Long-term stability of Class III malocclusion treatment with maxillary transversal deficiency, short roots, gingival recession, and alveolar bone loss

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Orthodontic treatment in patients with Class III malocclusion can be complex, particularly when associated with other problems. This case report describes the retreatment of a 32-year-old woman with Class III malocclusion, transverse maxillary deficiency, short roots, and gingival recession. The patient was retreated with fixed appliances combined with surgically assisted rapid palatal expansion. The results of the debonding were excellent esthetics, good intercuspation, gingival health with adequate overjet, and overbite. After 22 months of treatment, the proposed goals (dental Class III relationship correction and transverse maxillary deficiency) were obtained. After the 5-year follow-up, the sagittal and transverse relationship remained stable. (Am J Orthod Dentofacial Orthop Clin Companion 2022;XX:XX-XX)

The literature suggests that Class III malocclusion presents low prevalence and high impact on quality of life and orthodontic treatment often subjected to relapse.[1] Dissatisfaction with the tooth appearance and facial profile obtained with the previous treatment, often performed during adolescence,[2] and relapse severity[3] play an important role in deciding whether to retreat patients.

In the retreatment of a skeletal Class III malocclusion, the orthodontist and the patient must decide on orthognathic surgery or camouflage treatment. Although the risks and costs of camouflage treatment are smaller, it requires more time and collaboration of the patient,[4] who must understand that considerable skeletal improvements may not be obtained.

Class III malocclusion treatment in skeletally mature patients may be more complex if associated with transverse deficiencies, shortened roots of teeth, and periodontal problems.

In adult patients, segmental Le Fort I osteotomy or surgically assisted rapid palatal expansion (SARPE) are usually chosen to correct transverse deficiencies[5] >7 mm.[6] General indications for this technique are unilateral or bilateral transverse maxillary hypoplasia, symmetrical or asymmetrical maxillary transverse deficit, narrow dentoalveolar base with crowding and ossified median palatal suture.

Additional apical root resorption occurring during retreatment is worrying. Thus, given the hypothesis that shorter roots may have a more coronally placed center of resistance that may promote tooth tipping,[7] the patient's treatment plan for orthodontic mechanics must focus on light forces.

Periodontal problems are also an issue to consider in the treatment planning because the level of applied force must be reduced to account for the potential impact of vertical bone loss on the response of a tooth to biomechanical force

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This case report describes orthodontic retreatment associated with SARPE to correct a skeletal Class III malocclusion with transverse maxillary deficiency, short roots, and gingival recession.

DIAGNOSIS

A 32.7-year-old woman reported for orthodontic consultation with a primary complaint of crossbite. Her dental history showed previous orthodontic treatment. In her facial analysis, she appeared to be symmetrical with a slight deficiency in the middle third of the face, presented good chin prominence and satisfactory lip support, and displayed no maxillary gingiva when smiling (Fig 1). Intraorally, Class III malocclusion with edge-to-edge overjet, posterior crossbite, maxillary dental midline coincident with skeletal midline, 2.0 mm to the mandibular right midline shifting, and gingival recession were verified. In dental casts analysis, the maxillary arch presented a 1.0 mm arch length deficiency, and the mandibular arch presented a 6.0 mm positive discrepancy. Bolton analysis showed a 2.0 mm mandibular anterior excess (Fig 2).

Periapical radiographs revealed maxillary premolars and maxillary and mandibular incisors with shortened roots and general horizontal alveolar bone loss (Fig 3).

Cephalometric analysis showed a skeletal Class III pattern with mandibular prognathism, proclined maxillary incisors, and mandibular incisors within the normal reference range of inclination, resulting in a slightly increased slightly interincisal angle (Fig 3; Table).

Summarizing the patient's list of problems, she presented Angle Class III malocclusion, mandibular diastemas, posterior crossbite, shortened roots, maxillary left lateral incisor with negative overjet, gingival recession, and general horizontal alveolar bone loss.

TREATMENT OBJECTIVES

The orthodontic treatment aimed to compensate for the mandibular prognathism and obtain a Class I relationship of posterior teeth. The anterior edge-to-edge relationship would be corrected using spaces provided by the dental diastemas to retract mandibular incisors.

To correct the posterior crossbite, maintain maxillary incisor inclinations, and minimize the progression of root

Fig 1. Pretreatment facial and intraoral photographs.

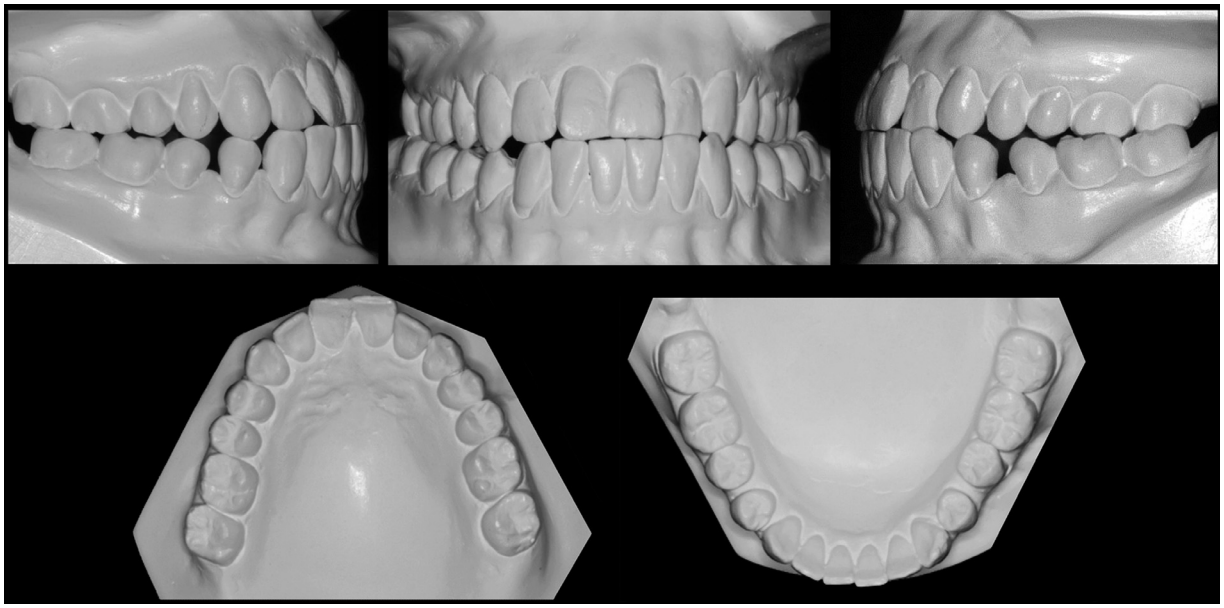

Fig 2. Pretreatment dental casts.

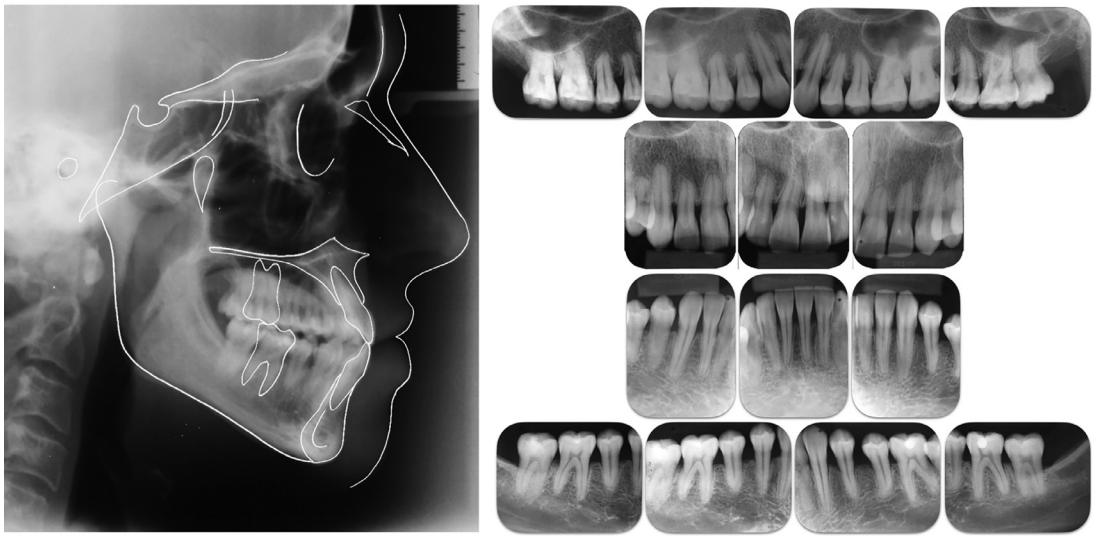

Fig 3. Pretreatment lateral cephalogram and periapical radiographs.

shortening, gingival recession, and alveolar bone level loss, a SARPE was indicated.

TREATMENT ALTERNATIVES

First, orthognathic surgery was suggested to set back the mandible, but it would be inappropriate care and would secondarily potentially lead to an airway obstruction problem. The patient also refused this option for financial reasons and asked for minimal surgical procedures. The patient did accept the correction of her transverse maxillary deficiency with SARPE.

The second option was an orthodontic camouflage retreatment approach by closing the diastemas to obtain Class I molar relationships and achieve optimal overjet using elastics. However, stability could be an issue in this treatment alternative.

TREATMENT PROGRESS

After installing the Hyrax expander, the SARPE procedure was performed in a hospital environment by the surgeon. Figure 4 illustrates maxillary expansion as the opening of the expander screw was stabilized. The Hyrax expander was maintained for 6 months for sutural reorganization. During this period, as expected, migration of the maxillary central incisors toward the dental midline occurred (Fig 5). The three phases of palatal expansion on

Table 1. Cephalometric measurements

Measurements	Norm	Pretreatment	Posttreatment	Change
SNA (°)	82.0	82.5	82.0	−0.5
SNB (°)	80.0	83.0	82.0	−1.0
ANB (°)	2.0	−0.5	0	0.5
SN-GoGn (°)	32.0	32.0	32.0	0
1-NA (°)	22.0	30.5	25.0	−5.5
1-NA (mm)	4.0	7.0	7.0	0
1-NB (°)	25.0	25.0	15.5	−4.5
1-NB (mm)	4.0	5.5	4.0	−1.5
U1/L1 (°)	131.0	124.5	140.0	15.5
Pog-NB (mm)	–	−1.0	−0.5	0.5
LS-Ls (mm)	0	−4.5	−3.0	1.5
LS-Li (mm)	0	0.5	−1.0	−1.5
FMA (°)	25.0	26.5	24.5	−2.0
FMIA (°)	65.0	65.5	75.5	10.0
IMPA (°)	90.0	88.0	80.0	−8.0
Z-angle (°)	75.0	74.5	82.5	8.0

occlusal radiographs are displayed in Figure 6 (before surgery, after palatal expansion, and 6 months after palatal expansion). Subsequently, the surgeon discharged the patient; all teeth were bonded with 0.022 × 0.028-in standard edgewise-metallic brackets and aligned with sequential nickel-titanium (NiTi) wires. Class III elastics (5/16-in, 3.5 oz) were used for 7 months, 24 h/d. The archwires progressed from 0.016-in NiTi, 0.016 × 0.022-in stainless steel (SS), and 0.018 × 0.025-in SS to align and level all teeth. The spaces between the mandibular teeth (first premolars and first molars) were closed with a 0.019 × 0.025-in SS archwire. The application of light orthodontic forces was prioritized throughout the treatment. For the initial 0.016-in NiTi arch, engaged to the

Fig 4. Progress after SARPE.

Fig 5. Progress after 6 months of SARPE.

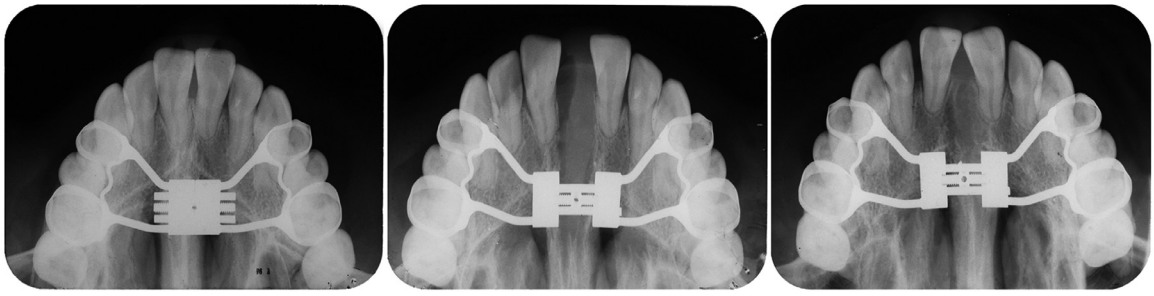

Fig 6. Occlusal radiographs of the 3 phases of palatal expansion (before surgery, after palatal expansion, and 6 months after palatal expansion).

archwire, such as the maxillary incisors, were only partially attached, preventing the arch from fully engaging in the slot. In addition, when excessive tooth mobility was observed, the application of higher forces was avoided, and excessive occlusal contacts were eliminated through adjustment by grinding when indicated.

After the desired results were achieved, the appliances were removed, a maxillary wraparound removable retainer was placed, a mandibular lingual wire retainer was bonded from canine to canine, and fixed retainers were bonded between mandibular first premolars and first molars to avoid the space opening.

TREATMENT RESULTS

After 22 months of treatment, the proposed goals (dental Class III relationship correction and transverse maxillary deficiency) were obtained. Orthodontic mechanics with light forces to avoid the progression of root shortening and gingival recessions were used during the entire treatment.

The posttreatment records showed improvement in the lower third of the facial profile. The lower lip was retracted with an improvement in the labiomental fold. Teeth were aligned and leveled in both arches. The posterior crossbite, edge-to-edge overbite, and overjet were corrected. The occlusion was improved to achieve posterior teeth Class I relationships on both sides (Figs 7 and 8).

The clinical and radiographic results show the progression of gingival recession and root shortening (Fig 9).

The transverse dimension changed slightly after treatment. In the maxillary arch, the intercanine width was expanded from 33.5 to 34.5 mm, whereas the intermolar width was slightly changed from 41.5 mm to 45.0 mm. In the mandibular arch, the intercanine width remained at 26.5 mm, whereas the intermolar width was constricted from 42.0 to 41.5 mm (Fig 10).

The posttreatment periapical radiograph showed no significant root resorption or other pathologic findings. Clinically, dental mobility was within the normal range.

The cephalometric analysis indicated that the SNB angle was reduced by 1°, contributing to an increased ANB angle and the Wits appraisal value. Vertically, the mandibular plane angle (FMA) was slightly increased by 2°. The

Fig 7. Posttreatment facial and intraoral photographs.

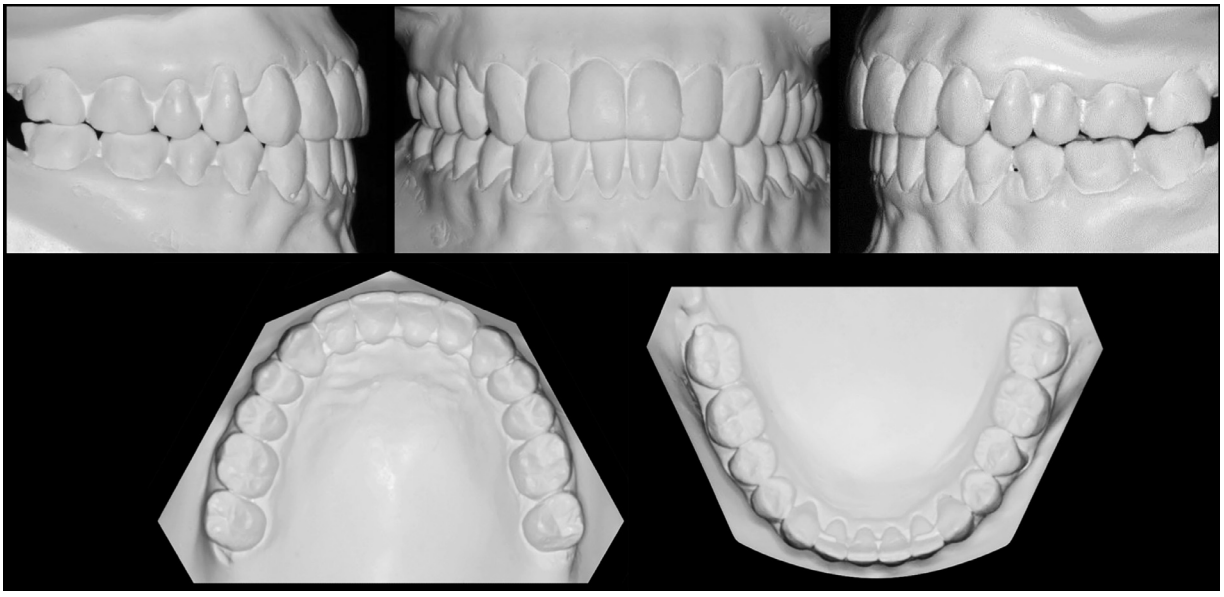

Fig 8. Posttreatment dental casts.

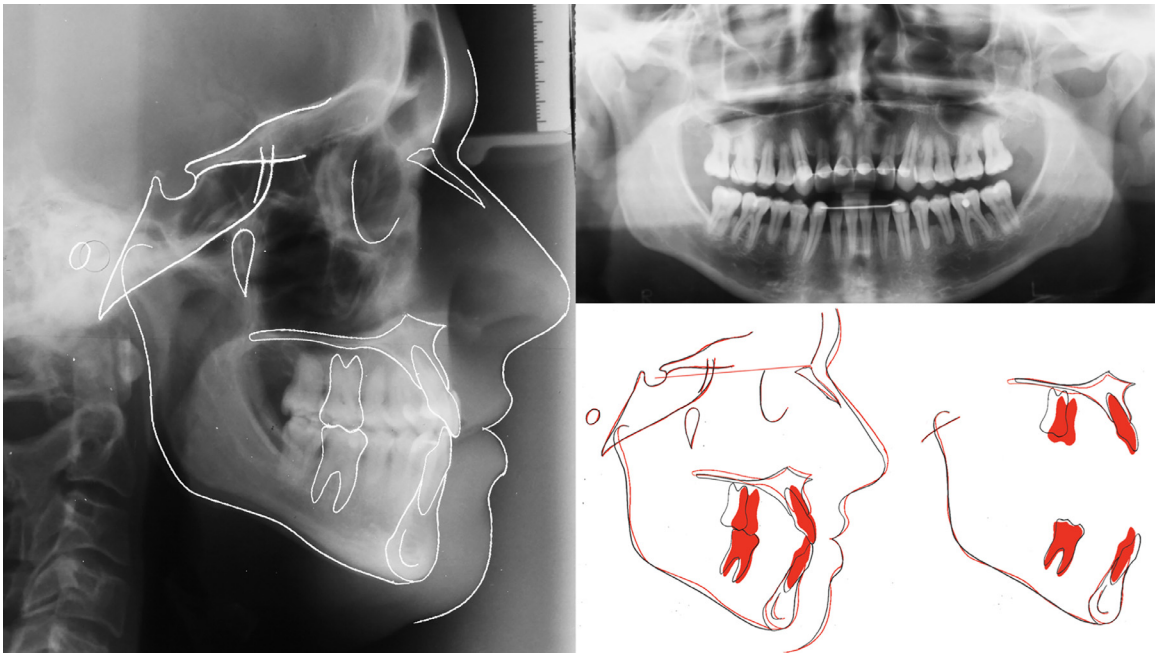

Fig 9. Posttreatment lateral cephalogram, panoramic radiograph, and superimposition. *Black*, pretreatment; *red*, posttreatment.

maxillary and mandibular incisors were retracted. In the superimposition, there were mandibular incisors uprighting with slight extrusion and a translational retraction, resulting in a 1.5 mm retraction of the lower lip in relation to the S line. Maxillary incisors were also uprighted, reflecting favorably in the upper lip (Fig 9: Table).

After 5 years of retention, the gingival recession and occlusion were stable. Overjet, overbite, and posterior teeth relationships remained unchanged (Fig 11). The comparative periapical radiographs (initial, final, and 5-year posttreatment) showed images compatible with the condition of normality (Fig 12).

DISCUSSION

In this case report, many factors intensified the complexity of orthodontic treatment: the combination of Class III malocclusion and an atresic palate, in an adult patient with shortened roots, gingival recession, and alveolar bone loss. Moreover, in retreatment, outcome expectations and treatment duration are also an issue to be considered.

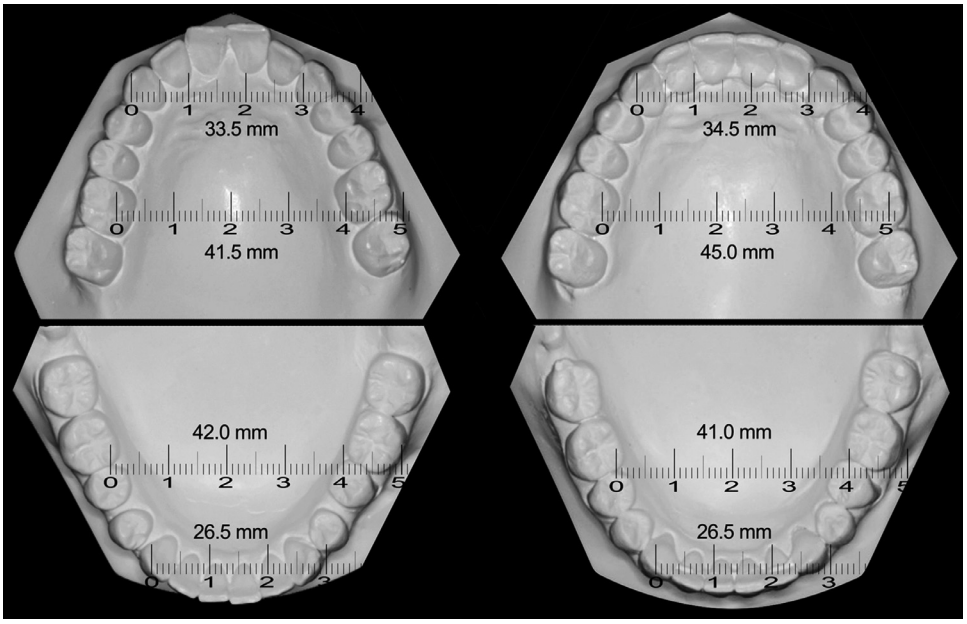

Fig 10. Comparison of intercanine and intermolar width changes between initial and final dental casts.

Fig 11. 5-year follow-up facial and intraoral photographs.

These results are in accordance with the literature, which affirms that in patients with mild-to-moderate skeletal Class III malocclusion, surgical and orthodontic camouflage approaches can have a successful result.

Although rapid maxillary expansion is a well-established and widely successful procedure, there are no definitive guidelines to select an age-appropriate procedure for treating maxillary transverse deficiency.[8] In mature patients like this one, SARPE was chosen[9] Miniscrew-assisted rapid palatal expansion anchored by orthodontic miniscrews positioned on the palatal bone introduced in 2010,[10] could also be applied in this patient, but the results would probably not be as predictable, leading to undesirable tooth movements and aggravating the bone loss, and also considering that the net expansion at the molar area was 4 mm even with SARPE.

Posttreatment skeletal changes in SARPE are modest (3-4 mm) but stable[11] in this case report. Relapse in the dental expansion was almost totally because of lingual movement of the posterior teeth.

There were no significant relapse signs in the presented patient 5 years after the end of orthodontic treatment, which was a success. The minor spacing in the maxillary arch is likely related to the retention method used (Fig 12). In the same direction, Magnusson et al[12] reported stability of treatment with SARPE in combination with fixed appliances, on average, after 6 years posttreatment.

To prevent dental relapse, strategies include starting the orthodontic treatment immediately after removing the expander device or leaving it for ≥6 months.[6] The use of a transpalatal arch as a retaining device does not improve dento-osseous stability after SARPE.[13]

It is strongly recommended that root length be analyzed before starting orthodontic treatment[14] because root resorption is a common side effect of orthodontic treatment.[15] If pretreatment radiographs screening is done, root shortening may be revealed in some instances. Lind[16] reported that the root is considered short when it is the same size or smaller than the crown. In

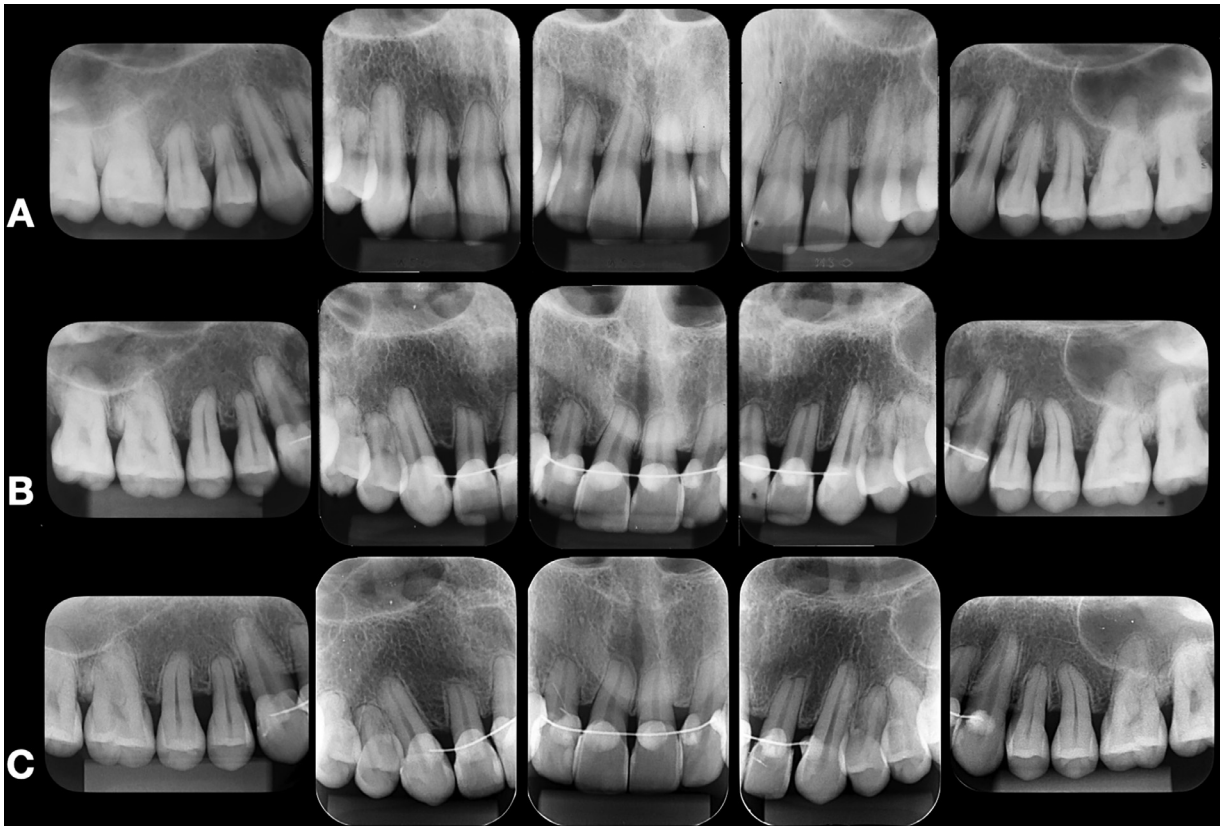

Fig 12. Periapical radiographs: **A,** Posttreatment; **B,** Posttreatment; **C,** 5-year posttreatment. Comparative periapical radiographs (initial, final, and 5-year posttreatment).

the patient reported in this article, pretreatment periapical radiography revealed the existence of root shortening, with the proportion of the root of the maxillary left central incisor being close to or equal to the size of the crown.

Through a finite element study using a short root model, Oyama et al[17] demonstrated that significant stress was concentrated in the middle of the root, sufficient for the development of root resorption. Thus, orthodontic forces should be applied with considerable caution. If teeth with short roots are diagnosed, biomechanical adaptations, periodic radiographic monitoring, clinical monitoring of teeth mobility, and permanent retention, particularly for the incisors, are needed.[18] In this patient, there was a careful application of forces to avoid further overload on the shortened roots of the maxillary incisors. Moreover, the period of use of intermaxillary elastics was minimized as much as possible.

However, even with the application of light forces, there was a decrease in the root length of the incisors, mainly in the maxillary right central incisor, but no appreciable degree of tooth mobility was observed.

This case report had an increased risk of root resorption and gingival recession because of the need to correct Class III malocclusion associated with transversal maxillary deficiency. Before starting orthodontic treatment, cone-beam computed tomography images were not requested because using these images for bone loss evaluation is controversial and not defined in the literature as the gold standard for this purpose.[19]

The obtained results show that if correct diagnosis and careful treatment planning are made, Class III malocclusions associated with constricted maxillary arch, shortened incisor roots, gingival recession, and horizontal bone loss can be successfully treated with SARPE and orthodontic camouflage, decreasing not only surgical risks and costs but also increasing patient's satisfaction.

CONCLUSIONS

Class III malocclusion, transverse maxillary deficiency, shortened root, and gingival recessions can be successfully treated, obtaining favorable results in occlusion, smile esthetics, and soft tissue, with the results remaining stable for at least 5-year posttreatment.

In patients seeking retreatment, SARPE procedures can be a predictable approach to correct Class III malocclusion and transverse maxillary deficiency.

Declaration of Competing Interest

All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

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