

The Effect of the Distance Between Post and Residual Gutta-Percha on the Clinical Outcome of Endodontic Treatment

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Abstract

To determine whether the distance between the post and the residual gutta-percha influences the clinical outcome of endodontic treatment, 94 endodontically treated teeth following post and core restoration were evaluated radiographically. The teeth were divided into three groups: (I) no gap between the gutta-percha and the post; (II) a gap of >0 to 2 mm; (III) a gap of >2 mm. Treatment outcome was evaluated in follow-up radiographs, taken 1 yr after treatment and up to 5 yr posttreatment. In group I, 83.3% of the teeth were evaluated normal, 53.6% of group II, and only 29.4% of group III. A gap between the gutta-percha and the post was related to an increased rate of emerged disease in endodontically treated teeth restored with a post and core.

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The success rate of endodontic treatment, 53 to 96%, has been extensively reviewed in the literature (1, 2). It is dependent upon many factors, among which are tooth type, preoperative apical status, the various techniques, and materials used for preparation and obturation, operator skills and the quality of the coronal seal (1–3).

Endodontically treated teeth are often restored by a post and core. The main purpose of the post is to retain the permanent restoration and disperse the forces along the root (4). Nevertheless, the seal provided by a full-length root canal filling may be compromised by the post space preparation. Coronal microleakage into the root canal by bacteria and their endotoxins can then occur, leading to failure of root-canal therapy (5). The need for an immediate and proper coronal restoration after root canal treatment is, therefore, of paramount importance (5, 6).

Microleakage may be influenced by the quality of the root-canal filling (7), the method used (8, 9), and the timing of post space preparation (10, 11), and cementation (12, 13). Many investigators compared the sealing ability of the intact root-canal filling with that of the residual root-canal filling after post preparation (5, 6, 11, 14, 15). Kvist found that after preparation of the post space, roots with residual apical gutta-percha of <3 mm are associated with a higher incidence of periapical radiolucency, compared with roots with longer residual root canal fillings (16). DeCleen maintained that 3 mm of remaining gutta-percha is the absolute minimum, but preferably 6 mm should be left in the root canal (15).

It is not uncommon to find a gap between the apical end of the post and the most coronal portion of the gutta-percha remaining in the root canal after preparation for the post space. However, to the best of our knowledge, this issue has not been investigated to date.

The purpose of our study was to determine whether the distance between the post and the residual gutta-percha is related to the clinical outcome of the endodontic treatment.

Materials and Methods

The present study entailed radiographic evaluation of endodontically treated teeth after post and core restoration at the undergraduate clinic of the Hebrew University-Hadassah School of Dental Medicine. Both treatments were carried out by the same student operator.

A total of 700 files of patients who underwent endodontic treatment and whose teeth were restored with a post and core were randomly retrieved from the Hadassah School of Dental Medicine Archives. Only files containing two full-mouth radiographs taken immediately after treatment and at least 1 yr after treatment were selected.

A total of 94 files corresponding to the following criteria were selected:

1. Periapical tissue of normal appearance before treatment.
2. Irreversible pulpitis before root canal treatment.
3. Pulp exposure during caries removal.
4. Elective root canal treatment before prosthetic treatment.

All teeth were isolated with rubber dam, cleaned, shaped, and obturated within 1 mm from the radiographic apex using the lateral condensation technique, and gutta-percha and AH-26 as sealer.

TABLE 1. The effect of the distance between post and residual gutta-percha on the clinical outcome.

| | 0 mm (N = 26) | >0–2 mm (N = 41) | >2 mm (N = 17) | P |
|---------|------------------|---------------------|-------------------|---|
| Disease | 6 (16.7%) | 19 (46.4%) | 12 (70.6%) | * |
| Normal | 20 (83.3%) | 22 (53.6%) | 5 (29.4%) | * |

* Chi-square, $p < 0.005$.

Cases in which there were additional factors that could influence the outcome of the root-canal treatment, such as a residual root-canal filling of <3 mm., broken instruments in the root canal, over or underextension of the root-canal filling or root fracture, were excluded.

The selected cases were divided into three groups, according to the radiographs taken immediately after post placement:

- Group I: no gap between the gutta-percha and the post.
- Group II: a gap of >0 to 2 mm between the gutta-percha and the post.
- Group III: a gap of >2 mm between the gutta-percha and the post.

The exact dates of root canal treatment, post restoration and follow-up were recorded.

Follow-up radiographs, made at least 1 yr after treatment and up to 5 yr post treatment, with the coronal part of all radiographs covered with a cardboard to prevent bias, were evaluated according to the following criteria:

Normal: no radiolucency in the periapical area and intact periodontal ligament (PDL).

Disease: periapical radiolucency or widening of the PDL space. Clinical outcome relates only to the root in which post were placed. The age and gender of the patient and tooth type were also recorded. χ^2 was used to analyze the data. Significance was set at $p < 0.05$.

Results

The 94 cases evaluated comprised 26 males and 68 females aged 23 to 88 yr. The treated teeth included 26 lower molars, 17 upper molars, 20 upper premolars, 20 lower premolars, and 11 anteriors: canines and incisors.

In 58 (61.7%) of the treated teeth, there was a gap between the gutta-percha and the post. Of all the cases, even those without a gap between the post and the gutta-percha, 37 (61%) were evaluated diseased.

As can be seen in Table 1, there was a higher disease rate in the >0 to 2 mm group, reaching 70.6% (12 roots) in the >2 mm group. These findings are statistically significant ($p < 0.05$). When the teeth were divided according to arch, maxillary, or mandibular, there was no statistical difference between the pattern of the clinical outcome (Table 2). The larger the gap is, the higher the disease rate. The same held true for incisors and bicuspid, as compared with molars: the larger the distance between the post and the gutta-percha, the more unfavorable the outcome. However, there was no difference in clinical outcome between incisors and bicuspid in which the gap between the post and the gutta-percha was >0 to 2 mm or ≥ 2 mm.

The influence of time of post preparation and cementation after completion of root canal treatment on the clinical outcome is shown in Table 2. The clinical outcome was similarly related to the distance between post and gutta-percha regardless whether post preparation and cementation were performed ≤ 1 yr or >1 yr after root canal treatment: the greater the gap the higher the disease rate ($p < 0.05$).

In group I, favorable outcome, as expressed by a normal PDL, was higher when 1 yr had passed between termination of root canal treatment and post preparation and cementation. In the other groups, the difference between the clinical outcome following early and delayed post restoration was not statistically significant.

Discussion

In this study, only cases in which the periapical tissue appeared normal before treatment were chosen (17–20). The Toronto study found that the risk for teeth not to heal was almost four times higher when radiolucency was present before treatment than in its absence (2).

A gap was present between the gutta-percha and the prepared post space in 61.7% of the teeth, reflecting the high incidence of this phenomenon, as previously reported by Grieve and McAndrew (21), who found gaps in 57% of the cases examined. The results indicate that when the gap is wider than 2 mm, the clinical outcome is significantly unfavorable. These findings may be explained by microleakage of saliva, dye, and anaerobic bacteria after post space preparation (7, 14, 22).

It was found that the outcome was compromised even in cases in which the gap was >0 to 2 mm. The favorable outcome in our patients was lower than that reported in the literature (2, 3): 61% of the cases showed an unfavorable outcome. This may be related to the fact that the treatments were carried out by undergraduate students. Less favorable outcome rates (48–70%) have been reported among students, who tend to make more procedural errors than experienced operators (23). Although in a recent study a favorable clinical outcome was registered in 91.05% of the cases treated by dental students (24) This study did not consider the status of the pulp and periradicular tissues at the time of treatment or the apical extent of the obturation material, and teeth were rated as a whole, rather than on individual roots, moreover did they relate to the type of coronal seal.

Friedman mentions the inconsistent definitions of treatment outcome, i.e. uncertain, questionable, or doubtful, accounting for different interpretations of success and failure in the endodontic literature (23). In the present study there was a 1 yr follow-up, although the estimated period of time required for evaluation of the success rate varies among researchers. In some studies, a 1 yr follow-up was recommended (2, 17, 19, 25), a 2-yr observation period was suggested by Bystrom et al. (26), whereas 3 to 4 yr may be required to record stable treatment outcome. Indeed, as Kvist and Reit stated: "From a scientific point of view, the length of the follow-up period is very important and may strongly influence the conclusions made" (27).

It may be assumed therefore, that a longer period of observation may result in different clinical outcomes. Moreover, Halse et al. raise the question of correct diagnosis of periapical lesions (28). Accordingly, borderline cases may have some weight on the final assessment.

When the teeth were divided into different groups according to type, the same pattern of disease was observed: a larger gap was associated with greater unfavorable outcome. In the molar group, a gap of >2 mm between the post and the gutta-percha resulted in an unfavorable clinical outcome in all the teeth examined. These results are compatible with the findings of some studies, in which anterior tooth treatment are associated with a more favorable outcome than that of posterior teeth (2, 23, 29), although not with those of others (25, 30). Despite the fact that they dealt with different factors related to the clinical outcome of treatment, it is likely that the anatomy of a multirrooted tooth presents a greater challenge for the operator, especially for an undergraduate student.

The position of the tooth in the arch had no significant influence as previously reported in studies regarding other aspects of the clinical outcome of endodontic treatment (29, 31).

According to the results, the time that elapsed between completion of root canal treatment and post preparation and cementation was associated with treatment outcome. Yet, in our 0 mm group, delayed post preparation and cementation, of more than 1 yr after root canal treatment, unexpectedly showed a more favorable outcome. Karapouou found a significant difference in the delayed preparation group only when zinc oxide-eugenol was used as sealer, when greater leakage was observed than in teeth sealed with AH-26 or immediately prepared for a post (7). In contrast, according to

TABLE 2. The influence of tooth position in the arch (maxillary or mandibular), tooth type and timing of post preparation and cementation on the clinical outcome.

| | No. of teeth | Periapical status | 0 mm | >0–2 mm | 2 = mm | Significance |
|---------------------------------------|--------------|-------------------|-------------|------------|-----------|--------------|
| Jaw | | | | | | |
| Maxilla | 12 | Disease | 3 (18.8%) | 4 (30.8%) | 5 (62.5%) | S |
| | 25 | Normal | 13 (81.2%) | 9 (69.2%) | 3 (37.5%) | |
| Mandible | 17 | Disease | 1 (6.25%) | 11 (47.8%) | 5 (71.4%) | NS |
| | 29 | Normal | 15 (93.75%) | 12 (52.2%) | 2 (28.6%) | |
| Tooth Type | | | | | | |
| Incisor/Bicuspid | 13 | Disease | 5 (71.4%) | 9 (45%) | 10 (50%) | S |
| | 36 | Normal | 2 (28.6%) | 11 (55%) | 10 (50%) | |
| Molar | 19 | Disease | 2 (12.5%) | 10 (45%) | 7 (100%) | NS |
| | 26 | Normal | 14 (87.5%) | 12 (55%) | 0 (0%) | |
| Post preparation & cementation timing | | | | | | |
| < 1 year after treatment | 29 | Disease | 6 (25%) | 14 (45.2%) | 9 (75%) | S |
| | 38 | Normal | 18 (75%) | 17 (54.8%) | 3 (25%) | |
| > 1 year after treatment | 7 | Disease | 0 (0%) | 4 (44.5%) | 3 (75%) | NS |
| | 18 | Normal | 12 (100%) | 5 (55.5%) | 1 (25%) | |

Chi square, $p < 0.05$; S = significant; NS = not significant.

other studies, post preparation should be carried out within three months of endodontic treatment to avoid coronal microleakage (6, 32). It bears mention that all these were *in vitro* studies, whereas ours was an *in vivo* study. However, we differentiated between posts prepared and cemented within 1 yr of completion of endodontic treatment and those made after more than 1 yr. The literature, however, only distinguishes between immediate and delayed post preparation and cementation. Therefore, a comparison is not possible.

Also, the length of the residual root canal filling as a variable was not taken into consideration. However, although teeth with <3-mm residual filling were not included, in most teeth the residual filling was at least 5 mm. A distinction between prefabricated posts and custom posts or between different cements was not made. These variables may also have some bearing on the results (12).

CONCLUSIONS

Posts placed following root-canal treatment should be in contact with the residual gutta-percha. Further research is indicated to determine the effect of post placement timing on the clinical outcome of endodontically treated teeth.

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