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The Difference Between Rapid and Slow Maxillary Expansion: A Literature Review

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Abstract

Objectives: *The aim of this study was to compare the dentoalveolar and skeletal outcomes between two types of maxillary expansion: rapid maxillary expansion (RME) and slow maxillary expansion (SME).*

Materials and Methods: *An electronic search was performed using different databases such as Google Scholar, PubMed, Springer Open, Elsevier, and journals such as The Angle Orthodontist, Progress in Orthodontics, Dental Press Journal of Orthodontics, Angle Orthodontist, and Cureus . From May 2013 to January 2023.*

Result: *The front teeth are hardly or barely tipped in SME while the RME group had higher inclinations and tendencies of relapse. There are very few in SME compared with RME. The intensity of pain during the first week is less in SME than RME prolonged treatment period is needed in SME. The RME group showed vague but not significant greater decreases in the buccal bone thickness than the SME at distal root level and mesial root levels, respectively and the outcome greater bodily movement of the teeth in the slow maxillary expansion group. Loss and reduction of height and thickness of bone were detected in both groups, with greater intensity and significance in the slow maxillary expansion group.*

Conclusions: *This literature Review study describes the efficacy of the two types of expansion for the correction of a constricted maxilla with slow and rapid palatal expansion, which are more efficient when used in a long-term period, for achieving a perfect treatment. During treatment carefully, protocol must be considered in order to prevent any uncontrolled maxillary movement. As a result, both types of maxillary expansion were effective to promote a dentoalveolar growth in the transversal direction. While there was no significant difference between the Sagittal and vertical measurements.*

Keywords: Rapid Maxillary Expansion, Slow Maxillary Expansion, Maxillary transverse Deficiency, Constricted Maxilla

Introduction

The main purpose of this literature review is to compare rapid and slow maxillary expansion. Maxillary expansion has been used to treat and correct maxillary transverse deficiency. Correction of the constricted maxilla requires expansion of the palate by orthopedic and orthodontic tooth movements. Orthodontists must choose the right appliances based on the treatment plan, patient's age, and malocclusion [1, 2]. The maxilla growth usually is completed at age 6, In order to achieve palatal expansion after puberty, there must be a strong force for separation to occur

at the maxillary suture [4]. Transverse force will tip the buccal segment laterally [5]. And to provoke a bodily translation, a 3rd-order moment and a proper appliance design are needed [6, 7]. The main etiological causes for the palatal constriction arise from the genetic and/or environmental maxillary discrepancies. The most common transversal malocclusion is the posterior crossbite. [8, 9]. Therefore, it is important for the orthodontist to recognize the different modalities of expansion to achieve the main goal of treatment, which is the patient's functional and aesthetic comfort [3]

Aim: The aim of this study was to compare the dentoalveolar, skeletal outcomes between two types of maxillary expansion: rapid maxillary expansion (RME) and slow maxillary expansion (SME).

Method: An electronic search was performed using different databases such as Google Scholar, PubMed, Springer Open, Elsevier, and journals from The Angle Orthodontist, Progress in Orthodontics, Dental Press Journal of Orthodontics, and Cureus. From May 2013 to January 2023. Using Rapid Maxillary Expansion, Slow Maxillary Expansion for the keywords. Only studies published in the English language were considered. The studies were heterogeneous. Randomized controlled trials, longitudinal prospective studies, prospective studies, review articles, systematic reviews, were eligible for inclusion. All titles and abstracts were screened only studies that considered both orthodontics and expansion have been examined. complete the database search yielded 50 potential articles. After evaluation of the titles and abstracts, articles that did not correlate rapid and slow maxillary expansion, articles that were not in English, and animal studies were excluded; eventually, 17 articles were selected and included in the review.

Finding

Two of the selected studies focused on the effect of RME and SME on the periodontal ligament for orthodontic treatment (Renta et al 2019; Mummolo et al, 2014). One study investigated the Mandibular impulsive dentoalveolar alterations after slow or rapid maxillary expansion (Alves et al, 2017). Three studies evaluated Rapid maxillary expansion vs slow maxillary extension in patients among cleft lip and/or palate (Gregorio et al, 2019; Ayub et al, 2022). Five studies evaluated the rapid and slow maxillary expansion Evaluate the difference between transverse dentoalveolar and skeletal modifications (Serafin et al, 2022, and Patil et al ,2023).Tow studies about amount of pain and pain sensation (Feras et al, 2021). Impacts of rapid and slow maxillary expansion on root resorption (Colak et al 2021). two studies inspected the stability of RME and SME one study monitored the An Otolaryngologic Evaluation in RME [10-17].

Results

This study describes the efficacy of the two types of expansion for the correction of a constricted maxilla with slow and rapid palatal expansion, which are more efficient when used in a long-term period, for achieving perfect treatment. During treatment, carefully protocol must be considered to prevent any uncontrolled maxillary movement. As a result, both types of maxillary expansion were effective to promote dentoalveolar growth in the transversal direction. While there was no significant difference between the Sagittal and vertical measurements.

Discussion

Slow Maxillary Expansion

SME is a method applied to correct the narrow upper arch by enhancing it transversally. Slow palatal expansion, or dentoalveolar enlargement, implies the use of appliances to expand the palate transversally. Still if the expansion is only dental, skeletal modifications are still evident. There is less tissue resistance in structures nearby the maxilla, and there is an enhancement in bone structure in the midpalate suture. Accordingly, it decreases the disadvantages of RME. Studies have confirmed that slow expansion promotes significant post-expansion stability [6, 7]. A force of 10-20 newtons must be applied on the upper arch, which creates 450-900 g of magnitude, which is not adequate to detach a developing suture [2, 3, 18]. Upper arch width varies from 3.8 to 8.7mm with slow maxillary expansion by utilizing 900 gm of force for 1mm per week. An appliance used for SME is divided into two removable appliances and a fixed appliance. Active Plate, Coffin Springs, and Schwartz Appliances are samples of removable devices [19, 15]. Quad Helix, Niti Palatal Expander and Spring Jet are samples of removable appliances.

The Advantages of SME

It applies to a constant physiological force. The anterior teeth are hardly tipped. Anchored teeth encounter a minimal amount of pressure. The patient will find the device to be affable and lightweight [15]. Incidences of relapse are very limited. Sutural integrity is preserved, and it is a minor trauma.

Disadvantages

Include that when evaluated to rapid maxillary expansion, an extended treatment period is required. For correction of minimal crowding by gaining spaces in patients with a crossbite slow maxillary expansion is indicated. Incorporate when evaluated to rapid maxillary expansion, a extended treatment period is required. For correction of minimal crowding by gaining spaces in patients with a crossbite slow maxillary expansion is indicated. SME is advised to use slow steady forces on patients who are developing mild maxillary constriction with cleft lip and palate.

Contraindication

It is contraindicated in patients whose growth is completed.

Rapid Maxillary Expansion

The main aim of the RME is to widen the narrow upper arch, but its impact is also seen on the bones of the face and head [20]. In 2-4 weeks, an expansion of 0.3 to 0.5mm occurs in the palate [21]. Cleft lip and palate birth abnormalities are among the most prevalent birth malformations, and the second is oral cleft [22, 23]. As newly, Graber promoted in 1940s RME as a method to treat patients suffering from cleft lip and palate problems [24]. The primary aim of the approach is to separate midpalate suture of the crossbite anterior and posterior, upper constricted arch high palate. It shows that there is a decrease in overbite and an increase in overjet. Additionally, it is utilized in situations of overcrowding by expanding the perimeter of the upper arch. The major difficulty was to the expansion of palatal sutures is the sphenoid and zygomatic bones [9]. The appliance used for RME is divided into tissue-borne and tooth-borne. And Hyrax and Isaacson appliances are a representative of tissue-borne appliances. While Hass and Derichsweiler appliances are examples

of tooth-borne appliances. Short treatment time is the advantage of rapid maxillary expansion when compared to slow maxillary expansion.

The Disadvantages of Rapid Maxillary Expansion are Stated Further

There is difficulty in sustaining oral cleanliness. It can also be broken or removed. Acute ulcerative gingivitis is one of the disadvantages can cause pain due to tissue infection. Occasionally sutures decline to open. Another disadvantage correlated with the RME is that in post-retention evaluation, relapse occurred mainly in the intercanine width of the upper arch.

RME Indication

RME indicated in patients with unilateral or bilateral discrepancies like posterior crossbite with multiple teeth [18]. Anterior posterior differences also came beneath the indication of RME like malocclusions that involve Class II division 1 and Class III. Patients with cleft lip and palate might also require rapid expansion.

Contraindications for Rapid Expansion

Include Single crossbite, open anterior bites, and a high mandibular plane angle, uncooperative patients are also a contraindication for RME. For patients having severe vertical skeletal incongruities along with asymmetrical upper or lower arches are contraindicated for RME.

Compare the Difference Between Transverse Dentoalveolar Changes

According to the results of the present study done by (Serafin et al 2022) . Rabid maxillary expansion and slow maxillary expansion are equally capable of producing both skeletal and dentoalveolar transverse expansion. RME produced more anterior expansion than SME, therefore it could be better suited for patients with respiratory dysfunctions and anterior dental crowding. Molar inclination control is more superior for SME than RME, making SME recommended in patients with severe buccal inclination of upper permanent molars without the need for a preparatory appliance to molar decompensation. SME provides a more controlled dental movement because of its constant release of forces, also eliminating the need for home activation.

A study randomized clinical trial done by Helder et al,2019 to compared the difference between transverse dentoalveolar changes The RME group showed indefinitely but not significant greater decreases in the buccal bone thickness than the SME group at distal root level and mesial root levels, respectively . SME showed greater buccal movement of mesial buccal root than distal buccal root while the RME the opposite pattern. Both maxillary expansions does not show first molar apical root resorption neither interrupt root formation.

RME and SME With Cleft Lip and/or Palate

Asystematic review and meta-analysis done by Alves et al 2016 in cleft patients SME and RME promote equal posterior expansion. With SME (QH appliance) anterior differential expansion is greater especially for bilateral cleft lip and palate. No clear evidence exists concerning the amount of dental side effects of SME and RME in cleft patients [25]. Transverse Changes. Arch width and perimeter increased remarkable with both SME and RME treatments [10]. Palatal depth did not increase with SME treatment but was significantly increased in patients treated with the RME. Found no significant increase in palatal depth for SME or RME [26]. The SME appliance produced differential expansion with a statistically significantly greater increase in intercanine width compared with intermolar width. In bilateral cleft lip and palate patients, no significant changes were found in differential openings of SME or RME. The molar width increase was not found to be different between SME and RME [28]. Patients treated with the RME appliance remained to have a slight transverse deficiency anteriorly and posteriorly, according to [27].

In Comparison on Intensity of Pain

In a comparison of intensity of pain between RME and SME that was done by Valentina et al 2022 During the first week of treatment in growing patients, the application of SME shows less pain intensity compared to RME. There were no differences in the first week of treatment for difficulty of speaking, difficulty in swallowing, trouble in hygiene, hypersalivation, and patient and parent satisfaction between RME and SME appliances. There were no significant variations in pain between the two procedures for all following weeks [29-32].

Rapid Maxillary Expansion Effect on an Otolaryngologic Perspective

The application of RME can have definite effects on obstructive sleep apnea (OSA). Numerous mechanisms have been supported, such as the reduction of adeno-tonsillar size, the reduced incidence of tongue collapse due to insistent oral breathing, and the stiffening of the collapsible pharyngeal segment of the airway [17].

The Effect of Rapid and Slow Maxillary Expansion in Periodontal Ligament

The activation frequency of the palatal screw might have affected dental and periodontal aspects and there were alterations in dental movements and periodontal side effects between RME and SME (Renta et al 2019). The palatal expander influences periodontal health: mutually rapid and slow expansion treatments present potential irritation effects and increase of plaque and bleeding on the periodontium (Mummolo et al 2014).

Dentoalveolar Changes After SME and RME in Mandibular Arch

Founded on the results from this systematic review done by Alves et al 2017 , there is sufficient sign to conclude that slight short and long-term impulsive dentoalveolar changes arise in the mandibular dental arch after SME or RME in the mixed and early permanent dentition. (Alves et al, 2017).

Effects of RME and SME on Root Resorption

In the study done by Cloak et al 2021 a higher total root resorption volume was found for the SME group in comparison to the RME group following the expansion period. During the retention period in which the active force delivery ceased, the root resorption volume decreased in the SME group but increased in the RME group (Colak et al 2021)002E

Stability of Rapid and Slow Maxillary Expansion

A systematic review study done by Fábio et al. assessed the long-term RME and SME retention and showed they were quite alike.

In the long-term post-treatment period, transverse arch width declined at the canine, premolar, and molar regions of all; however, it was remarkably greater in the RME associated to the SME [33, 34]. There was a similar percentage of clinically rebound cases of posterior crossbite for both rapid and slow maxillary expansion. Long-standing rapid and slow maxillary expansion stability are quite alike. Considerably greater intercanine width lessening was observed in rapid maxillary expansion only. The percentage of clinically relapsed cases of posterior crossbite was analogous for both rapid and slow maxillary expansion [16].

Conclusions

This literature review study describes the efficacy of the two types of expansion for the correction of a constricted maxilla with slow and rapid palatal expansion, which are more efficient when used in a long-term period for achieving a perfect treatment. During treatment, carefully protocols must be considered in order to prevent any uncontrolled maxillary movement. As a result, both types of maxillary expansion were effective to promote dentoalveolar growth in the transversal direction. While there was no significant difference between the Sagittal and vertical measurements [35, 36].

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