A Survey of Contemporary Philosophies and Techniques of Restoring Endodontically Treated Teeth in Kuwait

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Key Words

Pulpless teeth · Restoration, post and core · Prosthesis, dental · Root canal therapy · Endodontically treated teeth · Dentists' attitudes

Abstract

Objective: Numerous methods of restoring endodontically treated teeth have been advocated, and the prognosis of the treatment varies depending on the materials and techniques used. The objective of this study was to improve the understanding of contemporary philosophies and techniques of restoring endodontically treated teeth in Kuwait to serve as a baseline for continuous quality improvement of dental care in Kuwait. **Methods:** A questionnaire (English and Arabic versions) that comprehensively reviewed philosophies and techniques of restoring endodontically treated teeth was prepared. A research assistant identified prosthodontists, endodontists and general dentists practicing in government clinics in Kuwait. The sample represented 63% of the prosthodontists employed by the Ministry of Health, 91% of the endodontists and 7% of the general practitioners. Surveys were hand-carried by the research assistant and distributed to all dentists in the study group. Although all

responses were anonymous, all surveys were numbered for tracking, and the research assistant returned to the government clinics repeatedly until all questionnaires (100%) were recovered. Data from the returned questionnaires were tabulated and statistical analysis for associations was conducted by using χ^2 tests. **Results:** Almost 60% of dentists in the survey involved in the treatment of endodontically treated teeth believed a post would reinforce the tooth. One third of the respondents used or recommended the use of one-piece dowel crowns (Richmond crowns). One third lacked familiarity with the ferrule effect, and several misconceptions relative to the optimal length of a post were also recorded. The vast majority of general dentists in the survey did not report involvement in the treatment of 30 or more endodontically treated teeth per year. **Conclusions:** The majority of the respondents misunderstood the purpose of a post, and there were misconceptions regarding the optimal length of a post. One third did not report familiarity with the ferrule effect, which is an important restorative component. One third used or recommended an obsolete method of restoration with a one-piece dowel crown.

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1011-7571/01/0101-0014\$17.50/0

Accessible online at:
www.karger.com/journals/mpp

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Introduction

Contemporary endodontic therapy has allowed patients to retain teeth that were once commonly extracted without hesitation. Restored pulpless teeth present unique problems to the dentist, and several studies have indicated a poorer prognosis for these teeth compared to the survival of teeth with vital pulps [1–6].

Many *in vitro* studies of restored pulpless teeth have been published, but results are commonly conflicting and not always applicable clinically [7]. Some studies were conducted on extracted teeth, while others involved studies of plastic tooth analogs, photoelastic analyses or computer-generated, finite element analyses. When evaluating mechanical properties, some investigators directly loaded the cores, while others loaded teeth restored with cemented crowns. Different conclusions have been reported from these studies, reflecting the diverse experimental designs.

Several retrospective clinical studies have been reported, also with contradictory results [8–13]. These observational studies evaluated historical data from teeth restored many years previously, without controlling the treatment provided. Although these retrospective investigations allowed the inclusion of large numbers of teeth for analyses, unidentifiable biases were inevitable because of the retrospective design.

As new materials and techniques are introduced for restoring pulpless teeth, the efficacy of these developments must be evaluated critically, especially relative to the long-term prognosis of the teeth and the restorations [14]. Many unproven beliefs of the past have been dispelled by the results of studies reported over the past 20 years; nonetheless dentists appear slow to discard old ideas or to adapt to new knowledge. A recent comprehensive nationwide survey of US dentists' philosophies and techniques of restoring pulpless teeth reported by Morgano et al. [15] indicated significant variations nationwide depending on the dentist's geographic location, age, specialty status, and dental school faculty status. Some dentists adhered to outdated ideologies. For example, approximately 50% of the respondents believed that a post or dowel would reinforce a pulpless tooth, despite substantial scientific evidence to the contrary [16–21]. A post provides intraradicular retention for a core reconstruction for a structurally compromised pulpless tooth, and is indicated whenever there is insufficient remaining tooth structure to retain the core [14].

With the diversity in the education and qualifications of dentists practicing in the US, lack of uniformity in their

philosophies and treatment methods is understandable. However, control of dental education in the US is among the most rigid in the world, and US dental school curricula must conform to enforceable standards dictated by the American Dental Association [22]. If some US dentists are outdated in their concepts and treatment approaches, divergent concepts and perhaps outmoded methods are likely to be encountered in other countries as well. For example, there is anecdotal evidence that the one-piece dowel crown, or Richmond crown, is used today in many countries. The Richmond crown was introduced in 1878 in the US, but became unpopular because of a number of problems encountered clinically. This restorative method is now considered obsolete and has been replaced with a post and core restoration as a separate entity independent of the final complete crown [14, 23, 24]. Contemporary prosthodontic texts published in the US do not advocate the one-piece dowel crown [25–27].

All practicing dentists in Kuwait received their professional education elsewhere; therefore, their educational backgrounds are considerably more disparate than in the US. Until the present study, it was unknown which materials and techniques were commonly used by dentists in Kuwait to restore endodontically treated teeth.

The ability to save severely damaged teeth with the use of contemporary endodontics has merit only if a satisfactory restorative solution follows the endodontic treatment. The financial resources and time commitment required for the treatment and restoration of endodontically involved teeth are substantial. Inadequate restoration can significantly impact on the prognosis of these teeth, and represents a major public health issue. Enhancement of the quality of dental health care in Kuwait requires objective knowledge of prevailing methods and concepts. Baseline information concerning the knowledge of local dentists can serve as a fundamental guide for the development of continuing dental educational programs whose ultimate goal is the oral health of the Kuwaiti population.

The objective of this study was to improve understanding of contemporary philosophies and techniques of restoring endodontically treated teeth in Kuwait. The results will serve in the future as a baseline for continuous quality improvement of dental care in Kuwait.

Table 1. Educational background

	Professional dental degree	Postdoctoral education
Egypt	29 (39)	16 (32)
India	20 (27)	18 (36)
Syria	12 (16)	5 (10)
Yugoslavia	3 (4)	1 (2)
USA	2 (3)	5 (10)
Afghanistan	1 (1)	–
Algeria	1 (1)	–
Bosnia	1 (1)	2 (4)
European Union	1 (1)	–
Ireland	1 (1)	–
Pakistan	1 (1)	–
Philippines	1 (1)	–
Russia	1 (1)	–
Turkey	1 (1)	1 (2)
Germany	–	1 (2)
United Kingdom	–	1 (2)
Total	75 (100)	50 (100)

Figures represent number of respondents with the percentage given in parentheses.

Materials and Methods

A questionnaire was developed that comprehensively reviewed philosophies and techniques of restoring endodontically treated teeth. A replica of the form, which is a modification of the questionnaire previously used by Morgano et al. [15], is given in the Appendix. An Arabic version was also prepared. A research assistant identified 19 prosthodontists and 22 endodontists practicing in government clinics in Kuwait who were available to complete the survey. The 19 prosthodontists represented 63% of the 30 prosthodontists employed by government clinics, and the 22 endodontists accounted for 91% of the 24 endodontists. Thus, the majority of endodontists and prosthodontists practicing in government clinics were included. Those who were not included were absent because of annual leave, sick leave, administrative leave or educational leave. In addition, 38 general practitioners (approximately 7% of the general dentists employed by the Ministry of Health) were included for comparison with the specialists. Surveys were hand-carried by the research assistant and distributed to all the dentists in the study group. Although all responses were anonymous, all surveys were numbered for tracking, and the research assistant returned to the clinics repeatedly until all the questionnaires had been recovered. Data from the completed questionnaires were tabulated and analyzed by using χ^2 tests for associations.

All questionnaires were accounted for, representing a response rate of 100%, and there were 79 questionnaires included in the analysis. Some questions were left blank by the respondents on some surveys, so the total number of responses for some questions did not equal the total number of surveys. Dentists who indicated in question 7 that they were not involved with the treatment of 30 or more

endodontically treated teeth per year were requested to return their surveys without answering questions 8 through 24 (the remaining questions). Nevertheless, 3 dentists reported treating less than 30 endodontically treated teeth per year, but continued to answer questions 8 through 24. It was felt that perhaps the respondents misread this question. These 3 dentists were contacted by phone, and they verified that they were indeed involved in the treatment of 30 or more endodontically treated teeth. All responses for questions 8 through 24 for these 3 dentists were included in the survey analysis because these responses represented valid data. Responses were tabulated and analyzed by χ^2 tests according to gender, specialty status and age group. All calculated percentages with decimal points were rounded to the nearest unit value; therefore, percentages given may not add up to 100%.

Results

The ages of the respondents ranged from 24 to 61 years, with a mean age of 39 years. Sixty men (80%) and 15 women (20%) were identified in the survey. Thirty-six surveys, or 46% of the total, were collected from general practitioners, 19 (24%) from prosthodontists, 22 (27%) from endodontists, with the remaining 2 (3%) completed by other dental specialists who were engaged in general practice. Table 1 lists the countries where the respondents received their professional dental degrees and their postdoctoral education. Dentists receiving their dental degrees and postdoctoral education from either Egypt or India collectively represented two thirds of the respondents. Forty-four dentists (57%) reported involvement in the treatment or restoration of more than 30 endodontically treated teeth per year (question 7), whereas 33 respondents (43%) did not. Thirty-one general practitioners were not involved in the treatment of 30 or more endodontically treated teeth per year.

With regard to philosophical concepts, 6 respondents (13%) believed that every endodontically treated tooth must receive a post, while 41 respondents (87%) did not. More than half (27 respondents or 59%) believed that a post would reinforce an endodontically treated tooth. One third of the respondents (32%) placed or recommended one-piece dowel crowns (Richmond crowns). One third (35%) was not familiar with the concept of the 'ferrule effect'. Of the 38 dentists who responded to the question regarding the method of development of the ferrule, only 16% (6 respondents) indicated that the ferrule should come from the cemented artificial crown. Eight respondents (21%) indicated their belief in the use of a bevel as a component of the cast core for developing a ferrule, 10 (26%) reported that they believed in incorporating both approaches, and 14 (37%) indicated 'no opinion'.

Table 2. Variables by specialty status

		Total	Respondents by type of dentist			
			GP (n = 7)	PR (n = 19)	EN (n = 21)	p
Every ETT must receive a post	No	41 (87)	6 (86)	13 (72)	18 (100)	0.055 (NS)
	Yes	6 (13)	1 (14)	5 (28)	–	
Post will reinforce ETT	No	19 (41)	3 (43)	7 (37)	8 (47)	0.82 (NS)
	Yes	27 (59)	4 (57)	12 (63)	9 (53)	
Use or recommend one-piece dowel crown	No	28 (68)	2 (33)	14 (82)	12 (67)	0.08 (NS)
	Yes	13 (32)	4 (67)	3 (18)	6 (33)	
Familiar with ‘ferrule effect’	No	16 (35)	5 (71)	6 (33)	5 (24)	0.07 (NS)
	Yes	30 (65)	2 (29)	12 (67)	16 (76)	
How ferrule effect should be developed						
Component of cast core		8 (21)	–	–	8 (42)	0.07 (NS)
With artificial crown		6 (16)	1 (33)	2 (12)	3 (16)	
Both approaches		10 (26)	1 (33)	6 (38)	3 (16)	
No opinion		14 (37)	1 (33)	8 (50)	5 (26)	
Remove obturating material						
Rotary reamers	No	2 (4)	14 (1)	–	1 (5)	0.31 (NS)
	Yes	42 (95)	6 (86)	17 (100)	19 (95)	
Hand reamers	No	38 (86)	6 (86)	15 (88)	17 (85)	0.31 (NS)
	Yes	6 (7)	1 (14)	2 (12)	3 (15)	
Heated instrument	No	31 (69)	6 (86)	15 (83)	10 (50)	0.050 (<0.05)
	Yes	14 (31)	1 (14)	3 (17)	10 (50)	
Solvents	No	37 (82)	6 (86)	17 (94)	14 (70)	0.14 (NS)
	Yes	8 (18)	1 (14)	1 (6)	6 (30)	
Length of post						
As long as practical	No	35 (80)	6 (86)	15 (83)	14 (73)	0.70 (NS)
	Yes	9 (20)	1 (14)	3 (17)	5 (27)	
Equal length of clinical crown	No	38 (86)	5 (71)	14 (78)	19 (100)	0.065 (NS)
	Yes	6 (14)	2 (29)	4 (22)	–	
One half length of root	No	38 (100)	7 (100)	18 (100)	19 (100)	(NS)
	Yes	–	–	–	–	
Two thirds length of root	No	19 (43)	3 (43)	5 (28)	11 (58)	0.18 (NS)
	Yes	25 (57)	4 (57)	13 (72)	8 (42)	
Preserve 3 mm of obturating material	No	26 (59)	6 (86)	9 (50)	11 (58)	0.26 (NS)
	Yes	18 (41)	1 (14)	9 (50)	8 (42)	
Preserve 5 mm of obturating material	No	39 (89)	7 (100)	17 (94)	15 (79)	0.20 (NS)
	Yes	5 (11)	–	1 (6)	4 (21)	

Figures represent number with the percentage given in parentheses. Probability obtained from χ^2 analysis.

NS = Not significant; GP = general practitioner; PR = prosthodontist; EN = endodontist; ETT = endodontically treated tooth.

Nine respondents (20%) indicated that the post should be as long as practical, and 6 (14%) indicated that the length of the post should equal the length of the clinical crown. Twenty-five respondents (58%) indicated that the post should correspond to two thirds of the length of the root in bone. By contrast, 18 (41%) reported that preserving 3 mm of obturating material should serve as a guide-

line, while 5 respondents (11%) indicated that 5 mm of obturating material should serve as the guideline.

Results were not statistically significant regarding gender, with one notable exception. The one-piece dowel crown was used by 71% of the women respondents compared to only 22% of the men ($p = 0.01$). With regard to age, only the question concerning familiarity with the fer-

Fig. 1. Occlusal forces (OF) are transmitted to center of root through post as spreading forces (SF) that can cause vertical fracture of root. If artificial crown extends 2 mm apical to junction of core and tooth, ferrule effect (FE) will resist these spreading forces. This ferrule effect will also avoid tensile stresses in the cement seal at the crown margin and protect the post from stress concentration at the junction of the post and the core.

rule effect yielded significant results ($p = 0.018$) in which only 20% of the respondents 50 years of age and over reported familiarity with the ferrule effect while 74% of those under the age of 50 reported familiarity with this concept. Results are summarized in table 2. Responses to some questions did not yield useful information because of the relatively small sample size and are not reported, although the dentists responded adequately to these questions.

Discussion

The finding that only 7, or one fifth, of the general practitioners in the survey were involved in the treatment of 30 or more endodontically treated teeth per year is inconsistent with trends in general dental practice in most industrialized countries where the vast majority of general dentists provide restorative care for endodontically involved teeth [15]. Inquiry concerning this issue with the Director of Dental Services for the Ministry of Health

indicated that general dentists in Kuwait practice primarily in primary-care polyclinics. Dentists in these clinics 'do primarily fillings and extractions'. Although extractions are relatively common, the need for endodontics among the population is relatively high. It appears that dentists in the polyclinics either do not wish to offer this type of care or perhaps they lack the expertise, materials or equipment required to provide this treatment. The general dentists who reported treating 30 or more pulpless teeth per year were recent graduates in dental internships in the specialist clinics, and did not practice in the polyclinics.

The 63% of the prosthodontists who believed that a post would reinforce an endodontically treated tooth is comparable to the percentage of US general practitioners (59%) who reported this belief in the survey reported by Morgano et al. [15] in 1994. Nevertheless, this percentage is substantially higher than the percentage of American Board-certified prosthodontists (43%) in the US study who held this belief. Evidence that posts do not reinforce endodontically treated teeth is not new [16–20]; however, this topic has received considerable attention during the last 5 years [14, 21]. Consequently it could be assumed that more dentists would be aware of this concept today, compared to the early 1990s when the US survey was conducted [15].

Only two thirds of the respondents were familiar with the concept of a ferrule, and only 16% believed that the ferrule should come from the cemented artificial crown. Nevertheless, the ferrule has a profound effect on the prognosis of the restored pulpless tooth [14]. When a post is placed in the root, it provides retention for the core, which in turn provides retentive and resistance form for the complete crown. However, the post can transfer occlusal forces into the center of the root, and predispose the root to fracture (fig. 1). The cemented artificial crown encircles the residual tooth structure, counteracting the spreading effect generated by the post [28–32]. In addition, the ferrule effect will minimize stresses in the cement seal of the artificial crown and avoid stress concentration at the junction of the post and the core [13, 32–35]. This ferrule effect is difficult to establish when the remaining coronal tooth structure is limited, and preprosthetic surgical crown lengthening or orthodontic extrusion may be required to avoid violating the dentogingival attachment [29].

Forty-seven percent of those with an opinion about the ferrule indicated that the ferrule effect could be obtained from a contrabevel as a component of the core itself or from the core's contrabevel in combination with the fer-

rule effect from the artificial crown. Current knowledge suggests that there is no advantage to a contrabevel as a component of the core [36], and this contrabevel design for the core may be detrimental [37].

One third of the respondents used or recommended the one-piece dowel crown, although 82% of the prosthodontists did not use this restoration, which is now considered obsolete. One problem with the one-piece dowel crown is related to fabrication difficulties. Procedures for casting a post that will seat passively are completely different from those required to produce a passively fitting crown. The post must seat without binding in the root, while the crown must passively encircle the coronal tooth structure. There is no practical method to accurately cast simultaneously an internally fitting post in combination with an extracoronary casting, which must also provide a ferrule. When casting a post, the investment must be manipulated to provide minimal expansion of the mold to produce a slightly undersized post that will not bind in the root. However, when an extracoronary restoration is cast, maximal expansion of the mold is desired to create an oversized casting.

Another problem with this one piece restoration is related to the technical difficulty associated with its eventual replacement during the lifetime of the tooth. The one-piece dowel crown was introduced at a time when it was anticipated that patients would lose their teeth at a relatively early age. Today many patients are expected to retain their teeth for a lifetime; therefore, it is assumed that a tooth will last longer than a restoration. If a one-piece dowel crown must be remade for any reason, the dentist must remove the post to remove the crown. The forces necessary to dislodge a post are extremely dangerous and may irreversibly damage the remaining tooth structure. A two-piece system with the crown as a separate entity is more desirable because the crown can be removed easily while the post and core remain undisturbed.

An important consideration relative to the success of a post-restored tooth is the length of the post. Longer posts offer a better prognosis, although the apical seal must be maintained [38–40]. Few respondents indicated that a post should be as long as practical or that the post should equal the length of the clinical crown. Many respondents selected preservation of 3 mm of obturating material as a guideline for the post's length. However, contemporary research reports have indicated that 4–5 mm of obturating material should be retained, not 3 mm [41].

Conclusion

Based on the results of this survey the following conclusions were drawn. (1) Almost 60% of dentists involved in the treatment of endodontically treated teeth believed a post would reinforce a pulpless tooth. (2) One third of the respondents used or recommended one-piece dowel crowns (Richmond crowns). (3) One third of the respondents lacked familiarity with the concept of a ferrule effect, and only 16% of the respondents familiar with the ferrule indicated that the ferrule effect was derived from the cemented crown that extends 1.5–2 mm apical to the margin of the core. (4) The vast majority of general dentists in the survey reported involvement in the treatment of less than 30 endodontically treated teeth per year. (5) There was misunderstanding among some respondents relative to the optimal length of posts.

Acknowledgments

The authors thank all dentists who completed the surveys. This research project was funded by Kuwait University grant No. DX 03/99.

A Survey of Contemporary Philosophies and Techniques of Restoring Endodontically Treated Teeth in Kuwait

Please add any comments about your experiences with the restoration of endodontically treated teeth.

1. What is your specialty status?
 - (1) General dentist ☐
 - (2) Prosthodontist/Restorative Dentist/Crown and Bridge Specialist ☐
 - (3) Endodontist ☐
 - (4) Other dental specialist ☐ (PLEASE DO **NOT** CONTINUE AND **RETURN THIS QUESTIONNAIRE. THANK YOU VERY MUCH FOR YOUR INTEREST**)
2. What is your age? _____ years
3. What is your gender? (1) M ☐ (2) F ☐
4. From which country did you receive your professional dental degree? _____
5. If you are a specialist in Prosthodontics (Restorative Dentistry/Crown and Bridge) or Endodontics, from which country did you receive your specialty education? _____
6. How long have you been practicing dentistry?
 - (1) Less than 5 years ☐
 - (2) 6-10 years ☐
 - (3) 11-15 years ☐
 - (4) 16-20 years ☐
 - (5) More than 20 years ☐
 - (6) Retired ☐
7. Are you involved with the treatment or restoration of more than 30 endodontically treated teeth per year?
 - (1) YES ☐ (0) NO ☐

(IF **NO**, PLEASE DO **NOT** CONTINUE AND **RETURN THIS QUESTIONNAIRE. THANK YOU VERY MUCH FOR YOUR INTEREST.**)
8. In what percentage of endodontically treated teeth that are planned for a cast restoration (complete crown or cast onlay) do you place (or recommend) a post? _____%
9. Do you believe that every endodontically treated tooth must receive a post?
 - (1) YES ☐ (0) NO ☐
10. Do you believe that a post will reinforce an endodontically treated tooth and reduce the chances of fracture?
 - (1) YES ☐ (0) NO ☐
11. Do you place (or recommend) the one-piece post-and-crown (Richmond crown)
 - (1) YES ☐ (0) NO ☐
12. Are you familiar with the term "ferrule effect"?
 - (1) YES ☐ (0) NO ☐
13. If yes, how do you believe this "ferrule effect" should be developed?
 - (1) As a component of a cast core by placing a bevel for the core ☐
 - (2) By cementing an artificial crown that extends 1.5-2 mm apical to the finish line for the core ☐
 - (3) By incorporating *both* approaches mentioned above ☐
 - (4) No opinion ☐
14. How do you remove the obturating material (root-canal filling material) to establish a post space?
 - (1) Rotary reamers (e.g., Gates Glidden) ☐
 - (2) Hand reamers ☐
 - (3) Heated endodontic instrument ☐
 - (4) Solvents (e.g., chloroform) ☐
 - (5) Other ☐ (please specify) _____
15. What guidelines do you use (or recommend) for establishing the length of the post? (please check all that apply)
 - (1) As long as practical ☐
 - (2) Length of post should equal length of clinical crown ☐
 - (3) Length of post should equal one-half length of root in bone ☐
 - (4) Length of post should equal two-thirds length of root in bone ☐
 - (5) Length of post should preserve 3 mm of obturating material (root-canal filling material) ☐
 - (6) Length of post should preserve 5 mm of obturating material (root-canal filling material) ☐
 - (7) Other ☐ (please specify) _____

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16. What type of post do you use (or recommend)?
- (1) Prefabricated post only ☐
 - (2) Cast post and core only ☐
 - (3) Both ☐
 - (4) None ☐ What do you use (or recommend) in place of a post? Please specify _____
17. If you use (or recommend) prefabricated posts, which type do you use (or recommend) most often (more than 50% of the time)?
- (1) Parallel-sided serrated (e.g., Para-Post) ☐
 - (2) Tapered smooth (e.g., Kerr Endo-Post) ☐
 - (3) Screw post (e.g., Kurer Post) ☐
 - (4) Split flexible post (e.g., Flexi-Post) ☐
 - (5) Other ☐ (please specify) _____
18. If you use (or recommend) prefabricated posts, which material do you use (or recommend) most often (more than 50% of the time) as a core build-up?
- (1) Amalgam ☐
 - (2) Composite resin ☐
 - (3) Glass ionomer ☐
 - (4) Modified glass ionomer (e.g., Ketac-Silver) ☐
 - (5) Other ☐ (please specify) _____
19. If you use (or recommend) cast posts and cores, which alloy do you use (or recommend) most often?
- (1) Gold alloy ☐
 - (2) Silver palladium or palladium silver alloy ☐
 - (3) Base metal alloy ☐
 - (4) Don't know ☐
20. If you use (or recommend) cast posts and core, do you use (or recommend):
- (1) Direct-pattern technique (resin or wax) ☐
 - (2) Indirect method (impression) ☐
 - (3) Both techniques ☐
21. In your practice, what is the most commonly used (or recommended) post-and-core technique for a single-rooted tooth?
- 18a. As a single crown:
- (1) Custom cast ☐
 - (2) Prefabricated with build-up ☐
- 18b. As an abutment:
- (1) Custom cast ☐
 - (2) Prefabricated with build-up ☐
22. In your practice, what is the most commonly used (or recommended) post-and-core technique for a multi-rooted tooth?
- 18a. As a single crown:
- (1) Custom cast ☐
 - (2) Prefabricated with build-up ☐
- 18b. As an abutment:
- (1) Custom cast ☐
 - (2) Prefabricated with build-up ☐
23. What type of cement do you use (or recommend) most often to cement a post?
- (1) Zinc phosphate ☐
 - (2) Polycarboxylate ☐
 - (3) Glass ionomer ☐
 - (4) Resin cement ☐
24. How do you place (or recommend placement of) cement into the canal?
- (1) Apply cement on post only ☐
 - (2) Apply cement in canal with probe ☐
 - (3) Apply cement in canal with Lentulo spiral paste filler ☐
 - (4) Other ☐ (please specify) _____
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Thank you very much for your valuable contribution to this study.

References

- 1 Karlsson S: A clinical evaluation of fixed bridges, 10 years following insertion. *J Oral Rehabil* 1986;13:423-432.
- 2 Strub JR, Linter H, Marinello CP: Rehabilitation of partially edentulous patients using cantilever bridges: A retrospective study. *Int J Periodont Rest Dent* 1989;9:364-375.
- 3 Karlsson S: Failures and length of service in fixed prosthodontics after long-term function: A longitudinal clinical study. *Swed Dent J* 1989;13:185-192.
- 4 Hatzikyriakos AH, Reisis GH, Tsingos N: A 3-year prospective clinical evaluation of posts and cores beneath existing crowns. *J Prosthet Dent* 1992;67:454-458.
- 5 Testori T, Badino M, Castagnola M: Vertical root fractures in endodontically treated teeth: A clinical survey of 36 cases. *J Endodont* 1993;19:87-91.
- 6 Palmqvist S, Soderfeldt B: Multivariate analyses of factors influencing the longevity of fixed partial dentures, retainers, and abutments. *J Prosthet Dent* 1994;71:245-250.
- 7 Morgano SM, Milot P: Clinical success of cast metal posts and cores. *J Prosthet Dent* 1993;70:11-16.
- 8 Sorensen JA, Martinoff JT: Intracoronar reinforcement and coronal coverage: A study of endodontically treated teeth. *J Prosthet Dent* 1984;51:780-784.
- 9 Sorensen JA, Martinoff JT: Endodontically treated teeth as abutments. *J Prosthet Dent* 1985;53:631-636.
- 10 Weine FS, Wax AH, Wenckus CS: Retrospective study of tapered, smooth post systems in place for 10 years or more. *J Endod* 1991;17:293-297.
- 11 Vire DE: Failure of endodontically treated teeth: Classification and evaluation. *J Endod* 1991;17:338-342.
- 12 Creugers NH, Mentink AG, Kayser AF: An analysis of durability data on post and core restorations. *J Dent* 1993;21:281-284.
- 13 Torbjörner A, Karlsson S, Ödman PA: Survival rate and failure characteristics for two post designs. *J Prosthet Dent* 1995;73:439-444.
- 14 Morgano SM, Brackett SE: Foundation restorations in fixed prosthodontics: Current knowledge and future needs. *J Prosthet Dent* 1999;82:643-657.
- 15 Morgano SM, Hashem AF, Fotoohi K, Rose L: A nationwide survey of contemporary philosophies and techniques of restoring endodontically treated teeth. *J Prosthet Dent* 1994;72:259-267.
- 16 Standlee JP, Caputo AA, Collard EW, Pollack MH: Analysis of stress distribution by endodontic posts. *Oral Surg Med Oral Pathol* 1972;33:952-960.
- 17 Guzy GE, Nicholls JI: In vitro comparison of intact endodontically treated teeth with and without endo-post reinforcement. *J Prosthet Dent* 1979;42:39-44.
- 18 Standlee JP, Caputo AA, Halcomb J, Trabert KC: The retentive and stress-distributive properties of a threaded endodontic dowel. *J Prosthet Dent* 1980;44:398-404.
- 19 Trope M, Maltz DO, Tronstad L: Resistance to fracture of restored endodontically treated teeth. *Endodont Dent Traumatol* 1985;1:108-111.
- 20 Cooney JP, Caputo AA, Hanson EC: Retention and stress distribution of tapered-end endodontic posts. *J Prosthet Dent* 1986;55:540-546.
- 21 Morgano SM: Restoration of pulpless teeth: Application of traditional principles in present and future contexts. *J Prosthet Dent* 1996;75:375-380.
- 22 Commission on Dental Accreditation: Accreditation Standards for Dental Education Programs. Chicago, American Dental Association, 1998.
- 23 Hampson EL, Clark J: The post-retained crown. *Dent Pract Dent Rec* 1958;8:130-135.
- 24 Demas NC: Direct impression for cast Richmond crown using acetate crown forms. *Dental Dig* 1957;63:258-259.
- 25 Malone WFP, Koth DL, Cavazos E, Kaiser D, Morgano SM: Tylman's Theory and Practice of Fixed Prosthodontics, ed 8. St Louis, Ishiyaku EuroAmerica, 1989.
- 26 Shillingburg HT, Hobo S, Whitsett CD, Jacobi R, Brackett SE: Fundamentals of Fixed Prosthodontics, ed 3. Chicago, Quintessence, 1997.
- 27 Rosenstiel SF, Land MF, Fujimoto J: Contemporary Fixed Prosthodontics, ed 3. St Louis, Mosby, 2000.
- 28 Frank AL: Protective coverage of pulpless teeth. *J Am Dent Assoc* 1959;59:895-900.
- 29 Eissman HF, Radke RA: Postendodontic restoration; in Cohen S, Burns RC (eds): Pathways of the Pulp, ed 4. St Louis, Mosby, 1987, pp 640-643.
- 30 Barkhordar RA, Radke R, Abbasi J: Effect of metal collars on resistance of endodontically treated teeth to root fracture. *J Prosthet Dent* 1989;61:676-678.
- 31 Hemmings KW, King PA, Setchell DJ: Resistance to torsional forces of various post and core designs. *J Prosthet Dent* 1991;66:325-329.
- 32 Assif D, Bitenski A, Pilo R, Oren E: Effect of post design on resistance to fracture of endodontically treated teeth with complete crowns. *J Prosthet Dent* 1993;69:36-40.
- 33 Libman WJ, Nicholls JI: Load fatigue of teeth restored with cast posts and cores and complete crowns. *Int J Prosthodont* 1995;8:155-161.
- 34 Fan P, Nicholls JI, Kois JC: Load fatigue of five restoration modalities in structurally compromised premolars. *Int J Prosthodont* 1995;8:213-220.
- 35 Freeman MA, Nicholls JI, Kydd WL, Harrington GW: Leakage associated with load fatigue-induced preliminary failure of full crowns placed over three different post and core systems. *J Endod* 1998;24:26-32.
- 36 Sorensen JA, Engleman MJ: Ferrule design and fracture resistance of endodontically treated teeth. *J Prosthet Dent* 1990;63:529-536.
- 37 Loney RW, Kotowicz WE, McDowell GC: Three-dimensional photoelastic stress analysis of the ferrule effect in cast post and cores. *J Prosthet Dent* 1990;63:506-512.
- 38 Sorensen JA, Martinoff JT: Clinically significant factors in dowel design. *J Prosthet Dent* 1984;52:28-35.
- 39 Standlee JP, Caputo AA: Biomechanics in Clinical Dentistry. Chicago, Quintessence, 1987, pp 185-203.
- 40 Holmes DC, Diaz-Arnold AM, Leary JM: Influence of post dimension on stress distribution in dentin. *J Prosthet Dent* 1996;75:140-147.
- 41 Goodacre CJ, Spolnick KJ: The prosthodontic management of endodontically treated teeth: A literature review. II. Maintaining the apical seal. *J Prosthodont* 1995;4:51-53.