

# Retreatment of a Class II High Mandibular Plane Malocclusion Previously Treated with Extraction of Upper First Premolars

## Abstract

An 18-year-5-month female presented with a Class II malocclusion, bimaxillary protrusion, convex profile, high mandibular plane angle (MPA) and chin retrusion. The Discrepancy Index (DI) was 25. History: full fixed orthodontics treatment with extraction of both upper first premolars at age 12 produced a good dental result, but the facial profile was disappointing, because of excessive lip protrusion. At the 5 year follow-up evaluation the patient requested retreatment. Intermaxillary posterior anchorage in two upper quadrants was established by extracting both lower second premolars and placing extra-alveolar (E-A) infrazygomatic crest (IZC) bone screws, bilaterally. After 25 months of active treatment, the buccal relationship was corrected to Class I and an excellent intermaxillary alignment was achieved, as evidenced by a score of 10 on the Cast-Radiograph Evaluation (CRE). Facial esthetics were significantly improved by reducing both lip protrusion and lower facial height, to establish lip competence with a balanced soft tissue profile. (*Int J Orthod Implantol* 2016;42:4-18)

### Key words:

Class II high angle, retreatment, TADs (temporary anchorage devices), IZC (infrazygomatic crest) miniscrews, autorotation of the mandible, vertical dimension of occlusion, bimaxillary protrusion

## History

A young female (18y 5m) presented with a convex profile, bimaxillary protrusion, lip incompetence, chin retrusion and increased lower facial height (Figs. 1-3). She had received 14 months of orthodontic treatment with upper first premolar extractions at the age of 12. At the 5 year follow up (age 18) she desired retreatment to improve facial esthetics. The treatment plan proposed was extraction of both lower 2<sup>nd</sup> premolars and the use of bilateral infrazygomatic (IZC) miniscrews for extra-alveolar (E-A) anchorage. After 25 months of active treatment, the patient was treated to a near ideal dental and facial result using a passive self-ligation appliance (Figs. 4-6). Radiographic documentation is provided (Figs. 7 and 8) along with the cephalometric tracings (Fig. 9).

## Diagnosis and Etiology

Pre-treatment facial photographs from the original treatment and follow-up (Fig. 10) showed little improvement in the convex profile, lip protrusion, chin retrusion, increased lower facial height and mentalis

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■ Fig. 1: Pre-treatment facial photographs



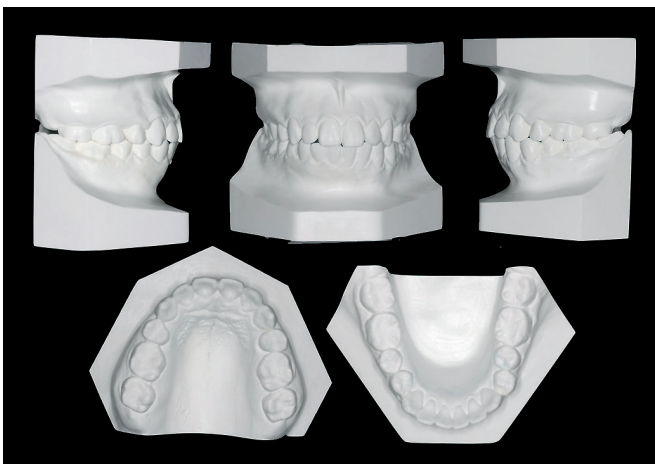
■ Fig. 4: Post-treatment facial photographs



■ Fig. 2: Pre-treatment intraoral photographs



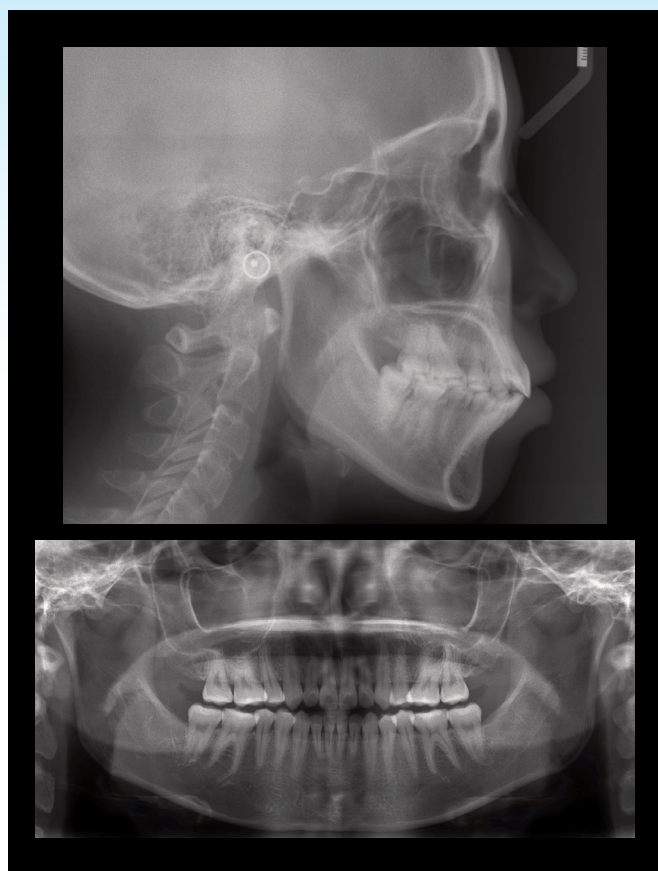
■ Fig. 5: Post-treatment intraoral photographs



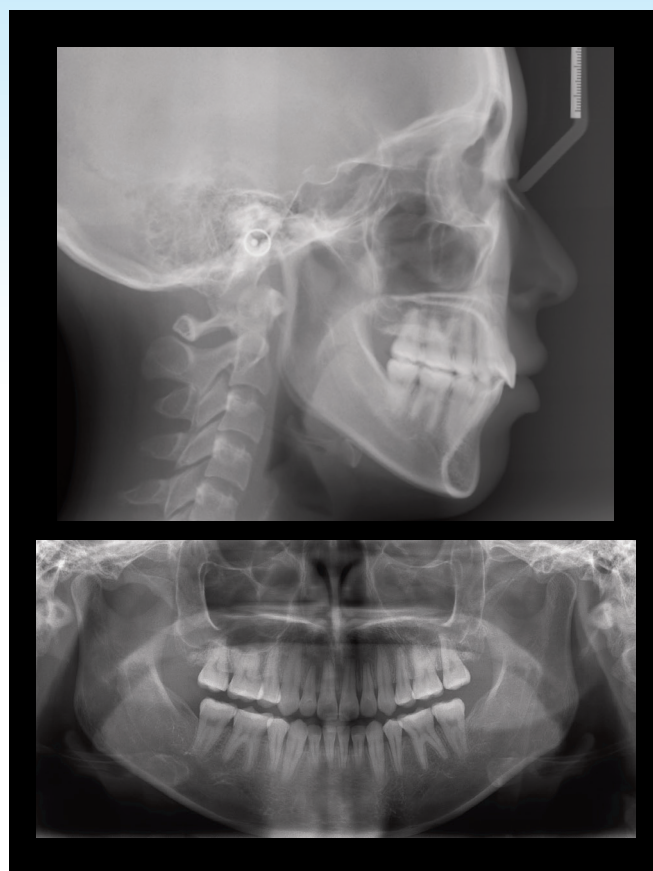
■ Fig. 3: Pre-treatment study models (casts)



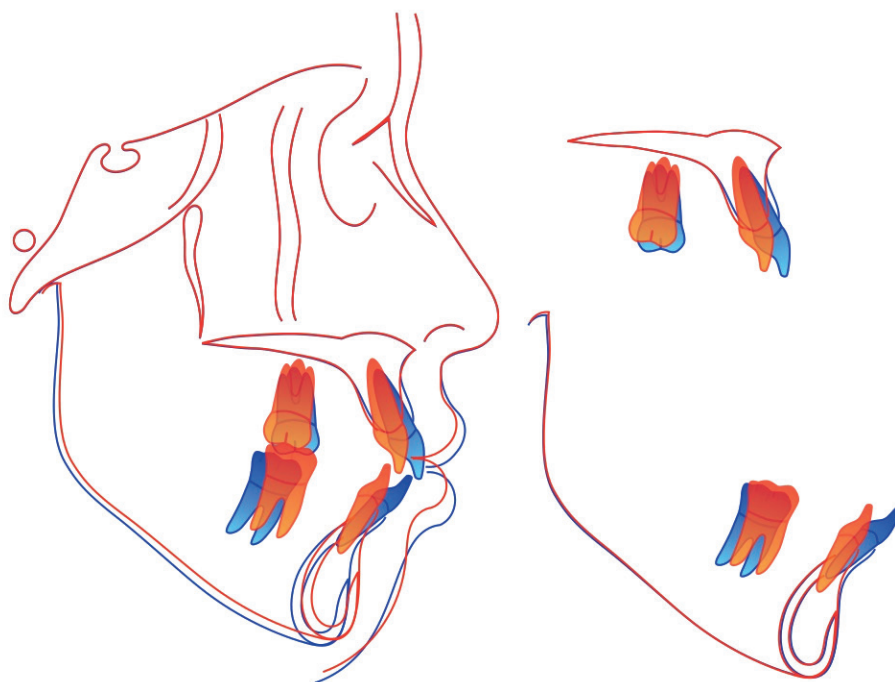
■ Fig. 6: Post-treatment study models (casts)



■ Fig. 7:  
Pre-treatment panoramic and cephalometric radiographs



■ Fig. 8:  
Post-treatment panoramic and cephalometric radiographs



■ Fig. 9: Cephalometric superimpositions (Blue:initial, Red: final)



strain (Fig. 1). The dental and facial midlines were coincident, but the chin point deviated slightly to the right. Pre-treatment intraoral photographs and study casts revealed Class I canine, but full-cusp Class II molar relationships bilaterally (Figs. 2 and 3). There was a shallow overbite of 0.5mm and slight overjet of 1mm. The cephalometric analysis (Table 2) reveals the following angles: ANB 6.5°, SN-MP 43.8°, FMA 33.0°, U1-SN 103.2°, L1-MP 105.1°. All of these measurements were consistent with a Class II, high mandibular plane angle (MPA) malocclusion with incisal compensation. The etiology appeared to be primarily genetic because a convex profile with bimaxillary protrusion is a common facial type for the patient's ethnic group.<sup>1</sup>

#### Skeletal:

- Sagittal Relationships: SNA 82.6°, SNB 76.1°, ANB 6.5°

- MPA: SN-MP 43.8°, FMA 33.0°
- Facial Symmetry: Chin point deviated slightly to the right

#### Dental:

- Missing Teeth: Both maxillary first premolars
- Molar Relationship: Bilateral full cusp Class II
- Canine Relationship: Bilateral Class I
- Overjet: 1mm
- Overbite: 0.5mm (5%)
- Space: 1mm deficiency in the lower arch
- Midlines: Upper and lower dental midlines were coincident with the facial midline
- Arch Forms: Symmetrical ovoid in the maxilla and in the mandible

#### Facial: Chinese Ethnicity



■ Fig. 10: Profile comparisons: Pre-treatment (12y2m), Post-treatment (13y4m), and 5-year-follow-up (18y3m).



- Convex profile
- Obtuse nasolabial angle
- Mandibular retrognathism
- Increased Lower Facial Height (LFH): *Excessive vertical dimension of occlusion (VDO)*
- Lip Incompetence: *Obvious mentalis strain and perioral muscle tone with mouth closed*

ABO Discrepancy Index (DI): 25 as shown in the subsequent worksheet.

### Specific Objectives of Treatment

After a thorough examination, and detailed discussion with the patient, retreatment with lower 2<sup>nd</sup> premolar extractions and IZC bone screw anchorage was planned.

#### Maxilla (all three planes):

- A - P: *Retract A point slightly*
- Vertical: *Maintain*
- Transverse: *Maintain*

#### Mandible (all three planes):

- A - P: *Maintain*
- Vertical: *Close slightly*
- Transverse: *Maintain*

#### Maxillary Dentition:

- A - P: *Retract*
- Vertical: *Intrude*
- Inter-molar / Inter-canine Width: *Maintain*

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	82.6°	82.5°	-0.1°
SNB°	76.1°	76.5°	0.4°
ANB°	6.5°	6.0°	-0.5°
SN-MP°	43.8°	42.4°	-1.4°
FMA°	33.0°	32.4°	-1.4°
DENTAL ANALYSIS			
U1 TO NA mm	3.8 mm	1.0 mm	-2.8 mm
U1 TO SN°	103.2°	97.1°	-6.1°
L1 TO NB mm	1.6 mm	6.1 mm	-5.5 mm
L1 TO MP°	105.1°	87.4°	-17.7°
U1 TO PP mm	29.7 mm	28.3	-1.4 mm
U6 TO PP mm	26.2 mm	24.1	-2.1 mm
L1 TO MP mm	44.8 mm	42.9 mm	-1.7 mm
L6 TO MP mm	33.4 mm	34.1 mm	0.7 mm
FACIAL ANALYSIS			
E-LINE UL	2.5 mm	-0.2 mm	-2.7 mm
E-LINE LL	7.0 mm	3.4 mm	-3.6 mm

■ Table 1: Cephalometric summary

#### Mandibular Dentition:

- A - P: *Maximal retraction of the anterior segment*
- Vertical: *Intrude incisors*
- Inter-molar / Inter-canine Width: *Maintain*

#### Facial Esthetics:

- Bimaxillary retraction
- Decrease LFH and the VDO
- Relieve mentalis strain to restore lip competence

## Treatment Plan

Extract both lower 2<sup>nd</sup> premolars, and place IZC miniscrews (2x8mm, SS) bilaterally, to establish anchorage in two upper posterior quadrants. Retraction of both arches to correct the bimaxillary protrusion and lip incompetence. Intrude the entire maxillary arch to close the VDO and rotate the mandible anteriorly to reduce LFH.

## Appliances and Treatment Progress

After extracting the lower 2<sup>nd</sup> premolars, both arches were bonded with an .022" slot Damon Q® passive self-ligating (PSL) appliance (Ormco, Glendale, CA) (Fig. 11). High torque brackets were used on the upper anteriors (*canine to canine*) to increase the

palatal root torque while retracting the upper arch. Standard torque brackets were used in the lower arch. Both initial archwires were .014x.025" CuNiTi.

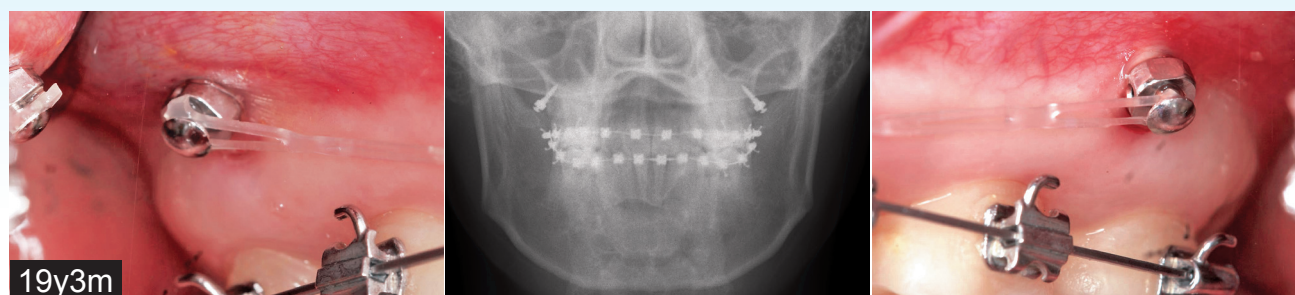
In the 10<sup>th</sup> month of treatment, the lower anteriors were retracted and the extraction spaces were closed, but the overjet was excessive. Two stainless steel (SS) infrazygomatic (IZC) miniscrews (2x8mm) were installed and upper arch retraction was initiated (Figs. 12 and 13). Two months later, the upper left miniscrew was loose, and it was replaced with another IZC miniscrew positioned about 4mm to the distal. CBCT images confirmed that the temporary anchorage devices (TADs) were buccal to the roots of the molars (Figs. 14 & 15). The overbite increased as the anterior segments were retracted on a flexible



■ Fig. 11: Full mouth passive self-ligating appliance with high torque brackets in the upper anterior segment.

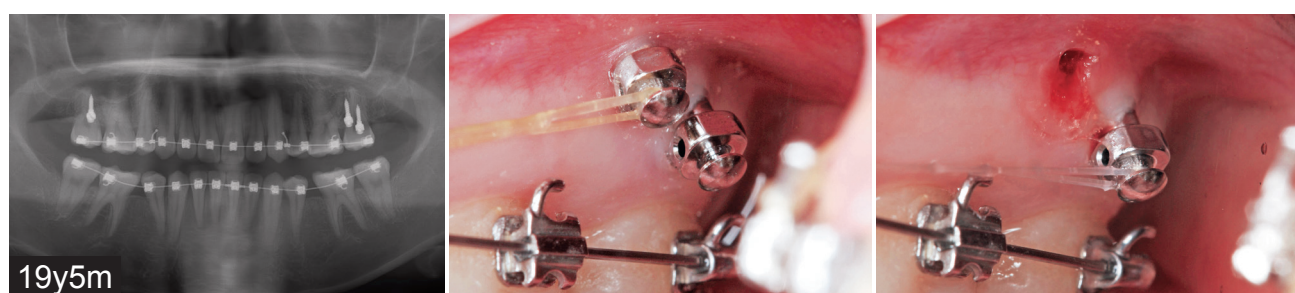


■ Fig. 12: After 10 months of treatment, the lower incisors were retracted and the overjet was increased. Two IZC miniscrews were placed to provide posterior maxillary anchorage for retraction and intrusion of the upper arch.



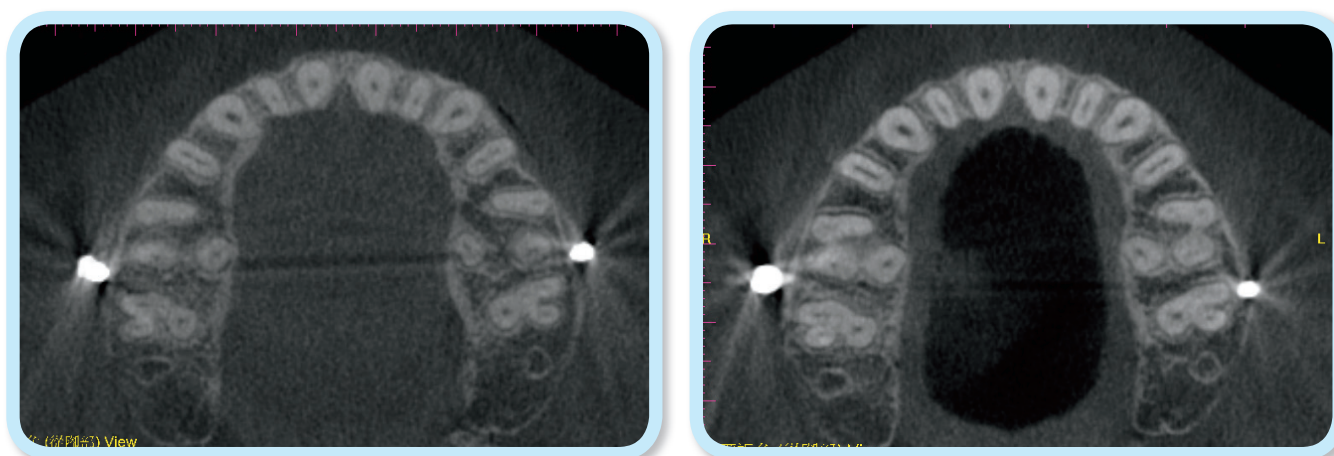
■ Fig. 13:

Position and angulation of IZC miniscrews is shown at 19y3m of age. The tissue level views are displayed on the right and the left, and the position of the screws lateral to the roots of the molars is revealed in an anterior-posterior radiograph (center).



■ Fig. 14:

The left IZC bone screw was loose two months after it was placed (19y5m). A new IZC miniscrew was placed 4 mm distally as shown in the panoramic radiograph (left) and intraoral photograph (center). The right photograph reveals the clinical picture when the original IZC screw was removed.



■ Fig. 15:

Axial view from a CBCT demonstrate that the IZC screws are lateral to the roots of upper molars, so the entire upper dentition can be retracted without root interference.



archwire (Fig. 16), so bite turbos were constructed with glass ionomer cement on the lingual surfaces of the upper central incisors to open the bite. When the posterior bite is opened, the relatively weak moments generated by the archwire are sufficient for leveling the arch (Fig. 17).

After 18 months of treatment, both lower extraction spaces were closed and the canine and molar relationships were near Class I (Fig. 17). In the last 3 months of active treatment, cross elastics from the buccal of the upper molars to the lingual of the lower molars were utilized to reduce the buccal

overjet in the molar areas (Fig. 18). All fixed appliances were removed after 25 months of treatment (Figs. 4-6).

### Results Achieved

The patient was treated to the desired result, as planned (Figs. 4-6). Cephalometric and panoramic radiographs document the pre-treatment and post-treatment morphology (Figs. 7 and 8). Cephalometric tracings superimposed in Fig. 9 show the treatment effects, and Table 1 is a summary of the cephalometric measurements. The score for



■ Fig. 16:

At 19y5m the bite was opened with bite turbos constructed with glass ionomer cement on the lingual surfaces of the maxillary central incisors (center). See text for details.



■ Fig. 17:

After 18 months of treatment (19y11mo), the lower extraction spaces were closed, the arch was leveled, and the buccal relationships were approaching Class I.



■ Fig. 18:

Cross elastics from the buccal of the upper molars to the lingual of the lower molars reduced the buccal overjet and coordinated the arch forms.

the American Board of Orthodontics (ABO) Cast-Radiograph Evaluation (CRE) was 10, as documented in the subsequent worksheet.

#### Maxilla (all three planes):

- A - P: Retracted at A point
- Vertical: Maintained
- Transverse: Maintained

#### Mandible (all three planes):

- A - P: Protracted
- Vertical: Decreased by forward rotation
- Transverse: Maintained

#### Maxillary Dentition

- A - P: Retracted
- Vertical: Intruded
- Inter-molar / Inter-canine Width: Expanded

#### Mandibular Dentition

- A - P: Retracted
- Vertical: Intruded incisors
- Inter-molar / Inter-canine Width: Expanded

#### Facial Esthetics:

- LFH and VDO: Decreased
- Lips: Retracted
- Lip Competence: Mentalis strain relieved and lips contact in repose

Facial Esthetics: Substantially improved and well harmonized.

#### Retention

Upper Hawley and lower spring retainers were delivered after the fixed appliances were removed at the 25<sup>th</sup> month of treatment. The patient was instructed to wear both retainers full time for the first 6 months and nights only thereafter. In addition, the patient was trained in proper home hygiene and maintenance of the retainers.

#### Final Evaluation of the Treatment

Overall, the patient was well satisfied with the treatment outcome. The CRE score of 10 points indicates an excellent intermaxillary alignment. A Class I canine and molar relationship with good

interdigitation was achieved bilaterally. Most of the points deducted on the CRE were for minor problems in alignment/rotations, marginal ridge discrepancies, or a lack of occlusal contact for the upper lateral incisors. See the subsequent worksheet for details. Facial esthetics were dramatically improved by retracting the dentition and decreasing the lower facial height.

## Discussion

A convex profile with lip protrusion is a common Asian facial type.<sup>1</sup> Taiwanese clinicians have a preference for the facial profiles of extraction patients,<sup>1</sup> but there is no statistically significant preferences for other parameters, such as tooth alignment, overbite, overjet, midline symmetry, or posterior occlusion.<sup>2</sup> Premolar extraction is the most common orthodontic treatment plan for correcting a convex profile with protrusive lips and lip

incompetence.<sup>3,4</sup> With extraction therapy, the most common post-treatment changes are an increase of the nasolabial angle, retraction of upper and lower lips to the E-line, and an decrease in the depth of the labiomental fold. The current patient was first treated at the age of 12 with upper first premolar extractions. That camouflage approach achieved a stable occlusion with molar relationships in a full cusp Class II,<sup>5,6</sup> but there was little improvement in the facial profile (Fig. 10). After 5 years of follow up, the patient was dissatisfied with her facial form, and desired retreatment. The lower second premolars were extracted to provide anchorage to retract the incisors to align them over the apical base of bone<sup>2</sup> and improve the facial esthetics (Fig. 19).

Missing first premolars limited the treatment options in the maxilla. The IZC miniscrews, positioned buccal to the maxillary molars, were a ideal solution for retracting the upper arch in coordination with



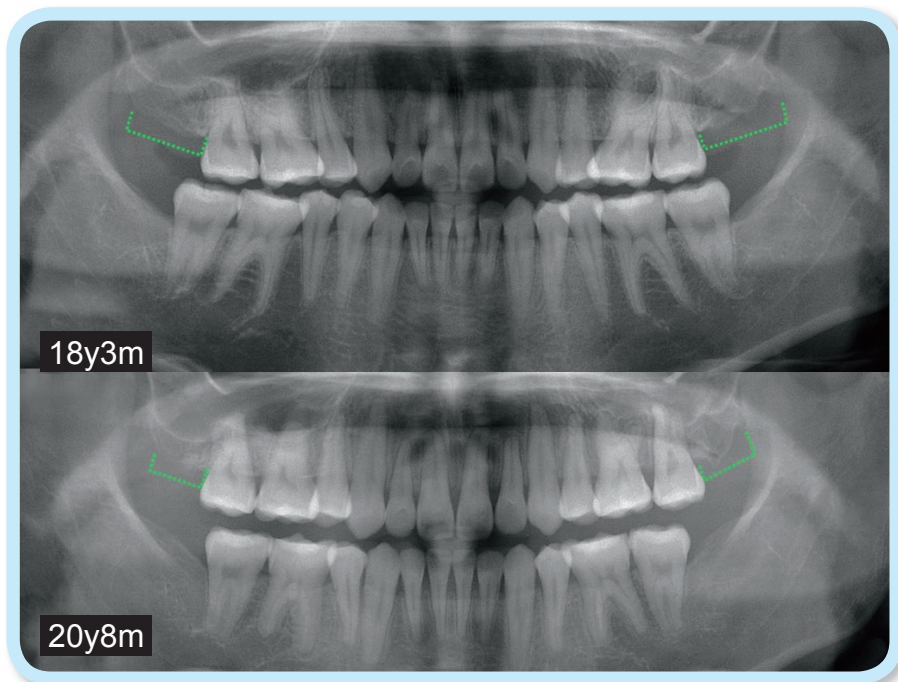
■ Fig. 19: The retraction of the dentition and decrease in LFH have greatly improved the facial profile at 20y8m.



mandibular space closure. Reduction of bimaxillary protrusion improves facial balance by correcting lip competence and sulcus depth as the lip prominence is reduced.<sup>7-9</sup> In addition to the mesial movement of the lower molars during space closure (Fig. 9), the firm IZC anchorage was adequate for retracting the entire upper arch to achieve a Class I molar relationship at the finish.<sup>10-12</sup> The upper arch was substantially retracted (Fig. 20) but also intruded to close the lower facial height (Fig. 9). In addition to the superior component of force from the IZC anchorage, the anterior bite turbos contributed to incisor intrusion that resulted in counterclockwise rotation of the mandible.

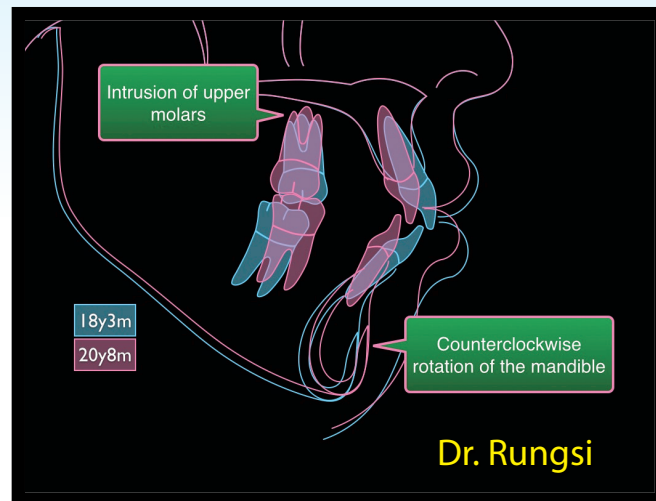
As noted in Figure 9, there was compensatory extrusion of the lower molars as the upper molars were intruded. Miniscrews in the posterior mandible would probably control lower molar extrusion and enhance the decrease in lower facial height (Fig. 21), but this approach may have been problematic for the present patient, because there was a tendency for the overbite to increase as the anterior segments were retracted (Fig. 16).

In the last 2 months of treatment, a .019x.025" NiTi archwire with 20 degrees of lingual root torque was used in the upper arch to increase the labial crown torque of the maxillary incisors (Fig. 22). If this arch



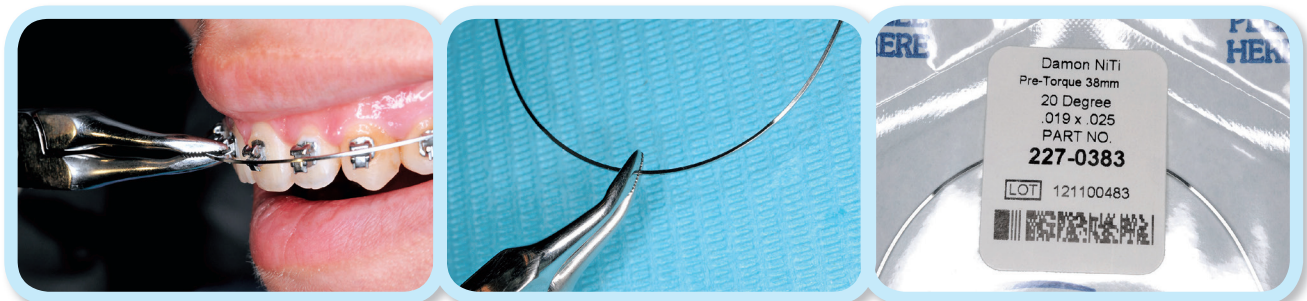
■ Fig. 20:

Comparison of panoramic radiographs from before (18y3m) to after retreatment (20y8m) document the substantial retraction of the maxillary arch (green brackets).



■ Fig. 21:

A schematic diagram by Dr. Thavarungkul Rungsi demonstrates the mechanism for counterclockwise rotation of the mandible when the maxillary arch is intruded.



■ Fig. 22: A 20° pre-torqued .019x.025" NiTi arch wire was used to increase the axial inclination of the upper incisors.

wire had been used earlier in treatment, it may have been possible to make the upper incisors less upright.

## Conclusion

Class II division 1 malocclusion can often be treated with maxillary premolar extraction, but the molar relationship shifts to Class II. Furthermore, there is a limited potential for facial correction, particularly

if the lower incisors are protrusive. Retreatment to correct lip protrusion with lower premolar extraction is not feasible without supplemental maxillary anchorage. Posterior miniscrews placed between the roots of the teeth would inhibit arch retraction, so IZC bone screws placed buccal to the roots of the upper molars are an ideal solution for the maxillary anchorage necessary to correct protrusive, incompetent lips.

## References

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## Discrepancy Index Worksheet

**TOTAL D.I. SCORE** 25

### OVERJET

0 mm. (edge-to-edge) =  
 1 – 3 mm. = 0 pts.  
 3.1 – 5 mm. = 2 pts.  
 5.1 – 7 mm. = 3 pts.  
 7.1 – 9 mm. = 4 pts.  
 > 9 mm. = 5 pts.

Negative OJ (x-bite) 1 pt. per mm. per tooth =

Total = 0

### OVERBITE

0 – 3 mm. = 0 pts.  
 3.1 – 5 mm. = 2 pts.  
 5.1 – 7 mm. = 3 pts.  
 Impinging (100%) = 5 pts.

Total = 0

### ANTERIOR OPEN BITE

0 mm. (edge-to-edge), 1 pt. per tooth  
 then 1 pt. per additional full mm. per tooth

Total = 0

### LATERAL OPEN BITE

2 pts. per mm. per tooth

Total = 6

### CROWDING (only one arch)

1 – 3 mm. = 1 pt.  
 3.1 – 5 mm. = 2 pts.  
 5.1 – 7 mm. = 4 pts.  
 > 7 mm. = 7 pts.

Total = 1

### OCCLUSION

Class I to end on = 0 pts.  
 End on Class II or III = 2 pts. per side 8 pts.  
 Full Class II or III = 4 pts. per side 8 pts.  
 Beyond Class II or III = 1 pt. per mm. 8 pts.  
 additional

Total = 8

### LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

### BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

### CEPHALOMETRICS (See Instructions)

ANB  $\geq 6^\circ$  or  $\leq -2^\circ$  = 4 pts.

Each degree  $< -2^\circ$  \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

Each degree  $> 6^\circ$  \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

#### SN-MP

$\geq 38^\circ$  = 2 pts.

Each degree  $> 38^\circ$  6 x 2 pts. = 12

$\leq 26^\circ$  = 1 pt.

Each degree  $< 26^\circ$  \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

1 to MP  $\geq 99^\circ$  = 1 pt.

Each degree  $> 99^\circ$  \_\_\_\_\_ x 1 pt. = \_\_\_\_\_

Total = 16

### OTHER (See Instructions)

Supernumerary teeth \_\_\_\_\_ x 1 pt. = \_\_\_\_\_  
 Ankylosis of perm. teeth \_\_\_\_\_ x 2 pts. = \_\_\_\_\_  
 Anomalous morphology \_\_\_\_\_ x 2 pts. = \_\_\_\_\_  
 Impaction (except 3<sup>rd</sup> molars) \_\_\_\_\_ x 2 pts. = \_\_\_\_\_  
 Midline discrepancy ( $\geq 3$ mm) @ 2 pts. = \_\_\_\_\_  
 Missing teeth (except 3<sup>rd</sup> molars) \_\_\_\_\_ x 1 pts. = \_\_\_\_\_  
 Missing teeth, congenital \_\_\_\_\_ x 2 pts. = \_\_\_\_\_  
 Spacing (4 or more, per arch) \_\_\_\_\_ x 2 pts. = \_\_\_\_\_  
 Spacing (Mx cent. diastema  $\geq 2$ mm) @ 2 pts. = \_\_\_\_\_  
 Tooth transposition \_\_\_\_\_ x 2 pts. = \_\_\_\_\_  
 Skeletal asymmetry (nonsurgical tx) @ 3 pts. = \_\_\_\_\_  
 Addl. treatment complexities 0 x 2 pts. = 0

Identify:

Total = 0

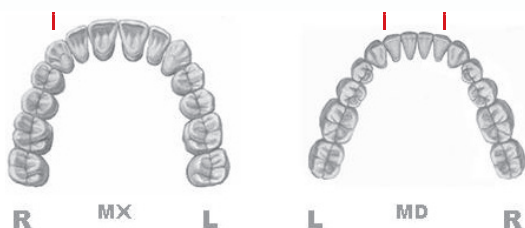
## Cast-Radiograph Evaluation

Total CRE Score

10

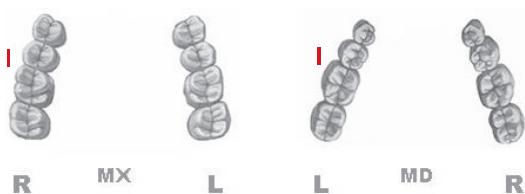
### Alignment/Rotations

3



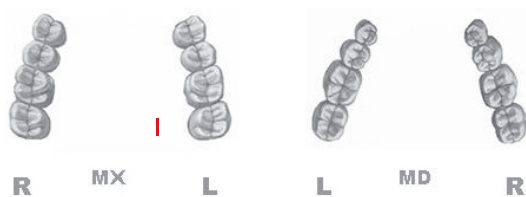
### Marginal Ridges

2



### Buccolingual Inclination

1



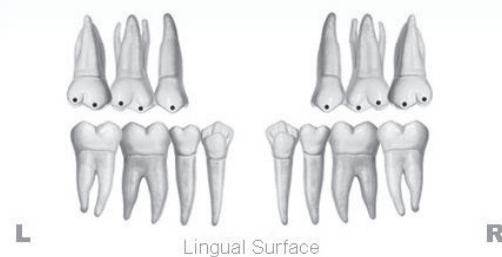
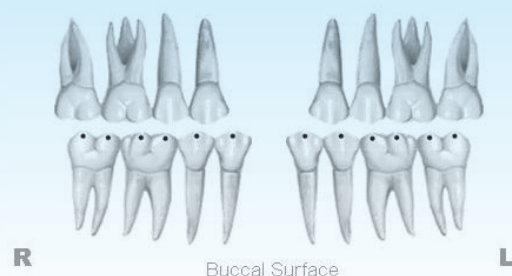
### Overjet

3



### Occlusal Contacts

0



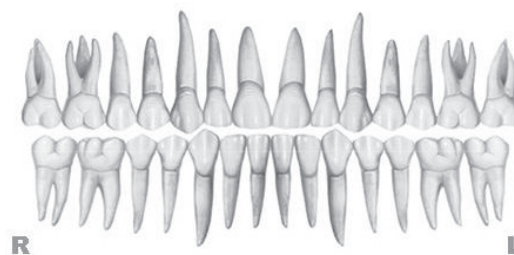
### Occlusal Relationships

0



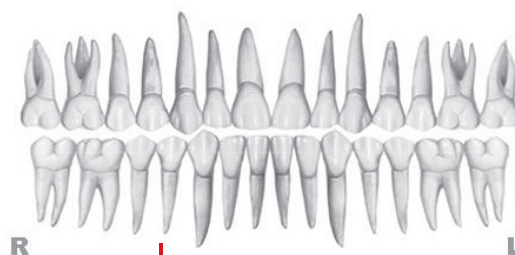
### Interproximal Contacts

0



### Root Angulation

1



**INSTRUCTIONS:** Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.