

iAOI Case Report

A Severe Skeletal Class III Open Bite Malocclusion Treated with Non-surgical Approach

This 20-year-8-month-old male presented with a chief concern of “*anterior cross bite and prognathic mandible.*” He has seen at least two other orthodontists and was told that surgery is the only solution for his severe malocclusion. Oral soft tissues, periodontium, frena, and gingival health were all within normal limits. Oral hygiene was excellent. Medical and dental histories were noncontributory.

DIAGNOSIS AND ETIOLOGY

Pretreatment facial photographs (Fig. 1) showed a straight profile with protrusive lower lip. The pretreatment intraoral photographs (Fig. 2) and study models (Fig. 3) revealed a molar relationship of bilateral Class III. The lower dental midline was shifted 1.5 mm to the right of the facial midline. A lingual cross-bite extended from the right 1st molar to the left 1st premolar. There was also an end-to-end cross-bite tendency extending from the left 2nd premolar to the 2nd molar. No contributing habits were reported, but the labial tipping of the mandibular incisors suggests a long-term maxillary lip trap. Intra-oral exam and the panoramic radiograph (Fig. 4) revealed impaction of the right mandibular third molar (#32). All other third molars were missing.

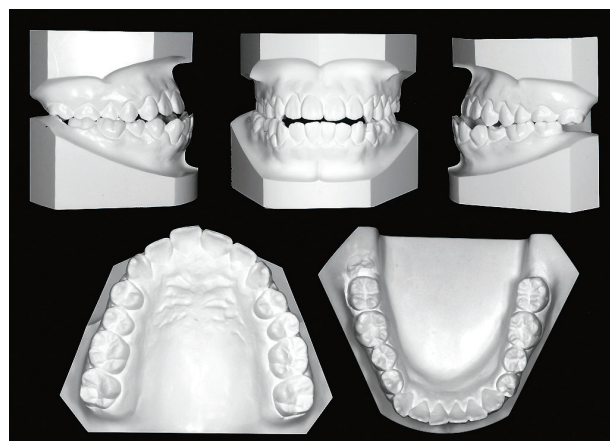
Cephalometric analysis showed a skeletal Class III pattern, due to a prognathic mandible that was manifest as a 7-mm anterior cross bite. The ANB angle was 1.5°, the SN-MP angle was 36°,



■ Fig 1. Pretreatment facial photographs



■ Fig 2. Pretreatment intraoral photographs



■ Fig 3. Pretreatment study models

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International Journal of Orthodontics & Implantology (right)

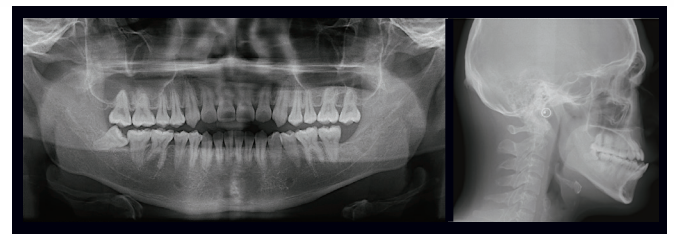


and the lower incisors were inclined 94° to Md plane. The cephalometric values are summarized in the Table entitled Cephalometric Summary. The IBOI (*International Board of Orthodontists and Implantologists*) and American Board of Orthodontics (ABO) discrepancy index (DI) was 71, as documented in the DI worksheet. The patient was successfully treated with a conservative camouflage method as documented in the finish records (Figs. 6-10).

TREATMENT OBJECTIVES

The overall objective of treatment was to keep the vertical dimension of occlusion (VDO), and retract the mandibular incisors, to compensate for the prognathic mandible, in order to achieve a Class I molar and canine relationships with ideal overjet and overbite. The specific treatment objectives were to:

- Maintain the A-P position of the maxilla.
- Maintain the position of the maxillary incisors and molars.
- Retract the mandible incisors and molars relative to the apical base of bone.
- Correct the anterior and posterior X-bite and align the midlines.
- Establish a normal overjet and overbite in a mutually protected, Class I occlusion.
- Retract upper and lower lips to improve facial balance.



■ Fig. 4-5. Pretreatment pano and ceph radiographs



■ Fig 6. Posttreatment facial photographs



■ Fig 7. Posttreatment intraoral photographs



■ Fig 8. Posttreatment study models

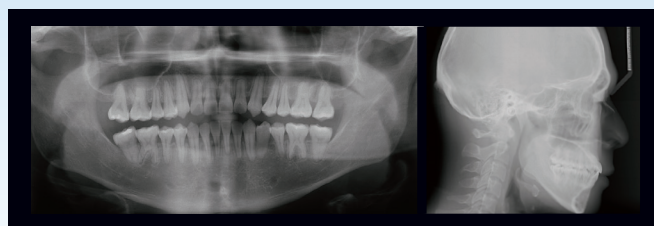
TREATMENT ALTERNATIVES

The patient's chief concerns were the anterior cross bite and the difficulty of incising food. Because of the protrusive lower lip and the extreme negative overjet (Fig. 11), an orthognathic surgical option was suggested by two other orthodontists, but the patient deemed that to be too aggressive. Thus a nonsurgical camouflage plan was devised to meet the patient's needs:

1. Extract mandibular right 3rd molar,
2. Place bilateral bone screws in mandibular buccal shelves to ensure maximal retraction of whole mandibular dentition.
3. Remove appliances and retain with upper and lower clear overlay retainers.

TREATMENT PROGRESS

0.022-in Damon Q® standard torque (Ormco) were used. Both arches were bonded and aligned. In the 9th month of treatment, .014 x .025" CuNiTi arch-wires were placed and the buccal shelf bone screws were installed to anchor retraction of the whole mandibular dentition (Fig. 12). In the 12th month of



■ Fig. 9-10. Posttreatment pano and ceph radiographs



■ Fig. 11. Huge negative overjet (-7 mm)

treatment the anterior cross-bite was corrected to almost edge-to-edge position. To resist further lingual tipping of lower incisors, the arch-wire was changed to .017x.025 low friction TMA. In the 14th month of treatment, the upper arch-wire was changed to .017x.025 low friction TMA (Fig. 13). Expansion of upper arch-wire was performed to assist in correction of the bilateral posterior lingual cross bite. Class II elastics (3.5 oz, 3/16") from upper canines to buccal shelf screws were introduced to distally tip the upper incisors to improve his acute naso-labial angle. In the 15th month of treatment, upper arch-wire was changed to .019x.025 SS and .016x.025 SS on lower arch for coordination. In the 19th month of treatment, lingual X-bite was corrected on left side while right side still remained in X-bite position. Cross elastics from upper 1st molars to buccal shelf screws was introduced to establish adequate transverse relation (Fig. 14). Meanwhile, Class II elastics were continued for smile arc enhancement. After the transverse problem has been over-corrected, one month later, a diagnostic impression was taken to evaluate the occlusion for final detailing. At that time, the major problem is



■ Fig 12.

Start whole mandibular arch retraction with 2 OrthoBoneScrews placed on buccal shelf as anchors in 9th month of treatment.



■ Fig 13.

The anterior X-bite was corrected in 14th month of treatment with space still left distal to mandibular left canine. Class II elastics (3.5oz, 3/16") from maxillary canines to buccal shelf screws were introduced to enhance smile arc. Upparch-wire was expanded for correction of posterior lingual X-bite.

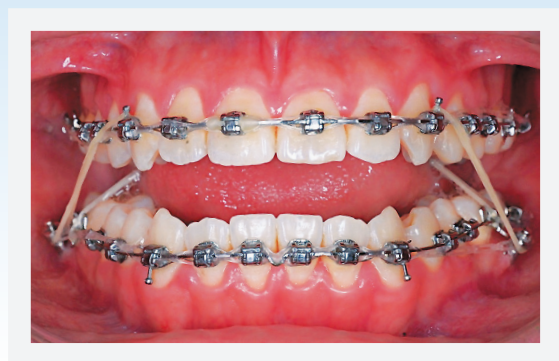
the distal tipping of the mandibular 2nd molars and the resulting open bite in the posterior molar area caused by tip-back effect due to retraction of the lower dentition with anchorage by buccal shelf screws. The archwire failed to provide an adequate root distal moment to maintain the axial inclination of the mandibular second molars. For final settling of the occlusion, the upper arch-wire was sectioned distal to canines and lower archwire was cut distal to 2nd premolars. Vertical elastics (3.5 oz, 1/8") were used in the molar area to finish the occlusion (Fig. 15). The appliance was removed in 21th month of treatment; upper and lower clear, overlay retainers were delivered. Gingivoplasty was performed on the upper central incisors with a diode laser to improve

the crown length-to-width proportion (Fig. 16). The biomechanics associated with retracting the entire mandibular dentition with buccal shelf screws are illustrated in Figure 17 and 18.

TREATMENT RESULTS

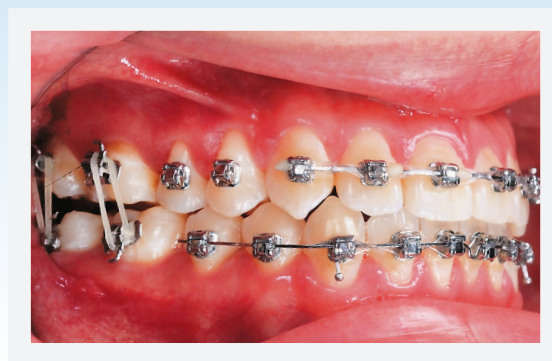
The overall results were pleasing to both the clinician and the patient. Facial harmony and lower lip protrusion were improved (Fig. 6). Post-treatment intraoral photographs (Fig. 7) and study casts show a slight Class II buccal interdigitation bilaterally. Dental midlines were aligned with the facial midline, and ideal overjet and overbite were achieved.

Cephalometric analysis and super-impositions (Fig. 19) showed maximal retraction of whole



■ Fig 14.

X-elastics from maxillary 1st molars and Class II elastics from maxillary canines to buccal shelf screws were introduced to correct posterior lingual X-bite and for smile arc enhancement.



■ Fig 15.

Finishing elastics. Upper and lower arch-wires were sectioned with posterior vertical elastics (3.5 oz, 1/8") to settle posterior occlusion.



■ Fig 16.

Gingivoplasty was performed for better crown length-to-width proportion. Probing depth revealed 3mm in depth from gingival margin to CEJ. And the CEJ is equal to bone level. And thus indicated delayed apical migration of central incisor gingivae.

mandibular dentition with counterclockwise rotation of mandibular occlusal plane, and a slight opening of the mandibular plane angle. The upper incisor to the SN angle increased from 114° to 115°. The lower incisor to the Md plane angle was decreased from 94° to 90°. The change of profile and inclination of maxillary and mandibular incisors were demonstrated in progress cephalograms (Fig. 20). Critical assessment of this case with the IBOI cast-radiograph method and IBOI Pink & White score resulted in score of 37 and 7, as documented on the form appearing later in this report. CRE score exceeds the usual limit of 26 for an acceptable board case. The following deviations from ideal (*from CRE and Pink & White score*) were noted:

1. Bilateral maxillary 2nd premolars exhibited minor mesial-in rotation.
2. Maxillary left and bilateral mandibular 2nd molars exhibited minor distal-in rotation.
3. Marginal ridge discrepancies existed between #2-3, #3-4, #13-14, #14-15, #18-19, #19-20, #29-30 and #30-31.
4. Lack of occlusal contacts was noted bilaterally on disto-buccal cusps of maxillary and mandibular 2nd molars and palatal cusps of maxillary 2nd premolars.
5. A slight Class II canine relationship was noted bilaterally.
6. Inadequate root parallelism existed between #20-#21, and #30-#31.

7. Uneven level of gingival margin, inadequate axial inclination: #7 and #8, Shorten crown length : #8 and #9, Uneven incisor curve

DISCUSSION

Conservative treatment of a Class III skeletal malocclusion, with marked negative overjet by a non-surgical approach, has long been challenging to orthodontists. The strategy to camouflage a Class III malocclusion usually involves proclination of the maxillary incisors and retroclination of the mandibular incisors to improve the dental occlusion, but that approach may not correct the underlying skeletal problem or facial profile. Clinical studies have shown an increase in the ANB angle, little or no change in the vertical dimension, and decreased concavity of the facial profile with Class III camouflage treatment.¹⁻⁵ However, little information is available in the literature regarding the possible tooth movements to camouflage this type of skeletal malocclusion. In most non-surgical Class III treatment, retraction of the lower incisors is helpful. McLaughlin and Bennet⁶ advise to not retract beyond 80° because of the risk of dehiscence and lack of bone support. Retraction of the lower incisors and Class I molar relationship can be obtained with the assistance of Class III elastics and/or with bone anchorage screws. With bone screw anchorage, the dental discrepancy can often be effectively treated within the limits of skeletal camouflage. And also, compared to Class III elastics, utilization of bony anchorage can avoid the proclination of upper incisors, which contributes to more acute naso-labial angle. In the present case, maximal retraction of whole mandibular dentition was attained with bilateral bone screws, inserted into the mandibular buccal shelves, without adverse effect of his naso-labial angle.

The major limitation of how much one can retract

the entire mandibular dentition is the distance between mandibular 2nd molar and the ascending ramus (Fig. 17). However, little information is available relative to this problem. In the present case, the patient presented with a right mandibular 3rd molar that is inclined mesially. This relationship equates to a distance of at least 10.5 mm⁷ between the mandibular 2nd molar and the ascending ramus. Thus, it is possible to correct the current malocclusion because the negative overjet after 9-months decompensation was 8 mm. In summary, the indications of correcting skeletal Class III malocclusion by retraction of the entire mandibular arch with bony anchorage are :

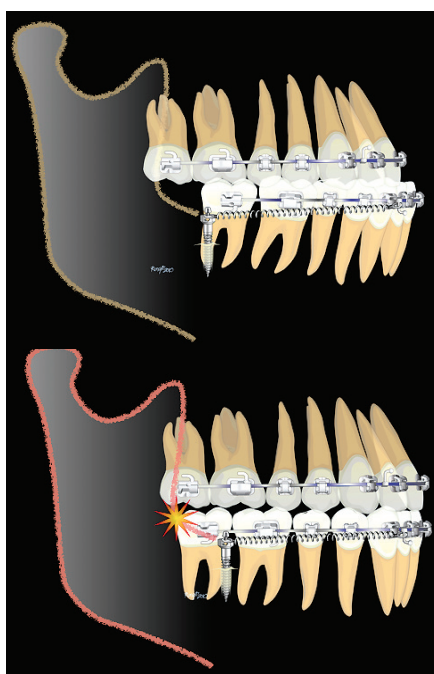
1. good profile, 2. normal A-P position of maxilla, 3. maxillary incisor to nasion-sella line⁸ within 120°, 4. slightly acute naso-labial angle, 5. negative overjet after decompensation of mandibular incisors within 11 mm (*average M-D width of mandibular 1st molar*).

Another concern in treating Class III open bite cases is smile arc enhancement. Class III open bite cases usually have a flat occlusal plane and smile arc. When correcting this kind of malocclusion with long Class III elastics, extrusion of both maxillary molars and mandibular incisors, as well as flaring of maxillary incisors, contributes to counterclockwise rotation of the functional occlusal plane and flattening of smile arc. In the present case, Class III elastics were not utilized to correct the malocclusion, but the treatment still resulted in a flattened smile arc. Retracting the entire mandibular dentition with screws in the buccal shelf results in extrusion of mandibular incisors and tip-back of molars (Fig. 18).^{9, 10, 11} The flexibility of the arch-wire is directly proportional to the degree of distal tipping experience by the terminal molar in the arch. From a biomechanical aspect, retraction of the entire mandibular dentition with buccal shelf anchorage

contributes to the correction of an open bite, but these mechanics do not enhance the smile arc. In this present case, Class II elastics were introduced after the anterior X-bite has been corrected, but it is difficult to extrude maxillary incisors when there is no open bite. Distally tipped 2nd molars contributed to the relatively high score of 37 using the IBOI cast-radiograph method due to poor axial inclination, marginal ridge discrepancies, and lack of intermaxillary tooth contacts. In the 20th month of treatment, diagnostic casts were obtained to plan another 4-6 months for final detailing. Unfortunately, this patient is an overseas Chinese student from Malaysia and he was required to return to his home country because he was unable to obtain a work

visa. Thus, it was necessary for him to return every other week for adjustments during the latter active treatment phase and he was debonded the day before he left Taiwan. Although this case may not be adequate for board certification purposes, both the patient and clinician were satisfied with the final result.

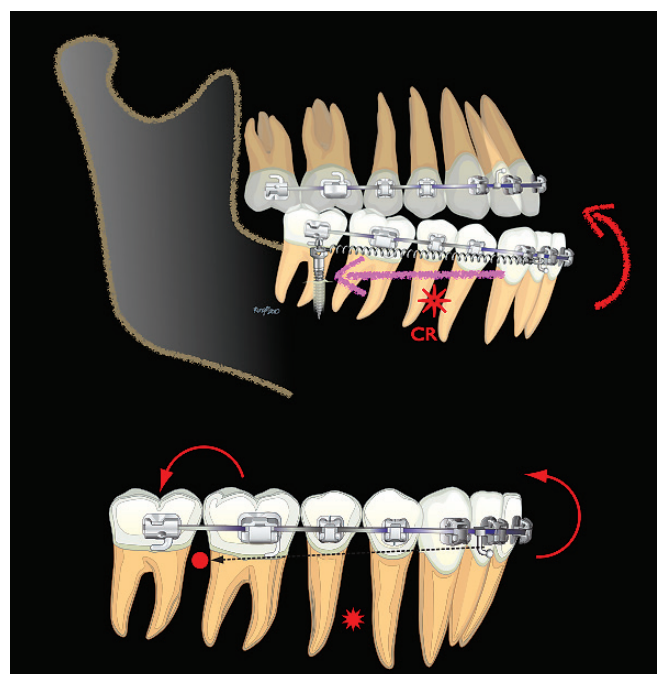
It should be noted that the mandibular arch alignment was similar to the Tweed philosophy of orthodontics finishing. In the denture completion stage of Tweed-Merrifield philosophy,¹² the distal cusps of the 1st and the 2nd molars should be slightly out of occlusion. If the canines and premolars are treated to solid Class I occlusion, the ideal occlusion



■ Fig 17.

The limitation of whole mandibular dentition retraction is the initial molar relationship in related to distance between 2nd molar and ascending ramus.

(Illustration of Dr. Rungsi Thavarungkul)



■ Fig 18.

Retracing whole mandibular dentition with bony anchorage will extrude mandibular incisors and tip the molar back.

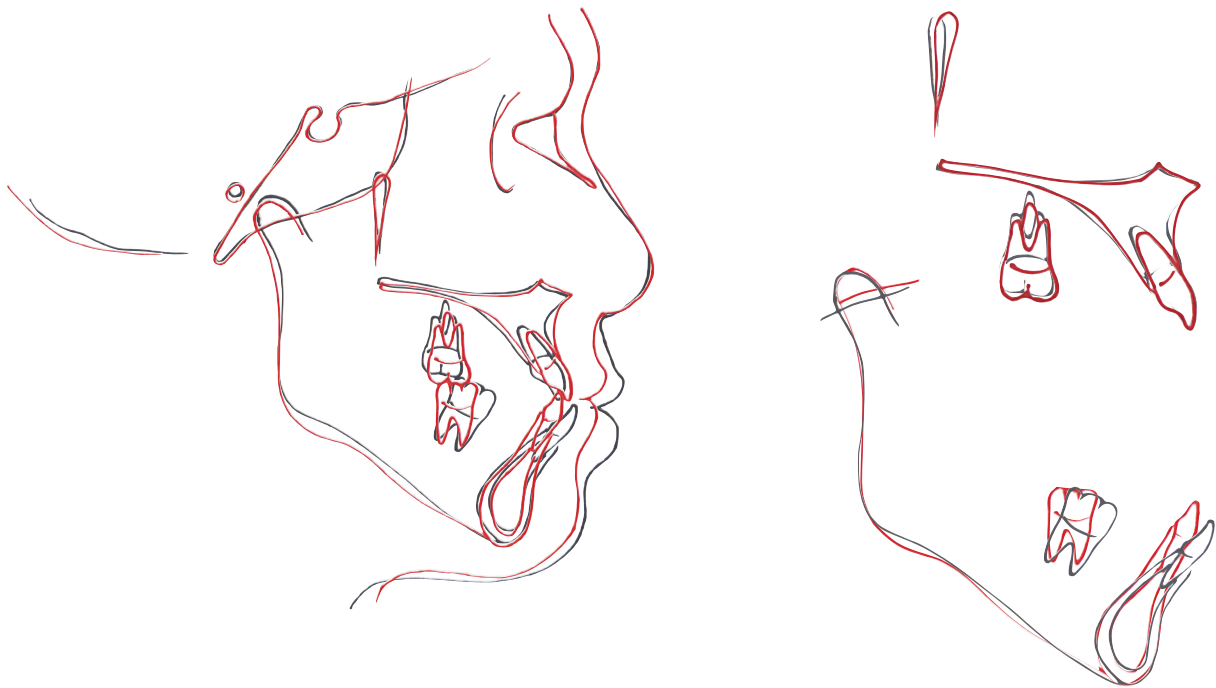
(Illustration of Dr. Rungsi Thavarungkul)

will occur after all treatment mechanics discontinued and uninhibited function and other environmental influences active in the post-treatment period will stabilize and finalize the position of the occlusion. This approach is deemed the “*denture recovery*” stage.¹² If this philosophy can be applied to this Class III non-extraction case, the axial inclination of the 2nd molars will recover because ideal overjet, overbite and buccal interdigitation were achieved. However, to avoid distally tipped mandibular molars, it would be better to retract the mandibular dentition with a stiffer archwire like .016x.025 SS to help prevent rotation of the occlusal plane and the tip back of molars. It would have been helpful to have progress panoramic radiographs to recognize the early stages

of distally tipping. In conclusion, significant dental and soft-tissue improvement can be expected in young adult Class III patients treated with camouflage orthodontic tooth movement. A wide range of skeletal dysplasias can be camouflaged with tooth movement, without deleterious effects to the periodontium. However, proper diagnosis, realistic treatment objectives, and efficient mechanics are necessary to prevent undesirable sequelae.¹³

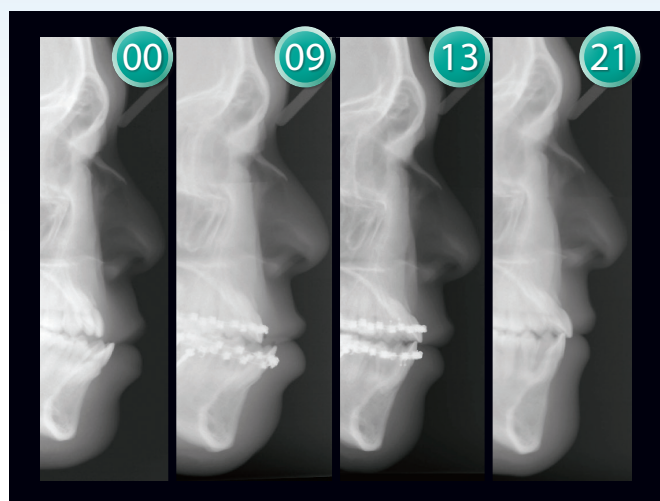
ACKNOWLEDGEMENT

Thanks to Ms. Tzu Han Huang for proofreading this article.



■ Fig 19.

Superimposed tracings. Superimposition on mandible revealed maximal retraction of anterior teeth and extrusion of molars. These contributed to correction of anterior cross-bite and vertical dimension opening.



■ Fig 20.

Progress cephalograms revealed that the anterior X-bite was corrected in 13th month of treatment.

CEPHALOMETRIC

SKELETAL ANALYSIS

	PRE-TX	POST-TX	DIFF.
SNA°	85°	86°	1°
SNB°	83.5°	84°	0.5°
ANB°	1.5°	2°	0.5°
SN-MP°	36°	36°	0°
FMA°	33°	32°	-1°

DENTAL ANALYSIS

U1 TO NA mm	4.5 mm	4.0 mm	-0.5 mm
U1 TO SN°	114°	115°	1°
L1 TO NB mm	12 mm	5.0 mm	-7.0 mm
L1 TO MP°	94°	90°	-4°

FACIAL ANALYSIS

E-LINE(U)	0.5 mm	-2.0 mm	-2.5 mm
E-LINE(L)	3.5 mm	-1.0 mm	-4.5 mm

■ Table . Cephalometric summary

REFERENCES

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IBOI Discrepancy Index Worksheet

TOTAL D.I. SCORE 71

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 = 34

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 = 16

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 = 2

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 = 7

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 $> 38^\circ$ x 2 pts. =

$\leq 26^\circ$ = 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 = 0

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 (≥ 3 mm) @ 2 pts. =
 Missing teeth (except 3rd molars) x 1 pt. =
 Missing teeth, congenital x 2 pts. =
 Spacing (4 or more, per arch) x 2 pts. =
 Spacing (Mx cent. diastema ≥ 2 mm) @ 2 pts. =
 Tooth transposition x 2 pts. =
 Skeletal asymmetry (nonsurgical tx) @ 3 pts. =
 Addl. treatment complexities 2 x 2 pts. = 4

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), ≥ 7 mm 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

IBOI Cast-Radiograph Evaluation

Case #

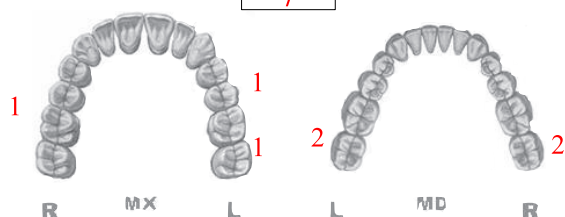
Patient

Total Score:

37

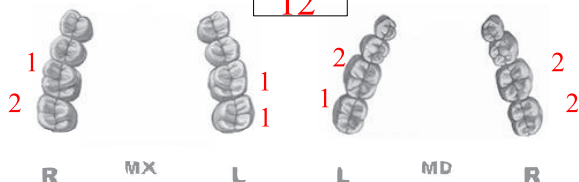
Alignment/Rotations

7



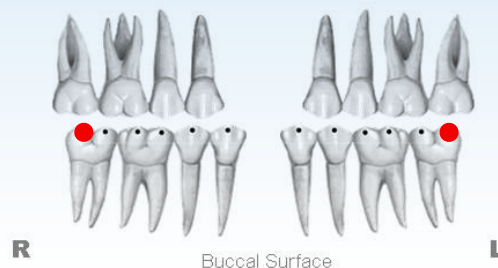
Marginal Ridges

12

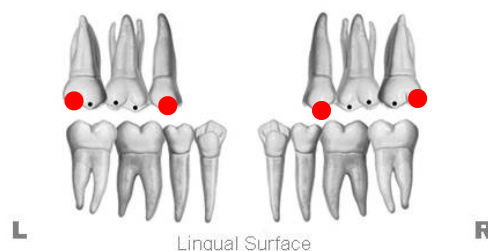


Occlusal Contacts

12



Buccal Surface



Lingual Surface

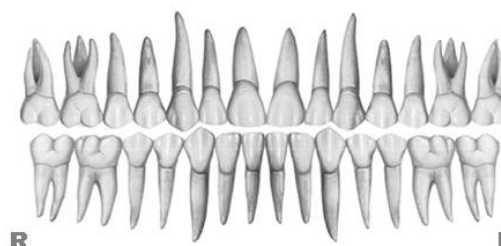
Occlusal Relationships

4



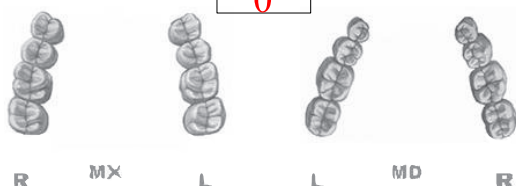
Interproximal Contacts

0



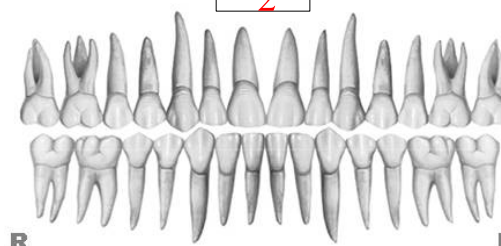
Buccolingual Inclination

0



Root Angulation

2



Overjet

0

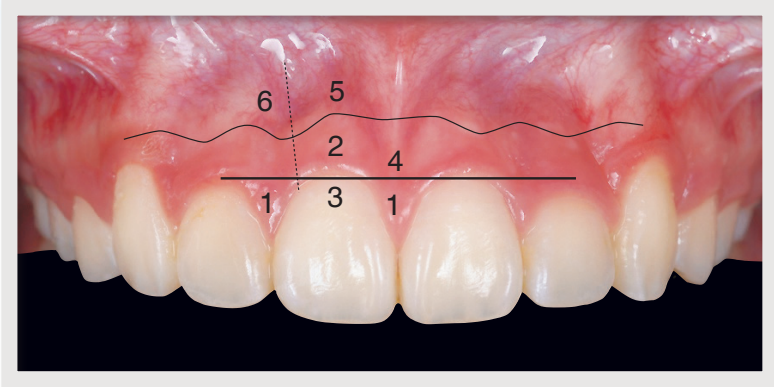


INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 7

1. Pink Esthetic Score

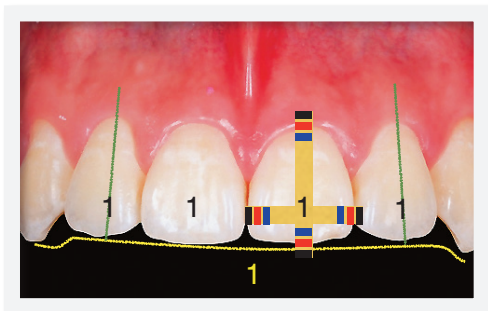
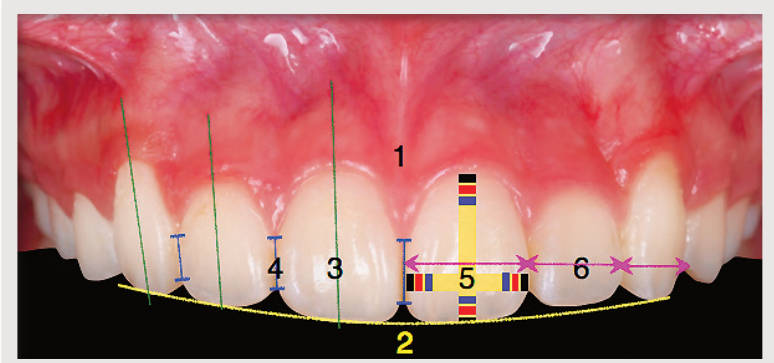


Total = 2

1. M & D Papilla	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

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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 = 5

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

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2. Incisor Curve	0	1	2
3. Axial Inclination (5°, 8°, 10°)	0	1	2
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5. Tooth Proportion (1 : 0.8)	0	1	2
6. Tooth to Tooth Proportion	0	1	2