

Class II Malocclusion with Crowding, Missing LR2 and Ectopic Eruption of UR3 is Treated Conservatively with Maxillary Retraction

Abstract

Introduction: A 22-year-old female presented for orthodontic consultation to evaluate a chief complaint: high upper right canine (UR3).

Diagnosis: Clinical and radiographic examination revealed a convex facial profile (G-Sn-Pg' 18°), slightly protrusive lips (E-line: UL 1mm, LL 3mm), mentalis strain, upper dental midline deviation to the right, congenitally missing LR2, Class II malocclusion, ectopic labial eruption of the UR3, maxillary crowding 8-9mm, a relatively low mandibular plane angle (SN-MP 30, FMA 20). The Discrepancy Index was 27 points.

Treatment: All permanent teeth were erupted including third molars. Following extraction of all four third molars, a passive fixed self-ligating (PSL) appliance was installed. At the same appointment, infrazygomatic crest (IZC) bone screws were inserted to provide posterior skeletal anchorage to retract both arches. Additional space was achieved by slightly expanding both arches, and interproximal reduction (IPR) as needed. Initial alignment was achieved via a 0.014-in and 0.014x0.025-in copper nickel titanium (CuNiTi) archwire. As the maxillary buccal segments were retracted, the bite was opened with an anterior bite turbo. Maxillary buccal segments were differentially retracted with elastomeric chains anchored with the IZC bone screws. Active treatment time was 23 months.

Outcomes: The upper dental midline was about 2mm right of the facial midline. The lower arch was finished in Class I on the left side and Class III on the right to compensate for the missing LR2. Vertical dimension of occlusion (VDO) and lower facial height (LFH) were increased about 2mm, resulting in 1° change in the mandibular plane angle. Despite the missing LR2, a good compromised occlusion was achieved as evidenced by a Cast-Radiograph Evaluation (CRE) of 21 and Pink & White Esthetic Score of 6 points. The maxillary incisors were retracted ~3mm to reduce lip protrusion and achieve lip competence. The decreased lip protrusion helped mask the increase in LFH, so no change in facial convexity (18°) was evident.

Conclusion: This challenging malocclusion with an ectopic erupted canine (DI=27), was treated conservatively in 23 months to a good dental alignment (CRE=21). PSL brackets, IZC bone screw anchorage and Class III elastics were effective mechanics for alignment and retraction of the maxillary arch to relieve crowding and provide space to align an ectopically erupted UR3. (*J Digital Orthod* 2018;50:4-20)

Key words:

Congenitally missing, lower lateral incisor, ectopic eruption, maxillary canine, passive self-ligating appliance, infrazygomatic bone screw, extra-alveolar anchorage, anterior bite turbo, arch retraction, facial convexity

History and Etiology

A 22-year-old female presented for orthodontic consultation with concerns about dental crowding (*high, blocked-out UR3*) and protrusive lips. Facial evaluation showed a convex profile (G-Sn-Pg' 18°), protrusive lips (1mm/3mm to the E-line), and slight mentalis strain when closing the lips. The full smile photograph (Fig. 1) revealed that the upper and lower dental midline were shifted 4-5mm to the right relative to the facial midline. The upper right canine (UR3) was ectopically erupted to the labial, and the lower right lateral incisor

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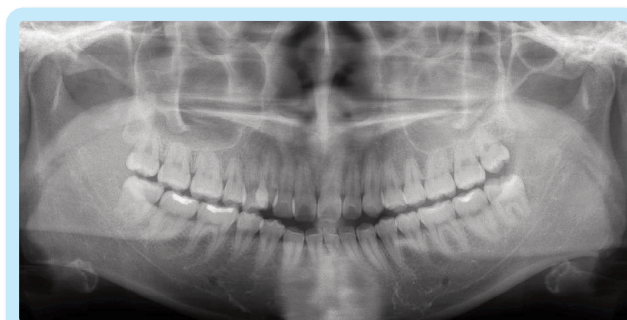
(LR2) was congenitally missing. Molar and canine relationships were asymmetric Class II bilaterally (Fig. 2). The panoramic radiograph (Fig. 3) documents that all 31 permanent teeth are erupted, and the cephalometric radiograph (Fig. 4) showed increased axial inclination of the upper and lower incisors, as well as protrusive, incompetent lips. Figure 5 is a frontal radiograph of the head showing that the upper and lower incisors are deviated to the right ~5mm. Lateral cephalometric measurements are shown in Table 1.



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



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



■ Fig. 3: Pre-treatment panoramic radiograph



■ Fig. 4: Pre-treatment lateral cephalometric radiograph

CEPHALOMETRIC SUMMARY

SKELETAL ANALYSIS

	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	82°	82°	0°
SNB° (80°)	79°	78°	1°
ANB° (2°)	3°	4°	1°
SN-MP° (32°)	30°	31°	1°
FMA° (25°)	20°	21°	1°

DENTAL ANALYSIS

U1 To NA mm (4 mm)	9 mm	6 mm	3 mm
U1 To SN° (104°)	113°	106°	7°
L1 To NB mm (4 mm)	11mm	9 mm	2 mm
L1 To MP° (90°)	111°	107°	4°

FACIAL ANALYSIS

E-LINE UL (2-3 mm)	1 mm	0 mm	1 mm
E-LINE LL (1-2 mm)	3 mm	3 mm	0 mm
%FH: Na-ANS-Gn (53%)	54%	56%	2%
Convexity: G-Sn-Pg' (13°)	18°	18°	0°

■ Table 1: Cephalometric summary

Diagnosis

Facial:

- Profile: Convex (G-Sn-Pg' 18°), decreased mandibular plane angle (FMA 20°)
- Frontal: Brachyfacial form
- Nasolabial Angle: Within normal limits (WNL)
- Protrusive Lips: 1mm/3mm to the E-line
- Lip Competence: Hypermentalis strain with lips closed

Skeletal:

- Sagittal Relationships: SNA 82°, SNB 79°, ANB 3°
- Low mandibular plane angle: SN-MP 30°, FMA 20°

- Facial asymmetry: Chin point is deviated to the right ~5mm (Fig. 5).

Dental:

- Midlines: 5mm/4mm upper and lower to facial
- Missing Teeth: LR2
- Sagittal: Angle Class II molar and cuspid bilaterally
- Overjet: 4mm
- Overbite: 0.5mm (5%)
- Crowding: 10mm in the upper arch and 0mm in the lower arch.
- Third molars: 4 third molars were fully erupted, but posterior space was inadequate.
- Arch form: Tapered lower arch but more U-Shaped upper arch

The American Board of Orthodontics (ABO) Discrepancy Index (DI)¹ was 27 points as shown in the worksheet at the end of this report.



■ **Fig. 5:**
Pre-treatment posterior-anterior (P-A) view radiograph of the head.

Treatment Objectives

1. Facial esthetics: *Retract relatively protrusive lips and establish lip competence.*
2. Level and align both arches
3. Correct overjet and overbite
4. Retract the lips and control the VDO to relieve mentalis strain
5. Dentition:
 - Extract all four third molars before orthodontic treatment.
 - Relieve upper arch crowding.
 - Align the upper midline as close to the facial midline as possible.
 - Optimize the intermaxillary occlusion and mandibular midline.
 - Achieve ideal overjet and overbite.

Treatment Alternatives

First Option: Establish symmetry by extracting three teeth (UR4, UL4, LL2), and substitute lower canines for lateral incisors. Correct upper and lower midlines and protrusive lips by differential retraction of anterior segments. Disadvantages for this treatment option are lack of a Class I relationship and substituted canines usually have more crown exposure compared to the adjacent central incisors.

Second Option: Asymmetric extraction of three teeth (UR4, UL4, LL4). Correct upper midline and lip protrusion by retracting the anterior maxillary segment. Disadvantages for this treatment option include more difficult mechanics for the lower dental midline and finish with an asymmetric dental alignment.

Third Option: Extract all four third molars, use infrazygomatic crest (IZC) bone screws and a passive self-ligating (PSL) appliance to retract the full dentition to optimize incisor alignment and the lateral lip profile. The disadvantages for this treatment are a compromised mandibular midline and asymmetric intermaxillary alignment.

At the consultation, all three options were presented to the patient, along with the pros and cons for each approach. She selected the third option.

Treatment Plan

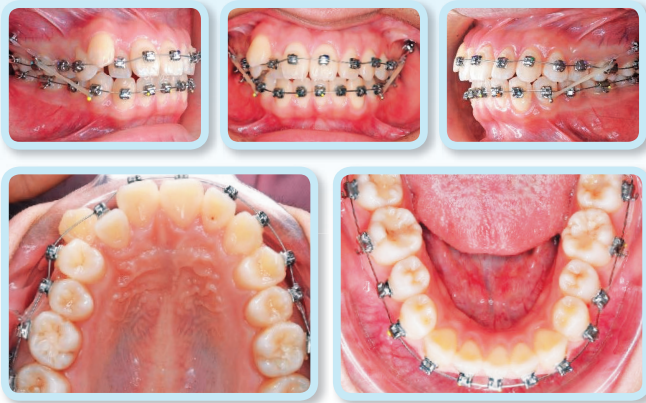
- Extractions: *All four third molars*
- Full Fixed PSL Appliance: *Bypass the UR3 with the initial archwire.*
- Anterior Bite Turbo: *Open the bite to facilitate arch retraction.*
- IZC Bone Screws: *2x8mm SS screws bilaterally to retract the maxillary arch and make room for the UR3.*
- Intermaxillary Elastics: *Retract the mandibular arch to optimize overjet, overbite, interdigitation, midline correction, and arch coordination.*
- Interproximal Reduction: *Optimize intermaxillary tooth size, detail and finish.*
- Retention: *Upper and lower Hawley retainers full time for first 6 months after fixed appliances removal and nights only thereafter.*

Treatment Progress

A full fixed 0.22-in slot Damon Q® PSL appliance (Ormco, Glendora, CA) was utilized, and all brackets were standard torque. The same supplier provided all the arch wires and auxiliaries as specified in the Archwire Sequence Chart, at the end of this report. At the initiation of active treatment, arch wires were 0.013-in CuNiTi in both arches, and bilateral IZC bone screws were installed buccal to the interproximal area between the upper first and second molars (Figs. 6 and 7). Maxillary buccal segments were retracted with elastomeric chains from each IZC bone screw to the corresponding upper 2nd premolars (U5). Class III elastics (Fox, 1/4-in 3.5-oz) from the maxillary first molars to the lower canines retracted the lower arch to create overjet.

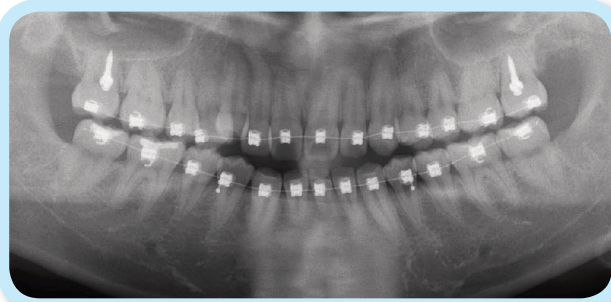
At two months (2M) into treatment (Fig. 8), arch wires were changed to 0.014x0.025-in CuNiTi. Both arches were retracted with elastomeric chains from the IZC bone screws to the UR4 and UL3. Class III elastics force was increased (Kangaroo, 3/16-in 4.5-oz). At four months (4M) into treatment (Fig. 9), the same mechanics were continued.

At eleven months (11M) (Fig. 10), UR3 was bonded and engaged on a 0.013-in CuNiTi archwire. The



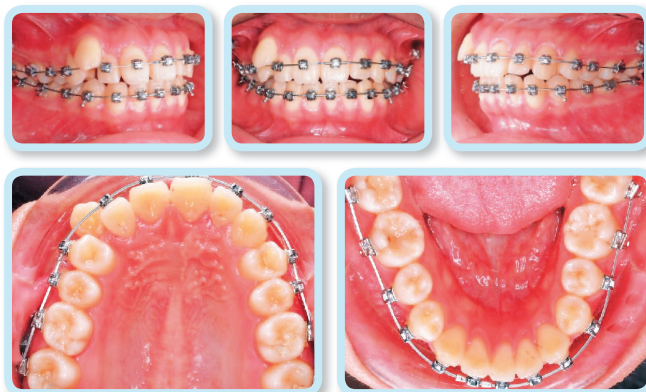
■ Fig. 6:

At the start of comprehensive orthodontic treatment, the UR3 was not bonded. Upper arch retraction was initiated by applying a chain of elastics from each IZC BS to the corresponding upper 2nd premolar. Class III elastics were used to retract the lower arch. See text for details.



■ Fig. 7:

A panoramic radiograph documents the post-operative position the 2x8mm SS bone screws that were placed in each IZC.



■ Fig. 8:

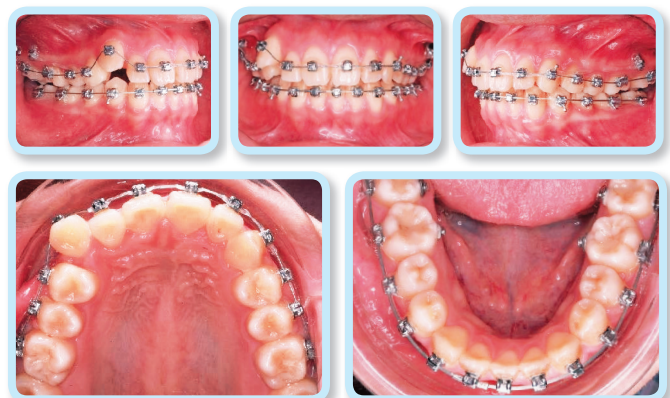
Two months (2M) into active treatment, a 0.014x0.025-in CuNiTi archwire was placed in each arch.



■ Fig. 9:

After four months (4M) of active treatment, the force of the Class III elastics was increased to 4.5-oz bilaterally.

lower arch wire changed to the 0.018x0.025-in NiTi. Lingual buttons were bonded on all lower molars, and intermaxillary cross elastics (Fox, 1/4-in 3.5-oz) were applied from the buccal to the lower lingual surfaces. The chains of elastics from IZC bone screws to the UR4 and UL3 were continued.



■ Fig. 10:

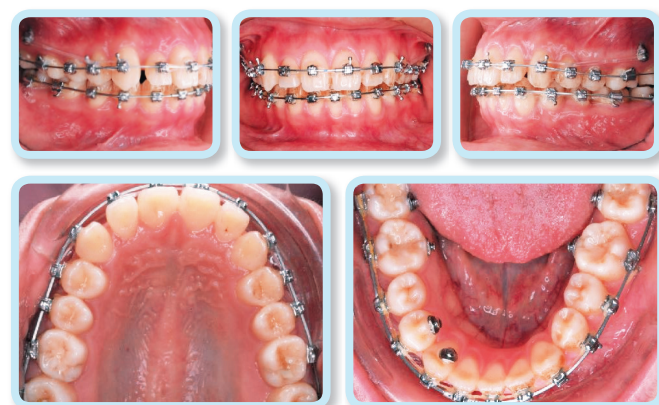
Eleven months (11M) into treatment, the UR3 was bonded and engaged on a 0.013-in CuNiTi archwire. Cross elastics (Fox, 1/4-in 3.5-oz) were applied from the upper buccal to the lower lingual surfaces on all molars bilaterally. See text for details.

In the twelfth month (Fig. 11), the posterior overjet was improved, and then cross elastics (*Penguin*, 5/16-in, 3.5-oz) were applied from the UR3 and UR4 to the LR3 and LR4 to reduce excessive buccal overjet.

In the sixteenth month (Fig. 12), the UR3 had been moved into the upper arch form, so the arch wire was changed to 0.018x0.025-in NiTi. Upper arch retraction was continued with bilateral elastomeric chains from each IZC to the respective maxillary



■ **Fig. 11:**
Twelve months (12M) into treatment, cross elastics (*Penguin*, 5/16-in, 3.5-oz) were applied from the buccal of the UR3 and UR4 to the lingual surfaces of the LR3 and LR4. See text for details.



■ **Fig. 12:**
Sixteen months treatment time, the upper arch wire was changed to 0.018x0.025-in NiTi.

canine. Class III elastic force was reduced (*Fox*, 1/4-in 3.5-oz).

At nineteen months (Fig. 13), the upper archwire was replaced with 0.016x0.022-in stainless steel. There was a 2mm overbite so anterior bite-turbos (BTs) composed of glass ionomer cement² were bonded on the lingual surfaces of the upper central incisors to facilitate retraction of the maxillary arch. Note the space that has been opened distal to the maxillary lateral incisors.

At twenty months (Fig. 14), the maxillary incisors were retracted with IZC anchored elastomeric chains that were attached to the maxillary archwire via crimpable hooks distal to the lateral incisors. Note there is a 2-3mm midline discrepancy between



■ **Fig. 13:**
Nineteen months into treatment, an occlusal bite-turbo (BT) was bonded on the lingual surfaces of the upper central incisors. See text for details.



■ **Fig. 14:**
Twenty months into treatment, the maxillary arch was retracted with IZC BS anchorage. See text for details.

the upper and lower midlines because of the asymmetric tooth loss (*missing LR2*).

At twenty-one months (*Fig. 15*), the anterior bite-turbo was removed and IPR was performed from UR4 to UL4 to help compensate for the missing LR2, and the spaces were closed with an elastomeric chain. Differential IPR would have improved the upper to lower midline discrepancy, but enhanced the facial to upper midline discrepancy. Symmetrical upper IPR from first premolar to first premolar was deemed preferable.



■ **Fig. 15:**

Twenty-one months treatment time, the BT was removed and IPR was used to reduce the width of the maxillary incisors.



At 22 months (*Fig. 16*), detailing and finishing were performed, and the Class III elastics were continued. One month later (23 months), all the fixed appliances were removed (*Fig. 17*). Post-treatment casts were made (*Fig. 18*), but the interdigitation of the buccal segments were different from photographs (*Fig. 17*) because of the angulation of the views. Finish radiographs were exposed (*Figs. 19-21*).

Results achieved

Maxilla (all three planes):

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

Mandible (all three planes):

- A - P: *Retracted (posterior rotation)*
- Vertical: *Increased*
- Transverse: *Expanded*

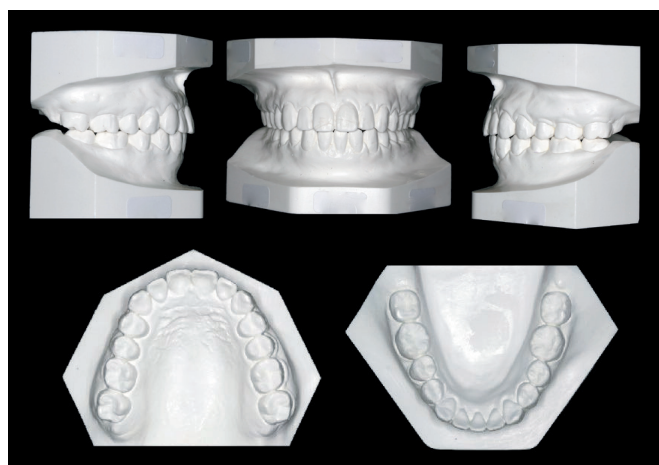


■ **Fig. 16:** Twenty-two months into treatment, finishing and detailing was performed in both arches. See text for details.



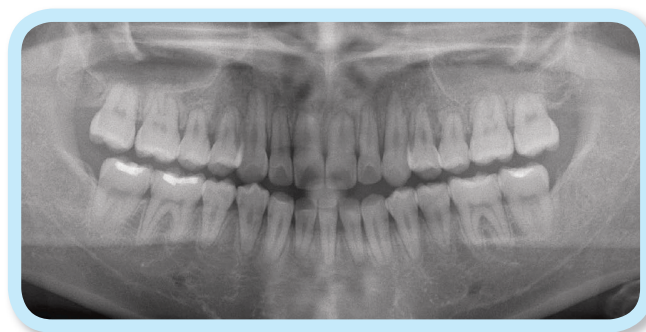
■ Fig. 17:

After twenty-three months of active treatment, fixed appliances were removed and post-treatment facial and intraoral photographs were taken.



■ Fig. 18:

Post-treatment dental models (casts) show about the same midline deviation as the intraoral photographs but the buccal segments are different. See text for details.



■ Fig. 19: Post-treatment panoramic radiograph

Maxillary Dentition

- A - P: *Retracted*
- Vertical: *Incisors maintained, molars extruded*
- Inter-molar / Inter-canine Width: *Increased*

Mandibular Dentition

- A - P: *Maintained*
- Vertical: *Slight incisor and molar extrusion*
- Inter-molar / Inter-canine Width: *Maintained*

Facial Esthetics

- LFH: *Increased from 2° by posterior (clockwise) rotation of the mandible*
- Lips: *Retracted to improve facial balance*
- Mentalis Strain: *Improved by incisal retraction but compromised by increased LFH*
- Lip protrusion: *Improved*
- Facial Profile: *Maintained*

Retention

Hawley retainers were delivered for both arches with instructions for full time wear the first 6 months and nights only thereafter.

Final evaluation of treatment

The anterior bite turbos resulted in extrusion of the upper and lower molars, producing a posterior (*clockwise*) rotation of the mandible (*Fig. 22*). For the present patient, the mechanics employed were acceptable because the decreased lip protrusion masked the more retrusive chain, resulting in no change in facial convexity (18°). Furthermore there was no evidence of mentalis strain in the lateral

cephalometric film at the finish (*Fig. 20*), and the frontal view of the face was more tapered and attractive face (*"Botox-like effect"*) due to the opening of the VDO. The final alignment was assessed at 21 points with ABO Cast-Radiograph Evaluation (CRE),³ as documented in the supplementary worksheet at the end of the report. The principal alignment discrepancies were: marginal ridges (6 *points*), occlusal contacts (5 *points*) and occlusal relationship on the right side (4 *points*). Overjet and overbite were near ideal. In the final dental photographs, the buccal relationships were Angle Class I on the left and slight Class III on the right due to the missing LR2. The final dental casts showed a slightly different relationship: Class I on the right and slight Class II on the left. The discrepancy between the photographs and the casts may reflect the orientation of the photographs and/or distorted impressions. The interior photographs are more consistent with the expectations for a finished occlusion with a missing LR2. The Pink and White esthetic scores was 6 points, as subsequently documented in worksheet, which is consistent with esthetic outcomes as recommended by Sarver and Yanosky.⁴

Discussion

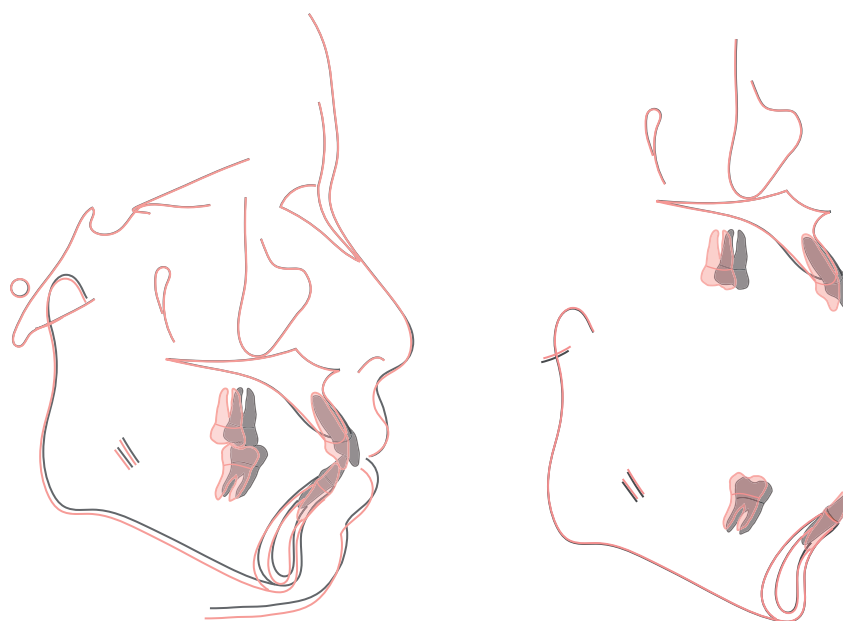
Average eruption time of the maxillary canines is 11.5 years, and the only permanent teeth to erupt later are second and third molars.⁵ There are a variety of factors that can lead to unilateral malocclusion of a maxillary canine. Genetics and family history may play a role,⁶ particularly with regard to the early loss of a maxillary deciduous second molar with mesial tipping or mesial migration of the permanent first molar.⁷ When associated with a maxillary to facial midline discrepancy, the most likely etiology



■ Fig. 20: Post-treatment lateral cephalometric radiograph

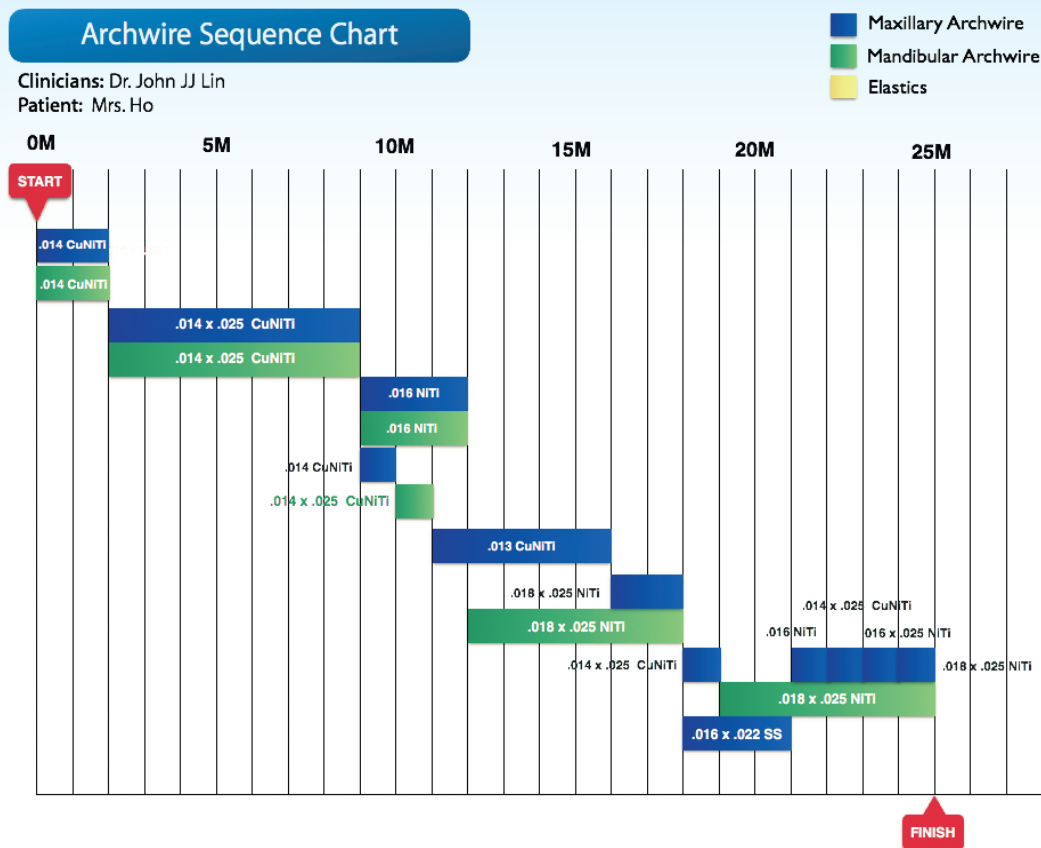


■ Fig. 21: Post-treatment P-A radiograph of the head



■ Fig. 22:

Cephalometric tracings superimposed on the anterior cranial base (left) show dentofacial changes over 23 months of treatment: pre-treatment is black and post-treatment is red. The lips are retracted slightly and the VDO is increased by posterior rotation of the mandible, but there is no net change in facial convexity. Maxillary superimposition (upper right) documents the retraction and slight extrusion of the maxillary arch. Mandibular superimposition (lower right) reveals the molars were slightly extruded. See text for details.



is ectopic eruption of the UR2 causing premature loss of the UR deciduous canine. The maxillary incisors subsequently tip into the edentulous space blocking out the eruption of the permanent canine (Fig. 1). This problem can lead to both esthetic and periodontal compromises.⁸

The most common congenitally missing teeth are maxillary lateral incisors (U2), upper and lower second premolars (U5/L5), and the upper third molars (U8) are missing more frequently than other teeth.⁵ Missing lower incisors is a rare trait worldwide, but is more common in Asia.⁹ Mandibular lateral incisors are more frequently missing than the adjacent central incisors,¹⁰ which is consistent with the time-honored morphogenetic field concept.¹¹

The present case report is consistent with these data because the distal tipping of the three mandibular incisor to the right (Fig. 3), indicates the LR2 was the missing tooth.

Space analysis and facial esthetics are critical considerations when formulating a treatment plan. Lip protrusion (Figs. 1 and 4) is commonly treated with symmetric or asymmetric premolar extraction, but crowding and differential anchor requirements must be carefully considered. Temporary anchorage devices (TADs) are an important asset for managing asymmetries. Mini-plates are effective TADs, but they are a relatively aggressive approach for most missing teeth.¹² Interradicular miniscrews are appealing,¹³ but they often block the path of tooth movement

when arches are retracted¹⁴ and may interfere with complete closure of a space. If TADs are moved outside the root area (*extra-radicular position*), the entire maxillary arch can be retracted.¹⁵ When bone screws are placed buccal to the root area, they are outside the alveolar process that supports the roots of the teeth, and are deemed extra-alveolar (E-A) bone screws (BS).¹⁶ The IZC is an extra-radicular area buccal to the upper molars that is a useful site for TADs to reliably retract the maxillary arch.^{15,17}

The current patient was concerned about the high canine on the upper right side, but was satisfied with her convex facial profile (*Fig. 1*). Correction of the upper crowding, midline shift and lip protrusion required extractions or E-A TADs to differentially retract the maxilla. The patient selected the latter option and the mechanics were very effective for correction incise axial inclinations (*Fig. 19*).

The anterior BT opened the bite to facilitate retraction of the maxillary arch, but they were also associated with a subsequent increase in the VDO and FMA. In retrospect, the BT was a problem because the patient appeared to have slightly incompetent lips pre-treatment (*Fig. 4*). However, the BT did facilitate arch alignment and probably decreased the overall treatment time. Maxillary molar extrusion (*Fig. 22*) due to the BT was controllable with intrusive force from the IZC bone screws, but the lower molars were still free to extrude. The increase in VDO complicated correction of lip incompetence, but resulted in improved facial esthetics in the frontal plane (*Figs. 1 and 17*). Increasing LFH within the limit of lip competence (*Fig.*

22) improves the frontal facial appearance of patients with wide and short lower face (*brachyfacial pattern*). This is a conservative approach to achieving a more attractive tapered facial pattern which is similar to the “*Botox® effect*” achieved by injecting botulinum toxin type A (*Botox®*) into hypertrophic masseter muscles.¹⁸

Conclusion

A challenging asymmetric malocclusion with a missing LR2 and an topically erupted UR3 (*DI=27*), was treated conservatively in 23 months to an attractive facial result with a good dental alignment (*CRE=21*). PSL brackets, IZC bone screw anchorage, and Class III elastics were effective mechanics for Intermaxillary retraction to relive crowding and lip protrusion. Bite turbos were associated with molar extrusion, posterior rotation of the mandible, and an increase in facial height. However, lip competence was maintained so facial form in the frontal plane was improved.

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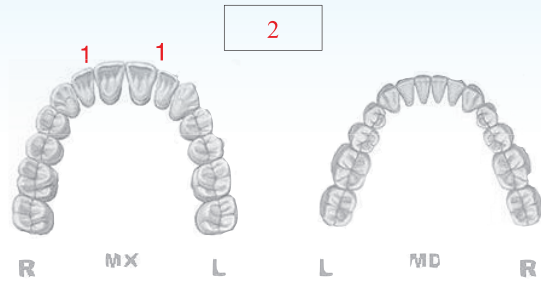
Cast-Radiograph Evaluation

Case #

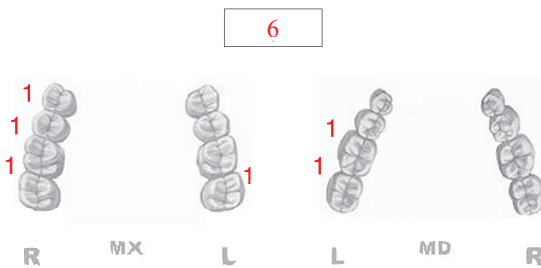
Patient

Total Score: **21**

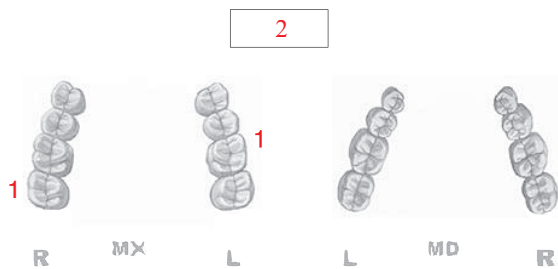
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Marginal Ridges



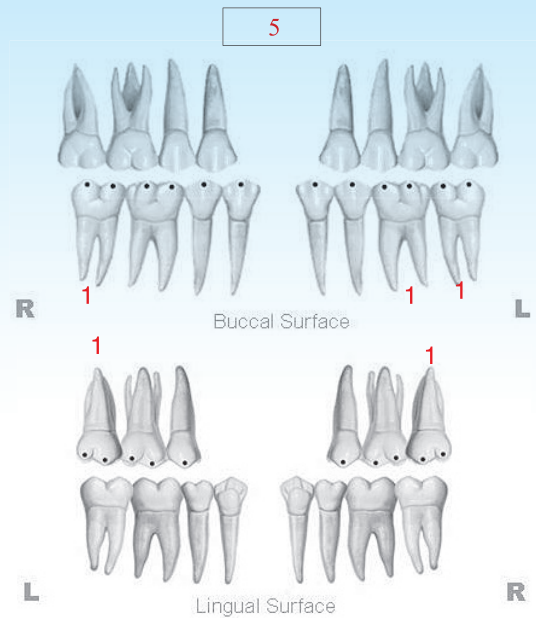
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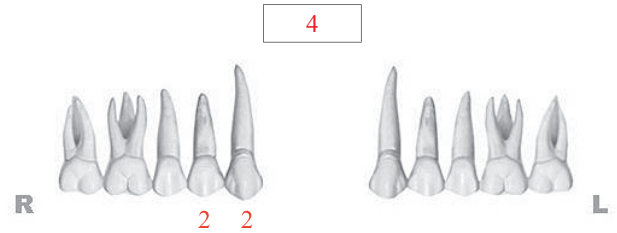
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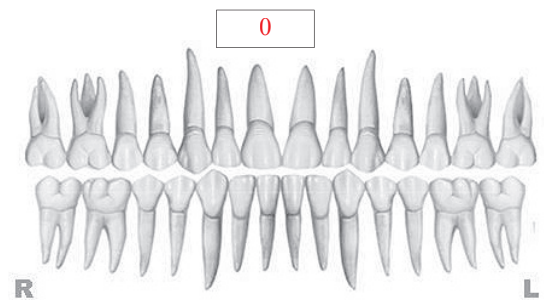
Occlusal Contacts



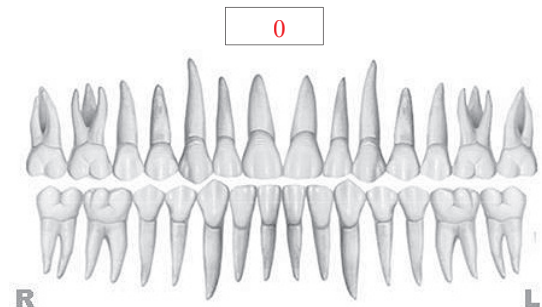
Occlusal Relationships



Interproximal Contacts



Root Angulation

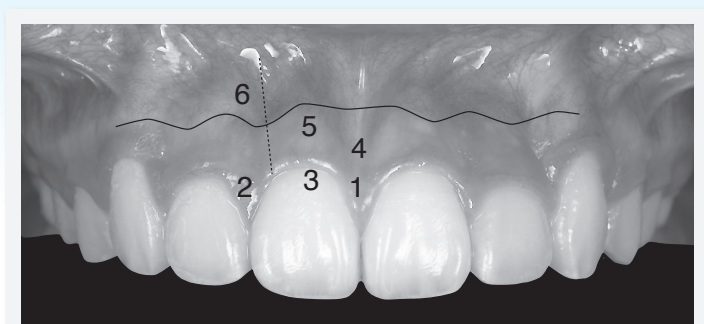


INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

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

Total Score: = **6**

1. Pink Esthetic Score

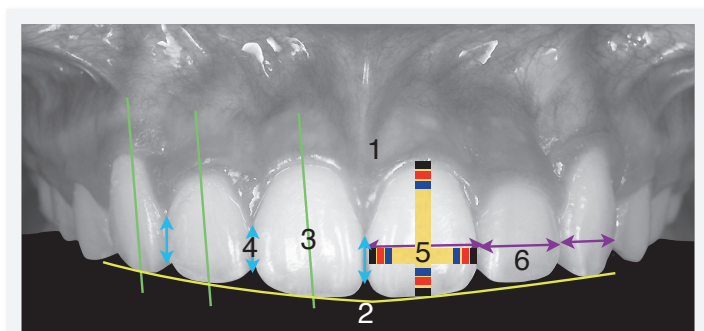


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

Total = **1**

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)



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 = **5**

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