Apical root resorption of vital and endodontically treated teeth after orthodontic treatment: A radiographic evaluation

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ABSTRACT

Introduction: Root resorption, generally expressed in a round apical shape, is one of the most common findings in the orthodontic clinic. **Objective:** To radiographically evaluate whether vital and endodontically treated teeth present similar severity of apical root resorption in response to orthodontic treatment. **Methods:** This study was conducted with twenty-eight patients who had one upper central incisor endodontically treated (experimental group) and its vital counterpart untreated (control group) before orthodontic movement. Measurements were made by means of periapical radiographs taken before and after orthodontic treatment. **Results:** There were no statistically significant differences ($P > 0.05$) in apical root resorption levels between endodontically treated and vital teeth. **Conclusion:** Endodontic treatment does not interfere in apical root resorption after orthodontic treatment.

Keywords: Root resorption. Orthodontic treatment. Endodontics. Apical root resorption.

How to cite this article: Esteves T, Ramos AL, Hidalgo MM. Apical root resorption of vital and endodontically treated teeth after orthodontic treatment: A radiographic evaluation. Dental Press Endod. 2013 Sept-Dec;3(3):69-73.

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» The authors report no commercial, proprietary or financial interest in the products or companies described in this article.

Submitted: September 13, 2013. Revised and accepted: September 15, 2013.

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Introduction

Movement of endodontically treated teeth has become more and more common due to an increase in the number of adult patients seeking orthodontic treatment. Many studies have been conducted to assess root resorption of vital teeth. They reveal that practically all teeth undergoing orthodontic treatment present some degree of external root resorption,[1-9] however, not too many researches have focused, in a controlled manner, on orthodontic treatment of endodontically treated teeth.[10,11] Many variables have been described as being predisposing factors of root resorption, namely: Genetics, anatomic factors, treatment time and applied mechanics.[5,12] The importance of local factors, such as root and alveolar bone crest morphology, has also been highlighted,[6,13,14,15] but its correlation with endocrine disorders and individual susceptibility has not yet been proved.[13,14,15] Conversely, intense forces and long-term treatment are directly related to an increase in root resorption associated with Orthodontics, of which risks are widely known by orthodontists.[4,5,12,15]

Although endodontically treated teeth respond to the application of forces similarly to how vital teeth do during orthodontic therapy, the literature investigating the theme is controversial and scarce. Wickwire et al[13] reported that devitalized teeth were subjected to a higher degree of root resorption in comparison to vital, during orthodontic movement. On the other hand, a radiographic study conducted by Spurrier et al[10] described that some endodontically treated teeth were less susceptible to root resorption, although no differences were found between groups. In animal models, there seems to be no significant difference between external root resorption of vital and devitalized teeth during orthodontic therapy.[17,18,19] In a previous study, we did not find differences between root resorption during orthodontic treatment of maxillary central endodontically treated and untreated teeth.[11]

The aim of this study was to radiographically assess whether there is any significant difference in apical root resorption found in vital and endodontically treated teeth subjected to orthodontic therapy.

Material and methods

The study comprised twenty eight patients with a vital maxillary central incisor and its endodontically treated counterpart. The latter had intact periodontal ligament in the apical region. Patients' selection involved a review of nearly 3,500 orthodontic records of three private orthodontic clinics. Thus, 56 incisors were assessed, 28 of which had been endodontically treated (experimental group) and 28 were vital teeth (control group). All patients were subjected to orthodontic movement with fixed appliance for at least six months. The endodontic interventions had been performed on the incisors at least one year before orthodontic treatment onset.

Patients whose crown presented alterations in size due to restorative procedures as well as patients with a history of trauma in the studied area were excluded from the study.

Pre and post-treatment periapical radiographs used for measuring the teeth were digitized (scanner HP Photo Smart, USA) and assessed by means of CorelDraw 11 parallel dimension tool. The images were under magnification of 350% for better visualization. All teeth had their longest length measured, from the incisal edge to the root apex, before and after orthodontic movement (Fig 1A).

In order to minimize any potential radiographic distortions before and after treatment, the longest distance from the incisal edge to the enamel-cementum junction of all radiographs were also measured (Fig 1B). Additionally, the differences for determining the foreshortening/elongation factors were calculated as suggested by Spurrier et al.[10]

The correction calculation was carried out as follows: initial total length, initial crown length, X (total expected length), final crown length, X – final total length = apical root resorption.

All measurements were repeated four times with a week interval in between. Arithmetic mean was used among the four assessments for comparison between groups. Student's t-test was employed for paired data, with a significance level set at 5%.

Results

Table 1 shows the results of apical root resorption assessment expressed in millimeters. Twelve patients (42.8%) presented greater apical root resorption in the endodontically treated tooth in comparison to its vital counterpart; whereas the remaining sixteen patients presented greater root resorption in the vital tooth. Nevertheless, the data did not reveal statistically significant differences (Table 2).

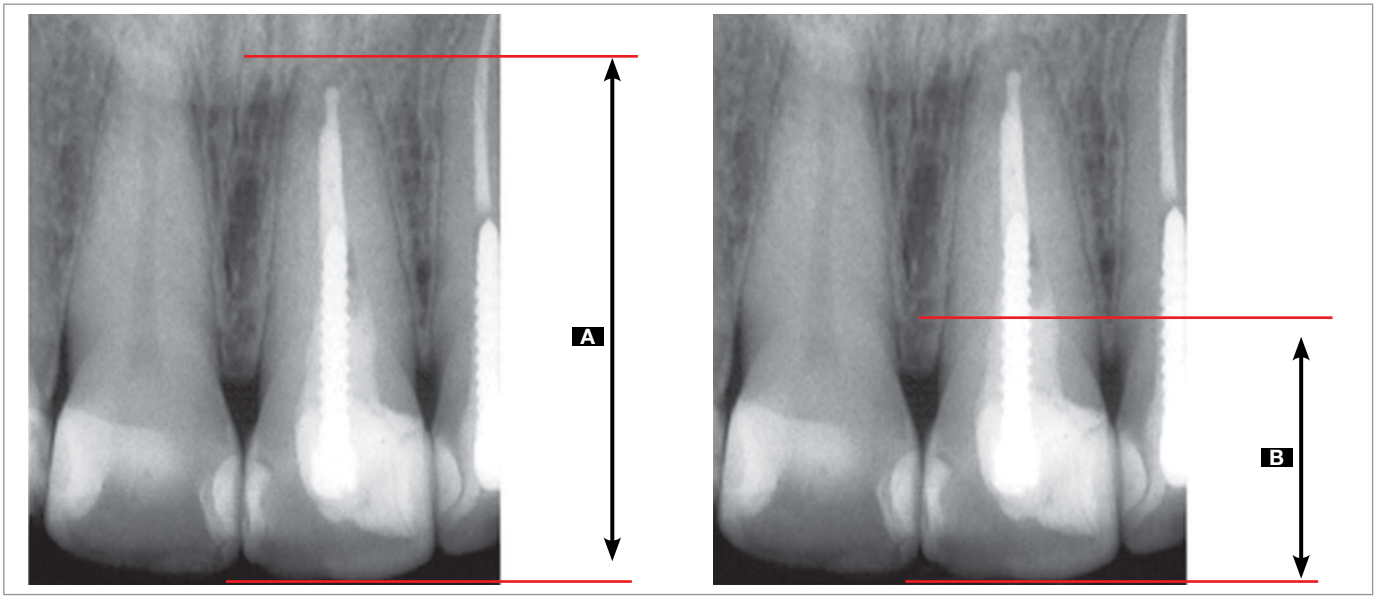

Figure 1. Radiograph representing the dental measurements carried out. Incisal-apical distance used to calculate root resorption. **B**. Incisal-enamel-cementum junction distance used to calculate the radiographic foreshortening/elongation factor.

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	0.80
5	0.21	0.11
6	4.42	1.65
7	0.69	0.00
8	0.92	1.26
9	0.16	3.50
10	0.00	0.40
11	0.35	0.20
12	0.52	0.30
13	0.79	1.60
14	0.20	0.30
15	0.20	1.40
16	0.20	1.20
17	0.92	0.09
18	1.18	2.37
19	0.25	0.44
20	0.13	1.82
21	0.77	1.03
22	0.56	0.07
23	0.77	0.97
24	2.65	4.00
25	0.35	0.48
26	0.89	1.82
27	0.17	0.31
28	0.31	0.23

Table 2. Comparative results of radiographic measurements between vital and endodontically treated teeth (n = 28).

	Mean	Standard deviation	Standard error	P value	Significance*
Vital T_1**-T_2*** (mm)	1.08	1.06	0.20	0.00005	S
Endo T_1-T_2 (mm)	0.79	0.99	0.18	0.00001	S
Endo T_1-T_2 x Vital T_1-T_2 (mm)	-0.29	1.03	0.19	0.14	N.S.

*Statistic significance set at $P \leq 0.05$. ** T_1- Pre-treatment. *** T_2- Post-treatment.

All means, standard deviation, standard error and p values obtained from measurements of radiographic examinations of vital and endodontically treated teeth are expresses in Table 2. Comparison between pre and post-treatment radiographs (T_2-T_1) of both vital and endodontically treated teeth revealed an increase in root resorption as a result of orthodontic treatment ($P < 0.001$). However, comparison of root resorption between groups does not reveal any statistically significant differences ($P > 0.05$).

Discussion

Root resorption of vital teeth expressed as a complication of orthodontic therapy has been widely discussed and studied. According to some authors,[4,5,12,14,15,16] etiological factors that may contribute to external root resorption include, but are not limited to: anatomic factors, amount of applied force and type of movement.

Only two out of the 56 teeth subjected to orthodontic treatment and assessed by this study (patient 7 vital tooth and patient 10 endodontically treated tooth) did not present apical root resorption (Table 1). Comparison between pre and post orthodontic treatment means revealed statistically significant differences in both groups (Table 2), not only proving the occurrence of apical root resorption as a result of induced tooth movement, but also corroborating the literature.[1,7,19] It is worth noting that the comparison of homologous incisors conducted in the present study resulted in a unique sample, given that both teeth underwent the same type of movement during the same period of time and presented similar intra-individual anatomy, thus reducing the influence of these variables.

No significant differences regarding apical root resorption as a result of orthodontic movement were radiographically observed in endodontically treated and untreated teeth (Table 2). These findings corroborate those of Spurrier et al[10] who assessed 43 patients by means of a similar radiographic methodology, although these authors described that some cases of endodontically treated teeth presented little root resorption as a result of greater mineral density as well as greater hardness, without, however, testing the teeth so as to verify such characteristics.[15] Mattison et al[18] also concluded that absence of vital pulp in endodontically treated teeth is not a predisposing factor of root resorption, even when submitted to orthodontic forces.

Likewise, no differences regarding macro and micro aspects of vital and endodontically treated teeth undergoing orthodontic movement were found in animal models.[17,18] Mah, Holland and Pehovich[19] reported that a microscopic analysis of weasels' teeth revealed greater loss of cementum in endodontically treated teeth in comparison to vital ones, while a radiographic analysis revealed no statistically significant differences in the root length of both groups.

Steadman[20] reported that histological slices of areas with root resorption in devitalized teeth were similar to those found in foreign body reactions, suggesting that endodontically treated teeth would react as a foreign body and cause chronic irritation. Therefore, endodontically treated teeth would be more susceptible to root resorption. Such reaction is not commonly found in teeth correctly treated, but may happen in cases of over-filled teeth or those which were filled at the limit of the apical foramen.[15] Wickwire et al[13] also reported a higher incidence of root resorption in devitalized teeth in comparison to vital teeth. However, the methods employed by these authors were subjected to criticism, given that the endodontically treated teeth of their study had already been traumatized, which naturally causes increased susceptibility to root resorption.[15,18,21]

Based on the results of this study as well as on data found in the literature about apical root resorption during induced orthodontic movement,[1,9,22,23] it is suggested that a further study on the etiology of endodontic treatment be carried out, thus rejecting the connection

between root resorption and previous trauma. Furthermore, additional studies should be conducted to investigate the history of trauma in vital teeth,[15,21] or the orthodontist might otherwise perform orthodontic movement without worrying about further root damage.

Conclusion

Endodontically treated and untreated teeth (without history of trauma) undergoing orthodontic therapy present apical root resorption similar to teeth subjected to induced tooth movement.

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