

ENDODONTICALLY TREATED TEETH RESTORATION ASSESSMENT, DECISION MAKING AND TREATMENT OPTION AMONG DENTAL PRACTITIONERS IN SAUDI ARABIA

Waseem Waleed Radwan^{1*}, Danah Saleh AlTuwaijri², Aldanah Turki Alwoseamer², Albatul Ibrahim AlMajed²

¹Department of Restorative Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia. waseem_rad1@hotmail.com

²College of Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia.

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ABSTRACT

This study aimed to assess the indirect restorative treatment plan decision-making of endodontically treated teeth (ETT) made by dental practitioners and their knowledge and perceptions of the available treatment alternatives in Saudi Arabia. A structured, close-ended, and self-administered questionnaire consisting of personal characteristics and various questions on the treatment concept and materials for restoring ETT were assessed among the study participants. The questionnaire was administered online and manually, and 425 responses were obtained. Descriptive statistics of frequency distribution and percentages were calculated for the categorical data. In addition, The Chi-square test or Fisher's exact tests were applied to compare responses across various characteristics of the study participants. A total of 425 responses were obtained from the study participants. The study participants commonly used post, core, and crown to restore the posterior endodontically treated tooth. Nearly half (49.40%) agreed that prefabricated fiber post was the most common type of post used for restoring posterior endodontically treated teeth. Almost 60.2% of study participants agreed to place a post after every endodontic treatment. Nearly 61.9% are not confident in doing endocrowns, and 69% did not attend any workshops on it. 31.8% reported that they got familiar with endocrowns through social media. Statistically significant associations were found between participants' characteristics and several items of ETT knowledge. The majority of study participants regarded fiber posts and crowned as the most common endodontic treatment. Undergraduate endodontic instruction is lacking.

Key words: Endodontically treated teeth, Restoration, Post, Core, Crown, Endocrown.

Introduction

The optimal option to restore endodontically treated teeth (ETT) continues to be a controversial topic that is highly debated. Dentine weakening caused by loss of structural integrity, dentine aging, decreased proprioception, and, to a lesser extent, endodontic medicament-induced dentine changes result in overall tooth strength reduction [1-3]. The clinician is left uncertain due to a lack of evidence regarding the best restorative choice and the availability of various restorative materials and techniques for restoring ETT [4].

Traditionally, fabricating crowns supported on posts and cores to restore the function and aesthetic of endodontically treated teeth was routinely performed [5]. A post is a dental restorative material inserted into the root of a badly affected tooth to offer additional retention and support in the retention of the core build-up [6]. Despite clinical success with the use of intraarticular posts, the main disadvantage remains in this system, which is the additional removal of sound tissue for fitting the post into the canal [7] and the overall effect on the biomechanical behavior of the restored teeth [8]. According to recent *in vitro* experiments, the use of posts did not affect the fatigue resistance of posterior teeth, nor in anterior teeth with ferrule [9, 10].

Microleakages are reduced, and the remaining tooth structure is preserved and protected, which leads to improved survival of teeth treated endodontically with adequate coronal cuspal coverage. Immediate placement of an excellent coronal restoration has been shown to reduce microleakage, and, as a result, the risk of endodontic treatment failure is reduced. In contrast, cuspal coverage and preservation of the remaining coronal tooth structure have improved fracture resistance of endodontically treated teeth [11].

In minimally invasive dentistry, precision is essential. Magnification and accurate rotating instrumentation provide the operator with the visual accuracy and delicate preparation abilities required to preserve good dental tissue while only removing decaying tissue [12]. A less invasive approach preserves and conserves the tooth structure and is superior in maintaining the balance between mechanical, biological, functional, and aesthetic of treating ETT without using intraarticular posts and performing total crown restoration instead, using the pulp chamber as a retentive resource, as in case of endocrowns [13].

Endocrown is a porcelain fixed crown to a nonvital posterior tooth anchored to the internal portion of the pulp chamber

and the margins of the cavity, thus obtaining both macro mechanical retention by pulp walls and micro retention by using adhesive cement [9]. Endocrown is indicated for teeth with badly damaged clinical crowns, little inter-occlusal clearance, and short, divergent roots [14]. Many factors influence the performance of endocrown, including the type of material used, the loading axis, and the design of the preparation. Along with its biomechanical features, lithium disilicate glass-ceramic (LDS) is the most commonly used material for endocrown restorations [15].

The way post-endodontic restorative therapy is administered does not entirely follow the recommendations of the literature but is instead impacted by geographic area, age, and specialty. These data show that each dentist develops their therapeutic philosophy based on experience. Thus, surveys are essential for evaluating and comprehending treatment options in post-endodontic restorations. Hence this survey-based research aims to assess the indirect restorative treatment plan decision-making of endodontically treated teeth made by dental practitioners, as well as their knowledge and perceptions of the available treatment alternatives.

Materials and Methods

Study design

It was a descriptive cross-sectional study conducted among a sample of dental practitioners in Saudi Arabia.

Sample size calculation

A minimum sample of 377 study participants was calculated based on an acceptable margin of error of 5%, a confidence level of 95%, a population of dentists of 16887 [16], and a response distribution of 50%. A convenient sampling methodology was employed to select the sample. However, to improve the power of the study, a sample of (N=425) participants was considered.

Study instrument

A thorough review of the literature was carried out, considering relevant publications. The questionnaire items were then extracted from the study conducted by Shetty *et al.* and others [17-19]. The subject experts were consulted to establish the face validity of the questionnaire. Based on the experts' suggestions, changes were made to the questionnaire. A pilot study was then carried out on a sample of ten dental practitioners working in the restorative dentistry department. The reliability of the questionnaire instrument was tested using Chronbach's coefficient alpha (0.711). These ten survey responses were excluded from the

final analysis.

Questionnaire content

The questionnaire comprised nine items on socio-demographic and practice-related information (gender, age, country of graduation, practice area, primary workplace, qualifications, and the number of patients treated per week), and the remaining items assessed knowledge, attitude, and confidence of dental practitioners towards various restorative options for endodontically treated teeth.

Questionnaire administration

Both an electronic version and a manual paper-based questionnaire were developed and administered to the study participants. A survey monkey platform was utilized to prepare the electronic version of the questionnaire, and the link was shared on dental practitioners' social media platforms such as Twitter, Telegram, Instagram, and WhatsApp. Similarly, a paper-based questionnaire was distributed to the dental practitioner who did not answer the questionnaire link shared on social media.

Data collected using electronic and manual methods were compiled in an excel sheet and then transferred to the statistical program for analysis. A structured, close-ended, and self-administered questionnaire, moreover an option was offered for further comments at the end of relevant questions, was distributed to the study participants. Moreover, a cover letter was included to explain the aims of the study, how the data would be used, and the voluntary and anonymous nature of study participation.

Statistical analysis

Data were analyzed using IBM-SPSS version 25 (Armonk, NY: USA). Descriptive statistics of frequency distribution and percentages were calculated for the categorical variables. The Chi-square test was applied to assess the association between the characteristics of the study participants and questionnaire items. A value of $p < 0.05$ was considered significant for all statistical tests.

Results and Discussion

A total of 425 responses were collected and analyzed. Most research participants (54.1%) were males aged 25 to 40 (49.4%). Many subjects graduated from Saudi Arabia (91.1%) and practiced in the central region (48.9%). The students/interns (38.1%) constituted the bulk of the study participants. Most of the subjects had less than five years of experience. The characteristics of the study participants are shown in (Table 1).

Table 1. Characteristics of the study participants (N=425)

	Characteristics	N	%
Gender	Female	195	45.9%
	Male	230	54.1%

Age	21-24 Years	137	32.2%
	25-40 Years	210	49.4%
	>40 Years	78	18.4%
Country Graduated from	Saudi Arabia	387	91.1%
	Others	38	8.9%
Practice Area	Central	208	48.9%
	North	75	17.6%
	South	73	17.2%
	East	43	10.1%
	West	26	6.1%
What is your main workplace?	Government	230	54.1%
	Private	195	45.9%
Dental practitioner type	Student/Intern	162	38.1%
	General Dentist	114	26.8%
	Postgraduate	70	16.5%
	Specialist/Consultant	79	18.6%
Qualified dentist since	<5 years	171	40.2%
	5-8	123	28.9%
	>8	131	30.8%
Number of patients per week	0-4	208	48.9%
	5-7	105	24.7%
	8-11	112	26.4%

When enquired about the reason for restoring posterior endodontically treated teeth, more than half (51.8%) agreed to reinforce the tooth. Almost 58.4% of the participants agree that the amount of remaining tooth structure is the criteria for restoring posterior endodontically treated teeth. The study participants commonly used post, core, and crown to restore the posterior endodontically treated tooth. Nearly half (49.40%) agreed that the most common type of post that is used for restoring posterior endodontically treated teeth was prefabricated fiber post. Almost 60.2% of study

participants agreed to place a post after every endodontic treatment, while 77.40% mentioned placing a post is a cost-effective option. Contrarily, 74.40% of the study subjects changed treatment options due to payment concerns (**Figure 1**). Cast post and core are more technique sensitive and more difficult. Nearly 61.9% are not confident in doing endocrowns, and 69% did not attend any workshops on it. 31.8% reported that they got familiar with endocrowns through social media (**Table 2**).

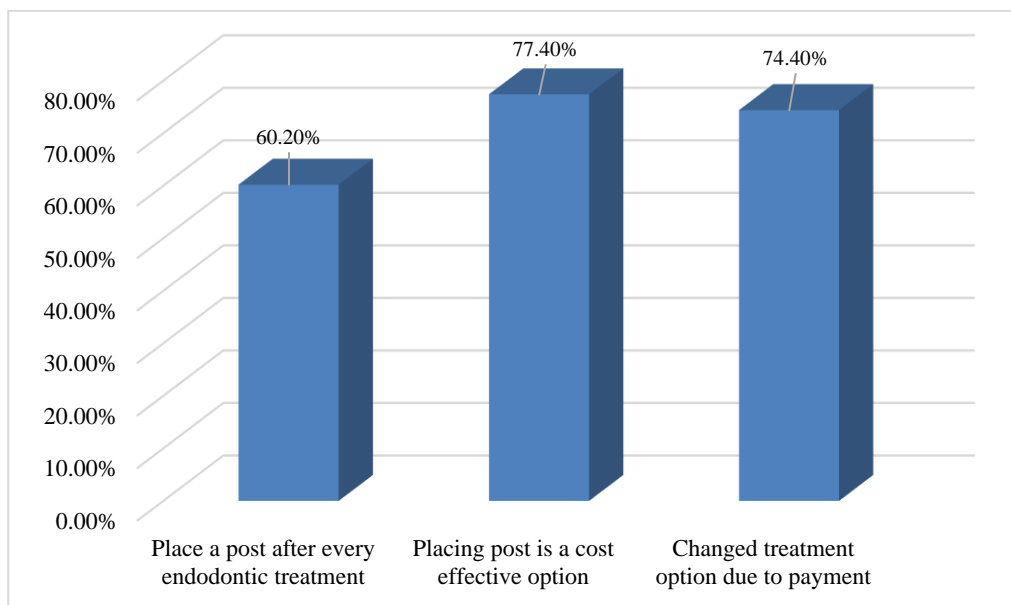


Figure 1. Endodontic Post-related items and responses**Table 2.** Knowledge of the treatment options for restoring endodontically treated tooth

Items	N	%	
Reason for restoring posterior Endodontically treated teeth	To reinforce the tooth	220	51.8%
	Esthetical Reasons	84	19.8%
	Unaware	121	28.5%
Criteria for restoring posterior Endodontically treated teeth	Amount of remaining tooth structure	248	58.4%
	Radiographical evidence of supporting bone	177	41.6%
Usually, how do you restore posterior endodontically treated tooth	Post and core, and crown	260	61.2%
	Without a post and crown	110	25.9%
	Direct restoration	32	7.5%
	Endocrown	23	5.4%
Most common type of post that is used for restoring posterior endodontically treated teeth	Cast metal post	135	31.8%
	Prefabricated fiber post	210	49.4%
	Prefabricated metal post	80	18.8%
More conservative option	Endocrown	238	56.0%
	Fiber-post and Crown	56	13.2%
	Cast post and core	85	20.0%
	Full coverage crown	46	10.8%
In your opinion, which is more costly?	Endocrown	68	16.0%
	Fiber-post and Crown	181	42.6%
	Cast post and core	97	22.8%
	Direct restorations	37	8.7%
	Full coverage crowns	42	9.9%
Which is more technique sensitive and more difficult	Endocrown	71	16.7%
	Fiber-post and Crown	110	25.9%
	Cast post and core	206	48.5%
	Full coverage crown	38	8.9%
Confidence in doing endocrowns	Yes	162	38.1%
	No	263	61.9%
Previous workshop on endocrown	Yes	131	31.0%
	No	294	69.0%
How did you get familiar with endocrowns?	Undergraduate studies	116	27.4%
	Postgraduate studies	73	17.2%
	Daily Practice	73	17.2%
	Social media	135	31.8%
	Articles	28	6.4%

The reasons for restoring endodontically treated teeth and the available options for treatment are shown in **Table 3**. The reason for restoring endodontically treated teeth showed significant association with age ($p<0.001$), graduation country ($p<0.001$), practice area ($p=0.001$), dental practitioner type ($p<0.001$), duration of qualification

as a dentist ($p<0.001$) and the number of patients seen per week ($p<0.001$). Similarly, the treatment option of restoring endodontically treated teeth showed a significant association with place of practice ($p=0.021$) and the number of patients seen per week ($p=0.044$).

Table 3. Reasons and treatment options for restoring endodontically treated tooth

		Reason Treat ETT			p	Treatment option for ETT				p
		To reinforce the tooth (%)	Esthetic Reasons (%)	Unaware (%)		Post and core and crown (%)	Without post and crown (%)	Direct restoration (%)	Endocrown (%)	
Gender	Female	46.8	44.0	45.5	0.905	45.0	46.4	53.1	43.5	0.844
	Male	53.2	56.0	54.5		55.0	53.6	46.9	56.5	
Age	21-24	45.9	20.2	15.7	<0.001	35.8	26.4	31.3	21.7	0.307
	25-40	47.3	66.7	41.3		45.0	54.5	56.3	65.2	
	>40	6.8	13.1	43.0		19.2	19.1	12.5	13.0	
Graduation country	Saudi Arabia	96.8	92.9	79.3	<0.001	93.1	87.3	93.8	82.6	0.136
	Others	3.2	7.1	20.7		6.9	12.7	6.3	17.4	
Practice Area	Central	56.4	41.7	40.5	0.001	46.5	43.6	62.5	82.6	0.109
	North	15.5	28.6	14.0		19.2	18.2	12.5	4.3	
	South	15.0	19.0	19.8		17.7	20.9	9.4	4.3	
	East	10.0	3.6	14.9		9.2	11.8	12.5	8.7	
	West	3.2	7.1	10.7		7.3	5.5	3.1	0.0	
Practice place	Government	50.5	58.3	57.9	0.291	54.6	61.8	34.4	39.1	0.021
	Private	49.5	41.7	42.1		45.4	38.2	65.6	60.9	
Dental practitioner type	Student/Intern	51.4	26.2	22.3	<0.001	43.1	27.3	37.5	34.8	0.154
	General Dentist	27.3	38.1	18.2		26.2	27.3	28.1	30.4	
	Postgraduate	18.6	26.2	5.8		16.2	20.0	12.5	8.7	
	Specialist/Consultant	2.7	9.5	53.7		14.6	25.5	21.9	26.1	
Qualified dentist since	<5 years	67.3	10.7	11.6	<0.001	41.9	34.5	37.5	52.2	0.524
	5-8	16.8	85.7	11.6		29.2	30.9	21.9	26.1	
	>8	15.9	3.6	76.9		28.8	34.5	40.6	21.7	
Number of patients per week	0-4	84.5	10.7	10.7	<0.001	52.7	39.1	50.0	52.2	0.044
	5-7	11.8	85.7	5.8		26.2	23.6	15.6	26.1	
	8-11	3.6	3.6	83.5		21.2	37.3	34.4	21.7	

A statistically significant association was found between the age ($p < 0.001$), practice place ($p = 0.014$), and Dental practitioner type ($p = 0.019$) with conservative treatment of endodontically treated teeth. Similarly perceived cost of the endodontically treated tooth differed significantly across

various practice areas ($p = 0.017$), dental practitioner type ($p = 0.044$), duration of qualification as a dentist ($p = 0.018$), and the number of patients seen per week ($p = 0.010$), as shown in **Table 4**.

Table 4. Association between characteristics of the study participants and conservative and costly treatment of endodontically treated tooth

Characteristics	Conservative treatment				p	More Costly				p
	Endocrown	Fiber post and crown	Cast post and core	Full coverage crown		Endocrown	Fiber post and crown	Cast post and core	Direct restorations	

Gender	Female	40.8	58.9	48.2	52.2	0.06	42.6	44.2	48.5	48.6	50.0	0.89
	Male	59.2	41.1	51.8	47.8		57.4	55.8	51.5	51.4	50.0	
Age	21-24 Years	43.3	17.9	20.0	15.2	<0.001	27.9	38.1	33.0	13.5	28.6	0.22
	25-40 Years	44.1	53.6	60.0	52.2		51.5	46.4	48.5	64.9	47.6	
	>40 Years	12.6	28.6	20.0	32.6		20.6	15.5	18.6	21.6	23.8	
Graduation country	Saudi Arabia	91.6	89.3	90.6	91.3	0.95	86.8	93.4	88.7	89.2	95.2	.346
	Others	8.4	10.7	9.4	8.7		13.2	6.6	11.3	10.8	4.8	
Practice Area	Central	52.5	44.6	47.1	39.1	0.54	52.9	50.8	49.5	29.7	50.0	.017*
	North	18.9	12.5	14.1	23.9		10.3	22.7	13.4	18.9	16.7	
	South	14.7	19.6	21.2	19.6		19.1	14.9	22.7	13.5	14.3	
	East	9.7	12.5	9.4	10.9		13.2	6.6	6.2	27.0	14.3	
	West	4.2	10.7	8.2	6.5		4.4	5.0	8.2	10.8	4.8	
Practice place	Government	52.9	48.2	49.4	76.1	.014	55.9	51.9	53.6	67.6	50.0	0.49
	Private	47.1	51.8	50.6	23.9		44.1	48.1	46.4	32.4	50.0	
Dental practitioner type	Student/Intern	43.7	28.6	40.0	17.4	.019	30.9	45.3	37.1	21.6	35.7	0.044
	General Dentist	23.5	37.5	21.2	41.3		22.1	24.9	29.9	29.7	33.3	
	Postgraduate	16.0	10.7	20.0	19.6		16.2	16.6	15.5	16.2	19.0	
	Specialist/ Consultant	16.8	23.2	18.8	21.7		30.9	13.3	17.5	32.4	11.9	
Qualified dentist since	<5 years	39.9	42.9	41.2	37.0	0.88	29.4	45.3	42.3	29.7	40.5	0.018
	5-8	29.0	28.6	31.8	23.9		26.5	28.7	26.8	24.3	42.9	
	>8	31.1	28.6	27.1	39.1		44.1	26.0	30.9	45.9	16.7	
Number of patients per week	0-4	52.9	46.4	40.0	47.8	0.29	39.7	56.4	49.5	32.4	45.2	0.010
	5-7	22.3	25.0	34.1	19.6		22.1	26.5	21.6	24.3	28.6	
	8-11	24.8	28.6	25.9	32.6		38.2	17.1	28.9	43.2	26.2	

The technique sensitivity in restoring endodontically treated teeth and confidence in restoring endodontically treated teeth are shown in **Table 5**. The participant's age (p=0.038), dental practitioner type (p=0.035), and the number of patients seen per week (p=0.021) were associated with

significant technique sensitivity in the restoration of endodontically treated teeth. However, restoration of the endodontically treated tooth did not show any significant association with the characteristics of the study participants.

Table 5. Association between characteristics of the study participants and questionnaire items

		Technique sensitive				P	Confident endocrowns		P
		Endocrown	Fiber post and crown	Cast post and core	Full coverage crown		Yes	No	
Gender	Female	50.7%	46.4%	42.7%	52.6%	0.531	46.3%	45.6%	0.893
	Male	49.3%	53.6%	57.3%	47.4%		53.7%	54.4%	
Age	21-24 Years	32.4%	39.1%	31.6%	15.8%	.038*	29.0%	34.2%	0.536
	25-40 Years	57.7%	42.7%	49.5%	52.6%		51.9%	47.9%	
	>40 Years	9.9%	18.2%	18.9%	31.6%		19.1%	17.9%	
Graduation country	Saudi Arabia	94.4%	90.0%	91.7%	84.2%	0.332	90.7%	91.3%	0.857
	Others	5.6%	10.0%	8.3%	15.8%		9.3%	8.7%	
Practice Area	Central	56.3%	47.3%	45.1%	60.5%	0.690	52.5%	46.8%	0.118
	North	18.3%	20.0%	17.0%	13.2%		11.7%	21.3%	
	South	14.1%	16.4%	19.9%	10.5%		17.9%	16.7%	
	East	9.9%	10.0%	10.7%	7.9%		12.3%	8.7%	

	West	1.4%	6.4%	7.3%	7.9%		5.6%	6.5%	
Practice place	Government	64.8%	46.4%	55.3%	50.0%	0.098	53.1%	54.8%	0.738
	Private	35.2%	53.6%	44.7%	50.0%		46.9%	45.2%	
	Student/Intern	45.1%	44.5%	34.0%	28.9%		37.0%	38.8%	
Dental practitioner type	General Dentist	14.1%	24.5%	31.6%	31.6%	.035*	23.5%	28.9%	0.133
	Postgraduate	25.4%	10.9%	17.0%	13.2%		15.4%	17.1%	
	Specialist/Consultant	15.5%	20.0%	17.5%	26.3%		24.1%	15.2%	
Qualified dentist since	<5 years	39.4%	42.7%	42.2%	23.7%	0.309	34.6%	43.7%	0.145
	5-8	32.4%	27.3%	28.6%	28.9%		30.2%	28.1%	
	>8	28.2%	30.0%	29.1%	47.4%		35.2%	28.1%	
Number of patients per week	0-4	53.5%	51.8%	51.0%	21.1%	.021*	46.3%	50.6%	0.661
	5-7	21.1%	23.6%	25.2%	31.6%		25.3%	24.3%	
	8-11	25.4%	24.5%	23.8%	47.4%		28.4%	25.1%	

The current study assessed clinicians' decision-making and treatment options for different aspects of endodontically treated teeth in Saudi Arabia. The study showed that prefabricated fiber posts and crowns are the most used procedure in restoring ETT. This is consistent with a survey that included 6029 dentists from Germany that reported preferring prefabricated post-placement after ETT [19]. Our results showed that the cast post and core are reported to be more technique sensitive and complex. Conversely, a Brazilian survey reported that the cast metal posts were preferred mainly by non-specialized dentists [20]. This study reveals a lack of endocrown training for dental practitioners, which corresponds to Rasidi *et al.*, in which 72.5 percent of dental practitioners reported that they had never practiced endocrown before. In comparison, only 27.5 percent reported previous exposure to crown preparation [18].

The most important factors to consider while repairing ETT are the maximum preservation and conservation of enamel, dentin, and the dentinoenamel junction. Four studies found that teeth restored with endocrown had lower dentin and cement stresses than teeth restored with other prostheses [21-24]. This could be linked to the longevity of ETT being dependent on the amount of sound tooth structure that remains following endodontic access and caries removal. Extension for prevention concepts should be avoided because the efficacy of restored ETT relies on the remaining tooth structure. These studies show that posts are often unnecessary for crown/endocrown retention and are even linked to higher chances of catastrophic failure [25]. Clinical research on the survival rates of endocrowns found that more than 90% were recorded from 6 months to 10 years of follow-up [26, 27].

Study limitation

This study was conducted with a relatively small sample of dental practitioners compared to registered dentists. Since clinical practice guidelines and assessment methods vary in different countries, caution should be exercised, generalizing our findings to other areas. Furthermore, there is a risk that the replies acquired in this research were

impacted by social desirability due to the online survey.

Conclusion

The majority of study participants considered placing fiber posts and crowns as the most used treatment options for endodontically treated teeth. There is a lack of training for endocrowns, which should be implemented in undergraduate training.

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