Orthodontic Root Resorption of Endodontically Treated Teeth

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Abstract

The purpose of this study was to evaluate, radiographically, whether there is similarity in the apical root resorption found in endodontically treated teeth and untreated teeth when they are submitted to orthodontic treatment. From 2,500 treatment records examined, 16 patients were selected who had a maxillary central incisor treated endodontically before initiation of the orthodontic movement, and a vital homologous tooth (for control). Measurements were made by comparing the periapical radiographs taken before and after the orthodontic treatment. There was no statistically significant difference ($p > 0.05$) in apical root resorption found in the endodontically treated teeth compared to the group of vital teeth. *(J Endod 2007;33:119–122)*

Key Words

Apical resorption, endodontics, orthodontic treatment, root resorption

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Apical root resorption, normally characterized by apical rounding, is a common event in orthodontic treatment (1–8). A wide array of variables have been suggested as predisposing factors to this resorption, including individual susceptibility, genetic influence, endocrine disturbances, anatomical factors, and the mechanics applied (1, 9, 10). Consolaro (11) emphasized the importance of local factors such as the morphology of the root and the alveolar osseous crest, and mentioned the lack of any correlation with endocrine disturbances and individual susceptibility because of genetic factors. The use of strong forces and prolonged treatment is directly related to an increase in root resorption associated with orthodontics (1, 9, 10, 12), and these risks are well understood by orthodontists. Some studies suggest that drugs such as anti-inflammatories (13) and bisphosphonates (11) could prevent, at some level, root resorption intensity. However, they also cause slower movement rates (11, 13).

Although endodontically treated teeth respond similarly to vital teeth to the application of force during orthodontic therapy, the common sense of many professionals is that treated teeth are more susceptible to apical root resorption (11, 14). This may perhaps be because of the scarcity of literature on the subject. Wickwire et al. (15) reported that devital teeth were subject to a greater degree of resorption than vital teeth undergoing orthodontic movement. Spurrier et al. (14) found the same, but noted that the mean difference was virtually undetectable at a clinical level; because of this, a major finding of their study was the absence of differences between vital and endodontically treated incisors. This point of view was confirmed by Huettner and Young (16), Mattison et al. (17), and Mah et al. (18) who showed that there was no significant difference between external root resorption in vital and devital teeth during orthodontic therapy. Contrariwise, Bender et al. (19) observed more root resorption in vital cases than in endodontically treated teeth after orthodontic treatment.

In relation to orthodontic and endodontic matches, De Souza et al. (20) recently showed that orthodontic movement delays but does not affect healing of the apex process.

Thus, the purpose of this study was to evaluate, radiographically, whether there is a significant difference in apical root resorption in vital and endodontically treated teeth that were submitted to orthodontic treatment.

Materials and Methods

Sixteen patients were selected who had a vital maxillary central incisor (control) and an endodontically treated homolog, in which the periodontal ligament of the apical region was still intact. This selection involved review of 2,500 orthodontic records from two private orthodontic clinics. All the patients selected had undergone orthodontic movement with the use of brackets for a minimum period of 20 months, and the treated incisor had had endodontic intervention at least 1 year before beginning the orthodontic treatment.

Pre- and posttreatment periapical radiographs taken with the use of a positioner, and obtained from the initial and final files of the orthodontic treatments, were measured. All images were digitalized by the same scanner (HP Photo Smart) and then processed by the program CorelDRAW 11 (Corel, Ottawa, Ontario, Canada) where the images were enlarged 350% for better visualization.

All the teeth were measured along their greatest length, from the incisal edge to the apex of the root, to compare the same tooth before and after orthodontic movement,

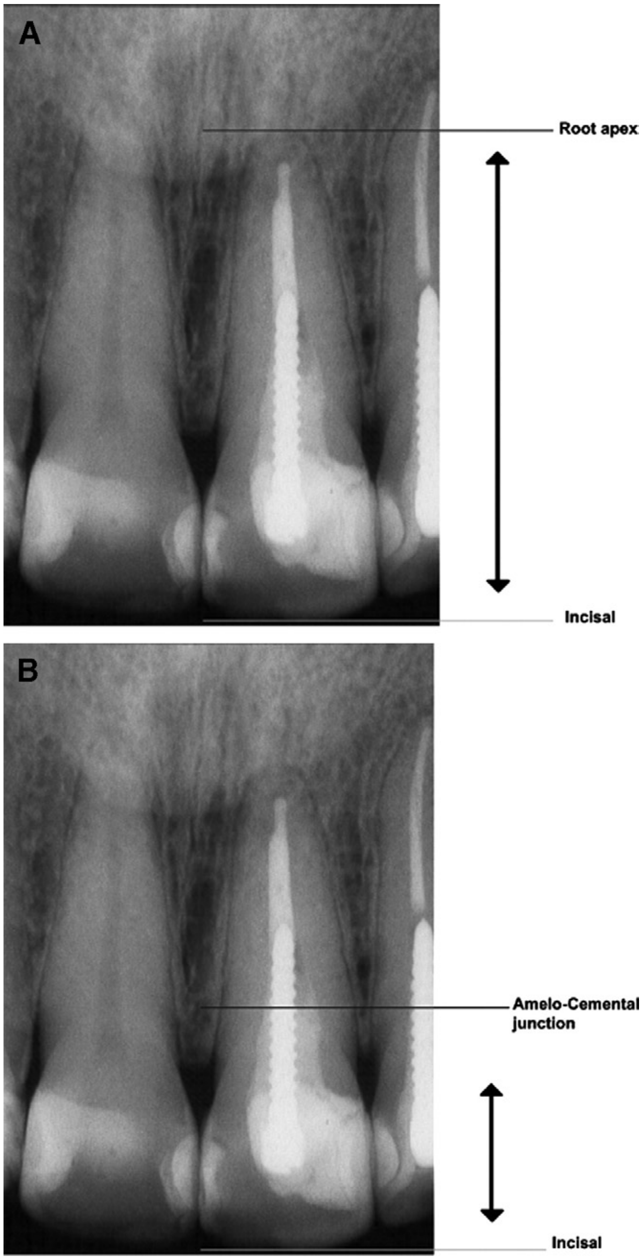

Figure 1. Radiographs illustrating the tooth measurements used. (*A*) Incisor-apical distance used to calculate root resorption. (*B*) Incisor to enamel-cementum junction distance used to calculate the factor of radiographic shortening or lengthening.

evaluating the possible apical root resorption occurring after the orthodontic movement (Fig. 1*A*).

To obtain standardized images, considering the possibility of distortions of the pre- and posttreatment radiograph, the greatest distance from the incisal edge to the amelocemental junction was also measured on all the radiographs (Fig. 1*B*); the differences were calculated as a factor of shortening or lengthening used in the measurement of the incisoapical length of the teeth, as recommended by Spurrier et al. (14) (Fig. 2). Therefore, patients who had crowns that changed in size because of restorative procedures were excluded from the study.

All the measurements were repeated four times at 1-week intervals, and the arithmetic mean was calculated to determine the values to be used in the statistical calculations. For determination of statistical

$$\frac{\text{initial total length}}{\text{X (expected total length)}} = \frac{\text{initial crown length}}{\text{final crown length}}$$

$$\text{X} - \text{final total length} = \text{Apical root resorption}$$

Figure 2. Equation used to correct radiographic distortions, according to Spurrier et al. (14).

significance, Student's *t* test for paired values was used, at the 5% probability level.

Results

Table 1 shows the results for the degree of apical root resorption found, expressed in millimeters, after measuring the radiographs of all the individuals analyzed in this study. Eight patients (50%) showed a greater apical root resorption in the endodontically treated tooth compared to its vital homolog, whereas the remaining eight showed more resorption in the vital tooth.

The values of means, standard deviations, standard errors, and p (from Student's *t* test) are given in Table 2. Comparing the pretreatment radiographs (T_1) with the posttreatment radiographs (T_2), statistically significant apical root resorption was observed in both groups. There was no statistically significant difference ($p > 0.05$) between apical root resorption in untreated teeth and endodontically treated teeth, although the vital teeth showed, on average, a slightly greater degree of mean apical root resorption (0.22 mm).

Discussion

Root resorption as a result of orthodontic movement has been the subject of many studies (1–19) that mention the etiological factors of dental and bone anatomy, the amount of force applied and type of movement, among others. Of the 32 teeth submitted to orthodontic treatment analyzed in this study, only two did not show apical root resorption (vital tooth of patient #7 and endodontically treated tooth of patient #10, Table 1).

The results showed that there was no significant difference in apical root resorption, observed radiographically, in endodontically treated and untreated teeth subjected to orthodontic movement (Table 2). However, the apical root resorption found in the group of vital teeth was highly significant ($p = 0.0004$), compared with the group of endodontically treated teeth ($p = 0.007$) (Table 2). Brezniak and Wasserstein (9) noted that in some cases of endodontically treated teeth, the

TABLE 1. Apical root resorption (mm)

Patient	Endodontically Treated	Vital (Control)
1	0.45*	0.34
2	0.64	0.63
3	3.07	2.86
4	0.31	0.8
5	0.21	0.11
6	4.42	1.65
7	0.69	0
8	0.92	1.26
9	0.16	3.5
10	0	0.4
11	0.35	0.2
12	0.52	0.3
13	0.79	1.6
14	0.2	0.3
15	0.2	1.4
16	0.2	1.2

*Arithmetic mean of measurements, repeated four times at 1-week intervals.

TABLE 2. Comparisons between the measurements (mm) of the radiographs of the vital and endodontically treated teeth (n = 16)

	Mean	SD*	Standard Error	p-value	Significance $p \leq 0.05$
Endo T_1T_2-Vital T_1T_2†	−0.22	1.1	0.39	0.29	NS
Vital T_1 to T_2	1.04	1	0.25	0.0004	S
Endo T_1 to T_2	0.82	1.19	0.29	0.007	S

*SD = standard deviation.

†T_1 = before treatment; T_2 = after treatment.

degree of resorption was less, as if they were protected, possibly by a greater mineral density and a greater degree of hardness. Weiss (21), cited by Mattison (17), in his master's thesis, concluded that the lack of vital pulp in an endodontically treated tooth does not predispose it to root resorption, even when it is submitted to orthodontic forces.

Huettner and Young (16) reported results similar to those of the present study, observing that there were no differences between the macro- and microscopic aspects of the vital and endodontically treated teeth of rhesus monkeys. These authors noted that the orthodontic forces were carefully regulated, the canals were cleaned and endodontically treated, and the periodontal membrane was kept intact. In the present study, the variable of force was not precisely controlled, but it is reasonable to accept that adjacent homologous teeth underwent similar forces. The orthodontic technique used was the straight wire system, so the continuous arch delivers action and reaction between adjacent brackets.

Mattison et al. (17), in a histological study of endodontically treated and untreated teeth of six adult cats that were submitted to induction of orthodontic forces, found no significant difference in root resorption between the groups, and concluded that the forces of orthodontic movement were the factor responsible for the resorption, and not whether the teeth were vital. Mah et al. (18) reported that, microscopically, the endodontically treated teeth of ferrets showed greater loss of cement compared with vital teeth, although radiographically no statistically significant difference was observed between the root length of the two groups.

On the other hand, Steadman (22) observed, in histological sections of devital teeth resorption areas, a similarity to that found in foreign-body type reactions, suggesting that endodontically treated teeth act as a foreign body causing chronic irritation, and in this way would be more susceptible to root resorption. This reaction is not usually observed in correctly filled teeth, but can happen in cases of overfilled teeth or where the limit of filling was at the apical foramen (11). Wickwire et al. (15) concluded that there was a greater frequency of root resorption in devital teeth compared to vital teeth; however, their methods involved teeth that were treated endodontically after trauma, which according to Mah et al. (18) would increase their susceptibility to resorption. Furthermore, Mattison et al. (17) added that the type of aggression to which the tooth was submitted was not clearly defined; an essential factor in analyzing occurrence of dental resorption (11, 23).

Bender et al. (19) presented two case reports and data from 43 private cases that showed more root resorption in vital pulp than in endodontically treated teeth after orthodontic treatment. The authors suggested that the role of vital pulp is yet undetermined, hypothesizing that pulpal neuropeptides in vital teeth and calcium hydroxide in the endodontic treatment might play some role in this event. Our data did not confirm their assumptions.

Comparison between the pre- and posttreatment radiographs, taken with the use of a positioner, showed statistically significant differences in both the groups (Table 2). These changes agree with data from the literature in which practically all teeth show some degree of external root resorption during dental movement (1–8, 24). The use of some kind of specific positioner to take these periapical radiographs would be the ideal; however, this study was retrospective and therefore the use of this technique was limited. Also, a comparative evaluation of proportionality proposed by Spurrier et al. (14) and used in this work corrected the distortions that may occur after the orthodontic movement, or occasionally as a fault of the radiographic positioner.

Segal et al. (12) carried out a meta-analysis of the related factors of external apical root resorption in orthodontically treated teeth. Data from nine well-designed studies showed that the treatment-related causes of root resorption appear to be the total distance that the apex has moved and the time that it took. In the present study, the homologous upper central incisors underwent the same treatment time, as well as apex movement (mean = 1.06 mm, SD = 1.52, obtained from cephalometric maxillary superimposition; data not shown). This could affect root resorption from pre- to posttreatment, which, in fact, showed a statistically significant increase in all groups. One could expect less root resorption in brief treatments and in those that require less movement of the incisor apex. However, when vital and endodontically treated teeth groups were compared, it is reasonable to assume that those causes related by Segal et al. (12) were similar to both groups (homologous and adjacent teeth).

The results of this study showed that there was no significant difference in apical root resorption found in maxillary central incisors treated endodontically and untreated homologs submitted to orthodontic treatment.

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