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CASE REPORT

Improved super-elastic Ti–Ni alloy wire intrusion arch for skeletal class II malocclusion combined with deep overbite: A case report

Ching-Yu Yang, Chih-Chieh Lin, I-Jia Wang, Yuan-Hou Chen, Jian-Hong Yu

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Abstract

BACKGROUND

Treatment for deep overbite cases can be difficult. This case report presents some techniques with improved super-elastic Ti–Ni alloy wire (ISW) for deep overbite correction.

CASE SUMMARY

A 21-year-old woman had a chief complaint of flaring maxillary teeth. Orthodontic evaluation revealed a skeletal class II malocclusion and a convex profile appearance. A deep overbite with palatal impingement and large overjet were also noted. Bilateral maxillary first premolars were extracted, and spaces were closed using a closed-coil spring and elastic chain. The deep overbite was corrected by applying the ISW curve and ISW intrusion arch. Intermaxillary elastics was used to adjust the intermaxillary relationship. Active treatment took approximately 3 years, and the appearance and dentition alignment noticeably improved.

CONCLUSION

The use of the ISW technique in a case of skeletal class II malocclusion with deep overbite achieved a desirable result, and the patient was satisfied with the treatment outcome.

Key Words: Dentistry; Orthodontics; Skeletal class II; Intrusion arch; Case report

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Core Tip: Treatment for deep overbite cases is always challenging. In this skeletal Class II malocclusion with deep overbite case, we applied improved super-elastic Ti-Ni alloy wire intrusion arch to achieve ideal overjet, and the improvement in appearance and dentition alignment was noticeable.

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INTRODUCTION

In orthodontic treatment, malocclusion means misalignment of teeth or incorrect relationship between the teeth and jaws. In Angle class II, division 1 malocclusion, the upper teeth are more prominent than normal, and patients usually complained of buck teeth. A 21-year-old woman with a chief complaint of flaring maxillary teeth sought orthodontic evaluation. Clinical examination revealed a skeletal class II malocclusion and a convex profile appearance. A deep overbite with palatal impingement and a large overjet were also noted. The patient denied any family history of present illness.

Treatments for correcting a deep overbite include anterior tooth intrusion, posterior tooth extrusion, or their combination. In class II malocclusion with a steep mandibular plane, anterior tooth intrusion might be favorable[1]. In conventional treatment, a two-wire system or a temporary anchorage device (TADs) might be needed for tooth intrusion. However, wire bending in a two-wire system is technique-sensitive, and TADs have potential problems of soft tissue irritation and tooth root damage. For this case, we used Improved super-elastic Ti–Ni alloy wire (ISW, L & H Titan, Tomy International, Tokyo, Japan) as the main wire. ISW was developed by the Tokyo Medical and Dental University. ISW is endowed with three superior abilities: super-elasticity, shape memory, and damping capacity[2-4]. The wire can be engaged into crowding dentition and can provide early dental torque control with ease.

In this deep overbite case, TADs were not used. ISW intrusion arch for anterior tooth intrusion was used. After 34 mo of treatment, a desirable aesthetic outcome was achieved. The patient was pleased with the final treatment outcome.

CASE PRESENTATION

Chief complaints

The 21-year-old woman complained of flaring maxillary teeth.

History of present illness

The patient denied any present illness.

History of past illness

She had nasal obstruction in childhood.

Personal and family history

The patient denied any family history of present illness.

Physical examination

Pretreatment facial photographs showed a convex profile and shallow mentolabial sulcus. In the frontal view, no chin deviation was observed. The maxillary midline was coincident with the facial midline, and the mandibular midline demonstrated a right deviation (Figure 1). On intraoral photographs, the mesio-buccal cusps of the maxillary first molars are ahead of the buccal grooves of the mandibular first molars, which represented bilateral Angle class II, division 1 malocclusion.

Laboratory examinations

All data were within normal limit.

Imaging examinations

A panoramic film radiograph revealed missing maxillary and mandibular third molars. Initial lateral and anteroposterior cephalometric radiographs (Romexis 3.2.0., Helsinki, Finland) were taken in centric

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Figure 1 Pretreatment photographs (21 years 4 months old). A-C: Facial profiles; D-K: Intraoral photographs.

occlusion with closed lips (Figure 2). Cephalometric analysis demonstrated a skeletal class II malocclusion (ANB angle: 8.0°), high mandibular plane angle (Frankfort-mandibular plane angle: 35.0°), proclined upper incisors (U1 to the Frankfort horizontal plane angle: 122.5°), and retroclined lower incisors (L1 to mandibular angle: 89.0°) (Figure 3). On anteroposterior cephalometric radiographs, the mandibular midline deviated 1.5 mm to the right side from the mid-sagittal plane (Cg–ANS).

FINAL DIAGNOSIS

The patient was diagnosed with skeletal class II with a deep overbite, hyperdivergent facial pattern.

TREATMENT

Treatment objectives

This patient has class II malocclusion and deep overbite. We aimed to achieve the ideal occlusion of the bilateral class I canine relationship, facilitate the angle class II molar relationship, and attain normal overbite and overjet. Our treatment objectives were to: (1) Relieve crowding; (2) retract the maxillary anterior teeth; (3) correct the deep overbite; and (4) achieve improved arch coordination and interdigitation.

Treatment alternatives

The patient was offered two treatment options. The first option was maxillary bilateral first premolar

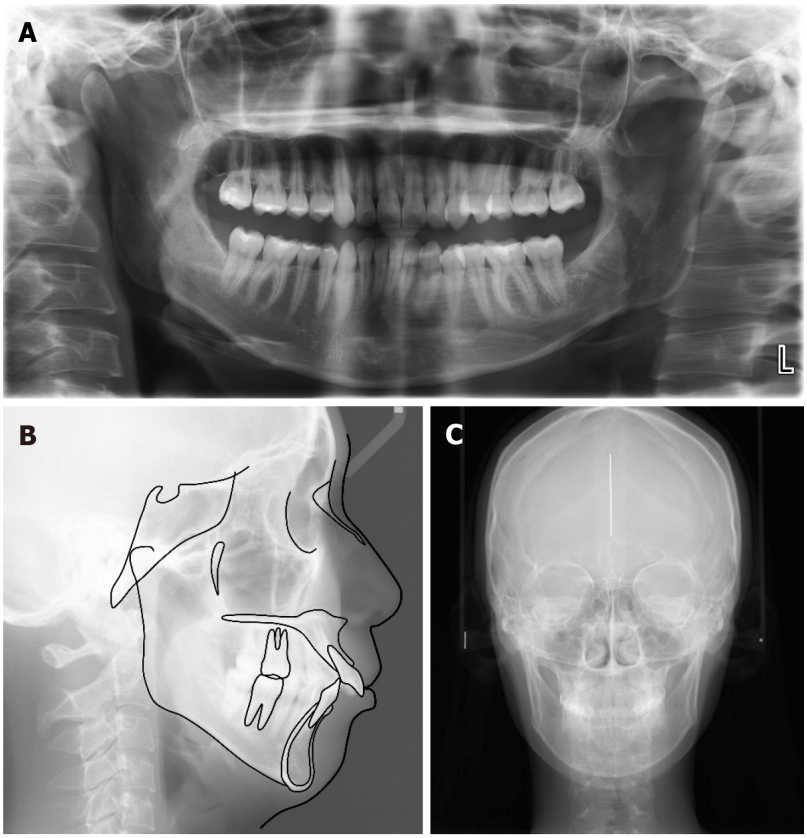

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Figure 2 Radiograph. A: Pretreatment panoramic radiograph; B: Lateral cephalometric radiograph; C: Anteroposterior cephalometric radiograph (21 years 4 mo old).

extraction and maxillary anterior teeth retraction. Considering the presence of occlusal plane canting and a relatively retruded chin, two-jaw surgery was also suggested. The patient refused surgery and chose the nonsurgical treatment.

Treatment progress

Before orthodontic treatment, the bilateral maxillary first premolars were extracted. Full-mouth DBS was performed with preadjusted edgewise metal brackets, Micro-arch, Roth type (Tomy Company, Tokyo, Japan). Initial leveling progressed over the bimaxillary arch with 0.016-inch × 0.022-inch ISW. A 100-gf Ti–Ni closed-coil spring was used for canine retraction (Figure 4A-C).

After the maxillary canines were retracted to the designated position, anterior retraction began. First, an elastic chain was used for anterior retraction, and to avoid the bowing effect, gable bends were placed between the lateral incisors and canines. The maxillary anterior teeth were then intruded using the ISW intrusion arch. A 0.018 × 0.025 ISW reverse curve was also provided to flatten the curve of Spee (Figure 4D-F). Class II intermaxillary elastics (IME) (medium, 3/16-inch size) was used for overjet and intercuspal interdigitation adjustment (Figure 4G-I). After 34 mo of active treatment, the full-mouth brackets were debonded. A circumferential retainer and Hawley retainer were provided for the maxillary arch and mandible, respectively.

OUTCOME AND FOLLOW-UP

In this case, bilateral maxillary bicuspids were extracted. Canine distalization was performed using a closed-coil spring. The deep overbite was corrected with the ISW curve and ISW intrusion arch (Figure 5). After the treatment, proclined upper and retroclined lower incisors were corrected (U1 to familial hypercholesterolemia plane angle: 122.5°→106.5°; L1 to mandibular plane angle: 89.0°→93.0°), and the profile was improved (upper lip to E-line: 3.0 mm→0 mm) (Figures 6-8).

	Value	Mean.	S.D.
Facial angle	85.5	84.83	3.05
Convexity	**15.0**	7.58	4.95
A-B plane	**-11.0**	-4.81	3.50
Mandibular plane	**35.0**	28.81	5.23
Y-axis	66.0	65.38	5.63
Occlusal plane	9.5	11.42	3.64
Interincisal	**114.0**	124.09	7.63
L-1 to Occlusal	24.5	23.84	5.28
L-1 to Mandibular	**89.0**	96.33	5.78
U-1 to A-P plane	**13.5**	8.92	1.88
FMIA	56.0	54.63	6.47
FH to SN plane	4.0	6.19	2.89
SNA	**88.5**	82.32	3.45
SNB	80.5	78.90	3.45
SNA-SNB diff.	**8.0**	3.39	1.77
U-1 to N-P plane	**18.0**	11.74	2.73
U-1 to FH plane	**122.5**	111.13	5.54
U-1 to SN plane	**118.5**	104.54	5.55
Gonial angle	**134.5**	122.23	4.61
Ramus inclination	**80.5**	87.07	4.40

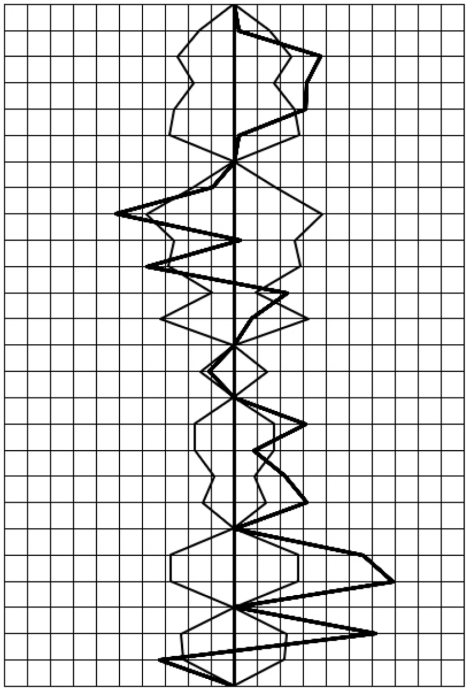

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Figure 3 Polygon: Before active treatment.

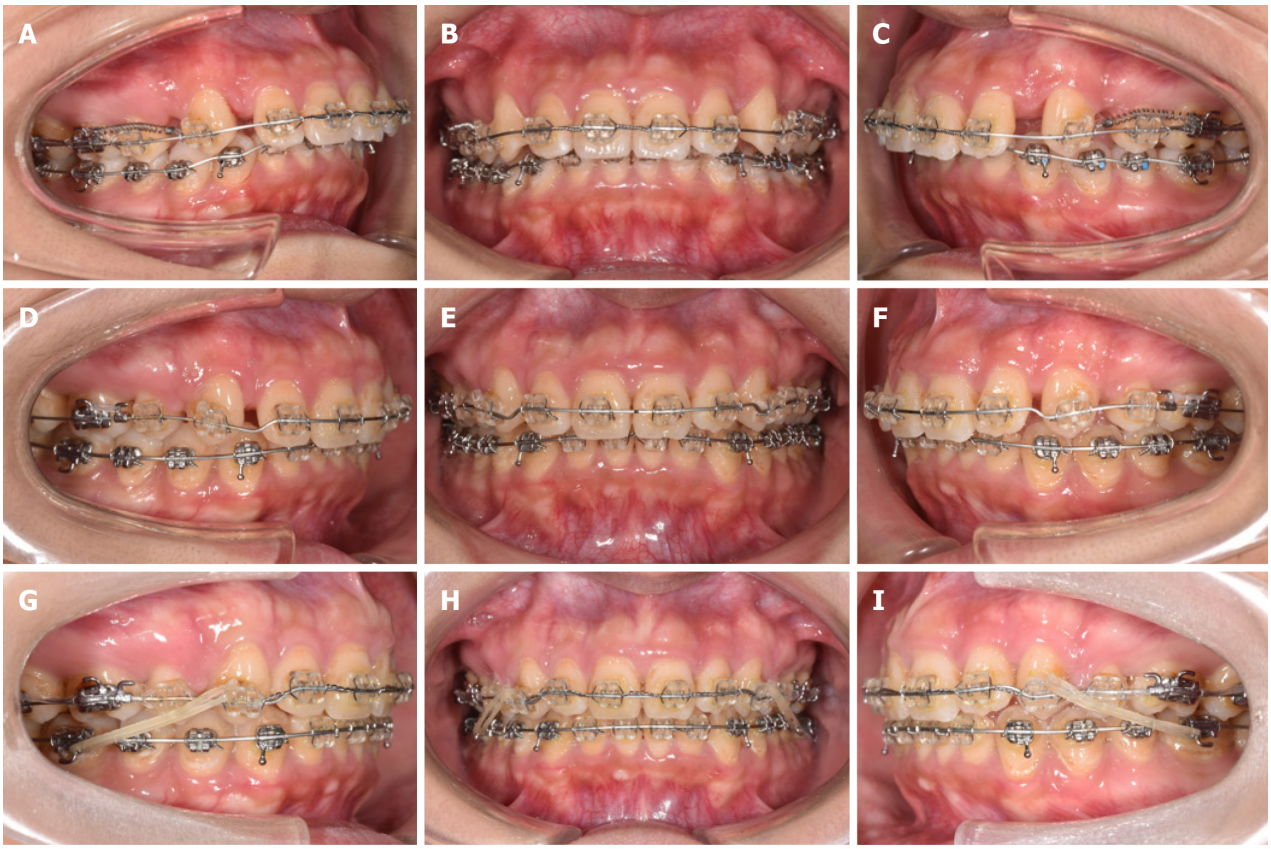

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Figure 4 Progressive intraoral photographs. A-C: 4 mo; D-F: 15 mo; G-I: 24 mo.

DISCUSSION

A deep overbite is always challenging to treat. We used several materials to reduce the initial large overjet, including Ni-Ti closed-coil spring, elastic chain and gable bend, ISW intrusion arch, and IME

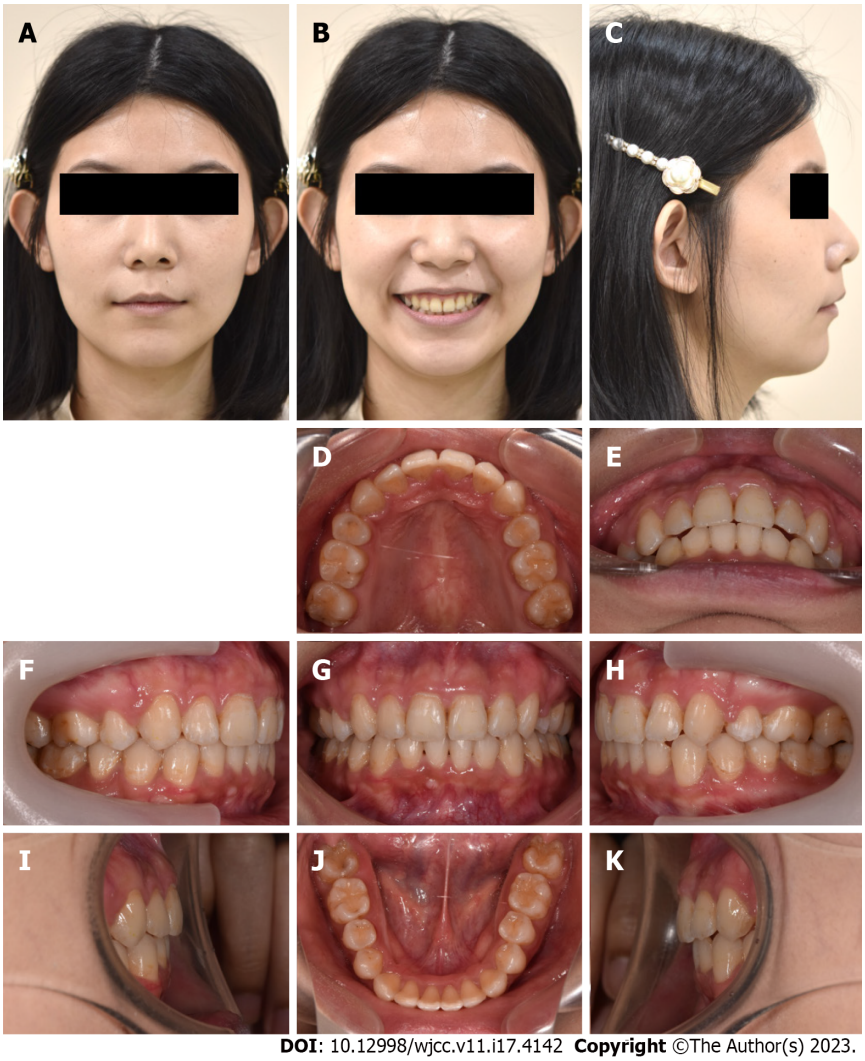

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Figure 5 Posttreatment photographs (24 years 2 mo old). A-C: Facial profiles; D-K: Intraoral photographs.

(Figure 9). We also attempted to solve the deep overbite by anterior tooth intrusion. The key to successful intrusion is light continuous force directed toward the root apex of incisors[5]. The ISW maintains continuous light force regardless of changes in the oral temperature, and this characteristic can be favorable during tooth intrusion[2,6-8].

Anterior tooth intrusion in a continuous wire system can be performed in several ways, such as the use of a utility arch[9] or Connecticut intrusion arch[10]; however, premolars are bypassed. In premolar extraction cases, simultaneous tooth intrusion and close extraction space might be difficult. Figure 10 summarizes ways to achieve this procedure in the ISW system. For incisor intrusion without extraoral appliance or skeletal anchorage, the intrusion amount can be classified into small (< 2.0 mm) and large (2.0–5.0 mm). In this case, an ISW intrusion arch for the upper incisor intrusion and an ISW curve plus active tie back for the lower incisor intrusion were applied.

In the ISW intrusion arch, we used the direct electric resistance heat treatment method for the second-order bend[11] by applying a Ni-Ti Heat Bender (SOARER X, Tomy International, Tokyo, Japan). With the second-order bend between the lateral incisors and canine, the anterior teeth can be guided to the final site. To avoid the buccal flaring effect of the anterior teeth, we applied an active tie-back mesial to the first molars using a crimpable hook and elastic chain (Figure 11).

The anterior tooth inclination plays an important role in posttreatment stability[12]. According to Riedel, a large interincisal angle after is associated with deep overbite relapse[13]. By adjusting the torque of the maxillary anterior teeth, a normal interincisal angle can be achieved, establishing an appropriate and stable anterior stop[14].

In this case, the treatment was completed without the use of TADs, thus avoiding risks of soft tissue irritation and root injury. While miniscrews were placed in loose alveolar mucosa, soft tissue irritation, such as tissue overgrowth or ulceration, may occur[15]. Root injury is highly relevant to the insertion site, especially in the interradicular insertion sites[16,17]. To intrude anterior teeth, the insertion site is usually between the apexes of the upper central incisor, where the risk of root injury is higher and is more prompt to soft tissue irritation like the labial frenum. It also reduces problems that might derive

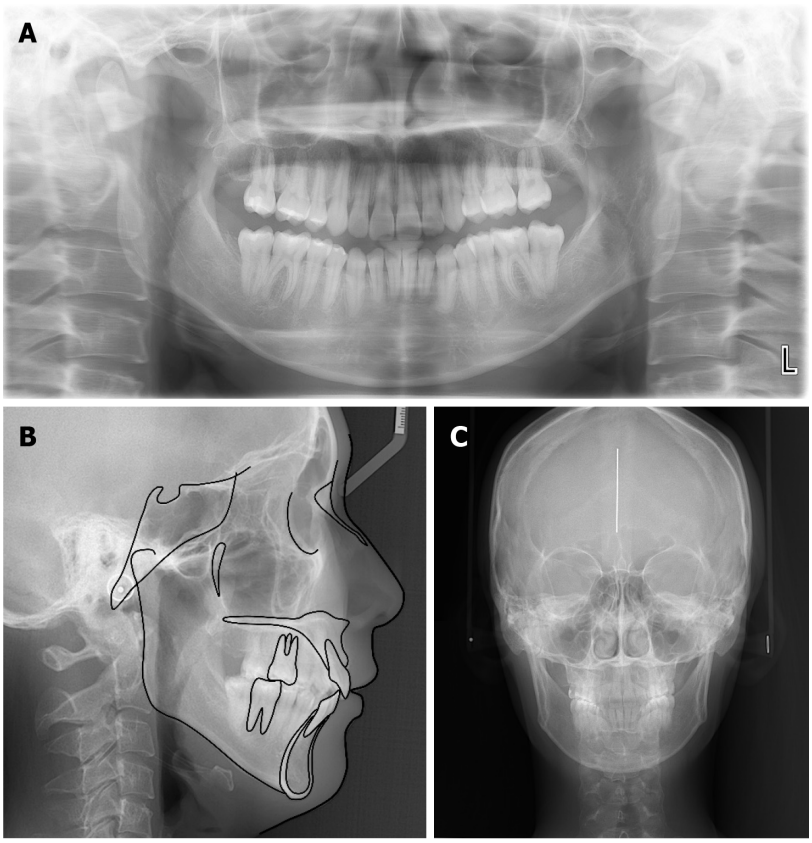

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Figure 6 Radiograph. A: Posttreatment panoramic radiograph; B: Lateral cephalometric radiograph; C: Anteroposterior cephalometric radiograph (24 years 2 mo old).

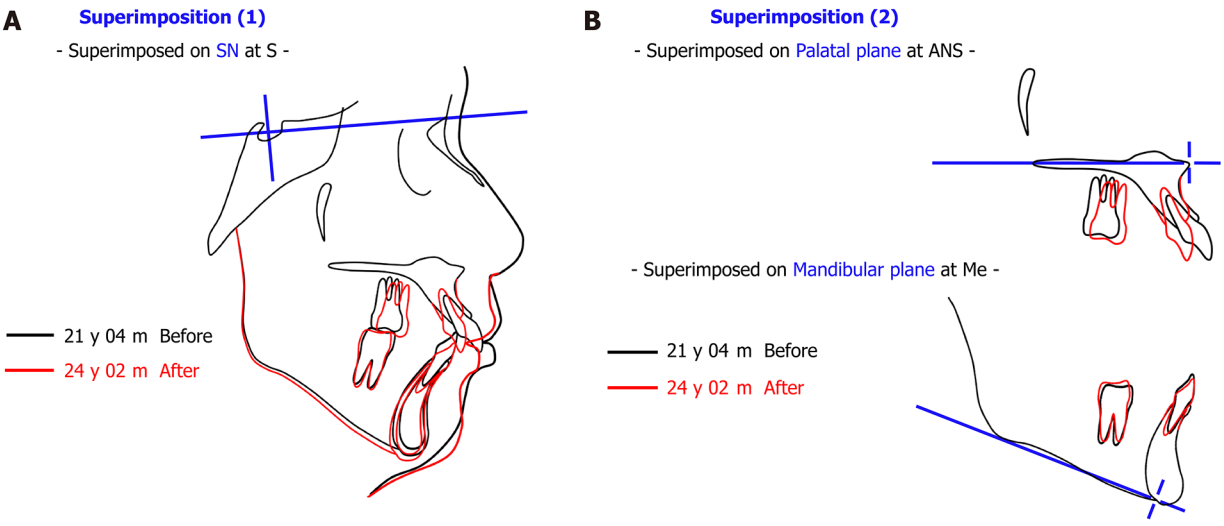

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Figure 7 Superimposition of pretreatment and posttreatment. A: Superimposed on sella-nasion plane at S; B: Superimposed on palatal plane at anterior nasal spine and Mandibular plane at Me. SN: Sella-Nasion plane; S: Sella; ANS: Anterior Nasal Spine; Me: Menton.

from TADs. TADs may become loose, tip, and extrude under orthodontic load. Mobile TADs will not regain stability and must be removed and reinserted[18,19]. Besides, if the insertion was inappropriate and removal torque was given, failure, or even implant body fracture, may occur[20]. Generally, in the maxilla, the insertion torque of TADs is approximately 12.1 ± 3.1 N-cm, and the average removal torque is 15.8 ± 3.6 N-cm[21].

As limitation, this report analyzed one case; a case series is needed to estimate the mean intrusion amount by the ISW intrusion arch. Without TADs, the intrusion amount of utility arch was 2.95 ± 0.78

	Before	After	Mean.	S.D.
Facial angle	85.5	84.5	84.83	3.05
Convexity	**15.0**	**16.5**	7.58	4.95
A-B plane	**-11.0**	**-11.5**	-4.81	3.50
Mandibular plane	**35.0**	**36.5**	28.81	5.23
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Interincisal	**114.0**	124.5	124.09	7.63
L-1 to Occlusal	24.5	24.0	23.84	5.28
L-1 to Mandibular	**89.0**	93.0	96.33	5.78
U-1 to A-P plane	**13.5**	**6.5**	8.92	1.88
FMIA	56.0	50.5	54.63	6.47
FH to SN plane	4.0	4.0	6.19	2.89
SNA	**88.5**	**89.0**	82.32	3.45
SNB	80.5	80.0	78.90	3.45
SNA-SNB diff.	**8.0**	**9.0**	3.39	1.77
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U-1 to FH plane	**122.5**	106.5	111.13	5.54
U-1 to SN plane	**118.5**	102.5	104.54	5.55
Gonial angle	**134.5**	**134.5**	122.23	4.61
Ramus inclination	**80.5**	**82.0**	87.07	4.40

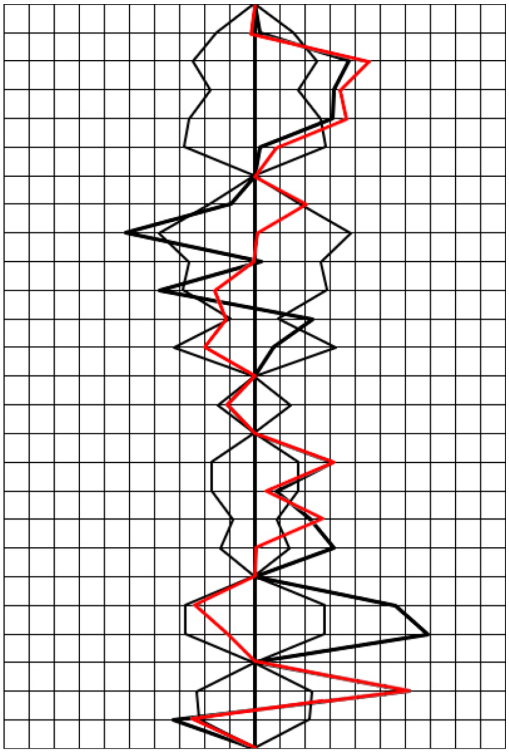

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Figure 8 Polygon: Before and after active treatment. SN: Sella-Nasion plane; FMIA: The Frankfort-Mandibular Incisor Angle; FH: Frankfort horizontal plane; SNA: Sella-nasion-A point; SNB: Sella-nasion-B point.

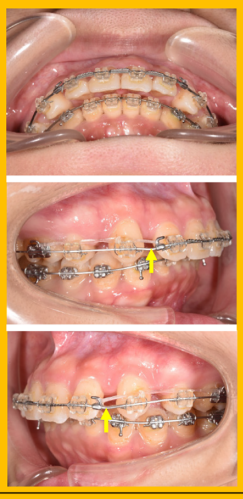
	2019.07.08 Overjet: 6.0 mm	2020.09.16 Overjet: 4.5 mm	2020.12.16 Overjet: 3.0 mm	2022.04.11 Overjet: 1.5 mm
Intra-oral photos				
Mechanism	Due to the large overjet, we decided to do maxillary bicuspids extraction, and attain a Class II molar finish	After canine distal drive was done, we started anterior retraction by elastic chain, along with gable bends between incisors and canines	Space closure and vertical control at the maxillary arch were managed by ISW intrusion arch. 0.018 x 0.025 inch ISW reverse curve was added to flatten Curve of Spee	Adequate overjet was achieved

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Figure 9 Overjet reduction methods. ISW: Improved super-elastic Ti–Ni alloy wire.

mm[22], which is close our results. Further quantitative analysis is necessary, like the relationship between second-order bends and intrusion in the ISW system.

	Method	Potential problems
Small amount	Not-in-slot	Tooth position and inclination control is difficult
	Elastic chain	Tooth position and inclination control is difficult
	Bracket rebonding	Material consuming
Large amount	ISW intrusion arch	Wire bending ability. Need to adjust the position of crimpable hook in every appointment.
	ISW curve + active tie back	Technique sensitive in determining the positions of the hooks

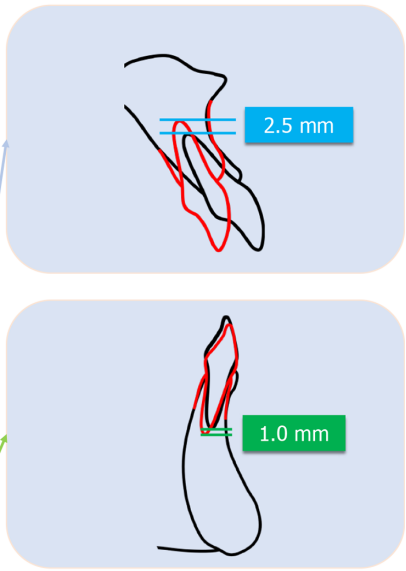

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Figure 10 Strategy of intrusion. ISW: Improved super-elastic Ti–Ni alloy wire.

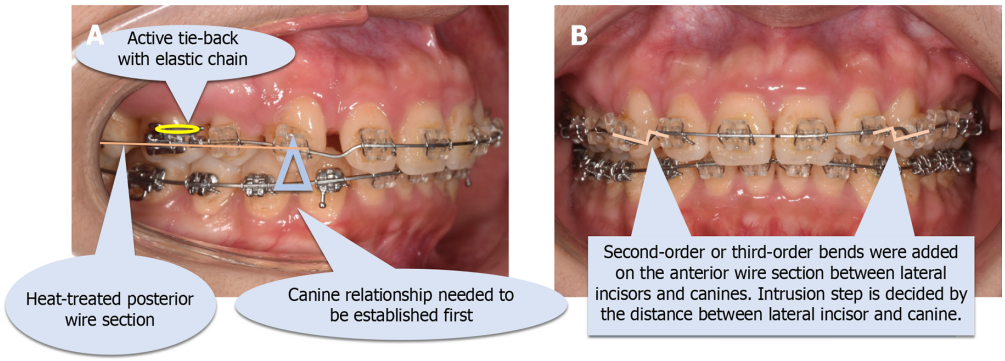

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Figure 11 Introduction of an improved super-elastic Ti–Ni alloy wire intrusion arch. A: Lateral view; B: Frontal view.

CONCLUSION

In the treatment of class II malocclusion with a deep overbite, anterior tooth intrusion should be considered. The use of the ISW intrusion arch achieved a desirable result, and the patient was satisfied with the treatment outcome.

FOOTNOTES

Author contributions: Yu JH was responsible for conceptualization and supervision; Yang CY was responsible for writing the original draft, reviewing, and editing; Wang IJ, Lin CC, Chen YH contributed to investigation and data curation; All authors have read and approve the final manuscript.

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