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Department of Orthodontics, School & Hospital of Stomatology, Wuhan University, China

Two-phase treatment of a patient with skeletal class II malocclusion and maxillary expansion

01.General Information

Patient Gender: Male

Patient Age: 8Y

Chief Complaint

Anterior tooth protrusion for more than 2 years.

Present History

His parents complained that the anterior teeth and upper lip of the patient began to protrude after teeth replacement, which gradually aggravated and influenced his profile.

Medical History

History of adenotonsillectomy due to snoring and mouth breathing

Denied family history or orthodontic treatment history.

02.Clinical Examination

Extra-oral Examination

Frontal view: The left face was fuller than the right; chin deviation to the left; lip incompetence; upper dental mid-line is coincident with the facial mid-line; Long face type

Lateral view: Convex profile; upper lip protrusion; acute nasolabial angle; high mandibular plane angle

Intra-oral examination

Mixed dentition; distal molar relationship; III° deep overbite and III° deep overjet (12mm); V-shaped maxillary arch; The curve of Spee is approximately 4mm in depth; There are scattered spaces among the upper anterior teeth; #11 and #21 proclination; #55 caries; Poor oral hygiene

Temporomandibular joint examination

Normal

Pre-treatment: Extra- and intra-oral images

03.Imaging Examination

Panoramic Radiograph

- Insufficient space for #13, #23, #33 and #43 to erupt;
- #18、#28、#38、#48 embryo exists

Lateral Cephalogram

CVM stage III; Skeletal Class II, maxilla protrusion, mandibular retrusion; High mandibular plane angle; Upper anterior teeth proclination, lower anterior teeth inclination

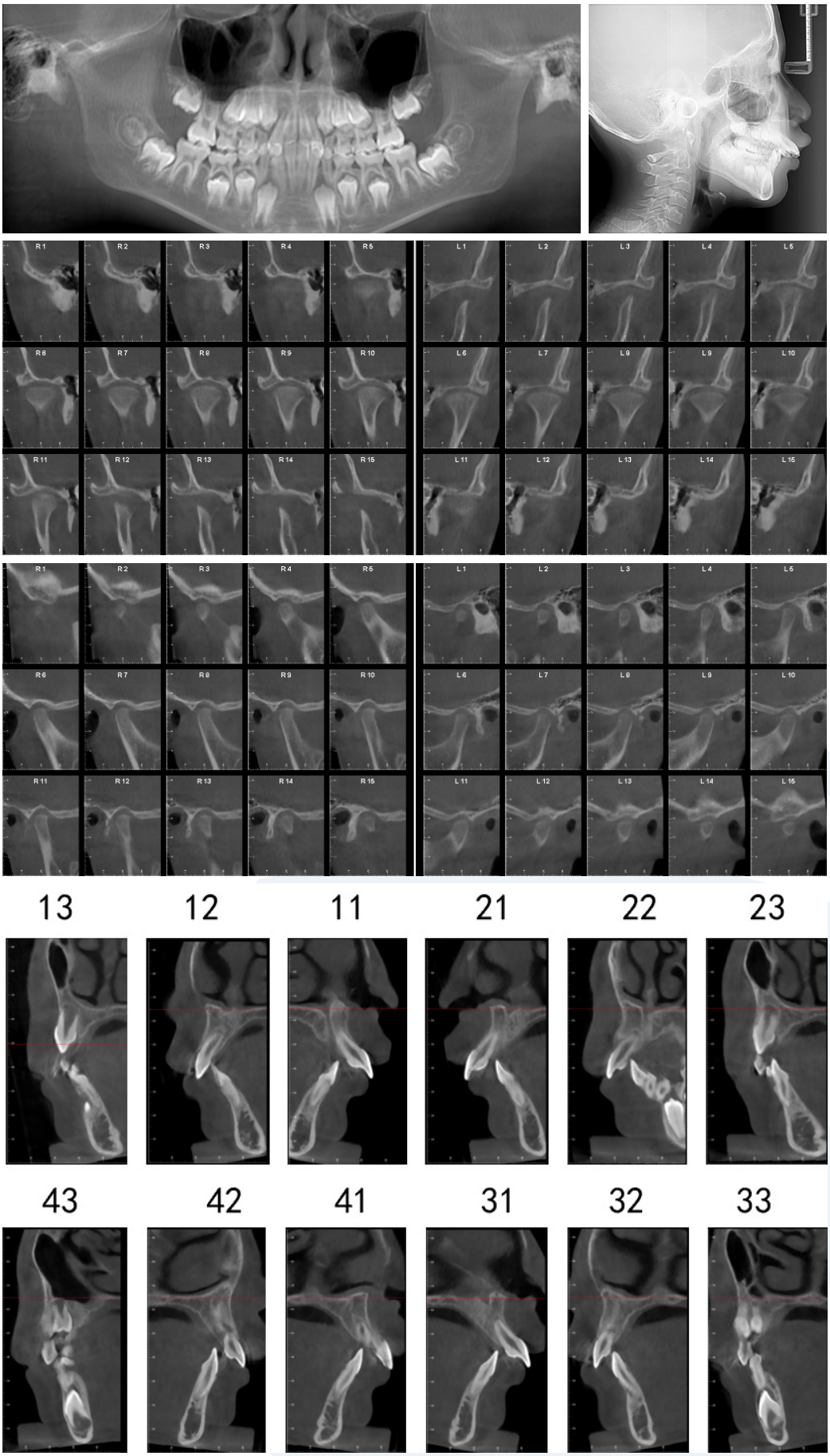
CBCT

- The alveolar bone on labial side of upper incisors and both labial and lingual side of lower incisors are thin;
- No obvious TMJ change

Arch Width Analysis

- University of Pennsylvania's CBCT transverse analysis: Maxillary transverse deficiency of 9.5 mm;
- Yonsei University's CBCT transverse analysis: Maxillary transverse deficiency of 10.6 mm

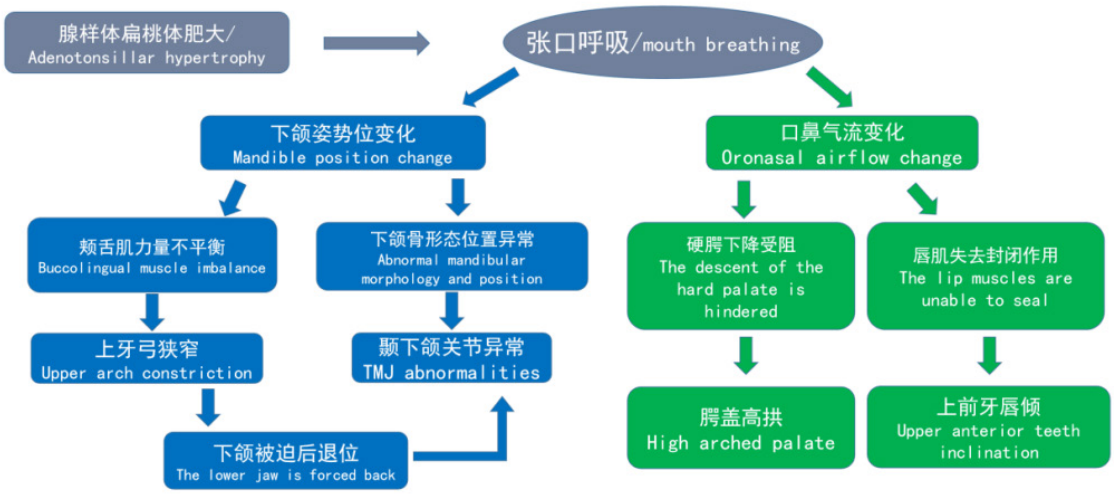
Pre-treatment: imaging examination



04.Diagnosis

- Skeletal class II malocclusion, maxilla protrusion, mandible retrusion; Vertical growth pattern; Maxillary transverse deficiency (10mm)
- Angle class II division 1 malocclusion with III° deep overbite and III° deep overjet

05.Etiology



06.Treatment Objectives

Improving profile, aligning and leveling teeth, and establishing a better occlusal relationship

07.Treatment Plan:

Preparation:

- Oral health instruction and cleaning teeth;
- Resin filling treatment of #55

Two phase treatment:

- Phase I: Maxillary expansion plus high-pull headgear treatment with myotherapeutic exercises for strengthening lip and tongue muscle;
- Phase II: Re-evaluation after the completion of tooth replacement.

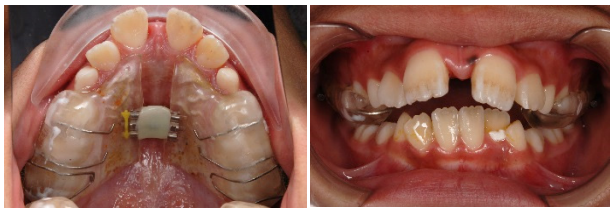
08.Treatment Progress

Phase-I:

- Rapid maxillary expansion (RME) was activated 2 turns per day for two weeks, and then maintained for six months.
- High-pull headgear with extra-oral arch, employing 2*4 technique for teeth leveling

Extra- and intra-oral images during phase-I treatment

Phase-I: After rapid maxillary expansion



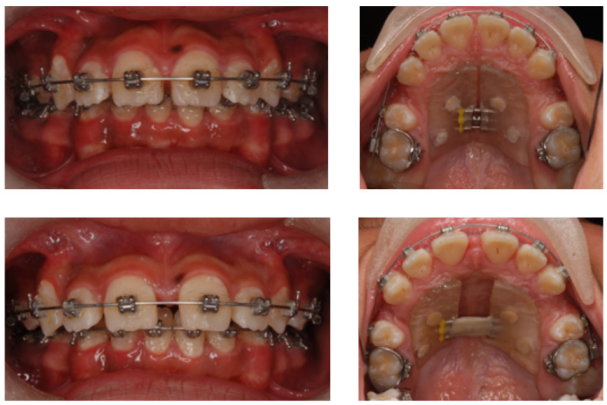
Phase-I: High-pull headgear with extra-oral arch and 2*4 technique for leveling

Phase II:

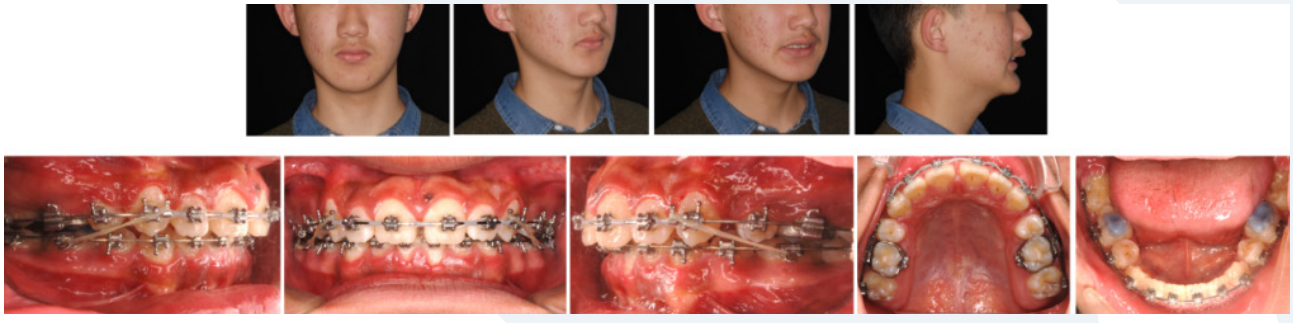
- Extraction of #14, #24, #34, #44;
- After square NiTi was applied in both maxilla and mandible, a miniscrew-assisted rapid palatal expansion (MARPE) was implemented;
- Space closing in conjunction with class Ⅱ inter-maxilla elastic traction

Extra- and intra-oral images during phase-I treatment

Phase-II: MARPE



Phase-II: Fixed orthodontic treatment



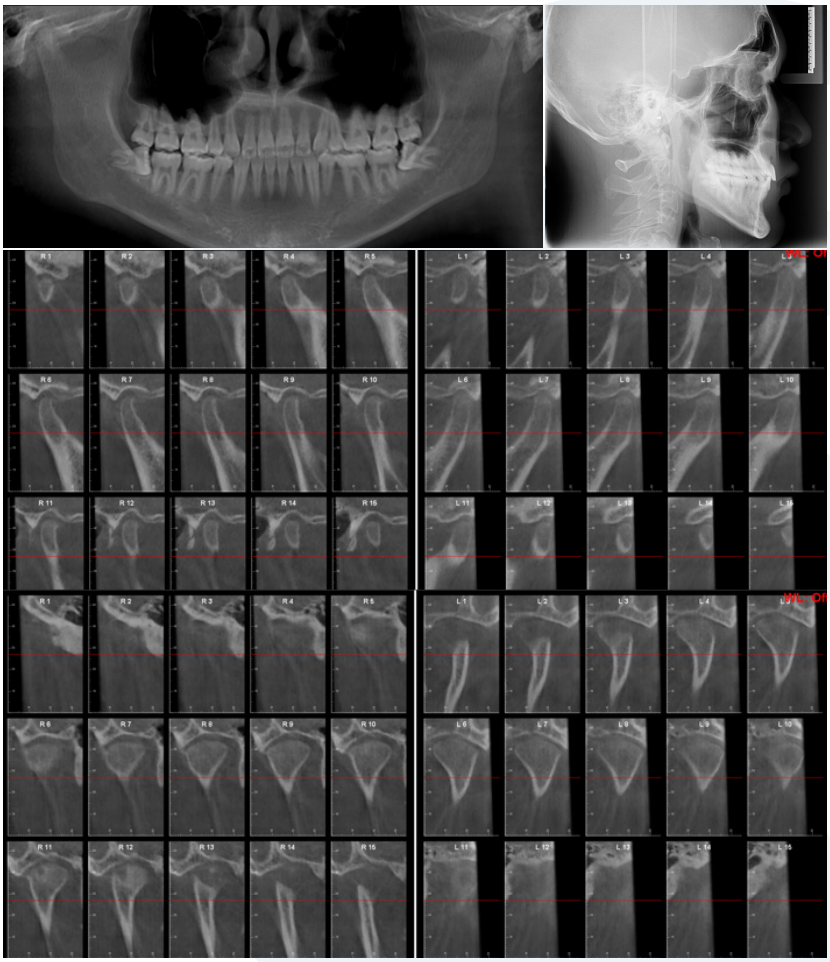
09.Treatment outcomes

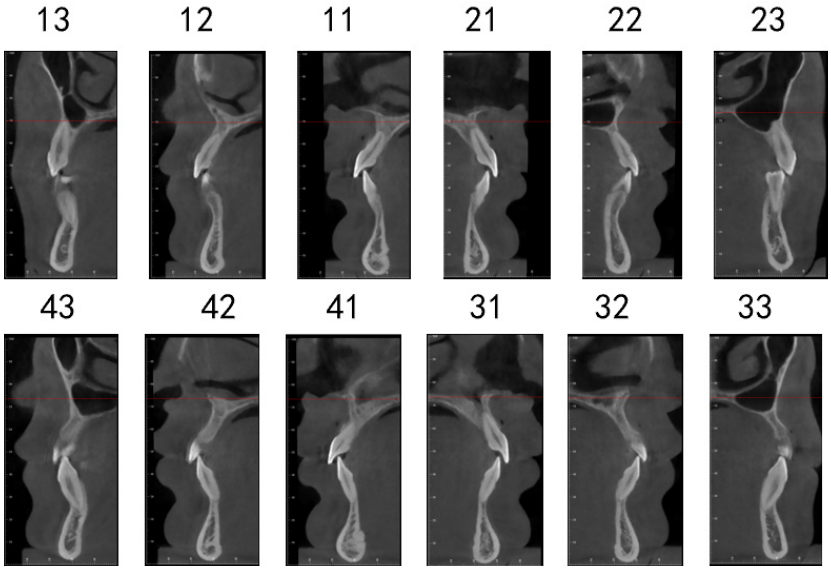
After treatment, the patient demonstrated a significant improvement in the profile and the upper and lower lips can close naturally with relaxation. The dentition and mid-lines of maxilla and mandibular were well-aligned. Moreover, the anterior teeth showed normal overjet and overbite, with bilateral class I canine and molar relationships. The maxillary arch was expanded and matched with mandibular arch.

Post-treatment panoramic radiograph depicted acceptable root parallelism and no obvious abnormalities. Cephalometric analysis revealed: ∠ANB = 0.1°, a reduction of the mandibular plane angle by 10°, a posterior-to-anterior face height ratio = 69.4%. Other results are detailed in Table 1. One year and two years follow-up showed stable maxillary width, good tooth alignment, and stable occlusal relationship.

Post-treatment: Extra- and intra-oral images

Post-treatment: Imaging examination





测量指标 /Values	治疗前 /Pre-Tx	I期治疗后 /Post-Ph1	II期治疗后 /Post-Ph2	正常值 /Normal
SNA	80.5	81.8	81.3	82.8±4.0
SNB	74.2	78.2	81.2	80.1±3.9
ANB	6.4	3.6	0.1	2.7±2.0
Wits	4.5	0.0	0.7	0±1.0
U1-SN	121.4	118.3	114.7	105.0±5.0
L1-MP	79.9	78.9	81.2	92.6±7.0
U1-L1	116.9	124.0	132.4	130.0±6.0
MP-SN	41.8	38.8	31.8	33.0±6.0
S-Go/N-Me	60.4	63.6	69.4	65.0±4.0
NSAr	117.9	113.5	110.2	124.0±5.0
SArGo	158.6	155.7	161.5	147.2±7.9
ArGoMe	125.3	129.5	120.1	122.1±6.3
SUM	401.8	398.8	391.8	392.5±5.4
ArGoNa	44.8	47.5	41.5	46.7±3.5
NaGoMe	80.6	82.0	78.6	75.3±5.0

Table 1 Comparison of the cephalometric analysis results

Two years Follow-up: Extra- and intra-oral images

10.Treatment Experience

Early removal of adverse factors

Both genetic and environmental factors can contribute to malocclusion. In this case, the profile of his father is straight, and the chin is well developed. However, the patient exhibits convex profile, which could be caused by his history of snoring and mouth breathing, a typical environmental factor for malocclusion. As a result, the objective of Phase-I treatment was aimed at correct mouth breathing habit and maxillary transverse deficiency. Subsequently with fixed orthodontic treatment, the patient gradually exhibited the inherent growth pattern.

This patient had problems in transverse, vertical and sagittal dimensions. In terms of transverse dimension, the growth of maxillary was insufficient; in terms of vertical dimension, a vertical growth pattern with high mandibular plane angle was evident; in terms of sagittal dimension, a skeletal class II relationship with maxilla protrusion and mandibular retrusion was observed.

After birth, transverse craniofacial growth ends up first with a minimal extent, whereas sagittal and vertical growth continues into adulthood. Insufficient maxilla width would affect the vertical and sagittal development. Therefore, early correction of transverse discrepancies is crucial. During the treatment process, we paid close attention to maxillary transverse deficiency and made effective maxillary expansion twice. Subsequently, expanded maxillary created a favorable environment for the natural growth of mandibular.

Vertical control and mandibular growth

High-pull headgear with an extra-oral arch was applied in this case aimed at, to some extent, controlling the vertical growth pattern. Additionally, addressing airway obstruction is favorable for vertical control as well. The patient was in the CVM III stage at the time of consultation, which is the peak of mandibular growth. Once the adverse factors were removed, substantial growth was observed in the ramus and body of mandible during the treatment progress. This played a key role in correcting the skeletal class II malocclusion.

Sagittal effect of maxillary expansion

Studies have documented that the mandible could exhibit sagittal movement after RME for children during mixed dentition, thus improving class II malocclusion. In this case, after Phase-I RME treatment, the molar relationship changed from complete distal into cusp-to-cusp class II relationship, demonstrating the protrusion of mandible. However, according to relevant systematic reviews, there is insufficient evidences to justify the effects of RME on class II malocclusion. As a result, high-quality randomized controlled trials are required for further investigation. Nevertheless, the possible mechanisms may be the compression force on the maxilla, and functional protrusion of mandibular during maintenance stage due to the over-correction of maxilla.

11.Expert Discussion

Professor Xiong Hui

Professor Xiong Hui regarded this case exemplifying one of the treatment strategies for this kind of patients, which concentrated on maxillofacial development.

This patient was diagnosed as skeletal class II malocclusion at the first consultation, and skeletal class I malocclusion after Phase-I RME according to ∠ANB. This raises thought-provoking question: Should our treatment plan change accordingly when a patient is diagnosed as skeletal class I or class II? Should treatment plans be made based on skeletal classification, patient's appearance, or occlusal relationship?

Moreover, although this case was successful, we should reflect on the possibility of using functional appliances. If mandible advancement devices could contribute to Angle class I relationship in the phase-I stage, might extraction be avoidable during Phase-II? Given the patient's lower anterior teeth are quite upright, it is challenging to perform orthodontic treatment involving extractions. The majority of extraction spance are closed by moving the molar forward, and orthodontic treatment is very difficult.

Eventually, it is recommended to choose different expansion appliances based on patient's age and CVM stage. For instance, MARPE or surgery-assisted expansion is suitable for those in CVM stage D. These strategies could achieve skeletal effect and avoid buccal tipping of the posterior teeth, which is often brought about by conventional ones.

Professor Yeweng Sanjie

Professor Yeweng Sanjie deemed this case was well-conducted, with a comprehensive case report and thorough literature analysis. Headgear cannot bring immediate changes, such as reducing overjet, when compared to functional appliances. As a result, patience is necessitated for both clinicians and the patients.

In addition, the chin of the patient was relatively well-developed, which indicated a favorable sagittal growth pattern and a positive prognosis of mandibular growth. However, due to the increased risk of tooth trauma caused by proclined upper anterior teeth, Professor Ye would choose early intervention as well. Functional appliances or simple fixed orthodontic treatment, such as 2*4 technique, could retrude the upper anterior teeth as early as possible in order to reduce trauma risk.

Professor Liu Zhijian

Professor Liu Zhijian appreciated the treatment strategy employed in this case. The necessity and effectiveness of functional appliances have always been a controversial topic. Usually, they are employed in combination with the maxillary expansion devices. Thus it is difficult to distinguish where the mandibular sagittal effect comes from. However, this case might serve as an example which explained the mandibular movement after maxillary expansion.

Moreover, extra-oral arch was suitable for this patient. On one hand, the patient exhibited upper anterior teeth and maxilla protrusion. This could be addressed by suppressive effect on maxilla generated from the extra-oral arch. On the other hand, the patient had a favorable growth pattern for mandible. As maxillary growth was inhibited, the "catch-up" phenomenon in mandible was observed.

Patient compliance is critical when utilizing an extra-oral arch. When wearing the extra-oral bow for the first time, try not to make too many adjustments in order to facilitate easy removal and application by the patient. Further adjustments for correcting molar torque or inter-molar width could be achieved via manipulating the angle between the extra-oral arch and buccal tube. Furthermore, it should be noted that the position of the extra-oral arch should not disturb the natural position and function of the lips.

Reference

1. 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. doi: 10.1016/j.ajodo.2013.04.022.

2. Guest SS, McNamara JA Jr, Baccetti T, Franchi L.Improving Class II malocclusion as a side-effect of rapid maxillary expansion: a prospective clinical study.Am J Orthod Dentofacial Orthop.2010 Nov;138(5):582-91. doi: 10.1016/j.ajodo.2008.12.026.

3. Feres MF, Raza H, Alhadlaq A, El-Bialy T.Rapid maxillary expansion effects in Class II malocclusion: a systematic review.Angle Orthod.2015 Nov;85(6):1070-9. doi: 10.2319/102514-768.1.

4. Jacob HB, Buschang PH.Mandibular growth comparisons of Class I and Class II division 1 skeletofacial patterns.Angle Orthod.2014 Sep;84(5):755-61

5. Zhao T, Ngan P, Hua F, Zheng J, Zhou S, Zhang M, Xiong H, He H.Impact of pediatric obstructive sleep apnea on the development of Class II hyperdivergent patients receiving orthodontic treatment: A pilot study.Angle Orthod.2018 Sep;88(5):560-566.

6. Tamburrino, etal.The transverse dimension: Diagnosis and relevance to functional occlusion.2011

7. Kee-Joon Lee, etal.Maxillary transverse expansion in adults: Rationale, appliance design, and treatment outcomes.Seminars in Orthodontics 24 (2018): 52-65.

8. Andrews LF.The 6-elements orthodontic philosophy： Treatment goals,classification,and rules for treating ［J］.Am J Orthod Dentofacial Orthop,2015,148(6)： 883 - 887.

9. Suzuki H, Moon W, et al.Miniscrew-assisted rapid palatal expander (MARPE): the quest for pure orthopedic movement[J].Dental Press J Orthod, 2016, 21(4):17-23.

10. Kee-Joon Lee, etal.Maxillary transverse expansion in adults: Rationale, appliance design, and treatment outcomes.Seminars in Orthodontics 24 (2018): 52-65.

11. Contemporary orthodontics, sixth edition.William R.Proffit.Mosby; 6th edition.2019

12. Orthodontics: Current Principles and Techniques.Lee W.Graber.Mosby; 6th edition.2017

An Orthodontic and Orthognathic treatment with MARPE: A Case Study

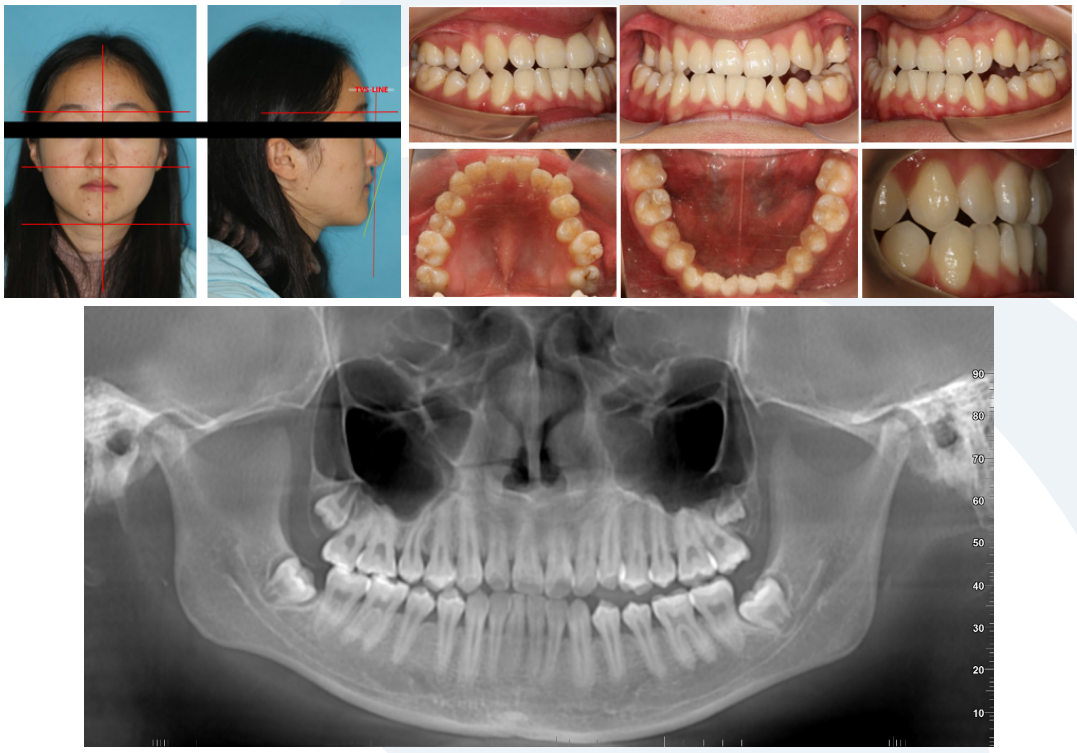
01.Basic Case Information

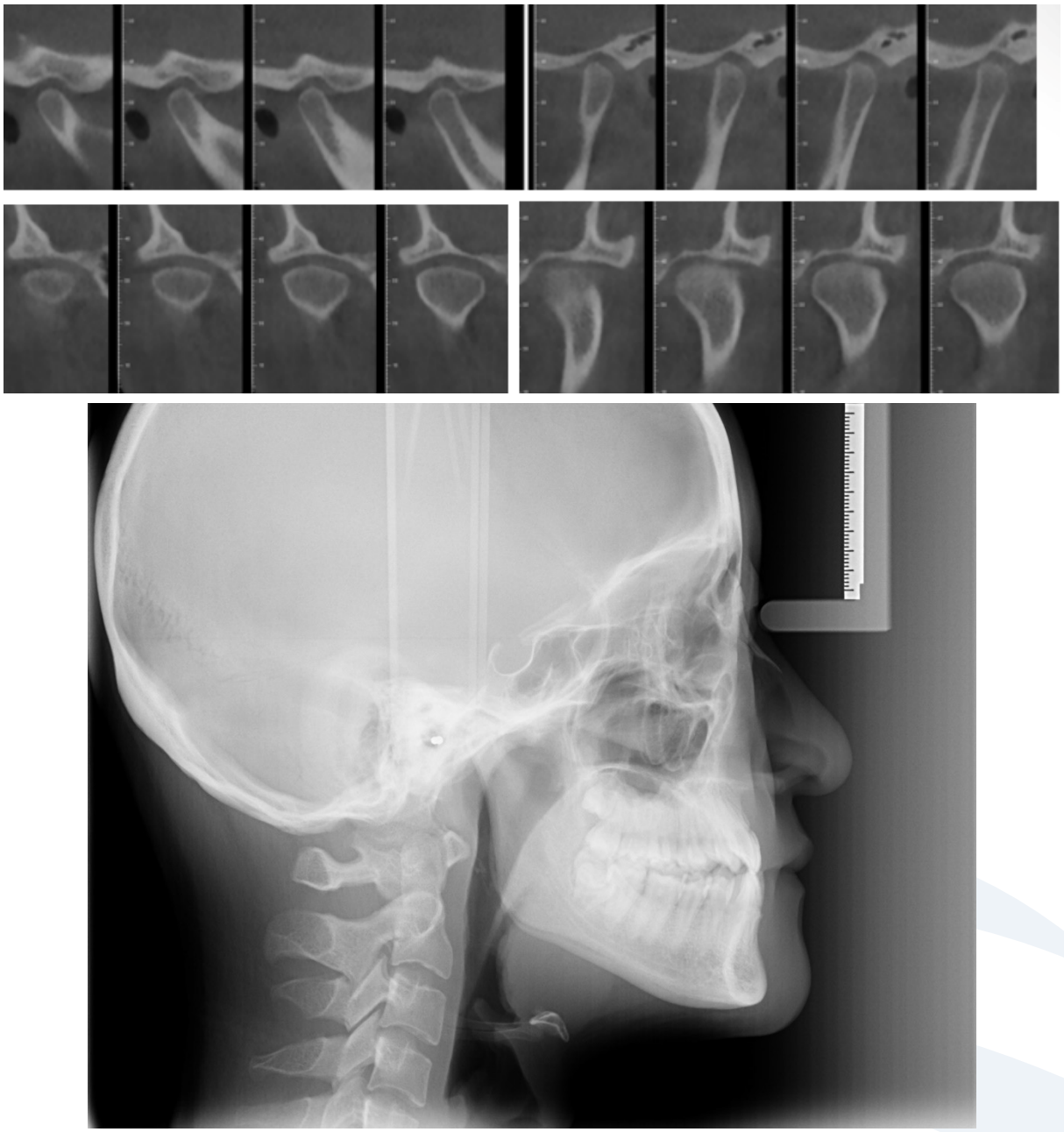
A 19-year-old female patient who complained of a desire to correct facial asymmetry was seeking treatment. She denied any relevant medical history, systemic diseases, genetic history, or allergies.

● Before treatment, she showed significant asymmetry in the mandible from the front view, with the chin point deviating to the right; from the side view, she had a concave profile with a high mandibular plane angle , and both the upper and lower lips were behind the aesthetic line. The midline of the upper dental arch was 3mm to the left, and the midline of the lower dental arch was 2mm to the right. Intraoral view showed mild crowding in both dental arches, with the anterior teeth in an edge-to-edge relationship. The bilateral molars were in a mesial relationship, with the left canine in a distal and the right in a mesial relationship. The right posterior teeth were in crossbite. There was an open bite in the left anterior molar area, crossbite in the molar area, and a canted occlusal plane.

● CBCT images showed a permanent dentition, with root resorption from 12-22. The floor of the maxillary sinus was low. The heights of the left and right condyles were inconsistent. Four wisdom teeth were present. The buccal alveolar bone of the anterior teeth in both jaws was thin. The maxillary posterior teeth were buccally tilted. Both condyles were abnormally shaped, with continuous cortical bone surfaces. The width of the maxillary basal bone was 43.3mm and that of the mandibular basal bone was 51.1mm, according to Yonsei analysis, with a high degree of ossification at the palatal midline.

Cephalometry indicated that the patient had underdeveloped maxilla and mandibular prognathism, classified as skeletal Class III. The mandibular plane angle and Y axis angle were normal, indicating that the patient had an average growth pattern. The lower anterior teeth were retro-clined, with dental compensation in the mandibular incisors. The lower lip was positioned 3.5mm behind the aesthetic plane.





02.Treatment plan

● Combined Orthodontic and Orthognathic Treatment

Phase I: MARPE.

Phase II: Pre-surgical orthodontics including extraction of maxillary 5 and mandibular wisdom teeth, aligning and leveling of the dental arches, coordinating the widths of the upper and lower dental arches, and decompensations.

Phase III: Orthognathic surgery.

Phase IV: Post-surgical orthodontics.

● Key Points of Treatment:

I. Design of implant-supported maxillary expansion (Mini screw assisted rapid palatal expansion, MARPE) to thoroughly address transverse discrepancies.

II. Complete removal of dental compensations before surgery.

03.Treatment Process

Three weeks after expansion, a diastema of about 4mm was visible between the two central incisors. The expander was sealed and maintained for six months. Then we bonded the lower arch.

After alignment and leveling of the maxillary arch, double key loop was used to close the extraction spaces.

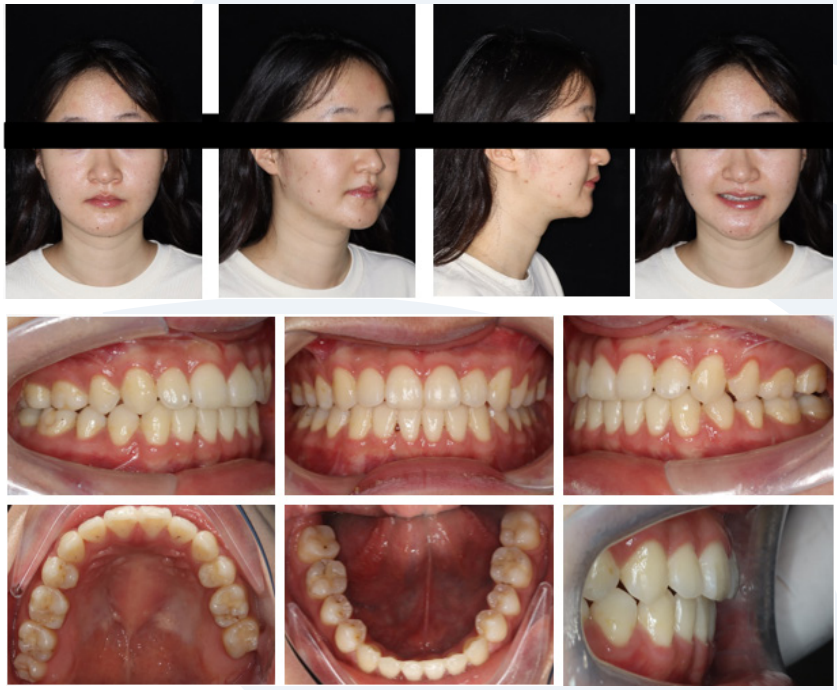
After the maxillary spaces were almost closed, screws were used to correct the dropping palatal cusps, and the remaining spaces in the mandible were closed by moving the molars forward. After taking plaster models to match the widths of the upper and lower dental arches, it was found that the expansion of the upper dental arch was still insufficient, thus a second expansion was performed.

Two weeks after the second expansion, the expander was sealed.

Six months after orthognathic surgery, fine adjustments were made.

04.Post-Treatment and Retention Phase

The facial asymmetry was greatly improved, the teeth were well-aligned, the anterior teeth had normal overbite and overjet, and the canines were in a neutral relationship.

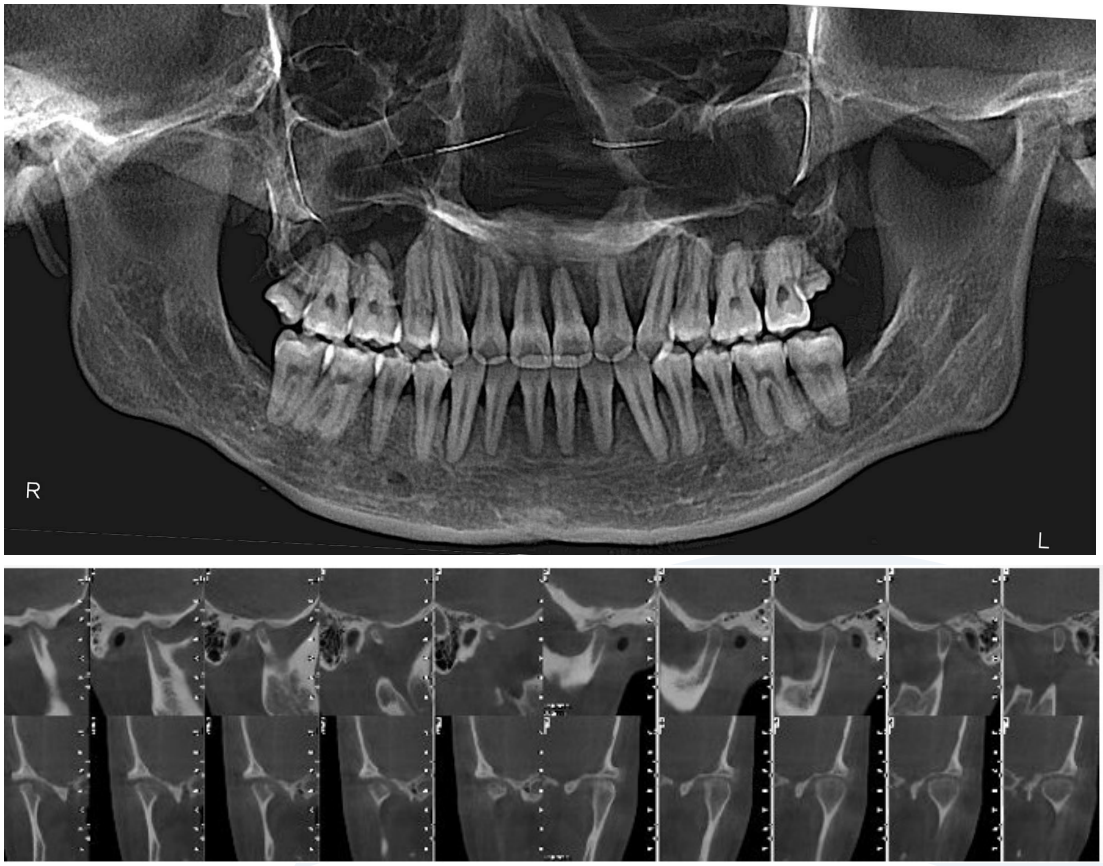


The lower midline was slightly off to the right by 0.1mm.

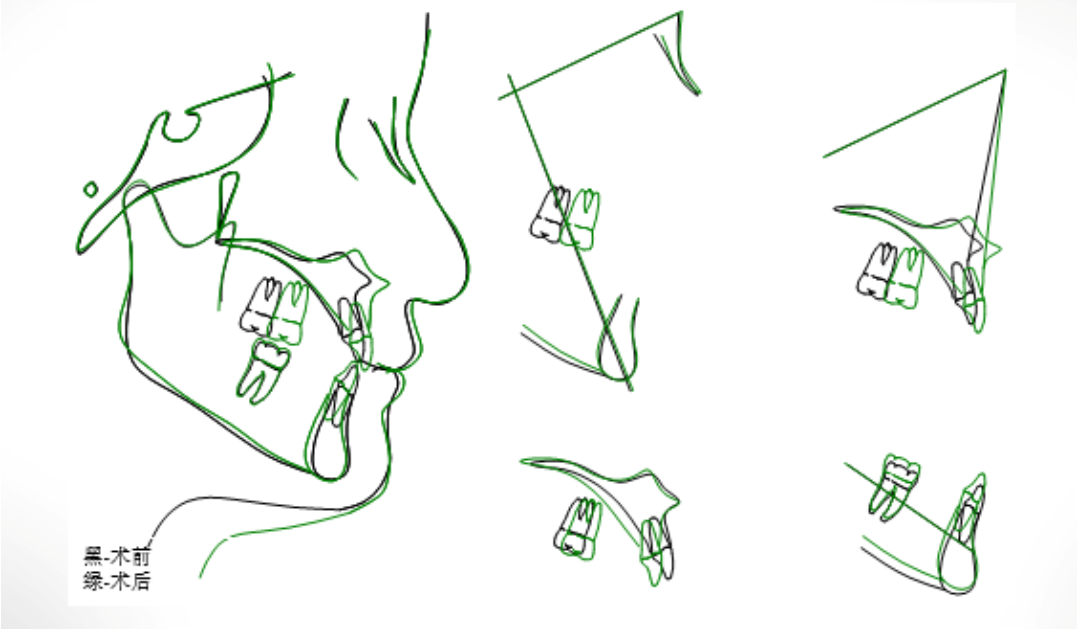
CBCT and cephalometric measurements at the end of treatment

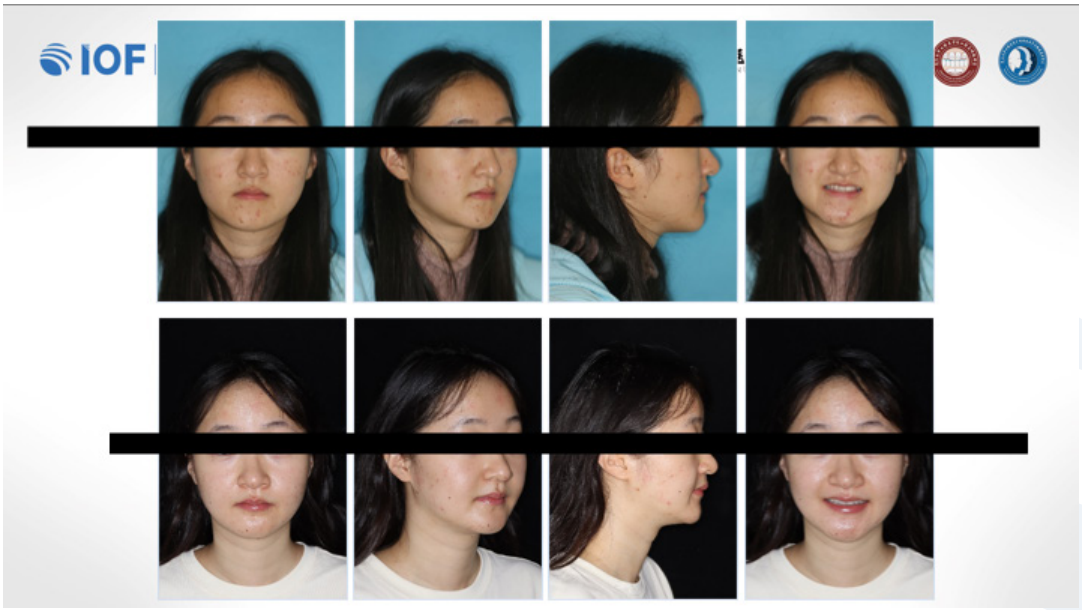
Post-treatment pano images showed: the root resorption of the anterior teeth in both jaws were slight, the parallelism of the roots was acceptable, and there was no significant change in the height of the alveolar bone compared to pretreatment condition. The width of the maxillary basal bone was 49.8mm, and that of the mandibular base bone was 50.9mm. Bilateral temporomandibular joint films showed: the joint condition was basically maintained.

Lateral cephalometry results showed: ANB angle returned to normal.



Pre- and Post-treatment Comparison





05.Discussion

Patients with facial asymmetry and Class III malocclusion not only exhibit obvious sagittal discrepancies but often also have mismatched widths between the maxillary and mandibular base bones. This mismatch can either be addressed during surgery by segmenting the maxilla or through orthodontic methods before surgery. Depending on the degree of ossification of the palatal midline, different orthodontic approaches are chosen to address the insufficient width of the maxilla. For cases with a high degree of ossification of the palatal suture, customized MARPE has recently become a favored option among orthodontists. In this case, to address nearly 8mm of insufficient maxillary width, we used MARPE twice, ultimately achieving satisfactory results.

In the discussion regarding this case, Professors Liu Zhijian and Yeweng Sanjie debated the pros and cons of addressing the width issue before surgery versus during surgery. Using MARPE before surgery to address the width discrepancy increases the complexity and workload of orthodontics but reduces the likelihood of segmenting the maxilla during surgery—segmentation of the maxilla would significantly increase the patient's trauma and costs. Therefore, when choosing the timing and method to address the width issue for similar patients, it is generally recommended that orthodontists, orthognathic surgeons, and patients consult together, compare the advantages and disadvantages of each plan, and make a decision based on fully informed consent. Professor Xiong Hui also pointed out in the subsequent discussion that solving the width discrepancy by segmenting during surgery would face the issue of steps between the bone segments of the maxilla, and to avoid nonunion, pre-bent or pre-customized 3D titanium plates might be needed during surgery, undoubtedly increasing the difficulty of the surgery. Using MARPE technology before surgery can avoid such difficulties. Regarding the design philosophy of the customized MARPE expander, Professor Xiong Hui reviewed his exploration experience: compared to commercialized implant-assisted expansion devices, customized expanders can avoid issues caused by high palatal vaults that prevent the expander from fitting well against the palate, thus demonstrating certain clinical practicality.