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Abstract
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Keywords
Angle Class III malocclusion; Anterior crossbite; Camouflage orthodontic treatment; Improved super-elastic Ti-Ni alloy wire (ISW)

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CASE REPORT

Improved Super-elastic Ti–Ni Alloy Wire for Nonsurgical Treatment of Skeletal Class III Malocclusion Combined with Anterior Crowding and Anterior Crossbite Case

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ABSTRACT

The article reported the use of improved super-elastic Ti–Ni alloy wire (ISW), which was developed by Tokyo Medical and Dental University, to correct a case of skeletal Class III malocclusion combined with anterior crowding and anterior crossbite. An 18-year-old male with a chief complaint of poor dental alignment and protruded lower incisors showed up in our clinic for treatment. Clinical examination revealed skeletal Class III facial profile. Anterior crowding and anterior crossbite could be also noted. Because the patient refused orthognathic surgery, we tried camouflage orthodontic treatment. First, we used ISW crossbite arch to eliminate the anterior interference in order to observe the change of the mandibular position. After that, we use ISW multiloop edgewise arch wire (MEAW) technique and intermaxillary elastics to achieve midline correction and adequate overjet with the bite raising process. The treatment was finished with the improvement of facial appearance and a stable occlusion. Taiwanese Journal of Orthodontics 2023;35(1):46–58

Keywords: Angle class III malocclusion; Anterior crossbite; Camouflage orthodontic treatment; Improved super-elastic Ti–Ni alloy wire (ISW)

INTRODUCTION

Tokyo Medical and Dental University developed improved super-elastic Ti–Ni alloy wire (ISW, also named as LH [low hysteresis] wire). ISW is endowed with three superior abilities: super-elasticity, shape memory and damping capacity.1–3 The wire can be engaged into crowding dentition, and provide early dental torque control.

Skeletal Class III malocclusion is one of the most challenging malocclusions for orthodontists to treat. Discrepancies of skeletal Class III can be caused by maxillary retrognathia and/or mandibular protrusion.4 Anterior crossbite significantly affects facial aesthetics and the function of the masticatory system. The incidence of anterior crossbite in the Chinese population is high and the affected children often present with a hypoplastic maxilla together with a hyperplastic mandible. Orthognathic surgery (OGS) or dental camouflage are possible treatment options for adult patients with Class III who miss the early chance of early orthodontic treatment or wait for skeletal maturity. OGS requires pre- and post-surgical orthodontic treatment which increases the treatment costs. Patients also take chances for a surgical risk.5 Some patients are unwilling to accept this treatment.

However, non-surgical functional correction for skeletal Class III patients who has completion of growth and development is difficult to achieve. The present case report aimed to investigate the application of ISW in a late adolescent patient presenting...
with Angle Class III malocclusion and anterior crossbite. ISW was considered as a clinically useful, effective, simple non-surgical strategy for the treatment of anterior crossbite in adults.

CASE REPORT

An 18-year-old man came to our clinic with a chief complaint of protruded lower incisors and functional crossbite. He refused to have surgery correction for his skeletal problem. He also denied any major systemic diseases or drug allergies and was considered to be healthy.

Clinical findings

Clinical examination depicted a skeletal Class III malocclusion with a straight profile, retrognathic

Figure 1. Pretreatment facial and intraoral photographs (17 years 6 months old).
maxilla and upper lip. The patient had an anterior crossbite with −2.0 mm overjet and the molars had Class III dental relationship in both sides (Figure 1). Upon guiding the patient towards the centric relation, the patient could reach an edge to edge anterior occlusion and the reverse overjet of −0.5 mm, indicated an anterior shift of incisors by the patient in centric occlusion. The patient had already lost his upper left second premolar due to unrestorable caries.

The cephalometric analysis also confirmed the Class III malocclusion with mandible prognathism (SNA = 81.1°, SNB = 90.2°, ANB = −9.1°) (Figure 2). Vertical relations showed low mandibular plane angle (FMA = 19.3°) and the patient had proclined maxillary (U1 to FH = 121.7°) and retroclined mandibular incisors (Table 1).

Treatment objectives

In this patient, Class III malocclusion with anterior cross bite can be noted, and we want to achieve an ideal occlusion of the bilateral Angle's Class I canine and molar relationship as well as to correct functional cross bite by orthodontic treatment along.

Figure 2. Pretreatment panoramic, lateral cephalometric radiographs (17 years 6 months old).
Our treatment objectives were (1) to relieve crowding and eliminate the occlusal interference, (2) to correct the maxillary-mandibular discrepancy by maxillary advancement, (3) to correct the reverse overjet and to achieve an ideal overbite and overjet, (4) to achieve better arch coordination and interdigititation.

**Treatment alternatives**

If this patient desires to improve facial proportion and appearance, OGS should always be first considered. To relieve crowding and decompensate the flaring upper incisors, upper right first premolar extraction in the presurgical orthodontics. Meanwhile, lower anterior teeth should be flaring out for decompensation with non-extraction. Le Fort I osteotomy in the maxilla and bilateral sagittal split ramus osteotomy (BSSRO) in the mandible can correct the sagittal and transverse skeletal discrepancy. Reduction of mandibular angle can also improve the mandibular contour.

In non-surgical option, upper right bicuspid extraction was required to relieve his severe crowding and keep his upper dental midline. Under this condition, ISW crossbite arch technique was used to correct anterior crossbite and to eliminate dental interference. When interference of mandible was removed, we could re-check the mandibular position. However, this approach will also compromise the facial appearance. The patient declined the proposal of surgical-orthodontic treatment and agreed to receive camouflage orthodontic treatment instead.
Figure 3. Progressive intraoral photographs (3rd month).

Figure 4. Progressive intraoral photographs (5th month).
Figure 5. Progressive intraoral photographs (11th month).

Figure 6. Progressive intraoral photographs (25th month).
Treatment progress

After thorough explanation and discussion of the treatment options with the patient, he agreed to have orthodontic treatment without surgical approach. Before orthodontic treatment, all of third molars and upper right first premolar were extracted. Full mouth bonding was done with preadjusted edgewise metal brackets, Micro-arch, Roth type (Tomy company, Tokyo, Japan).

The preliminary leveling and alignment in both arches were gradually achieved after leveling. At the same time, Class III intermaxillary elastics (IME) were applied for bite raising. We used crossbite arch technique for crossbite correction (Figure 3). The crossbite was efficiently corrected within two months by this crossbite arch technique (Figure 4). The 0.016 Ni-Ti Sentalloy wire and elastic chain (#34 to #44) were used for overjet reduction by lower anterior lingual tipping (Figure 5). To correct lower
dental midline, unilateral multiloop edgewise arch wire (MEAW) in lower left region and short IME (12-43 22-32) were used (Figure 6). After 37 months active treatment, full mouth brackets were deboned.

Treatment results

After 37 months of therapy, adequate overbite, overjet and coordinated dental midline were achieved. The lip profile of the patient was greatly improved. Before orthodontic treatment, the patient’s upper lip was behind to the esthetic line and lower lip was forward to it. After orthodontic treatment, both this upper lip and lower lip are in line with the esthetic line. Overall, the patient was satisfied with his profile improvement and smile arc (Figure 7).

The cephalometric analysis indicated almost all the measurements had greatly improved (Figure 8). Due to functional crossbite correction and bite raising effect by the Class III IME, mandibular plane

Figure 8. Post-treatment panoramic, lateral cephalometric radiographs (17 years 6 months old).
angle was increased (19.3° → 27.9°) and ANB angle was decreased (-9.1° → -5.6°) (Figure 9, Table 2).

Because the patient refused to accept invasive surgery, we can only correct the anteroposterior relationship with camouflage treatment. At the end of treatment, we gave the patient a circumferential retainer at the upper arch, a Hawley retainer at the lower arch, and auxiliary clear plastic retainers for retention. Moreover, a functional orthopedic appliance was also provided to stabilize the inter-jaw relationship for night wearing only.

**DISCUSSION**

Functional shifts of the mandible can happen in any direction. There are different types of functional shift

<table>
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<th>Table 2. The polygon of cephalometric measurements after active treatment.</th>
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<td><strong>Facial angle</strong></td>
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including lateral functional shifts, which cause unilateral posterior crossbites; or forward functional shifts, which cause pseudo Class III malocclusions.\(^6\) Our case had forward functional shift, which was confirmed by an edge to edge anterior occlusion was presented by guiding his mandible toward the centric relation. Functional crossbite are mainly caused by occlusal interference of the lingually displaced upper anterior teeth to occlude with the lower teeth, hindering the normal closure of the mandible in the normal centric relation. According to the study that was presented by Adly et al., all types of functional shifts totally disappeared after bite opening and the mandible resumes its normal functional position automatically.\(^7\) Therefore, we let patient have long Class III elastics for bite opening at the beginning of treatment.

At the same time, we used crossbite arch technique to correct his crossbite. Crossbite arch technique is constructed by fixation of ISW archwire with two stoppers mesial to canines by forming an omega loop in between the upper central incisors. The following procedure is how we performed this technique. We used the black midpoint of the archwire as a guide to locate the stoppers. Then we ligated the archwire with stoppers, from mesial side of the two canines, gradually to the central incisors. After full ligation of all the teeth involved, an anterior crossbite arch was formed. With the assistance of Class III elastics, the efficiency of correction was noticeable (Figure 10). After usage of crossbite arch technique, we will gain space for crowding relief (Figure 11).

Figure 10. Crossbite arch technique.

Figure 11. With space which created by crossbite arch technique, tooth 23 was mesial moved to regain space for tooth 25. The stoppers located mesial and distal to tooth 22 were used for anchorage reinforcement.
For Class III bite correction, we used long Class III IME (L4-U6) for mandibular plane opening and preventing lower anterior teeth from lingual tipping (compared with L3-U6 elastics) initially. When the edge to edge was achieved or the anterior crossbite was corrected, long Class III IME (L3-U6) was used for continuing opening of mandibular plane till adequate anterior overjet achieved. Behavior control was also important. During the phase of bite correction, we suggested the patient not to bite hard food to avoid unnecessary interference from the antagonistic teeth (Figure 12).

According to Seung-Hak Baek et al., dental space could be created from tipping back the posterior teeth by MEAW. Therefore, with unilateral MEAW in lower left region and IME, we created space over the lower left area. This space could be used to correct lower dental midline and canine relationship.

Before orthodontic treatment, the patient's upper lip was behind the esthetic line and lower lip was

Figure 12. Intermaxillary elastic strategy for crossbite correction.
forward to it. After orthodontic treatment, patient's upper lip and lower lip were located on the esthetic line (Figure 13). This favorable change benefits from the buccal flare-out of the upper anterior teeth as a result of crossbite arch technique and lingual tipping of the lower anterior teeth as a result of the lower MEAW application.

**CONCLUSION**

In this case, we corrected poor dental alignment and functional crossbite by rapid leveling and crossbite arch technique by using ISW. ISW can provide an efficient approach to correct this particular malocclusion. After 37 months of treatment, a desirable esthetic outcome was achieved. This patient was pleased with the final treatment result.

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**ETHICAL APPROVAL**

Not required.

**PATIENT CONSENT**

Provided.

**CONFLICT OF INTEREST STATEMENT**

The authors declare no conflicts of interest.

**REFERENCES**


