

**WHAT WE KNOW ABOUT MINI-SCREW ASSISTED RAPID PALATAL EXPANSION****\*AbdulMajeed AlMogbel**

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**Abstract**

Transverse maxillary deficiency (TMD) is becoming common among adults and adolescents. The defects in the mandibular arch and maxillary can result in the emergence of "posterior crossbite." The outcomes can be a narrowing of the palates and an imbalance within the facial muscles. The palatal expansion has been used over the years to "open the mid-palatal suture" and repair the malocclusion. Specifically, rapid palatal expansion (RPE) remains the mainly applied modality to treat TMD. However, this technique is only effective in patients below 15 years. Above this age, the mid-palatal suture is rigid, causing resistance. Miniscrew-assisted rapid palatal expansion (MARPE) is a promising treatment procedure for TMD in adults because it allows for maximum skeletal and dental expansion. The process is a non-invasive, cost-effective and risk-free intervention with the highest success rate and minimal complications. The surgical-assisted rapid palatal expansion (SARPE) is a technique for treating TMD and has shown much success. However, patients reject it because it entails the surgical procedure, leading to higher risks and costs. This paper examines the current literature on the application and efficacy of MARPE in expanding mid-palatal sutures. It also compares MARPE with SARPE.

**Keywords:** Mid-palatal suture, palatal expansion, and transverse maxillary deficiency.**INTRODUCTION**

Transverse maxillary deficiency (TMD) is increasingly becoming a common problem within the orthodontic practice. This issue is accompanied by bilateral or unilateral posterior crossbite, resulting in various health-related challenges.<sup>1</sup> The TMD prevalence stands at 10% among adults and 8%-23% among adolescents.<sup>2</sup> The disconnect between the mandibular arches and maxillary leads to narrowing and deepening of the palate, damage to the periodontal, and excess growth in the alveolar, creating an imbalance in the facial muscles.<sup>3</sup> The most used technique to treat TMD is rapid palatal expansion (RPE), which entails either tooth-borne or tooth-tissue-borne. While RPE has effectively treated this defect, the optimal timing should be below 15 years of age.<sup>4</sup> When used in older people above 15 years, there are increased chances of rigidity and resistance to the expansion forces because the mid-palatal sutures fuse. Therefore, researchers continue to review the usefulness of miniscrew-assisted rapid palatal expansion (MARPE) as an alternative treatment for TMD in older patients. Lee and Moon initially introduced MARPE as a tool that would address the weaknesses of conventional RPE in adult patients. Due to the lack of dental and skeletal expansion effects when RPE is used in adults, MARPE emerged as an alternative treatment due to its ability to enhance expansion and minimize side effects.<sup>3</sup> MARPE can be a bone-borne or a tooth-bone-borne device containing a rigid element inserted into the palate and connected to the miniscrew, allowing for direct expansion straight to the maxilla.<sup>5</sup> The designing of MARPE primarily aimed to help achieve maximum skeletal effects and reduce the dentalveolar issues due to the existing evidence that mid-palatal suture becomes more rigid with age.<sup>6</sup> In the early days of its introduction, Moon *et al.* came up with a maxillary skeletal expander (MSE), which was placed

posteriorly between the first molars to minimize the high skeletal resistance, leading to greater suture expansion.<sup>6</sup> The procedure involves miniscrews, usually away from the mid-palatal suture, to support the expansion and achieve a more parallel lining.<sup>7</sup> According to Suzuki *et al.*, the goal of the screws is to enhance stability while facilitating efficiency during the procedure.<sup>8</sup>

**Procedure and Efficacy of MARPE**

MARPE is increasingly gaining attention from researchers regarding its effectiveness in treating TMD in adults. While the conventional RPE is well documented, the several side effects and age limitations make it less effective. Kapetanović *et al.*<sup>3</sup> studied the efficacy of MARPE in patients over 16 years and found that this intervention helps improve dental and skeletal expansion, thus being successful for TMD. Similar outcomes were discovered in research by Moon *et al.*, who noted that micro-implants make it easier to get skeletal anchorage. MARPE remains a reliable, simple, and non-invasive technique that can repair defects caused by TMD.<sup>9</sup> Compared to the traditional treatment methods, Minervino *et al.*<sup>10</sup> revealed that MARPE is a more practical option for treating crossbite and maxillary atresia. The procedure shows limited risks of periodontal side effects, minimal tooth inclination, better stability, and more expansion at the mid-palatal suture.<sup>10</sup> While planning for the placement of MARPE, it is recommended that a suture evaluation be conducted using "cone-beam computer tomography (CBCT)" to determine the possibility of expansion. The current investigations examining the success of MARPE revealed that it results in better mid-palatal suture separation, representing a 71%-92% efficacy rate in comparison to the traditional modalities.<sup>11</sup> In the treatment results for MARPE in post-adolescents using CBCT, there was a "dental and skeletal expansion" after a pyramidal pattern.<sup>11</sup> The results of this inquiry are consistent with the past outcomes that MARPE can cause parallel expansion patterns in the mid-palatal suture. Research by Prévé and Alcázar

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produced consistent findings by reaffirming that when MARPE is applied with CBCT, there is an enhancement in airflow accompanied by maxillary skeletal expansion, hence making it more effective than conventional techniques.<sup>12</sup> Oliveira *et al.*<sup>13</sup> studied 28 patients with TMD to assess the efficacy factors for MARPE. The findings of this research demonstrated that this method is a clinically viable and stable modality to treat maxillary deficiencies, producing a success rate of 86.9%.<sup>13</sup> Besides, MARPE shows positive results in broadening the dental arch form, even though the efficacy rate remains restricted to a particular age.<sup>14</sup> The palatal expansion can boost breathing because it broadens the nasal cavity. MARPE can cause maxilla expansion and widening of airways.<sup>15</sup> These findings agree with past studies on the efficacy of MARPE in treating TMD.

Hur *et al.*<sup>16</sup> studied the impacts of MARPE on the airflow variation in adults' upper airways. Obstructive sleep apnea syndrome (OSAS) entails the decline in the flow of oxygen due to shallowness in breathing. MARPE, as a non-invasive technique, has been suggested to expand the airways and enhance breathing in OSAS patients. Hur *et al.*<sup>16</sup> found that MARPE can facilitate resistance within the upper airways, leading to airflow and breathing. These findings agree with that of Kumar *et al.*<sup>15</sup>, who also revealed that MARPE could cause the expansion of the maxillary, leading to the broadening of the airways. Despite the evidence of MARPE's success in treating TMD and OSAS, Shin *et al.*<sup>17</sup> found that mid-palate suture maturation and palate length remain key predictors of palatal expansion in adults. As age increases, the mid-palate interdigitation occurs, and palatal length expands, lowering the success of MARPE.

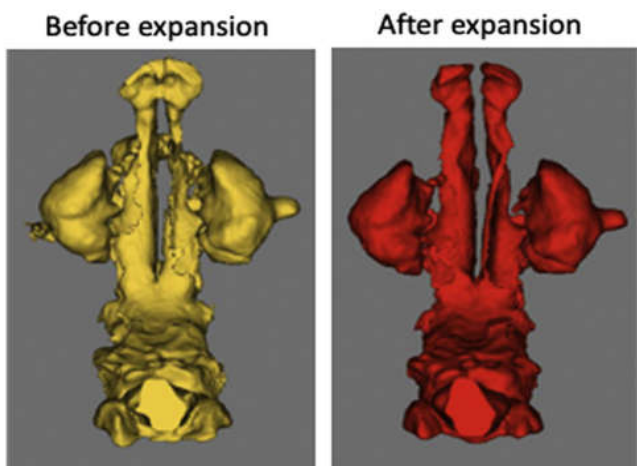
of MARPE, this modality comes with limited risks of failure and reduced complications.<sup>22</sup> Besides, its effectiveness relies on the ability to exert stress distribution and displacement on the craniofacial structures, leading to less buccal tipping and greater skeletal expansion.<sup>23</sup> MARPE, therefore, remains an innovative and reliable method to treat TMD.



Source: (Suzuki *et al.*, 2018)

Figure 2. Positioning of Miniscrews

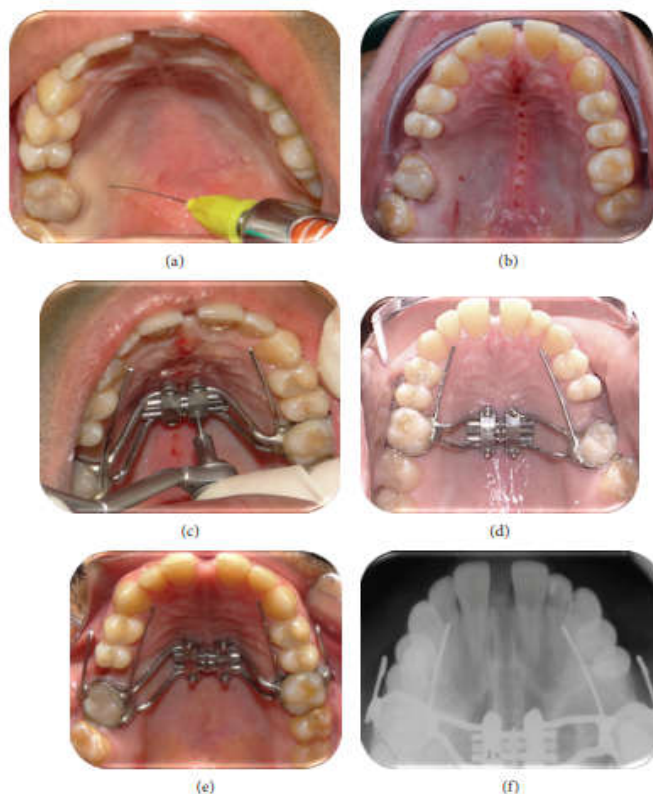
Due to the increased "interdigitation of the mid-palatal suture" and rigidity as one ages, the use of MARPE in adults remains a limitation. The present literature examines the methods that can reduce the rigidity of the mid-palatal suture to achieve maximum skeletal and dental expansion, even in adults, when using MARPE. Dr. Suzuki *et al.*<sup>24</sup> introduced the corticotomy technique to expand the mid-palatal suture for adult patients whose palates have matured. In this study involving a 35-year-old female patient with a crossbite, corticopunctures were added to enhance palatal expansion after failure in the initial procedure.<sup>24</sup>



Source: (Baik *et al.* 2020)

Figure 1. Airway Axial View

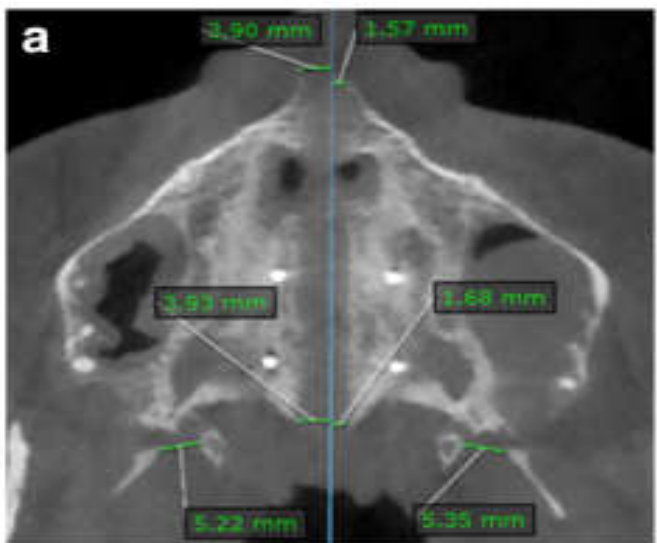
MARPE has also been used in treating adult patients with mild "buccal inclination of maxillary" molars. When applied with CBCT, it yields positive results because of the lack of superimposition of the anatomical structure.<sup>18</sup> With the advancing technology, CBCT offers a 3D view of the maxilla area, thus allowing for a successful MARPE procedure to insert the four miniscrews.<sup>19</sup> Copello *et al.*<sup>20</sup> investigated the success of MARPE and found that achieving greater stability requires the evaluation of mid-palatal suture expansion abilities and using devices with a 2 mm diameter. Similar outcomes were discovered by Lim *et al.*<sup>21</sup>, who noted that MARPE is successful in treating TMD, with much stability after a year. While mid-palatal structure determines the success



Source: (Suzuki *et al.* 2018)

Figure 3. The Corticotomy Procedure to facilitate expansion

The research involved eight bone perforations performed along the mid-palatal suture, mainly done 2 mm apart. During the corticopuncture procedure, a 9 mm "titanium alloy miniscrew" 5mm thread length x 4mm neck length x 1.8mm diameter" was manually inserted between the mid-palatal suture. Following the corticopuncture procedure, a CBCT was used to observe the opening of the mid-palatal suture. The outcome of this study revealed that performing corticopuncture before MARPE can help achieve skeletal and dental expansion. The investigation showed that the process led to a 3.14 mm suture split and a 2.06 mm molar area.<sup>24</sup> Therefore, performing corticopuncture before MARPE can help achieve maximum expansion in adults whose mid-palatal suture has matured. Cantarella et al.<sup>25</sup> examined the use of bone-borne expanders to realize greater skeletal expansion in post-puberty patients with MTD. Due to the limitation of MARPE in adults, this study sought to research the role of "bone-borne expanders" in achieving pterygopalatine and mid-palatal expansion in adults using CBCT. The research involved 15 patients with MTD, showing that the "inter-maxillary distance" expanded by 2.7 mm while the posterior "inter-zygomatic" increased by 2.4 mm.<sup>25</sup> The bone-borne expanders resulted in the perfect "parallel split of the suture" in post-puberty patients. The "anterior nasal spine (ANS) split increased by 4.8mm, while that of the posterior nasal spine" was 4.3mm. Similar outcomes were supported in another study by Cantarella et al.,<sup>26</sup> who noted that when a maxillary skeletal expander (MSE) is applied in adults, maximum palatal expansion is achieved at zygomatic bones. The procedure leads to the displacement of the zygomatic arch. Therefore, MSE can help enhance skeletal expansion in adults with mature mid-palatal sutures, reducing resistance and rigidity during the MARPE. On the other hand, Lione et al.<sup>27</sup> examined the skeletal effects of tooth-borne maxillary expanders used with computer tomography in adult patients. The outcome of the research is consistent with that of the previous investigations that MSE and tooth-borne expanders can help achieve more parallel suture split, thus reducing the rigidity caused by age. Therefore, in adults above 16 years, resistance in the mid-palatal suture when using MARPE can be achieved through skeletal expanders.



Source: (Cantarella et al., 2017b)

**Figure 4. V-shape produced by tooth-borne expansion**

Like MARPE, "surgically-assisted rapid palatal expansion (SARPE)" emerged to address the limitations of traditional RPE in adults. However, this modality is invasive, thus

creating more risks and complications. According to de Oliveira et al.<sup>28</sup>, MARPE and SARPE are successful interventions for treating transverse deficiencies. Contrastingly, most patients would reject SARPE and choose MARPE due to the risks involved in surgical procedures and cost.<sup>28</sup> Jesus et al.<sup>29</sup> noted that the dental effects from the MARPE process are few; thus, limited reoccurrence risks compared to SARPE. Studies reveal that SARPE and MARPE are valuable in opening the "mid-palatal suture," eliminating the possibilities of adverse outcomes.<sup>30</sup> Despite their efficacy, people usually choose non-invasive procedures because it removes the pain of surgical processes and complications.<sup>31</sup> Hence, MARPE is a simpler intervention and is more effective due to its non-invasiveness and minimal complications. In conclusion, MARPE remains a preferred treatment method for TMD and an alternative to traditional RPE. The technique is successful because it allows for dental and skeletal expansion. Besides, it is non-invasive, making it safe, simple, and less costly for patients. While SARPE also remains effective, it entails a surgical process, leading to risks of complications and high costs.

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