Case Report

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Correction of Angle Class II division 1 malocclusion with a mandibular protraction appliances and multiloop edgewise archwire technique

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A Brazilian girl aged 14 years and 9 months presented with a chief complaint of protrusive teeth. She had a convex facial profile, extreme overjet, deep bite, lack of passive lip seal, acute nasolabial angle, and retrognathic mandible. Intraorally, she showed maxillary diastemas, slight mandibular incisor crowding, a small maxillary arch, 13-mm overjet, and 4-mm overbite. After the diagnosis of severe Angle Class II division 1 malocclusion, a mandibular protraction appliance was placed to correct the Class II relationships and multiloop edgewise archwires were used for finishing. Follow-up examinations revealed an improved facial profile, normal overjet and overbite, and good intercuspation. The patient was satisfied with her occlusion, smile, and facial appearance. The excellent results suggest that orthodontic camouflage by using a mandibular protraction appliance in combination with the multiloop edgewise archwire technique is an effective option for correcting Class II malocclusions in patients who refuse orthognathic surgery.
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INTRODUCTION

According to Angle,[1] a Class II malocclusion is characterized by the distal occlusion of the mandibular first molar in relation to the maxillary first molar; in a Class II division 1 malocclusion, the maxillary incisors additionally exhibit proclination. This malocclusion is also characterized by an anteroposterior dental discrepancy, which may be associated with skeletal changes. The overjet may be excessive and the overbite is most likely deep. The retrognathic profile and excessive overjet result in abnormal contraction patterns of the facial muscles and tongue. Typically, the mentalis becomes hyperactive, to elevate the orbicularis oris and achieve lip sealing.[2] The marked overjet also increases the patient's susceptibility to dental trauma. Additionally, the unaesthetic facial appearance often has psychosocial consequences.[3]

Class II division 1 malocclusions have a multifactorial origin and are mainly attributable to evolutionary changes in craniofacial growth, dietary and social habits, and ethnic admixture. Therefore, orthodontic treatment planning depends on several factors, including the nature of the malocclusion, patient characteristics, and family history.[4] One treatment option is the combined use of a mandibular protraction appliance (MPA) and multiloop edgewise archwires (MEAWs). The MPA is a fixed orthopedic appliance used for treating Class II malocclusions. Its advantages include ease of fabrication by the dentist or assistant, easy placement, and the possibility of concomitant use with other appliances, thus reducing the total treatment time and increasing post-treatment stability.[5] The MEAW technique was developed in 1967 to treat severe open bites and was found to be extremely effective. Since then, it has been applied in various malocclusions, especially at the final treatment stage, to achieve better intercuspation.[6]

This paper reports a case of severe Angle Class II

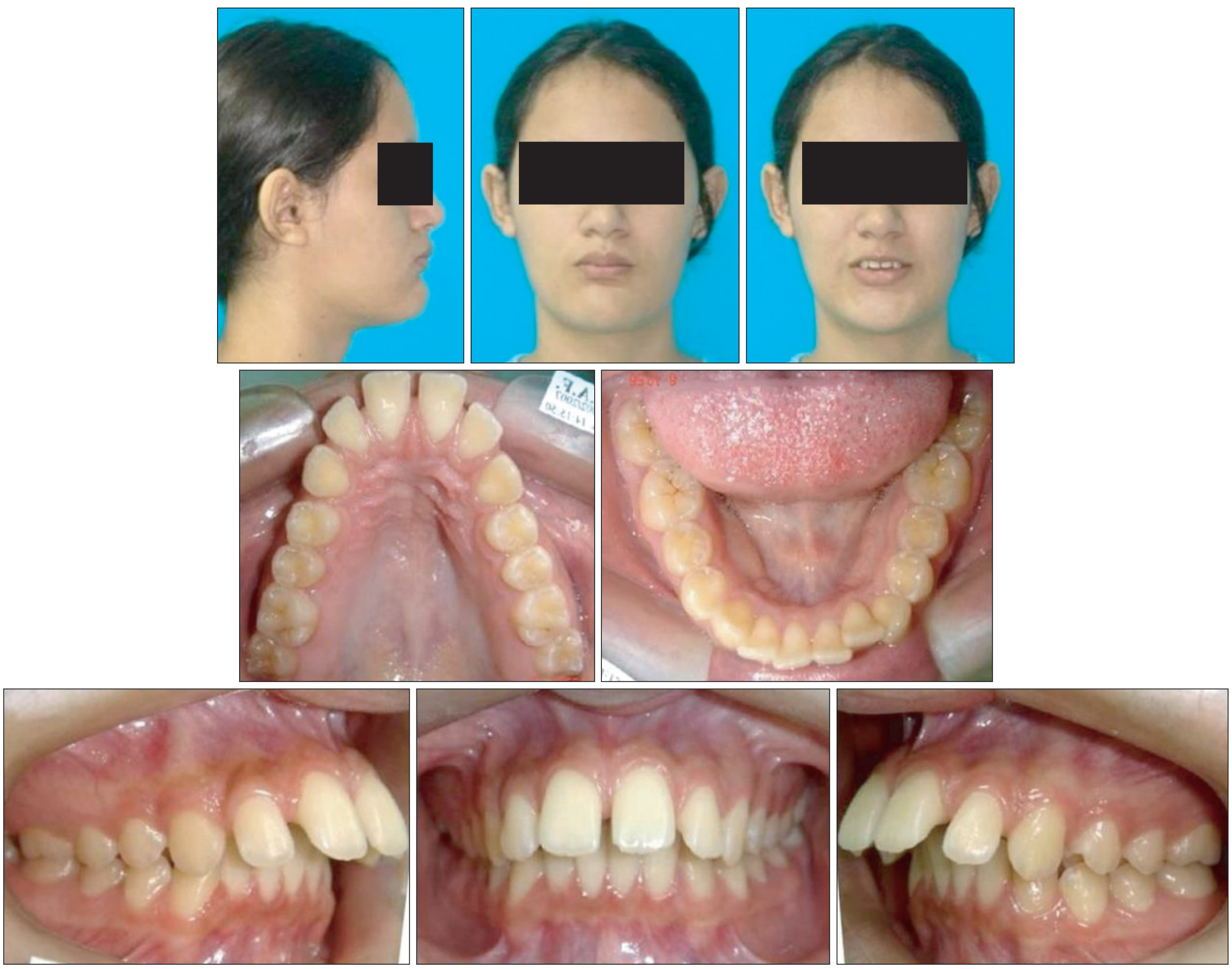

Figure 1. Pretreatment facial and intraoral photographs.

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division 1 malocclusion in a female patient outside the maximum pubertal growth peak who was treated by orthodontic camouflage using the MPA and MEAW technique.

DIAGNOSIS AND ETIOLOGY

A Brazilian girl aged 14 years and 9 months presented with a chief complaint of protrusive teeth. She had a convex facial profile, deep bite, lack of passive lip seal, acute nasolabial angle, retrognathic mandible, and no midline deviation. No signs of temporomandibular dysfunction such as clicks, cracks, and crepitation were noted. She also did not report systemic problems or a family history of the same malocclusion. Intraoral examination revealed good oral hygiene, maxillary diastemas, slight crowding of the mandibular incisors, a small maxillary arch, overjet of 13 mm, and overbite of 4 mm (Figure 1).

Her occlusion was assessed using the Dental Aesthetic Index (DAI), as recommended by the World Health Organization.[7] The assessment revealed a very severe or disfiguring malocclusion, necessitating orthodontic treatment (Table 1).

Table 1. Dental Aesthetic Index (DAI) values before and after treatment and at the 3-years follow-up examination

Component	Weight	Pre-treatment	Post-treatment	Three-year retention
MVT (n)	6	0	0	0
CIS	1	1	0	0
SIS	1	1	0	0
MD (mm)	3	1	0	0
LAIMx (mm)	1	0	0	0
LAIMd (mm)	1	1	0	1
AMxOJ (mm)	2	13	3	2.5
MdOJ (mm)	4	0	0	0
VAOB (mm)	4	0	0	0
APMR	3	0	0	0
DAI		45	19	19

MVT, Missing visible teeth (incisors, canines, and premolars in the maxillary and mandibular dentitions); CIS, crowding in the incisal segments (0 = no crowding; 1 = one segment crowded; 2 = two segments crowded); SIS, spacing in the incisal segments (0 = no spacing; 1 = one segment spaced; 2 = two segments spaced); MD, midline diastema; LAIMx, largest anterior irregularity in the maxilla; LAIMd, largest anterior irregularity in the mandible; AMxOJ, anterior maxillary overjet; AMdOJ, anterior mandibular overjet; VAOB, vertical anterior open bite; APMR, anteroposterior molar relationship (0 = normal; 1 = half cusp; 2 = one cusp).

The initial panoramic radiograph (Figure 2) revealed the presence of well-positioned third molars and the absence of morphologic changes to the condyles. The initial lateral cephalogram showed a horizontal growth pattern (FMA = 22°), well-positioned maxilla (SNA = 79°), retrognathic mandible (SNB = 76°), and marked incisor proclination (1.NA = 44°) (Figure 2 and Table 2).

TREATMENT OBJECTIVES

The treatment objectives were to improve the facial aesthetics, balance the lip musculature, achieve stable occlusion, correct the maxillary dental protrusion and canine relationship, reduce the overjet and overbite, and correct the mandibular incisor crowding.

MPA fabrication

The MPA consisted of three parts: the maxillary and mandibular parts and the bootstrap.

To construct the maxillary portion, a short piece of stainless steel tubing was joined transversely to one end of a telescopic stainless steel tube (outer diameter = 1.0 mm; inner diameter = 0.9 mm; length = 35 mm) by point welding (fusion welding held the tubes together while silver soldering them with flux and a blowtorch). After the tubing was cut flush with the telescopic tube, a 0.9-mm-diameter stainless steel wire clip was inserted into the telescopic tube and maxillary first molar tube

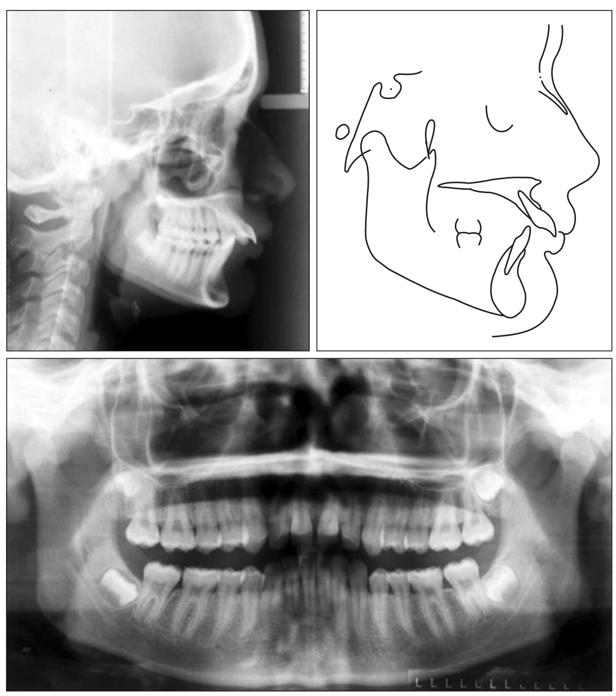

Figure 2. Pretreatment panoramic and cephalometric radiographs and tracing.

Table 2. Cephalometric measurements

Measurement	Norms	Pretreatment	Posttreatment	Three-year retention
Maxilla				
SNA (°)	82	79	82	82
Co-A (mm)	85	92	89	81
A-Nperp (mm)	1	−2	−1	0
Mandible				
SNB (°)	80	76	80	79
Co-Gn (mm)	108	120	120	120
P-Nperp (mm)	−2	−2	−3	+1.5
Growth pattern				
FMA (°)	25	22	22	24
SN.Ocl (°)	14	1.5	7	8.5
SN.GoGn (°)	32	29	20	25
LFH (mm)	62	72	68	69
Facial axis (°)	90	93	93	89
ODI (°)	74.5	69	68	71
Jaw relation				
ANB (°)	2	3	2	2
Wits (mm)	0	+4	+2.5	+2.5
APDI (°)	81.5	77	80	80.5
Upper teeth				
1.NA (°)	22	44	25	22
1-NA (mm)	4	13	5	34
1.PP (°)	112.1	130	110	110
1-PP (mm)	33	38	31.5	33
6-PP (mm)	27.9	26	26	24
Lower teeth				
1.NB (°)	25	25	26	26
1-NB (mm)	4	3	3.5	4.7
IMPA (°)	92	91	101	100
1-GoMe (mm)	48.3	43	42	42
Soft tissue				
Nasolabial angle (°)	110	80	90	91
Line E (mm)	−2	−4	−3	−3.5

SNA, Sella-nasion-A point; Co-A, distance from condylion to A point; A-Nperp, distance from A point to nasion perpendicular line; SNB, sella-nasion-B point; Co-Gn, distance from condylion to gnathion; P-Nperp, distance from pogonion to nasion perpendicular line; FMA, Frankfurt-mandibular plane angle; FH, Frankfurt horizontal plane; SN.Ocl, sella-nasion-occlusal plane angle; SN.GoGn, sella-nasion line to gonion-menton line angle; LFH, lower facial height; facial axis, basion-nasion line to pterygoid-gnathion line angle; ODI, overbite depth indicator; ANB, A point-nasion-B point; Wits, distance from A point to B point at the occlusal plane; APDI, anteroposterior dysplasia indicator; 1.NA, angle between the maxillary central incisor axis and nasion-A point line; 1-NA, distance from the maxillary central incisor to nasion-A point line; 1.PP, angle between the maxillary central incisor axis and the palatal plane; 1-PP, distance from the edge of the maxillary central incisor to the palatal plane; 6-PP, distance from the occlusal surface of the maxillary first molar to the palatal plane; 1.NB, angle between the mandibular central incisor and nasion-B point line; 1-NB, distance from the edge of the mandibular central incisor to nasion-B point; IMPA, incisor axis-mandibular plane angle; 1-GoMe, distance from the mandibular central incisor edge to the mandibular plane; Nasolabial angle, angle between the line drawn through the midpoint of the nasal aperture and the line drawn perpendicular to the Frankfurt horizontal plane while intersecting subnasale; Line E, distance from the lower lip connecting the tip of nose and soft tissue pogonion.

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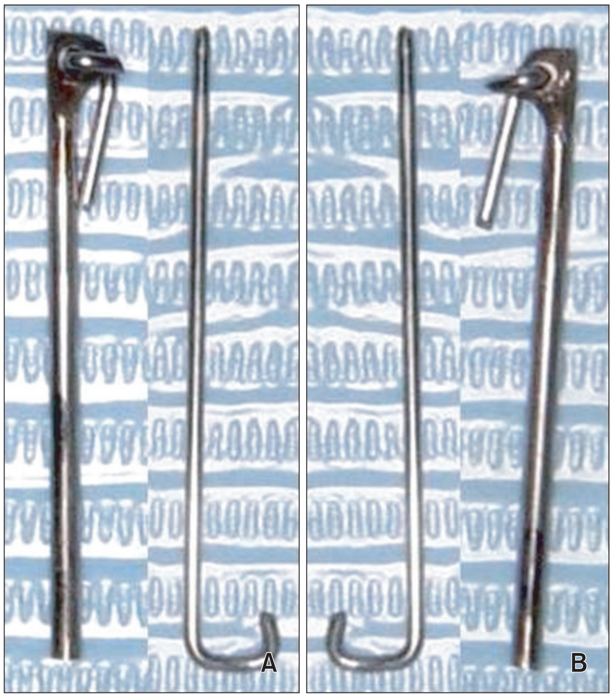

Figure 3. The mandibular protraction appliances. **A**, Right side; **B**, left.

on each side (Figure 3).

For the bootstrap, a piece of 0.9-mm-diameter stainless steel wire was bent at 90° on one end and inserted into the maxillary telescopic tube to prevent subsequent deformation of the tube. Then, the straight end of the wire was inserted into the maxillary tubing, and the wire was bent until it was parallel to the maxillary telescopic tube. The wire was cut so that its total length was approximately twice the length of the maxillary first molar tube. The wire was annealed to allow for easy bending around the maxillary first molar tube during its placement and to prevent dislodgement of the appliance (Figure 3).

The mandibular part was fabricated from a 0.9-mm-diameter stainless steel rod and 0.019 × 0.025-inch stainless steel archwire with a helix between the canine and the first premolar on each side. The rod had a U-shaped bend at one end; the bend was threaded through each helix from the lingual side and turned parallel to the archwire. During MPA placement, the rods were inserted into the maxillary tubes, which were shortened to match the helices when the mandible protruded to the point where the optimal overbite, overjet, and midline were achieved. The rods extended

Figure 4. Intraoral progress photographs showing the mandibular protraction appliance used in conjunction with Class II elastics in the multiloop edgewise archwire technique.

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less than a millimeter distally from the maxillary tubes (Figure 3).

TREATMENT ALTERNATIVES

Two treatment options were presented to the patient. The first option was orthognathic surgery including mandibular advancement and genioplasty. The second option was nonsurgical treatment by dentoalveolar compensation without extraction (orthodontic camouflage).

The patient rejected the first option, so nonsurgical treatment comprising mandibular advancement with the MPA and orthodontic finishing with the MEAW technique (Figure 4) was planned.

TREATMENT PROGRESS

Treatment was initiated by banding the maxillary and mandibular first molars and bonding pre-adjusted edgewise brackets (0.022 × 0.025-inch slot, Roth prescription). Leveling was performed with 0.014-inch nickel titanium (NiTi), 0.016-inch NiTi, 0.018-inch stainless steel, 0.020-inch stainless steel, and 0.019 × 0.025-inch stainless steel archwires. During leveling, in addition to the 0.016-inch NiTi archwire, a continuous ligature was tied from molar to molar to reduce the maxillary diastemas and to prevent labial tipping of the mandibular incisors. Interproximal enamel reduction of 2 mm was performed on the mandibular lateral incisors to relieve the mandibular crowding. After the 0.020-inch stainless steel archwire was placed, the ligature was replaced with an elastic chain. In the mandibular 0.019 × 0.025-inch stainless steel archwire, a helix was included between canines and premolars for placement of the MPA.

The MPA was maintained for 10 months in total. The initial mandibular advancement was 6 mm. After 4 months, further advancement was performed to achieve an edge-to-edge relationship. The MPA was

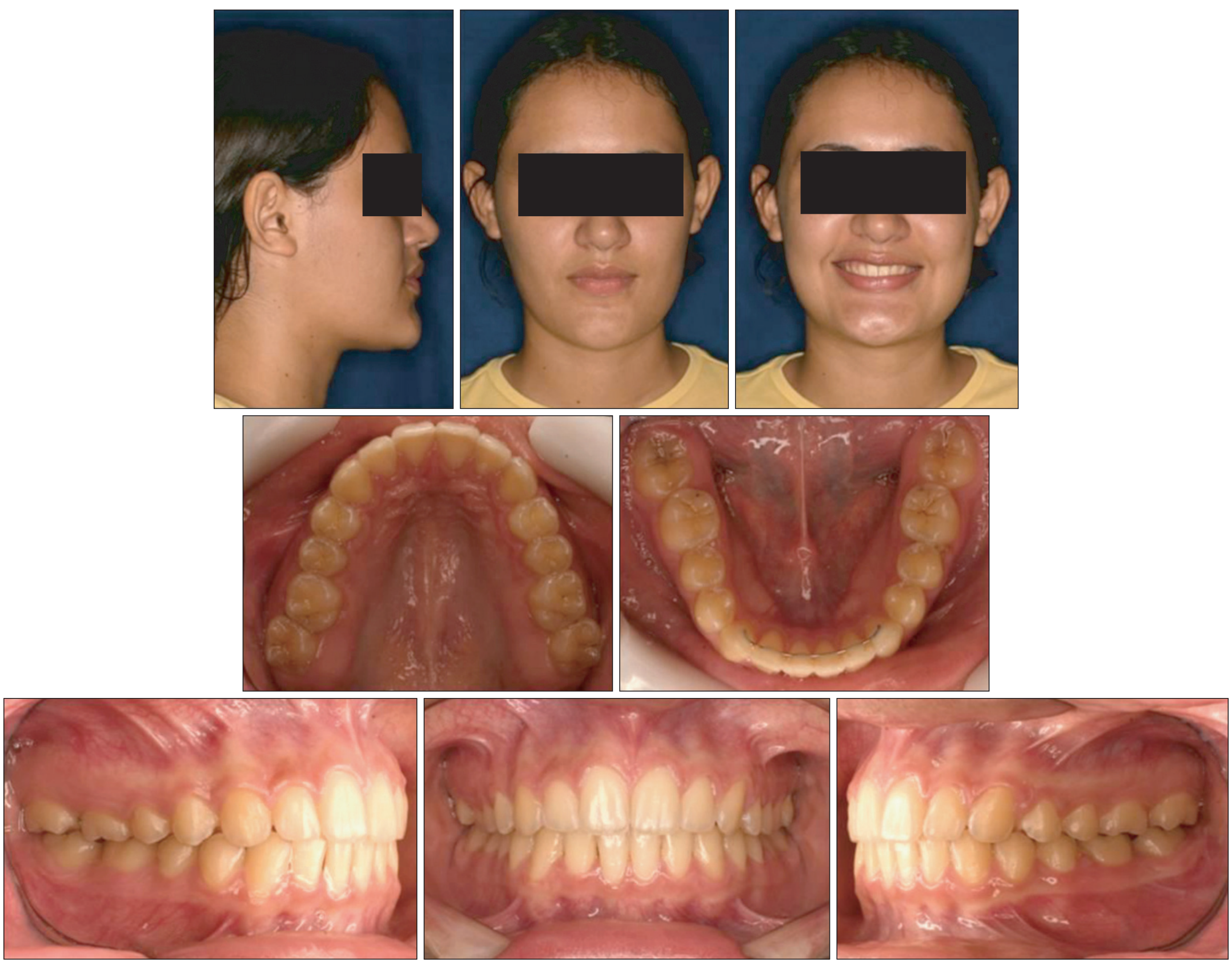

Figure 5. Posttreatment facial and intraoral photographs.

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removed after an additional 6 months of use. Although correction of the molar relationship was observed, a mild Class II malocclusion remained in the canine and premolar regions. MEAWs (0.019 × 0.025-inch stainless steel archwires) were placed in the dental arches. Intermaxillary (5/16 inch) elastics were used from the first "L" loops on the maxillary lateral incisors to the mandibular first molar tubes. The MEAWs were maintained for 2 months to avoid possible relapse of the Class II relationship (Figure 4). The patient showed excellent compliance during the treatment. After 26 months of active treatment, the appliances were removed and impressions were taken to fabricate retainers. A modified Hawley plate and 3 by 3 fixed retainer were used in the maxillary and mandibular arches, respectively.

RESULTS

The post-treatment photographs revealed an improved facial profile (Figure 5). The intraoral photographs exhibited bilateral Class I molar and canine relationships and an occlusion with a normal overjet and overbite (Figures 5 and 6). Good intercuspation, proximal contacts, and root parallelism were achieved (Figure 6). The decreased DAI value suggested normal occlusion at the completion of orthodontic treatment (DAI = 19) and 3 years thereafter (DAI = 19) (Table 1).

The final lateral cephalogram demonstrated proper inclination of the maxillary incisors (Figure 6). The mandibular incisors were facially inclined and the upper lip projection was reduced. The patient was satisfied with her dental and facial appearance. Dentoalveolar stability was maintained even after 3 years (Figures 7, 8, and 9).

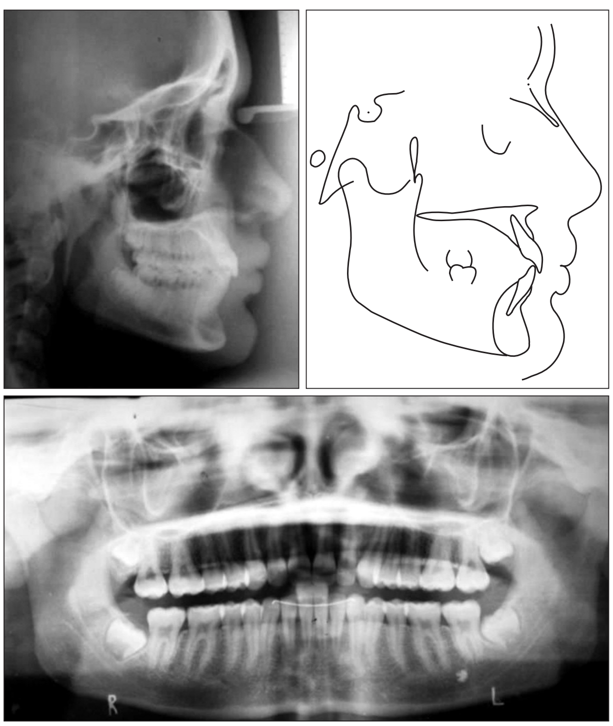

Figure 6. Posttreatment panoramic and cephalometric radiographs and tracing.

DISCUSSION

Angle Class II malocclusions, commonly characterized by an anteroposterior dental discrepancy, are more severe when combined with skeletal disharmony, which may be caused by mandibular deficiency, maxillary protrusion, or a combination of both.[8] Mandibular retrusion is the most common characteristic in children with Class II malocclusions[9] and shows no tendency for self-correction with growth. Furthermore, mandibular retrusion worsens during the pubertal growth spurt,[10] and maintains the same standard after this period until young adulthood.[11] For patients with skeletal Class II malocclusions who have completed growth, the following treatment options are possible: (1) orthodontic camouflage, which may be combined with extraction, based on retraction of the facially inclined maxillary incisors and facial inclination of the mandibular incisors, to improve occlusion and facial aesthetics without correcting the underlying skeletal problem; or (2) orthognathic surgery to reposition the mandible or maxilla, depending on the skeletal Class II problems associated with mandibular deficiency and downward and backward mandibular rotation caused by excessive maxillary vertical growth. Another option would have been orthodontic treatment with first premolar extraction; however, given the horizontal growth pattern of the patient, this alternative was not considered because it would impair deep bite correction and affect facial aesthetics.

Surgical treatment includes mandibular advancement, superior maxillary repositioning, or a combination of both. Mandibular deficiency is a problem existing in nearly two thirds of surgical patients, and one third of surgical patients require maxillary surgery alone (15%) or in combination with mandibular surgery (20%). In the present case, orthognathic surgery was considered for anterior mandibular repositioning and genioplasty after the growth period, but the patient did not accept this option. Although surgical patients achieve an ideal skeletal relationship, with the mandible positioned anteriorly and the mandibular incisors in an ideal relationship with the basal bone, patients treated by orthodontic camouflage usually present less problems than those who are surgically treated.[12] Orthognathic

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Figure 7. Three-years follow-up facial and intraoral photographs.

surgery may cause complete condylar resorption in 10% of surgical cases.[13] Patients treated with orthodontic camouflage also report less functional problems in the temporomandibular joint than those treated by orthognathic surgery. Finally, with regard to the cost-benefit relationship for patients outside the growth period, similar results have been observed between the treatment options, although orthodontic camouflage may yield a slightly greater overjet one year after treatment.[8] In the present case, both the overjet and the overbite were in the normal range even at 3 years post-treatment (Figure 9).

Treatment with extraction of the two first premolars, which is often indicated in comparison to treatment without extraction, is reportedly the most effective protocol when assessed by a normative index.[14] This protocol was considered for the present patient; however, extractions may have led to a marked facial concavity and worsened the facial profile.[15] Furthermore, the normative index used showed a dramatic change in the severity of malocclusion, with reduction to a level considered to require little or no orthodontic treatment after treatment without extraction.

More recently, several approaches to orthopedic treatment of Class II malocclusions in young adults have been indicated with mandibular advancement appliances.[5,16-25] Some studies have indicated associated problems, such as increased treatment time[26] or partial loss of outcomes after use of Class II elastics.[27] The present patient underwent orthodontic treatment after her maximum growth peak. Orthodontic camouflage with the MPA[16] was used in addition to Class II elastics in the MEAW technique within a relatively normal treatment time. However, one should also consider the

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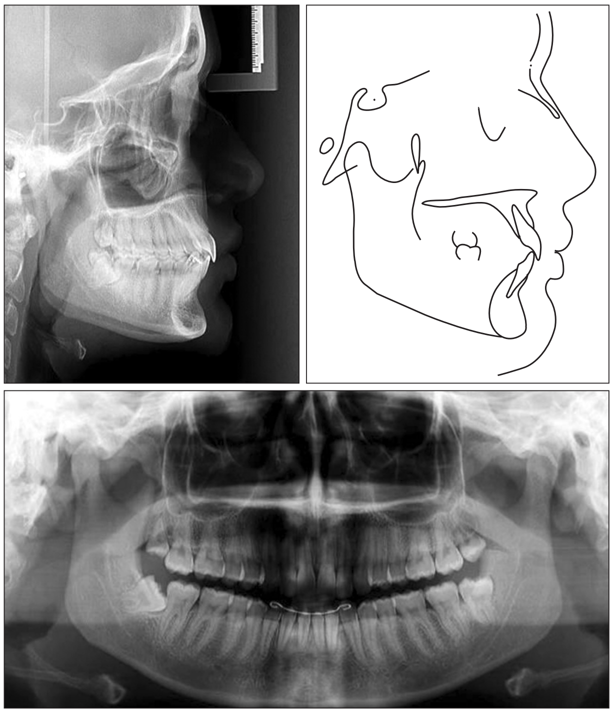

Figure 8. Three-years follow-up panoramic and cephalometric radiographs and tracing.

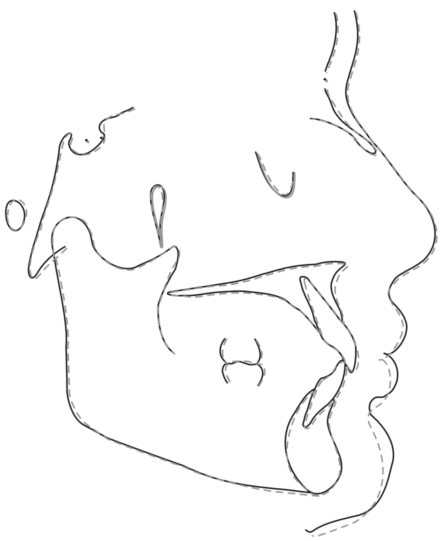

Figure 9. Superimposition of the post-treatment (solid line) and three years follow-up (dotted line) tracings.

greater success of treatment of a bilateral half cusp Class II malocclusion, as in the present case, than treatment with extraction resulting in a bilateral full cusp Class II malocclusion.[15] According to Franchi et al.,[28] the peak in skeletal growth occurs between stages 3 and 4 of cervical vertebral maturation in 93.5% of individuals. The present patient was past her growth peak, between

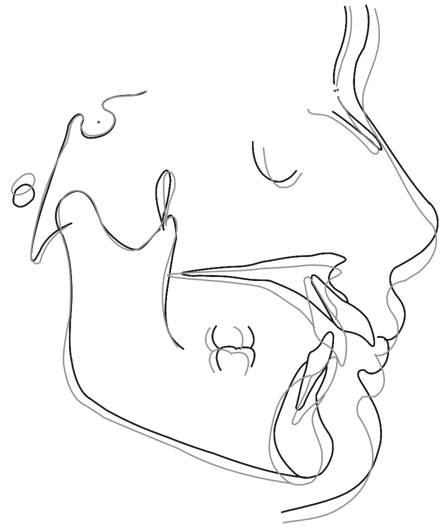

Figure 10. Superimposition of the pretreatment (black line) and post-treatment (gray line) tracings.

stages 5 and 6, when treatment was started (Figure 3). Some growth could still occur, but not enough to correct the Class II malocclusion by mandibular growth (Figure 10).

CONCLUSION

Orthodontic camouflage using the MPA and MEAW technique is an effective option for correcting Class II malocclusions in patients who refuse orthognathic surgery. In the present case, this treatment significantly improved the facial profile, achieved a satisfactory occlusion and pleasant aesthetics, and ensured good dentoalveolar stability even at 3 years after treatment was completed.

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