



## Radiographic Evaluation of Post–core Restorations fabricated by Dental Students at Jazan University

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### ABSTRACT

**Aim:** Post and core procedures are important clinical methods in routine dental practice. The present research aimed to radiographically assess the quality of post seating performed by undergraduate students at the College of Dentistry, Jazan University.

**Materials and methods:** A total of 343 periapical X-rays of cemented posts (170 from males and 173 from females) were assessed. The assessment covered tooth type, arch, gender, type of post, length of post in relation to the crown and root lengths, the presence of any abnormality in post space, status of the remaining gutta-percha (GP), and the presence or absence of spaces between the end of post and GP. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) program (version 21), and associations between variables were determined using chi-squared or Fisher's exact tests.

**Results:** Maxillary teeth were the most frequently restored with posts, and the majority (41%) comprised incisors. Similarly, glass fiber post (69%) and taper-shaped posts (86%) were the most used posts. The majority of posts (81.6%) featured a width one-thirds that of the root. Lengths of posts were twice (58%) or equal to (51%) crown and root length respectively. More than 55% of cases presented 3 to 5 mm of GP at their apical portion, and 29% reached more than 5 mm. Approximately 5 to 8% of assessed cases revealed widening of periodontal ligaments,

presence of periapical pathologies, and deviation of posts from the canal wall. Most cases (75%) showed the absence of space between GP and the post end.

**Conclusion:** Qualities of assessed post and core restorations conducted by the 6th year dental students were clinically acceptable.

**Clinical significance:** Periodic evaluation to determine the quality of delivered treatments is a vital cue for health service authorities. This evaluation will improve quality of services and treatments provided by dental students to their patients under the supervision of the faculty. Results obtained will also provide authorities with a clear feedback about academic infrastructure.

**Keywords:** Dental students, Dowel, Fixed prosthesis, Periapical radiograph, Post and core restorations.

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**Conflict of interest:** None

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### INTRODUCTION

Post and core systems (PCSs) are mainly used to restore endodontically treated teeth (ETT) with extensive loss of structure.<sup>1</sup> Different PCSs have already been tested radiographically. Typically, post and restorative failures have been cited as the most common causes of failure in ETT.<sup>2</sup>

Preparation for post and core restorations is a common clinical procedure in routine dental practice. In the College of Dentistry at Jazan University, as part of competency and graduation requirements, all students must complete preclinical and clinical preparation of post and core restorations.

Outcomes of post and core restorations in the prosthetic treatment plan depend on the success of each treatment phase. Hence, radiographic assessment must be performed as follows: Before post insertion, checking of root canal treatment (RCT) system seal, after cementation, during follow-up after teeth exposure to masticatory loading forces, and monitoring during maintenance recall to evaluate the treatment method according to data provided by specialized literature references.<sup>3,4</sup>

Typically, a correlation exists between preclinical performance on typodont and clinical performance on patients, which is relevant to the preparation of post and core restorations by dentistry students.<sup>5</sup> Thus, dentistry graduates should develop optimum skills through well-supervised preclinical and clinical trainings.<sup>6</sup> To assess the effectiveness of teaching strategies, the knowledge and skills of graduates should be assessed continually.<sup>7</sup> This study aimed to radiographically assess the quality of the post and core preparations performed by the 6th year graduating dental students of Jazan University during the academic year 2015 to 2016.

## MATERIALS AND METHODS

This cross-sectional study was approved by the Research Committee, College of Dentistry, Jazan University. Informed consent was obtained from all patients selected for the study. Posts fabricated by the 6th year dental students in October 2015 to May 2016 were included in this study based on data in the logbook and CS-R4 program (CSR4 Software, Carestream Dental LLC, USA). The following data were extracted:

- Gender, arch, and type of tooth treated or involved;
- Post type: Glass fiber post (GFP), custom-made post (CP), and prefabricated metal post, shape of the side of post, and post width in relation to root diameter;
- Post length in relation to crown and root lengths;
- Presence of radiographic abnormality: Widening of periodontal ligament space (WPL), periapical pathosis (PA), deviation of the post from the root canal, and fitting of post to walls;
- Radiographic condition of the remaining GP: 3 to 5 mm, extruded, unsatisfactorily condensed, or more than 5 mm at the apex;
- Presence or absence of space between the end of post and GP. All relevant data of posts were collected and recorded in a self-designed pro forma. Then, data were summarized as frequencies and percentages. Associations between different factors were determined using chi-squared or Fisher's exact tests as deemed appropriate;  $p < 0.05$  was considered statistically significant. All statistical analyses were performed using SPSS software (version 21, SPSS, Chicago, Illinois, USA).

## RESULTS

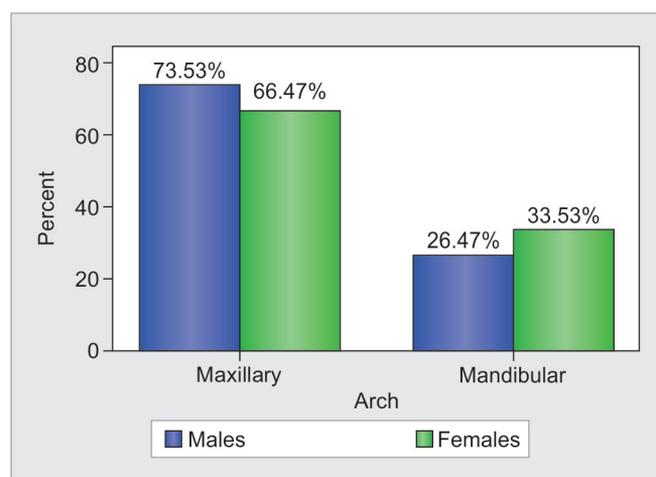
A total of 82 patients (44 males and 38 females) were included in this study. Digital periapical X-ray for 343 posts was assessed among the mentioned subjects. Graph 1 provides an overview of post distributions according to arch. The highest frequency was observed in the maxillary arch ( $n = 240$ , 70%) followed by the mandibular arch ( $n = 103$ , 30%).

Incisor teeth were the most frequently restored with posts ( $n = 142$ , 41%), followed by premolar ( $n = 83$ , 24%) and molars ( $n = 75$ , 22%). Canines were the least frequently restored teeth ( $n = 43$ , 12%) with posts. Distributions of posts by tooth types statistically differed among males compared with females ( $p = 0.002$ ; Table 1). Similarly, distributions of posts significantly differed by arch ( $p = 0.002$ ). Incisor teeth were more frequently restored with posts in maxillary arch (111/46.2%), followed by premolars [50 (20.8%)], molars [44 (18.3%)], and canine [35 (14.6%)]. Corresponding figures for the mandibular arch were as follows: 31 (30%), 33 (32%), 31 (30%), and 8 (8%) for central, molars, premolars, and canines respectively [Table 1].

More tapered posts were significantly detected among male patients ( $n = 158$ , 93%) compared with females ( $n = 137$ , 79%), whereas parallel posts were more frequent among females ( $n = 36$ , 21%) compared with males ( $n = 12$ , 7%,  $p < 0.001$ ; Graph 2).

Table 2 presents the results of post width in relation to root diameter. The most frequently used posts yielded a width of 1/3 ( $n = 280$ , 82%), followed by a 2/3 [ $n = 39$  (11%)] width of a reference post. Distribution of post widths by gender exhibited statistical difference ( $p = 0.026$ ).

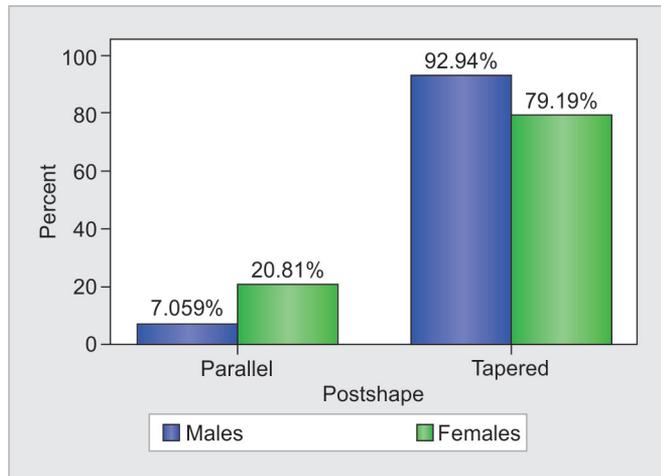
The GFPs were the most frequently used among 145 males (86%) and 91 females (53%) followed by CPs ( $n = 16$ , 9% and  $n = 64$ , 27% respectively). Metal prefabricated posts were detected among 8 (5%) males and



Graph 1: Distribution of posts by gender and arch type

**Table 1:** Distributions of posts by gender, arch, and tooth type

Gender	Tooth type				Total, n/100	p-value
	Incisors, n/%	Canine, n/%	Premolars, n/%	Molars, n/%		
Males	71/41.8	10/5.9	47/27.6	42/24.7	170	0.002
Females	71/41.0	33/19.134.2	36/20.8	33/19.1	173	
Total, n/100%	142/41.4	43/12.5	83/24.2	75/21.9	343/100	
Tooth type						
Maxillary	111/46.2	35/14.6	50/20.8	44/18.3	240	0.002
Mandible	31/30.1	8/7.8	33/32.0	31/0.1	103	
Total	142/41.4	43/12.5	83/24.2	75/21.9	343/100	



**Graph 2:** Distributions of posts by gender and post shape

36 (21%) females; the above distributions statistically differed by gender ( $p < 0.001$ ; Table 3).

Approximately equal proportions of posts with a post:crown ratio of 2:1 were observed among males and females with values of 57 and 59%, whereas those

**Table 2:** Distributions of posts by length among genders in relation to post width

Gender	Post width				Total, n/100%	p-value
	1/3, n/%	2/3, n/%	1/2, n/%	1/1, n/%		
Males	130/76.5	22/12.9	16/9.4	2/1.2	170	0.026
Females	150/86.7	17/9.8	6/3.5	0/0.0	173	
Total	280/81.6	39/11.4	22/6.4	2/0.6	343/100	

of posts with post:crown ratio of 1:1 totaled 41 and 35% respectively ( $p = 0.1$ ; Table 4).

Regarding distributions of the ratio of post length in relation to root length, a ratio of 2:1 was observed in 90 males (52.9%) and 86 (49.7%) females. A ratio of 1:1 was noted in 69 males (40.6%) and 70 females (40.5%; Table 5).

Although periapical radiographs revealed that most assessed posts were fitted to the canal wall, significantly more female patients were diagnosed with WPL, PAs, and deviation of post from the canal (12, 12, and 9% respectively) compared with males (4, 2, and 0% respectively ( $p < 0.001$ ; Table 6).

**Table 3:** Distributions of posts by gender and post type

Gender	Post type			Total, n/100%	p-value
	Metal prefabricated, n/%	Custom made, n/%	Glass fiber, n/%		
Males	8/4.7	16/9.4	146/85.9	170	<0.001
Females	36/20.8	46/26.6	91/52.6	173	
Total	44/12.8	62/18.1	237/69.1	343/100	

**Table 4:** Distributions of post length among genders in relation to post length-to-crown length ratio

Gender	Post length/crown ratio				Total, n/100%	p-value
	2/1, n/%	1/1, n/%	1.3, n/%	1.2, n/%		
Males	97/57.1	70/41.2	3/108	0/0.0	170	0.100
Females	102/59.0	60/34.7	8/4.6	3/1.7	173	
Total	199/58.0	130/37.9	11/3.2	3/0.9	343/100	

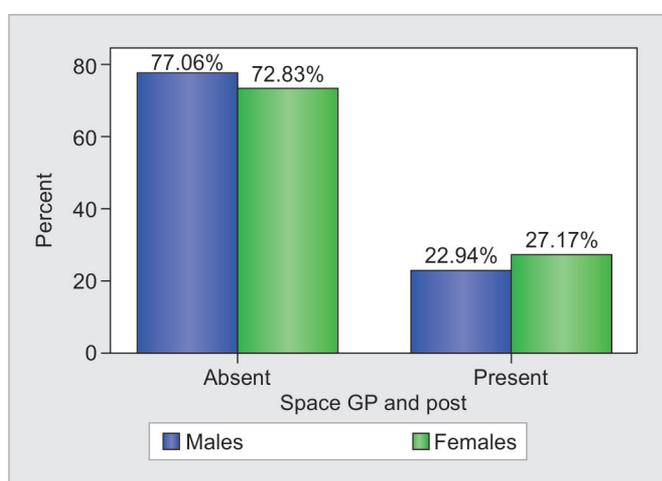
**Table 5:** Distribution of posts length-to-root length ratio by gender

Gender	Post length in relation to root ratio			Total, n/100%	p-value
	2/1, n/%	1/1, n/%	1.3, n/%		
Males	90/52.9	69/40.6	11/6.5	170	0.515
Females	86/49.7	70/40.5	17/9.8	173	
Total	176/ 51.3	139/40.5	28/8.2	343/100	

**Table 6:** Distribution of presence of radiographic abnormality and condition of remaining GPs by gender

Presence of radiographic abnormality						
Gender	WPL, n/%	PA, n/%	Deviation of post from the canal, n/%	Fitting of post to wall, n/%	Total n/100	p-value
Males	6/3.5	3/1.8	0/0.0	161/94.7	170	0.000*
Females	20/11.6	20/11.6	16/9.2	117/67.6	173	
Total	26/7.6	23/6.7	16/4.7	278/81.0	343/100	
Condition of remaining GP						
Gender	3–5 mm, n/%	Extruded beyond the apex, n/%	Unsatisfactory condensation, n/%	More than 5 mm, n/%	Total, n/100	p-value
Males	86/50.6	7/4.1	23/13.5	54/31.8	170	0.305
Females	105/60.7	6/3.5	17/9.8	45/26.0	173	
Total	191/55.7	13/3.8	40/11.7	99/28.9	343/100	

\*Significant value



**Graph 3:** Distributions of posts by gender and space between GP and post end

Regarding the condition of remaining GP in relation to posts, the majority of cases in males and females (86, 51% and 105, 61% respectively) featured 3 to 5 mm of GP apical to the post end. A total of 54 (31.8%) and 45 (26%) of males and females respectively, showed more than 5 mm of GP apical to the end of post. About 13 (3.8) cases showed unsatisfactory condensation of GP, whereas 3.8% showed extrusion of GP beyond the apex (p = 0.305).

Graph 3 presents the relationships between space at the post end and GP by gender. The majority of cases showed the absence of space in both genders (77.1% of males and 72.8% of females). A total of 39 (22.9%) cases in males and 47 (27.2%) in females revealed the presence of space between posts and GP (p = 0.385).

**DISCUSSION**

The ETT supported with post and cores is considered a common procedure in dental practice. Many criteria have been suggested to assess the quality of post and core restorations. The majority of these criteria are based mainly

on radiographic evaluation alone or in combination with clinical examination.<sup>8,9</sup>

Results of the present study revealed that posts are more frequently used in maxillary than in mandibular teeth (Graph 1). These results support some previously reported findings by Jamani et al<sup>10</sup> and Al-Hamad et al,<sup>11</sup> who showed that the most frequently restored teeth with posts and cores were, incisors followed by premolars (Table 1). Their findings also reflect their desire to save damaged teeth. According to the findings of the present study, canines in both arches are the least frequently restored teeth with posts, and this result disagrees with the above previous studies, which reported molar teeth. In general, canine teeth are the least frequently RCT-treated teeth.<sup>12,13</sup> In our study, percentages of posts in molars and premolars were almost the same in both arches (Table 1); however, Jamani et al<sup>10</sup> reported that mandibular teeth are the least frequently retained by posts. On the contrary, Al Subait et al<sup>14</sup> discovered that posterior maxillary and mandibular teeth are the most frequently retained by posts (73.6%). Such differences indicate that esthetics (incisors) and functions (molars) are important motivating factors behind seeking dental treatment.

Canines were the least frequently restored teeth with posts in both arches, as also previously revealed.<sup>12,13</sup> This finding indicates the reluctance of dentists to save badly destroyed canines because of their position at the angle of the arch and their rule in guidance occlusion.

Literature states that tapered posts are less retentive than parallel ones, with clinically acceptable retention of both types.<sup>15</sup> Results of the present study show that the majority of posts were tapered (81%), with a value higher than the 62% as reported by Al-Hamad et al,<sup>11</sup> but was closer to that reported by Jamani et al<sup>10</sup> (74%). This result can be attributed to the high numbers of tapered GFP systems available for use in dental markets (Graph 2).

The diameter of clinically acceptable posts should be one-third of that of roots.<sup>16,17</sup> The most frequent post

width found in the present study measured one-third of that of roots (82% in both genders; Table 2), whereas the rest were too thin or too thick. This result can be explained by the lack in experience of some newly graduated dentists in preparing root canals for post reception.

In the present study, GFP was used in the majority of cases (69.1%), whereas CM and prefabricated metals were used in 18.1 and 12.8% of cases respectively (Table 3). Such findings have already been revealed by the results of Nimigean et al,<sup>16</sup> who showed that CPs accounted for 69.6% of included cases. This result can be explained by the economic status of the college. However, in our study, incidence rate (5.8%) of prefabricated metallic posts was less compared with that of the above previous study. Such differences can be explained by the availability of GFP at the time of research. Studies have claimed that GFP possesses physical properties, such as modulus of elasticity, similar to those of natural dentine.<sup>16,17</sup> Therefore, most studies have recommended the wide use of GFP whenever possible. This phenomenon may explain the results of our study.

Ideal post length should be as long as possible, but without jeopardizing the apical seal or strength and integration of remaining roots.<sup>11,18,19</sup> In cases of GFP, its length should not be shorter than or equal to clinical crown length.<sup>15,18,19</sup> In addition, an optimal ferrule should be present.<sup>15</sup> Others recommended that post length should be half the root length,<sup>20</sup> midway between the apex and alveolar crest,<sup>21</sup> and should leave a space of 4 mm for GP at the apex.<sup>15,18</sup> In this study, a 2:1 ratio of post length:crown length was identified in 58% of cases (Table 4), similar to that reported by Al-Hamad et al.<sup>11</sup> Acceptable length, which equals the crown length,<sup>19,22,23</sup> was observed in 37.9% of included cases and is superior compared with those reported by Jamani et al<sup>10</sup> and Nimigean et al.<sup>16</sup>

Percentage of 2:1 ratio of post length:crown length reached 58% of the cases in the present study (Table 4), similar to that reported by Al-Hamad et al.<sup>11</sup> Acceptable length, which equals crown length, was found in 37.9% of the included cases. Our results are better compared with those reported by Jamani et al<sup>10</sup> and Nimigean et al.<sup>16</sup> This observation can be attributed to the effectiveness of methods used in post preparations, especially for GFP. All our students worked under direct supervision of responsible staff. We can consider the proportion of 37.9% of post cases in our study as within the acceptable range because it features a 1:1 ratio of post length:crown length, coinciding with the studies by McLean,<sup>22</sup> who emphasized that post length within root canals should be at least equal to crown height.<sup>22,23</sup>

Our study showed good ratios of post length in relation to root length, i.e., 2:1 and 1:1 in 51.3 and 40.5%

of the cases respectively. These values were excellent proportions compared with results of Jamani et al<sup>10</sup> and Nimigean et al.<sup>16</sup> This observation can be attributed to the high number of GFPs used in this study and the ease of handling during work. The present findings agree with those of the other similar study by Farina et al,<sup>19</sup> who considered GFP length in relation to root length (Table 5).

Our results on the presence of PA and WPL at almost 7% were completely in contrast with that of Jamani et al,<sup>10</sup> who reported a value of 53.93%. This observation can be explained by the presence of numerous extruded GPs among their cases. Extruded GP was reported in 3.8% of cases in our study, and this value is extremely close to that reported by Al-Hamad et al<sup>11</sup> (2.3%). However, 48.8% of cases studied by Adanir and Belli<sup>17</sup> presented periapical radiolucency associated with WPL. This result can be explained by the time elapsed since the final obturation and occlusal forces generated from final prostheses during functioning. Our radiographs were obtained immediately at the end of treatments, whereas in their study, mouth radiographs were procured after a certain period.

Around 5% of total samples had been reported to feature deviated posts from the canal. This result was slightly higher than that reported by Al-Hamad et al<sup>11</sup> at 2.3%, whereas a higher proportion (25%) was reported by Jamani et al.<sup>10</sup>

The majority of posts (81%) were fitted with lateral walls of root canals; Al-Hamad et al<sup>11</sup> revealed that 16.3% of their assessed posts showed unsatisfactory fitting to root canal walls. This result can be attributed to posts and RCTs made in our study by the same operators (Table 6).

The length of remaining GP that needs to be placed at the left apical of the end of posts, to maintain apical integrity and a proper apical seal, should range from 3 to 4 mm or 3 to 5 mm.<sup>10,11,15</sup> In this context, 55.7% of assessed ETT in our study featured 3 to 5 mm of GP, and 28.9% presented more than 5 mm. This result can be considered excellent, especially that 70% of our cases were restored with GFPs.<sup>15</sup> This percentage was slightly higher than the 70.7% observed among posts evaluated by Jamani et al.<sup>10</sup> This result may be related to other factors, including root-crown ratio, crown length, and amount of ferrule left rather than the amount of GP left to avoid jeopardizing the GP seal.

Regarding condensation and density of the remaining GPs, 11.7% of included cases exhibited poor density, which was in contrast with findings of studies by Smadi et al,<sup>9</sup> Abraham and Abdullah,<sup>13</sup> AbuMostafa et al,<sup>24</sup> Chakravarthy and Moorthy,<sup>25</sup> and Balto et al.<sup>26</sup> Warm vertical condensation was used in our school during RCT; this method shows greater advantages over cold lateral condensations.

The majority of cases in the present study showed no spaces between post end and GP (Graph 3). This observation is explained by the assumption that the student who performed RCT was also the one who proceeded with post preparation and the most knowledgeable regarding the presence of the area of root curvatures and further apical preparations.<sup>18</sup>

Up to 25% of our cases were presented with spaces between post and GP; this result was very close to the 22.2% obtained by Al-Hamad et al.<sup>11</sup>

The present study focused on performances of the 6th year undergraduate students in Dental College, Jazan University. This work assessed the quality of different types of cemented posts and cores with postoperative periapical radiographs. However, this type of radiograph can show only two-dimensional image. Thus, superimposition of lingual and buccal structures occurred. This phenomenon is considered the limitation of this study and may result in a clinical error during post evaluations.

## CONCLUSION

Under limitations of the current study, the following can be concluded:

- Post-retained crown designs achieved in the majority of cases were acceptable and close to ideal design characteristics.
- The GFPs were the most frequently used post types, followed by CPs and prefabricated ready-made metallic posts.
- Tapered shaped posts were more widely used than parallel side posts.
- The majority of posts measured one-third of the root width and equal to or twice the length of crowns or roots of restored teeth.
- The majority of post cases presented 3 to 5 mm of GP at their apex and 29% more than this.
- Few cases of PA were reported in assessed cases.
- The majority of post cases featured 3 to 5 mm of GP at their apex and 29% more than 5 mm.

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## REFERENCES

1. Ozturk E, Bolay S, Tuzgiray E, Baykara M. Esthetic restoration procedures for endodontically treated anterior roots. *Clin Dent Res* 2011 Jan;35(2):28-34.
2. Santos AF, Meira JB, Tanaka CB, Xavier TA, Ballester RY, Lima RG, Pfeifer CS, Versluis A. Can fiber posts increase root stresses and reduce fracture? *J Dent Res* 2010 Jun;89(6):587-591.
3. Weaver RG, Haden NK, Valachovic RW. Annual ADEA survey of dental school seniors: 2003 graduating class. *J Dent Educ* 2004 Sep;68(9):1004-1027.
4. Cherlea, V. *Tratamentul Endodontic*. Na ional edition. Coperta: Bucure ti; 2000. pp. 24, 25, 216, 258-260.
5. Harty, FJ. *Endodontics in clinical practice*. Cambridge: University Press; 1990. pp. 128-202.
6. Curtis DA, Lind SL, Brear S, Finzen FC. The correlation of student performance in preclinical and clinical prosthodontic assessments. *J Dent Educ* 2007 Mar;71(3):365-372.
7. Shillingburg, H.; Hobo, S.; Whitsett, LD.; Richard, J.; Brackett, SE. *Fundamentals of Fixed Prosthodontics*. 4th ed. Chicago (IL): Quintessence; 2012. pp. 119-130, 148-51.
8. Adebayo ET, Ahaji LE, Nnachetta RN, Nwankwo O, Akabogu-Okpeseyi N, Yaya MO, Hussain NA. Technical quality of root canal fillings done in a Nigerian general dental clinic. *BMC Oral Health* 2012 Oct;12:42.
9. Smadi L, Hammad M, El-Ma'aita AM. Evaluation of the quality of root canal treatments performed by dental undergraduates: is there a need to review preclinical endodontic courses? *Am J Educ Res* 2015 Nov;3(12):1554-1558.
10. Jamani KD, Aqrabawi J, Fayyad MA. A radiographic study of the relationship between technical quality of coronoradicular posts and periapical status in a Jordanian population. *J Oral Sci* 2005 Sep;47(3):123-128.
11. Al-Hamad KQ, Al-Omari M, Al-Wahadni A, Darwazah A. Radiographic assessment of post-retained crowns in an adult Jordanian population. *J Contemp Dent Pract* 2006 Sep;7(4):29-36.
12. Iqbal A. The factors responsible for endodontic treatment failure in the permanent dentitions of the patients reported to the college of dentistry, the University of Aljouf, Kingdom of Saudi Arabia. *J Clin Diagn Res* 2016 May;10(5):ZC146-ZC148.
13. Abraham SB, Abdullah N. Quality of root canal fillings performed by undergraduate students at the college of dental medicine, University of Sharjah, UAE. *J Dent Sci* 2016 Oct;1(2):1-7.
14. Al Subait A, Albawardi A, Alghomlas A, Daabash M, Alotaibi M, Alturki Y. Success and survival rates of teeth restored with cast post and core among national guard health affairs patients, Riyadh, Saudi Arabia. *Adv Dent Oral Health* 2016 Jul;2(2):1-5.
15. McComb, D. *Ensuring continued trust. Restoration of the endodontically treated teeth*. London: Quintessence; 2008. pp. 1-19.
16. Nimigean VR, Butincu L, Nimigean V. A radiographic study regarding post retained restorations. *Rom J Morphol Embryol* 2012;53(3 Suppl):775-779.
17. Adanir N, Belli S. Evaluation of different post lengths' effect on fracture resistance of a glass fiber post system. *Eur J Dent* 2008 Jan;2(1):23-28.
18. Goodacre, CJ.; Baba, NZ. Restoration of endodontically treated teeth. In: Ingle JI, Bakland LK, Baumgartner JC, editors. *Endodontics*. 6th ed. Hamilton: BC Decker Inc.; 2008. pp. 1431-1471.
19. Farina AP, Cecchin D, Spazzin AO, Pires-de-Souza Fde C, Dartora NR, Mesquita MF. Evaluation of resistance to displacement of metal posts with different lengths. *Indian J Dent Res* 2012 Sep-Oct;23(5):613-616.
20. Hunter AJ, Flood AM. The restoration of endodontically treated teeth. Part 2. Posts. *Aust Dent J* 1989 Feb;34(1):5-12.
21. Stren N, Kochavi D. Immediate restoration of an endodontically treated teeth by mean of a screw-post and composite materials. *Gen Dent* 1977;25:26-28.

22. McLean A. Criteria for the predictably restorable endodontically treated tooth. *J Can Dent Assoc* 1998 Oct;64(9):652-656.
23. McLean A. Predictably restoring endodontically treated teeth. *J Can Dent Assoc* 1998 Dec;64(11):782-787.
24. AbuMostafa A, Ahmad IA, Alenzy G, AlZoman A. Quality of root canal fillings performed by undergraduate Students in Saudi Dental College. *J Dent Oral Hyg* 2015 May;7(5): 64-70.
25. Chakravarthy PV, Moorthy JR. Radiographic assessment of quality of root fillings performed by undergraduate students in a Malaysian Dental School. *Saud Endo J* 2013 Sep;3(2): 77-81.
26. Balto H, Al Khalifah Sh, Al Mugairin S, Al Deeb M, Al-Madi E. Technical quality of root fillings performed by undergraduate students in Saudi Arabia. *Int Endod J* 2010 Apr;43(4): 292-300.