Does Maxillary Expansion Lead to Root Resorption? - A Comprehensive Review

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ABSTRACT

The objective of this review article is to assess root resorption of conventional rapid maxillary expansion (RME) and mini screw assisted rapid palatal expansion (MARPE) with 2D and 3D radiographic imaging method. For this review article, the current literature was searched on the studies conducted on the effects of such expansion appliances on root resorption. Orthodontic patients with transverse maxillary deficiency undergo maxillary expansion therapy for the correction of posterior crossbite. The evaluation of root resorption in such patients can be done with either 2D radiographs such as periapical radiograph, panoramic radiograph or 3D radiographs such as cone beam computed tomography. This review article will discuss the studies showing that conventional RME appliances can result in root resorption in molar teeth after the expansion procedure. In contrast, MARPE appliances have not shown significant root resorption after expansion procedures.

Keywords: Adolescent, cone beam, diagnostic radiologic examination, maxillary expansion, root resorption, young adults.

I. INTRODUCTION

Root resorption is believed to be an important side effect of orthodontic treatment. As severe amounts of root resorption can have a negative influence on the long-term sustainability of the affected teeth. Root resorption is identified as a process leading to the loss of cementum and dentin in the roots of teeth [1]. The causative factors for root resorption are complex and intermingle with each other. It is believed that root resorption is multifactorial in nature with numerous factors playing a role such as genetic factors, orthodontic factors, mechanotherapy related factors, and iatrogenic factors [2]. The orthodontic factors associated with root resorption are not as simple and therefore not completely deciphered yet.

There is not much agreement in the literature regarding the incidence of root resorption [3]. It has been shown in previous studies that heavy forces are mainly harmful and can lead to root resorption [3]. Several studies have shown a correlation between increased root resorption and heavy orthodontic forces when compared with light forces or controls [4]-[7]. When compared with light forces, heavy forces have shown to result in increased root resorption in both compression areas and tension areas. However, there is more evidence needed to identify if orthodontic procedures such as maxillary expansion can lead to root resorption and to identify ways to manage the severity and prevalence of root resorption in such patients. This review article will discuss about the effects of maxillary expansion procedures on root resorption.

II. METHODS OF ANALYZING ROOT RESORPTION

Historically, the identification of root resorption is performed by using two-dimensional (2D) radiographs. Such radiographs are periapical radiographs, lateral cephalometric radiographs, panoramic radiographs, posterior-anterior (PA) cephalometric radiographs, etc. Such radiographs project the three-dimensional structures of head and neck in two dimensions. Therefore, there are certain geometric limitations associated with the 2D imaging and therefore, the use of such 2D radiographs in quantifying the amount of root resorption is questionable [4], [8], [9]. With rapid maxillary expansion, the transverse force is directed buccally and this leads to buccal movement of the teeth. Because of this, the pressures created are on the buccal

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aspect of periodontal ligament creating compressive zones and associated hyalinization [10], [11]. If this process was to lead to root resorption, the resorption would act on the buccal aspects of the teeth, which is not visible in the traditional 2D radiographic imaging. The limitations of panoramic radiographic imaging such as the distortion of the position and angulation of teeth and magnification results in inaccurate assessment of root resorption [11]-[15]. Chan et al. therefore concluded that 2D radiography is not appropriate for evaluation of root resorption and should be avoided [4]. However, with 3D imaging, the evaluation of the amount of root resorption either linear assessment or volumetric assessment has been found to be accurate and reliable [4], [16], [17].

III. MAXILLARY DEFICIENCY

Maxillary Deficiency is a common orthodontic condition that is accompanied with unilateral posterior crossbite or bilateral posterior crossbite, narrow maxillary arch, anterior crossbite, and crowding of teeth [18]-[20]. The most common type of treatment for such condition is rapid maxillary expansion or RME. It can be performed with a tooth-anchored expansion (Hyrax) screw Tooth-tissue anchored expansion (Hass) screw, or with mini-screw anchored expansion appliance (MARPE) [21]-[26]. The expansion screw is soldered to the bands on the posterior teeth in tooth-anchored and tooth-tissue anchored expansion appliances. The MARPE appliance requires mini-screws to be inserted into the palate for the anchorage. Palatal mini-screws have shown very high success rates compared to mini-screws inserted in mandibular areas such as buccal shelf and ramus [27]-[29]. The disadvantage of the tooth-anchored expansion appliances has been identified in that it can result in loss of root volume [23], [30] due to the dental side-effects such as unwanted buccal tipping of the molar teeth with tooth-anchored expansion appliances. MARPE appliances can decrease the dental side effects [31] and possibly have a decreased incidence of root resorption.

IV. ROOT RESORPTION WITH RME AND MARPE

This review article was undertaken to critically evaluate the current literature on the effects of conventional RME and MARPE on root resorption. The available literature on the assessment of root resorption with conventional maxillary expansion (RME) and mini screw assisted rapid palatal expansion (MARPE) is scarce. Furthermore, the results of the current literature show inconsistencies in the method of identification of root resorption after RME and MARPE, mainly because of use of 2D imaging in older studies. The 2D radiographic studies have shown that there is no significant root resorption with maxillary expansion [32]. However, Barber et al. showed that there is presence of isolated buccal resorption have been shown with maxillary expansion [33]. With 3D approach, it was observed that there is significant loss of root volume after tooth-anchored maxillary expansion [30].

The literature on the effects of MARPE on root resorption is even less. Mehta et al. showed that there is reduced root resorption with MARPE compared to conventional RME after expansion procedures when evaluated after 6 months in short term follow-up [34]. This study was performed with 3D imaging Cone Beam Computed Tomography (CBCT). The authors also observed the same patients at long term follow up after 32 months and observed that there was no difference in the root resorption between the MARPE group compared with the control group in the long term. The study concluded that MARPE procedure is a safe option for expansion as it does not lead to root resorption [34].

In addition to molar teeth, the root resorption of premolars has also been evaluated after conventional maxillary expansion (RME). Barber et al., identified the apical root resorption of more than 4mm on one anchor premolar in his study [33]. Histological findings and radiological findings have also been compared with respect to root resorption with either light microscopy of scanning electron microscopy [32]. It has been observed that most anchored premolar exhibit root resorption mostly on the buccal surface, and some root resorption on the mesial, distal, and apical portions of the roots [33]. With MARPE, the anchor and non-anchor premolars have not shown significant root resorption [34].

Multiple factors affect root resorption process in addition to the type of expansion appliance used for orthodontic treatment. These factors include additional procedures such as osteoperforations. For many patients, osteoperforations can help in increasing the amount of skeletal expansion [37]. However, osteoperforations have been shown to increase root resorption because of the increased remodeling following such procedures [38]. Other methods of maxillary expansion with aligners have also gained traction in the recent years as an esthetic alternative to conventional orthodontic treatment [39], [40]. However, root resorption can be found with such methods as well [41]. The presence of short roots at the start of treatment, genetic predisposition of patients to root resorption, and trauma are other factors influencing root resorption.

V. CONCLUSION

Transverse maxillary deficiency can be treated with conventional rapid maxillary expansion (RME) or mini screw assisted rapid palatal expansion (MARPE). 2D imaging with periapical radiographs does not reveal the true extent of root resorption associated with maxillary expansion. 3D Cone Beam Computed Tomography allows the visualization of significant root resorption with maxillary expansion. RME can result in root resorption of molar teeth after expansion. MARPE appliances have shown to not cause root resorption after expansion.

REFERENCES


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