

ISW for the Treatment of an Adult Facial Asymmetry Skeletal Class III Case

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Abstract

In this case, ISW (improved superelastic Ti-Ni alloy wire, commonly called a low-hysteresis wire, developed by Tokyo Medical and Dental University) was employed in the treatment of an adult facial asymmetry skeletal Class III case without extraction and surgery. A 23-year-old man came to our clinic with a chief complaint of poor bite and for esthetic consultation. A clinical examination revealed a bilateral Class III molar relationship with anterior crossbite and mild crowding with a lower midline deviated to the right. Active treatment included establishment of a crossbite arch in the upper arch by using an ISW without extraction and removal of the lower-right fixed bridge prosthesis. Using ISW and adequate Class III intermaxillary elastic traction meant that the malocclusion was corrected with a minimal orthodontic approach. Treatment was completed within 19 months, and a stable occlusion was achieved after the active treatment.

Introduction

Correct differential diagnosis of skeletal, functional, and dental anterior crossbite malocclusion has always been critical in clinical practice. The limitation of dental compensation includes the surrounding bone quantity and level. Nonextraction treatment of Class III malocclusion in adult patients usually requires distal movements of the mandibular molars to establish Class I molar and canine relationships [1-3].

When functional anterior crossbite occurs, the deviated mandibular position caused by anterior occlusal interference often misleads treatment planning and practice. In the case presented herein, due to the existence of a lower-right fixed prosthesis bridge, orthodontic treatment was brought up more strictly, being done without the removal of the lower-right fixed prosthesis according to the patient's wish. The patient's unstable mandible position, the so-called "mandibular position trap," resulted from two dimensions of occlusal malocclusion interference. One was the sagittal anterior crossbite, and the other was the fixed partial bridge over the 45-x-47 region. Because sequential orthodontic treatment originated with the idea of "transverse → sagittal → vertical," the lower-right fixed partial prosthesis partially contributed to the occlusal interference, resulting in facial asymmetry [4]. Therefore, the patient's chin was shifted slightly to the right. Moreover, the lower arch distalization and multiloop edgewise arch wire technique could not be applied over the lower dentition because of the prosthesis and because the posterior overbite/overjet had already been favorable. An improved super-elastic Ti-Ni alloy wire (ISW) crossbite arch was applied over the upper arch to correct the upper anterior crossbite. The overjet was reduced for two main reasons: the tipping of the upper anterior teeth and the adjustment to the mandible using Class III Intermaxillary Elastic (IME) traction. Active treatment was completed within 19 months. Harmony in the upper anterior dentition was achieved through derotation and anterior torque control. The bracket position of the correcting derotation and anterior crossbite was also critical. The Class III IME traction reduced the possibility of Obstructive Sleep Apnea (OSA) and contributed to a more suitable position of the hyoid bone. The suitable inclination of the upper anterior incisor and smile design was critical in this case. Because the lower-right fixed prosthesis was not removed, facial asymmetry was improved by simply correcting the upper anterior crossbite and changing the upper occlusal plane. Furthermore, the re-organization of soft tissue that resulted from correcting the upper anterior crossbite was also critical [5-9].

Diagnosis and Etiology

The patient was a 23-year-old Taiwanese man at the time of his initial visit. He came with a chief complaint of poor bite and for esthetic consultation regarding the upper anterior teeth. His profile was concave, and the frontal view showed facial asymmetry (Figures 1 and 2). His occlusion exhibited a bilateral Class III molar relationship and a Class I canine relationship. He presented with an anterior crossbite (overjet -4.0 mm), a deep bite (overbite -3.5 mm), and a lower midline deviation to the right side (2.0 mm). Upper and lower anterior dentition revealed mild crowding. Oral hygiene and gingival conditions were normal.

Cephalometric analysis showed a skeletal Class III jaw relationship (Figure 2, Table 1). The patient had a combination of a prognathic mandible and retrognathic maxilla (SNA

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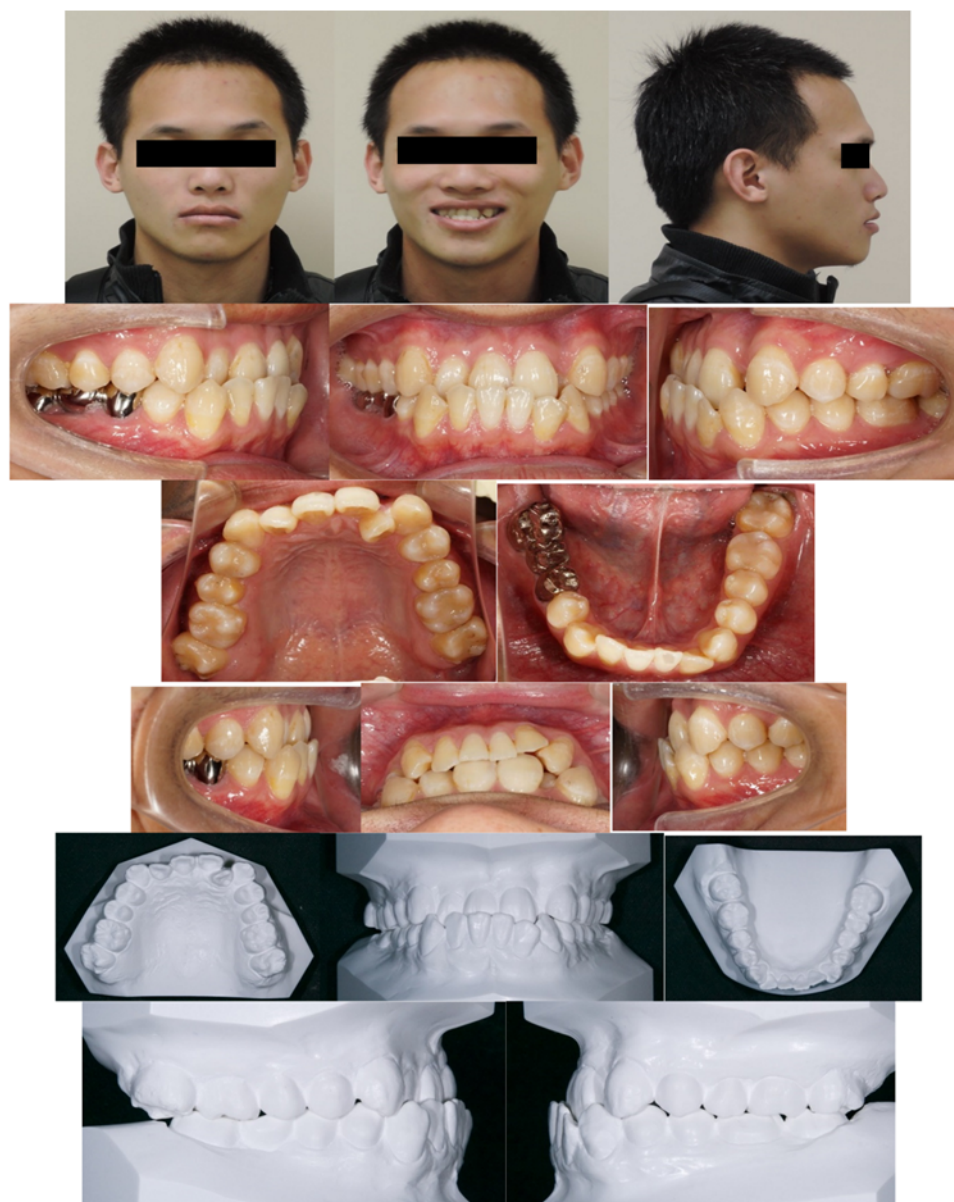


Figure 1: Pretreatment photographs and models (23 years 8 months old).



Figure 2: Pretreatment lateral and PA (postero-anterior) cephalometric radiographs (23 years 8 months old).

Measurements	Pretreatment (23y 08 mo)	PosttreatmentT (25y 05 mo)	Retention at 2y (27y 05 mo)
SNA	88.8	86.8	86.8
SNB	90.5	88.1	88.1
ANB	-1.8	-1.3	-1.3
FMA	21.9	23.2	23.2
U1 to FH plane	109.7	128.1	128.1
IMPA	88.8	90.2	90.2
Interincisal angle	139.6	118.5	118.5

Table 1: Cephalometric Comparison

88.8°, mean 81.82°; SNB 90.5°, mean 78.61°; ANB -1.8°, mean 3.28°). Vertically, he presented a short face, that is, a hypodivergent skeletal pattern (Frankfort-mandibular plane angle [FMA] 21.0°). Because he had an upper anterior crossbite, the interincisal angle was large at 139.6°, and the occlusal plane was relatively small (0.9°) due to the functional anterior crossbite. A temporomandibular joint (TMJ) radiograph showed no apparent irregularity over the condylar head (Figure 3). The diagnosis was skeletal Class III malocclusion with facial asymmetry. If the patient had preferred a full-mouth tooth alignment arrangement, the lower-right fixed prosthesis would have had to be removed (Figure 4).

A summary of the diagnosis is as follows:

1. Functional (+): anterior crossbite
2. Skeletal (±): ANB = -1.8°, skeletal Class III tendency
3. Denture (+): upper incisor (UI) to Frankfort horizontal (FH) plane (109.7°)
4. Dental (+): existence of #38
5. Discrepancy (+): upper: right: -4.0 mm, left: -6.0 mm
lower: right: -3.0 mm, left: -4.0 mm

The treatment plan included the following steps:

1. Extraction of #38
2. Full-mouth DBS (Direct bonding system) and leveling
3. Correction of the anterior crossbite using a crossbite arch
4. Confirmation of the mandibular position; long Class III IME traction to camouflage the esthetic concern

Treatment Objectives

ISW was used for management of the 23-year-old patient presenting with functional anterior crossbite and facial asymmetry with maxillary and mandibular anterior dental crowding. The treatment objective was to achieve an ideal occlusion of the bilateral angle's Class I canine and molar relationship.

Our treatment objectives were (1) to improve the patient's facial profile, (2) to improve the skeletal jaw relationship as much as possible by removing the occlusal interference of the functional anterior crossbite and redirecting the change of mandible position in a downward, backward direction, (3) to accomplish desirable anterior occlusion for establishing functional occlusion, (4) to correct the midline deviation, and (5) to follow up the retention to assess the need for further treatment.

Treatment Alternatives

Because of the patient's functional disharmony, we explained to him the high possibility of jaw movement if the functional interference of the anterior crossbite was removed. Also, bilateral upper first bicuspid extraction was possible if the patient had concerns about a protruding esthetic, as well as the possibility of removing the lower-right fixed prosthesis to correct the occlusal interference that was causing the mandibular shift, forming an asymmetrical facial profile [10]. We also informed him of the possibility of a surgical approach if he had a strong desire for profile improvement. The treatment alternatives included either extraction or nonextraction of the upper bicuspid, depending on the patient's expectations of profile

improvement. Because the patient preferred nonextraction, we thoroughly explained that if correcting the upper anterior crowding and crossbite resulted in further (subjective) concern of a protruding profile, extraction of the upper bicuspid would be an option during subsequent treatment.

Because IME traction could not be used over the lower dentition because of the lower-right fixed prosthesis, mandibular clockwise rotation would only contribute from if the upper molars were extruded. Mandibular clockwise rotation would enhance the reduction of the anterior overjet and offer improved vertical control; furthermore, because the patient preferred nonextraction and was unwilling to remove the lower-right fixed prosthesis, the treatment could only be accomplished by reassessing the treatment response regarding the correction of facial asymmetry and by using the ISW crossbite arch to tentatively remove the interference caused by the functional anterior crossbite.

Moreover, the patient strongly preferred nonextraction and nonsurgical treatment.

Treatment Progress

Treatment started on February 12, 2014, with upper arch DBS and leveling with a 0.016-inch × 0.022-inch L&H Titan Wire (ISW) (Tomy International Inc., Tokyo, Japan) for relief of anterior crowding (Figure 5).

On May 16, 2014, the crossbite arch was set between #13 and #23 to correct the anterior crossbite (with crimpable stoppers placed mesial to the bilateral upper canines to form a central omega loop) (Figure 6). Also, Class III IME traction was used to raise the bite and to adjust the jaw relationship.

On July 9, 2014, after 5 months of active treatment, the anterior crossbite was corrected (Figure 7). The anterior teeth reached an edge-to-edge relationship using an open coil spring for creating space between #21 and #23, an elastic chain for correcting the upper midline, and IME traction for Class III jaw relationship correction.

Soon afterwards, derotation of #22 was performed, and on August 20, 2014, re-DBS of #22, #31, and #35 was applied and an elastic chain for correcting the lower midline was fitted (Figure 8).

On January 12, 2015, after 5 months, derotation was completed through re-DBS of #12, #11, and #21 and upper and lower leveling with a 0.016-inch × 0.022-inch ISW (Figure 9). The periodontal condition of #22 was confirmed by using periapical radiography (Figure 10).

On March 16, 2015, panoramic radiography was used for reconfirmation, and re-DBS of #22, #32, #35, #43, and #44 was performed for ideal root parallelism to achieve more accurate root parallelism adjustment (Figure 11 and 12).

Finally, on June 10, 2015, an elastic chain for midline correction and right (3-3) and left (3-3) IME traction were used to consolidate the canine relationship and for final finishing and detailing (Figure 13).

Treatment Results

On September 16, 2015, after 19 months of active treatment, debonding of the bracket was performed, and a circumferential retainer was placed in the upper arch and a Hawley retainer in the lower arch (Figure 14).

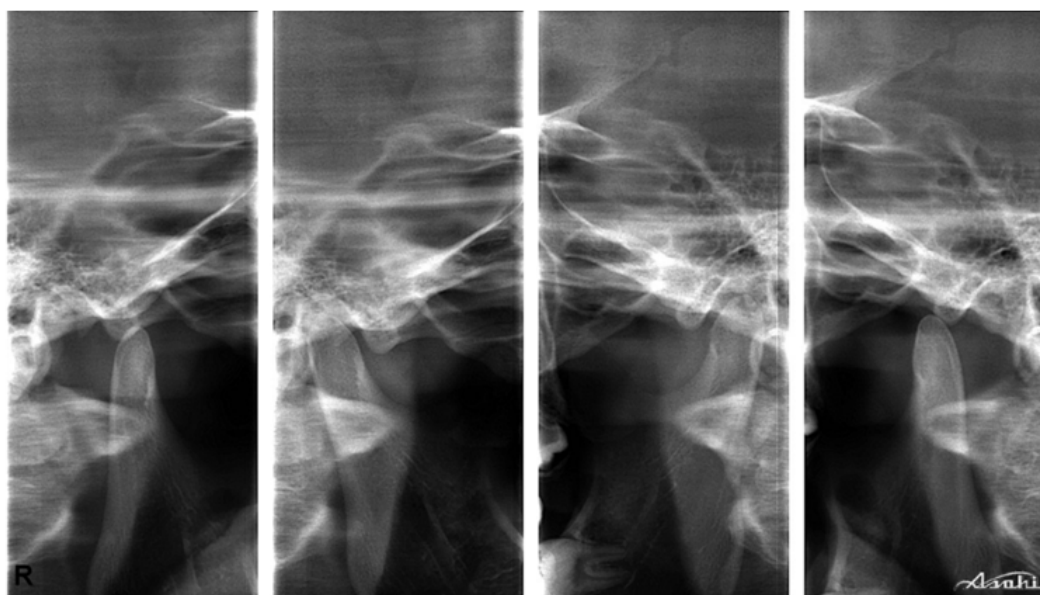


Figure 3: Pretreatment TMJ radiographs.



Figure 4: Pretreatment panoramic radiographs.



Figure 5: Intraoral photos of the beginning of active treatment.



Figure 6: Intraoral photos of 3 months of active treatment.



Figure 7: Intraoral photos of 5 months of active treatment.



Figure 8: Intraoral photos of 6 months of active treatment.



Figure 9: Intraoral photos of 11 months of active treatment.

#22 Periapical film



Figure 10: Periapical film of #22 of 15 months of active treatment.



Figure 11: Intraoral photos of 13 months of active treatment.



Figure 12: Panoramic film of 13 months of active treatment.



Figure 13: Intraoral photos of 16 months of active treatment.



Figure 14: Intraoral photos of 19 months of active treatment.

Active treatment was completed within 19 months, and a stable occlusion was achieved. After 19 months of active treatment, including 18 months of multibracket appliance treatment, the anterior crossbite and facial asymmetry were corrected and a normal functional occlusion was established (Figure 15).

The patient's profile had markedly improved, and the mandibular deviation had been corrected. A cephalometric superimposition (Figures 16 and 17, Table 1) showed that the anteroposterior relationship had improved (ANB $-1.8^{\circ} \rightarrow -1.3^{\circ}$). The UI had tipped labially (UI to FH plane $109.7^{\circ} \rightarrow 128.1^{\circ}$), with the SNA reduced (SNA $88.8^{\circ} \rightarrow 86.8^{\circ}$). Because of the upper molar extrusion, the mandibular plane was camouflaged by a downward and backward clockwise rotation of the mandible (FMA $21.9^{\circ} \rightarrow 23.2^{\circ}$).

The anterior overbite and overjet was ideal because of (1) the

change in the lower incisor (LI) to the mandibular plane ($88.8^{\circ} \rightarrow 90.2^{\circ}$) and (2) the change of the FMA angle, but mostly because of the correction of the anterior crossbite resulting from (3) the change of U1 to the FH plane angle ($109.7^{\circ} \rightarrow 128.1^{\circ}$) (Figure 18). The interincisal angle was reduced and compensated mostly by the tooth movement of the UIs (U1 to FH plane angle change $18.4^{\circ}/2.5^{\circ} = 7.36$ mm change in the anterior overjet).

In the panoramic view, the root parallelism was excellent, and no apparent root resorption was found (Figure 12). A 2-year follow up (the patient was 27 years old) showed that he had a balanced esthetic profile and occlusion, and he was pleased with the result (Figure 19). A comparison of the post-treatment (25 years and 5 months) and 2-year retention (27 years and 5 months) cephalograms (Figure 20, Table 1) illustrates stable dentoalveolar and maxillomandibular relationships.



Figure 15: Posttreatment photographs and models (25 years 5 months old).

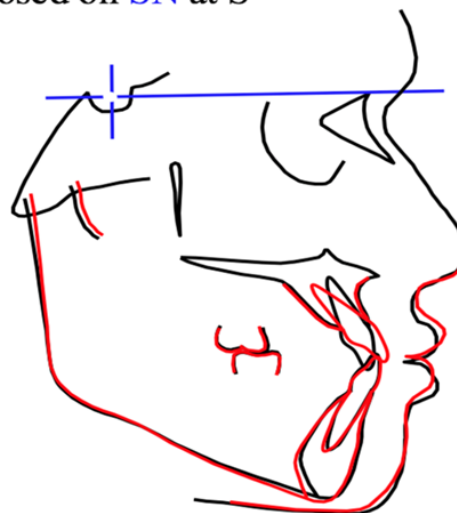


Figure 16: Posttreatment lateral and PA (posterior-anterior) cephalometric radiographs (25 years 5 months old).

Superimposition (1)

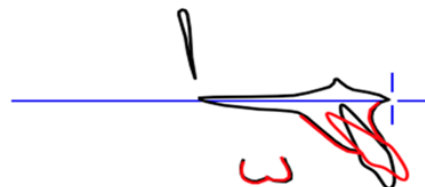
- Superimposed on **SN** at S -

— 23y 08m before
— 25y 05m after



Superimposition (2)

- Superimposed on **Palatal plane** at ANS -



- Superimposed on **Mandibular plane** at Me -

— 23y 08m before
— 25y 05m after

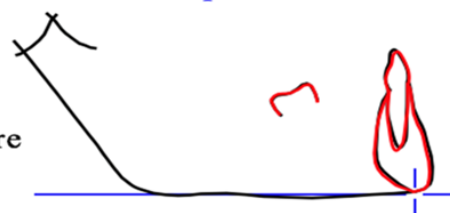


Figure 17: Superimposition of cephalometric tracings before (black line) and after (red line) treatment.

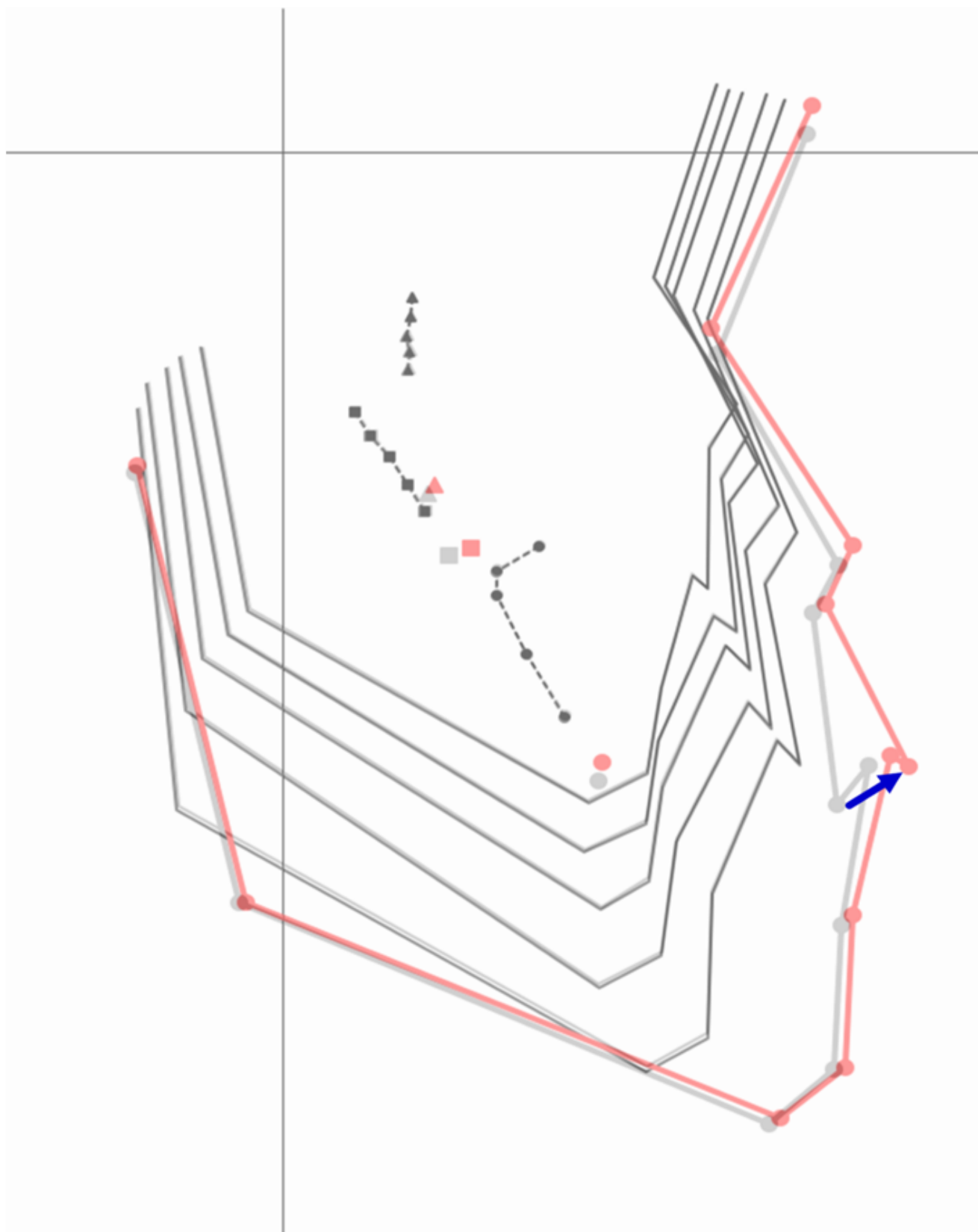


Figure 18: Anterior overjet correction results mostly from the change of U-1 to FH plane after treatment (blue arrow indicated the U1 tip movement).



Figure 19: Posttreatment photographs and models at 2-years follow-up (27 years 5 months old).



Figure 20: Posttreatment lateral and PA (posterior-anterior) cephalometric radiographs at 2-years follow-up (27 years 5 months old).

Discussion

Treatment using ISW crossbite arch to correct the anterior crossbite without extraction and surgery for the correction of facial asymmetry was critical in this case. The crucial part of the upper anterior crowding and the upper anterior crossbite caused further esthetic concern in the patient because of the demand of the upper anterior to flare out (tipping).

For a patient whose growth spurt had already passed, controlled tipping among the upper anterior teeth was considered vital. Without the expansion of the middle dentition and distalization of the posterior teeth, correcting the anterior crossbite was performed mainly through flaring out the anterior teeth, with the space also used for the derotation of the anterior teeth. Upper left lateral incisor derotation combined with the long Class III IME traction was adopted to reduce the overjet. For Ti-Ni wires such as ISW, friction control between the surface of the bracket slot and arch wire is paramount [11].

Differentially diagnosing a Class III case using dental, functional, or skeletal indicators is critical before active treatment. This case showed slight facial asymmetry, crowding over the anterior crossbite region, and the presence of a unilateral prosthesis in the lower-right portion. After 19 months of treatment, interdigitation was improved, and with the use of Class III IME, the anterior crossbite was corrected easily. Finally, a desirable esthetic outcome was achieved and the patient was pleased with the result. The discussion is continued in four categories.

Progress in Crossbite Correction (Figure 21)

An elastic chain was applied over the #11 and #12 palatal side. The upper anterior teeth inclination improved by 21° (labially), the overjet by 5 mm, and the overbite by 3 mm. The progress of correcting the anterior crossbite correlated with two vital factors: the bracket position of the upper anterior teeth and the interference of the lower anterior teeth. The overjet over the left anterior teeth (−2.0 mm) was smaller than the overjet of the right anterior teeth (−3.0 mm). The anterior crossbite was completely corrected within 5 months. On April 16, 2014, after 2 months of active treatment, a second crossbite arch was used for correcting the more demanding anterior overjet (−3.0 mm).

Midline control after the anterior crossbite was corrected deviated to the left side because of palatal tipping of the right lateral incisor, resulting in inadequate horizontal clearance; therefore, 1 month after the first crossbite arch (between #11 and #21) was applied, a second crossbite arch was used to effectively correct the anterior crossbite in the upper-left region. Discrepancy over the upper-left anterior teeth

was larger because #22 required derotation. Eliminating the lower anterior teeth occlusal interference included either not-in-slot over the lower anterior teeth or labial tipping over the lower anterior teeth (creating a horizontal clearance for the limited bracket bonded space of the upper anterior teeth).

Smile Arc Consideration (Figure 22)

The smile arc has always been a challenging consideration in all prosthodontic fields. For a more consonant smile arc and for anterior crossbite correction, upper incisors should be tipped forward to establish a normal overjet (according to Dr. Pitchford JH. published in JPD) [12]. Because the FH plane is not always parallel to the ground, the esthetic reference plane can be used to determine the presentation of a smile arc. Smile attractiveness was perceived to be improved and a more favorable smile line was established after the active treatment.

Bracket Position and Derotation (Figure 23)

Bracket position and derotation had a long-term influence in this case. Re-DBS of #33 was considered to eliminate the occlusal interference and improve the canine relationship. After the anterior crossbite was corrected, an elastic chain was applied for the derotation of #22. The space for the derotation was created by the effect of the crossbite arch.

Pharyngeal Airway and Hyoid Bone (Figure 24)

Because the treatment plan involved no extraction or surgery, the adjustment to the jaw relationship mostly derived from the Class III IME traction application. Although the patient denied any history of OSA, the hyoid to mandible distance decreased by 2.75 mm (6.90 to 4.15 mm), and the noted nasal congestion also improved. Patients with OSA have an inferiorly placed hyoid bone, which tends to result in markedly smaller airway dimensions. The patient's airway would have been enlarged if the hyoid bone was advanced and rotated counter-clockwise after the active treatment.

Conclusions

Friction control of Ti-Ni wires is critical in ISW treatment philosophy. Esthetic concerns should be critical when correcting an anterior crossbite, when derotating the upper-left lateral incisor, in torque control of the upper anterior teeth, and in appropriate IME traction for achieving an adequate anterior overjet [13-18]. Because the lower-right prosthesis was not included in the orthodontic tooth movement, distalization and space creation for the posterior part of the lower arch could not be achieved. Before the active treatment,

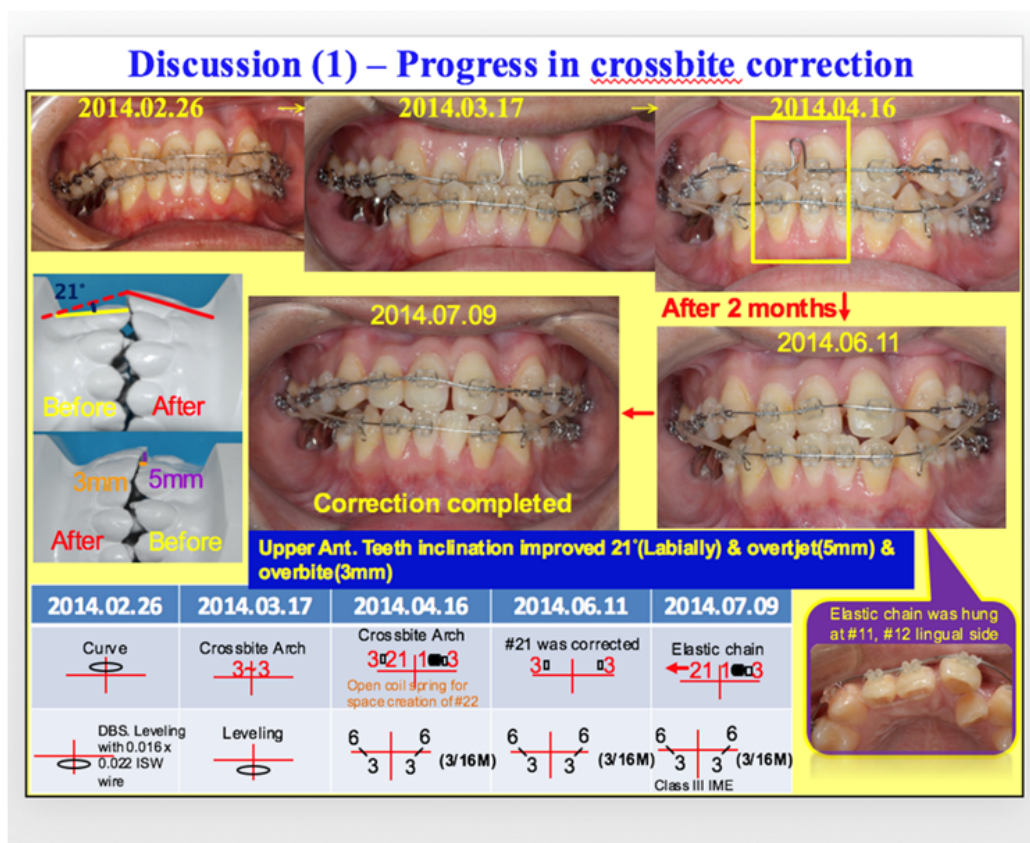


Figure 21: Progress in crossbite correction.

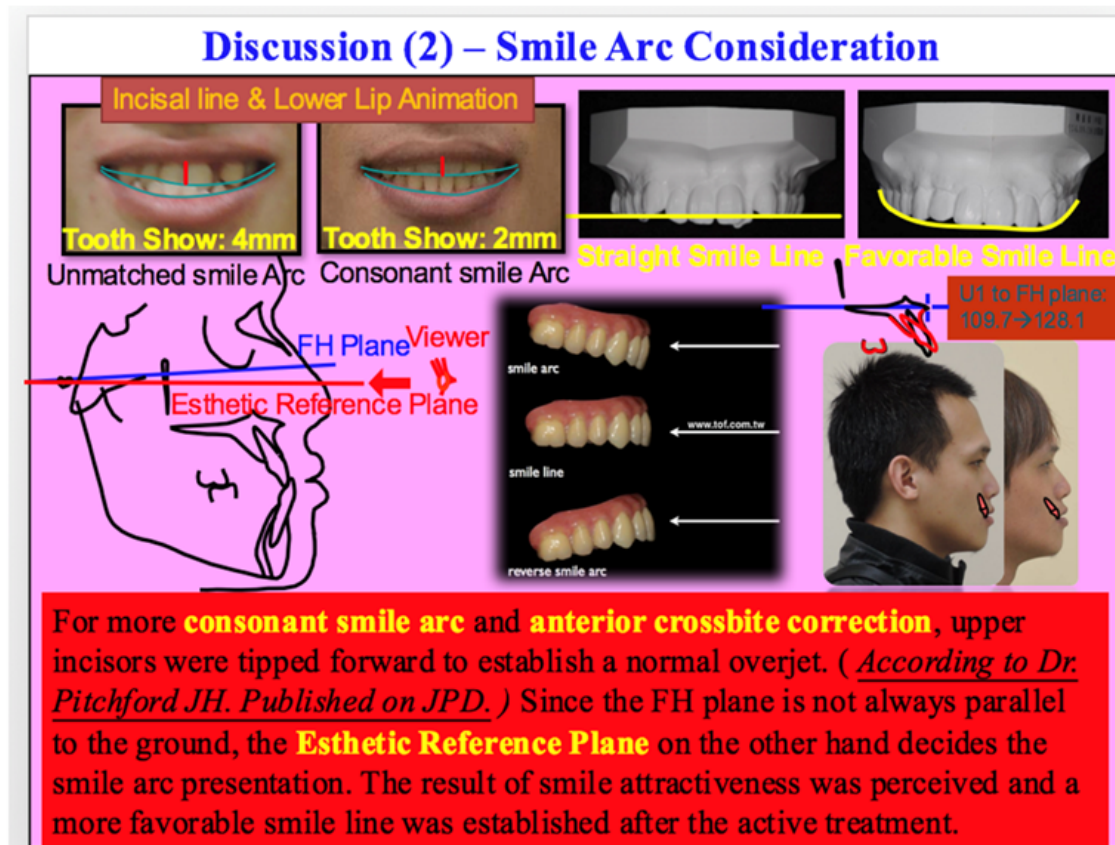


Figure 22: Smile arc consideration.

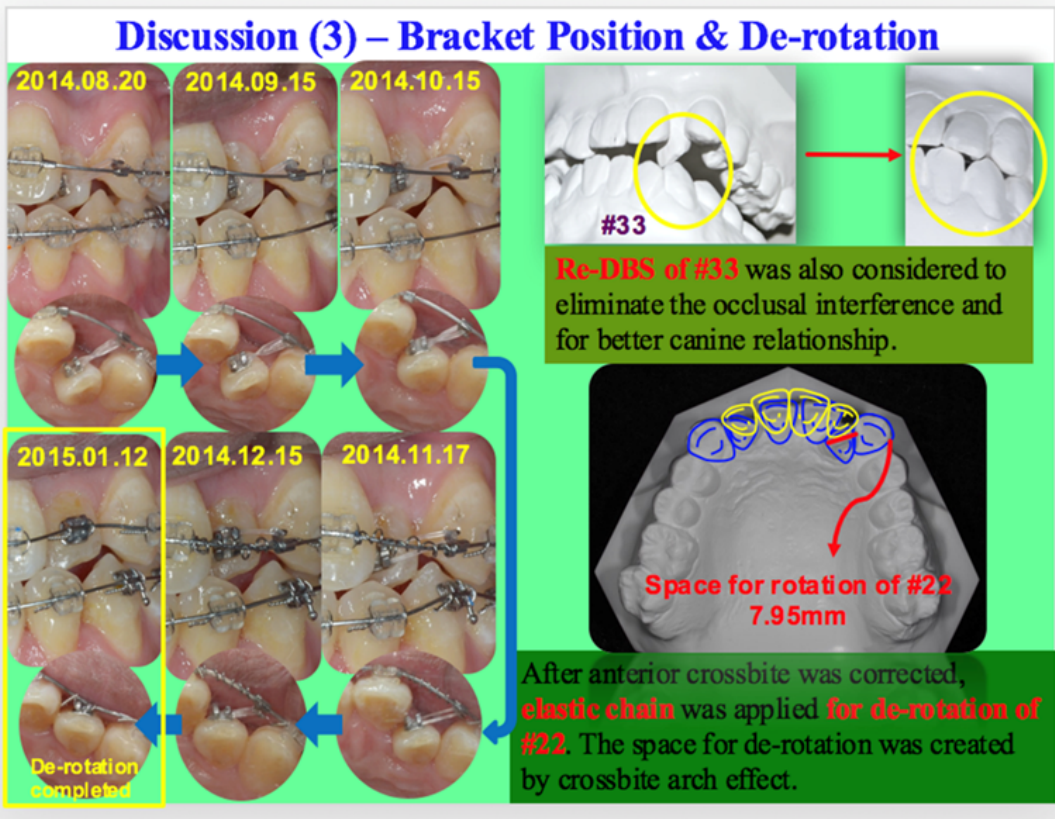


Figure 23: Bracket position and derotation.

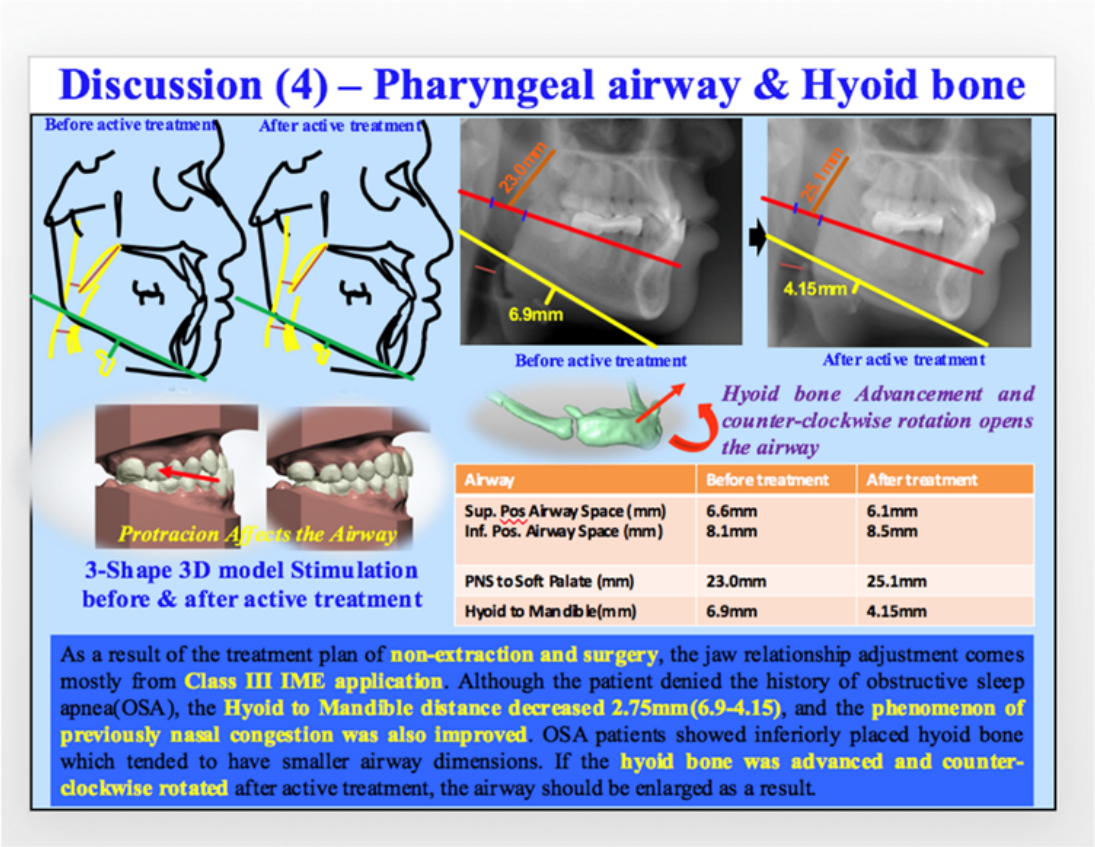


Figure 24: Pharyngeal airway and hyoid bone.

the patient already had a favorable lateral/posterior over jet. The anterior crossbite was corrected and a suitable anterior overbite and over jet was achieved mainly due to favorable upper anterior torque control and IME traction. Because of the patient's mid face concave profile, the flaring out of the upper anterior teeth improved the patient's divergent profile and enhanced the flaring effect of the lower anterior teeth. The active treatment included a crossbite arch in the upper arch by using ISW without extraction or removal of the lower-right fixed bridge prosthesis (using a Ti-Ni alloy ISW and adequate Class III IME traction). Consequently, the malocclusion was corrected using a minimal orthodontic approach. Treatment was completed within 19 months, and a stable occlusion was achieved after the active treatment.

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