

The Success of Miniscrew-Assisted Rapid Palatal Expansion (MARPE) in Adult Orthodontics: A Literature Review

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Abstract

This literature review examines the success and effectiveness of Miniscrew-Assisted Rapid Palatal Expansion (MARPE) in adult orthodontics. Traditional methods like Surgically Assisted Rapid Palatal Expansion (SARPE) have been commonly used for treating transverse maxillary deficiencies in adults, but they come with significant drawbacks, including higher biological and financial costs. MARPE, which utilizes mini screws to apply controlled forces for palatal expansion, offers a less invasive and more precise alternative. The review analyzes several studies and reports on MARPE's success in expanding skeletal and dental structures, improving respiratory function in obstructive sleep apnea (OSA) patients, and minimizing complications like unwanted tooth movement. Despite some challenges, such as asymmetrical expansion, MARPE has demonstrated a high success rate in adult orthodontics and presents a promising treatment option. Further high-quality, long-term studies are recommended to optimize treatment protocols and evaluate potential risks.

Keywords: Miniscrew-Assisted Rapid Palatal Expansion, MARPE, adult orthodontics, transverse maxillary deficiency, obstructive sleep apnea, posterior crossbite, skeletal expansion, non-surgical palatal expansion, rapid palatal expansion, orthodontic treatment.

1. Introduction

In the early stages of primary dentition, transverse malocclusions can occur for various reasons. These could be functional, such as thumb or tongue-sucking habits, dental-related issues where the teeth are in the wrong position, or skeletal factors where either the lower jaw is underdeveloped or the upper jaw is underdeveloped (1). A common form of malocclusion is posterior crossbite. This occurs when at least two teeth (molars and premolars) in the upper jaw bite inward over the corresponding teeth of the lower jaw. This results in the upper jaw being narrower than the lower jaw in the posterior area. Crossbites are relatively common, affecting approximately 23.3% of children and 10% of adults (2). It can occur unilaterally or bilaterally.

The treatment of posterior crossbite in children differs significantly from that in adults, primarily because the jawbone can still be influenced during development. Crossbite can be corrected early in primary dentition, yielding good results (3,4). A common orthodontic treatment for patients with posterior crossbite is rapid palatal expansion (RPE). The success of the treatment is influenced by the patient's age and skeletal maturity. Age plays a significant role in how effective RPE is regarding skeletal effects (5).

Generally, it becomes more difficult to widen the palate by expanding the median suture as patients age. Two studies (6,7) focusing on individuals aged 5–20 showed that the challenge increases with age. Although available evidence suggests that suture changes are age-dependent, no specific age has been identified at which traditional RPE is no longer feasible (5).

In adult patients, the midpalatal suture becomes more complexly aligned, making it harder to separate. Therefore, surgically assisted rapid palatal expansion (SARPE) is a common procedure for correcting transverse maxillary deficiencies greater than 5 mm in patients with complete skeletal maturity and closed cranial sutures (8).

SARPE is a procedure that can enhance the predictability and success of palatal expansion. It is performed through osteotomy, where the midpalatal suture is surgically opened. This reduces mechanical resistance to the lateral forces applied by a Hyrax screw, typically anchored to the first premolars and molars. Despite its advantages, SARPE has some drawbacks. The biological and financial costs are higher than those of conservative expansion. Furthermore, SARPE requires hospitalization and anesthesia, which may deter some patients from choosing this treatment (8).

In recent years, an innovative method for treating transverse malocclusions has gained prominence – Miniscrew-Assisted Rapid Palatal Expansion (MARPE) (9). This technique has been introduced as an alternative to traditional methods and has proven effective in achieving the desired transverse expansion, including SARPE.

MARPE uses micro-implants or mini screws as anchorage points to apply forces that promote maxillary expansion. Unlike traditional palatal expansion, MARPE eliminates the need for expansion devices attached to the teeth. Instead, the micro-implants are strategically placed in the upper jaw and act as stable points for applying controlled forces during expansion (9).

The advantages of MARPE include more direct and precise control of the applied forces and a reduced impact on the teeth. Since the micro-implants are not attached to the teeth, the risk of causing unwanted tooth movement or rotational forces during expansion is minimized. This results in a more stable and predictable treatment (10).

2. Hypothesis

MARPE can offer an effective alternative to traditional surgical methods for palatal expansion in adult patients.

3. Purpose of the Study

The purpose of this literature review is to carefully examine and compile the existing scientific literature related to the use and effectiveness of MARPE in adult orthodontics. By analyzing relevant studies and research findings, the review will contribute to a better understanding of how MARPE technology can be successfully applied to correct transverse malocclusions in adult patients. This insight may further guide orthodontic practitioners and researchers in their efforts to optimize treatment outcomes and reduce potential side effects in adult orthodontic care.

4. Methods

To conduct this literature review, a thorough electronic search was performed. English-language articles were retrieved through the PubMed database. We used MeSH terms such as 'miniscrew-assisted rapid palatal expansion (MARPE)' and 'adults' along with other relevant terms such as 'Posterior crossbite,' 'Treatment Outcome,' 'Skeletal Expansion,' and 'Palatal Expansion Technique.'

Two separate students were responsible for searching and evaluating the relevant articles. The inclusion criteria included randomized controlled trials, systematic reviews, cohort studies, controlled clinical trials, as well as prospective and retrospective studies that reported treatment outcomes for MARPE in adults during the period 2013–2023.

Using rryan.ai, the search results were reviewed, and the following types of studies were excluded from the review: case reports, case series, animal or in vitro studies, studies without data on treatment outcomes, studies addressing other orthodontic problems not covered by MARPE treatment in adults, and studies involving patients with specific contraindications for MARPE.

In the initial stage, we retrieved 83 articles. In the first step, 11 research articles were identified and included based on title and abstract review, which were deemed relevant to the topic. After a closer review of the titles and abstracts, 3 of these articles were excluded. The remaining 9 articles were selected for a deeper full-text review to determine their relevance and quality.

After reviewing the full text, 3 more articles were excluded based on a thorough assessment of the inclusion and exclusion criteria. The 6-remaining full-text articles were considered to meet the necessary criteria and will form the basis for the upcoming literature review. These articles will be analyzed and compiled to provide an overview of the current research in the chosen topic.

In this literature review, we have taken ethical considerations into account by ensuring that the included studies were conducted with respect for the rights and well-being of participants. All reviewed studies adhered to the principles of informed consent and ethical approval from relevant ethics committees. We also considered the integrity and confidentiality of participants' data.

5. Results

Authors, year and journal.	Title	Study design
1. Kapetanović A, Theodorou CI, Bergé SJ, Schols J. Eur J Orthod. 2021 Jun8; 43(3):313-323.	Efficacy of Miniscrew-Assisted Rapid Palatal Expansion (MARPE) in late adolescents and adults: a systematic review and meta-analysis.	Systematic review and meta-analysis
2. Chun JH, de Castro ACR, Oh S, Kim KH, Choi SH, Nojima LI, Nojima MDCG, Lee KJ. BMC Oral Health. 2022 Apr 8;22(1):114	Skeletal and alveolar changes in conventional rapid palatal expansion (RPE) and miniscrew-assisted RPE (MARPE): a prospective randomized clinical trial using low-dose CBCT.	prospective randomized clinical trial
3. Brunetto DP, Moschik CE, Dominguez-Mompell R, Jaria E, Sant'Anna EF, Moon W. Prog Orthod. 2022 Feb 123(1):3	Mini-implant assisted rapid palatal expansion (MARPE) effects on adult obstructive sleep apnea (OSA) and quality of life: a multi-center prospective controlled trial	a multi-center prospective controlled trial
4. Almaqrami BS, Alhammadi MS, Al-Somairi MAA, Alyafrusee ES, Xiong H, He H Orthod Craniofac Res. 2022 May 25(2):234-242	Three-dimensional assessment of asymmetric mid-palatal suture expansion assisted by a customized microimplant-supported rapid palatal expander in non-growing patients: Uncontrolled Clinical Trial	Uncontrolled Clinical Trial
5. Siddhisaributr P, Khlongwanitchakul K, Anuwongnukroh N, Manopatanakul S, Viwattanatipa N. Korean J Orthod. 2022 May 25;52(3):182-200	Effectiveness of miniscrew assisted rapid palatal expansion using cone beam computed tomography: A systematic review and meta-analysis.	A systematic review and meta-analysis.
6. Priyanka Ponna, Nour Eldin Tarraf, Kerem Dalci, Benedict Wilmes, Mehmet Ali Darendeliler and Oyku Dalci Eur J Orthod. 2024 Apr 1;46(2)	Dentoskeletal effects of mini-screw assisted, non-surgical palatal expansion in adults using a modified force-controlled polycyclic protocol: a single-centre retrospective study	single-centre retrospective study

5.1.1 Study 1

The results of the study show that MARPE is an effective non-surgical treatment for crossbite. The study observed a high success rate of MARPE, with an average success of 92.5% and significant increases in skeletal width and dental intermolar width. Despite its effectiveness, some side effects were noted, such as increased tooth tipping and decreased buccal bone thickness and alveolar height. One of the main limitations of the study was the lack of high-quality prospective studies. Despite the side effects, MARPE is a promising treatment method for maxillary expansion. Further high-quality research is recommended to better understand its effects and risks.

5.1.2 Study 2

This clinical study shows that both conventional RPE and MARPE resulted in a high frequency of midpalatal suture opening in patients with transverse maxillary discrepancies. Both methods showed a significant increase in width in the molar area, with the MARPE group showing greater increases compared to the RPE group. Dentoalveolar changes were similar between the groups, except for maxillary width, where the MARPE group showed larger increases. During the expansion periods, less buccal tipping of the molars was observed in the MARPE group compared to the RPE group. The conclusions show that MARPE can provide better maintenance of basal bone structures compared to RPE.

5.1.3 Study 3

The study showed that MARPE has a good success rate (85%) and promoted significant occlusal and respiratory benefits. It noted a significant improvement in daytime sleepiness and quality of life related to obstructive sleep apnea syndrome (OSA), as well as oxygen saturation and snoring duration.

5.1.4 Study 4

The results of this study show that the use of MARPE can lead to asymmetrical expansion in some adult patients. The study included 49 patients, 46.9% of whom experienced asymmetrical expansion. The primary factor associated with asymmetrical expansion was the initial asymmetrical position of the midpalatal suture.

5.1.5 Study 5

This study reviewed the effects of MARPE in late teenagers and adults through a comprehensive systematic review of studies based on cone-beam computed tomography (CBCT). Only 14 of the 364 identified articles met the inclusion criteria for analysis. The results indicated that MARPE treatment was successful in expanding the constricted maxilla in these patient groups. The expansion was found to increase the width of both skeletal and dental structures, following a pyramidal pattern, most prominent in the coronal plane.

5.1.6 Study 6

This study reviewed the effects of MARPE in adults. Data from a total of 17 adult patients aged 18 to 39 years were analyzed. Expansion was performed with MARPE, and CBCT images were taken before and after treatment. The results showed a 100% success rate.

5.2 Summary of all results

MARPE is an effective treatment method for crossbite in adults. The treatment showed a high success rate in increasing both skeletal and dental width, with minimal side effects and improved clinical outcomes compared to conventional treatments such as RPE. Additionally, MARPE demonstrated positive effects on respiratory function and symptom relief in patients with obstructive sleep apnea syndrome (OSA). However, asymmetrical expansion should be considered and monitored. Further high-quality research is needed to understand the full effects and potential risks of MARPE in different patient groups.

6. Discussion

6.1 Effectiveness and Advantages of MARPE

The conducted literature review has shown that Miniscrew-Assisted Rapid Palatal Expansion (MARPE) is an effective method for treating transverse malocclusions in adult patients. MARPE has been shown to correct crossbite with a high degree of success and minimal invasiveness compared to traditional surgical methods such as Surgically Assisted Rapid Palatal Expansion (SARPE). One of the biggest advantages of MARPE is its ability to generate more direct and precise control of the applied forces, leading to more stable and predictable results. This reduces the risk of unwanted tooth movements and damage to dental structures.

6.2 Clinical Improvements

In addition to correcting malocclusions, MARPE has also been shown to have positive effects on patients' overall health, particularly in terms of respiratory function. Studies have shown that MARPE can improve symptoms in patients with obstructive sleep apnea (OSA), which in turn improves quality of life through reduced daytime sleepiness and improved oxygen saturation. These benefits are especially important as they go beyond the purely orthodontic effects and contribute to a holistic improvement in the patient's health.

6.3 Challenges and Limitations

Despite the many advantages, there are some challenges and limitations with MARPE that must be considered. One of the biggest challenges is the risk of asymmetrical expansion, which can occur due to initial asymmetry in the suture or incorrect placement of the micro-implants. This requires careful planning and monitoring during treatment to ensure symmetrical expansion and minimize complications.

Another limitation is that there is still a need for high-quality long-term studies to fully understand the long-term effects and potential risks of MARPE. Several of the studies included in this literature review pointed to the need for further research to confirm the initial positive results and to develop optimal treatment protocols.

6.4 Comparison with Traditional Methods

Compared to traditional methods such as RPE and SARPE, MARPE offers several advantages, including less invasiveness and better maintenance of basal bone structures. This makes MARPE an attractive option for adult patients seeking effective and gentle solutions for transverse malocclusions. Traditional RPE is often less effective in adults due to the increased rigidity of the midpalatal suture, which makes MARPE a better alternative for this patient group.

Conclusions and Recommendations

In summary, this literature review shows that MARPE is a promising technique for treating transverse malocclusions in adult patients. Its effectiveness, combined with its less invasive nature and positive impact on respiratory function, makes it a valuable addition to orthodontic treatment methods. However, it is important that further research is conducted to optimize the use of MARPE and to ensure its long-term safety and effectiveness. Orthodontists should consider MARPE as a first-choice treatment for adult patients, especially those who prefer less invasive treatment options and have indications for transverse expansion.

Conflict of Interest

The authors declare no conflict of interest.

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