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Anatomical variation consideration and guidelines for MARPE placement: A review

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Abstract
Diagnosis and treatment planning plays an important role in orthodontic treatment. Execution of treatment planning, proper appliance selection, accurate positioning of the appliance and following correct treatment protocol prevents the untoward effects during the treatment. Treatment of a unilateral posterior crossbite with facial symmetry is difficult with orthodontics alone. This article describes the untoward complication that occurred during the skeletal expansion using MARPE due to improper positioning of appliance for the correction of unilateral posterior crossbite and describes the guidelines for the placement of MARPE appliance as well as the anatomical variation consideration for the planning during placement.

Keywords: MARPE, anatomical variations, Midpalatal Suture, CBCT

Introduction

Case report

A 22-year-old female with ongoing orthodontic treatment reported to Government Dental College and Hospital, Aurangabad with a chief complaint of her jaw shifted to the right side. The patient had no specific medical history and no TMJ symptoms were present. She had a Skeletal Class III relationship with facial asymmetry with the chin deviated towards right side and unilateral posterior crossbite on the right side. The facial analysis shows straight facial profile, normal divergence, competent lips, slightly protrusive lower lip and obtuse nasolabial angle. Patient has a slight maxillary deficiency and an average growth pattern. The molar and canine relationship was Class III on the right side and Class II on the left side. The upper midline was shifted to right by 2 mm whereas the lower midline was shifted to right by 7 mm with respect to midsagittal plane. A mild cant of occlusal plane was observed. Spacing was present in the lower arch. Patient showed gingival recession in the lower anterior and upper posterior region.

Functional examination revealed that the patient had a slight transverse CO-CR discrepancy. This functional shift of the mandible caused the mandibular asymmetry. Cephalometric analysis revealed a Skeletal Class III with an average growth pattern. The maxilla was retrognathic whereas the mandibular base length was increased. The upper anteriors are proclined and soft tissue analysis showed a slight strain of the upper lip.

The primary treatment objective was the correction of facial asymmetry, deviation of the chin, unilateral posterior crossbite on the right side, mandibular dental midline deviation and improving the transverse discrepancy. Thus, the main objective was to establish a facial symmetry, along with normal overjet and overbite, coincident upper and lower midline with respect to midsagittal plane and obtain a Class I canine to molar relationship.

Fig 1: Pretreatment extraoral and intraoral photographs

The following treatment options were given to the patient

First treatment plan was to do orthodontic treatment followed by orthognathic surgery for the correction of asymmetry as this plan has the advantage of eliminating the underlying skeletal asymmetry. Second treatment option was to expand the constricted upper arch that can relieve the posterior crossbite in the right side and help to correct the transverse discrepancy. The patient selected the second plan as she did not want to undergo orthognathic surgery.

Discussion

The treatment was initiated with the expansion of the constricted upper arch. Since there was a need for skeletal expansion, MARPE (Mini screw assisted rapid palatal expansion) was opted. Bands were fabricated on the first molar region and pick up impression was taken for the construction of the MARPE appliance. After the fabrication, cementation of the appliance was done. After cementation, it was noticed that the appliance was positioned along the Mid Palatal Suture line but was not positioned equidistant from the Mid Palatal suture. The mini-implant holes were closer to mid palatal suture on the right side as compared to the left side.

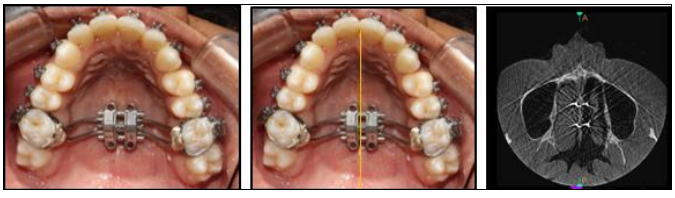

Fig 2: A. Cementation of MARPE appliance. B, C. Mini implant holes on the right side appears closer to mid palatal suture compared to left side.

Also, during the insertion of the min implant, care was taken not to over insert the mini-implant beyond bi-cortical engagement. The activation of MARPE appliance was done on the next day of insertion. The expansion was done based on the protocol suggested by Dr. Won Moon for adults. The appliance was activated twice per day and was planned to activate one turn per day after the appearance of diastema. In the initial first week of activation, equal expansion occurred bilaterally. However, it was noticed that there was an unequal expansion, more of the expansion occurred only on the left side leaving the right side of the upper jaw unexpanded and untreated where the unilateral crossbite was present. The appliance got entirely shifted to the side of expansion with tissue impingement of the palatal mucosa. A post expansion CBCT was taken to confirm the position of the appliance and the amount of expansion.

Fig 3: Post expansion intraoral photographs

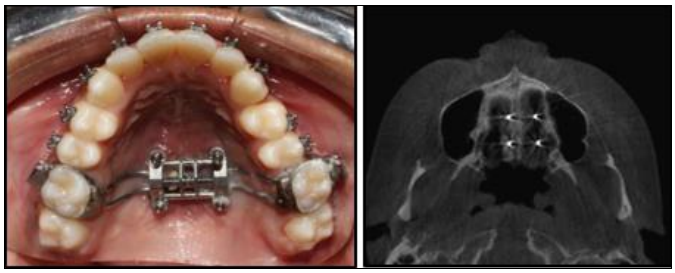

Fig 4: Shift of the MARPE appliance towards the left side.

Post expansion CBCT confirmed the unequal expansion and the split of the Midpalatal suture was evident**.** This untoward complication could have been prevented if the initial positioning of appliance during fabrication was placed equidistantly from the Midpalatal suture. The appliance was removed and there was no bending of the mini-screws found. Further repositioning of the appliance is planned for the patient after healing of the palate following the below mentioned guidelines.

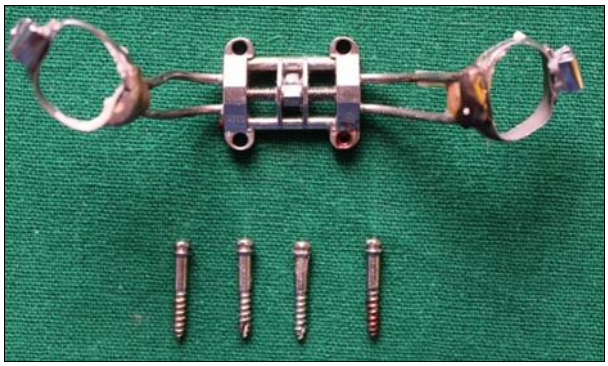

Fig 5: Removal of appliance with mini-screws

Guidelines for the accurate positioning of the MARPE appliance

For the accurate positioning of the appliance, it is essential to take Cone Beam Computed Tomography (CBCT) to view the anatomical landmarks of the nasomaxillary complex region and assess the placement of mini-implants. The advantage of CBCT compared to conventional imaging system is that it provides the 3D view of the anatomical structures without superimposition.

The depth of mini-implant insertion also can be measured by assessing the thickness of the palatal bone using CBCT. This is important as it is necessary to achieve bicortical engagement which allows for wider distribution of forces of expansion avoiding stress concentration around the mini-implants providing better stability of the appliance and skeletal effects.

I. Assessment of Anatomical Structure

It is important to consider the location and variations in the anatomical structures for the placement of MARPE appliance.

1. Evaluate bone thickness

The site of mini-implant insertion should have enough bone thickness to allow for bicortical engagement and for expansion. In cases of reduced bone thickness, additional mini-implants can be added to the device.

2. Locate the anatomical structures

Incisive foramen, Midpalatal suture (MPS), Transpalatal suture.

Anatomical evaluation of following structures along with bone thickness plays a key role in the placement of the appliance.

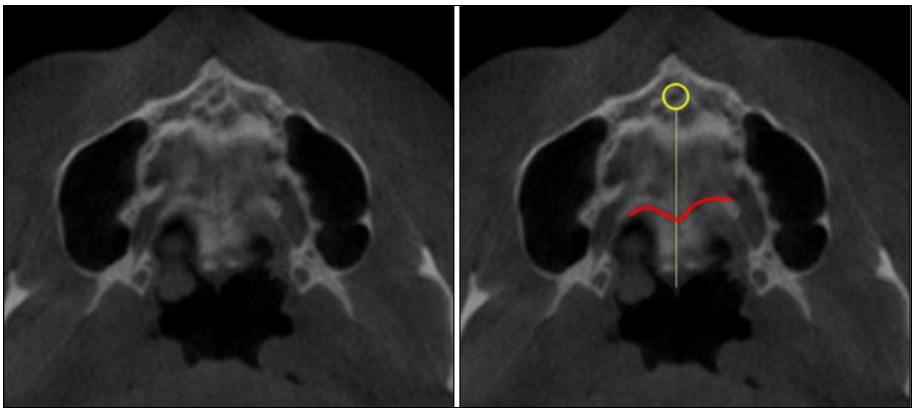

Fig 6: Evaluation of anatomical structures

3. Assessment of midpalatal suture maturation

Midpalatal suture maturation has been classified by Angelieri *et al*. [2] The suture is evaluated from stage A to E where stage A is the earliest stage of maturation and E is the most advanced stage of maturation. It is important to consider the status of suture maturation as it provides valuable information regarding the resistance during separation of midpalatal suture according to the stage of maturation.

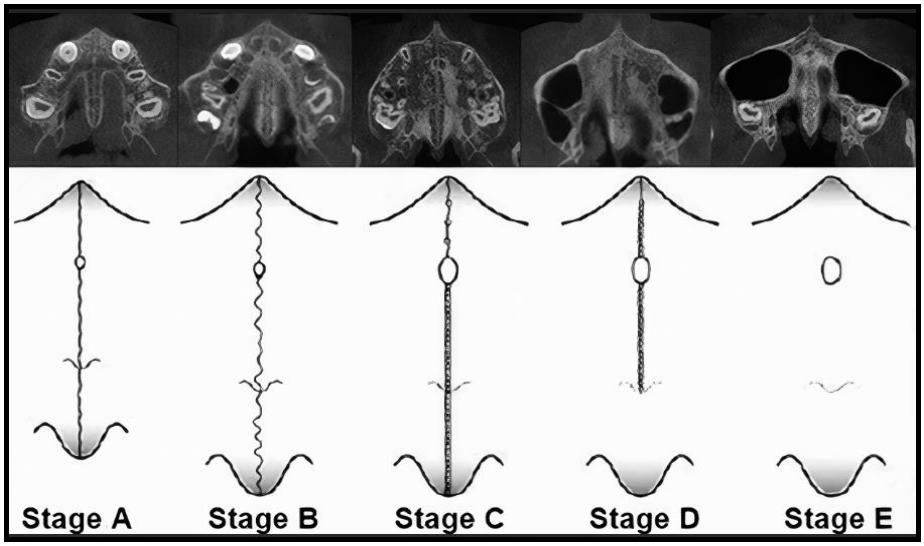

Fig 7: Midpalatal Suture Maturation

Schematic drawing of the maturational stages of the midpalatal suture. Stage A of the morphology of the midpalatal suture is characterized by one relatively straight high-density midpalatal suture line. Stage B is observed as one scalloped, high-density line at the midline. Stage B may present some areas as two parallel, scalloped, high-density lines close to each other and separated by small low-density spaces. Stage C is visualized as two parallel, scalloped, high-density lines that are close to each other, separated in some areas by small low-density spaces. Stage D is visualized as two scalloped, high-density lines at the midline on the maxillary portion of the palate, but the midpalatal suture cannot be identified in palatine bone. At stage E, sutural fusion has occurred in the maxilla. The midpalatal suture cannot be identified, and the parasutural bone density is the same as in other regions of the palate.

4. Assessment of shape of the MPS

The shape of the MPS should be noticed as these sutures can be straight, sinuous or curvilinear which can occur in both horizontal and vertical planes and needs to be assessed in both coronal and axial sections of CBCT. This is important in order to place the mini-implant adjacent to the sutural line without inserting into the suture.

5. Soft tissue thickness evaluation

Soft tissue thickness is measured to aid in the selection of the length of mini-implant required for bicortical engagement.

II. Anatomical variation consideration

Andre emphasized on the careful evaluation of important anatomical structures such as nasal septum deviation, maxillary sinus extension, sinuosity of sutures evaluated, location of incisive foramen and transpalatal suture.

a. Nasal Septal deviation

MARPE rendered almost parallel palatal expansion antero-posteriorly but showed an asymmetric nasomaxillary expansion at the rate of 30.3–50.0%. Asymmetric nasomaxillary expansion after MARPE was influenced by initial facial asymmetry with chin deviation, initial asymmetric position of the mid-palatal suture, unilateral crossbite, asymmetric loosening of the circummaxillary suture, and discrepancies in zygomatic bone density and morphology, but it was impossible to predict the amount of asymmetric expansion initially. Thus, it is important to Nasal Septal Deviation before placement. Once the mini-implants are inserted into the septum, due to non-identification of its deviation, there is a high chance of failure.

b. Asymmetry in the palate

The figure shows asymmetry of palate (both in bone and soft tissue). Based on this observation, we can plan MARPE mini-implants with different sizes on the left and right side both for the thread and the transmucosal profile.

c. Absence of bone / thin palatal bone

The bone absence of the floor of the nasal cavity which may make the use of the MARPE technique unfeasible.

d. Anatomical variation in the maxillary sinus

The variation in the anatomy of the maxillary sinuses observed in this case requires a rigorous evaluation of the positioning of the rings of the MARPE, which will receive the mini-implants.

e. Asymmetry of palatal plane and nasal floor plane

The positioning of the MARPE and the mini-implants should be planned so that they are as horizontally as possible, without following the asymmetry present, because the incorrect positioning, accompanying the asymmetry can aggravate it.

f. Non-coincidence of MPS and mid palatine raphe

In some cases, there could be non-coincidence of MPS and mid palatine raphe. The evaluation of the palatal midline clinical or in models may generate an incorrect planning since the mini-implants can be inserted on the bone median palatine suture which leads to failure.

III. Selection of mini-implant length and accurate positioning in MARPE [3]

1. Obtaining working dental cast

Banding of Upper 1st molar on both the sides is done and impression is taken along with bands to achieve working dental cast.

After obtaining dental cast, the Midpalatal suture line is traded on the cast for the proper positioning of the expanding screw in the transverse position. For the positioning of expanding screw in the anteroposterior direction, the following reference lines are taken into consideration:

a) A reference line extending from the distal surface of upper 1st molar on one side to another side and the center of fixation rings of distal screws are positioned w.r.t this reference line anteroposteriorly.
b) The screws are positioned at the level of the 1st molar region in order to position the distal screws anterior to the transpalatal suture.
c) A second reference line is extended from the center of fixation ring of mesial screw to the adjacent tooth on the cast.

Once the reference lines are obtained, the CBCT can be assessed for the bone thickness measurement at the site of mini-screw insertion.

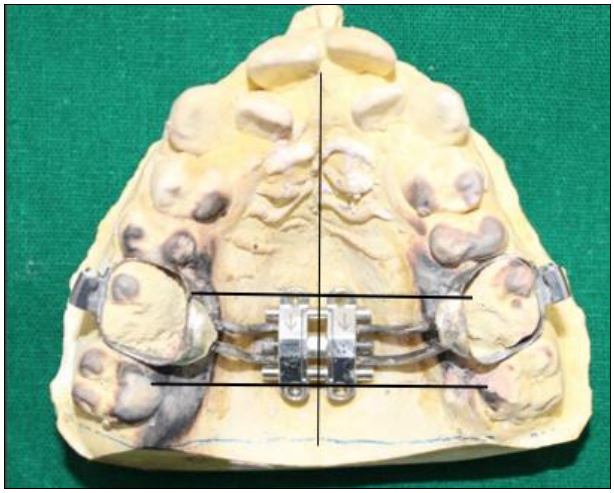

Fig 8: Posterior reference lines placed slightly distal to 1st molar in this case because narrow palate in anterior region did not allow for placement of appliance slight anteriorly

2. Orientation of maxilla in CBCT

It is important to have a clear vision of anatomical region at the site of mini-implant insertion. The CBCT should be taken in such a way that it provides adequate field of view of the adjacent structures. The minimum area considered should

include the cortical plate of the nasal fossa and occlusal aspects of maxillary teeth.

To orient the maxilla, the axial plane should coincide with the occlusal plane of upper teeth, i.e., the incisal edges of upper central incisors and cusp tips of upper molars.

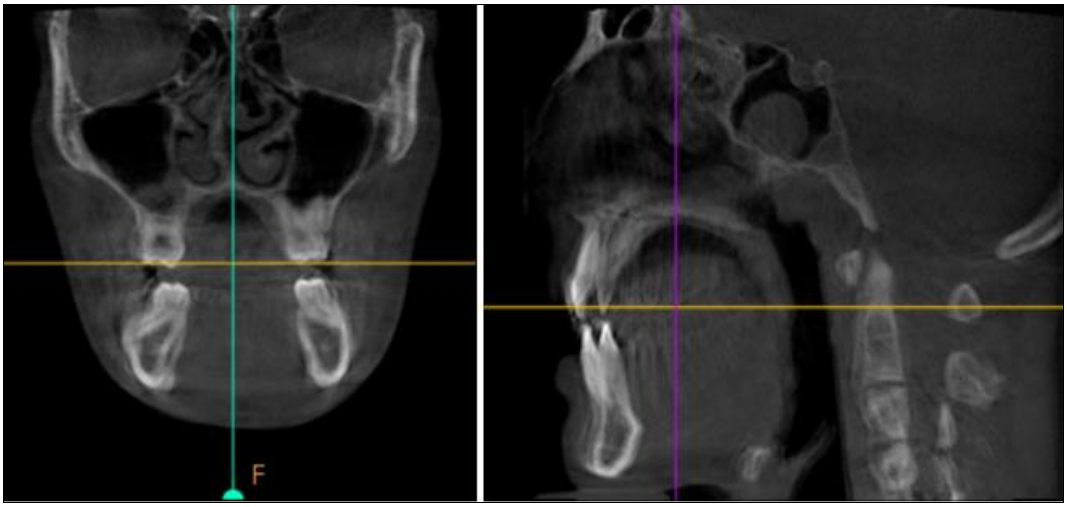

Fig 9: Orientation of maxilla: a. Coronal section b. Sagittal section.

3. Bone and Soft tissue thickness measurement on coronal section of CBCT image

The reference lines marked on the casts for both mesial and distal screws are delineated on the axial section of the CBCT and the same position is selected on the coronal section of CBCT to measure the bone and soft tissue thickness at the site of mini-screw insertion.

The width between the center of adjacent fixation rings of screw is measured with a caliper. This distance in a MARPE screw was found to be 5.2 m.

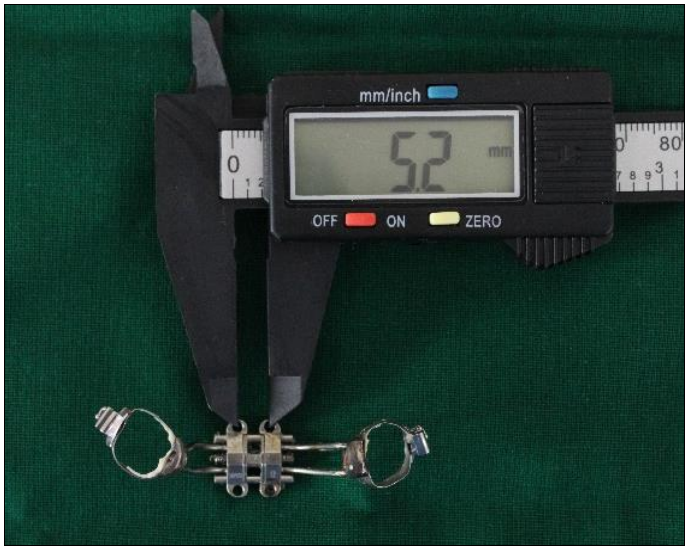

Fig 10: Measurement of width between fixation rings of screw

This distance is similarly taken on the coronal section positioned equidistantly from midpalatal suture. This measurement gives an idea of how to position the screw properly and equidistantly from the midpalatal suture and to avoid any untoward complications. Bone and soft tissue thickness can be measured from the coronal section to select the length of the mini-screw.

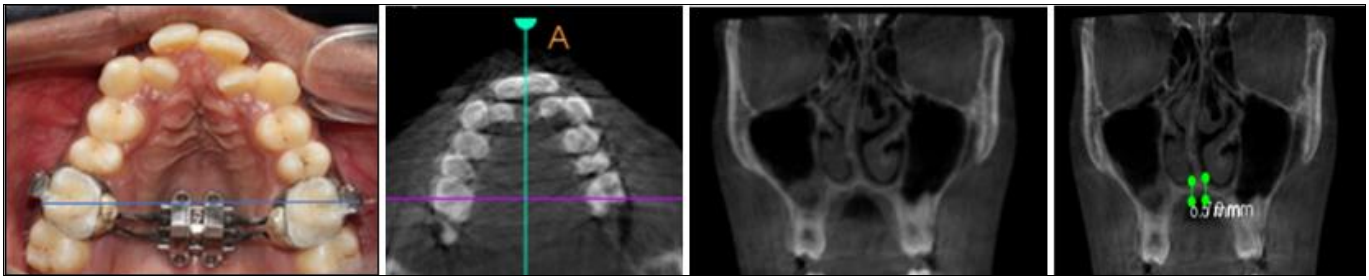

Fig 11: Transfer of anterior reference line in CBCT to evaluate the bone thickness

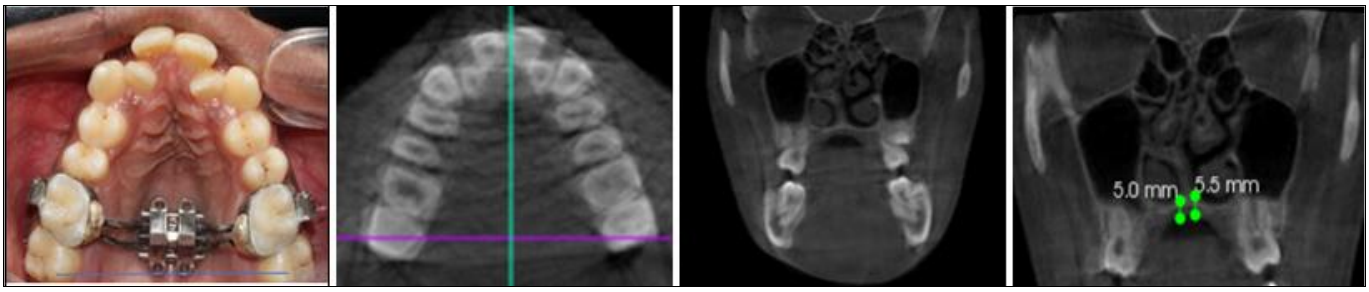

Fig 12: Transfer of posterior reference line in CBCT to evaluate the bone thickness

4. Selection of length of mini-screw

The length of mini-screw is selected by adding up the following measurements done on the working cast and CBCT:

A: Bone thickness measured on CBCT.

B: Soft tissue thickness measured on CBCT.

C: Distance between palatal surface and fixation ring of screw

D: Length of the fixation ring of screw

E: Length required to surpass the cortical plate of nasal floor for bicortical engagement.

Length of mini-screw = A+B+C+D+E

The measurement is done for both the mesial and distal screws corresponding to the reference lines.

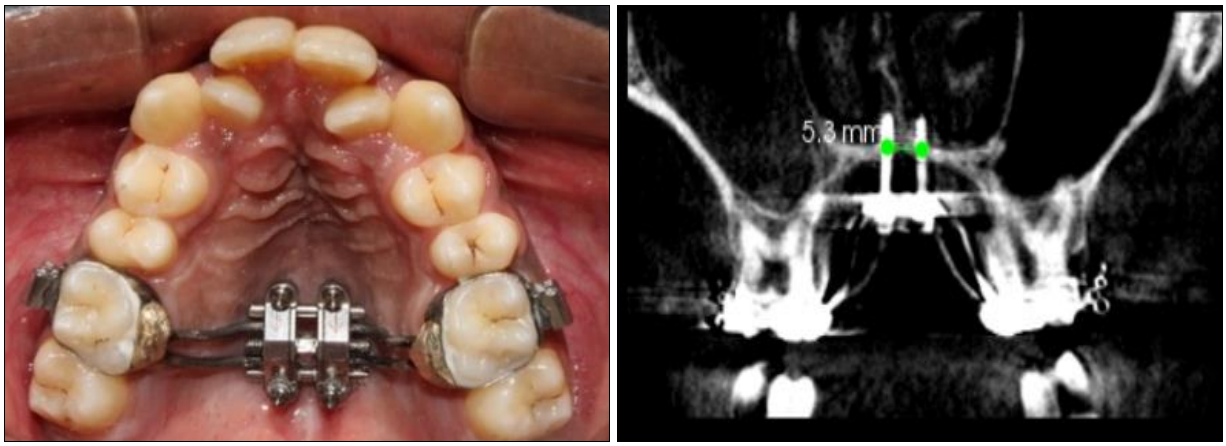

Fig 13: Post insertion A. Clinical B. CBCT

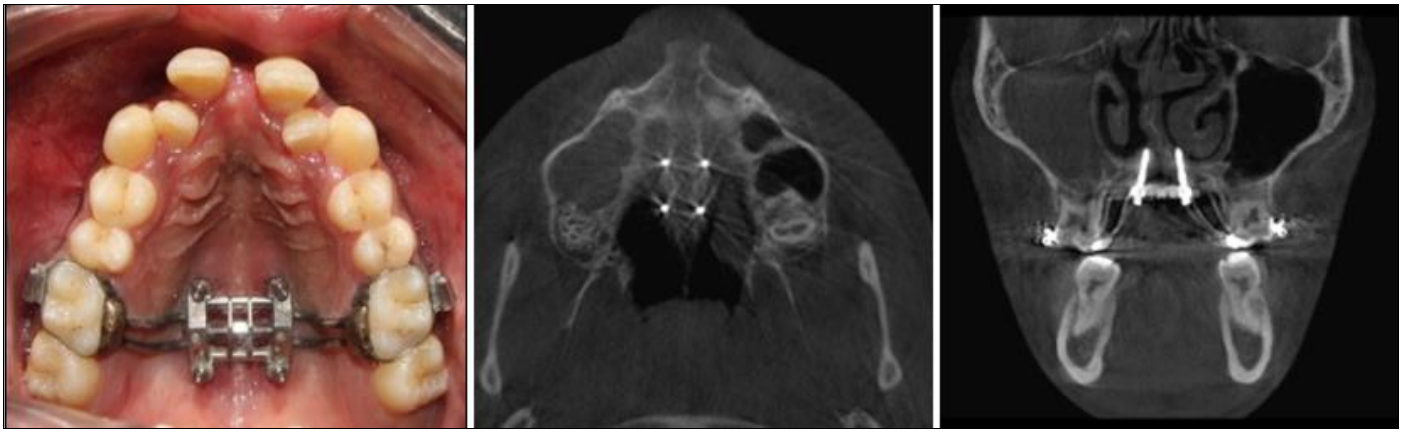

Fig 14: Post Expansion A. Clinical B. CBCT photographs

Conclusion

Learning from mistakes is the key to success. Thus, it can be concluded that for the placement of MARPE appliance, it is important to know the anatomical structure as well as the variations associated with palatal structure. An evaluation of CBCT for the thickness of bone and soft tissue thickness adjacent to midpalatal suture is very important for the selection of mini-implant. A thorough knowledge and meticulous planning is required for the proper diagnosis and treatment planning and success of MARPE appliance and avoid complications.

Conflict of Interest

Not available

Financial Support

Not available

References

1. André CB. Análise tomográfica para técnica Marpe. Rev Clin Ortod Dental Press 2018;17(4):50-53
2. Angelieri F, Cevidanes LH, Franchi L, Gonçalves JR, Benavides E, McNamara JA Jr. Midpalatal suture maturation: classification method for individual assessment before rapid maxillary expansion. Am J Orthod Dentofacial Orthop. 2013 Nov;144(5):759-69.
3. Nojima LI, Nojima MD, Cunha AC, Guss NO, Sant'Anna EF. Mini-implant selection protocol applied to MARPE. Dental press journal of orthodontics. 2018 Sep;

23:93-101.
4. Hoque T, Srinivasan D, Gnaneswar SM, Chakravarthi S, Rajaram K, Kannan R. Microimplant-Assisted Rapid Palatal Expansion (MARPE)-A Comprehensive Review. Int J Dentistry Oral Sci. 2021 Oct 26;8(10):4848-52.
5. André CB, de Paula Machado Pasqua B, Neto JR, Nascimento FD. Surgical digitally guided planning for the mini-screw assisted rapid palatal expansion (MARPE) and suture perforation: MARPE guide. Current Trends in Orthodontics. 2022 Aug 17:143.
6. Minervino BL, Barriviera M, Curado MD, Gandini LG. MARPE guide: A case report. The Journal of Contemporary Dental Practice. 2019 Sep 1;20(9):1102-7.

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