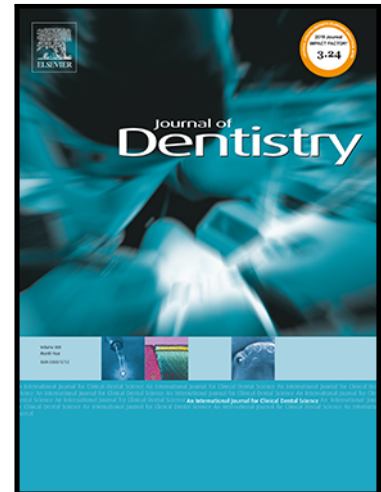


## Journal Pre-proof

### Assessing Dentists' Knowledge and Experience in Restoring Endodontically Treated Teeth Using Post & Cores

K. Shankla , R. Sambrook , P. Fine , R. Blizard , A. Leung

PII: S0300-5712(21)00238-4  
DOI: <https://doi.org/10.1016/j.jdent.2021.103815>  
Reference: JJOD 103815



To appear in: *Journal of Dentistry*

Received date: 12 July 2021  
Revised date: 9 September 2021  
Accepted date: 13 September 2021

Please cite this article as: K. Shankla , R. Sambrook , P. Fine , R. Blizard , A. Leung , Assessing Dentists' Knowledge and Experience in Restoring Endodontically Treated Teeth Using Post & Cores, *Journal of Dentistry* (2021), doi: <https://doi.org/10.1016/j.jdent.2021.103815>

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**Assessing Dentists' Knowledge and Experience in Restoring  
Endodontically Treated Teeth Using Post & Cores**

K Shankla, R Sambrook, P Fine, R Blizard, A Leung

UCL Eastman Dental Institute, Rockefeller Building, 20 University Street, London WC1E  
6DE, United Kingdom

Shankla: [kiran.shankla.16@ucl.ac.uk](mailto:kiran.shankla.16@ucl.ac.uk)

Sambrook: [r.sambrook@ucl.ac.uk](mailto:r.sambrook@ucl.ac.uk)

Fine: [p.fine@ucl.ac.uk](mailto:p.fine@ucl.ac.uk)

Blizard: [r.blizard@ucl.ac.uk](mailto:r.blizard@ucl.ac.uk)

Leung: [albert.leung@ucl.ac.uk](mailto:albert.leung@ucl.ac.uk)

**Abstract**

**Objectives:** The restoration of endodontically, heavily filled teeth has been a challenge for the dental profession for decades. The aims of this study were to investigate dentists' experience and knowledge in the use of post & core when restoring endodontically treated teeth.

**Method:** This was a mixed method study incorporating quantitative and qualitative data collection. An online questionnaire was developed and distributed, comprised of 18 questions. It was calculated that 93 respondents were needed to validate the study of which 60% should meet a minimum knowledge requirement.

**Results:** 173 respondents completed the questionnaire. 109 (63% (95% CI 56%, 70%)) demonstrated proficient knowledge of post & core restorations. Recent graduates were more likely to follow current guidelines ( $F=4.570$ ;  $P<0.034$ ). As the age of the respondent increases the number of posts placed ( $F=18.85$ ;  $p<0.001$ ) and the perceived confidence level increases (Spearman's Rho 0.43;  $P<0.01$ ). Experience of postgraduate education also positively influenced clinical confidence.

**Conclusion:** The placement of post & cores is influenced by age. Confidence is also influenced by age. More evidence on post usage is required and several questions remain to be answered on what drives decision making and perceived long-term success.

**Clinical significance:** There is a general acceptance of when a post and core restoration should be used. Clinician experience and age can have an impact on what type of restorations are used. Fibre posts are more commonly used due their accessibility and cost.

Keywords

Post & Cores; endodontically treated teeth; heavily restored teeth; knowledge of restoring with a post & core

## 1. Introduction

An important challenge in dentistry is to restore a severely broken-down, endodontically treated tooth (ETT). The use of a post & core restoration followed by a crown has been used for several decades to restore these broken-down teeth [1].

There is a wide repertoire of restorative techniques and materials for clinicians to choose from when deciding which post to use to provide the optimum aesthetics, function, and longevity. This study considered a post & core restoration to have achieved longevity by surviving for a minimum of 10 years [2]. Possessing a good understanding of the design and components of the various systems would enable the clinician to select the material and method to provide a most successful and predictable outcome [3].

Custom cast metal posts have been used for many years with reliable evidence to support their use. These posts require minimal tooth structure removal due to being largely customised to the most tapered post space, have a very good adaptation and are less likely to fail at the interface between the post and core as it is cast as one piece [3,4]. Prefabricated fibre posts have similar properties to that of dentine making them flexurally compatible and are tooth coloured making them more aesthetic [5]. These posts require a technique sensitive adhesive luting cement to remain in situ [6-8]. Furthermore, it is advisable to use these posts when a sufficient ferrule is present as the bond strength of the resin cement can reduce once the teeth are in function [9]. In contrast, as the effectiveness of bonding to dentine has improved with contemporary techniques, some dentists have opted not to use posts at all when restoring ETT, but instead to rely on the chemical bond between the available tooth structures and the restoration [10, 11, 12].

To date, there is little clinical evidence to support one post type to be more efficacious over another for restoring an ETT [13]. The consensus [14] is that there is a lack of high-quality methodological data on post & cores and little clinical evidence to support the use of any type [15, 16, 17]. The quality of recent systematic reviews was brought into question by Schmitter et al, (2013), who revealed that of the 10 studies included in their review of post & cores, only one achieved a high R-AMSTAR score (Revised Assessment of Multiple Systematic Reviews). Whilst looking specifically at Australian prosthodontists views on post & core construction and use, findings were inconclusive in terms of a definitive guide for restoring an ETT [15].

Research on dentists' attitudes towards using post & core restorations have previously been undertaken outside the UK [9, 15]. This research has highlighted that multiple factors influence the decision making process. However, there seems to be no such studies specifically looking at the use of post & cores, nor their relative merits, within the last 10 years.

The aims of the study were to investigate how dentists assess ETT for post & cores, if there were any demographics factors which would affect their choice and why certain methods/materials were used more frequently. The study principally enrolled UK dentists.

## **2. Material and Methods**

This study was primarily a quantitative study however qualitative data was collected via comments in appropriate comment boxes. The questionnaire was designed to include a mixture of multiple-choice and open-ended questions which facilitated the respondents to elaborate the reasoning behind their choices [14]. Three specific questions to investigate respondent's knowledge and experience were designed. A pilot survey was conducted, and feedback received was used to confirm the final text of the questionnaire [15].

The Covid-19 pandemic restricted the distribution of the questionnaire, which was originally designed to be delivered face to face. Therefore, an alternative method had to be found [16]. Opinio, a web-based survey tool which provides a framework for authoring and distributing surveys, was used for the creation and online delivery of the questionnaire [17].

Based on results from previous studies [8, 18-21], it was anticipated that  $60\% \pm 10\%$  of respondents would have proficient knowledge to answer the questions related to post & cores correctly. 'Proficient knowledge' is defined as getting a minimum of 2/3 knowledge questions correct. At the time of this study 37,065 dentists were registered with the General Dental Council (GDC) [22], Epi-tools was used to calculate a minimum of 93 respondents would be required to estimate 60% with a confidence interval of  $\pm 10\%$  [23].

Prospective respondents were contacted in the following manners: by email to postgraduate dental students at a specific teaching facility; posting on closed dental groups on Facebook; and by posting a link on a dental Instagram page.

All respondents were required to read the participant information sheet and electronically signed a consent form before taking the survey. Data collection was kept “live” for three weeks (as per the ethics approval granted by the UCL Research Ethics Committee Approval ID: 17507/001).

Quantitative data was coded and inputted into Microsoft Excel and subsequently uploaded into SPSS for statistical analysis (Version 26) [24]. P value, chi-squared and Spearman’s Rho tests were used and any results  $<0.05$  was determined to be significant.

The qualitative data resulting from comments on the questionnaire were analysed thematically. To investigate the knowledge questions, the most appropriate answer was pre-determined from the best evidence available, as presented in the literature.

### **3. Results**

#### **3.1. Demographics**

173 respondents completed the questionnaire. It was not practicable to be able to determine a response rate for the study as it was unknown how many respondents received the questionnaire due to the nature of the delivery process.

Table 1. Demographic distribution (n=173)

Demographics	Mean (SD)	No of respondents (%) n
Age (years)	37.5 (11.37)	
Year of graduation	2000 (11.58)	
<b>Type of Practice:</b>		
National Health Service (NHS)		(19.1%) 33
Part NHS/Private		(46.2%) 80
Private only		(34.7%) 60
<b>Postgraduate Qualification:</b>		
No qualifications		(44.5%) 77
Non-Restorative qualification		(37.6%) 65
Restorative qualification		(14.5%) 25
Specialist		(3.5%) 6

### 3.2. Knowledge

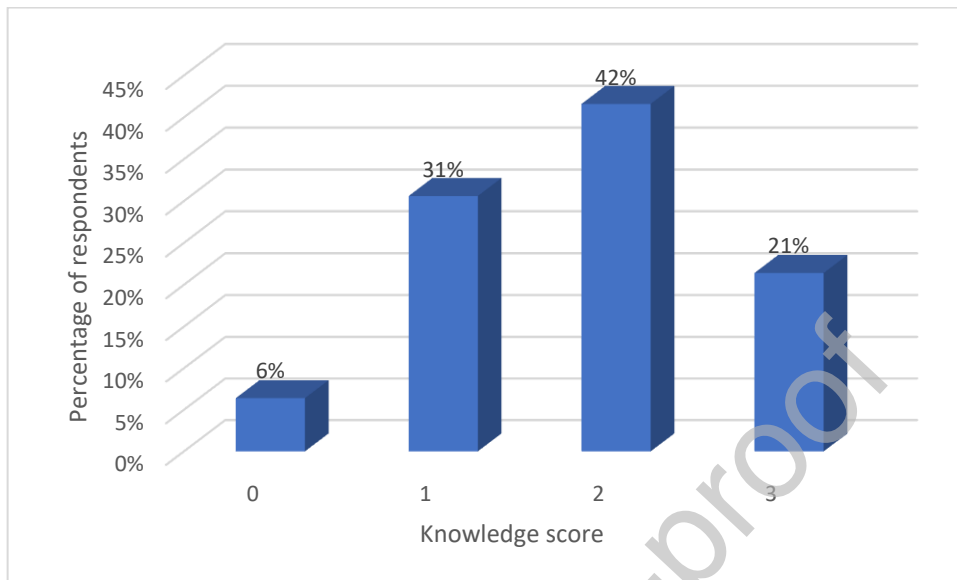
The first of three questions to establish knowledge asked respondents their opinion about residual apical seal requirements when preparing a canal for a post. 53.2% (n=92) respondents selected the most appropriate answer of 4-5 mm of Gutta Percha; whilst 34.1% (n=59) suggested 3 mm or below was considered optimal for apical seal requirements.

Respondents were given a list of tooth and crown related options and were asked which of these was the main factor which could influence the success of a post & core restoration. An overwhelming 82.7% (n=143) of respondents correctly selected a 'ferrule' as a key factor for the long-term success/survival of posts and cores.

Lastly, the ideal length of a post was reported to be 2/3rds the length of the root 42.2%, (n=73).

Respondents could achieve a maximum score of 3 and a minimum score of 0. Good knowledge was determined on respondents providing 2 out of 3 correct answers, achieved by 109 (63% (95% CI 56%, 70%)) of respondents (Fig 1).

Fig. 1 – Distribution of knowledge scores



Distribution of the knowledge scores highlighted that those respondents who had graduated more recently, were more likely to select the appropriate answer in comparison to the older graduates (Table 2). This suggests that age and year of graduation influenced knowledge based on the questions asked ( $f=4.570$ ;  $p < .034$ ).

Table 2. Distribution of knowledge scores according to mean age and year of graduation

Knowledge		Age	Year of graduation
0 Q's correct	Mean	41.73	2001.73
	N	11	11
1 Q's correct	Mean	39.09	2003.94
	N	53	53
2 Q's Correct	Mean	36.31	2006.97
	N	72	72
3 Q's correct	Mean	36.30	2008.03
	N	37	37



There was no statistical difference between the different qualifications of respondents ( $\chi^2 = 10.828$ ;  $P < 0.544$ ). (Table 3)

Table 3: Illustrating how a postgraduate qualification effects knowledge

Postgraduate qualification	0 or 1 questions correct	2 or 3 questions correct
No qualifications	35%	65%
Non-Restorative qualification	40%	60%
Restorative qualification	36%	64%
Specialist	33%	66%

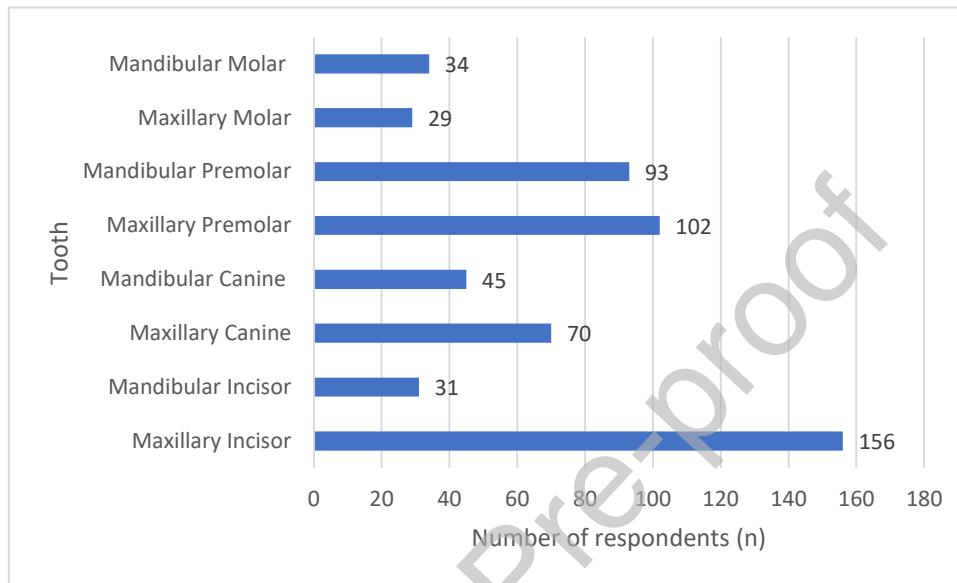
### 3.3. Experience

The most popular post materials were prefabricated fibre 52%, (n=90) and custom cast metal 38.2%, (n=66). When assessing against the demographics of the respondents, it was apparent that the age of the respondent influenced the post material selected. Older graduates were more likely to choose a custom cast metal post, whereas recent graduates were more likely to choose a prefabricated fibre post ( $F = 9.93$ ;  $P < 0.001$ ). There was no apparent association between post material and type of practice or post material and the possession of postgraduate qualifications ( $\chi^2 = 6.238$ ;  $P < 0.621$ ).

Qualitative data indicated that the most popular reason for using custom made cast metal posts was the intimacy of fit of the post to the canal wall. Other motives included strength, the integrity of post-core and the conservation of tooth tissue. For prefabricated fibre posts, ease of use, convenience and cost were the most frequent indications. Respondents wrote 'Cuts down the number of appointments', 'Avoids the needs for temporary posts as these leak' and 'Cheap'.

Maxillary incisors were reported to receive a post & core most frequently (90.1% n=156) followed by maxillary premolars (58.9%, n=102), and mandibular premolars (53.7%, n=93) (Fig. 2).

**Fig. 2** - Frequency of post placement per tooth



In respect of the cementation of the post, the most frequently used cement used by respondents was a dual-cure resin cement (46.8%, n=81), followed closely by a resin modified / non-resin modified glass ionomer cement (38.8%, n=67). In contrast, zinc phosphate cement was used by 7.5% (n=13) of respondents.

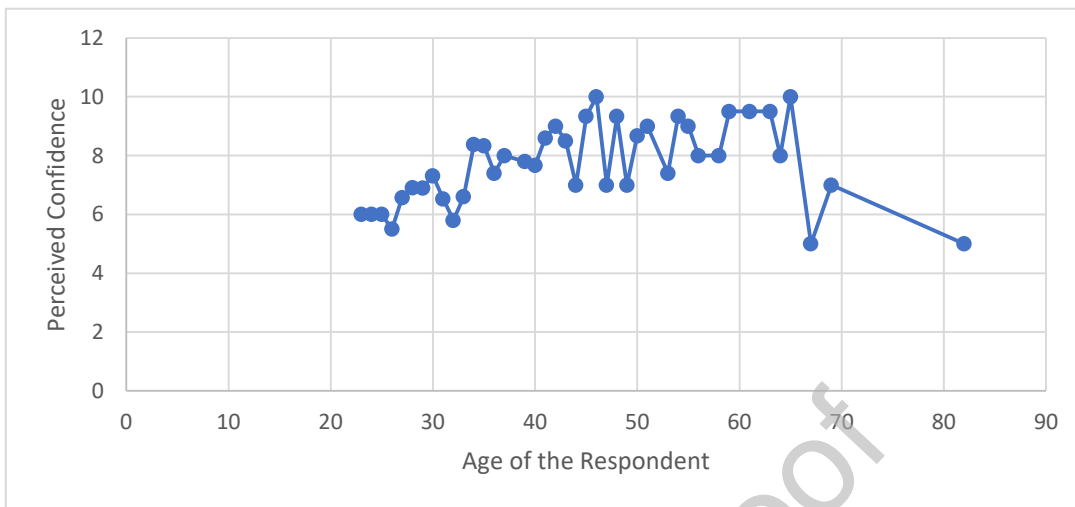
In terms of failure, nearly half of the respondents indicated firstly root fracture (44.5%, n=77), and secondly post de-cementation (31.8%, n=55) as the most common reasons they encountered on post failure.

53.8% (n=93) of the respondents indicated that they placed between 1-5 post & core restorations per year. 13.3% (n=23) respondents reported >15 posts placements per year.

Interestingly, when assessed against the demographic data, the earlier the year of graduation, the greater number of posts were placed ( $f= 18.85$ ;  $p < .001$ ). 5.2% (n=9) respondents did not place any posts in a year, though all the respondents who did not place any posts stated this was due to their main field of work being implant dentistry.

Most respondents (87.3%, n=151) indicated that they were confident ( $\geq 6/10$ ) in their skills placing a post & core restoration, with 13.9% (n=24) indicating that they were totally confident (10/10).

Respondents aged from their mid-30's upwards were more confident than the younger respondents in placing posts. In addition, this confidence dropped after their mid-60s (Spearman's Rho 0.43:  $P < 0.01$ ) (Fig. 3). Furthermore, the higher the postgraduate qualification, the more confident respondents were when placing posts ( $f = 2.87$ :  $p < .024$ ). Specialists were the most confident with a mean score of 9.5/10.

**Fig. 3-** Perceived confidence versus age

## Discussion

This piece of research aimed to gain insights into the use of post & cores to restore ETT by general dentists. It is acknowledged that in addition to different post systems available, year of graduation, experience and training may influence practitioners' choices.

The study had set out to achieve a 95% confidence interval which was met. The good knowledge scores attained by respondents was an indication that this cohort has kept up to date with contemporary knowledge of post & cores despite the ongoing development in materials and designs. However, those respondents who had graduated more recently appeared to demonstrate more awareness of clinical requirements.

This illustrates the importance of the professional responsibility of clinicians to ensure that their treatment is evidence based. Older graduates may not have been exposed to contemporary evidence when preparing post & core restorations. This contradicts previous findings that reported dentists with more years of experience showed a higher level of compliance with the literature [25]. Explanations for this could be due to personal experience, what works best in an individual's hands, a lack of up-to-date knowledge, or a disregard of clinical requirements [26]. This number is a cause for concern when extrapolated to the total number of dentists working in the UK and highlights deficiencies in practitioner knowledge which should be updated by continuing professional development (CPD). The challenge for

CPD is the un-mandatory nature of many dental topics including post & core techniques; currently, it is the personal interest of the practitioner which ensures that they seek information and knowledge [27]. The role of life-long learning and the importance of evidence-based practice should be encouraged, and dentists should ensure that they challenge their current practices against modern research. Furthermore, in respect of CPD, topics need to be taught in a relevant, challenging and interesting way. The teaching/learning interface can be linked to the success/survival rates of these challenging restorations [28].

The role of the ferrule in providing a predictable coronal restoration for a severely compromised tooth was seen to be essential by most respondents, resonating with current literature [29, 30]. Maintaining a ferrule of 2mm in height is seen to add to the predictability of the final restoration as it provides anti-rotational force and reduces the risk of root fracture [6, 31]. Clinical experience and evidence-based knowledge offer vital support when deciding whether the prognosis of the tooth concerned warrants the provision of a post and core with the aid of the ferrule to retain the definitive coronal restoration. It is promising that many clinicians are aware of this indicator for success which is consistent with the current evidence [2, 8, 25]. A small percentage did not believe a ferrule to be a key factor for success. It has been shown that if a post is cemented using a resin cement, a shorter ferrule may be acceptable, although the tooth is more likely to fail prematurely [32, 33]. This current study has demonstrated dual-cure resin cements are the most popular and may be used more frequently where a sufficient ferrule is not present [9].

There was no consensus on the ideal length of a post and only 53% of respondents were aware of apical seal requirements [34]. The length of the post plays an important role in retention and maintaining a vital seal of the apical portion of a root canal [35]. There is insufficient evidence to decide what the ideal length of a post is and there are many recommendations varying from half to three-quarters of the root [36,37]. It is widely accepted that the post should be at least two thirds the length of the root canal to help maintain an apical seal of 4-5mm to prevent re-infection of the root canal system [2,34]. Root anatomy varies between teeth and the most ideal teeth to have posts are maxillary incisors [31], which has been demonstrated by this study.

Many respondents placed posts & cores in the maxillary anterior teeth as they have a smaller amount of residual tooth tissue left after a root canal treatment [38]. In contrast, the least frequent site was in the mandibular incisors due to the presence of narrow canals and a risk of

perforation [39]. These results are consistent with those found in other surveys [8, 19, 21] and did not differ between places of work. Furthermore, the second most popular site for post placement were in the pre-molar teeth which is similar to previous studies [40]. Nevertheless, this is surprising when one considers the root configuration of many pre-molars and the potential for irreparable root damage during preparation.

Fibre posts were the most widely used material, 51% (n=89), especially amongst recent graduates (F =9.93: P<0.001). At least 38.2% (n=66) respondents chose cast-metal posts as their preferred material, which corresponds to results in previous studies [18, 41, 42]. Previous studies assessing dentists' attitude and choice of post & cores highlights that availability of materials and efficiency of post core placement has influenced decision making [42]. It could be argued that as newer materials and techniques become available the use of custom cast post may become redundant following previous trends [8, 43].

Caution should be taken with these results as the average age of respondents for the study was 37.5 years and they do not represent all age group equally. It should be questioned if the use of a post core system should be based on evidence, experience or based on what 'worked' in the past. As highlighted by the qualitative responses many respondents in this current study use the most convenient system available to them in their working environment, with a secondary consideration for what was a more ideal material. This could be a reflection of the demographics of our sample, their role within their clinical practice or the availability of materials. Whilst clinical research and evidence support the use of different systems for different clinical scenarios, [44] the most appropriate should be employed to optimise the longevity of the restoration.

As the years of practitioner experience increased, the number of posts placed (F= 18.85: P<0.001), and confidence level increased with specialists being the most confident (F=7.92: P<0.001). These results are not surprising as the more senior practitioners are more likely to be confident and have more experience [41]. Specialists tend to have more experience and accept referrals from general dental practitioners to carry out certain more complex treatment on a more regular basis.

Surprisingly, there was no difference in material choice demonstrated by those who had a postgraduate qualification ( $\chi^2 = 2.317$ : P<0.314). This contradicts previous studies which reported that having a postgraduate education influenced clinicians' decisions on post and cores and that specialists were more likely to choose a custom cast post [19, 45, 46]. This

could be due to having good undergraduate knowledge or constraints in the type of practice one works in. Further in-depth interviews and analysis are required to explore post choice and what steps a dentist takes to decide which type of post to use.

Varieties of dual-cured cement were reported by respondents in this current study to be the most common cementing material. The main advantage of using a dual-cured resin cement is the assurance that the cement will set, whereas other materials may be less predictable. Though, the challenges of such a cement include needing excellent moisture control and the capacity on effectively bonding within the canal [47]. Both resin-modified glass ionomer cement (RMGIC) and glass ionomer cement (GIC) were the next most popular cements. These cements lack the strength of a dual-cured resin cement but overcome some of the challenges associated with adhesion within the post space. Unfortunately, like the choice of post & cores material there is no clear consensus or guideline on cement choice for post & cores. Furthermore, other factors affecting longevity of the ETT restored with a post & core relating to cementation include the use of rubber dam [48] canal preparation [49], pre-treatment conditioning [50] and bond strength of the cements [51]. These considerations were not investigated as part of this survey. [52].

It was interesting to note that an increase in confidence is allied to knowledge [53] although the respondents in the context of this study did not display the same. However, it is more likely to be linked to the standard of education and feedback practices of the relevant education programmes [54] which makes the material difference.

Distributing a questionnaire through social media sites, means it is possible that the sample of respondents is not truly representative of all UK dentists. The authors acknowledges that the age range of respondents could also be considered narrow.

The interpretation of knowledge for post & cores is ambiguous as there are multiple factors involved. Part of this study set out to assess knowledge based on the literature review; however, as demonstrated, there are rarely set answers that are correct for every scenario especially when it comes to the use of post & cores.

**Conclusion**

The use of post & cores as a method of restoring ETT is well recognised and appears to be a familiar technique to the cohort of respondents in this study.

Despite indications that alternative treatment options are becoming more readily available, and dentists are willing to try new ideas, the role of the post & core as a restorative technique seems to be secure. Nevertheless, there is an ongoing need for dentists to keep up to date with their knowledge of materials and techniques to ensure that their clinical practice remains evidence based.

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#### Autors contributions

Dr K. Shankla has contributed with: study design, data collection, data analysis, writing of the manuscript and revision of the manuscript

Dr R Sambrook has contributed with: study design, data collection, data analysis, writing of the manuscript and revision of the manuscript

Dr Peter Fine has contributed with: study design, data collection, data analysis, writing of the manuscript and revision of the manuscript

Mr R. Blizard has contributed with: analysis of data and writing the manuscript

Prof. A. Leung has contributed with: study design, data collection, data analysis, writing of the manuscript and revision of the manuscript

#### **Credit Author statement**

All authors declare that this is an original piece of research and has not been published elsewhere or is not being submitted for publication to any other journal.

#### **Declaration of competing interest**

The authors declare that they have no competing financial, professional, or personal interests that might have influenced the performance or presentation of the work described in this manuscript. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for profit sectors

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