

A radiographic study of the relationship between technical quality of coronoradicular posts and periapical status in a Jordanian population

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Abstract : A radiographic study was conducted to investigate the relationship between the technical quality of coronoradicular posts and periapical status. A total of 400 periapical radiographs, including 560 posts, of patients attending the Dental Department at Jordan University Hospital were scanned and studied. It was found that maxillary teeth were more frequently restored with posts (65.36%) than mandibular teeth (34.64%). Tapered posts accounted for 73.93% of the posts used. The ratio of the mean post length to crown length was 0.8, and that to root length was 0.45. The mean length of the remaining gutta percha apical to the end of the post was 6.22 mm. In addition, 25% of the posts deviated from the line of the root canal. Periapical radiolucency was evident in 53.93% of the assessed teeth. It is concluded that inadequate root canal treatment and coronoradicular posts are associated with increased prevalence of periapical radiolucency, and that general dental practitioners should be better trained in performing endodontic treatment and restoring endodontically treated teeth. (*J. Oral Sci.* 47, 123-128, 2005)

Keywords: radiographic; coronoradicular posts; periapical status; Jordanian.

Introduction

The primary function of coronoradicular posts is to provide retention of the coronal tooth structure without compromising the apical seal of the endodontic filling (1). A direct relationship has been demonstrated between the length of a post and its retentive capability (2). However, preparation of the root canal to accommodate a post may displace the remaining gutta percha and jeopardize the apical seal, thus exposing the periapical tissues to irritants from within the root canal (3). Therefore, a degree of apical leakage following post space preparation has been the subject of several in vitro studies (4-7). However, clinical conclusions based on the findings of in vitro studies with respect to the effect of post length on periapical health must be made with great caution since acceptable rates of microleakage have not been determined (8).

The present radiographic study was undertaken to investigate the relationship between the technical quality of coronoradicular posts with an apical seal and the associated periapical status.

Materials and Methods

The criteria used to collect periapical radiographs were based on those described by Grieve and McAndrew (9). The radiographs were collected from among those taken for any reason for patients attending the Dental Department at Jordan University Hospital for routine treatment. The selection of radiographs was done randomly, the criterion for inclusion in the study being that they were in themselves satisfactory from a diagnostic viewpoint and that they included at least one coronoradicular post. All radiographs were taken using the bisecting technique. A total of 400 radiographs were studied, and they included 560 posts.

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All radiographs were scanned using a Canon Cano Scan D2400 U (Tokyo, Japan) and the images were evaluated on the computer monitor. Adobe Photoshop version 7.0 (Adobe System, San Jose, USA) was utilized to achieve the best magnification and contrast of the images. All measurements were performed utilizing CorelDRAW version 10 (Corel, Ottawa, Canada).

Inter-examiner agreement (first author versus second author) with regard to the classification of the radiographs was determined by assessment of 200 radiographs and computing Cohen’s Kappa for the tooth scores (Kappa = 0.960). On the basis of this score it was considered justified to use the scores of one author for assessing the rest of the radiographs.

The data were analyzed statistically using z-scores wherever applicable.

Results

A total of 400 periapical radiographs including 560 coronoradicular posts were assessed. Figure 1 gives an overview of the distribution of the posts according to tooth type. Maxillary teeth were found to be more frequently restored with posts (366 teeth; 65.36%) than mandibular teeth (194 teeth; 34.64%). Eighty-four (22.95%) of the posts in the maxillary teeth were in the anteriors, 162 (44.26%) were in premolars, and 120 (32.79%) were in molars. For

mandibular teeth, 18 (9.28%) of the posts were in the anteriors, 146 (75.26%) were in premolars, and 30 (15.46%) were in molars. The difference was statistically highly significant ($z = 10.28$, critical region $z = 1.96$).

Regarding the configuration of the posts used, the results indicated that 146 (26.07%) of the posts were parallel-sided and 414 (73.93%) were tapered (Fig. 2). The difference was statistically highly significant ($z = 11.23$).

The distribution of post length in proportion of crown length is presented in Fig. 3. The ratio of the mean post length to crown length was 0.8 with a range of 0.33 - 1.71. The lengths of 120 posts (21.43%) were less than half the length of the crowns, the lengths of 260 posts (46.43%) ranged between 0.51 – 1.0 of the crown length, and the lengths of 180 posts (32.14%) were greater than those of the crowns. The distribution of post length as a proportion of root length is presented in Fig. 4. The ratio of the mean post length to root length was 0.45 with a range of 0.22 – 0.67. Only 18 posts (3.21%) had a post-to-root length ratio of more than 0.65, whereas 222 posts (39.64%) had a post-to-root ratio ranging between 0.5 and 0.65. However, it was found that the post-to-root ratio was less than 0.5 in most cases (320 posts; 57.15%).

The mean length of the remaining gutta percha apical

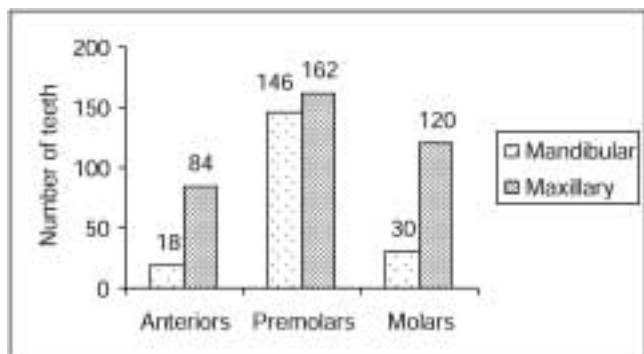


Fig. 1 Distribution of posts according to tooth type.

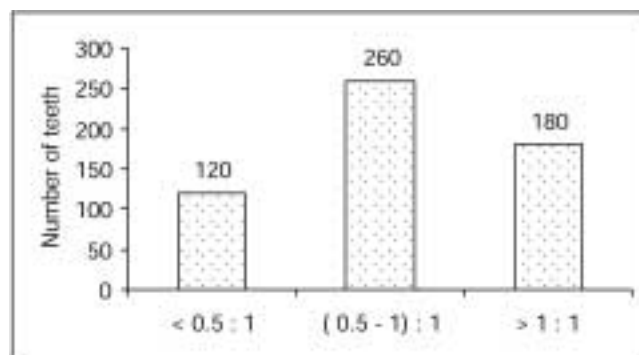


Fig. 3 Distribution of teeth according to the ratio of post length to crown length.

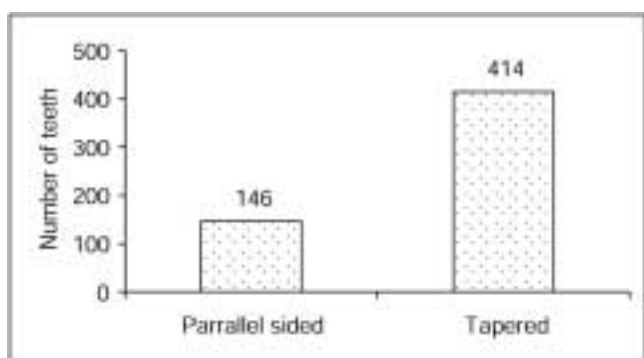


Fig. 2 Distribution of teeth according to post configuration.

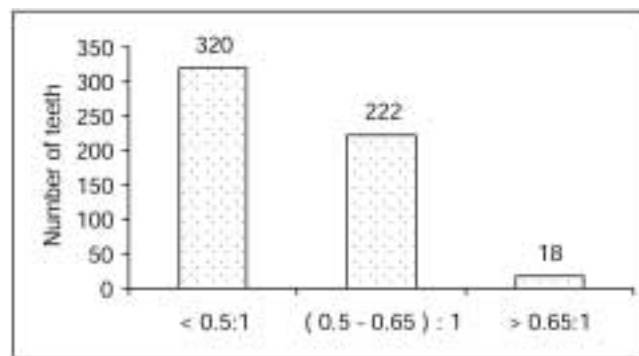


Fig. 4 Distribution of teeth according to the ratio of post length to root length.

to the end of the post was 6.22 mm with a range of 1.0 - 12.0 mm. The distribution of the teeth according to the length of the remaining gutta percha is shown in Fig. 5. The majority of the teeth (396; 70.71%) had more than 5 mm of remaining gutta percha apical to the post end, whereas 58 (10.36%) of the teeth had 4 - 5 mm of remaining gutta percha and 12 (2.14%) had 1 - 3 mm. However, 94 (16.79%) of the teeth showed no evidence of any gutta percha apical to the end of the post.

Furthermore, 140 (25%) of the 560 posts studied deviated from the line of the root canal.

The quality of endodontic filling with respect to the length of the root canal is shown in Fig. 6. There was no radiographic evidence of any root filling in 94 (16.79%) of the teeth. Of those with a filled root, only 190 (40.77%) showed an apical relationship of 0.0 - 2 mm short of the radiographic apex. In 160 (34.34%) of the filled roots, the fillings were through the apex. However, in 116 (24.89%) of the filled teeth, the root fillings were more than 2 mm from the radiographic apex.

The relationship between the quality of endodontic filling length and periapical status is shown in Fig. 7. Periapical radiolucency (PAR) was evident in 302 (53.93%) of the assessed teeth. The distribution of teeth associated

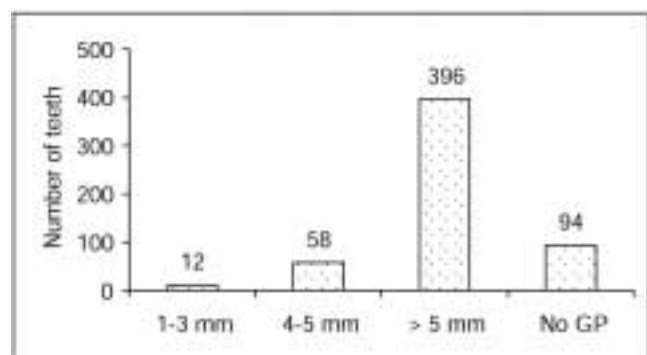


Fig. 5 Distribution of teeth according to the length of remaining gutta percha.

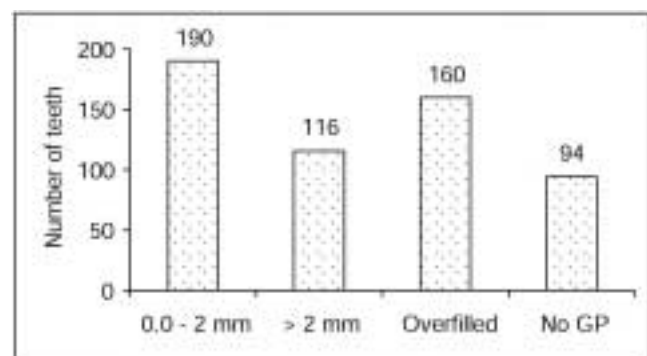


Fig. 6 The quality of endodontic fillings with respect to root canal length.

with apical radiolucencies in relation to the quality of root canal fillings was as follows: 16 (5.3%) in which the root canal fillings were 0.0 - 2 mm from the radiographic apex, 140 (46.36%) in which the root fillings were through the apex, 82 (27.15%) in which the root fillings were more than 2 mm from the apex and 64 (21.19%) in which there was no radiographic evidence of root canal filling. However, the remaining 258 teeth (46.07%) showed no evidence of periapical radiolucency. The distribution of healthy teeth in relation to the quality of root canal fillings was as follows: 174 (67.44%) in which the root canal fillings were 0.0 - 2 mm from the radiographic apex, 20 (7.75%) in which the root canal fillings were through the apex, 34 (13.18%) in which the root canal fillings were more than 2 mm from the radiographic apex, and 30 (11.63%) in which there was no radiographic evidence of any root canal filling.

Statistical comparison between the healthy teeth and those associated with periapical radiolucency found in each category of root canal filling quality is presented in Table 1.

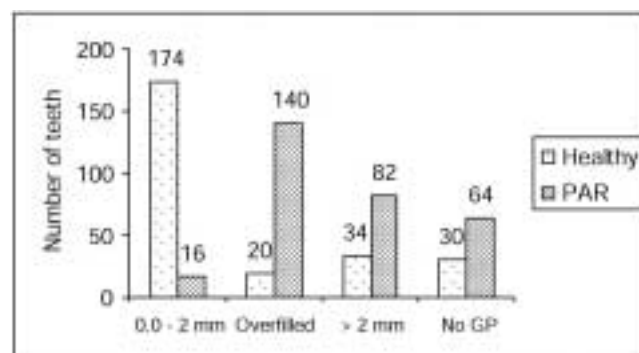


Fig. 7 The relationship between the quality of endodontic filling length and periapical status.

Table 1 Statistical comparison between teeth with periapical radiolucency (PAR) and healthy teeth associated with each quality of root canal filling (critical region $z = 1.96$)

Quality of root canal filling	Periapical status		z value
	Healthy	PAR	
Less than 2 mm	174	16	16.21
Overfilled	20	140	13.416
More than 2 mm	34	82	6.303
No gutta percha	30	64	4.959
Total	258	302	2.63

Discussion

The results of this study indicated that posts were more frequently used in maxillary than in mandibular teeth. This confirms the findings of Turner (10), who reported that almost all post-retained crowns (99%) were on maxillary teeth, and that maxillary central incisors (51%) predominated. This is presumably because maxillary teeth receive endodontic treatment more frequently (11). The present study revealed that maxillary premolars had the highest prevalence of post-retained restorations (28.93%), followed in order by mandibular premolars (26%), maxillary molars (21.42%), and maxillary anterior teeth (15%). This is in contrast to the findings of previous studies (9,10), which reported that the maxillary anterior teeth have the highest prevalence of post-retained crowns. However, Grieve and McAndrew (9) reported that the lowest prevalence of post-retained crowns was for mandibular anterior teeth (4.2%), which agrees with the present data (3.21%).

Although it is well established that tapered posts are the least retentive (12), the present study revealed that tapered posts were more widely used (73.93%) than parallel-sided posts (26.07%). This is in close agreement with the findings of previous studies (9,10). There is no general agreement in the literature regarding the length of the post, as evidenced by the diversity of formulas for length determination (13). Guidelines for post length include: equal to the length of the clinical crown (14), half the length of the root (15), midway between the apex and the alveolar crest (16), leaving 3 to 5 mm of root canal filling material (4), and two thirds of the root length (12). It is surprising that only about one third (32.14%) of the teeth examined in the present study had a post-to-crown length ratio of 1:1 and that 21.14% of the teeth had a post-to-crown length ratio of $< 0.5:1$. In addition, 57.14% of the teeth evaluated had a post-to-root length ratio of $< 0.5:1$ and 39.28% had a post length of one half to two thirds the length of the root. This confirms the findings of previous studies (17) revealing that almost one half of the cast posts were half the desired length or less. Furthermore, Grieve and McAndrew (9) stated that only 34% of the cases they investigated had a post-to-crown length ratio of 1:1.

The length of gutta percha that needs to be left apical to the end of the post to maintain the integrity of the apical seal has been extensively investigated. Recommendations have ranged from 3–5 mm (18), but 4–5 mm appears to be the most popular (4,14). In this context, the results of the present study (Fig. 4) revealed that 70.71% of the evaluated teeth have a residual gutta percha length equal to or more than 6mm, while only 6.74% of the teeth had a remaining gutta percha length of 4–5 mm. This is not

surprising because a substantial number of posts were shorter than the desired length. However, 16.79% of the examined teeth showed no radiographic evidence of gutta percha. This was not unexpected because tooth mummification, rather than proper root canal filling, is still common practice in Jordan. This is presumably due to two factors: first, economic considerations since tooth mummification costs less than root canal filling, and second, dentists practicing in Jordan are trained in various countries including Eastern Europe and the Middle East, where tooth mummification is still part of the curriculum in some dental schools. However, the proportion revealed in this study (16.79%) is higher than that reported by Grieve and McAndrew (9), who stated that there was no radiographic evidence of any root canal filling in 9.5% of the teeth they examined.

The number of posts that deviated from the line of the root canal was high (25%) and each of these represents a potential for lateral perforation. However, this is not surprising, since Grieve and McAndrew (9) reported that 20% of the posts in their study showed such deviation. This might be due to the use of inappropriate instrumentation for post space preparation, and therefore the use of instruments such as Gates Glidden burs, which remove gutta percha with little or no risk of lateral perforation, is strongly encouraged.

The quality of endodontic treatment found in the present study (Fig. 5) was disappointing since only one third (33.93%) of the evaluated teeth exhibited an ideal length of root canal filling (0.0–2 mm from the radiographic apex). However, this is in general agreement with previous studies in which 27% (9), 43.3% (11), 60.0% (19), 40.2% (20), and 54% (21) of teeth were found to have an adequate length of root canal filling.

There was no radiographic evidence of any root canal filling in 16.79% of the teeth we evaluated. Previous studies have reported a prevalence of pulpotomy in 9.5% (9), 7.1% (11) and 1.1% (21) of teeth. This wide disparity between the present findings and those of previous studies is not surprising, since tooth mummification rather than proper root canal filling is still common practice in Jordan, as mentioned earlier.

The percentage of endodontic fillings that were scored as short with respect to root canal filling length (> 2 mm from the radiographic apex) was 20.71%, which is less than figures of 57.8% (9), 47.1% (11), 39.6% (19) and 56.7% (21) reported in previous studies. In this context, it should not be forgotten that the length of the root canal filling has been measured in different ways, and few studies have used the same criteria. Some have scored endodontically treated teeth filled flush with the apex as adequate and some as

inadequate. The apical limit of root canal obturation has been the subject of debate amongst endodontists for decades (19). Several authors have suggested “periapical limits” of instrumentation and obturation, ranging from 0.5 to 2 mm from the radiographic apex (19). The location of the apical foramen has also been investigated and found to be 0.2 to 3.8 mm from the radiographic apex (22).

The prevalence of endodontically treated teeth with overextended root canal fillings was 28.57%, which is greater than figures of 10% (23), 5.4% (9), and 2.6% (11) reported in the literature. Periapical radiolucency was judged to be associated with the apices of 55.39% of the assessed teeth. This falls within the range of 16% (3), 29% (24), 29.3% (25), 47% (9), and 77% (26) reported in previous studies. This disparity among the results of the different studies is presumably due to the quality of the endodontic treatment in the populations studied.

The prevalence of root canal fillings that were 0.0–2 mm from the radiographic apex was 33.93%, which is lower than figures reported previously [40.7% (11), 51% (27), 60% (19)] and reflects the poor quality of endodontic treatment in the present population. However, the prevalence of root canal fillings judged to be short (> 2 mm from the radiographic apex) was 20.71%, which is lower than previously reported figures [39.58% (19), 47.1% (11), and 57.8% (9)], possibly due to the high prevalence of overfilled and mummified teeth in the present population.

The prevalence of overfilled teeth in the present study was higher (28.57%) than that reported in previous studies [2.6% (11), 5.4% (9), and 11% (27)], again indicating the generally poor quality of endodontic treatment performed in the studied population.

Among the assessed teeth, 53.93% showed radiographic evidence of periapical radiolucency. Various figures for the prevalence of periapical radiolucency associated with teeth restored using coronoradicular posts have been reported [22% (9), 16% (3), 29% (24), 70.7% (25), and 77% (26)]. The disparity among these figures seems to be due to the use of different criteria for assessment of periapical status. However, the highest prevalence of teeth with periapical radiolucency in the present investigation was for those with root canal fillings extruding through the apex (46.36% of all teeth with periapical radiolucency). In this respect, there is general agreement in the literature that overfilled root canals show a high prevalence of periapical radiolucency (11,19,23,26,27).

Conclusions

The findings of the present study indicate that, in this Jordanian population:

1) Posts are used more frequently in maxillary than in

mandibular teeth.

- 2) Tapered posts are more widely used than parallel-sided posts.
- 3) A substantial number of posts are shorter than the desired length.
- 4) Tooth mummification is still common practice in Jordan.
- 5) The quality of endodontic treatment is disappointing.
- 6) More than half of the assessed teeth were found to be associated with periapical radiolucency.

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