

## A survey of contemporary methods of restoring endodontically treated teeth in Riyadh area-Part II: Premolar teeth

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يعتبر ترميم الأسنان التي عولجت جذورها موضع خلاف في الآراء. تهدف هذه الدراسة إلى معرفة نسبة الطرق المفضلة في ترميم الضواحك التي تم علاج جذورها في حالاتها المختلفة. تم توزيع استبيان على أخصائيي وأخصائيات الإستعاضة السنية الصناعية وأطباء وطبيبات الأسنان الممارسين العاميين الذين يقومون أيضاً بالعمل في مجال الإستعاضة الصناعية في منطقة الرياض. طلب منهم إدراج سنة ومكان تخرجهم، درجتهم العلمية ومكان عملهم الحالي. تم جمع استجابة مائة وخمسون طبيباً وطبيبة وحلت الردود إحصائياً. أشارت النتائج إلى أن غالبية المستجيبين يفضلون استعمال الأملغم (54%) في حال بقاء أكثر من 50% من مادة السن السليمة (حالة أ). وفي حال بقاء حوالي 50% من مادة السن السليمة (حالة ب) فإن غالبية المستجيبين يفضلون استعمال المواد الأخرى المختلفة يليها التاج المصنوع (37.3%). بينما في حال بقاء أقل من 50% من مادة السن السليمة (حالة ج)، فإن 72.7% من المستجيبين يفضلون استعمال الوند والقلب المعدني يليه التاج المصنوع. وجد أنه عند استعمال الأسنان كدعامات لتركيبات صناعية ثابتة أو متحركة يفضل المستجيبون تغيير خيارهم بأخر أكثر تطوراً. وجدت عوامل أخرى تؤثر على اختيار الطريقة العلاجية. يمكن الإستنتاج بأن لدى معظم المستجيبين القدرة على اختيار الطرق المناسبة لترميم الضواحك التي تم علاج جذورها.

Restoration of endodontically treated teeth is an area of controversy and divergence of opinions. This study was initiated to detect the frequency of the preferred methods of restoring endodontically treated premolars in different clinical conditions. A questionnaire form was distributed among prosthodontists and general practitioners in Riyadh area. They were asked to indicate their year and institution of graduation, degree and current institutions. Responses from 150 dentists were collected and statistically analyzed. The results indicated that most of respondents preferred to use amalgam restorative material (54%) when more than 50% of sound tooth structure remains (condition A). When about 50% of the sound tooth structure remains (condition B), most of respondents preferred to use a restorative material/crown (37.3%). However, when less than 50% of the sound tooth structure remains (condition C), 72.7% of respondents preferred to use a cast post and core/crown. When those premolars were used as abutments for fixed or removable partial dentures, respondents changed their choice of restorative treatment to more advanced ones. Other factors may affect the choice of restorative method. It can be concluded that most of respondents had the ability to select the appropriate restorative method of the endodontically treated premolar teeth.

### Introduction

Endodontically treated teeth should be first assessed to determine their restorability. The restorable teeth are then evaluated for the amount of remaining sound coronal tooth structure. This is because the restoration of endodontically treated teeth is dictated by the extent of coronal destruction in addition to the type of tooth, root morphology, the functional demands and whether this tooth serves as an abutment for fixed or removable partial dentures.<sup>1</sup> Posterior teeth carry greater occlusal forces than anterior ones. Therefore, teeth with minimal remaining tooth structures are at increased risk for fracture and provide decreased retention for the restoration. The restorations must be planned to protect posterior teeth against fracture. Additionally, the horizontal and torquing forces exerted on abutments for fixed or removable partial dentures dictate more extensive protective and retentive features in the restoration.<sup>2</sup> A tooth that has a minimal coronal structure missing (only an

endodontic access opening and a slight enlargement of the pulp chamber) can be restored by placement of a restorative material. The restorative material can range from a traditional glass ionomer, resin-modified glass ionomer, bonded composite and bonded amalgam restorations.<sup>3-5</sup> New generation of dentin bonding systems results in cusps with a higher resistance to fracture than those restored with the acid-etch resin technique.<sup>6</sup> A cuspal coverage is indicated to conserve the remaining tooth structure and to protect weakened cusp of endodontically treated premolars from fracture.<sup>7</sup> It was found that the rate of a clinical success significantly improves with coronal coverage of maxillary and mandibular premolars.<sup>8</sup> Pin-retained composite or amalgam restorations are also recommended to restore posterior teeth that have sufficient tooth structure remaining after endodontic treatment not requiring dowel core restorations.<sup>9</sup> In posterior teeth, a post with an amalgam core is considered the strongest and most resistant to fracture next to a natural tooth.<sup>10</sup> When the teeth serve as abutments for fixed or removable partial dentures, additional stresses and loads are expected. In order to provide some resistance to fracture

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against those forces, a post and core foundation is indicated.<sup>7</sup>

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

### Material and Methods

A questionnaire was designed and distributed among prosthodontists and general practitioners that work in private and governmental clinics in Riyadh area. Respondents were asked to indicate their year and institution of graduation, the dental degree(s) obtained and the current institution. The questionnaire contained different choices of restorative methods of restoration of endodontically treated premolars 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 (F/RPDs). Responses from 150 prosthodontists and general practitioners were collected. The data were entered into microcomputer using FOX PRO (Windows version 2.5). A Statistical Package of Social Sciences (SPSS version 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 54.0% of respondents preferred to restore the tooth with an amalgam restoration while only 13.3% of respondents preferred to restore it with a tooth-colored

restorative material (Table 1). Using only an amalgam restoration was preferred more by respondents who graduated in the 1990s and who constituted 66.3% (Table 2), more by graduates of Kingdom of Saudi Arabia (KSA) institutions at 61.8% (Table 3), more by those Bachelor (BDS) degree at 60% (Table 4) and by governmental workers at 60.6% (Table 5). Chi-square analysis demonstrated a statistically significant relationship only between the year of graduation and the current institution and the preferred method of restoration. Were the same tooth to be used as an abutment for fixed or removable partial dentures (F/RPDs), 50% of respondents preferred to protect the tooth with a crown (Table 6). When the teeth were used as abutments for F/RPDs, the use of a restorative material/crown was preferred more by respondents who graduated in the 1980s representing 68.2% (Table 7). The same restoration of the same tooth was preferred slightly more by KSA graduates (58.8%) as shown in Table 8 and almost equally preferred by respondents with BDS and MSc/PhD degrees at 57.6% and 56.3%, respectively (Table 9) and also almost equally by private and governmental workers at 57.9% and 57.1%, respectively (Table 10).

**Table 1.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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 An amalgam restoration	81 (54.0)	5 (03.3)	2 (01.3)
2 A tooth-colored restorative material (composite)	20 (13.3)	2 (01.3)	0 (00.0)
3 A cast onlay	5 (03.3)	22 (14.7)	0 (00.0)
4 A restorative material/crown	33 (22.0)	56 (37.3)	7 (04.7)
5 A prefabricated post and a restorative material	3 (02.0)	13 (08.7)	4 (02.7)
6 A prefabricated post and a restorative material core/crown	8 (05.3)	43 (28.7)	27 (18.0)
7 A cast post and core/crown	0 (00.0)	8 (05.3)	109 (72.7)
8 Others	0 (00.0)	1 (00.7)	1 (00.7)
Total Freq. (%)	150 (100.0)	150 (100.0)	150 (100.0)

**Table 2.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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 %		
	≤ 1970s Freq. (%)	1980s Freq. (%)	1990s Freq. (%)	≤ 1970s Freq. (%)	1980s Freq. (%)	1990s Freq. (%)	≤ 1970s Freq. (%)	1980s Freq. (%)	1990s Freq. (%)
1	3 (27.3)	19 (38.0)	59 (66.3)	1 (09.1)	0 (00.0)	4 (04.5)	0 (00.0)	0 (00.0)	2 (02.2)
2	1 (09.1)	12 (24.0)	7 (07.9)	0 (00.0)	2 (04.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
3	1 (09.1)	1 (02.0)	3 (03.4)	2 (18.2)	2 (04.0)	18 (20.2)	0 (00.0)	0 (00.0)	0 (00.0)
4	5 (45.5)	11 (22.0)	17 (19.1)	3 (27.3)	23 (46.0)	30 (33.7)	0 (00.0)	2 (04.0)	5 (05.6)
5	0 (00.0)	2 (04.0)	1 (01.1)	0 (00.0)	4 (08.0)	9 (10.1)	0 (00.0)	1 (02.0)	3 (03.4)
6	1 (09.1)	5 (10.0)	2 (02.2)	4 (36.4)	14 (28.0)	25 (28.1)	4 (36.4)	10 (20.0)	13 (14.6)
7	0 (00.0)	0 (00.0)	0 (00.0)	1 (09.1)	5 (10.0)	2 (02.2)	7 (63.6)	37 (74.0)	65 (73.0)
8	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	1 (01.1)	0 (00.0)	0 (00.0)	1 (01.1)
Total	11 (100.0)	50 (100.0)	89 (100.0)	11 (100.0)	50 (100.0)	89 (100.0)	11 (100.0)	50 (100.0)	89 (100.0)
Chi-square	P= 0.012			P=0.111			P= 0.797		

1- An amalgam restoration, 2-A tooth-colored restorative material (composite), 3-A cast onlay, 4-A restorative material /crown, 5- A prefabricated post and a restorative material, 6-A prefabricated post and a restorative material /crown, 7-A cast post and core /crown, 8-Others

**Table 3.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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. (%)	Other Countries Freq. (%)	K.S.A.* Freq. (%)	Other countries Freq. (%)	K.S.A.* Freq. (%)	Other countries Freq. (%)
1	55 (61.8)	26 (42.6)	2 (02.2)	3 (04.9)	1 (01.1)	1 (01.6)
2	11 (12.4)	9 (14.8)	0 (00.0)	2 (03.3)	0 (00.0)	0 (00.0)
3	4 (04.5)	1 (01.6)	16 (18.0)	6 (09.8)	0 (00.0)	0 (00.0)
4	13 (14.6)	20 (32.8)	36 (40.4)	20 (32.8)	4 (04.5)	3 (04.9)
5	2 (02.2)	1 (01.6)	7 (07.9)	6 (09.8)	3 (03.4)	1 (01.6)
6	4 (04.5)	4 (06.6)	22 (24.7)	21 (34.4)	13 (14.6)	14 (23.0)
7	0 (00.0)	0 (00.0)	5 (05.6)	3 (04.9)	67 (75.3)	42 (68.9)
8	0 (00.0)	0 (00.0)	1 (01.1)	0 (00.0)	1 (01.1)	0 (00.0)
Total	89 (100.0)	61 (100.0)	89 (100.0)	61 (100.0)	89 (100.0)	61 (100.0)
Chi-square	P= 0.098		P= 0.335		P= 0.733	

\*Kingdom of Saudi Arabia, 1-An amalgam restoration, 2- A tooth-colored restorative material (composite), 3- A cast onlay, 4-A restorative material /crown, 5- A prefabricated post and a restorative material, 6-A prefabricated post and a restorative material core /crown, 7-A cast post and core /crown, 8-Others

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

Most of the respondents preferred to use a restorative material /crown and a prefabricated post and a restorative material core/crown at 37.3% and 28.7%, respectively (Table 1). A restorative material/crown was preferred more by respondents who graduated in the 1980s (46%) as shown in Table 2. However, the use a prefabricated post and a restorative material core /crown was preferred more by respondents who graduated in 1970s and before (36.4%). The use of a restorative material/crown was also preferred more by respondents who graduated from K.S.A. (40.4% in Table 3), more by general practitioners (38.3% in Table 4) and more by governmental workers

(38.5% in Table 5). When the tooth was used as an abutment for F/RPDs, the percentages of respondents who preferred to use a prefabricated post and a restorative material core/crown and a cast post and core/crown were increased (33.3% and 30.7%, respectively) as shown in Table 6. At this time, the use of a restorative material /crown was preferred more by respondents who graduated in the 1980s (40.9%) as shown in Table 7 and equally preferred by graduates of K.S.A. and other institutions (29.4% and 29.2%, respectively) as shown in Table 8. The same treatment method was preferred more by respondents with BDS degree (38.9%) as shown in Table 9 and more by governmental workers (30.4%) as shown in Table 10.

**Table 4.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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. (%)	M.Sc./PhD Freq. (%)	BDS Freq. (%)	M.Sc./PhD Freq. (%)	BDS Freq. (%)	M.Sc./PhD Freq. (%)
1	69 (60.0)	12 (34.3)	4 (03.5)	1 (02.9)	2 (01.7)	0 (00.0)
2	14 (12.2)	6 (17.1)	1 (00.9)	1 (02.9)	0 (00.0)	0 (00.0)
3	3 (02.6)	2 (05.7)	18 (15.7)	4 (11.4)	0 (00.0)	0 (00.0)
4	21 (18.3)	12 (34.3)	44 (38.3)	12 (34.3)	7 (06.1)	0 (00.0)
5	3 (02.6)	0 (00.0)	11 (09.6)	2 (05.7)	4 (03.5)	0 (00.0)
6	5 (04.3)	3 (08.6)	30 (26.1)	13 (37.1)	24 (20.9)	3 (08.6)
7	0 (00.0)	0 (00.0)	6 (05.2)	2 (05.7)	77 (67.0)	32 (91.4)
8	0 (00.0)	0 (00.0)	1 (00.9)	0 (00.0)	1 (00.9)	0 (00.0)
Total	115 (100.0)	35 (100.0)	115 (100.0)	35 (100.0)	115 (100.0)	35 (100.0)
Chi-square	$P=0.120$		$P=0.867$		$P=0.091$	

1-An amalgam restoration, 2-A tooth-colored restorative material (composite), 3-A cast onlay, 4-A restorative material /crown, 5- A prefabricated post and a restorative material, 6- A prefabricated post and a restorative material core /crown, 7-A cast post and core /crown, 8-Others

**Table 5.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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	18 (39.1)	63 (60.6)	0 (00.0)	5 (04.8)	0 (00.0)	2 (01.9)
2	8 (17.4)	12 (11.5)	1 (02.2)	1 (01.0)	0 (00.0)	0 (00.0)
3	1 (02.2)	4 (03.8)	3 (06.5)	19 (18.3)	0 (00.0)	0 (00.0)
4	15 (32.6)	18 (17.3)	16 (34.8)	40 (38.5)	1 (02.2)	6 (05.8)
5	2 (04.3)	1 (01.0)	5 (10.9)	8 (07.7)	2 (04.3)	2 (01.9)
6	2 (04.3)	6 (05.8)	18 (39.1)	25 (24.0)	13 (28.3)	14 (13.5)
7	0 (00.0)	0 (00.0)	3 (06.5)	5 (04.8)	30 (65.2)	79 (76.0)
8	0 (00.0)	0 (00.0)	0 (00.0)	1 (01.0)	0 (00.0)	1 (01.0)
Total	46 (100.0)	104 (100.0)	46 (100.0)	104 (100.0)	46 (100.0)	104 (100.0)
Chi-square	$P=0.103$		$P=0.238$		$P=0.199$	

1-An amalgam restoration, 2-A tooth-colored restorative material (composite), 3-A cast onlay, 4-A restorative material /crown, 5-A prefabricated post and a restorative material, 6- A prefabricated post and a restorative material core /crown, 7-A cast post and core /crown, 8-Others

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

Most of respondents preferred to use a cast post and core/crown (72.7%) as shown in Table 1. The cast post and core/crown was found to be used more by respondents who graduated in the 1980s and 1990s at 74% and 73%, respectively (Table 2), more by graduates (75.3%) of KSA institutions (Table 3), more by respondents (91.4%) with MSc/PhD degree (Table 4) and more by governmental workers (76%) as shown in Table 5. When the same tooth was used as an abutment for F/RPDs, the percentage of respondents using a cast post and core/crown further increased

(86.7%) as shown in Table 6. All respondents who graduated in the 1970s and before preferred to restore the tooth with a cast post and core/crown (Table 7). It was also preferred more by 92.2% of graduates of KSA institutions (Table 8), by all respondents with MSc/PhD degree (Table 9) and slightly more by 87.5% governmental workers (Table 10).

### Discussion

It was recommended to treat premolars that still have most of their coronal structure as virgin teeth requiring a root canal therapy.<sup>3</sup> Steele and Johanson<sup>11</sup> stated that unaltered premolars and

premolars with endodontic access were similar and more resistant to fracture than any other teeth at other different clinical conditions. Hansen and Asmussen<sup>12</sup> also concluded that the best protection against cusp fracture in posterior teeth; apart from cast restoration, is an enamel-bonded

**Table 6.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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 An amalgam restoration	12 (16.0)	0 (00.0)	0 (00.0)
2 A tooth-colored restorative material (composite)	2 (02.7)	0 (00.0)	0 (00.0)
3 A cast onlay	5 (06.7)	1 (01.3)	0 (00.0)
4 A restorative material/crown	43 (57.3)	22 (29.3)	4 (05.3)
5 A prefabricated post and a restorative material	3 (04.0)	4 (5.3)	1 (01.3)
6 A prefabricated post and a restorative material core/crown	4 (05.3)	25 (33.3)	5 (06.7)
7 A cast post and core/crown	6 (08.0)	23 (30.7)	65 (86.7)
8 Others	0 (00.0)	0 (00.0)	0 (00.0)

resin filling. In this study, low percentages of respondents preferred to use composite restorations, while much higher percentages of them preferred to use amalgam restorations. This is well supported by the study of Scuria *et al.*<sup>5</sup> where 20% of premolars, that were restored without crowns, was restored with amalgam restorations. Only 6% of them were restored with composite restorations. The best fracture resistance was reported when restoring beveled mesio-occluso-distal (MOD) preparations of premolars with bonded composite restorations which did not differ significantly from that of sound natural teeth.<sup>13</sup> On the other hand, the use of an amalgam restoration without a cuspal coverage especially in MOD cavities is considered unacceptable even when the restoration is bonded to the teeth.<sup>12,14</sup> This is because the amalgam restoration was reported to have a high frequency of cuspal fracture.<sup>13,14</sup> Mondelli *et al.*<sup>15</sup> stated that restoring weakened premolars with cuspal coverage amalgam restorations is a possible low-cost, immediate alternative to metal cast restorations. The use of an amalgam onlay that covers and protects cusps from possible fracture is recommended.<sup>1,15</sup> When the premolars are used as abutments for F/RPDs, a cast onlay was preferred by low percentages of respondents of this study. An earlier study found that when coronal damage is minimal and the cuspal forces are also minimal with a low risk of fracture, the use of a MOD cast onlay is considered suitable.<sup>16</sup> Costa *et al.*<sup>17</sup> reported the greatest resistance to fracture of endodontically treated premolars restored with MOD cast onlays when compared to those

**Table 7.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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 %		
	≤ 1970s Freq. (%)	1980s Freq. (%)	1990s Freq. (%)	≤ 1970s Freq. (%)	1980s Freq. (%)	1990s Freq. (%)	≤ 1970s Freq. (%)	1980s Freq. (%)	1990s Freq. (%)
1	0 (00.0)	1 (04.5)	11 (23.4)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
2	0 (00.0)	2 (09.1)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
3	0 (00.0)	0 (00.0)	5 (10.6)	0 (00.0)	0 (00.0)	1 (02.1)	0 (00.0)	0 (00.0)	0 (00.0)
4	3 (50.0)	15 (68.2)	25 (53.2)	0 (00.0)	9 (40.9)	13 (27.7)	0 (00.0)	2 (09.1)	2 (04.3)
5	0 (00.0)	1 (04.5)	2 (04.3)	0 (00.0)	0 (00.0)	4 (08.5)	0 (00.0)	1 (04.5)	0 (00.0)
6	1 (16.7)	1 (04.5)	2 (04.3)	4 (66.7)	6 (27.3)	15 (31.9)	0 (00.0)	1 (04.5)	4 (08.5)
7	2 (33.3)	2 (09.1)	2 (04.3)	2 (33.3)	7 (31.8)	14 (29.8)	6 (100.0)	18 (81.8)	41 (87.2)
8	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	6 (100.0)	22 (100.0)	47 (100.0)	6 (100.0)	22 (100.0)	47 (100.0)	6 (100.0)	22 (100.0)	47 (100.0)
Chi-square	P= 0.061			P= 0.424			P= 0.625		

1-An amalgam restoration, 2-A tooth-colored restorative material (composite), 3-A cast onlay, 4-A tooth-colored restorative material /crown, 5-A prefabricated post and a restorative material, 6-A prefabricated post and a restorative material core /crown, 7-A cast post and core /crown, 8-Others

**Table 8.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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. (%)	Other countries Freq. (%)	K.S.A.* Freq. (%)	Other countries Freq. (%)	K.S.A.* Freq. (%)	Other countries Freq. (%)
1	9 (17.60)	3 (12.90)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)
2	0 (00.00)	2 (08.30)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)
3	3 (05.90)	2 (08.30)	1 (02.00)	0 (00.00)	0 (00.00)	0 (00.00)
4	30 (58.80)	13 (54.20)	15 (29.40)	7 (29.20)	1 (02.00)	3 (12.50)
5	2 (03.90)	1 (04.20)	3 (05.90)	1 (04.20)	0 (00.00)	1 (04.20)
6	4 (07.80)	0 (00.00)	15 (29.40)	10 (41.70)	3 (05.90)	2 (08.30)
7	3 (05.90)	3 (12.50)	17 (33.30)	6 (25.00)	47 (92.20)	18 (75.00)
8	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)	0 (00.00)
Total	51 (100.00)	24 (100.00)	51 (100.00)	24 (100.00)	51 (100.00)	24 (100.00)
Chi-square	<i>P</i> = 0.276		<i>P</i> = 0.797		<i>P</i> = 0.101	

\*Kingdom of Saudi Arabia, 1-An amalgam restoration, 2-A tooth-colored restorative material (composite), 3-A cast onlay, 4-A restorative material crown/crown, 5-A prefabricated post and a restorative material, 6-A prefabricated post and a restorative material core /crown, 7-A cast post and core /crown, 8-Others

**Table 9.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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. (%)	M.Sc./PhD Freq. (%)	BDS Freq. (%)	M.Sc./PhD Freq. (%)	BDS Freq. (%)	M.Sc./PhD Freq. (%)
1	10 (16.9)	2 (12.5)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
2	2 (03.4)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
3	5 (08.5)	0 (00.0)	1 (01.7)	0 (00.0)	0 (00.0)	0 (00.0)
4	34 (57.6)	9 (56.3)	20 (33.9)	2 (12.5)	4 (06.8)	0 (00.0)
5	2 (03.4)	1 (06.3)	4 (06.8)	0 (00.0)	1 (01.7)	0 (00.0)
6	4 (06.8)	0 (00.0)	19 (32.2)	6 (37.5)	5 (08.5)	0 (00.0)
7	2 (03.4)	4 (25.0)	15 (25.4)	8 (50.0)	49 (83.1)	16 (100.0)
8	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total	59 (100.0)	16 (100.0)	59 (100.0)	16 (100.0)	59 (100.0)	16 (100.0)
Chi-square	<i>P</i> = 0.096		<i>P</i> = 0.206		<i>P</i> = 0.372	

1-An amalgam restoration, 2- A tooth-colored restorative material (composite), 3- A cast onlay, 4-A restorative material /crown, 5-A prefabricated post and a restorative material, 6-A prefabricated post and a restorative material core /crown, 7-A cast post and core /crown, 8-Others

restored with either MOD silver amalgam restorations or resin-bonded MOD inlays. When a tooth is subjected to horizontal forces as that exerted by fixed and removable partial dentures, an occlusal coverage in a form of cast onlays, partial or full veneer crowns is considered favorable.<sup>1,9</sup> The finding of this study agrees with this. Restoration of the teeth can range from a cast post and core to a prefabricated post and amalgam core that can provide a primary support for a cast restoration.<sup>8,18</sup> It was stated that because some bicuspid teeth have inadequate room for sufficient bulk of buildup material around the post to provide a solid unit, a cast post and core becomes the choice of treatment.<sup>19</sup> However, one study showed that 11% of premolars were restored with

a prefabricated dowel and core and only 7% were restored with a cast post and core prior to crown restoration.<sup>5</sup> Morgano and Brachett<sup>20</sup> recommended restoring moderately damaged premolars with either prefabricated posts and direct restorative cores or custom-cast posts and cores. Silver amalgam is considered as the best core material under simulated clinical conditions because of its high compressive strength<sup>4,10,21,22</sup> while glass ionomer is considered a poor core material.<sup>4,23-26</sup> On the other hand, composite has a strength intermediate between silver amalgam and glass-ionomer core materials,<sup>22,27</sup> but is less desirable when there is limited supporting dentin.<sup>27,28</sup> Pin-retained composite or amalgam build-up can be used in posterior teeth to

**Table 10.** Frequency and percentage of respondents using different restorative methods of endodontically treated premolars 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	1 (05.3)	11 (19.6)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
2	2 (10.5)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
3	2 (10.5)	3 (05.4)	0 (00.0)	1 (01.8)	0 (00.0)	0 (00.0)
4	11 (57.9)	32 (57.1)	5 (26.3)	17 (30.4)	1 (05.3)	3 (05.4)
5	0 (00.0)	3 (05.4)	1 (05.3)	3 (05.4)	1 (05.3)	0 (00.0)
6	0 (00.0)	4 (07.1)	8 (42.1)	17 (30.4)	1 (05.3)	4 (07.1)
7	3 (15.8)	3 (05.4)	5 (26.3)	18 (32.1)	16 (84.2)	49 (87.5)
8	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)	0 (00.0)
Total	19 (100.0)	56 (100.0)	19 (100.0)	56 (100.0)	19 (100.0)	56 (100.0)
Chi-square	$P=0.052$		$P=0.884$		$P=0.385$	

1-An amalgam restoration, 2-A tooth-colored restorative material (composite), 3-A cast onlay, 4:A restorative material /crown, 5-A prefabricated post and a restorative material, 6-A prefabricated post and a restorative material core /crown, 7-A cast post and core /crown, 8-Others

reconstitute a clinical crown for an ideal preparation for a cast restoration.<sup>9</sup> A post may also be needed in cases where lateral stresses on the premolar tooth require a more lateral resistance to fracture.<sup>3</sup> The cast restoration also protects the weakened posterior tooth from failure by vertical forces of occlusion and horizontal forces of fixed or removable partial dentures.<sup>18</sup> This also supports the finding of this study where a prefabricated post and restorative material/crown and a cast post and core/crown were used to restore premolar teeth that were used as abutments for F/RPDs. This reflects the awareness of most of respondents regarding the need to resist lateral forces exerted by fixed and removable partial dentures on the teeth by the use of posts. At condition C, most of respondents preferred to use a cast post and core/crown. This is also supported by several studies one of which recommended the use of a post attaching the root structure to the core material that is being bonded to the remaining coronal tooth structure followed by a crown.<sup>3</sup> It was also recommended to restore severely damaged premolars with either a prefabricated posts and restorative material cores or custom-cast posts and cores.<sup>20</sup>

Multiple factors may affect the choice of restorative method. These factors include: patient medical condition, patient financial support and cooperation, time factor, laboratory support and availability of required materials.

In general, the results of this study reflected the ability of the respondents to first diagnose and detect the extent of damage of endodontically treated teeth then to formulate the suitable

treatment plan in order to bring those teeth back to form and function.

### Conclusions

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

1. At condition A, 54% of respondents preferred to use only an amalgam restoration. There was a statistically significant relationship between the year of graduation and the choice of restorative method of the teeth at this condition.
2. At condition B, most of respondents preferred to use a restorative material/crown.
3. At condition C, 72.7% of respondents preferred to use a cast post and core/crown.
4. When the teeth were used as abutments for fixed or removable partial dentures, respondents changed their choice of restorative methods at all conditions of remaining sound tooth structure to more advanced ones.
5. The selection of a suitable restoration of endodontically treated premolar teeth by respondents seemed to be based on sound restorative principles.
6. Factors like patient medical and financial status, patient cooperation and the availability of time, material and laboratory support may affect the choice of the restorative method.

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