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Rapid Maxillary Expansion In Adults: A Review

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Abstract:

Maxillary Transverse Deficiency (MTD) in adults presents with constricted maxillary arches, posterior crossbites, dental crowding, and functional and aesthetic concerns. Unlike pediatric patients, adult midpalatal sutures are often fused or highly interdigitated, limiting conventional rapid maxillary expansion (RME) and increasing the risk of dental tipping and alveolar bending. Contemporary approaches, including Surgically Assisted Rapid Maxillary Expansion (SARME) and Mini-implant Assisted RME (MARPE), enable predictable skeletal expansion while minimizing dental side effects. SARME involves osteotomies to overcome sutural resistance, whereas MARPE utilizes skeletal anchorage via palatal miniscrews to transmit expansion forces directly to the basal bone. Both methods improve occlusal function, facial aesthetics, and airway dimensions, though complications such as root resorption, periodontal changes, or surgical risks may occur. Careful patient selection, imaging assessment, appliance design, and retention protocols are essential for long-term stability. Advances in digital planning and minimally invasive techniques continue to enhance the safety and efficacy of adult RME.

Keywords: Rapid Maxillary Expansion, MARPE, SARME, Adult Orthodontics, Maxillary Transverse Deficiency

Introduction

Maxillary Transverse Deficiency (MTD), also referred to as maxillary hypoplasia, is a skeletal anomaly characterized by a reduced transverse width of the maxilla. Clinically, it manifests as a constricted maxillary arch, often presenting with unilateral or bilateral posterior crossbites, a narrow and high-arched palate, and decreased intermolar width. MTD can occur alone or alongside other sagittal or vertical malocclusions, frequently resulting in dental crowding due to insufficient arch space. Beyond dental misalignment, MTD affects facial aesthetics and function, presenting with features such as widened buccal corridors and narrowing of the nasal base.[1] In adults, untreated MTD can lead to several complications, including malocclusion with posterior crossbites, dental crowding, functional mandibular shifts due to occlusal interferences, localized periodontal issues such as bone loss and gingival recession, airway constriction

increasing the risk of mouth breathing and obstructive sleep apnea, and aesthetic concerns related to altered facial proportions. [2]

The outcomes of rapid maxillary expansion (RME) differ significantly between pediatric and adult patients. In children, RME is highly effective due to the incomplete fusion of the midpalatal suture, allowing true skeletal expansion with minimal dental tipping, better alveolar adaptation, and greater long-term stability. In adults, however, the midpalatal suture is often fused or highly interdigitated, limiting nonsurgical skeletal expansion.[3] Conventional tooth-borne expanders primarily induce alveolar bending and dental tipping, which increases the risk of gingival recession and relapse. To overcome these limitations, surgically assisted rapid palatal expansion (SARPE) and mini-implant assisted devices (MARPE/MSE) have been developed, offering enhanced skeletal expansion while minimizing dental side effects. Given the rising demand for adult orthodontic treatment for both functional and esthetic reasons, reviewing contemporary techniques and outcomes of adult RME is essential.[4] This article gives an overview on Rapid Maxillary Expansion in Adults

Historical Perspective on Rapid Maxillary Expansion in Adults

Rapid maxillary expansion (RME) has a rich history dating back to 1860, when Emerson C. Angell first described lateral maxillary expansion by separating the maxillary sutures, successfully widening a 14-year-old patient's dental arch using a screw appliance an achievement notable for its time despite the absence of radiographic confirmation. Early adaptations by orthodontists such as Farrar, Goddard, G.V. Black, and Monson demonstrated variable success, though the procedure initially gained limited acceptance, particularly in adults, due to the progressive fusion and interdigitation of the midpalatal suture after adolescence.[5] The technique was later repopularized in the mid-20th century, with Landsberger demonstrating skeletal effects using occlusal radiographs in 1956, followed by Korkhaus reintroducing RME in the United States, and Haas advancing its application in growing patients in the 1960s. Studies highlighted that while transverse growth at the midpalatal suture continues into late adolescence, nonsurgical RME in adults remained unpredictable due to sutural resistance, resulting predominantly in alveolar bending and dental tipping rather than true skeletal expansion.[6]

To address these limitations, surgically assisted rapid palatal expansion (SARPE) emerged in the late 20th century, allowing reliable skeletal expansion in skeletally mature patients. Further refinements, including corticotomies and the development of mini-implant assisted devices (MARPE/MSE), have enhanced skeletal anchorage, enabling effective maxillary expansion in adults without extensive surgery.[7] Historical reports also emphasized the importance of careful diagnostic imaging to assess suture patency prior to intervention, and modern studies have continued to explore the biomechanical principles, clinical outcomes, and adjunctive strategies that optimize RME in adult patients. [8]

Biological Basis of Adult Rapid Maxillary Expansion (RME)

In adults, the biological response to rapid maxillary expansion (RME) is markedly different from that in children due to the maturation and ossification of the midpalatal suture. Unlike pediatric patients, where the suture is patent and allows true skeletal expansion, adults typically exhibit a highly interdigitated and partially or fully fused midpalatal suture, which increases resistance to expansion forces.[9] Consequently, traditional tooth-borne RME in adults often produces a combination of skeletal and dental-alveolar effects, including alveolar bending and dental tipping, rather than pure skeletal displacement.[10] The progressive ossification of the suture, generally reaching stages D or E after approximately 15 years of age, correlates with increased bone density and interdigitation, making nonsurgical expansion challenging and less predictable. Factors influencing the success of adult RME include age, suture morphology, bone density, and gender differences, with males often exhibiting thicker palatal bone and more mature sutures, thereby necessitating surgical adjuncts or skeletal anchorage. Mini-implant assisted rapid palatal expanders (MARPE) have emerged as a significant advancement, enabling more predictable skeletal expansion by transmitting forces directly to the palatal bone. Careful patient selection is critical, guided by imaging modalities such as cone-beam computed tomography (CBCT) to assess suture maturation and anatomical

considerations, which helps determine the suitability of nonsurgical RME, MARPE, or surgically assisted approaches. Beyond orthodontic correction, RME in adults has also demonstrated functional benefits, particularly in the management of obstructive sleep apnea (OSA), where expansion of the maxilla increases upper airway volume, reduces airway resistance, and improves breathing, highlighting its role as both a therapeutic and functional intervention in adult patients.[11]

Surgical Approaches: Surgically Assisted Rapid Maxillary Expansion (SARME)

Surgically Assisted Rapid Maxillary Expansion (SARME) is the preferred approach for adult patients with fused or highly interdigitated midpalatal sutures, where conventional nonsurgical RME is ineffective or carries significant risks.[12] SARME effectively accelerates maxillary expansion, addressing complex transverse deficiencies while also enhancing facial aesthetics a critical consideration in adult patients and typically requires a coordinated interdisciplinary approach between orthodontists and surgeons. Indications for SARME include severe transverse maxillary deficiency exceeding the limits of orthopedic forces, persistent unilateral or bilateral posterior crossbites, the need for increased arch perimeter to alleviate crowding without extractions, preparation for orthognathic surgery, craniofacial syndromes with premature suture fusion, cleft palate with maxillary collapse, cases with nonsurgical RME complications such as pain or periodontal lesions, and situations where nasal airway improvement is desired. SARME involves various osteotomies tailored to facilitate safe maxillary expansion.[13]

Le Fort I osteotomy separates the maxilla from the nasal septum and pterygoid plates, sometimes combined with segmental surgery for complex deformities. Midpalatal osteotomy allows direct separation of the midpalatal suture, while pterygomaxillary separation disengages the maxilla from the pterygoid plates, a critical step enabling lateral movement of the maxillary halves, though it carries increased risk due to proximity to major vessels.[14] Complications associated with SARME include hemorrhage, particularly during pterygomaxillary separation; infection or delayed healing; asymmetric expansion leading to midline deviations or bite discrepancies; root resorption or dental injury; palatal fistula or soft tissue trauma; postoperative pain, edema, and risk of relapse if retention is inadequate; and potential temporomandibular joint (TMJ) issues due to altered occlusion.[15] Despite these risks, when properly indicated and executed, SARME remains a highly effective method to overcome skeletal resistance in adults, providing predictable, stable, and clinically significant maxillary expansion.[16]

Non-Surgical Methods: Mini-implant Assisted Rapid Maxillary Expansion (MARPE)

Mini-implant assisted rapid maxillary expansion (MARPE) is a modern orthodontic technique designed to address transverse maxillary deficiencies in adolescents and adults by promoting skeletal expansion while minimizing unwanted dental effects.[17] Unlike conventional tooth-borne expanders, MARPE utilizes temporary anchorage devices (miniscrews) inserted directly into the palatal bone, allowing for more predictable separation of the midpalatal suture and enhanced skeletal widening. Traditional tooth-borne devices, such as Hyrax or Haas expanders, transmit forces primarily through the teeth, often resulting in dental tipping, alveolar bending, and periodontal stress, particularly in adults with fused sutures.[18] In contrast, MARPE delivers forces directly to the basal maxillary bone, either as a purely bone-borne device or as a hybrid tooth-bone-borne system, thereby maximizing skeletal effects and reducing dental side effects. MARPE is indicated in patients beyond the optimal age for conventional nonsurgical RME, particularly young adults with moderate to severe transverse deficiencies, individuals contraindicated for or unwilling to undergo surgical expansion (SARPE), and patients with obstructive sleep apnea, where expansion can improve airway volume.

It is also suitable for cases with significant suture interdigitation where traditional RME is unlikely to succeed.[19] Limitations include reduced efficacy in very mature sutures with advanced ossification, anatomical variability necessitating careful CBCT evaluation for miniscrew placement, potential complications such as miniscrew loosening or mucosal irritation, and the requirement for patient compliance

during activation and retention.[20] While some dental tipping or alveolar bending may still occur, these effects are generally less pronounced than with tooth-borne expanders.[21] Success depends on careful patient selection, detailed anatomical assessment, and meticulous clinical execution, and ongoing research continues to evaluate long-term stability and outcomes in older adults.[22]

Clinical Outcomes of Rapid Maxillary Expansion (RME) in Adults

Rapid maxillary expansion in adults produces transverse widening at both the alveolar and basal bone levels; however, skeletal expansion is generally less pronounced than in adolescents due to increased resistance from the ossified midpalatal suture. Palatal width typically increases, extending to the nasal cavity in a triangular pattern, with the greatest expansion occurring at the dental crown level and diminishing toward the nasal floor.[4] Maxillary basal bone expansion in adults averages around 1.3 mm following conventional RME, compared to approximately 2.7 mm in younger patients, with greater skeletal effects observed when skeletal anchorage (MARPE) or surgical assistance (SARME) is employed. Expansion also positively impacts airway dimensions, increasing nasal cavity volume and potentially benefiting patients with obstructive sleep apnea or compromised nasal breathing. In adult RME, tooth movement predominantly involves tipping rather than bodily translation, particularly with tooth-borne devices. Buccal inclination of molars increases, contributing to a greater intermolar angle post-expansion, while alveolar bone bending occurs in response to skeletal resistance. These dental-alveolar changes may predispose to mild periodontal concerns, including gingival recession and bone dehiscence, especially if excessive forces are applied or expansion is rapid.[5]

Short-term stability after RME is generally favorable, with retention appliances maintained during bone remodeling. Long-term stability, however, depends on skeletal maturity, the magnitude of expansion, and adherence to post-expansion retention protocols. Relapse is influenced by incomplete suture opening, dental tipping, soft tissue resistance, and patient compliance, with adults exhibiting a higher tendency toward relapse due to reduced skeletal remodeling compared to younger patients. Use of skeletal anchorage devices or surgical approaches can enhance long-term stability by promoting true skeletal expansion. Adults typically experience mild to moderate discomfort during activation, often greater than in younger patients. Aesthetic benefits, such as a broader smile and reduced buccal corridors, contribute to high patient satisfaction. Some temporary functional effects, including altered speech or increased salivation, may occur during treatment.[23]

Table1 : Comparison Between MARPE and SARPE in Adult Rapid Maxillary Expansion

Parameter	MARPE (Miniscrew-Assisted Rapid Palatal Expansion)	SARPE (Surgically Assisted Rapid Palatal Expansion)
Type of Approach	Nonsurgical, minimally invasive	Surgical, invasive
Mechanism of Action	Uses miniscrews anchored in palatal bone to apply skeletal forces directly	Involves osteotomies (Le Fort I, midpalatal, pterygomaxillary) to release skeletal resistance
Anesthesia	Usually performed under local anesthesia	Requires general or regional anesthesia
Indications	Mild to moderate transverse maxillary deficiency; partially fused sutures; patients unwilling/unfit for surgery	Moderate to severe transverse maxillary deficiency; fully fused sutures; complex skeletal discrepancies
Age Suitability	Late adolescents and young adults (up to ~25 years)	Adults with complete skeletal maturity (>25 years)

Parameter	MARPE (Miniscrew-Assisted Rapid Palatal Expansion)	SARPE (Surgically Assisted Rapid Palatal Expansion)
Skeletal Expansion	Moderate skeletal expansion (1–3 mm at basal bone)	Greater and more stable skeletal expansion (3–5 mm or more)
Dental Effects	Minimal dental tipping due to skeletal anchorage	Minimal dental effects if performed correctly; risk reduced with segmental control
Pattern of Expansion	"V-shaped" expansion—wider anteriorly	"Parallel" expansion—uniform separation along midpalatal suture
Airway Improvement	Increases nasal cavity volume moderately; useful in mild OSA cases	Produces significant airway enlargement; beneficial in moderate to severe OSA
Stability	Good short-term; slightly higher relapse risk in older adults	High skeletal stability with lower relapse rates
Complications	Miniscrew loosening, mucosal irritation, partial suture opening, dental tipping	Hemorrhage, infection, asymmetric expansion, postoperative pain, root injury
Recovery Time	Shorter recovery and minimal downtime	Longer recovery period; requires postoperative care
Cost	Relatively cost-effective	Higher due to surgical and hospitalization expenses
Patient Comfort	Better tolerance; mild discomfort	Greater postoperative discomfort and swelling
Clinical Settings	Can be done in orthodontic clinic	Requires hospital or surgical setting
Adjunctive Use	Can combine with aligners or limited surgical assistance	Often combined with orthognathic surgery or corticotomy for complex deformities

Complications and Limitations of Rapid Maxillary Expansion (RME) in Adults

Rapid maxillary expansion in adults, while effective, carries certain complications and limitations that must be carefully considered. Root resorption is generally minimal when forces are controlled and appliances are properly designed, but excessive or rapid expansion and uncontrolled dental tipping can increase the risk. Bone-borne devices such as MARPE reduce stress on the periodontal ligaments compared to traditional tooth-borne expanders, thereby minimizing the potential for root resorption.[24] Gingival recession, particularly on the buccal aspects of anchor teeth, may occur due to alveolar bone bending and dental tipping, with some evidence suggesting female patients may experience more significant attachment loss. Proper appliance fabrication, controlled activation, and meticulous oral hygiene can mitigate these risks, and long-term periodontal outcomes have been reported as clinically acceptable when nonsurgical RME is properly managed.[25]

Surgical complications associated with SARME include hemorrhage especially from the internal maxillary artery during pterygomaxillary disjunction postoperative infection, delayed wound healing, palatal fistula formation, asymmetric expansion, root injury, postoperative pain and edema, temporomandibular joint disturbances, and potential relapse if retention or bone remodeling protocols are inadequate. Factors limiting skeletal expansion in adults include increased bone density and ossification of the midpalatal suture,

interdigitation or complete fusion of sutural margins, craniofacial structural resistance such as the zygomatic buttress and pterygopalatine junction, individual variability in skeletal anatomy, and age-related reductions in skeletal responsiveness. Additionally, poor anchorage design or concentration of forces on the teeth rather than the basal bone can result in dental tipping and alveolar bending instead of true skeletal expansion. [26]

Discussion

Rapid maxillary expansion (RME) in adults has emerged as a promising therapeutic option for managing maxillary transverse deficiencies, particularly in cases where conventional orthodontic approaches are less effective due to increased sutural resistance. Among the available methods, miniscrew-assisted rapid palatal expansion (MARPE) has gained popularity for its ability to achieve skeletal expansion with reduced dentoalveolar tipping, offering a less invasive alternative to surgically assisted rapid palatal expansion (SARPE). While MARPE demonstrates favorable outcomes in young adults and minimizes periodontal risks, SARPE remains the preferred choice in patients with advanced suture ossification or severe transverse discrepancies, as it provides more predictable skeletal widening, albeit with higher risks of surgical complications. [27]

Evidence suggests that both approaches can effectively correct crossbites and increase maxillary arch dimensions in adults, with MARPE associated with fewer dental side effects and SARPE offering enhanced stability when carefully indicated. Beyond orthodontic correction, RME has also been increasingly recognized for its role in managing obstructive sleep apnea, as maxillary expansion can enlarge the upper airway and improve respiratory function. Nevertheless, the success of RME in adults is highly dependent on patient selection, anatomical considerations, and retention strategies. Continued research is necessary to refine biomechanical approaches, reduce complications, and establish long-term evidence to guide clinical decision-making in adult populations. [28]

Conclusion

Rapid maxillary expansion in adults has evolved significantly, with advances such as MARPE, surgical assistance, and digital planning enhancing skeletal expansion while minimizing dental side effects. Current evidence demonstrates that both nonsurgical and surgically assisted approaches can effectively correct transverse deficiencies, improve occlusion, and positively impact airway function, though outcomes remain influenced by age, suture morphology, and individual anatomy. Careful patient selection, precise appliance design, and retention protocols are critical for optimizing stability and reducing complications. Future directions, including 3D-guided expansion, CAD/CAM-based devices, biomechanical optimization, and combination therapies with aligners or orthognathic surgery, hold promise for more predictable, minimally invasive treatment. Long-term, multicenter studies are needed to further validate outcomes, refine clinical guidelines, and expand the applicability of adult RME.

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