Conservative Adult Treatment for Severe Class III, Openbite Malocclusion with Bimaxillary Crowding

SUMMARY

A 24-year-old woman presented for orthodontics evaluation of a severe Class III malocclusion, that was complicated with an an anterior open bite, marked crowding in both arches, and lower lip protrusion. Maxillary first premolars and mandibular first molars were extracted. Differential space closure with a fixed, self-ligating appliance was supplemented with short, light Class III elastics. These conservative mechanics retracted the mandibular dentition to correct the negative overjet, reduced the buccal discrepancy and corrected the lower lip protrusion. In addition, the short, light Class III elastics produced a differential moment on the mandibular dentition to rotate the plane of occlusion counterclockwise, to correct the anterior open bite. This severe Class III malocclusion with a Discrepancy Index of 60 was corrected to an excellent functional and esthetic result, as documented by a Cast-Radiograph Score of 20, and a Pink and White Esthetic Score of 2. (IJOI 2014;34:12-25)

Key word:
Class III openbite malocclusion, bimaxillary crowding, atypical extraction, self-ligating appliance

History and Etiology

A severe Class III openbite malocclusion (*Figs. 1-3*) was treated to a near ideal result (*Figs. 4-6*) without orthognathic surgery. Chief complaints were anterior cross-bite and protrusive lower lip. An intraoral examination revealed a severely decayed mandibular right first molar and a restoratively compromised mandibular left first molar. The maxillary canines were blocked out bilaterally. The panoramic radiograph (*Fig. 7*) revealed that both mandibular third molars were mesially-angulated impactions. There was no additional contributing medical or dental history.

Low tongue posture was considered to the prevailing environmental etiology of the malocclusion, as evidenced by anterior interdental spaces and posterior cross-bite in centric occlusion (*CO*). The patient was treated with light force mechanics in an attempt to reverse the tongue posture etiology. When the dental morphology was corrected, the low tongue posture corrected spontaneously. The pleasing result is documented with clinical photographs (*Figs. 4-5*), casts (*Fig. 6*), as well as both lateral cephalometric and panoramic radiographs (*Fig. 8*). Superimposed cephalometric tracings (*Fig. 9*) show that light force, extractions and carefully focused mechanics resolved this severe dentoalveolar malocclusion without opening the vertical dimension of occlusion (*VDO*).

Diagnosis

Skeletal:

- Skeletal Class III (*SNA 80°, SNB 81°, ANB -1°*)
- Increased mandibular plane angle (*SN-MP 44°, FMA 37°*)

Dental:

- Negative overjet (*2 mm*)
- Anterior open bite (*3 mm*)
- Severe crowding (*>7mm*) in both arches

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Fig. 1: Pretreatment facial photographs

Fig. 4: Post-treatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 5: Posttreatment intraoral photographs

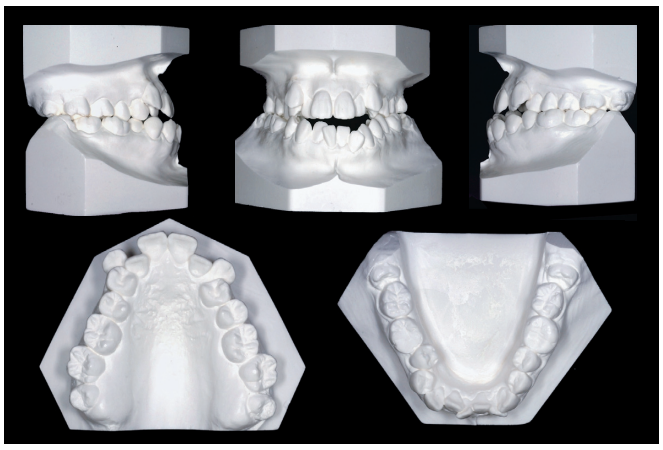

Fig. 3: Pretreatment study casts

Fig. 6: Posttreatment study casts

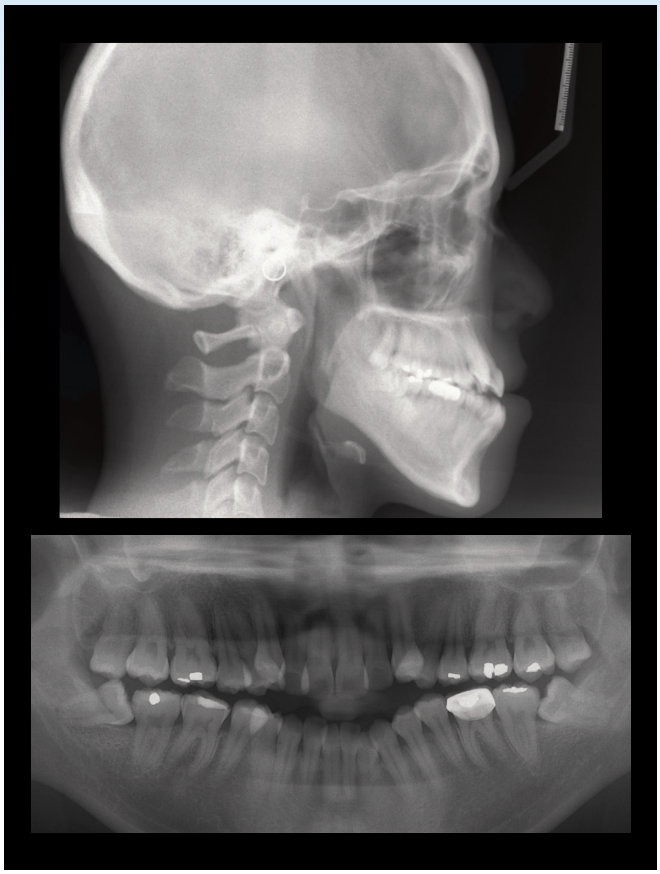

Fig. 7:

Pre-treatment panoramic and lateral cephalometric radiographs. The panoramic film shows that both mandibular third molars are mesially-angulated impactions.

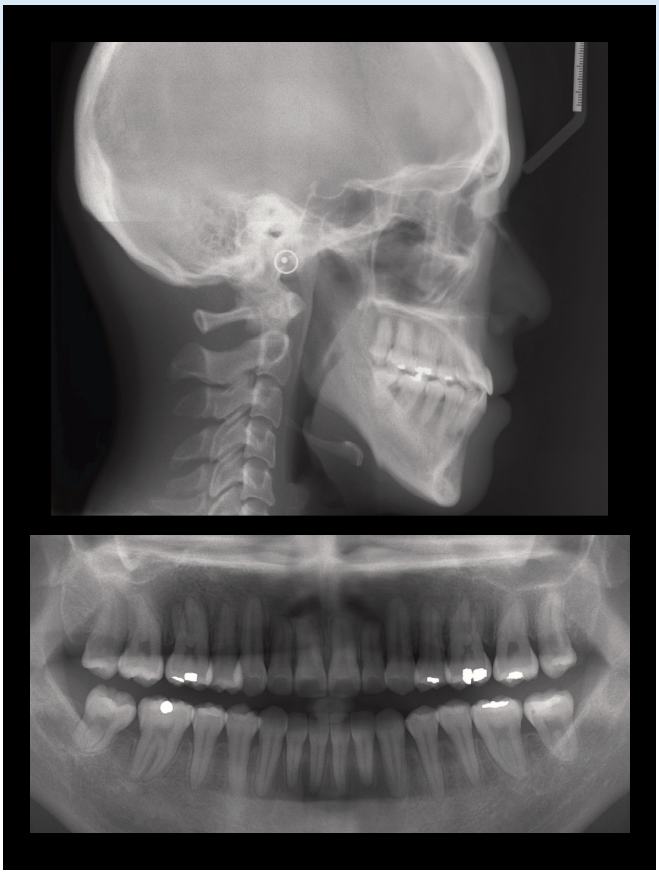

Fig. 8:

Post-treatment panoramic and lateral cephalometric radiographs. The panoramic film reveals that both mandibular third molars were uprighted and well aligned.

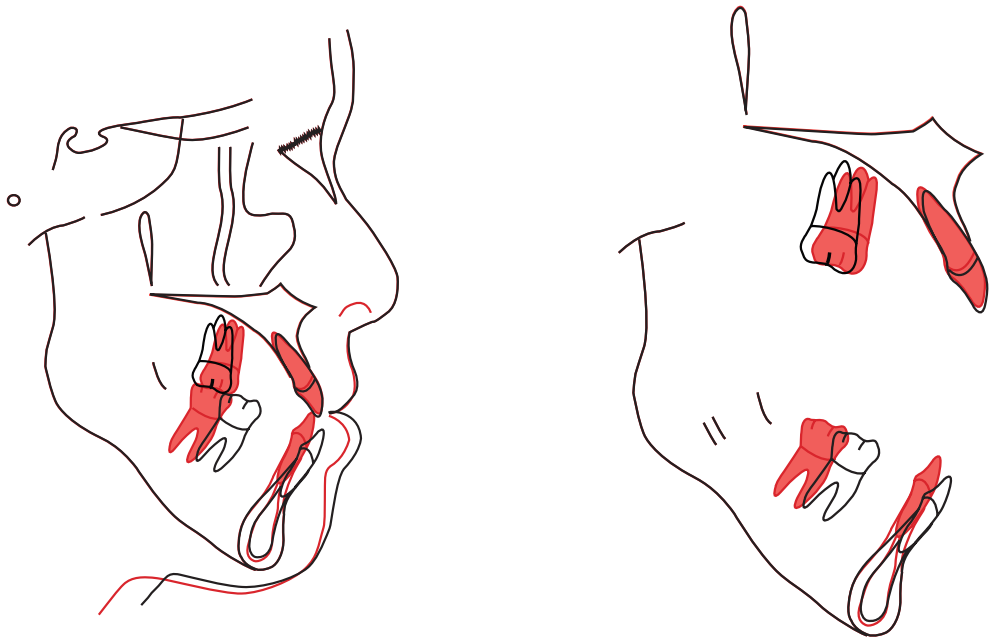

Fig. 9:

Superimposed cephalometric tracings indicate that the maxillary incisors have been maintained and molars have been protracted. The lower incisors have been retracted and the second molars have replaced the first molars. The protrusive lower lip has been corrected.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	80°	80°	0°
SNB°	81°	81°	0°
ANB°	-1°	-1°	0°
SN-MP°	44°	44°	0°
FMA°	37°	37°	0°
DENTAL ANALYSIS			
U1 TO NA mm	8 mm	8 mm	0 mm
U1 TO SN°	117°	117°	0°
L1 TO NB mm	8 mm	5 mm	3 mm
L1 TO MP°	82°	74°	8°
FACIAL ANALYSIS			
E-LINE UL	-3 mm	-3 mm	0 mm
E-LINE LL	1 mm	-0.5 mm	1.5 mm

■ Table 1: Cephalometric summary

- Bilateral Class III molar relationship (*7-8mm, more than a full cusp*)
- Posterior lingual crossbite (*#3, 4, 12, 13*)

Facial:

- Orthognathic profile Protrusive lower lip
- As shown in the subsequent worksheet, the Discrepancy Index (*DI*) was 60.

Specific Objectives of Treatment

Maxilla (*all three planes*):

- A - P: Maintain
- Vertical: Maintain
- Transverse: Maintain

Mandible (*all three planes*):

- A - P: Maintain
- Vertical: Maintain
- Transverse: Maintain

Maxillary Dentition

- A - P: Maintain
- Vertical: Maintain
- Inter-molar Width: Expansion

Mandibular Dentition

- A - P: Retract the mandibular incisors
- Vertical: counterclockwise rotation of the occlusal plane to correct the openbite
- Inter-molar / Inter-canine Width: Maintain

Facial Esthetics: Retract protrusive lower lip

Treatment Plan

Extract both maxillary first premolars to resolve crowding of the upper dentition. Since the long-term prognosis for mandibular first molars was poor, they were extracted instead of the first premolars. This approach created space for resolving the mandibular crowding and correcting the negative overjet. Light, short Class III elastics were used to retract the entire lower dentition, as well as to rotate the lower occlusal plane counterclockwise to correct the anterior openbite.

Appliances and Treatment Progress

The maxillary first premolars and the mandibular first molars were extracted prior to bonding with a .022" Damon Q fixed appliance (*Ormco, Glendora, CA*). The maxillary incisors were bonded with low torque brackets, and high torque brackets were placed on the maxillary canines. For the lower arch, low torque brackets were bonded upside down on the incisors, and high torque brackets were placed on the lower canines (*Fig. 10*). The maxillary archwire was tied-back

Fig. 10:

The maxillary incisors were bonded with low torque brackets and the mandibular incisors were bonded with upside-down low torque brackets. High torque brackets were bonded on the upper and lower canines.

to the maxillary first molar to prevent labial flaring of the anterior teeth. An elastic chain was placed between the maxillary lateral incisor and canine to correct the mesial rotation of the lateral incisor. On the lower arch, the wire was tied-back from the mandibular second molar to the second premolar to avoid the archwire being pulled out of the second molar tube (*Fig. 11*). After the initial alignment, light short Class III elastics (*2 oz*) were applied from the

Fig. 11:

The maxillary canines are tied-back with stainless steel (SS) ligature first molar to canine to prevent labial flaring as the anterior teeth align. A elastic chain from the maxillary canine to the lateral incisor was used to correct and canine to correct mesial-in rotation of the lateral incisor. Another SS ligature was used to tie back the mandibular second premolar to the second molar to help avoid disengagement of the archwire during mastication.

maxillary first molar to the mandibular first premolar (*Fig. 12*). To correct the posterior crossbite, four buttons were bonded on the palatal side of the maxillary first and second molars and cross elastics were applied from these buttons to the mandibular molars (*Fig. 13*).

In the 11th month, .019x25" and .017x25" SS archwires were placed on the upper and lower arches, respectively. Elastic chains and intra-arch elastics (*3.5 oz*) were used to close the spaces.

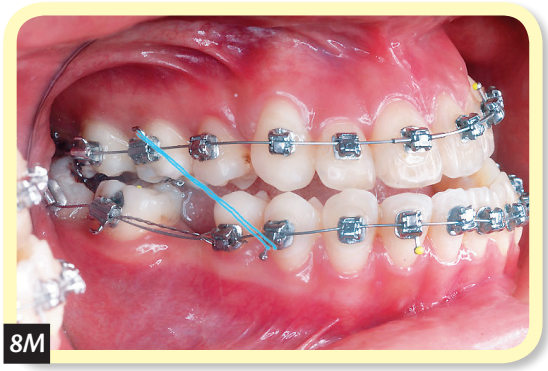

Fig. 12:

Light short Class III elastics (2 oz) were applied from the maxillary first molar to the mandibular first premolar.

Fig. 13:

Four buttons were bonded on the palatal side of the maxillary first and second molars and cross elastics were applied to the mandibular molars to correct the posterior crossbite.

At about 13 months after the initiation of active treatment, the negative overjet was corrected. Apparent gingival recession of the mandibular anterior teeth was noted and the patient was evaluated for connective tissue graft surgery (*Fig. 14*). However, careful assessment of the photographs relative to the radiographs revealed the problem was interproximal black triangles due to the tapered shape of the incisor crowns.

After closing all the spaces, the upper archwire was expanded with cross-elastics to correct the posterior crossbite. The lower archwire had step-in bends to move the mandibular third molars lingually (*Fig. 15*). In the finishing phase, the mandibular anterior brackets were rebonded to correct the angulation of the incisors and deepen the overbite (*Fig. 16*). Interproximal reduction was applied to reshape the mandibular incisors, which increased the contact area between the mandibular incisors and reduced the black triangles (*Fig. 17*). For final settling of the molar occlusion, the upper archwire was sectioned

Fig. 15:
The mandibular third molars were stepped-in to complete lower arch alignment.

Fig. 14:
Once the negative overjet was corrected, black triangles were noted between the tapered crowns of the mandibular incisors.

Fig. 16:
The brackets on the mandibular anterior teeth were rebonded to correct the axial inclinations and deepen the overbite.

Fig. 17:

Interproximal enamel reduction reshaped the mandibular incisors. Space closure with an elastic chain was indicated to reduce the black triangles.

Fig. 18:

The maxillary archwire was sectioned distal to the second premolars to allow the molars to settle.

distally to the second premolars (*Fig. 18*). After 27 months of active treatment, all appliances were removed.

Results Achieved

Maxilla (*all three planes*):

- A - P: Maintained
- Vertical: Maintained
- Transverse: Maintained

Mandible (*all three planes*):

- A - P: Retraction of the alveolar process
- Vertical: Maintained
- Transverse: Maintained

Maxillary Dentition

- A - P: Molars moved mesially
- Vertical: Maintained
- Inter-molar Width: Expanded in the molar area

Mandibular Dentition

- A - P: Mandibular incisors retracted
- Vertical: incisors were extruded due to counterclockwise rotation of the occlusal plane
- Inter-molar / Inter-canine Width: Maintained

Facial Esthetics: Protrusive lower lip retracted

Retention

Upper Hawley and lower spring retainers were delivered for upper and lower arches, respectively. Full time wear was prescribed for the first 6 months, and nights only thereafter. The patient was instructed in the home care and maintenance of the retainers.

Final Evaluation of Treatment

The ABO Cast-Radiograph Evaluation (*CRE*) score was 20 points, indicating an excellent resolution of a severe Class III openbite malocclusion. The major CRE discrepancies were buccolingual inclination and marginal ridge discrepancies. Since both of the mandibular first molars had a questionable long-term prognosis, and there were normal mandibular third molars on both sides, the optimal treatment plan for the mandible was extraction of the first molars rather than the first premolars. This extraction

pattern minimizes the eventual need for prosthetic restoration, but does result in bilateral Class II molar relationships.

The IBOI Pink & White Esthetic score was 2. The only problems were a flat incisal curve and the excessive axial inclination of the canines. The buccolingual angulation of the upper incisor and the nasolabial angle were maintained. The lower incisors were retracted which corrected the protrusive lower lip.

Discussion

The treatment of Class III malocclusion is challenging primarily due to inadequate diagnosis which often results in inappropriate mechanics. The 3-Ring Diagnosis[1] (*Fig. 19*) is an effective method for identifying Class III malocclusions conducive to conservative management. In addition, new technologies such as the MEAW[2] effect of the Damon system (*Ormco, Glendora, CA*) and extra-alveolar (*E-A*) Temporary Anchorage Devices (*TADs*) like the OrthoBoneScrew (*OBS*) (*Newton's A, Taiwan*) expedite the treatment of Class III malocclusion. Particularly when the two techniques are combined, there is a considerable expansion of the 3D envelope for conservative correction.

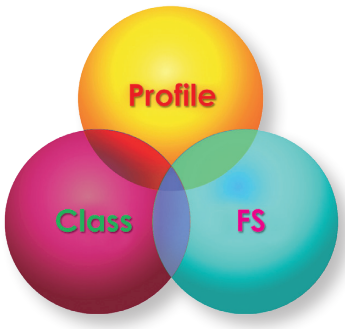

Fig. 19:

The 3-Ring Diagnosis:

1. **Profile** - *orthognathic profile at centric relation (CR) position.*
2. **Class** - *Canine and molar sagittal relationship (interdigitation).*
3. **FS** - *functional shift fro the CR to the CO positions of the mandible.*

The treatment options of Class III malocclusion depend on the nasolabial angle and the upper incisor inclination. For Class III patients who have a good nasolabial angle with normal upper incisor angulation, Class III elastics and low torque maxillary incisor brackets are sufficient to correct the malocclusion.[3] Labial flaring of the upper incisors is controlled by the low torque brackets when Class III elastics are used to retract the lower dentition. Low torque mandibular incisor brackets are placed upside down to achieve a high torque effect to prevent the lower incisors from tipping lingually, as the lower arch is retracted with Class III elastics (*Fig. 20a, b*).

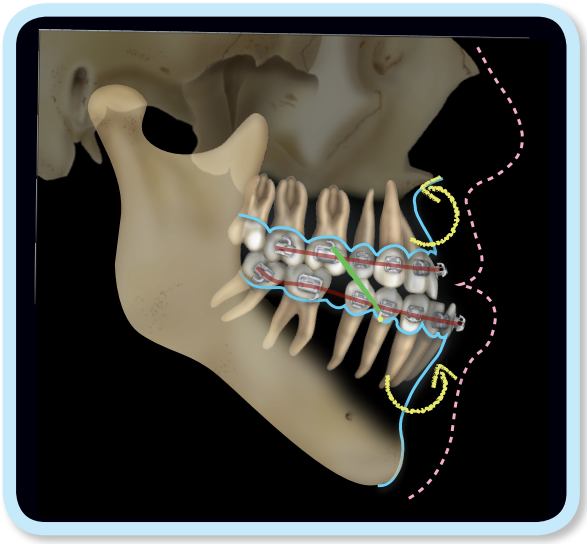

Fig. 20a:

Class III elastics produce counterclockwise moments on both arches, as well as tend to flare maxillary incisors, and tip mandibular incisors lingually. The undesirable incisor effects can be prevented with incisor brackets that have decreased labial root torque (LLT) in the maxilla and increased LLT in the mandible.

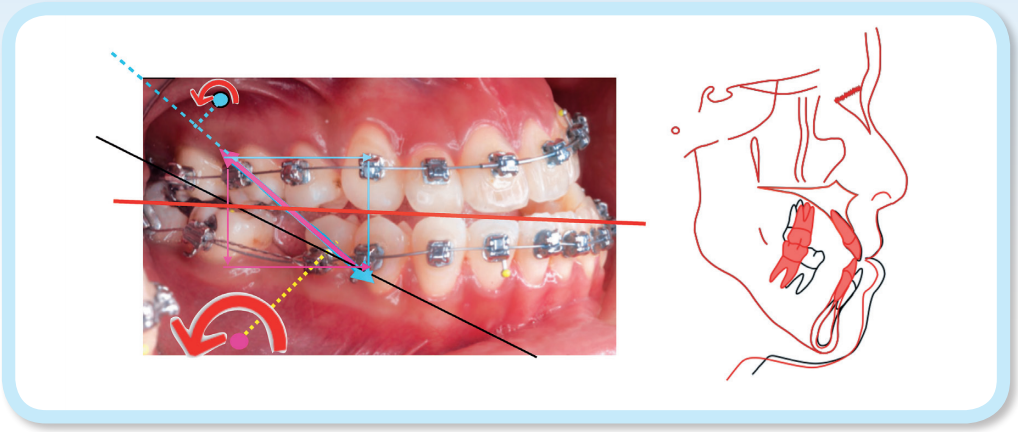

Fig. 20b:

Light, short Class III elastics have a line of force relative to the centers of resistance of the arches that produces differential counterclockwise moments on the maxillary and mandibular dentition favoring a flattening to the lower plane of occlusion (solid to dotted black line).

For severe Class III malocclusions with proclined upper incisors, mandibular buccal shelf E-A TADs can be used to retract the lower dentition to avoid a further increase in the axial inclination of the upper incisors. Another method is to place OBS screws in the infrazygomatic crest (*IZC*) areas. IZC screws are effective for retracting the upper dentition to resolve the problem of upper incisor proclination. Furthermore, Class III elastics from the IZC screws can be used to retract the entire lower dentition.[3]

To effectively retract the lower dentition of some severe Class III patients, the extraction of mandibular teeth is necessary. Lower arch extractions are helpful for the following aspects of treatment: 1. providing space for lower incisor retraction, and 2. controlling distal angulation of the terminal molar when the entire lower arch is retracted. Lower first premolar extractions are efficient for incisor extraction, but may be unfavorable for the correction of molar relationships.[4-5] Third molar extractions provide space to retract the entire lower dentition, but controlling the axial inclination of the second molars can be a problem. If a severe Class III molar relationship has a large negative overjet and the lower third molars are present, extraction of lower first or second molars provides several advantages: 1. more space for retracting the lower dentition, 2. less tendency to compromise the axial inclination of the terminal molar, 3. an opportunity to salvage third molars that otherwise may require extraction,[6] and 4. eliminate teeth with extensive caries, apical pathoses, or compromised restorations. All of these advantage applied to the present patient, so extraction the mandibular first molars was indicated.[7-8]

Facial profile plays a critical role for treatment planning of Class III malocclusion. An acceptable profile can deteriorate with Class III mechanics, so torque control of the anterior teeth is important.[9-10] For the present patient, low torque maxillary incisor brackets and reversed low torque mandibular incisor brackets were used to resist the axial inclination effects of Class III elastics. During the retraction of the lower dentition and extrusion of the anterior segment, gingival recession and black triangles were

noted for the lower incisors. Interproximal enamel reduction was indicated.[11] Moreover, rebonding the mandibular incisor brackets in a more gingival position improved the overbite (*Fig. 21a, b*).

Conclusion

Effective management of Class III malocclusion is a three step process. First, the 3-Ring Diagnosis method is used to assess the face. If a patient has an orthognathic profile or is willing to accept a slightly prognathic profile, conservative treatment without orthognathic surgery is indicated. Second, determine the position of the upper incisors required for an ideal nasolabial angle. If the upper incisors are proclined and/or there is crowding in the upper arch, placing IZC screws is a better option than using Class III elastics. Third, determine the optimal method for retracting the lower incisors: 1. buccal shelf E-A OBS, 2. Class III elastics and/ or 3. extraction of teeth in the lower arch. Careful adherence to these principles leads to efficient, conservative management of skeletal Class III malocclusion when indicated.

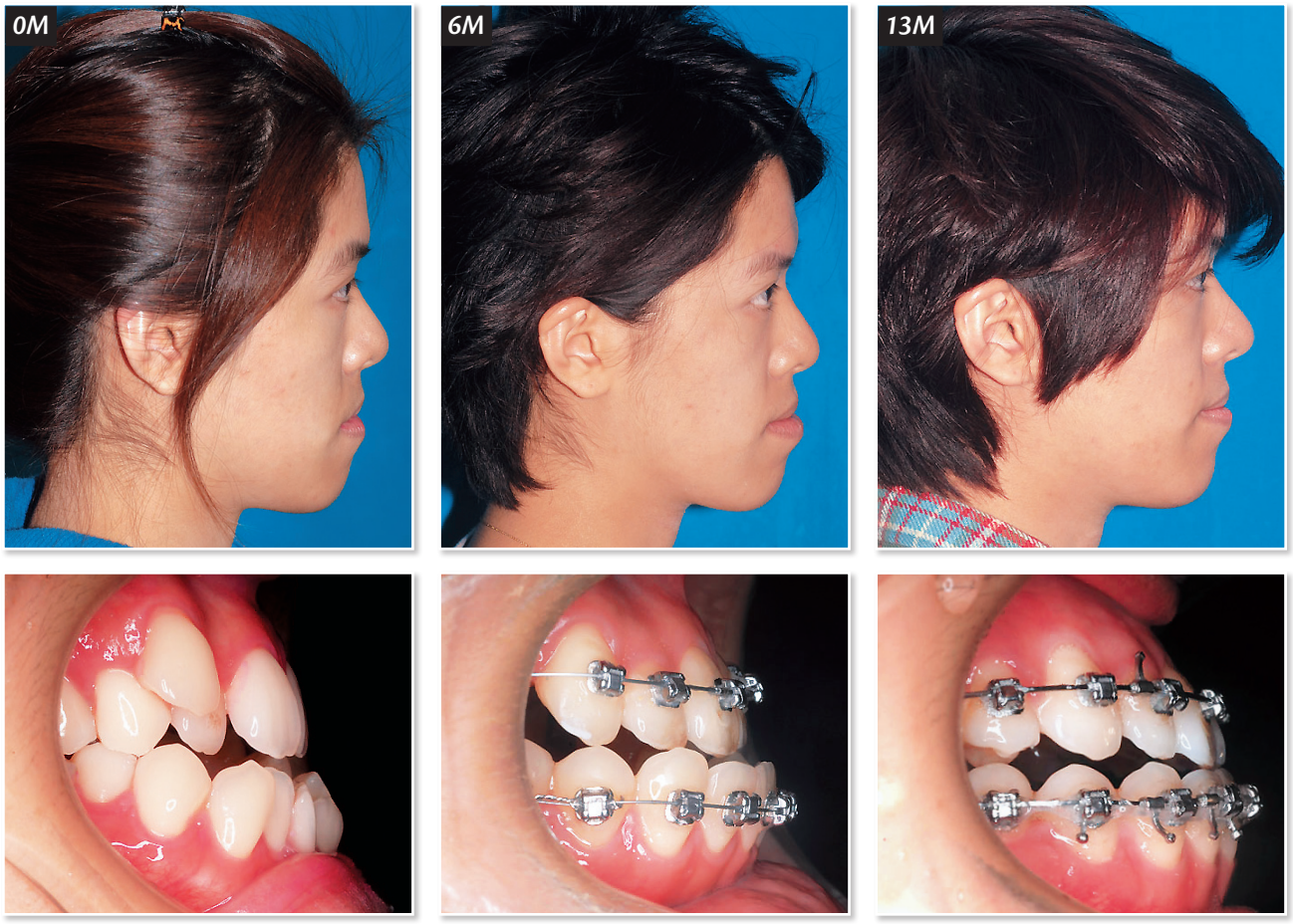

Fig. 21a:

At the initial leveling phase (6 mo), the profile became more protrusive. The subsequent use of light force Class III elastics improved the profile by retracting the lower incisors and decreasing their axial inclination (13 mo).

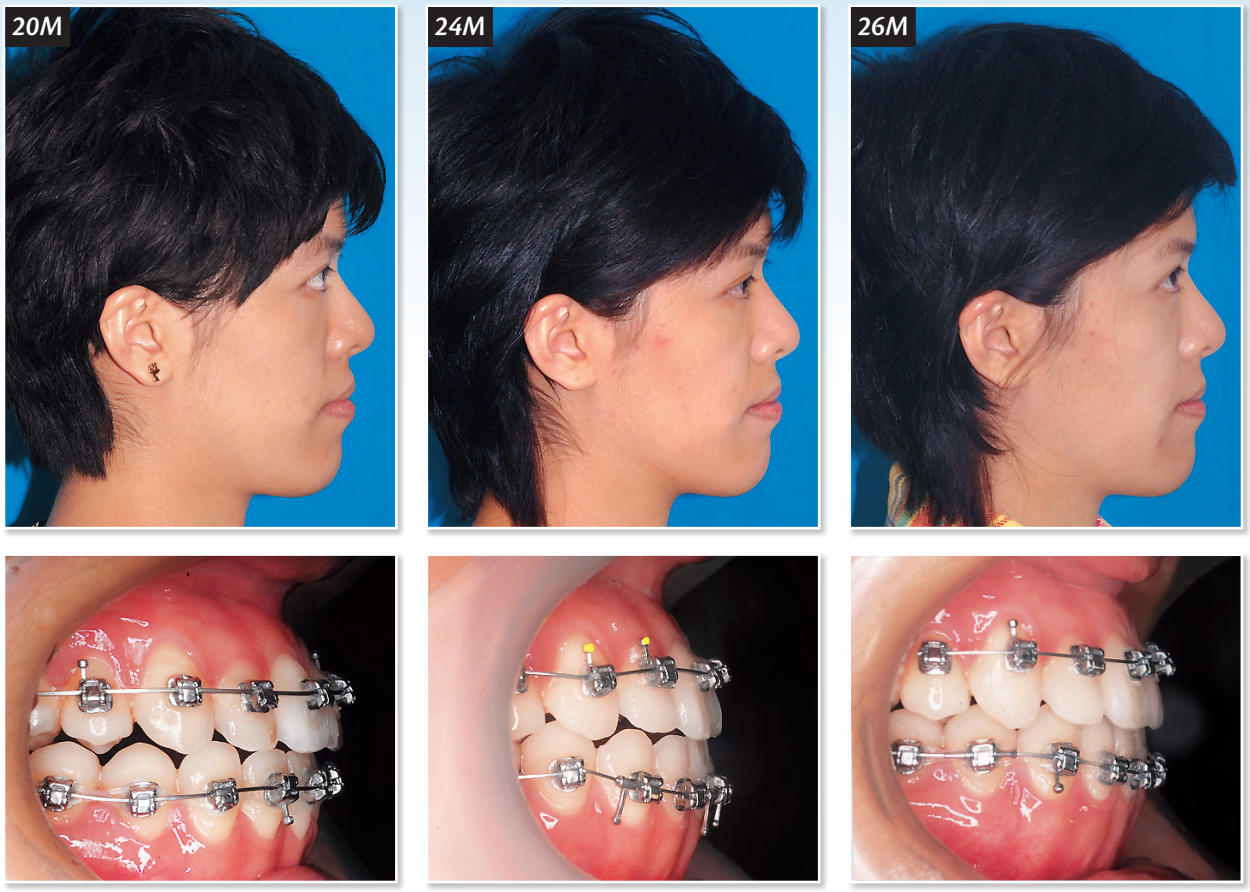

Fig. 21b:

During finishing, the mandibular incisor brackets were rebonded gingivally (24 mo) to adjust the labial crown torque and overbite. The profile was further improved (26 mo).

References

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 60

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 = 16

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 = 11

LATERAL OPEN BITE

2 pts. per mm. per tooth

Total = 0

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 = 7

OCCLUSION

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

Total = 8

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 4

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

Each degree < -2° _____ x 1 pt. = _____

Each degree > 6° _____ x 1 pt. = _____

SN-MP
≥ 38° = 2 pts.
Each degree > 38° 6 x 2 pts. = 12

≤ 26° = 1 pt.
Each degree < 26° _____ x 1 pt. = _____

1 to MP ≥ 99° = 1 pt.
Each degree > 99° _____ x 1 pt. = _____

Total = 14

OTHER (See Instructions)

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

Identify:

Total = 0

IMPLANT SITE

Lip line : Low (0 pt), Medium (1 pt), High (2 pts) =_____
Gingival biotype : Low-scalloped, thick (0 pt), Medium-scalloped, medium-thick (1 pt), High-scalloped, thin (2 pts) =_____
Shape of tooth crowns : Rectangular (0 pt), Triangular (2 pts) =_____
Bone level at adjacent teeth : ≤ 5 mm to contact point (0 pt), 5.5 to 6.5 mm to contact point (1 pt), ≥ 7mm to contact point (2 pts) =_____
Bone anatomy of alveolar crest : H&V sufficient (0 pt), Deficient H, allow simultaneous augment (1 pt), Deficient H, require prior grafting (2 pts), Deficient V or Both H&V (3 pts) =_____
Soft tissue anatomy : Intact (0 pt), Defective (2 pts) =_____
Infection at implant site : None (0 pt), Chronic (1 pt), Acute(2 pts) =_____

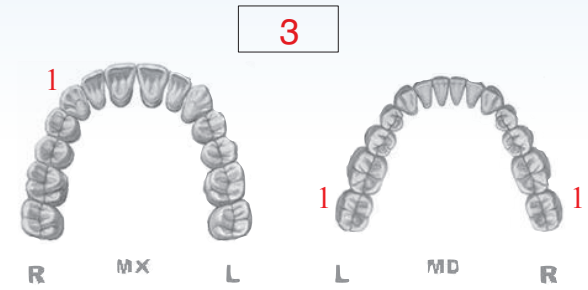
Total = 0

Cast-Radiograph Evaluation

Total Score: 20

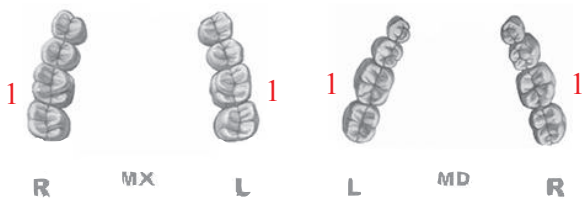
Alignment/Rotations

3



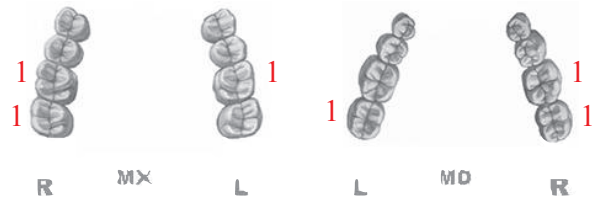
Marginal Ridges

4



Buccolingual Inclination

6

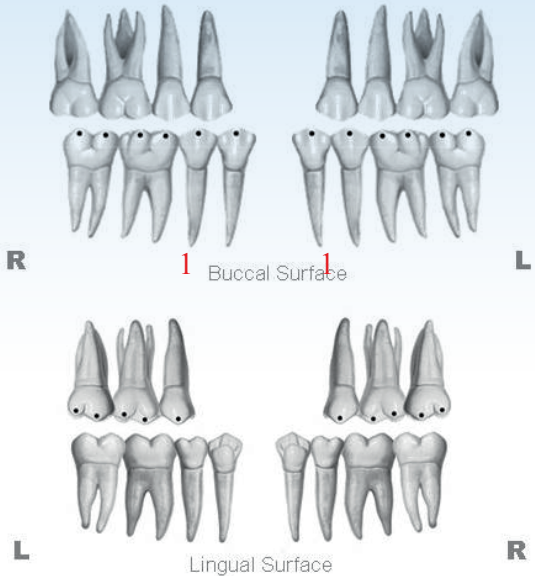


Overjet

2

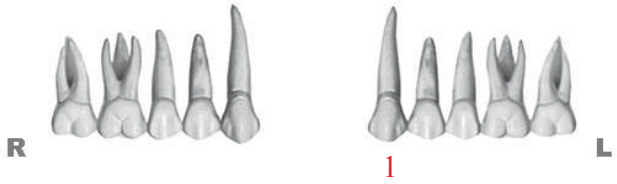
Occlusal Contacts

2



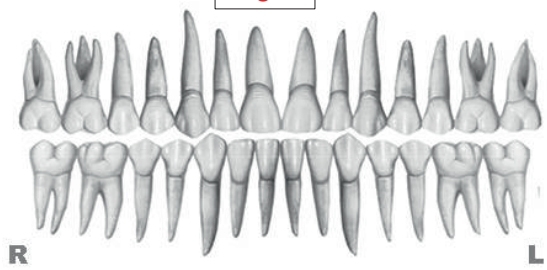
Occlusal Relationships

1



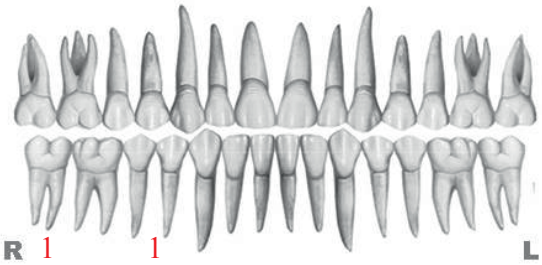
Interproximal Contacts

0



Root Angulation

2



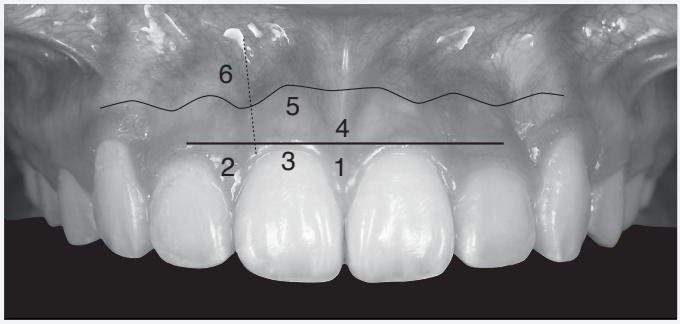
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 2

1. Pink Esthetic Score

Total = 0

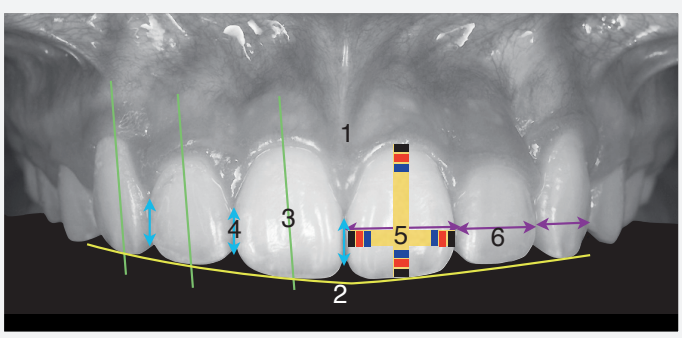


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

1. M & D Papillae	(0)	1	2
2. Keratinized Gingiva	(0)	1	2
3. Curvature of Gingival Margin	(0)	1	2
4. Level of Gingival Margin	(0)	1	2
5. Root Convexity (Torque)	(0)	1	2
6. Scar Formation	(0)	1	2

2. White Esthetic Score (for Micro-esthetics)

Total = 2



1. Midline	0	1	2
2. Incisor Curve	0	1	2
3. Axial Inclination (5° , 8° , 10°)	0	1	2
4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion (1:0.8)	0	1	2
6. Tooth to Tooth Proportion	0	1	2

1. Midline	(0)	1	2
2. Incisor Curve	0	(1)	2
3. Axial Inclination (5°, 8°, 10°)	0	(1)	2
4. Contact Area (50%, 40%, 30%)	(0)	1	2
5. Tooth Proportion (1:0.8)	(0)	1	2
6. Tooth to Tooth Proportion	(0)	1	2