

Review Article

Special considerations for orthodontic treatment in patients with root resorption

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ABSTRACT

Background: Orthodontic treatment needs good consideration especially when there are unfavorable conditions for orthodontic treatment, such as periodontal diseases or tooth with root resorption. Root resorption should not become worse due to orthodontic treatment. All risk factors should be eliminated before orthodontic treatment is started. Otherwise, the goal of orthodontic treatment could be difficult to achieve because of poor dental and or oral health. **Purpose:** The purpose of this study was to learn more about mechanical factors that could worsen the root resorption that has already been there or even provoke root resorption to develop during orthodontic treatment. **Reviews:** Resorption of dental root surface is the condition in which cementum is depraved and the damage could also include dentin of dental root. It can occur either physiologically or pathologically due to some causes. The occurrence of the root resorption is suspected because of the biological factor, the tooth condition, the supportive tissue and the mechanical factors. Panoramic x-ray which routinely used to support diagnose in orthodontic cases, can detect root resorption in general, although sometimes periapical x-ray with parallel technique is needed to enhance the diagnosis. Before starting a treatment, the risk factors that suspected as the causes of root resorption should be eliminated, thus the mechanical treatment can be calculated. **Conclusion:** Orthodontic treatment in patient with root resorption should not escalate the root resorption which already occurs. The treatment should be done effectively by using optimal forces. Giving discontinued forces and avoiding intrusion and torque movements could reduce the risk factors of root resorption.

Key words: Root resorption, orthodontic treatment

ABSTRAK

Latar belakang: Keadaan gigi dan jaringan pendukung yang kurang menguntungkan bagi perawatan ortodontik hendaknya membutuhkan perhatian ekstra para klinisi. Kondisi tersebut misalnya adanya penyakit periodontal ataupun adanya gigi dengan resorpsi akar. Perawatan ortodontik yang dilakukan hendaknya tidak menambah parah resorpsi akar yang telah ada sebelumnya. Sebelum memulai perawatan, seluruh faktor yang diduga sebagai faktor resiko dihilangkan terlebih dahulu. Sebaliknya, tujuan perawatan ortodontik akan sulit dicapai akibat buruknya keadaan gigi dan jaringan pendukungnya. **Tujuan:** Mempelajari lebih jauh mengenai faktor-faktor mekanik yang dapat menyebabkan resorpsi akar atau bahkan memperparah terjadinya resorpsi akar yang telah ada akibat perawatan ortodontik. **Ringkasan:** Resorpsi permukaan akar gigi adalah kondisi rusaknya jaringan sementum akar gigi yang dapat berlanjut hingga ke jaringan dentin akar gigi. Resorpsi akar dapat terjadi secara fisiologis atau patologis. Terjadinya resorpsi akar ini diduga karena adanya faktor-faktor biologis, kondisi gigi dan jaringan pendukung serta adanya faktor mekanik. Foto ronsen panoramik yang rutin digunakan sebagai penunjang diagnosa pada perawatan ortodontik dapat mendeteksi secara umum adanya resorpsi akar, meskipun terkadang dibutuhkan foto ronsen periapikal teknik paralel untuk memperjelasnya. Sebelum memulai perawatan, faktor resiko yang diduga sebagai penyebab terjadinya resorpsi akar hendaknya dihilangkan lebih dahulu, baru kemudian mempertimbangkan biomekanika perawatan ortodontik. **Kesimpulan:** Perawatan ortodontik pada pasien dengan resorpsi akar hendaknya tidak memperparah resorpsi akar yang telah ada. Perawatan yang dilakukan haruslah seefektif dan seefisien mungkin

dengan menggunakan gaya yang optimal. Selain itu pemberian gaya dilakukan secara diskontinyu dan menghindari pemberian gaya intrusi dan torquing sehingga dapat mengurangi terjadinya resorpsi akar gigi.

Kata kunci: resorpsi akar gigi, perawatan ortodontik

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INTRODUCTION

The goals of orthodontic treatment are to achieve harmonic relations among teeth and jaws, and to attain good esthetic without neglecting healthy condition of periodontium.¹ It could be achieved only if the patient has healthy general condition, dental, and periodontium. However, some patients come with unfavorable conditions for orthodontic treatment. For example, there is a periodontal disease or a tooth with root resorption.^{2,3} Dental root resorption can occur either physiologically or pathologically.⁴⁻⁶ It should be considered by practitioners in order not to escalate the root resorption that already occurs before an orthodontic treatment begins.⁷

If a patient with root resorption look for orthodontic treatment, the treatment should be done without increasing the root resorption. Ideally, practitioner could detect it before starting the orthodontic treatment and eliminate the risk factors that can be suspected to promote root resorption. Beside that, the mechanotherapy should be considered to prevent the worsening of root resorption that already occurs. Since a practitioner must take all known measures to prevent the root resorption before orthodontic treatment starts, the purpose of this study was to learn more about mechanic factors that could worsen the root resorption that has already been there or even provoking root resorption to develop during orthodontic treatment.

The types and risk factor of root resorption

Dental root resorption is the condition in which cementum is depraved and the damage could also include dentin of dental root. It can occur due to osteoclast and cementoclast activities.⁸ Based on the degree of severity, dental root resorption could be classified into 3 types which are surface resorption, inflammatory resorption, and replacement resorption.⁹ Graber divided dental root resorption into superficial resorption of root surface and apical root resorption.¹ Malmgren *et al.*¹⁰ divided root resorption into 4 types: irregular contour of dental root, apical resorption less than 2 mm, apical resorption 2 mm to a third of root length, and root resorption more than a third of previous root length.

Superficial resorption of root surface is caused presumptively by some factors. This type of resorption is developed by an imbalance between resistance capacity and repairing ability of periodontal tissues toward forces received by dental root and presumptively occurs as the result of biological, dental, periodontal, and

mechanical factors.^{11,12} Age is one of biological factors that are considered playing role in the occurrence of dental root resorption. This issue has been studied a lot by many researchers, but the results differs from each other.^{1,4,5,12-17} Besides age, sex is also considered as risk factor in occurrence of dental root resorption, but it is still a controversial issue.^{5,11,13,17}

The risk factor of dental root resorption according to Newman is genetic, although the pattern of hereditary remains unclear; however cytokines inflammatory protein is considered to play the role.^{11,18,19} Systemic condition is also presumed having a relationship with dental root resorption.^{20,21} Whereas, the local factor considered having relationship with dental root resorption is the unfavorable periodontium, such as which under the condition of occlusion traumatic, parafunctions, and bad habit for examples tongue thrusting and nail biting.^{1,22,23} In the condition, periodontium receives continuous excessive loading, which lead to the damage of cementum and the exposure of underlying dentin.¹ Another local factor that is also presumed to play role is the adjacent impacted tooth. Rimes *et al.*²⁴ studied about resorption of incisive caused by impacted canine and the result showed that the resorption has tendency to occur extensively, reaches the two third of apical and causes symptoms to patients.^{25,26} The form of apical portion could also play rule in the occurrence of dental root resorption. Lavender and Malmgren divided the form of dental root into 5 categories which are: normal, short, dilacerated, pipette like, and blunt. Similarly, Mirabella and Artun classified the form of apical portion into 6 types that are: normal, blunt, eroded, pointed, curved, and cork like.^{13,17,28} Tooth with more root length is more susceptible to resorption because it needs more force to be moved and the movement of the root is also greater during tipping and torque movements.²⁸

Traumatic tooth is suspected having greater risk to root resorption compared to non-traumatic tooth.^{10,29} Meanwhile, a vital tooth has greater risk to root resorption compared to a non-vital tooth that has undergone endodontic treatment.^{28,30} Reitan stated that an endodontically treated tooth has harder dentin compared to a vital tooth. It may explain why an endodontically treated tooth has less resorption.¹ It also occurs in teeth with incomplete root formation because they have thick predentin layer.^{14,30,31}

Another factor suspected to play role in surface root resorption is mechanical factor of orthodontic treatment. The consideration of the magnitude of forces, the methods of force applying, the duration and the direction of forces influence the occurrence of dental root resorption.^{1,8,12,32,33}

Beside the magnitude of forces, the methods of force applying is one of the factors suspected to trigger dental root resorption. There are 3 known methods of force applying: continuing, interrupted or intermittent.^{32,34}

A factor that is not less important is duration of orthodontic force. It is equivalent with the longevity of treatment.^{1,35,36,37} Another mechanical factor that can cause root resorption is the types of dental movement. It is stated that intrusion and torque are the most frequent movements causing dental root resorption.^{1,38,39}

Pathophysiology of dental root resorption

Dental cementum is an independent tissue; unlike bone, cementum does not involve in metabolic process such as calcium homeostatic. The process of resorption of dental root surface is developed by imbalance between resistance capacities and repairing ability of periodontal tissues toward forces applied to dental root surface.¹¹ The resorption of cementum is almost similar with the resorption of alveolar bone. Similarly to bone, cementum becomes narrower at the compressed side and undergoes deposition at the opposite side; however cementum is more resistant to resorption compared to bone. In orthodontic tooth movement, this phenomenon leads bone to undergo resorption first if an excessive force applied while dental cementum will undergo resorption later.¹⁴

The process of root resorption is an elimination of hyalinization zone.^{1,9} Hyalinization is a process marked with the presence of cellular and vascular changes that cause degeneration to cells and vascular structures. If this condition persists, necrotic tissues and hyalinization zone will be formed. Hyalinization zone would be self-eliminated by body and at that time the resorption would occur.^{1,8,9,33,39}

The detection of dental root resorption

The detection of dental root resorption can be performed by some methods, some of them are though radiography, histology, scanning electron microscopy (SEM) or micro computed tomography (Micro-CT). Histological detection, SEM, or micro CT could only be done in extracted tooth.³⁹⁻⁴¹

Lateral cephalogram and panoramic x-rays are routinely used prior to orthodontic treatment. However, sometimes additional radiographs are required, such as dental, periapical, occlusal photos, and other projections.^{12,13,42}

Periapical radiograph gives more accurate details, less distortion and less error in superimposition compared to panoramic and lateral cephalogram. By periapical projection, pathologic condition in periapical tissue could be seen in more detail compared to by panoramic projection.^{42,43} McNicol *cit.* Brezniak and Wasserstein¹² stated that the most favorable radiograph technique in detecting root resorption is periapical with parallel technique. Geometrically, the result is accurate and it is the most preferable technique for observing root resorption, as shown in the picture below.⁴²

DISCUSSION

Some mechanical factors of orthodontic treatment are related to the increase of the risk of surface root resorption. So it is easy to understand that to perform orthodontic treatment at a patient with dental root resorption as special considerations are needed. Orthodontic treatment should be done without enhancing the severity of resorption.

Before discussing about the management of root resorption, early detection is necessary to be completed first. Routine panoramic x-rays used as supporting diagnostic tool for orthodontic cases could show the appearance of existing root resorption, although additional periapical radiograph is necessary to be indicated.^{13,42,43} Orthodontic treatment could be performed without deteriorating the existing root resorption. It was stated that local risk factor should be eliminated first and afterward the magnitude, the direction, and the duration of force applied and mechanics used should also be considered.^{1-3,8,9} The magnitude of forces applied should be light. The light force can be achieved by reducing friction, space closing with non-sliding mechanic, or by adding anchorage teeth.^{32,39} Sliding mechanism produces kinetic friction which will produce higher orthodontic forces.^{44,45}

A number of studies have observed the influencing factors toward frictional force. Some of them are the material of the bracket, the design of bracket slot, the material of wire, the sectional form of wire, the diameter of wire, and the ligation used.^{44,47} It was stated that stainless steel bracket has lower friction compared to ceramic bracket because the surface of the ceramic is coarser than of stainless steel. Moreover, the design with larger intra-bracket distance and self ligating bracket has lower friction.^{33,48,49}

Besides bracket selection, another factor influences frictional force is orthodontic wire. It is stated that nickel titanium wire has coarser surface than stainless steel. However, the greatest friction is obtained from beta titanium wire.³³ Wire with round cross section form has lower friction than one with square form. Besides, wire with smaller diameter has smaller friction too. The friction produced could be reduced by ligating wire to bracket technique. Ligation using elastomer rubber gives higher friction compared to ligation using wire.^{44,45} Another effort to reduce friction can be seen from the method of space closing. The post extraction space closing process could be performed by sliding or non-sliding mechanics. According to Profitt, the non-sliding method gives lower friction compared to the sliding one.³² However, the development of brackets nowadays based on sliding mechanic movement. To minimize the friction, modification to bracket, wire or ligation methods are performed. The principle to produce light force can be achieved by adding anchorage to anchoring side so that the force applied to the tooth which is going to be moved is relatively low toward the anchoring teeth.^{1,33}

Another consideration in orthodontic treatment of tooth with root resorption is the method of force application. Continuous force application is more susceptible for producing root resorption compared to intermittent method. In intermittent method, cementum tissue has an opportunity to do self repairing and to prevent the occurrence of more severe resorption. The cementum repair occurs after force application is stopped and starts from periphery area of resorption because of cementoblast migration.¹ Acar *et al.*⁵⁰ observed the effect between continue and discontinue techniques in force application toward root resorption and they stated that the discontinue force application has less resorption area compared to the continue method.

The duration of force application is proportional with the longevity of orthodontic treatment performed. The presence of root resorption occurring in the beginning of the treatment indicates that the tooth has root resorption risk towards orthodontic treatment. The regular radiograph x-rays is necessary to monitor root resorption occurred.¹

Orthodontic treatment in patient with existing dental root resorption - should be done as efficiently as possible.^{35,36} Harry *et al.*³⁵ stated that the duration of force application factor is more crucial than the magnitude of force applied. In their study, it was found that with applied force as big as 40-60 gram in the day of 14, it was started to show small area of root resorption; in the day of 35, bigger zone of resorption was seen; and so did in the day of 200. The result showed that the extent of root resorption goes bigger as duration of force increasing.

Another thing that should be noticed in orthodontic treatment with dental root resorption is the types of tooth movement. It is reported that the movement conducts with avoiding intrusion in teeth with existing root resorption.^{2,3} Sometimes intrusion and torque movement cannot be avoided in treating certain cases. Graber *et al.*¹ asserted that intrusion and torque can be performed with minimal force along with resting phases in the interval. Intrusion with light force would be more effective. One of the methods of intrusion is using intrusion arch. It gives intrusion effect to anterior teeth as well as extrusion effect to molar tube. The important mechanical factors in intrusion are the magnitude of forces, the constant force, the point of force applying and the molar tip back moment.³³

Besides the consideration of the magnitude of force applied, the point of force application is another factor that is needed to be considered. If the force is applied to the center of resistance then pure intrusion force will be produced; but if the force is applied through bracket attaching to tooth, the moment of force will emerge. The usage of intrusion arch with chinch back in molar will avoid flaring in anterior teeth that is caused by the moment.³³ According to the third law of Newton, in the usage of intrusion arch there is a contributory effect to the third molar, that is tip back moment of molar. It could be advantageous in class II molar relation, but in class I molar relation, anticipation should be performed by adding anchorage in molar teeth.³³

Although theoretically the force should be applied as light as possible, but practically it is difficult for clinician to measure the magnitude of force applied to teeth. Yet, in the market, the tool that is able to measure the magnitude of force is already available; it is known as stress and tension gauge. The tool has two ends with hook or fork like forms. On the body of the tool, there is a line scale which shows the magnitude of force. Stress and tension gauge is used by hooking one of its end to the orthodontic wire, or to other orthodontic appliances, followed by counting the number of lines seen on the tool. On the 16 oz gauze, there are 16 lines, each line represents 1 oz.

The importance of prevention otherwise it could lead to deterioration of the existing root resorption. The point is that the magnitude of force applied should be as light as possible. It can be achieved by reducing friction which could be attempted by selecting the types of bracket, wire and closing technique, applying ligating method, and adding anchorage.

It is important to remember that the intermittent method of force application is the safest one because it gives a chance for cementum tissue to do self repairing so that the duration of treatment can be controlled by scheduling dental visits in order to allow roots to rest. In addition, it is necessary to measure the magnitude of force and if it is possible to possess the tool used for measuring the magnitude of force that is already available in the market.

It is concluded that panoramic x-ray which is routinely used to support diagnosis in orthodontic cases, can detect root resorption in general, although sometimes periapical x-ray with parallel technique is needed to enhance the diagnose. Besides the importance of early detection, it could also be concluded that patient who already has root resorption as the result of local factor, the orthodontic treatment should eliminate the factor so it should not escalate the root resorption that already occurs. In this case, the force should be applied as light as possible and discontinuous force is recommended to give opportunity for cementum tissue to do self repair and to prevent the occurrence of more severe resorption. The orthodontic treatment also should be performed as effective and as efficient as possible. Intrusion and torque forces give risk in root resorption caused by the great stress in apical part of a tooth.

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