The effect of the gap between the post restoration and the remaining root canal filling on the periradicular status in a Turkish subpopulation

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Objective. The aim of this study was to evaluate whether the gap between the post restoration and the remaining root canal filling had an impact on the periapical health of endodontically treated teeth in a Turkish subpopulation.

Study design. Digital panoramic radiographs, evaluated for this cross-sectional study, were randomly selected from files of patients who attended to Yeditepe University, Faculty of Dentistry, between June 2007 and December 2008. The total number of teeth with endodontic posts and crowns was 407. Two observers assessed the radiographs and evaluated the quality of root canal filling and the gap between the root canal filling and the post restoration. Periapical status of the teeth was assessed by the Periapical Index (PAI) scores. Only the teeth with a minimum of 5 mm apical root canal filling that was classified as “good endodontic treatment” were included in the study. Teeth that had no root canal filling, poor endodontic treatment, or less than 5 mm remaining root canal filling beyond post restoration were not assessed. Chi-square test was used for statistical analysis and significance level was established at 5%.

Results. In cases with good endodontic treatment, there were 207 teeth that had no gap between the remaining root canal filling and the post restoration. In this group, 135 (65%) teeth had healthy periapex and 72 (35%) teeth showed signs of apical periodontitis. There were 81 teeth that had a gap between the remaining root canal filling and the post restoration. Of these teeth, 69 (85%) had periapical pathosis; however, only 12 (15%) teeth had healthy periapex.

Conclusion. Statistical analysis revealed that the success rate of good endodontic treatment was significantly affected by the gap between the post restoration and remaining root canal filling (P < .001). (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;110:131-135)

Apical leakage is one of the most important factors in the outcome of endodontic treatment and is positively correlated with the technical quality of root canal filling.1 However, recent epidemiologic studies that evaluated the success rates of root-filled teeth have stated that the leakage from the oral environment along the root canal filling to the periapical region was also an important contributing factor to the development of periapical pathosis.2 The significance of coronal restorations on periradicular health was also supported by ex vivo studies.3,4 A cornerstone study by Torabinejad et al.4 stated that without coronal restorations, bacterial products were found at the apex after only 3 weeks. Contradictory results have been reported about the impact of coronal restoration on the success rate of endodontic treatment.5 Some studies have concluded that the technical quality of coronal restoration was more important than the quality of root canal filling.6 On the other hand, others stated that coronal leakage may not be such a great clinical importance on periradicular health.7,8 In addition, it has also been indicated that a well-performed root canal treatment and a well-sealed coronal restoration were both important factors for success.7 In these studies, the parameters of the coronal restorations were varied. Some of them evaluated both intracoronal and crown restorations, but the criteria in some studies were restricted.1,5,7 For instance, post restorations have not been taken into consideration while evaluating the outcome of endodontically treated teeth.5

Root-filled teeth are often restored by a post and core because the loss of structural integrity as a result of removal of extensive caries and existing restorations during endodontic cavity preparation results in the lack of sufficient hard tissue support for a permanent coronal restoration.8-12
Conflicting results have been reported in investigations concerning the prevalence of apical periodontitis in teeth with post restorations. Eckerbom et al., concluded that the endodontically treated teeth with posts often had more apical periodontitis than other teeth. Tronstad et al. reported that posts increased the success rate of root-filled teeth and Hommez et al. indicated that posts had no influence on periapical health. It is obvious that the sealing ability of the remaining root canal filling, the weakening of the root unnecessarily, and the time of post space preparation are important factors in the outcome of teeth restored with posts. For years, it has been accepted that the remaining root canal filling of 5 mm maintained a seal similar to that of intact root canal filling. Moreover, DeCleen stated that 3 mm of remaining gutta-percha was the absolute minimum. Nevertheless, it has been concluded recently that even 7 mm of apical filling had an inferior seal compared with that of an intact root canal filling. Recently, it has also been stated that it was better to prepare a post space immediately after preparation, because the sealer is still within working time and there is chance to recondense the remaining root canal filling. There is no doubt that the post space preparation should not disrupt the integrity of remaining root canal filling. It was stated that a combination of removing gutta-percha by heat pluggers followed by the post drill was the safest method even for inexperienced operators.

For post restoration, additional preparation is required; this weakens the tooth and can cause vertical root fractures. In addition to the effects of post space preparation, the design, length, and diameter of posts are also decisive factors in the success of teeth restored with posts. However, only a few studies have evaluated the success rate of endodontically treated teeth according to the gap between the post and root canal filling, but, unfortunately, it is not surprising to detect an empty space between the coronal end of the remaining root canal filling and the post restoration. Therefore, the aim of this study was to evaluate the apical status of endodontically treated teeth considering the gap between the post and the root canal filling in a Turkish subpopulation. The null hypothesis tested was that the gap between the post and the root canal filling would have an adverse effect on the periapical health.

METHODS

Digital panoramic radiographs, evaluated for this cross-sectional study, were randomly selected from files of patients who attended to Yeditepe University, Faculty of Dentistry, between June 2007 and December 2008. The main criteria for inclusion in the study were that the patients should be attending for the first time. Only endodontically treated teeth with post and crown restorations were included in the study. The type of post or crown was not evaluated. Panoramic radiographs with poor image quality, particularly in the upper and lower anterior region were excluded from the study. All radiographs were taken and processed in Yeditepe University, Faculty of Dentistry, Department of Oral Diagnosis. Trophy Orthoslice 1000 C (Trophy Orthoslice 1000 C, Trophy Spa, Lissome, Italy) panoramic roentgen unit was used to take radiographs. Of the evaluated 1633 panoramic radiographs, a total of 407 teeth with posts and crowns from 265 patients matched the inclusion criteria. Of these 265 patients, 93 were males and 172 were females. Patients were between 24 and 88 years old with a mean age of 53.57.

All radiographs were evaluated independently by an endodontist and a prosthodontist who both had more than 10 years of clinical experience. Examiners were calibrated before the radiographic evaluation step. As a part of the calibration phase, study methodology was explained to the examiners. To minimize discrepant results, examiners also familiarized themselves with the scores they should attribute to the radiographic images and the established evaluation method for the study. Fifty teeth were assessed to calibrate the 2 examiners, and interexaminer agreement was detected by Cohen’s kappa (kappa = 0.91). To provide optimal image quality and radiographic contrast, the surrounding light was controlled by darkening the room. When disagreement occurred between 2 examiners, a third observer, an endodontist with 15 years of clinical experience, was asked to make a decision. The quality of root canal fillings was evaluated according to the criteria determined by Tronstad et al. Parameters were as follows:

1. Good endodontic treatment: All canals obturated without voids. Root canal filling between 2 mm short or maximum 1 mm beyond radiographic apex.
2. Poor endodontic treatment: Root canal filling ending more than 2 mm short of the radiographic apex or grossly overfilled. Root canal filling with inadequate density, voids, unfilled canals, or poor condensation.

The empty space between the post restoration and the remaining root canal filling was scored as follows:

1. Gap: There is a gap between remaining the root canal filling and post.
2. No gap: There is not a gap between remaining the root canal filling and post.

Apical status was assessed by the Periapical Index (PAI) proposed by Ørstavik et al., who scored the apical area of the teeth as follows:
1. Normal periapical structures
2. Small changes in bone structure
3. Changes in the bone structure with little mineral loss
4. Periodontitis with well-defined radiolucent area
5. Severe periodontitis with exacerbating features

PAI 1, which is normal width of permanent ligament space and normal appearance of surrounding bone, was defined as healthy periapex. All other PAI scores were evaluated as apical periodontitis.

As the aim of this study was to evaluate the effect of the gap between the remaining root canal filling and the post restoration, only the teeth with a minimum of 5 mm of apical root canal filling that was classified as “good endodontic treatment” were included in the study. Teeth that had no root canal filling or poor endodontic treatment or less than 5 mm remaining root canal filling beyond post restoration were not assessed.

SPSS software was used for statistical analysis (SPSS Inc., Chicago, IL). Differences between the groups were examined using the chi-square test. Significance level was established at 5%.

RESULTS

Out of 407 endodontically treated teeth with post restorations, 119 (29.23%) had poor and 288 (70.76%) had good endodontic treatment. Table I gives an overview of the relationship between the presence of the gap and periapical status in teeth with good endodontic treatment.

In cases with good endodontic treatment, there were 207 teeth that had no gap between the remaining root canal filling and the post restoration. In this group, 135 (65%) teeth had healthy periapex; 72 (35%) teeth showed signs of apical periodontitis. A total of 81 teeth had a gap between the remaining root canal filling and the post restoration. Of these teeth, 69 (85%) had periapical pathosis; however, only 12 (15%) teeth had healthy periapex. Statistical analyses revealed that the success rate of good endodontic treatment was significantly affected by the gap between the post restoration and remaining root canal filling ($P < .001$).

Table I. Statistical analysis of periapical status of the teeth with good endodontic treatment according to gap occurrence ($P < .001$)

<table>
<thead>
<tr>
<th></th>
<th>With gap</th>
<th>%</th>
<th>Without gap</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apical periodontitis</td>
<td>69</td>
<td>85</td>
<td>72</td>
<td>35</td>
<td>141.85</td>
</tr>
<tr>
<td>Healthy periapex</td>
<td>12</td>
<td>15</td>
<td>135</td>
<td>65</td>
<td>147.15</td>
</tr>
<tr>
<td>Total</td>
<td>81</td>
<td></td>
<td>207</td>
<td></td>
<td>288</td>
</tr>
</tbody>
</table>

$P < .001$

DISCUSSION

This is a cross-sectional study based on the evaluation of radiographs. A disadvantage of a cross-sectional study is the impossibility of determining whether a periapical pathosis is healing or not, because a radiograph provides only static description of the dynamic inflammatory process. Another disadvantage of cross-sectional research is the lack of information about the time passed between treatment and observation.

Initial diagnosis of the pathosis, size of the lesion, quality of root canal shaping, disinfection, and obturation are also unknown prognostic factors. It is different from controlled clinical studies started by Strindberg, who evaluated the effects of factors such as preoperative pulp status, periapical health, or apical resorption on the outcome of root canal treatment.

Nevertheless, the reliability of a cross-sectional study was proved by Petersson et al., who concluded that the number of healed periapical lesions was equal to the number of developing lesions after a 10-year period. Obtaining a large sample size and randomized selection of the cases are the important advantages of a cross-sectional study.

As in several recent epidemiologic studies, this study was also based on the evaluation of panoramic radiographs. There have been some doubts about the sensitivity of panoramic radiographs in terms of the detection of periapical lesions. However, Muhammed et al. showed no significant difference between panoramic and periapical radiographs in the detection of periapical pathosis. They also indicated that a survey must include periapical, panoramic, and bite-wing radiographs for an ideal radiographic evaluation. This finding was also supported by Ahlqvist et al. who found that panoramic radiographs, when used for diagnosing osteolytic lesions, had a sensitivity of 76% to 96%. In addition, the relatively low patient dose compared with full-mouth periapical radiographs is another advantage of panoramic radiographs. Langlais and Langland stated that when panoramic radiographs were used, there was a 10-fold reduction in radiation to the patient compared with full mouth survey. On the contrary, periapical pathosis cannot always be detected with the
aid of radiographic evaluation. It was stated that periapical lesions were underestimated if they were limited to cancellous bone. It is also impossible to detect the microbiologic status of the root canal system by radiographic evaluation.

In this study, PAI scores were used to evaluate the status of periapical pathosis. Although panoramic radiographs are accepted to be sensitive in the detection of periapical pathosis, images that had some distortions particularly in the anterior region were excluded from the study. In addition, only the teeth that had been scored as PAI 1 were considered healthy to prevent misinterpretation. An advantage of the PAI scoring system is to compare the results with other studies that used the same evaluation.

Endodontically treated teeth commonly received post-retained restorations. Recently, more studies have been focused on the coronal leakage of post restorations. Research showed that not only the length of the remaining root canal filling, but also the adhesion between the post and the root canal dentin played a key role in coronal microleakage. It has also been pointed out that the seal of both post and cores had to be improved for the prevention of recontamination. In 1995, Fogel showed that none of the stainless steel periapical lesions were underestimated if they were creased the adhesion of post restorations. Reid et al. used the same evaluation. Reid et al. 36 concluded that the nonmetallic posts showed a statistically significant decrease in microleakage compared with metallic posts. Poor cementation of temporary crowns or temporary posts is also an important factor in coronal leakage in endodontically treated teeth. Demarchi et al. concluded that permanently cemented prefabricated posts showed the best seal compared with temporary posts. It was also stated that post space was seldom irrigated between appointments for the elimination of invading microorganisms.

It has been claimed that the gap between the post and the remaining root canal filling is another decisive factor in the inclusion of microorganisms after post restorations. Nevertheless, there are only a few studies about the effect of this gap in the success of endodontically treated teeth. It is obvious that root canals should be hermetically obturated for the long-term outcome. The gap between the post and the root canal filling does not match this criteria and it is common to detect this gap when radiographs are evaluated. Grieve and McAndrew examined 327 post-retained crowns and found that most posts fitted well laterally, whereas 43% did not extend longitudinally as far as the end of the prepared post space. This study was also supported by Moshonov et al., who presented the impact of the gap between the post and remaining root canal filling. Their results showed that the clinical outcome was significantly unfavorable when the gap was larger than 2 mm. In this study, it was also detected that the gap between the post restoration and the remaining root canal filling could be a contributing factor in the prognosis of endodontically treated teeth. It has been accepted that, in cleaned and shaped root canal space, microorganisms have been eliminated or seriously disrupted. To preserve this condition, the root canal should be obturated hermetically. One of the primary functions of a root canal filling is entombing the bacteria in the dentinal tubules to deny their nutrition and space to multiply. However, the space occurring after a post restoration can be a good shelter for the microorganisms that negatively affect the outcome of endodontic treatment. In teeth with cast post restorations, the probable explanations of this gap may be inaccurate impression of the post space or thermal contraction of metal alloys during casting procedures. On the other hand, in teeth restored with prefabricated posts, the main reason for this gap may be the inability of determining the accurate post that corresponds with the drill that is used for post space preparation. Therefore, radiographic confirmation of the post adaptation should be performed before cementation of all kinds of posts.

REFERENCES


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