Received: 13 May 2024 | Revised: 11 July 2024 | Accepted: 17 July 2024

DOI: 10.1002/ccr3.9216

CASE REPORT

Clinical Case Reports Open Access WILEY

Successful treatment for an adult with bilateral posterior teeth crossbite by miniscrew-assisted rapid palatal expansion: A case report

Yuan Fan[1,2] | Yuanyuan Li[3] | Manlin Fan[1,4] | Yanfang Lin[1,4] | Jiarong Xu[1,4] | Zhihua Li[1,2] | Jun Luo[1,2]

[1]Department of Orthodontics, The Affiliated Stomatological Hospital, Jiangxi Medical College, Nanchang University, Nanchang, China

[2]Jiangxi Province Key Laboratory of Oral Biomedicine, Nanchang, China

[3]Pingxiang People Hospital, Pingxiang, China

[4]Jiangxi Province Clinical Research Center for Oral Diseases, Nanchang, China

Correspondence
Zhihua Li and Jun Luo, Department of Orthodontics, The Affiliated Stomatological Hospital, Jiangxi Medical College, Nanchang University, Nanchang 330006, China.
Email: lwlq323@163.com and luojun@ncu.edu.cn

Key Clinical Message

Successful treatment by miniscrew-assisted rapid expansion and clinical aligner therapy for an adult diagnosed with maxillary transverse deficiency (MTD) by clinical examinations and Yonsei transverse analysis.

Abstract

Adult orthodontic diagnosis and treatment with maxillary transverse deficiency (MTD) is challenging. Miniscrew-assisted rapid palatal expansion (MARPE) is a fast and low-risk method to expand the width of maxillary basal bone. This case report describes a 23-year-old female with mandible deviation and bilateral posterior teeth crossbite. She was diagnosed as MTD by the clinical examinations and Yonsei transverse analysis, and treated by the MARPE and clinical aligner therapy. After 26 months' treatment, cone-beam computed tomography (CBCT) images showed that the width of maxillary basal bone increased by 3.8 mm, that of zygomatic arch and nasal bone increased by 1.0 and 1.9 mm, respectively, and the bilateral posterior teeth crossbite was corrected. Furthermore, the dental midline of lower arch was consistent with that of upper arch and face, the molars arrived Angle Class II and canines was Class I relationships, the profile was maintained, the facial asymmetry was improved. The results of seventeen-month follow-up showed that the effect of orthodontic treatment is very stable. This case report demonstrates that MARPE is the effective approach for patients with MTD and facial asymmetry, which provide the alternative for the treatment of similar cases.

KEYWORDS

adults, diagnosis, miniscrew, rapid palatal expansion

Yuan Fan and Yuanyuan Li contributed equally to this work.

1 | INTRODUCTION

Maxillary transverse deficiency (MTD) is a common clinical malocclusion. The prevalence of MTD in the mixed dentition is as high as 8%–23.3%, and in adults also reaches to 9.4%.[1] If patients with MTD are not treated in the timely and appropriate treatment, periodontal tissue damage, functional displacement of the mandible, joint and muscle dysfunction, and other adverse consequences would appear.[2] Furthermore, the function of the stomatognathic system and facial esthetics can be affected significantly. More seriously, it may cause narrowing of the nasal cavity and ventilation dysfunction, which may lead to obstructive sleep apnea syndrome (OSAS) and greatly affect the quality of life and health of patients.[3]

Maxillary arch expansion is the effective approach for MTD treatment. By producing the bone and tooth effect, the width of maxillary basal bone can be expanded. Conventional palatal expanders include Hyrax and Hass appliances, their expansion ways are mainly rapid maxillary expansion (RME) and slow maxillary expansion (SME). For children and young adolescents at the age of 8–15, MTD are effectively treated with RME, however, for adults, it may cause undesired effects such as dental tipping, alveolar bone dehiscence, and root absorption, due to the fusion of midpalatal suture.[4] Therefore, surgically assisted rapid palatal expansion (SARPE) have become the alternative for adults, which can release the interdigitated suture. However, the clinical application of SARPE is limited by the potential risks, such as infection and fracture associated with surgery.[5]

Recently, the miniscrew-assisted rapid palatal expansion (MARPE) procedure has been developed vigorously, which utilizes miniscrew implanted in the palate to delivery orthopedic force directly to the palatal bone, not to teeth.[6] MARPE enhances significantly the bone effect and decreases the teeth effect, while shows technical advantages such as simple operation, minimal trauma, and less root resorption.[7] Therefore, MARPE has been widely used in the orthodontic treatment for adult patients with MTD. This case report illustrated that an adult patient was diagnosed as MTD by clinical examinations and Yonsei transverse analysis, and treated successfully with MARPE to achieve the separation of midpalatal suture. Furthermore, the diagnosis methods of MTD and MARPE details were discussed, and some new ideas for future clinical practice can be provided.

2 | CASE HISTORY/ EXAMINATION

A 23-year-old 4-month-old woman presented with the chief complaint of terrible bite and crowding dentition. Additionally, she complained the medical history of temporomandibular joint popping, and cone-beam computed tomography (CBCT) images showed asymmetry on both sides of the mandibular ramus, while the right mandibular ramus was longer than the left. The patient denied orthodontic treatment, family, and trauma history.

Extraoral examination showed facial asymmetry with the chin point deviating to the left, a slightly deviated facial midline, and the longer right upper lip than the left. Her soft tissue profile is straight. The temporomandibular joint examination was abnormal with popping (Figure 1).

Intraoral examination revealed that maxillary dental midline was consistent with face midline, and the mandibular dental midline deviated 1.5 mm to the left. Her oral

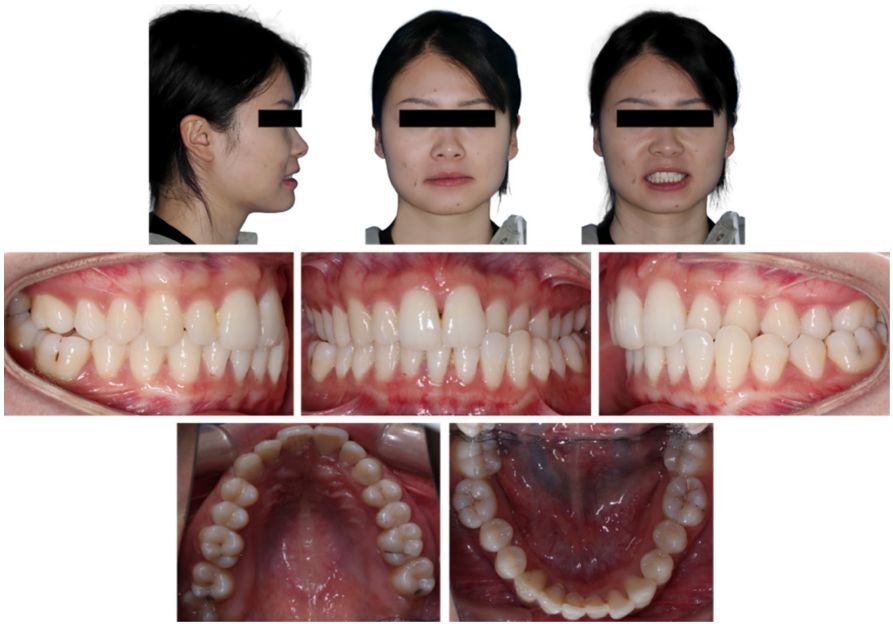


FIGURE 1 Initial facial and intraoral photographs.

hygiene was poor with some calculus on the mandibular anterior, gingiva occurred recession on maxillary incisors to form black triangle, and the thin biotype of periodontium. The upper and lower dentition all presented mild crowding, furthermore, left anterior and bilateral posterior teeth showed crossbite with dental compensation. The right molars and canines displayed the Angle Class I relationship, and the left molar and canines were the Angle Class II relationship. The overbite and overjet were normal (Figures 1 and 2).

The panoramic radiograph showed alveolar bone level height decreased, and the length of both side mandibular ramus was different. The initial lateral cephalogram analysis (Figure 3, Table 1) displayed the skeletal Class I relationship (ANB, 2.8°) and Frankfort mandibular angle was low (FMA, 20.2°). The position and inclination of the maxillary and mandibular incisors were within the normal ranges (U1-SN, 105°, IMPA, 91.4°).

3 | METHODS

Except to clinical examinations, Yonsei transverse analysis also was chosen to evaluate the transverse problems of this patient. The Materialize's Interactive Medical Image Control System (MIMICS) software was used to calculate the following parameters: the arch width, tooth inclination, the distance between miniscrews, and the distance of center of resistance (CR) of interfirst permanent molar. The estimated CR points was located on the middle of the root furcation of the first permanent molars. Precisely, the CR points were located and checked on different cutting slices in 3 planes of space, including the sagittal, coronal, and transverse views. The Yonsei transverse index of normal occlusion is -0.39 ± 1.87 mm, if the difference is less than -2.24 mm, the patient can be diagnosed with the MTD.[8] In this case report, the arch widths of maxillary intercanine and interfirst permanent molar were 31.05

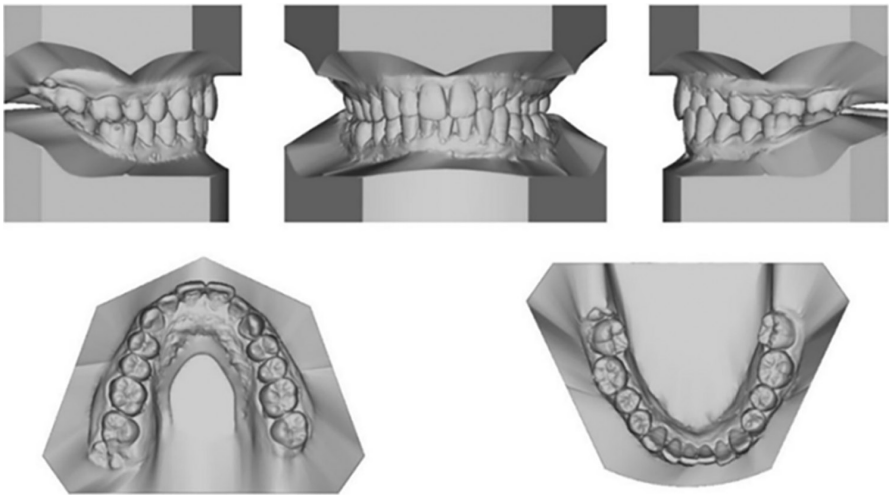


FIGURE 2 Initial digital study models.

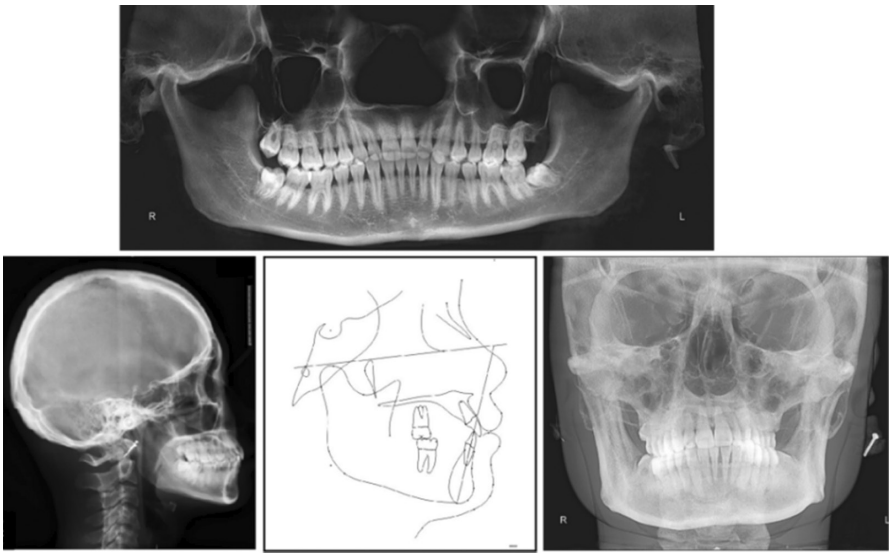


FIGURE 3 Initial panoramic, lateral cephalogram, cephalometric tracing, and posteroanterior cephalogram.

TABLE 1 Cephalometric measurements.

Measure	Pretreatment	Posttreatment	Norm	Change
SNA (°)	85.7	85.6	82.8	−0.1
SNB (°)	82.9	81.7	80.1	−1.2
MP-SN (°)	28.3	33.0	32.5	4.7
FMA (°)	20.2	24.7	31.1	4.5
ANB (°)	2.8	3.9	2.7	1.1
U1-NA (°)	19.3	14.5	22.8	−4.8
U1-SN (°)	105	100.1	105.7	−4.9
L1-NB (°)	22.4	26.8	30.3	4.4
IMPA (°)	91.4	94.0	92.6	2.6
Upper lip to E-Plane (mm)	0.3	−0.4	2.0	−0.7
Lower lip to E-Plane (mm)	0.9	−0.5	3.0	−1.4

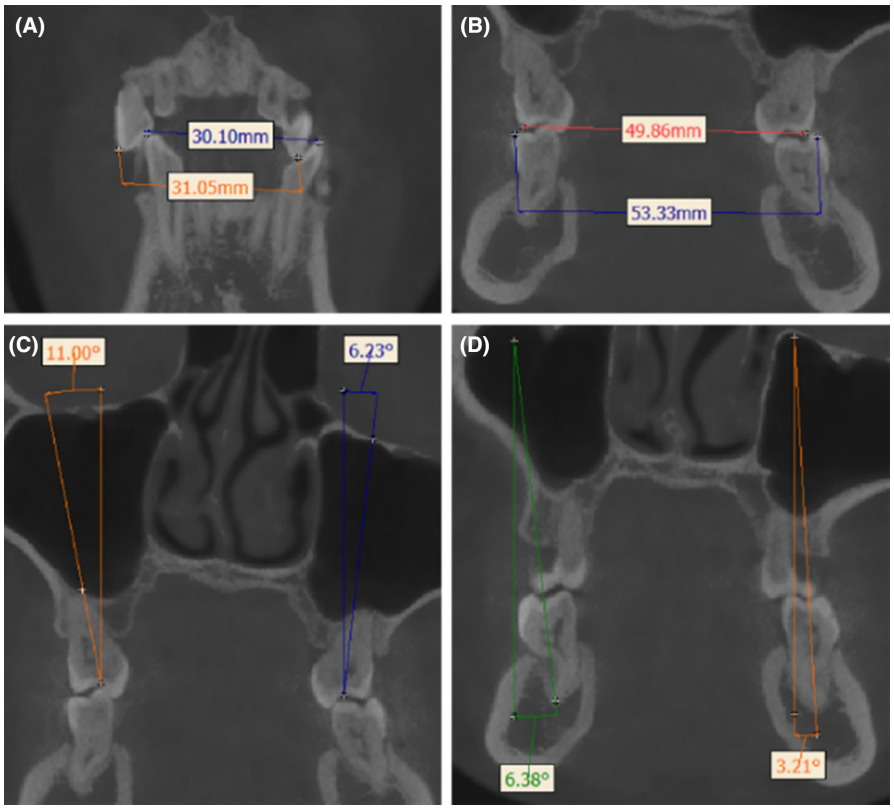


FIGURE 4 The measurement of initial arch width and dentition angulation. (A) The intercanine width. (B) The interfirst molar width. (C) The angulation of fist molar on maxillary. (D) The angulation of fist molar on mandible.

and 49.86 mm, respectively, and that of the mandibular intercanine and interfirst molar were 30.10 and 53.33 mm, respectively, which indicated the dental arch widths deficiency (Figure 4, Table 2). The maxillary and mandibular distance of CR point of interfirst molar were 42.87 and 45.27 mm, respectively, the difference was −2.4 mm, which also demonstrated the width deficiency of maxillary basal bone (Figure 5, Table 2). Furthermore, the angulation of first molar on maxillary were lingual inclination and that on mandibular were buccal inclination. Above all, the patient was diagnosed with facial asymmetry, a skeletal Class I with MTD.

The main objective was to resolve MTD by expanding the maxilla basal bone to coordinate the width of upper and lower dental arches and correct crossbite. The stable and ideal occlusion relationship was required in the long time, while dental compensation and undesirable effects on the maxillary teeth or bone should be avoided. Furthermore, the treatment goals also include the achievement of stable occlusal relationship, soft tissue profile maintenance,

TABLE 2 Transverse measurements (mm)[a].

Measure	Pretreatment	Posttreatment	Change
Maxilla			
Intercanine width	31.05	35.77	4.72
Interfirst molar width	49.86	60.27	10.41
Yonsei analysis	42.87	46.76	3.89
Mandible			
Intercanine width	30.10	29.94	−0.16
Interfirst molar width	53.33	53.40	0.07
Yonsei analysis	45.27	45.79	0.52
Various anatomic sites			
Maxillary basal bone	64.2	68.0	3.8
Zygomatic bone	127.8	128.8	1.0
Nasal cavity	24.1	26.0	1.9
Miniscrews			
Anterior	6.02	10.43	4.41
Posterior	5.27	11.17	5.90

[a]Note, the widths of transverse dimension were measured by Materialize's Interactive Medical Image Control System (MIMICS) software.

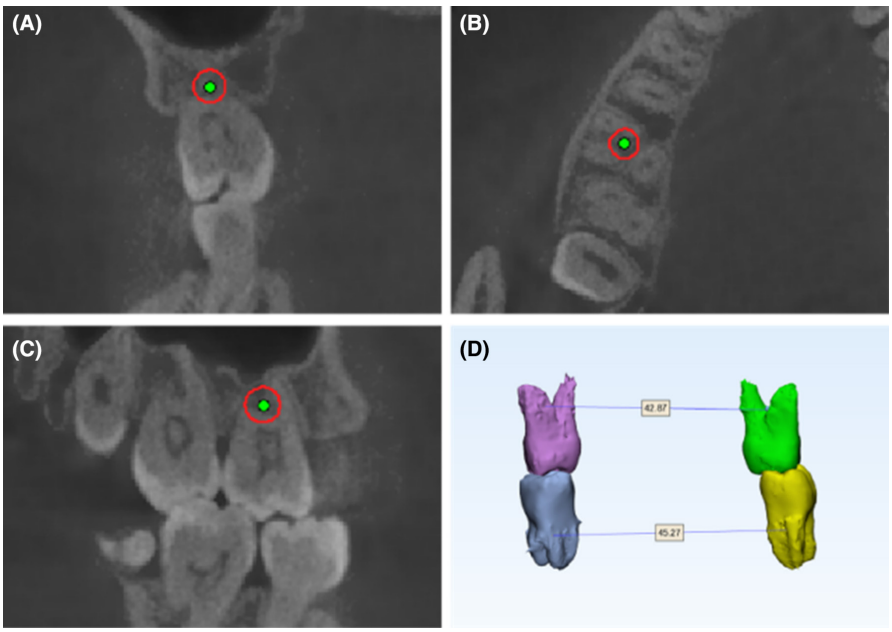


FIGURE 5 Yosei transverse analysis in this case report. (A–C) The location of the estimated center of resistance (CR) points on the coronal, transverse, and sagittal view, respectively. (D) The distance (mm) between the points could be calculated digitally in Materialize's Interactive Medical Image Control System (MIMICS).

improved facial esthetics, the elimination of crowding, and the correction of the dental midline deviation.

There were two treatment options considered. The first option involved SARPE with the combination of orthodontic treatment to coordinate the relationship between the upper and lower jaws and correct the facial deviation. However, the surgery treatment would suffer from huge trauma, high risk, high cost, and many complex complications.

Another option was MARPE procedure to match the width of the dental arch. After expansion, the occlusal refinement was performed by clinical aligner therapy. However, the patient's periodontal status was poor, which added risks of adverse effect, such as root absorption, bone fenestration, gingival recession, and etc. After comprehensive consideration, she chose the MARPE treatment plan. Notably, the diagnosis of this case may be related to condylar hyperplasia, which can result in facial asymmetry, mandibular deviation, malocclusion, and crossbite. However, this case report was completed earlier, and the relevant technique for the diagnosis and treatment of unilateral condylar hyperplasia is limited in our hospital, more importantly, the patient strongly refused the surgery treatment. Therefore, the authors only provided relevant

diagnosis and treatment for this case from the perspective of MTD.

At the beginning, the maxillary expander was inserted in the midpalatal area. The miniscrews (1.8-mm diameter, 13-mm length) were parallel to each other, and implanted without oblique, otherwise, the imbalance occurred in the expander, which directly affected the retention of expander and the effect of expansion. The 13-mm length implants penetrated across the expander and palatal soft tissue to palatal bone tissue, finally forming the double cortical bone pivot (Figure 6). The advantages of double cortical bone anchorage was more stable and the activation of more bone to promote the expansion of midpalatal suture rapidly.

The patient activated the expander once a day with the frequency of ¼ (0.25 mm) turn at a time for maxillary expansion. After 1 month of expansion, the 3 mm space was observed between incisors, and the width of maxillary interfirst molar and that of maxillary basal bone increased by 10.41 and 3.8 mm, respectively (Table 2), the arch width of maxilla and mandible were basically matched, at which point the activation of the arch expander was stopped and the width was maintained to wait the ossification of midpalatal suture (Figures 7 and 8). At the sixth month, the band ring was removed and replaced by the buccal tube, and the palatal arch expander was used continuously to maintain the maxillary width till the end of orthodontic treatment.

After 1 week of the insertion of expander, the aligners (German Forestadent Bioquick brackets) were bonded on the ideal location of teeth surface. A sequence of 0.014, 0.018, 0.016×0.022, 0.018×0.025 inch nickel-titanium (NITI) were performed during the alignment and leveling phase. The 0.018×0.025 stainless steels was used to close the gap, and adjust the torque of anterior and posterior tooth. Intermaxillary Class II elastics on left was required to improve the sagittal relationships of canine and molar. The third molar was extracted and periodontal therapy was performed during orthodontic treatment. After 26 months, the expander and brackets all were removed, and the transparent wraparound retainer was used for retention.

4 | CONCLUSION AND RESULTS

Through the 26 months' treatment, the malocclusion of patient was improved greatly. Extraoral examination showed that the soft tissue lateral profile was maintained at straight type, which was consistent with goals. Notably, the smiling esthetics was changed dramatically owing to the resolution of crossbite of anterior teeth. Furthermore, the maxillary and mandibular dental midline coincided with the facial midline (Figure 9). However, the right upper lip is still longer slightly than the left, this may be ascribed to the asymmetry on both the sides of the mandibular ramus. Due to the adequate preoperative communication, the patient is satisfied for the treatment result.

Intraoral examination displayed that the maxillary basal bone was expanded significantly and the posterior crossbite was successfully resolved with proper teeth alignment (Figures 9 and 10). The width of maxillary intercanine was expanded from 31.05 to 35.77 mm and that of intermolar was from 49.86 mm to 60.27 mm, and difference of Yonsei transverse index increased from −2.4 to 0.97 mm (Table 2). The expansion effect of MARPE not only presented on the dental arch, but also on other structures, such as maxillary basal bone, zygomatic bone, and nasal cavity, which showed the uniform increase with other transverse measurements (Table 2). Furthermore, the CBCT slices of palatal bone tissue showed the midpalatal suture was expanded successfully and the expansion region have already occurred new bone tissue deposition (Figure 8). All results revealed that the expansion of MARPE was effective. Class I canine and Class II molar

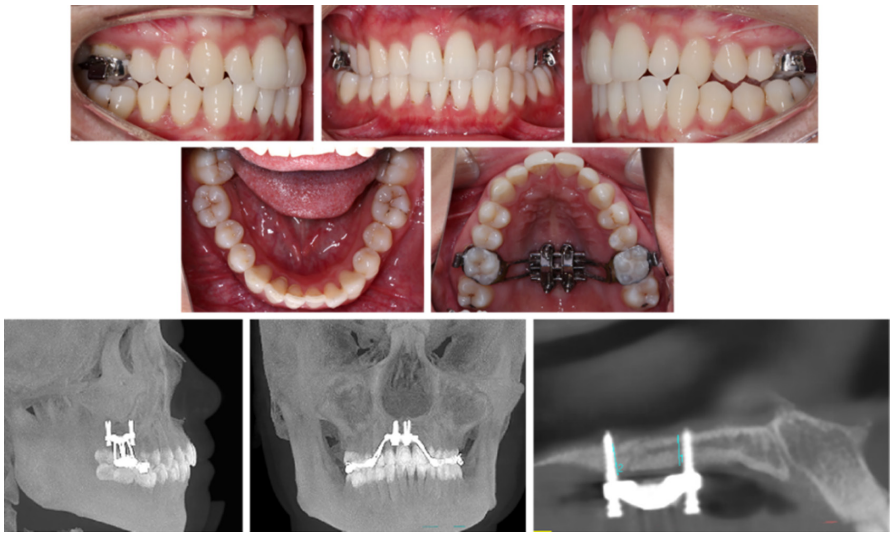


FIGURE 6 Intraoral and cone-beam computed tomography (CBCT) images of initial installation of maxillary arch expander.

FIGURE 7 Images of orthodontic treatment process. (A) 1 month. (B) 6 months. (C) 26 months.

relationship were obtained on both side, which may be ascribed to the bolton discrepancy, and the ideal overjet and overbite were maintained. The angulation of maxillary bilateral first molars inclined to buccal side (Table 3).

The final panoramic radiograph showed the alveolar bone level basically kept the same with initial status without further loss, also exhibited the proper root parallelism and no evident root resorption (Figure 11). The posttreatment lateral cephalometric analysis indicated the skeletal Class I relationship (ANB, 3.9°). The mandibular plane angle changed from low which to average angle (FMA, 24.7°) and the MP-SN was increased to 33.0°, which demonstrated that vertical direction was controlled well. Compared to the pretreatment, the maxillary incisors slightly inclined to lingual side (U1-SN, 100.1°) and the mandibular incisors to labial side (IMPA, 94°), while remained in the limited range. At the end of the orthodontic treatment, the patient didn't happen complications and the superimposition of lateral cephalograms and CBCT results indicated that arch morphology was harmoniously matched in the transverse, vertical, and sagittal directions (Figures 12 and 13). 17-month follow-up demonstrated that the results of treatment is stable (Figure 14).

We evaluated the coordination of upper and lower basal bone arch by clinical examination and Yonsei transverse analysis for this case, and applied the MARPE to correct insufficient maxillary width. After treatment, the midpalatal suture and the surrounding craniofacial structures was separated successfully, and the occlusal function and facial esthetics were improved. Although the midpalatal suture of adults occurred closure with different degree, this case showed the alternative for MTD treatment without surgery. Overall, the successful treatment results demonstrated the preoperative detailed analysis and diagnosis is essential for treatment, and MARPE procedure provide the alternative for orthopedic expansion in adult patients with MTD.

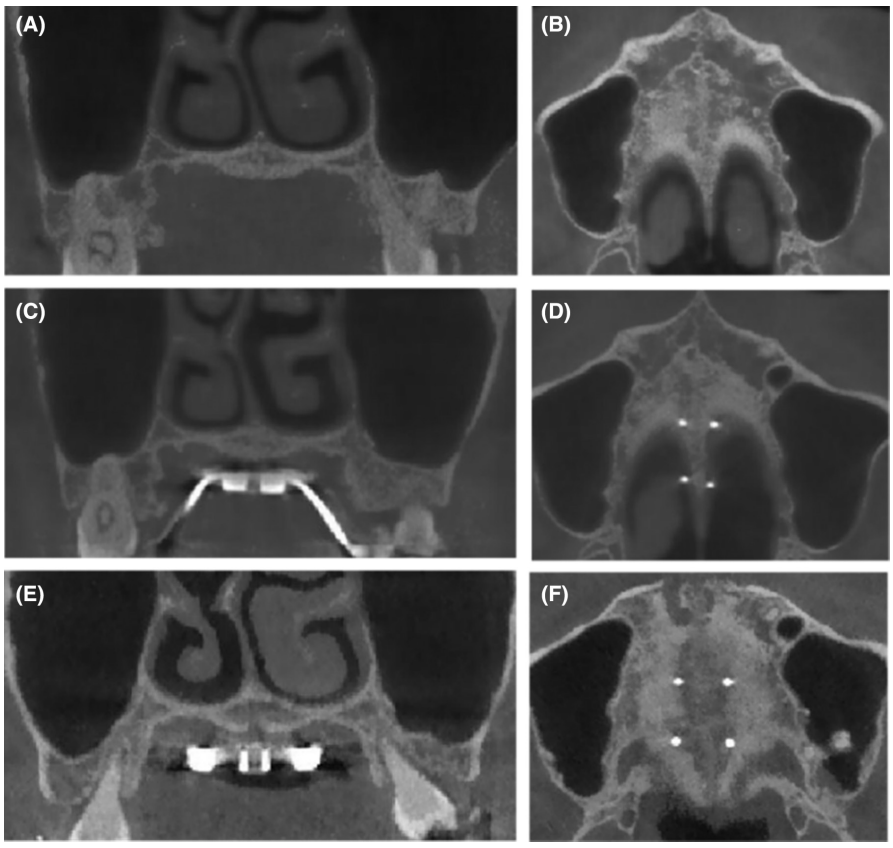


FIGURE 8 The cone-beam computed tomography (CBCT) images of midpalatal suture. (A, B) Before orthodontic treatment. (C, D) Initial installation of miniscrew-assisted rapid palatal expansion (MARPE) device. (E, F) At the end period of the orthodontic treatment.

FIGURE 9 Final facial and intraoral image.

5 | DISCUSSION

MTD is the complicated malocclusion, which usually accompanied with the bilateral posterior crossbite, anterior crowding, compensative dental tipping, and wide buccal corridors.[9] However, the maxilla transverse skeletal imbalance always ignored or not recognized, which lead to more difficulty in the subsequent treatment.[10] Therefore, the accurate diagnosis and treatment of MTD is very important and challenging. Except for clinical examination, diagnostic methods derived from CBCT has attracted more attention in recent years, among them, the Yonsei transverse analysis was proposed by Koo et al.[8] The authors thought that the transverse dental compensation

FIGURE 10 Final digital study models.

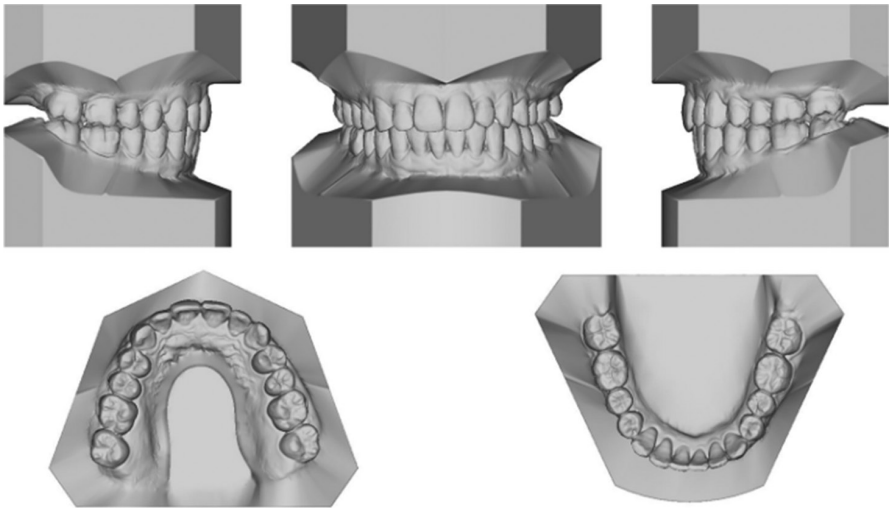
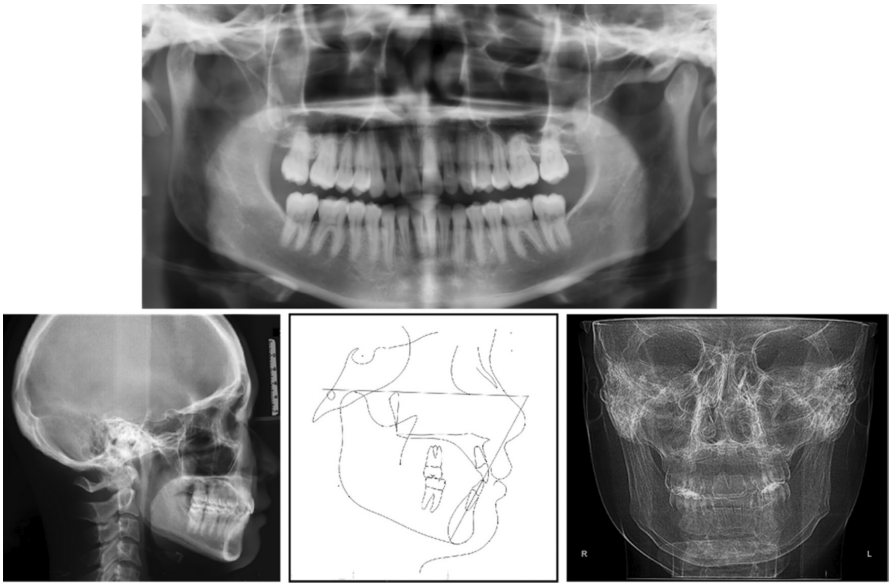


TABLE 3 Angulation of the first molars measured to the vertical line (°).

Measure	Pretreatment	Posttreatment	Change
Maxillary right first molar	−11.0	5.2	16.2
Maxillary left first molar	−6.2	13.6	19.8
Mandibular left first molar	−3.2	11.8	15.0
Mandibular right first molar	6.4	4.1	−2.3

FIGURE 11 Final panoramic, lateral cephalogram, cephalometric tracing, and posteroanterior cephalogram.



of the first permanent molars would occur in the form of rotation around the near CR, and the CR is stable and not influenced by the tipping of molars. In this case, the compensation of molars on the maxillary and mandibular all were not enough, the maxillary molars had the evident lingual inclination and the mandibular molars presented the slight buccal inclination. Yonsei transverse analysis was chosen to evaluate the transverse dimension of this patient (Figure 5), the reasons are following: (1) the method could avoid misjudgments that caused by obvious teeth inclination; (2) the posterior arch crowding is not obvious and there is no molars distalization, thus the point of CR is relatively stable; and (3) Yonsei transverse analysis possessed the high reliability in width measurements and high diagnostic agreement.[11]

MARPE have widely been used to correct MTD and gain popularity in orthodontic doctors since Kee-Joon Lee et al. proposed in 2010.[12] The success rate of MARPE is related closely to the ossification degree of midpalatal suture, the traditional RME is effective

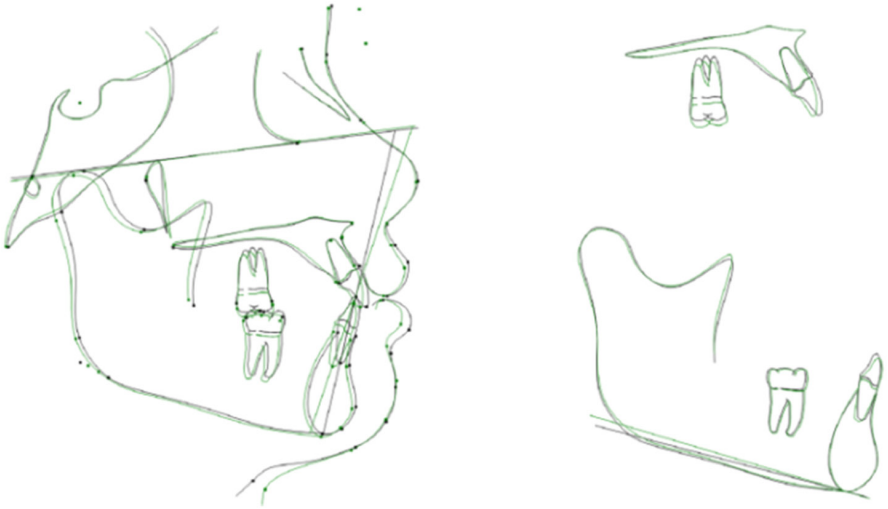


FIGURE 12 Overall superimposition, maxillary superimposition, and mandibular superimposition: Pretreatment (black) and posttreatment (green).

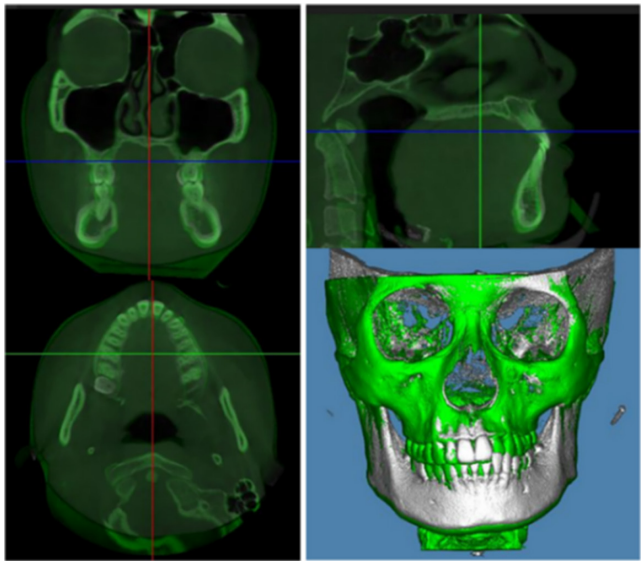


FIGURE 13 Superimposition of cone-beam computed tomography (CBCT): Pretreatment (argent), and posttreatment (green).

before the calcification of midpalatal suture generally under 15 years old, relatively, and the expansion of adult patients older than 25 years of age could produce many side effect.[13] Chronological age is often chosen as the judgment criteria of palatal suture calcify so that to decide the timing of expansion. However, some findings indicate the midpalatal suture closure present individual variability, and the suture obliteration is not directly correlated to chronological age.[14] Thus, McNamara et al. proposed the new classification method of midpalatal suture for individual evaluation according to the morphology of suture using CBCT images and identified and defined A–E five stages based on the maturation of the midpalatal suture.[15] Generally, the choice for MTD patients between MARPE and SARPE treatment mainly depends on the maturation of the midpalatal suture, at stage A-B, the traditional RME approach can be used due to the no or little interdigitation of midpalatal suture, at stage C, the partial region of midpalatal suture start fusion, thus the suture opening is still possible in this stage, however, patients at stage D-E are advised to treat by SARPE due to the total fusion of midpalatal suture.[15,16] In this patient, the midpalatal suture maturation was in stage C, implying that the suture opening is possible by MARPE (Figure 8). Furthermore, the treatment results also showed that the suture was opened parallelly and the widen region happened ossification at the end of the orthodontic treatment (Figure 8, Table 2), proving the success of orthopedic correction.

Miniscrews in MARPE as medium deliver the force to basal bone, not directly to teeth or periodontium, therefore, except to midpalatal suture maturation, the stability of miniscrews is very significant for the success of orthopedic expansion. In the presented case, four mini-implants were implanted parallelly in the posterior location of palatal bone tissue by the experienced operator, and the CBCT images showed that the miniscrews penetrated the bicortical bone to arrive the underneath the nasal mucosal tissue. Throughout the treatment, the miniscrews did not occur the fracture, loosening and fall, and always was present at the stability state, which is essential for the success of MARPE expansion.

After appropriate diagnosis analysis and treatment, the patient had a successful expansion with minor dental effects. Furthermore, many investigation proved that MARPE can improve the OSAS by increasing nasal cavity,[17] the patient of this case showed increased nasal cavity, but we did not further study the volume of upper airway and respiratory function, this was ascribed to the no breathing problems or sleep disturbance complaint of this patient. The 17-month follow-up results indicate treatment effect is very stable, the case provide insights and alternative for similar cases.

FIGURE 14 Seventeen-month follow-up facial and intraoral image.

AUTHOR CONTRIBUTIONS

Yuan Fan: Writing – original draft. **Yuanyuan Li:** Data curation. **Manlin Fan:** Investigation. **Yanfang Lin:** Formal analysis. **Jiarong Xu:** Data curation. **Zhihua Li:** Project administration. **Jun Luo:** Conceptualization; supervision.

FUNDING INFORMATION

None.

CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests.

DATA AVAILABILITY STATEMENT

All data generated during this study are included in this published article.

ETHICS STATEMENT

The study participant provided written informed consent.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

ORCID

Jun Luo https://orcid.org/0009-0009-6807-136X

REFERENCES

1. Ma T, Wang YH, Zhang CX, Liu DX. A novel maxillary transverse deficiency diagnostic method based on ideal teeth position. *BMC Oral Health*. 2023;23:82.
2. Kutin G, Hawes RR. Posterior cross-bites in the deciduous and mixed dentitions. *Am J Orthod Dentofacial Orthop*. 1969;56:491-504.
3. Miranda F, Garib D, Pugliese F, Bastos J, Janson G, Palomo JM. Upper airway changes in class III patients using miniscrew-anchored maxillary protraction with hybrid and hyrax expanders: a randomized controlled trial. *Clin Oral Investig*. 2021;26:183-195.
4. Melsen B. Palatal growth studied on human autopsy material. A histologic microradiographic study. *Am J Orthod Dentofacial Orthop*. 1975;68:42-54.
5. Carvalho PHA, Moura LB, Trento GS, et al. Surgically assisted rapid maxillary expansion: a systematic review of complications. *Int J Oral Maxillofac Surg*. 2020;49:325-332.
6. Salmoria I, de Souza EC, Furtado A, Franzini CM, Custodio W. Dentoskeletal changes and their correlations after micro-implant-assisted palatal expansion (MARPE) in adults with advanced midpalatal suture ossification. *Clin Oral Investig*. 2022;26:3021-3031.
7. Lin L, Ahn HW, Kim SJ, Moon SC, Kim SH, Nelson G. Tooth-borne vs bone-borne rapid maxillary expanders in late adolescence. *Angle Orthod*. 2015;85:253-262.
8. Koo YJ, Choi SH, Keum BT, et al. Maxillomandibular arch width differences at estimated centers of resistance: comparison between normal occlusion and skeletal class III malocclusion. *Korean J Orthod*. 2017;47:167-175.
9. Takagi T, Tanaka E. An adult case of unilateral posterior crossbite caused by maxillary transverse deficiency treated with miniscrew-assisted rapid palatal expansion. *J Stomatol Oral Maxillofac Surg*. 2023;124:101443.
10. McNamara JA, Lione R, Franchi L, et al. The role of rapid maxillary expansion in the promotion of oral and general health. *Prog Orthod*. 2015;16:33.
11. Zhang CX, Tan XM, Wu W, et al. Reliability of 2 methods in maxillary transverse deficiency diagnosis. *Am J Orthod Dentofacial Orthop*. 2021;159:758-765.
12. Lee KJ, Park YC, Park JY, Hwang WS. Miniscrew-assisted nonsurgical palatal expansion before orthognathic surgery for a

patient with severe mandibular prognathism. *Am J Orthod Dentofacial Orthop*. 2010;137:830-839.
13. Annarumma F, Posadino M, De Mari A, et al. Skeletal and dental changes after maxillary expansion with a bone-borne appliance in young and late adolescent patients. *Am J Orthod Dentofacial Orthop*. 2021;159:361-373.
14. Korbmacher H, Schilling A, Püschel K, Amling M, Kahl-Nieke B. Age-dependent three-dimensional micro-computed tomography analysis of the human midpalatal suture. *J Orofac Orthop*. 2007;68:364-376.
15. Angelieri F, Cevidanes LHS, Franchi L, Gonçalves JR, Benavides E, McNamara JA. Midpalatal suture maturation: classification method for individual assessment before rapid maxillary expansion. *Am J Orthod Dentofacial Orthop*. 2013;144:759-769.
16. Dries G, Oliver DC, Melisa G, François C, Reinhilde J, Constantinus P. Can surgically assisted rapid palatal expansion (SARPE) be recommended over orthodontic rapid palatal expansion (ORPE) for girls above the age of 14?: A cone-beam CT study on midpalatal suture maturation. *J Orofac Orthop*. 2023;84. https://doi.org/10.1007/s00056-023-00487-x
17. Hur JS, Kim HH, Choi JY, Suh SH, Baek SH. Investigation of the effects of miniscrew-assisted rapid palatal expansion on airflow in the upper airway of an adult patient with obstructive sleep apnea syndrome using computational fluid-structure interaction analysis. *Korean J Orthod*. 2017;47:353-364.

How to cite this article: Fan Y, Li Y, Fan M, et al. Successful treatment for an adult with bilateral posterior teeth crossbite by miniscrew-assisted rapid palatal expansion: A case report. *Clin Case Rep*. 2024;12:e9216. doi:10.1002/ccr3.9216