Management of Anterior Cross Bite, Severe Crowding and Loss of a Lower First Molar by Utilizing a Horizontally Impacted Third Molar

History and Etiology

A 23 year old female presented for a consultation about crowding and crossbite of her anterior teeth, as well the impending loss of the lower right first molar (*Figs. 1-3*). She had obtained previous orthodontic consultations but was dissatisfied because none of the treatment plans focused on recovering her lower right impacted third molar (#32) and aligning it in the quadrant to replace the hopeless first molar. There was no other contributing dental or medical history.

The patient had a prominent lower lip, but an otherwise acceptable profile, and the buccal segments were Class I (*or close to it*) bilaterally with anterior crowding and a crossbite. Collectively, these findings are consistent with Lin's[1] pseudo Class III malocclusion which is effectively managed with conservative orthodontics therapy. In addition, Chang[2] has proposed a method for recovering horizontally impacted lower third molars. Utilizing these concepts the patient was treated for 26 months with fixed appliances. The facial profile was improved, the second molar (#31) was moved mesially to replace the missing #30, and #32 was uprighted and moved into the #31 position (*Figs. 4-6*). Radiographic documentation of the pre-treatment condition and post-treatment results are provided in Figs. 7-8, respectively. The cephalometric

Fig. 1: Pretreatment facial photographs

Fig. 2: Pretreatment intraoral photographs

Fig. 3: Pretreatment study models (casts)

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International Journal of Orthodontics & Implantology (right)

Fig. 4: Posttreatment facial photographs

Fig. 5: Posttreatment intraoral photographs

Fig. 6: Posttreatment study models (casts)

values are summarized in Table 1. Figs. 9-10 show cephalometric tracings that superimposed on the anterior cranial base, maxilla, and mandible. The diagnosis, treatment plan and therapeutic approach will be discussed.

Diagnosis

Skeletal:

- Class III tending toward bimaxillary protrusion (*SNA 85°, SNB 85°, ANB 0°*)
- Mandibular plane angle: SN-MP 37°, FMA 30°

Dental:

- Right side: Class I molar and canine in centric occlusion (*Co*)
- Left side: Class III molar (*1-2 mm*) and Class I Canine in Co
- Upper midline shifted 2 mm to the left of the mandibular midline
- Upper incisor to SN plane angle was 120°
- Severe maxillary anterior crowding (*space deficiency of more than 7 mm*).
- Anterior crossbite at #7, 8, 10 with negative overjet of 1-2 mm.
- Lower right first molar (#30) was hopeless and required extraction
- The adjacent second molar (#31) had been

Fig. 7:

Pre-treatment panoramic and cephalometric radiographs show protruded lower lip, severe decay #30, and horizontally impacted #32.

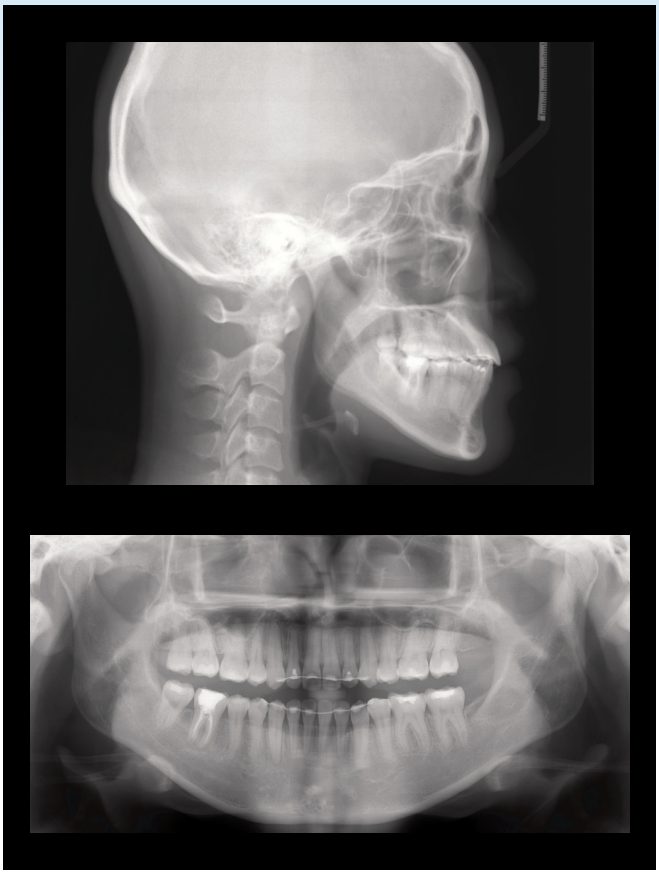
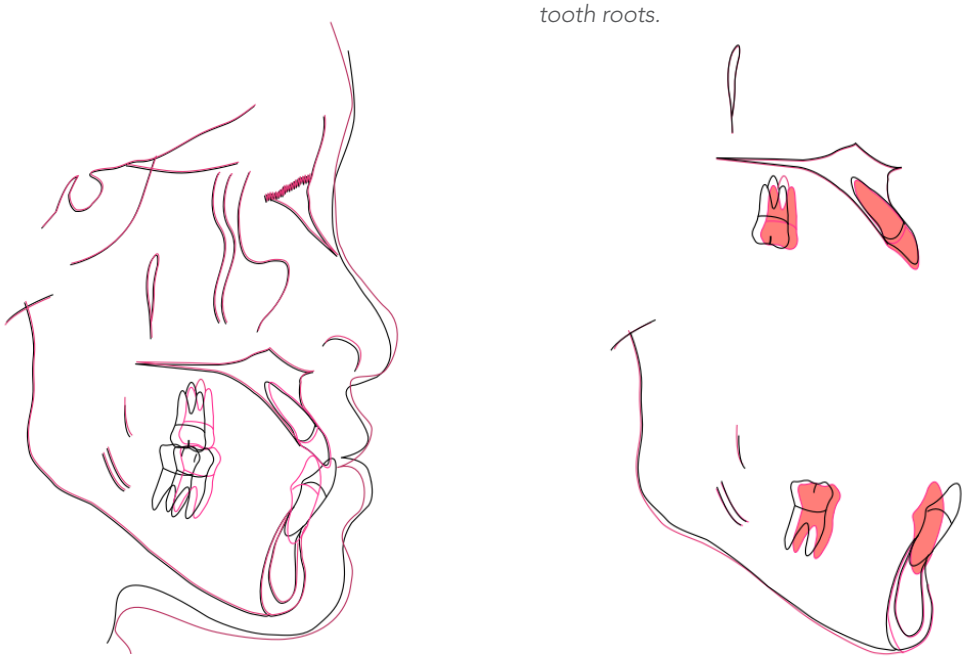


Fig. 8:

Post treatment panoramic and cephalometric radiographs show balanced lip profile and the parallel alignment of all tooth roots.



Figs. 9 &10:

Superimposed cephalometric tracings document lingual tipping of the mandibular incisors and protraction of upper and lower molars.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	85°	84°	1°
SNB°	85°	82°	3°
ANB°	0°	2°	2°
SN-MP°	37°	38°	1°
FMA°	30°	31°	1°
DENTAL ANALYSIS			
U1 TO NA mm	9 mm	7 mm	2 mm
U1 TO SN°	120°	115°	5°
L1 TO NB mm	9 mm	4mm	5 mm
L1 TO MP°	90°	87°	3°
FACIAL ANALYSIS			
E-LINE UL	0mm	-1mm	1 mm
E-LINE LL	2mm	0mm	2 mm

Table. 1: Cephalometric summary

treated endodontically, but the periapical radiolucencies on both roots had not yet resolved

- #17 and 32 were horizontally impacted

Facial:

- Straight (*orthognathic*) profile
- Protrusive lower lip

The ABO Discrepancy Index (*DI*) was 24, as shown in the subsequent worksheet.

Specific Objectives of Treatment

The principal treatment goals were to align the anterior segments, correct the crossbite, and retract the lower incisors. In this regard, the specific treatment objectives are as follows:

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

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

Maxillary Dentition

- A - P: Maintain incisor position, move molars anteriorly
- Vertical: Maintain.
- Inter-molar Width: Maintain

Mandibular Dentition

- A - P: Retract the lower incisors, anterior movement of the molars
- Vertical: Maintain
- Inter-molar / Inter-canine Width: Maintain.
- Molar substitution for the extracted #30 by moving #31 and 32 mesially

Facial Esthetics

- Retract lower lip

Treatment Plan

The main concerns in developing the appropriate treatment plan were to correct the crowding, crossbite and edentulous space after the extraction of #30. After considering multiple options, the most ideal treatment plan from the patient's perspective was to extract #5, 12, 21 and #30. This asymmetric approach presented some significant challenges: 1. large unilateral molar space to close, 2. uprighting and aligning the horizontally impacted

#32, 3. asymmetric space closure required careful management of anchorage to achieve midline correction.

The treatment plan was: 1. extraction in all four quadrants as previously specified, 2. posterior bite turbos with Class III elastics to correct the anterior crossbite and intermaxillary relationship, 3. protract #31 to close the #30 space, 4. uncover, upright and protract #32 to occlude in the lower right second molar postion.[2]

Appliances And Treatment Progress

Operative dentistry needs, as well as extraction of teeth #5, 14, 21, and 30, were accomplished before starting the orthodontic treatment. At the first treatment appointment, Damon D3MX .022" Brackets (*Ormco*) were bonded on the upper arch and posterior bite turbos were constructed with Fuji II glass ionomer cement on the occlusal surfaces of teeth #18 and 31. The patient was instructed to use a tongue depressor to help correct the anterior cross bite (*Fig. 11*). After three months of treatment, the crowding was almost resolved, and the anterior cross bite was corrected. The posterior bite turbos were removed and the lower arch was bonded with Damon D3MX .022" brackets. High torque brackets were needed for the lower incisors, to compensate for Class III elastics wear, but the special brackets required were not on the market at that time. So standard lower incisor brackets were banded upside down to achieve +6° of torque (*Fig. 12*). The wire sequence in both arches was .014 CuNiTi, .014x.025

Fig. 11:
Tongue depressor and posterior bite turbos were used to correct the anterior cross-bite.

Fig. 12:
Three months into treatment, the posterior bite turbos were removed. The crossbite was resolved but the patient only had contact on #8 and 9, which required a slow adaptation from a soft to a normal diet. Note the orientation of the bracket (circled).

CuNiTi, .017x.025 TMA, .019x.025 SS and then back to .017x.025 TMA for detailing. The extraction space closure with chains of elastics began after the .019x.025 SS arch wires were placed.

After sixteen months of treatment, #31 was protracted to close the space of #30 (*Fig. 13-14*). The third molar (#32) erupted and its axial inclination

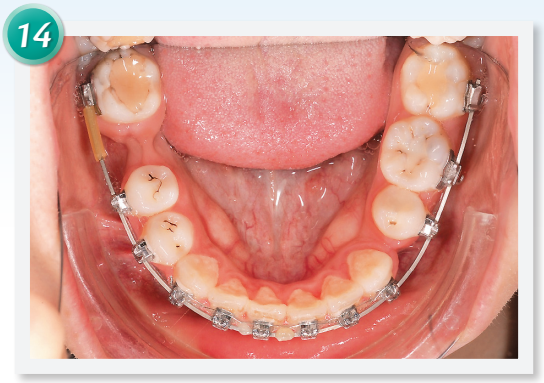


Fig. 13:

In the 14th month of treatment, note the severe ridge atrophy in the extraction site of the lower right first molar (#30). The space is being closed by protracting #31.

Fig. 15:

In the 19th month, the first molar space was closed; #32 has erupted further and is starting to upright spontaneously.

Fig. 14:

In the 18th month, the #30 space was almost closed and #32 is erupting into the oral cavity.

Fig. 16:

In the 22nd month, an open coil spring was placed between #31 and 32 to complete space closure with the second premolar, and to further upright #32.

improved (*Fig. 15*) sufficiently to be bonded. An open coil spring was used to complete the uprighting of the third molar so it could be aligned in the second molar position (*Fig. 16*).[2] Fig. 17 is a sequence of radiographs documenting the alignment of #32.

At twenty-four months, the maxillary left central incisor (#9) had decreased axial inclination and the root of #10 was tipped lingually. To correct these reciprocal problems, a torquing spring was used for tooth #9, and the bracket on #10 was turned upside down to change the torque from +8° to -8° (*Figs. 18-20*). In the 25th month, a lingual button and cross elastic were used to correct lingual tilting of #32; this is a common problem when uprighting mandibular 3rd molars.[2] After twenty-nine months of active treatment, the appliances were removed and a diode laser was used to increase the crown exposure of all maxillary incisors except #9 (*Fig. 21*).

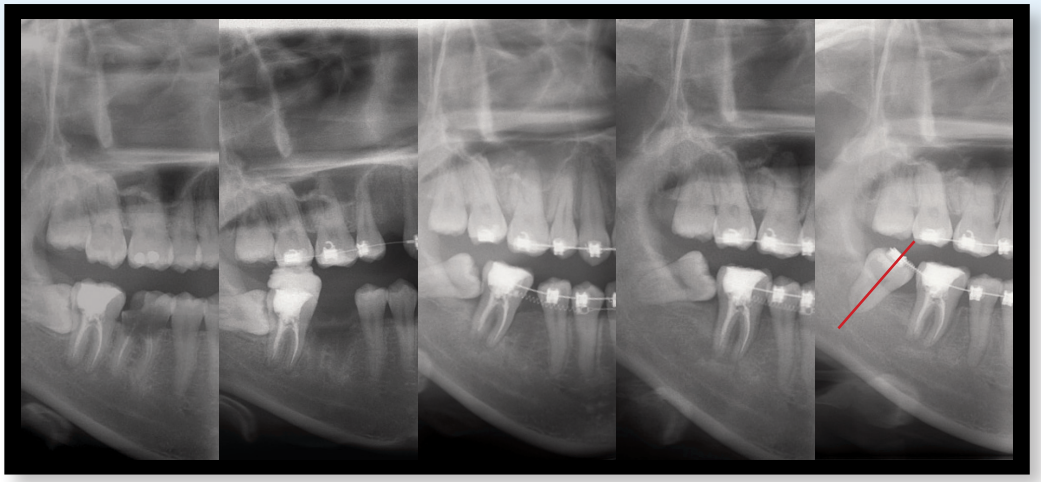


Fig. 17:

Progressive panoramic x-rays show the mesial movement of #32; after 22 months the bracket was bonded on #32 with the slot perpendicular to the long axis of the tooth.

Fig. 18:

The left maxillary central incisor (#9) received a torque spring to increase its axial inclination. Note that the bracket on the adjacent lateral incisor (#10) is bonded upside down.

Fig. 20:

Note the more symmetrical palatal crown exposure as the axial inclinations of teeth #9 and 10 are corrected.

Fig. 19 :

Note the difference in clinical crown exposure between #8 and 9 due to excess buccal root torque of #9. Tooth #10 has excessive lingual root torque.

Fig. 21:

A selective gingivectomy was performed to improve the symmetry of clinical crown lengths for the maxillary incisors.

Results Achieved

Maxilla:

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

Mandible :

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

Maxillary Dentition:

- A - P: Incisors maintained, molars protracted ~2mm
- Vertical: Incisors extruded slightly, molars maintained
- Inter-molar Width: Maintained

Mandibular Dentition:

- A - P: Mandibular incisor tipped lingually
- Vertical: Incisors intruded, molars maintained
- Inter-molar/Inter-canine Width: Maintained.

Facial Esthetics:

- Lower lip has been retracted ~ 2-3 mm, chin is more prominent

Retention

Immediately following removal of the fixed appliances, fixed 3-3 retainers were bonded on all anterior teeth in both arches. In addition, a clear overlay retainer was used for the upper arch. The patient was instructed to wear the overlay retainer full time for the first 6 months and nights only thereafter. Home care and retainer maintenance instructions were provided.

Final Evaluation of Treatment

A well conceived treatment plan is essential for achieving a favorable outcome. The extraction space for a hopeless lower first molar was utilized to resolve crowding. The protraction of the second molar into the first molar space provided the necessary space to upright and align the horizontally impacted third molar. Although the occlusal relationships on the right side were not ideal, the compromised interdigitation was superior to the prosthetic option (*fig. 5*). The patient is very pleased with the treatment results.

The anterior crowding and reverse overjet were treated to an ideal outcome. The patient's facial appearance was improved. Post-treatment photographs (*Fig. 5*) and study casts (*Fig. 6*) reveal a Class I molar and canine relationship on the left side. There was a Class II molar with Class I canine relationship on the right side, due to the asymmetric extraction pattern. The facial and dental midlines were coincident. Tooth #9 still shows excessive clinical crown height, but a minor gingivectomy on other maxillary incisors provided more symmetrical gingival esthetics (*Fig. 19*).

Discussion

According to Lin's study[1] Class III malocclusion is more prevalent among Asians, and a pseudo-Class III relationship is found in about 2.31% of Taiwan's population. Pseudo Class III has a better prognosis than true skeletal Class III malocclusion. Lin[1] classified the pseudo Class III malocclusion according to its etiology. The principal factor for the present patient was decreased perimeter in the anterior region

that resulted in severe crowding (*Figs. 2-3*). Lin's[3] three-rings, diagnostic protocol for Class III patients predicts the potential for conservative treatment to manage an anterior cross-bite. Some pseudo Class III patients may habitually occlude in a cross-bite or end-to-end incisal relationship.[1,3]

This is compatible with Lin's[1,3] diagnostic method, but is not consistent with the traditional concept of Graber[4] and Moyers,[5] both of whom assumed that all pseudo Class III patients had a functional shift.

The most common treatment option for anterior cross-bite with severe crowding is extraction of upper 2nd and lower 1st premolars.[6] Although it complicated the mechanics, the best option for the present patient was extraction of the hopeless #30 instead of #28. Thus, the Class I molar relationship was sacrificed on the right side, but protracting the second and third molars eliminated the need for prosthetics. According to Cristina[7] 66.2% of the mandibular third molars erupt in good positions after 2nd molar extraction, but some horizontally impacted third molars cannot be salvaged. Most unsuccessful eruptions of mandibular third molars are due to excessive mesial tipping or lack of achieving proximal contact.[8] Acceptable third-molar eruption is most difficult to achieve in older patients.[7] Additionally, the size and morphology of 3rd molars is another consideration for 2nd molar substitution, because 3rd molar morphology is highly irregular.[8] For the present patient, the morphology of #32 was adequate when viewed in the panoramic radiograph.

After 19 months of active treatment, the 2nd molar was protracted to provide the necessary space for the 3rd molar to erupt and upright; this scenario is similar to a second molar extraction.[7,8] Chang[2] summarizes some important points to consider when uncovering an impacted 3rd molar:

1. age of the patient,
2. degree of impaction,
3. root form of the tooth, single root and conical root shapes are easier to move;
4. periodontal status of the 3rd molar and adjacent teeth;
5. access for mechanics to upright the 3rd molar.

Chang[9] demonstrates two options for uprighting an impacted 3rd molar: 1. occlusal approach anchored with a TAD, and 2. buccal approach with a bonded bracket and open coil spring.[2] Use of a self-ligation bracket is recommended because it is easier to insert the archwire with an activated open coil spring. The buccal approach was used for the present patient (*Fig. 16*). Following the uprighting of a 3rd molar, a fixed retainer on the buccal side of 2nd and 3rd molars is strongly recommended because space is likely to reopen between the molars. Although a fixed retainer was not used for the right second and third molars in the present case, the correction was well maintained 3 years later (*Fig. 22*). A persistent gingival cleft may occur mesial to a protracted molar (*Fig. 23*). If the periodontium of adjacent teeth is healthy, the cleft is not a problem in posterior areas. However, if the cleft occurs in an esthetic zone, periodontal correction may be indicated.

The IBOI Cast-Radiograph score was 17 points, which is well within the acceptable range for the board style case reports in this series. The major discrepancies were occlusal relationships and contact points. For the present patient, the principal finishing problems were in the interdigitation in the right segment due to asymmetrical extraction

Fig. 23:

Three years after the mandibular first molar space was closed, a gingival cleft (arrow) has persisted where the #30 space was closed. The cleft has not affected the periodontal health of the adjacent teeth.

Fig. 22:

Post treatment photographs taken 3 years after treatment show that the orthodontics result has been stable.

pattern: upper first premolar (#5) and lower first molar (#30).

Conclusion

Lower third molars have the highest incidence of impaction and are a problem for many patients. Although lower third molars are usually extracted, they may be salvaged to replace a missing first or second molar in the same quadrant. Even horizontally impacted third molars can may be recovered and aligned to provide longterm function.[2] Patients are pleased with replacing a non-restorable tooth with one of their own teeth, that would otherwise be extracted.

References

1. Lin JJ. Creative orthodontics blending the Damon system & TADs to manage difficult malocclusions: Differential diagnosis and management of anterior crossbite. Taipei: Yong Chieh; 2007.
2. Chang CH. Damon Course No. 14-6: Class III high angle patient with a horizontally impacted 3rd molar. Beethoven Podcast Encyclopedia in Orthodontics [podcast] Hsinchu: Newton's A Ltd; 2011.
3. Lin JJ, Roberts WE. Differential diagnosis and management of anterior crossbite. In: Orthodontics Vol. III, Class III correction. Lin JJ, Liaw J, CH Chang, Roberts WE, editors. Taipei: Young Chieh; 2013, p. 12-29.
4. Graber TM. Orthodontics: principles and practice, 3rd ed. Philadelphia: W.B. Saunders; 1972.
5. Moyers RE. Handbook Of Orthodontics for the Student and General Practitioner, 4th ed. Chicago: Yearbook Medical Publishers Inc; 1988.
6. Campbell MA, Jacobson A. Class III crowding: the extraction dilemma. Am J Orthod Dentofacial Orthop 1987;92(5):365-74.
7. De-la-Rosa-Gayla C, Valmaseda-Castellón E, Gay-Escoda C. Spontaneous third-molar eruption after second-molar extraction in orthodontic patients. Am J Orthod Dentifacial Orthop 2006;129:337-344.
8. Orton-Gibbs S, Crow V, Orton HS. Eruption of third permanent molars after the extraction of second permanent molars. Part 1: assessment of third molar position and size. Am J Orthod Dentofacial Orthop 2001;119:226-238.
9. Chang CH, Roberts WE. Twelve applications of TADs for impacted teeth. Orthodontics Vol. II. Taipei: Yong Chieh; 2012.

Discrepancy Index Worksheet

Total DI Score 24

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 = 7

OVERBITE

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

Total = 2

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

Total = 2

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

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° 1 x 2 pts. = 2

≤ 26° = 1 pt.

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

1 to MP ≥ 99° = 1 pt.

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

Total = 2

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. =	
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	1 x 2 pts. =	2

Identify: Trans-alveolar impaction

Total = 4

IMPLANT SITE

Lip line : Low (0 pt), Medium (1 pt), High (2 pts) = _____

Gingival biotype : Low-scalloped, thick (0 pt), Medium-scalloped, medium-thick (1 pt), High-scalloped, thin (2 pts) = _____

Shape of tooth crowns : Rectangular (0 pt), Triangular (2 pts) = _____

Bone level at adjacent teeth : ≤ 5 mm to contact point (0 pt), 5.5 to 6.5 mm to contact point (1 pt), ≥ 7mm to contact point (2 pts) = _____

Bone anatomy of alveolar crest : H&V sufficient (0 pt), Deficient H, allow simultaneous augment (1 pt), Deficient H, require prior grafting (2 pts), Deficient V or Both H&V (3 pts) = _____

Soft tissue anatomy : Intact (0 pt), Defective (2 pts) = _____

Infection at implant site : None (0 pt), Chronic (1 pt), Acute(2 pts) = _____

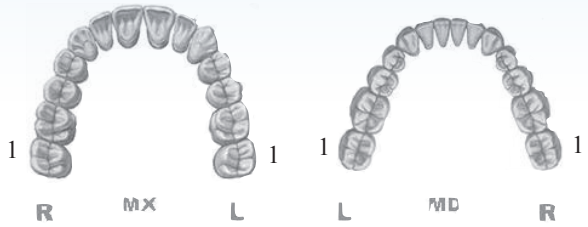
Total = 0

Cast-Radiograph Evaluation

Total CRE Score 17

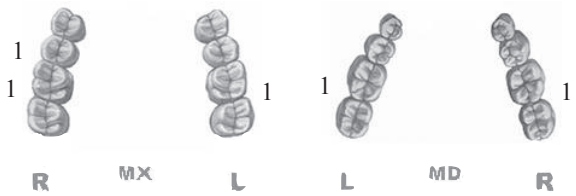
Alignment/Rotations

3



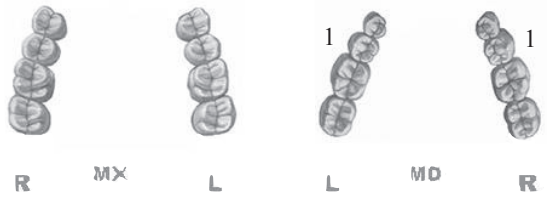
Marginal Ridges

2



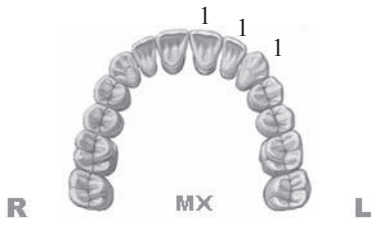
Buccolingual Inclination

1



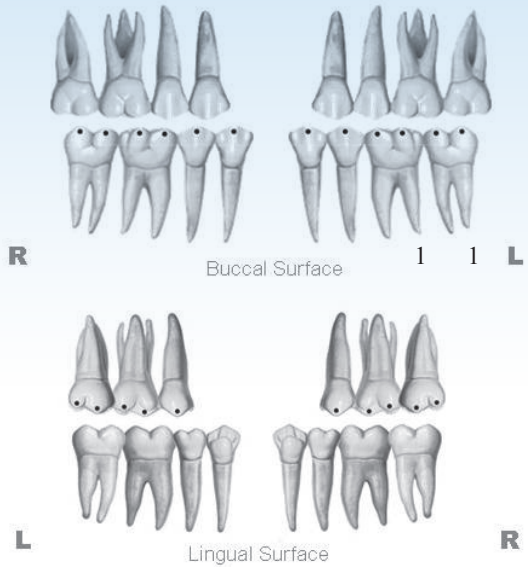
Overjet

2



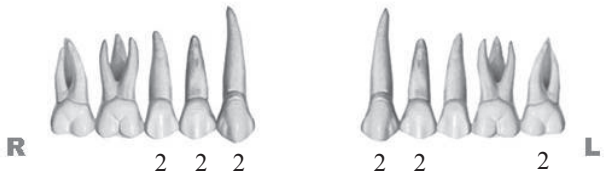
Occlusal Contacts

3



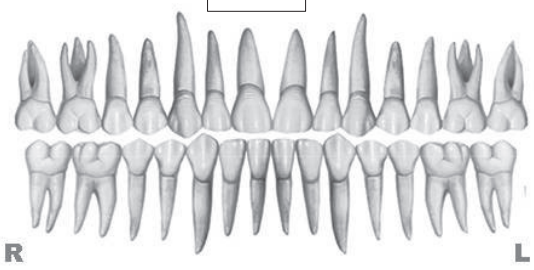
Occlusal Relationships

4



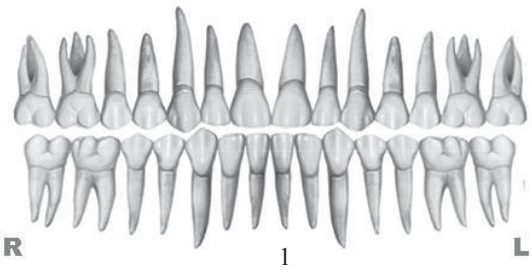
Interproximal Contacts

0



Root Angulation

2



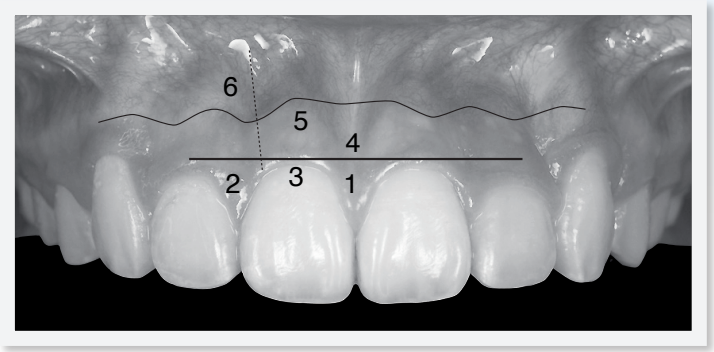
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 3

1. Pink Esthetic Score

Total = 1

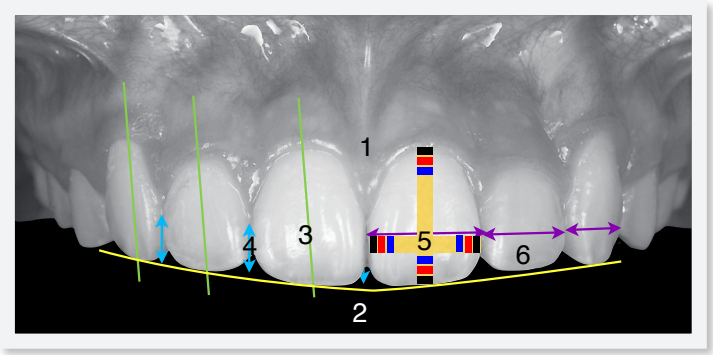


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0		2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

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

2. White Esthetic Score (for Micro-esthetics)

Total = 2



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

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