Improved Super-elastic Ti-Ni alloy wire (ISW) for Treatment of Adult Angle Class III with Anterior Crossbite

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Improved super-elastic Ti-Ni alloy wire (ISW); functional anterior crossbite; differential multiloop edgewise archwire (MEAW) technique; intermaxillary elastic (IME) strategy.

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CASE REPORT

Improved Super-elastic Ti–Ni Alloy Wire (ISW) for Treatment of Adult Angle Class III With Anterior Crossbite

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ABSTRACT

An adult female (35 years old) came for orthodontic consultation with a chief complaint of poor dental alignment with protruded mandible. Clinical findings revealed that Class III malocclusion with functional anterior crossbite. Low Hysteresis Improved Super-elastic Ti–Ni alloy wire (ISW), developed by Tokyo Medical and Dental University with ISW curve applied over upper arch for flaring out the upper anterior tooth. MEAW technique applied on lower arch to correct a negative overjet. Treatment was completed within 41 months and patient was pleased with the improvement of appearance and dental alignment. *Taiwanese Journal of Orthodontics 2023;35(3):147–157

Keywords: Improved super-elastic Ti–Ni alloy wire (ISW); Functional anterior crossbite; Differential multiloop edgewise archwire (MEAW) technique; Intermaxillary elastic (IME) strategy

INTRODUCTION

A Class III malocclusion is a type of dental misalignment refer to a situation result from numbers of either facial skeletal or dental alveolar anomalies. Therefore, Class III malocclusions can be classified into three types: pseudo, dentoalveolar, and skeletal. These classifications include a prognathic mandible with a normally positioned maxilla, a retrognathic maxilla with a normally positioned mandible, and a retrognathic maxilla with a prognathic mandible.1,2 Class III malocclusion’s occurrence varies between 0% and 26%. This is influenced by factors like genetics and the environment, as well as differences in ethnicity, gender, and geographic location.3–6 People from China or other Asian countries show a higher prevalence than other races. This can cause functional and aesthetic problem and may require orthodontic treatment or undergo an orthognathic surgery to correct the anomalies.

Anterior crossbite with functional mandibular shift also known as pseudo Class III malocclusion. It is a malocclusion that maxillary and mandibular anterior tooth occlude edge to edge in centric relation, then forcedly guided mandible anterior position in centric occlusion.7 Anterior crossbite may produce increased pressure on periodontium and lead to structural trauma during mastication, potentially causing harm and discomfort.8,9

This article aimed to presents a case of Angle Class III with anterior crossbite. We used low hysteresis improved super-elastic Ti–Ni alloy wire (ISW), developed by Tokyo Medical and Dental University, and multiloop edgewise archwire (MEAW) technique, ISW curve and intermaxillary elastic to successfully correct the negative overjet and improve the dental alignment.10,11

CASE REPORT

History and diagnosis

An adult female (35 years old) came for orthodontic consultation with a chief complaint of poor
dental alignment with protruded mandible. In the clinic, we could directly observe her lateral profile belonged to concave type. From the frontal view, the chin showed a mild deviation to the left side. The maxillary midline was coincided with the facial midline, but the mandibular demonstrated a minor left deviation of 0.5 mm (Figure 1).

Clinical examination revealed bilateral Class III canine and molar relationship with anterior crossbite and mild lower anterior crowding (Figure 2). The radiographic examination was done by an experienced dental radiologist in patient bite in the centric occlusion and closed lips. The panoramic film photograph showed all third molars were extracted in four quadrants (Figure 3). The cephalometric radiograph showed skeletal Class III jaw relationship with hyperdivergent pattern (SNA: 86.5°, SNB: 91.5°, ANB angle, −5.0°) and dental compensation (U-1 to FH plane: 121.0°, L-1 to mandibular plane: 83.5°) (Figure 4 and Table 1).

Therefore, the patient's summary diagnosis reveals the following findings: The patient presents a pseudo Class III malocclusion accompanied by a functional anterior crossbite. This indicates that...
when patient's teeth come together in centric occlusion, the upper anterior teeth are positioned behind the lower anterior teeth. Consequently, to achieve proper occlusion, the upper anterior teeth tend to procline labially, while the lower anterior teeth retrocline lingually simultaneously. This observation is clearly depicted in the polygon chart, where the angle between the upper incisor and the Frankfort Horizontal plane measures 121.0°, and the angle between the lower incisor and the Mandibular plane is 83.5°. Notably, no significant dental issues were identified during the diagnosis.

Treatment alternatives

Various treatment options were taken into consideration to address both the skeletal and dental malocclusion. In this case, orthodontic treatment combined with orthognathic surgery might be the best way to solve the skeletal problem considering the facial esthetic. During the period of pre-orthodontic phase, a bilateral first premolar extraction and lower arch leveling is essential to achieve an adequate decompensation of the sagittal malocclusion and create the most optimal surgical conditions. The surgical procedure involves a Le Fort I operation on the maxilla, where the upper jaw is advanced forward, and a bilateral sagittal split ramus osteotomy (BSSRO) on the mandible to set it back.

We extensively discussed the camouflage alternatives and clarify that the underlying skeletal anomalies would remain unresolved and the occlusion wouldn't be stable and harmonious enough when comparing to the orthognathic surgery.
However, patient still refused surgery, and therefore non-surgical orthodontic approach became an alternative.

The process of dental camouflage using mechanism involved ISW curve and MEAW technique with intermaxillary elastic (IME) for correcting the anterior crossbite to reduce overjet and for relieving mild lower anterior crowding. In the end, correction of arch coordination, a compromised and acceptable bite control and occlusal stability were achieved and maintained.

Treatment objectives

Considering the patient’s request of improving the poor dental alignment and profile without undergoing orthognathic surgery, our treatment objectives were (1) to facilitate the correction of the anterior crossbite (2) to achieve bilateral Class I canine and molar relationship (3) to improve facial profile (4) to establish appropriate overbite and overjet (5) to achieve better arch coordination and individualized occlusion.

Therefore, our treatment plan for dental camouflage included:

- Full mouth bonding and ISW leveling.
- MEAW technique for negative overjet correction.
- IME for mild facial asymmetry.

Treatment progress

The activation of the treatment was started with lower arch bonding using pre-adjusted edgewise metal brackets, Micro-arch, Roth prescription (Tomy company, Tokyo, Japan). Initial leveling with 0.016 × 0.022 ISW. Meanwhile, long Class III IME were applied between the 16–43 and 26–33 (Figure 5).

After 5 months of treatment, the minor anterior crowding was relieved. But the problem of anterior crossbite still remained, so upper arch was bonded and ISW curve mechanism was applied over upper arch to flare out the upper anterior teeth. The correction of anterior crossbite was done within 2 months (Figure 6).

For adjustment of left-sided arch coordination, ISW MEAW technique was performed on the lower left side arch. Class III IME were also applied between the 16–43 and 26–33 for further correction of lower anterior crossbite (Figure 7).

Table 1. The polygon of cephalometric analysis of the patient before treatment.

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<tr>
<th></th>
<th>Value</th>
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<th>S.D.</th>
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<td>4.40</td>
<td>-8.58</td>
<td>-1.95</td>
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</table>
Figure 5. Period of active treatment: 0 month.

Figure 6. Period of active treatment: 5–7th month.

Figure 7. Period of active treatment: 11th month.
With midline assumption, differential MEAW technique (right and left side with different degrees) was applied over the lower arch. At the same time, interferences from the antagonistic teeth were noticed. Not-in-slot technique applied on teeth 13 and 23 can temporarily eliminate the cuspal interferences by intruding the teeth (Figure 8).

For constricting the lower arch, lower stripping at the interproximal area from 32 to 42 and elastic chain was applied over the lower arch from 36 to 46. At this moment, several teeth needed to be repositioned for establishing a better cuspal interdigitation. So, Class II IME were applied between the 13–46 and 23–36 (Figure 9).

After 41 months of active treatment, the full mouth bracket was debonded. Circumferential retainer was delivered for the upper arch and Hawley retainer for the lower arch.

**Treatment result**

With the chief complaint of poor dental alignment and protruded mandible, the final records showed that problems were improved with the help of MEAW technique and IME (Figure 10). A compromised occlusion was established, both maxillary and mandibular midline were coincided with the facial midline, and bilateral Class I canine relationship achieved. Finally, the anterior crossbite was corrected to positive overjet.

Since the patient refused to orthognathic surgery, we can only deal with the problem of dental and surrounding alveolar bone. The posttreatment cephalometric radiograph (Figure 11 and Table 2) still showed several cephalometric measurements out of normal range. Polygon and superimposition illustrated dental decompensation was achieved.
(mandibular plane angle was increased from 24.0° to 26.0° and U-1 to FH plane angle was changed from 121.0° to 128.5°) by ISW curve and Class III IME. SNB and ANB angle were also reduced (SNB angle reduced by 91.5°–89.5° and ANB angle reduced by −5.0° to −3.5°) (Figure 12).

DISCUSSION

In this case, we discussed the mechanism of ISW differential MEAW technique. By using ISW with Class III MEAW and IME, we successfully corrected the anterior crossbite and mild facial asymmetry. After the treatment, although a compromised and acceptable outcome was achieved, the patient was pleased with the treatment result.

We chose ISW as our material for orthodontic treatment relying on its exceptional characteristic such as shape memory, super-elasticity, shock and vibration absorbing property, and capacity to achieve individualized normal occlusion. ISW consistently exert extremely light orthodontic force that remain steady and unaffected by intraoral temperature. The minimal load-hysteresis property provide patient a gentle bending sensation, considerably enhance overall comfort through the treatment process.

Clinical examination of functional anterior crossbite

The diagnosis of combined anterior crossbite with functional mandibular shift and skeletal
anomalies including typical intra- and extra-oral clinical examination and evaluation of patient's temperomandibular joint function. One of an additional diagnostic technique is to assess the ability of mandible movement. In order to confirm the presence of functional mandibular shift, our orthodontists may perform the procedure by manipulating the mandible backward to check if

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Table 2. The polygon of cephalometric analysis of the patient after treatment.

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</tbody>
</table>

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Figure 11. Cephalometric radiograph after treatment.
the patient can achieve the occlusion that upper and lower anterior teeth bite in edge to edge position without experiencing any discomfort in TMJ.

**ISW curve**

The ISW curve is a wire bending technique used in orthodontics that relies solely on manual manipulation. By placing utility pliers in the space between the canines and the first premolars, we create a shape that reverse the curve of Spee. The angle of the bend is adjusted based on the severity of the patient's condition.

The ISW curve serves multiple functions. Apart from flattening the curve of Spee to bring the anterior teeth outward and address molar intrusion, bite raising is also a crucial function for adjusting the occlusion. Last but not least, it also enhances anchorage for posterior tooth movement. If the desired effect is not achieved, crimpable stoppers can be placed on the mesial side of the first molars to maintain wire length and enhance the curve's effect. Finally, heat treated wire can be a way to increase its rigidity. In our specific case, it's clear that we successfully corrected the initial crossbite by employing the ISW curve mechanism on the upper arch. This approach led to the desired outcome of flaring out of the upper anterior teeth, a result from applying the curve, and (2) lingual tipping of the lower anterior teeth, which was the result from the lower MEAW application (Figure 13).

**MEAW technique**

Both ISW wire and SSW wire can effectively demonstrate the characteristic of MEAW technique which encompasses space creation, establishing anchorage for tooth movement, opening of the

**Facial profile change**

Before the orthodontic treatment, we can find this patient's upper lip was lingual to the E-line. Upper and lower lips relative to the E-line are –2.5 mm/+2.0 mm before the treatment and 0.0 mm/+0.5 mm after the treatment. This favorable change

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**Figure 12. Cephalometric superimposition of pretreatment and posttreatment.**

**Figure 13. Changes in facial profile in before and after treatment.**
mandibular plane, and dental arch constriction. Due
to the absence of complex L-shaped bending in ISW
MEAW technique, it creates fewer undercuts that's
not reachable. This design makes it easier for pa-
tients to maintain their oral hygiene, leading to a
notable enhancement in comfort levels. Moreover,
the SSW MEAW technique is much more technique
sensitive and time-consuming. In the contrary, we
can easily perform ISW MEAW bending in the same
appointment with the heat bender.
Various methods are available for space creation,
such as extraction, interproximal stripping, and
MEAW technique. In this situation, we applied the
MEAW technique, by performing serial step-up and
tip-back bends using a heat bender. With the effect
of MEAW technique, we accomplished uprighting
and distal tipping the tooth from canines to second
molars contributing better tooth control.
In this case, MEAW technique was utilized not
only for arch constriction to achieve improved arch
coordination, but also used differential MEAW
technique for midline correction. It's notable that
the lower first molar was uprighted within 5°
(Figure 14). We used the MEAW technique in
conjunction with Class III IME to successfully
address the anterior crossbite. This led to an
improvement in the overall profile appearance of
the patient. The reduction in overjet was achieved
through adjustments in the inclination of the in-
cisors and changes in the occlusal plane.
Not-in-slot technique

In order to achieve the maximum effect of MEAW, we eliminated the 23 interference that would interfere with the movement of the lower teeth. Using not-in-slot technique, we intentionally placed the archwire underneath the bracket instead of engaging the wire into the slot. The resilience forces of the archwire temporarily intruded the 23, so that the interference from the antagonistic tooth could be temporarily eliminated (Figure 15).

IME strategy

We initially employed bilateral Class III IME on tooth 16–43 and 26–33 to enhance the correction of the lower anterior crossbite and attain improved balance. Following the successful correction of the anterior crossbite, we transitioned to utilizing bilateral Class II IME 13–46 and 23–36. This adjustment aimed to manage the inclination of the upper incisors, guiding them to tip in a lingual direction, thereby preventing Class III protrusion (Figure 16).

CONCLUSION

With the help of ISW curve accompanied with MEAW technique, we can successfully correct the anterior crossbite and achieve notable enhancement in the facial profile. The use of IME facilitates midline adjustment and establish better arch coordination. After a 41-month active treatment, a normal individual occlusion and appropriate overbite and overjet were achieved.

FUNDING

All authors declare that the study has received no financial support.

ETHICAL APPROVAL

Not required.

PATIENT CONSENT

Provided.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

REFERENCES