental aesthetics may be seen as being friendlier, having a higher social class and being more popular and intelligent (26). Therefore, there

may be potential effects in future education and career and these are also aspects to consider in future research.

CONCLUSIONS

- Patients within this study identified three main benefits of treatment: Health related behavioural change, Dental health, Psychosocial influences. These findings are important for both orthodontist and patients to know, particularly when managing expectations during the informed consent stage.

- Health related behavioural changes were discussed by most of the interviewees, suggesting positive short-term benefits on oral health and dental attitudes, and the potential for longer-term benefits. Patients also noticed an improvement in self-confidence, self-esteem, social interactions and social acceptance, therefore supporting the QoL benefits of orthodontic treatment.

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CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest.

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Tables:

Main themes	Subthemes				
Health-related behavioural change	Oral hygiene awareness	Dietary Changes			
Dental health	Improved aesthetics	Functional changes	Reduced food trapping and plaque retention	Avoidance of future complex treatment	Avoidance of future dental health benefits
Psychosocial influences	Self-image and perceptions of self	Self-esteem and confidence	Social-norms and acceptance	Social interactions	Alleviation of dental anxiety

Table 1: Main themes and subthemes