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Orthopedic Treatment of Maxillary Expansion: A Review of the Literature

Sylvia Ng, Minjie Li, Yanqi Yang

Introduction

The narrow maxillary arch compared to the mandibular arch usually results in the transversal discrepancy of posterior teeth. Characterized by unilateral or bilateral crossbite, it is necessary to expand the constricted upper arch in order to correct the transverse discrepancy in these malocclusion cases. [1] By dental tipping and midpalatal suture opening, the dentofacial abnormality including transverse maxillary deficiency, unilateral crossbite and minimal crowding can be corrected. There are different types of methods and appliances for maxillary enlargement, but since the midpalatal suture becomes more tortuous and interdigitated with increasing age [2], arch expansion is suggested to initiate before pubertal peak in skeletal growth.

The overall goal of this review is to compare different types of maxillary expansion treatment and to describe both the advantages and disadvantages of some common sorts of expanders.

Types of Maxillary Expansion and Mechanism

According to the duration of the activation period and the expansion rate, there are three main kinds of maxillary expansion treatment protocol, which will be described below.

Rapid Maxillary Expansion (RME)

RME therapy is one of the most common orthopedic treatments for narrow maxilla. The RME device usually composed of a midline screw that is either tooth-borne or tooth and tissue-borne. The rational being with rapid force is that with rapid force application to the posterior teeth, there would not be enough time for tooth movement, the force would be transferred to the suture, and the suture would open up while the teeth moved only minimally relative to their supporting bone. It can not only increase the width and perimeter of the upper arch, but also create space for maxillary dentition to relieve crowding.

With rapid expansion, at a rate of 0.1 to 0.5 mm per day, one centimeter or more of expansion is obtained in 2 to 3 weeks, with most of the movement being in separation of the two halves of the maxilla. Two to four turns of the midline screw per day are applied to the expansion device for couples of weeks to correct crossbite until overcorrection. During arch expansion, median diastema occurs between the upper central incisors. However, the space created at the midpalatal suture is filled initially by tissue fluids and hemorrhage, which makes the expansion highly unstable. Therefore, the expansion device must be stabilized so that it cannot screw itself back shut. Generally, the appliance is left in place for 3 to 4 months after expansion. By then, new bone has filled in the space at the suture, and the skeletal expansion is stable. In a study of Sandkicicolu [3], RME showed remarkable dental and skeletal results in transversal, sagittal and vertical planes compared to slow maxillary expansion and semi-rapid maxillary expansion.

Slow Maxillary Expansion (SME)

An alternative to traditional RME is SME, which uses relatively lower orthopedic forces in longer time to accomplish similar amount of expansion. Instead of several weeks, lower force takes months to induce palatal expansion with less dental tipping and less sutural trauma. The theory is that rather than the suture itself,
the main resistance to opening the midpalatal suture is offered by the surrounding tissues such as midface sutures and circum-maxillary structures. Relatively slower and lower maxillary expansion may cause minor tissue resistance in the nasomaxillary complex. A retrospective study done by Huynh [4] showed a stability rate of 84% for posterior crossbite correction using SME. Other than RME, SME allows the maximum rate with approximately 0.5 mm per week at which the tissues of the midpalatal suture can adapt. In this way, tissue damage and hemorrhage at the suture are minimized, and a large diastema would never appear, so a more physiologic response is obtained. For a Haas and Hyrax expander, SME is defined as roughly 0.25 mm or quarter turn of expansion every other day, or 1 molar of width activation for a quad-helix appliance.

Semi-rapid Maxillary Expansion (SRME)

Although RME has been demonstrated having an effective impact on palatal expansion, its long term evaluation has shown a relapse tendency. High level orthopedic force generated by RME is applied to various structures in the craniofacial complex which have different degrees of resistance depending upon their location and orientation to the direction and center of force. There is research showing that rapid deformation and displacement of maxillofacial bones leads to remarkable relapse in the long run. [3,5]

Thus, Iseri [6] suggested SRME, whose regime is that instant SME following the separation of midpalatal suture produced by RME. To be specific, two turns per day for the first 5 to 6 days followed by three turns per week for the remainder of the SRME treatment. Through stimulating the adaptation process in nasomaxillary complex, SRME would minimize relapse in post-retention period even in young and adult patients.

In order to investigate the effects of RME and SRME, a research [7] was performed in the mixed dentition. The results showed that SRME had a similar impact on dentofacial structures as the RME did, and the modifications occurred in vertical, sagittal and transverse planes. But since the activation protocol is faster for RME than SRME, RME has the advantage of shorter active treatment time as well as shorter bonded device wearing. Regarding to the possibilities of relapse, further research should be performed to investigate whether the decrease of residual stresses in dentofacial structures after SRME therapy would be advantageous.

Types of Expansion Appliances and Therapeutic Effects

A wide variety of appliances and methods are available for accomplishing maxillary and palatal expansion. It often depends on the degree of maxillary deficiency, the amount of expansion desired and the age of the patient.

Jackscrew Appliances

Differences in treatment effect and stability are attributed to appliance design to some extent. Patients, whose growth has not ceased, are advised to use jackscrew appliances to achieve skeletal expansion along with dental expansion. There are two types of jackscrew appliances are most often used. The Haas-type expand-
skeletal expansion with insignificant relapse.

Nonscrew Expanders

Palatal arch is a type of nonscrew expander which is widely used for expanding the maxilla. It is made of arch wire loops attached to the palatal aspects of bands encircling upper first molars, and is activated before cementation. The palatal arch incorporates quad-helix with four helices, and the expansion force is delivered via the wires against the teeth. Nonscrew expanders are mainly used in the primary or mixed dentition to open up the maxillary suture, but the sutural expansion is minimal. However, Boysen et al [19] demonstrated that the basal expansion the quad-helix accomplished was beyond the removable jack screw expander. Additionally, McNally et al [12] found no difference in clinical effectiveness between quad-helix and expansion arch regarding to the crossbite correction. And other research also indicated quad-helix had similar results with jack screw expanders. [4]

Surgically Assisted Rapid Palatal Expansion (SARPE)

SARPE is a surgical procedure and optional treatment indicated for adult patients with transverse maxillary deficiency because skeletal maturity has already been reached in midpalatal suture. The surgery involves median palatine suture split with or without pterygoid osteotomy, after which a maxillary expander is cemented and activated on the upper arch for a couple of weeks until overcorrection. The retention period usually lasts for 3 to 6 months. When compared with only RPE in some studies, SARPE is indicated to loosen the circummaxillaritysural resistance therefore to restrict unwanted tooth movement from dentoalveolar expansion. [21] Nonetheless not every patient is willing to accept SARPE because of surgical risks and economic factors. [8]

Age Limits

Previous studies have shown that the morphologic development of the midpalatal suture diverse from each growth period with broad and Y shaped in infantile stage and more wavy during juvenile stage. During adolescent stage of development, the two maxillary segments are highly interdigitated in a very tortuous course. The transverse growth of the suture continues up to 16 year-old age in girls and 18 in boys.

Midpalatal suture opening can be achieved in both children and adults, but as the skeletal components mature, the rigidity of the bony interdigitation becomes so heavy that it is not possible to separate the two halves of the maxilla unless assisted by surgical fracturing of the maxilla. [22]

Conclusion

Many palatal expansion devices can be used to modify maxillary deficiency. After orthopedic expansion of the midpalate, the most prominent dental and skeletal changes appear in the transverse plane rather than in the sagittal or vertical planes. The stability of the expansion with different appliances and therapies vary. Maximum treatment effect would be achieved if the orthopedic expansion is done before pubertal peak. For patients that have passed the growth spurt assisted surgery to separate the midpalatal suture can be considered.

References