

Review Article

Surgically assisted rapid palatal expansion: A way to treat transverse maxillary deficiency

ABSTRACT

Transverse maxillomandibular discrepancies are a major component of several malocclusions. Transverse maxillary discrepancies are routinely corrected in growing patients with appliances that separate the median palatal and associated maxillary sutures. This type of rapid palatal expansion (RPE) is not feasible in adults, however, because of the increasing resistance of the sutures. Surgically assisted RPE is an alternative method that reduces the resistance of the closed midpalatal suture to correct maxillary constriction in an adult. It allows clinicians to achieve effective maxillary expansion in a skeletally mature patient.

Keywords: Midpalatal suture, surgically assisted rapid palatal expansion, transverse maxillary discrepancies

INTRODUCTION

Nonsurgical rapid palatal expansion (RPE) was used by Angle^[1] as early as 1860 and continues to be used by orthodontists with a high rate of success for growing children. Although RPE has been relatively successful in children and adolescents, it has been fraught with failures in adults.^[2-5] In adults, orthodontic RPE may result in alveolar bending, periodontal membrane compression, lateral tooth displacement, tooth extrusion, and transverse relapse, which can subsequently lead to failure of the procedure.^[6,7] Historically, the midpalatal suture was thought to be the area of resistance to expansion, but Lines^[5] and Bell and Jacobs^[8] demonstrated that the area of increased facial skeletal resistance to expansion was not the midpalatal suture but the zygomaticotemporal, zygomaticofrontal, and zygomaticomaxillary sutures. This stimulated the development of various maxillary osteotomies to expand the maxilla laterally in conjunction with orthodontic RPE appliances.^[9-14]

Indications for surgically assisted rapid palatal expansion

The following have been reported in the literature as indications for surgically assisted RPE (SARPE), all applying to a skeletally mature patient with a constricted maxillary arch.^[15,16]

1. To increase the maxillary arch perimeter, to correct posterior crossbite, and when no additional surgical jaw movements are planned,
2. To widen the maxillary arch as a preliminary procedure, even if further orthognathic surgery is planned. This is to avoid increased risks, inaccuracy, and instability associated with segmental maxillary osteotomy,
3. To provide space for a crowded maxillary dentition when extractions are not indicated,
4. To widen maxillary hypoplasia associated with clefts of the palate,
5. To reduce wide black buccal corridors when smiling,
6. To overcome the resistance of the sutures when OpenManage Essential (OME) has failed.

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ETIOLOGY OF TRANSVERSE MAXILLARY DISCREPANCY

Transverse maxillary deficiency are most commonly associated with^[17]

1. Habits – thumb-sucking,
2. Obstructive sleep apnea,
3. Iatrogenic (cleft repair),
4. Palatal dimensions and inheritance,
5. Syndromes-
 - Klippel–Feil syndrome
 - Cleft lip and palate
 - Congenital nasal pyriform aperture stenosis
 - Marfan syndrome.
6. Craniosynostosis (Apert, Crouzon, and Carpenter disease),
7. Nonsyndromic palatal synostosis,
8. Multifactorial.

PATIENT SELECTION

1. Diagnosis

The first step in the case selection process is determination of transverse maxillary discrepancy (TMD). Clinical evaluation includes:^[17]

- Assessment of the maxillary arch form and symmetry
- The shape of the palatal vault
- The width of the buccal corridors on smiling
- Occlusion
- The predominant mode of breathing (nasal or oral)
- Excessively wide buccal corridors, paranasal hollowing or narrow alar bases usually suggest magnetic thickness detector (MTD).

Unilateral or bilateral crossbite, severe crowding, a V-shaped or an hourglass-shaped occlusion, and a high palatal vault are additional visual parameters that can help the clinician make the first determination of TMD in a patient. Study models should be used to thoroughly assess the arch form and the shape and make specific measurements to evaluate for MTD. Several indexes have been proposed by various authors to measure lateral discrepancies. The most common include the indexes of Pont, Linder Harth, and Korkhaus.^[18]

2. Age as criterion

- Epker and Wolford recommended surgical assistance for maxillary expansion in patients over 16 years of age^[7-11]
- Timms and Vero used 25 years as the upper limit for recommending OME^[7,12]
- Mossaz *et al.* arbitrarily recommended “after the second decade of life” for the surgical assistance of maxillary expansion^[13-19]
- Alpern and Yurosko suggested that sex should also be considered as a selection criterion. According to them,

men over the age of 25 and women over 20 require surgical assistance for expansion.^[18]

3. Medical history

In treatment planning and case selection for MTD, the patient's medical condition must be thoroughly evaluated. These include hyperthyroidism, hypophosphatemic, Vitamin D-resistant rickets, mucopolysaccharidoses, and mucopolipidoses.^[20,21]

4. Periodontal status

Müller *et al.* pointed out that it is essential to record the thickness of the gingival tissues during clinical evaluation of the periodontium. Orthodontic tooth movement can have a detrimental influence on the mucogingival complex, especially when the keratinized tissue and underlying bone appear to be thin. Therefore, evaluations of the gingival tissues and the biotype are essential to determine the ability of the tissues to withstand the pressure of OME; otherwise, surgical release of the sutures is needed to remove interferences to maxillary expansion.^[22-24]

Orthodontic considerations and preparation

Before sending a patient for a SARPE, the orthodontist must ensure that there is enough space between the roots of the central incisors for a midline split. A periapical or occlusal radiograph should be taken, and the interradicular bone evaluated [Figure 1]. If space is inadequate, preoperative root divergence must be created to ensure the postoperative and posttreatment health of the teeth; the patient should be seen regularly by a periodontist [Figure 2].^[25]

Surgical technique

Bell described surgical technique: ^[26]

- A rigid fixed tooth-borne appliance capable of producing orthopedic forces, which is usually cemented to the maxillary first molars and first premolars before surgery,



Figure 1: Occlusal radiograph

- The operation may be performed with the patient under general anesthesia or local anesthesia,
- A paramedian incision is made under local anesthesia [Figure 3],
- After the mucoperiosteum is released, the midpalatal suture is separated with a midline cut, about 3-mm deep but not reaching the foramen incisivum. The mucosal and bony cuts should not overlap [Figure 4],
- Two bony cuts, each about 4-mm long, are then made on each side of the lateral maxillary buttress above the root apices and parallel to the occlusal plane [Figure 5],
- After the osteotomy, the maxillary segments are not fully detached but can be separated by rapid expansion with a jackscrew appliance [Figure 6],
- The expansion appliance should be cemented in place just after surgery and activated three or four quarter – turns by the surgeon after the bony cuts are made,
- The rest of the expansion is achieved in daily increments for about 2 weeks after surgery. Overcorrection of about 2.5 mm per side (5 mm total) is usually advisable,
- Surgically assisted palatal expansion affects only the transverse plane of space,
- Patients with anteroposterior or vertical skeletal problems often undergo a two- or three-piece Le Fort I osteotomy. However, we believe that surgically assisted expansion followed by a one-piece Le Fort procedure has less risk of complication and produces more stable expansionm,
- Surgically assisted expansion can also be used in cases of unilateral or asymmetrical narrowing of the maxilla. The osteotomies are made on only one side, creating a differential anchorage situation, and the expansion appliance then produces more lateral translation on that side,
- Orthodontic retention should be similar to that of a nonsurgical case: the expansion appliance should remain in place for at least 3 months,
- When further orthodontic correction is required, the expansion appliance can be replaced after 3 months with a palatal arch between the first molars, and orthodontic treatment can proceed as usual [Figure 7],
- The overcorrection should be maintained throughout active treatment,
- A slight relapse of 2–3 mm is common, but this is accommodated by the overcorrection.



Figure 2: Inadequate, preoperative root divergence must be created

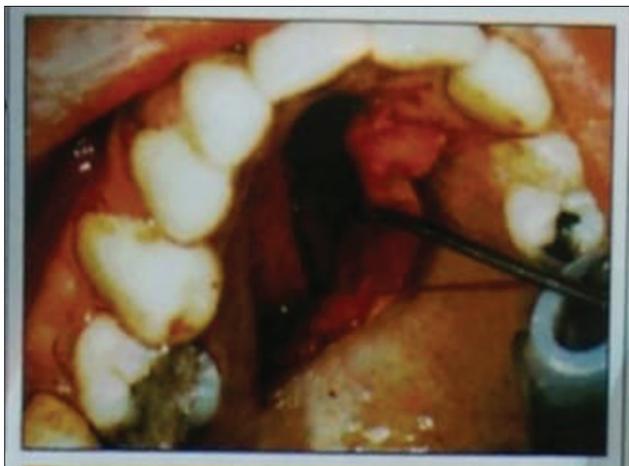


Figure 4: Midpalatal suture is separated with a midline cut

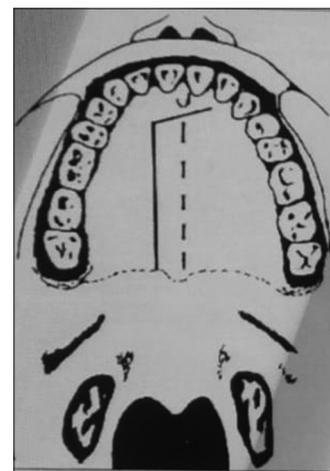


Figure 3: A paramedian incision given

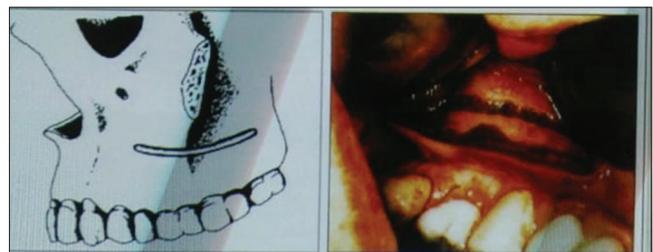


Figure 5: Bony cuts

Postexpansion evaluation and treatment

A periapical or occlusal radiograph is taken, and the symmetry of the bone should be evaluated.^[25] The circumference of the central

incisors is gently probed, and the pocket depths compared to presurgical values. Four outcomes are possible:

1. Symmetric bone on the mesial surfaces of both central incisors and the gingival attachment is intact, i.e. the interdental bone was fractured through the palatal suture and equal bone exists on the mesial surfaces of both central incisors; activate the appliance one turn every day and evaluate weekly [Figure 8].
2. Symmetric bone on the mesial surfaces of both central incisors but the gingival attachment is poor. Do not activate appliance until the gingiva is healthy. Activate appliance one turn every other day and evaluate weekly.
3. Asymmetric bony separation with healthy gingival attachment. Activate appliance one turn every other day and evaluate every 48–72 h.
4. Asymmetric bony separation with poor gingival attachment [Figure 9]. Do not activate appliance until the gingiva is healthy. Activate appliance one turn every other day and evaluate every 48–72 h.

Other uses of surgically assisted rapid palatal expansion

- A morphologically narrow palate has been associated with mouth breathing and altered neuromuscular patterns^[27]

- The consequences of ventilatory dysfunction are complex and thought to be related to sleeping disorders, including sleep apnea and nocturnal enuresis
- It can be hypothesized that similar associations between MTD in adults and some effects of ventilatory dysfunction exist in which SARPE might be useful^[28]
- The recovery of transverse growth discrepancy by surgical and mechanical enlargement produces substantial enlargement of the maxillary apical base and the palatal vault.^[29]

Retention, stability, and relapse

In general, most reports state that surgical expansion is more stable than OME. Some authors recommended that retention is not necessary for SARPE, and the orthodontist can begin orthodontic treatment without a holding phase. Other authors recommended a period of retention after expansion varying from 2 to 12 months. The relapse rates for SARPE vary from 5% to about 25%. These rates are significantly lower than the relapse rate of OME, which can be as high as 63%, 68%, and 95%. The high rate of relapse associated with OME is due to its use in skeletally advanced patients. OME is neither predictable nor stable in older patients.^[30-32]

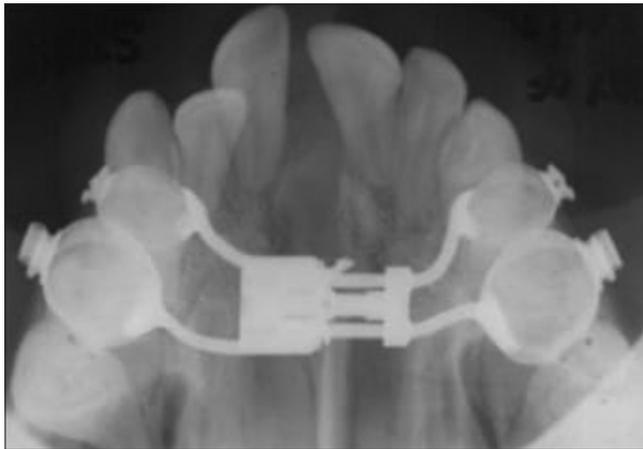


Figure 6: Rapid expansion with a jack screw appliance

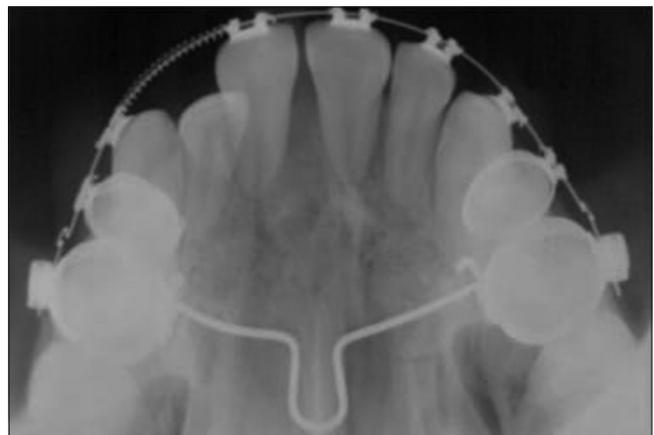


Figure 7: Proceed orthodontic treatment

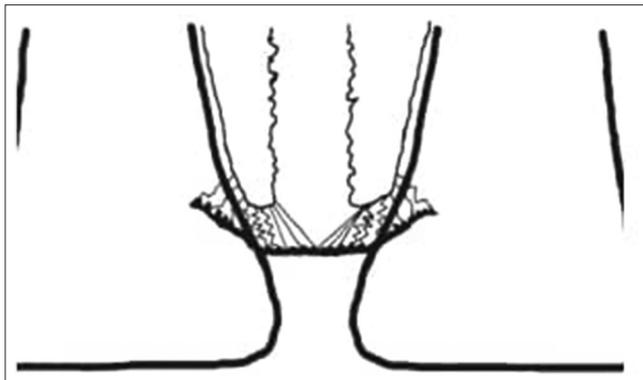


Figure 8: Symmetric bony separation with healthy gingival attachment

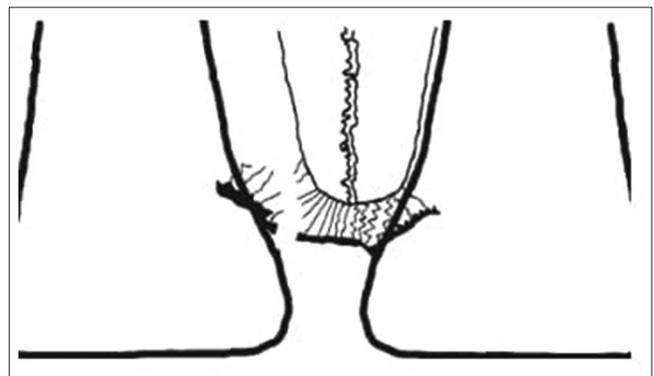


Figure 9: ASymmetric bony separation with poor gingival attachment

Risks, limitations, and complications

SARPE procedures have conventionally been reported to have low morbidity, especially when compared with other orthognathic surgical procedures. Palatal tissue irritation is a frequent complication of SARPE. This can be either due to impingement from the appliance or associated with a rapid rate of expansion.^[33,34]

Other complications include hemorrhage, gingival recession, root resorption, injury to the branches of the maxillary nerve infection, pain, devitalization of the teeth and altered pulpal blood flow, periodontal breakdown, sinus infection, extrusion of teeth attached to the appliance, relapse, and unilateral expansion.^[35,36]

CONCLUSION

SARPE is a widely used procedure for the correction of MTD in skeletally mature patients. Like any other surgical procedure, SARPE is not free of risks, and careful planning and execution of treatment are necessary to ensure an acceptable outcome. However, there is sparse information on many issues pertaining to SARPE. There are still no conclusive ways to identify the optimal equilibrium between extensive surgeries for adequate mobilization versus a conservative procedure with minimal complications. Advances in imaging techniques have added another dimension to the evaluation of bone density and surgical manipulation. These can assist in achieving greater precision and help standardize surgical techniques and orthodontic treatment protocols.

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Conflicts of interest

There are no conflicts of interest.

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