A Simple Method to Treat Asymmetric Expansions in Three-Segment Surgically Assisted Rapid Maxillary Expansion

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Surgically assisted rapid maxillary expansion (SARME) is a well-documented and established procedure indicated to treat maxillary transverse deficiencies in the adult patient. Currently, the most popular SARME technique consists of performing a Le Fort I osteotomy without downfracture and a midline osteotomy that splits the maxilla into 2 halves between the central incisors. It is supposed that the 2 halves expand equally during the activation phase. However, after completion of the osteotomies, the expander is supported by only mobile segments; thus, if 1 side remains more resistant than the other, the less resistant side expands more than the other, resulting in asymmetric expansion of the maxilla. When this complication occurs in SARME, an open revision surgery is necessary to remove bone interferences that prevent bone movement on the resistant segment or to create resistance on the other half. An alternative SARME technique consists of performing an osteotomy above the maxillary apical roots, similar to the Le Fort I osteotomy, and bilateral transalveolar osteotomies between the lateral incisors and canines, dividing the maxilla into 3 segments: a central fixed segment containing the incisors and 2 lateral segments that are expanded. Some advantages of 3-segment SARME have been described, such as a less esthetic compromise resulting from the midline diastema, less midline dental papilla compromise, preservation of the nasopalatine bundle, and greater acceptance of the procedure. This article describes another advantage of 3-segment SARME: the possibility to treat asymmetric expansions of the maxilla with an easy and conservative technique.

J Oral Maxillofac Surg 71:2130-2136, 2013

Surgically assisted rapid maxillary expansion (SARME) is a well-documented and established procedure indicated to treat maxillary transverse deficiencies in the adult patient. The simplicity and low rate of complications have made this procedure very popular among orthodontists and oral and maxillofacial surgeons.[1-4]

Different techniques and modifications have been described. Currently, the most popular SARME technique consists of performing a Le Fort I osteotomy without downfracture and a midline osteotomy that splits the maxilla into 2 halves between the central incisors.

It is supposed that the 2 halves expand equally during the activation phase. However, after completion of the osteotomies, the expander is supported by only mobile segments; thus, if 1 side remains more resistant than the other, the less resistant side expands more than the other, resulting in an asymmetric expansion of the maxilla. Asymmetric expansions have been described as a very common complication in SARME.[5,6] It usually occurs when 1 side is mobilized more than the other during surgery, when bone resistance areas are not equally removed between sides, or when bone impediment prevents movement in 1 segment during activation.[7]

When this complication occurs in SARME, an open revision surgery is necessary to remove bone interferences that prevent bone movement on the resistant segment or to create resistance on the other half.

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Received March 25 2013

Accepted July 11 2013

0278-2391/13/00933-6$36.00/0

http://dx.doi.org/10.1016/j.joms.2013.07.022

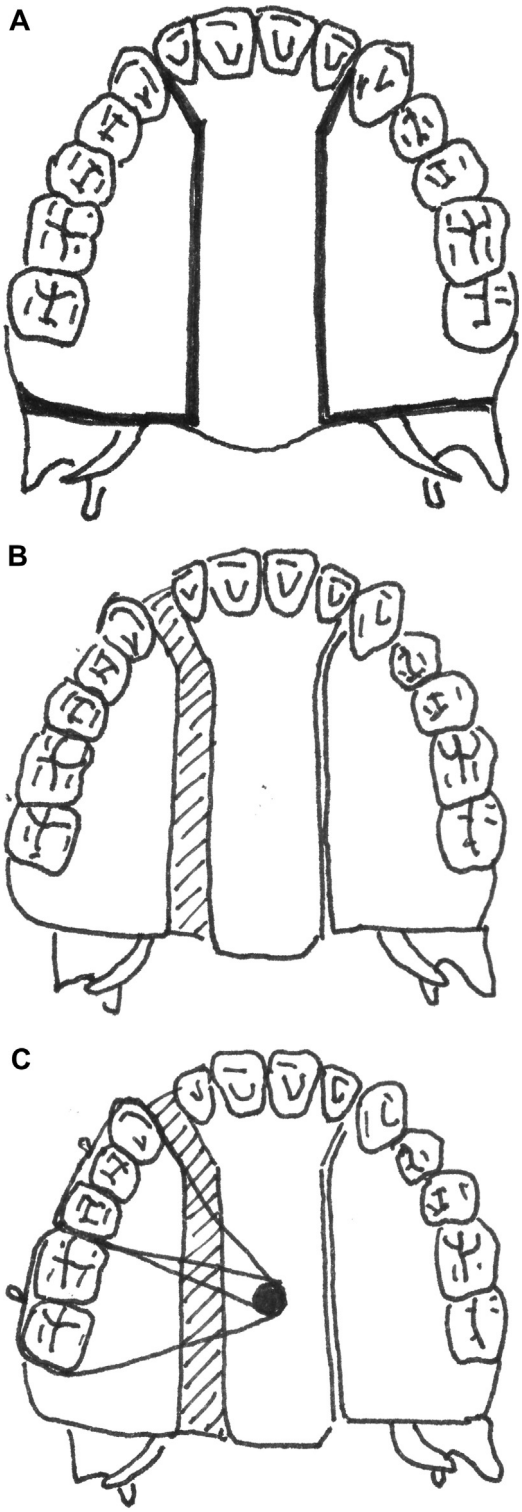

FIGURE 1. *A,* Three-segment surgically assisted rapid maxillary expansion osteotomy design. *B,* During expansion, equal diastemata are expected to develop on the 2 sides. When an asymmetric expansion occurs, it is easily recognized by unequal diastema formation. *C,* The expanded segment can be stabilized by wiring it to an intramaxillary screw placed in the central fixed segment. With this segment stabilized, only the other side will be expanded throughout activation.

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An alternative SARME technique consists of performing an osteotomy above the maxillary apical roots, similar to the Le Fort I osteotomy, and bilateral transalveolar osteotomies between the lateral incisors and canines, dividing the maxilla into 3 segments: a central fixed segment containing the incisors and 2 lateral segments that are expanded.[8-10]

Some advantages of 3-segment compared with 2-segment SARME have been described, such as less esthetic compromise resulting from the midline diastema, less midline dental papilla compromise, preservation of the nasopalatine bundle, and greater acceptance of the procedure.[8-10] In this article, another advantage of 3-segment SARME is presented: the possibility to treat asymmetric expansions of the maxilla with an easy and conservative technique. Also, the 3-segment SARME technique is briefly revisited.

Three-Segment SARME Technique

Three-segment SARME is performed under general anesthesia or local anesthesia if performed by an experienced surgeon.

A linear incision is performed bilaterally in the gingivolabial folder, extending from the lateral incisor to the second premolar. The periosteum is detached, exposing the anterior wall and the posterior region of the maxilla. The dentoalveolar region, between the lateral incisor and the canine teeth, also is exposed, maintaining the soft tissues in the cervical third of the attached alveolar process. The paranasal muscles and nasal mucosae are not detached.

A horizontal osteotomy is performed at the Le Fort I level, extending from the periapical area of the lateral incisors and canine teeth to the maxillary tuberosity. The osteotomy is designed to descend posteriorly and to finish below the pterygoid plates. Anteriorly, the osteotomy usually ends some millimeters laterally to the piriform aperture.

Next, the interdental osteotomy is performed between the lateral incisors and canines with the aid of a sagittal saw or a piezo sonic device. It is initiated in the periapical region, above the root apices, uniting with the horizontal osteotomy. At this level, it is important to carry out the osteotomy as parallel as possible to the sagittal plane. This will ensure that the osteotomy will run straight in the palate, parallel to the median palatine suture. As the interdental osteotomy is carried out more inferiorly, usually there is less space between teeth roots; thus, a straight chisel must be directed perpendicularly to the alveolar process, parallel to the roots, to avoid root injuries.

After completion of the osteotomy on the 2 sides, the segments are tested to check their mobility. Thus, the palatal expander is activated 3 mm, opening a 1.5-mm diastema on each side. It is important to

FIGURE 2. *A,* Initial presentation of malocclusion. Note the posterior crossbite on the right side. *B,* Asymmetric expansion was diagnosed 10 days after surgery. The left side was overcorrected, whereas the right side exhibited end-to-end malocclusion at the molar level. **(Fig 2 continued on next page.)**

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FIGURE 2 (cont'd). *C,* The expander was deactivated until the left side was in the ideal position. Then, an intramaxillary screw was placed in the center of the hard palate and the posterior teeth were engaged to stabilize this segment. *D,* After stabilization of the left segment, the expander was reactivated and the right segment could move laterally sufficiently to accomplish the ideal expansion. **(Fig 2 continued on next page.)**

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FIGURE 2 (cont'd). *E,* Occlusion during the orthodontic finishing phase. The patient is wearing lingual braces.

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check if the diastemata are equal in size to be sure that the 2 segments are well mobilized. If 1 side is mobilized more than the other, the osteotomy is reviewed on the other side to release any resistant area that was overlooked. It is important to have the 2 sides equally mobilized to avoid asymmetric expansions. Next, the expander is deactivated 1 mm to create a 1-mm diastema on each side.

After 5 days, the activation is initiated at a rhythm of 1 to 2 mm/day. Once the planned expansion is achieved, the expander is kept in place for an additional 3 months.

A Conservative Method for Treatment of Asymmetric Expansion

In 3-segment SARME, the lateral mobile segments support the expander, but the central segment remains fixed. Diastemata appear on the 2 sides of the maxilla, between the lateral incisors and the canines, and must have the same size during the entire activation period. When diastemata are unequal, asymmetric expansion may be taking place (Fig 1).

After asymmetric expansion diagnosis, it is important to define which side is resistant to expansion and which is not. In most cases, the 2 sides are mobile, but 1 side is more mobile than the other. Once the expander is supported in the 2 mobile segments, the more mobile segment will move more than the other, resulting in asymmetric expansion. An interesting maneuver to ensure that the 2 sides are mobile is to exert pressure on the teeth of the mobile overexpanded segment toward the opposite side. If the other side moves during this pressure, then the "resistant" side is not entrapped. Thus, if resistance is applied to the more mobile segment, the other will move during activation.

It is also important to determine whether the expanded side has already accomplished the desired expansion, has overexpanded, or requires more expansion. If overexpansion has occurred, the activations are returned until the desired transverse correction is achieved on that side. If the mobile segment still needs to be expanded, activation is continued until the ideal expansion is accomplished on that side.

Subsequently, an intramaxillary screw (IMS) is placed in the center of the hard palate, in the fixed central segment. One or preferably 2 steel wires are passed through the center of the screw and used to engage the teeth of the mobile side. One wire is used to wrap the molars, and the other is used to engage the

premolars and canine. The wire is tightened until adequate resistance is noted. Engagement of the teeth in the mobile segment to the fixed central segment stabilizes it and prevents further expansion on this side. If the IMS is placed with inadequate torque, then an additional screw may be required (Fig 1).

At this point, the expander device is reactivated to ensure that the other segment can move laterally, whereas the other remains stationary. If the other segment does not expand or remains too resistant to expansion even after stabilization of the mobile segment, an open revision surgery is indicated on the resistant segment to ensure that all bone interferences are eliminated.

Report of Case

A 30-year-old woman was referred by her orthodontist for evaluation of a maxillary transverse deficiency. Three-segment SARME was indicated for malocclusion correction and esthetic improvement. A bone-borne palatal distractor was used.

Five days after surgery, activation was initiated at a rhythm of 1 mm/day. After 7 days, an asymmetric expansion had begun. The left side was overexpanded, whereas the posterior crossbite on the right remained. There also were unequal diastemata in the 2 sides. During examination, by digital pressure on the teeth in the left side, it was noted that the other segment moved, showing that the 2 segments were mobile, although the right side was more resistant.

The expander device was deactivated until the overexpansion on the left side was corrected. Under local anesthesia, an IMS was placed in the center of the hard palate and a steel wire was used to engage the second premolar and first molars in the mobile segment (Fig 2). Then, the device was reactivated to ensure the right side would expand.

After correction of the posterior crossbite, the wire was left in place for an additional 15 days. The wire was removed after 15 days of the consolidation period and the expander was removed after 3 months. There was adequate healing and the patient is being treated with postsurgical orthodontics (Fig 2).

Discussion

The traditional SARME technique involves separation of the maxilla into 2 halves between the central incisors. Although considered a simple and popular procedure associated with few complications, the diastema that arises in the midline during the activation period causes social and psychological disturbances related to esthetic compromise.[2] The diastema in the midline can be frequently mistaken for tooth loss by the lay population, resulting in prejudice in interpersonal relationships. Thus, patients frequently refuse treatment, even when well informed that the diastema is temporary.

Some advantages of 3-segment compared with traditional 2-segment SARME have been described, which include less esthetic disturbance during the activation period because diastemata are bilateral and away from the midline, less paranasal tissue detachment and thus less change in nasal esthetics, and nasopalatine bundle preservation.[8-12] Landes et al[9,10] also reported more symmetrical expansion, less vestibular bone remodeling compared with 2-segment SARME, and better periodontal and esthetic outcomes. The disadvantages related to the technique are that it is more difficult to perform compared with the traditional technique, produces more dental tipping, and is contraindicated in cases of severe crowding between the canines and lateral incisors.

Another advantage the authors noted in their cases is the ability to recognize and treat early asymmetric expansion of the maxilla. Two diastemata of the same size are supposed to develop during the activation period; therefore, if unequal-sized diastemata arise, asymmetric expansion may be taking place. In the traditional technique, just 1 diastema develops and thus the only reference to evaluate symmetry during activation is the mandible, which is a mobile bone. Asymmetric expansion of the maxilla may not be recognized early in the traditional technique. The present technique provides an additional advantage to 3-segment SARME, that is, the possibility to treat asymmetric expansion with a low-morbidity procedure. Also, this technique is useful to treat early asymmetric expansion and may have the potential to produce the desired and controlled asymmetric expansion when indicated. Thus, if there is a need for more expansion on 1 side than the other, 1 segment can be secured after the desired expansion is achieved, allowing the other to expand to the desired amount. In the reported case, the right side of the maxilla required greater expansion than the left side. In this case, a screw could be placed in the center of the hard palate. After accomplishment of the desired expansion on the left side, a wire could engage this segment to hold it in position while the other would expand. However, at that time, this possibility had not been considered and the left side expanded more than the right side, exactly the opposite of what was desired.

The major concern related to the technique is the possibility of periodontal injuries to the teeth that are engaged to the fixed bone segment. To avoid periodontal injuries, after wiring the teeth to the central segment, it is important to ensure that the other segment is moving laterally without resistance. If the other segment is entrapped by bone interferences, it will not expand and the teeth will support the

entire load of the activation. In this situation, an open revision surgery is indicated on the resistant side and all bone interferences must be removed. The authors also advocate wiring as many teeth as possible in the segment so all teeth in the segment can share the load.

Thus, when deciding to perform 2-segment or 3-segment SARME, one should consider that, among all the advantages of 3-segment SARME, the early recognition and treatment of asymmetric maxillary expansion is possible using the described technique. Moreover, controlled asymmetric expansion can be performed, if intended.

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