

Comprehensive Retreatment of a 60yr Female: Skeletal Class II Division 2 Malocclusion, Severe Deepbite and Extraction Spaces

Abstract

History: A 60yr female presented with the chief complaint—unacceptable dentofacial esthetics. As an adolescent she had received full fixed orthodontic treatment including extraction of four premolars.

Diagnosis: A relatively straight facial profile was associated with an excessive ANB angle (5.2°), protrusive maxilla (83.3°) and retrusive mandible (78.1°). The occlusion was Class II Division 2 with an impinging deep bite ($>9\text{mm}$) and overjet of $\sim 7\text{mm}$ in centric occlusion. First premolar extraction sites were open ($2\text{--}3\text{mm}$ bilaterally) in the maxillary arch. The ABO discrepancy index (DI) was 15.

Etiology: The unfavorable longterm outcome was probably due to extraction of premolars in the lower arch, inadequate root alignment, and steepening of the plane of occlusion with extensive Class II elastics.

Objective: Optimize dentofacial esthetics consistent with an acceptable dental alignment.

Treatment: Open the vertical dimension of occlusion (VDO) $\sim 8\text{mm}$ with bite turbos placed on the maxillary canines. Use a full fixed, passive self-ligating (PSL) appliance to align both arches, close space, and maintain an $\sim 5\text{mm}$ increase in the VDO. Correct black triangles in the maxillary anterior segment with enamel interproximal reduction (IPR) and space closure. Resolve the overjet and intermaxillary discrepancy with Class II elastics applied to the buccal or lingual of the U3s and L6s according to their relative axial inclinations. Utilize torquing auxiliaries to increase the axial inclination of the maxillary incisors. Retain with upper and lower Hawley to be worn full time for 6 mo, and nights only thereafter.

Outcomes: The mandibular plane rotated posteriorly (2.5°), facial convexity increased, and lip protrusion decreased, but the Class II intermaxillary discrepancy increased. Residual Class II buccal segments resulted in an ABO cast-radiograph evaluation (CRE) of 30 points.

Conclusions: A pleasing dentofacial result was achieved by increasing the VDO and correcting the incisal relationships, but longterm retention with Hawley retainers is indicated. (*J Digital Orthod* 2018;51:4-17)

Key words:

Class II, deepbite, Retreatment, Bite turbos, Torquing spring, IPR (interproximal reduction)

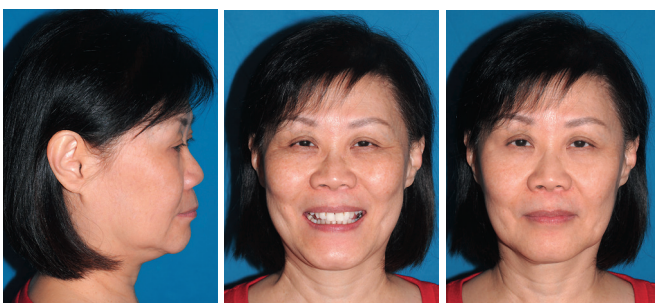
History

This 60-year-old female received full fixed orthodontic treatment as an adolescent, that included extraction of upper first (4s) and lower second (5s) premolars. In the absence of longterm retention, the malocclusion relapsed and extraction spaces were evident in the upper arch. Overall, the chief complaint was poor dentofacial esthetics, but she also had a number of specific oral concerns: 1. relatively protrusive lips, 2. deep overbite, 3. food impaction in the upper extraction sites, and 4. difficulty with oral hygiene (Figs. 1-3). After 2 years and 7 months (31mo) of active treatment, a desirable dentofacial result (Figs. 4-6) was achieved with a passive self-ligation (PSL) fixed appliance. Radiographic documentation before and after treatment is

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■ Fig. 1: Pre-treatment facial photographs



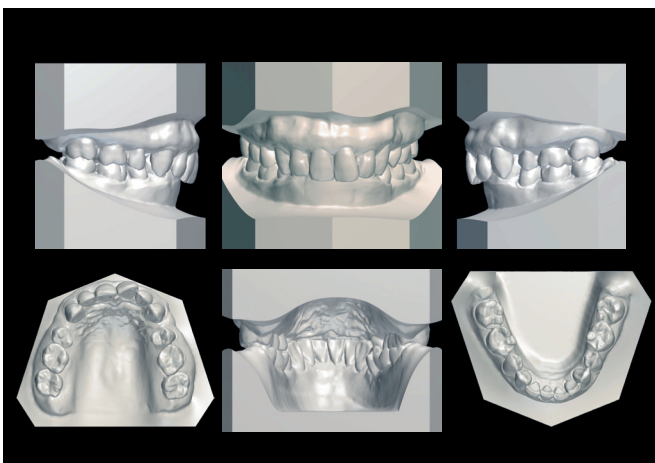
■ Fig. 4: Post-treatment facial photographs



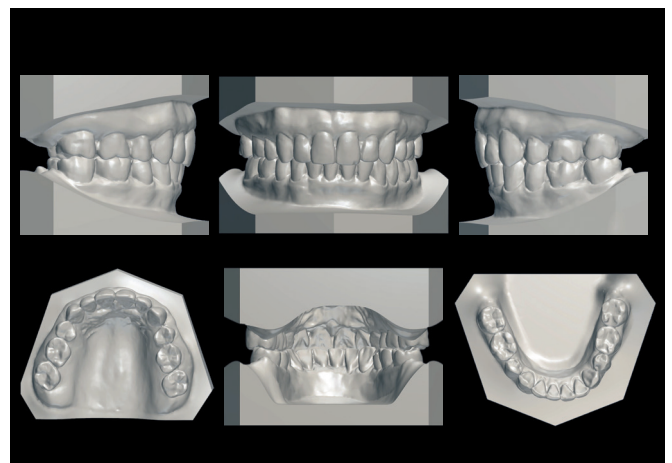
■ Fig. 2: Pre-treatment intraoral photographs



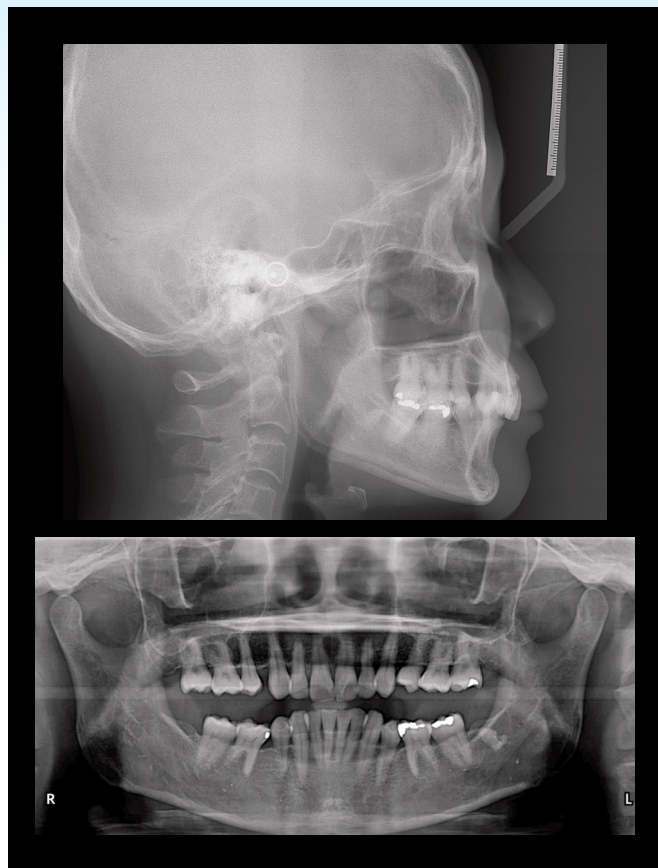
■ Fig. 5: Post-treatment intraoral photographs



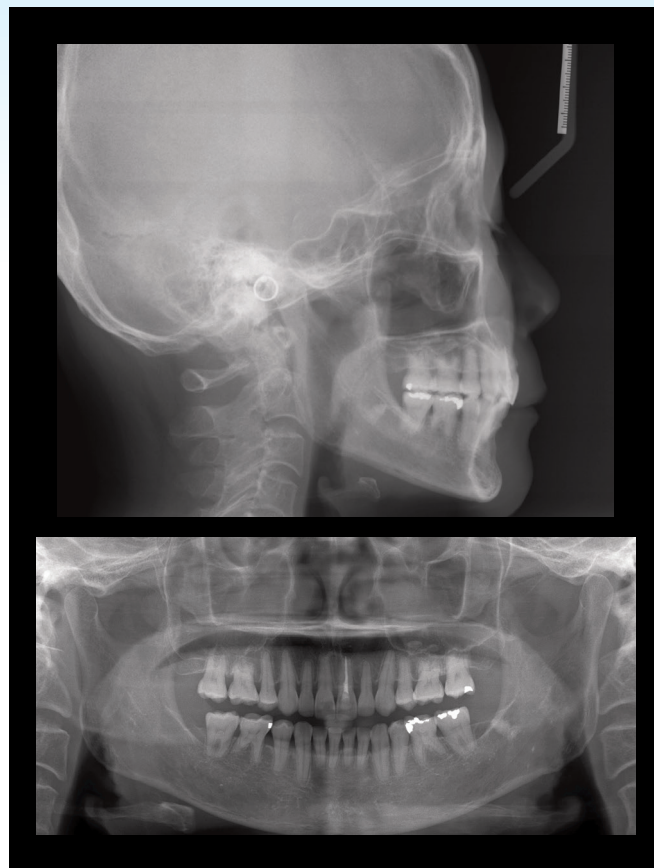
■ Fig. 3: Pre-treatment study models (casts)



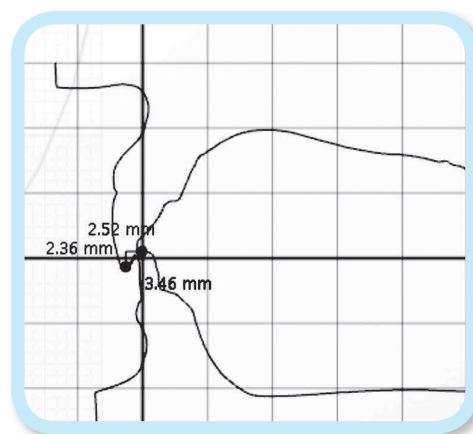
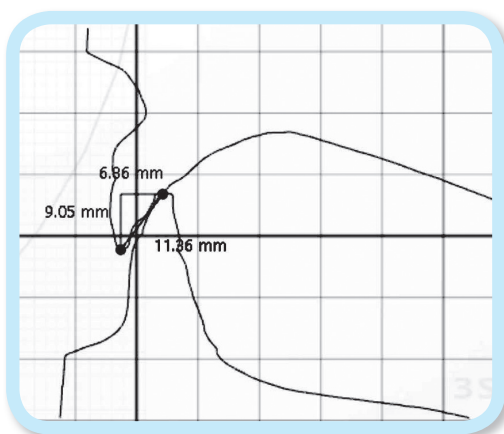
■ Fig. 6: Post-treatment study models (casts)



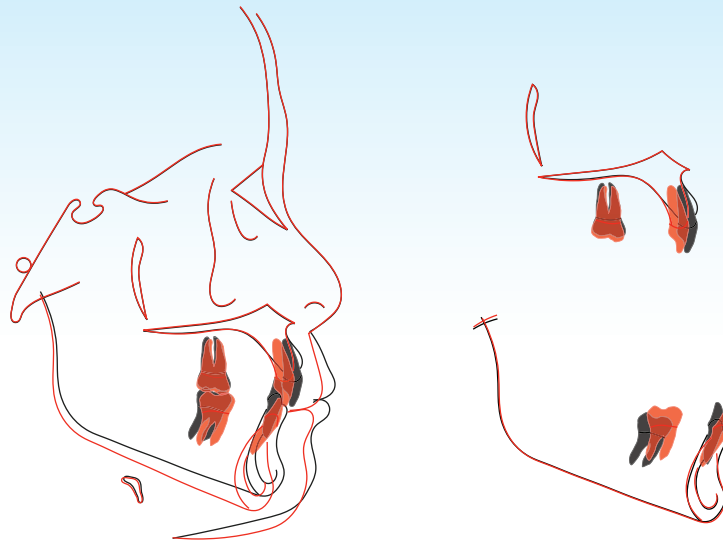
■ **Fig. 7:**
Pre-treatment cephalometric and panoramic radiographs



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



■ **Fig. 9:**
A profile projection of the overjet and overbite correction is plotted the mid-sagittal plane. Initial is on the left and final is on the right.



■ Fig. 10: Cephalometric superimpositions (Black: initial, Red: final).

provided in Figs. 7 and 8, respectively. Overjet and overbite data are shown in Fig. 9, and cephalometric superimpositions document the skeletal and dentofacial results (Fig. 10).

Diagnosis

Pre-treatment facial photographs (Fig. 1) show a straight profile with slight lip protrusion. Although the patient was concerned about her lips, that relative protrusion was within normal limits (WNL) based on cephalometric standards (Table 1). The upper dental midline was coincident with the facial midline, but the axial inclination of upper incisors was tilted to the left, and the chin point was deviated to the right. Pre-treatment intraoral photographs and study casts (Figs. 2 and 3) revealed Class II canine and molar relationships bilaterally. There was minor crowding, 1.5mm of space deficiency, in the lower arch, and 4.5mm of residual extraction space in the upper arch. An impinging deep overbite of 9.05mm (>100%) was associated with an excessive overjet of 6.86mm in centric occlusion (Fig. 9). Cephalometric

analysis (Table 1) shows ANB angle of 5.2° with a mandibular plane that is WNL (SN-MP of 37.1°, FMA of 26.8°). Dental compensation of the incisors resulted in decreased axial inclinations, U1-SN is 79.7° and L1-MP is 79.5°.

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	83.3°	83.4°	0.1°
SNB° (80°)	78.1°	76.6°	-1.5°
ANB° (2°)	5.2°	6.8°	1.6°
SN-MP° (32°)	37.1°	39.7°	2.6°
FMA° (25°)	26.8°	29.3°	2.5°
DENTAL ANALYSIS			
U1 To NA mm (4 mm)	-3.6 mm	-3.1 mm	0.5 mm
U1 To SN° (104°)	79.7°	84.7°	5.0°
L1 To NB mm (4 mm)	1.9 mm	5.2 mm	3.3 mm
L1 To MP° (90°)	79.5°	94.5°	15.0°
FACIAL ANALYSIS			
E-LINE UL (2-3 mm)	1.5 mm	-0.4 mm	-1.9 mm
E-LINE LL (1-2 mm)	1.7 mm	-1.5mm	-3.2 mm

■ Table 1: Cephalometric summary

Skeletal:

- Skeletal Class II ($SNA\ 83.3^\circ$, $SNB\ 78.1^\circ$, $ANB\ 5.2^\circ$)
- Mandibular plane angle ($SN-MP\ 37.1^\circ$, $FMA\ 26.8^\circ$) is WNL
- Facial asymmetry: *Chin point deviated to the right*

Dental:

- Bilateral Class II canine relationship
- Overjet: 6.86mm
- Overbite: 9.05mm (*exceeding 100% and impinging in the palate*)
- Upper arch space: 4.5mm excess
- Lower arch space: -1.5mm deficiency
- Lower Curve of Spee: 6mm
- Midlines: *Upper coincident with the facial midline, lower deviated 0.5mm right*
- Arch forms: *Asymmetric tapered arch forms in the maxilla and mandible*

Facial:

- Convex profile
- Acute nasolabial angle
- Relatively protrusive upper lip

The ABO Discrepancy Index (DI) was 15 as shown in the first worksheet at the end of this report.

Etiology

About 45 years after treatment as an adolescent, follow-up radiographs (Fig. 7) suggest incomplete correction of a Class II division 2 malocclusion: 1. poor root alignment in the lower arch, 2. open extraction sites in the upper arch, and 3. palatally

tipped maxillary incisors. The unfavorable long-term outcome was probably due to extraction of premolars in the lower arch, inadequate root alignment, and steepening of the plane of occlusion, due to extensive use of Class II elastics.

Treatment Objectives

The patient's principal objective was improved dentofacial esthetics. After a thorough examination and discussion of the options, a comprehensive retreatment plan was formulated utilizing a PSL bracket system to: 1. open the vertical dimension of occlusion (VDO), 2. flatten the deep curve of Spee, 3. correct maxillary anterior black triangles, 4. correct axial inclination of the incisors, 5. align both arches, 6. close spaces in the upper arch, 7. relieve slight crowding in the lower arch, and 8. correct as much of the Class II buccal discrepancy as possible.

Maxilla (all three planes):

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

Mandible (all three planes):

- A – P: *Maintain*
- Vertical: *Increased*
- Transverse: *Maintain*

Maxillary Dentition:

- A – P: *Retract*
- Vertical: *Increase*
- Transverse: *Expand*

Mandibular Dentition:

- A – P: *Advance*
- Vertical: *Increase*
- Transverse: *Expand*

Facial Esthetics:

- Convexity: *Increase*
- Lip Protrusion: *Decrease*

Treatment Plans

Open the VDO ~8mm with glass ionomer bite turbos (GIBTs) placed on the upper canines. Close upper spaces, and flatten the lower curve of Spee. Utilize high torque brackets on the upper anterior teeth to improve axial inclinations as they are retracted. Complete the correction of upper incisor inclinations with torquing auxiliaries, and resolve as much of the sagittal intermaxillary discrepancy as possible with Class II elastics applied to the buccal or lingual of the U3s and L6s according to their relative axial inclinations.

Appliances and Treatment Progress

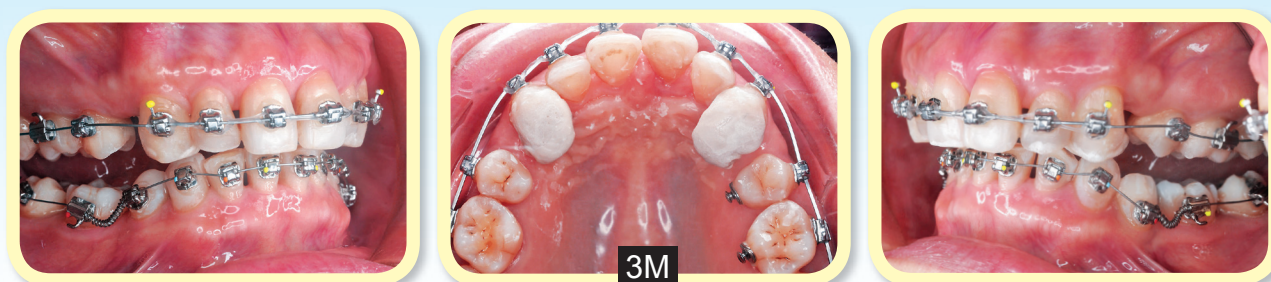
The full fixed PSL appliance (Damon Q®, Ormco, Glendora CA) was bonded on the upper arch and high torque brackets were utilized on the upper incisors. The initial archwire was 0.014-in CuNiTi (Fig. 11). GIBTs were cemented on the lingual surface of upper canines to increase the VDO to establish clearance for placing brackets in the lower arch. Two segments of open coil spring were used between lower first premolars (L4s) and first molars (L6s) bilaterally to correct axial inclinations and provide space to flatten the excessive curve of Spee. After arch alignment, the GIBTs were removed and relatively light force (4-oz, 112g, ~1N) Class II elastics were applied bilaterally from the lingual of the L6s to the upper canines (U3s) to retract the maxillary anterior segment and protract the lower posterior segments (Fig. 12).

In the 6th month of treatment, an expanded 0.016x0.025-in SS archwire was used to increase upper arch width (Fig. 13). After 7 months of initial alignment, ~4mm of space was opened bilaterally in the lower arch, and the curve of Spee was flattened (Figs. 14 and 15). Interproximal reduction (IPR) of enamel was performed with abrasive strips and an



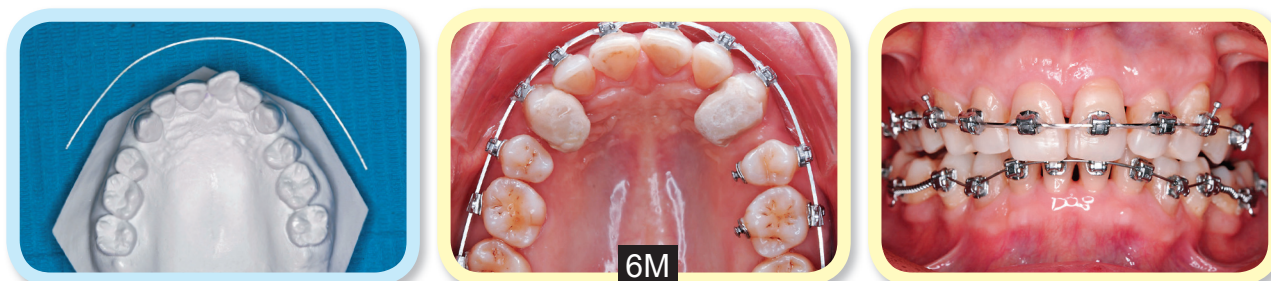
■ Fig. 11:

At the start of treatment (0M), high torque Damon Q brackets were bonded on the maxillary anterior segment to increase palatal root torque. The initial archwire was 0.014-in CuNiTi. See text for details.



■ Fig. 12:

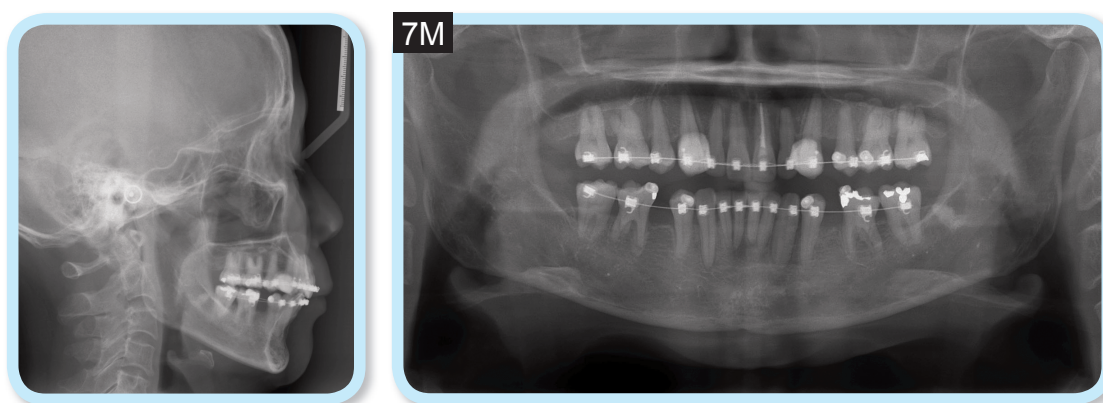
At three months (3M) into treatment, bite turbos were bonded on the lingual surface of upper canines to provide clearance for brackets in the lower arch. Two segments of open coil spring were used between lower first premolars and first molars bilaterally to help level the mandibular arch and correct the deep curve of Spee. The initial archwire was 0.013-in CuNiTi. See text for details.



■ Fig. 13: At six months (6M) into treatment, an expanded 0.016x0.025-in SS archwire was used to expand the upper arch.



■ Fig. 14: Seven months (7M) into treatment, reopening of the extraction spaces was noted as the arches were aligned.



■ Fig. 15: Cephalometric and panoramic radiographs document progress at seven months (7M).

air-rotor on the upper incisors. The interproximal space was closed to reduce the black triangles and enhance dental esthetics (Fig. 16).

Long-term Class II elastics wear retracted the upper dentition and protracted the lower dentition to reduce the excessive overjet. The increase in VDO and flattening of the curve of Spee corrected the

deep overbite (Fig. 17). Retracting the upper anterior segment resulted in palatal tipping of the incisors despite the high torque brackets, so torquing springs were used on upper incisors beginning 22 months into treatment (Fig. 18). A progressive series of intraoral profile views of the incisors documents management of incisal coupling from the start (0M) to the end (2Y7M) of active treatment (Fig. 19).



■ Fig. 16:

At thirteen months (13M), IPR was done with high speed burs and abrasive stripes on the upper incisors. The space was closed with elastomeric chains to reduce black triangles.

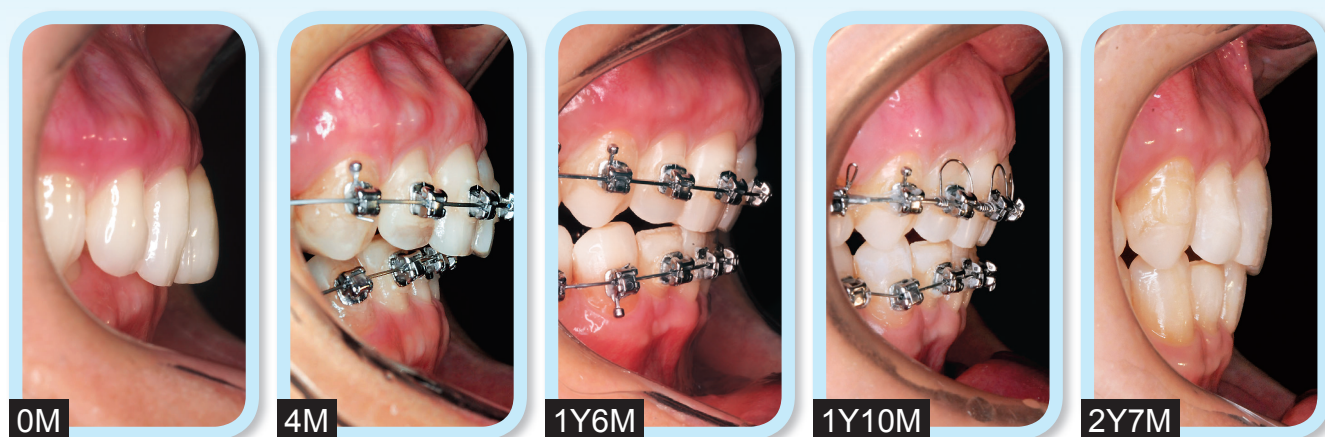


■ Fig. 17: Long-term use of Class II elastics helped reduce the large overjet, but the maxillary incisors were tipped palatally.



■ Fig. 18:

At twenty-two months (22M), auxiliary torquing springs were used to move the roots of the upper incisors palatally.



■ Fig. 19:

Incisal Coupling: a progressive series of intraoral radiographs, labeled in years (Y) and months (M) of age, show the overjet and overbite relationships before (0M), during (1Y6M, 1Y10M), and after (2Y7M) treatment. Compare these photographs to the two dimensional analysis of incisal coupling illustrated in Fig. 9. See text for details.

Repositioning of brackets and wire adjustments were used to detail the occlusion throughout treatment. All fixed appliances were removed after 2yr and 7mo for a total treatment time of 31 months. Retention was with upper and lower Hawley retainers to be worn full time for 6 mo, and nights only thereafter. In addition, instructions were provided in proper home hygiene and retainer maintenance.

Results Achieved

The patient was treated to an acceptable but compromised result as documented in Figs. 4-6. Cephalometric and panoramic radiographs document the pre-treatment condition compared to the post-treatment results (Figs. 7 and 8). Correction of the overbite and overjet is revealed in Fig. 9. Superimposed before and after treatment cephalometric tracings (Fig. 10) show the skeletal and dentofacial changes, and a summary of cephalometric measurements is provided in Table 1.

The ABO Cast-Radiograph Evaluation (CRE) is 30 as shown in the subsequent worksheet.

Maxilla (all three planes):

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

Mandible (all three planes):

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

Maxillary Dentition:

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

Mandibular Dentition:

- A – P: *Protraction*
- Vertical: *Increase*
- Transverse: *Expand*

Facial Esthetics:

- Improved with increased facial height, convexity and lip retraction.

Final Evaluation of Treatment

Overall, the patient was satisfied with the treatment outcome. The upper and lower arches were well-aligned, space was closed, and optimal occlusal contacts were achieved. The deep overbite was reduced from 9.05mm to 2.36mm (*Fig. 9*). Facial esthetics were improved with increased facial height and lip retraction. However, the intermaxillary buccal relationships remained Class II. The ABO cast radiograph evaluation (CRE) score was 30, and more than half of the discrepancies (16 points) were due to the residual Class II buccal relationships. See the second worksheet at the end of this report for details.

Discussion

The demand for retreatment has increased for patients who have experienced unfavorable long-term outcomes. It may be difficult to determine whether a “relapse” is due to incomplete correction and/or an unstable result. The initial treatment plan must be carefully considered to achieve an adequate prognosis for stability with additional orthodontics. The retreatment of adults is particularly challenging

because of periodontal disease, tooth mobility, multiple missing teeth, atrophic ridges, existing prostheses/implants, severe tooth attrition etc.¹ The interdisciplinary perspective of orthodontics, periodontal and restorative treatment are important considerations.¹

Resolving a Class II malocclusion, with a severe deepbite and maxillary anterior black triangles (*interproximal spaces*), requires careful management of the VDO, as well as maxillary incisor form, angulation, overjet and overbite. Increasing the VDO may improve dentofacial esthetics (*Figs. 4 and 5*), but results in a more severe Class II sagittal discrepancy (*Table 1*). Deficiencies in incisal coupling compromise intermaxillary alignment² and invite instability.^{1,3} Correcting black triangles with IPR and space closure reduces the circumference of the anterior segment, requiring excessive palatal torquing of the incisors to correct the Class II buccal segments.³ Class II treatment with extraction of a premolar in each quadrant requires substantial palatal root torque for upper incisors to achieve a Class I buccal interdigitation. Upright upper incisors, as a side effect of Class II elastics and/or IPR to correct black triangles, may result in an edge-to-edge incisor relationship and/or Class II buccal segments.^{3,4}

High torque brackets were used for upper incisors because increased axial inclination was required (*Figs. 11 and 12*). Despite this prospective consideration, the angulation of the upper incisors decreased during treatment (*Fig. 19*). A rectangular archwire (0.018x0.025-in CuNiTi), inserted 4mo into treatment, expressed the desired labial crown torque, but also

increased the overjet and extraction site spaces. As the upper anterior segment was retracted, incisal torque was lost as the overbite and overjet decreased. To correct the upper incisal inclination, torquing springs were placed at 22 months into treatment. Because the VDO was increased, it was not possible to adequately torque the maxillary incisors without risking root resorption by contacting the palatal cortical plate.⁵ The axial inclination of the incisors was improved late in treatment ($U1-SN: 79.7^\circ \rightarrow 84.7^\circ$; $L1-MP: 79.5^\circ \rightarrow 94.5^\circ$). However, the increase in skeletal discrepancy ($ANB 5.2$ to 6.5°) was excessive, so maxillary incisor torque at the end of treatment was under-corrected $\sim 20^\circ$. Earlier use of torquing springs or a larger diameter upper archwire (0.019×0.025 -in SS/TMA or 0.215×0.215 -in TMA) may have further moderated the final interdigitation, but opening the VDO in addition to IPR to correct maxillary anterior black triangles precluded ideal correction of the Class II relationship.

When dentofacial esthetics is the principal priority for treatment, appraisal of the position of upper central incisors relative to the upper lip is a critical diagnostic consideration.⁴ An aging face is usually characterized by a longer upper lip and reduced maxillary incisor exposure.⁶ To preserve the smile arc and desirable incisal exposure, deepbite correction may require opening the VDO rather than intruding the upper incisors. Correcting the curve of Spee and leveling the arches at the desired occlusal plane results in a pleasing dentofacial outcome for an aging face with a long upper lip (Fig. 4). However, opening the VDO increases the mandibular plane angle ($SN-MP: 37.1^\circ \rightarrow 39.7^\circ$; $FMA: 26.8^\circ \rightarrow 29.3^\circ$), which lengthens the face and further compromises

the Class II relationship. Long-term use of Class II elastics decreased the overjet from 6.86mm to 2.52mm and overbite from 9.05mm to 2.36mm (Fig. 9). Inadequate upper incisor inclination and decreased anterior circumferential arch length prevented ideal correction of the Class II relationship (Figs. 5 and 6).

An option to control posterior rotation of the mandible is to intrude the mandibular anterior segment with miniscrew anchorage, rather than extruding the posterior buccal segments to level the arch. However, this approach was inappropriate because the patient's lips were redundant and her lower incisors were slightly abraded. The preference was to lengthen her face and retract the lips (Figs. 4, 8 and 10). An additional option to restore the abraded edges of the lower incisors was also declined because that may have resulted in an excessive increase in the VDO, due to the restorative space required.⁶

As documented in Fig. 16, IPR was performed on the upper central and lateral incisors to reduce the black triangles and improve the dental esthetics.⁶⁻⁸ Open gingival embrasures (*black triangles*) are related to interproximal alveolar bone height to the base of the contact area (>5.5 mm), crown shape and root angulations.⁶ If the Bolton⁹ ratio for interarch dental widths is WNL, IPR and space closure to correct incisal black triangles decreases arch length of the maxillary anterior segment, thereby preventing complete correction of Class II buccal segments.

When evaluating lip protrusion, it is important to respect ethnic preferences. The most commonly

used cephalometric standards are based on American and Northern European caucasians who typically prefer more full lips (*Table 1, E-Line*). Asian patients are more concerned about relative lip protrusion. In general, the preference is for flatter lips compared to caucasians, and extraction therapy is well accepted for reducing protrusive lips, by the Chinese ethnic group.¹⁰

Conclusions

Opening the bite to improve facial esthetics for an aging patient aggravated a skeletal Class II discrepancy. IPR and space closure to correct black triangles in the maxillary anterior region contributes to palatal tipping which precludes achieving an ideal Class I correction of the buccal segments. The patient was pleased with the dentofacial esthetics achieved, but longterm retention with Hawley retainers is indicated. Based on the current experience, it is concluded that meeting esthetic goals for aging patients can be challenging.

References

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Discrepancy Index Worksheet

TOTAL D.I. SCORE **15**

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 = **3**

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 = **1**

OCCLUSION

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. = _____

SN-MP

$\geq 38^\circ$ = 2 pts.

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

$\leq 26^\circ$ = 1 pt.

Each degree $< 26^\circ$ _____ x 1 pt. = _____

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

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

Total = **0**

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 pt. = _____
 Missing teeth, congenital _____ x 2 pts. = _____
 Spacing (4 or more, per arch) _____ x 2 pts. = _____
 Spacing (Mx cent. diastema ≥ 2 mm) @ 2 pts. = **2**
 Tooth transposition _____ x 2 pts. = _____
 Skeletal asymmetry (nonsurgical tx) @ 3 pts. = _____
 Addl. treatment complexities _____ x 2 pts. = _____

Identify:

Total = **2**

Cast-Radiograph Evaluation

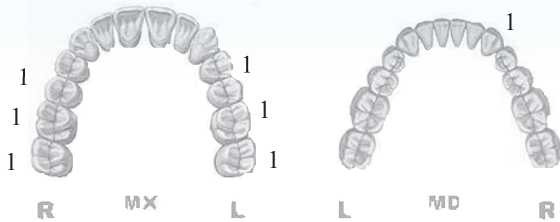
Case #

Patient

Total Score: **30**

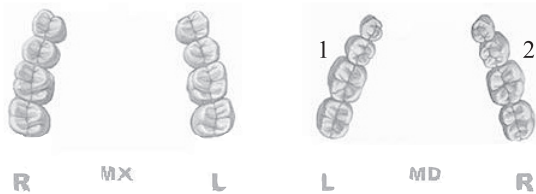
Alignment/Rotations

7



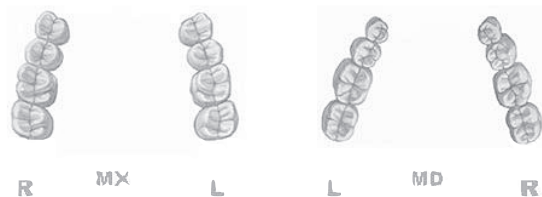
Marginal Ridges

3



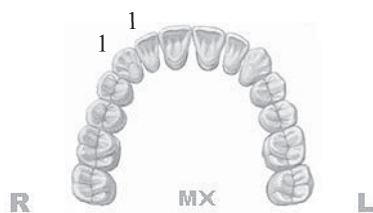
Buccolingual Inclination

0



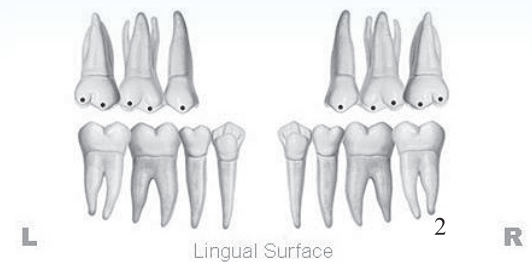
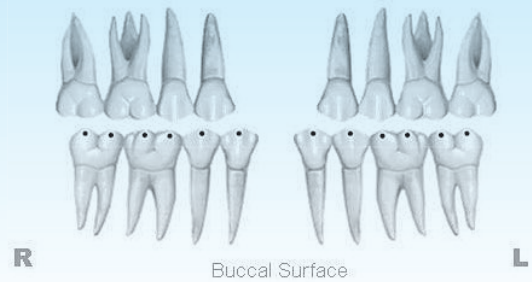
Overjet

2



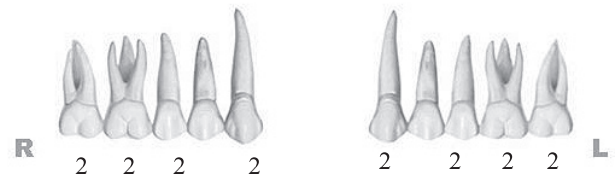
Occlusal Contacts

2



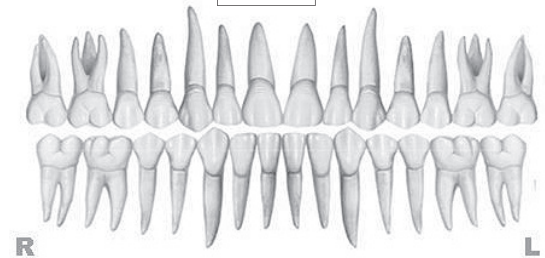
Occlusal Relationships

16



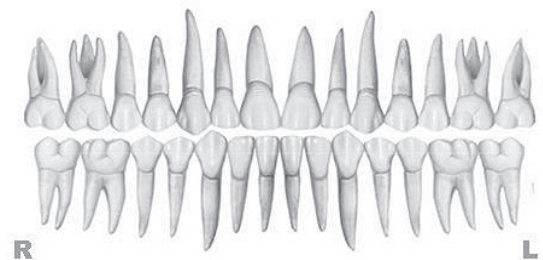
Interproximal Contacts

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.