Dental root periapical resorption caused by orthodontic treatment

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ABSTRACT

Dental root resorption especially in maxillary incisive region almost always happens simultaneously with orthodontic treatment, and it gained researchers attention, in particular after the use of periapical radiography. However, the fundamental etiology of dental root resorption is still dubious. Multifactoral causes are mentioned, among others are hormonal, nutritition, trauma, dental root form and dental root structure anomalies, genetic, while from treatment side are duration, types, strength scale and dental movement types. Based on these findings, orthodontic treatment was proven to cause dental root resorption in maxillary incisive teeth.

Key words*: dental root resorption, orthodontic treatment*

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INTRODUCTION

Dental root resorption in maxillary incisive region, almost always happens simultaneously with orthodontic treatment and it became researcher's concern after the availability of periapical radiography.[1,2,3] Dental root resorption case studies from 1856 until 1993 with 120 reported cases were still unable to conclude the fundamental etiology of dental root resorption caused by orthodontic treatment.[3,4] It was stated that dental root resorption had multifactoral causes.[5] Epidemiologic studies revealed that dental root resorption post-orthodontic treatment was not a major problem. Apical morphologic scoring by measuring directly the pre-treatment dental length, seldom demonstrated heavy resorption. Recent studies showed that risk factor had an important role in dental root resorption. The risk factor constituted of genetic factor and the application of orthodontic equipment system. That research explained how risk factor only 20% influenced the dental root resorption due to orthodontic treatment, while many other factors were assumed as risk factors, such as dental agenesis, dental malformation, hormonal, pre-treatment trauma, number and dental movement types.[2,6] The aim of this writing was to study dental root resorption in various type of orthodontic treatment along with its cause.

Dental root resorption

Dental root resorption is a related condition of physiologic and pathologic processes causing dentin, cementum or bone disappearance. The resorption process is a joint-work of inflammation cells, resorber, and hard tissue structure, which are difficult to predict, to diagnose and also to treat. Dental root resorption is very similar to bone resorption. Bone, dentin and cementum laceration and irritation will bring about chemical changes of those tissues causing the formation of multinucleotide giant cells or more commonly known as osteoclasts. This cell working along with macrophage and monocyte is responsible for hard tissue resorption. As a whole, this cell holds a role in molecular biologic complex involving cytokine, enzyme and hormones on the continuation of resrption process.[7]

Resorption causal factors

Numerous studies found out the influence of orthodontic treatment did not cause heavy dental root resorption. But, several individual variations must be noticed. Some studies revealed individual predisposing factor existed and turned into multifactoral causes. Thus, the study result of the relation between post-orthodontic dental root resorption and risk factors was not clear.[8] Various causal factors were assumed to be the cause of dental root resorption due to orthodontic treatment, they were called risk factors, i.e.: 1) long, narrow and atypical dental root form, 2) pre-treatment traumatic laceration, 3) bad habit of fingers and tongue for a long period of time, 4) some dental agenesis, 5) Peg-form teeth, dental invagination, taurodontism, severe dental root deviation; and 6) eruption pattern of decidual teeth and abnormal permanent and ectopic eruption.[6,9] Other researchers expressed that peg-formed and rudimentary teeth will not increase the risk factor of dental root resorption caused by orthodontic treatment.[10] Other influential factor was biologic factor i.e. endocrinologic gland deviations, nutrition, hormonal imbalance, dental root structure, and alveolar bone density.

The causal factor was also from the treatment side i.e. 1) treatment, 2) the beginning age of orthodontic treatment, this was connected to dental root forming stage, and

3) variations of mechanical factor, such as the type of tools, its strength, treatment types, plaque retention on the application of orthodontic equipment, and the direction of dental movement.[3,4]

Dental root resorption in various orthodontic treatment system

Treatment with Edgewise system

From 200 patient's post-treatment panoramic radiography using Edgewise system, the dental root resorption was as follows: 40% was moderate resorption i.e. blunting teeth until ¼ dental root in one region that was central or lateral incisive; and 20% had root resorption level equal with incisive central mandibular teeth. Severe dental root resorption was shown in 6 patients (3%) on both sides of central incisive teeth. Moderate dental root resorption was found in premolar teeth (6%). In this study, the mean of root resorption on maxillary central incisive teeth was 1.17 mm, whereas on mandibular incisive was 0.87 mm.[11]

Other study with Edgewise system on division 1 class II mal-occlusion treatment, without tooth extraction, added with maxillary oral extra equipment, and the use of class II elastic, revealed 99.08% subject, suffered post-treatment dental root resorption. From 208 treated maxillary incisive teeth, 172 (82.69%) endured dental root resorption. Male patients was 84.37% and female patients was 81.25%. The dental root resorption in male was more often on lateral incisivum (87.50%) compared to central incisivum (81.25%). Ignoring gender, the resorption on lateral incisivum was 83.65%, while on central incisive was 81.73%. The percentage of right maxillary incisive dental root resorption was 84.62%. and the left side was 80.77%. Ignoring gender, the frequency of dental root resorption on right maxillary incisive was bigger than the left side. The mean of central incisive was 2.19 mm, and the lateral incisivum was 2.31 mm.[12]

Treatment with Begg system

The study was done on 42 patients treated with Begg system. Pre-treatment already showed dental root resorption on 4% cases, during treatment, before doing uprighting on tipping teeth, irregular dental root form was found 25% (score 1) and 31% score 3 root resorption (less than 2 mm). At the end of treatment, 48% was root resorption less than 2 mm (score 3) and score 5 (less than 2 mm up to 1/3 dental root was 3%). Six months after treatment, the biggest dental root resorption was on mandibular central incisive (95%), maxillar central incisivum (90%), maxillar lateral incisivum (87%), mandibular canine (79%), and maxillar canine (72%). There was low incidence of mandibular premolar dental root resorption. It was affirmed that should dental root resorption already existed on pre-treatment, will cause more severe resorption during orthodontic treatment.[13]

Dental root resorption in various dental movement

Orthodontic treatment with dental intrusion, acquired a significant root shortening. Mandibular incisive dental root shortening was smaller than maxillary, probably due to smaller intrusion on mandibula or because of the different speed of bone turnover rates. Several cases showed severe dental root resorption in upper and lower jaw with treatment-length 28.6 ± 4.3 months. The total number of intruded teeth in the lower jaw was significant with the total number of dental root shortening.[14] Other writer obtained insignificant correlation (r = 0.03) between dental root resorption number and intrusion achievement on both sides of incisivus. It was said that no correlation was found between dental root resorption and the span of time of teeth intrusion (r = 0.02).[15] On treatment of anterior opened bite case, there was no significant difference between the length of dental root pre- and post-treatment. If compared with control group, i.e. inside bite, the dental root of anterior opened bite case was shorter before treatment. Post-treatment showed dental root resorption and less significant facial bone support. The result of this study demonstrated orthodontic treatment had no big role in dental root resorption of anterior opened bite case treatment of adults.[16]

The research on the correlation of dental root resorption and dental root to labial side treatment with torque, displayed dental root torque to labial, did cause dental root resorption. Observation was done towards incisive teeth, as the result of dental movement yielding a shortening of the central incisive teeth length by 0.9 mm per year. The disapperance of dental root structure was 1.4 mm per year or 1.56% per year. This happened because of dental extrusion with arch wire mechanical power.[17]

Vardimon *et al*. [18] in his research on external dental root resorption with iatrogenic nature on treatment with palatal expansion, found a dental mesiobuccal root of tooth with more than 1 root, closest to buccal cortical plate(12%), while distobuccal root was external dental root resorption (49%). In canines, the dental root resorption was 12% lower than tooth abutment. It can be explained as follows, canine dental root moved farther from solid bone lamellae whereas dental root with more than one translation bodily into buccal cortical plate. Dental root located close to buccal cortical plate, will have external root rersorption bigger than dental root located closer with less solid palatal cortical plate.

DISCUSSION

Irreversible dental root resorption on apical dental root was caused by dental movement in orthodontic treatment and it was known as treatment phenomenon. The specific feature of hard tissue disappearance, was widely publicized on orthodontic library, although the causal factor and the real impact of orthodontic treatment was yet to be proven. Dental root resorption caused by orthodontic treatment most often happened to maxillary incisive teeth.[3,9,13,15,16,19,20] Many possibilities were considered as the cause, such as high abnormality frequency from dental root and the distance passed through of dental movement during orthodontic treatment.

Another factor for incisive dental root resorption was due to the development of dental root closer with maxillary canine dental eruption. Therefore, there was a possibility that lateral incisive dental root acted as the guide for caninus eruption teeth. Erupted canine follicles often brought *damage* to lateral incisive apical, but the *damage* will not be seen in the radiography. Caninus eruption teeth often resorbed lateral incisive dental root from the palatal side.[9,19]

Maxillary dental root resorption was more severe than mandibular. Incisive teeth had undergone more root resorption than canine teeth on its curve. Lateral incisive dental root was the most severe resorption, followed by maxillary central incisivus, maxillary canine, mandibular canine, mandibular central incisivus and mandibular lateral incisivus. Several possibilities to explain why maxillary lateral incisivus undertook the most severe resorption, was the maxillary lateral incisivus showed the highest percentage in abnormality of dental root form i.e. peg-form, barrel, crown. Also in maxillary lateral incisive was ranked the 3rd of missing teeth after M3 and premolar of two mandibles. The root of lateral incisive dental root proned to be slimmer, so that often mislocated to messial direction should there be growth deficit on premaxillary. In this condition, if a bodily movement was needed at distal of anterior region, only lateral incisive teeth could move to 3 sectors significantly. The lateral incisive teeth often showed abnormalities i.e. dilacerated teeth, bottled form, and pointed teeth.[9,19]

As a rule, the sign of incisive dental root resorption had come out in the first stage of utilizing the orthodontic equipment, although only minimal change of periapical contour without significant root length shortening.[20,21] In this research, 24% research subjects underwent root shortening, but only 3.6% experienced shortening more than 2 mm. More or less 4.1% of patients endured root resorption with mean of 1.5 mm on all four maxillary incisive teeth. Minimal one maxillary incisive tooth underwent dental root shortening ≤ 2 mm. Dental root resorption happened in 3–9 months after the application of orthodontic equipment. This research also revealed the influence of risk factor to dental root resorption caused by orthodontic treatment with less than 25% explained.[20]

The impact of history of trauma as risk factor in dental root resorption caused by orthodontic treatment was still debatable. Previous studies demonstrated dental movement with severe lacerations often followed by moving of dental place without resorption and inflammation. Malmgren[22] in his study of light and moderate traumatic history showed no additional dental root resorption. Pre-treatment observation of minimal 5 months gave the same result with observed cases more than 1 year. Dental root resorption caused by trauma, was reported on all cases for 2–5 months after trauma causing luxation and subluxation. Trauma on incisive teeth causing dental root resorption will continue without signs. This happened due to the damage of periodontal ligament and cementum which will yield to easier process of dental root resorption. Orthodontists tried to minimize dental root resorption by avoiding big power on cases with history of trauma. Treatment system used in this study was varied between fixed and removable including the use of activator. Incidence and the degree of resorption without trauma history was 33% with score 2 (blunting dental root until ¼ of root length) and 10% with score 3 (blunting dental root more than ¼ root length) on treatment with Edgewise system. In Begg system treatment, 43% was with score 2 and 5% with score 3. The degree of dental root resorption in Begg system treatment was lower than previously reported study.[22]

External dental root resorption was also connected to genetic predisposing. There was a correlation of the scale of dental root resorption during orthodontic treatment to IL-BL gene. This gene was produced by cytokine IL-1, believed to be able to decrease the risk of external dental root resorption.[23]

It was concluded that orthodontic treatment was proven to cause dental root resorption, in particular the maxillary incisivum. The dental root resorption caused by orthodontic treatment most often happened to maxillary incisive teeth, the most severe was on lateral incisive dental root. No conclusive data of the influence of risk factor to dental root resorption caused by orthodontic treatment. The result of this study was not yet able to demonstrate clearly the impact of treatment variables, i.e. treatment duration, system and the scale of power being used in orthodontic treatment towards dental root resorption.

Dental root resorption happened almost always to teeth undertaking orthodontic power. Therefore, orthodontic strength must be adjusted to dental movement, avoiding to give extra power to dental with risk factor, among others history of trauma, hormonal imbalance, dental form deviation, and genetic abnormality.

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