

Conservative Treatment for Severe Skeletal Class III Openbite Malocclusion: Reversing the Etiology of Interincisal Tongue-Posture

Abstract

Skeletal Class III malocclusion with bimaxillary protrusion and anterior openbite is a major esthetic and functional disability. A 15-year-old female presented for orthodontic consultation with excessive facial height (58%), concave profile (-5°), facial asymmetry (chin deviated 5mm to the left), bimaxillary protrusion (SNA 85° , SNB 89.5°), and an intermaxillary discrepancy (ANB -4.5°). The full-cusp Class III malocclusion was complicated with lower arch crowding (-5mm), anterior openbite (6mm), and posterior crossbite tendency. The Discrepancy Index (DI) was 70. A thorough diagnosis and assessment of etiology indicated an effective treatment plan: asymmetric molar extraction pattern (UR7, UL7, LR7, LL6), bone screw anchorage for retraction of the lower arch, and correction of anterior, interincisal tongue posture. This severe malocclusion was treated to a satisfactory result in 24 months without orthognathic surgery. The Cast-Radiograph Evaluation (CRE) score was 30. (J Digital Orthod 2020;60:4-16)

Key words:

Skeletal Class III, full-cusp Class III, molar extraction, anterior openbite, anterior tongue posture, posterior crossbite, asymmetrical extraction, passive self-ligating appliance

Introduction

A 15-year-9-month-old female presented for orthodontic consultation with the chief complaint of poor dentofacial esthetics and function. Specific concerns were facial protrusion, openbite, speech impediment, and compromised masticatory function. Clinical examination revealed a full-cusp ($>10\text{mm}$) Class III malocclusion bilaterally, which was complicated with anterior openbite, posterior crossbite, lower dental midline and chin deviation 5mm to the left, and an excessive lower facial height (Figs. 1-3). Medical and dental histories were within normal limits (WNL). There was no history nor evidence of temporomandibular dysfunction. The

morphology of the malocclusion was consistent with an asymmetric airway-compensation: (1) low tongue posture, (2) incompetent lips, and (3) mandibular midline deviation.^{1,2}

This case report focuses on an etiology-based diagnosis to treat a severe malocclusion without orthognathic surgery in only 24 months. The direct comparisons of the start and finish photographs, casts, and radiographs are presented in Figs. 1-8. Superimposed cephalometric tracings before and after treatment are shown in Fig. 9.

Eric Hsu,
Lecturer, Beethoven Orthodontic Course (Left)

Chris H. Chang,
Founder, Beethoven Orthodontic Center
Publisher, Journal of Digital Orthodontics (Center)

W. Eugene Roberts,
Editor-in-Chief, Journal of Digital Orthodontics (Right)



■ Fig. 1: Pre-treatment facial photographs



■ Fig. 4: Post-treatment facial photographs



■ Fig. 2: Pre-treatment intraoral photographs



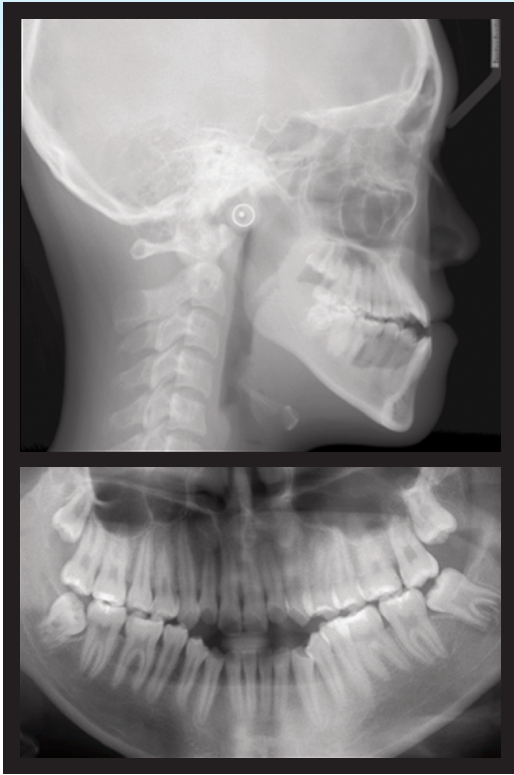
■ Fig. 5: Post-treatment intraoral photographs



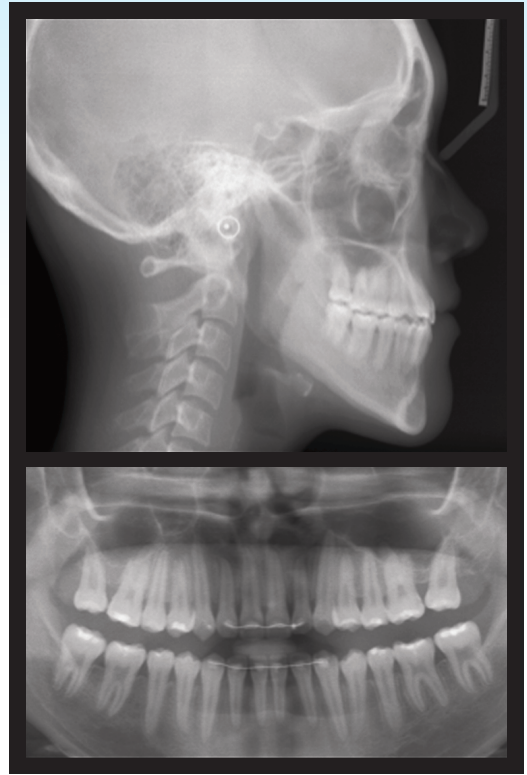
■ Fig. 3: Pre-treatment study models (casts)



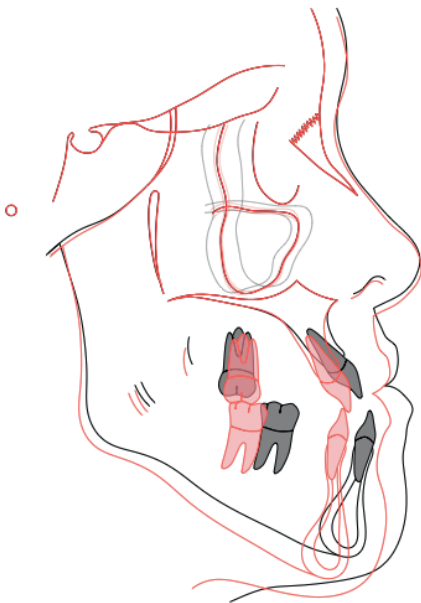
■ Fig. 6: Post-treatment study models (casts)



■ **Fig. 7:**
Pre-treatment cephalometric and panoramic radiographs document the original dentofacial morphology.



■ **Fig. 8:**
Post-treatment cephalometric and panoramic radiographs reveal the dentofacial morphology immediately after fixed appliances were removed.



■ **Fig. 9:**
Pre- (black) and post-treatment (red) cephalometric tracings are superimposed on the anterior cranial base (left), the maxilla (upper right), and the stable internal structures of the mandible (lower right). See text for details.

The dental nomenclature for this report is a modified Palmer notation. Upper (U) and lower (L) arches, as well as the right (R) and left (L) sides, define four oral quadrants: UR, UL, LR, and LL. Teeth are numbered 1-8 from the midline in each quadrant, e.g., a lower right first molar is LR6.

- Symmetry: Upper dental midline deviated from facial midline 1mm to the right. Lower dental midline deviated 5mm to the left.

The ABO Discrepancy Index (DI) was 70 as shown in the subsequent worksheet (Worksheet 1).^{1,2}

Diagnosis

Facial:

- Length: Long tapered face, Na-ANS-Gn 58% (Table 1)
- Convexity: Concave profile, G-Sn-Pg' = -5°
- Symmetry: Chin deviation 5mm to the left
- Smile: Insufficient maxillary incisal exposure
- Hypermentalis Strain: Incompetent lips

Skeletal:

- Intermaxillary Relationship: Bimaxillary protrusion (SNA 85°, SNB 89.5°, ANB -4.5°)
- Mandibular Plane: WNL (SN-MP 34.5°, FMA 27.5°)
- Vertical Dimension of Occlusion (VDO): Excessive Na-ANS-Gn (58%)
- Symmetry: Mandible deviated to the left about 5mm.

Dental:

- Classification: Full-cusp Class III relationship bilaterally
- Overbite: -6mm (anterior openbite)
- Overjet: -6mm (anterior crossbite)
- Posterior Crossbite: UL4, UL5, UL6 in lingual version

Treatment Objectives

The treatment objectives were: (1) retract and posteriorly rotate the lower arch; (2) align both arches; (3) correct openbite; (4) align dental midlines; (5) improve the facial profile; and (6) optimize smile esthetics.

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	85°	84°	1°
SNB° (80°)	89.5°	86°	3.5°
ANB° (2°)	-4.5°	-2°	2.5°
SN-MP° (32°)	34.5°	38°	3.5°
FMA° (25°)	27.5°	31°	3.5°
DENTAL ANALYSIS			
U1 To NA mm (4mm)	8.5	6	2.5
U1 To SN° (104°)	121.5°	111.5°	10°
L1 To NB mm (4mm)	4.5	1.5	3
L1 To MP° (90°)	71.5°	68°	3.5°
FACIAL ANALYSIS			
E-LINE UL (-1mm)	-4.5	-4.5	0
E-LINE LL (0mm)	0.5	-3	3.5
Convexity: G-Sn-Pg' (13°)	-5°	1.5°	6.5°
%FH: Na-ANS-Gn (53%)	58%	60%	2%

Table 1: Cephalometric summary

Treatment Alternatives

Plan A.

Camouflage treatment is directed at correction of the occlusion and masking the skeletal discrepancy: (1) asymmetric extraction for midline correction: UR7, UL7, LL7, and LR6; (2) buccal shelf bone screws and Class III elastics for retracting the mandibular arch; and (3) counseling, exercises, and lingual spurs to correct interincisal tongue posture. These mechanics are designed to produce an optimal Class I dental midline correction and improve the concave facial profile (Fig. 10).

Plan B.

Orthognathic surgery is often the preferred approach to correct the skeletal component of a Class III malocclusion with an openbite. However, the patient and her parents refused orthognathic surgery, which was previously suggested by multiple orthodontists. Thus, camouflage treatment (*Plan A*) was the family choice.

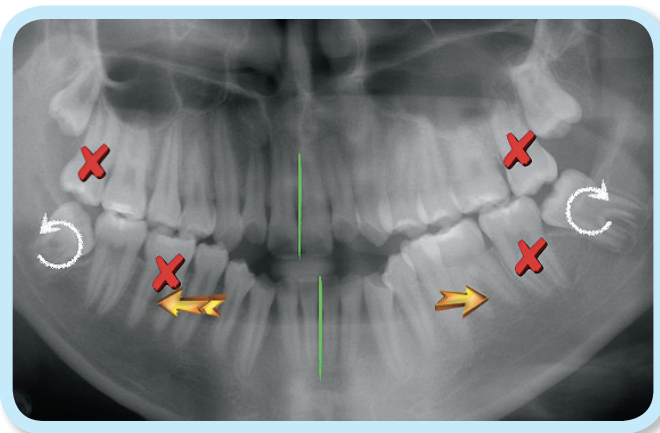


Fig. 10: The treatment plan required extraction of four molars and space closure to correct the anterior crossbite. See text for details.

Appliances and Treatment Progress

A 0.022-in slot passive self-ligating (PSL) bracket system, Damon Q® (Ormco, Brea, CA, USA), was selected, with the following third-order adjustments: low torque brackets on upper incisors, and low torque brackets bonded inversely (*upside down*) on lower incisors.^{1,2} All archwires and auxiliaries were supplied by the same manufacturer. The lower arch was bonded at the start of treatment (0M), and the upper arch was bonded one month later (1M). The initial mechanics for both arches were 0.014-in CuNiTi archwires fitted with resin balls bonded on the ends to prevent mucosal irritation (Table 2).

After 4 months of active treatment, crowding on both arches were relieved, so both archwires were changed to 0.014x0.025-in CuNiTi. In the 8th month of treatment, the upper archwire was changed to 0.017x0.025-in TMA, and lower archwire was changed to 0.016x0.025-in stainless steel (SS). Then Class III elastics (Fox, 1/4-in, 3.5-oz) were applied.

In the 9th month of treatment, the anterior openbite was resolved (Fig. 11), and UL8, LR8, and LL8 had erupted spontaneously (Fig. 11). Three months of Class III elastics (Fox 1/4", 3.5oz.) corrected the anterior crossbite (Fig. 12). Brackets were bonded on lower 3rd molars, and the lower archwire was replaced with a 0.016-in CuNiTi. In the 15th month of treatment, electrocautery exposed the UR8 to facilitate eruption (Fig. 13). Brackets were bonded one month after the tooth had erupted (17M). At the same appointment, a 0.014-in CuNiTi archwire was engaged.

After 19 months of active treatment, a 2x12-mm bone screw (OBS®, iNewton, Inc., Hsinchu City, Taiwan)



Fig. 11: Anterior openbite was resolved in 9 months. Note the third molar erupted spontaneously.



Fig. 12: Anterior crossbite was corrected with only Class III elastics.

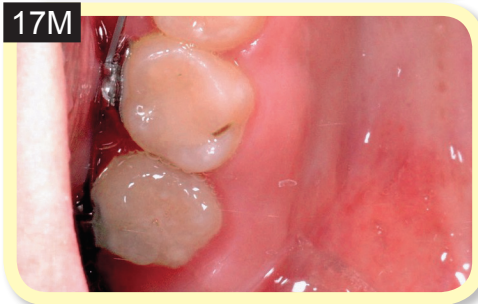


Fig. 13: Electrocautery at 15 months into treatment (15M) removed soft tissue impeding the eruption of the UR8. The tooth erupted two months later (17M).

was inserted in each buccal shelf for the last two months of lower arch retraction. Both bone screws were removed at twenty-one months (21M). To improve the occlusal contacts, archwires were sectioned distal to second premolars, and vertical (*up-and-down*) elastics (*Chipmunk*, 1/8-in, 3.5-oz) were applied. The mechanics for treatment for the current patient are illustrated in the Archwire Sequence Chart (Fig. 14).

After 24 months of active treatment, all fixed appliances were removed. A diode laser was used to improve soft tissue contours in the upper anterior segment to enhance pink and white esthetics.

Treatment Results

Facial esthetics, dental alignment, and intermaxillary occlusion were remarkably improved (Figs. 4-6). No periodontal problems were noted. The post-treatment panoramic radiograph documented acceptable root parallelism, except for the UR6, UL7, and LL2 (Fig. 8), which are reflected in the CRE score. Superimposed cephalometric tracings documented that the mandibular arch was retracted about 7mm with Class III elastics and buccal shelf bone screw anchorage (Fig. 9). The axial inclination of the upper incisor (*U1-SN*) was decreased 10° during treatment (121.5° to 111.5°), and the axial inclination of the lower incisors (*L1-MP*) was relatively well-maintained despite considerable retraction (71.5° to 68°). Correction of the posterior crossbite and extrusion of the mandibular arch increased the mandibular plane angle (*SN-MP*) by 3.5° (Table 1). The tongue anterior postural problem resolved spontaneously as the dental alignment was corrected (Figs. 4-6), so no

Archwire Sequence Chart

Clinician : Dr. Chris Chang
 Patient : A4252 Miss Peng

Maxillary archwire Elastic
 Mandibular archwire Miniscrew

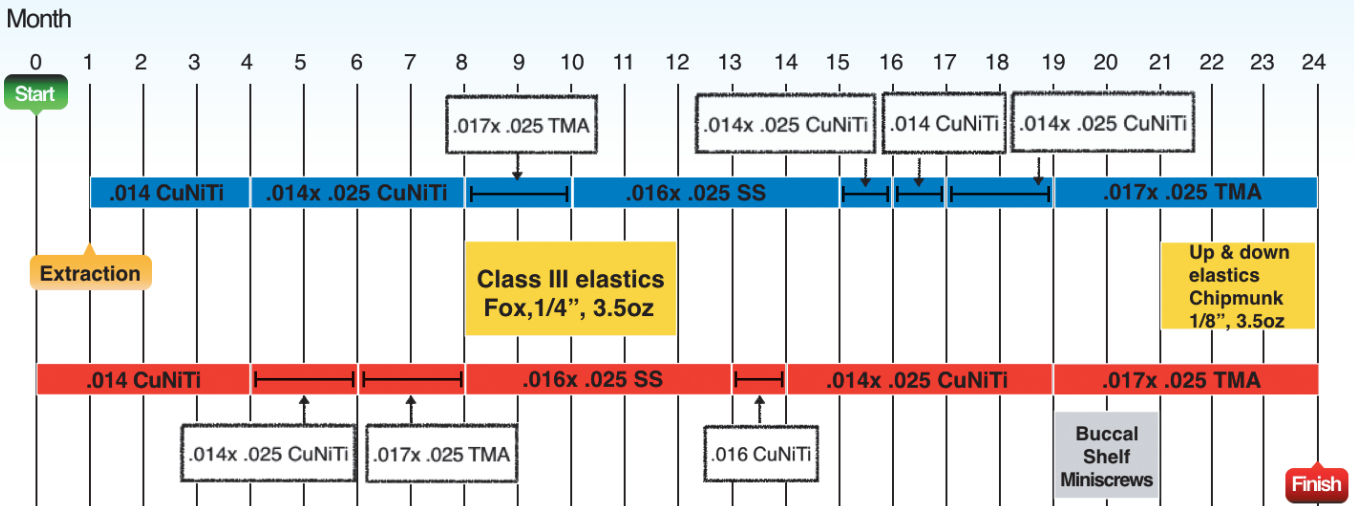


Fig. 14:

The Archwire Sequence Chart shows all the mechanics of treatment. Principal archwires are shown for the maxillary and mandibular arches in blue and red respectively. Additional archwires (black boxes) were used for special purposes as indicated.

myofunctional therapy was needed. The ABO CRE score was 30 points, as shown in the supplementary CRE chart (Worksheet 2).³ The principal deficits in the final alignment were marginal ridge discrepancies and buccal lingual inclination of posterior teeth. The Pink and White dental esthetic score was 2 points (Worksheet 3).⁴ The patient was well satisfied with the result.

Retention

Fixed lingual retainers were placed on all maxillary incisors, and from canine to canine in the mandibular arch. Clear overlays were delivered for each arch. The patient was instructed to wear them full time for the first month and nights only thereafter. Instructions were provided for home hygiene, as well as for maintenance of the retainers.

Discussion

Prevalence of Class III malocclusion ranges from 0.8% to 4.0% in Caucasians, but it is much more prevalent among the Chinese and Japanese (12-13%).⁵ The etiology of Class III malocclusion may be genetic and/or environmental.⁶⁻⁹ Incisal interference may be compensated by protruding the mandible to achieve a more functional occlusion, which results in anterior crossbite.⁶ Compensations for breathing problems (*sleep apnea*) are well documented.⁷⁻¹⁵ Airway compromise may be compensated by anteriorly posturing the mandible to achieve a more patent airway.^{6,9,10} A low tongue posture with the distal segment positioned between the teeth is the etiology of anterior openbite.^{8,9}

The appropriate diagnosis and treatment plan focused on the etiology of a skeletal Class III

openbite malocclusion (Figs. 1-3, and 7), which was treated to a pleasing result (Figs. 4-6, and 8) in only 24 months without orthognathic surgery. The major problems were (1) severe openbite (6mm), (2) full-cusp Class III malocclusion, (3) dental midline deviation (5mm), and (4) unfavorable anterior root torque.

1. Openbite

The proximal cause (*etiology*) of anterior openbite is interincisal resting tongue position (Fig. 15). To swallow, patients with an anterior openbite must protrude the tongue between the incisors to achieve an anterior seal. However, transient loads associated with that occasional reflex do not move teeth. The constant position of the tongue between the incisors at rest dictates tooth position, and is the etiology of openbite.⁸ Upper arch expansion provided space for an appropriate tongue rest position, and lingual spurs helped guide the tongue to its correct postural position. The combination of this form of treatment and the spontaneous correction of tongue posture by the patient resulted in resolution of the anterior openbite in 9 months (Figs. 15 and 16).

2. Full-Cusp Class III Malocclusion

Asymmetric molar extraction in all four quadrants provides the space needed to correct the negative overjet and to improve the posterior intercuspation. Extraction of 4 premolars (*mandibular first and maxillary second*) failed to provide appropriate space to correct the molar relationship. A full-cusp Class III molar relationship can be corrected by retracting and posteriorly rotating the lower arch.^{1,2} For this patient, the first and second molar extractions provided excellent lower anchorage to correct the anterior crossbite with space closure and retraction



■ Fig. 15:

Low tongue position with an interincisal posture of the tip (distal segment) resulted in anterior openbite.



■ Fig. 16:

Tongue spurs for tongue position correction remind the patient to elevate and retract the tongue.

of 12 teeth. However, the lower molars were not intruded, so the bite was opened as evidenced by the 3.5° increase in the MPA (Fig. 9, Table 1). The bite opening did improve the facial convexity by 6.5°.

3. Midline Deviation

A conventional solution of midline deviation is using unilateral elastics, but that approach tips teeth and rarely achieves a skeletal effect. Buccal shelf miniscrews are osseous anchorage to achieve a skeletal effect. However, both elastics and buccal

shelf bone screws require a long time to correct large midline deviation (5mm), and would produce compromises in intercuspation. On the other hand, asymmetric molar extraction is a simple approach for correcting the deviation with differential space closure (Figs. 5 and 6).

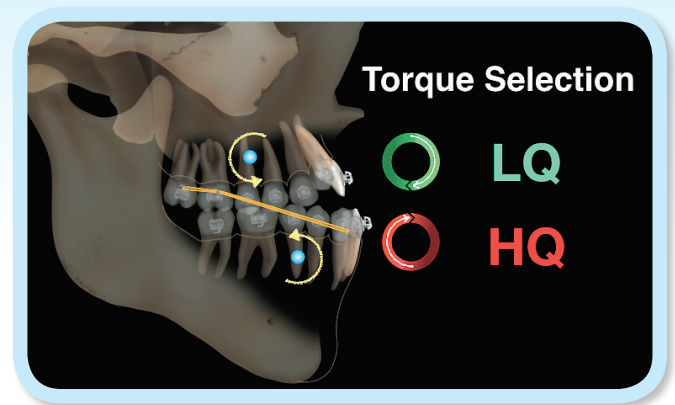
4. Unfavorable Anterior Root Torque

The maxillary ($U1-SN 121.5^\circ$) and mandibular ($L1-MP 71.5^\circ$) incisors were compensated prior to treatment (Table 1). Class III elastics exacerbate the problem, so low torque brackets were indicted for the upper incisors, and high torque brackets were preferred for the lower incisors. There are no high torque brackets designed for lower incisors, so low torque brackets were bonded inversely (*upside down*) to achieve the desired torque (Fig. 17).

Conclusions

Careful assessment of the etiology is essential for efficient management of severe skeletal Class III malocclusion with anterior open bite. The patient must understand the etiology of the malocclusion to appreciate his/her responsibility for correcting the problem, and particularly for maintaining the correction. Most Class III malocclusions are a developmental anomaly that can be corrected by reversing the etiology of the problem(s). Adequate patient cooperation based on knowledge of the etiology of the malocclusion is essential for correction and maintenance of the outcome.

Fig. 18 documents the current condition of the patient 2 years post-treatment.



■ Fig. 17:

Low torque brackets for upper and high torque brackets for lower anterior segments compensate the side effects of Class III elastics.

References

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■ Fig. 18: Facial and intraoral photographs at 2-year follow-up

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 70

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 = **16**

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 = 26

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 _____ pts.
- Full Class II or III = 4 pts. per side _____ pts.
- Beyond Class II or III = 1 pt. per mm. _____ pts.
additional

Total = 11

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 4

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

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 = 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 (≥ 3 mm) @ 2 pts. = 2
- 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 ≥ 2 mm) @ 2 pts. = _____
- Tooth transposition _____ x 2 pts. = _____
- Skeletal asymmetry (nonsurgical tx) @ 3 pts. = 3
- Addl. treatment complexities _____ x 2 pts. = _____

Identify:

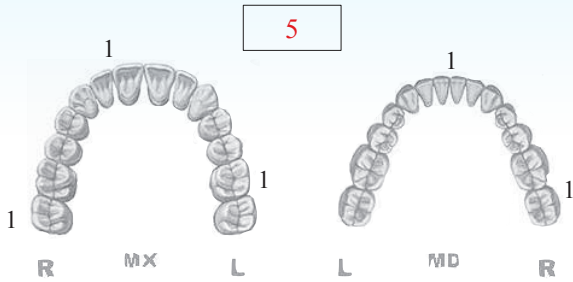
Total = 5

Cast-Radiograph Evaluation

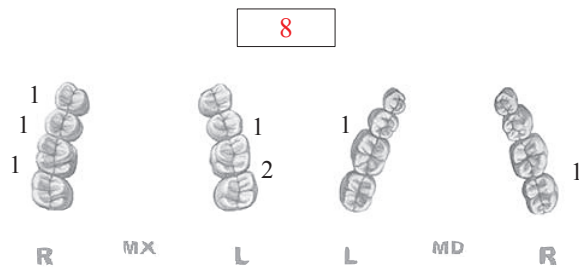
Case # Patient

Total Score: **30**

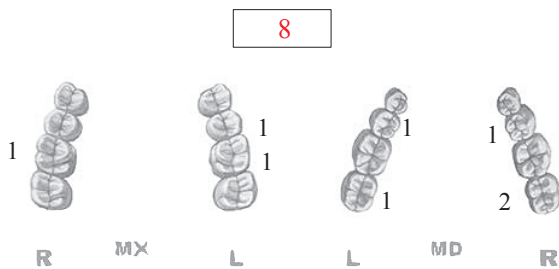
Alignment/Rotations



Marginal Ridges



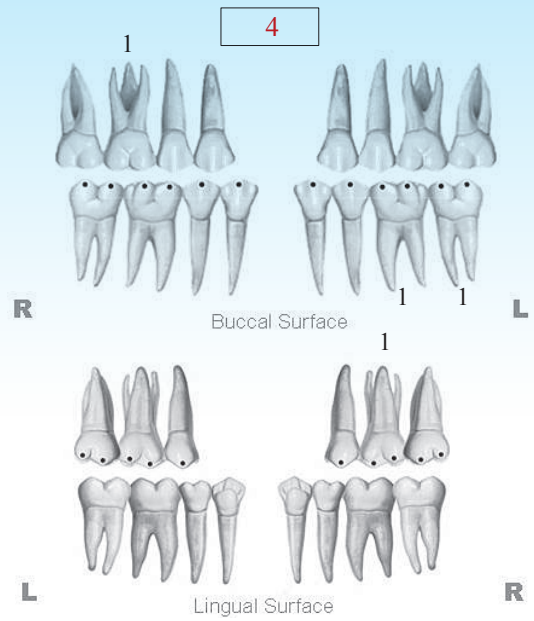
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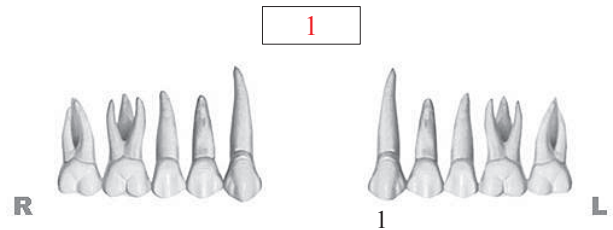
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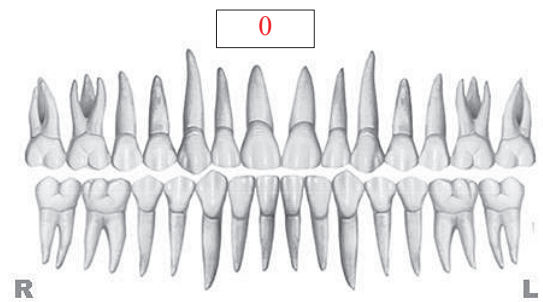
Occlusal Contacts



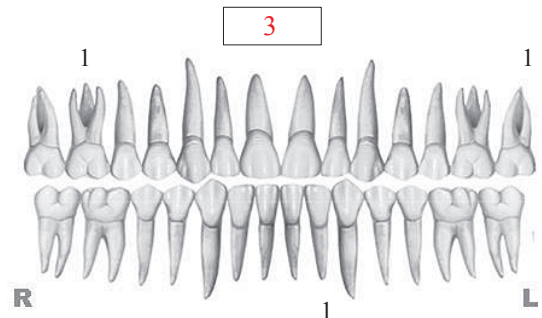
Occlusal Relationships



Interproximal Contacts



Root Angulation

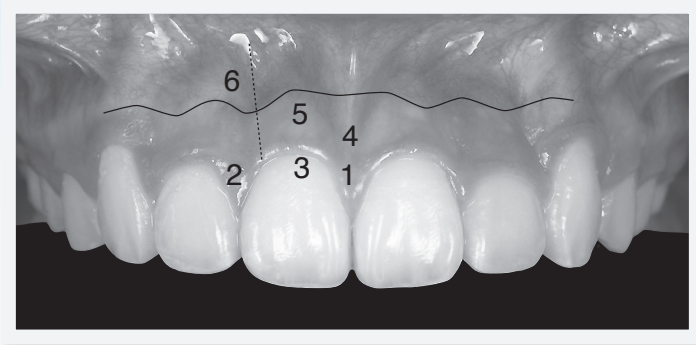


INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score (Before Surgical Crown Lengthening)

Total Score: = 2

1. Pink Esthetic Score

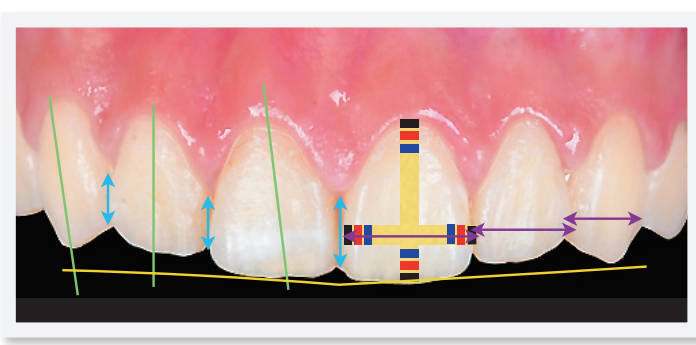
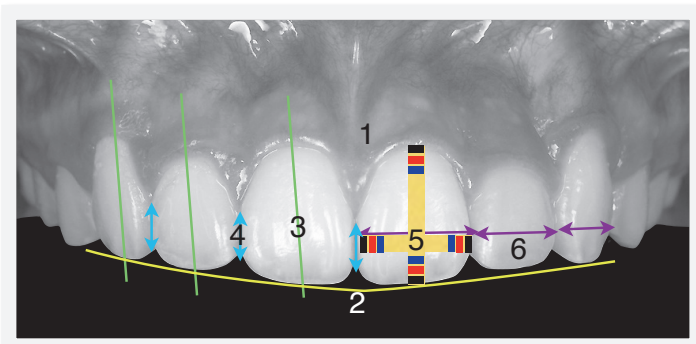


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

Total = 1

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

2. White Esthetic Score (for Micro-esthetics)



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

Total = 1

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