

Treatment of a Class III Malocclusion with Anterior Crossbite and Deepbite, Utilizing Infrazygomatic Crest (IZC) Bone Screws as Anchorage

Abstract

Malocclusions with anterior crossbite are a major esthetic and functional concern for patients and their parents. A 14-year-old boy was diagnosed as a Class III malocclusion, combined with anterior crossbite, deepbite, concave profile, and inadequate maxillary incisor exposure. There was functional shift on closure, and the mandible could be manipulated to an edge-to-edge incisal occlusion, when the condyles were positioned in centric relation. The Discrepancy Index (DI) was 24. A passive self-ligation appliance, with infrazygomatic crest (IZC) bone screw anchorage, and Class III intermaxillary elastics were used to correct this severe malocclusion in only 10 months to a Cast-Radiograph Evaluation (CRE) score of 18. The IZC bone screws were installed buccal to the alveolar process between the upper 1st and 2nd molars. They provided reliable anchorage for intermaxillary elastics to retract the lower incisors and increase the vertical dimension of occlusion. The malocclusion was corrected with a relatively short treatment time, but the maxillary incisors were excessively flared. Long term follow up is required to monitor the potential for late mandibular growth to produce a skeletal Class III relationship. (*Int J Orthod Implantol*;40:2-14)

Key words:

Class III deep bite malocclusion, functional shift, passive self-ligation appliance, IZC bone screws, extra-alveolar bone screw anchorage

History and Etiology

A 14 year-old male presented for orthodontics consultation with Class III malocclusion, anterior crossbite and deep overbite. He had a decreased vertical dimension of occlusion (VDO), lip redundancy, mildly concave profile, and a slightly protrusive lower lip (Figs. 1, 2 and 3). The chief complaint was poor dental esthetics and function due to the anterior crossbite. Medical and dental histories were non-contributory. A functional examination revealed that the mandible could be manipulated from centric occlusion (CO) to a centric relation (CR) position with an edge-to-edge occlusion of incisors, but there was a large posterior open bite, due to the deep curve of Spee in the lower arch. The patient was treated to a

pleasing result in 10 months with a passive self-ligation appliance, combined with infrazygomatic (IZC) bone screws and Class III elastics (Figs. 4, 5 and 6). Cephalometric and panoramic radiographs document the dentofacial patterns before (Fig. 7) and after (Fig. 8) treatment. Superimposed cephalometric tracings show dentofacial changes associated with treatment (Fig. 9).

Diagnosis

Skeletal:

- Class III malocclusion (SNA 83.8°, SNB 89.6°, ANB -5.8° in CO)
- Low mandibular plane angle (SN-MP 25.8°, FMA 19.5 °)

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Fig. 1:
Pre-treatment facial photographs show a mild concave profile with acute nasolabial angle and lower lip protrusion.



Fig. 4: Post-treatment facial photographs:
The upper incisal exposure has increased although the nasolabial angle appears more acute due to proclination of the upper incisors.



Fig. 2:
Pre-treatment intraoral photographs show mild Class III canine and molar relationships on the left, and Class I canine and molar relationships on the right. Anterior crossbite with a deep overbite and deep Curve of Spee resulted from a lack of vertical stops for the lower anteriors.



Fig. 5
Post-treatment intraoral photographs show that the upper and lower midlines are coincident. Positive overjet as well as bilateral canine and molar Class I relationships have been achieved.

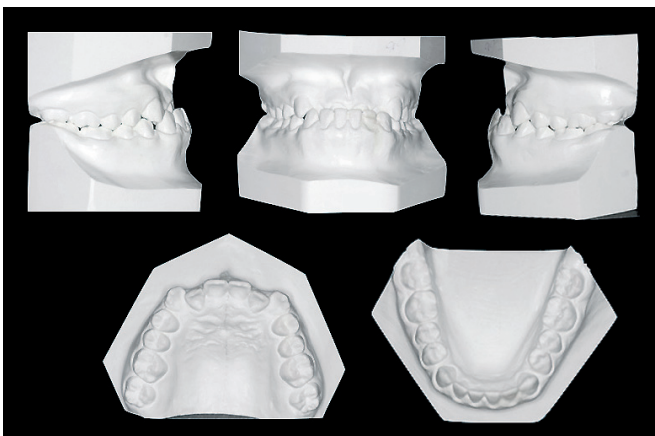
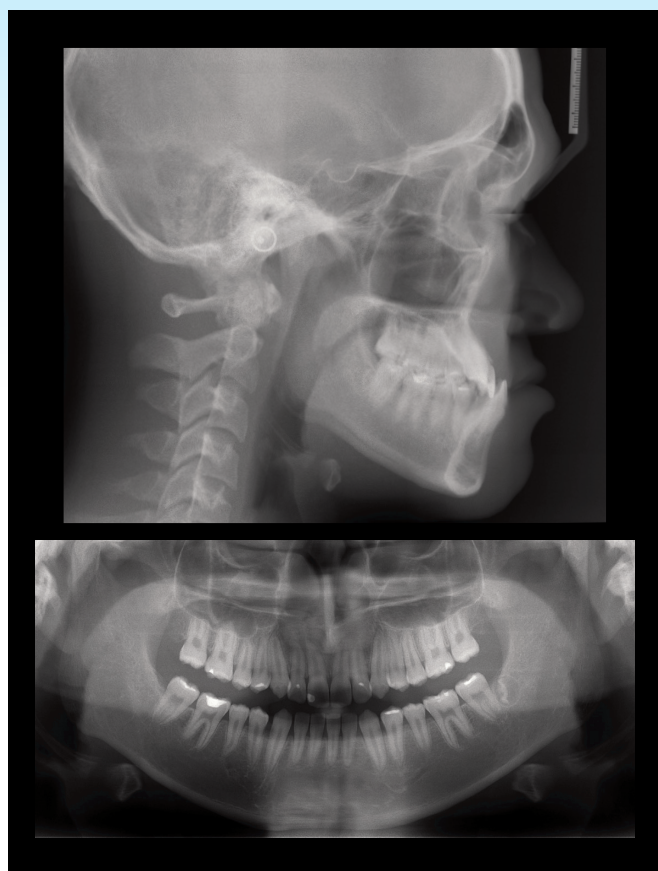


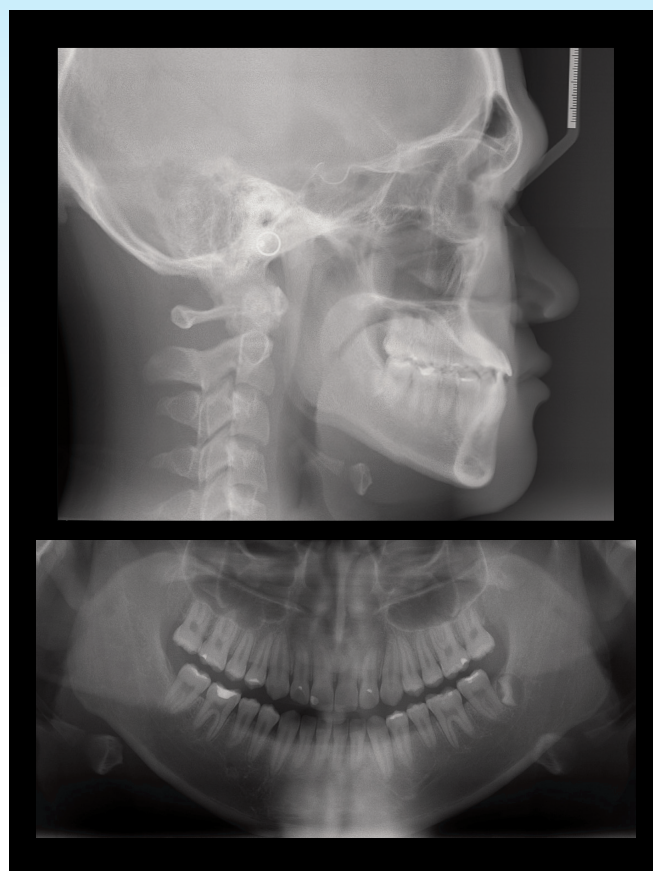
Fig. 3: Pre-treatment study models (casts)



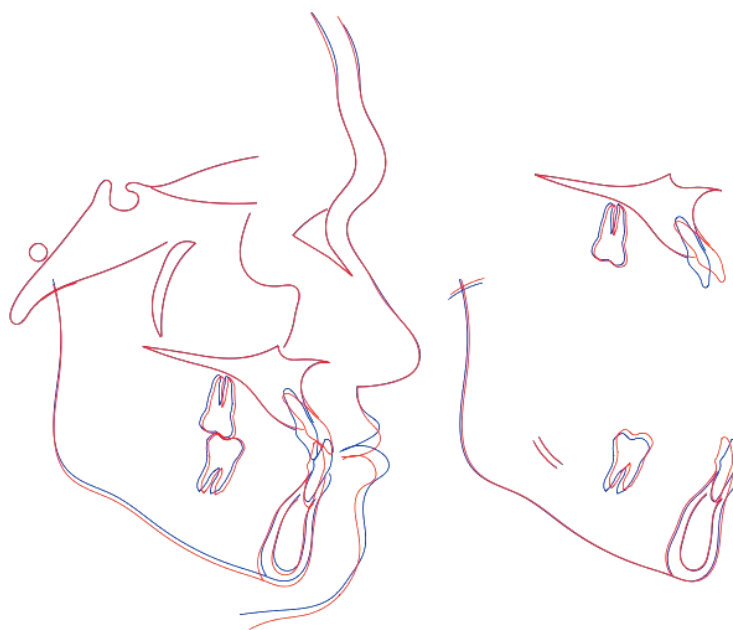
Fig. 6: Post-treatment study models (casts)



■ **Fig. 7:**
Pre-treatment panoramic and cephalometric radiographs



■ **Fig. 8:**
Post-treatment cephalometric and panoramic radiographs



■ **Fig. 9:**
Cephalometric superimposition on the anterior cranial base (blue pre-treatment and red post-treatment) revealed that the anterior crossbite was corrected with marked proclination of upper incisors and retraction of lower incisors. Extrusion of the lower incisors and molars is due to the bite turbo and Class III elastics. The slight increase in length of the mandible indicates there was some growth during the 10 month treatment phase.

Dental:

- Molar relationship in CO: *Class I on the right and Class III on the left*
- Canine relationship in CO: *Class I on the right and Class III on the left*
- The negative OJ was -3.5 mm
- The deep overbite was 78% (7 mm) with a deep curve of Spee
- Space deficiency in the upper arch was 5.5 mm
- Redundant space in the lower arch was 3 mm
- Lower left 3rd molar is still developing
- Upper dental midline was coincident with the facial midline; lower dental midline was shifted to the right about 1.5 mm
- Arch forms: *symmetrical square form in the maxilla and ovoid in the mandible*

Facial:

- Slightly concave profile
- Acute nasolabial angle
- Short upper lip and slightly protrusive lower lip
- Decreased vertical dimension of occlusion (VDO)
- Chin point deviated to the right

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

Treatment Objectives

Maxilla (all three planes):

- A – P: *Allow for normal expression of growth*

- Vertical: *Allow for normal expression of growth*
- Transverse: *Maintain*

Mandible (all three planes):

- A – P: *Decrease*
- Vertical: *Increase*
- Transverse: *Maintain*

Maxillary Dentition:

- A – P: *Increase the axial inclination of the upper incisors*
- Vertical: *Maintain*
- Transverse: *Maintain*

Mandibular Dentition:

- A – P: *Retract the lower incisors*
- Vertical: *Maintain*
- Transverse: *Maintain*

Facial Esthetics: Retract the lower lip, and increase the maxillary incisor exposure

Treatment Plan

Non-extraction treatment with a full fixed orthodontic appliance was planned to align and level the dentitions to correct the anterior crossbite. IZC bone screws (2x8 mm, SS) were planned as anchorage for Class III elastics to retract the lower incisors.

Appliances and Treatment Progress

A full fixed .022" slot Damon Q PSL appliances (Ormco, Glendora, CA) was installed (Fig. 10). Low torque brackets were used on the upper incisors (+2°



■ Fig. 10:

Bracket prescription: Low torque brackets were bonded on the upper incisors to counteract the labial crown torque while aligning upper anteriors. Upside down low torque brackets were used on the lower incisors and high torque brackets bonded on the lower canines to provide more labial crown torque while retracting lower anteriors to correct the anterior crossbite.

on the central incisor, and -5° on the lateral incisor) to counteract the excessive tipping expected when the incisors are aligned to correct the anterior crossbite. Upside down, low torque brackets were used on the lower incisors to deliver $+11^\circ$ of torque. High torque brackets were bonded on the lower canines ($+13^\circ$) to provide labial crown torque as the lower dentition was retracted to correct the anterior crossbite with Class III elastics (Fig. 10). The initial archwires were .014" CuNiTi for both arches. A GIBT (Glass Ionomer Bite Turbo) was constructed on the lingual surfaces of the lower incisors. The immediate increase in the VDO improved the concave profile considerably (Fig.

11). The IZC bone screws (2x8 mm, SS), installed on the same day the brackets were bonded, provided anchorage to retract the upper buccal segments with elastic chains, and the entire lower arch with Class III elastics (Fig. 12). An intra-arch elastic chain between the first molars was used to help level the curve of Spee in the lower arch (Fig. 13).

The anterior crossbite was corrected in 2 months by retracting the lower anteriors and flaring the upper anteriors. In the third month of treatment, .014x.025" CuNiTi archwires were placed (Fig. 14). Repositioning of brackets and detailing bends were carried out in



■ Fig. 11:

GIBT (Glass Ionomer Bite Turbos) were bonded on the lingual surface of lower incisors to raise the bite, and the facial profile improved immediately.



Fig. 12: 2 IZC bone screws (2x8mm, SS) were installed in the extra-alveolar (E-A) area located between the upper 1st molars and 2nd molars. They provided reliable anchorage for simultaneous retraction of upper and lower arches to help control flaring on upper dentition due to Class III elastics application.

the 8th month of treatment (Fig. 15). After 10 months of active treatment, the dentition was aligned and all the fixed appliances were removed.

Result Achieved

The patient was treated to the planned result as

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	83.8°	83.5°	-0.4°
SNB°	89.6°	89.5°	-0.1°
ANB°	-5.8°	-6.0°	-0.3°
SN-MP°	25.8°	26.0°	0.2°
FMA°	19.5°	20.2°	0.7°
DENTAL ANALYSIS			
U1 TO NA mm	7.4 mm	12.6 mm	5.2 mm
U1 TO SN°	114.0°	131.7°	17.7°
L1 TO NB mm	3.5 mm	-0.3 mm	-3.1 mm
L1 TO MP°	79.8°	69.7°	-10.1°
FACIAL ANALYSIS			
E-LINE UL	-6.7 mm	-4.6 mm	2.1 mm
E-LINE LL	-0.9 mm	-2.1mm	-1.2 mm

Table 1: Cephalometric summary

documented by the cephalometric radiograph superimpositions. The latter demonstrated that the correction of the anterior crossbite was achieved by labial tipping of the upper incisors and extrusion of the lower molars to increase the VDO (Figs. 4-6 and 9). A summary of the cephalometric measurements is provided in Table 1. Pre-treatment and post-treatment panoramic radiographs document the appropriate root parallelism after treatment (Figs. 7 and 8). Cephalometric superimpositions reveal a small increase in the length of the mandible, increased axial inclination of the maxillary incisors, and an increased VDO (Fig. 9).

The ABO Cast-Radiograph Evaluation (CRE) is 18 as shown in the subsequent worksheet.

Maxilla (all three planes):

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

Mandible (all three planes):

- A – P: Maintained



■ Fig. 13:

Intra-arch elastics connected from lower right 1st molar to lower right canine, from lower right canine to lower left canine passed over the top of lower incisors and from lower left canine to lower left 1st molar. These mechanics helped level the curve of Spee and closing all lower spaces.



■ Fig. 14: Anterior crossbite was corrected in the 2nd month of treatment.



■ Fig. 15: Repositioning and detailing were performed.

- Vertical: *Increased*
- Transverse: *Maintained*

Maxillary Dentition:

- A – P: *Increased*
- Vertical: *Decreased incisal exposure as they were tipped labially*
- Transverse: *Maintained*

Mandibular Dentition:

- A – P: *Retracted*
- Vertical: *Increased with molar extrusion to flatten the Curve of Spee*
- Transverse: *Maintained*

Facial Esthetics:

- Increased the lower facial height and VDO
- Increased maxillary incisal exposure
- Increased length of the upper lip

Retention

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

Final Evaluation of Treatment

Both arches were well aligned and articulated in Class I canine and molar relationships with the

dental midlines coincident. The overjet has reduced from -3.5 to 2 mm and the overbite has improved from 7mm (80%) to 4 mm (40%) at the end of the treatment. The Cast-Radiograph Evaluation (CRE) score was 18 points, which reflects an excellent alignment. Most of the residual problems were in alignment/rotations, marginal ridge discrepancies, and the axial inclinations of the molars. For details, see the CRE worksheet at the end of this case report.

Discussion

Correction of anterior crossbite is usually requested by patients and their parents during the developmental years because of esthetic and functional concerns.¹ Anterior crossbite may be a pseudo Class III malocclusion if there is a functional shift of the mandible to achieve maximal intercuspation.^{2,3,4} The functional shift (Fig. 16) indicated that the anterior crossbite could be managed orthodontically, without resorting to extractions and/or orthognathic surgery. Although the patient's mandible could be manipulated backward to an edge-to-edge position, his occlusion was still diagnosed as a dental Class III on the left side, and a dental Class I on the right. In addition, there was a low mandibular plane angle and Class III compensation: ANB -5.8°, SN-MP 25.8°, U1-SN 114°, and L1-MP 79.8°. Mandibular manipulation is important for anterior crossbite patients to determine if there is a functional shift, and whether the malocclusion can be treated

with conservative orthodontics, as opposed to extractions and/or orthognathic surgery. Furthermore, the differences in the facial profile, when the mandible is positioned in CO and CR, is helpful for understanding the probable outcome of treatment, by patients and their parents (Figs. 16 and 17).^{5,6} However, there may be a large discrepancy between the estimated outcome and the actual result, particularly if the patient is still growing. The pre-treatment CR profile for deepbite patient is usually better than the final result because occluding on an incisal prematurity increases the VDO, and produces a more obtuse nasolabial angle. However, as the patient is treated and the occlusal prematurity is corrected, the deepbite pattern will

return, which requires increased labial inclination of the maxillary incisors to correct the negative overjet.

For the present patient, differential pretorqued brackets were selected for better control of axial inclinations for the upper and lower anterior segments.⁷ Low torque brackets were used on the upper incisors (*Central: +2°, lateral: -5°*) to counteract the labial crown torque, due to the labial force associated with protracting the upper incisors, to correct the anterior crossbite. However, there was still too much labial flaring of the upper incisors at the end of the treatment (*U1-SN 114°→131.7°*). In retrospect, standard torque brackets (*central: +15° lateral: +6°*), placed upside down on the maxillary



■ Fig. 16:

Different profile changes are shown in centric occlusion (CO), in centric relation (CR) with an edge-to-edge bite, and after treatment.



■ **Fig. 17:**
Cephalometric superimpositions at initial C.O. (Blue), initial C.R. (edge-to-edge bite, Green), and end of treatment (Red). The dramatic increase in the VDO achieved with the bite turbos was not sustained after the arches were aligned. Compare to Figure 9.

incisors, would have delivered more negative torque (*central*: -15° , *lateral*: -6°) to help control the labial tipping. Furthermore, labial movement of the upper incisors could have been delayed until enough space was created by retraction the upper canines with elastic chains anchored by the IZC bone screws. In the lower arch, upside down low torque brackets were used on the lower incisors ($+11^\circ$) and high torque brackets were bonded on the lower canines ($+13^\circ$) to provide more labial crown torque to offset the retraction force applied by Class III elastics.

In addition to differential bracket torque, elastic chains from the canines to the IZC bone screws

provided a distal force to counter labial flaring of the maxillary incisors, as the crowding was relieved and the incisors were advanced. Because of their extra-alveolar (E-A) location (Fig. 12), IZC bone screws are effective anchorage for retracting both arches, as well as for resisting incisal flaring due to Class III elastics.⁸ The upper molars were stabilized for Class III elastic anchorage by the retraction force from the IZC bone screws to the maxillary canines bilaterally (Fig. 10).

The treatment for this severe malocclusion was completed in 10 months. It is possible that the final result could have been improved with additional detailing, but a CRE score of 18 at the finish is excellent for a malocclusion with a DI of 24. The treatment reported was conducted relatively early in adolescence (*age 14yr*) so long term follow up is indicated until the age of $\sim 21yr$ to rule out late mandibular growth. Late adolescent and early adult males may grow out of a Class III correction because of continuing mandibular growth, and develop into a skeletal Class III malocclusion.⁹

Conclusion

Some functional malocclusions may appear to be very difficult in habitual or CO occlusion, but are less imposing in the CR (*retruded*) position of the mandible. It is important to assess or rule out functional discrepancies in the initial evaluation. E-A IZC bone screws provide reliable anchorage for intra-arch alignment and orthopedic correction of both

the maxilla and mandible. Skeletal malocclusions can be corrected in growing adolescent patients, but long term follow up is necessary until the growth of the mandible is complete.⁹

References

1. Major PW, Glover K. Treatment of anterior crossbite in early mixed dentition. *J Can Dent Assoc* 1992;58:574-575.
2. Rabie AB, Gu Y. Management of pseudo-Class III malocclusion in southern Chinese children. *Br Dent J* 1999;186:183-7.
3. Rabie AB, Gu Yan. Diagnostic criteria for pseudo-Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2000;117:1-9.
4. Lin JJ, Liaw JL, Chang CH and, Roberts WE. *Class III Correction Orthodontics*. Taipei: Yong Chieh; 2013.
5. Wood NG. Centric relation and the treatment position in rehabilitating occlusion: A physiologic approach. Part II: The treatment position. *J Prosthet Dent* 1988;60:15-18.
6. Dawson PE. A classification system for occlusions that relates maximal intercuspation to the position and condition of the temporomandibular joints. *J Prosthet Dent* 1996;75:60-66.
7. Lin JJ. *Creative Orthodontics: Blending the Damon system & TADs to manage difficult malocclusions*. 2nd ed. Taipei: Yong Chieh; 2010.
8. Lin JJ. A new method of placing orthodontic bone screws in IZC. *News & Trends in Orthodontics* 2009;13:4-7.
9. Alexander AE, Mcnamara JA Jr, Franchi L, Baccetti T. Semilongitudinal cephalometric study of craniofacial growth in untreated class III malocclusion. *Am J Orthod Dentofacial Orthop* 2009 Jun;135(6):700. e. 1-14.



Discrepancy Index Worksheet

TOTAL D.I. 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 = **14**

Total = **14**

OVERBITE

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

Total = **3**

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 = **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 = **0**

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = **0**

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 $< -2^\circ$ **4** x 1 pt. = **4**

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 $< 26^\circ$ **1** x 1 pt. = **1**

1 to MP $\geq 99^\circ$ = 1 pt.

Each degree $> 99^\circ$ _____ x 1 pt. = _____

Total = **5**

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 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. = _____
Addl. treatment complexities _____ x 2 pts. = _____

Identify:

Total = **0**

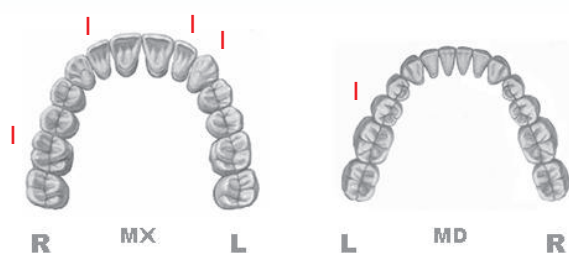
Cast-Radiograph Evaluation

Total CRE Score

18

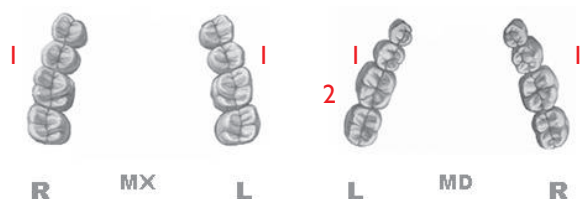
Alignment/Rotations

5



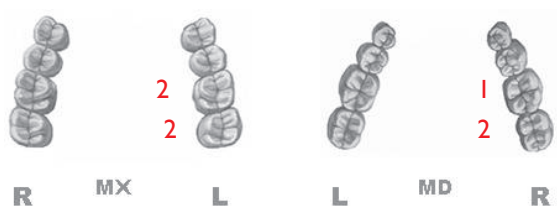
Marginal Ridges

6



Buccolingual Inclination

7



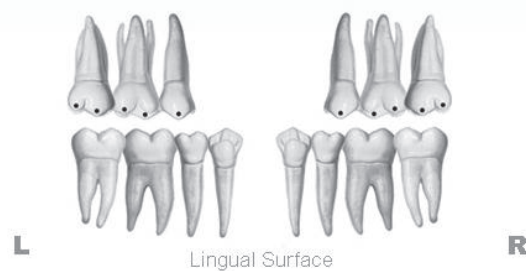
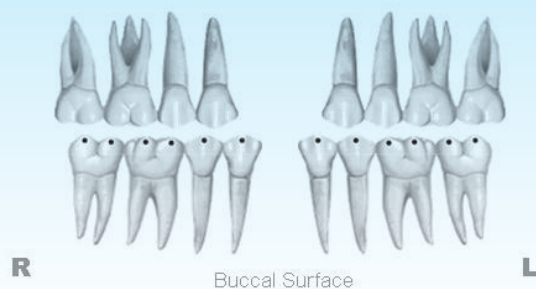
Overjet

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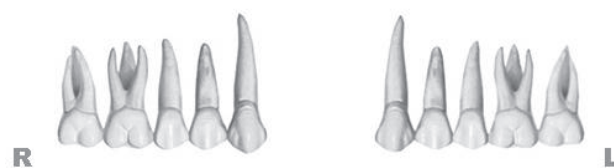
Occlusal Contacts

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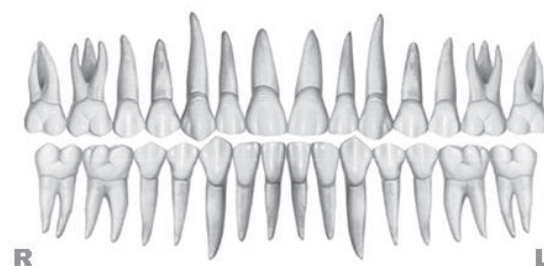
Occlusal Relationships

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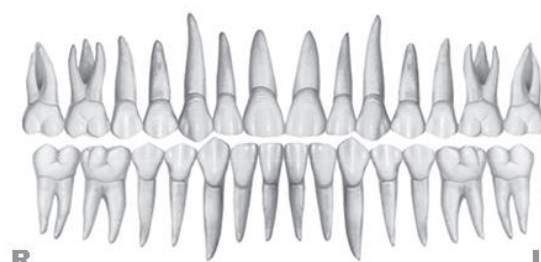
Interproximal Contacts

0



Root Angulation

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.