

ROOT RESORPTION IN ORTHODONTIC TREATMENT WITH EMPHASIS ON DENTAL INTRUSION

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ABSTRACT

The present study on orthodontic root resorption addresses factors associated to root resorption occurrences and reports some procedures that must be followed before and during orthodontic treatment. Factors related to patients and technical procedures are closely linked to the occurrence of this pathology. Some other procedures as: periapical radiographs of anterior tooth; following-up periapical radiographs of the anterior teeth after six months of treatment; if the resorption was diagnosed, treatment discontinuance from 60-90 days and reevaluation required to continue the treatment, are very important and must be considered with each and every patient undergoing orthodontic treatment.

KEYWORDS: Orthodontics, dental intrusion, root resorption.

1. INTRODUCTION

The occurrence of root resorption in Orthodontics is quite evident, so much that several authors state that the orthodontic movements increase the risk of root resorption, which is the main and more frequent cause in the western population^{1,2}.

Orthodontists sought the best approach of orthodontic treatments to achieve the best results in shape, function and dentofacial aesthetic, but not worrying about the occurrence of root resorption. Currently, professionals reach the same goals in the completion of orthodontic treatments, but concerning about the root resorption, focusing on prevention. Severe and structurally important root resorption occurs in 10% of people undergoing orthodontic treatment¹. In most orthodontic treatments, no impairment of functional capacity and longevity of the affected tooth occur. The forces applied on the teeth to achieve effective movements must promote some degree of stress on the periodontal tissues, either by hypoxia, or compression³.

This study addresses the relationship of resorption with mechanical intrusion, because root resorption exhibits higher incidence in this type of orthodontic mechanics.

When the intrusion is associated with higher corrections, it induces more root resorption. It should be emphasized the differentiation of pure or isolated intrusion movements, from those of an intrusive mechanics in which there is a combination of movement types and greater movements³.

In orthodontic treatment, many malocclusions have a deep curve of Spee, which contributes to a deep overbite; therefore, it is necessary to level the curve of Spee both for functional reasons and those proposed by the orthodontic treatment. Accordingly, it is very common to use archwires with reverse and marked curves to correct the overbite. This implies in individual tooth movements, with the intrusion and protrusion of the anterior teeth as the most common effects^{4,5}.

Studies have not exclusively evaluated the intrusive mechanics characterized by the use of archwires with reverse and marked curves and their effects on the degree of root resorption⁴.

This paper aimed, then, to review the literature and search for general considerations that help to prevent certain occurrences, so that mainly root resorption can be minimized⁶.

Capelozza Filho *et al.* (1998)¹ suggested that the etiology of root resorption seems to depend on genetic, physiological and anatomical variables. Thus, didactically they classify the factors in general, local and mechanical. According to the authors, the general factors include heredity, gender, age, and health status. As for local factors, these are represented by the type of malocclusion, habits, history of previous trauma, root development stage, root shape, and oral health. There are also mechanical factors that are part of the orthodontic force magnitude, the force application interval, and the force type and duration.

According to Sameshima & Sinclair (2001)⁷, the resorption occurs mainly in maxillary anterior teeth with marked positive overjet and deep overbite, due to the

demand for greater torque, amount of root displacement and intrusion, required to correct this type of malocclusion.

Of the tooth movement in Orthodontics, the intrusion and retraction are associated with root resorption. The intrusion is an aggressive and harmful movement to periodontal structures, so it is often related to external apical root resorption during orthodontic treatment³.

Apical root resorption is a serious iatrogenic event associated with orthodontic treatment. It is believed that they result from a complex combination of individual biology and effects of mechanical forces⁸. Several factors have been implicated in the initiation and progression of external root resorption during orthodontic treatment, divided into host factors, local factors and factors related to orthodontic mechanotherapy. The magnitude of orthodontic forces was shown to be an etiological factor in the external apical root resorption (EARR). The external root resorption is a common sequel of orthodontic treatment and can occur in the absence of this. Genetic factors account for at least 50% of the variation in EARR⁹. The apical root resorption is defined as a pathological or physiological process resulting in the loss of cementum and dentin¹⁰.

The intrusion is often cited as a cause of great risk for apical root resorption and resorption on inter-root or bifurcation region^{2,8}. Apical root resorption depends on the intensity of orthodontic movements. In orthodontic movement, the driving inclination forces promote compression of the tooth's periodontal ligament on the alveolar bone surface^{2,3}.

Several authors investigated the intrusion as a possible cause of resorption. As a result, they found that the intrusion can be performed with light force to reduce the overbite while causes negligible apical root resorption^{11,12}. Compared with the continuous force, orthodontic intermittent activation may be a reliable method to prevent significant root resorption^{11,13,14}. One should be aware that the extrusion can also cause resorption in susceptible patients¹².

Studies show that patients treated with mechanical intrusion to accent and reverse the curve of Spee had statistically greater root resorption than patients with normal overbite not receiving this mechanics¹¹. In general, there was no difference in the amount of root resorption among the appliance systems and between age, sex and extraction treatment, but in the treatment duration a difference was observed¹⁵. There was no difference in root resorption between the conventional and the self-ligated systems^{16,17}.

From the geometric point of view, the shape of the roots can be classified into triangular, rhomboid and quadrilateral. By applying the same type of force and tooth movement, the triangular roots tend to concentrate higher forces on a smaller apical area than the rhomboid and

quadrilateral shapes. Therefore, these types of short roots tend to undergo more resorption during orthodontic movements^{7,12-14,18,19}.

In the context of orthodontic technique, some technical and operational aspects are mentioned as enhancers of the highest frequency of root resorptions, for example:

- The use of intermaxillary elastics;
- Extraction in the context of the treatment;
- Intrusive mechanical;
- Extensive tooth displacements.

The literature affirms that only 10% of root resorption in orthodontics are severe, so it is indicated that periapical radiographs of the upper and lower incisors are routinely performed in adolescents and a series of radiographs in adults as usual preventive procedure, previously at the beginning treatment^{10,18,20}. During orthodontic treatment, it is recommended that periapical radiographs of the upper and lower incisors should be taken at every six months for controlling the biological cost of mechanotherapy. The higher predisposition to resorption of maxillary incisors is related to the extension of movement of these teeth as a result of malocclusion, function and aesthetics correction¹⁰. If at the radiographic examination, there is evidence of a minimum or no resorption, it can be stated that the patient is at low risk of severe resorption at the end of treatment, so the same treatment regimen is maintained. If detecting a moderate absorption, the patient is at regular risk of severe resorption and small risk of marked resorption at the end of treatment. In these cases, a rest period (passive archwire mechanically stabilized) from 60 to 90 days is recommended and the susceptibility must be communicated to the patient^{10,21}.

Following the literature, the routine requires practicality in the management and planning. For this purpose, there are 10 topics to be remembered during orthodontic treatment to prevent the root resorption and its consequences:

- Conduct a thorough medical history to find previous treatments, dental trauma history, replantation, and jaw surgeries;
- Make a periapical radiographic evaluation of all teeth during the planning of the case. In 7-10% of cases of patients without orthodontic treatment root resorption has been diagnosed, which may be exacerbated during orthodontic treatment; if not diagnosed during treatment planning, they will be later assigned to the treatment itself.
- harmonize the use of less aggressive forces and moves to root morphology, maxillary bone crest when these aspects are unfavorable;
- When planning external movements, reveal the most probability of causing resorption in such cases;
- Indicate extractions when strictly necessary;

- Consider that the use of intrusive mechanical is favorable to the occurrence of root resorption;
- Worry about the distribution of forces preferably regarding to the occurrence and intensity;
- Six months later, re-evaluate radiographically whether or not significant resorption occurred. If diagnosed, discontinue treatment for 5-8 weeks and then return normally. This maneuver decreases significantly tooth shortening at the ending of orthodontic treatment.
- In cases of retreatment or transference of patients, previously promote a thorough assessment of periapical radiographs to have knowledge on the diagnosis of the current case situation.

2. CASE REPORT

K. F. A, female, aged 10 years and six months old, attended the clinics complaining about the diastemas. At extraoral analysis, face balance with convex profile and presence of passive lip seal was observed (Figure 1).



Figure 1. Initial extraoral photographs.

At intraoral and radiograph examination, Class I bilateral malocclusion, diastema between the upper front teeth, overbite of approximately 3-4 mm, slightly flaring of the maxillary central incisors, and presence of some deciduous teeth were present (Figures 2 to 5).



Figure 2. Initial intraoral photographs.



Figure 3. Initial Lateral Cephalogram.

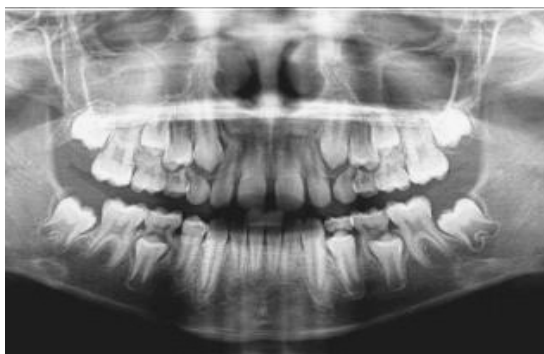


Figure 4. Initial panoramic radiograph.

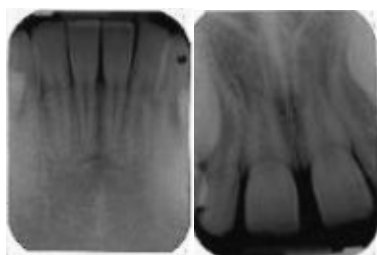


Figure 5. Initial periapical radiographs.

TREATMENT

The initial treatment was performed with installation of a removable expander with labial bow, due to patient's age and the presence of some deciduous teeth, used for 5 months (Figure 6). Then, the protocol with fixed appliances began by the cementation of orthodontic bands and bonding of maxillary brackets during 4x2

leveling, due to the presence of deciduous teeth (Figure 7). Pre-adjusted brackets with Roth prescription and 0.022 "x 0.028" slot were used. Due to the overbite, the mandibular appliance was installed after a few months.

The alignment and leveling were performed with 0.012", 0.014", 0.016", 0.018" Niti wires and 0.018" and 0.020" stainless steel wires with accentuation and reverse of curve of Spee.



Figure 6. Removable expander.



Figure 7. Beginning of 4x2 leveling

After alignment and leveling, we used the 0.017" x 0.025" and 0.019" x 0.025" Niti rectangular arches and then the 0.017" x 0.025" and 0.019" x 0.025" rectangular steel arches throughout alignment and leveling phase and finishing with rectangular arches, applying the accentuation and reverse of the curve of Spee, thus observing the severe root resorption, especially on the maxillary central incisors. The simplification of the mechanics was prioritized until orthodontic finishing as soon as possible (Figure 8).



Figure 8. Intraoral photos; finalization phase.

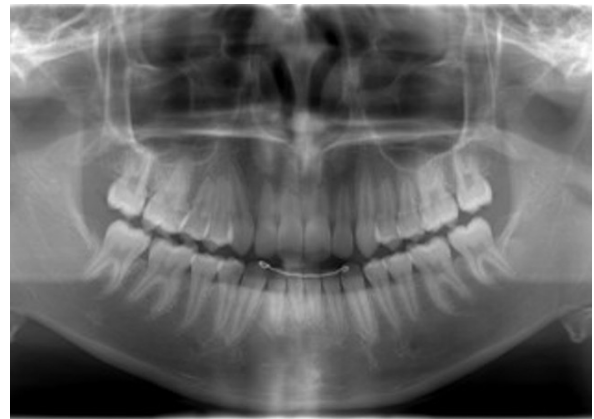


Figure 9. Final panoramic radiograph.

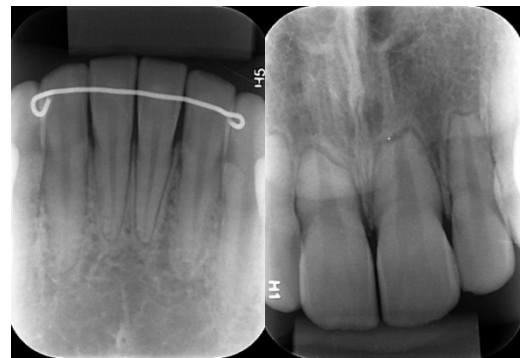


Figure 10. Final periapical radiographs.



Figure 11. Final Lateral Cephalogram.

The case ended with Class I bilateral occlusion. The patient was instructed to use Hawley and 3 x 3 retainers continuously for two years (Figure 12 and 13).



Figure 12. Final photographs.



Figure 13. 3x3 Mandibular retainer and maxillary Hawley retainer.

3. DISCUSSION

The intrusive mechanics is widely used in the treatment of overbite, because it promotes the intrusion of anterior teeth. It is known that the intrusive force causes stress mainly on the apex and therefore implies in damaging this area of the tooth, resulting in apical resorp-

tion^{3,22}.

Authors report that the force intensity applied during the initial period of intrusion can determine the final degree of root resorption, as the reaction of the intruded teeth varies according to the magnitude of the force exerted².

Of the orthodontic movements, the intrusion and root torque are the most likely causal factors of root resorption, which if combined, further increase the occurrence of this resorption^{6,8,23}. The studies have recommended the application of light forces on the intrusion movements that depend on the magnitude of the applied force for prevention^{1,8}.

The overbite correction basically involves four types of tooth movement: anterior intrusion, posterior extrusion, incisor inclination, and differential growth of the maxillary and mandibular structures. Some types of treatment are more likely to cause extrusion of posterior teeth; others to cause intrusion of anterior teeth⁴.

The extrusion of the posterior teeth can be obtained by use of the bite plates, because they prevent the contacts of these teeth, allowing the fast development of the posterior dentoalveolar area^{4,5}.

The leveling archwire with reverse and accentuated curve is another common approach for correcting deep bite. These archwires provide an intrusion force on anterior teeth and extrusion force on posterior teeth, combining both teeth movements^{2,5,11}.

The literature reports that root resorption is closely associated with certain risk factors that may be related to the patient and techniques themselves. As regards to Orthodontics, some clinical procedures should be adopted to prevent such resorption³.

As can be seen, a large number of authors stated that the highest incidence of root resorption occurs on the maxillary anterior teeth, followed by the mandibular anterior teeth, first molars, canines and premolars^{7,24}.

Concerning to the prevention during orthodontic treatment, the authors suggest a periapical radiograph shot of the incisors after 6-9 months of treatment, as control, when the risk of resorption at the end of treatment is defined^{3,10}.

A protocol of actions has been recommend to be taken preventively after the detection of some degree of resorption according to the classification recommended by Levander and Malmgren at 6-9 months of treatment: instructing the patient's about the susceptibility to this root damage, panoramic radiograph to verify the remaining teeth, and perform the periodic following-up at every 90 days^{16,26}. The authors do not advocate the rest period only for teeth with minimal resorption. For other types, they recommend mandatory rest from 60 to 90 days. For severe resorption, they suggest treatment optimization to reduce its duration. In extreme resorption cases, they advocate mandatory discontinuation of

treatment^{6,10}.

4. CONCLUSION

After the review of the literature on the occurrence of root resorptions in orthodontic treatment, we can conclude that there are factors related to the patient commonly associated with root resorption: group of teeth because the degree of resorption is higher in anterior teeth;

Root morphology: is an important risk factor during orthodontic treatment; gender, age and pulp vitality does not confer greater or lesser susceptibility to root resorption.

Factors related to technical procedures associated with root resorption: root approximation to lingual cortical: this occurrence caused severe resorption; root torque, intermaxillary elastics, extensive movements require careful planning and management; the intrusion is closely associated with the magnitude of the force used.

Some important approaches should be adopted before and during orthodontic treatment as:

- Periapical radiographs for the diagnosis of anterior teeth;

- Clarify the patient about the possibility and the risk of root resorption during orthodontic treatment;

- Periapical radiographs of anterior teeth after six months of treatment;

- if resorption is diagnosed after six months of treatment, inform the patient and discontinue the treatment for a period from 60-90 days; reassess and simplify orthodontic mechanics or even discontinue treatment in the event of severe or extreme resorption.

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