CASE REPORT

A Maxillary Expander for Treatment of Unilateral Posterior Crossbite with Anterior Open Bite

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Anterior open bite is one of the most difficult malocclusions to treat because it is often caused by multiple interacting factors and is frequently associated with other anteroposterior, transverse, and vertical discrepancies.[1-8] This case shows an anterior open bite combined with unilateral posterior crossbite and a missing maxillary lateral incisor.

Diagnosis

A 16-year-old girl presented with the chief complaint of gaps between her maxillary central and lateral incisors on both sides (Fig. 1). Examination revealed a convex profile with competent lips, a Class I molar relationship on the left side, and a posterior crossbite involving the maxillary premolars and first molar on the right. The patient's long-standing tongue-thrust habit had contributed to an anterior open bite of 5mm and an overjet of 1mm. Her maxillary right lateral incisor was congenitally missing, and the adjacent canine had drifted into that region, causing significant bilateral anterior spacing. The lateral incisor on the left side was peg-shaped. The lower arch was well aligned, with minor spacing between the lateral incisors and canines on both sides. The patient maintained good oral hygiene and showed no evidence of periodontal disease.

Cephalometric analysis indicated a Class I skeletal relationship with a normal growth pattern (Table 1). Cephalometric measurements, including the mandibular plane angle, anterior-to-posterior facial-height ratio, and Kim's Overbite Depth Indicator[5] (ODI), indicated a dentoalveolar open bite. ODI is the sum of the angles of the AB plane to the mandibular plane and the palatal plane to Frankfort horizontal. The norm is 74° ± 6°; 68° or less indicates a skeletal open-bite tendency.

Treatment Plan

Because the patient presented with a number of esthetic and dental problems, a multidisci-

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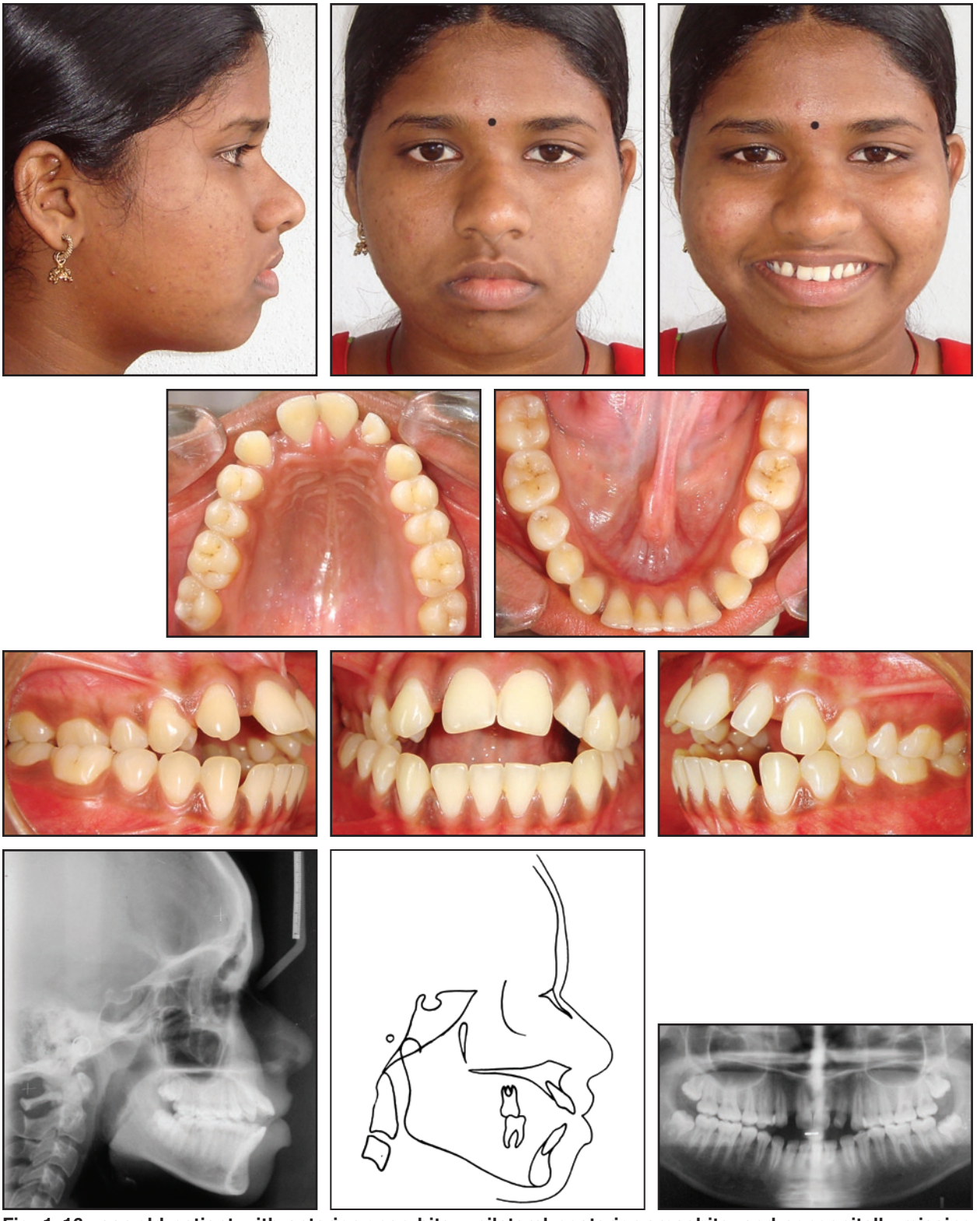

Fig. 1 16-year old patient with anterior open bite, unilateral posterior crossbite, and congenitally missing lateral incisor.

TABLE 1
CEPHALOMETRIC DATA

	Pretreatment	Post-Treatment
SNA	86°	86°
SNB	82°	84°
ANB	4°	2°
Angle of convexity	–8°	–7°
FMA (Tweed)	26°	25°
SN-GoGn	28°	27°
U1-NA	36°	24°
U1-NA	6mm	4mm
U1-SN plane	122°	111°
L1-NB	36°	30°
L1-NB	8mm	7mm
L1-mandibular plane	101°	98°
Interincisal angle	104°	121°
Nasolabial angle	103°	111°

Fig. 2 Asymmetric Maxillary Expansion (AMEX) appliance.

plinary plan was developed involving orthodontic treatment and prosthodontic restoration. The objectives of the treatment plan were to:

- Correct the unilateral posterior crossbite on the right side.
- Correct the anterior open bite to achieve ideal overbite and overjet.
- Achieve proper inclination of the maxillary and mandibular occlusal planes.
- Create space for the missing maxillary right lateral incisor.
- Place a prosthetic implant and a porcelain crown in the space of the missing incisor.
- Perform esthetic restoration of the peg-shaped maxillary left lateral incisor.

Asymmetric Expansion

To move selected teeth on the constricted side of the maxillary arch while limiting undesirable overexpansion of the unaffected side, an Asymmetric Maxillary Expansion (AMEX) appliance was used. This device was first described by Enacar and Ozgen[9] and subsequently evaluated by Toroglu and colleagues,[10] who found it to be effective in correcting unilateral posterior crossbite.

Maxillary and mandibular impressions were taken with the molar bands in place, and study casts were mounted in centric occlusion. An AMEX appliance was fabricated from .036" stainless steel wire (Fig. 2). First, a Quad Helix-type appliance, incorporating two helices on the right (crossbite) side, was constructed. The active arm of the appliance was extended to the most anterior tooth in crossbite, the first premolar.

On the left (non-crossbite) side, a vertically extending wire "stopper" was adapted to the lingual surfaces of the mandibular first molar and first and second premolars. Care was taken to ensure that the stopper was in contact with the tooth surfaces during mastication and swallowing and at rest. This consolidated the maxillary and mandibular posterior teeth on the left side into a single anchorage unit, which was used by the activated AMEX appliance to exert buccal force on the maxillary posterior teeth on the crossbite side (Fig. 3).

A smooth, round plastic bead was added to the appliance in the anterior region, and the appliance was soldered to the molar bands. The AMEX was activated by expanding the active arm to a distance equivalent to 8mm, keeping the two arms parallel to each other, and bonded in

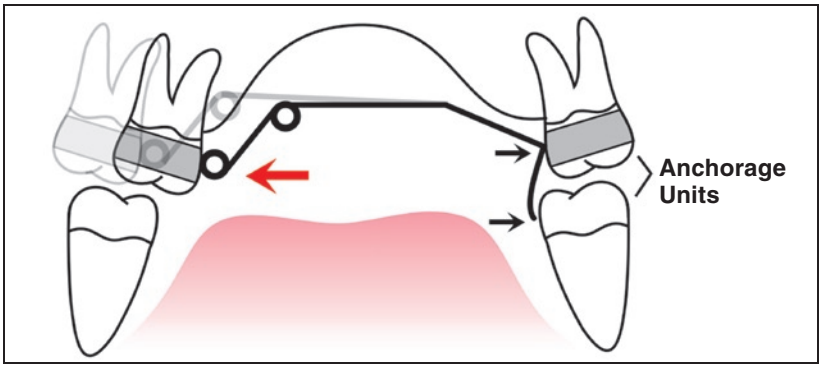

Fig. 3 Vertically extending "stopper" consolidates upper and lower posterior teeth on non-crossbite side into single anchorage unit.

the patient's mouth (Fig. 4).

Reactivations involving removal and recementation of the appliance were performed at four-week intervals as needed until the posterior crossbite was corrected. Expansion was discontinued when the buccal aspects of the lingual cusps of the maxillary right premolars and molars contacted the lingual aspects of the buccal cusps of the mandibular right premolars and molars. The patient was encouraged to play with the anterior plastic bead with her tongue to position the tongue away from the anterior teeth and help resolve the tongue thrust, thereby improving the anterior open bite.

Expansion was completed in four months (Fig. 5). The anterior open bite was reduced by 2mm, and the spaces distal to the lower canines were closed, possibly because the anterior plastic bead had positioned the tongue superiorly. The reduction in open bite could also be attributed to the tongue-crib effect of the AMEX, which interferes with the establishment of an oral seal during deglutition.

To measure the expansion on each side, anteroposterior cephalometric radiographs and tracings were obtained before and after expansion. An .018" × .025" stainless steel wire was bent with a terminal helix and inserted into each maxillary first molar tube before the radiograph was taken (Fig. 6). Lines were drawn from the wire locations to the plane between the zygomatic arches (Z-Z) on the tracings, and the outer angles were measured to determine the changes in axial inclination of the maxillary first molars (U6-ZZ). During the expansion, the first molar on the crossbite side tipped 9° buccally, while the first molar on the non-crossbite side tipped only 3°.

Space Creation

The maxillary arch was then bonded with Roth-prescription .022" preadjusted edgewise appliances, and an .014" round nickel titanium archwire was placed for initial alignment (Fig. 7). The distally tipped

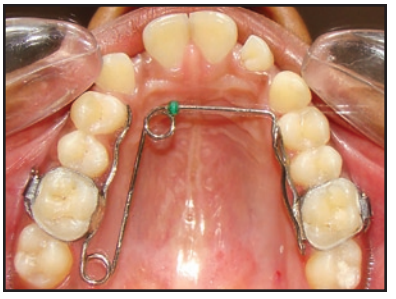

Fig. 4 AMEX appliance bonded in maxillary arch.

Fig. 5 Maxillary expansion and correction of crossbite after four months, with open bite reduced by 2mm.

crowns of the maxillary canines deflected the wire occlusally and aided in closure of the anterior open bite. Over the next four months, the archwires were stepped up to .016" nickel titanium, .018" nickel titanium, and .020" Australian* stainless steel. An open-coil spring was inserted between the maxillary right cen-

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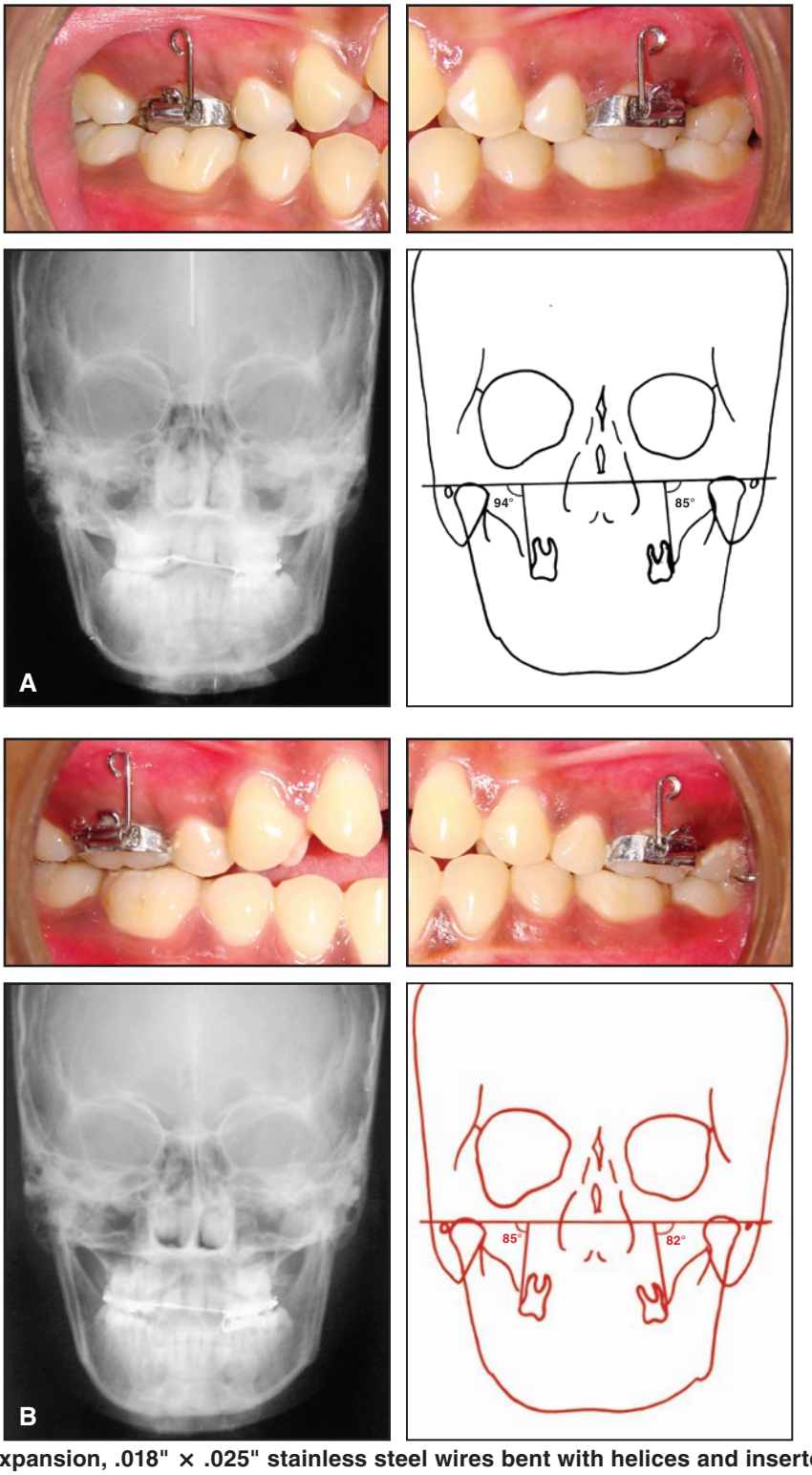

Fig. 6 A. Before expansion, .018" × .025" stainless steel wires bent with helices and inserted into maxillary right and left first molar tubes. Anteroposterior radiograph and tracing show construction of reference plane between zygomatic arches and measurement of maxillary first molar inclinations, using outer angles between images of wires and reference plane. B. After four months of expansion.

Fig. 7 Initial maxillary alignment using .014" round nickel titanium archwire, with distally tipped crowns of maxillary canines aiding in closure of open bite.

Fig. 8 Open-coil spring placed on .020" Australian stainless steel archwire to create space for missing upper right lateral incisor.

Fig. 9 Mandibular arch bonded and .016" nickel titanium wire placed after 10 months of treatment.

tral incisor and canine to create space for the missing lateral incisor (Fig. 8).

After 10 months of treatment, the mandibular arch was bonded, and an .016" nickel titanium initial archwire was placed, followed by an .019" × .025" stainless steel wire. Closed-coil springs were inserted between the maxillary left central incisor and the peg-shaped lateral incisor and between the lateral incisor and canine to maintain space for later esthetic restoration of the lateral incisor (Fig. 9).

Three months later, a 6mm space had opened between the maxillary right central incisor and canine. The open-coil spring was replaced with a closed-coil spring to maintain the space. Box elastics were used in the anterior region to close the bite, first to an edge-to edge position and then to a positive overbite. Triangular elastics were then worn to settle the posterior occlusion (Fig. 10).

Prosthetic Restoration

A dental implant was placed in the space opened for the maxillary right lateral incisor (Fig. 11A), and a riding pontic was fabricated to protect the implant and improve the patient's appearance and speech. An acrylic lateral incisor was reshaped to fit the available space, a section of the acrylic was relieved to accommodate the implant, and a bracket was bonded onto the facial surface of the pontic with self-curing acrylic. The pontic was then ligated onto the archwire (Fig. 11B).

Four months later, osseointegration of the implant was complete, and a porcelain-fused-to-metal right lateral incisor crown was fabricated and permanently luted over the implant (Fig. 12). The peg-shaped maxillary left lateral incisor was restored with composite.

Results

After 16 months of active treatment, the brackets were debonded, and upper and lower wraparound retainers were delivered (Fig. 13). Post-treatment facial and intraoral photographs showed good esthetic and functional results. The patient's profile improved slightly, and lip prominence decreased, with marked esthetic improvement in the appearance of the frontal smile. The posterior crossbite on the right side was corrected, and Class I molar and cuspid relationships were maintained. Due to extrusion of the upper and lower incisors, the –5mm anterior open bite was improved to a 2mm overbite (Table 1). The interincisal angle decreased, and upper and lower incisor inclination and proclination were corrected and controlled, keeping the dental midlines coincident.

The prosthetic implant was successfully osseointegrated, and the color and shade of the porcelain crown were reasonably matched to the adjacent teeth. The anatomy of the maxillary left lateral incisor was corrected by composite restoration. On the whole, there was a marked improvement in facial esthetics, dental function, and occlusion.

Discussion

Treatment of open bite is often complicated by the patient's growth pattern and the presence of multiple dentoalveolar and

Fig. 10 Box and triangular elastics used to close bite and settle occlusion after creation of space for upper right lateral incisor.

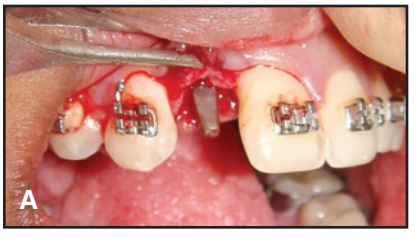

Fig. 11 A. Surgical placement of prosthetic implant for missing upper right lateral incisor. B. Acrylic riding pontic placed over implant.

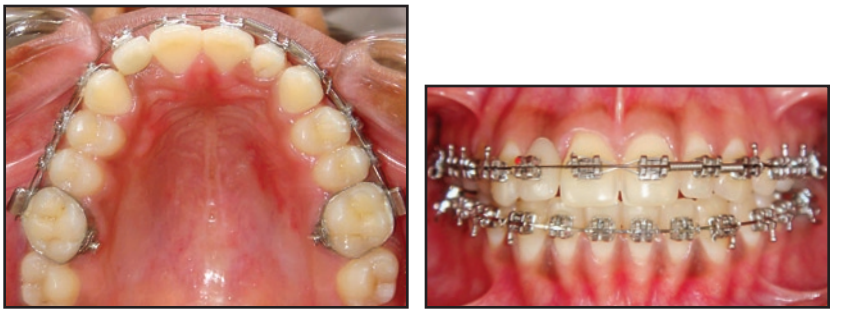

Fig. 12 After four months of implant osseointegration, porcelain-fused-to-metal lateral incisor crown luted over implant; peg-shaped upper left lateral incisor esthetically restored with composite.

skeletal etiologic factors.[11] In some cases, open bite corrects spontaneously after detrimental habits are eliminated in the early mixed dentition. If the vertical discrepancy has a skeletal pattern, many clinicians prefer to postpone treatment until after puberty to avoid extrusion of the posterior teeth. Orthognathic surgery is indicated in an adult patient with severe open bite and unfavorable facial proportions.

Cephalometric measurements such as the mandibular

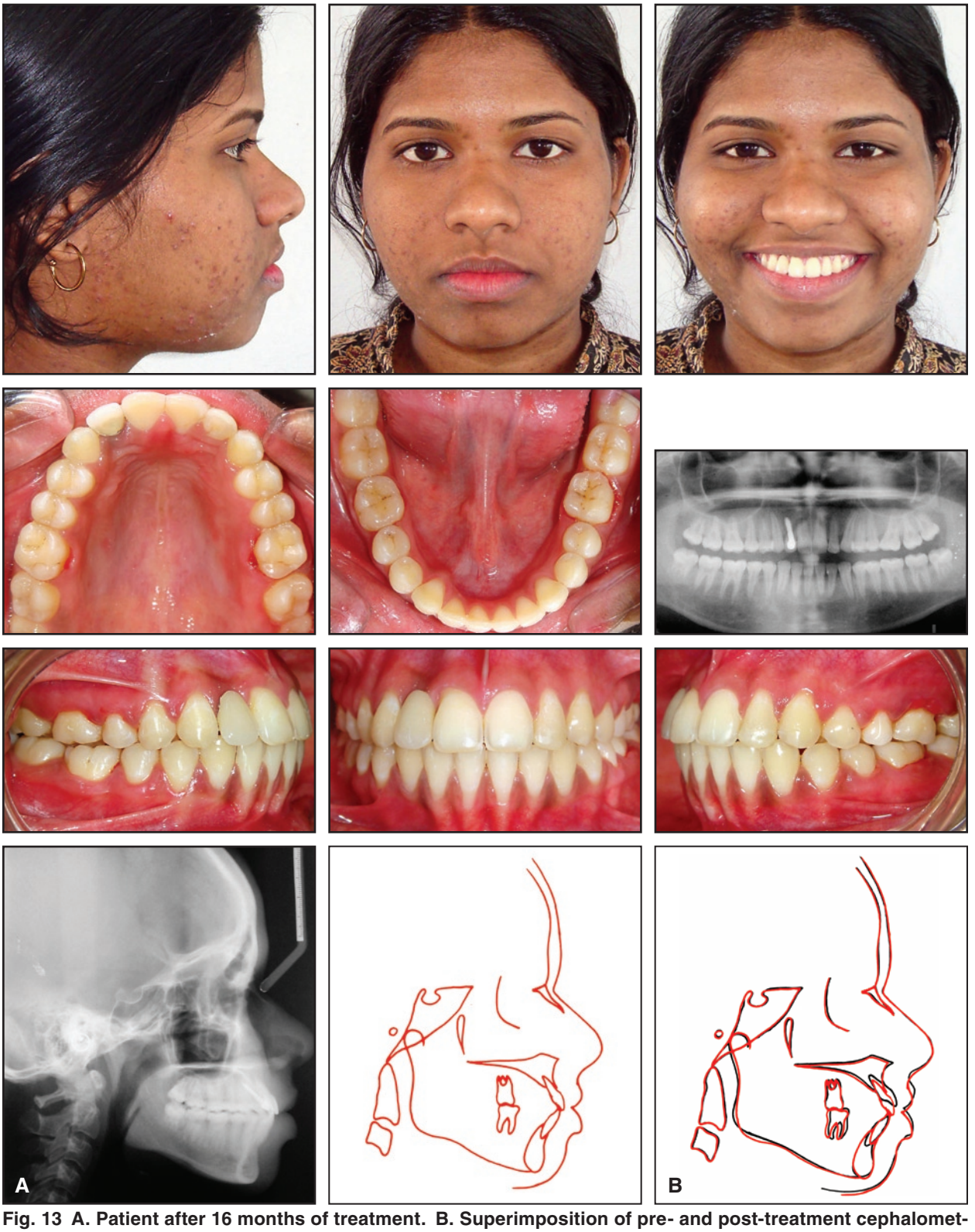

Fig. 13 A. Patient after 16 months of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.

plane angle, upper-to-lower facial-height ratio, and anterior-to-posterior facial-height ratio have been used to identify vertical discrepancies, but these measurements do not always predict the treatment response or the stability of open-bite correction.[12,13] The ODI can be helpful in determining the skeletal pattern and thus in enhancing long-term stability.[5]

The patient shown here maintained an acceptable occlusion during the first year of active retainer wear, but minor spaces developed thereafter distal to the mandibular canines on both sides. It is possible that a bonded 4-4 lower lingual retainer would have prevented this relapse. Although it was unclear whether the tongue thrust was a primary or secondary contributor to the anterior open bite, a tongue crib was not required after treatment. Many previous studies have indicated that ongoing anterior posturing of the tongue can cause the bite to reopen.[1-8] In this patient, successful repositioning of the tongue and the mechanics of the AMEX appliance may have contributed to post-treatment stability. Nevertheless, the long-term success of the treatment approach described here will not be known until post-treatment results have been followed in many additional patients.

REFERENCES

1. Subtelny, J.D. and Sakuda, M.: Openbite: Diagnosis and treatment, Am. J. Orthod. 50:337-358, 1964.
2. Spyropoulos, M.N. and Askarieh, M.: Vertical control: A multifactorial problem and its clinical implications, Am. J. Orthod. 70:70-80, 1976.
3. Niide, J.: A study of dentofacial and masticatory functional characteristics in anterior open bite children and adults, J. Jap. Orthod. Soc. 45:38-47, 1986.
4. Ishikawa, F.; Endo, T.; Kamegaya, T.; Kunitake, K.; and Ide, K.: A roentgenographic cephalometric study of the anterior open bite, J. Jap. Orthod. Soc. 30:64-72, 1971.
5. Kim, Y.H.: Overbite Depth Indicator with particular reference to anterior open-bite, Am. J. Orthod. 65:586-611, 1974.
6. Tanaka, S.: Morphological study of open bite: Skeletal Class I and Class II open bite, Aichi-Gakuin J. Dent. Sci. 28:1129-1150, 1990.
7. Negoro, T.: Morphological study of open bite with lateral cephalograms—Orthodontic treatment changes of skeletal Class II and Class III open bite in adult females, J. Jap. Orthod. Soc. 50:303-314, 1991.
8. Kajiwara, T.: Morphological study of open bite—Skeletal class open bite, J. Jap. Orthod. Soc. 51:40-52, 1992.
9. Enacar, A. and Ozgen, M.: Asymmetric maxillary expansion appliance (ABHE), Cleft Pal. Craniofac. J. 30:416-417, 1993.
10. Toroglu, M.S.; Uzel, E.; Kayalioglu, M.; and Uzel, I.: Asymmetric maxillary expansion (AMEX) appliance for treatment of true unilateral posterior crossbite, Am. J. Orthod. 122:164-173, 2002.
11. Nielsen, I.L.: Vertical malocclusions: Etiology, development, diagnosis and some aspects of treatment, Angle Orthod. 61:247-260, 1991.
12. Katsaros, C. and Berg, R.: Anterior open-bite malocclusion: A follow-up study of orthodontic treatment effects, Eur. J. Orthod. 15:273-280, 1993.
13. Dung, D.J. and Smith, R.J.: Cephalometric and clinical diagnoses of open-bite tendency, Am. J. Orthod. 94:484-490, 1988.