Maxillary and mandibular dentoalveolar expansion with an auxiliary beta-titanium arch

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Traditionally, adult patients with mild to moderate transverse discrepancies are treated with a combination of slow maxillary expansion with palatal appliances and expanded archwires. In this case report, we describe an alternative approach for anterior crowding and excessive buccal corridors in a 20-year-old man who was treated using a beta-titanium auxiliary expansion archwire. The perceived benefit of this approach was related not only to the esthetic improvement of the smile resulting from elimination of the anterior crowding and reduction of the buccal corridors, but also to the minimal disruption of the patient's speech, which was his main functional concern. (Am J Orthod Dentofacial Orthop 2017;152:543-52)

Nonsurgical orthodontic treatment options for a transverse deficiency in adult patients are limited because of the lack of growth potential. Although maxillary dentoalveolar expansion is feasible in adults,[1] it has an increased risk for fenestration and gingival recession, especially in the mandible, because of the intrinsic tendency for a reduction of intermolar distance.[2,3]

Rapid maxillary expansion in adults has been described as viable when factors such as the correct diagnosis, modification of the activation protocol, and control of dentoalveolar effects are observed.[4] The use of the Haas appliance has been recommended when remodeling or displacement of the alveolar processes is needed in the maxilla.[5-7] On the other hand, the use of a lingual arch or expanded archwires has been recognized for the dentoalveolar expansion of an adult mandible.

Other appliances frequently used for maxillary expansion in adults are the quad-helix and the auxiliary expansion arch known as the jockey arch. The jockey arch appliance is easy and inexpensive to construct, and it can be incorporated into a fixed edgewise appliance. It is made from 0.040- to 0.050-in stainless steel wire and is inserted into the headgear tubes of the maxillary first molar bands.[8] The effect produced by this appliance is dentoalveolar expansion with a certain degree of buccal crown torque, particularly in the molars, that is controlled during the treatment by incorporating buccal root torque in the main rectangular archwire.

Beta-titanium alloy has been used in different types of appliances and techniques.[9,10] Its low stiffness and resilience allow its use in different phases of the orthodontic treatment.[11,12] Considering the favorable mechanical properties of beta-titanium wires, we proposed to design an auxiliary overlay arch for dentoalveolar expansion in the maxillary and mandibular arches.

This case report highlights the orthodontic treatment of an adult patient using a beta-titanium auxiliary expansion archwire (TMA-EA) to achieve maxillary and mandibular dentoalveolar expansion.

DIAGNOSIS AND ETIOLOGY

A 20-year-old man came for orthodontic treatment with crowding and excessive buccal corridors as his chief complaints. His medical and dental histories showed good general health, good periodontal status, and lack of oral habits. The facial analysis indicated facial symmetry, a straight profile, lip competence, a good nasolabial

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Fig 1. Pretreatment facial and intraoral photographs.

angle, and balanced facial thirds. The analysis of his smile showed a consonant smile with excessive buccal corridors (Fig 1).

The dental analysis showed transverse deficiencies in both maxillary and mandibular arches.[13] The intermolar distances were 32 mm in the maxilla and 30 mm in the mandible (Fig 2; Table I).

The clinical examination and the panoramic radiograph showed no soft tissue or hard tissue abnormalities and normal periodontal conditions, except for a calcified well-defined rounded lesion in the apical area of the mandibular right molar that was diagnosed as idiopathic osteosclerosis. The cephalometric analysis showed a skeletal Class I relationship and normal dental position (Fig 3; Table II).

TREATMENT OBJECTIVES

The primary goals of the treatment proposed were as follows: (1) transverse dentoalveolar expansions of the maxilla and the mandible, (2) correction of maxillary and mandibular crowding, and (3) esthetic smile improvement with reduction of the buccal corridors.

TREATMENT ALTERNATIVES

Based on the treatment objectives, the following treatment options were suggested: (1) nonsurgical maxillary dentoalveolar expansion and uprighting of the mandibular posterior teeth with a maxillary expander (Haas or hyrax) followed by edgewise appliance and interproximal reduction for correction of

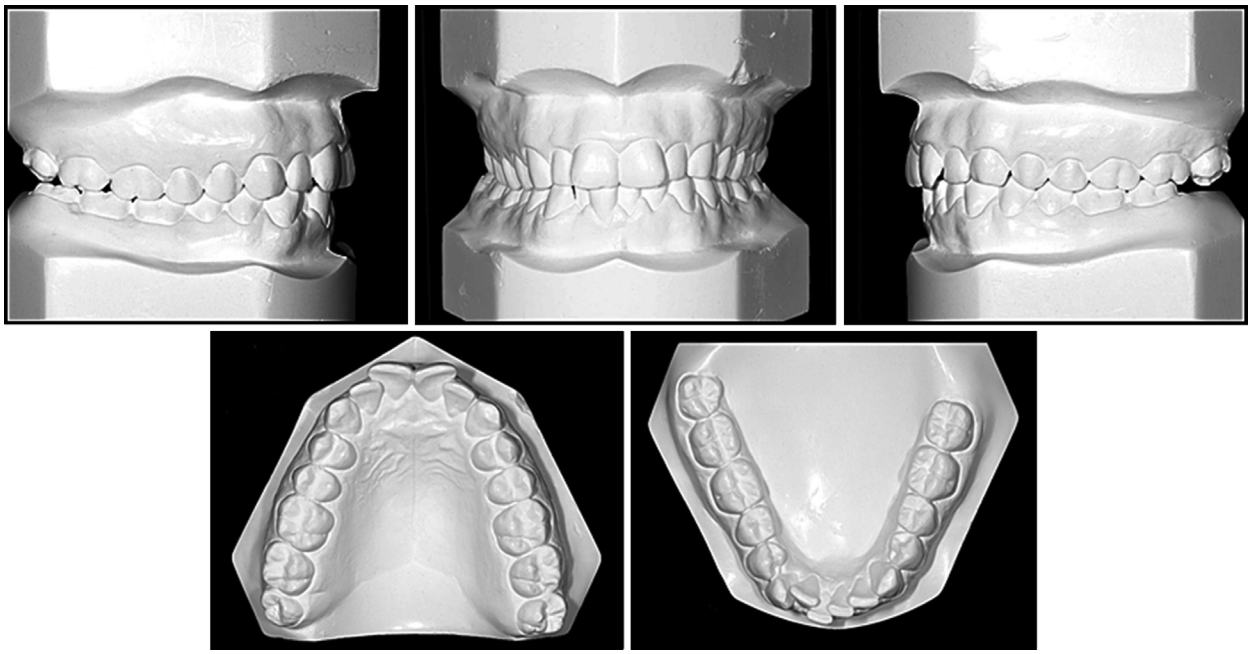

Fig 2. Pretreatment dental casts.

Table I. Transverse maxillary and mandibular measurements

	Width (mm)				
	Pretreatment (T0)	*Postexpansion (T1)*	*Posttreatment (T2)*	*1-year follow-up (T3)*	*Change, T2-T0*
U3-U3	20	24.5	24.5	25	4.5
U4-U4	22	28	27	27	5
U6-U6	32	36	36	36	4
L3-L 3	15	-	18	18	3
L4-L4	20.5	-	24	24	3.5
L6-L6	30.5	-	32.5	32.5	2.5

crowding; (2) simultaneous maxillary and mandibular dental arch expansions with edgewise appliance, and overexpanded nickel-titanium (NiTi) and stainless steel archwires; and (3) dentoalveolar maxillary and mandibular expansion with edgewise appliance and TMA-EA archwires.

The patient was concerned about possible temporary speech and swallowing problems caused by the fixed expansion appliances (Haas or hyrax); therefore, he chose the third option as the most comfortable treatment method.

TREAMENT PROGRESS

Fixed 0.022 × 0.028-in Roth prescription brackets were bonded first on the maxillary arch and 30 days later on the mandibular arch. The same archwire sequence was used on both arches: alignment was initiated using a 0.012-in NiTi archwire for 30 days and followed by a 0.018-in thermo-activated NiTi archwire (NiTi thermo). At the third appointment, a 0.016 × 0.022-in NiTi thermo archwire plus the TMA-EA were used to start the dentoalveolar expansion.

The TMA-EA was made using a straight 0.032-in beta-titanium wire with tear-form hooks on both ends to facilitate its engagement in the 0.016 × 0.022-in NiTi thermo archwire (Fig 4). The TMA-EA was maintained as a straight segment, thus not contoured in an arch form, to induce buccal traction of the NiTi thermo archwire and consequently the dentoalveolar process. The length of the TMA-EA was calculated by measuring the perimeter between each mesial entrance of the molar tubes. The hooks of the TMA-EA were engaged with the main archwire at the interproximal area between the second premolars and the first molars. Additionally, 3

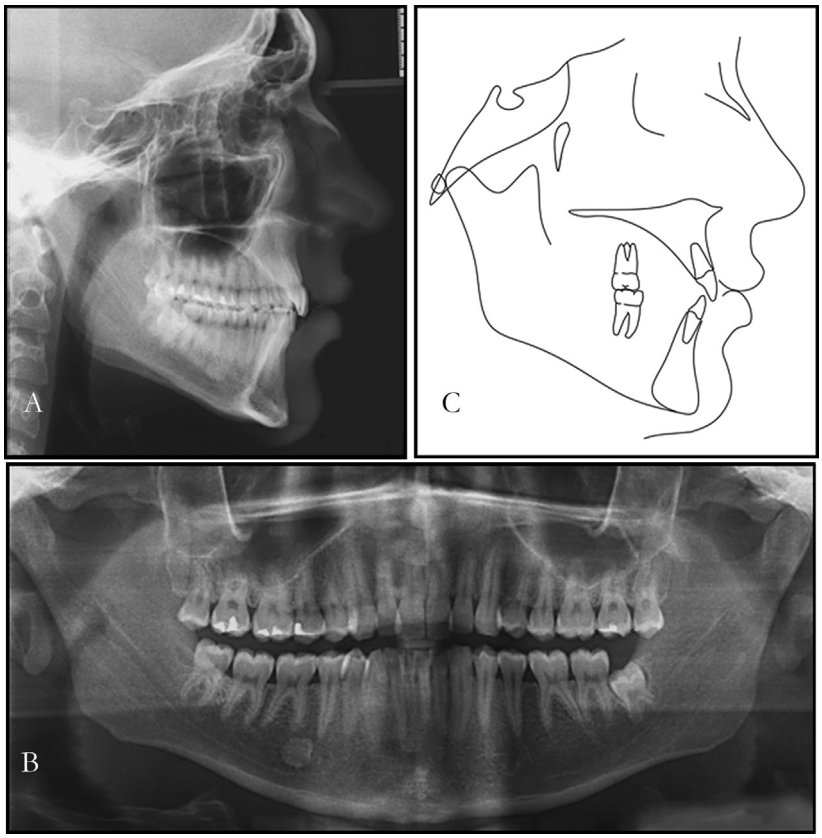

Fig 3. **A,** Pretreatment cephalogram; **B,** pretreatment panoramic radiograph; **C,** initial cephalometric tracing.

Table II. Cephalometric analysis

Variable	*Norm*	*Pretreatment*	*Posttreatment*
ANB (°)	2 ± 1.9	0.5	1.5
SNA (°)	81.5 ± 3.2	77	76.5
SNB (°)	79.5 ± 2.9	76.5	75.0
IMPA (°)	87 ± 5.4	87	87.0
U1 to NA (°)	23.2 ± 5.5	22	30
U1 to NA (mm)	5.6 ± 1.9	4.5	2.7
L1 to NB (°)	26 ± 4.2	22.3	20.6
L1 to NB (mm)	5.2 ± 1.6	2.0	3.0

stainless steel ligature ties (0.008 in) were placed at the central incisor and premolar areas to improve the stability of the TMA-EA.[14] During each appointment, the ligature wires were cut, and the TMA-EA was removed and straightened.

The TMA-EA was used for 60 days until an overcorrection of the transverse relationship was achieved. In sequence, 0.019 × 0.025-in NiTi archwires were placed for 30 days, followed by 0.019 × 0.025-in stainless steel archwires. Finally, 0.019 × 0.025-in beta-titanium archwires were used for finishing; intercuspidation was achieved with bilateral intermaxillary elastics (1/4 in, 4 oz) adapted in a box configuration on both dental arches (Fig 5). The fixed orthodontic appliance was removed after 18 months, and vacuum-formed retainers were used full time after debonding (Fig 6).

TREATMENT RESULTS

The bimaxillary transverse deficiency was corrected, and it also allowed for the correction of crowding and the reduction of the wide buccal corridors. The smile improvement was obtained with no disturbance of speech or swallowing, as requested by the patient. The vertical and horizontal dental relationships were maintained satisfactorily.

Dental casts were obtained and analyzed at pretreatment, postexpansion, and the end of treatment (Table I). The postexpansion measurements were similar to the dentoalveolar expansion at the end of treatment. The values represent the distance from the cervical margin of a tooth (the point of greatest convexity) to its contralateral tooth in the same arch.[8,15]

Fig 4. Treatment progress photos showing the dentoalveolar expansions achieved in the maxilla and the mandible.

Fig 5. Posttreatment facial and intraoral photographs.

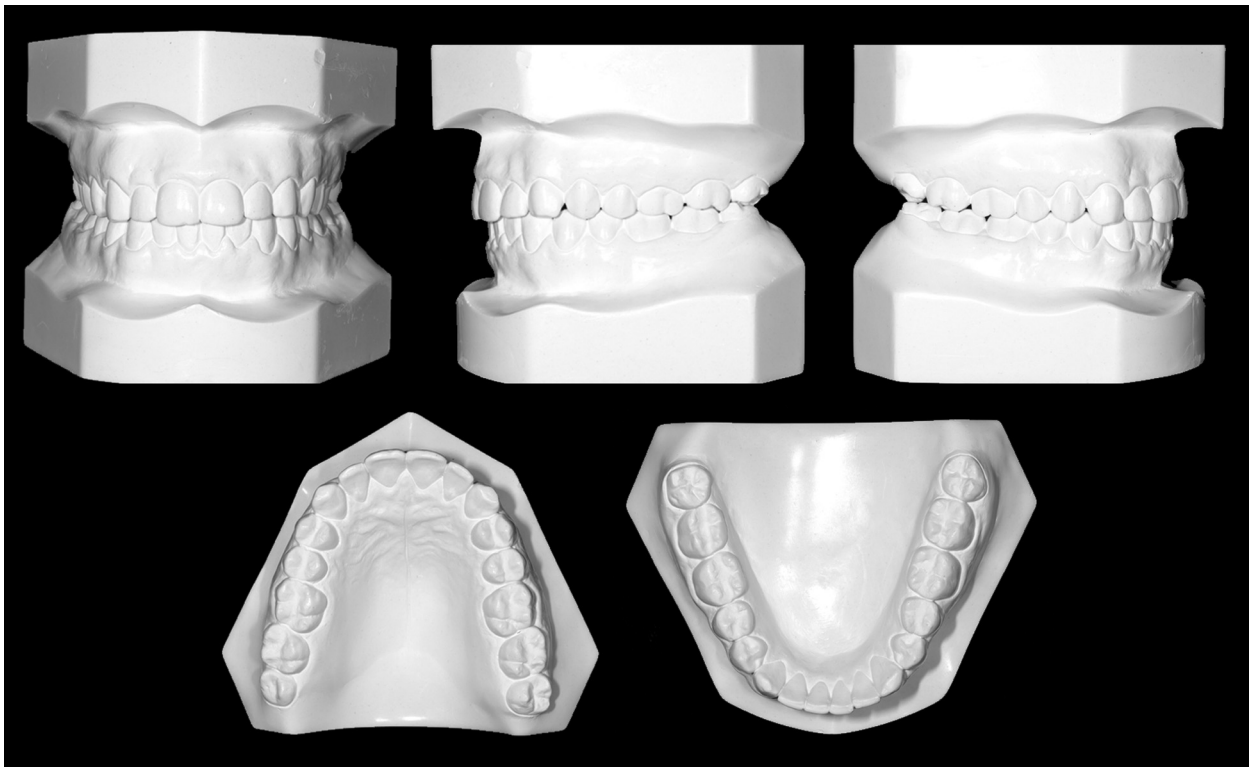

Fig 6. Posttreatment dental casts.

In 60 days, the TMA-EA increased the widths of both dental arches. The maxillary intercanine distance increased by 4.5 mm, the interpremolar distance by 6 mm, and the intermolar distance by 4 mm. At the end of treatment, only the interpremolar distance relapsed by 1 mm; the mandibular intercanine width increase was 3 mm, the interpremolar increase was 3.5 mm, and the intermolar increase was 2.5 mm (Table I).

The cephalometric analysis and superimposition did not show changes in the skeletal relationships and proclinations of the mandibular incisors (Figs 7 and 8; Table II). The panoramic film showed no significant root resorption and no changes in the idiopathic osteosclerosis. The increase in the transverse dimension was stable at the 1-year follow-up (Fig 9; Table I).

DISCUSSION

The patient's comfort is an important factor during the selection of the orthodontic treatment modality, especially in adults. Successful maxillary expansion with hyrax and Haas appliances has been reported in adult patients[6,7]; however, the palatal area is covered by these appliances, and this can create difficulties with oral hygiene, speech, and swallowing.

Traditionally, the jockey arch appliance has been used as a more comfortable option for dentoalveolar expansion in adults. The main advantage of the TMA-EA used for this patient was its versatility; it can be used in the maxilla or the mandible because it does not need headgear tubes on the first molar bands. Additionally, the diameter of the TMA-EA is reduced, and the beta-titanium alloy is more resilient in comparison with the jockey arch appliance (made of stainless steel), making the former more comfortable for the patient.

The NiTi archwires (0.012 and 0.018 in) used for 60 days before the TMA-EA could have produced some changes in arch dimensions, but the observed dentoalveolar expansions were obtained by the simultaneous use of the TMA-EA and a 0.016 × 0.022-in NiTi thermo archwire. The expansion of the mandibular arch was comparable with the maxillary expansion during a similar period of time.

Appointments were scheduled monthly to monitor the amounts of expansion and dental tipping. A rectangular archwire (0.016 × 0.022-in NiTi thermo) was used concomitantly with the TMA-EA for tipping control.

Since the transpalatal width is on average between 36 and 39 mm, a suitable dentoalveolar expansion with the

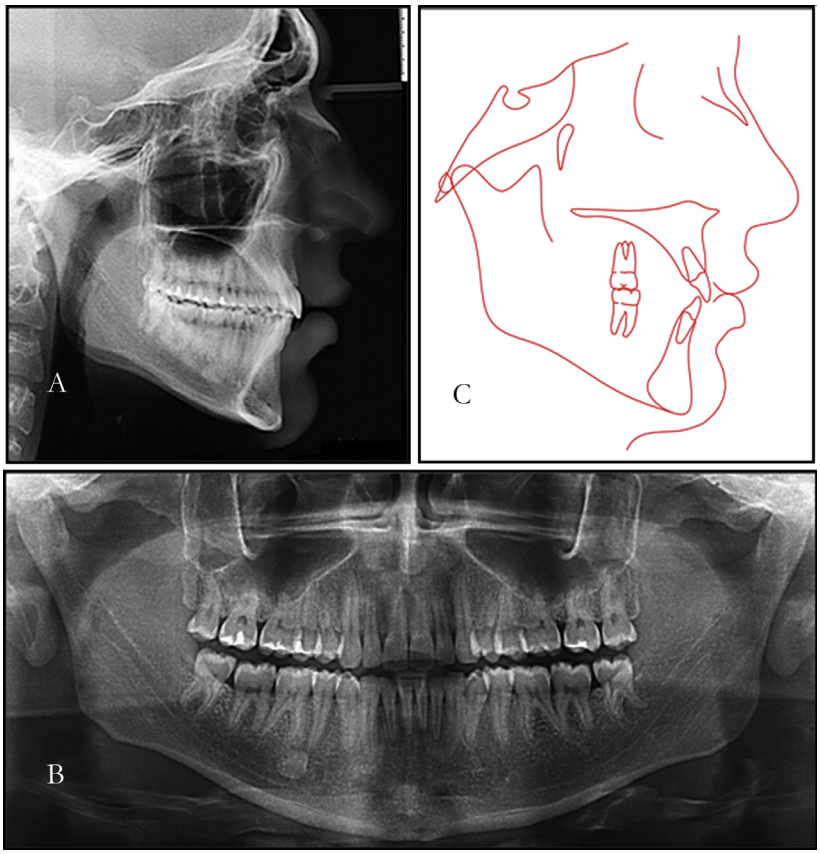

Fig 7. Posttreatment radiographs: **A,** lateral cephalogram; **B,** panoramic radiograph; **C,** final cephalometric tracing.

TMA-EA should obtain an intermolar distance between 31 and 36 mm.[13] In patients with a transpalatal width less than 31 mm, orthopedic or surgically assisted expansion is indicated.[16]

The maxillary dentoalveolar expansion achieved in this patient was similar to other reports using appliances with variable activation protocols.[15] The transverse increment of 4 mm at the maxillary first molars is the average expansion observed in previous reports of adult patients.[5,6,17,18] Moreover, the TMA-EA produced an expansion with a regular contour of the dental arch, perhaps as a result of a better distribution of the expansion force throughout the main archwire, including the premolar region; this eliminated the need for further alignment in the posterior segments as is usually necessary when hyrax or Haas appliances are used (Fig 10, *A* and *B*).

The 2.5-mm transverse increase in the mandibular arch with the TMA-EA may be considered too small to justify the use of an auxiliary expansion archwire; however, this amount of expansion is considered safe to maintain a healthy periodontal status.[19] The long-term stability of this dimensional change in the mandible is questionable, especially in adults,[20] unless a retention protocol is maintained for a long time.[21] The follow-up measurements showed that in our patient the mandibular transverse gain continued to be stable at 12 months posttreatment.

Alternatives for dentoalveolar expansion considered were a fixed lingual expansion arch and a removable Schwartz appliance. However, these appliances had greater potential to interfere with speech and swallowing than the TMA-EA.

Since our patient was a 20-year-old adult, we expected to achieve maxillary and mandibular transverse increases as a result of dentoalveolar expansion only. Therefore, it was necessary to use light forces for a longer time to promote physiologic tooth movement. Although the literature does not describe the occurrence of recessions from dentoalveolar expansions, it is extremely important to assess the periodontal health status, including the amount of attached gingiva, before and throughout the orthodontic treatment.[17]

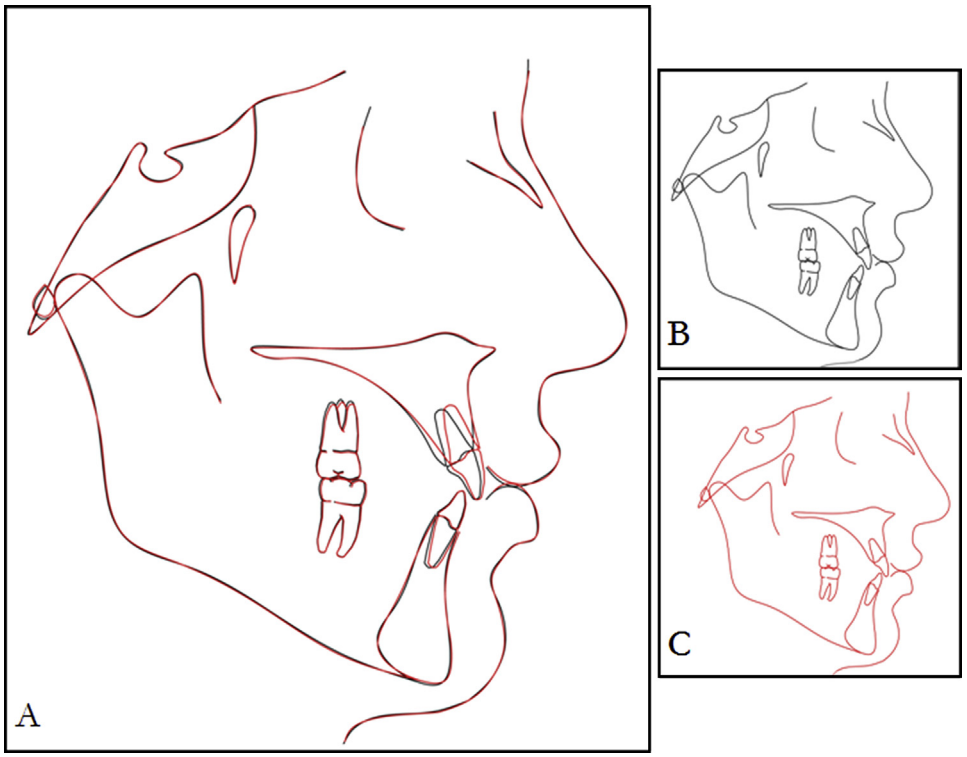

Fig 8. Superimposition of pretreatment (*black*) and posttreatment (*red*) cephalometric tracings.

Fig 9. Final photographs (1 year after treatment) demonstrating the stability of the transverse correction.

The beta-titanium alloy used in the TMA-EA, compared with the stainless steel used in the jockey arch appliance, is more resilient and produces a lighter force, reducing the risk of periodontal damage. A posttreatment cone-beam computed tomography image showed intact buccal cortical plates in the maxillary and mandibular alveolar processes (Fig 10, *C*), confirming the physiologic nature of the force

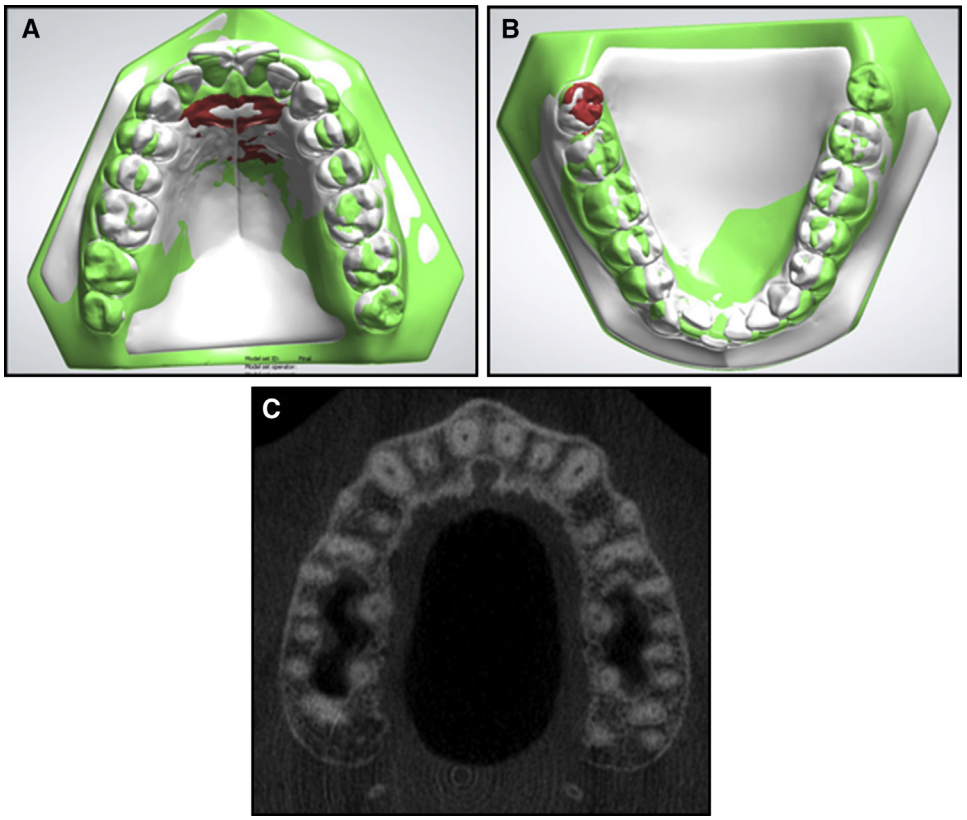

Fig 10. Superimposition of pretreatment (*white*) and posttreatment (*green*) models shows the transverse and sagittal changes produced during treatment: **A,** in the maxilla and **B,** in the mandible. The reference for superimposition (*red*) in the maxilla was the palatal rugae, and the right third molar was used in the mandible. **C,** The integrity of the buccal and lingual cortical plates of the maxillary alveolar process can be observed in this axial view of a cone-beam computed tomography image taken 1 year after treatment.

used during the expansion. As part of our expansion protocol in adults, we recommend 1 month of use of the TMA-EA for each decade of life. At each monthly appointment, the TMA-EA must be removed, cleaned, and straightened to maintain a constant expansion force.

The stability of nonsurgical palatal expansion in adults with the Haas expander followed by edgewise appliances has been described as stable.[17] Using the TMA-EA, we achieved correction of the maxillary and mandibular transverse constrictions by producing similar dentoalveolar expansions. Because the transverse correction was stable 1 year after treatment, which is the time when most relapse occurs, it is expected that these results will continue to be stable in the long term. Our retention protocol included the use of vacuum-formed retainers full time for 1 month followed by nighttime use only for 2 years. The normal reduction of arch dimensions due to aging should also be considered when assessing the long-term changes in the maxillary and mandibular widths.[22]

Although the clinical success for this patient has been consistent in our practice, the efficacy, safety, and stability of this newly proposed approach for the correction of maxillary and mandibular arch constriction need to be subjected to rigorous testing.

CONCLUSIONS

The use of an auxiliary expansion arch made from beta-titanium alloy is an alternative for the correction of bimaxillary arch constriction in adult patients when a nonsurgical treatment is indicated. The auxiliary arch was an efficient method to promote dentoalveolar maxillary and mandibular expansion in an adult who had concerns about oral hygiene, speech, and swallowing caused by palatal expanders.

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