Molar Retraction in All Four Quadrants to Correct a Class III, Crowded Malocclusion in a Patient with a Flat Profile

HISTORY AND ETIOLOGY

A 26 year old male patient presented for consultation with a chief complaint of dental protrusion. He asked for extraction treatment to reduce the perceived protrusion. However clinical examination revealed a relatively retrusive maxilla and straight profile, with no sign of dental protrusion. Apparently the maxillary incisor prominence, due to severe crowding, led to his mistaken impression of "*protrusion*" (*Figs. 1-3*). The preliminary diagnosis was a mild skeletal Class III relationship, with dental compensation, that resulted in flaring of the upper incisors and lingual tipping of the lower incisors. Based on the examination and history, the etiology of the malocclusion appeared to be primarily genetic.

Although the arch length discrepancy was 8mm in the lower arch and 7mm in the upper arch, a nonextraction treatment approach with temporary anchorage devices (*TADs*) was indicated to avoid a concave profile in the midfacial region after extraction treatment. The patient was skeptical about the nonextraction treatment plan but later agreed to it on the condition of conducting a re-evaluation in 8 to 10 months.

The patient was treated to an optimal result as documented in Figs. 4-6. The cephalometric and panoramic radiographs document the pre-treatment condition and the post-treatment results (*Figs. 7-8*). The cephalometric tracings before and

Fig. 1: Pretreatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 3: Pretreatment study models

Johnny JL Liaw, Director, Beauty Forever Dental Clinic (left)
W. Eugene Robert, Consultant,
International Journal of Orthodontics & Implantology (right)

Fig. 4: Posttreatment facial photographs

Fig. 5: Posttreatment intraoral photographs

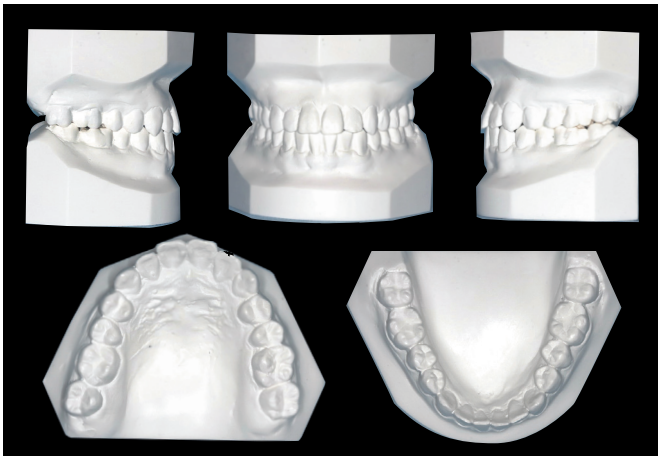

Fig. 6: Posttreatment study models

after treatment are superimposed in Fig.9, and the summary of cephalometric measurements is provided in Table 1.

DIAGNOSIS

Skeletal:

- Skeletal Class III (*SNA 79°, SNB 83°, ANB -4°*)
- Low mandibular plane angle (*SN-MP 29°, FMA 20°*)
- Facial asymmetry: no significant asymmetry was noted

Dental:

- Bilateral molar Class III relationship
- Class III canine relationship on the right side
- Class I canine relationship on the left side
- Both upper lateral incisors were locked-in palatally and were in crossbite with the lower incisors
- The OJ was 0.5mm, and the OB was 0.5mm
- 7mm space deficiency in the upper arch
- 8mm space deficiency in the lower arch
- Upper dental midline was shifted to the right by 2mm
- Lower dental midline was coincident with facial midline
- Upper left third molar was present.
- Archforms: symmetrical ovoid in the maxilla; narrow, tapering shape in the mandible

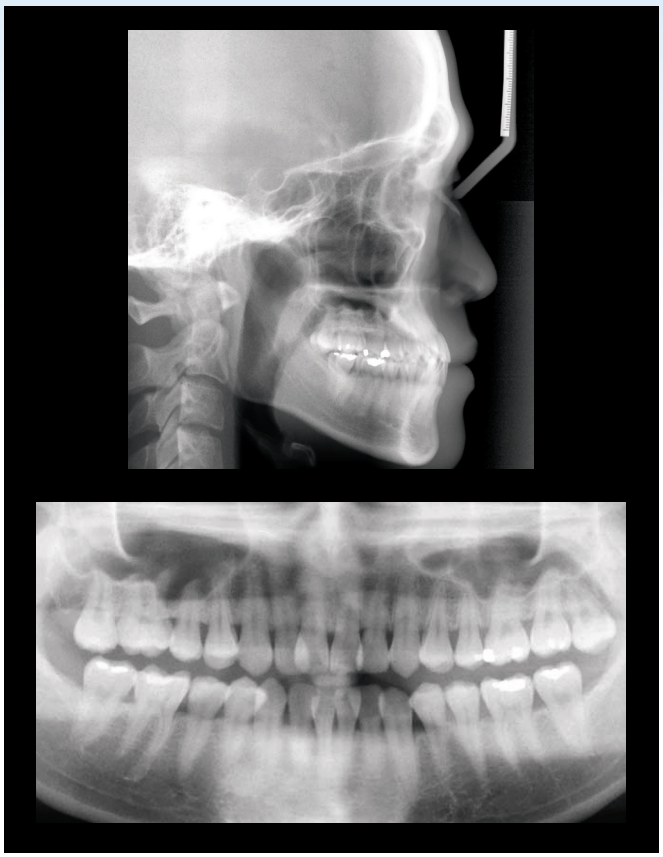

Fig. 7: Pretreatment pano and ceph radiographs

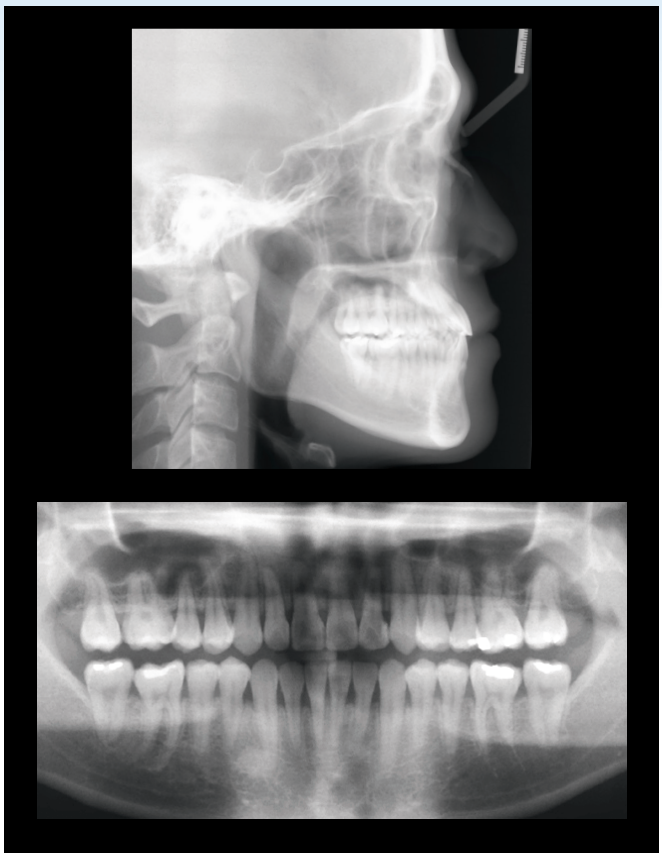

Fig. 8: Posttreatment pano and ceph radiographs

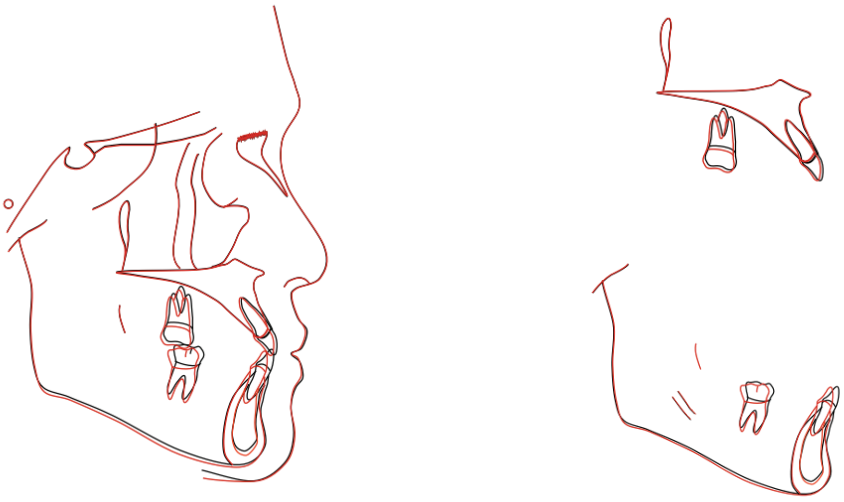

Fig. 9: Superimposed tracings

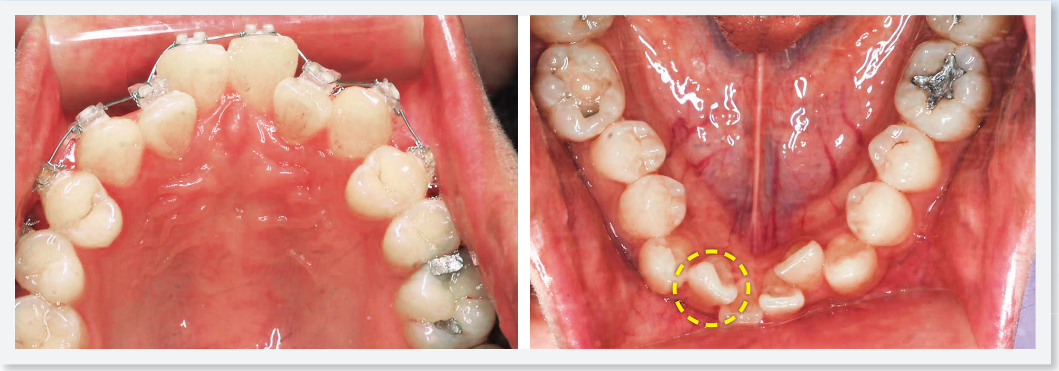

Fig. 10:

A bite turbo was bonded on the lingual surface of lower right lateral incisor to avoid the bracket loosening of upper right lateral incisor.

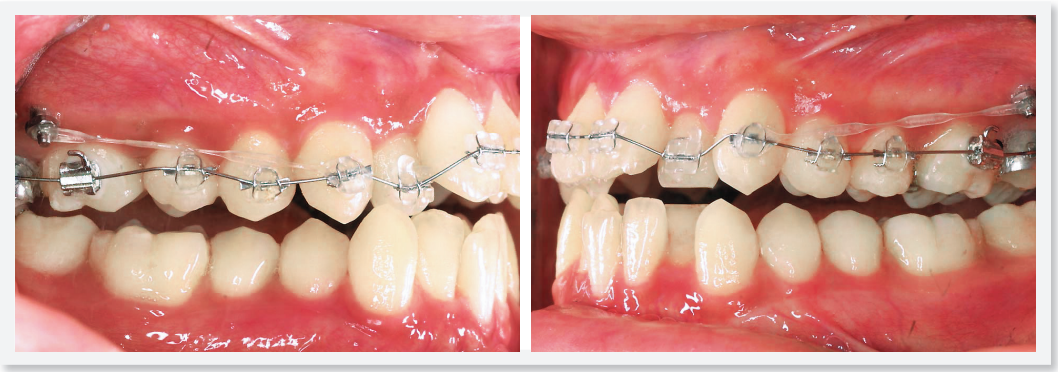

Fig. 11:

Two upper posterior miniscrews were installed on the day of upper initial bonding. Elastic chains were attached from the miniscrews to upper canines for the distal movement of the buccal segment.

Facial:

- Straight profile
- Midface deficiency
- Prominent chin

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

- A – P: Maintain
- Vertical: Open slightly
- Transverse: Maintain

Maxillary Dentition:

- A – P: Slight retraction to upright originally flared upper incisors
- Vertical: Slight increase
- Transverse: Maintain

Mandibular Dentition:

- A – P: Total arch retraction
- Vertical: Intrusion of incisors
- Transverse: Maintain

Facial Esthetics:

- Maintain

The ABO Discrepancy Index (*DI*) was 25 as shown in the subsequent worksheet.

Fig. 12:

Two segment of NiTi open coil springs were inserted on .016 x .022" NiTi archwire between bilateral upper central incisors and upper canines to create space for aligning the locked-in upper lateral incisors. A second .016 NiTi archwire was used to align and intrude bilateral upper lateral incisors.

SPECIFIC OBJECTIVES OF TREATMENT

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

- A – P: Maintain
- Vertical: Open slightly
- Transverse: Maintain

Maxillary Dentition:

- A – P: Slight retraction to upright originally flared upper incisors
- Vertical: Slight increase
- Transverse: Maintain

Mandibular Dentition:

- A – P: Total arch retraction
- Vertical: Intrusion of incisors
- Transverse: Maintain

Facial Esthetics:

- Maintain

TREATMENT PLAN

Nonextraction treatment was pursued with extra-alveolar bone screw anchorage, lateral to the molars in all four quadrants. The skeletal anchorage was used for retraction of all posterior segments to alleviate maxillary arch crowding and retract the entire mandibular dentition. A bite turbo on the lingual surface of the lower right lateral incisor (*Fig. 10*) was used to facilitate correction of anterior crossbite. Besides the TADs for canine distalization, open coil springs were also used to create space for the locked-in upper lateral incisors. A segment

Fig. 13: Upper arch was well aligned after three months treatment. Lower arch was initially bonded at this time.

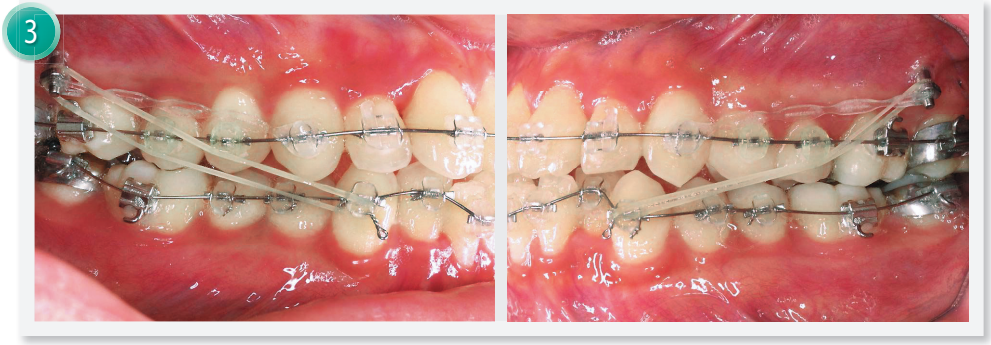

Fig. 14: Class III elastics from the upper posterior miniscrews were used to distalize lower canines.

Fig. 15:

Class III elastics were discontinued two months later, because the lower canines were not distalized efficiently. Two miniscrews were inserted on both buccal shelves of mandible for further canine distalization.

Fig. 16: Both arches were well aligned into .016 x .022" NiTi archwires after 11 months treatment.

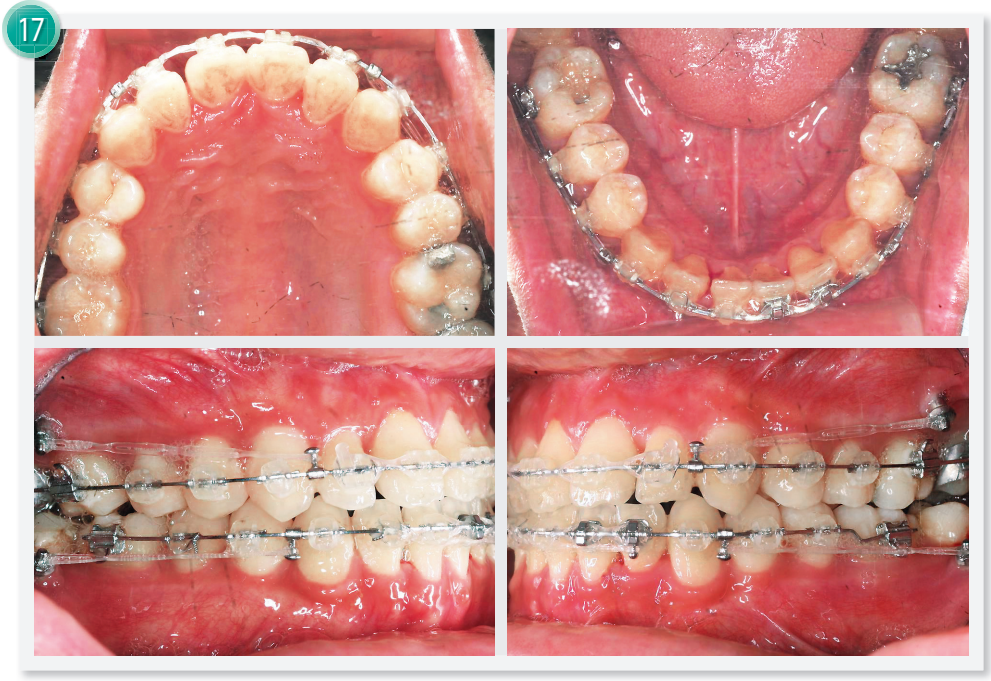

Fig. 17: Further adjustment in arch form and occlusal detailing were done on .016 x .022" archwires.

Fig. 18: IPR was performed for reducing the black triangles.

of .016 NiTi archwire was introduced to align and intrude the upper lateral incisors for the correction of anterior crossbite.

APPLIANCES AND TREATMENT PROGRESS

A modified Alexander prescription was used. The slot size of the anterior teeth (*canine to canine*) were .018", and .022" for the posterior teeth. The initial archwire for the upper arch was .016" thermal (*Copper*) NiTi archwire. A bite turbo was bonded at the lingual surface of lower right lateral incisor to avoid bracket interference while correcting the cross-bite (*Fig. 10*). Two miniscrews (*OrthoBoneScrew, Newton's A, Inc. 2x12mm*) were installed in the upper posterior area (*zygomatic crest*) on the same day as the initial bracket bonding (*Fig. 11*). Bilateral elastic chains were attached from the miniscrews to the maxillary canines for retraction to crearte space for the anterior tooth alignment. One month later, a dual-archwire force system was introduced. The .016 x .022" NiTi archwire engaged the brackets on all the maxillary teeth, and a "*piggy-back*" 016 NiTi archwire, with two segments of NiTi open coil springs, was inserted to create space for the blocked-out lateral incisors (*Fig. 12*).

Once space was opened, both upper lateral incisors were fully engaged on a .016 Thermal NiTi archwire, and retraction of the upper canines continued, utilizing TAD anchorage (*Fig. 13*). At the same appointment, brackets were bonded on the lower arch, but the patient declined having two additional miniscrews placed. Therefore, Class III elastics (*Ram, 5/16", 4.5 oz*) were prescribed to retract the lower canines to alleviate lower anterior crowding (*Fig. 14*). However, the Class III elastics were not very efficient, so two months later two additional miniscrews (*OrthoBoneScrew, Newton's A, Inc. 2x12mm*) were installed on the bilateral buccal shelves to retract the lower canines (*Fig. 15*). The alignment of both arches improved rapidly with four quadrants of miniscrew anchorage. After 11 months of active treatment, both arches were well aligned with .016 x .022" NiTi archwires (*Fig. 16*). Adjustment of the archform and detailing of the occlusion was performed with .016 x .022" SS archwires (*Fig. 17*). Interproximal reduction (*IPR*) was performed in the anterior segments of both arches to reduce the black triangles (*Fig. 18*). Following space closure and final detailing, appliances were removed after 20 months of active treatment.

RESULTS ACHIEVED

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

- A – P: Slight retraction with modest clockwise rotation of the mandible
- Vertical: Opened slightly as the mandible rotated posteriorly
- Transverse: Maintain

Maxillary Dentition:

- A – P: Maintain
- Vertical: Slight extrusion of the molars
- Transverse: Maintain

Mandibular Dentition:

- A – P: Retraction of the entire arch
- Vertical: Maintain
- Transverse: Maintain

Facial Esthetics:

- Maintain

RETENTION

Upper and lower clear retainers were delivered, and the patient was instructed to wear them full time for the first 6 months and nights time only thereafter. In addition, the patient was instructed in proper home hygiene and maintenance of the retainers.

FINAL EVALUATION OF TREATMENT

The Cast-Radiograph Evaluation score was 23 points, with most of the points reflecting problems in marginal ridge alignment. The discrepancies in marginal ridges resulted from the distal forces on both arches, which retracted the buccal segments, resulting in distal tipping of posterior teeth. Cephalometric superimpositions demonstrated total arch retraction of the lower dentition, so that the upper incisors could be uprighted to correct the patient's perception that the maxillary arch was "*protrusive.*" Overall, this challenging skeletal and dental malocclusion was treated to an appropriate facial and dental result with no iatrogenic problems.

DISCUSSION

Tweed[1] reported that Angle used the E-arch to expand a crowding dentition to achieve a nonextraction correction of crowded malocclusions. This approach contrasted with Case who advocated extractions to avoid excessive dental arch expansion.[1] The dominant treatment option for crowding in the first half of the 20th century was Angle's nonextraction treatment. Tweed conducted follow up studies of of his patients and found some relapses, so he retreated these cases with premolar extraction to avoid over-expansion of the arches and excessive mandibular incisor protrusion. Overall, the corrections were much more stable. Tweed later published his findings to explain the importance of Frankfort-mandibular incisor angle (*FMIA*) in orthodontic diagnosis and treatment planning.[2,3] In that study he closely analyzed the cephalograms of winners from a beauty pageant. He found out that the FH plane, the long axis of the lower incisors, and the mandibular plane angle formed a triangle, which is commonly known as the "*Tweed triangle.*" He concluded the

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	79°	79°	0°
SNB°	83°	81°	2°
ANB°	-4°	-2°	2°
SN-MP°	29°	29°	0°
FMA°	25°	27°	2°
DENTAL ANALYSIS			
U1 TO NA mm	2 mm	3 mm	1 mm
U1 TO SN°	118°	112°	6°
L1 TO NB mm	2 mm	0 mm	2 mm
L1 TO MP°	89°	83°	6°
FACIAL ANALYSIS			
E-LINE UL	-3 mm	-5 mm	2 mm
E-LINE LL	-1 mm	-2 mm	1 mm

■ Table. Cephalometric summary

FMIA of these "*good looking ladies*" was above 65 degrees. Hence, Tweed set his treatment goal to achieve an FMIA above 65 degrees. He removed four bicuspids to make room for incisor retraction, and to achieve balance for lower face esthetics. However, following the "*rule of numbers*" blindly may lead to a dished in face in some cases. So consideration of the profile is important when reviewing the numbers on cephalometric analyses.

Considering the profile of this patient (*Fig. 1*), extraction treatment may result in unacceptable midface deficiency ("*dishedin*").[4,5] Hence, a nonextraction treatment plan was indicated. However, the marked crowding in each arch precluded conventional non-extraction treatment because it would produce excessive expansion of the arch and/or proclination of incisors. Such compromises may predispose the patient to relapse. The rationale for the nonextraction modality in the current patient was to alleviate anterior crowding by distal movement (*retraction*) of the entire dentition. Such an approach can avoid flaring of the incisors and over-expansion of the intercanine width.[6] In effect, the corrected dentition can be aligned over the apical base of bone. Three-year post-treatment records of the present patient show satisfactory stability (*Figs 19, 20*).

One of the major limiting factors for total arch distalization is the posterior limit of the alveolar process. The distal boundaries are formed by the maxillary tuberosity, and the mandibular accending ramus with its over-lying soft tissue. For maxillary dental arch retraction, Sugawara suggested that the average amount of upper molar distalization is 3.78mm at the crown level and 3.2mm at the root level.[7] However, attempts to translate mandibular molars distally have been less successful: 3.5mm at crown level and 1.8mms at root apex level.[8] Thus, there is more of a tendency for mandibular molars to tip rather than be translated distally. Root distal bends in the mandibular archwire or repositioning of molar brackets for a root distal moment may be indicated for patients undergoing retraction of the entire mandibular arch.

Because of the limitations in the average amount of molar retraction that can be achieved with TAD anchorage, clinicians should inform patients that a re-evaluation will be conducted at 8 to 10 months after the start of the treatment to decide on the final treatment plan. If the initial nonextraction treatment is unsatisfactory, the treatment plan can be modified into an extraction approach. Furthermore, there may be complaints of discomfort as periodontal tissue builds-up distal to the terminal molars, and periodontal surgery may be necessary to reduce the amount of gingival tissue in the direction of tooth movement.

Fig.19: Three years posttreatment facial photographs

Fig. 20: Three years posttreatment intraoral photographs

CONCLUSION

Total arch distalization with TADs provides a valuable treatment option for patients with severe crowding and a straight profile. By increasing the arch circumference, crowded teeth can be aligned over the apical base of bone, and this nonextraction approach helps avoid the dished-in midface that commonly occurs with extraction treatment.

ACKNOWLEDGMENT

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ABO 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 = 6

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 = 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 4 pts.
Beyond Class II or III	=	1 pt. per mm. additional ____ pts.

Total = 4

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 2

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

Each degree < -2° 2 x 1 pt. = 2

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 = 6

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

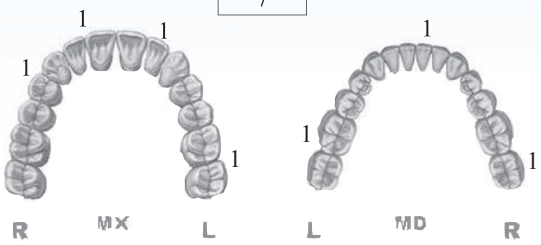
Cast-Radiograph Evaluation

Case # 2 **Patient**

Total Score: 23

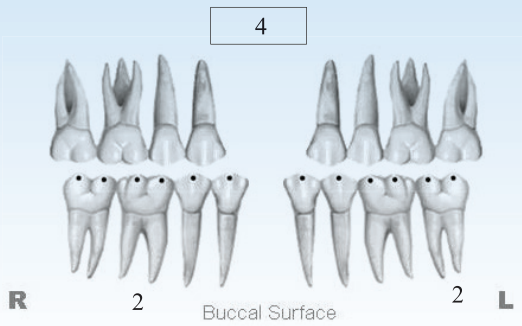
Alignment/Rotations

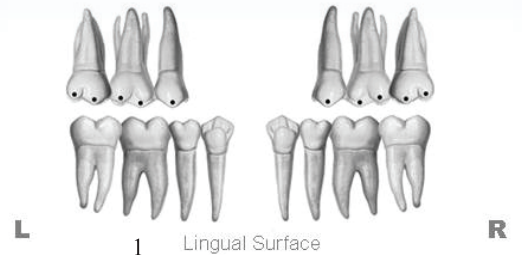
7



Occlusal Contacts

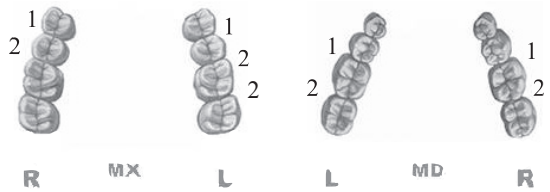
4





Marginal Ridges

10

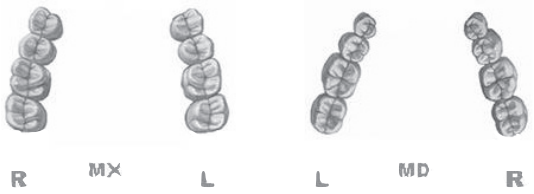


Occlusal Relationships

1

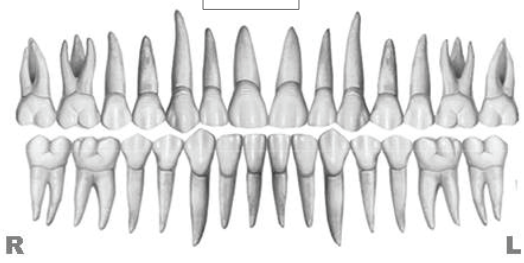
Buccolingual Inclination

0



Interproximal Contacts

0

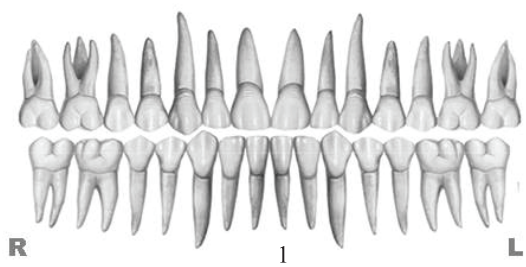


Overjet

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.