

# ISW (improved super-elastic Ti-Ni alloy wire) for non-extraction treatment of adult case with linguoversion of bilateral lower second premolars

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Summary: An adult male (20 years old) came to our clinic with a chief complaint of lower posterior crowding. Clinical examination found mild spacing over the lower anterior teeth and lingually blocked-in lower second premolars. Because the patient didn't want to receive extraction treatment, ISW (improved super-elastic Ti-Ni alloy wire) leveling was performed to relieve lower arch crowding. Sufficient space was created by distalization with open coil spring and crimpable stopper. With ISW MEAW-like wire as reinforced anchorage over the lower arch, a satisfactory result was obtained. Meanwhile, lower left second premolar was derotated with open coil spring and elastic chain. Treatment was completed within 11 months and a stable occlusion was achieved after the active treatment.

Keywords: premolar linguoversion, distalization , ISW(improved super-elastic Ti-Ni alloy wire), orthodontic treatment

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## **Introduction**

Distalization of mandibular molars is one of the most difficult orthodontic treatments; it is more difficult than the distal movement of maxillary molars<sup>1</sup>.

Ideally the distalization of molars should be in bodily movement without distal tipping; however, bodily movement is hard to achieve. The greater the distal tipping is, the more unfavorable influence occurs on the occlusion and on the stability of treatment results<sup>2</sup>.

The causes of lower arch crowding include tooth size/arch length discrepancy, premature loss of primary second molar, traumatic displacement of tooth, ectopic eruption, poor eruption direction, second molars erupt early, prolonged retention of primary teeth...etc<sup>3,4</sup>. This case showed lower bilateral second premolars were with blocked-in linguoversion.

Distalization of the mandibular molars enables the clinician, without extracting premolars, to correct anterior crossbites, mandibular incisor crowding, mandibular dental asymmetry, especially to resolve mandibular tooth size/arch length discrepancy<sup>1,5</sup>. The methods of resolving tooth size arch/length discrepancies include distalization of molars, stripping, extraction of teeth, flaring of incisors, and expansion of the arches<sup>5</sup>. Several ways can be used to move the mandibular molars distally, eg, mandibular headgear, lip bumper, distal extension lingual arch, Jones jig, Franzulum appliance, and multiloop edgewise archwire<sup>1</sup>.

The super-elastic nickel-titanium(Ni-Ti) alloy wires with low stiffness and high spring-back are generally used in the leveling

and alignment of orthodontic treatment<sup>6</sup>. And the SMAs(shape memory alloys) are materials with an intrinsic ability to remember an initial configuration. It has two main unusual behaviors: the super-elastic effect and shape memory effect<sup>7</sup>. The stress hysteresis of the ISW (improved super-elastic Ti-Ni alloy wire) was significantly smaller than that of the conventional austenitic-active super-elastic Ni-Ti wire and the frictional resistance of ISW wire was lower than that of the Sentalloy wire<sup>6</sup>. ISW has three main mechanical behaviors: the super-elastic effect, shape memory effect and shock and vibration absorbing property.

In this paper, we reported a case of an adult male with bilateral lingually blocked-in lower second premolars who received orthodontic treatment by using ISW wire (developed by Tokyo Medical and Dental University ) and a technique “crimpable stopper with open coil spring” for distalization of lower molars.

## **Patient’s history**

The 22-year 1-month-old adult male came to our clinic with a chief complaint of lower posterior crowding. He had no history of systemic diseases, bad oral habit, drug and metal allergies. The clicking sounds on his bilateral TMJ were not found while mouth opening. Clinical examination found mild spacing over the lower anterior teeth and bilateral lingually blocked-in lower second premolars(figure1-4).

## **Diagnosis**

The patient had a canine Class II and

molar Class III dental malocclusion and skeletal Class I pattern, with 5.0mm of overbite, 2.0mm of overjet, upper anterior teeth labially tipped, #35,#45 lingually blocked-in, and a mild curve of Spee. The maxillary and mandibular arches are both ovoid shaped. The arch length discrepancies were 0 mm in the maxillary arch and -12.0 mm in the mandibular arch.

From his facial photo, no facial asymmetry and mentalis strain, normal nasolabial angle, slight convex facial profile, and no gummy smile could be cited (figure 1).

### **Treatment plan and treatment**

### **objectives**

Non-extraction orthodontic treatment was adopted after discussion with the patient. The patient's lower arch crowding was corrected by lower bilateral molars distalization and dental midline correction would be included in the treatment plan.

Treatment objectives:

- Facial esthetics: to improve facial balance, and profile convexity.
- Establish individual adequate overbite, overjet and arch coordination
- Establish individual coincident occlusion
- Lower arch crowding relief



Fig 1. pretreatment facial photographs.

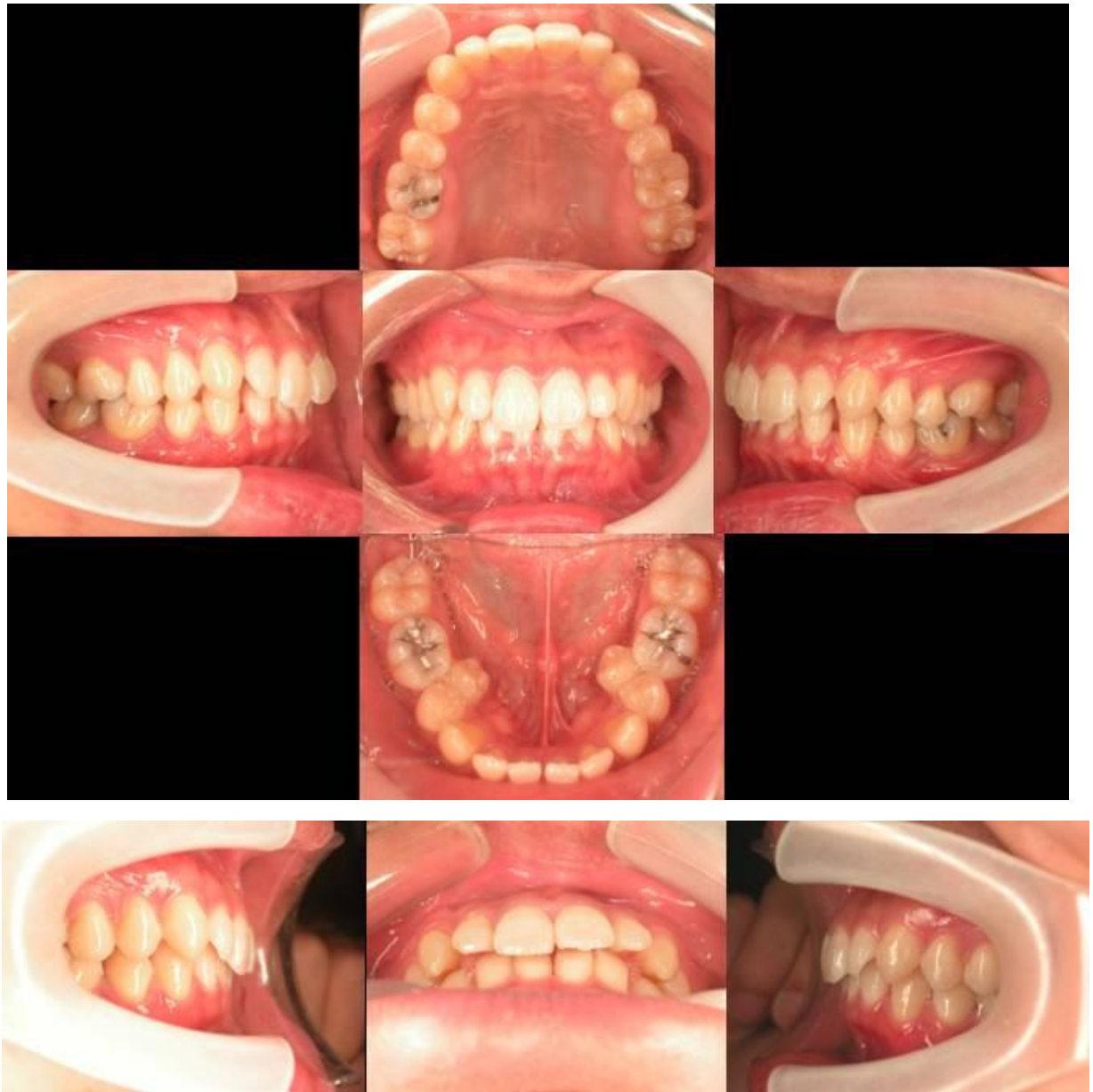


Fig 2. pretreatment intraoral photographs.



Fig3. pretreatment panoramic radiograph



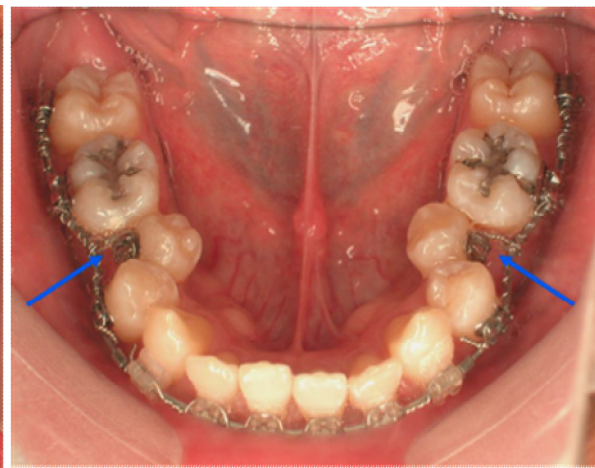
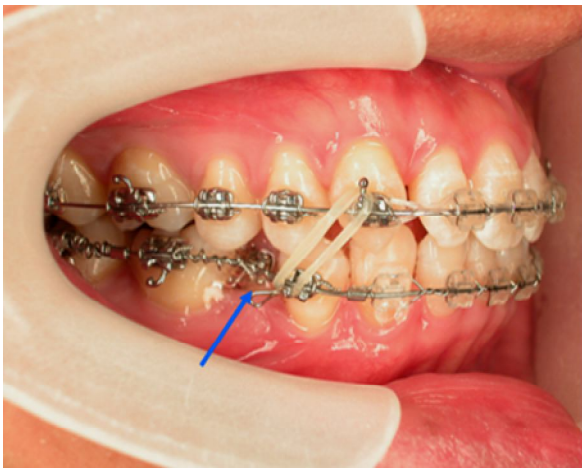
Fig 4. pretreatment cephalometric lateral and PA views



a.



b.



c.





d.

Fig 5. treatment process

- (a) Period of active treatment: 0 m, lower molar distalization (crimpable stopper + open coil spring)
- (b) Period of active treatment: 2m, one stopper with two open coil springs were set between lower first premolar and first molar
- (c) Period of active treatment: 4 m, mechanical stress to lower second premolars
- (d) Period of active treatment: 5 m, #35, #45 were fully engaged by ISW, and ISW MEAW-like wire was added as posterior anchorage

### Treatment process

The orthodontic brackets were placed by using a direct bonding technique. Preadjusted 0.018×0.025 slot brackets and 0.016×0.022 ISW wire were used. The treatment process was listed in figure 5.

At the start of active treatment, the lower molar distalization (crimpable stopper + open coil spring) was performed bilaterally. By using ISW distalization, the spaces between lower first and second molar were created within 2 months.

At the period "2 month" of active treatment, one stopper with two open coil springs were set between the lower first premolar and the first molar for distalization of first molar and mesial drive of first premolar.

At the period "4 months" of active treatment, the space between lower first and second molar was enough to add the mechanical stress to the lower second premolars. At the same time, we used the intermaxillary elastics from upper canine to lower first premolar for more space creation.

At the period "5 months" of active treatment, #35, #45 were fully engaged by ISW, and ISW MEAW-like wire as posterior anchorage was set over #36,#37,#46,#47 for #35,#45 space creation.

At the period "6 months" of active treatment, lower left second premolar was derotated with open coil spring and elastic chain. The lower right second premolar was derotated with elastic chain.

Then the detailing and finishing were

started. The square IME (intermaxillary elastics) was set to facilitate interdigitation. After a short 11 months of active treatment, a stable occlusion with adequate overbite & overjet was achieved. All brackets were removed at the end of treatment, and the retainers were placed in both arches. The upper arch retainer was circumferential type, and the lower arch was Hawley type.

### **Treatment results**

At the end of treatment (figure6-11), the maxillary incisor proclination (maxillary central incisor to FH plane angle) was increased from a pretreatment angle of 116.2° to a posttreatment angle of 119.1°, but the angle was still bigger than the mean value of 108.94°. The mandibular incisor proclination (mandibular central incisor to mandibular plane angle) was increased from a pretreatment angle of 93.4 to a posttreatment angle of 97.4°. Therefore maxillary and mandibular incisor proclinations were both increased. The arch length deficiency in the mandibular arch was eliminated. The mandibular plane angle was decreased from a pretreatment angle of 28.1° to a posttreatment angle of 27.5°, so the mandible was rotated counterclockwise.

From the facial photos, the patient's lower lip protrusion and profile convexity were not increased, and facial balance was improved. The patient was satisfied with his final profile.

Appropriate overjet and overbite were obtained and good arch coordination and occlusion were achieved, resulting in slight Class II canine and molar Class I relationship.

The dental midline was coincident at the end of treatment. The posttreatment panoramic radiograph revealed that root parallelism was obtained.

## **Discussion**

### **Lower arch crowding relief**

The methods of resolving tooth size arch/length discrepancies include distalization of molars, stripping, extraction of teeth, flaring of incisors, and expansion of the arches<sup>5</sup>. Several ways can be to move the mandibular molars distally, eg, mandibular headgear, lip bumper, distal extension lingual arch, Jones jig, Franzulum appliance, and multiloop edgewise archwire<sup>1</sup>.

In this case, we created space by leveling, combined with crimpable stoppers, open coil springs for distalization, IME for mesial drive, and ISW MEAW-like wire to facilitate space creation so as not to incur disadvantage in profile change. The major treatment sequence in this case to relieve lower arch crowding was cited in figure 12.

By so doing, teeth could be aligned well without any tooth extraction or stripping.

### **Bite control**

There are several ways to perform bite control. In this case, bite raising (4.0 mm [8.0-4.0]) was due to upper curve and lower incisor flare-out and molar distalization. Then we used ISW MEAW-like wire in the lower arches combined with IME to deepen the shallow bite by 1.0mm [8.0-7.0] (due to excessive bite raising from the above mentioned methods). As a result, a desirable overbite and overjet was achieved.



To sum up, bite raising was 3.0 mm[7.0-4.0] treatment.  
from the beginning to the end of the



Fig 6. posttreatment facial photographs.



Fig 7. posttreatment intraoral photographs.



Fig8. posttreatment panoramic radiographs



Fig9. posttreatment cephalometric lateral and PA views

	Value.	After	Mean.	SD.
Facial angle	84.5	84.4	85.07	5.76
Convexity	4.7	4.2	5.60	4.33
A-B plane	-3.6	-4.5	-5.10	3.28
Mandibular plane	28.1	27.5	26.25	6.34
Y-axis	65.6	66.1	65.71	3.27
Occlusal plane	11.1	12.3	9.52	4.01
Interincisal	122.4	116.1	129.66	8.99
L-1 to Occlusal	20.3	22.6	21.69	6.03
L-1 to Mandibular	93.4	97.4	94.67	7.21
U-1 to A-P plane	10.6	10.8	7.86	2.31
FMA	58.6	55.1	58.98	6.69
FH to SN plane	4.8	4.5	5.98	3.35
SNA	81.7	81.2	81.82	3.09
SNB	79.2	79.2	78.61	3.14
SNA-SNB diff	2.5	2.8	3.28	2.66
U-1 to N-P plane	12.5	12.2	9.91	2.78
U-1 to FH plane	116.2	119.1	108.94	5.62
U-1 to SN plane	111.4	114.5	103.06	5.53
Gonial angle	117.6	117.5	119.38	5.83
Ramus inclination	90.5	90.0	87.36	4.14

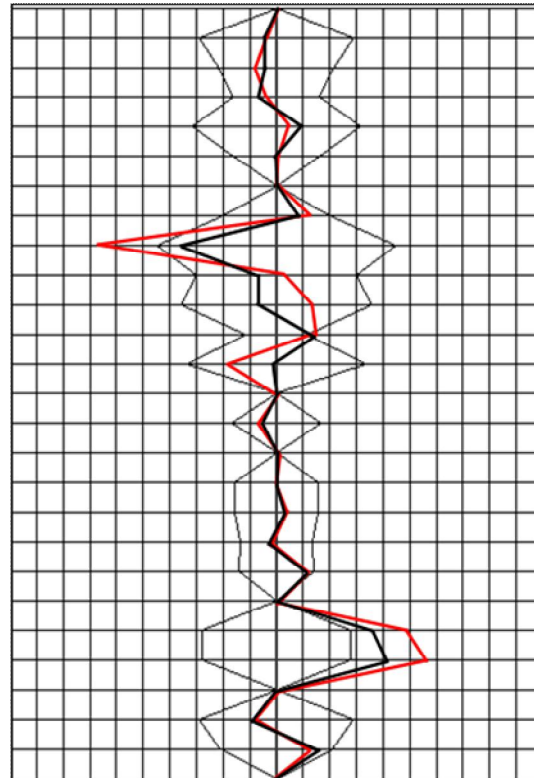


Fig 10. pretreatment and posttreatment cephalometric analysis

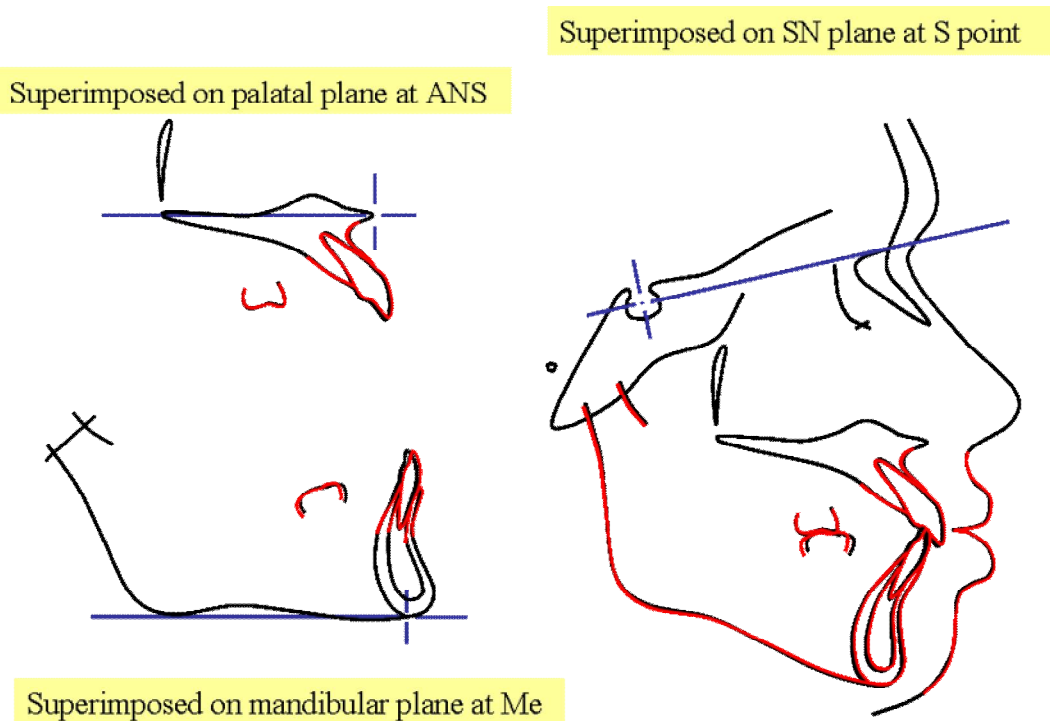


Fig 11. pretreatment and posttreatment cephalometric superimposition

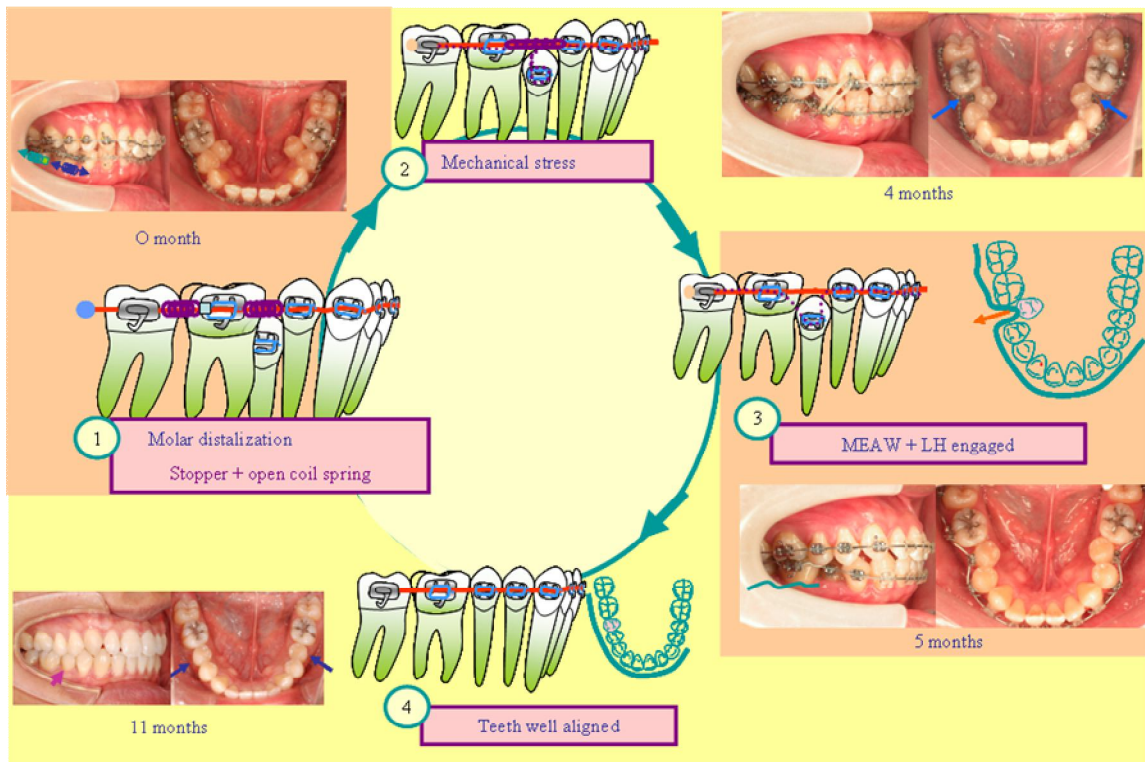


Fig 12. sequence in lower arch crowding relief

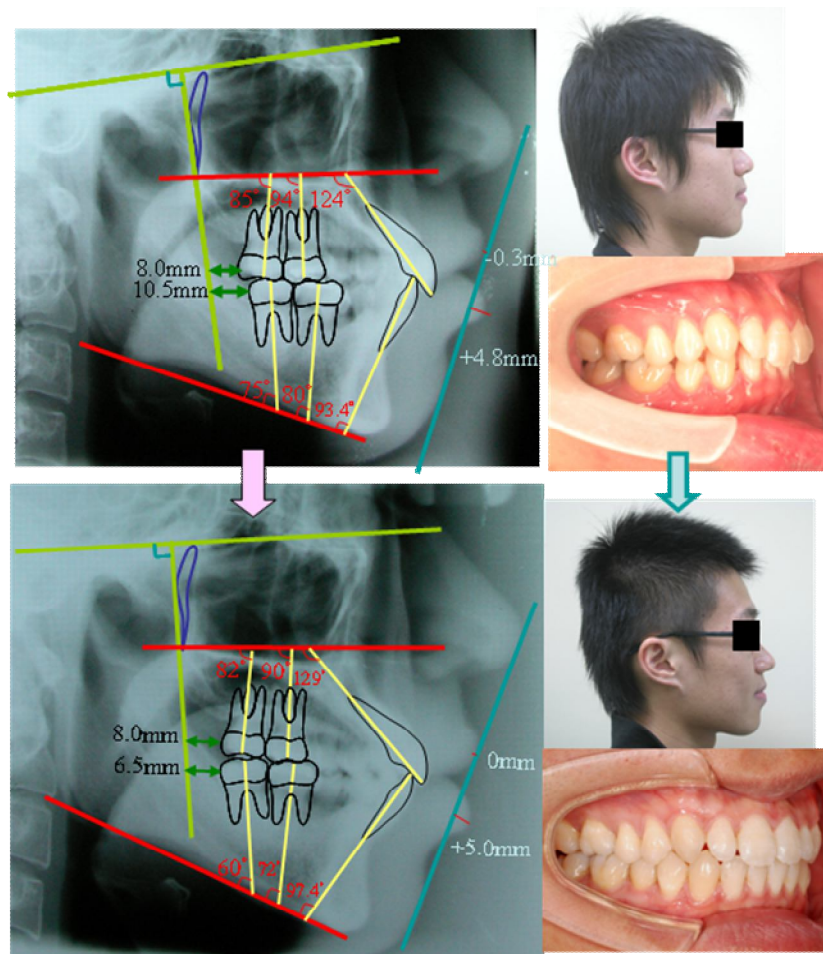


Fig13. distalization and MEAW-like effect



### **Distalization and MEAW effect**

The effect of curve over the upper arch makes upper anterior teeth flare out about 5 degrees[ 124°-129°] and upper posterior teeth tip back about 3 degrees[ 85°-82°] . The effect of distalization makes lower posterior teeth move distally about 4.0 mm (10.5mm-6.5mm). Additionally the effect of ISW MEAW-like wire makes the lower posterior teeth tip back 15 degrees[75°-60°] and thus space was gained.

By these effects we can relieve lower posterior crowding without worrying about making the profile too protrusive(figure13).

### **Derotation**

Full engagement of ISW into #35 & #45 brackets, #36-#37 / #46-#47 ISW MEAW-like wire as reinforced posterior anchorage, and open coil spring mesial to #35 aided in the correction of #35 rotation. Moreover, we used the elastic chain to exert a posteriorly pulling force upon #35, #45 for derotation and distal retraction.

### **Summary**

Severe crowding is a crucial problem on conditions that patient doesn't want to have any of his tooth extracted. Distalization for severe crowding relief was usually obtained from extra-oral devices or orthodontic implants. This case showed severe crowding around the lower posterior areas. However, with ISW leveling for crowding relief, combined with crimpable stopper, open coil spring, IME, and ISW MEAW-like wire for space creation, teeth could be aligned without any tooth extraction. As a result, a

stable occlusion and a desirable cusp interdigitation were achieved.

### **Reference**

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使用 ISW(improved super-elastic Ti-Ni alloy wire)不拔牙治療成人下顎雙側第

二小白齒完全舌側偏移之病例

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一位 20 歲成年男性因下顎後牙擁擠而來求診。臨床檢查發現下顎前牙有輕微齒間空隙及雙側第二小白齒完全舌側偏移。由於病人不願接受拔牙治療，因此使用改良型鎳-鈦合金線(ISW)進行牙齒平整化來紓解下顎牙弓擁擠。藉由 crimpable stopper 及 open coil spring 進行牙齒遠心移動以創造足夠空間，同時在下顎後牙以 ISW MEAW 進行錨定的加強。同時藉由 open coil spring 及 elastic chain 改正左下第二小白齒之旋轉。治療在 11 個月內完成且達成一個穩定咬合。

關鍵詞: 小白齒完全舌側偏移、遠心移動、改良型鎳-鈦合金線、齒顎矯正

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