

Non-Extraction Treatment of Facial Asymmetry, Midline Deviation, Missing UR4 and TMD

Abstract

A 24 year 5 month female presented with chief complaints: facial asymmetry, missing upper right premolar (UR4), crowding, and left TMJ clicking.

Diagnosis: Assessment of the face revealed decreased convexity (8°), increased lower facial height (57%), steep mandibular plane (FMA 30.5°), as well as mandibular deviation and an occlusal cant to the right (4°). An asymmetric Class II malocclusion (1mm left and 3mm right) was associated with a maxillary dental midline 3mm to the right, impinging deepbite (6mm, 70%), deep curve of Spee (3mm), wear facet on the UL3 (bruxism), and crowding in both arches (6mm/10mm). The Discrepancy Index (DI) was 30.

Etiology: Constricted arches reflect inadequate masticatory loading, probably relating to the refined diet of most industrialized countries. Decreased arch length secondary to constricted jaws resulted in severe crowding of both arches. The UR4 was previously extracted to make room for the erupting UR3. The facial asymmetry, occlusal cant to the right, and TMJ clicking are probably related to a habitual sleep posture on the left side of the face.

Treatment Plan: Avoid sleeping in the same habitual position, and refrain from wide opening of the jaws, that exceeds the requirement for normal function. Place a full fixed passive self-ligating (PSL) appliance for nonextraction alignment and leveling. Utilize expansion and bilateral infrazygomatic crest (IZC) bone screw anchorage to relieve crowding and correct asymmetry. Correct posterior crossbites with arch coordination and cross-elastics, as needed. Assess the need for more invasive treatment if the current camouflage approach fails to satisfy the esthetic and functional needs of the patient.

Results: A severe malocclusion (DI 30) was corrected to a CRE score of 24 with 33 months of active treatment. Facial form was maintained, the asymmetry was improved $\sim 3^\circ$, and the maxillary dental midline was corrected. TMD symptoms were reduced by correcting sleep posture and establishing a coincident centric relation to centric occlusion relationship.

Conclusion: Non-extraction camouflage treatment, utilizing a low force PSL appliance for arch expansion, and IZC bone screws for retraction, produced near ideal dental alignment (CRE 24). The facial asymmetry and the cant of the occlusal plane was reduced to an acceptable level ($\sim 1^\circ$). The patient was well satisfied with the outcomes of the conservative treatment. (*J Digital Orthod* 2018;49:4-20)

Key words:

Facial asymmetry, midline deviation, deepbite, early loss of a maxillary premolar, canting of the occlusal plane, TMJ clicking, passive self-ligation appliance, IZC bone screws, sleep posture, bruxism

History and Etiology

A 24 year 5 month female (Figs. 1-6) presented with decreased facial convexity (8°), and lower facial deviation to the right (4°), that was manifest as decreased length of the right ramus, maxillary midline 3mm to the right, and a canted occlusal plane (4°). The upper right first premolar (UR4) was missing and both arches were crowded ($-8\text{mm}/-10\text{mm}$). The left TMJ clicked when opening wide, and there was a wear facet on the UL3. The etiology of the asymmetry was unknown,¹⁻³ but the signs and symptoms had a delayed onset in the growing years, consistent with a habitual sleep posture on the left side of the face.⁴ The UR4 was extracted in adolescence to facilitate eruption of the UR3.

Dr. Yu-Hsin Huang,
Lecturer, Beethoven Orthodontic Course (Left)

Dr. John Jin-Jong Lin,
Examiner of JDO, Director of Jin-Jong Lin Orthodontic Clinic (Center)

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



Diagnosis

Facial:

- Length: Long face (LFH 57.5%) with a relatively short upper lip
- Protrusion: Relatively straight profile (8°) with retrusive lips (-2mm/-1mm to the E-Line)
- Symmetry: Maxillary dental midline deviated 3mm to the right, occlusal plane cant 5mm superior on the patient's right side, 5mm chin deviation to the right
- Smile: Full smile with more gingival exposure in the left anterior region



■ Fig. 1: Pre-treatment facial and intraoral photographs at 24y5m of age

Skeletal:

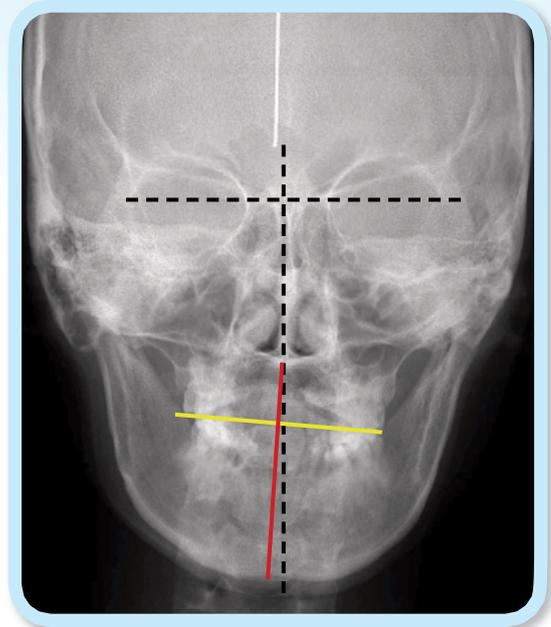
- Intermaxillary Relationship: *Mild mandibular retrusion (SNA 82.5°, SNB 79°, ANB 3.5°)*
- Mandibular Plane: *Excessive (SN-MP 37.5°, FMA 30.5°) (Fig. 5) (Table 1)*
- Vertical Dimension of Occlusion (VDO): *Excessive ANS-Gn segment (57.5%) of the Na-ANS-Gn dimension (Table 1).*
- Symmetry: *Lower face deviated to the right (Figs. 1 & 3)*

Dental:

- Classification: *Class II, right end-on (~3mm) and left slight (~1mm) (Fig. 2)*
- Overbite: *7mm*
- Overjet: *1mm*
- Missing Teeth: *UR4 previously extracted*
- Parafunction: *Bruxism evidenced by wear a facet on the UL3*
- Symmetry: *Upper midline deviated 3mm right with an occlusal cant (Figs. 1 & 3)*



■ Fig. 2: Pre-treatment dental models (casts)



■ Fig. 3: An anterior-posterior cephalometric radiograph documents facial asymmetry, occlusal canting and mandibular deviation.

The ABO Discrepancy Index (DI) was 30 as documented in to the subsequent worksheet.⁵

Specific Objectives of Treatment

1. Expand both arches
2. Align and level
3. Correct posterior crossbites
4. Asymmetric retraction of the upper left buccal segment to correct the midline

Maxilla (all three planes):

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

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	82.5°	82.5°	0°
SNB° (80°)	79°	79°	0°
ANB° (2°)	3.5°	3.5°	0°
SN-MP° (32°)	37.5°	37.5°	0°
FMA° (25°)	30.5°	30.5°	0°
DENTAL ANALYSIS			
U1 To NA mm (4 mm)	2 mm	2 mm	0 mm
U1 To SN° (104°)	95°	102°	7°
L1 To NB mm (4 mm)	3.5 mm	5.5 mm	2 mm
L1 To MP° (90°)	78°	89°	1°
FACIAL ANALYSIS			
E-LINE UL (-1 mm)	-2 mm	-1.5 mm	0.5 mm
E-LINE LL (0 mm)	-1 mm	-1 mm	0 mm
%FH: Na-ANS-Gn (53%)	57.5%	57.5%	0%
Convexity: G-Sn-Pg' (13°)	8°	8.5°	0.5°

Table 1: Cephalometric summary

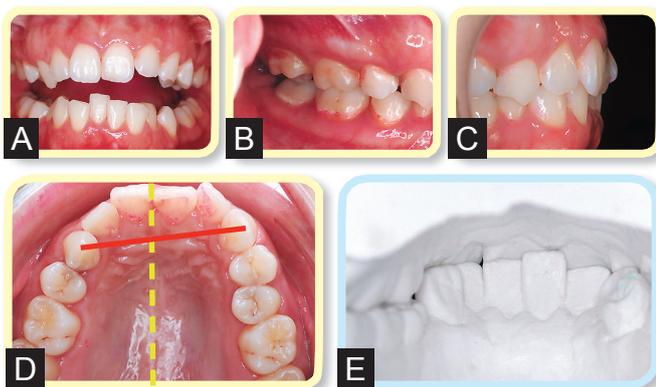


Fig. 4:

Major problems before orthodontic treatment:

A. occlusal plane canting and maxillary midline deviated to the right, B. UR7 are in posterior buccal crossbite, C. retroclined (upright) incisors in both arches. D. UL5 rotated 180 degrees and asymmetric buccal segments, and E. palatal impingement of lower incisors on maxillary palatal gingiva.



Fig. 5: Pre-treatment lateral cephalometric radiograph



Fig. 6: Pre-treatment panoramic radiograph

Mandible (all three planes):

- A - P: Maintain
- Vertical: Maintain
- Transverse: Maintain

Maxillary Dentition:

- A - P: Maintain
- Vertical: Intrude slightly
- Inter-molar / Inter-canine Width: Expand

Mandibular Dentition:

- A - P: *Retract*
- Vertical: *Intrude incisors*
- Inter-molar / Inter-canine Width: *Expand*

Facial Esthetics:

- Maintain the profile

Treatment Alternatives

As diagrammed in Fig. 7, three alternative treatment plans were considered:

- 1.** Extract three remaining 1st premolars, and use differential space closure in both arches to achieve Class I buccal segments with coincident midlines.
- 2.** Extract upper left first premolar, and use differential space closure and Class III elastics as needed to correct the maxillary midline. Finish the canines in a Class I relationship, and mesially translate maxillary posterior segments to achieve bilateral Class II molar relationships.
- 3. Non-Extraction:** Use bilateral IZC bone screws for asymmetric maxillary arch retraction to correct the midline and achieve Class I canines. The right molar occlusion will be Class II because of the missing UR4.⁶ The patient desires to maintain lip protrusion. Both extraction options present the risk of excessive lip retraction, and opening space to restore the missing UR4 may result in undesirable lip protrusion. An additional concern in retracting the dentition is the possibility of incisal interferences to exacerbate bruxism and TMD symptoms.⁷ The non-extraction alternative was the most conservative and esthetic

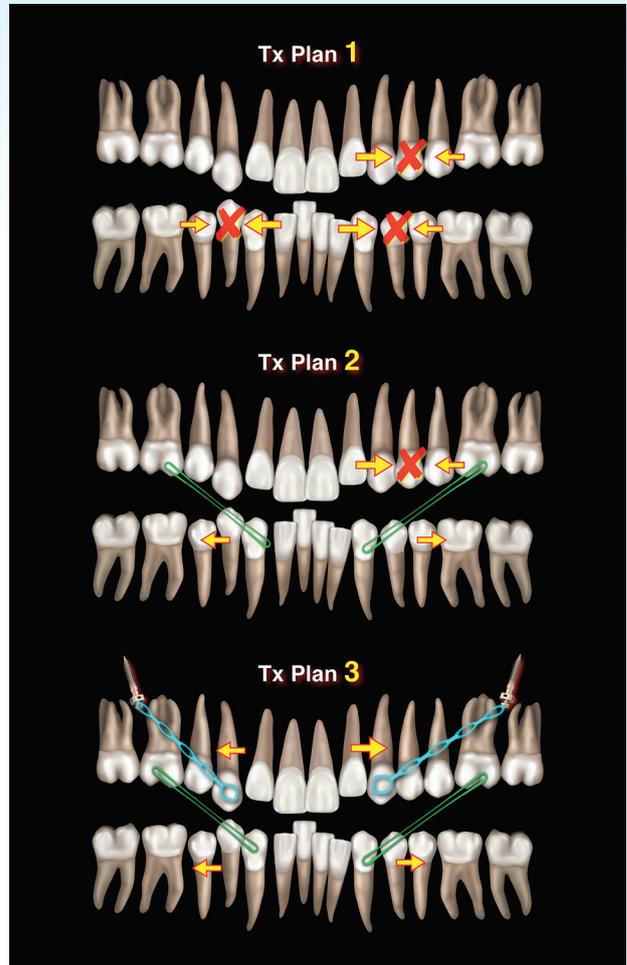


Fig. 7: Three alternative treatment (Tx) plans are diagrammed. Red Xs mark extractions, and yellow arrows outlined in red show paths of tooth movement. Class III elastics are green, and elastomeric chains anchored by IZC bone screws are blue.

option, but required asymmetric mechanics utilizing IZC bone screws, for differential retraction of the buccal segments to correct the maxillary midline.⁸

Treatment Progress

Before initiating orthodontic treatment, the health was confirmed for the dentition, periodontium and TMJs. A full fixed 0.022-in slot Damon Q® PSL appliance (Ormco, Glendora, CA) was installed in

both arches, utilizing standard-torque brackets on all teeth. All archwires and elastics were provided by the same manufacturer. Bite turbos were placed on the upper 1st molars to open the bite for crossbite correction (Figs. 8 and 10), and 0.014-in copper-nickel-titanium (CuNiTi) round archwires were installed in both arches. The archwires engaged all brackets, except the lower 1st premolars and the lower right central incisor (LR1), because of the extreme crowding. IZC-7 bone screws (buccal to the U7s) were inserted bilaterally on the mesial aspect of the U7s (Fig. 9), and power chains were used to retract the upper dentition.⁹



Fig. 8: Close-up views of the initial mechanics: A. IZC-7 screw on the right side. B. IZC-7 screw on the left side. C. bite turbos and cross elastics for buccal-crossbite UR7. D. The LR2 is intruded and moved labially by ligation to the archwire with an 0.010-in SS ligature through the hole for dropping hook.

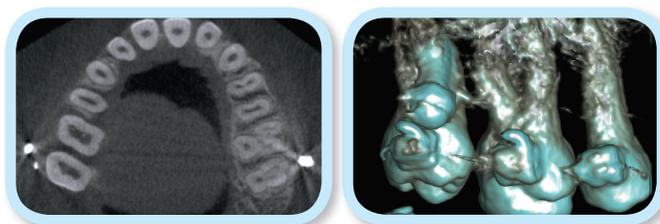
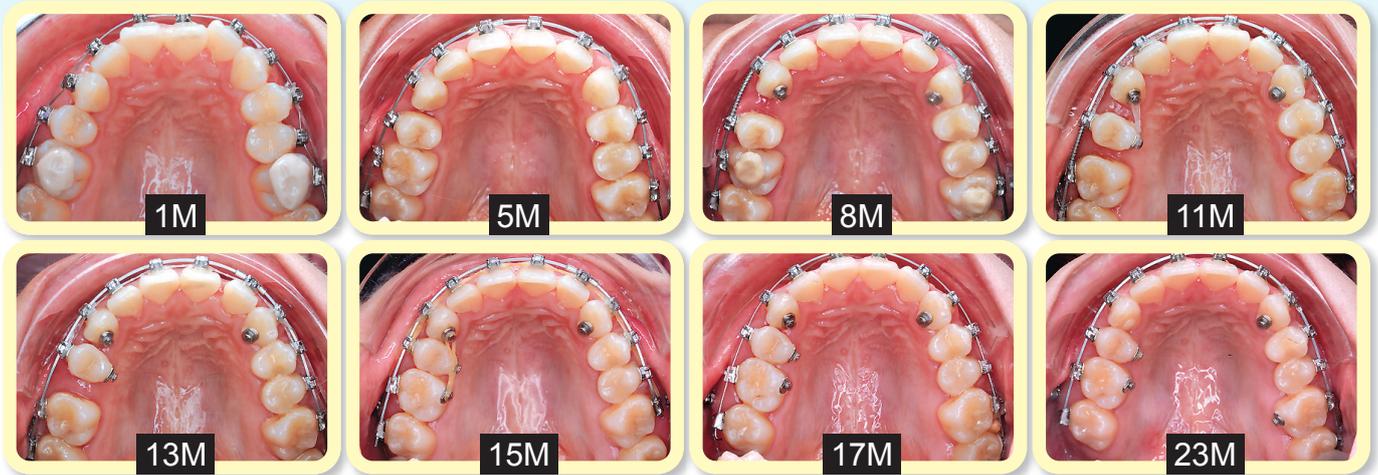


Fig. 9: CBCT images document the location and orientation of the IZC-7 bone screws in the alveolar process buccal to the U7s.

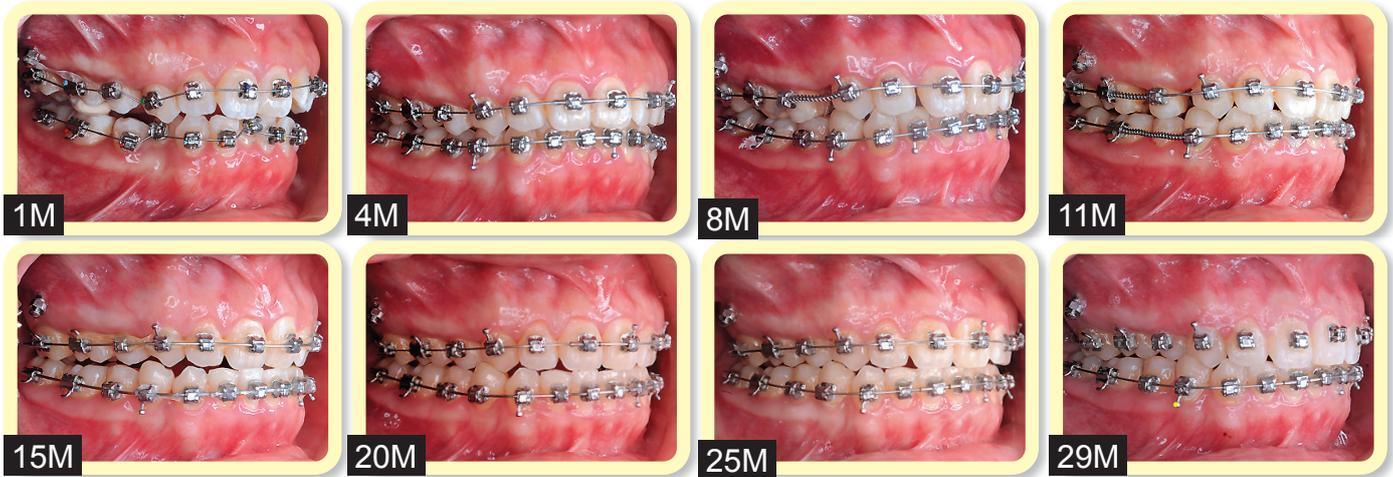
In the third month of treatment, the crossbites were corrected and the bite turbos were removed. The lower archwire was changed to 0.014x0.025-in CuNiTi. The buccal crossbite relapsed 2 months later, so in the fifth month, bite turbos were reinstalled, and cross elastics were used. A section of open coil spring was placed between the upper right canine (UR3) and premolar (UR4) to help correct the midline (Figs. 10 & 11). Space that spontaneously opened in the maxillary anterior region, was closed with elastomeric chains placed on the facial and lingual surfaces (Fig. 10). An 0.018x0.025-in CuNiTi archwire was placed and one month later, a panoramic radiograph revealed several teeth required bracket repositioning. The lower right incisors (LR1 and 2) and second premolar (LR4) were rebonded, and a 0.014x0.025-in CuNiTi archwire was placed (Fig. 12). The strength of cross elastics was increased to Kangaroo® 13/16-in, 4.5-oz. Space was consolidated and closed with elastic chains. In the 14th month, the upper left second molar (UL7) developed pericoronitis after being retracted into the retromolar soft tissue. The UL7 bracket was removed to facilitate hygiene. The gingival inflammation was resolved in 2 months.

In the 16th month of treatment, the bracket was rebonded on the UL7, and an 0.018-in CuNiTi archwire was inserted for alignment. Class III elastics (Fox® 1/4-in, 3.5-oz) were initiated to correct the negative overjet. One month later, a loose IZC-7 bone screw was removed on the left side. During correction of the intermaxillary discrepancy with Class III elastics, the morphology of upper canines was restored with composite.



■ Fig. 10:

Maxillary occlusal views show a progression of progress from one (1M) to twenty-three months (23M). Correction of the midline required distal translation of the left buccal segment. Note space mesial to the UR6 at 13M in preparation for asymmetric retraction of the anterior segment.



■ Fig. 11:

A series right buccal views document progress from one (1M) to 29 months (29M). Note a bite turbo on the occlusal surface of the UR6 was used to facilitate correction of the UR7 buccal crossbite.

In the 21st month, diagonal and intra-arch elastics were placed to correct the diastema and midline discrepancy. One month later, the L6 bite turbos were removed, and 0.014x0.025-in CuNiTi archwires were placed in both arches. Brackets were rebonded as needed to correct second order problems, and both arches were leveled with 0.016-in CuNiTi archwires (Fig. 12). In the following month, the left IZC-7 screw was replaced and used as an anchor to correct midlines. Following detailing with bracket repositioning and archwire corrections, all fixed appliances were removed after 33 months of active treatment (Figs. 13-15). The progressive mechanics are summarized in Table 2.



■ Fig. 12:

A panoramic radiograph in the 11th month (11M) revealed that brackets on LR1, LR2 and LR4 required rebonding. A similar radiograph at twenty-three months (23M) indicated that rebonding was needed for brackets UL3, UL6, LL5, LL6 and LR4.



■ Fig. 13: Post-treatment facial and intraoral photographs



■ Fig. 14: Post-treatment dental models (casts)

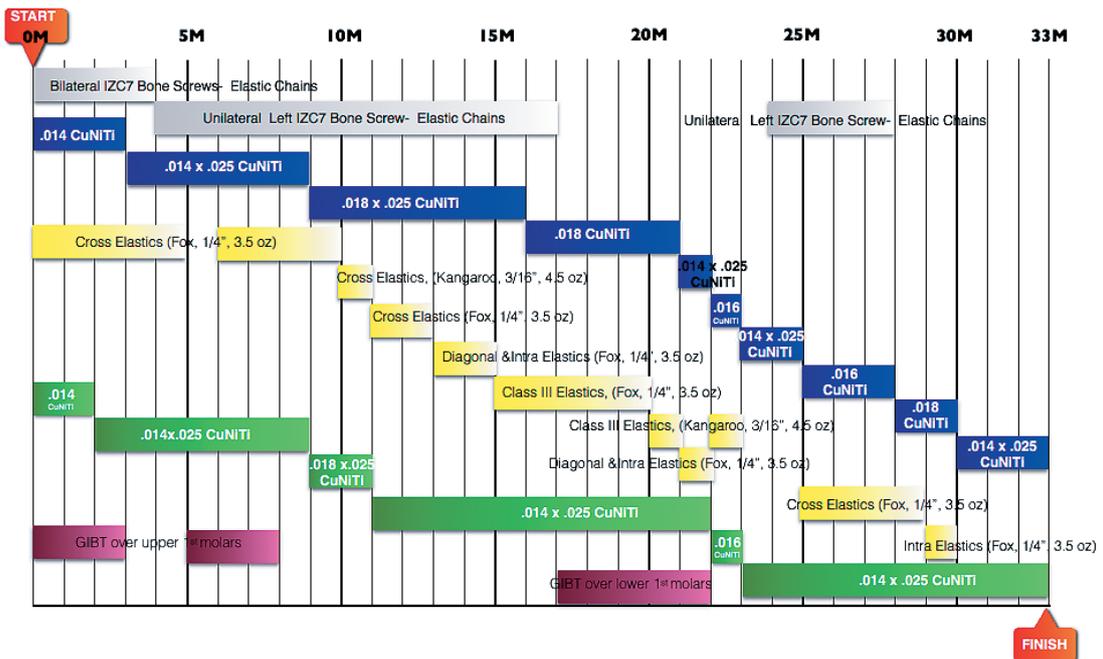


■ Fig. 15: Post-treatment panoramic radiograph

Archwire Sequence Chart

Clinicians: Dr. John Jin-Jong Lin
 Patient: Miss Zheng

■ Maxillary Archwire ■ Mandibular Archwire ■ Elastics
 ■ Bone Screw ■ Bite Turbo



■ Table 2: Archwire Sequence Chart

Results achieved

This severe, asymmetric skeletal malocclusion (*DI 30*) was corrected, with 33 months of active treatment to a near ideal result (*CRE 24*), as documented in worksheet 2 at the end of this report. Despite the extensive dental correction, there were no facial or skeletal changes (*Figs. 16 & 17*). The VDO was maintained as evidenced by no change in the percent lower facial height (*Table 1*). The facial convexity remained relatively straight (*G-Sn-Pg' 8°*), compared to an ideal 13° ,^{10,11} and there was no functional shift of the mandible when closing into centric occlusion.

Specific treatment objectives (*Figs. 16 & 17, Table 1*) were:



■ **Fig. 16:** Post-treatment lateral cephalometric radiograph



■ **Fig. 17:**

Superimposed cephalometric tracings from before (black) and after (red) treatment were superimposed on the anterior cranial base (left), the maxilla (upper right), and the mandible (lower right). See text for details.

Maxilla (all three planes):

- A - P: *Maintained*
- Vertical: *Maintained*
- Transverse: *Maintained*

Mandible (all three planes):

- A - P: *Maintained*
- Vertical: *Maintained*
- Transverse: *Maintained*

Maxillary Dentition

- A - P: *Retraction of incisor roots, slight protraction of the molars*
- Vertical: *Slight incisor intrusion*
- Inter-molar / Inter-canine Width: *Maintained / Increased*

Mandibular Dentition

- A - P: *Protraction of molars and incisors*
- Vertical: *Intrude incisors*
- Inter-molar / Inter-canine Width: *Increased / Increased*

Facial Esthetics

- Profile unchanged (Figs. 16 & 17), but slight skeletal asymmetry remained (Fig. 18)

Retention

Clear overlay retainers were fabricated for both arches. The patient was instructed in proper home hygiene and care for the retainers. Full time retainer wear was prescribed for the first 6 months and nights only thereafter.

Final Evaluation of Treatment

Facial form was maintained and the maxillary dental midline was corrected. The ABO Cast-Radiography Evaluation was 24 points (*Worksheet 2*). The most prominent alignment deficiencies were alignment/rotations (6 points) buccolingual inclinations (6 points), and occlusal contacts (5 points) (Figs. 16 & 17). The pink and white (P&W) dental esthetic score was 4.¹² See Worksheet 3 at the end of this report.

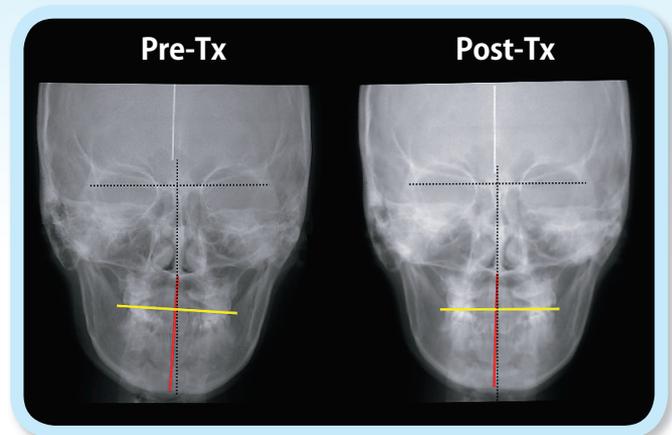
Discussion

Asymmetric malocclusions are often complex problems involving the dentition, skeletal base of bone, and functional shifts in occlusion (Figs. 1-4). Non-extraction correction of the occlusion is facilitated by extra-alveolar (E-A) bone screw anchorage. IZC bone screw anchorage is particularly well suited for resolving maxillary midline discrepancies (Figs. 8-11), but this approach is unlikely to completely resolve skeletal problems (Fig. 3). When there is unilateral loss of a premolar, the buccal occlusion is usually finished in an asymmetric molar relationship (*Class I/II*). For the current patient (Fig. 1), the missing UR4 required finishing the first molars on the right side in a full cusp Class II relationship (Figs. 13 & 14). This was deemed the most desirable outcome, but E-A bone screw anchorage was required. IZC bone screws can be placed mesial to the U6s (IZC-6) or mesial to the U7s (IZC-7). They are osseous anchorage for managing buccal asymmetry and midline correction, but skeletal problems may persist to a lesser extent: mandibular deviation and cant of the occlusal plane (Fig. 13). The residual asymmetry is less noticeable when the dentition is

well aligned, spaces are closed, and the midlines are coincident (Figs. 13-16).

Arch width is directly related to biting strength. The constriction of the dental arches is a common acquired characteristic in industrialized countries because the diet tends to be more refined.¹ Constricted arches decrease arch length (*circumference*), but teeth are largely genetic structures, that are not affected by biomechanics. As the permanent incisors erupt in the transitional dentition, crowding occurs.¹⁻³ If a canine is blocked out of the arch particularly in the maxilla, dentists often recommend extracting the adjacent first premolar so the canine can erupt. If only one premolar is extracted, crowding is decreased but the maxillary midline tends to drift in the direction of the missing premolar. If the asymmetry is diagnosed in the early mixed dentition,^{2,3} rapid palatal expansion and space opening for erupting teeth avoids the necessity to extract a first premolar to create room for an erupting canine. Unilateral extraction of a first premolar creates a subdivision malocclusion¹³ that is impossible to treat to a Class I molar relationship bilaterally.

Anterior-posterior cephalometric radiography documents arch width as well as the axial inclinations of the teeth in the buccal segments. Orthognathic surgery¹³ and/or additional premolar extractions¹³ are common procedures for managing skeletal and dental asymmetry.^{2,3} However, more conservative nonextraction approaches are a viable option if there is adequate supplemental anchorage, e.g. IZC bone screws. It is important to thoroughly diagnose all dental and skeletal problems, but



■ Fig. 18:

Dental alignment and retraction of the left buccal segment to correct the maxillary midline spontaneous decreased the facial asymmetry and occlusal plane cant from $\sim 4^\circ$ (Pre-Tx) to $\sim 1^\circ$ (Post-Tx).

camouflage treatment to achieve an acceptable compromise may be the most practical approach (Figs. 17 & 18).^{4,9}

Intermaxillary elastics can improve the overjet and correct midlines, but they may not achieve a stable result.¹⁵ Furthermore, excessive use of intermaxillary elastics may cause a dual bite and temporomandibular disorder.¹⁶ Intermaxillary elastics were used sparingly for the current patient, and the major mechanics depended on IZC bone screw anchorage. Asymmetric treatment in the absence of E-A bone screw anchorage tends to result in distortion of the arch, as well as in occlusal prematurities that may exacerbate TMJ clicking and bruxism.

Bone is a dynamic tissue that is continuously adapting via the processes of remodeling and modeling.¹⁷ Frankel¹⁸ used his function regulator appliances to produce transverse alveolar modeling

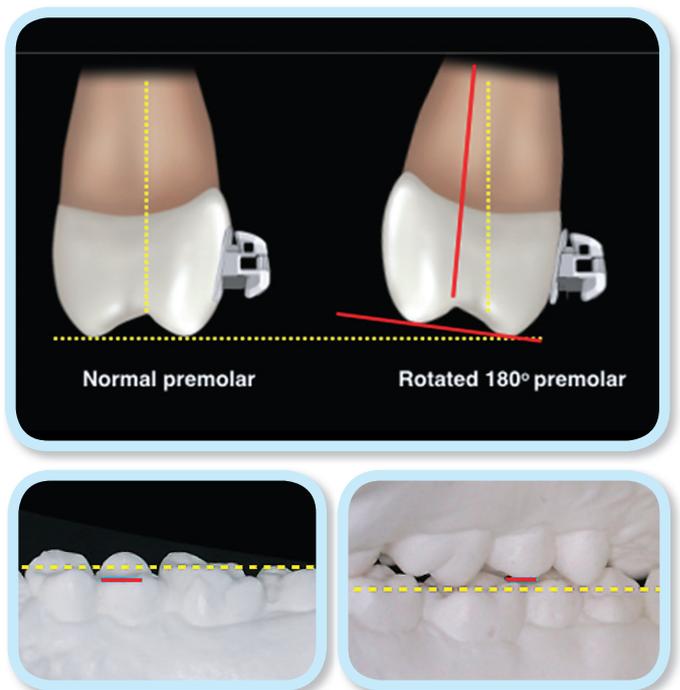
in adolescent patients. The acrylic shields extending into the vestibule exerted a constant outward traction on connective tissue fibers and muscle attachments; the tension in the soft tissue is then transmitted to the alveolar bone by the fibers of the periosteum, increasing the apposition of buccal bone on the alveolar process.¹⁹ It is hypothesized that the low expansion force delivered by the self-ligating appliance can expand the arch by alveolar bone forming ahead of the roots of the posterior teeth.^{20,21} For this reason, the patient's orthodontic treatment is not limited by an immutable arch width. A narrow maxillary arch with crowded/asymmetrical dentition can be corrected by conservatively expanding the arch rather than with orthognathic surgery.²² The posterior occlusal contacts are readily improved with vertical (*up and down*) elastics.²³

For a rotated-180-degree upper premolar (Fig. 4), the UL5 bracket is bonded on what is normally the lingual surface of the tooth, so the usual -11 degrees of built-in torque is not appropriate (Fig. 19). The excessive torque results in more labial root prominence and an intruded palatal cusp which compromises occlusal contact. A customized bracket is indicated for a 180 degree rotated premolar,²⁴ to avoid occlusal interferences that may contribute to TMD and bruxism.²⁵

Conclusion

Asymmetric malocclusion is manifest as abnormal form and function of the face, occlusion and TMJs.

Nonextraction treatment, that levels and aligns the dentition with light forces and E-A anchorage, may produce a camouflage result which meets the needs of the patient, but it is unlikely to completely resolve skeletal asymmetry. More invasive approaches such as extractions and orthognathic surgery are indicated if conservative alignment is unsatisfactory to the patient.



■ Fig. 19:

The 180° rotation of UL5 presented finishing problems with respect to ideal esthetic and functional alignment: 1. relative to normal axial inclination and occlusal plane, the rotated premolar with a pretorqued bracket requires excessive buccal root movement (red lines) for acceptable dental esthetics, 2. the palatal cusp (along the red line) is inferior to adjacent teeth (lower left view), 3. the palatal cusp is out of occlusion (red line) compared to the plane of the adjacent palatal cusps (lower right view), and 4. the mesial-distal dimension is less on the buccal compared to the lingual surface (See Fig. 4D).

Acknowledgment

Thanks to Mr. Paul Head for proofreading this article and Dr. Rugsí's beautiful diagrams.

References

1. Roberts WE. Bone physiology, metabolism and biomechanics in orthodontic practice. In: *Orthodontics: Current Principles and Techniques*. Chap 10, 5th ed. Graber LW, Vanarsdall RL Jr, Vig KWL (Eds). St. Louis: Elsevier Mosby; 2012. pp287-343.
2. Bishara SE, Burkey PS, Kharouf JG. Dental and facial asymmetries: a review. *Angle Orthod* 1994;64(2):89-98.
3. Cheong YW, Lo LJ. Facial asymmetry: etiology, evaluation, and management. *Chang Gung Med J* 2011 Jul-Aug;34(4):341-51.
4. Chang MJ, Lin JJ, Roberts WE. Probable airway etiology for a severe Class III openbite malocclusion: conservative treatment with extra-alveolar bone screws and intermaxillary elastics. *Int J Orthod Implantol* 2017;45:4-20.
5. Chang CH, Roberts WE. *Orthodontics Vol. 1* [E-reader version]. Hsinchu: Newton's A; 2012. Available from: <https://itunes.apple.com/book/orthodontics-vol.-i/id520098562?mt=11>.
6. Lin JJ. *Creative Orthodontics: Blending the Damon system & TADs to manage difficult malocclusions*. 2nd ed. Taiwan: Yong Chieh Enterprise Co, Ltd; 2010.
7. Wang MQ, Xue F, He JJ, Chen JH, Chen CS, Raustia A. Missing posterior teeth and risk of temporomandibular disorders. *J Dent Res* 2009 Oct;88(10):942-5.
8. Lin JJ, Roberts WE. Guided infra-zygomatic screws: reliable maxillary arch retraction. *Int J Orthod Implantol* 2017;46:4-16.
9. Huang YH, Lin JJ, Roberts WE. Periodontally-compromised class II malocclusion with early loss of both L6s and the UL3: Class III elastics for L6 space closure and retraction of the maxillary arch with IZC bone screws. *Int J Orthod Implantol* 2017;47:4-24.
10. Burstone CJ, James RB, Legan H, Murphy GA, Norton LA. Cephalometrics for orthognathic surgery. *J Oral Surg* 1978 Apr;36(4):269-77.
11. Legan HL, Burstone CJ. Soft tissue cephalometric analysis for orthognathic surgery. *J Oral Surg* 1980 Oct;38(10):744-51.
12. Su B. IBOI Pink & White esthetic score. *Int J Orthod Implantol* 2012;28:96-101.
13. Burstone CJ. Diagnosis and treatment planning of patients with asymmetries. *Semin Orthod* 1998;4:153-64.
14. Sekiya T, Nakamura Y, Oikawa T, Ishii H, Hirashita A, Seto K. Elimination of transverse dental compensation is critical for treatment of patients with severe facial asymmetry. *Am J Orthod Dentofacial Orthop* 2010;137:552-62.
15. Burstone C, Filleul MP, Pigeot V. Stability of orthodontic treatment of occlusal asymmetry. *Orthod Fr* 2000;71:197-205.
16. Janson G, de Freitas MR, Araki J, Franco EJ, Barros SE. Class III subdivision malocclusion corrected with asymmetric intermaxillary elastics. *Am J Orthod Dentofacial Orthop* 2010;138:221-30.
17. Barron TW, Bogdan E. Alveolar bone modeling with a fixed, continuous-arch appliance. *Clinical Impressions* 2017;20(01):e. 4-7.
18. Frankel R. The theoretical concept underlying the treatment with function correctors. *Eur Orthod Soc* 1966;42:233.
19. Moss M. *The functional matrix (Chapter) Vistas in orthodontics*. Philadelphia: Lea and Febiger; 1962.
20. Damon DH. Treatment of the face with biocompatible orthodontics in *Orthodontics: current principles & techniques*. 4th ed. Editors: Graber TM, Vanarsdall RL, Vig KWL. Philadelphia: Elsevier Inc; 2005. pp. 753-831.
21. Basciftci FA, Akin M, Ileri Z, Bayram S. Long-term stability of dentoalveolar, skeletal and soft tissue changes after non-extraction treatment with a self-ligating system. *Korean J of Orthod* 2014;44(3):119-127.
22. Ferro F, Spinella P, Lama N. Transverse maxillary arch form and mandibular asymmetry in patients with posterior unilateral crossbite. *Am J Orthod Dentofacial Orthop* 2011 Dec;140(6):828-38.
23. Steffen JM, Haltom FT. The five-cent tooth positioner. *J Clin Orthod* 1987;21:528-529.
24. Lee A, Chang CH, Roberts WE. Skeletal Class III Crowded Malocclusion Treated with the Insignia® Custom Bracket System. *Int J Orthod Implantol* 2017;47:52-69.
25. Tsukiyama Y, Baba K, Clark GT. An evidence-based assessment of occlusal adjustment as a treatment for temporomandibular disorders. *J Prosthet Dent* 2001 Jul;86(1):57-66.



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 =

Total = 0

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 = 7

OCCLUSION

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

Total = 2

8 mm (lower)

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 4

CEPHALOMETRICS (See Instructions)

ANB $\geq 6^\circ$ or $\leq -2^\circ$ 3.5° = 4 pts.

Each degree $< -2^\circ$ x 1 pt. =

Each degree $> 6^\circ$ x 1 pt. =

SN-MP 37.5°
 $\geq 38^\circ$ = 2 pts.

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

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

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

1 to MP $\geq 99^\circ$ 78° = 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. = 2
- Missing teeth (except 3rd molars) 1 x 1 pts. = 1
- 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. = 3
- Addl. treatment complexities 3 x 2 pts. = 6

Identify: Occlusal canting
TMJ Disorder
Deep curved of spee

Total = 12

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 augmt (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 = 0

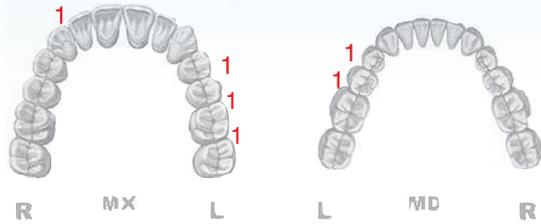
Cast-Radiograph Evaluation

Case # Patient

Total Score: **24**

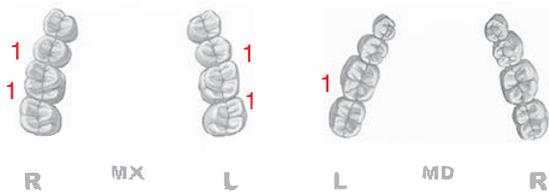
Alignment/Rotations

6



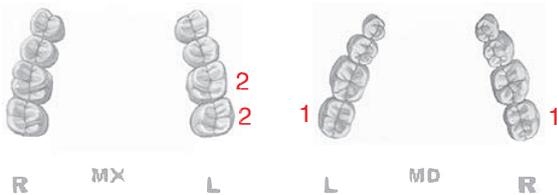
Marginal Ridges

5



Buccolingual Inclination

6



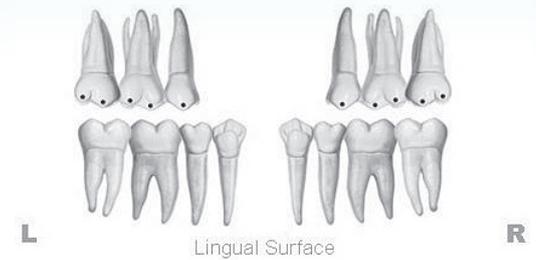
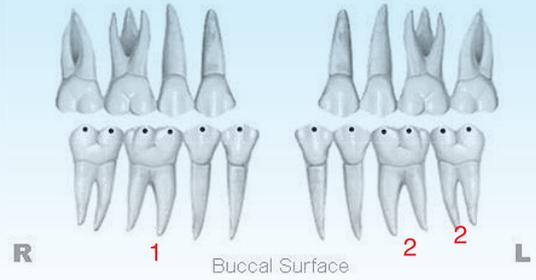
Overjet

1



Occlusal Contacts

5



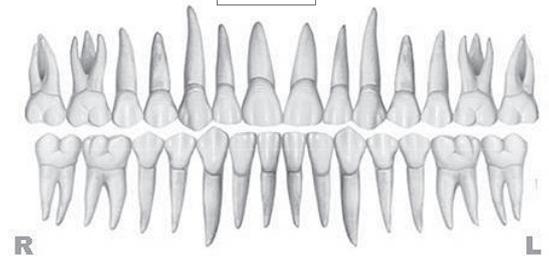
Occlusal Relationships

0



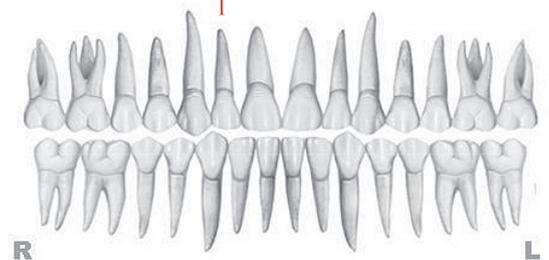
Interproximal Contacts

0



Root Angulation

1



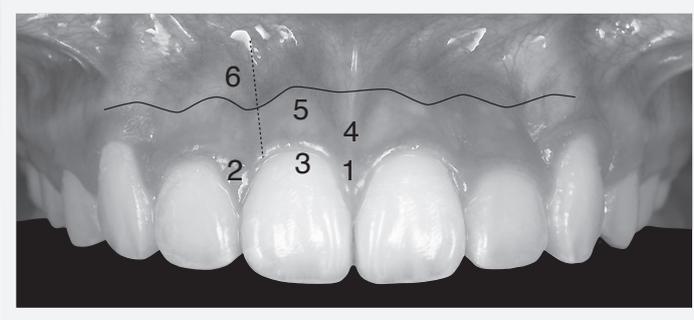
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

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

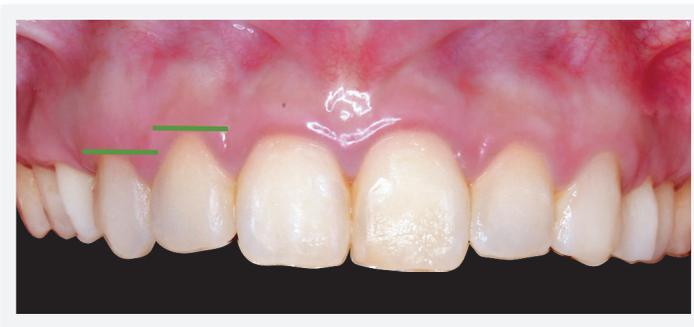
Total Score: = 4

1. Pink Esthetic Score

Total = 1



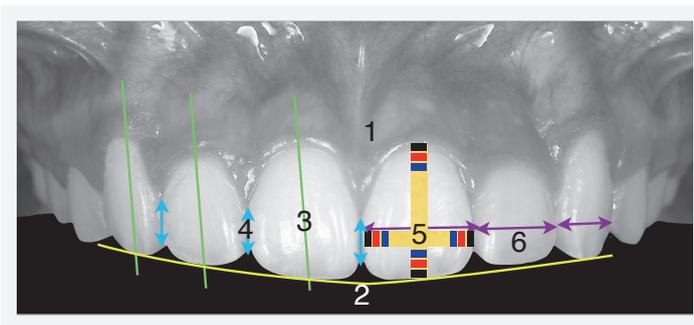
1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2



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

2. White Esthetic Score (for Micro-esthetics)

Total = 3



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