

Risk variables of external apical root resorption during orthodontic treatment

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Introduction: External apical root resorption (EARR) is an adverse outcome of the orthodontic treatment. So far, no single or associated factor has been identified as responsible for EARR due to tooth movement.

Objective: This study investigated the association of risk variables (age, gender, extraction for orthodontic treatment and Angle classification) with EARR and orthodontic treatment.

Methods: The sample (n=72) was divided into two groups according to presence (n=32) or absence (n=40) of EARR in maxillary central and lateral incisors after orthodontic treatment.

Results: There were no statistically significant differences in EARR according to age, gender, extraction or type of malocclusion ($p>0.05$).

Conclusion: The risk variables examined were not associated with EARR in the study population.

Keywords: Orthodontics. Root resorption. Tooth movement.

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How to cite this article: Barroso MCF, Devita RL, Lages EJP, Costa FO, Drummond AF, Pretti H, Lages EMB. Risk variables of external apical root resorption during orthodontic treatment. *Dental Press J Orthod*. 2012 Mar-Apr;17(2):39-41.

Submitted: March 11, 2009 - **Revised and accepted:** August 16, 2009

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

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Editor's abstract

External apical root resorption (EARR) is one of the main adverse effects of orthodontic treatment. Due to its irreversible nature, EARR is a huge concern for clinicians and researchers, as losses in root length greater than 3 mm cause a reduction in the supporting periodontium and, in severe cases, can lead to tooth mobility. According to the literature, a number of etiological factors are associated to EARR, such as dental anomalies, abnormal root morphology, type and severity of malocclusion, orthodontic treatment involving extraction, magnitude and duration of the force applied, gender, age and individual variability. The aim of the present study was to assess the association between the presence/absence of EARR and gender, age, orthodontic treatment with/without extraction and type of malocclusion (Angle classification). The sample consisted of 72 individuals with a mean initial age of 15.7 years (± 7.3) treated with fixed orthodontic appliance at the Specialization Course in Orthodontics of the Dental School of the Federal University of Minas Gerais (Brazil). Periapical radiographs of the upper incisors taken at the beginning and end of treatment were scanned and analyzed using the ARARA program. For such,

the median point of the enamel-cementum junction was determined, which divided the crown and root of the upper central and lateral incisors. EARR of each incisor was determined by the difference between the initial and final root length, multiplied by the ratio between the initial and final crown length, which furnished data on the lengthening or shortening of the roots. Individuals with at least one incisor with $\text{EARR} \geq 2$ mm were considered affected (32 patients), whereas those with $\text{EARR} < 2$ mm were considered unaffected and made up the control group (40 patients). Data on age, gender, type of orthodontic treatment (with/without extraction) and malocclusion were obtained from the patient charts. For the determination of intra-examiner agreement, the same examiner performed the same measurements on 20 radiographs a second time following a seven-day interval and the data were analyzed using the Kappa test. The Student's t-test, chi-square test and Fisher's exact test were employed for the statistical treatment of the data, with the level of significance set at 5% ($p < 0.05$). The results demonstrated no statistically significant differences between the affected group ($\text{EARR} \geq 2$ mm) and control group with regard to age, gender, orthodontic treatment with/without extraction or type of initial malocclusion.

Questions to the authors

1) In a number of studies in the literature, orthodontic treatment with tooth extraction has been associated with the presence of external apical root resorption (EARR) in the anterior teeth. In the authors' opinion, why was this not verified in the present study?

Different factors may have contributed to our present findings:

1. The etiopathogenesis of EARR is unclear and complex, influenced by numerous risk variables. In the case-control study design, it is difficult to control biases and the causal association can be relatively weak.
2. The subjects analyzed were part of a convenience sample from a Dental School and were, therefore, not representative of a large population.
3. Orthodontic treatment conducted in an academic setting may mean greater care in terms of planning, execution and finalization in comparison to treatment carried out in private practice.
4. Longitudinal studies with larger, representative samples should be conducted to confirm these findings.

2) In orthodontic diagnosis and planning, what characteristics should be considered for the determination of the risk of EARR in the upper incisors?

The etiological factors of root resorption stemming from orthodontic treatment are not yet fully clarified and seem to be complex. Root resorption may result from a combination of individual factors, genetic predisposition and the effect of mechanical factors. The risk factors cited in the literature

include a previous history of root resorption, trauma prior to orthodontic treatment, root length and morphology, abnormal root development, genetic factors, systemic factors, asthma, proximity of root to the bone cortex, bone density, root canal treatment, type and severity of malocclusion, age and gender. The literature remains inconclusive regarding the risk of root resorption when such variables are analyzed. The prediction of root resorption considering these risk factors during the diagnosis and planning of treatment is not supported by the literature.

3) In the present study, 44.44% of the patients analyzed had an EARR index equal to or greater than 2 mm stemming from orthodontic treatment. Considering this fact, what conduct do the authors recommend for the early diagnosis of EARR during orthodontic treatment? How should orthodontic treatment be conducted?

Periapical radiographs should be solicited within 6 to 12 months after the onset of orthodontic treatment for the early detection of root resorption. Patients with detectable root resorption in the first six months of active orthodontic treatment are more susceptible to resorption. For patients with positive diagnose for root resorption, a pause of 2 to 3 months with a passive archwire can minimize additional resorption. In cases of severe resorption, the treatment plan should be reevaluated with the patient. Alternatives to extraction may include prosthetics. If severe root resorption is detected in the final radiographs after treatment, follow-up radiographs are recommended until the resorption is stabilized. The stabilization of the resorption activity generally occurs after the removal of the orthodontic appliance. Additional care should be taken when fixing the teeth, as occlusal trauma may occur and lead to extreme resorption.