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High-efficiency treatment with the use of traditional anchorage control for a patient with Class II malocclusion and severe overjet

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Patients with Class II malocclusion and severe overjet are often dissatisfied with their facial disharmony. Although temporary skeletal anchorage devices (TSADs) are now widely used in orthodontic treatment, traditional anchorage devices should not be overlooked as a treatment option. Proper design of traditional anchorage can achieve 3-dimensional control of incisors and molars as efficiently as TSADs in some patients with severe malocclusion. We used traditional anchorage devices, including a transpalatal arch and a Nance palatal arch, combined with a utility arch to treat an 11-year-old Chinese girl with a skeletal Class II malocclusion and severe overjet. The space was closed in 2 steps to protect molar anchorage. Facial improvement, especially smile esthetics, and Class I molar relationship and overjet correction were achieved in 17 months of treatment. Follow-up records 22 months after treatment show that the results remained stable. (Am J Orthod Dentofacial Orthop 2019;155:411-20)

Crooked teeth are common in children in China. But misaligned teeth are generally judged to be less attractive and less acceptable today in Chinese populations. Children who have a facial disharmony that includes protruding incisors are more likely to seek orthodontic treatment.[1] In addition to esthetics, improvement of oral health and myofascial function are other objectives of orthodontic treatment.

Various factors contribute to Class II malocclusion. These include genetics, environmental factors, long-term myofascial muscle dysfunction, and pernicious habits. Recently, myofunctional therapy has attracted greater interest among dentists and orthodontists.[2,3] Abnormal myofascial muscle function is considered to be a key factor contributing to malocclusions and poor facial esthetics. Mouth breathing might affect both tooth arch and facial esthetics.

Various types of functional appliances have been prescribed for the correction of skeletal and occlusal disharmonies in growing patients,[4,5] but there are some disagreements regarding the efficacy of the Twin-Block, Bionator, Activator, Frankel, and Herbst functional appliances. Because skeletal anchorage can provide large forces without affecting other teeth, temporary skeletal anchorage devices (TSADs) are widely used today in treating adults and adolescents—especially mini-implants[6,7]—but the suitability and stability of TSADs in the early permanent dentition is still not unequivocal.

The present case report presents an 11-year-old girl with severely protruding maxillary incisors who was treated with traditional anchorage control devices and a utility arch. The posttreatment cephalometric analysis showed that a Class I molar relationship and a normal overjet were achieved through reciprocal anchorage coupled with a large retraction of maxillary anterior segment. Favorable skeletal, dental, and soft tissue relationships were accomplished after 17 months of

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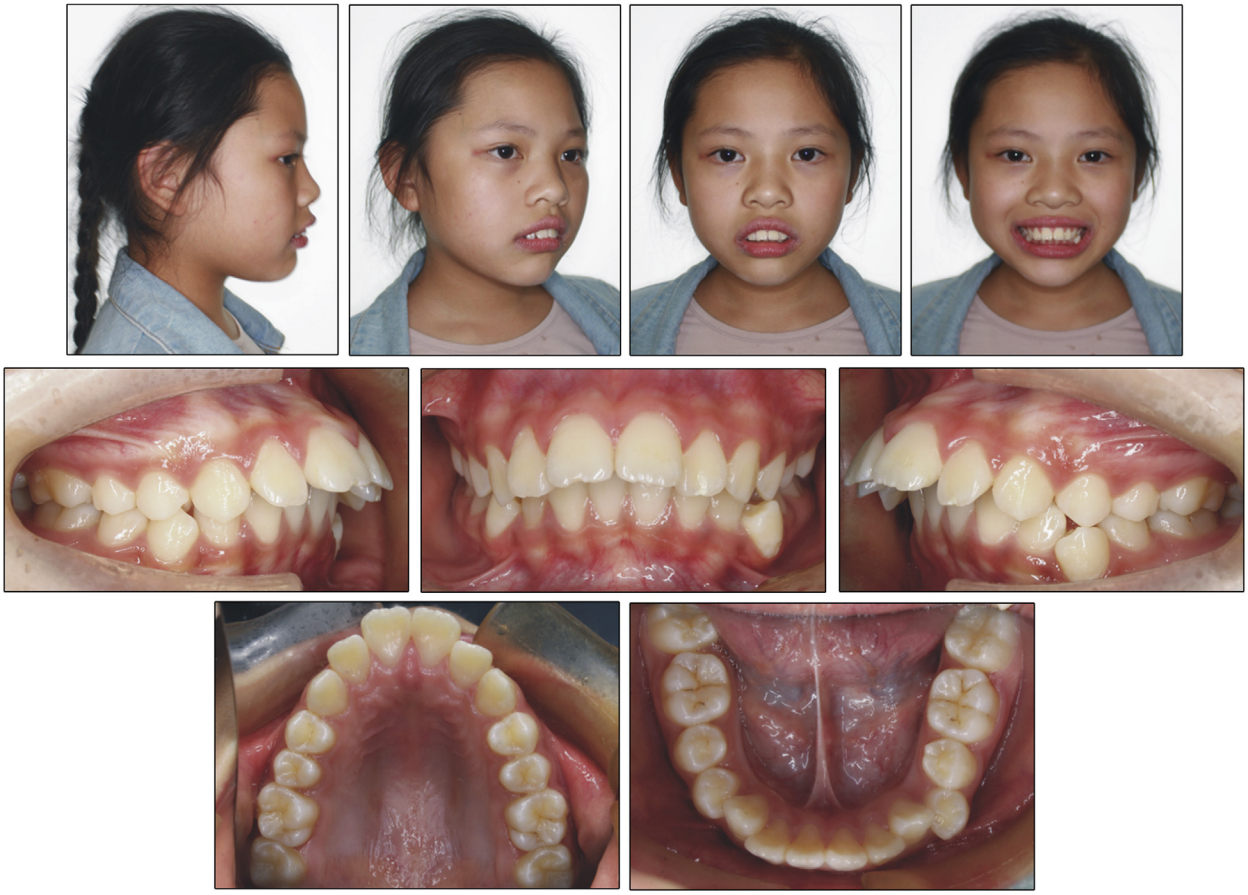

Fig 1. Pretreatment extraoral and intraoral photographs.

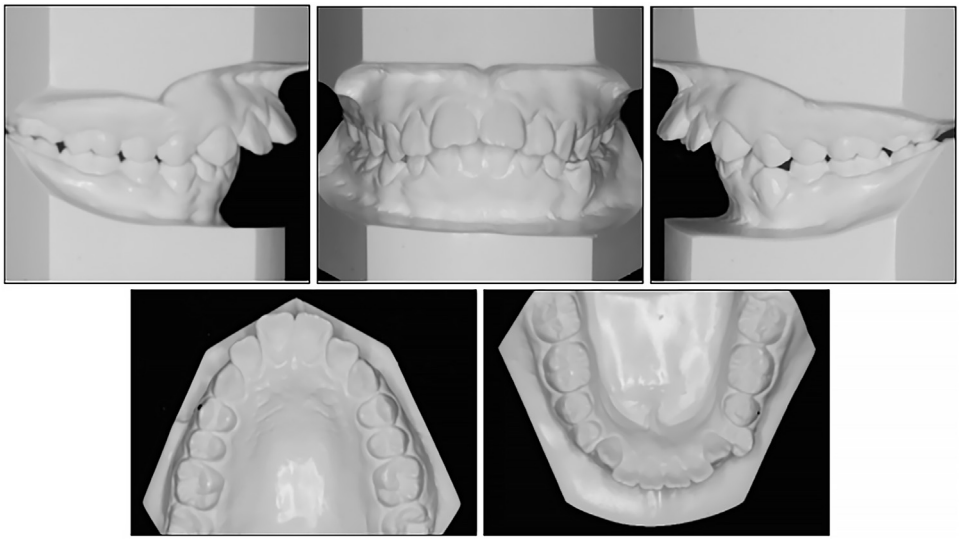

Fig 2. Pretreatment dental casts.

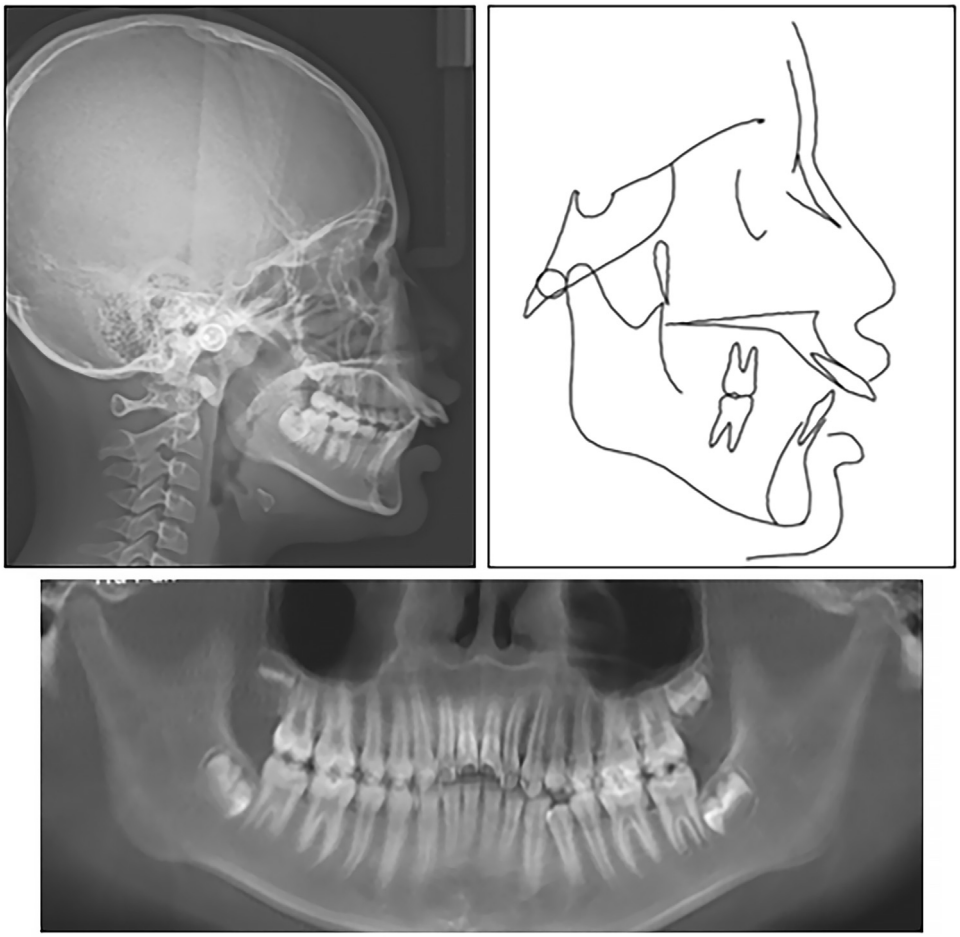

Fig 3. Pretreatment cephalogram, tracing, and panoramic radiograph.

Table. Cephalometric analysis

Measurement	*Average ± SD*	*Before treatment*	*After treatment*
SNA (°)	82.8 ± 4.0	86.3	86.3
SNB (°)	80.1 ± 3.9	79.1	80.2
ANB (°)	2.7 ± 2.0	7.2	6.1
FH to NPo (°)	87.4 ± 3.0	84.5	85.8
MP to FH (°)	29.1 ± 4.8	29.9	30.5
MP to SN (°)	32.5 ± 5.2	34.5	35.6
Y-axis (°)	65.8 ± 3.1	63.7	62.8
S-Go/N-Me	62-64	64.2	64.9
U1 to L1 (°)	125.4 ± 7.9	99.6	122.9
U1 to SN (°)	105.7 ± 6.3	127.9	105.7
U1 to NA (°)	23.6 ± 4.6	37.8	18.7
U1 to NA (mm)	4	12.5	3.8
L1 to MP (°)	94.7 ± 5.2	96.1	96.2
L1 to NB (°)	30.8 ± 4.9	33.3	33.1
L1 to NB (mm)	7	7.2	7.0
Upper lip to E-plane (mm)	−3.7 ± 2.0	3.0	0.1
Lower lip to E-plane (mm)	−2.0 ± 2.0	0.3	0.2

treatment, and a subsequent review of the occlusion after 22 months of retention demonstrated a stable treatment result.

DIAGNOSIS AND ETIOLOGY

An 11-year-old girl came to our orthodontic clinic with the chief complaint of crooked teeth. Her medical history was noncontributory other than the presence of severe mouth breathing. No other history of myofascial habits was evident. The clinical examination revealed a protrusive profile, a Class II molar relationship associated with a large overjet, and deep overbite.

Facially, the patient had a convex soft tissue profile with an acute nasolabial angle. The maxillary midline was coincident with the facial midline, but the mandibular midline was shifted 2 mm to the left. There was a significant lip incompetence at rest, and no facial asymmetry was present from a frontal view (Fig 1).

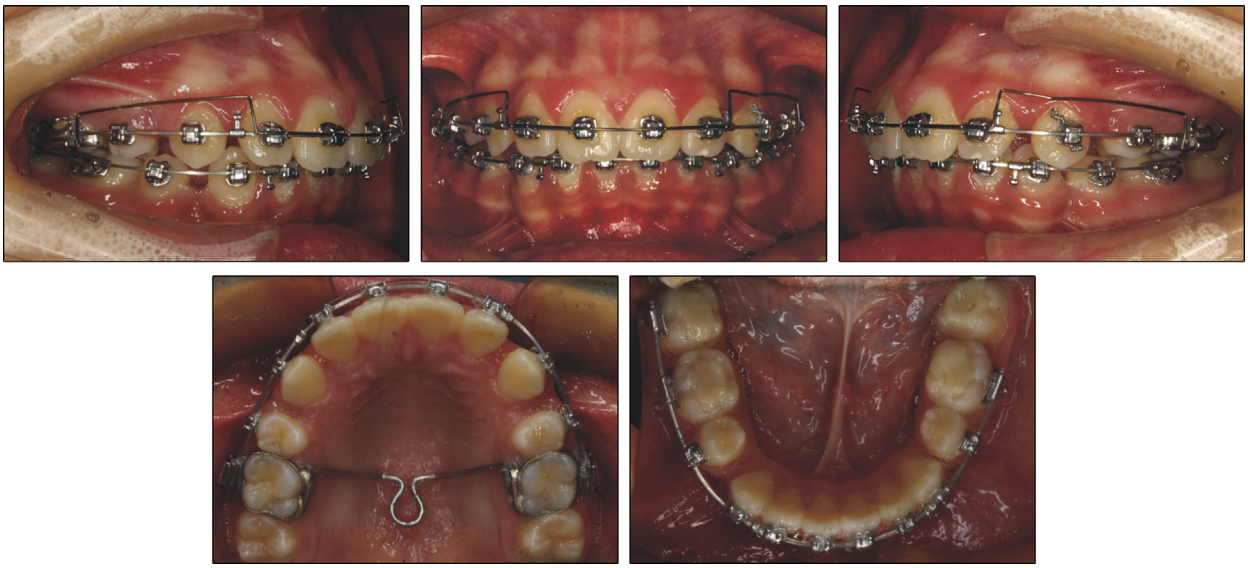

Fig 4. Intraoral photographs during orthodontic treatment with utility arch.

Intraoral and dental cast examinations revealed that the patient had a Class II molar and canine relationship bilaterally, a 4-mm overbite, a 12-mm overjet, and a 5-mm curve of Spee in the mandibular arch. There was a moderate maxillary-mandibular arch length discrepancy with significant maxillary incisor procumbency. V-Shaped maxillary and U-shaped mandibular arch forms were asynchronus (Fig 2).

The cephalometric analysis showed a skeletal Class II relationship with maxillary prognathism and a normal mandible skeletal position (SNA 86.3°, SNB 79.1°, ANB 7.7°). The maxillary incisor proclination contributed an excessive interincisal angle (U1-SN 127.9°, U1-L1 99.6°; Fig 3; Table). The panoramic radiograph showed normal root morphology. No temporomandibular joint disorder symptoms were present on radiographic and clinical evaluations.

DIAGNOSTIC VARIANCES

Angle Class II malocclusion, skeletal Class II, severe overjet, deep overbite, maxillary protrusion, lip incompetence, and narrow smile.

TREATMENT OBJECTIVES

Correct the mouth breathing habit. Relieve the crowding in both arches and correct arch width discrepancy between the maxillary and mandibular dentition.

Reduce the increased overjet and overbite, resolve the sagittal dental discrepancies and establish proper occlusion. Correct the midline discrepancy. Establish an esthetic facial profile and relieve the lip incompetence and mentalis strain. Maintain good periodontal health.

TREATMENT ALTERNATIVES

Several alternative treatment options were considered. A functional appliance followed by comprehensive orthodontic treatment was considered to restrain the maxilla and harmonize the jaw relationships. Orthopedic treatment with high-pull J-hook headgear or other extra-oral devices to distalize the maxillary arch could partially correct the molar relationship and reduce the overjet. This option might also restrain the maxilla. However, the result would be less predictable because it would be based almost totally on the patient'cooperation.[8]

TSADs were another alternative treatment option for this patient: increasing maxillary anchorage and retracting maxillary incisors. Previous studies have supported the use of miniscrews or miniplates to provide skeletal anchorage allowing efficient effective retraction of the maxillary anterior segment, thereby improving the profile.[9] However, the failure of TSADs in the late mixed or early permanent dentition has also been well documented.[10]

With effective anchorage protection and directional force design, the profile could be improved without using TSADs. A utility arch could provide vertical control of anterior teeth, and a transpalatal arch (TPA) and archwires with the use of tip-back bends could be implemented to control the posterior teeth 3-dimensionally. Because the parents did not consent to the use of TSADs for their daughter's care, the use of a TPA and a utility arch was chosen.

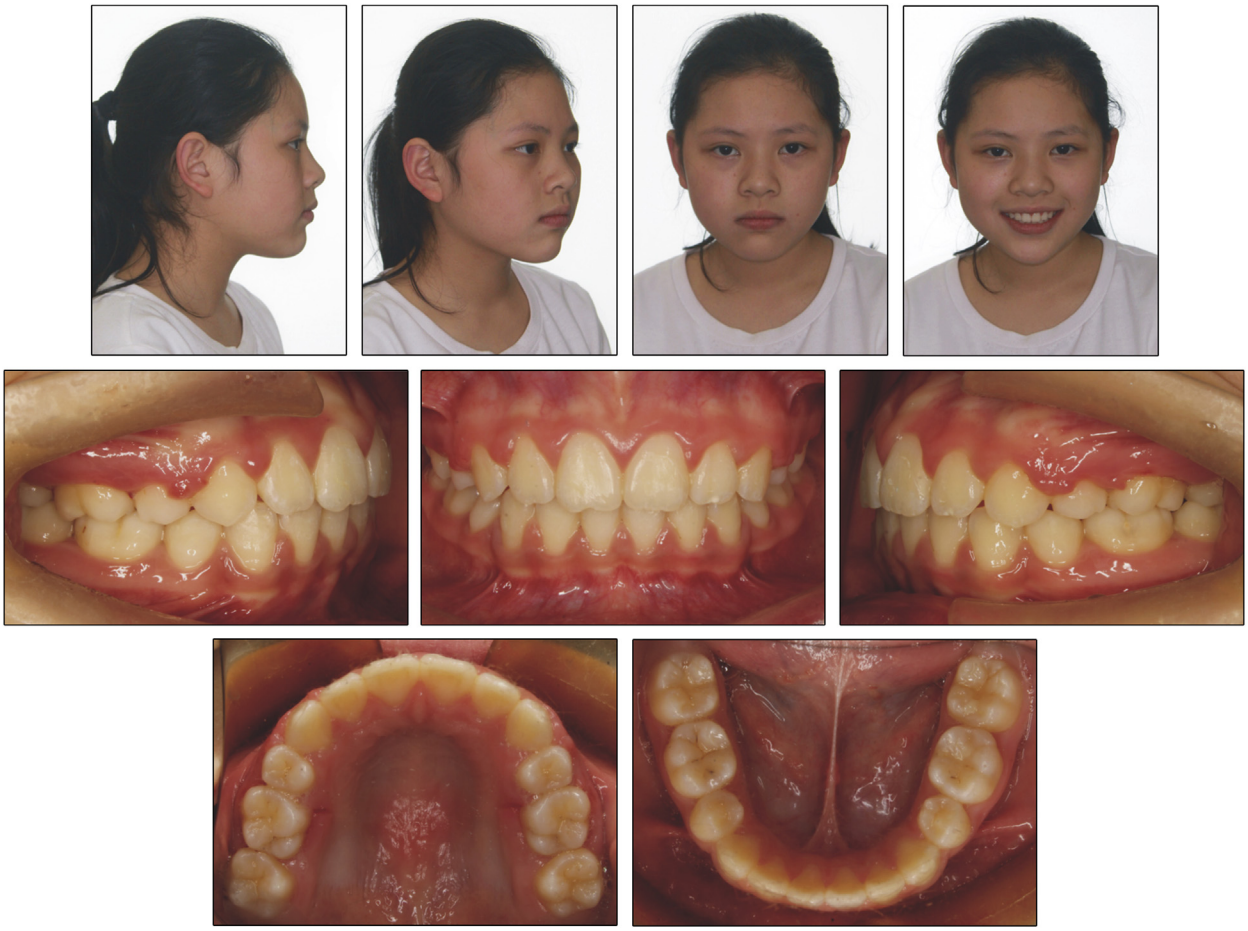

Fig 5. Posttreatment extraoral and intraoral photographs.

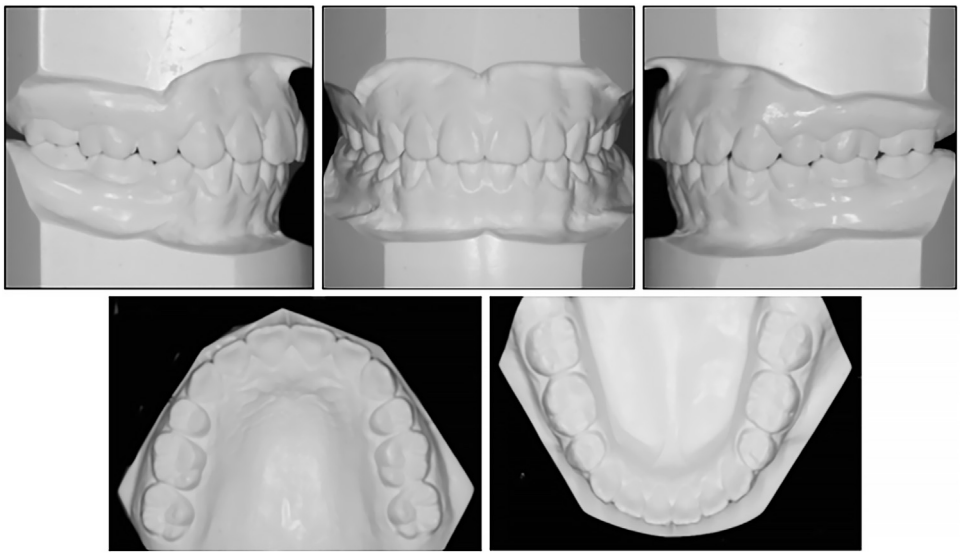

Fig 6. Posttreatment dental casts.

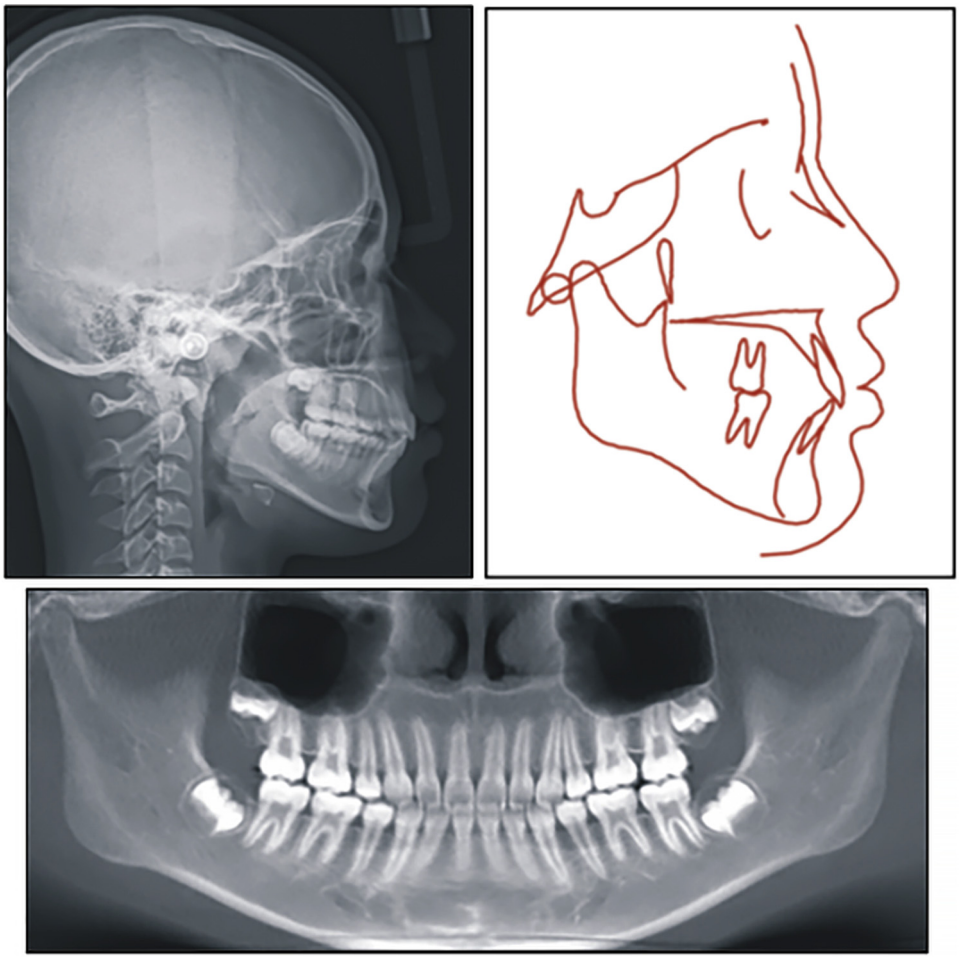

Fig 7. Posttreatment cephalogram, tracing, and panoramic radiograph.

TREATMENT PROGRESS

The patient suffered from a mouth breathing habit: therefore, myofunctional therapy instruction was part of the overall orthodontic treatment plan. The retraction of the maxillary anterior teeth was accomplished in a 2-phase retraction process to prevent anchorage loss. The canines were retracted first. After stabilizing the maxillary posterior buccal segments, which included the maxillary canines, the maxillary incisors were retracted, pitting the posterior dentition against the 4 maxillary incisors. The traditional anchorage control devices—Nance palatal arch and TPA—were designed to protect the maxillary molar anchorage before distal movement of maxillary canines was achieved. The utility arch, combined with a curve of Spee built into the maxillary archwire, was used to control the vertical position and the torque of upper anterior teeth while they were retracted. The TPA and tip-back bends were used to control posterior teeth in a 3-dimensional position after the Nance palatal arch was removed.

After extraction of the mandibular and maxillary first premolars, the Nance palatal arch and TPA were immediately placed to achieve vertical control and prevent anchorage loss. The TPA was attached to maxillary first molars, and the middle part of TPA was 6 mm away from palate. After the extraction, both arches were bonded with self-ligating brackets (0.022-inch slot; Damon, Ormco, Calif) and aligned with initial 0.014-inch nickel titanium archwires and changed sequentially. Short Class II elastics (3/8 inch, 2 oz; Ormco) were applied at night on both sides to coordinate the canine relationship. The elastics were applied from the maxillary canines to the mandibular second premolars. This denture preparation phase of treatment was completed with the use of 0.019 × 0.025–inch stainless steel archwires in both arches. A V-shaped maxillary arch form was

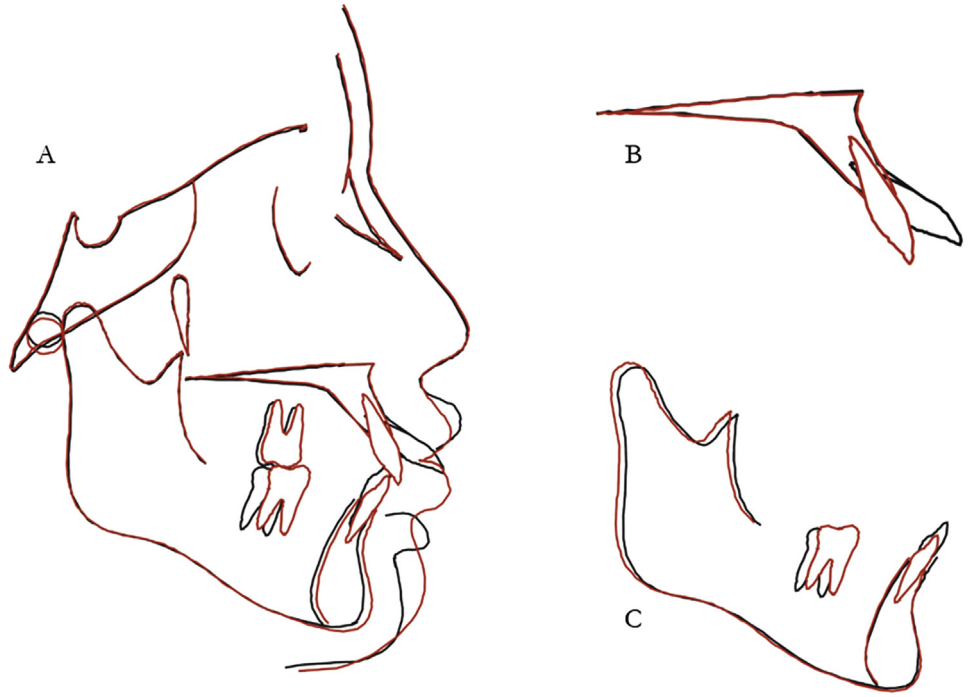

Fig 8. Superimpositions of the cephalometric tracings before (*black*) and after (*red*) treatment. **A,** Sella/nasion plane at sella. **B,** Palatal plane at ANS. **C,** Mandibular plane at menton.

changed to U-shaped form to be consistent with and harmonize with the mandibular arch form.

The first step of denture correction was to remove the Nance palatal arch to eliminate its interference with maxillary incisor retraction. The TPA was left to prevent the maxillary first molars from buccal tipping or extrusion. Then a maxillary 0.018-inch Australia-wire utility arch was used to control anterior tooth position (Fig 4). A curve of Spee in 0.019 × 0.025–inch stainless steel maxillary archwire and a utility arch were used during the entire space-closing procedure to control the anterior dental torque and to intrude the maxillary anterior teeth to lessen the gummy smile. Class II intermaxillary elastics were used during the treatment to correct molar relationship (5/16 inch, 3.5 oz; Ormco).

The active orthodontic treatment lasted 17 months. Ideal incisor overbite and overjet and Class I molar and canine relationships were achieved. After fixed orthodontic appliances were removed, vacuum-formed retainers were placed in both arches. The patient was instructed to wear the retainers full time for 6 months and then at night for the next 2 years.

TREATMENT RESULTS

Acceptable facial improvement was achieved as a result of treatment. The photographs demonstrated a symmetric and harmonious relationship, as observed from a frontal and profile perspective (Fig 5). A Class I occlusion was achieved, demonstrating a normal anteroposterior (AP) relationship, a U-shaped upper arch form, and a satisfactory alignment (Fig 6).

The cephalometric analysis indicated:

AP relationship improvement; SNB angle increased by 1.1°; maxillary anterior dentition was retracted, maxillary incisors were significantly retroclined (U1-SN decreased from 127.9° to 105.7°), mandibular incisors were not proclined by the treatment (L1-MP 96.7°), and the retraction of the maxillary incisors led to a 2.9-mm retraction of the upper lip in relation to the E-line (Fig 7; Table).

The cephalometric superimposition (Fig 8) revealed: anteriorly positioned B point; effective vertical and horizontal control of the maxillary dentition, and mandibular incisor intrusion achieved without labial inclination.

A posttreatment panoramic radiograph showed acceptable root parallelism with no apparent root resorption (Fig 8).

A stable balanced occlusion and a harmonious facial profile were present after 22 months of retention (Fig 9). Molar and canine relationships, as well as the overjet and overbite, remained unchanged.

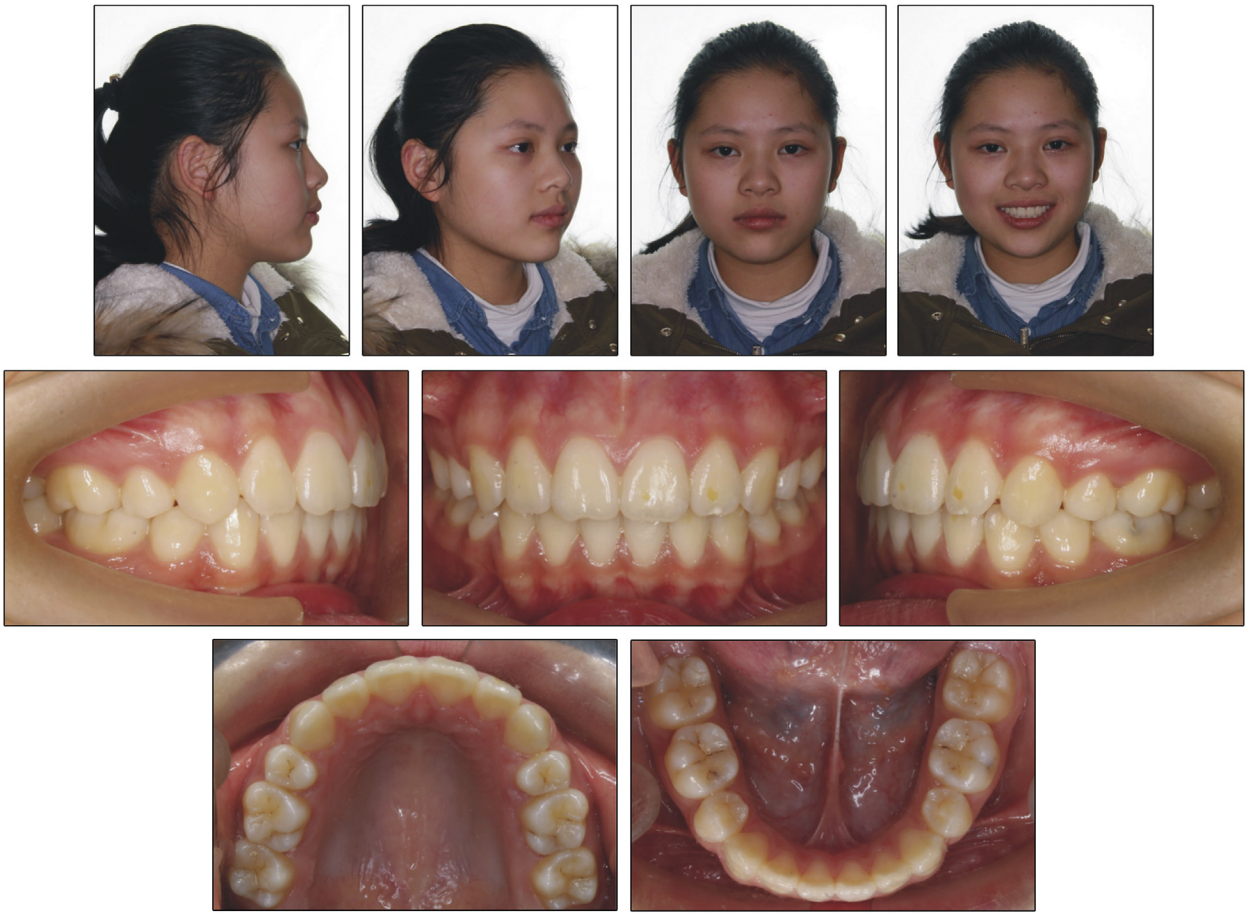

Fig 9. Extraoral and intraoral photographs at the 22-month retention follow-up.

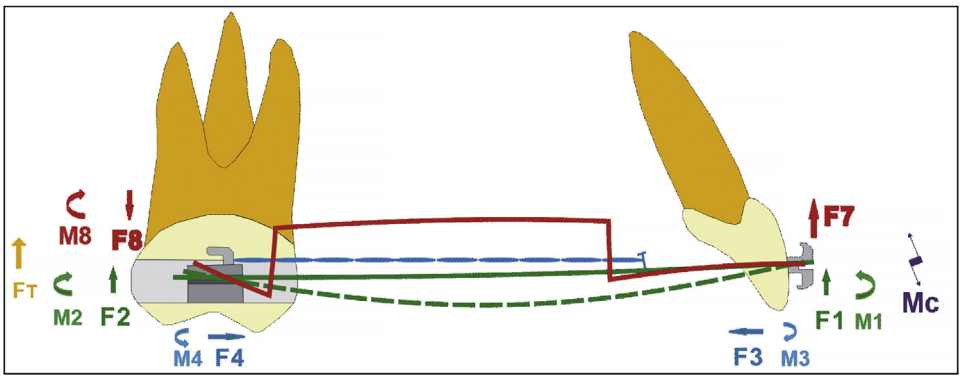

Fig 10. Biomechanical analysis of anterior and posterior section during maxillary anterior tooth retraction. Curve of Spee, utility arch, and TPA were used. *F1, M1, F2, M2,* forces and moments on maxillary incisor and molar, respectively, generated by a curve of Spee in the working wire; *F3, M3, F4, M4,* forces and moments on upper incisor and molar, respectively, generated by intramaxillary elastics; *F7, F8, M8,* forces and moment on upper incisor and molar, respectively, generated by utility arch; *Mc,* moment of couple on maxillary incisor bracket from working wire; *FT,* intrusive force on upper molar from TPA generated by tongue.

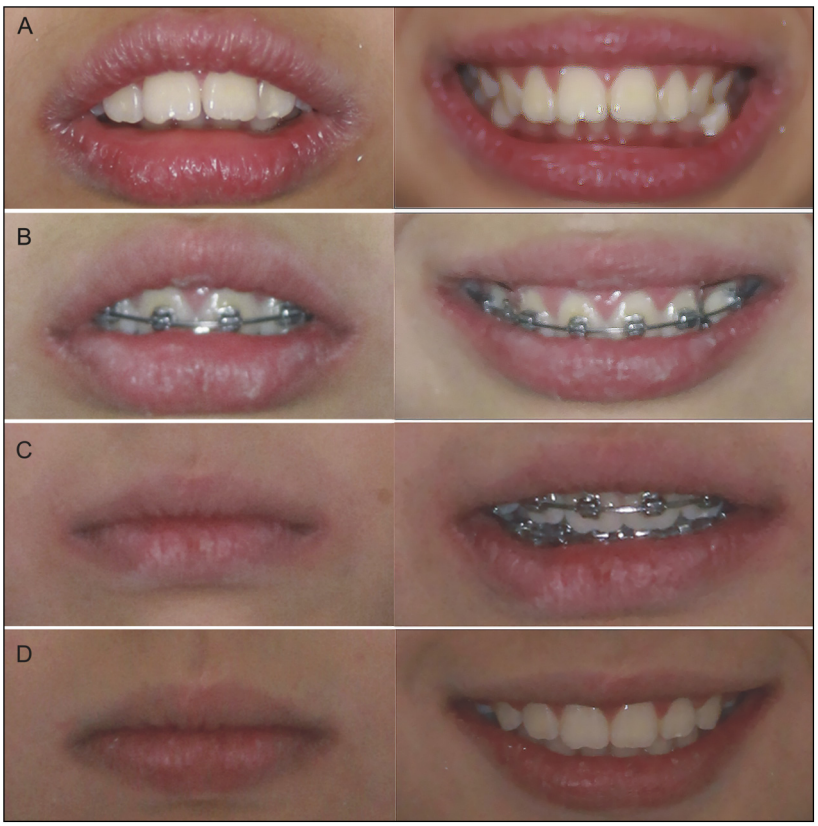

Fig 11. Anterior vertical control improves patient's lip and tooth relationship. **A,** Incompetent lips at rest (left), narrow smile and gingival display (right) before treatment. **B,** Incompetent lips at rest (left) and gingival display on smiling (right) at 6th month just before utility arch was placed. **C,** No lip strain (left) and maxillary anterior tooth exposure reduced on smiling (right) at 13th month after 7 months of utility arch use. **D,** Lip incompetence corrected (left) and smile improved (right).

DISCUSSION

Presently, skeletal anchorage applications are becoming more and more popular. However, buccally placed TSADs, especially in patients in the late mixed or early permanent dentition, have several disadvantages. The smaller interradicular spaces and low cortical bone density increase the risk of root contact and/or the potential loss of the miniscrews. Surgical miniplates have been used to correct abnormal sagittal positions, but placement of miniplates can induce a greater morbidity and a protracted healing time.[10]

Treatment with the use of a functional appliance, followed by comprehensive orthodontic treatment, was not considered for this patient, because the maxilla was protrusive but the mandibular position was within normal limits. Potentially, the orthopedic treatment with a headgear could have been considered to distalize the maxillary buccal segments, but the efficiencies of these removable appliances and headgear depend primarily on patient cooperation.[8]

A directionally oriented force system was designed and applied to control the 3-dimensional movement of the teeth and enhance a favorable change in the profile and jaw relationship. Biomechanical analysis of anterior and posterior sections during upper anterior tooth retraction is shown in Figure 10. A utility arch and a 0.019 × 0.025–inch stainless steel archwire with a curve of Spee in each were used in the maxilla during the entire space-closing procedure. Because the maxillary dentition was significantly proclined, retraction could have untoward side-effects, such as loss of control of anterior teeth torque or vertical position. During retraction, the utility arch, acting as an auxiliary wire, was used to control anterior teeth torque, avoid anterior teeth extrusion, and improve the gummy smile. Retraction and vertical control was achieved concomitantly as the length of utility arch was adjusted. Improved esthetics and reduction of lip incompetence were achieved (Fig 11). Maxillary incisor torque and intrusion during retraction were supported by the use of a utility arch and archwires

containing a curve of Spee. A TPA was used throughout the majority of treatment to resist buccal tipping of the molars. The tongue could also provide a force mediated through the TPA to resist the extrusion of upper first molars (Fig 10).

Implementation of myofunctional therapy was an integral adjunct to enhance the posttreatment occlusal stabilty.[11-13] Continued long-term mouth breathing can negatively affect facial esthetics.[14] The literature suggests that some patients experience open-bite reductions with the use of recommended jaw exercises.[15] Therefore, proper orofacial muscle exercises might be useful to overcome the pernicious influence of insufficient orofacial muscle force on facial skeletal growth.

CONCLUSION

The successful and efficient correction of this Class II patient with a mouth breathing habit depended on a comprehensive diagnostic protocol and a rational treatment design, including the complexity of the malocclusion, maxillary-mandibular skeletal discrepancy, abnormal habit correction, proper anchorage design, and tooth movement control. To enhance a favorable change in the profile and jaw relationship, orthodontists should use a directionally oriented force system to control the 3-dimensional movement of the teeth.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajodo.2017.08.030.

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