

Convex, Class II, Deepbite, Gummy Smile and Lingually Tipped Incisors: Conservative Correction with Bone Screws and a Crown Lengthening Procedure

Abstract

Introduction: A 26-year-old female sought orthodontics consultation for nonextraction treatment to correct unsatisfactory facial and dental esthetics. She attributed her concerns to a protrusive upper lip and gummy smile.

Diagnosis: Severe facial convexity (28%) and increased lower facial height (57.6%) was associated with a protrusive maxilla (SNA 85°), retrusive mandible (SNB 75°), Class II occlusion, high mandibular plane angle (FMA 33°), 100% deepbite, lingually tipped maxillary incisors (U1 to SN 88°), asymmetric gummy smile, and extrusion of the maxillary incisors.

Etiology: This complex malocclusion was consistent with a functional retrusion and clockwise rotation of the mandible, due to the lingual orientation of the upper incisors ("locked-in bite").

Treatment: Initial bite opening was with bite turbos on the upper maxillary canines that were then transferred to the adjacent central incisors, after they were aligned. Both arches were aligned with a passive self-ligating (PSL) fixed appliance. Class II correction was accomplished with intermaxillary elastics, and osseous anchorage provided by maxillary bone screws, placed apical to the incisors and buccal to the molars. Following alignment, surgical crown lengthening was performed in the maxillary anterior segment, and 6 months later the gingival contours were refined with a diode laser.

Result: Facial esthetics were improved by decreases in facial height (5°) and facial convexity (3%), as well as correction of the asymmetric gummy smile and lip competence. In 30 months, this severe malocclusion, with a Discrepancy Index (DI) of 27, was treated to an excellent Cast-Radiograph Evaluation (CRE) of 24, and a pleasing Pink & White Esthetic Score of 3. The facial and dental results were stable at the six month follow-up evaluation. (*Int J Orthod Implantol* 2017;45:60-81)

Key words:

Asymmetry, Gummy smile, deepbite, Class II malocclusion, self-ligating brackets, bite-turbos, temporary anchorage devices, arch retraction, surgical crown lengthening, infrazygomatic crest, extra-alveolar, bone screws

History and Etiology

The chief complaints of this 26-year-old woman were maxillary protrusion and an unattractive smile. She preferred conservative treatment without extractions or orthognathic surgery. No contributing medical, dental, or family history was reported. She presented with maxillary protrusion, prominent upper lip, severe facial convexity, and a hyperactive mentalis muscle, when lips were closed (Fig. 1). Asymmetric, excessive gingival display ("gummy smile") was noted when the patient was smiling (Fig. 2). Intraoral examination revealed decreased clinical crown height in the esthetic zone (*maxillary anterior segment*). Moderate crowding in the mandibular anterior region (Fig. 3), and deepbite with 3-mm of overjet (Fig. 4) were noted.

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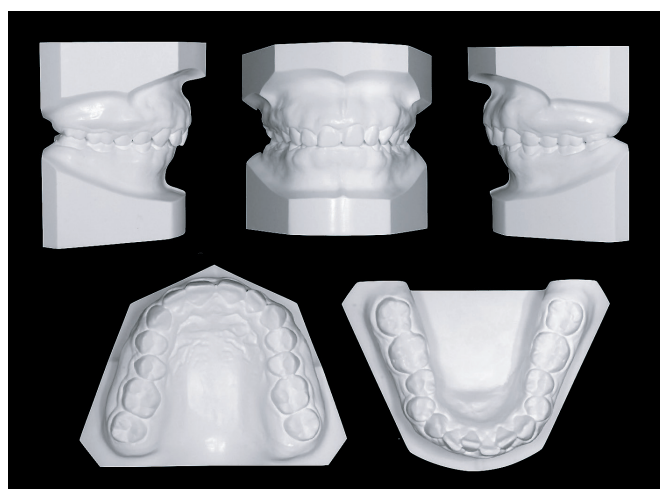
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■ Fig. 1: Pre-treatment facial and intraoral photographs



■ **Fig. 2:**
Gummy smile, asymmetrical gingival display, and cant of the occlusal plane



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



■ **Fig. 4:**
Impinging (100%) deepbite and lingually tipped maxillary incisors



■ **Fig. 5:**
Pre-treatment lateral cephalometric radiograph showed lingually tipped maxillary incisors.

Radiographic documentation is provided by lateral cephalometric (Fig. 5) and panoramic (Fig. 6) films. Cephalometric analysis is summarized in Table 1. Diagnostic details are outlined below.

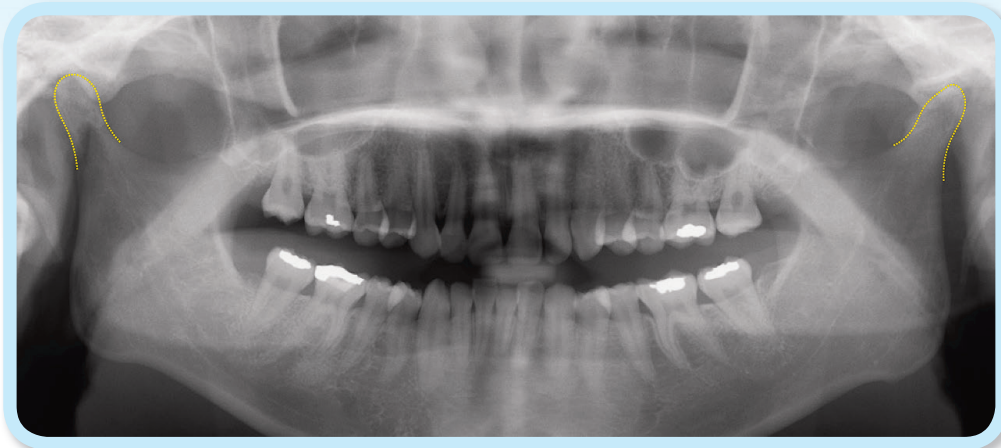
Diagnosis

Skeletal:

- Maxillary protrusion and mandibular retrusion ($SNA\ 85^\circ$, $SNB\ 75^\circ$, $ANB\ 10^\circ$)
- Steep mandibular plane angle ($SN-MP\ 40^\circ$, $FMA\ 33^\circ$)

Dental:

- End-on Class II molar relationships
- Class II canine relationships
- 100% impinging deepbite



■ Fig. 6: Pre-treatment panoramic radiograph shows both condylar heads outlined in yellow.

Facial:

- Convex profile
- Everted lower lip
- Hypermental activity with lips closed

The American Board of Orthodontics (ABO) Discrepancy Index (DI) was 27 as shown in the subsequent worksheet.

Treatment Objectives

Maxilla (all three planes):

- A - P: *Retract*
- Vertical: *Maintain*
- Transverse: *Maintain*

Mandible (all three planes):

- A - P: *Anterior by decreasing the vertical dimension of the occlusion (VDO)*
- Vertical: *Decreased by closing the VDO*
- Transverse: *Maintain*

CEPHALOMETRIC			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	85°	82°	3°
SNB° (80°)	75°	75.5°	0.5°
ANB° (2°)	10°	6.5°	3.5°
SN-MP° (32°)	40°	39.5°	0.5°
FMA° (25°)	33°	32.5°	0.5°
DENTAL ANALYSIS			
U1 TO NA mm (4 mm)	-3 mm	-1 mm	2mm
U1 TO SN° (110°)	88°	103°	15°
L1 TO NB mm (4 mm)	9 mm	8 mm	1mm
L1 TO MP° (90°)	98°	103°	5°
FACIAL ANALYSIS			
E-LINE UL (2-3 mm)	0 mm	-2 mm	2 mm
E-LINE LL (1-2 mm)	2 mm	0 mm	2 mm
Convexity: G-Sn-Pg' (13°)	28°	23°	5°
%FH: Na-ANS-Gn (53%)	57.6%	54.9%	2.7%

■ Table 1: Cephalometric summary

Maxillary Dentition

- A - P: *Retract*
- Vertical: *Intrude molars*
- Inter-molar / Inter-canine Width: *Maintain*

Mandibular Dentition

- A - P: *Maintain*
- Vertical: *Intrude incisors to correct curve of Spee*
- Inter-molar / Inter-canine Width: *Maintain*

Facial Esthetics: Retract the everted lower lip

Treatment Plan

Non-extraction treatment with passive self-ligating (PSL) brackets was indicated. Because of the labially inclined lower incisors, use Class II elastics sparingly, for correction of the sagittal discrepancy. Use temporary anchorage devices (TADs) to retract the maxillary incisors and increase their axial inclination. Provide bilateral extra-alveolar (E-A) anchorage with infrazygomatic crest (IZC) bone screws. Prevent extrusion of the maxillary anterior segment as it is retracted, by placing interradicular (I-R) miniscrews between the roots of the upper incisors. Upon completion of active treatment, remove fixed appliances, and perform surgical crown lengthening in the maxillary anterior segment. Retain with clear overlay retainers for both arches.

Treatment Progress

A full fixed appliance with 0.022-in slot Damon Q® brackets (Ormco, Glendora, CA) was used with the archwires and accessories, as specified by the manufacturer. High torque brackets were chosen

for the maxillary anterior segment to increase axial inclination. Low torque brackets were chosen for the mandibular incisors to prevent flaring, due to correction of crowding and the use of the Class II elastics. The archwire sequence in the upper was: 0.014-in CuNiTi, 0.014x0.025-in CuNiTi, 0.017x0.025-in TMA, 0.016x0.025-in SS, 0.019x0.025-in SS. For the lower arch, the progression of archwires was 0.014-in CuNiTi, 0.014x0.025-in CuNiTi, 0.017x0.025-in TMA, 0.016x0.025-in SS.

In the 2nd month of treatment, two anterior bite-turbos (BTs) were bonded on maxillary canines to help correct the 100% deepbite (Fig. 7). In the 8th month, Class II elastics (Fox 1/4-in, 3.5-oz) were used to assist in correction of the Class II molar and canine relationships (Fig. 8).



■ **Fig. 7:**
In the 2nd month, two anterior BTs were bonded on maxillary canines to help correct the 100% deepbite.

In the 19th month, a 2x12-mm bone screw (OrthoBoneScrew® Newton's A Ltd, Hsinchu City, Taiwan) was placed in each IZC for E-A anchorage. Retracting the entire maxillary dentition with IZC anchorage extrudes maxillary incisors and rotates the arch posteriorly. Two 1.5x8-mm miniscrews made by the same manufacturer (Newton's A Ltd, Hsinchu City, Taiwan) were inserted between the upper central and lateral incisors (Fig. 9) to prevent extrusion in the maxillary anterior segment¹ (Fig. 10). With these mechanics, the entire maxillary dentition was retracted and aligned, while extrusion was controlled with anterior and posterior TADs. In the 29th month of treatment, the anterior miniscrews were removed and the upper arch wire (0.019x0.025-in SS) was expanded to correct a posterior crossbite tendency.

Surgical Crown Lengthening

In the 29th month, the short anterior crowns appeared even shorter because of the gingival inflammation associated with fixed appliances (Fig. 11). Surgical crown lengthening was performed prior to removing the brackets to obtain proper clinical crown height and re-establish biological width at a more apical level. The stepwise procedure is described below.

First, the dentogingival complex was measured on each tooth by bone sounding under local anesthetic. This diagnostic procedure reveals the level of the cemento-enamel junctions (CEJ) relative to the alveolar crest.

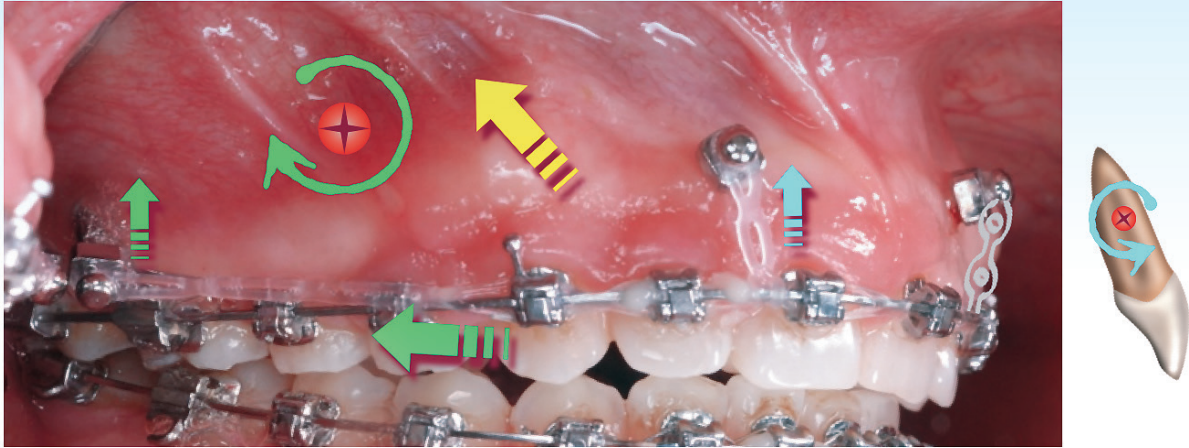
Second, the width of keratinized gingiva was checked. Although not essential for periodontal



■ Fig. 8: In the 8th month, Class II elastics were used to correct the Class II molar and canine relationships.



■ Fig. 9: Two I-R miniscrews are placed between the central and lateral incisors, and they deliver force of 60~80 gm (cN) gm per side. Two IZC miniscrews were inserted and loaded with 280 gm (cN) per side.



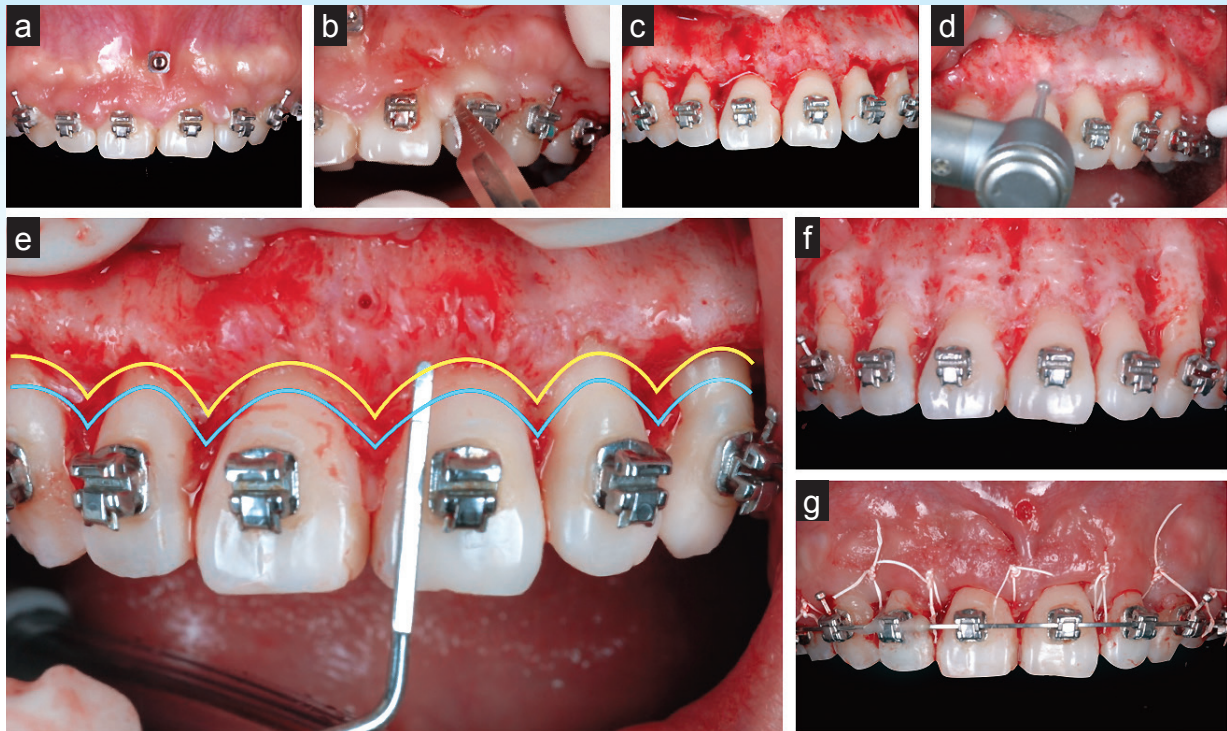
■ Fig. 10:

The presumed force system is diagrammed for the IZC bone screws and I-R miniscrews. The right blue straight arrow indicates the intrusive force anchored by the I-R miniscrews. In the illustration to the right, the blue circular arrow shows a moment relative to the C_R (X in a red dot) of the incisal root that flares the maxillary incisors. The horizontal green arrow is the retraction force to the canines that is anchored by the IZC miniscrew. The vertical green arrow is the intrusive component on the posterior maxillary segment that is provided if the IZC bone screw is engaged. The green circular arrow around the C_R of the maxillary arch (black cross in a red dot) represents the moment of the retraction force due to the force applied to the canines from the IZC bone screws. The large yellow arrow is the net resultant force on the maxilla based on the presumed C_R .



■ Fig. 11:

Gummy smile is shown at the start of treatment (0M) in the facial (upper left) as well as the intraoral views (lower left). The 100% deepbite was improved at 29 months (29M). A single I-R miniscrew (lower right) was placed between the central incisor roots at 23 months, because one of the original miniscrews placed between the central and lateral incisor roots at 19 months failed.



■ Fig. 12:

The crown-lengthening surgical procedure is illustrated: (a) short clinical crowns with excessive gingival display, (b) marginal and submarginal incisions, (c) a full-thickness flap is reflected, (d) bone is removed at the alveolar crest with a #5 round carbide bur, (e) a uniform 2-mm biological zone is established for soft tissue attachment between the CEJ (blue line) to the alveolar crest (yellow line), (f) alveolar bone is contoured and festooned, and (g) the flap is repositioned and sutured.

health, it is difficult to maintain a healthy dentition if the keratinized gingiva is less than 2-mm wide for any tooth. An apically positioned flap is indicated to increase the width of attached gingiva. Gingivectomy is preferable for increasing crown height if there is adequate gingiva, occlusal to the epithelial attachment.

Third, a full-thickness mucoperiosteal flap was reflected to examine the alveolar crest and CEJ for all teeth under treatment. It is important to identify all areas where the alveolar crest is <2-mm from the CEJ (Figs. 12b-c).

Fourth, bone was removed with a #5 round carbide bur to establish a uniform 2-mm wide zone between the alveolar crest and CEJ. This bone-free attachment zone is critical for establishing a healthy biologic



■ Fig. 13:

At thirty months (30M), 6 months post-operative for the crown-lengthening procedure, all fixed appliances were removed, and irregularities were noted in the gingival margins. Gingival recontouring was accomplished with a diode laser at the 6 months post-treatment follow-up (6M-F/u).

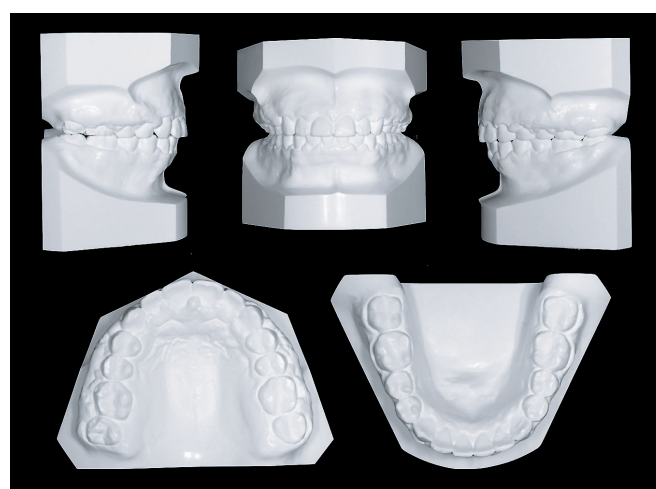


■ Fig. 14:

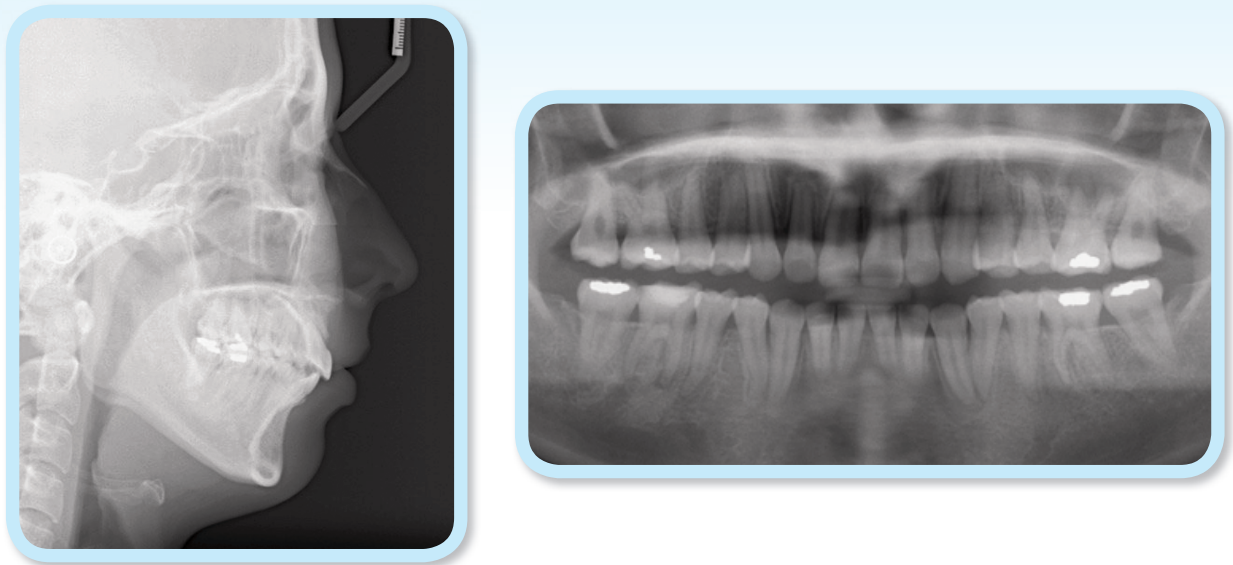
6-month post-treatment follow-up facial and intraoral photographs, gingival recontouring was accomplished with a diode laser.

width and optical clinical crown height, for all teeth treated requiring crown lengthening (Figs. 12d-f).

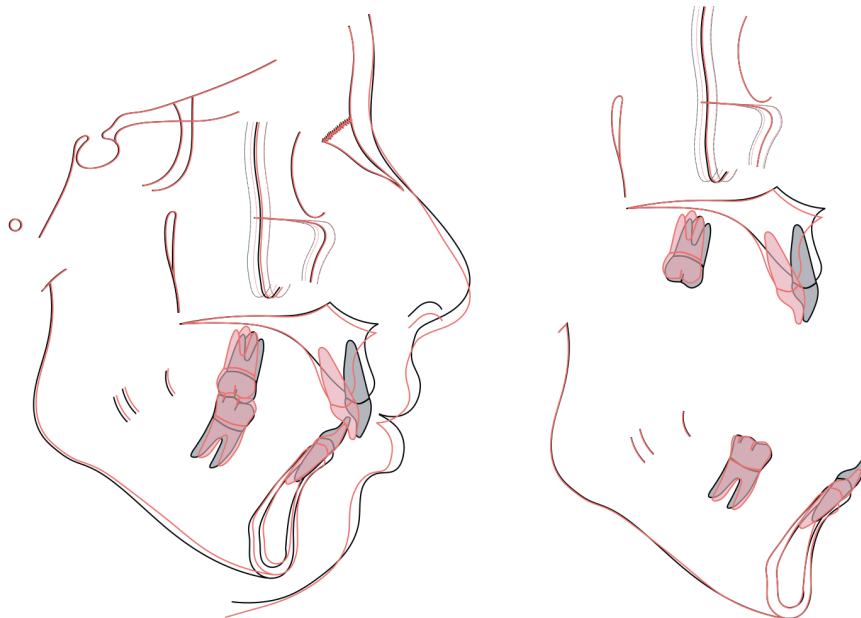
Following the ostectomy procedure, the tissue is repositioned slightly coronal to the CEJ and sutured with #4 Gore-Tex® sutures (Gore Medical Products, Flagstaff, AZ) (Fig. 12g). The gingiva usually heals with minimal coronal or apical movement of the repositioned soft tissue flap. It is often necessary to perform minor adjustments of gingival height and contour with a diode laser about 6 months post-operatively (Fig. 13).



■ Fig. 15: Post-treatment dental models (casts)



■ **Fig. 16:**
Post-treatment cephalometric (left) and panoramic (right) radiographs. See text for details.



■ **Fig. 17:**
Superimposed pre-treatment (black) and post-treatment (red) cephalometric tracings are superimposed on the anterior cranial base (left), maxilla (upper right), and mandible (lower right). See text for details.

After 30 months of active treatment, all fixed appliances were removed and clear overlay retainers were delivered. The patient was instructed to wear the retainers full time for the first 6 months and nights only thereafter. Home care and retainer maintenance instructions were provided.

Treatment Results

Interdisciplinary therapy with orthodontics and surgical crown lengthening produced an optimal result as documented in Figs. 14-15. The cephalometric and panoramic radiographs document the post-treatment results (Fig. 16). Superimposition of cephalometric tracings before and after treatment reveal the dentoalveolar changes (Fig. 17). The patient's lips were competent and protrusion was decreased. Facial convexity was improved $\sim 5^\circ$ when the head films were measured directly. Hypermental activity ("golf-ball chin") was reduced by a slight decrease in the VDO and correction of the lower lip eversion. These changes were not as obvious in the cephalometric superimpositions because of soft-tissue smoothing of the automated superimposition process. Improved intermaxillary alignment, particularly the correction of the impinging deepbite and lingually inclined upper incisors, provided for a mutually protected occlusion and more efficient mastication.

The final panoramic radiograph (Fig. 16) revealed moderate external apical root resorption of the four maxillary incisors, consistent with the intrusion mechanics (Fig. 10). The lower right first molar has an asymptomatic endodontic problem, evidenced

by a periapical radiolucent lesion on the mesial molar, that was associated with condensing osteitis (Fig. 16). In retrospect, the lesion may have been present in a less obvious form at the start of treatment (Fig. 6). An endodontics evaluation is indicated.

ABO Cast-Radiograph Evaluation (CRE) score was 24 points which was an excellent result for a severe malocclusion with a DI of 27. The major CRE discrepancies were: alignment/rotations (8 points), occlusal contact (4 points) and occlusal relationship (6 points). The Pink & White Esthetic score was 3 reflecting problems with mesial and distal papillae, incisal edge curvature, and incisal contact areas. The surgical crown lengthening resulted in pleasing crown heights. Six months post-operatively, irregular gingival margins were corrected with a diode laser. Overall, the maxillary incisors were prevented from extruding and the upper molars were slightly intruded. The gummy smile, everted lower lip, and facial convexity were significantly improved (Fig. 14). The patient was satisfied with the result.

Discussion

Patients are often concerned about dentofacial esthetics because a pleasant smile conveys a friendly nature, happiness and confidence. The smile is an important non-verbal communication that is an esthetic interaction between the lips, teeth and gingiva.¹ In western culture, a smile line with minimal gingival display is desirable. Excessive gingival exposure when smiling is commonly

referred to as a “gummy smile.” This is a relatively common condition affecting about 7% of men and 14% of women aged 20-30 years.²

The maxillary exposure, gingival margin to lip distance, was evaluated to determine when a “gummy smile” becomes unattractive. Orthodontists rated 2-mm³ to 3-mm⁴ of gingival exposure as unattractive, but general dentists and laypeople feel that 4-mm is required to rate a smile as unattractive.³ The physiologic reasons for a gummy smile include excessive vertical growth of the maxilla, extrusion of maxillary incisors, incomplete exposure of the anatomic crowns of teeth, hyperactivity of the elevator muscles of the upper lip, or a combination of all of these factors.⁵⁻⁷ Excessive gingival display is a clinical impression with a highly variable etiology.

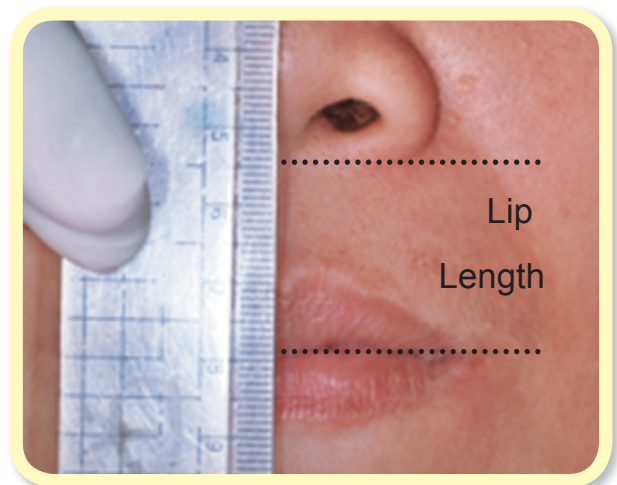
Gummy Smile

• Extra-Oral Component

Contributing factors to gummy smile are a short and/or hypermobile upper lip, anterior dentoalveolar extrusion and vertical maxillary excess.

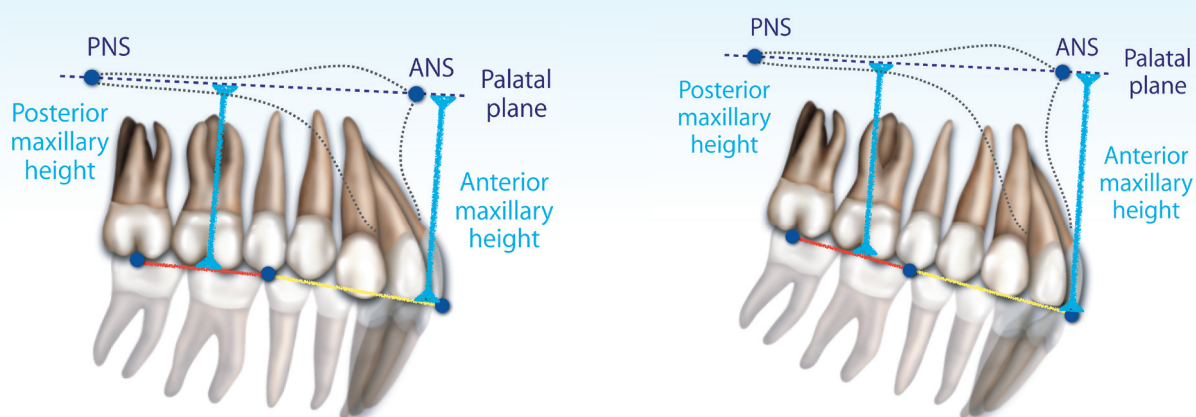
1. **Short upper lip:** Excessive gingival display is a frequent consequence of short upper lip, as measured from subnasale (Sn) to the inferior border of the lip (Fig. 18). The average length of the maxillary lip is 20~22-mm for young adult females, and 22~24-mm for young adult males.⁸ Individuals with less than ~20-mm of lip length are usually classified as having a short lip.

2. **Hypermobility:** The upper lip is excessively elevated by functional contraction of the lip elevator muscles⁹ and often results in excessive gingival display when smiling. A hypermobile upper lip is considered the primary etiologic factor for excessive gingival display, when the maxillary lip length is within the normal range, and the lower third of the face is within normal limits (WNL). Effective treatment for most types of gummy smile are well documented,^{5,9-14} but short hypermobile lips continue to be a challenging problem. Recently, the injection of botulinum toxin type A has been suggested as a temporary treatment.¹⁵
3. **Incisor exposure at rest:** The lips are incompetent if they do not touch at rest. If incisor exposure is more than 2-mm, excessive vertical growth of the maxilla may be a factor, and orthognathic



■ Fig. 18:

The length of the upper lip is measured from subnasale (Sn), which is intersected by the upper dotted line, to the inferior border of the lip (lower dotted line). See text for details.



■ Fig. 19:

The occlusal plane in the sagittal dimension is constructed according to the anterior and posterior maxillary heights as shown. A normal occlusal plane (left) is compared to a steepened occlusal plane (right) that is associated with vertical maxillary excess (VME). See text for details.

surgery (*LeFort 1 osteotomy*) is indicated. If the lips are competent, but incisal display is more than 4-mm when smiling, the hypermobile lip elevation may require botulinum toxin injection or lip repositioning.^{15,16}

4. Anterior dentoalveolar extrusion (ADE):

Exceeding the average anterior maxillary height of 29.7-mm,⁸ is deemed anterior dentoalveolar extrusion. This condition may be associated with anterior tooth wear or a deep bite (Fig. 19). The latter is usually associated with an occlusal disharmony between the anterior and posterior segments.¹⁷ Maxillary anterior teeth can be intruded with anterior miniscrew anchorage.⁸

5. Vertical maxillary excess (VME):

Inferior positioning of the maxilla was associated

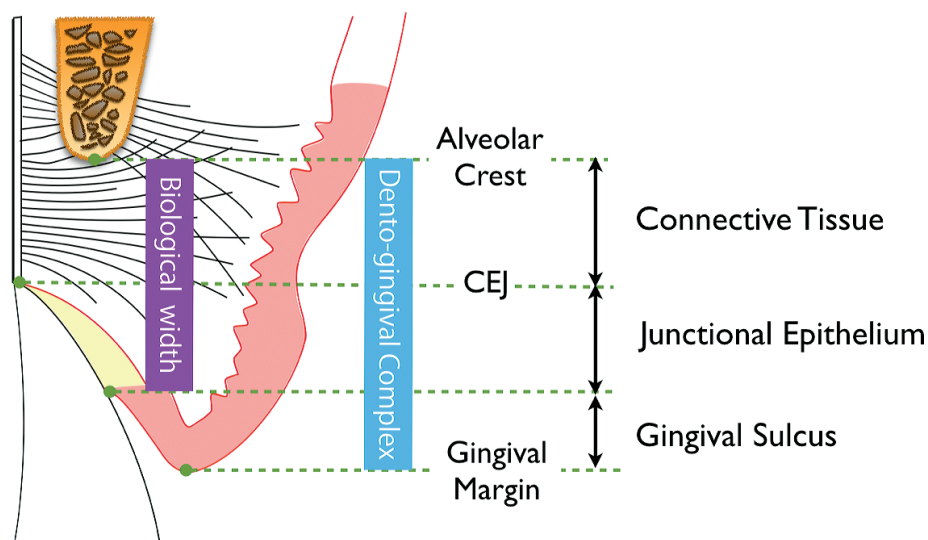
with clockwise rotation of the upper jaw, and an increase in lower facial height (Fig. 5, Table 1). A visual diagnosis of VME is made when the lower third of the face is excessive.⁵ Cephalometric analysis is indicated to quantify the problem (Table 1). Linear measurements can be made directly on cephalometric radiographs but the magnification of the images must be controlled. The average anterior maxillary height is 29.7-mm,⁸ whereas the average posterior maxillary height is 20.6-mm.¹⁸ The current patient's anterior and posterior maxillary heights were 29-mm and 19-mm respectively, so she did not qualify as either an ADE or VME type.

Relative cephalometric measures may be more sensitive for detecting skeletal discrepancies contributing to excessive gingival exposure.

The current patient was severely convex, 28° compared to a norm of 13° , and her lower facial height was 57.8% compared to the norm of 53% (Table 1). Relative values are useful for the facial assessment of all patients, but they are particularly sensitive for detecting skeletal patterns favoring a gummy smile.

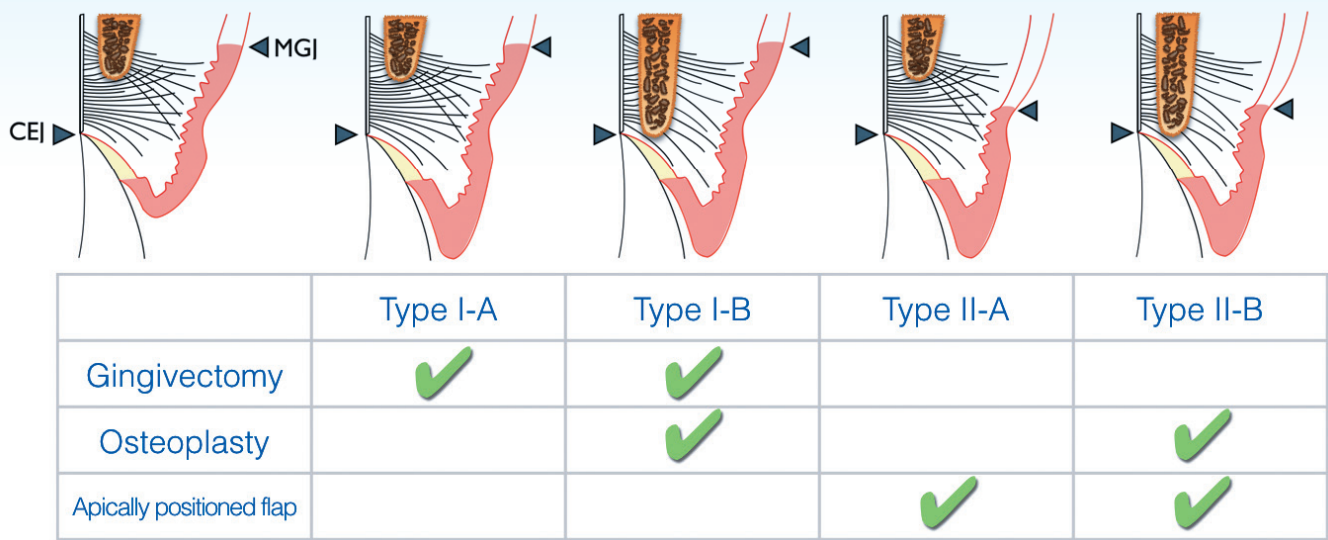
VME is often treated with orthognathic surgery. A LeFort I procedure down-fractures the maxilla, allowing for segmentalization and three-dimensional repositioning of the dento-alveolar complex. Most patients who undergo this procedure require hospitalization and a substantial recovery period. Post-operative complications may include significant swelling, edema, bruising, and physical discomfort (*pain*).¹⁹ For some patients with

VME, a multidisciplinary approach is indicated: orthodontics, orthognathic surgery, periodontics and restorative dentistry.¹ Some authors propose surgical correction of hypermobile and/or short upper lips,^{10,20-22} but most procedures involve increasing the depth of the vestibule. Increasing the depth of the fold may involve stripping the attachment of some elevator muscles, and is often indicated for dental alveolar anomalies.²³ Partial re-sectioning of the levator labii superioris muscle may be helpful.²⁰ However, the stability of this surgical procedure beyond 8 months²¹ is unknown. Minimally invasive surgical procedures are advocated for moderate VME and hypermobile upper lip.²³ A mucosal coronally positioned flap reduces gingival display by shortening the vestibular depth.²³



■ Fig. 20:

The thickness or width of the dentogingival complex is measured clinically by sounding to bone with a periodontal probe. The vertical dimension of a normal dentogingival complex from the gingival margin to bone is approximately 3.0-mm on the buccal and lingual surface, but increases to 4.5~5.0-mm interproximally.



■ Fig. 21:
It is important to note the relationship of the bone height and mucogingival junction (MGJ) to the cemento-enamel junction (CEJ). In general, increased pocket depth with a normal attachment at the CEJ, and adequate gingival width as defined by the MGJ, can be treated with a gingivectomy (Type I-A and I-B). A decreased band of attached gingiva is best treated with an apically positioned flap (Type II-A and II-B). If the bone height encroaches on the epithelial attachment (Type I-B and II-B), a 2-mm zone is established (Fig. 12e) for soft tissue attachment to avoid the inflammation associated with a biologic width violation.

• Intra-Oral Component

- 1. **Gingival enlargement:** Hypertrophic gingival tissues may be due to chronic inflammation, infection or medication (e.g. *phenytoin*, *cyclosporine*, *calcium channel blockers*). The treatment for this condition should focus on oral hygiene, but a gingivectomy may be indicated.¹⁷
- 2. **Clinical crown length:** The average crown length for an upper central incisor is 11-mm.
- 3. **Altered passive eruption:** Tooth eruption is divided into two phases: active and passive. Active eruption

is the movement of the teeth in the direction of the occlusal plane, whereas passive eruption is the exposure of the teeth by apical migration of the gingiva.²⁴ Before a crown-lengthening surgical procedure, a careful evaluation of biologic width and other factors of the dento-gingival complex is indicated (Fig. 20).¹ Depending on the level of the mucogingival junction (MGJ) and alveolar bone crest, there are four types of altered passive eruption: Type I A, type I B, type II A and type II B (Fig. 21).⁹ Type I and II are distinguished by the width of the keratinized gingiva (*soft tissue*). Subtype A and B refers the level of alveolar bone crest. Bone sounding revealed the current patient was type I B (*gingival width was WNL, but bone height was elevated*), which is best treated with flap exposure and osteoplasty.



■ Fig. 22:

Pre- and post-treatment images show the patient smiling and at rest (lips closed). The asymmetric gummy smile has been corrected.

4. **Incisal wear:** A discrepancy in gingival levels may reflect excessive incisal wear (*attrition*) of one or more teeth. Orthodontic correction focuses on leveling the gingival margins in preparation for restoration of the teeth, as needed.
5. **Crown-root ratio:** If the root is supported by adequate alveolar bone, crown lengthening can be performed without orthodontic intrusion.

• Treatment

Gummy smile of skeletal origin usually requires orthognathic surgery for correction, but a dental origin such as extrusion of the maxillary incisors can be corrected with intrusion mechanics. The

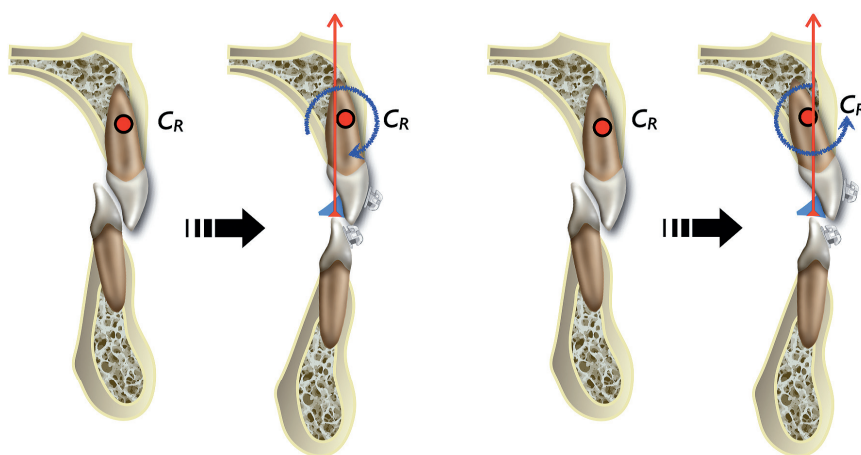
dentogingival type of gummy smile is related to abnormal dental eruption or lack of normal gingival recession, and requires lengthening of the anatomic crown. The neuromuscular type of gummy smile is caused by excessive contraction of the lip elevator muscles and can be improved temporarily by injecting botulinum toxin type A.

The lips of the current patient were incompetent as demonstrated by hypermental activity, (Figs. 1 and 5) so it was important to control the VDO. The use of maxillary anterior miniscrews as proposed by Lin et al.,²⁵ supplemented with IZC bone screw anchorage (Fig. 10), was successful (Fig. 22).

The IZC bone screws resisted heavy orthodontic forces for over 10 months, and remained stable. In the absence of definitive studies, the center of resistance (C_R) for the maxillary arch was presumed to be near the apices of the premolars (Fig. 10). Billiet et al.²⁶ used double exposure holography to evaluate headgear force applied to skulls, but they were unable to distinguish the C_R for the dentition, from that for the entire nasomaxillary complex. The C_R for rotation of the lower arch with mandibular buccal screw (MBS) anchorage is an axis through the midroot area of the canines bilaterally, as determined with finite element analysis (FEA).²⁷ It is important that similar studies be performed

to determine the C_R for bilateral IZC anchorage in the maxillary arch. Estimating arch rotation in 2D, relative to the line of force from an IZC bone screw, is unreliable unless the C_R of the arch is known.²⁷

As documented in the cephalometric superimpositions, there was a clockwise rotation of the anterior portion of the maxilla. This response is consistent with a line of force anchored by a IZC bone screw, that is inferior to the C_R for the maxillary dentition (Fig. 10). However, the maxillary retraction and rotation (Fig. 17) suggests the C_R for the upper dentition is more anterior than previously estimated (Fig. 10), which is consistent with MBS bone screw anchorage in the mandible.²⁷ An



■ Fig. 23:

Left two drawings: An anterior BT is bonded on the palatal surface of a lingually inclined maxillary incisor. The line of force from occlusion is lingual to the center of resistance (C_R) of the incisor (red dot) which tends to rotate the incisor (blue circular arrow) palatally.

Right two drawings: If the axial inclination of the maxillary incisor is corrected before the BT is attached, the line of occlusal force is labial to the C_R tending to increase the axial inclination of the incisor (blue circular arrow). See text for details.

accurate C_R for retracting the maxillary dentition with IZC anchorage would be very helpful for advanced treatment planning strategies to improve the scope of treatment and stability.

Anterior Bite-turbos

Anterior bite-turbos (BTs) are excellent tools for deepbite correction when bite opening and posterior rotation of the mandibular are acceptable. They are easy for efficient correction of deepbite. However, severe lingual tipping of maxillary incisors presents a unique problem in biomechanics. BTs generate an axial force on the upper central incisors that tends to increase their clockwise rotation relative to the maxilla.^{28,29} When anterior BTs are bonded on maxillary canines (Fig. 7), the moment arm on the vertical force is increased. So it was important to focus on correcting the axial inclinations of the upper central incisors early in treatment, so that the BTs could be moved to their lingual surfaces to produce an occlusal force that is anterior to the C_R (Fig. 23).

Conclusions

Excess gingival display (*gummy smile*) is a major esthetic concern for many patients. It is often a very complex problem. An effective strategy is to reverse the apparent etiology of the problem with specific mechanics, that are anchored with bone screws.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE

27

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

2

OVERBITE

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

Total

5

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

4

OCCCLUSION

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

Total

4

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 $< -2^\circ$ _____ x 1 pt. = _____Each degree $> 6^\circ$ _____ x 1 pt. = **4**

SN-MP

 $\geq 38^\circ$

=

2 pts.Each degree $> 38^\circ$ _____ x 2 pts. = **2** $\leq 26^\circ$

=

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

=

12

OTHER

(See Instructions)

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

IMPLANT SITE

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

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

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

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

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

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

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

Total

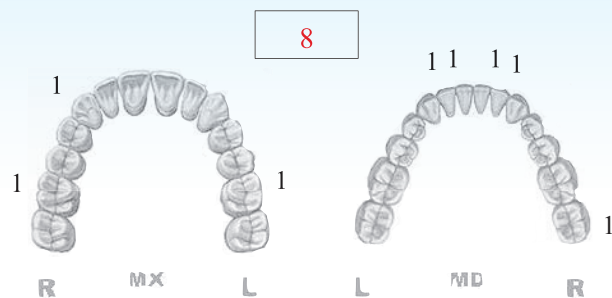
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0

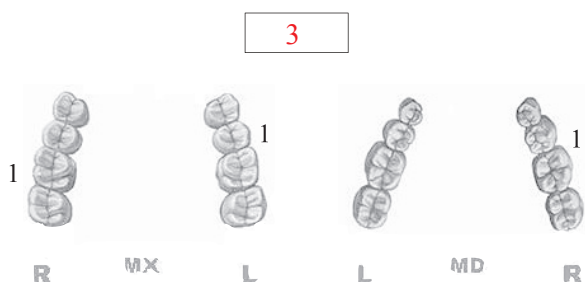
Cast-Radiograph Evaluation

Total Score: **24**

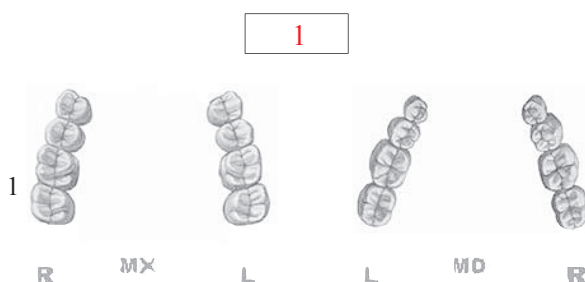
Alignment/Rotations



Marginal Ridges



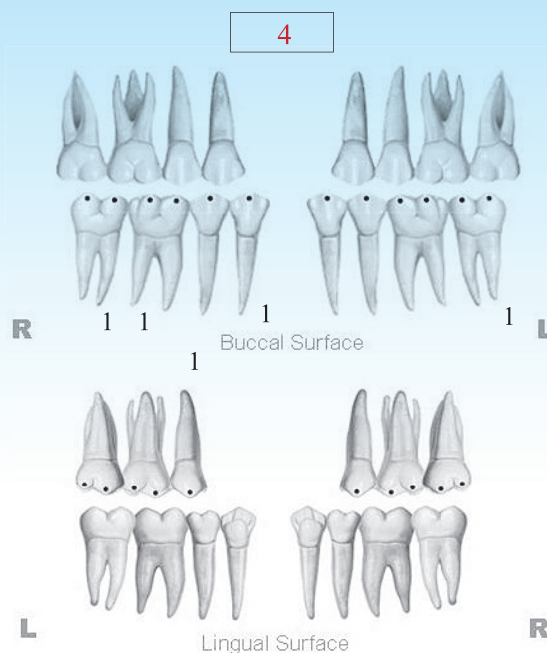
Buccolingual Inclination



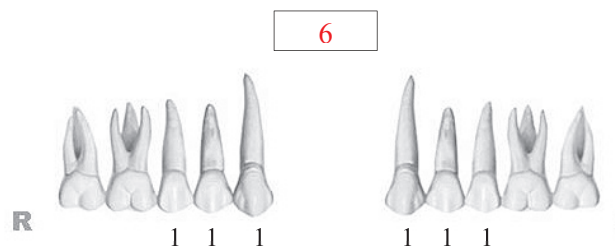
Overjet



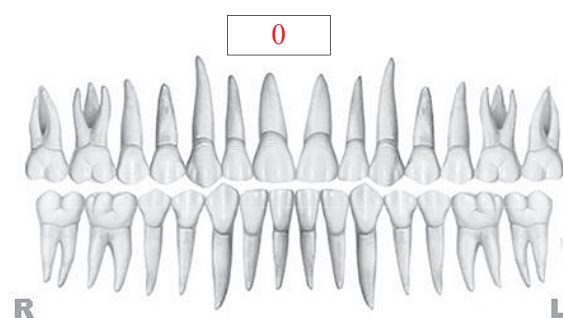
Occlusal Contacts



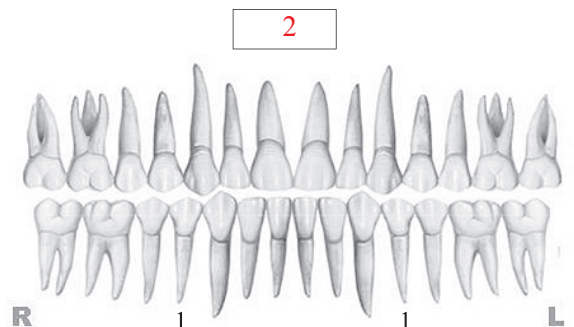
Occlusal Relationships



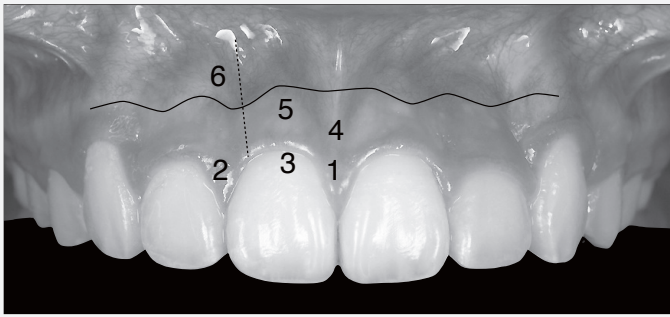
Interproximal Contacts



Root Angulation

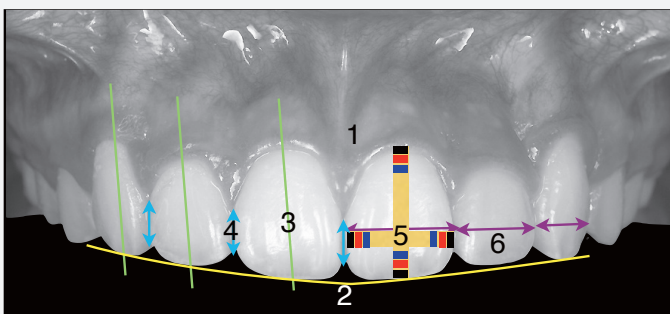


INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score (Before Surgical Crown Lengthening)Total Score: = **3****1. Pink Esthetic Score**

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

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

Total = **1****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

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 = **2**