



📍 Tokyo Medical and Dental University (TMDU)-Department of Orthodontic Science

POTENTIALS OF THE IMPROVED SUPERELASTIC NI-TI ALLOY WIRE (ISW)

The prototype of the Japanese Ni-Ti alloy wire is first introduced to the world by a milestone publication by Professor Fujio Miura and colleagues (Miura F et al, AJODO, 1986) followed by the two related articles in the other journals (Miura F et al, AJODO, 1988; EJO, 1988). Since then, the wire has been renovated, and the modified version known as the improved superelastic Ni-Ti alloy wire (ISW) is frequently used in the clinic. The aim of the course is to update your knowledge with regards to the myths and facts about the orthodontic treatment with the ISW by showcasing two cases of malocclusion.

The first case was presented by Dr. Ikuo Yonemitsu. He is Assistant Professor of the Department of Orthodontic Science, Graduate School, Tokyo Medical and Dental University (TMDU), Tokyo, Japan. He studied at TMDU, Yokohama City University, Kanagawa, Japan and the University of Geneva, Switzerland.

He has published 2 book chapters and 24 scientific articles about Histological and Biochemical research, Materials in Dentistry, and Orthodontic mechanics and treatment.

Case 1

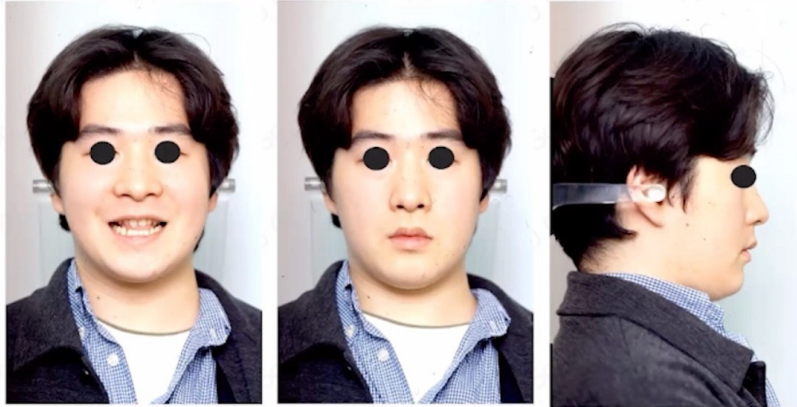
A severe class III openbite case treated by modified MEAW technique using the ISW

Case summary: A 21-year-old male complained of chewing difficulty

- Facial & occlusal view: severe openbite, with only bilateral second molars in contact; Class III molar relationship; Lower arch space; Abnormal tongue posture;
- Panoramic radiography: 18,28,48 captured; Mandibular molars were mesially tipped; No signs of TMD;
- Posterior-anterior radiographs: bilateral mandibular asymmetry
- Lateral cephalogram: mandibular plane angle increased (FMA 36)

CLASS III OPEN BITE CASE TREATED BY THE ISW

Pre-Tx



21-year-old male
Chief complaint: Difficulty in chewing

CLASS III OPEN BITE CASE TREATED BY THE ISW

Pre-Tx



CLASS III OPEN BITE CASE TREATED BY THE ISW

Pre-Tx



CLASS III OPEN BITE CASE TREATED BY THE ISW

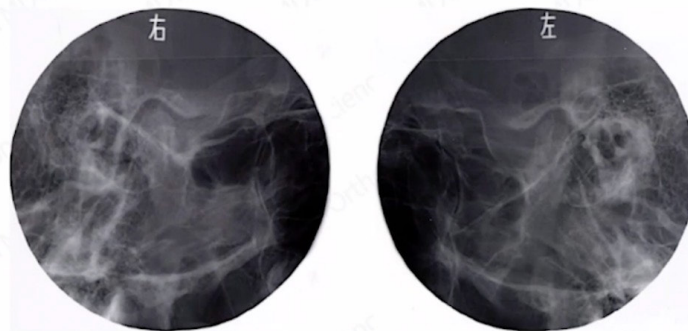
Pre-Tx



SNA	83
SNB	79
ANB	4.0
MP	36
U1 to FH	102
L1 to MP	77
FMIA	66

CLASS III OPEN BITE CASE TREATED BY THE ISW

Pre-Tx



Problem list:

- Skeletal problem: skeletal openbite and steep mandibular plane
- Dental problem: uprighted upper and lower incisors and lower arch spacing
- General condition: poor oral hygiene, abrasion of molars
- Soft tissue and function: Abnormal tongue posture and swallow pattern

Treatment objectives:

- Establish proper anterior and lateral occlusal guidance
- Close lower arch space
- Improve tongue posture and swallow pattern

Treatment concept and plan:

- Relieve anterior openbite by counterclockwise rotation of the mandible and prevent incisors' root resorption or gingival recession
- Extract the third molar to provide the space for distal tipping and intruding lower posterior teeth

Treatment plan:

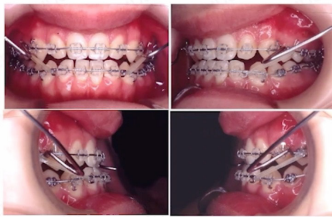
The modified MEAW technology was used with ISW, and the J hook was performed at the same time to distal tip and intrude both the upper and lower posterior teeth and close the lower space.

Treatment process:

- After extracting 18,38,48, start treatment with 0.018 * 0.025 Roth brackets, upper initial arch wire was 0.016 * 0.022 ISW, lower initial arch wire was 0.016 Sentalloy.
- After one month of treatment, maintain the original arch wire in the upper jaw, add the compensation curve, replace the lower jaw arch wire with 0.016 * 0.022 ISW, add the reverse Spee curve, and perform short class III traction in the bilateral canine areas.
- After 3 months of treatment, the position of Class III traction was adjusted to the mesial traction hook of the first maxillary premolar and the mandibular canine, and the J hook (120g/side between the canine and the first bicuspid) was worn at the same time, in order to obtain the counterclockwise rotation of the mandible and avoid the side effect of Class III traction on the labial inclination of the upper incisors.

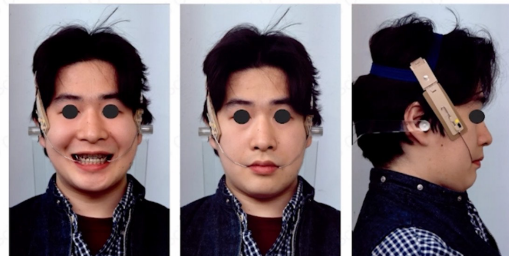
CLASS III OPEN BITE CASE TREATED BY THE ISW

3M



CLASS III OPEN BITE CASE TREATED BY THE ISW

3M



- After 6 months of treatment, the anterior overjet was improved, and there was still space remained in the lower arch.
- After 11 months of treatment, use 50g elastic chain to close space, further improve the anterior overjet.
- After 14 months of treatment, remove the upper and lower braces, bond the upper and lower lingual retainers, wear Hawley retainers at the same time, and put on Class III traction at night.

CLASS III OPEN BITE CASE TREATED BY THE ISW

14M



CLASS III OPEN BITE CASE TREATED BY THE ISW

14M



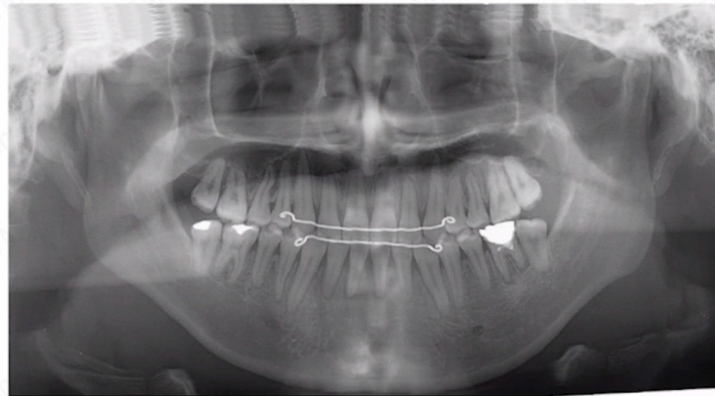
CLASS III OPEN BITE CASE TREATED BY THE ISW

14M



CLASS III OPEN BITE CASE TREATED BY THE ISW

14M



CLASS III OPEN BITE CASE TREATED BY THE ISW

14M

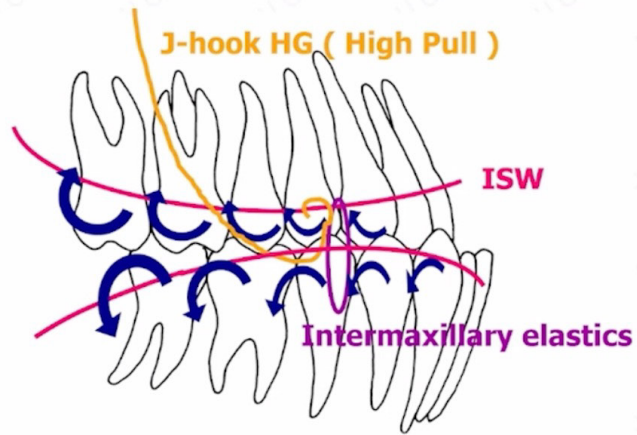


	Pre-Tx	→	Post-Tx
SNA	83	→	83
SNB	79	→	80
ANB	4.0	→	3.0
MP	36	→	31
U1 to FH	102	→	104
L1 to MP	77	→	72
FMIA	66	→	77

Treatment evaluation:

Compared with traditional MEAW technology, this case was treated with improved MEAW technology using ISW, which simplified the bending procedure of the arch wire and improved the patient's oral comfort. The upper molars were intruded by using the ISW with J hook traction, while the lower molars were distal tipped and intruded by adding reserve Spee curve on ISW with the intermaxillary traction. After treatment, the patient's profile was significantly improved, and the lip incompetence was also improved. The after treatment panoramic radiographs showed that there was no significant root resorption, and the upper and lower molars were distally tipped and intruded. Compared with the initial stage, the mandibular plane angle decreased by 5 degrees after treatment, indicating that the mandibular counterclockwise rotation occurred during treatment. It can be contributed to the intrusion of posterior teeth, and it helped to improve the anterior open bite. At the same time, there was no significant change in labial inclination of the upper anterior teeth during treatment, while the lower anterior teeth were retracted and extruded by about 2mm. The 11 months retention showed that the improvement of the profile was stable, the positive anterior overjet were maintained, and there was no relapse in dental arch spaces. It can be seen that the occlusal relationship is very stable, and the over-corrected second molars at the end of treatment also gradually establish contact.

CLASS III OPEN BITE CASE TREATED BY THE ISW

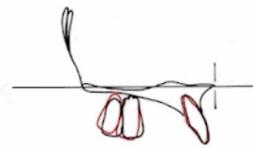


Yonemitsu et al. Semin Orthod. in press

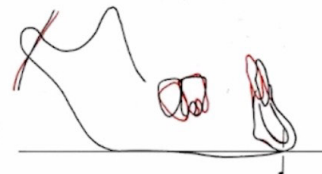
CLASS III OPEN BITE CASE TREATED BY THE ISW

Superimposition on SN plane at S

Superimposition on Palatal plane at ANS



Superimposition on Mandibular plane at Me



CLASS III OPEN BITE CASE TREATED BY THE ISW

11M in Retention

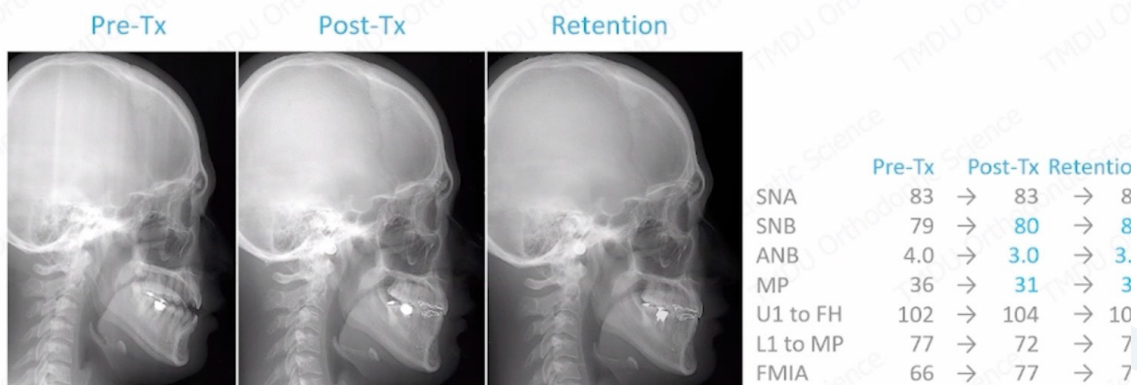


CLASS III OPEN BITE CASE TREATED BY THE ISW

11M in Retention



CLASS III OPEN BITE CASE TREATED BY THE ISW



Case discussion:

Dr. Kenko Jian-hong Yu, who is currently the professor and head of school of dentistry, dean of orthodontic department of China Medical University in Chinese Taiwan was the guest expert for this case discussion. In the process of clinical teaching and treating patients, he has accumulated many years of experience in the use of ISW. Dr. Yu discussed this case with Dr. Takashi Ono and Dr. Ikuo Yonemitsu in the following aspects:

Etiology and differential diagnosis of open bite

The causes of the open bite include genetic inheritance, bad oral habits, environmental and other factors. It is common to see that the maxillary and mandibular molars are vertically over erupted due to abnormal growth and development. At the same time, the mandibular ramus is underdeveloped, or the height of the middle cranial fossa is underdeveloped. At such a situation, the over erupted posterior teeth are taken as the fulcrum, the mandible rotates clockwise and grows, while the eruption of the lower anterior teeth is insufficient, which forms the dental factor of anterior open bite. Meanwhile, the increased size and abnormal posture of the tongue will also constitute exogenous factors for the anterior open bite. In addition, various syndromes such as condylar bone resorption caused by rapidly progressing osteoarthropathy, severe rickets in children or Apert's Syndrome may also lead to systemic diseases and genetic factors.

Open bite can be divided into two types: dental open bite or skeletal open bite. The former one is mainly a problem of teeth and alveolar bone, which is manifested by insufficient eruption of anterior teeth and (or) excessive eruption of posterior teeth. There is no obvious abnormality on the facial pattern, and the craniofacial development is basically normal. Based on this, the skeletal open bite alone or simultaneously appears abnormal jaw development. The mandibular ramus is short, the mandibular plane is steep, and the mandible grows clockwise; The maxilla may be accompanied by hypoplasia of width. According to the extension of dental open bite, we can divide it into three severity levels: 1) simple open bite: the opening range is from one canine to the other; 2) Complex open bite: the opening range is from bicuspid on one side to bicuspid on the other side; 3) Genetic (Severe) open bite: the opening range is from one molar to the other.

Generally, cephalometric measurement is used to measure and analyze the relationship between the jaw and the teeth of patients. Patients with open bite often show that the jaw growth and development indicators SN-MP angle increases, S-Ar-Go angle increases, SN-PP angle and PP-MP angle increases, as well as the alveolar height indicators U6-PP and L6-MP increase, the facial height indicator ANS-Me height increases, the S-Go height is shorter or normal, and the arch width indicator is abnormal. On the basis of the judgment of the relationship between jaw and teeth, it is also necessary to understand the cause of the patient's open bite, whether there are bad habits that lead to open bite as the habit of tongue thrusting, or whether the temporomandibular joint is normal.

Common treatment options for open bite

The treatment options of open bite can be divided into three types:

- 【1】 The external force (J hook traction) and intermaxillary traction of the fixed orthodontic appliance;
- 【2】 Fixed orthodontic appliance with orthognathic surgery (SSRO/Le Fort I+SSRO);
- 【3】 Fixed orthodontic appliance with TADs.

Among them, the first option is relatively simple, but the external force and intermaxillary traction are largely relied on the degree of cooperation of patients, and the treatment effect is not stable. In contrast, the second or third treatment option, although it requires less patient cooperation, has additional surgical risks.

In the application of non-surgical treatment for open bite, we can consider: 1) anterior tooth retraction and posterior tooth mesial movement; 2) Posterior teeth distal tipping and intruding; 3) Anterior tooth extrusion. The anterior teeth of the patients with open bite usually have been over erupted to certain degrees to make compensation. If we extrude the maxillary anterior teeth to improve the open bite, not only the smile arc is not beautiful, but also easy to relapse after treatment. In the current case, the mandibular anterior teeth were retracted through closing the lower space. The superimposition before and after treatment showed that the mandibular anterior teeth moved lingually with a small amount of extrusion, which helped to improve the open bite.

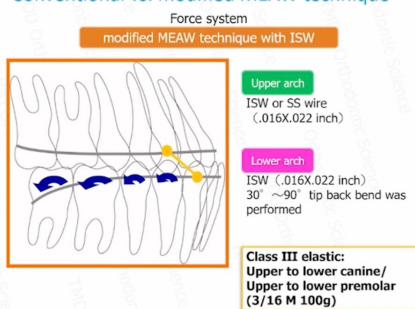
When selecting treatment options for patients with open bite, an important consideration is the mandibular plane angle. For patients with high mandibular plane angle, we tend to distally tip and intrude mandibular molars to obtain counter-clockwise rotation of the mandible, especially for patients of Class II. For patients with low mandibular plane angle, anterior tooth extrusion can be properly considered. It is a common clinical treatment option to improve anterior open bite by means of posterior teeth uprighting and intruding, including 1) multiple curved edgewise arch (MEAW); 2) Modified MEAW straight wire appliance; 3) straight wire appliance with TADs.

The case was treated with external force (J hook traction) combined with the improved MEAW technology straight wire appliance. The case reports showed that the improved MEAW technology was successfully used to treat adult open bite or adolescent reverse deep bite Class III patients. By using the ISW and intermaxillary traction, the Class I molar relationship can be established through distally tipping mandibular molars, showing a satisfactory treatment result. The traditional MEAW technology generally uses 0.019 * 0.025 stainless steel wire to add a total of 15-20 degrees of distal tipping angle to the mandibular posterior teeth by bending several continuous boot-shaped loops and cooperating with Class III traction from the upper molar area to the mandibular anterior tooth area. In current case, the modified MEAW straight wire appliance was used, 0.016 * 0.022 ISW was used to add a total of 30-90 degrees of distal tipping for the posterior teeth by adding the reverse Spee curve, and it was combined with Class III traction from the maxillary canine area or the bicuspid area to the mandibular canine area. Compared with the traditional MEAW technology, this treatment can reduce the side effects such as labial inclination of upper incisors and extrusion of upper molars. The difficulty of treatment is how to get the counterclockwise rotation of the mandible by simultaneously intruding the bimaxillary molars, and at the same time, it is necessary to avoid the extrusion of anterior teeth as much as possible. Therefore, during the application of J hook traction, this case changed the traction site of the upper jaw from the traditional canine mesial to the first premolar mesial, and during the Class III traction, the site between the upper posterior teeth and the lower anterior teeth used in the traditional MEAW technology was also changed to the upper premolar area to the lower canine area. At the same time, adding maxillary compensation curve or mandibular reverse Spee curve on the ISW to achieve bimaxillary molars intrusion at the same time.

However, non-surgical treatment cannot be applicable to all patients. Some serious skeletal open bite deformities cannot be treated satisfactorily through orthodontic treatment. For example, patients with open bite accompanied with serious skeletal deviation, such as ANB>10 or<- 4, APDI>100 or<60, ODI>80 or<60, should consider combined orthodontic and orthognathic treatment.

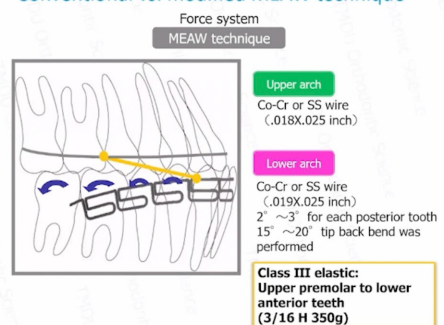
CLASS III OPEN BITE CASE TREATED BY THE ISW

Conventional vs. modified MEAW technique



CLASS III OPEN BITE CASE TREATED BY THE ISW

Conventional vs. modified MEAW technique

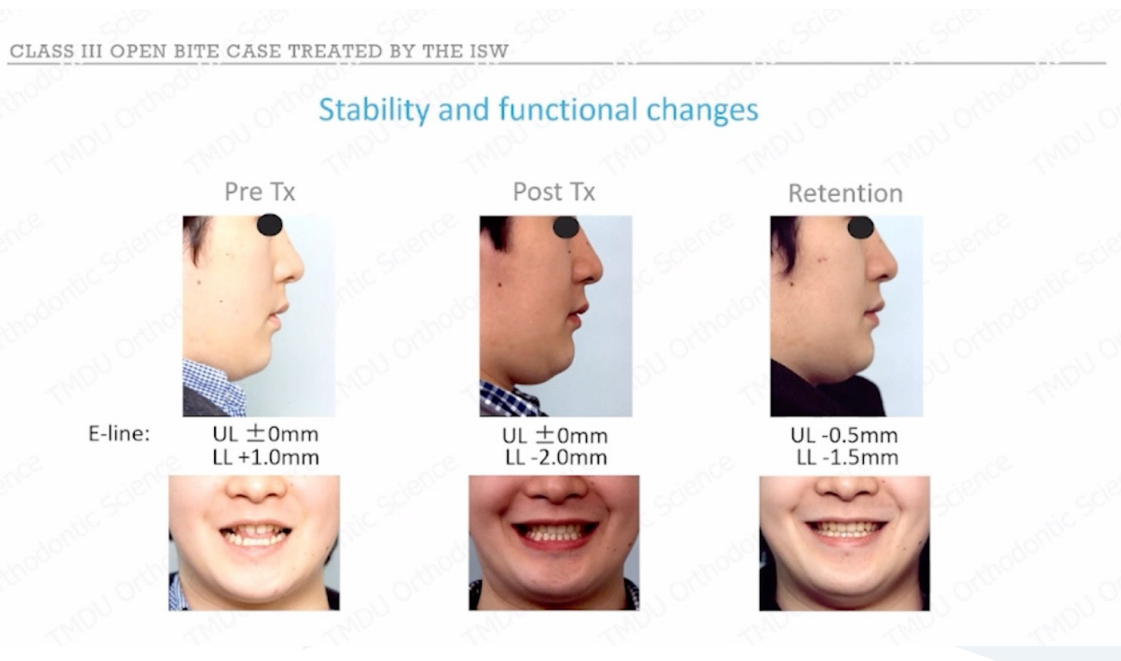


Stability after treatment with openbite

Literature review that the stability of surgical treatment (82%) is slightly higher than that of non-surgical treatment (75%), but there is no significant difference between the two treatment options. The treatment option of improving the open bite by nonsurgical orthodontic treatment with TADs can obtain similar stability of surgical treatment. Muscle training has a positive impact on stability by adjusting the swallowing habits, changing the position of the tongue, eliminating bad muscle activities, and improving the coordination environment of craniofacial functions. Previous studies have shown that improving the functional position of the tongue with tongue spur is helpful to relieve open bite and obtain long-term stability. The position of the tongue is an important factor in maintaining long-term stability. If we can carry out successful muscle training, it will help to increase stability. This patient successfully gave up the bad habit of tongue thrusting during the treatment, so the tongue spur was not added to the retainer to help maintain, but Hawley retainer combined with night class III traction was designed.

On the other hand, from the perspective of treatment stability and functional changes, the patients' lip closure and the relationship between the upper and lower lips to the E-line were significantly improved after treatment from the lateral view, and the tension of the muscles around the mouth was also significantly relieved from frontal smile view. After treatment, no obvious alveolar bone absorption or root absorption of the lower incisor was found in apical film, and the periodontal condition was good. It was mentioned in the previous literature that some periodontal tissue loss or root absorption occurs after the treatment of open bite cases. In addition, compared with before treatment, the EMG activity of masticatory muscles increased after treatment, and the contact range of occlusion also increased. It shows that the patient has reestablished a stable occlusal contact relationship in the bicuspid area through treatment and maintain well.

In general, this case was treated by using ISW and high J hook traction with improved MEAW technology for adult Class III patients, and successfully achieved counterclockwise mandibular rotation. At the same time, it also avoided common complications such as alveolar bone absorption, gingival recession or root absorption, and the treatment result was very stable.



Occlusal hypofunction induces atrophic changes in rat gingiva. Angle Orthod 2008
Occlusal hypofunction causes periodontal atrophy and VEGF/VEGFR inhibition in tooth movement. Angle Orthod 2013

The second case was presented by Dr. Yuji Ishida. He is Assistant Professor of the Department of Orthodontic Science, Graduate School Tokyo Medical and Dental University (TMDU), Tokyo, Japan. He studied at TMDU. He has published 26 scientific articles.

Case 2

Nonsurgical treatment of a skeletal class II gummy smiling case with the ISW and TADs

Case summary: 36 year old female, complained of gummy smile, lip incompetence, and crooked teeth

NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Pre-Tx



36-year-old Japanese female
Chief complaint: Gummy smile, Difficulty with lip closure, Crowding

NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Pre-Tx



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Pre-Tx

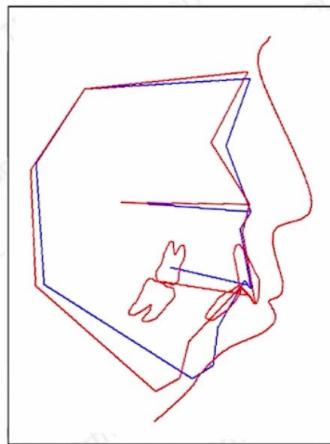
Case 2



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Pre-Tx

Case 2

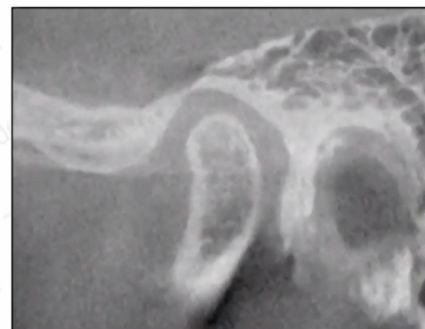
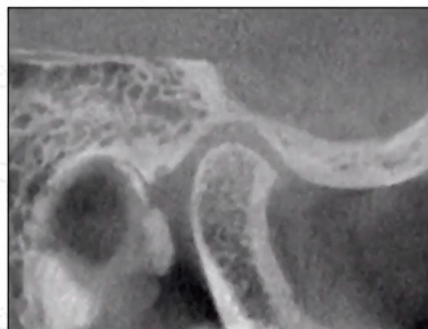


SNA	82.2
SNB	72.7
ANB	9.5
FMA	38.4
IMPA	101.9
FMIA	39.7
U1 to FH	114.2
Occl. plane	6.1

NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Pre-Tx

Case 2



Clinical examination:

- Facial & occlusal view: many gums are exposed at smile, and when the lips are closed, the chin muscles are tense; profile shows that the patient is convex, and both lips protrude beyond the E-line. Intra-oral occlusal view showed that both molars and canines were Class II relationship, the upper right lateral incisor was missing, and the upper midline was right shifted according to the face midline; The overjet was 8.5 mm, and the overbite was 4.5 mm. The space analysis results show that the estimated crowding for upper jaw is 7.5 mm, and that for the lower jaw is crowded 9.5 mm.
- Panoramic radiography: root canal filling of the upper right canine and central incisor, horizontal impaction of left mandibular third molar, generally slight absorption of alveolar bone, no abnormality in bilateral temporomandibular joints
- Cephalometric analysis: skeletal class II facial type (ANB=9.5), high angle (FMA=38.4), excessive labial inclination of lower incisors (IMPA=101.9)

Problem list:

- Skeletal problems: 1) Class II facial type characterized by mandibular retrusion; 2) high mandibular plane angle;
- Dental problems: 1) Excessive labial inclination of mandibular incisors; 2) Deep overbite 3) Complete distal molar relationship; 4) Severe crowding
- General condition: the maxillary right lateral incisor was missing; horizontal impaction of left mandibular third molar
- Soft tissue and functional status: gummy smile; difficulty in lip closure and facial convexity

Treatment objectives:

1. Orthodontic compensatory treatment without orthognathic surgery
2. Establish normal anterior overjet and overbite
3. Improve gummy smile and reduce lip protrusion
4. Relieve serious crowding
5. Establish a good occlusal relationship with stable posterior support

Treatment options:

1. Combined orthodontic treatment and orthognathic surgery: Le Fort I+SSRO
2. Fixed appliance extraction 24, 38, 41
3. Fixed appliance extraction 24, 35, 38, 45 with molar distalization by TADs.
4. Fixed appliance extraction 24, 35, 38, 45 with maxillary intrusion by TADs and ISW (final plan implemented)

Treatment concept and plan:

- Improve gummy smile by maxillary intrusion
- Establishment of Class I molar relationship by maxillary molar distalization
- Reduce bimaxillary protrusion and improve convexity
- Relieve crowding by extraction of 24, 35 and 45
- Absolute strong anchorage control (zygomatic alveolar ridge micro titanium plate)

Treatment process:

The case was treated with two-step method. First, the bimaxillary posterior teeth were leveled, distally moved and intruded with ISW segmental arch in combination with TADs. Then, ISW continuous arch wire with steps were used to retract and intrude the anterior teeth with TADs.

- Before treatment, third molars and 24 were extracted, 0.022 * 0.028 straight wire brackets were bonded, and 0.016 * 0.022 ISW segment arch wires were placed on the maxillary posterior teeth to start alignment and leveling;
- One month after treatment, zygomatic alveolar ridge micro titanium plates were implanted in the gingival area between the bilateral maxillary second premolars and the first molars
- After 3 months of treatment, use nickel titanium spring to distalize bilateral molars on 0.018 * 0.025 ISW segmental arch with implant anchorage, so as to establish a Class I molar relationship
- After establishing the Class I molar relationship, the transverse palatal bar was added to the upper jaw to help maintain the position of the upper molars. The 35 and 45 were extracted, and ISWs was used for alignment and leveling
- After 14 months of treatment, the maxillary anterior teeth are bonded with brackets, and 0.016 * 0.022 ISW continuous arch wire is used for alignment and intrusion, then replaced to 0.018 * 0.025 ISW with compensation curve. At the same time, the maxillary bicuspid teeth were ligated to the TADs to strengthen anchorage
- Adjust the anterior teeth bracket after intrusion, and fine adjust the occlusal contact with intermaxillary traction
- After 37 months of treatment, the brackets were removed, and vacuum-formed retainer was used for the upper arch, and the fixed lingual retainer was used for the lower arch with Hawley retainer. Subsequently, the periodontal surgery and aesthetic restoration of maxillary anterior section were performed.

NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

0M

Case 2



Mx: 016 x 022-inch ISW

NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

3M

Case 2



Mx: 018 x 025-inch ISW

NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

14M

Case 2



Compensating curve

Mx: 018 x 025-inch ISW
Md: 018 x 025-inch ISW

NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

33M

Case 2



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

37M

Case 2



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Post-Tx

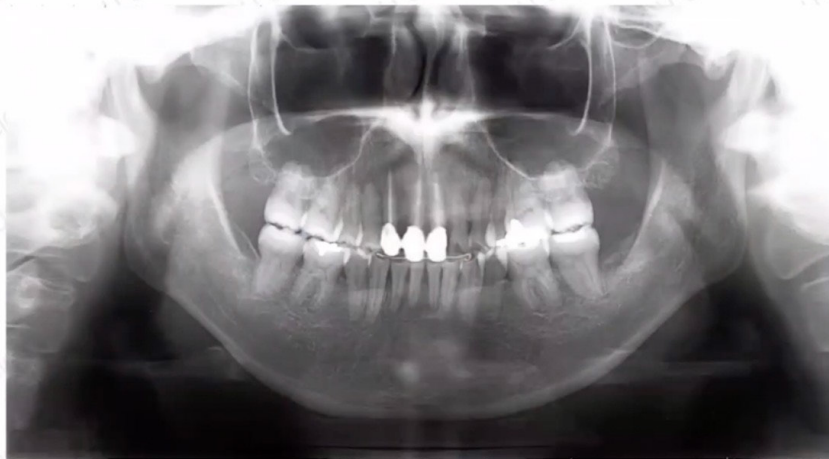
Case 2



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Post-Tx

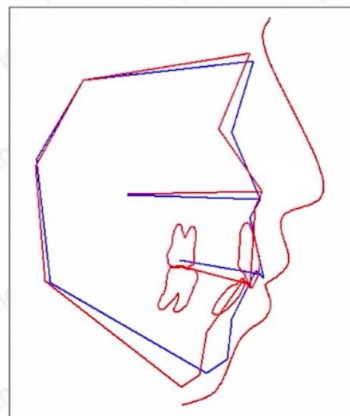
Case 2



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Post-Tx

Case 2



SNA	82.2 → 82.4
SNB	72.7 → 73.4
ANB	9.5 → 9.0
FMA	38.4 → 37.6
IMPA	101.9 → 95.7
FMIA	39.7 → 46.7
U1 to FH	114.2 → 93.8
Occl plane	6.1 → 14.2

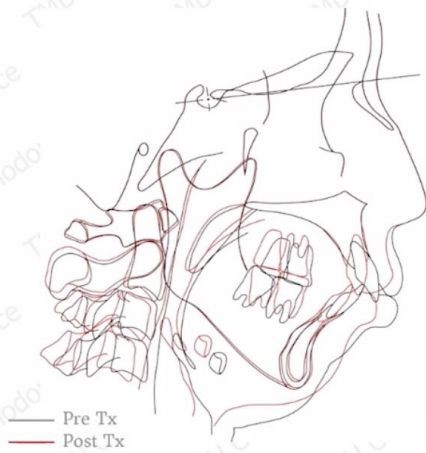
Treatment evaluation:

It can be seen from the treatment result that the problems of gummy smile, crooked teeth and bimaxillary protrusion of the patients have been significantly improved. After treatment, no further alveolar bone absorption was found on panoramic radiographs. The cephalometric changes before and after treatment showed that the protrusion of the upper incisor decreased (U1/FH: 114.2-93.8), the labial inclination of the lower incisor decreased (IMPA: 101.9-95.7), and the angle of the ANB (9.5-9.0) and the mandibular plane angle decreased (FMA: 38.4-37.6). The superimposition showed that the upper molars were intruded by 3.4 mm, distalized 3.6 mm, the upper incisors were intruded by 2.2 mm, and retracted 8.5 mm with regard to incisal edge. At the same time, the mandible showed counterclockwise rotation changes. The retention after three years shows that the occlusion of the posterior teeth is stable and the facial improvement is maintained very well. From the comparison of facial images before and after treatment and after retention, it can be seen that the gummy smile and bimaxillary protrusion of this case are significantly improved, and all remain stable after treatment. In general, this is a successful case of using ISW with TADs to treat adult skeletal Class II gummy smile patient. While improving aesthetics and function, it avoids root resorption and other complications.

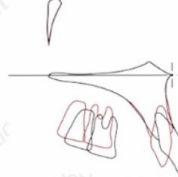
NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Case 2

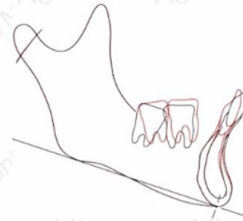
Superimposition on SN plane at S



Superimposition on Palatal plane at ANS



Superimposition on Mandibular plane at Me



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Case 2

Ret 36M



NON-SURGICAL Tx for GUMMY SMILING with ISW & TAD

Case 2

Pre-Tx ⇒ Post-Tx ⇒ Post-Ret



Case discussion:

Dr. Chooryung Judi Chung, who is a professor at the Department of Orthodontics, Gangnam Severance Hospital, Yonsei University College of Dentistry, Seoul, South Korea, served as the guest expert of the discussion for this case. She discussed the case with Dr. Takashi Ono and Dr. Yuji Ishida in the following aspects:

Diagnosis and treatment plan of Gummy smile

Smile is one of the common facial expression types and an important part of facial beauty. Any aesthetic or functional factors that affect the normal smile may become the treatment concerns of patients. Among them, gummy smile is one of the common orthodontic treatment chief complaints. About 26% of orthodontic patients have gummy smile. Previous studies have shown that gingival exposure exceeds 3mm of maxillary anterior teeth when smiling can be defined as gummy smile. The incidence of gummy smile is 7% in male patients and 14% in female patients. Common causes of gummy smile include overgrowth of maxilla and/or maxillary alveolar bone in vertical direction, abnormal passive eruption of maxillary anterior teeth, excessive tension of levator labii superioris and zygomaticus major muscles, too short upper lip, and maxillary protrusion.

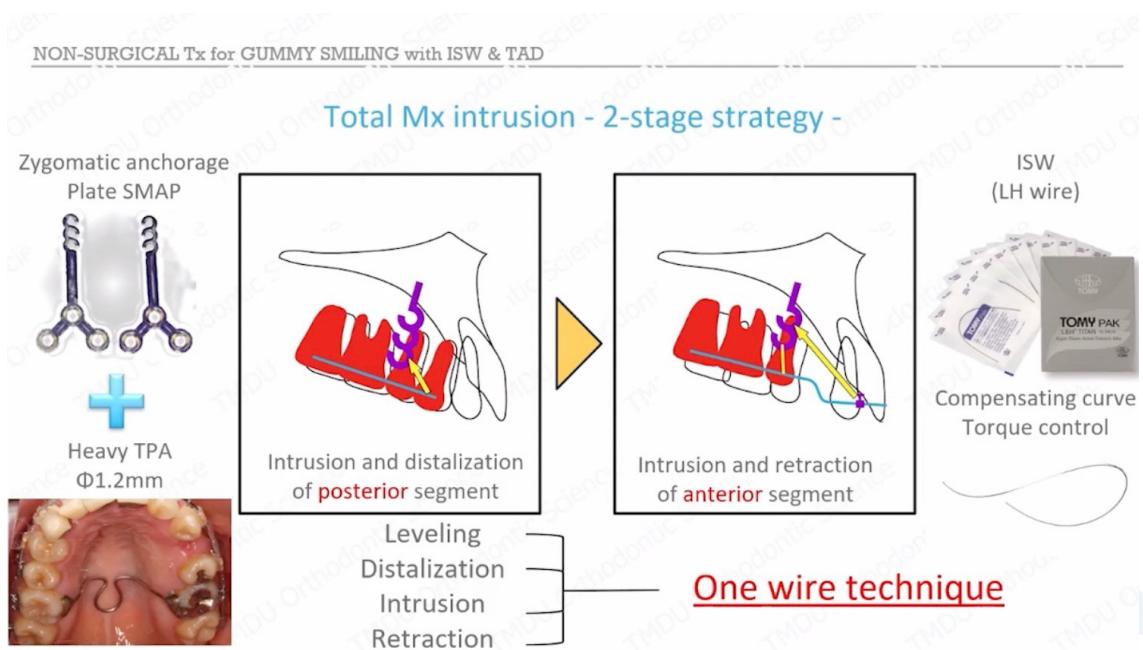
It is very important to make a correct diagnosis of the cause of gummy smile and treat the cause of disease clinically, and multidisciplinary treatment is the first choice for patients with multiple causes of malocclusion. The common orthodontic treatment methods of gummy smile include intruding upper anterior teeth with the external force, such as J-hook, or with TADs, which is applicable to the Garber grade I case. However, when Garber grades are II and III, orthognathic surgery should be considered, such as Lefort I osteotomy. For patients with gingival hyperplasia and abnormal passive eruption of teeth, periodontal surgery, such as gingivectomy or crown lengthening, should be considered. In addition, associated plastic surgery, such as Botox A injection, micro autologous fat transplantation or lip repositioning, can assist in solving soft tissue related problems.

Two step method vs One step method

In this case, the two-step method was used to first use segmental arch wire to intrude and distalize the posterior teeth, and then use continuous arch wire to intrude and retract the anterior teeth. What are the advantages of this two-step method compared with the traditional straight wire technology, which uses continuous arch wire to level and intrude the anterior teeth at the same time? The patient was treated with ISW. One of the important characteristics of ISW is its super elasticity, which has advantages in providing continuous light force, but its rigidity is reduced. Generally speaking, nickel titanium wire is not suitable for use with TADs due to its insufficient rigidity. When ISW is used with TADs for molar distalization and intrusion, it is difficult to maintain the arch shape. Therefore, in this case, the segmental arch wire was first used to intrude and distalize the bilateral posterior teeth. After establishing the Class I molar relationship, a transverse palatal bar was added to prevent the buccal inclination of the posterior teeth, and help control the shape of the maxillary arch. This can not only take advantages of the characteristics of the ISW arch wire's super elasticity and light force, but also avoid the complications of the above conventional nickel titanium wire. In addition, the two-step method avoids the need to transfer the TADs position during the treatment, and reduces the surgical trauma.

Selection of implant anchorage

Compared with the zygomatic alveolar ridge micro titanium plate implant used in this case, the micro screw commonly used in clinical practice has more clinical convenience. However, this case chose the former. This case plans to establish a Class I molar relationship with the maxillary molar distalization by 4mm. If the micro screw is used, the implant screw will inevitably be displaced during the treatment process, it may cause multiple surgical risks and injuries. Therefore, it is recommended to consider the implant form of micro titanium plate when patients need to carry out a large number of distal displacement and intrusion. Moreover, during the treatment, the implant anchorage not only provides a direct force site for the posterior teeth to distalize and intrude, but also can offset the reaction force on the posterior teeth through the passive ligation of the implant and bicuspid segment when the anterior teeth are retracted and intruded with continuous ISW arch wire and compensation curve.



Torque control of upper and lower incisors

In this case, the mandibular extraction space is mainly used to solve the problems of crowding and misalignment of the midline. However, after leveling, there was no significant labial inclination of the mandibular incisors. This is because the ISW was added with reverse Spee curve, through the distal tipping of the posterior tooth crown, and the crown buccal torque was added, so as to provide space for leveling and avoid excessive labial inclination of the mandibular incisors. On the other hand, the upper incisors of this case are too upright after treatment, which is the need of skeletal Class II patients for orthodontic compensatory treatment. In addition, if you want to further regulate the inclination of the upper incisors with the use of ISW adding compensation curves, you can consider supporting implant anchorage in the incisor area. Previous studies compared the treatment effects of different surgical schemes of micro implant in different sites to intrude the upper anterior teeth, and showed that the stress distribution of the upper anterior teeth was more uniform due to the force applied between the lateral incisors and canines by the micro implant.

Maintenance after Gummy smile treatment

Establishing a wide contact and stable occlusal relationship is a necessary condition for stable treatment results. Another important factor affecting stability is the balance of the oral and maxillofacial muscle system. Compared with that before treatment, the range of mandibular movement and masticatory muscle movement increased after treatment. Although the right maxillary canine and bicuspid were mesially moved to replace the lateral incisors and canines, there was no significant interference after treatment. The occlusal contact was stable and the occlusal function was improved, which was a necessary condition for stability.

On the other hand, it is a challenge to keep the incisor intruded after treatment. In this case, only the conventional vacuum-formed retainer is used to maintain the upper dentition. It is mainly considered that the right maxillary canine and bicuspid have been restored and reshaped after treatment. If a fixed lingual retainer is added to the crown restoration, it may cause a certain degree of interference. However, after the retention, the gingival margin of the maxillary anterior teeth still had an uncoordinated change. Professor Yuji Ishida believed that this was due to the partial relapse and extrusion change of the teeth were intruded, which brought about the change of the gingival margin. Therefore, after orthodontic treatment, appropriate time should be selected to cooperate with periodontal surgery and restorative treatment. Previous studies showed that the vertical position of the free gingival margin could be gradually determined 3 months after the crown lengthening operation, so the initiation of the final restoration treatment should wait at least 3 months, or even up to 6 months. Finally, in terms of long-term effects, we need to consider the following factors in the treatment of gummy smile patients: 1) inhibit the passive eruption of intruded teeth, which is important for our stability after treatment of gummy smile; 2) Discuss with patients the treatment options for improving smile besides orthodontic treatment.

ISW characteristics

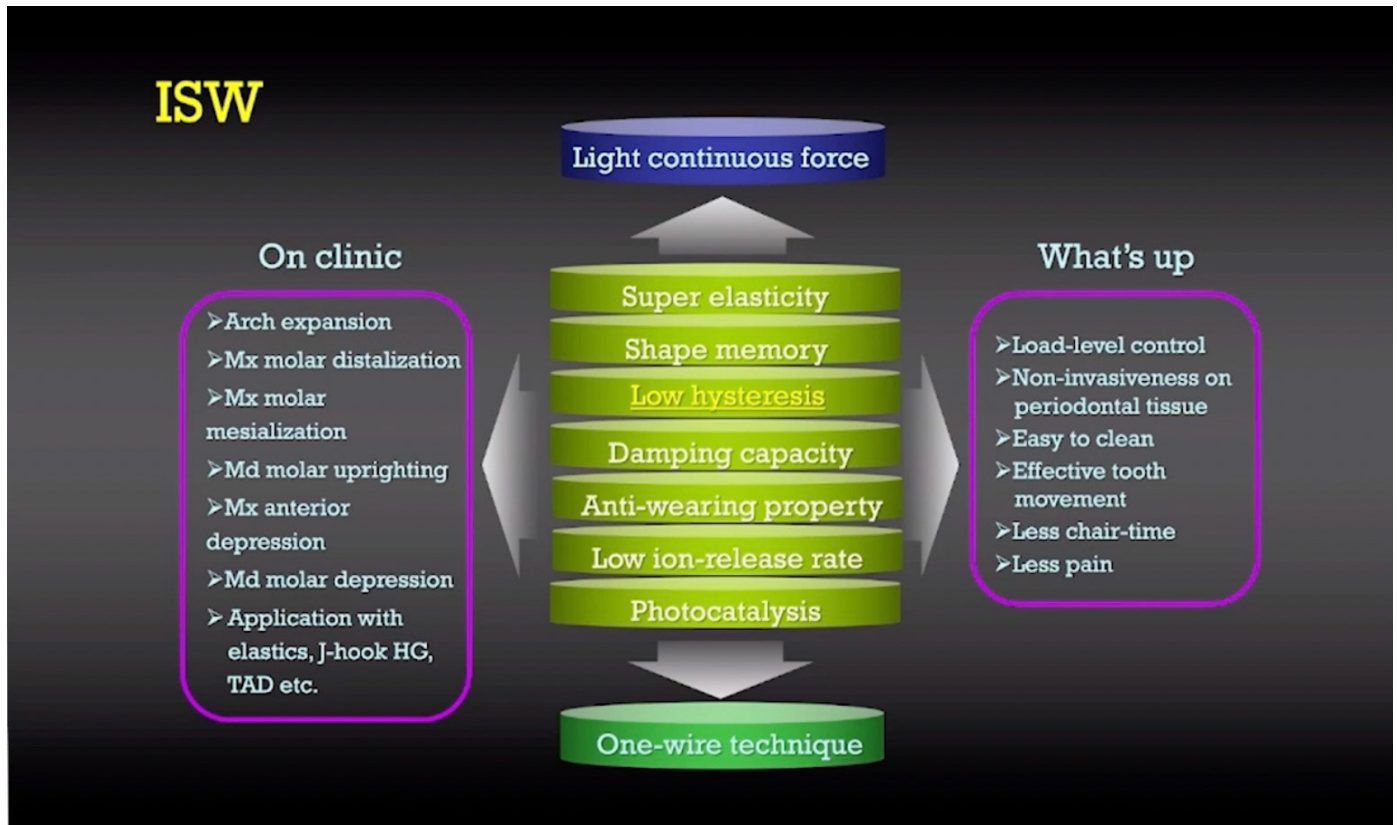
Since its development and production in Tokyo Medical and Dental University in 1978, ISW arch wire has experienced more than 40 years of clinical application and performance improvement. Compared with stainless steel wire and Co Cr Ni wire, the main characteristics of this arch wire include light force release, shape memory, super elasticity, and low hysteresis. It can be bent at different temperatures and operating times to meet different needs in clinical treatment.

It is well known that root resorption is one of the most common complications of tooth intrusion. Literature review shows that root resorption is related to excessive force application, too long treatment time or too extensive range of tooth movement. Root resorption may be caused by tooth intrusion, or the root touches the bone cortex during movement. In this case, only ISW was used in the whole process, which is often referred to as "single arch wire technique" in clinical practice. The continuous ISW arch wire applied continuous light force to the teeth. Thanks to its light force characteristics, there was no significant root resorption after treatment in this case. Because the applied force is very light, it is very friendly to periodontal tissue, and the pain felt by patients when using ISW is relatively low.

In addition to the characteristics of super elasticity and light force, ISW also has the characteristics of thermoplastic forming. In this case, asymmetry tooth movement was carried out in the process of closing the gap. Because the right maxillary canine is designed to replace the lateral incisor, and the bicuspid is designed to replace the canine, the right maxillary canine moves mesially while the left maxillary canine moves distally during the space closing. It can be seen from the treatment results that the torque and tip angle of the right canine are well controlled. Since the ISW is not particularly rigid, Dr. Yuji Ishida bent the arch wire for different tooth movements on the left and right to control the torque during the mesial movement of the right maxillary canine and avoid the contact between the root and the bone cortex.

Due to the high elasticity of the ISW, it is difficult to form it directly by hand, and its bending requires professional machines. With the Soarer X heating machine, we can bend the ISW. The temperature should be around 500 degrees. Overheating may affect the super elasticity and shape memory ability of ISW. However, when we need to add a compensation curve to the ISW, it can be directly adjusted by hand, without causing permanent deformation of the wire.

In general, it can be seen from the treatment display of these two complex cases that ISW actually has many excellent characteristics and can be used for the treatment of various types of clinical cases.



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