Adult skeletal Class III correction with camouflage orthodontic treatment

Jae Hyun Park,[a,b] Morvarid Emamy,[a,c] and Somang Hope Lee[a,d]
Mesa and Chandler, Ariz, Orange County, Calif, and Seoul, Korea

A 19-year-old woman with a skeletal Class III pattern, anterior and posterior crossbites, and a low mandibular plane angle was treated with nonextraction camouflage treatment. The total active treatment time was 17 months. After treatment, her occlusion, smile esthetics, and soft tissue profile were significantly improved. (Am J Orthod Dentofacial Orthop 2019;156:858-69)

Class III malocclusions are very difficult to treat. This is due to the dental and skeletal components associated with most Class III malocclusions.[1] Nongrowing skeletal Class III malocclusions are even more difficult to treat owing to the limited treatment options available. After growth is complete, the only way to camouflage the skeletal Class III condition is through dentoalveolar compensations. Most times, the ideal treatment for adults with Class III malocclusion is orthognathic surgery; however, many patients decline the surgical option because of finances or the invasiveness of the procedure. Alternative treatment modalities to orthognathic surgery include temporary skeletal anchorage devices (TSADs) for mandibular total arch distalization, extractions, Class III elastics, or facemask.[2-6]

Facemask is a nonsurgical method of modifying the dentoalveolar complex in nongrowing patients. The effects of a facemask include protraction of the maxillary dentoalveolar complex, proclination of maxillary incisors, retroclination of the mandibular incisors, and a clockwise rotation of the mandible.[7] Mandall et al[8] reported clockwise rotation of the maxilla after facemask therapy, which can improve smile esthetics in patients with a low smile line, but it also increases lower anterior face height. For patients with a Class III malocclusion and a high mandibular plane angle, the force vector should be appropriately adjusted to avoid undesirable results. Although facemask wear in nongrowing patients provides only dentoalveolar changes, in borderline cases or when patients decline orthognathic surgery or the use of TSADs, this is a viable option.[6]

This case report presents the use of expansion and facemask therapy to correct a skeletal Class III malocclusion with crossbites. Treatment results were clinically acceptable, and improved facial esthetics were achieved.

DIAGNOSIS AND ETIOLOGY

A 19-year-old Vietnamese woman came to the Arizona School of Dentistry & Oral Health Postgraduate Orthodontic Program. Her chief complaint was that her mandibular teeth were covering her maxillary teeth. She also stated that she did not want surgery or extractions. She had a symmetrical face, low smile line, a concave profile, protrusive lower lip, and a strong chin.

Intraorally, she showed anterior crossbites and posterior crossbites on the maxillary left first premolar and the maxillary right first molar. Her maxillary second molars showed extrusion because of missing mandibular third molars. She had full-step Class III molars and canines on both sides, with a negative overjet of 3.5 mm and an overbite of 6.0 mm.

Her maxillary arch showed mild crowding, whereas her mandibular arch showed mild crowding with a deep curve of Spee. Compared with her facial midline, her maxillary dental midline was coincident with her facial midline, and the mandibular dental midline was deviated 3 mm to the left. Although she had anterior and posterior crossbites, when her mandible was guided into centric relation, a functional shift was not detected (Figs 1 and 2).

[a]Arizona School of Dentistry & Oral Health, A.T. Still University, Mesa, Ariz.
[b]Graduate School of Dentistry, Kyung Hee University, Seoul, Korea.
[c]Formerly Arizona School of Dentistry & Oral Health, A.T. Still University, Mesa, Ariz; currently, Private office, Orange County, Calif.
[d]Formerly Arizona School of Dentistry & Oral Health, A.T. Still University, Mesa, Ariz; currently, Private practice, Chandler, Ariz.
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Address correspondence to: Jae Hyun Park, Postgraduate Orthodontic Program, Arizona School of Dentistry & Oral Health, A.T. Still University, 5835 East Still Circle, Mesa, AZ 85206; e-mail, JPark@atsu.edu.
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Fig 1. Pretreatment facial and intraoral photographs.

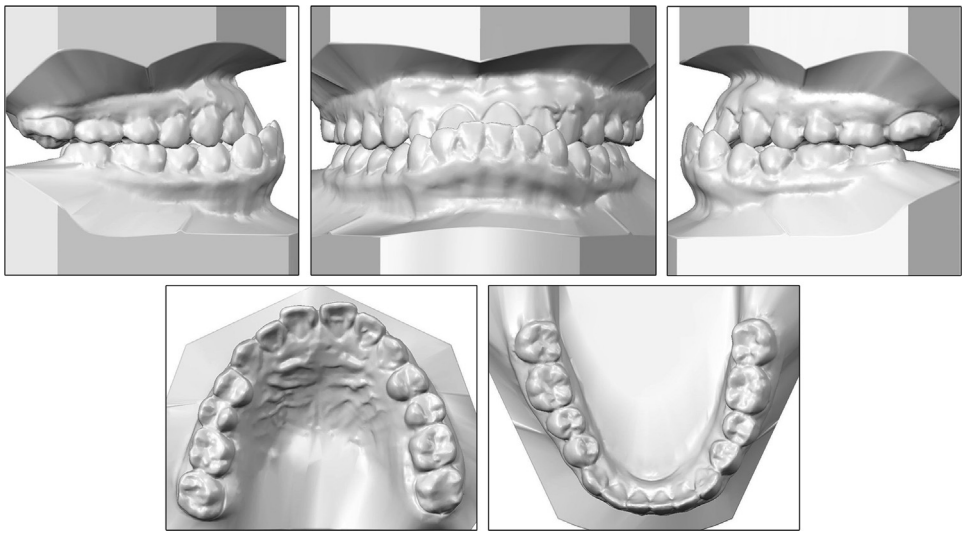


Fig 2. Pretreatment dental casts.

A panoramic radiograph showed that her mandibular third molars were missing. Her right and left condylar heads were different in shape, and her right condylar head showed a thin cortical bone at the superior portion. In a temporomandibular joint (TMJ) evaluation, there were no TMJ symptoms, such as pain, restricted jaw movement, or joint noise, or other symptoms (Figs 3 and 4). The lateral cephalometric analysis indicated a

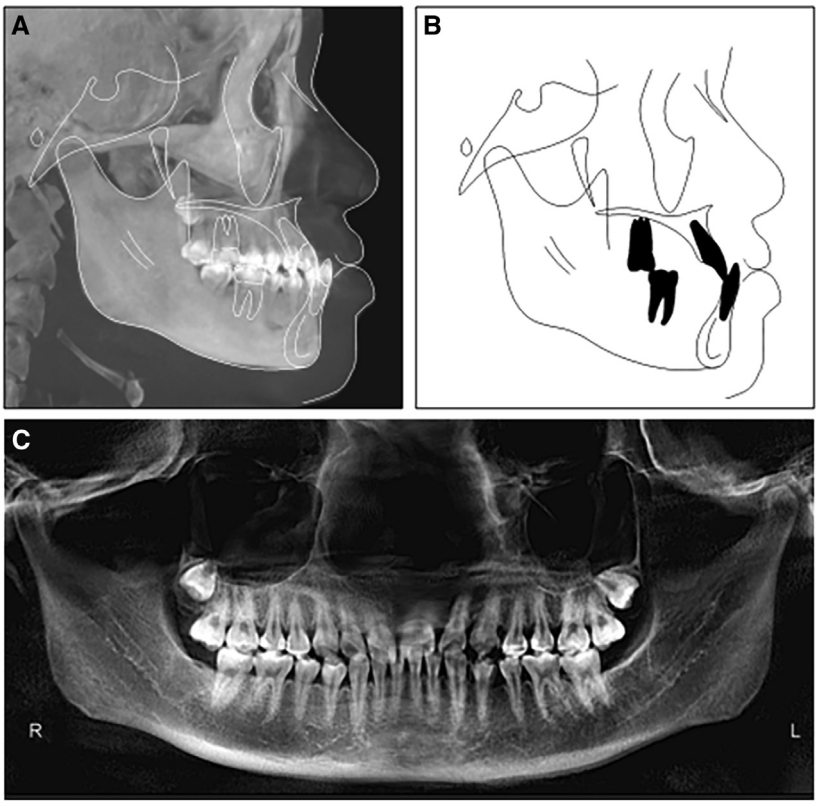


Fig 3. Pretreatment radiographs: **A,** lateral cephalogram; **B,** cephalometric tracing; **C,** panoramic radiograph.

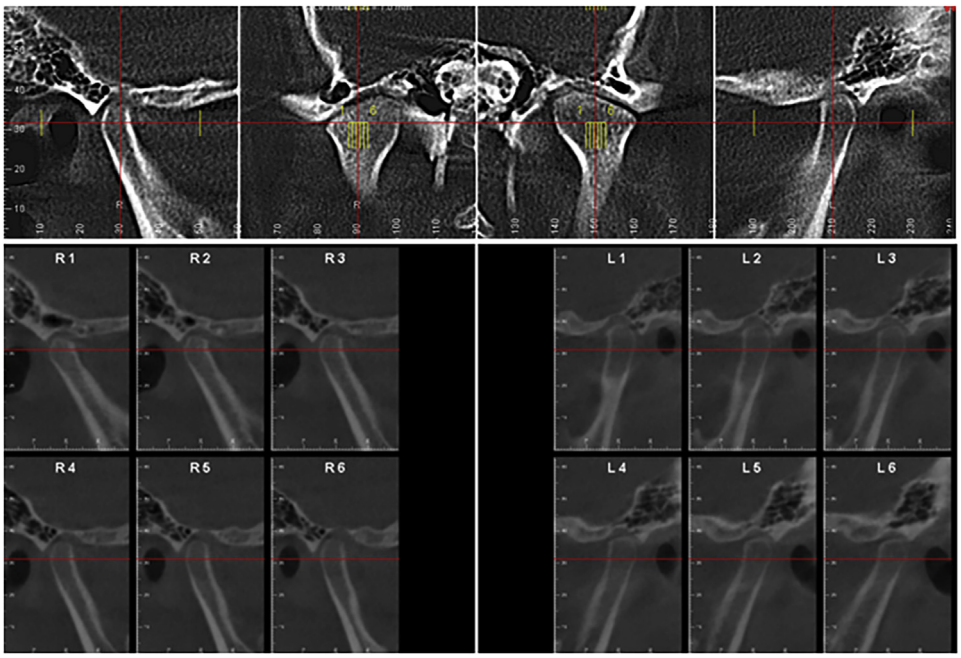


Fig 4. Pretreatment cone-beam computed tomography images of the TMJ.

skeletal Class III pattern (ANB, −5.7°; Wits appraisal, −11.2 mm) with a hypodivergent growth pattern (SN-MP, 25.1°). Her maxillary incisors were proclined (U1-SN, 111.9°), and mandibular incisors were slightly proclined (IMPA, 92.3°) (Fig 3; Table). She also had a familial skeletal Class III pattern on her maternal side. The etiology of the Class III malocclusion appeared to be a combination of heredity and environmental factors. Her American Board of Orthodontics Discrepancy Index score was 35 (Fig 5).

TREATMENT OBJECTIVES

The following treatment objectives were established: (1) to correct anterior and posterior crossbites, (2) to establish Class I dental relationships, (3) to obtain normal overjet and overbite, (4) to obtain a stable occlusal relationship, (5) to correct the dental midline, (6) to level the curve of Spee, (7) to relieve crowding, (8) to improve facial and dental esthetics by establishing an esthetic smile, and (9) to reduce facial concavity.

TREATMENT ALTERNATIVES

Orthognathic surgery to set back the mandible with the possibility of maxillary advancement, combined with fixed orthodontic treatment was discussed with her. Skeletal discrepancy correction, maximum facial and dental esthetics, and establishment of an ideal occlusion would all be possible with this approach.

Orthodontics alone could help camouflage some skeletal and dental aspects of the malocclusion, improving esthetics and function. The orthodontic options would include distalization of the mandibular dentition with TSADs to establish Class I dental relationships and slow maxillary expansion to correct the posterior crossbites,[2,9] a protraction facemask at night to correct the anterior crossbites, and, if necessary, mandibular interproximal reduction to correct the anterior crossbite.[6] Because her mandibular incisors were not severely proclined, extraction of her 2 mandibular first premolars was not chosen to correct her anterior crossbites.

The patient declined orthognathic surgery extractions, but not TSADs in the event that TSADs were needed for distalization of mandibular dentition. Hence, we decided to treat her with conventional orthodontic treatment using an expander, facemask at night, and Class III elastics.

TREATMENT PROGRESS

Before orthodontic treatment, the patient was referred to a general dentist to verify the absence of dental caries. To correct the transverse problem, an expander was delivered in the maxillary arch and was turned 1 turn per week until her posterior crossbites were corrected. Along with the expander, preadjusted appliances with 0.022 × 0.028-in slots were bonded on her maxillary arch. A facemask appliance was used concurrently with the maxillary expander. Hooks for facemask were soldered between the maxillary lateral incisors and canines on both sides to the mesial sides of the expander.

Table. Cephalometric measurements

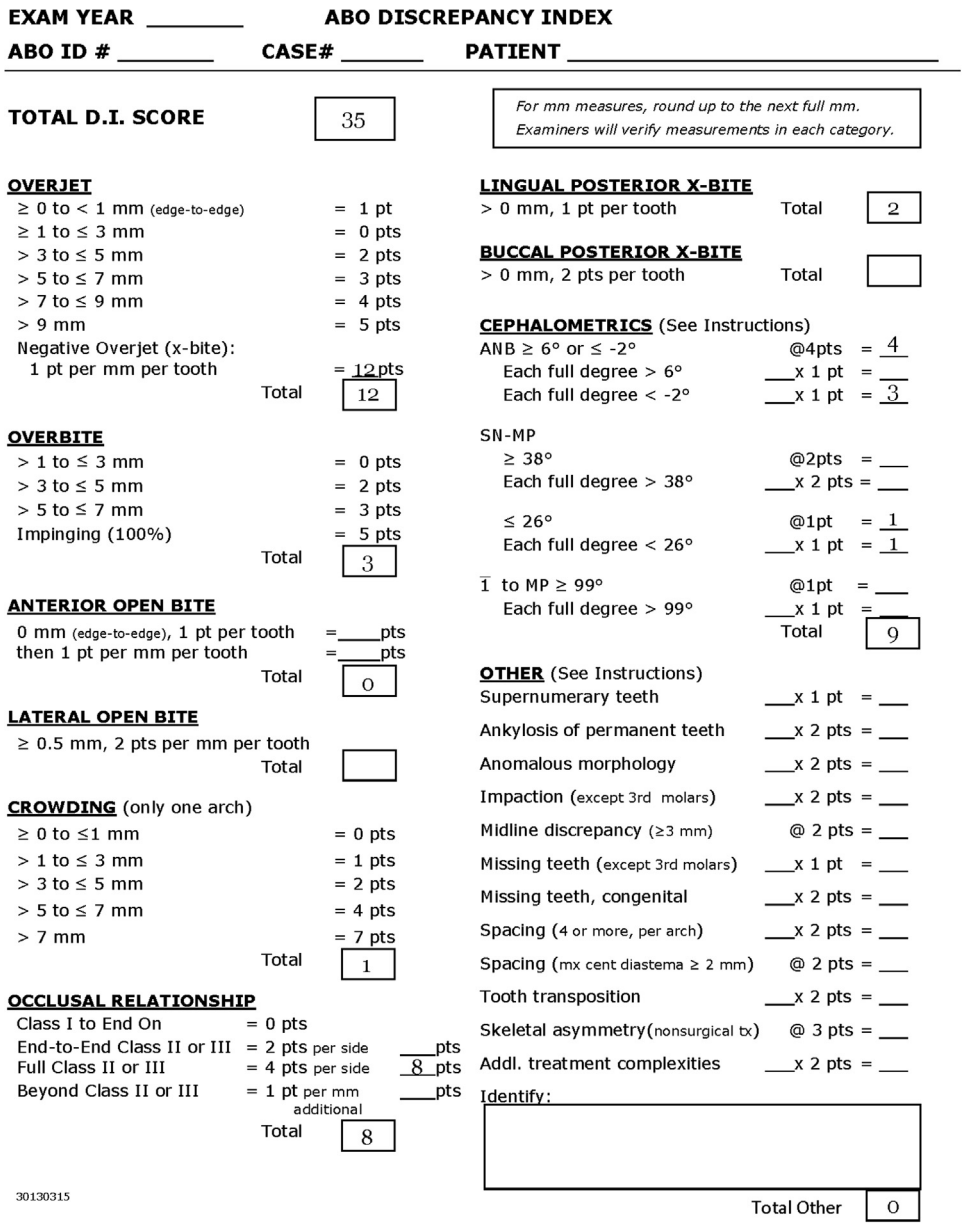
Measurement	*Norm*	*Pretreatment*	*Posttreatment*
SNA (°)	82.0	80.6	81.1
SNB (°)	80.0	86.3	82.6
ANB (°)	2.0	−5.7	−1.5
Wits (mm)	−1.0	−11.2	−1.6
SN-MP (°)	32.0	25.1	29.6
FH-MP (°)	24.0	14.5	18.8
LFH (ANS-Me/N-Me) (%)	55.0	62.5	70.2
U1-SN (°)	104.0	111.9	116.0
U1-NA (°)	22.0	31.1	34.7
IMPA (°)	90.0	92.3	94.4
L1-NB (°)	25.0	23.2	25.8
U1/L1 (°)	131.0	130.8	121.0
Upper lip (mm)	−4.0	−2.5	−1.0
Lower lip (mm)	−2.0	4.2	4.6

The patient's maxillary arch was leveled with continuous archwires, starting with 0.014-in nickel titanium and working up to 0.019 × 0.025-in stainless steel to control torque. After removal of the expander (total time in expander was 8 months), hooks were added to the heavy rectangular wires for facemask use between the maxillary lateral incisors and canines (total time in facemask was 9 months). After correction of the posterior crossbites, a mandibular arch was bonded with preadjusted appliances with 0.022 × 0.028-in slots. To alleviate the anterior crossbite, anterior bite turbos were bonded on the lingual surface of the mandibular central incisors to unlock the bite.

During the finishing stage, after the molars and canines were in Class I occlusion, final detailing of the occlusion was accomplished with 0.017 × 0.025-in titanium molybdenum alloy archwires in conjunction with triangle elastics from the maxillary canines to the mandibular canines and first premolars, along with anterior box elastics from the maxillary lateral incisors to the mandibular lateral incisors to settle the occlusion and establish an ideal overbite (Figs 6 and 7). Along with her mandibular fixed retainer, Essix removable retainers were also delivered to secure the stability of both arches. Total treatment time for this patient was 17 months.

TREATMENT RESULTS

Posttreatment records revealed that the treatment objectives were achieved. Because the patient did not



EXAM YEAR _____ ABO DISCREPANCY INDEX

ABO ID # _____ CASE# _____ PATIENT _____

TOTAL D.I. SCORE 35

For mm measures, round up to the next full mm.
Examiners will verify measurements in each category.

OVERJET
- ≥ 0 to < 1 mm (edge-to-edge) = 1 pt
- ≥ 1 to ≤ 3 mm = 0 pts
- > 3 to ≤ 5 mm = 2 pts
- > 5 to ≤ 7 mm = 3 pts
- > 7 to ≤ 9 mm = 4 pts
- > 9 mm = 5 pts
- Negative Overjet (x-bite): 1 pt per mm per tooth = 12 pts

Total 12

OVERBITE
- > 1 to ≤ 3 mm = 0 pts
- > 3 to ≤ 5 mm = 2 pts
- > 5 to ≤ 7 mm = 3 pts
- Impinging (100%) = 5 pts

Total 3

ANTERIOR OPEN BITE
- 0 mm (edge-to-edge), 1 pt per tooth = ____pts
- then 1 pt per mm per tooth = ____pts

Total 0

LATERAL OPEN BITE
- ≥ 0.5 mm, 2 pts per mm per tooth

Total

CROWDING (only one arch)
- ≥ 0 to ≤1 mm = 0 pts
- > 1 to ≤ 3 mm = 1 pts
- > 3 to ≤ 5 mm = 2 pts
- > 5 to ≤ 7 mm = 4 pts
- > 7 mm = 7 pts

Total 1

OCCLUSAL RELATIONSHIP
- Class I to End On = 0 pts
- End-to-End Class II or III = 2 pts per side ____pts
- Full Class II or III = 4 pts per side 8 pts
- Beyond Class II or III = 1 pt per mm additional ____pts

Total 8

30130315

LINGUAL POSTERIOR X-BITE
> 0 mm, 1 pt per tooth Total 2

BUCCAL POSTERIOR X-BITE
> 0 mm, 2 pts per tooth Total

CEPHALOMETRICS (See Instructions)
- ANB ≥ 6° or ≤ -2° @4pts = 4
- Each full degree > 6° ___x 1 pt = ___
- Each full degree < -2° ___x 1 pt = 3

SN-MP
- ≥ 38° @2pts = ___
- Each full degree > 38° ___x 2 pts = ___
- ≤ 26° @1pt = 1
- Each full degree < 26° ___x 1 pt = 1

$\overline{1}$ to MP ≥ 99° @1pt = ___
Each full degree > 99° ___x 1 pt = ___

Total 9

OTHER (See Instructions)
- Supernumerary teeth ___x 1 pt = ___
- Ankylosis of permanent teeth ___x 2 pts = ___
- Anomalous morphology ___x 2 pts = ___
- Impaction (except 3rd molars) ___x 2 pts = ___
- Midline discrepancy (≥3 mm) @ 2 pts = ___
- Missing teeth (except 3rd molars) ___x 1 pt = ___
- Missing teeth, congenital ___x 2 pts = ___
- Spacing (4 or more, per arch) ___x 2 pts = ___
- Spacing (mx cent diastema ≥ 2 mm) @ 2 pts = ___
- Tooth transposition ___x 2 pts = ___
- Skeletal asymmetry(nonsurgical tx) @ 3 pts = ___
- Addl. treatment complexities ___x 2 pts = ___

Identify:

Total Other 0

Fig 5. American Board of Orthodontics Discrepancy Index score form. *DI*, Discrepancy Index.

want to undergo orthognathic surgery or extractions, the results, although not ideal, addressed her chief concern and corrected her malocclusion. Her smile esthetics were significantly improved, and her dental midlines were aligned with the facial midline. Her anterior and posterior crossbites were corrected. Acceptable overbite and overjet were achieved along with Class I canine and molar relationships and coincident dental midlines (Figs 8 and 9).

A posttreatment panoramic image revealed no signs of significant root or bone resorption, and good root parallelism was observed. Lateral cephalometric analysis showed skeletal changes with a slight forward movement of the maxillary skeletal base (SNA: from 80.6° to 81.1°) and backward movement of the mandible (SNB: from 86.3° to 82.6°). The ANB changes may be explained by the downward and backward rotation of the mandible (SN-MP: from 25.1° to 29.6°). To correct her anterior crossbite, her maxillary incisors were proclined compared with pretreatment (U1-SN: from 111.9° to 116.0°), and her mandibular incisors were slightly proclined compared with pretreatment (IMPA: from 92.3°

Fig 6. Progress intraoral photographs (7 months in treatment).

Fig 7. Progress intraoral photographs (14 months in treatment).

to 94.4°) owing to leveling the deep curve of Spee. Cone-beam computed tomography revealed no further worsening of her right condyle, in shape or cortical thickness. She did not report any TMJ pain or discomfort during or after the orthodontic treatment (Figs 10-12).

From the lateral cephalometric superimposition, a point moved forward slightly, and her maxillary first molars were extruded, allowing for the unlocking of her bite. Her mandible was rotated clockwise owing to extrusion of the maxillary first molars by an expander and facemask, as well as the use of anterior bite turbos. The expansion of her maxilla did not result in skeletal expansion, but it tipped her maxillary posterior buccally, alleviating the posterior crossbite because the mandible also rotated in a clockwise fashion (Fig 13). The patient was satisfied with her occlusion and facial esthetics; she had full compliance in wearing her facemask and elastics, which helped her treatment plan progress as expected. Her American Board of Orthodontics Cast-Radiograph Evaluation score was 13 (Fig 14).

DISCUSSION

This case is interesting because we were able to obtain good dental and facial esthetic results in a

Fig 8. Posttreatment facial and intraoral photographs.

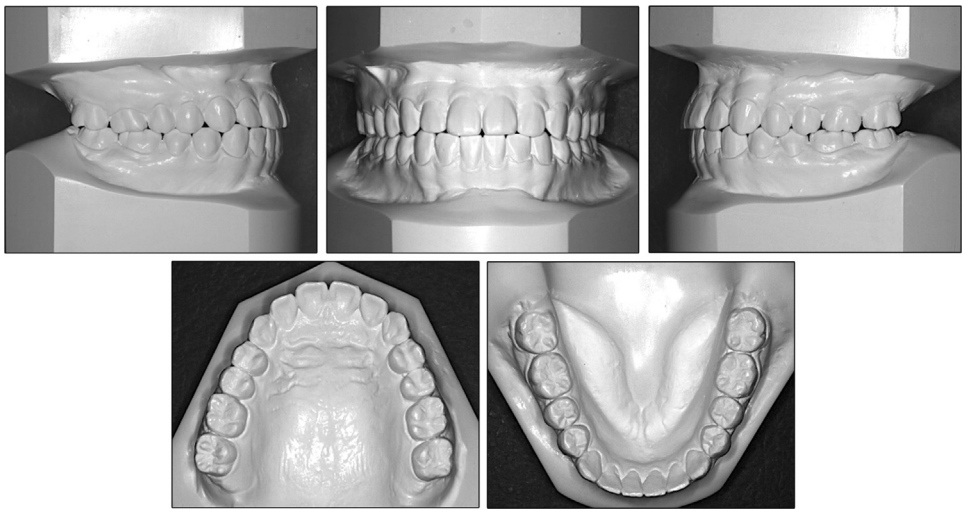


Fig 9. Posttreatment dental casts.

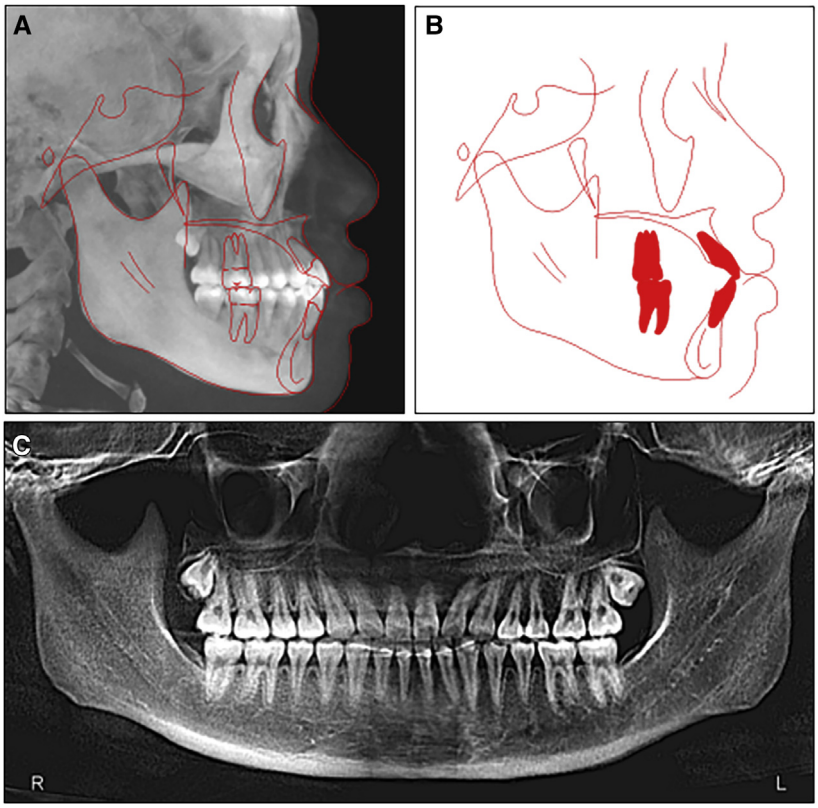


Fig 10. Posttreatment radiographs: **A,** lateral cephalogram; **B,** cephalometric tracing; **C,** panoramic radiograph.

nongrowing patient despite treating her without surgery. There are several points for discussion in this case that clinicians may find interesting.

The first is regarding dentofacial orthopedic treatment. Kim et al[10] stated that orthopedic intervention should be done before the age of 10 years in patients with Class III skeletal malocclusions to achieve maximum skeletal changes. Although many studies[11-14] indicate that intervention for Class III malocclusion is more favorable in children before their pubertal growth peak, the success of this treatment is not predictable.[15] Furthermore, many patient factors affect the predictability of long-term stability of orthopedic treatment, the strongest influence being mandibular growth.[15] Mandall et al[8] found that early intervention for skeletal Class III malocclusion treated by facemask therapy did result in improvement of SNA, SNB, and ANB initially, but these results were not maintained when followed up in 6 years. This relapse was most likely because of excessive horizontal mandibular growth.[4] Reyes et al[16] reported similar findings in Class III patients undergoing excessive mandibular growth in a forward direction. With such individual variation in differential horizontal growth of the maxilla and mandible, retention of early Class III malocclusion correction such as positive overjet is difficult to maintain.[4]

The other issue is that, to date, there is a lack of long-term studies to support the benefits of early facemask treatment to improve skeletal and dental relationships in patients with Class III malocclusion.[17] Still there are certain patient conditions in which the use of a facemask is more likely to treat skeletal Class III malocclusions. These conditions are retrusive maxilla and hypodivergent growth patterns.[4] There are dentoalveolar changes from facemask therapy that can be used even past a patient's peak pubertal growth period to obtain changes that aid in correcting a dental Class III malocclusion. Apart from protraction, clockwise rotation in the maxilla and mandible with the use of a facemask is helpful in correcting a Class III malocclusion.[18] Mandall et al[8] found statistically significant changes showing clockwise rotations in the maxilla and mandible in patients who underwent facemask therapy with elastics placed in a downward and forward direction relative to the occlusal plane. However, if patients with Class III malocclusion show a gummy smile with vertical maxillary excess, the effects of the facemask therapy should be carefully monitored.

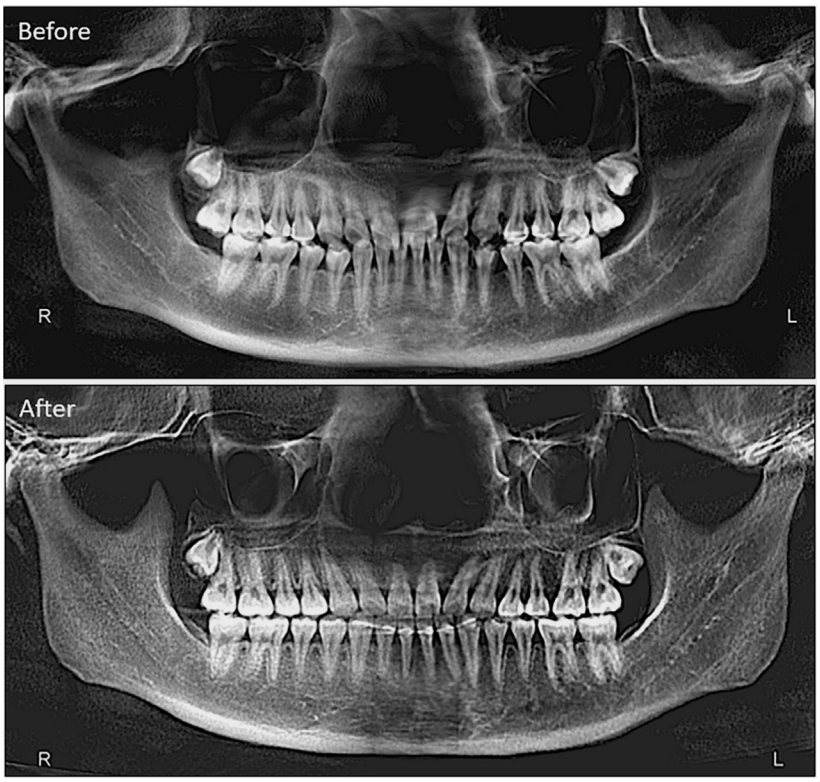


Fig 11. Before and after treatment panoramic radiographs showing the improvement of dental relationships.

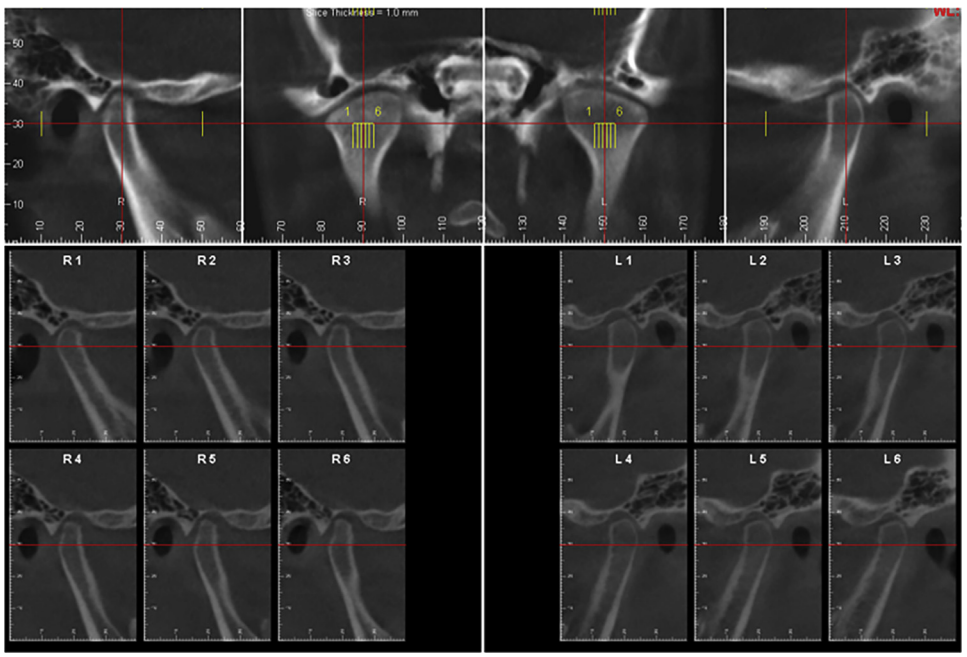


Fig 12. Posttreatment CBCT images of the TMJ. *CBCT*, cone-beam computed tomography.

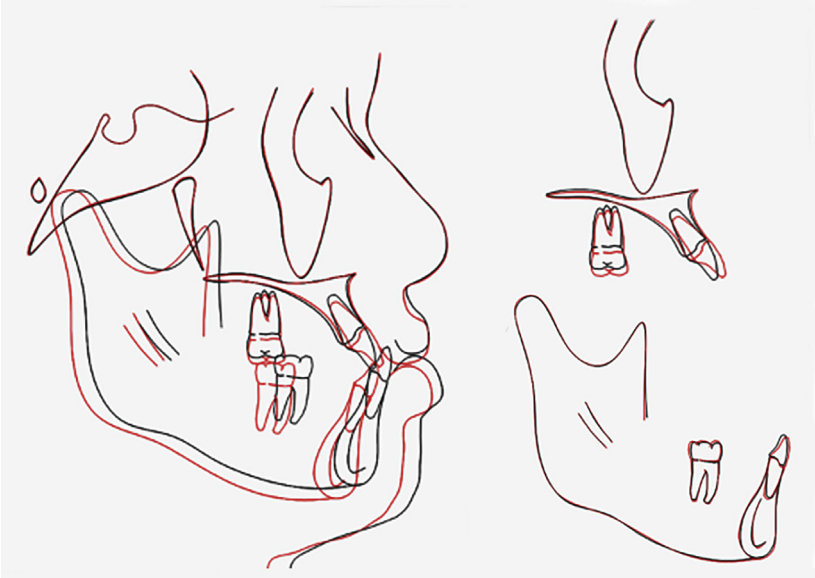


Fig 13. Cephalometric superimposition (*black*, pretreatment; *red*, posttreatment).

Previous case reports[6,19] presented nongrowing patients treated with facemask therapy for Class III malocclusions with satisfactory clinical results on this basis. Our patient's case was particularly interesting because of the satisfactory treatment results despite the severity of her Class III relationship and the presence of a complete anterior crossbite. Because our patient presented with a low mandibular plane angle (pretreatment, SN-MP: 25.1°) and retrusive maxilla (pretreatment, SNA: 80.6°), we found her to be a good candidate for facemask therapy. If she had been treated at a younger age before her growth peak, there would have a possibility of us having gained more Class III skeletal correction owing to her favorable growth pattern.[7]

Skeletal Class III malocclusions are some of the most complicated cases to treat.[20] There are different schools of thought when it comes to treating Class III malocclusions. As discussed previously, some clinicians advocate early treatment before a patient's peak growth spurt if possible, to attempt to benefit from orthopedic effects.[8] However, to date, there is no method to predict the Class III growth pattern in an individual with certainty. Therefore, some clinicians prefer to wait until patients have completed growth to treat them with a combination of orthodontics and orthognathic surgery. For nongrowing patients, orthodontic camouflage can also be a treatment option under the right circumstances. However, the exact delineation of patients for whom orthodontic camouflage and orthognathic surgery would be successful is still unclear.[5]

Martinez et al[21] reported that the ideal parameter for determining whether surgical treatment is needed is the Wits appraisal. In their research, they reported the pretreatment Wits appraisal to be -7 ± 1.9 mm for patients treated by orthodontic camouflage and -11.2 ± 3.2 mm for patients who had undergone orthognathic surgery. Stellzig-Eisenhauer et al[1] reported similar findings where the Wits appraisal is the best measurement to use in delineating whether to treat a patient with orthodontic camouflage or surgery. However, regardless of pretreatment Wits measurement results, Martinez et al[21] and Troy et al[22] found that there was often incomplete decompensation of incisors in surgical patients, which impeded complete surgical correction of the skeletal malocclusion. This finding was also confirmed in other studies.[23-25] Therefore, after surgery, further compensation of the incisors was necessary to achieve good overjet and overbite.[22] Furthermore, owing to the incomplete decompensation of incisors in the surgical treatment group, there were no cephalometric values that showed statistical differences between the camouflage and surgery groups.[22]

Our patient started with an expander to correct her posterior crossbites. Because of the patient's age and lack of growth potential, the correction of her crossbite was dentoalveolar by buccal flaring of posterior teeth. Although there is individual variability in the exact time of palatal suture fusion, in general, the midpalatal suture starts closing at the age of 14-15 years in females and 15-16 years in males.[26] When the midpalatal suture matures, there is more dental tipping involved in the correction, and less skeletal expansion is possible.[26] If the patient was seen at an earlier age when it was evident that they were not finished growing and their midpalatal suture was not

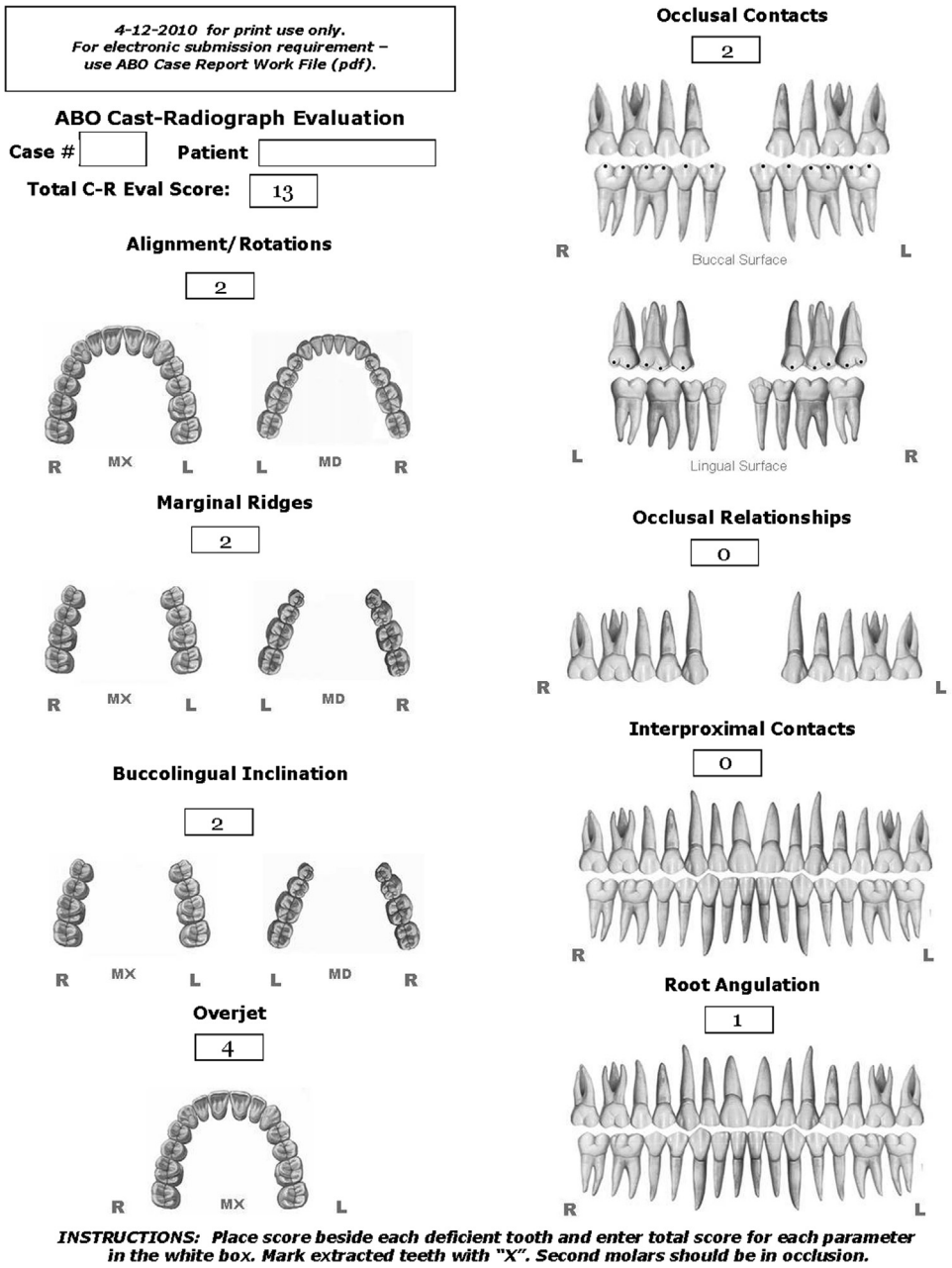


Fig 14. American Board of Orthodontics Cast-Radiograph Evaluation form. *ABO*, American Board of Orthodontics.

fused, the result of the tooth-borne expander would have been more skeletal in nature, leading to more stable over time owing to the skeletal correction.

We could have tried using a bone-borne expander to achieve more skeletal expansion in our nongrowing patient. Owing to the stresses around TSADs placed in the palate on a bone-borne expander, less dental tipping occurs.[27] However, because our patient presented with not only posterior crossbites but also with a need for Class III correction, we chose a treatment method that we thought would be best in correcting both at the same time. Even though further clinical studies are needed, Park et al[28] found through their finite element analysis that when trying to achieve expansion and maxillary protraction at the same time, the conventional tooth-borne expander enhanced the protraction, whereas the bone-borne expander had no influence or even reduced the protraction effects.

Although this treatment plan was not ideal, many times orthodontists are faced with providing camouflage treatment for patients because of the patients' finances or fear of surgery. We came up with the optimal treatment option for our patient and ended up with a favorable dental and esthetic facial result within the parameters of a camouflage treatment.

CONCLUSIONS

If an adult patient with a Class III malocclusion has a low mandibular plane angle, an expander and facemask might be used to induce downward and backward rotation of the mandible to improve their profile. However, to improve a patient's soft tissue profile and skeletal problems, orthognathic surgery is recommended.

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