

A survey of contemporary methods of restoring endodontically treated teeth in Riyadh area-Part I: Anterior teeth

Sahar Sabbak*, BDS, MSc Amal Al-Qahtani**, BDS Huda Tulba***, BDS

يعتبر الاختيار الأفضل لترميم الأسنان التي عولجت جذورها ذو أهمية بالغة. تهدف هذه الدراسة إلى معرفة غالبية الطرق المفضلة لإعادة تأهيل الأسنان الأمامية التي تم علاج جذورها في حالاتها المختلفة. تم توزيع استبيان على أخصائيي وأخصائيات الإستعاضة السنية الصناعية وأطباء وطبيبات الأسنان الممارسين العاملين الذين يقومون أيضا بالعمل في مجال الإستعاضة الصناعية في منطقة الرياض. طلب منهم إدراج عام ومكان تخرجهم، درجتهم العلمية ومكان عملهم الحالي. سئل جميعهم وافي الإستبيان عن طريقتهم المفضلة لإصلاح الأسنان في حالاتها السريرية المختلفة. تم جمع استجابة مائة وحمسون طبيبا وطبيبة وحلت إحصائيا. أشارت النتائج إلى أن 71 و 3% من المستجيبين يفضلون استعمال الكومبوزيت في حال بقاء أكثر من 50% من مادة السن السليمة (حالة أ). في حال بقاء حوالي 50% من مادة السن السليمة (حالة ب) فإن غالبية المستجيبين يفضلون استعمال الكومبوزيت يليها التاج المصنع (39 و 3%). بينما في حال بقاء أقل من 50% من مادة السن السليمة (حالة ج)، فإن 79 و 3% من المستجيبين يفضلون استعمال الوند و القلب المعدني يليه التاج المصنع. وجد أنه عند استعمال الأسنان كدعامات لتركيبات صناعية ثابتة أو متحركة فإن هناك قابلية لإستعمال طرق أكثر تطورا لترميم الأسنان. وجدت عوامل أخرى تؤثر على اختيار الطريقة العلاجية. نستنتج أن معظم المستجيبين لهذه الدراسة مؤهلين سريريا لاتخاذ القرارات المثلى بخصوص ترميم الأسنان الأمامية التي عولجت جذورها.

Proper selection of a restoration for endodontically treated teeth is mandatory. This study was initiated to detect the frequency of preferred methods of restoring endodontically treated anterior teeth under different conditions. A questionnaire was distributed among prosthodontists and general practitioners in Riyadh area. They were also asked to indicate their year and institution of graduation, acquired degree and current institution. In the questionnaire, they were asked about their preferred restorative methods of the teeth under different clinical conditions. Responses from 150 dentists were collected and statistically analyzed. The results indicate that 71.3% of respondents preferred to use a composite restoration when more than 50% of sound tooth structure remains (condition A). When about 50% of sound tooth structure remains (condition B), most of the respondents preferred to use composite/crown (39.3%). However, when less than 50% of sound tooth structure remains (condition C), 79.3% of respondents preferred to use a cast post and core/crown. When the teeth are used as abutments for fixed or removable partial dentures (F/RPDs), the use of a more advanced methods of restorations is preferred. Other factors were found to affect the choice of treatment method. It can be concluded that most of respondents of this study are clinically capable of making proper decisions concerning the restoration of endodontically treated anterior teeth.

Introduction

Loss of coronal tooth structure can occur as a result of trauma, caries, previous restoration and endodontic access procedure. This may range, from a very minimal access preparation of an intact tooth to a very extensive damage that endangers the longevity of the tooth itself.¹ The restorative decision depends on factors like the amount of remaining sound tooth structure, the location of the tooth in the dental arch, the functional demands that are placed on the tooth and the need of this tooth to serve as an abutment for fixed or removable partial dentures.^{2,3} When coronal damage is minimal and the tooth is esthetically accepted, the complete coverage is not required, and a composite resin, glass ionomer or amalgam restoration is considered adequate.⁴⁻⁶ It has been shown repeatedly that the fracture resistance of an intact endodontically treated anterior tooth approaches that of an untreated tooth and that an intact anterior tooth with conservative endodontic

access and intact marginal ridges does not require a post or coronal coverage.^{7,8} However, ElKhadery *et al.*⁹ indicated the importance of reinforcing endodontically treated anterior teeth even if they are sound and not carious. When a crown is indicated for esthetic reasons, the axial reduction combined with an endodontic access preparation frequently leaves insufficient sound dentin to support a crown especially if a metal-ceramic crown is planned. Therefore, a dowel core is probably needed. Ko *et al.*¹⁰ found that under vertical loading, posts reduce dentin stress substantially because they are under compression. As incisors and canines are rarely subjected to vertical loading, the reinforcement effects of posts seem to be doubtful in these teeth.¹⁰ When restoring endodontically treated anterior teeth with moderate damage and those with severe destruction, cast posts and cores are considered by several researchers as the restorative method of choice.¹¹⁻¹³ Many restorative dentists base their decision-making process regarding restoration of endodontically treated teeth on past clinical experience rather than follow a specific protocol.⁴

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* Assistant Professor and Consultant

Department of Prosthetic Dental Sciences

College of Dentistry, King Saud University, Riyadh, KSA

** Demonstrator, College of Medicine & Healthcare

Ministry of Health, Riyadh, Saudi Arabia

*** Private Practitioner

Address reprint requests to:

Dr. Sahar Asaad Sabbak

King Saud University, College of Dentistry

P.O. Box 5967, Riyadh 11432

The purpose of this survey study was to determine the frequency of the preferred methods of restoring endodontically treated anterior teeth at different conditions (percentages) of remaining sound tooth structure by prosthodontists and general practitioners in Riyadh area.

Material and Methods

A questionnaire was designed and distributed among prosthodontists and general practitioners who work in private and governmental clinics in Riyadh area. Respondents were asked to indicate their year and institution of graduation, obtained degree and current institution. The questionnaire contained different choices of restorative treatment methods of restoration of endodontically treated anterior teeth at different conditions (percentages) of remaining sound tooth structure (>50%: minimal coronal tooth structure is missing with no previous restoration, = 50%: up to one-half of the coronal tooth structure is missing with minor previously placed restorations and <50%: all or more than one-half of the coronal tooth structure is missing). Respondents were asked to indicate their preferred method of restoration of those teeth. They were also asked to indicate whether the chosen method would change if the same tooth at the same condition of remaining sound tooth structure were used as an abutment for fixed or removable partial dentures. Responses from 150 prosthodontists and general practitioners were collected. The data were entered into microcomputer using FOX PRO (Window ver. 2.5). A Statistical Package of Social Sciences (SPSS ver 7.5) was used for all computational purposes. One-way frequency tables were generated to summarize the responses. Two-way cross tabulation tables were computed to show the relationship between the variables.

Results

Condition A (More than 50% of sound tooth structure remaining)

Results showed that majority of respondents (71.3%) preferred to restore the tooth only with a tooth-colored restorative material (Table 1). The use of only a tooth-colored restorative material was preferred more by respondents who graduated in the 90s (82%) as shown in Table 2, more by graduates of Kingdom of Saudi Arabia (KSA) institution (79.5%) as shown in Table 3, more

Table 1. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth with different percentages of remaining sound tooth structure

Method of Restoration	Amount (%) of Remaining Sound Tooth Structure		
	Condition A > 50% Freq. (%)	Condition B = 50% Freq. (%)	Condition C < 50% Freq. (%)
1. A tooth-colored (composite) restoration	107 (71.3)	4 (02.7)	0 (00.0)
2. A tooth-colored (composite) restoration/crown	34 (22.7)	59 (39.3)	0 (00.0)
3. A prefabricated post and a tooth-colored (composite) restoration	6 (04.0)	26 (17.3)	2 (02.0)
4. A prefabricated post and a restorative material core / crown	2 (01.3)	47 (31.3)	28 (18.7)
5. A cast post and core / crown	1 (00.7)	14 (09.3)	119 (79.3)
Others	0 (00.0)	0 (00.0)	0 (00.0)
Total Frequency (%)	150 (100.0)	150 (100.0)	150 (100.0)

by those with Bachelor (BDS) degree (73.9%) as shown in Table 4 and more by governmental workers (80.8%) as shown in Table 5. Statistical analysis using Chi-square demonstrated a statistically significant relationship only between the year and institution of graduation and the current institution and the preferred restorative method. When the same tooth is used as an abutment for fixed or removable partial dentures (F/RPDs), 51.9% of respondents preferred to protect the tooth with a crown (Table 6). This is also used more by respondents who graduated in the 90s (54.7%) as shown in Table 7, almost equally by graduates of both institutions (Table 8), more by those with BDS degree (53.2%) as shown in Table 9 and more by private practice workers (Table 10).

Condition B (About 50% of sound tooth structure remaining)

Majority of respondents preferred to use the tooth-colored restorative material/crown and a prefabricated post and restorative material/crown 39.3% and 31.3%, respectively (Table 1). The percentage of those who preferred to use a tooth-colored restorative material was significantly reduced at this condition to 2.7%. The use of a

Table 2. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth with different percentages of remaining sound tooth structure compared with the year of graduation

Restorative Method	Condition A: > 50 %			Condition B: = 50%			Condition C: < 50 %		
	≤ 70s Freq. (%)	80s Freq. (%)	90s Freq. (%)	≤ 70s Freq. (%)	80s Freq. (%)	90s Freq. (%)	≤ 70s Freq. (%)	80s Freq. (%)	90s Freq. (%)
1	7 (63.6)	27 (54.0)	73 (82.0)	0 (00.0)	0 (00.0)	4 (04.5)	0 (00.0)	0 (00.0)	0 (00.0)
2	3 (27.3)	19 (38.0)	12 (13.5)	4 (36.4)	14 (28.0)	41 (46.1)	0 (00.0)	0 (00.0)	0 (00.0)
3	1 (09.1)	1 (02.0)	4 (04.5)	1 (09.1)	11 (22.0)	14 (15.7)	0 (00.0)	0 (00.0)	3 (03.4)
4	0 (00.0)	2 (04.0)	0 (00.0)	5 (45.5)	19 (38.0)	23 (25.8)	3 (27.3)	11 (22.0)	14 (15.7)
5	0 (00.0)	1 (02.0)	0 (00.0)	1 (09.1)	6 (12.0)	7 (07.9)	8 (72.7)	39 (78.0)	72 (80.9)
6	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	11 (100.0)	50(100.0)	89 (100.00)	11 (100.0)	50 (100.0)	89 (100.0)	11 (100.0)	50 (100.0)	89 (100.0)
Chi-Square	$P = 0.012$			$P = 0.304$			$P = 0.509$		

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown, 3: A prefabricated post and a tooth-colored (composite) restoration, 4: A prefabricated post and a restorative material core / crown, 5: A cast post and core / crown, 6: Others.

Table 3. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth with different percentages of remaining sound tooth structure compared with the institution of graduation

Restorative Method	Condition A: > 50 %		Condition B: = 50%		Condition C: < 50 %	
	K.S.A.* Freq. (%)	Others Freq. (%)	K.S.A.* Freq. (%)	Others Freq. (%)	K.S.A.* Freq. (%)	Others Freq. (%)
1	71 (79.5)	36 (59.0)	3 (03.4)	1 (01.6)	0 (00.0)	0 (00.0)
2	15 (16.9)	19 (31.1)	36 (40.4)	23 (37.7)	0 (00.0)	0 (00.0)
3	1 (01.1)	5 (08.2)	17 (19.1)	9 (14.8)	1 (01.1)	2 (03.3)
4	2 (02.2)	0 (00.0)	25 (28.1)	22 (36.1)	14 (15.7)	14 (23.0)
5	0 (00.0)	1 (01.6)	8 (09.0)	6 (09.8)	74 (83.1)	45 (73.8)
6	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	89 (100.0)	61 (100.0)	89 (100.0)	61 (100.0)	89 (100.0)	61 (100.0)
Chi-Square	$P = 0.012$		$P = 0.803$		$P = 0.324$	

*K.S.A: Kingdom of Saudi Arabia.

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown, 3: A prefabricated post and a tooth-colored (composite) restoration, 4: A prefabricated post and a restorative material / crown, 5: A cast post and core / crown, 6: Others.

tooth-colored restorative material/crown was preferred more by respondents who graduated in the 90s (46.1%) as seen in Table 2, more by graduates of KSA institution (40.4%) as seen in Table 3, more by general practitioners (45.2%) as seen in Table 4 and more by governmental workers (42.3%) as seen in Table 5. However, when the same tooth is used as an abutment for F/RPDs, a greater percentage of respondents (43.2%) preferred to use a prefabricated post and a

restorative material core/crown (Table 6). This treatment method is preferred more by those who graduated in the 80s (50%) as seen in Table 7, more by graduates of institutions other than KSA (46.2%) as seen in Table 8, almost equally by respondents with BDS and MSc/PhD degrees (43.5% and 42.1%, respectively) as seen in Table 9 and more by governmental workers (44.3%) as seen in Table 10. The Chi-square analysis demonstrated a statistically significant relationship only between

Table 4. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth with different percentages of remaining sound tooth structure compared to the degree

Restorative Method	Condition A: > 50 %		Condition B: = 50%		Condition C: < 50 %	
	BDS Freq. (%)	MS/PhD Freq. (%)	BDS Freq. (%)	MS/PhD Freq. (%)	BDS Freq.(%)	MS/PhD Freq. (%)
1	85 (73.9)	22 (62.9)	4 (03.5)	0 (00.0)	0 (00.0)	0 (00.0)
2	24 (20.9)	10 (28.6)	52 (45.2)	7 (20.0)	0 (00.0)	0 (00.0)
3	4 (03.5)	2 (05.7)	21 (18.3)	5 (14.3)	3 (02.6)	0 (00.0)
4	2 (01.7)	0 (00.0)	30 (26.1)	17 (48.6)	26 (22.6)	2 (05.7)
5	0 (00.0)	1 (02.9)	8 (07.0)	6 (17.1)	86 (74.8)	33 (94.3)
6	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	115(100.0)	35 (100.0)	115(100.0)	35(100.0)	115(100.0)	35 (100.0)
Chi-Square	$P = 0.249$		$P = 0.011$		$P = 0.043$	

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown, 3: A prefabricated post and a tooth-colored (composite) restoration, 4: A prefabricated post and a restorative material core / crown, 5: A cast post and core / crown, 6: Others

Table 5. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth with different percentages of remaining sound tooth structure compared with the current institution

Restorative Method	Condition A: > 50 %		Condition B: = 50%		Condition C: < 50 %	
	Private Freq. (%)	Governmental Freq. (%)	Private Freq.(%)	Governmental Freq. (%)	Private Freq. (%)	Governmental Freq. (%)
1	23(50.0)	84 (80.8)	0 (00.0)	4 (03.8)	0 (00.0)	0 (00.0)
2	17 (37.0)	17 (16.3)	15 (32.6)	44 (42.3)	0 (00.0)	0 (00.0)
3	4 (08.7)	2 (01.9)	7 (15.2)	19 (18.3)	1 (02.2)	2 (01.9)
4	1 (02.2)	1 (01.0)	20 (43.5)	27 (26.0)	12 (26.1)	16 (15.4)
5	1 (02.2)	0 (00.0)	4 (08.7)	10 (09.6)	33 (71.1)	86 (82.7)
6	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	46(100.0)	104(100.0)	46(100.0)	104(100.0)	46 (100.0)	104(100.0)
Chi-Square	$P = 0.002$		$P = 0.212$		$P = 0.294$	

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown, 3: A prefabricated post and a tooth-colored (composite) restoration, 4: A prefabricated post and a restorative material core / crown, 5: A cast post and core / crown, 6: Others.

the degree and the choice of treatment method whether or not the teeth are used as abutments for F/RPDs ($P>0.05$).

Condition C (Less than 50% of sound tooth structure remaining)

At this condition, most of respondents preferred to use a cast post and core/crown (79.3%) as seen in Table 1. This percentage

increases to 91.1% when the teeth are used as abutments for F/RPDs (Table 6). Whether or not the tooth was used as an abutment for F/RPDs, this restorative method is used more by respondents who graduated in the 90s (Tables 2 & 7), more by graduates of KSA institution (Tables 3 & 8), more by respondents with MSc/PhD degree (Tables 4 & 9) and more by governmental workers (Tables 5 & 10).

In this study, 95.3% of respondents believed that multiple factors like: patient medical

Table 6. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth when used as abutments for F/RPDs with different percentages of remaining sound tooth structure

Method of Restoration	Amount (%) of Remaining Sound Tooth Structure		
	Condition A: > 50% Freq. (%)	Condition B: = 50% Freq. (%)	Condition C: < 50% Freq. (%)
1. A tooth-colored (composite) restoration	14 (17.3)	0 (00.0)	0 (00.0)
2. A tooth-colored (composite) restoration / crown	42 (51.9)	13 (16.0)	0 (00.0)
3. A prefabricated post and a tooth-colored (composite) restoration	5 (06.2)	5 (06.2)	0 (00.0)
4. A prefabricated post and a restorative material core / crown	9 (11.1)	35 (43.2)	8 (09.9)
5. A cast post and core / crown	11 (13.6)	28 (34.6)	73 (90.1)
Others	0 (00.0)	0 (00.0)	0 (00.0)

condition, patient financial support and cooperation, time factor, laboratory support and availability of required materials may affect their choice of treatment method.

Discussion

The finding of this study is supported by other studies which stated that when coronal damage is minimal, a conservative treatment in a form of composite resin, glass ionomer or amalgam restorations should be considered.^{1,2,5,6} In the present study, the importance of protecting teeth that serve as abutments of F/RPDs by fabricating extra-coronal restorations reflects the awareness of the clinicians about the extra load and additional stresses that are exerted on such teeth.

A prefabricated post with a restorative material core build-up is widely used. Christensen¹⁴ stated that core materials that are used under crowns and replace most of the coronal portion of the tooth should have at least the compressive strength of the tooth structure being replaced (40,000 psi). At this time, only two types of core materials were found to meet this requirement: composite resin (~ 40,000 psi) and silver amalgam (~ 65,000 psi).¹⁴ It was found that amalgam cores under artificial crowns had the lowest rate of defects.¹⁵ Amalgam and composite cores recorded a statistically significant higher resistance to cyclic fatigue loading than reinforced glass ionomer cements.¹⁵ On the basis of strength, both resin composites and amalgam may be indicated for use as core materials while glass ionomer-based materials are not.^{16,17} Composite resin and silver amalgam should be bonded to tooth structure using dentin

Table 7. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth when used as abutments for F / RPDs with different percentages of remaining sound tooth structure compared with the year of graduation

Restorative Method	Condition A: > 50 %			Condition B: = 50%			Condition C: < 50 %		
	≤ 70s Freq. (%)	80s Freq. (%)	90s Freq. (%)	≤ 70s Freq. (%)	80s Freq. (%)	90s Freq. (%)	≤ 70s Freq. (%)	80s Freq. (%)	90s Freq. (%)
1	0 (00.0)	3 (15.0)	11 (20.8)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
2	3 (37.5)	10 (50.0)	29 (54.7)	0 (00.0)	3 (15.0)	10 (18.9)	0 (00.0)	0 (00.0)	0 (00.0)
3	0 (00.0)	1 (05.0)	4 (07.5)	0 (00.0)	1 (09.0)	4 (07.5)	0 (00.0)	0 (00.0)	0 (00.0)
4	3 (27.5)	3 (15.0)	3 (05.7)	3 (37.5)	10 (50.0)	22 (41.5)	1 (12.5)	2 (10.0)	5 (09.4)
5	2 (25.0)	3 (15.0)	6 (11.3)	5 (62.5)	6 (30.0)	17 (32.1)	7 (87.5)	18 (90.0)	48 (90.5)
6	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	8 (100.0)	20 (100.0)	53 (100.0)	8 (100.0)	20 (100.0)	53 (100.0)	8 (100.0)	20 (100.0)	53 (100.0)
Chi-Square	$P = 0.224$			$P = 0.597$			$P = 0.964$		

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown, 3: A prefabricated post and a tooth-colored (composite) restoration, 4: A prefabricated post and a restorative material core / crown, 5: A cast post and core / crown, 6: Others.

Table 8. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth when used as abutments for F/RPDs with different percentages of remaining sound tooth structure compared with the institution of graduation

Restorative Method	Condition A: > 50 %		Condition B: = 50%		Condition C: < 50 %	
	K.S.A.* Freq. (%)	Others Freq. (%)	K.S.A.* Freq. (%)	Others Freq. (%)	K.S.A.* Freq. (%)	Others Freq. (%)
1	11 (20.0)	3 (11.5)	0 (00.0)	0 (00.0)	0 (00.0)	0 (0.0)
2	29 (52.7)	13 (50.0)	8 (14.5)	5 (19.2)	0 (00.0)	0 (00.0)
3	4 (07.3)	1 (03.8)	4 (07.3)	1 (03.8)	0 (00.0)	0 (00.0)
4	4 (07.3)	5 (19.2)	23 (41.8)	12 (46.2)	3 (05.5)	5 (19.2)
5	7 (12.7)	4 (15.4)	20 (36.4)	8 (30.0)	52 (94.5)	21 (80.8)
6	0 (00.0)	0 (00.0)	0(00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	55 (100.0)	26 (100.0)	55 (100.0)	26 (100.0)	55 (100.0)	26 (100.0)
Chi-Square	$P = 0.485$		$P = 0.846$		$P = 0.052$	

*K.S.A: Kingdom of Saudi Arabia

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown, 3: A prefabricated post and a tooth-colored (composite) restoration, 4: A prefabricated post and a restorative material core / crown, 5: A cast post and core / crown, 6: Others

Table 9. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth when used as abutments for F/RPDs with different percentages of remaining sound tooth structure compared to the degree

Restorative Method	Condition A: > 50 %		Condition B: = 50%		Condition C: < 50 %	
	BDS Freq. (%)	MS/PhD Freq. (%)	BDS Freq. (%)	MS/PhD Freq. (%)	BDS Freq. (%)	MS/PhD Freq.(%)
1	12 (19.4)	2 (10.5)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
2	33 (53.2)	9 (47.4)	13 (21.0)	0 (00.0)	0 (00.0)	0 (00.0)
3	4 (06.5)	1 (05.3)	5 (08.1)	0 (00.0)	0 (00.0)	0 (00.0)
4	7 (11.3)	2 (10.5)	27 (43.5)	8 (42.1)	7 (11.3)	1 (05.3)
5	6 (09.7)	5 (26.3)	17 (27.4)	11 (57.9)	55 (88.7)	18 (94.7)
6	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	62 (100.0)	19 (100.0)	62 (100.0)	19 (100.0)	62 (100.0)	19 (100.0)
Chi-Square	$P = 0.440$		$P = 0.024$		$P = 0.441$	

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown, 3: A prefabricated post and a tooth-colored (composite) restoration, 4: A prefabricated post and a restorative material core / crown, 5: A cast post and core / crown, 6: Others.

bonding materials to reduce leakage and increase retention to tooth structure.¹⁸ It is well known that a composite restoration is recommended for restoration of anterior teeth to avoid possible root staining by the amalgam restoration that could hinder esthetics.¹⁹ Several studies indicated the importance of placing a post in the root portion to attach the root structure to the core material that is

being bonded to the remaining coronal tooth structure.^{1,2,4,5,7} The posts can be prefabricated or custom-cast. Prefabricated posts are best suited for circular canals, while custom-cast posts and cores possess superior adaptation to all root canals.^{2,4} Cast posts and cores do not require auxiliary retention such as pins to retain the core as in some prefabricated systems. On the other hand,

Table 10. Frequency and percentage of respondents using different restorative methods of endodontically treated anterior teeth when used as abutments for F/RPDS with different percentages of remaining sound tooth structure compared with the current institution

Restorative Method	Condition A: > 50 %		Condition B: = 50%		Condition C: < 50 %	
	Private Freq. (%)	Governmental Freq. (%)	Private Freq.(%)	Governmental Freq. (%)	Private Freq. (%)	Governmental Freq. (%)
1	2 (10.0)	12 (19.7)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
2	12 (60.0)	30 (49.2)	5 (25.0)	8 (13.1)	0 (00.0)	0 (00.0)
3	0 (00.0)	5 (08.2)	1 (05.0)	4 (06.6)	0 (00.0)	0 (00.0)
4	4 (20.0)	5 (08.2)	8 (40.0)	27 (44.3)	4 (20.0)	4 (06.6)
5	2 (10.0)	9 (14.8)	6 (30.0)	22 (36.1)	16 (80.0)	57 (93.4)
6	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total Freq. (%)	20 (100.0)	61 (100.0)	20 (100.0)	61 (100.0)	20 (100.0)	61 (100.0)
Chi-Square	$P = 0.294$		$P = 0.657$		$P = 0.098$	

1: A tooth-colored (composite) restoration, 2: A tooth-colored (composite) restoration / crown , 3: A prefabricated post and a tooth-colored (composite) restoration , 4: A prefabricated post and a restorative material core / crown , 5: A cast post and core / crown, 6: Others

a prefabricated post with a restorative material core build-up is widely used. In 1987, Brandal *et al.*¹³ reported the highest mean failure load of prefabricated post and composite buildup restorations of endodontically treated anterior teeth. Glass-ionomer/amalgam coronal-radicular buildups exhibited the lowest failure load.¹³ In a survey study in the United States, the majority of dentists used either cast posts exclusively or both cast posts and prefabricated posts in their practices.²⁰ However, Morgano and Milot¹¹ and, Morgano and Brackett¹² considered cast posts and cores as the restorative method of choice for endodontically treated anterior teeth with moderate destruction. Fraga *et al.*²¹ reported a significantly higher resistance to fracture of single-rooted teeth restored with nickel-chromium cast posts and cores than that of single-rooted teeth restored with steel prefabricated posts. It was concluded that a cast post and core is indicated where alignment of the proposed crown is significantly different from the inclination of the canal, which is often the case with anterior teeth.²² In most of anterior teeth, there is an inadequate room for sufficient bulk of build up material around the post to provide a solid unit.²² Thus a cast post and core is required for restoring these teeth.²² In the present study, more percentages of respondents at condition B preferred to use a tooth-colored restorative material with and without a prefabricated post and a crown than those seen at condition A. On the other hand, the

use of only a tooth-colored restorative material is significantly reduced more than that at condition A. This also reflects the awareness of the respondents regarding the need of an additional reinforcement mean by using an occlusal coverage for replacement of the lost tooth structure. Several authors stated that if the tooth is significantly damaged, esthetically poor or serves as an abutment for F/RPDs, a complete coverage is indicated and the tooth will require a post and core for a crown retention and support.^{4,22} In this study, a high percentage of respondents of KSA institution preferred to protect the teeth that serve as abutments for F/RPDs by extra-coronal restorations. This can give a clear idea about attained high levels and proper treatment choices of graduates of KSA institution.

Conclusions

Within the limits of this study, the following conclusions were drawn:

1. At condition A, 71.3% of respondents preferred to use only a tooth-colored restorative material. There was a statistically significant relationship between the year and institution of graduation and the current institution and the choice of restorative method at this condition.
2. At condition B, 39.3% and 31.3% of respondents respectively preferred to use a tooth-colored restorative material/crown and a prefabricated post and restorative

material/crown. There was a statistically significant relationship only between the degree and the choice of treatment method at this condition whether or not the teeth are used as abutments for F/RPDs.

3. At condition C, 79.3% of respondents preferred to use a cast post and core followed by a crown. There was a statistically significant relationship only between the degree and the choice of treatment method at this condition.
4. When the teeth were to be used as abutments for F/RPDs, respondents changed their choice of restorative methods at all conditions of remaining sound tooth structure to more advanced ones.
5. The proper choice of the method of restoration of endodontically treated anterior teeth by most of the respondents was expected to maximize chances for successful restorative outcomes.

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References

1. McKerracher PW. Rational restoration of endodontically treated teeth.1. Principles, techniques and materials. *Aust Dent J* 1981; 26: 205-208.
2. Goerig AC, Mueninghoff LA. Management of the endodontically treated tooth. Part I: Concept for restorative designs. *J Prosthet Dent* 1983; 49: 340-345.
3. Gutmann JL. The dentin-root complex: Anatomic and biologic considerations in restoring endodontically treated teeth. *J Prosthet Dent* 1992; 67: 458-467.
4. Smith CT, Schuman N. Restoration of endodontically treated teeth: A guide for the restorative dentist. *Quintessence Int* 1997; 28:457-262.
5. Christensen GJ. Posts: Necessary or unnecessary? *JADA* 1996; 127: 1522-1526.
6. Scurria MS, Shugars DA, Hayden WJ, Felton DA. General dentists' patterns for restoring endodontically treated teeth. *JADA* 1995; 126: 775-779.
7. Robbins JW. Guidelines for the restoration of endodontically treated teeth. *JADA*, 1990; 120: 558-562.
8. Trabert KC, Caputo AA, Abou Rass M. Tooth fracture - comparison of endodontic and restorative treatments. *J Endodont* 1978; 4: 341-345.
9. El-Khodery AM, El-Baghdady YM, Ibrahim RM. A comparative study of restorative techniques used to reinforce intact endodontically treated anterior teeth. *Egypt Den J* 1990; 36: 193-205.
10. Ko CC, Chu CS, Chung KH, Lee MC. Effects of posts on dentin stress distribution in pulpless teeth. *J Prosthet Dent* 1992; 68: 421-427.
11. Morgano SM, Milot P. Clinical success of cast metal posts and cores. *J Prosthet Dent* 1993; 70: 11-16.
12. Morgano SM, Brackett SE. Foundation restoration in fixed prosthodontics: Current knowledge and future needs. *J Prosthet Dent* 1999; 82: 643-657.
13. Brandal JL, Nicholls JI, Harrington GW. A comparison of three restorative techniques for endodontically treated anterior teeth. *J Prosthet Dent* 1987;58: 161-165.
14. Christensen GJ. Posts, cores and patient care. *JADA* 1993; 124: 86-89.
15. Gateau P, Sabek M, Dailey B. Fatigue testing and microscopic evaluation of post and core restorations under artificial crowns. *J Prosthet Dent* 1999; 82: 341-347.
16. Cho GC, Kaneko LM, Donovan TE, White SN. Dimetral and compressive strength of dental core materials. *J Prosthet Dent* 1999; 82: 272-276.
17. Christensen GJ. Fixed prosthodontics - State of art. *Aust Dent J* 1995; 40: 164-166.
18. Kantor ME, Pines MS. A comparative study of restorative techniques for pulpless teeth. *J Prosthet Dent* 1977; 38: 405-412.
19. Baraban DJ. The restoration of endodontically treated teeth: An update. *J Prosthet Dent* 1988; 59: 553-557.
20. 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.
21. Fraga RC, Chaves BT, Mello GSB, Siqueira JR JF. Fracture resistance of endodontically treated roots after restoration. *J Oral Rehab* 1998; 25: 809-813.
22. McLean A. Predictably restoring endodontically treated teeth. *J Can Dent Assoc* 1998; 64: 782-787.