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Paediatric Orthodontics Part 2: Periodontal effects of maxillary expansion

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Abstract

Periodontal effects of maxillary expansion on teeth in deciduous and mixed dentition

Both rapid and slow maxillary expansion protocols may produce different effects on the palatal suture, on the periodontium, and on alveolar anatomy such as lateral flexion of the alveolar processes, root resorption, bone fenestration and the anchorage teeth can show different degrees of inclination and dislocation. In order to reduce these side effects, maxillary expansion devices anchored to deciduous teeth or miniscrew-supported appliances should be considered.

KEYWORDS Maxillary expansion; Miniscrew-assisted rapid palatal expander; Orthodontic treatment; Periodontal effects.

Introduction

Maxillary Expansion (ME) technique is the most common method to correct transversal skeletal upper arch deficiency. It is a dentofacial procedure performed during orthodontic treatment to increase transverse maxillary diameter [Angell et al., 1860; Haas et al.,1965]. The traditional maxillary expansion appliance is fixed on maxillary teeth to express the skeletal movement which involves separation of the mid-palatal suture and moving the palatine shelves away from each other [Kumar et al., 2011; Fastuca et al., 2014]. The orthopaedic movement is always combined with a labial tooth movement (buccal displacement and buccal tipping) of anchored teeth [Quinzi et al., 2018; Sandıkçıoglu et al., 1997].

Depending on magnitude of the force applied, treatment duration, frequency of activation and patient's age, the maxillary expansion procedure may produce different effects on the palatal suture and on the periodontium [Haas et al., 1965; Sandıkçıoglu et al., 1997; Caprioglio et al., 2017]. Transverse maxillary expansion mechanism can be slow or rapid. It has been observed that rapid maxillary expansion (RME) utilises high-intensity forces and, compared with slow maxillary expansion (SME), RME results in minimum dental movement and maximum skeletal movement [Agarwal et al., 2010]. On the contrary, SME is more closely related to dental than orthopaedic effects compared to RME. Moreover, RME performed before the peak of skeletal maturation produces more orthopaedic effects than RME performed after the peak [Giuca et al., 2012; Baccetti et al., 2001; Mummolo et al., 2014].

Periodontal effect of ME on alveolar anatomy

It has been seen that both rapid and slow maxillary expansion protocols can cause lateral flexion of the alveolar processes and the anchorage teeth can show different degrees of inclination changes [Brunetto et al., 2013; Mummolo et al., 2014]. RME is characterised by great forces that should be discharged mainly on the middle-palatal suture. Nevertheless, the forces of the RME device create dislocation of the supported teeth and hyalinisation of the periodontal ligament [Caprioglio et al., 2017; Digregorio et al., 2019; Marchetti et al., 2009].

Teeth buccal displacement outside the alveolar process might cause periodontal and radicular lesions. According to the results of Garib et al. [2006], RME induced gingival

recession, root resorption, bone dehiscence and fenestration, reduction of buccal bone thickness and alveolar levels of the crestal bone, both horizontally and vertically. These side effect occur mainly in subjects with thinner buccal bone plates [Garib et al., 2006; Rungcharassaeng et al., 2007; Mummolo et al., 2018]. In some cases, uncontrolled expansion may even lead to alveolar bone fracture (Fig. 1).

Periodontal effects of ME on the micro anatomy of the periodontium

Clinical and histological studies have shown microfractures at the mid-palatal suture, relapse and especially external root resorption in rapid maxillary expansion treatment [Linder-Aronson et al., 1979; Barber et al., 1981; Fastuca et al, 2015].

Histologic and scanning electron microscope studies have assessed the grade of root surface damage and the subsequent repair of such root defects [Barber et al. 1981; Greenbaum et al., 1982]. Only recently, the advent of computed tomography, allowed to appreciate the effects of expansion protocols. The 3D methodology offers quality diagnostic information and the radicular and periodontal aspects can be better evaluated by means of micro computed tomography (micro-CT) [Kaur et al., 2017; Fastuca et al., 2017]. A low-dose CT-based randomised controlled trial [Martina et al., 2012] showed how RME and SME are equally effective in producing skeletal maxillary expansion in patients with posterior crossbite.

From cone beam computed tomography (CBCT) investigations, it has been seen that an excessive labial tooth movement can lead to apical migration of the buccal alveolar crest of posterior anchor teeth, especially when the treatment is performed in permanent dentition patients [Lagravére et al., 2006; Rosa et al., 2016].

Animal investigations [Steiner et al., 1981; Wennström et al., 1987] and human studies [Wehrbein et al., 1994; Biondi et al., 2016; Tecco et al., 2015] demonstrated that labial tooth movement with mild forces increases the distance between the labial alveolar crest and the cementoenamel junction, which leads to bone dehiscence in the short-term [Engelking et al., 1982; Steiner et al., 1981; Thilander et al., 1983; Wehrbein et al., 1994; Wennstrom et al., 1987] and to gingival recession in the long-term [Artun et al., 1987]. In the CT-based study of Garib et al. [2006], the authors concluded that RME induced bone dehiscences on the buccal aspect of anchor teeth especially those with initially thinner buccal bone plate. In a recent study, two groups of patients treated with RME have been considered [Digregorio et al., 2019] using (CBCT) to evaluate the buccal bone plate thickness (BBPT) of maxillary permanent first molars: a group of patients using first deciduous molars as anchorage (E) and a second group using the first permanent molars as anchorage (6). In group E no reduction in BBPT of the maxillary permanent first molars was observed, except for the mesial roots in both sides. On the contrary, in group 6, RME caused a reduction in BBPT of the maxillary permanent first molars. Moreover, the amount of reduction of the buccal bone plate thickness of the maxillary permanent first molars in group 6 showed statistically significant differences compared with the overall absence of bone reduction when RME was performed in the mixed dentition [Digregorio et al., 2019].

Alternative: skeletal anchor and deciduous anchor

To prevent side effects on the periodontium of permanent teeth, appliances anchored to deciduous teeth [Garib et al., 2014] or miniscrew supported appliances [Lee et al., 2010] should be considered.



FIG. 1 Periodontal effects of RME: note the lines of fracture trough the alveolar process of upper central and lateral incisors in a case of RME anchored to teeth E and C.

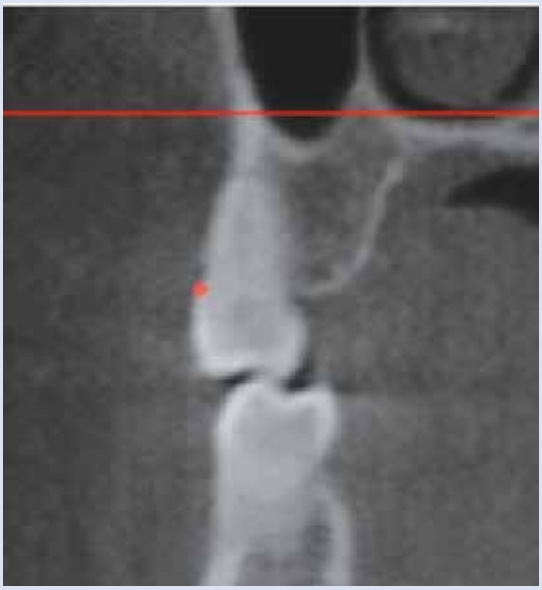


FIG. 2 Proximity of the root of an upper right first molar to the cortical maxillary bone after expansion.

Garib [2006] investigated the periodontal bone changes due to RME in the early mixed dentition using deciduous teeth as anchorage. He reported that RME increased the transverse maxillary diameters and prevented possible periodontal side effects to permanent teeth that were not involved in the appliance compared with RME anchored to permanent teeth showing a decrease in the buccal bone plate thickness.

Moreover, other authors showed that RME appliances anchored to deciduous teeth allow resolution of crossbite of the permanent first molars. The permanent first molars spontaneously follow the deciduous teeth and the expansion with a more bodily movement and avoid the buccal tipping that usually occurs when the appliance is anchored to them [Cozzani et al., 2003; Dinoi et al., 2015].

To prevent side effects to the alveolar bone and teeth, other authors [Lee et al., 2010; Dinoi et al., 2016] introduced a rigid element that delivers the expansion force directly to the basal

bone through opening of the mid-palatal suture. The device, a non-surgical miniscrew-assisted rapid palatal expander (MARPE), was designed and used especially in young adults, to avoid or reduce the impact of a possible maxillofacial surgical treatment. MARPE is an effective method for the non-surgical correction of maxillary transverse deficiency and many case reports show the outcomes and stability of the MARPE in patients with severe maxillary constriction and mandibular prognathism [Parkset al., 2000; Suzuki et al., 2016; Giuca et al., 2008].

Conclusion

- Maxillary expansion with a device anchored to teeth performed in deciduous and mixed dentition results mainly in basal bone skeletal movement and secondly in dental movement and alveolar bone flexion.
- To reduce side effects such as root resorption and bone fenestration, ME devices anchored to deciduous teeth or miniscrew-supported appliances should be considered.
- During ME treatment, gingival biotype and oral hygiene should also be taken into account.
- It is important to monitor the periodontal tissues since orthodontic appliances can cause an imbalance of the oral flora, leading to accumulation of cariogenic and/or periodontopathic bacteria.
- Recent low-dose CBCT investigations have shown the periodontal effects of ME on deciduous and permanent teeth but more studies and follow-ups are needed.

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