Interdisciplinary Conservative Treatment for Gummy Smile and Deep Bite

Abstract

Diagnosis and Etiology: A 23-year-old female presented with chief complaints of excessive gingival display ("gummy smile") and severe intermaxillary crowding (>7mm). She desired improved smile esthetics without orthognathic surgery. The constricted, underdeveloped arches suggested inadequate occlusal loading, probably associated with a relatively soft, refined diet. Increased facial height (56.5%), bimaxillary retrusion (SNA 78.5°, SNB 74°), and extrusion of the maxillary dentition were consistent with a transient juvenile airway problem. The Discrepancy Index (DI) was 33.

Treatment: Interdisciplinary treatment involved dentofacial orthopedic alignment followed by maxillary anterior crown-lengthening surgery. All four first premolars were extracted to correct crowding. Skeletal anchorage was provided with three bone screws: infrazygomatic crests bilaterally, and another between the apices of the upper central incisors. Differential space closure with bone screw anchorage reduced lip protrusion, intruded the maxillary incisors, and achieved a near ideal Class I alignment. Surgical crown lengthening was performed in the maxillary anterior segment.

Results: 25 months of interdisciplinary treatment achieved a near ideal dentofacial result as evidenced by a Cast-Radiograph Evaluation (CRE) score of 27, and a Pink & White dental esthetic score of 2. (J Digital Orthod 2020;60:22-35)

Key words:

Gummy smile, deep bite, Class II malocclusion, bite-turbos, surgical crown lengthening, temporary anchorage devices, infrazygomatic crest, extra-alveolar, bone screws, etiology

Introduction

Gummy smile, excessive gingival exposure when smiling, is a common chief complaint (*CC*) for adults seeking orthodontic consultation. Previously, severe gummy smile was a clear indication for orthognathic surgery, but the expense and morbidity produced interest in less invasive camouflage treatment.¹ Temporary anchorage devices (*TADs*) and periodontal surgery enhance the capability for resolving gummy smile without resorting to undesirable orthognathic surgery.^{1,2} OrthoBoneScrews (*OBS*[®]s) are TADs produced by iNewton, Inc. (*Hsinchu City, Taiwan*). A 2mm diameter stainless steel (SS) OBS® achieves extraalveolar (*E-A*) anchorage in the infrazygomatic crest (*IZC*) region of the posterior maxillary arch;² while a 1.5mm SS OBS® is used for incisal anchorage near the root apices.^{1,2} The primary objective for this case report is to present interdisciplinary treatment with OBS® anchorage and crown-lengthening surgery as a viable conservative option for complex malocclusions including gummy smile. **Lomia Lee,** Orthodontist, Mozart Orthodontics (Left)

Chi Huang, Orthodontist, Mozart Orthodontics (Center left)

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

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



Diagnosis and Etiology

A 23-year-old female presented with a common CC: gummy smile and severe crowding in both arches (*Figs. 1-6*). She desired an attractive smile but was opposed to orthognathic surgery. Pre-treatment records revealed a straight facial profile (*Figs. 1 and 5*). The intra-oral examination showed that molar relationships were near Class I, but canine

relationships were Class II (*Fig.* 3). The overbite was 5mm (75%) with severe crowding of >7mm in both arches (*Fig.* 4). The upper left canine was blocked out, i.e., outside the dental arch form (*Fig.* 3). A lateral cephalometric radiograph (*Fig.* 5) indicated retrusive arches, particularly the mandible (*SNA* 78.5°, *SNB* 74°, *ANB* 4.5°), steep mandibular plane angle (*SN*-



Fig. 1: Pre-treatment facial and intraoral photographs

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MP 45°), and normal lip protrusion to the E-line (*0mm/1mm*) (*Table 1*). The panoramic radiograph was within normal limits (*WNL*), as was the radiographic assessment of the temporomandibular joint (*TMJ*) (*Figs. 6 and 7*). The ABO Discrepancy Index (*DI*) was 33 as shown in the subsequent worksheet (*Worksheet 1*).





Fig. 5: Pre-treatment lateral cephalometric radiograph

Fig. 2:

Gummy smile, asymmetrical gingival display, and blocked-out canine are documented in a frontal photograph.



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



Fig. 4:

Inferior (left) and lateral (right) intraoral views show a 6mm anterior deepbite.



Fig. 6: Pre-treatment panoramic radiograph



Fig. 7:

Pre-treatment TMJ transcranial radiographs are shown for the right (R) and left (L) sides in the rest and open positions. The mandibular condyles are outlined in red.

CEPHALOMETRIC SUMMAR	۲Y	1
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SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	78.5°	78°	0.5°
SNB° (80°)	74°	74.5°	0.5°
ANB° (2°)	4.5°	3.5°	1°
SN-MP° (32°)	45°	44.5°	0.5°
FMA° (25°)	38°	37.5°	0.5°
DENTAL ANALYSIS			
U1 To NA mm (4mm)	5.5	3.5	2
U1 To SN° (104°)	105°	104°	1°
L1 To NB mm (4mm)	8.5	5	3.5
L1 To MP° (90°)	93°	82.5°	10.5°
FACIAL ANALYSIS			
E-LINE UL (-1mm)	0	-2	2
E-LINE LL (0mm)	1	-2	3
%FH: Na-ANS-Gn (53%)	56.5%	56%	0.5%
Convexity: G-Sn-Pg' (13°)	8°	8°	0°

Table 1: Cephalometric summary

Treatment Objectives

After a discussion of potential treatment options, the following goals were established:

- (1) Extract four first premolars to relieve crowding.
- (2) Align, level, and expand both arches to reduce buccal corridor width.
- (3) Place three TADs: an OBS in each IZC, and an incisal miniscrew apical to upper central incisors.
- (4) Correct the Class II buccal relationships with TAD anchorage.
- (5) Reduce overbite by intruding upper and lower incisors.

(6) Correct the upper anterior crown-to-root ratio with surgical crown-lengthening.

Treatment Alternatives

The patient was opposed to orthognathic surgery, so the conservative treatment plan with bite turbos (*BTs*) and bone screws was the preferred option (*Figs.* 8 and 9). The conservative treatment procedures were explained: (1) occlusal inconvenience when the vertical dimension was opened with anterior bite turbos, (2) use of TAD anchorage, and (3) surgical crown lengthening with selective laser gingivectomy. After a thorough discussion of the entire treatment sequence, the patient provided informed consent for all the planned treatment procedures.

Treatment Progress

First premolars were extracted in each quadrant, and a 0.022-in Damon Q[®] (*Ormco, Brea, CA*) fixed appliance was installed. The maxillary central incisors and canines were bonded with high torque brackets,



Fig. 8:

At 9 months into treatment, palatal bite turbos were placed on upper central incisors, and Class II elastics (Ormco, Fox) were applied.



📕 Fig. 9:

A 2D design of the intermaxillary mechanics on the right side is shown relative to bone screw anchorage apical to the maxillary molars and central incisors. In 3D, the mechanics and anchorage are symmetrical on both sides. The chain of elastics from the IZC bone screw (upper left) to the cuspid bracket is a line of force with posterior and vertical components (blue arrows) that produce a clockwise moment around the maxillary arch center of resistance (blue curved arrow). The maxillary anterior miniscrew (upper right) anchors an intrusive force (yellow arrow) that creates a counterclockwise moment (yellow curved arrow), tending to flare the maxillary incisors. The presumed resultant for all the applied loads is the green arrow that shows intrusion and retraction of the entire maxillary arch.

and standard torque brackets were used for the rest of the dentition. Both arches were leveled and aligned with the following archwire sequence: 0.014" CuNiTi, 0.014x0.025" CuNiTi, 0.017x0.025" TMA, and 0.016x0.025" SS (*Fig. 10*). All archwires and elastics were also supplied by Ormco.

Bite turbos were placed on the palatal surfaces of the upper central incisors at 9 months, and Class II elastics (*Fox 1/4-in, 3.5-oz*) were applied simultaneously (*Fig. 8*). Three bone screws (*TADs*) were placed at 10 months to anchor intrusion of the entire maxillary dental arch. A 2x12-mm OBS[®] was placed in each IZC, and a 1.5mm miniscrew was placed between the apices of the upper central incisors. The planned mechanics, diagramed in Fig. 9, corrected the malocclusion. Careful clinical management produced the desired functional occlusion with proper anterior guidance and adequate posterior support. After routine finishing and detailing procedures, all appliances were removed after 24 months of active treatment. Retention was accomplished with maxillary and mandibular clear overlay retainers. Surgical crownlengthening was performed one month later. Detailed treatment progress is described in the discussion section.

Treatment Results

The patient was satisfied with the outcome: balanced profile, attractive smile, gummy smile correction, and good dental alignment (*Fig. 11*). The canine and molar relationships were corrected to Class I (*Fig. 12*). A functional occlusion with stable posterior support and near ideal anterior



Fig. 10: Treatment progress in months (M) is shown in six right buccal intraoral views arranged in clockwise order. See text for details.



Fig. 11: Post-treatment facial and intraoral photographs

guidance was established (*Fig. 13*). Cephalometric superimpositions before and after treatment showed that the maxillary first molars were translated about 3mm anteriorly (*Fig. 14*). The maxillary central incisors were intruded 1.5mm, and retracted about 3mm. Mandibular first molars were moved anteriorly

about 2mm. The lower incisors were uprighted about 10°, and intruded 1mm. The amount of counterclockwise rotation of the mandible was less than predicted (*Fig. 14*), but it was adequate to serve as a platform for the crown-lengthening procedure to achieve optimal correction of the gummy smile.



Fig. 12: Post-treatment dental models (casts)



Fig. 13: Post-treatment lateral cephalometric radiograph



Fig. 14:

Cephalometric tracings superimposed on the anterior cranial base (left), on the maxilla (upper right), and on the mandible (lower right) show the dentofacial changes associated with 24 months of active treatment (red) compared to pre-treatment (black). See text for details.

Panoramic radiography at the end of the treatment showed near ideal root alignment (*Fig. 15*), and the follow-up TMJ evaluation was WNL (*Fig. 16*). The ABO Cast-Radiograph Evaluation (*CRE*) score was 27 points (*Worksheet 2*). The major CRE discrepancy was decreased occlusal contacts, which may reflect the anatomy of previous posterior dental restorations. The patient accepted the condition, and was not interested in further restorative treatment.

The Pink and White dental esthetic score was 2 points, as shown in the supplementary Worksheet 3. The patient was well satisfied with her dentofacial esthetics and functional occlusion.

Discussion

The term "gummy smile" refers to excessive gingival display >3mm during a full smile (Fig. 17a).³ The specific problems for the current patient were: (a) short and hyper-mobile upper lip, (b) vertical maxillary excess, (c) extrusion of upper anterior dentition, and (d) altered passive eruption.^{1,4} Myofunctional training to control expression of the smile is useful for a short and hyper-mobile lip, but structural correction is required for vertical maxillary excess, dental extrusion and altered passive eruption.^{1,2,5} Gummy smile correction focused on intrusion of the entire maxillary arch (Fig. 17b). There were three keys for treatment:



Fig. 15: Post-treatment lateral panoramic radiograph



📕 Fig. 16:

Post-treatment TMJ transcranial radiographs are shown of the right (R) and left (L) sides in the rest and open positions. The contours and articular relationships are WNL. See text for details.



Fig. 17:

- (a) **Post-Orthodontic Treatment**: frontal photograph revealed increased gingival exposure when smiling, due to excessive gingival tissue, short clinical crowns, and exaggerated lip elevation.
- (b) **Final Outcome**: Crown-lengthening, laser gingivectomy, and more natural upper lip elevation resulted in an attractive smile.

- 1. Anterior Bite Turbo (BT): BTs were bonded on the lingual surfaces of upper central incisors for correction of deep bite. Anterior BTs are most effective when bite opening produces ideal anterior overbite and overjet, but apical loads on incisors commonly result in intrusion of upper and lower incisors.^{6,7} BTs also serve as incisal stops to establish the level of the posterior occlusion at the desired vertical dimension of occlusion (*VDO*).⁸ The desired plane of occlusion is produced by spontaneous eruption of the posterior dentition and orthodontic extrusion via NiTi archwire leveling and Class II elastics.
- **2. TAD Force Design and Position**: According to Dellinger,⁹ light forces (*50-100g*) provide optimal intrusion with minimal root damage. A force of approximately 20 gram/tooth,^{7,9} is suggested for axial intrusion with minimal risk of root resorption.^{10,11} The anterior position of the incisal miniscrew determines the line of force relative to the smile arc (*Fig. 18*). A 2-TAD design is preferred for distributing the intrusive force to protect the smile line. In contrast, a 1-TAD mechanism applies a single line of force between the upper

central incisors that may flatten the smile arc. The latter is less invasive, but adjustment of a relatively stiff archwire is required in order to achieve an attractive maxillary anterior smile line (Figs. 18 and 19).⁴

3. Surgical Crown Lengthening: Osteoplasty is usually required in order to apically reposition the alveolar bone margin. This procedure is necessary to provide adequate biologic width for soft tissue attachment (Fig. 19). Measuring gingival sulcus depth and bone sounding under local anesthesia are important diagnostic tools for determining the appropriate level for crestal bone.⁵ The present patient exhibited an adequate zone of attached gingiva, and the bone sounding depth was 3mm. Based on Coslet's classification of altered passive eruption,¹² the patient was classified as Type I-B (excessive bone and gingiva). Surgical crown lengthening and selective laser gingivectomy were used to enhance dental esthetics by apically repositioning the gingival margin while maintaining an appropriate biologic width (Fig. 19).¹ The cementoenamel junction (CEJ) is the anatomical reference for crown lengthening.⁵



Fig. 18:

Comparison of a 1-TAD (a) to a 2-TAD (b) design for intrusion of the upper anterior segment shows the advantage of the 2-TAD design for maintaining the smile arc (curved blue line). Achieving an adequate smile line with the 2-TAD mechanism requires a stiffer archwire adjusted to enhance the smile arc. See text for details.



Fig. 19: Sequential steps in the surgical crown-lengthening procedure shown in a clockwise order were :

(a) Short clinical crowns with adequate keratinized gingiva are shown relative to the mucogingival junction (MGJ) depicted as a dotted line.

(b) Yellow line represents the CEJ, the biologic width (green BW) is 2mm of exposed root apical to the CEJ, and the blue line represents the ideal bone position.

(c) After osteoplasty, the CEJ (yellow line) is separated from the bone level (blue line) by a 2mm width of exposed root apical to the CEJ.

(d) Marginal gingiva is repositioned and sutured with 4-0 Gore-Tex® (Gore Medical Products, Flagstaff, AZ, USA).

(e) 10 days post-operatively, the sutures are removed.

(f) Gingival contours are shown after refinement with selective diode laser gingivectomy. Compare to image (a), note the wide band of attached gingiva inferior to the MGJ.

The relationship of the CEJ to the osseous crest was mapped. Bone removal was performed with a [#]5 round carbide bur to establish a uniform 2mm biologic width¹³ for the anterior teeth. After gingival wound healing, diode laser gingivectomy was performed to refine gingival margins. Following the periodontal procedures, the patient was trained in natural lip elevation by observing her smile in a mirror. Attractive dentofacial esthetics when smiling was achieved (*Fig. 17b*).

Conclusions

Esthetic correction of deep-bite with a gummy smile is challenging. This case report is a step-bystep protocol for achieving an excellent outcome without orthognathic surgery. The maxillary arch was orthodontically intruded with TAD anchorage. Then, the desired enamel exposure (*crown length*) in the upper anterior segment was achieved with crown-lengthening surgery and selective laser gingivectomy. Natural lip elevation training was provided. A four-year follow-up evaluation of the patient documented excellent stability, good periodontal health, and routine expression of an attractive, natural smile (*Fig. 20*).

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Fig. 20: Four-year post-treatment follow-up records: facial and intraoral photographs

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Discrepancy Index Worksheet

33

TOTAL D.I. SCORE

OVERJET

=	
=	U pts.
=	2 pts.
=	3 pts.
=	4 pts.
=	5 pts.

Negative OJ (x-bite) 1 pt. per mm. per tooth =



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

=

CROWDING (only one arch)

1 – 3 mm. 3.1 – 5 mm. 5.1 – 7 mm. > 7 mm.	= = =	1 pt. 2 pts. 4 pts. 7 pts.
> / mm. Total	=	/ pts.

1

OCCLUSION

Class I to end on End on Class II or III Full Class II or III Beyond Class II or III	= = =	0 pts. 2 pts. per side <u>pts.</u> 4 pts. per side <u>pts.</u> 1 pt. per mm. <u>pts.</u> additional
Total	=	0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth	Total	=		0
BUCCAL POSTERIO	<u>OR X-B</u>	BITE		
2 pts. per tooth	Total	=		2
<u>CEPHALOMETRIC</u>	<u>S</u> (Se	e Instruct	ions))
ANB $\geq 6^{\circ}$ or $\leq -2^{\circ}$			=	4 pts.
Each degree $< -2^{\circ}$		_x 1 pt.	=_	
Each degree $> 6^{\circ}$		_x 1 pt.	=_	
SN-MP				
\geq 38° Each degree > 38°	7	_x 2 pts	= . =_	2 pts. 14
$\leq 26^{\circ}$			=	1 pt.
Each degree $< 26^{\circ}$		_x 1 pt.	=_	
1 to MP \geq 99°			=	1 pt.
Each degree $> 99^{\circ}$		_x 1 pt.	=_	
	Tota	al	=[16

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 (≥3mm)	@ 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 \geq 2mm)	@ 2 pts. =	
Tooth transposition	x 2 pts. =	
Skeletal asymmetry (nonsurgical tx)	@ 3 pts. =	
Addl. treatment complexities	2 x 2 pts. = 4	

Identify: severe gummy smile short clinical crowns

Total = 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.

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





1. Pink Esthetic Score





2. White Esthetic Score (for Micro-esthetics)





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
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

1

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