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Marpe (Mini Implant Assisted Rapid Palatal Expansion Vs Sarpe (Surgically Assisted Rapid Palatal Expansion): A Review

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ABSTRACT
A minimally invasive orthodontic technique called Miniscrew-Assisted Rapid Palatal Expansion (MARPE) efficiently corrects maxillary transverse discrepancies. MARPE circumvents the drawbacks of traditional dental anchorage by introducing regulated strains to the palatal suture, guaranteeing predictable expansion results. Its adaptability extends to different age groups and orthodontic and craniofacial problems. The accuracy and comfort of MARPE have been improved by developments in skeletal anchoring systems and orthodontic biomechanics. MARPE has been adapting to various patient requirements by incorporating new technologies such as miniscrews and specific auxiliary equipment.It is recommended that future study focus on improving treatment protocols, investigating complementary techniques to improve long-term stability, and examining the potential synergistic effects of MARPE with other orthodontic procedures. To promote innovation and enhance the therapeutic efficacy of MARPE in orthodontic practice, collaboration between researchers and clinicians is essential. More precisely planned and carried out treatments are made possible by continuous improvements in imaging modalities such as cone beam computed tomography (CBCT), which provide insightful knowledge of anatomical factors influencing treatment outcomes.It is crucial for orthodontic practitioners to stay up to date on the latest innovations and include these approaches into their treatment approach, given the encouraging results and continuous advancements in MARPE. Clinicians can minimize treatment length and patient discomfort while achieving optimal orthodontic outcomes by embracing MARPE and utilizing its benefits.

Key words:-Craniofacial reconstruction,Long-term stability, Miniscrews,Orthognathic surgery, Skeletal anchoring

I. INTRODUCTION

Maxillary transverse discrepancies frequently necessitate orthodontic procedures such as rapid palatal expansion (RPE) in patients with malocclusions [1]. The two main methods used in the past were surgically assisted rapid palatal expansion (SARPE) and traditional RPE [2]. But the development of MARPE, or rapid palatal expansion with miniscrew support, has completely changed the way orthodontic treatment is administered [1]. Miniscrews and other temporary skeletal anchoring devices are used in MARPE to achieve controlled palate development, in contrast to SARPE, which surgically separates the midpalatal suture for manual extension [3-6]. Although maxillary expansion is the goal of both procedures, there are important distinctions in terms of invasiveness, length of therapy, and stability of expansion [1,2]. Clinical trials [4], case reports [7], meta-analyses [8], and systematic reviews [3] are only a few of the recent studies that thoroughly assess the effectiveness, stability, and patient outcomes of MARPE and SARPE, weighing the respective advantages and disadvantages of each strategy.

In clinical practice, several criteria, such as age, skeletal maturity, patient desire, and the degree of maxillary transverse discrepancy, influence the decision between MARPE and SARPE [6,5]. Because MARPE requires less time to treat and is less invasive, it may be preferred by adults and adolescents looking for a quick, non-surgical expansion [6]. On the other hand, patients who need orthognathic surgery or who have large transverse discrepancies might benefit from SARPE [5]. Both approaches' long-term stability is still under question; whereas MARPE exhibits encouraging short-term expansion results, sustainability and recurrence are still unknown [3]. The degree of surgical osteotomies and postoperative stability are two examples of variables that may have an impact on SARPE results. To evaluate the predictability and stability of both approaches in preserving maxillary breadth

and occlusal stability over time, more investigation is required.

SARPE (Surgically Assisted Rapid Palatal Expansion) and MARPE (Mini Implant Assisted Rapid Palatal Expansion) are contrasted in this review. Every technique has pros and cons as well as therapeutic concerns of its own. While SARPE is still a possibility for individuals who need concurrent orthognathic surgery or considerable maxillary expansion, MARPE is less intrusive and less uncomfortable for patients. It is imperative to elucidate the enduring stability and effectiveness of MARPE. Treatment planning and evaluation can be improved by utilizing cutting-edge imaging modalities like CBCT and 3D printing. Custom appliances and CAD software are examples of tailored biomechanical procedures that may improve treatment results and patient comfort even more. Thus, this review vividly elucidates the various characteristic aspects of both MARPE and SARPE with exquisite difference between them both.

MARPE

In orthodontics, miniscrew-Assisted fast Palatal Expansion (MARPE), which combines traditional fast palatal expansion with miniscrews as skeletal anchorage devices, completely transforms maxillary transverse expansion [1,2]. MARPE produces more secure and predictable results than older techniques that only use tooth-borne prosthetics by applying regulated stresses to the palatal suture post-miniscrew insertion [1]. By directly targeting maxillary skeletal components, this novel technique circumvents the drawbacks of dental anchorage, including possible relapse and tooth tipping[2].

- **Evolution of MARPE:**MARPE has changed and modified with time owing to thedevelopments in skeletal anchoring systems and orthodontic biomechanics.The zygomatic buttress and infrazygomatic crest were two sites of placement for miniplates and micro-implants that were used in early attempts at skeletal anchoring for palatal expansion [9,10]. Miniscrews, on the other hand, changed the field when they were introduced as temporary anchorage devices because they offered a more flexible and less invasive way to achieve skeletal anchorage [2,8].
- **Significance of MARPE in orthodontic treatment:**A crucial tool in modern orthodontics, MARPE addresses maxillary transverse discrepancies that are common in malocclusions and tooth crowding. To avoid negative consequences on occlusal stability and face aesthetics, this deficiency needs to be addressed right away [5,11]. For adults and teenagers alike, MARPE provides a minimally invasive and effective means of correcting transverse discrepancies [6,11]. Recent research has explored the potential of this treatment modality to cure diseases such as obstructive sleep apnea (OSA) and improve the quality of life for adult patients, going beyond the typical orthodontic goals [12]. MARPE exhibits potential in co-addressing medical and dental issues by inducing remodeling of the bone and increasing the size of the upper airway [8,12].
- **Materials Used in MARPE:**Miniscrews are essential anchoring devices in Miniscrew-Assisted Rapid Palatal Expansion (MARPE), providing size and design flexibility to accommodate different treatment requirements. Clinicians can select miniscrews based on anatomical considerations and treatment objectives by using alternatives such as hybrid designs, self-drilling, and self-tapping [13]. Biomechanical performance depends on dimensions like length and diameter, which affect stability and insertion strategy [14]. Titanium alloys are frequently selected to reduce tissue responses and encourage osseointegration because of their mechanical strength, resistance to corrosion, and biocompatibility [10,16]. Miniscrews, then, are essential to MARPE because they guarantee the biocompatibility and stability required for orthodontic therapy to be successful [10,13,14,15].
- **Auxiliary appliances:-**Auxiliary appliances supporting expansion control, force application, and treatment efficiency are essential elements of MARPE therapy, in addition to miniscrews. By gradually expanding the midpalatal suture and extending the maxilla, expansion devices such as the Hyrax appliance enable orthopedic expansion. By evenly distributing stresses throughout the palate to maximize expansion efficiency, palatal bars, which are usually composed of titanium or stainless-steel alloys, improve appliance rigidity and stability during MARPE therapy [5,11]. In addition, CAD/CAM technology and digital workflow transform the production and modification of auxiliary appliances, guaranteeing accurate fit to each patient's oral anatomy and enhancing treatment results and patient comfort. Along with improving overall MARPE treatment efficiency, this innovation expedites the treatment procedure by cutting chairside time [16,17].

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- **Clinical applications and indications:**Miniscrew-Assisted Rapid Palatal Expansion (MARPE) provides a flexible clinical tool for a variety of age groups and skeletal development phases; however results are dependent on patient-specific characteristics and understanding of efficacy [6,12,14,8,19]. For late adolescents and adults, MARPE offers a minimally invasive option that uses miniscrews for skeletal anchoring, ensuring predictable growth even in skeletally mature individuals [6,9,18]. MARPE is particularly effective in correcting arch symmetry, resolving transverse disparities, improving airway dynamism, and reducing obstructive sleep apnea (OSA) symptoms [2,5,12,14]. In difficult craniofacial reconstruction scenarios, it also expedites therapy, improves postoperative stability, and promotes esthetic and functional outcomes through its involvement in pre-surgical orthodontic preparation and as an auxiliary in orthognathic surgery [4,14,19]. The versatility of MARPE highlights its importance in providing customized solutions for a range of skeletal and orthodontic needs.
- **Advantages of MARPE:**There are several benefits associated with MARPE, chief among them being its minimally invasiveness, which lowers surgical morbidity and patient pain [1, 2]. MARPE improves patient comfort and makes better oral hygiene maintenance possible by doing away with the necessity for dentition-anchored palatal expansion appliances [6, 15]. Furthermore, especially in adult orthodontic situations, MARPE frequently accomplishes rapid palatal expansion in a shorter amount of time, resulting in quicker treatment outcomes and higher patient satisfaction [4, 7]. Long-term treatment success is facilitated by the predictable and controlled skeletal growth that is ensured using miniscrews in MARPE, with a reduced risk of adverse dental effects [3,8,11]. Furthermore, MARPE broadens its application in orthodontic practice by expanding the field of therapy to encompass skeletally mature patients and those requiring adjunctive care in cases involving orthognathic surgery [13,16].
- **Disadvantages and limitations:-**The miniscrew insertion procedure for MARPE carries surgical risks such as mucosal perforation and infection, even though it is less invasive than SARPE [5, 12]. To reduce these risks, precise patient selection and surgical technique are essential [5]. Individualized treatment approaches are necessary for appropriate miniscrew implantation and long-term outcomes due to anatomic variability in the midpalatal area [9,20]. MARPE exhibits early success in maxillary expansion; however, its long-term stability is unknown, requiring continued monitoring and retention measures [15,18]. To avoid inadequate development or recurrence, patient compliance is essential throughout the activation phase [6,10]. Furthermore, some patient populations may find MARPE therapy less accessible due to its greater initial cost.
- **Future prospects and research directions:**Subsequent developments in MARPE might concentrate on reducing oral side effects and optimizing skeletal expansion using adjuvant methods and treatment plans [3,11]. To evaluate MARPE's durability and create successful retention plans that stop recurrence, long-term clinical studies are essential [8,18]. Cone beam computed tomography (CBCT), one of the more sophisticated imaging modalities, can help interpret anatomical factors that influence miniscrew placement and expansion results [20]. Treatment options for maxillary transverse discrepancies may be expanded by further investigation into the synergistic effects of MARPE with aligner therapy or temporary anchoring devices[5,17]. To promote innovation and enhance MARPE's therapeutic efficacy in orthodontic treatment, researchers and clinicians must work together.

SARPE

Surgically Assisted Rapid Palatal Expansion (SARPE) is a surgical orthodontic technique that uses surgical intervention to quickly expand the maxilla to treat maxillary transverse insufficiency [21,22]. To preserve the expansion gained, this procedure entails separating the midpalatal suture and creating a bony gap, which is then filled in using orthodontic appliances [23,24]. SARPE is usually recommended when significant transverse discrepancies cannot be adequately addressed by traditional orthodontic techniques, such as maxillary expansion using palatal expanders [25]. SARPE provides patients with constricted maxillary arches with a complete remedy by integrating orthodontic and surgical techniques.

- **Evolution of SARPE:**Surgical methods were used in the early attempts to broaden the maxilla to achieve surgically assisted palatal extension, which dates back several decades [23,26]. The SARPE operation has been

improved throughout time by developments in surgical methods, orthodontic appliances, and knowledge of craniofacial growth [27,28]. In the past, standard surgical methods were used for SARPE; however, as technology and surgical techniques have advanced, minimally invasive techniques have gained popularity [29]. The goals of these minimally invasive techniques are to enhance patient outcomes, hasten recuperation, and lessen surgical trauma.The integration of digital technologies, such as computer-aided design/computer-aided manufacture (CAD/CAM), which improve accuracy and predictability in treatment planning and execution, is another development in SARPE [30].

- **Importance in correcting maxillary transverse deficiency:-**Several functional and cosmetic problems, such as malocclusion, crowding, and facial asymmetry, can result from a maxillary transverse deficit [21]. SARPE expands the maxilla to obtain adequate dental arch alignment and balance face proportions, which is a critical step in repairing these deficits [22]. SARPE widens the maxillary arch, which improves nasal airflow, gives crowded teeth more room, and improves the overall appearance of the face [23,24]. Furthermore, treating maxillary transverse insufficiency at an early stage of care can avert the need for more involved orthognathic and orthodontic surgical procedures down the road [25]. SARPE is therefore a crucial instrument in the orthodontic toolbox for treating a variety of craniofacial abnormalities and enhancing the oral health and overall well-being of patients.
- **Procedure and technique:** The surgical approach and site preparation for Surgically Assisted Rapid Palatal Expansion (SARPE) are guided by meticulous consideration of anatomical variables, which ensures good access and visualization [21,23,27]. With CAD/CAM technology improving precision in treatment planning and execution, minimally invasive procedures are preferred to improve patient outcomes and minimize surgical stress [29,20]. Using orthodontic equipment to ensure consistent force distribution and regulated, comfortable expansion, SARPE's activation procedure is customized for each patient [22,23, 24]. Insights into bone remodeling and therapy changes are facilitated by radiographic monitoring, which evaluates the stability and extension of the midpalatal suture [23,28,30]. Regular clinical monitoring and follow-up appointments guarantee patient compliance and comfort, facilitate prompt changes, and maximize therapy results [28,29].
- **Materials used in SARPE:**Customized appliance dimensions and designs guarantee excellent stability and efficacy during expansion in Surgically Assisted Rapid Palatal Expansion (SARPE). Titanium alloys are frequently utilized to reduce tissue responses because of their well-known mechanical qualities and biocompatibility [23]. Osteotomies and expansions are made easier by surgical instruments, which call for specific equipment to provide precise procedures and less trauma [28]. Throughout the surgical procedure, the patient's safety and comfort are guaranteed via anesthetic and sedative techniques. To efficiently enlarge the maxilla while minimizing patient discomfort and consequences, SARPE makes use of certain instruments, supplies, and techniques [29].
- **Clinical applications and indications:**Rapid palatal expansion with surgical assistance (SARPE) can be customized to meet a variety of age ranges and therapeutic goals. Given the impact of skeletal maturity on stability, SARPE provides a less intrusive option for age groups and patient selection in adults and adolescents with maxillary transverse discrepancies [25]. The objectives of treatment include treating obstructive sleep apnea (OSA) and correcting maxillary transverse discrepancies, which will enhance facial look and align the dental arches [22]. By increasing occlusal coordination and alignment, SARPE's inclusion into orthodontic and surgical contexts improves pre-surgical orthodontic preparation, which improves surgical results and postoperative stability. SARPE also functions as an adjuvant in orthognathic surgery, facilitating surgical correction and minimizing the necessity for substantial surgical intervention [19]. SARPE shows promise as a flexible method for treating a range of craniofacial and orthodontic issues in diverse patient populations due to its many uses and integrations [19, 25].
- **Advantages:**For the treatment of maxillary transverse deficits, SARPE has several benefits. First off, it offers a practical way to address maxillary transverse abnormalities, which enhances face aesthetics and dental arch alignment [22]. SARPE also improves nasal airflow and makes more room for crowded teeth, which improves the overall appearance and function of the mouth [23,24]. Moreover, SARPE may be able to avoid the need for

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future, more intrusive orthognathic and orthodontic operations by treating maxillary transverse insufficiency early in therapy [25].

- **Disadvantages:**SARPE has some drawbacks and restrictions in addition to its effectiveness. The possibility of surgical hazards, such as infection, mucosal puncture, and close closeness to tooth roots, is one of the main causes for worry [5,12]. Furthermore, the success and stability of SARPE may be impacted by anatomical changes in the midpalatal region, necessitating cautious patient selection and treatment planning [9,20]. Another factor to consider is the long-term stability of maxillary expansion attained with SARPE, since skeletal relapse and rebound effects might happen over time [15,18]. During the activation period, SARPE requires active patient compliance; otherwise, unsatisfactory results may occur [6, 10]. Lastly, when compared to conventional orthodontic procedures, the initial cost of SARPE therapy, which involves the surgical insertion of devices and orthodontic equipment, may be higher [2,13]. When thinking about SARPE as a maxillary transverse deficiency therapy option, these issues should be carefully considered.
- **Future prospects and research directions:**Subsequent developments in surgically assisted rapid palatal expansion (SARPE) center on optimizing treatment plans and investigating complementary methods to improve stability and predictability over the long run [3,11]. Research is required to determine how long the bone modifications brought on by SARPE will last and to create practical retention techniques [8, 18]. New developments in imaging, including cone beam computed tomography (CBCT), provide important information on the anatomical variables influencing the results of SARPE. For SARPE treatment outcomes to improve and innovation to be driven, collaboration between researchers and physicians is essential.

II. CONCLUSION

MARPE is a less invasive method of addressing maxillary transverse discrepancies that is so effective that it revolutionizes orthodontic therapy. By precisely applying strain to the palatal suture, MARPE overcomes the drawbacks of conventional dental anchorage and guarantees predictable expansion consequences. Its adaptability allows it to address a wide range of craniofacial and orthodontic issues in people of different ages and skeletal development stages. The accuracy and comfort of patients using MARPE have been improved by developments in skeletal anchoring systems and orthodontic biomechanics. MARPE uses technologies such as miniscrews and specialized equipment to adapt to changing patient needs.Future studies should focus on optimizing treatment plans, investigating supplementary methods for long-term stability, and evaluating the synergy between MARPE and other orthodontic procedures. For MARPE to be innovative and successful, collaboration between researchers and physicians is essential. Technological developments in imaging modalities, such as CBCT, facilitate accurate therapy planning by providing insights into anatomical aspects influencing treatment outcomes. For best results, orthodontic practitioners need to stay current on MARPE's most recent advancements. Adopting MARPE maximizes orthodontic outcomes while reducing treatment time and discomfort.

Table 1:- Difference between MARPE and SARPE based on various characteristics

SPECIAL CHARACTERISTICS	MARPE	SARPE
Anchorage method	Uses miniscrews to secure the skeleton	Depends on surgery to open a bone gap and enlarge the maxilla
Invasiveness	Minimally invasive methodology	Surgical procedures require more intrusive methods.
Stability and predictability	Produces expansion results that are steady and predictable.	Anatomical alterations may have an impact on stability and predictability.

Age group suitability	Effective in late adolescents and adults	Suitable for various age groups
Treatment duration	Achieves rapid expansion in a shorter time frame	Requires longer treatment duration
Complications and risks	Lower risk of surgical complications	Associated with potential complications (mucosal perforations)
Orthognathic surgery	May serve as pre-surgical orthodontic preparation	Can be used as an adjunctive treatment in orthognathic surgery
Cost	Initial cost may be higher	Potentially lower initial cost
Long-term stability and relapse rate	Questionable	Skeletal relapse and rebound effects may occur over time
Auxillary appliances	Utilizes expansion devices and digital technologies	Relies on surgical instruments and equipment
Airway effects	Enhances upper airway volume	Effects on facial soft tissues
Flexibility of expansion	Allows for controlled expansion in multiple directions	Expansion direction and extent may be limited by surgical technique
Post-treatment adjustability	Limited ability for post-placement adjustment	May require additional surgical interventions for adjustments
Patients comfort during treatment	Generally well-tolerated by patients	Surgical procedure may cause discomfort and require recovery time
Follow-up and post-treatment effects	Involve periodic evaluations and adjustments	Post-surgical follow-up includes monitoring for complications and bone healing.

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