Conservative Treatment of Periodontally Compromised Class III Malocclusion Complicated by Early Loss of Lower First Molars

Abstract

A 29-year-old woman presented with a skeletal Class III malocclusion, anterior crossbite, atrophic extraction sites in the mandibular first molar areas, and periodontal pockets on the mesial aspect of the lower second molars. Probable etiology of the anterior crossbite was early loss of lower first molars. The severe malocclusion (Discrepancy Index 30) was corrected with the asymmetric extraction of maxillary second premolar and a passive self-ligating appliance. The anterior crossbite was resolved with anterior bite turbos and light force Class III elastics. Despite the periodontal problems, closing the mandibular spaces was deemed the best option for retracting the mandibular anterior segment to correct lower lip protrusion. Following 38 months of active treatment, dentofacial esthetics were improved and excellent dental alignment was achieved (Cast-Radiograph Evaluation 23). After treatment, the periodontally-compromised mandibular second molars had grade I mobility without pain, in addition to external root resorption. Follow-up records one year later documented the stability of the malocclusion correction. Periapical radiographs at 1 and 1.5yr after treatment revealed improvement in the osseous support, and an arrest of root resorption for the right mandibular second molar, but the mesial root of the contralateral second molar was affected by internal and external root resorption. Both compromised lower second molars served as adequate anchorage and subsequently functioned normally. Although one or both of the compromised molars may be lost in the future, retaining them for as long as possible was the optimal treatment plan. (Int J Orthod Implantol 2016;42:44-59)

Key words:

Class III anterior cross-bite malocclusion, atrophic extraction site, external root resorption, self-ligating appliance

Skeletal Class III malocclusion with anterior cross-bite requires a careful differential diagnosis to formulate a viable treatment plan, particularly when there is periodontal compromise. Clinical examination[1-4] is usually more reliable than cephalometric analysis for determining if conservative treatment without orthognathic surgery is indicated. Functional assessment in centric relation (C_R) and centric occlusion (C_O) is critical for distinguishing a true skeletal Class III from a pseudo Class III malocclusion.[4] Pseudo Class III patients who have an orthognathic profile in C_R usually have a good prognosis with conservative treatment.[5]

Closing atrophic extraction sites in the posterior mandibular arch is challenging. If the periodontium is healthy, the space can be closed with routine mechanics, anchored with osseointegrated extra-alveolar implants.[6-8] If the periodontium is compromised, space closure is much less predictable.[9-11] Bone resorption decreases an edentulous alveolar ridge in width and height;[10,11] however if the periodontium of the second molar is healthy, it will generate new bone ahead of the moving tooth.[12,13] On the other hand, a

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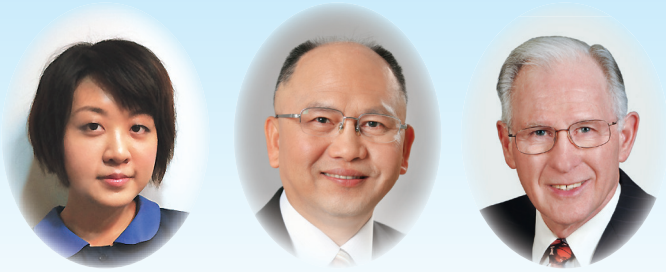

Fig. 1: Pre-treatment facial and intraoral photographs.

compromised periodontium may fail to generate adequate new bone and attached gingiva as the space is closed; in addition, it may present an increased risk of root resorption.[14-16]

The aim of this case report was to present a conservative approach to a skeletal Class III malocclusion, compromised by atrophic mandibular spaces and periodontal deterioration.

Diagnosis and Etiology

A 29-year-old woman was concerned about her unattractive smile. There was no contributory medical history and the only relevant dental history was the loss of lower first molars in childhood, probably due to molar-incisor enamel hypomineralization.[17,18] The latter type of enamel defects, which affect up to 20% of children worldwide, is thought to result from common illnesses with high fever in the first year or two of life. When the affected first molars erupt, they are susceptible to catastrophic caries, resulting in extraction during the juvenile years. Loss of these posterior centric stops in occlusion can result in functional shifts such as anterior crossbite (*Fig. 1*) when the deciduous molars are lost. Facial examination revealed symmetry in the frontal plane, a concave profile, and a prominent lower lip. The anterior segment of the lower arch was prominently displayed when smiling (*Fig. 1*). This clinical picture is consistent with a loss of posterior occlusal support in early adolescence.

There were no signs or symptoms of temporo-mandibular joint dysfunction (*Fig. 2*). The maxillary dental midline was coincident with the facial midline, but the mandibular dental midline was 2mm to the left in C_O. There was an anterior crossbite of all four maxillary incisors (*Fig. 1*). A fracture line was noted on the occlusal surface of a maxillary left second premolar, between the palatal cusp and an amalgam restoration, that was deemed unrestorable. The pre-treatment study casts showed a Class I

Fig. 2:
Functional assessment of mandible movement is an important diagnostic procedure.

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

molar relationship (*Fig. 3*). Overjet was a negative 2mm and overbite was 6mm. There was 10mm of crowding in the upper arch but the lower arch had 11mm of edentulous space. The buccolingual widths of atrophic alveolar ridges in the lower arch was 4mm on the right side and 5mm on the left.

The pre-treatment cephalometric analysis was consistent with a Class III skeletal pattern. There was decreased axial inclination for both the upper and lower incisors. Lips were retrusive in the upper arch, and protrusive in the lower (*Fig. 4, Table I*). The panoramic radiograph (*Fig. 5*) revealed that the mandibular second molars were mesially inclined with significant periodontal pockets on the mesial surface, particularly on the left side. The maxillary right third molar was impacted.

Fig. 4:
Pre-treatment cephalometric radiograph in centric occlusion (CO).

The American Board of Orthodontics (*ABO*) Discrepancy Index (*DI*) was 30 points, as shown in the Supplementary Discrepancy Index (*Worksheet 1*).

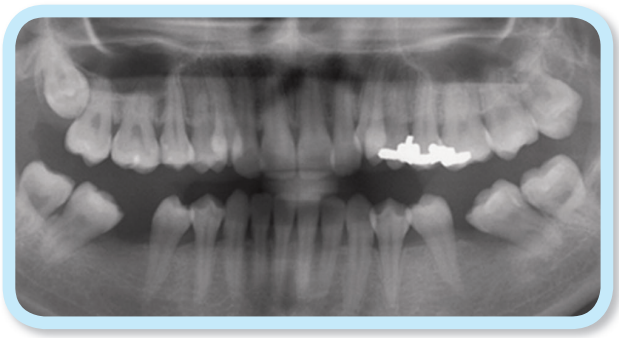

Fig. 5:
Pre-treatment panoramic radiography reveals mandibular edentulous spaces and periodontal pockets on the mesial surfaces of the lower second molars.

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	79°	79°	0°
SNB°	83°	81°	2°
ANB°	-4°	-2°	2°
SN-MP°	34°	35°	1°
FMA°	23°	24°	1°
DENTAL ANALYSIS			
U1 TO NA mm	4 mm	5 mm	1 mm
U1 TO SN°	102°	103°	1°
L1 TO NB mm	2 mm	1 mm	1 mm
L1 TO MP°	85°	82°	3°
FACIAL ANALYSIS			
E-LINE UL	-6 mm	-5 mm	1 mm
E-LINE LL	-2 mm	-3 mm	1 mm

Table 1: Cephalometric summary

Treatment Objectives

1. Full fixed, passive self-ligating appliance to level and align both arches.
2. Open the bite and rotate the mandible posteriorly.
3. Tip the upper incisors anteriorly and retract the lower incisors for anterior cross-bite correction and to improve the incisor display when smiling.
4. Extract the unrestorable, cracked maxillary left second premolar.
5. Upright and protract the mandibular molars to close the atrophic first molar spaces.
6. Retract the mandibular anterior segment to correct the lower lip protrusion.
7. Mandibular dental midline correction with asymmetric intermaxillary elastics.
8. Optimize occlusal contacts with archwire finishing and posterior vertical elastics.[19]

Treatment Alternatives

Asymmetric extraction of maxillary premolars is efficient for relieving crowding and correcting the midline, but the patient has a retrusive upper lip and decreased axial inclination of the maxillary incisors. A better alternative was extraction of the compromised maxillary left second premolar because it was not restorable with routine procedures.

The long-term prognosis for the mandibular second molars was guarded because of the periodontal pockets on their mesial surfaces. However, those teeth are still viable anchorage units for retracting the mandibular anterior segment. If the lower second molars are extracted, implant-supported anchorage would be necessary to establish centric stops in occlusion to retract the mandibular anterior segment.[12,13] However, implant placement would require augmentation bone grafts to increase the width of the edentulous spaces. Considering the pros and cons, the patient selected the most conservative approach: retaining the compromised mandibular second molars to serve as anchorage to retract the mandibular anterior segment. She understood that in the future it may eventually be necessary to extract the compromised lower second molars and replace them with implant-supported prostheses.

Treatment Progress

The maxillary left second premolar was extracted. An .022-in fixed appliance Damon Q (*Ormco, Glendora, CA*) fixed appliance was bonded on both arches, using low torque brackets on the maxillary central incisors and canines. After the fixed appliances were placed, the maxillary right third molar was extracted. Open coil springs were placed between maxillary central incisors and canines to open space bilaterally. In the lower arch, low torque brackets were bonded upside down on the incisors, and high torque brackets were placed on the canines (*Fig. 6*). Two anterior bite turbos were bonded in the lingual surface of the mandibular central incisors and light short Class III elastics (*2oz*) were used to correct anterior cross-bite (*Figs. 6 and 7*). Six months into

Fig. 6:
The anterior crossbite was corrected with bite turbos, alignment of the maxillary anterior segment and 2oz Class III elastics. See text for details.

Fig. 7:
Two anterior bite turbos were bonded in the lingual surfaces of the mandibular central incisors.

Fig. 8:
Once the anterior crossbite was near resolution, low torque brackets were bonded on the maxillary lateral incisors.

active treatment, the anterior cross-bite was almost corrected and the maxillary lateral incisors were bonded with low torque brackets (*Fig. 8*).

In the nineteenth month, .016x.025" stainless steel archwires were placed in both arches. The upper archwire was expanded and the lower archwire was constricted. Buttons were bonded on the lingual surfaces of the mandibular first premolars and second molars to receive power-chains for space closure (*Fig. 9*). Class II elastics (3.5oz) were applied

Fig. 9:
Nineteen months (19M) into treatment, buttons were bonded on the mandibular first premolars and second molars, and power chains were used on the buccal and lingual surfaces to close the lower posterior spaces.

from the mandibular second molar to the maxillary canine, bilaterally. In the thirtieth month, spaces were closed and a Class II elastic (*3.5oz*) was applied from mandibular right second premolar to maxillary left central incisor for dental midline correction (*Fig. 10*). Two months before the fixed appliances were removed, the upper archwire was sectioned distal to the canines, and all upper teeth from first molar to first molar were ligated with stainless steel to prevent space opening. The lower archwire was sectioned mesially to the terminal molar, finishing bends were placed in the buccal segments, and vertical elastics were used to optimize intermaxillary tooth contacts (*Fig. 11*).

Fig. 10:
At thirty months (30M), an elastic (3.5oz) (not shown) was applied from mandibular right second premolar to maxillary left central incisor for dental midline correction.

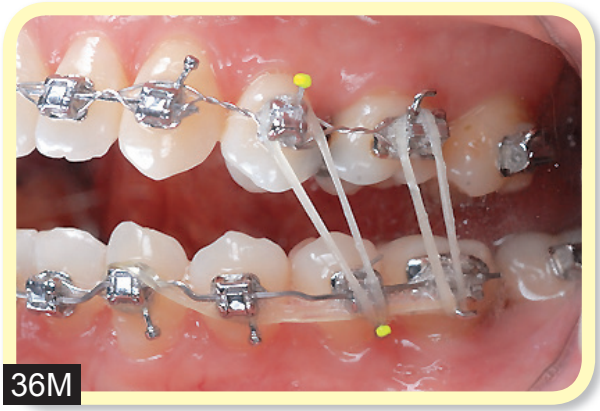

Fig. 11:
The upper archwire was sectioned distal to the canines and the lower archwire was sectioned distal to the first molars. Light vertical elastics (2oz) were used to settle the posterior occlusion. Finishing bends were placed in the lower archwire.

Treatment Results

Facial esthetics were markedly improved by correcting mandibular lip protrusion and increasing the maxillary incisor exposure when smiling (*Fig. 12*). Near ideal dental alignment was achieved as evidenced by an ABO Cast-Radiograph Evaluation (*CRE*) score of 23 points (*Worksheet 2*). The major residual discrepancies were the axial inclinations of the mandibular left and maxillary right second molars. Substituting mandibular third for second molars is challenging because of morphologic variability. Specialized mechanics are often required to optimize intermaxillary alignment (*Fig. 13*). The asymmetric extraction of the maxillary left second premolar helped relieve crowding but resulted in a Class II molar relationship on the right side (*Fig. 14*).

The post-treatment panoramic film revealed external root resorption on the periodontally compromised mandibular second molars (*Fig. 15*). These teeth were slightly mobile, but vital and pain-free dental units that were in a satisfactory functional occlusion. The concave profile was improved (*Fig. 16*) due to the retraction of the mandibular anterior segment, correction of lower lip protrusion, and opening

Fig. 12: Post-treatment facial and intraoral photographs.

Fig. 13:
The bracket was bonded in a more distal position on the first molar to achieve distal-out rotation for improving the occlusal finish.

Fig. 14: Post-treatment study models (casts).

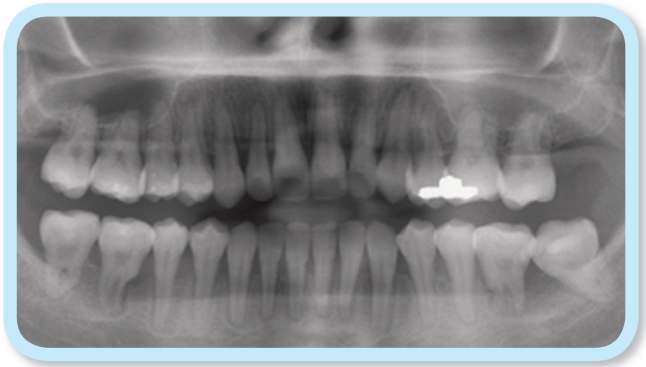

Fig. 15: Post-treatment panoramic radiograph.

Fig. 16: Post-treatment cephalometric radiograph.

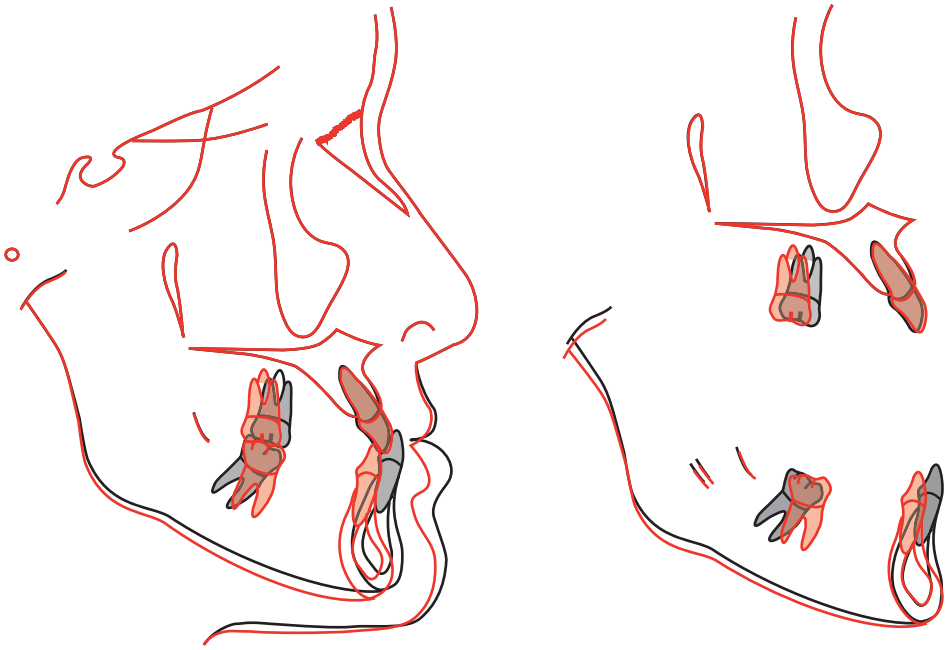

Fig. 17:
Cephalometric tracings before (black) and after (red) treatment were superimposed on the anterior cranial base (left). The upper right illustration is a superimposition of tracings on the maxilla, and the lower right is a superimposition of tracings on the skeletally stable mandibular structures (internal symphysis and inferior alveolar canal).

of the vertical dimension of occlusion (*Fig. 17*). The maxillary molars were retracted, and the mandibular second molars were uprighted and extruded. Leveling the occlusal plane resulted in posterior rotation of the mandible to improve the concave profile (*Fig. 17*). The patient was well satisfied with the result and understood the necessity to monitor the compromised lower second molars long-term. Follow-up periapical radiographs at 1 and 1.5 years revealed improvement in the osseous support for the right mandibular second molar, but external and internal root resorption affected the mesial root of the contralateral second molar (*Fig. 18*).

Fig. 18: One year follow-up records document that the correction of the malocclusion is stable.

Discussion

The conservative treatment of Class III malocclusion is challenging primarily due to inadequate diagnosis. Because of the necessity for extensive tooth movement, periodontal health is essential, particularly if closure of atrophic space is required. The 3-Ring Diagnosis is an effective method, and for the differential diagnosis for identifying Class III malocclusions that are well suited to conservative treatment.[1,2,5] There are three critical considerations:

Profile in CR: If the facial profile is orthognathic, or at least acceptable in the C_R position, the patient is a good candidate for conservative dentoalveolar treatment. If the patient has a severe prognathic mandible with a concave profile in C_R, orthognathic surgery is usually the best treatment option.

Class: Evaluate the sagittal classification of the canines and first molars in C_O. An anterior crossbite is readily resolved when the molars are Class I in C_O (*pseudo Class III*) compared to Class III in C_O (*true skeletal Class III*).

Functional Shift: The presence or absence of a functional shift from C_R —> C_O is a essential aspect of the diagnosis. Class III patients with a functional shift (*pseudo-Class III*) have an improved prognosis for conservative treatment that is proportional to the magnitude of the shift.

The present Class III patient had a straight facial profile and Class I molar relationship in C_R. Anterior bite turbos and light force Class III elastics facilitated anterior crossbite correction. In the eleventh month of active treatment, the anterior crossbite was corrected.

Closing atrophic extraction sites lengthens the treatment time, and may result in significant root resorption.[14-16] Thirty months were required to upright, align, and mesially translate the mandibular second molars. The alternatives were to extract the second molars and protract the third molars to serve as prosthetic abutments, or remove all mandibular molars in favor of implant-supported prostheses. The latter approach could shorten the orthodontic treatment time, but that advantage would probably be offset by bone augmentation and implant surgical procedures. Moreover, maintaining the posterior centric stops in occlusion facilitated correction of the anterior crossbite and excessive overbite.

Mesial translation of the periodontally compromised mandibular second molars was a calculated risk, but that approach had two important advantages: 1. development of the narrow alveolar ridges as potential implant sites if needed, and 2. retract the mandibular anterior segment to correct the anterior crossbite and excessive lower lip protrusion. To help

control the expression of external root resorption, the force levels and treatment time are minimized, as much as possible.[14,15] Periodic pauses in treatment allowed the resorbed cementum to heal.[14,16]

The primary concerns associated with closure of the lower atrophic spaces were the narrow ridges and periodontal pockets on the mesial aspects of the tipped second molars. Pseudo-periodontal pockets are common on mesially tipped mandibular molars,[15] but the initial panoramic radiograph for the present patient suggested the pockets were considerably deeper than that (*Fig. 5*). According to Brown,[9] orthodontic uprighting reduces the depth of pseudo-pockets but well established apical migration of the epithelial attachment persists. An important consideration when uprighting mandibular molars is occlusal trauma, which may contribute to alveolar bone loss and root resorption.[20-22] Occlusal trauma for the present patient was controlled with anterior bite turbos and occlusal adjustment of the mandibular second molars.

The narrow ridges were expected to contribute to bone loss as the periodontally compromised second molars were moved mesially.[23,24] The ideal dimensions of the alveolar ridge for mandibular first molar space closure are reported to be 6mm or less of mesiodistal length and 7mm of buccolingual width.[25] However, if the periodontium is healthy, space closure will generate adequate periodontium.[6-8] To prevent the tendency for mesial and lingual tipping of second molars during space closure, a relatively large rectangular stainless steel archwire was used, and force was applied from both the buccal and lingual surfaces.[26,27]

Although both mandibular atrophic spaces were closed, and the severe malocclusion was resolved, the mandibular second molars were both slightly mobile. Post-treatment radiographs revealed a bilateral loss of supporting bone and external root resorption. Periapical radiographs at 1 and 1.5yr of follow-up revealed improvement in the osseous support for the right mandibular second molar, but the contralateral second molar continued to be affected by root resorption. Continued monitoring of the questionable teeth is indicated. In the future, it may be necessary to remove one or both of them in favor of implant-supported prostheses. Despite this potential problem, the periodontally compromised second molars served as important anchorage units to resolve the malocclusion and develop the edentulous areas as implant sites. At 1.5yr after treatment the affected molars are stable and comfortable dental units in routine function (*Fig. 19*), but continuing clinical and radiographic monitoring is required.

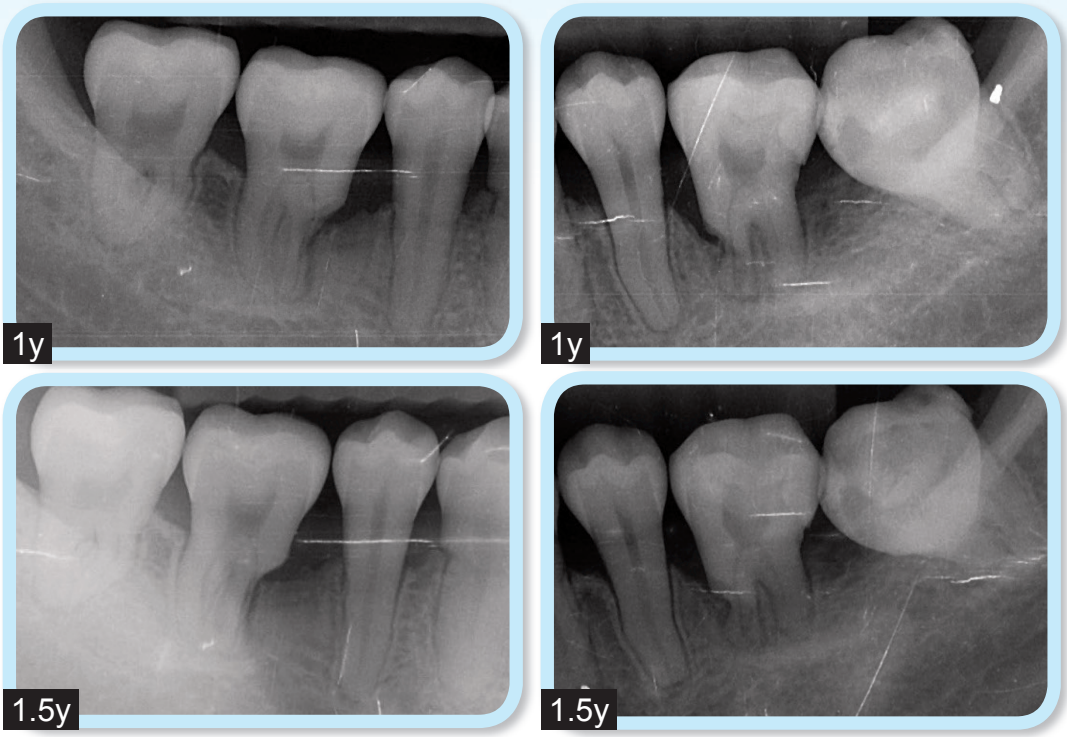

Fig. 19:
Periapical radiographs of the mandibular buccal segments show the osseous support of both periodontally compromised second molars is relatively stable. Root resorption has ceased on the lower right second molar (lower left radiograph), but is still evident on the external and internal surfaces of the mesial root of the lower left second molar (lower right radiograph).

Conclusions

An appropriate differential diagnosis of Class III malocclusion with anterior crossbite requires an assessment of its etiology, as well as an evaluation of the facial profile, molar classification, and functional shift. Differentiating true skeletal from pseudo Class III malocclusions is critical for prescribing the appropriate treatment. Closing atrophic edentulous sites is desirable if the result is a more favorable alignment of the teeth. For the present patient, the utilization of periodontally compromised molars for anchorage provided an optimal outcome.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 30

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 = 7

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 = 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 = 7

OCCLUSION

Class I to end on	=	0 pts.
End on Class II or III	=	2 pts. per side _____ pts.
Full Class II or III	=	4 pts. per side _____ pts.
Beyond Class II or III	=	1 pt. per mm. additional _____ pts.

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 1

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

Each degree < -2° 2 x 1 pt. = 2

Each degree > 6' _____ x 1 pt. = _____

SN-MP

≥ 38° = 2 pts.

Each degree > 38° _____ x 2 pts. = _____

≤ 26° = 1 pt.

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

1 to MP ≥ 99° = 1 pt.

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

Total = 6

OTHER (See Instructions)

Supernumerary teeth	_____	x 1 pt. =	_____
Ankylosis of perm. teeth	_____	x 2 pts. =	_____
Anomalous morphology	_____	x 2 pts. =	_____
Impaction (except 3rd molars)	_____	x 2 pts. =	_____
Midline discrepancy (≥3mm)		@ 2 pts. =	_____
Missing teeth (except 3rd molars)	2	x 1 pts. =	2
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	2	x 2 pts. =	4

Identify: Atrophic ridges (both sides)

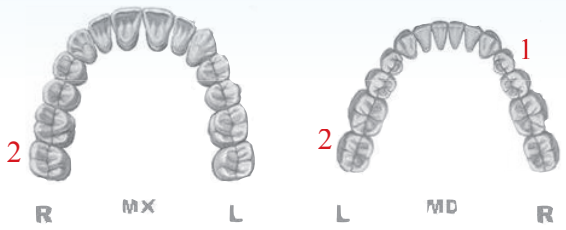
Total = 6

Cast-Radiograph Evaluation

Total Score: 23

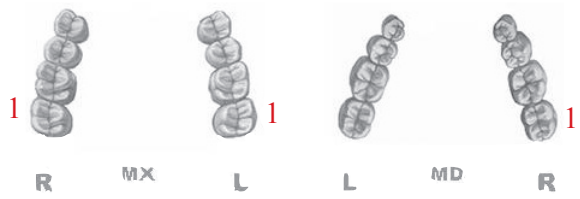
Alignment/Rotations

5



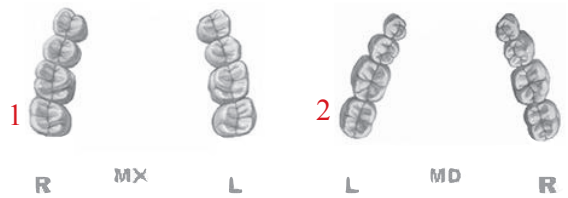
Marginal Ridges

3



Buccolingual Inclination

3

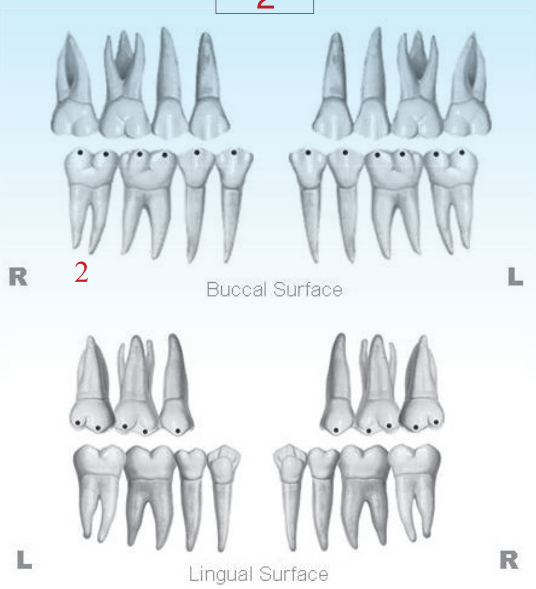


Overjet

1

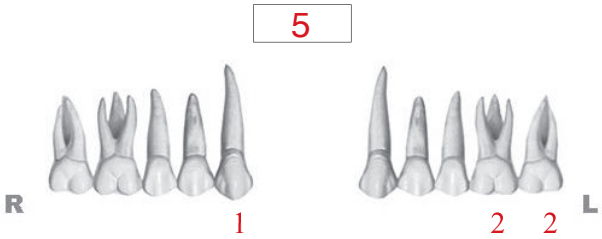
Occlusal Contacts

2



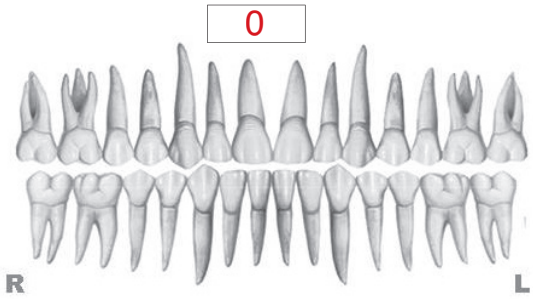
Occlusal Relationships

5



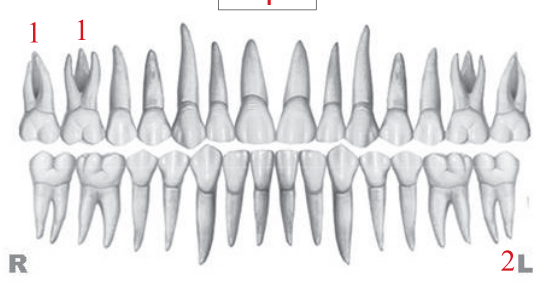
Interproximal Contacts

0



Root Angulation

4



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.