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Case Report

Combination of Removable and Fixed Appliances to Correct Anterior and Unilateral Posterior Crossbite Associated with a Functional Mandibular Shift in a Late Adolescent Patient: A Case Report

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Abstract

Various methods have been proposed to correct anterior and posterior crossbites in the permanent dentition. This case report presents the orthodontic management of a 15-year-old female with partial anterior and unilateral posterior crossbites. The maxillary right and left lateral incisors, left canine, and posterior teeth on the left side, except first premolar and second molar—were in crossbite, accompanied by a functional shift in the transverse dimension. Treatment consisted of a removable posterior bite plane with unilateral expansion screw followed by fixed edgewise appliances using a bidimensional bracket system. The total treatment duration was 25 months. At the end of treatment, both anterior and posterior crossbites were successfully corrected, which resulted in a stable occlusion, centered dental midlines, and improved facial symmetry.

Keywords: Anterior crossbite, Functional shift, Orthodontic treatment, Posterior crossbite

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Introduction

Crossbite is a relatively frequent malocclusion that can involve either the anterior or posterior segments of the dental arches. It is characterized by an abnormal buccolingual relationship between maxillary and mandibular teeth and may originate from dental, skeletal, or functional discrepancies.[1] Crossbite has been reported in approximately 56 % of malocclusion cases, with a prevalence of 10 % in primary dentition, 11 % in the mixed dentition, and 5 % in permanent dentition.[2] The etiology of crossbite is multifactorial[3] and may include hereditary influences, discrepancies in dental arch, retained deciduous or supernumerary teeth, mouth-breathing patterns, sucking habits, or occlusal interferences originating from premature contacts.[4,5]

Untreated crossbite in adolescents and adults can lead to asymmetric mandibular movement, occlusal trauma, gingival recession, or temporomandibular-joint dysfunction.[6-8] Anterior crossbite, in particular, may cause labial displacement of mandibular incisors, gingival margin discrepancy, and thinning of alveolar bone,[9] whereas posterior crossbite often produces a functional mandibular shift and midline deviation.[10] Because the potential for spontaneous correction in permanent dentition is minimal, active orthodontic intervention is recommended.[11]

Numerous treatment approaches have been reported for crossbite correction depending on its extent and etiology.[12,13] Removable expansion plates with jackscrews are effective for mild transverse deficiencies and allow convenient oral-hygiene maintenance,[14,15] whereas fixed appliances offer precise three-dimensional control for alignment and finishing.[16] In cases with functional posterior crossbite accompanied by anterior crossbite, a staged removable–fixed treatment approach may be advantageous, that allows initial transverse correction with removable appliances followed by fixed appliances for alignment while minimizing unwanted side effects.

This case report aims to present a simple and effective technique for managing posterior and anterior crossbites using a removable posterior bite plane with unilateral expansion screw, followed by fixed edgewise appliances. Illustrations of treatment progress and appliance design are provided to serve as clinical guidance.

Case report

A 15-year-old female was brought to the the Orthodontic Clinic of Prince of Songkla University by her mother due to concerns about dental crowding and chin deviation. There was no family history of chin deviation, and her parents reported no any premature loss of primary teeth. The patient had no known underlying disease, allergies, or regular medication. Menarche had occurred approximately three years earlier. Cervical vertebral maturation



Figure 1 Pretreatment extraoral and intraoral photographs.

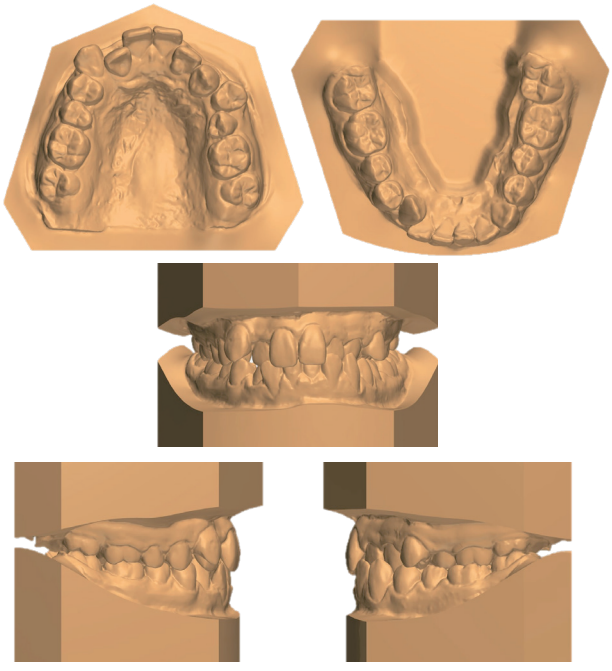


Figure 2 Pretreatment dental casts.

analysis showed CS5, which indicated that most craniofacial growth had been completed.[17]

Extraoral examination in the frontal view revealed a mesofacial type with chin deviation to the left side by 3 mm from the facial midline. Although the patient had competent lips, lip redundancy was observed due to mandibular overclosure in maximum intercuspation. In the lateral profile view, the patient exhibited a straight facial profile with chin prominence (Figure 1).

The intraoral examination revealed anterior crossbite that involved teeth 12/42-43, 22/32, and 23/33, as well as posterior crossbite on 25/35 and 26/36. The overjet and overbite measured 2 mm and 4 mm, respectively. According to Angle's classification, both canine and molar relationships were Class I. Upper dental midline coincided with facial midline, whereas the lower dental midline deviated from facial midline to the left by 3 mm. Moyer's analysis indicated severe crowding in the upper arch and mild crowding in the lower arch (Figures 1 and 2).

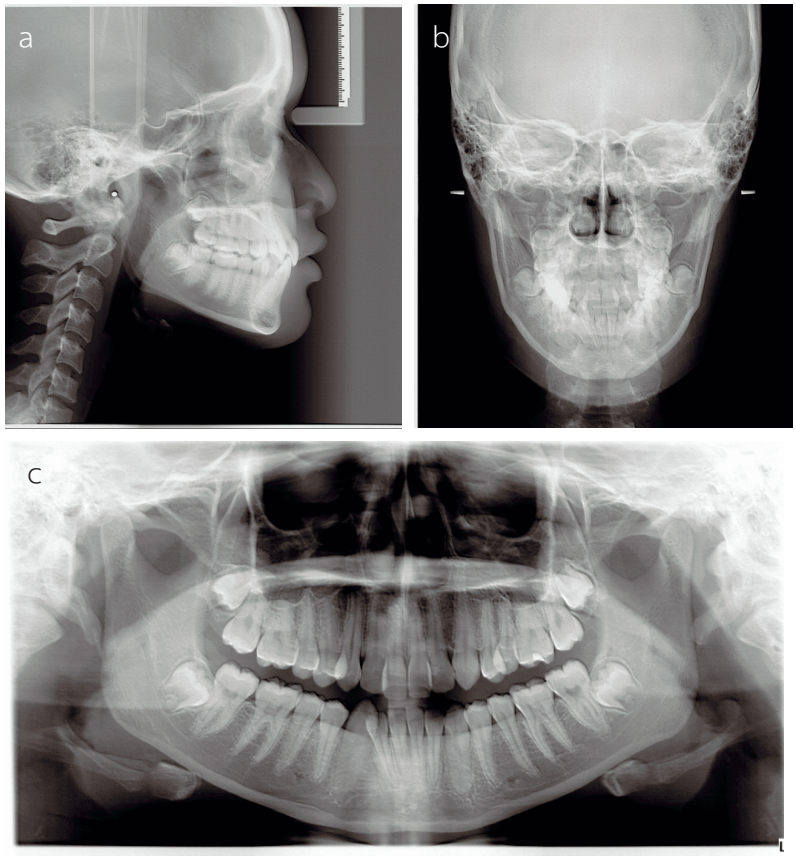


Figure 3 Pretreatment lateral cephalometric
(a) posteroanterior cephalometric
(b) panoramic
(c) radiographs.

A functional shift was detected. Bimanual manipulation was performed to identify the condylar position in centric relation.[18] The first contact in centric occlusion occurred between 12/43, and a 3 mm transversal discrepancy between the centric occlusion and maximum intercuspation positions was observed during clinical examination.

Panoramic radiography demonstrated fully developed permanent dentition with developing third molars and no pathology. Lateral cephalometric analysis revealed a skeletal Class I normodivergent pattern with orthognathic maxilla and mandible, normally inclined and positioned upper incisors, retroclined and retruded lower incisors, obtuse interincisal angle, normally positioned upper and lower lips, and obtuse nasolabial angle. The posteroanterior cephalogram also showed a 3 mm chin deviation to the left. (Figure 3 and Table 1)

Table 1 Pretreatment, treatment progression, and posttreatment cephalometric analysis

Area		Measurement	Norm Mean ± SD	Pre treatment	Progression	Post treatment
Skeletal	Maxilla to Cranial base	SN-FH (°)	6 ± 3	8	8	8
		SNA (°)	84 ± 4	87	87.50	87
		SN-PP (°)	9 ± 3	5	5	5
	Mandible to Cranial base	SNB (°)	81 ± 4	83	82	83
		SN-MP (°)	29 ± 6	28	29	29
		SN-Pg (°)	82 ± 3	83	82	83
		NS-Gn (°)	68 ± 3	66	67	67
	Maxillo-Mandibular	ANB (°)	3 ± 2	3	5	4
		Wits (mm)	-3 ± 2	-2	-2	-2
		MP-PP (°)	21 ± 5	23	24	24
		FMA (°)	23 ± 5	20	21	21
Dental	Maxillary dentition	UI-NA (°)	22 ± 6	18.50	19	22
		UI-NA (mm)	5 ± 2	4	4	4
		UI-SN (°)	108 ± 6	105	105	108
	Mandibular dentition	LI-NB (°)	30 ± 6	20	26	26
		LI-NB (mm)	7 ± 2	4	6	6
		LI-MP (°)	99 ± 5	88	92	94
	Maxillo-Mandibular	UI-LI (°)	125 ± 8	137	131	127
Soft tissue	Soft tissue	E line-UL (mm)	-1 ± 2	0	0	0
		E line-LL (mm)	2 ± 2	1	2	2
		NLA (°)	91 ± 8	111	111	108
		H-angle (°)	14 ± 4	15	16	17

Abbreviations: FH, Frankfurt horizontal plane; PP, palatal plane; MP, mandibular plane; FMA, Frankfort mandibular plane angle; UI, upper incisor; LI, lower incisor; UL, upper lip; LL, lower lip; NLA, Naso-labial angle; H, Holdaway



Figure 4 Intraoral photographs of the bilateral posterior bite plane with unilateral expansion screw.

Based on the diagnostic information, the treatment objectives were: (1) eliminate the functional shift and improve facial asymmetry (2) relieve crowding and achieve proper alignment (3) correct both anterior and posterior crossbite and (4) obtain normal overjet, overbite, stable intercuspation, and centered dental midlines.

Two treatment approaches were considered: (1) a removable appliance consisting of a posterior bite plane with unilateral expansion screw and (2) fixed bi-dimensional preadjusted edgewise appliances with 0.018-inch slots for incisors and 0.022-inch slots for canines, premolars, and molars.

Treatment was initiated with a bilateral posterior bite plane incorporating a unilateral jackscrew oriented buccolingually to tip teeth 25-27 buccally. Two Adams clasps, one triangular clasp, and four C-clasps were used for retention. The patient was instructed to wear the appliance full time, including during meals except for toothbrushing, and to activate the jackscrew by one quarter turn per week. (Figure4)

After the posterior crossbites were corrected, C-clasps on teeth 13 and 23 were removed. Brackets were then bonded to teeth 14-24 to correct the anterior crossbite, and to the mandibular teeth to relieve crowding. Leveling was carried out using sequential 0.012-inch and 0.014-inch nickel–titanium (NiTi) archwires with bends[19] on both upper and lower arches.



Figure 5 Intraoral photographs after three months of leveling and alignment that showed coincidence of the upper and lower dental midlines.



Figure 6 Treatment progress extraoral and intraoral photographs showing complete correction of the anterior and posterior crossbites at 11 months.

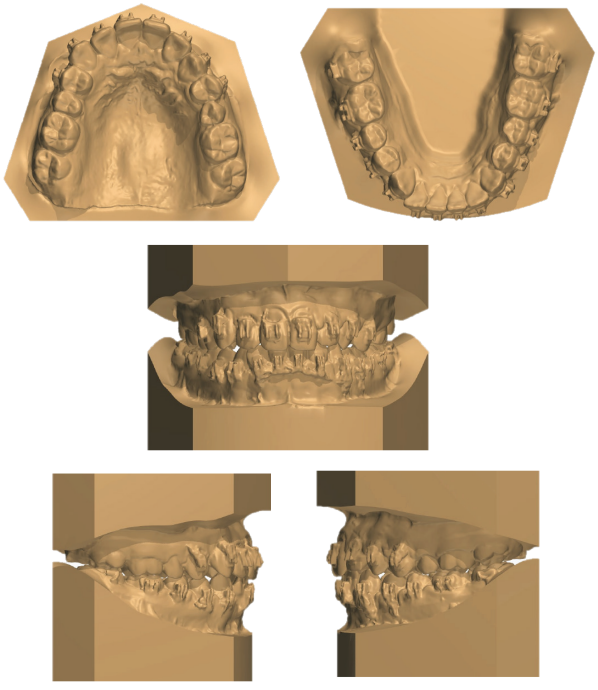


Figure 7 Treatment progress dental casts.

After three months of leveling and alignment and relieving the acrylic interference that impeded normal tooth alignment, the functional shift was corrected, as demonstrated in Figure 5, with coincidence of the upper and lower dental midlines. Since the anterior crossbite had not yet been fully resolved, the patient was instructed to continue wearing and activating the posterior bite plane until the jackscrew reached its maximum advancement. The total activation time was seven months.

After 11 months of treatment, both the anterior and posterior crossbites were fully corrected, and treatment-progress records were obtained (Figures 6 and 7). The treatment-progress radiographs, cephalometric analysis (Figure 8 and Table 1) and superimposition tracing between pretreatment and progress stages (Figure 9) demonstrated the changes in skeletal, dental, soft-tissue aspects. Cranial base superimposition revealed slight forward and downward displacement of the maxilla, downward displacement of the mandible, and a clockwise rotation of the mandible. Maxillary superimposition showed that the upper incisors were slightly proclined, protruded, and extruded, while the upper molars were mesialized. Mandibular superimposition showed that the lower incisors were proclined, protruded, and extruded and the lower molars were extruded and mesialized. Upward growth of the mandibular condyle and ramus were also observed. At the same time, the soft-tissue profile became more convex, and an increase in the lower anterior facial height was observed. The upper lip was more retruded whereas the lower lip position remained stable, and the nasolabial angle was maintained.

No traumatic occlusion was observed even without the removable appliance. Furthermore, since activation of the expansion screw resulted in proper posterior occlusion, the removable appliance was discontinued. Subsequently, fixed appliances were placed, and brackets were bonded to teeth 15-17 and 25-27. Leveling and alignment were carried

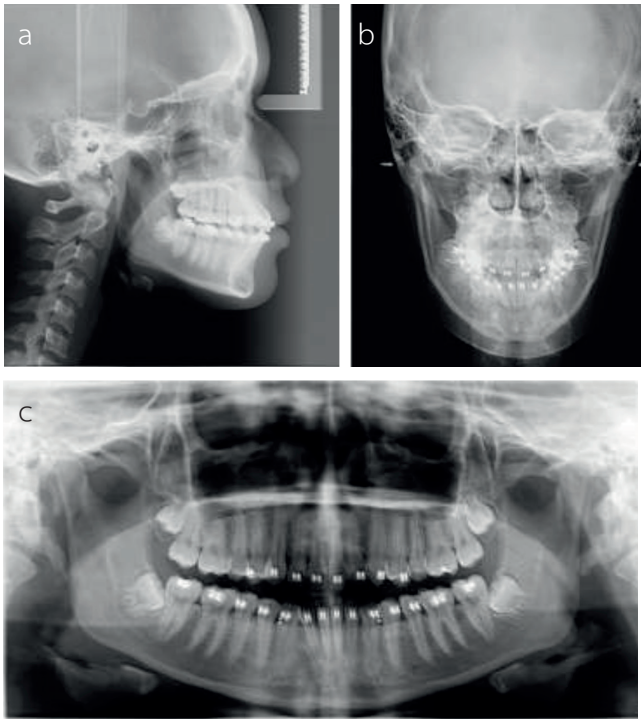


Figure 8 Treatment progress lateral cephalometric (a) posteroanterior cephalometric (b) panoramic and (c) radiographs.

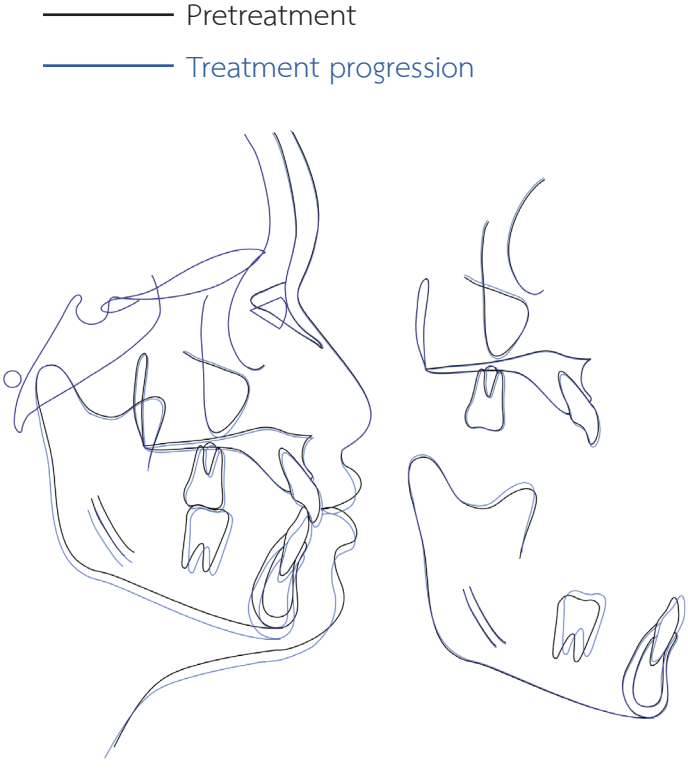


Figure 9 Cephalometric superimposition of the pretreatment (black lines) and treatment progress (blue lines) tracings.

out using sequential 0.012-inch, 0.014-inch, 0.016-inch, and 0.016 × 0.016-inch nickel–titanium (NiTi) archwires on both the upper and lower arches. Finishing was performed with 0.016 × 0.016-inch and 0.016 × 0.022-inch stainless steel wires, incorporating torque, artistic bends, open coil spring, and chains to close residual spaces.

A satisfactory facial appearance was achieved, with improvement of the facial asymmetry and normal upper and lower lip positions (Figure 10). Normal occlusion was established, as the anterior and posterior crossbites and upper and lower arch crowding were corrected, and the dental midlines were centered. Normal overjet and overbite were achieved, along with a well-interdigitated and stable occlusion. (Figures 10 and 11). Posttreatment radiographs are shown in Figure 12, and the posteroanterior cephalogram demonstrated coincidence of the chin and facial midlines. The posttreatment cephalometric analysis is summarized in Table 1.



Figure 10 Posttreatment extraoral and intraoral photographs.

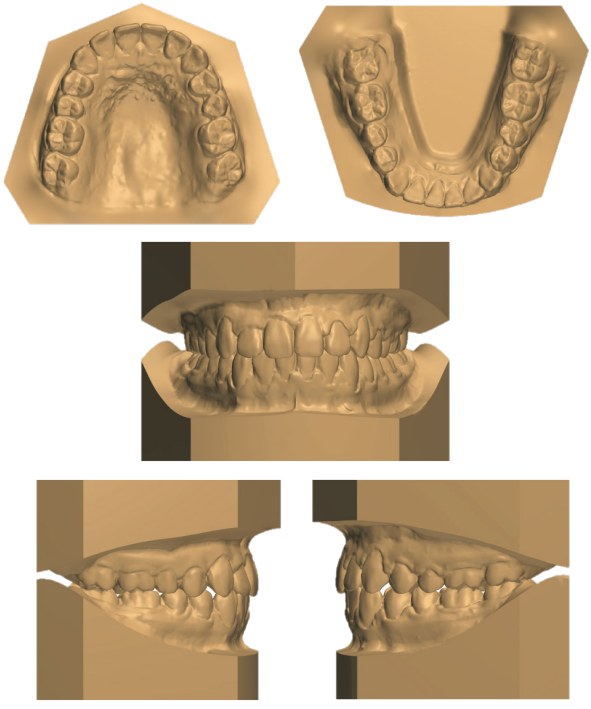


Figure 11 Posttreatment dental casts.

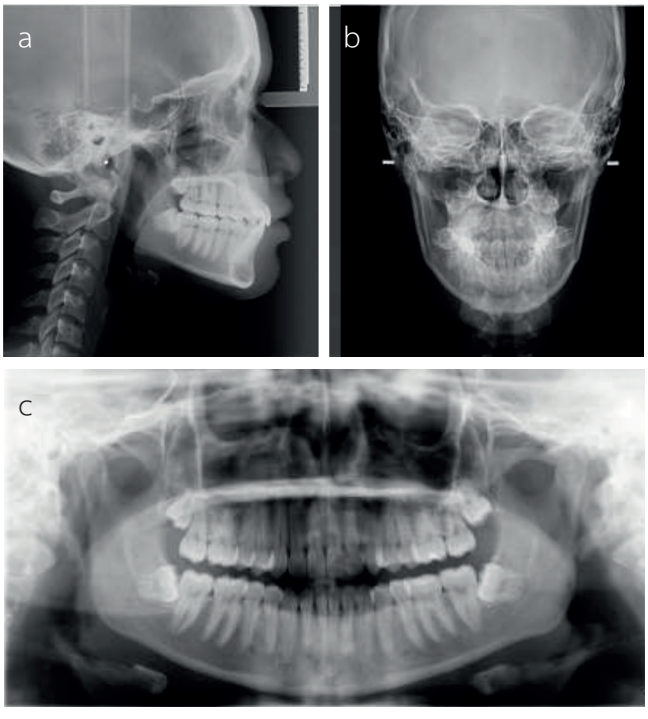


Figure 12 Posttreatment lateral cephalometric
(a) posteroanterior cephalometric
(b) panoramic
(c) radiographs.

Pretreatment, treatment progress, and posttreatment cephalometric tracings were superimposed to analyze the change after treatment (Figure 13). Only minor changes were observed following

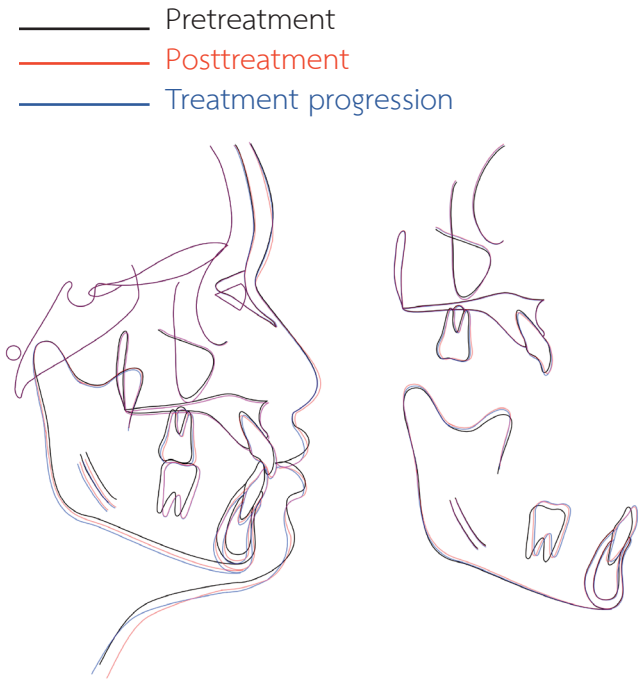


Figure 13 Cephalometric superimposition of pretreatment (black lines), treatment progress (blue lines) and posttreatment (red lines) tracings.

the placement of full fixed edgewise appliances for re-leveling and finishing. The primary differences were limited to dental inclination, which was adjusted toward a more normal orientation.

The treatment was completed in 25 months, after which all appliances were removed. Retention consisted of wearing a maxillary wraparound retainer full time with a passive anterior bite plane, and a mandibular wraparound retainer.

Follow-up records were obtained at 1, 3, and 6 months, and at 1 year after appliance removal. During the follow-up period, the corrected anterior and posterior occlusal relationships remained unchanged, and no re-establishment of crossbite was observed. Clinical examination did not reveal any apparent increase in facial asymmetry.

Discussion

Crossbite correction requires a comprehensive understanding of the dental, skeletal, soft-tissue, and functional components that together determine

the patient's occlusal and facial presentation. Although anterior crossbite may be the most obvious clinical finding, the underlying cause of functional mandibular shift is often related to posterior transverse discrepancy rather than the anterior teeth themselves. Functional mandibular shifts commonly originate from posterior occlusal interferences, even when the first occlusal contact is observed in the anterior region. For this reason, correction of the transverse discrepancy—particularly posterior crossbite—is recommended before attempting anterior correction.[7,20] Several authors have emphasized that addressing posterior crossbite with functional shift first helps re-establish a stable and unstrained closure path and prevents persistent anterior locking.[7]

Beyond the presence of a functional mandibular shift, additional diagnostic findings supported the diagnosis of a functional posterior crossbite rather than a true skeletal posterior crossbite. Posteroanterior cephalometric analysis did not demonstrate a significant maxillary transverse deficiency or skeletal asymmetry, and the maxillary and mandibular basal relationships were within normal transverse limits. In addition, coincidence of the maxillary and mandibular dental midlines was observed when the patient was instructed to open the mouth to maximum opening, which is a clinical feature consistent with functional deviation rather than a true skeletal discrepancy.[21] Furthermore, elimination of the posterior crossbite resulted in immediate coincidence of the maxillary and mandibular dental midlines, which indicated resolution of the functional shift rather than correction of a fixed skeletal transverse discrepancy.

Based on the diagnostic findings, posterior crossbite correction was prioritized in this patient to eliminate the functional shift. A removable posterior bite plane with unilateral expansion screw was designed to correct the posterior crossbite while simultaneously providing posterior disocclusion to allow the incisors to move freely without anterior interference. The acrylic plate also provided additional anchorage from multiple teeth and palatal support that improved appliance stability. Although removable expansion appliances primarily produce uncontrolled buccal crown tipping, careful monitoring in this case—through extraoral examination and posteroanterior cephalometry—confirmed the absence of maxillary canting or clinically significant vertical discrepancies after transverse correction.

An alternative approach using fixed appliances alone with cross-elastics was also considered. However, this method would have required additional disocclusion, most commonly through the use of bite turbos. Because bite turbos are typically placed from the early stage of treatment, they have been reported to interfere with mastication and cause patient discomfort during the initial treatment period.[11] Therefore, a posterior bite plane was selected as a more appropriate initial treatment modality in this patient.

Prior to fabrication of the removable appliance, bite registration was performed in a position that eliminated both anterior and posterior occlusal interferences. The vertical dimension of the bite construction was determined with reference to the incisal edges of the upper and lower anterior teeth, approximately 5 mm of anterior separation was created while ensuring that the vertical opening did not exceed the patient's physiologic freeway space.

In addition to occlusal correction, other treatment options were discussed with the patient. Since the patient exhibited an asymmetric smile line at baseline, she was counseled regarding smile training. Adjunctive esthetic procedures, which included botulinum toxin injections, were also discussed as optional treatments for further improvement of smile symmetry, if she desired.

Elimination of the posterior crossbite resulted in the disappearance of the functional mandibular shift, as demonstrated by the coincidence of the upper and lower dental midlines during closure (Figure 5). Once the functional shift was resolved and anchorage

from the removable appliance was no longer required, brackets were bonded to teeth 14-24 to proceed with anterior correction. Following correction of both posterior and anterior crossbites, full bonding was performed, and re-leveling was initiated.

In cases with large palatal displacement of the maxillary lateral incisors, mild proclination may remain after alignment because the tooth travels a long path into the arch. This occurred in the present patient, where slight proclination of the lateral incisors was noted. Various techniques, such as upside-down bracketing or applying additional palatal crown torque, have been described to refine incisor inclination when needed.[20,22] However, further torque adjustment was not performed in this case because gingival recession was observed on the maxillary lateral incisors, and the incisors already exhibited light, stable contact with the mandibular teeth. Although acceptable esthetic outcomes were achieved, the gingival margin heights did not fully follow the ideal pattern in which the maxillary central incisors and canines share a similar gingival level, with the lateral incisors positioned approximately 0.5 mm lower.[23] If the patient desires further esthetic enhancement, periodontal surgery may be recommended.[24] Overall, the staged removable–fixed protocol used in this case allowed efficient correction of both transverse and anterior discrepancies while minimizing unwanted effects. The elimination of the functional shift, the coordinated alignment of the incisors, and the improvement in occlusal and soft-tissue balance demonstrate the effectiveness of prioritizing transverse correction before comprehensive fixed appliance therapy in patients with combined anterior and posterior crossbite.

Although the short-term follow-up up of 1 year demonstrated maintenance of the corrected occlusal relationships and facial appearance, longer-term observation would be beneficial to further assess treatment stability.

Conclusion

This case demonstrates that a staged approach using a removable posterior bite plane with unilateral expansion screw followed by fixed appliances is effective for correcting both posterior and anterior crossbites associated with a functional mandibular shift. Priority correction of the transverse discrepancy restored a stable mandibular closure pathway, eliminated the functional shift, and facilitated subsequent anterior alignment. At the end of treatment, the patient achieved a stable Class I occlusion, corrected crossbites, centered midlines, improved facial symmetry, and acceptable soft-tissue balance. This approach highlights the value of combining removable and fixed appliances in managing complex crossbite cases in late adolescents.

Author Contributions

Ornjira Wiriyapongsukit: Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing - Original Draft, Visualization, Project administration; **Chairat Charoemratrote:** Conceptualization, Writing - Review & Editing, Supervision

Ethical statement

The patient's consent was obtained before publication.

Disclosure statement

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AI-assisted writing declaration

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