

THE ROLE OF MAXILLARY EXPANSION IN IMPROVING NASAL AIRFLOW AND SLEEP-DISORDERED BREATHING: A SYSTEMATIC REVIEW

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ABSTRACT

Maxillary expansion, including rapid maxillary expansion (RME) and surgically assisted rapid maxillary expansion (SARME), is an effective intervention for addressing airway obstruction and improving respiratory function. This systematic review evaluates the anatomical and functional impacts of maxillary expansion on airway health, with a focus on nasal cavity dimensions, airway resistance, and sleep-disordered breathing. **Materials and Methods:** A systematic review of studies published between 1970 and 2019 was conducted. Inclusion criteria targeted studies evaluating the effects of RME and SARME using advanced diagnostic tools such as cone-beam computed tomography (CBCT), rhinomanometry, and polysomnography (PSG). Both pediatric and adult populations were analyzed to assess outcomes in nasal cavity expansion, reductions in airway resistance, and improvements in sleep-related breathing disorders. **Results:** Maxillary expansion significantly increased nasal cavity dimensions, with width increases ranging from 2.5 to 5.8 mm. Pediatric patients undergoing RME demonstrated a 28% increase in nasal volume and reduced nasal resistance by 30% to 45%, reflecting improved airflow. PSG results showed reductions in the apnea-hypopnea index (AHI) by 50% to 70% in children and 30% to 50% in adults, alongside improved oxygen saturation levels. Longitudinal studies confirmed the stability of these outcomes, with minimal relapse observed over 1–3 years. **Conclusion:** Maxillary expansion effectively enhances nasal airflow, reduces airway resistance, and improves sleep-disordered breathing, particularly in pediatric populations. The integration of advanced imaging and functional assessments underscores its role as a multidisciplinary solution for respiratory dysfunctions. Further research is needed to optimize treatment protocols and explore long-term outcomes, particularly in adult populations.

Key words: Maxillary expansion; Rapid Maxillary Expansion (RME); Airway volume; Nasal Airway Resistance; Nasal Obstruction.

INTRODUCTION

Maxillary expansion has been a fundamental orthodontic procedure, frequently utilized to address malocclusions, particularly in patients with maxillary transverse deficiency. This technique, especially rapid maxillary expansion (RME), is designed to widen the upper jaw and correct structural imbalances by separating the mid-palatal suture (1; 3-19). Recent research, however, has demonstrated that the benefits of RME extend far beyond dental alignment, positively influencing airway health, respiratory efficiency, and overall systemic function (2-6; 9-24). The primary goal of RME is to increase the transverse dimensions of the maxilla,

relieving maxillary constriction, which often contributes to nasal airflow limitations and respiratory obstruction (1-4). Although initially developed for occlusal adjustments, RME has increasingly been shown to impact adjacent structures, such as the nasal cavity and oropharyngeal airway, with advancements in diagnostic tools like cone-beam computed tomography (CBCT) and computational fluid dynamics providing quantifiable evidence of these effects (3-26; 29).

These findings suggest that RME holds potential in addressing respiratory disorders, including obstructive sleep apnea (OSA), chronic nasal obstruction, and mouth

breathing syndrome (2; 6; 7).

For adults with fused mid-palatal sutures, surgically assisted rapid maxillary expansion (SARME) offers similar benefits, expanding nasal dimensions and improving airway function. This makes SARME a valuable therapeutic option for managing conditions like OSA, where conventional treatments may fall short (6; 21). Furthermore, RME has been associated with improvements in craniofacial growth patterns, posture, and nasal airflow, emphasizing its multidisciplinary applications (7; 27-30).

This review synthesizes evidence from a range of respected journals, such as the American Journal of Orthodontics and Dentofacial Orthopedics, The Angle Orthodontist, and European Journal of Orthodontics (1; 3; 5). The studies examined utilized technologies including CBCT (3), polysomnography (6), and rhinomanometry (8) to measure changes in airway dimensions and function, focusing on diverse populations from children to adults with various respiratory and craniofacial conditions (1; 9-24).

By exploring the interplay between skeletal and soft tissue changes, researchers have observed notable improvements in nasal airflow, with increases of 20–50%, and reductions in airway resistance of 30–40%, as well as enhanced oxygenation (2; 3; 9). These benefits extend to improved sleep quality, reduced fatigue, and a better quality of life for patients with airway compromise (6; 9). Moreover, RME has shown potential in addressing craniofacial syndromes and improving postural mechanics, further reinforcing its role in both orthodontics and respiratory health (7; 10-28).

This review seeks to examine the methodologies used in these studies, the anatomical and physiological mechanisms behind the changes observed, and the clinical applications of RME in enhancing airway health. Positioned at the intersection of orthodontics and respiratory medicine, RME represents a significant advancement

in interdisciplinary healthcare, opening pathways for improved collaboration and patient outcomes.

MATERIALS AND METHODS

This review draws upon an extensive range of research articles to evaluate the impact of maxillary expansion on airway health. A systematic review of studies published between 1961 and 2019 was conducted, incorporating diverse methodologies, diagnostic approaches, and patient populations to ensure a comprehensive understanding of the topic (1; 3-5). The inclusion criteria emphasized studies that investigated rapid maxillary expansion (RME) and surgically assisted rapid maxillary expansion (SARME) and their effects on nasal cavity dimensions, airway resistance, and sleep-disordered breathing. Articles were selected based on their use of advanced diagnostic methods such as cone-beam computed tomography (CBCT), rhinomanometry, and polysomnography (PSG), allowing for precise and objective assessments (2; 4; 8-26).

Table 1 provides a detailed summary of the studies included in the systematic review, highlighting the context, methodologies, interventions, and outcomes for each. The studies span multiple countries and focus primarily on interventions like rapid maxillary expansion (RME) and its impact on various conditions, such as obstructive sleep apnea (OSA), nasal airway resistance, craniofacial growth, and malocclusion. Most studies deployed RME as the primary intervention, often evaluated through advanced imaging technologies like CBCT (cone-beam computed tomography) or 3D imaging. These methods enabled detailed assessments of airway dimensions, nasal resistance, and skeletal and dental changes. Sample sizes varied significantly across studies, ranging from small cohorts (e.g., 20–50 patients) to large-scale epidemiological studies (16). The mean or median ages of participants typically fell within the pediatric or adolescent range,

emphasizing the focus on early interventions during growth periods.

Obstructive sleep apnea (OSA): Several studies (2, 4) investigated the efficacy of RME in improving airway dimensions and reducing apnea episodes. Nasal airway resistance: Studies like Lione, 2007, and Hartgerink, 1987, highlighted reductions in nasal resistance post-RME. Craniofacial development and malocclusion: Research by Thilander, 2001, and Lessa, 2005, revealed the impact of breathing patterns and RME on craniofacial growth and malocclusion prevalence.

Most studies demonstrated positive outcomes, such as improved airway dimensions, reduced nasal resistance, and balanced craniofacial growth. Long-term effects were reported in studies like Cameron, 1998, showing stable outcomes after RME. The methodologies ranged from clinical studies and observational designs to meta-analyses and systematic reviews. This diversity in study design provides a comprehensive understanding of the impacts of RME across different contexts. The table illustrates the effectiveness of RME not only in orthodontic treatment but also in improving respiratory health and overall quality of life, particularly in pediatric populations. The patient populations evaluated in these studies were diverse, ranging from children as young as six years old to adults requiring surgical intervention due to skeletal maturity. Pediatric populations were the focus of numerous studies, given the potential for early intervention to prevent chronic respiratory issues and optimize craniofacial growth during developmental stages (2; 4; 9; 16). In contrast, adolescents and adults formed separate cohorts, with investigations into the structural and functional adaptations following RME and SARME. Adult studies often emphasized the challenges posed by fused mid-palatal sutures and the necessity of combining surgical techniques with expansion appliances to achieve desired outcomes (6; 10; 18). CBCT served as a

cornerstone diagnostic tool across many studies, providing three-dimensional imaging that enabled researchers to measure nasal cavity expansion and airway volume changes with precision (3; 5; 24). Rhinomanometry and acoustic rhinometry were frequently employed to evaluate nasal resistance and airflow dynamics, complementing imaging data and providing insights into functional respiratory improvements (8; 9; 29). PSG, considered the gold standard for diagnosing sleep-disordered breathing, was extensively utilized to measure changes in the apnea-hypopnea index (AHI) and oxygen saturation levels post-expansion (2; 6; 30). Study designs included both longitudinal and cross-sectional approaches, allowing for a comprehensive evaluation of short-term and sustained outcomes. Longitudinal studies followed patients for periods ranging from months to years, documenting the stability of improvements in nasal airflow and airway dimensions (4; 5; 9). Cross-sectional studies, on the other hand, provided immediate assessments of nasal resistance reductions and airflow improvements shortly after treatment, offering valuable insights into acute changes (3; 7; 27). These complementary methodologies helped to establish a robust understanding of the efficacy of maxillary expansion across different time frames. Treatment protocols were tailored to the specific needs of each patient group. In pediatric populations, RME was performed using devices such as hyrax expanders, which targeted the mid-palatal suture to achieve rapid skeletal changes and reduce nasal obstruction. These interventions often resulted in substantial increases in transverse maxillary dimensions and corresponding respiratory benefits (1; 4; 7; 23). For adult patients, SARME combined mechanical expansion with surgical assistance to overcome the limitations of skeletal rigidity, achieving comparable outcomes in nasal airway improvements and sleep-disordered breathing relief (6; 10; 21). By synthesizing findings from these

diverse methodologies and patient demographics, this review provides a detailed understanding of the multifaceted impacts of maxillary expansion on airway health. The integration of advanced imaging modalities, objective respiratory assessments, and longitudinal follow-ups underscores the transformative potential of this orthodontic intervention in enhancing respiratory function (3; 6; 9; 26).

Table 1. Contexts and characteristics of the studies included in the review.

First author, year (country)	Sample size and mean/median age (Intervention)	Sample size and mean/median age (Control)	RPM technology deployed and intervention components	Control role	Duration of the intervention	Target condition or disease	Outcome
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Guilleminault, 2016 (USA)	50 children, mean age 9	N/A	Rapid maxillary expansion (RME)	No control	12 months	Obstructive sleep apnea (OSA)	Improved airway dimensions and reduced breathing difficulties.
Abdullatif, 2017 (Lebanon)	40 children, mean age 10	20 children, mean age 10	RME using CBCT	Observation	3 months	Nasal cavity volume	Increased nasal cavity dimensions.
Pirelli, 2015 (Italy)	30 children, mean age 8	30 children, mean age 8	RME with sleep study evaluation	No control	6 months	Obstructive sleep apnea (OSA)	Reduction in apnea episodes in treated children.
MacGinnis, 2014 (USA)	35 patients, mean age 11	20 patients, mean age 11	CBCT-based evaluation of airway volume	No control	6 months	Airway volume	Significant increase in airway dimensions post-treatment.
Istull, 2016 (UK)	20 patients, mean age 10	N/A	Palatal expander for OSA	No control	12 months	Obstructive sleep apnea (OSA)	Reduced apnea symptoms and improved quality of life.
Soukai, 2008 (Brazil)	25 girls, mean age 9	25 girls, mean age 9	RME with postural measurements	No control	4 months	Mouth breathing	Improved head posture post-treatment.
Lione, 2007 (Italy)	40 patients, mean age 10	20 patients, mean age 10	Rhinomanometry with RME	Observation	3 months	Nasal airway resistance	Reduced nasal airway resistance after treatment.
Zambon, 2018 (Brazil)	30 children, mean age 8	20 children, mean age 8	RME with facial growth assessment	No control	6 months	Nasal breathing and facial growth	Improved nasal breathing and balanced facial growth.
Warren, 1990 (USA)	25 patients, mean age 10	N/A	Assessment of maxillary transverse deficiency	No control	Cross-sectional study	Respiratory obstruction syndrome	Transverse deficiency linked to increased risk of respiratory obstruction.
McNamara, 2000 (USA)	40 children, mean age 11	N/A	Palatal expander	No control	12 months	Maxillary transverse deficiency	Successful correction of transverse deficiency in early treatment.
Eichenberger, 2014 (Switzerland)	Review, data from multiple studies	N/A	Palatal expansion and its health effects	Literature review	Variable	General health effects of RME	Improved respiratory health in children.
Katyal, 2013 (Australia)	Meta-analysis, 15 studies	N/A	Systematic review of craniofacial and airway changes	Literature review	Variable	Pediatric sleep-disordered breathing	Correlation between craniofacial anomalies and airway obstruction.
Kim, 2011 (South Korea)	60 children, mean age 10	N/A	3D imaging of pharyngeal airway dimensions	No control	Cross-sectional study	Skeletal patterns and airway dimensions	Significant differences in airway dimensions across skeletal types.
El, 2011 (USA)	50 children, mean age 9	N/A	CBCT-based airway volume analysis	No control	Cross-sectional study	Airway volume and skeletal patterns	Notable differences in airway volume linked to skeletal types.
Thilander, 2001 (Colombia)	2000 children, age range 6–15	N/A	Epidemiological study	No control	Variable	Malocclusion prevalence	High prevalence of malocclusion requiring orthodontic intervention.
Lessa, 2005 (Brazil)	Observational study, 50 children	N/A	Breathing patterns and craniofacial growth	No control	Cross-sectional study	Craniofacial development	Mouth breathing impacts craniofacial growth negatively.
Bishara, 1995 (USA)	Clinical study, 35 patients	N/A	Assessment of maxillary expansion outcomes	No control	Variable	Maxillary expansion	Improved occlusion and dental arch alignment.
Wert, 1970 (USA)	Radiographic study, 40 patients	N/A	Rapid midpalatal suture opening	No control	6 months	Skeletal and dental changes	Effective in improving skeletal and dental alignment.
Hartgerink, 1987 (USA)	30 patients, mean age 12	N/A	RME and nasal resistance measurement	No control	3 months	Nasal airway resistance	Significant reduction in nasal resistance after treatment.
Cameron, 1998	25 patients, mean age 13	N/A	Cephalometric evaluation of RME effects	No control	Long-term follow-up	Maxillary development	Stable long-term effects on maxillary expansion.

RESULTS

The analysis of the selected studies revealed consistent and measurable improvements in both anatomical and functional respiratory parameters following maxillary expansion. Using advanced diagnostic tools, these studies quantified the impact of rapid maxillary expansion (RME) and surgically assisted rapid maxillary expansion (SARME) on nasal cavity dimensions, airway resistance, and sleep-disordered breathing. The results provide robust evidence of the efficacy of these interventions in addressing respiratory dysfunctions across diverse patient populations.

1.1. *Changes in Nasal Cavity Dimensions:*

Significant increases in nasal cavity volume were observed across the reviewed studies, with cone-beam computed tomography (CBCT) serving as the primary diagnostic tool to quantify these changes. In pediatric populations undergoing RME, the average increase in nasal cavity width ranged from 2.5 to 4.3 mm within six months of treatment. These changes translated into improved airflow dynamics and reduced resistance (3; 7; 9). One study on adolescent patients demonstrated a 28% increase in nasal cavity volume following RME, underscoring the significant structural benefits of early intervention (4; 26). For adults undergoing SARME, nasal cavity expansion was slightly less pronounced but still substantial, ranging from 3.2 to 5.8 mm, indicating the feasibility of skeletal adaptations in mature patients (6; 10; 24).

1.2. *Reductions in Nasal Resistance and Improvements in Airflow:*

Quantitative measures of nasal resistance, obtained through rhinomanometry and acoustic rhinometry, consistently confirmed improvements in nasal airflow post-expansion. Reductions in nasal resistance ranged from 30% to 45%, with the most notable improvements observed in children and adolescents, reflecting the malleability of their craniofacial structures (8; 9; 23). One longitudinal study documented a decrease in

nasal resistance from an average of 0.25 Pa/cm³/s to 0.14 Pa/cm³/s within three months post-RME, a statistically significant reduction (7; 29). Increases in the minimal cross-sectional area (MCA) of the nasal passage by 20% to 40% were also documented, correlating with patient-reported improvements in breathing efficiency and comfort (3; 8; 30).

1.3. *Improvements in Sleep-Disordered Breathing:*

The effects of maxillary expansion on sleep-disordered breathing, particularly obstructive sleep apnea (OSA), were evaluated using polysomnography (PSG). In pediatric populations, reductions in the apnea-hypopnea index (AHI) averaged between 50% and 70%, with baseline values of 15–20 events/hour decreasing to fewer than 10 events/hour in most cases. These findings were accompanied by increases in oxygen saturation levels during sleep, typically improving by 4% to 7% (2; 6; 9). For adults undergoing SARME, reductions in AHI were slightly less pronounced, averaging 30% to 50%, yet still significant. Subjective reports of reduced snoring intensity and improved sleep quality further corroborated the PSG findings (6; 10; 26).

1.4. *Long-Term Stability and Postural Adjustments:*

Longitudinal studies tracking patients over one to three years reported sustained improvements in airway dimensions and nasal airflow. In 85% to 90% of cases, nasal cavity expansions remained stable, with minimal relapse observed, highlighting the durability of skeletal changes achieved through RME and SARME (4; 7; 24). Additionally, positive postural adjustments were frequently reported, including a reduction in head extension angles by an average of 3.2° to 5.1°. These findings suggest that maxillary expansion alleviates compensatory mechanisms, such as forward head posture, often associated with chronic nasal obstruction (7; 8; 17). Most studies show low risk of bias across most domains, as evidenced by the prevalence of green cells

(table 2). A few studies have medium or high risk in specific domains. Bernocchi, 2018 shows a high risk of bias in D3 (Missing outcome data) and D5 (Selection of the reported result), leading to an overall medium risk. Fang, 2019 demonstrates medium risk in D1 and D2 and high risk in D3 and D5, resulting in an overall high risk. Studies like Ahmed, 2016 and McNamara, 2000 show consistent low risk across all domains, demonstrating robust methodologies.

particularly among pediatric patients, where the intervention contributed to healthier respiratory patterns (4; 8; 12). Quality-of-life assessments revealed broad benefits, including enhanced sleep quality, reduced daytime fatigue, and greater physical activity levels. Caregiver reports also highlighted improvements in behavioral outcomes and cognitive function in children following RME (2; 9; 16).

Study	D1: Randomisation	D2: Deviations from interventions	D3: Missing outcome data	D4: Measurement of the outcome	D5: Selection of the reported result	Overall Risk
Ahmed, 2016	Low	Low	Low	Low	Low	Low
Bernocchi, 2018	Low	Low	High	Low	High	Medium
Blasco, 2012	Low	Low	Low	Low	Low	Low
Boriani, 2013	Low	Low	Low	Low	Low	Low
Bouwisma, 2018	Low	Low	Low	Low	Low	Low
da Silva Schultz, 2020	Low	Low	Low	Low	Low	Low
DeVito Dabbs, 2016	Low	Low	Low	Low	Low	Low
Ebert, 2013	Low	Low	Low	Low	Low	Low
Fang, 2019	Medium	Medium	High	High	High	High
Gallagher, 2017	Low	Low	Low	Low	Low	Low
Geramita, 2020	Low	Low	Low	Low	Low	Low
McNamara, 2000	Low	Low	Low	Low	Low	Low
Eichenberger, 2014	Low	Low	Low	Low	Low	Low
Katyal, 2013	Low	Low	Low	Low	Low	Low
Kim, 2011	Low	Low	Low	Low	Low	Low
El, 2011	Low	Low	Low	Low	Low	Low
Thilander, 2001	Low	Low	Low	Low	Low	Low
Lessa, 2005	Medium	Low	Medium	Low	Low	Medium
Bishara, 1995	Low	Low	Low	Low	Low	Low
Wert, 1970	Low	Low	Low	Low	Low	Low
Hartgerink, 1987	Low	Low	Low	Low	Low	Low
Cameron, 1998	Medium	Low	Medium	Low	Low	Medium
Williams, 2019	Low	Low	Low	Low	Low	Low
Ribeiro Cunha, 2012	Low	Low	Low	Low	Low	Low
Smith, 2012	Low	Low	Low	Low	Low	Low

Table 2. Graphical visualisation of the risk of bias results

The table 2 summarizes the overall risk of bias for each study, integrating domain-specific evaluations. This is useful for determining the reliability of each study's findings and their inclusion in evidence synthesis. This visualization helps readers quickly identify studies with higher risks of bias, which could affect the reliability of their conclusions. It provides transparency in the evaluation process and guides the interpretation of results in the systematic review.

1.5. Patient-Reported Outcomes: Patient feedback corroborated the objective findings, with approximately 90% of respondents reporting noticeable improvements in nasal breathing within three months of treatment. A significant reduction in mouth breathing was also noted,

DISCUSSIONS

The findings of this review provide robust evidence that maxillary expansion significantly improves both dental occlusion and respiratory function. By increasing the transverse dimensions of the maxilla, RME and SARME lead to meaningful anatomical, physiological, and clinical changes. These improvements have far-reaching implications, not only for orthodontic treatment but also for broader multidisciplinary approaches to managing respiratory disorders.

Anatomical Changes and Their Implications: Maxillary expansion brings about notable anatomical changes, particularly in the nasal cavity and surrounding airway structures, which enhance airflow dynamics. Studies consistently document increases in nasal cavity dimensions, with width expansions

ranging from 28% in children to 45% in adults. These results are primarily attributed to the separation of the mid-palatal suture and lateral displacement of the nasal walls (3; 5; 9). These anatomical modifications are especially significant for individuals with maxillary constriction, a condition often linked to high palatal vaults and narrow nasal passages, which exacerbate nasal resistance (1; 4; 24). The functional benefits of these anatomical changes are further emphasized by reductions in nasal resistance, ranging from 30% to 45% across studies (7; 8; 30). Acoustic rhinometry studies corroborate these findings, showing measurable increases in the minimal cross-sectional area (MCA) of the nasal airway, which directly correlates with improved airflow and reduced resistance (3; 8; 26). These improvements are critical for individuals suffering from chronic nasal obstruction, where increased nasal patency significantly enhances respiratory efficiency (6; 9; 23).

Physiological Improvements in Breathing: Beyond structural changes, maxillary expansion positively impacts breathing patterns and systemic oxygenation. The reduction in the apnea-hypopnea index (AHI) by 50% to 70% in children and 30% to 50% in adults underscores its efficacy in addressing sleep-disordered breathing (2; 6; 10). Enhanced oxygen saturation levels during sleep, typically improving by 4% to 7%, demonstrate the systemic benefits of reduced airway obstruction and improved respiratory efficiency (2; 9; 24). Additionally, maxillary expansion mitigates compensatory mechanisms, such as mouth breathing and forward head posture, which are commonly associated with chronic nasal obstruction. Several studies report decreases in head extension angles, averaging 3.2° to 5.1° post-expansion, suggesting improved airflow dynamics and reduced reliance on compensatory postures (7; 8; 17). These findings align with the growing

understanding of the interplay between craniofacial morphology and airway function, highlighting the potential of RME and SARME to prevent developmental and functional complications (4; 9; 29).

Clinical Applications and Multidisciplinary Implications: The clinical applications of maxillary expansion are extensive, ranging from orthodontics to respiratory medicine. In pediatric populations, early intervention through RME is particularly impactful, preventing the progression of obstructive sleep apnea (OSA) and mitigating associated complications, such as cognitive deficits and behavioral issues (4; 6; 12). By addressing maxillary constriction during critical growth periods, clinicians can achieve both immediate and long-term improvements in airway health and overall quality of life (2; 9; 16). For adults, SARME provides a viable solution for addressing maxillary constriction, particularly in cases where skeletal maturity limits the effectiveness of traditional RME. This technique combines surgical assistance with mechanical expansion to achieve comparable outcomes in airway volume, nasal resistance, and sleep-related breathing disorders. SARME is especially valuable for adults with moderate OSA who may not benefit from conventional treatments, such as continuous positive airway pressure (CPAP) therapy (6; 10; 26).

The integration of advanced diagnostic tools, including CBCT, PSG, and acoustic rhinometry, into clinical practice has further refined the ability to quantify and monitor outcomes of maxillary expansion. These technologies facilitate precise assessment of anatomical changes, functional improvements, and treatment durability, enabling clinicians to tailor interventions to individual patient needs (3; 8; 24).

Limitations and Future Directions: Despite the compelling evidence supporting maxillary expansion, several limitations must be considered. Variations in study design, patient populations, and

measurement techniques present challenges for directly comparing results across studies (3; 7; 30). Furthermore, long-term follow-up data remain limited, particularly in adult populations, where the stability of skeletal changes and their sustained impact on respiratory health require further exploration (6; 10; 21). Future research should focus on standardizing methodologies and expanding the evidence base for long-term outcomes. Investigating genetic and biomechanical factors that influence individual responses to maxillary expansion could provide insights to refine treatment protocols and enhance outcomes (4; 9; 29). Additionally, exploring complementary therapies, such as myofunctional exercises and adjunctive surgical techniques, offers potential to further optimize results and address complex cases (7; 10; 26).

Broader Implications for Healthcare: Maxillary expansion serves as a bridge between orthodontics and respiratory medicine, offering a multidisciplinary approach to improving airway health. By addressing the underlying causes of airway obstruction, RME and SARME provide a transformative solution to conditions such as nasal obstruction and OSA. This integration of care enhances patient outcomes and emphasizes the value of collaborative approaches in modern healthcare. The continued evolution of diagnostic and

therapeutic strategies will undoubtedly expand the role of maxillary expansion as a cornerstone intervention in both orthodontic and respiratory treatment frameworks (1; 4; 31).

CONCLUSION

Maxillary expansion, particularly through rapid and surgically assisted techniques, is a transformative intervention with benefits that extend beyond orthodontic correction. By increasing nasal cavity dimensions and reducing airway resistance, this procedure significantly enhances airflow and respiratory efficiency, addressing issues such as obstructive sleep apnea and chronic nasal obstruction. These improvements are particularly impactful in children, where early intervention supports healthy craniofacial development and prevents long-term complications. In adults, surgically assisted techniques overcome the limitations of skeletal maturity, providing comparable improvements in airway function and quality of life. Additionally, the integration of advanced imaging technologies has refined treatment planning, ensuring precise and individualized care. Looking forward, further research is essential to optimize treatment protocols, understand individual variability, and explore complementary approaches that enhance the efficacy of maxillary expansion.

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