Correction of severe anterior open bite using tongue spurs and temporary anchorage devices

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This case report describes the orthodontic treatment carried out on a 13.5-year-old male patient who presented with a hyperdivergent growth pattern combined with a severe anterior open bite of 5.0 mm, associated with an anterior position of the tongue at rest. The parents chose a nonextraction treatment approach, combined with the insertion of temporary skeletal anchorage devices for vertical control of posterior teeth and bonded tongue spurs for tongue position and function reeducation. After four years of treatment, good results were obtained in occlusion, dental esthetics, and the facial profile. The patient's self-esteem and confidence were improved. Treatment results were stable after 1-year follow-up. (Am J Orthod Dentofacial Orthop Clin Companion 2023;XX:XX-XX)

Anterior open bite (AOB) prevalence ranges from 1.5% to 11%.[1] The etiology of AOB is multifactorial and may be due to mouth breathing, nonnutritive sucking habits, the anterior position of the tongue at rest, and an unfavorable vertical growth pattern.[2] Depending on its origin, AOB can be classified as either dental or skeletal. Patients diagnosed with skeletal AOB present with shorter posterior face height, increased anterior face height, and increased gonial and mandibular plane angles.[3]

One of the most relevant components of skeletal open bite is the excessive posterior vertical dentoalveolar growth of the maxilla, with the consequent downward and backward rotation of the mandible, which contributes to the development of skeletal AOB.[4]

In addition, abnormal tongue function and position contribute to bite opening, proclined incisors, and vertical skeletal disproportions as long as this parafunction is present during the patient's active growth.[5]

Depending on the components involved, several treatment approaches have been proposed for AOB correction, including vertical chincups, curved archwires,[6] tongue spurs,[7] tongue grids,[8] bracket placements closer to the gingival area,[9] extractions of permanent teeth,[10] anterior vertical elastics, intrusion of maxillary molars using temporary skeletal anchorage device (TSADs) or miniplates, posterior bite-blocks, and orthognathic surgery.[11]

This case report describes a patient with severe AOB who was treated with a nonextraction treatment approach, including complete fixed appliances associated with TSADs

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inserted in the maxilla and mandible for vertical control of posterior teeth and bonded lingual tongue spurs to reeducate the inadequate position and function of the tongue, allowing successful and stable closure of the AOB.

DIAGNOSIS AND ETIOLOGY

A 13.5-year-old male patient arrived with his parents at the orthodontic consultation with the main complaint of a "huge open bite." Facial evaluation revealed a convex profile, absence of lip competence, increased lower facial height, and appearance of mouth breather (Fig 1).

Intraorally, the patient exhibited an Angle Class I malocclusion associated with a severe AOB of 5.0 mm. The maxillary arch presented a 1.0 mm positive discrepancy, and the mandibular arch presented a 4.0 mm arch length deficiency (Fig 2). The patient exhibited a habitual anterior position of the tongue at rest and a tongue-thrust pattern when swallowing.

No signs or symptoms of temporomandibular joint disorder were observed.

The panoramic radiograph showed the presence of developing third molars. The cephalometric analysis showed a skeletal Class I relationship with a slightly retrognathic mandible (ANB, 3.0°) and a marked hyperdivergent growth pattern (SN-GoGn, 42.0°; FMA, 36.0°). In addition, the maxillary and mandibular incisors were protruded and proclined (U1-NA, 7.0 mm; L1-NB, 7.0 mm; U1-NA, 33°; L1-NB, 31.5°) (Fig 3; Table).

TREATMENT OBJECTIVES

The following treatment objectives were established: (1) correct the AOB, (2) correct the anterior position of the tongue at rest-thrust swallowing, (3) maintain Class I molar relationship, (4) obtain normal overjet and overbite, and (5) improve the facial profile.

TREATMENT OPTIONS

The following treatment options were proposed:

1. Protocol with four premolar extractions and complete fixed appliances combined with bonded tongue spurs.
2. Nonextraction protocol with complete fixed appliances combined with bonded tongue spurs and insertion of TSADs in the maxilla and mandible for vertical control of posterior teeth.

Fig 1. Pretreatment facial and intraoral photographs.

Fig 2. Pretreatment dental casts.

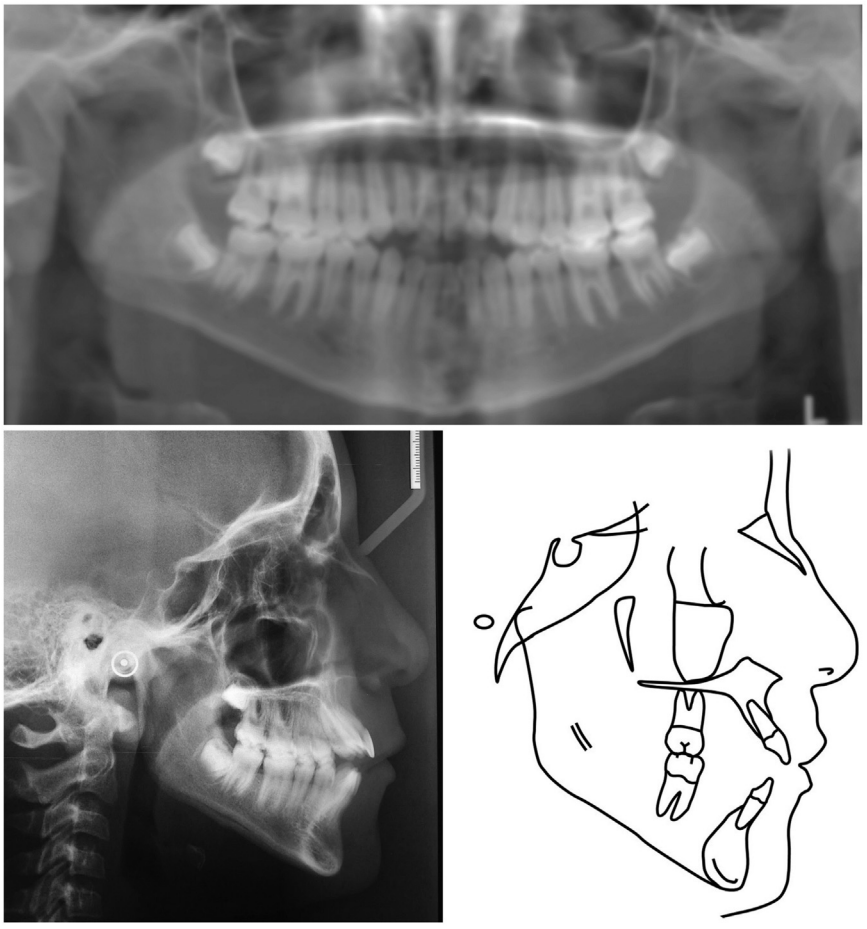

Fig 3. Pretreatment panoramic and cephalometric radiographs and tracing

Table. Cephalometric measurements

Measurements	*Norm*	*Pretreatment*	*Posttreatment*	*1-y Retention*
SNA (°)	82.0 ± 2.0	78.0	78.0	79.0
SNB (°)	80.0 ± 2.0	75.0	76.0	76.5
ANB (°)	2.0 ± 2.0	3.0	2.0	2.5
Wits (mm)	−1.0 ± 1.0	−2.5	− 1.0	−2.0
Facial angle (°)	87.8 ± 5.0	84.5	84.0	84.0
Angle of convexity (°)	0.0 ± 8.5	5.0	3.0	3.5
FMA (°)	25.0 ± 4.0	36.0	36.0	37.0
GoGn-SN (°)	32.0 ± 3.0	42.0	41.0	42.0
Y-axis (°)	59.4 ± 6.0	64.0	65.0	65.5
U1-NA (mm)	4.0 ± 1.5	7.0	8.0	7.5
U1-NA (°)	22.0 ± 5.0	33.0	29.0	28.0
L1-NB (mm)	4.0 ± 1.5	7.0	8.0	8.0
L1-NB (°)	25.0 ± 5.0	31.5	27.0	28.0
IMPA (°)	92.0 ± 5.0	92.0	86.0	87.0
Interincisal angle (°)	130.0 ± 8.0	113.0	122.0	122.0
Z-angle (°)	75.0 ± 5.0	73.0	70.5	71.0

3. Combined protocol with orthodontics and orthognathic surgery in adulthood.

TREATMENT PLAN

The nonextraction protocol using complete fixed appliances associated with bonded lingual tongue spurs for reeducation of tongue position and function and insertion of TSADs in the maxilla and mandible for vertical control of posterior teeth was the treatment chosen, on the basis of the parent's wishes, because it was the most conservative strategy.

TREATMENT PROGRESS

MBT 0.022 × 0.028-in slot preadjusted fixed appliances were bonded to the maxillary and mandibular dental arches, combined with a transpalatal arch and lingual bonded tongue spurs. In the mandibular arch, all teeth were bonded from the left first molar to the right first molar, except for the mandibular left central incisor. An open coil spring was placed to obtain space and correct the rotation of this tooth. After the space opening, the mandibular left central incisor and second molars were included.

Alignment and leveling were performed using 0.014-in, 0.016-in and 0.019 × 0.025-in nickel-titanium, heat-activated archwires. After 6 months of starting treatment, interradicular TSADs were inserted between the maxillary first and second molars on both sides for initial molar intrusion with 200 g of force per side (Fig 4). Three months later, a lingual arch was placed in the mandible associated with interradicular TSADs inserted between the first and second molar on both sides to intrude the posterior teeth with 200 g of force per side. Therefore, the patient could not receive care for a couple of months during the coronavirus disease 2019 pandemic lockdown; these mechanics generated a tendency of posterior open bite, and the palatal cusps of the maxillary second molars appeared to be dropped. Later, one of the TSADs placed in the mandible was lost after 3 months, and then it was also decided to remove the other contralateral TSAD and allow posterior seating of the occlusion (Fig 5).

After 6 months of continuous maxillary molar intrusion, the AOB was almost closed; however, as mentioned above, the palatal cusps of the maxillary second molars remained dropped, so a decision was made to insert a TSAD near the palatal midline and bond buttons on the palatal aspect of

Fig 4. Progress intraoral photographs, 6 months treatment progress.

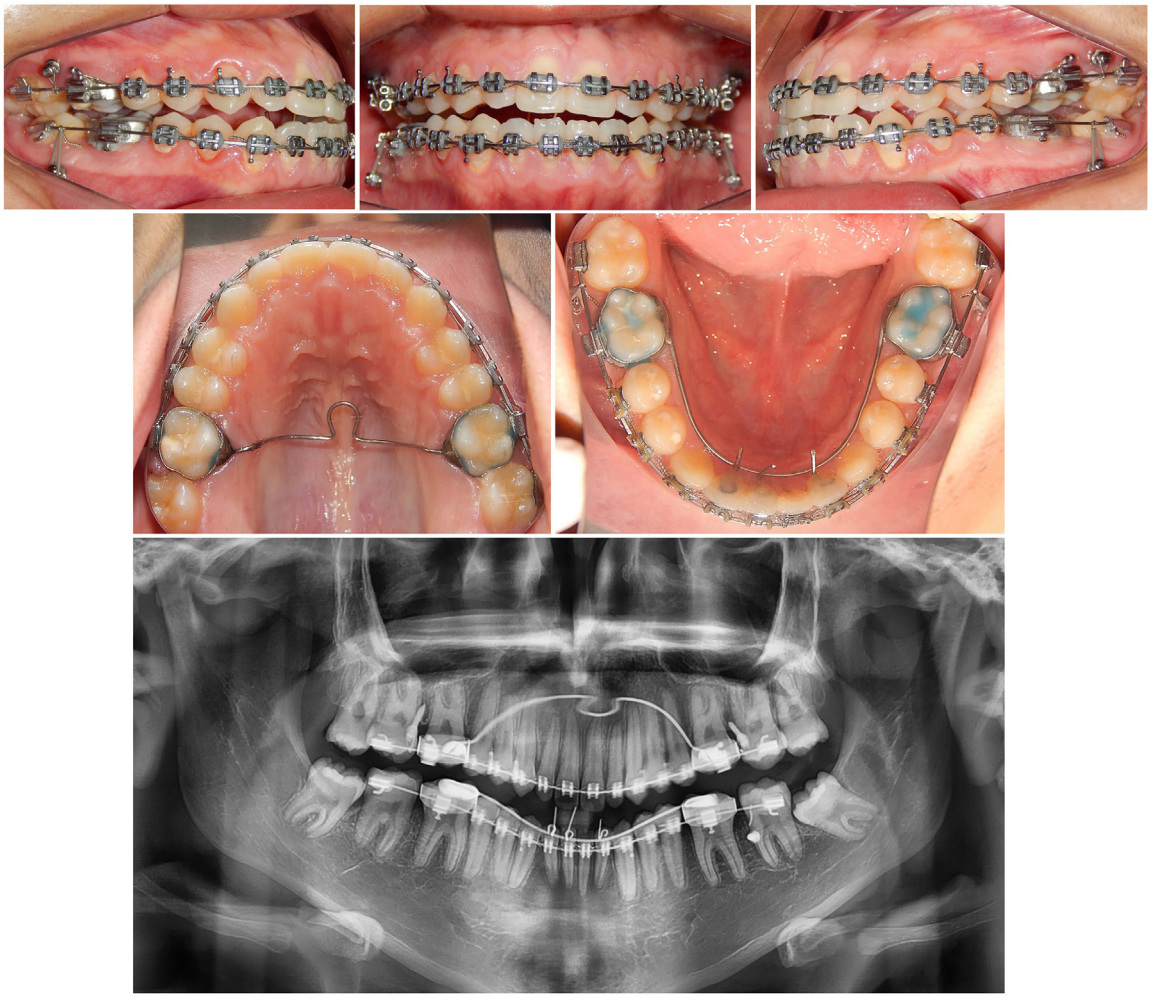

Fig 5. Progress intraoral photographs and panoramic radiograph, 12 months treatment progress.

the maxillary second molars to intrude the fallen palatal cusps with elastomeric chain. After 2 months, once the palatal cusps of the second maxillary molars were intruded, 0.019 × 0.025-in stainless steel archwires were fitted so that the torque on individual teeth was fully established, and the leveling was completed.

The interradicular TSADs in the maxilla were removed and reinserted in the infrazygomatic crest in an extraalveolar position and away from the proximal contact of the roots to continue promoting unobstructed teeth distalization. For 5 months, elastomeric chains were placed from the soldered hooks of maxillary stainless steel archwire to the TSADs in the infrazygomatic crest with 250 g of force per side to promote distalization and simultaneously serve as anchorage combined with Class III elastics to upright mandibular incisors (Fig 6). After 36 months, it was decided to remove the bonded tongue spurs once it was verified that the inadequate position and function of the tongue had been completely corrected.

TREATMENT RESULTS

After 4 years of treatment, all objectives were achieved, and the treatment results seemed stable (Figs 7 and 8). The AOB was corrected, and adequate overjet and overbite were established. The Angle Class I molar relationship was maintained, and maxillary and mandibular incisors were retroclined. In addition, the facial profile was improved, including maxillary incisor exposure when smiling. A fixed retainer was bonded from canine to canine in the mandibular arch, and a removable wraparound retainer was positioned in the maxillary arch (Figs 9-11). Treatment results remained stable after a 1-year follow-up (Figs 12-14). The overall superimposition of the pretreatment, posttreatment, and 1-year follow-up cephalograms showed skeletal growth with forward and downward displacement of the maxilla and mandible. The regional superimposition of the maxilla showed downward skeletal growth, greater extrusion of incisors, and less extrusion of molars. The regional superimposition of the mandible showed skeletal growth with greater extrusion of incisors than molars (Fig 15).

Fig 6. Progress intraoral photographs, 20 months treatment progress.

Fig 7. Progress lateral and posteroanterior cephalometric radiographs.

DISCUSSION

Although premolar extraction is a well-known treatment approach that aids AOB correction,[12] this case report described a patient who underwent a nonextraction approach with complete fixed appliances combined with TSADs inserted in the maxilla and the mandible for vertical control of posterior teeth and lingual bonded tongue spurs for tongue function and position reeducation, which allowed successful and stable closure of the AOB.

Vertical traction with TSADs in patients, who experienced excessive posterior vertical dentoalveolar growth of the maxilla, which contributed to skeletal AOB development, reduces the posterior dentoalveolar height of the maxilla, aiding in the closure of the AOB. However, simultaneous eruption or extrusion of mandibular molars should be controlled.[4] In this case report, the primary biomechanics applied to the intrusion of maxillary and mandibular molars with TSADs, combined with controlled extrusion and retroclination of incisors, promoted the AOB correction. This applied biomechanics produced skeletal and dentoalveolar changes during treatment, which was reflected in the superimposition as vertical control with some restriction of the

Fig 8. Progress intraoral photographs, 30 months treatment progress.

Fig 9. Posttreatment facial and intraoral photographs.

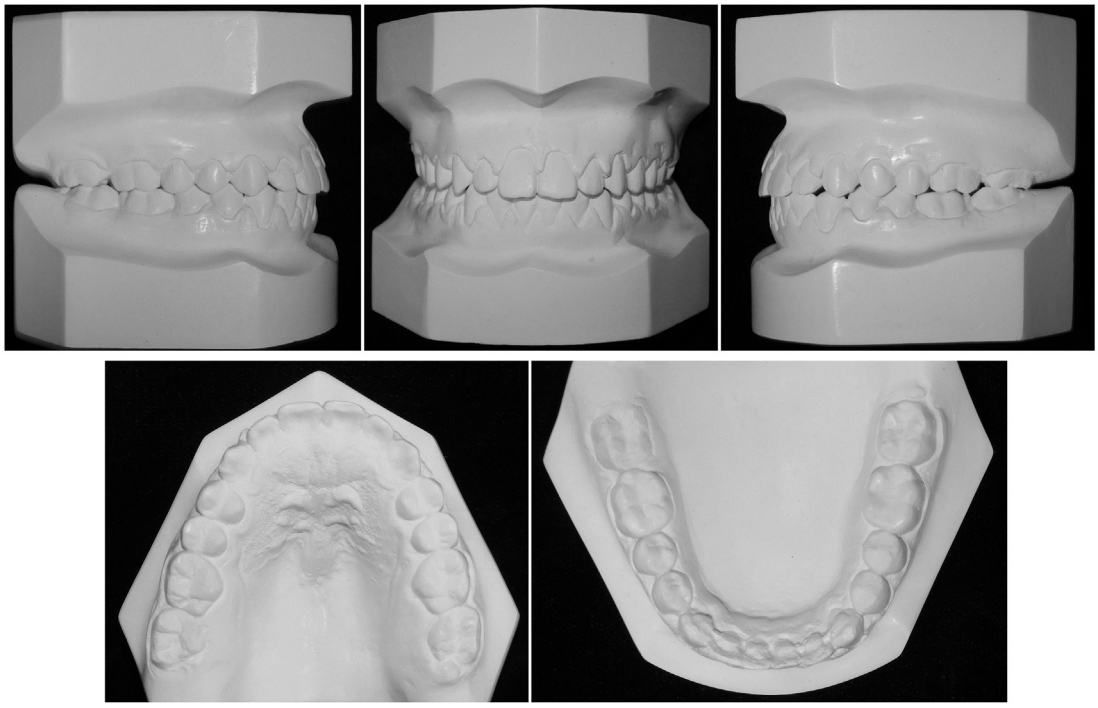

Fig 10. Posttreatment dental casts.

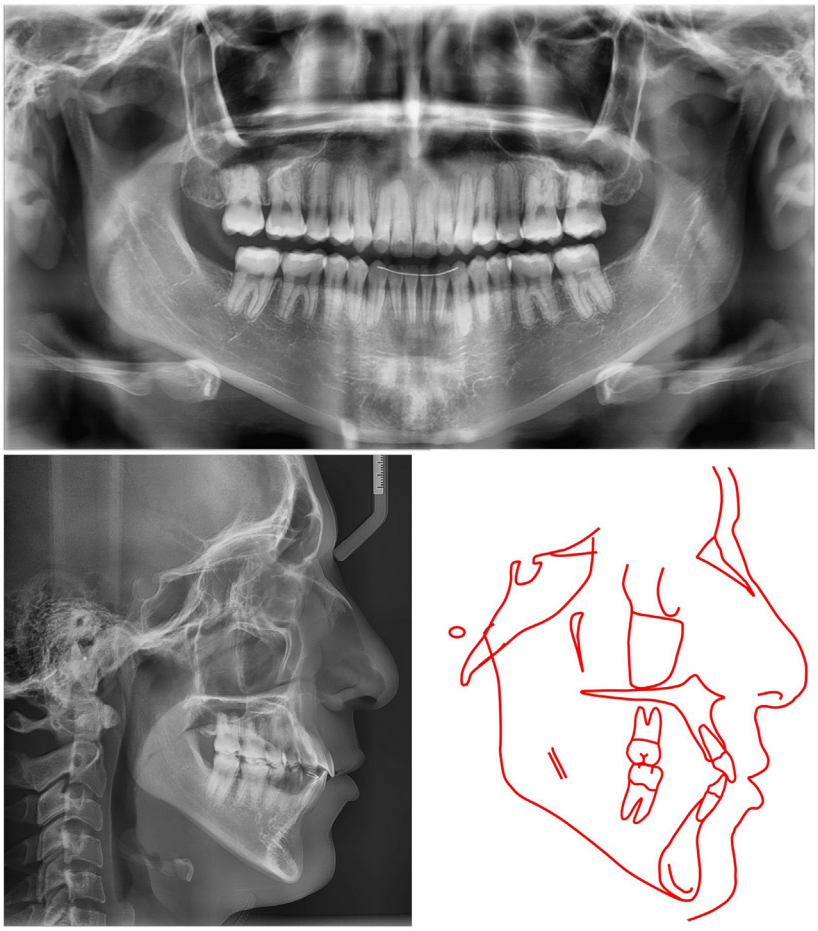

Fig 11. Posttreatment panoramic and cephalometric radiographs and tracing.

natural eruption of posterior teeth during treatment because the patient still underwent facial growth. Therefore, no absolute intrusion of posterior teeth was required to close the AOB.

The anterior posture of the tongue at rest is the main factor contributing to bite opening, proclined incisors, and vertical skeletal disproportions, as long as this parafunction is present during the patient's active growth. Other possible etiologies can cause AOB, including severe vertical growth and digital and lip-sucking habits. Using tongue spurs aids ABO correction by modifying the anterior tongue posture. Moreover, the long-term results remain stable because of the triggering of a proprioceptive reflex to prevent soreness, resulting in a new tongue posture engram.[5] A study of 3-year posttreatment stability of AOB treated by maxillary posterior teeth intrusion with TSADs, found that it is important to pay attention to the collaborative influence of the tongue and the soft tissues around the teeth to achieve good stability.[13] As described in this case report, the patient presented with an anterior tongue position at rest and consequent tongue thrust. These habits coexisted for much of the patient's facial growth over several years, exacerbating the underlying pattern of skeletal hyperdivergence. Therefore, tongue spurs were bonded to the mandibular incisors at the beginning of the treatment to reeducate the improper function and position of the tongue and enhance the stability of the AOB correction in the long term.

The combined approach of orthodontics and orthognathic surgery is a useful option for correcting skeletal AOB in patients who have achieved full growth.[14] However, because the patient described in this case report had not yet completed the growth phase, the bones would continue growing, leaving the patient prone to relapse.[15] Therefore, TSADs were inserted in the maxilla and mandible for vertical control of posterior teeth, aiding AOB

Fig 12. One-year posttreatment facial and intraoral photographs.

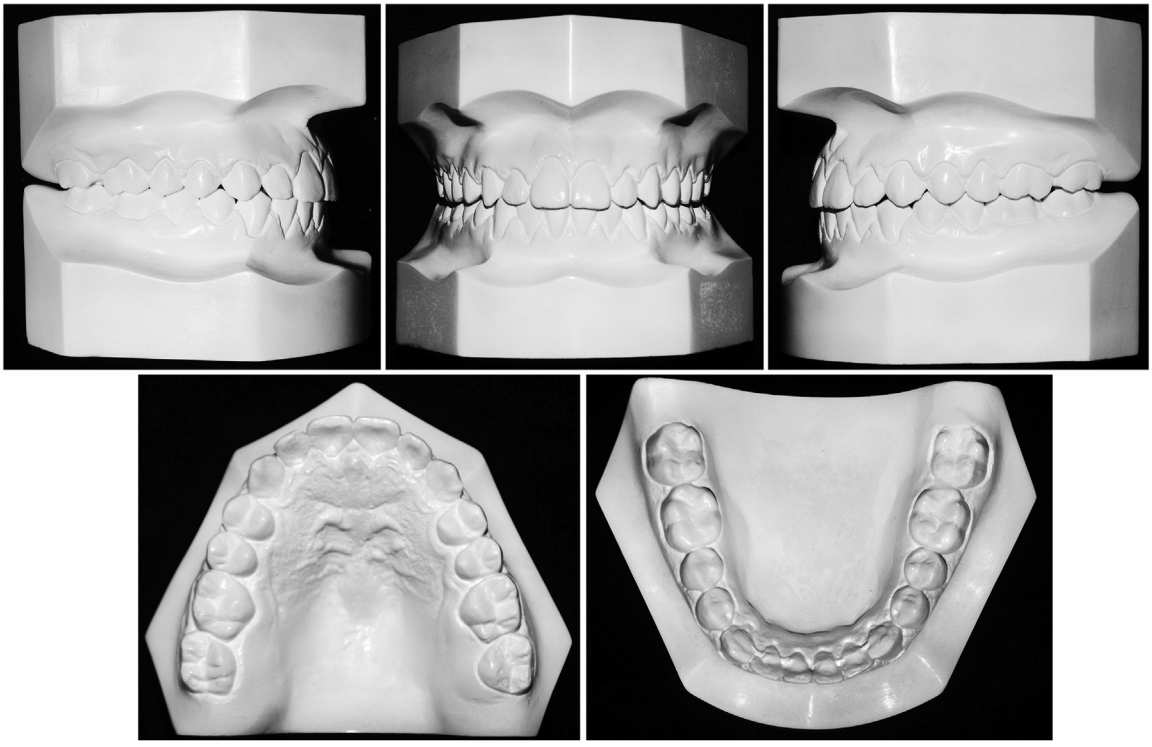

Fig 13. One-year posttreatment dental casts.

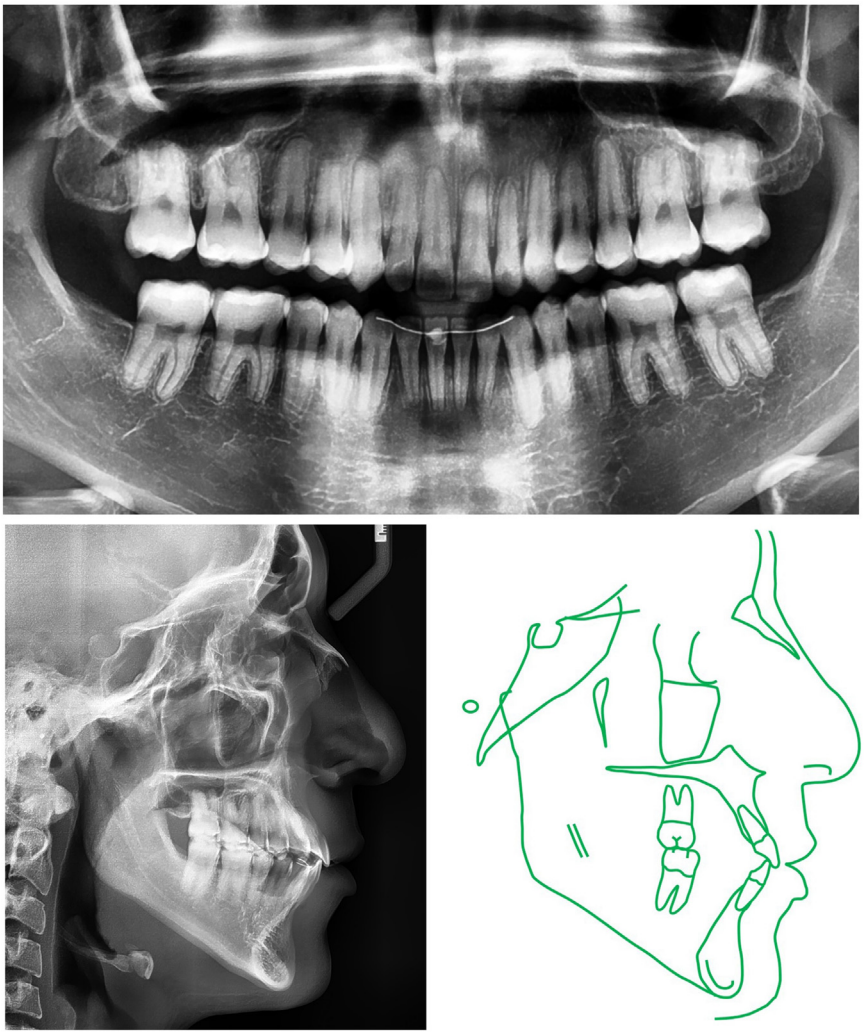

Fig 14. One-year posttreatment panoramic and cephalometric radiographs and tracing.

correction. The results of this therapy could be compared with those of orthognathic surgery, but with the advantage of being simpler and less invasive than a surgical approach.[16]

We advise that to avoid adverse effects such as posterior open bite and dropped palatal cusps of second maxillary molars, it would be better to place the TSADs in the mandible to hold the vertical position of the posterior teeth, and in the maxilla place the TSADs palatally and buccally, on both sides respectively, to perform intrusion of the posterior teeth.

Satisfactory AOB treatment helps improve oral health—related quality of life in young patients.[17] After the AOB closure, our patient felt more self-confident, and his self-esteem improved when interacting in his social environment.

CONCLUSIONS

The vertical control, with some restriction of the natural eruption of posterior teeth with TSADs, was the main reason for the good treatment results obtained in the patient, who still underwent facial growth. In addition, the bonded tongue spurs for reeducation of improper tongue function and posture increased the stability of results in the long term.

We state that informed consent was obtained by the patient.

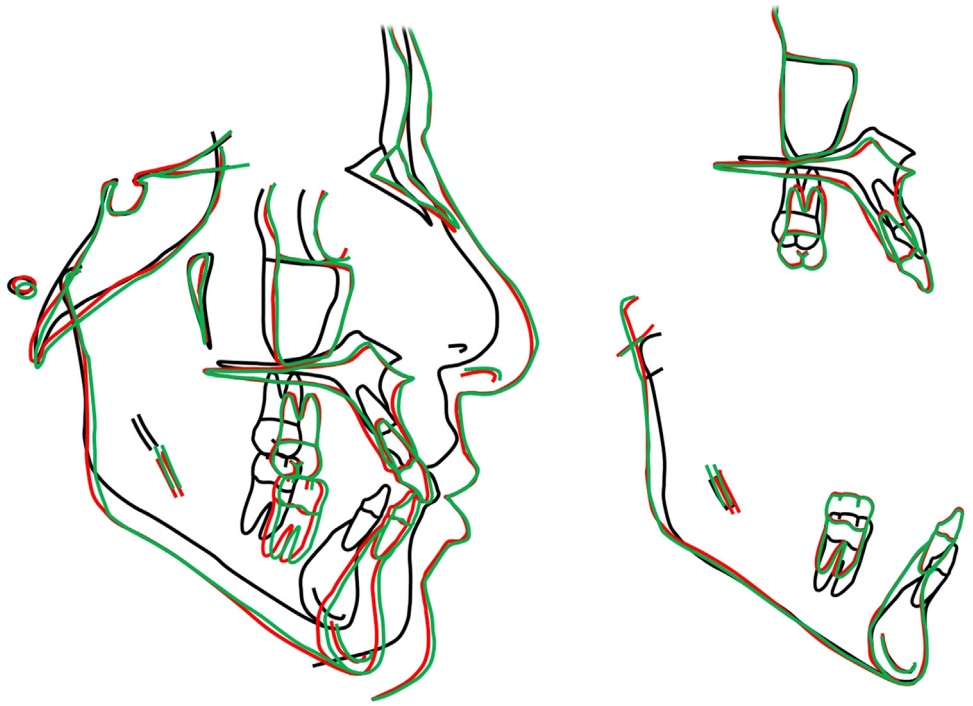

Fig 15. Cephalometric superimposition. *Black,* Pretreatment; *Red,* Posttreatment; *Green,* 1-year follow-up.

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