Compromised Treatment for an Asymmetric Class II/III Mutilated Malocclusion with Facial Asymmetry

History and Etiology

A 23-year-6-month-old male presented for orthodontic consultation with chief complaints of irregular dentition, mandible shift and facial asymmetry (*Fig. 1*). There was no contributory medical or dental history. A clinical exam revealed that the permanent maxillary canines were erupted but blocked out labially. In centric occlusion (*Co*) the lower midline was shifted to the right by 6.5mm, which was equivalent to almost the width of a lower incisor. Lingual crossbite was noted on the right side, and the right lower second molar was missing (*Fig. 2*). The traditional treatment approach for a managing this severe malocclusion is orthognathic surgery, but that option was declined by the patient. He preferred only dentoalveolar correction which produced the compromised result, as documented in Figs. 4-6. The cephalometric and panoramic radiographs before treatment are shown in Fig. 7: matched post-treatment results are illustrated in Fig. 8. The before and after treatment cephalometric tracings are superimposed in Fig. 9. The cephalometric measurements summary is provided in Table 1. The details for the diagnosis and treatment approach are discussed below.

Fig. 1: Pretreatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 3: Pretreatment study models

Diagnosis

Skeletal:

Dr. Hsing-Wen Chang, Lecturer, Beethoven Orthodontic Course (right)
Dr. Chris Chang, Director, Beethoven Orthodontic Center (middle)
Dr. W. Eugene Roberts, Consultant,
International Journal of Orthodontics & Implantology (left)

Fig. 4: Posttreatment facial photographs

Fig. 5: Posttreatment intraoral photographs

Fig. 6: Posttreatment study models

- Skeletal Class III (*SNA 85°, SNB 84°, ANB 1°*)
- Mandibular plane angle (*SN-MP 35°, FMA 28°*)

Dental:

- Right side: full cusp Class II malocclusion Left side: Class III molar relationship
- Overjet: 0 mm
- Overbite was 3mm
- Crowding: ~ 15 mm due to blocked-out canines and blocked-in lateral incisors, bilaterally.
- Midline: mandibular midline was 7 mm right of the facial and upper dental midlines

Facial:

- Convex profile, protrusive lower lip, and the chin was shifted to the right side ABO Discrepancy Index (*DI*) was 38 as shown in the subsequent worksheet.

Specific Objectives of Treatment

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

- A - P: Retract
- Vertical: Open the bite slightly

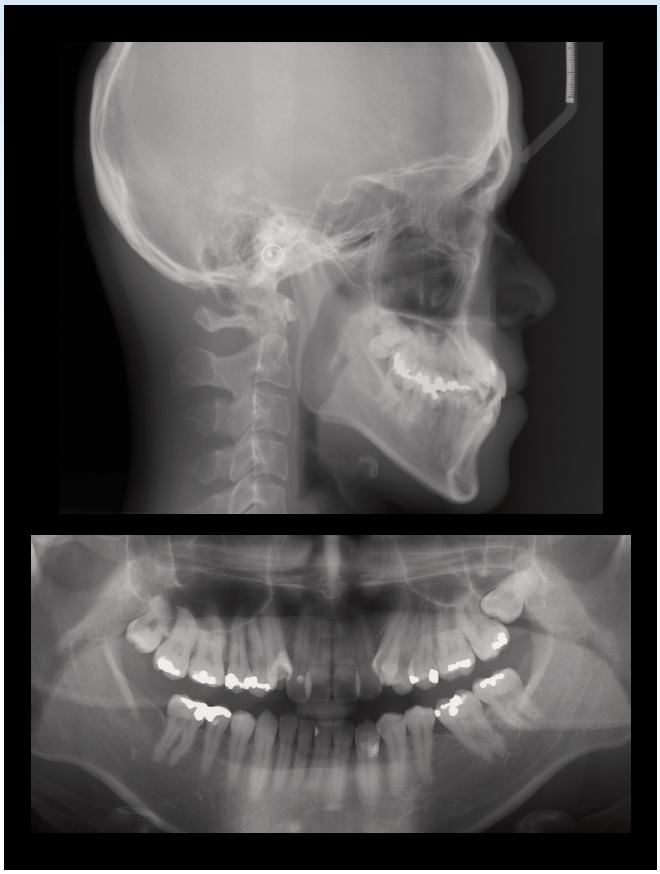

Fig. 7: Pretreatment pano. and ceph. radiographs

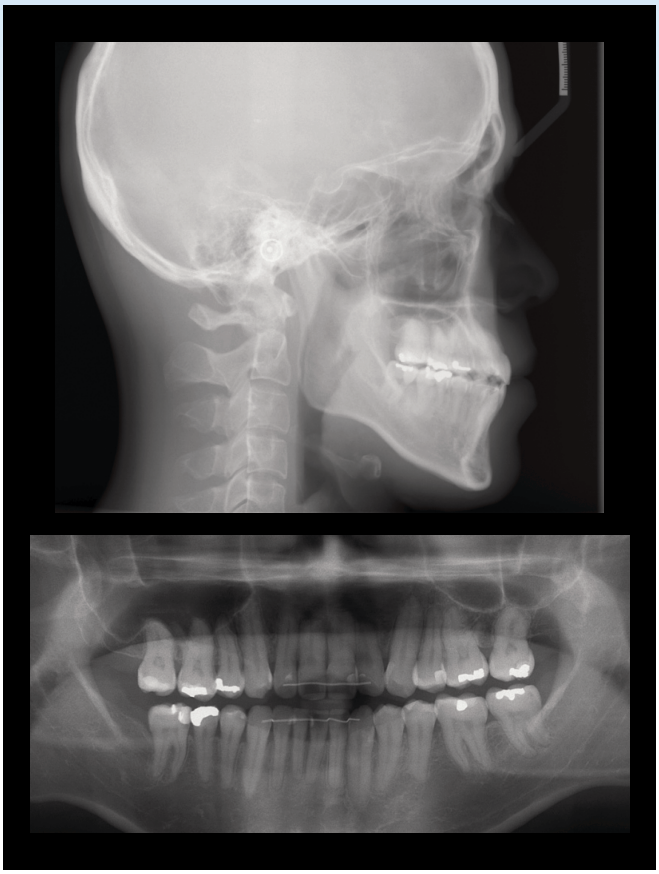

Fig. 8: Posttreatment pano. and ceph. radiographs

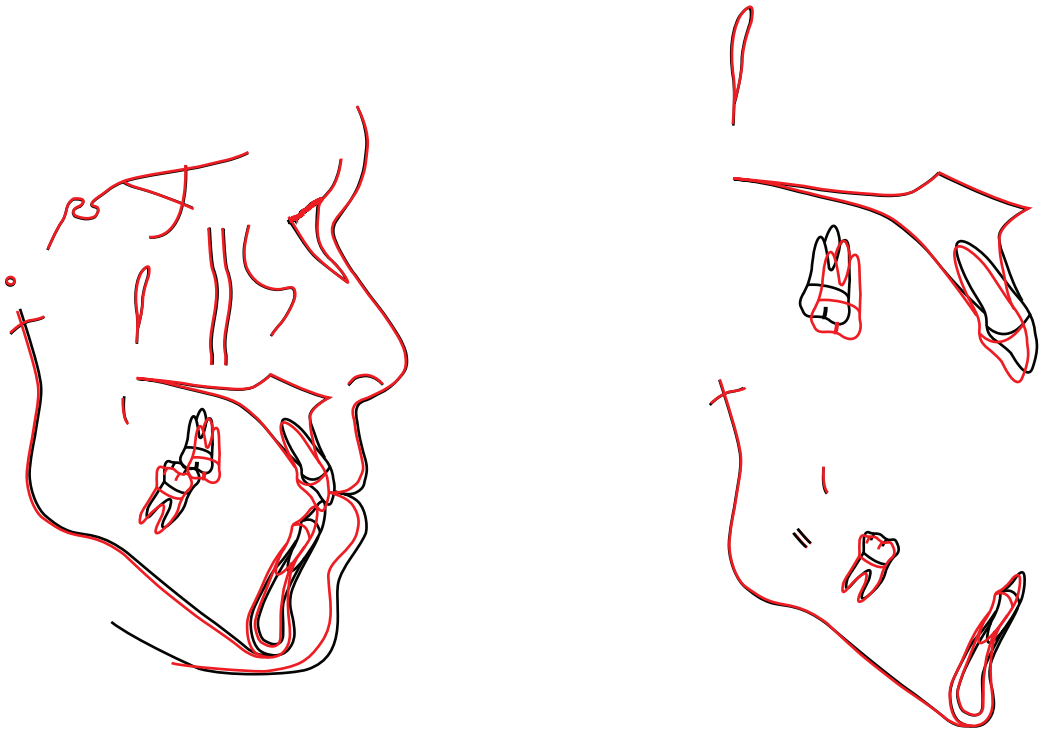

Fig. 9. Superimposed tracings

- Transverse: Maintain

Maxillary Dentition

- A - P: Retract incisors
- Vertical: Extrude incisors and molars
- Inter-molar / Inter-canine Width: Slightly expand

Mandibular Dentition

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

Facial Esthetics: Maintain

Treatment Plan

Since the patient declined the orthognathic surgery option, asymmetric extraction of upper premolars was indicated. A full fixed orthodontic appliance was planned with the supplemental anchorage of bilateral extra-alveolar bone screws[1] (*2x12 mm OrthoBoneScrew, Newton's A inc.*) in the mandibular buccal shelves. The buccal crossbite was addressed with upper archwire expansion and lower archwire constriction. Subsequently, extra-alveolar bone screws were used as supplemental anchorage to help correct the protruded mandibular dentition, dental midline shift and crossbite relationship. Bilateral Class III and crossbite elastics[2] with bite turbos were used respectively to achieve the treatment goal of a better occlusal interdigitation. Following the removal of fixed appliances, the corrected dentition was retained with fixed anterior retainers in both arches: Mx 2-2 and Md 3-3.

Appliances and Treatment Progress

A .022" slot Damon D3MX bracket system (*Ormco Corporation*) was used. After extracting the maxillary second premolars, the mandibular arch was bonded with low torque brackets on the incisors. One month later the maxillary arch was bonded with standard torque brackets on the incisors. The initial arch-wire for both arches was .014" NiTi wire.

In the 3rd month of treatment, bite turbos were installed on both lower first molars as well as the right central and lateral incisors (*Fig. 10*), to open the bite and serve as an inclined plane for the severely blocked-in right lateral incisor (*Fig. 11*). The arch-wires were changed to .016" NiTi in the upper and

Fig. 10:
Bilateral lower first molars and lower right first and second incisors was bonded with bite turbos.

Fig. 11:
Bite turbos can both open the bite and serve as an inclined plane.

.014x.025" NiTi lower arches. From the 4th month to the end of the treatment, Class III elastics from the lower canines to upper first molars were used as needed, to retract the mandibular dentition and correct the dental midline discrepancy.

In the 6th month, the upper arch-wire was changed to .014x.025" NiTi and in the 7th month, the upper arch was changed to a .016x.025" pre-torqued NiTi arch-wire. In the 9th month of treatment, two buttons were bonded to the lingual side of the upper left first and seconded molars (*Fig. 12*) as attachments for cross elastics (*Fig. 13*). The upper and lower arch-wires were changed to .017x.025" TMA in the 10th and 11th months, respectively.

At the 9th month of treatment, buttons were attached on the lingual side of the upper right first and second molars for use of cross elastics (*Fig. 12*). At 16 months, similar lingual buttons were attached on the left side and thereafter cross elastics were used bilaterally (*Fig. 14*). In the 17th month of treatment, the lower arch-wire was changed to .016x.025" SS and the arch-wire was constricted to decrease the lower arch width. A maxillary elastometric chain was attached from first molar to first molar for space closure. In the 18th month, archwires were changed to .019x.025" SS. Arch coordination, expansion in

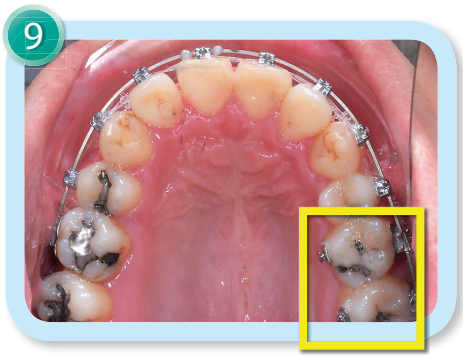

Fig. 12:

Two lingual buttons were bonded to the lingual side of upper left first and seconded molars.

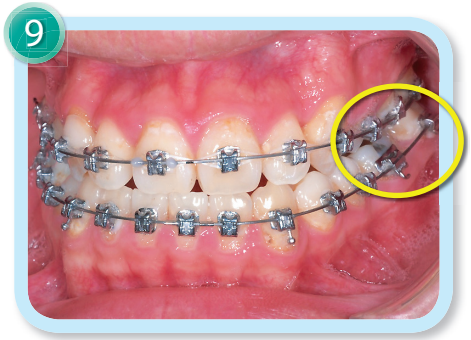

Fig. 13:

After the upper extraction space was almost closed, the overjet was still positive but the left side became a lingual crossbite. The corssbite elastic was used to correct the problem.

Fig. 14:

Upper right side lingual buttons were used to correct the right side lingual crossbite.

the upper and constriction in the lower, was used to control the crossbite tendency (*Fig. 15*).

In the 25th month of treatment, the palatal side of the upper right canine was bonded with a lingual button, and a cross-elastic was used to correct the crossbite. Mandibular buccal shelf miniscrews were inserted to serve as anchorage to retract the mandibular dentition (*Fig. 16*).

From the 27th to the 29th month, the ART (*Anterior Root Torque*) spring[3] was attached to the upper anteriors (*Fig. 17*). At 35 months of treatment, IPR (*InterProximal Reduction*) was performed on the upper anterior teeth and the residual spaces in the maxillary and mandibular dentition were closed using elastometric chains (*Fig. 18*). After appliance removal, upper clear overlay and fixed anterior (*Mx 2-2, Md 3-3*) retainers were delivered.

The maxillary wire sequence was .014" CuNiTi, .014x.025" CuNiTi, .016x.025" pre-torqued NiTi,

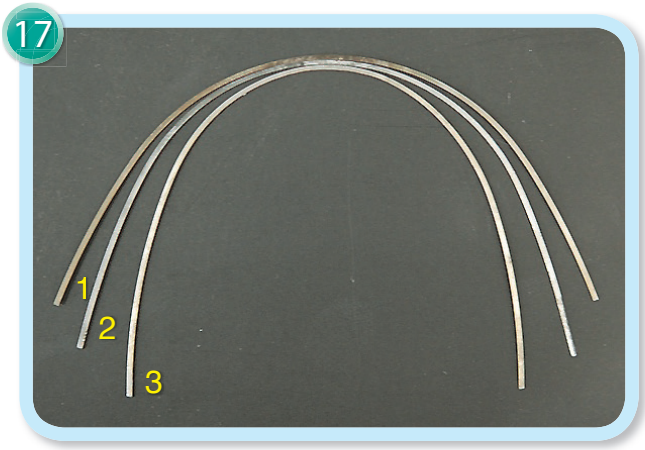

Fig. 15:
Arch wire adjustment: 1: expanded. 2: normal. 3: narrowed

Fig. 16:
The lingual button was bonded to correct upper right canine crossbite (yellow line). Two miniscrews were inserted in lower buccal shelves to retract the lower dentition (the arrows).

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	85°	85°	0°
SNB°	84°	84°	0°
ANB°	1°	1°	0°
SN-MP°	35°	36°	1°
FMA°	28°	29°	1°
DENTAL ANALYSIS			
U1 TO NA mm	8 mm	6 mm	2 mm
U1 TO SN°	120°	117°	3°
L1 TO NB mm	8 mm	7 mm	1 mm
L1 TO MP°	85°	88°	3°
FACIAL ANALYSIS			
E-LINE UL	-4 mm	-4 mm	0 mm
E-LINE LL	0.5 mm	0 mm	0.5 mm

Table. 1: Cephalometric summary

Fig. 17:
Use a ART to increase upper anteriors lingual root torque.

Fig. 18:
Upper: Before IPR
Lower: After IPR and close space with elastometric chain.

.017x.025" TMA, and .019x.025" SS. For the mandibular dentition, the sequence was .014" CuNiTi, .014x.025 CuNiTi, .016x.025" CuNiTi .017x.025" TMA, .016x.025" SS, and .019x.025" SS.

Results Achieved

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

- A - P: Mild retracted
- Vertical: 1° clockwise rotation of the mandibular plane angle
- Transverse: Maintained

Maxillary Dentition

- A - P: Incisors retracted
- Vertical: Entire arch extruded
- Inter-molar / Inter-canine Width: Expanded

Mandibular Dentition

- A - P: Incisors slightly retracted
- Vertical: Slight intrusion of the entire arch
- Inter-molar / Inter-canine Width: Constricted

Facial Esthetics:
Slightly retracted upper and lower lip

Retention

Fixed retainers were bonded on all maxillary incisors, and from canine to canine in the mandibular arch. An upper clear overlay was delivered. The patient was instructed to wear it full time for the first 6 months and nights only thereafter. Home care instructions were provided.

Final Evaluation of Treatment

The ABO Cast-Radiograph Evaluation Score (*CRS*)

was 26 points and IBOI Pink & White score was 4 points, as documented on the forms appearing later in this report. The major discrepancies were the occlusal relationships (*8 points*), root angulation (*5 points*), lack of occlusal contacts (*4 points for the right second molars*), marginal ridges (*3 points*), buccolingual inclination (*3 points*), alignment/ rotation (*2 points*) and overjet (*1 point*). Most of these problems resulted from dental compensations for the facial asymmetry, i. e. posterior dental expansion in the maxillary arch and tip-back of the molars in the mandibular arch. The OB and OJ were 2mm, the lower dental midline was shifted 5mm to the right of the facial midline and the chin was still deviated to the right. The facial profile and the interdigitation was acceptable. Root resorption of the maxillary incisors was noticed in the post treatment panoramic film. Overall, the treatment outcome for this challenging case were satisfactory for both the patient and the clinician.

Discussion

This patient will be discussed in four categories:

1. Facial Asymmetry
2. Diagnosis (*Dental Midline and Facial Asymmetry*)
3. Treatment Plan and Result
4. Root resorption

Facial asymmetry

Eiology of facial asymmetry[4] includes genetic as well as congenital malformations, such as hemifacial microsomia or unilateral cleft of the lip and palate. Defining the characteristics of a facial deviation involves a careful assessment of:

a. Environmental factors: habits and trauma

b. Functional deviations: mandibular shifts due to interference or prematurity in occlusion

c. Other factors: temporomandibular joint disorder, degenerative joint disease, neoplasia

Classification of dentofacial asymmetries is as follows:

a. Dental: due to local factors such as early loss of deciduous teeth, a congenitally missing tooth (*teeth*), and/or habits such as thumb sucking.

b. Skeletal: the deviation may involve abnormal morphology of the maxilla and/or mandible.

c. Muscular: hyperplasia and/or hypoplasia of facial or masticatory muscles.

d. Functional: dental interference in centric relation, often associated with a constricted maxillary arch or a malposed tooth, results in a shift to achieve maximal intercuspation.

Diagnosis

Evaluation of the dental midline to facial symmetry

includes assessing the intermaxillary relationship in the following positions: mouth open, centric relation, initial contact, and centric occlusion. The lower dental midline for the current patient was shifted ~7mm to the right in the centric occlusion, compared to only 4mm to the right side with the mouth open (*Fig. 19*). The patient's chin was deviated to the right both at rest and in maximal intercuspation, but the problem was more severe in Co position because of the functional shift.

Cone-beam CT is a valuable tool for evaluation of facial asymmetry,[5-6] but most patients are still diagnosed with frontal (*posterior-anterior view*) cephalograms. Landmarks are identified with the methods recommended by Sassouni and Ricketts (*Fig. 20*).[7-9]

The current patient had a complex multifactorial malocclusion associated with both dentofacial asymmetry and a functional shift. The ramus height was greatest on the left side which contributed to the chin deviation to the right. Maxillary arch symmetry was within normal limits, but the A-P position of the mandibular dentition was asymmetric, which may have been due to the early loss of a deciduous teeth in addition to the early loss of the permanent first molar. As previously specified, the chin asymmetry was more pronounced when the patient was in the occluded position (*Fig. 20*).

Fig. 19:

Left: Lower dental midline shifted 7mm to the right side in CO

Right: Lower dental midline shifted 4mm to the right side with the mouth open

Treatment Plan and Result

The panoramic film (*Fig. 7*), shows that the lower left first molar has been missing for some time, as evidenced by the mesial inclination of the adjacent second and third molars. Thus, uprighting of the tipped molars was expected to produce some lower midline correction. Due to the crowded upper dentition with an acceptable nasolabial angle (*Figs.*

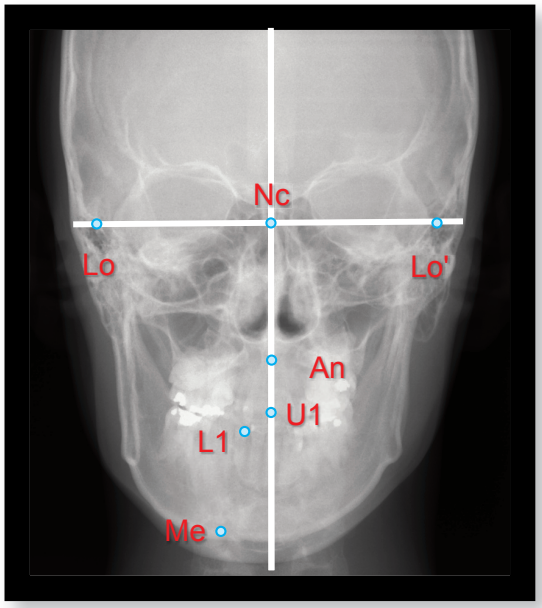

Fig. 20: Diagnosis of facial asymmetry

Lo and Lo': bilateral intersection of the oblique orbital line with the lateral contour of the right and left side orbits.

Nc: the neck of crista galli

ANS: anterior nasal spine

U1(L1): mesial contact point of upper (lower) central incisors.

Me: menton

The facial midline was defined as a line perpendicular to the line connecting Lo and Lo' through Nc

1-2), extraction of the upper second premolars was indicated. The treatment outcome was compromised because: 1. lower left molar uprighting did not produce enough midline correction, and 2. the skeletal Class III pattern required upper dental arch expansion and lower dental arch constriction to avoid posterior crossbite.

Although the mesially tipped lower right molars were uprighted from 400 to 850 degrees (*Fig. 21*), this was insufficient anchorage to correct the midline. Subsequently, in the 25th month of treatment, the decision was made to use lower extra-alveolar miniscrews in the buccal shelves to correct the midline and retract the entire lower dentition. In retrospect, treatment time could have been considerably reduced if the extra-alveolar anchorage had been initiated earlier in treatment.

Another major problem was the coordination of the arches to correct the posterior crossbite. This discrepancy was due to Class III skeletal pattern and the necessity to extract second premolars in the upper arch. The upper arch was expanded and the lower arch was constricted (*Fig. 15*). Cross elastics were used from lingual buttons on the upper molars (*Figs. 12-14,16*). The ART spring (*Fig. 17*) was used for palatal root movement of the maxillary incisors. Overall, the maxillary arch was widened but there was little change in the mandibular arch.

In retrospect, extracting the lower left first premolar would have helped correct the midline, as well as the Class III buccal segment and the posterior crossbite tendency. This approach may have improved the cast-radiograph score and reduced the need for extra-alveolar miniscrew anchorage.

Root Resorption

Root resorption of maxillary incisors, a common problem in orthodontics,[10-11] was noted (*Figs. 8, 22*). The reason may be excessive incisor retraction or tipping of the roots into the palatal plate of bone to obtain overjet correction. In this regard, it is important to note that lingual root torque using an ART auxiliary was performed on the upper anteriors in the 27th month of treatment.

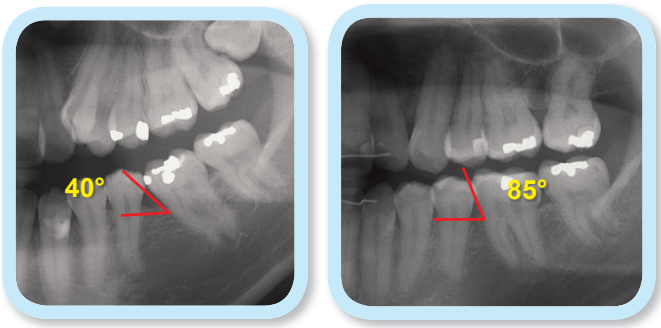

Fig. 21:
Left: Pre-treatment
Right: Post-treatment

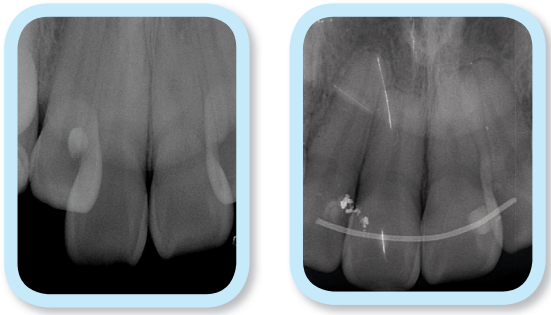

Fig. 22. Left:
Left: Pre-treatment
Right: Post-treatment

Conclusion

This case report presents a Class III patient with dentofacial asymmetry combined with a functional shift in occlusion. Conservative non-surgical treatment with the Damon self-ligating system and buccal shelf bone screws proved to be effective for the correction of this severe Class III malocclusion. This was a treatment compromise (*camouflage approach*) because the underlying skeletal asymmetry was not addressed. For patients with dentofacial discrepancies, the most common reasons for seeking professional help are problems with biting and chewing.[12] Another major reason is dissatisfaction with their facial appearance. With conservative mechanics it is possible to improve the patient's appearance and masticatory function, but corrections of major skeletal discrepancies require orthognathic surgery.

References

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 38

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 = 4

OVERBITE

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

Total = 4

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 = 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° _____ x 2 pts. = _____

≤ 26° = 1 pt.

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

1 to MP ≥ 99° = 1 pt.

Each degree > 99° _____ x 1 pt. = _____

Total = 4

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. =	2
Missing teeth (except 3rd molars)	_____ x 1 pts. =	2
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. =	3
Addl. treatment complexities	_____ x 2 pts. =	_____

Identify: Trans-alveolar impaction

Total = 7

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

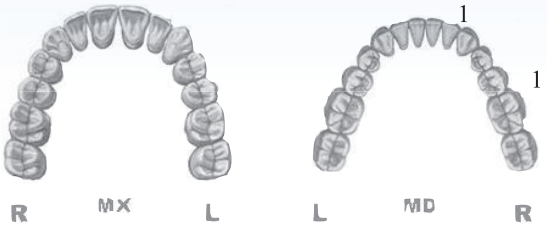
Cast-Radiograph Evaluation

Case # 1 **Patient**

Total Score: 26

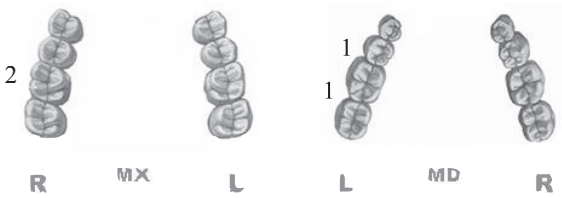
Alignment/Rotations

2



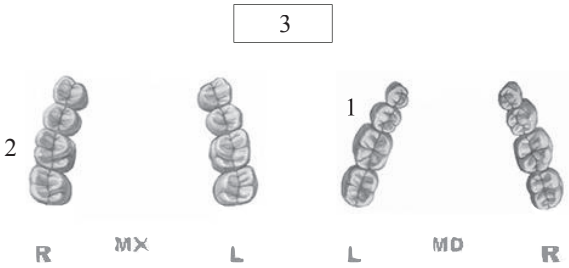
Marginal Ridges

3



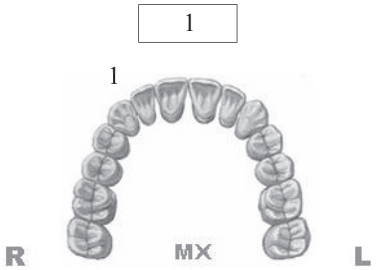
Buccolingual Inclination

3



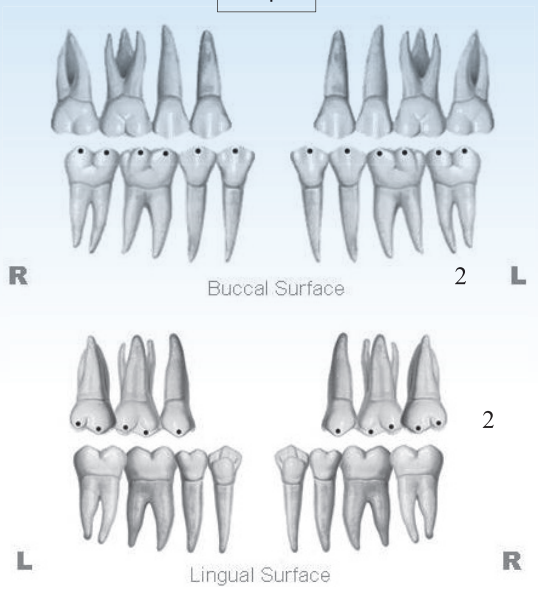
Overjet

1



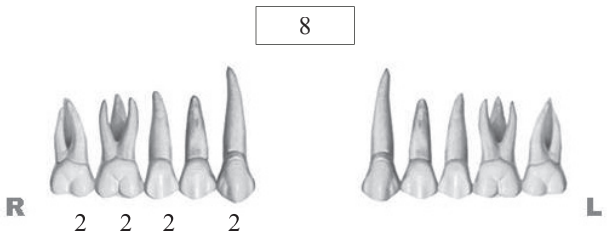
Occlusal Contacts

4



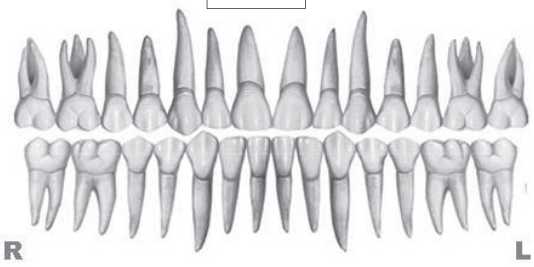
Occlusal Relationships

8



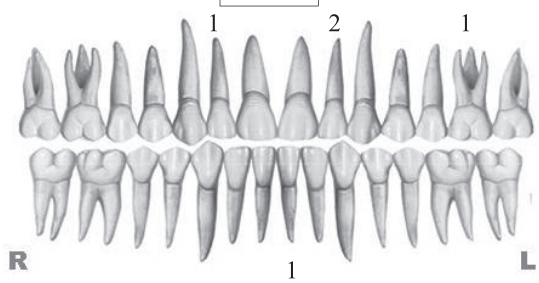
Interproximal Contacts

0



Root Angulation

5



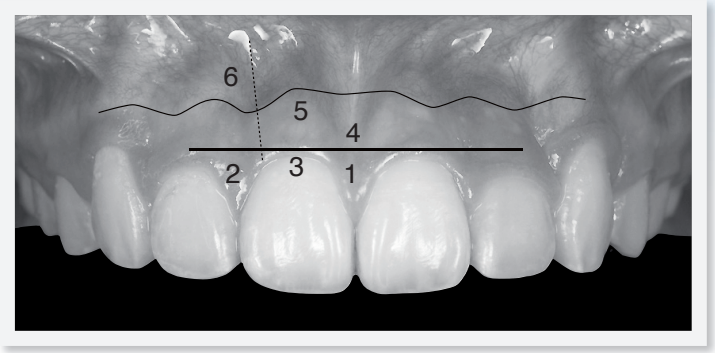
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 4

1. Pink Esthetic Score

Total = 1

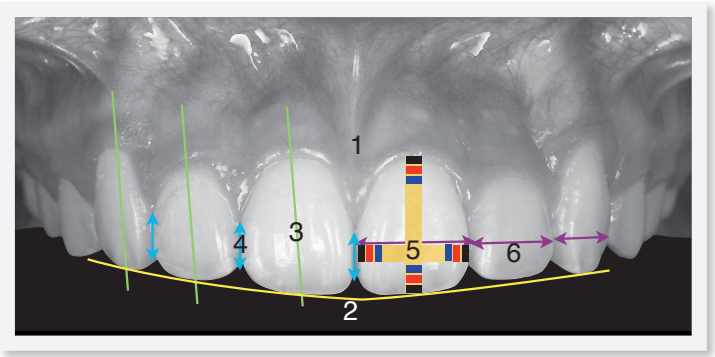


1. Mesial Papilla	0	1	2
2. Distal Papilla	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

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 = 3



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