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The 2nd annual China Insignia Users' Meeting in Suzhou, China. Dr. Chris Chang gave a lecture on the Insignia™ and shared his insight on the digital Orthodontics.

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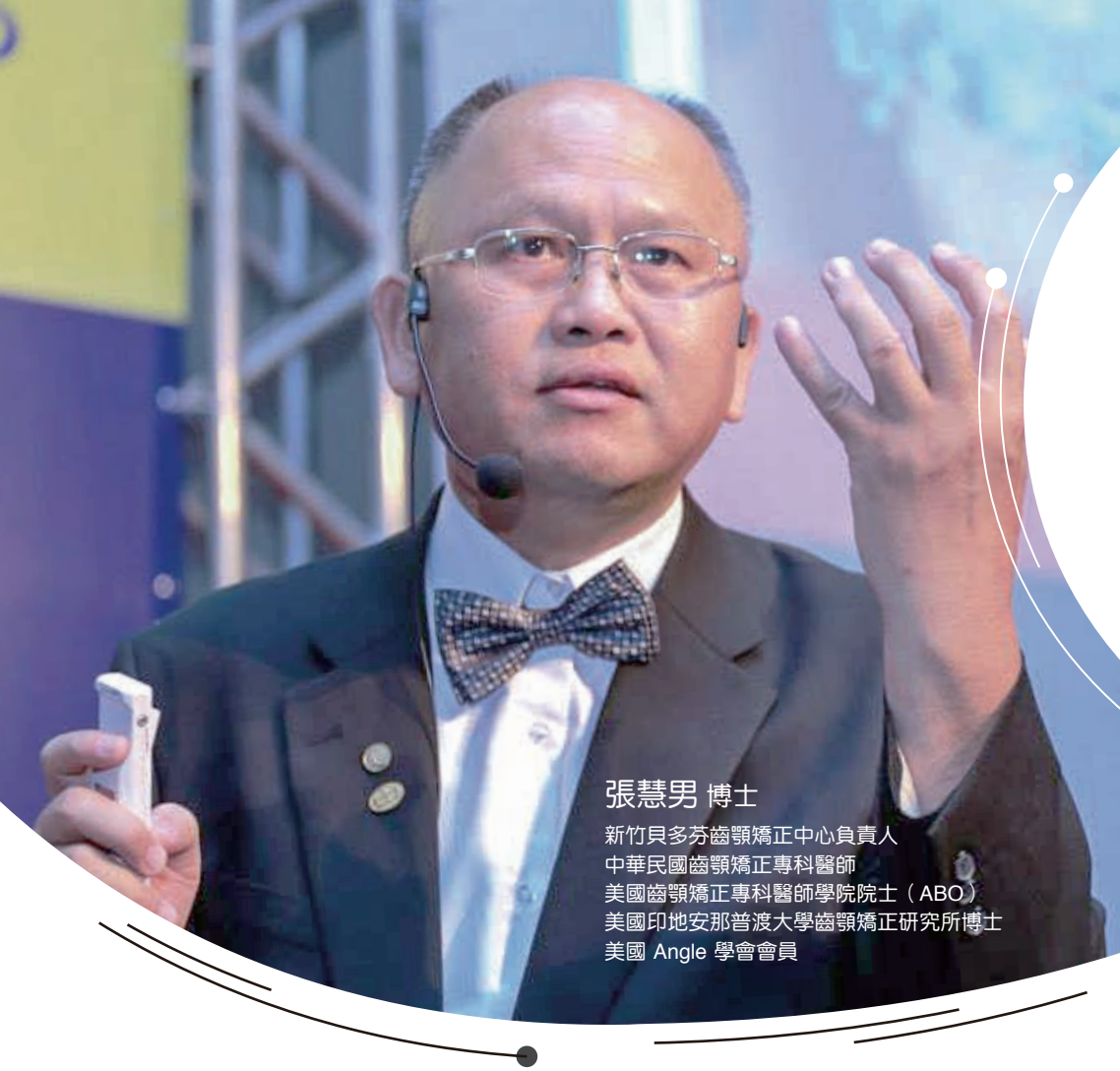

2019-20
熱愛學矯正

全新的貝多芬高效 Damon 矯正大師系列課程是由國際知名講師張慧男醫師親自規劃及授課，課程特色強調由臨床病例帶動診斷、分析、治療計畫擬定與執行技巧。此外，透過數位影片反覆觀看，課堂助教協助操作，以及診間臨床見習，讓學員在短時間能快速上手，感染「熱愛矯正學，熱愛學矯正」的熱情。

張慧男 博士

新竹貝多芬齒顎矯正中心負責人
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Damon Master

(Thu) 9:00-5:00 中文授課

The Beethoven Damon Master Program, created by Dr. Chris Chang, is a two-year clinical program. Its hands-on orientation features case study-based diagnosis, analysis, treatment planning andresult evaluation. Combining in-class teaching assistants, after-class video review and chair-side observation, participants will learn to master the essential tips of the Damon System.

Year 1 2019

Module 1 - **4/25**/19' Module 4 - **7/18**
Module 2 - **5/16** Module 5 - **8/22**
Module 3 - **6/20** Module 6 - **6/19.21.22**（擇一）

Year 2 2019-20

Module 1 - **9/12** Module 4 - **12/12**
Module 2 - **10/17** Module 5 - **1/9**/20'
Module 3 - **11/21**

Excellent Finishing

(Tue) 9:00-12:00 中文授課

Critically reviewing classical literature and contemporary papers and applying lessons learned to clinical work; utilising ABO's DI and CRE standards to turning excellent finishing into attainable goals.

Finishing X

Module 1 - **8/14**/18' Module 6 - **2/26**
Module 2 - **9/4** Module 7 - **3/19**
Module 3 - **10/16** Module 8 - **4/16**
Module 4 - **11/13** Module 9 - **5/14**
Module 5 - **1/8**/19' Module 10 - **6/25**
Module 11 - **7/23**

Damon, OBS & VISTA International Workshop

English Class

The workshop provides a 2.5 day, advanced hands-on program to experienced Damon users. The program includes world-class lectures, model and surgical hands-on workshops and clinical observation on patient care and clinic management.

course@newtonsa.com.tw
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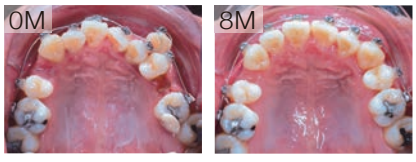
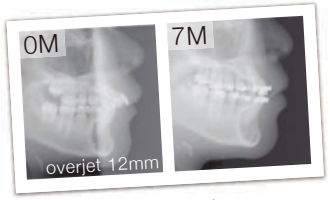
2019

Class 1 - **5/21-24** Class 2 - **12/03-06**
Additional session for Brazilian - **6/27-29**



Damon + .014 Cu NiTi

Damon Clear



Damon + Bite Turbo +
Early Light Short Elastic

每次上課請依最新一期 JDO 公告為主

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Simple Digital Mechanics

Several years ago in New York there was the first ever Insignia Users' Meeting, which since then has become an annual event. Recently I was invited to the 2nd annual China Insignia Users' Meeting in Suzhou, China.

During this meeting, with over 400 attendees, I not only had the pleasure of being the Keynote Speaker, but also listening to 2 Doctors who had each treated more than 2000 patients with Insignia. The thing that really struck me is the fact that there is a "*Chinese Fever*" for digital Orthodontics. As you all know, it is not a question of if, but rather **when** Digitial Orthodontics is going to skyrocket and become the most popular trend in our profession.

As Orthodontics becomes more popular in China, it would seem that it is easier for the younger generation of Chinese Orthodontists to embrace new technologies, as they have no confinements and this, coupled with their desire and ambition to climb to the peak of the mountain, only increases their yearning to learn new techniques and new ideas, **especially digital**.

The Chinese Orthodontists have recognized that Digital Orthodontics is the future and they are most keen to ride this digital wave. I predict that China will be the largest Insignia market in the world; not necessarily because of having such a large population, but rather due to the eagerness and openness of the practising Orthodontists there.

I really look forward to experiencing the Orthodontic digital fever that is rising in China and hope you will join them and myself on this new digital path to glory.

Chris Chang DDS, PhD, Publisher of JDO.

Recovery of an Inverted Maxillary Central Incisor Impaction with a Dilacerated Root

Abstract

Introduction: *A 19 year- 4 month male presented with a chief complaint (CC) of poor dental and facial esthetics.*

Diagnosis: *Increased facial convexity (16˚) and lower facial height (59%) were associated with a steep mandibular plane (FMA 31˚), retrusive maxilla (SNA 80.5˚) and mandible (77˚), plus an intermaxillary base discrepancy (ANB 3.5˚). Moderate anterior crowding was noted in both arches, and molar relationships were Class I. The UR1 was missing, contributing to a 4mm midline deviation and full anterior crossbite. Radiographic images documented complete inversion of the UR1, with a dilacerated root conforming to palatal contour distal to the root of the UR2. The Discrepancy Index (DI) was 28.*

Etiology: *Severe impaction of the UL1 was apparently due to a deviated path of eruption which may have related to improper development of the tooth, and/or limited space in the arch due to traumatic injury of the primary dentition.*

Treatment: *Standard torque, passive self-ligating (PSL) brackets were bonded upside down on the upper anterior teeth to prevent labial flaring, when the UR1 space was opened. Low torque brackets were bonded upside down on the lower incisors to prevent lingual tipping with Class III elastics. Two infra-zygomatic (IZC) bone screws were placed buccal to the second molars (IZC 7) to retract the entire maxillary arch. Surgical exposure of the UR1 was performed following 12 months of space opening. A UR1 replica was produced with a 3D printer using the cone-beam computed tomography (CBCT) image. The replica was used clinically to plan the staged path for traction. A slow traction procedure, with regular periodontal maintenance, was performed to avoid a premature perforation of the labial alveolar plate. A rectangular archwire and Warren torquing spring were used to upright the UR1.*

Results: *Facial esthetics and symmetry were improved, but moderate root resorption was noted for all four maxillary incisors. This challenging malocclusion with an inverted UR1 (DI = 28) was treated in 60 months to an excellent outcome, as evidenced by a Cast-Radiography Evaluation (CRE) score of 17, and Pink & White (P&W) dental esthetic score of 5. The UR1 was recovered and aligned in a satisfactory position, which required only removable retention.*

Conclusion: *Despite root dilaceration of more than 90˚ in the sagittal plane, and a horizontal rotation of the impaction to impinge on the roots of the UR2, the UR1 was recovered and optimally aligned. Complex interdisciplinary care required a long treatment time (60 mo), but resulted in an excellent outcome. CBCT images and 3D printed replicas were valuable for diagnosis and recovery of the complex impaction. (J Digital Orthod 2019;53:4-25)*

Key words:
Inverted impacted maxillary central incisor, root dilaceration, IZC bone screws, anterior crossbite, CBCT, three dimensional printing, self-ligation appliance, 3D printed replica

History and Etiology

Dental nomenclature for this report is a modified Palmer notation: upper right (*UR*) and left (*UL*), and lower right (*LR*) and left (*LL*) quadrants. Teeth in each quadrant are numbered from 1-8 relative to the midline. A 19 year 4 month male presented with a convex lateral profile, anterior crossbite, impacted UR1, and the maxillary midline shift was 4mm to the right (*Figs. 1 and 2*). Cephalometric, panoramic, and anterior-posterior

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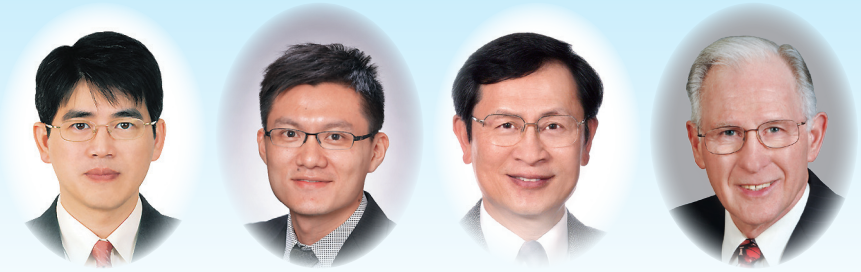

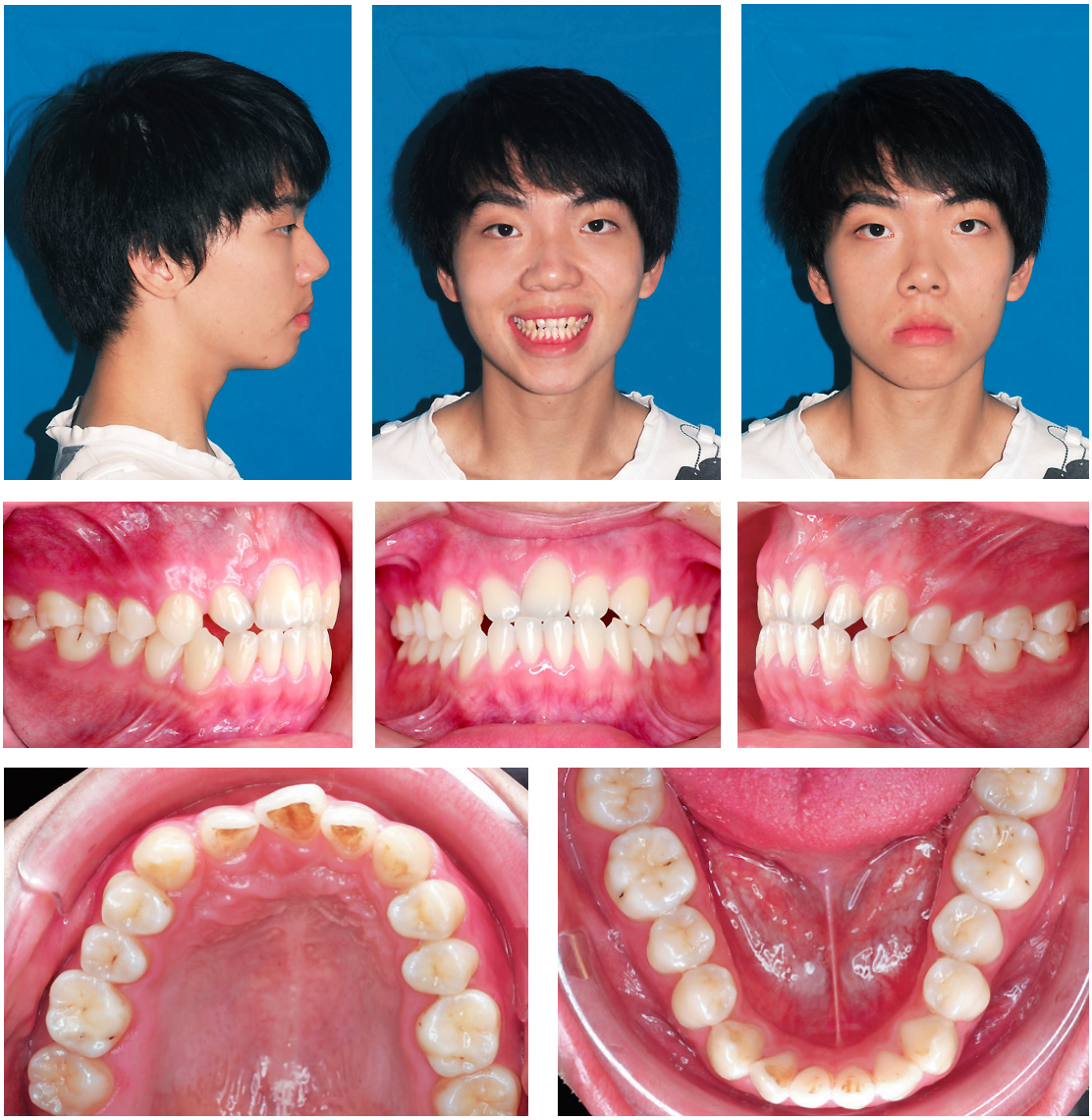

Fig. 1: Pre-treatment facial and intraoral photographs

radiographs of the head (*Figs. 3-5*) revealed that the UR1 was a complex, inverted impaction with a dilacerated root. There was no history of significant trauma, dental problems, or medical disorders. The etiology appeared to be a deviated path of eruption of the UR1 followed by root formation in a distolingual direction that encroached on the cortical plate of the palate, resulting in a horizontal impaction lingual to the UR2. Recognizing the severity of the problem, the patient's dentist referred him to an interdisciplinary team: orthodontist, periodontist and radiologist.

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

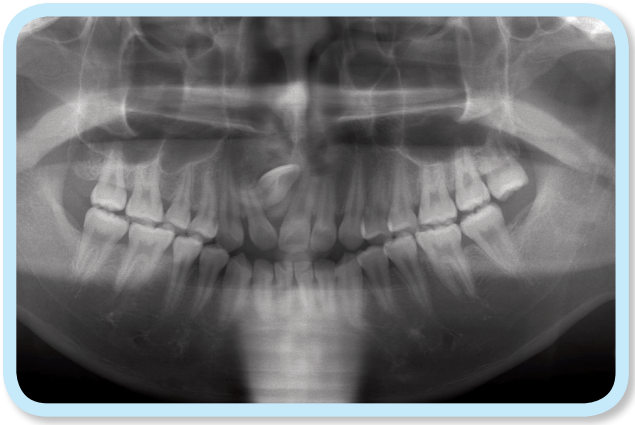

Fig. 3:
Pre-treatment panoramic radiograph shows the impacted UR1 with a dilacerated root superimposed under the UR2 root.

Fig. 4:
Pre-treatment cephalometric radiograph in centric occlusion reveals an anterior crossbite with an inverted maxillary central incisor impaction.

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

Diagnosis

Facial:

- Facial Height: *Increased (59%) with tapered facial form*
- Protrusion: *Relatively protrusive lower lip (3mm to the E-Line)*
- Symmetry: *Maxillary dental midline 4mm to the right, occlusal plane cant (Fig. 1)*
- Smile Line: *Upper lip has an asymmetric elevation on the right side consistent with the occlusal cant (2mm inferior on the patient's right side).*

Skeletal:

- Intermaxillary Relationship: *Retrusive (SNA 80.5˚, SNB 77˚, ANB 3.5˚)*
- Mandibular Plane: *Excessive (SN-MP 38˚, FMA 31˚)*
- Vertical Dimension of Occlusion (*VDO*): *Excessive Na-ANS-Gn (59%)*
- Symmetry: *Within normal limits (WNL)*

Dental:

- Classification: *Class I bilaterally*
- Overbite: *1mm*
- Overjet: *-2mm*
- Missing / Unerupted / Impacted: *UR1 inverted with severe root dilaceration and positioned palatally to the UR2*
- Symmetry: *Upper midline deviated 4mm to the right*

The American Board of Orthodontics (*ABO*) Discrepancy Index (*DI*) was 28 as documented in to the subsequent worksheet.

Specific Objectives of Treatment

The treatment objectives were: 1. correct the anterior crossbite and asymmetric dental arches, 2. open space for the impacted UR1, 3. extrude, upright and rotate the inverted UR1 into occlusion, 4. coincide the upper dental midline from the right to facial midline.

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

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

Maxillary Dentition:

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

Mandibular Dentition:

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

Facial Esthetics:

- Correct protrusive lower lip

Treatment Alternatives

The 3-Ring Diagnosis for assessing anterior crossbite is helpful for evaluating skeletal discrepancies.[1,2]

Extraction of the UR1 impaction simplifies dental alignment in the upper arch, but extraction and enamel stripping is indicated in the lower anterior region to correct the overjet and overbite. In addition, periodontal crown lengthening and esthetic restorations and/or implant surgery may be required to adequately restore esthetics and function. A nonextraction treatment plan to recover an inverted impaction (*UR1*) is complicated, and will require an extended duration of active treatment, but it would probably be the most esthetic outcome. In this context, three treatment options are considered (*Fig. 6*):

1. **Option 1** (*Plan A*): Extract the impacted UR1, UL1 and both lower first premolars (*LR4, LL4*). Differential closure of the extraction spaces achieves Class II canine and Class I molar relationships. Apply interdisciplinary periodontal surgery and restoration procedures as indicated.

2. **Option 2** (*Plan B*): Extract the UR1 and retract both upper buccal segments with anchorage provided by infra-zygomatic crest (*IZC*) bone screws. Open space to install an osseointegrated implant to restore the UR1. Perform bone and soft tissue augmentation as needed for an optimal outcome.[3,4]

3. **Option 3** (*Plan C*): Open space for the impaction while retracting both maxillary buccal segments with IZC bone screw anchorage. Uncover the UR1 and bond attachments to upright and rotate the impaction into an optimal occlusion. This approach results in a Class I occlusion, but the severely dilacerated root of the UR1 may penetrate the labial alveolar plate.

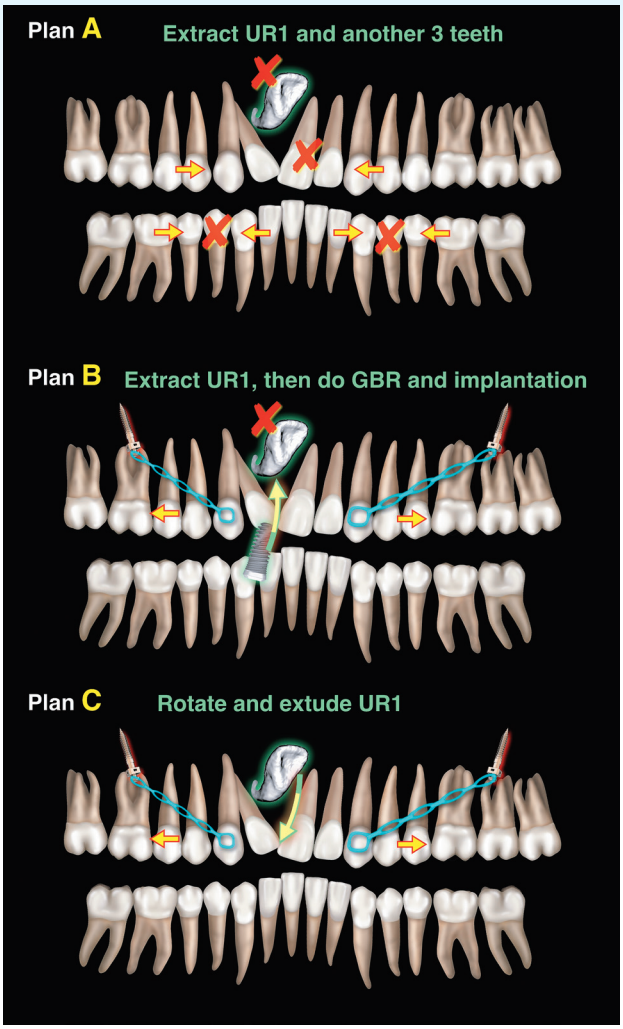

Fig. 6:
A three-part diagram shows three treatment approaches: Plan A is Option 1, Plan B is Option 2, and Plan C is Option 3. See text for details.

Rationale: Extracting 4 teeth as specified in Option 1 would correct dental crowding, reduce facial protrusion, and retract the lips, probably resulting in favorable lip protrusion to the E-line. However, the Class II canine relationships and substitution of lateral for central incisors are

esthetic compromises that require considerable periodontal and restorative rehabilitation for an optimal outcome. Option 2 avoids the long and uncertain recovery process for the challenging impaction, but favorable longterm outcomes are unpredictable for an implant-supported prosthesis replacing a single maxillary incisor. Complicated bone augmentation and implant surgery for the expected atrophic ridge are unlikely to match the natural periodontium of the adjacent UL1. An additional challenge is the longterm aging of the patient because osseointegrated implants do not move physiologically like natural teeth.[3-5] Correcting the position of an implant-supported prosthesis may require surgical repositioning with a segmental osteotomy and osseodistraction.[6] The last treatment option (*Plan C*) preserves all the teeth except the UR8. Although the inverted UR1 has an extremely dilacerated root, the crown of the incisor is ideal for alignment in the arch. Furthermore extruding and rotating the UR1 into position naturally generates periodontium to match the adjacent teeth.

3D Imaging and Replica: CBCT images and a replica produced with a 3D printer were valuable procedures for determining that a recovery procedure was practical. Based on imaging confirmation of a well-formed crown for the UR1 impaction, a plan was formulated for a staged rotation in two planes, that was associated with extrusion of the impaction into occlusion. Despite the well discussed technical challenges and long treatment time, the patient preferred the recovery and alignment of the UR1 impaction (*Option 3*) because that approach was most likely to produce the most desirable esthetics and function.

Treatment Progress

A 0.022-in slot Damon Q® passive self-ligating (*PSL*) appliance (*Ormco, Glendora, CA*) was installed on all permanent teeth, and 0.014-in copper-nickel-titanium (*CuNiTi*) wires were placed in both arches. Standard-torque brackets were bonded upside down on the upper anterior teeth to prevent excessive flaring as the UR1 space was opened (*Fig. 7*). Inverted low torque brackets were bonded on the lower anterior teeth (*Fig. 8*) to prevent lingual tipping as they were retracted with Class III elastics (*Fox 1/4-in, 3.5-oz*). Space was opened for the UR1 (*Fig. 9*). Elastic chains were placed from the maxillary canines to the

Fig. 7:
The initial mechanics for the selected treatment Option 3 (Plan C) included an open coil spring, IZC-7 bone screws, elastic chains and Class III elastics. See text for details.

IZC screws to prevent anterior flaring as the space was opened.

In the 5th month, upper left posterior segment retraction failed to keep pace with the contralateral side. CBCT images revealed that retraction of the UL7 roots was blocked by the IZC bone screw (*Fig. 10*). The screw was repositioned and upper left segment retraction was continued. One month later, the arch wires were changed to 0.018-in CuNiTi in the upper and 0.014x0.025-in CuNiTi in the lower. Class III elastics (*Fox 1/4-in, 3.5-oz*) from U6s to L3s was combined elastic chains from the bone screws to U4s. After one month, arch wires were changed to 0.014x0.025-in CuNiTi in the upper and wire, the lower archwire was upgraded to a 0.018x0.025-in CuNiTi in the lower. Diagonal elastics were utilized as needed to achieve a Class I canine relationship.

Fig. 8:
The self-ligation brackets were bonded upside down. See text for details.

In the 9th month of treatment, smaller diameter archwires (*0.014x0.025-in CuNiTi*) were placed in both arches to accommodate the repositioned brackets on UR2 UL3 LL3 LR1 and LR3. The UR2 bracket was specifically oriented to incline the root distally to create adequate space for UR1 rotation and extrusion. Three months later, the UR1 was exposed, a bracket was bonded on the enamel surface, and an elastic chain was connected to the archwire (*Fig. 11*). Following three months of traction, the incisal edge of the UR1 was sufficiently exposed to bond a bracket near the incisal edge on the labial

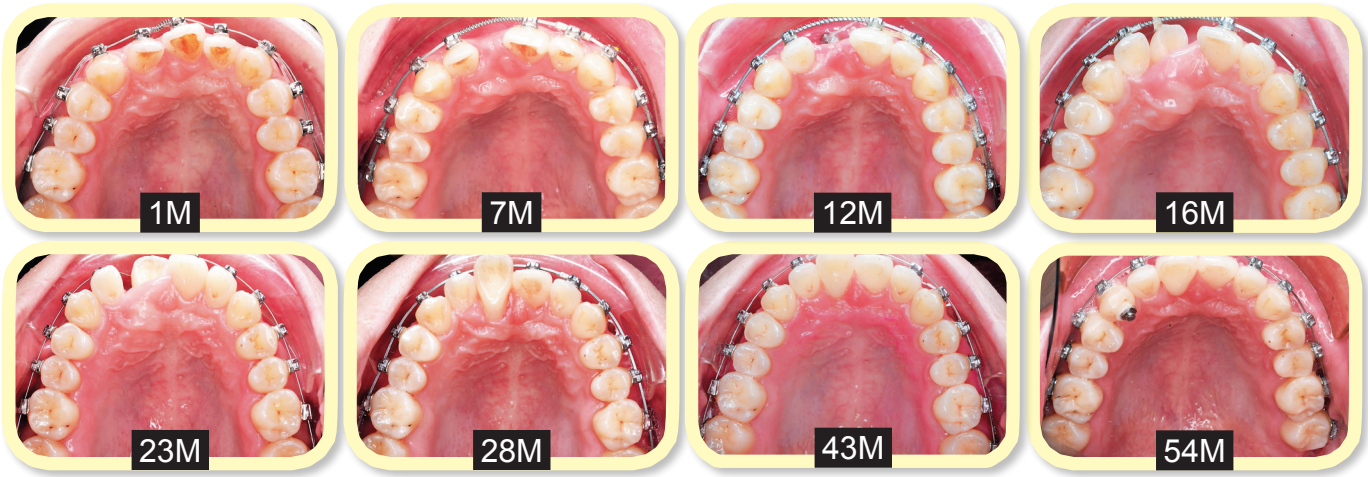

Fig. 9: A progressive series of occlusal photographs show treatment progress from 1-54 months (1M-54M). See text for details.

surface. The line of traction force was adjusted so the dilacerated root of UR1 rotated mesially to unlock the root from the palatal surface of the UR2. The rotational plane for the UR1 was carefully monitored with CBCT imaging. The replica of the impaction produced with a 3D printer (*Fig. 12*) was used to plan the mechanics. In the 18th month of active treatment, a gum boil-like lesion was noted in the vestibule above the UR1. Fortunately, the lesion was submucosal scar tissue and not a penetrating root tip. The scar tissue was removed without compromising the vitality of the UR1.

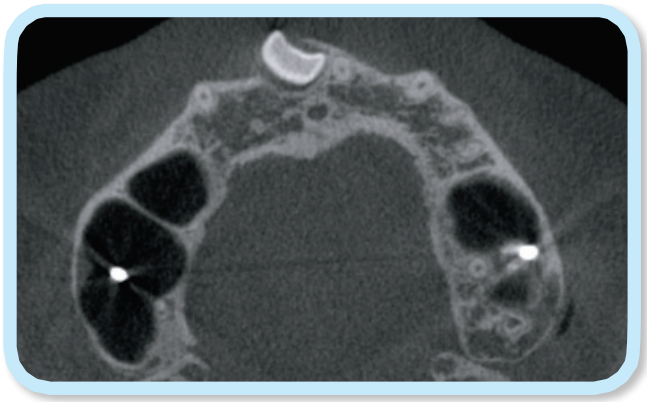

Fig. 10:
A horizontal cut from a CBCT image shows the crown of the impaction and two IZC screws that are near or within the maxillary sinus. See text for details.

To apply a more horizontal force with a chain of elastics, a long hook was crimped mesial to the coil spring in the edentulous site on a new stiffer archwire (*0.016x0.025-in SS*). In the 20th month of treatment, the dilacerated root of UR1 was still lodged behind the UR2 root so two buttons were bonded near the incisal surface of the UR1, and a chain of elastics was activated to the archwire to apply a moment to the UR1 root in the frontal plane (*Fig. 13*).

After 23 months of treatment, the UR1 root was mesial to the UR2 root, so a PSL bracket was bonded on the UR1, and the entire upper arch was engaged with a light-force 0.013-in CuNiTi (*Fig. 14*). Three months later, the incisal edge of UR1 was

Fig. 11:
A progressive series of frontal intraoral photographs show UR1 extrusion, rotation and alignment from 12-31 months (12M-31M). See text for details.

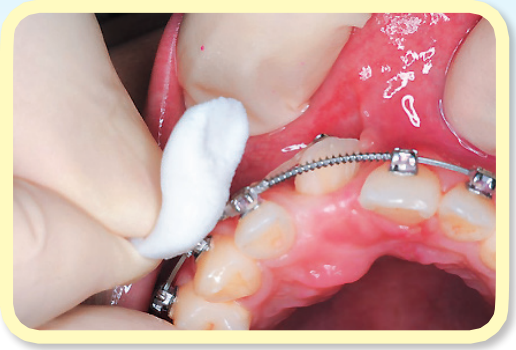

Fig. 12:
Clinical evaluation of the UR1 position using a 3D printed replica. See text for details.

Fig. 13:
Extrusion and rotation mechanics adjusted to move the root of the UR1 past the root of the UL2. See text for details.

aligned, but there was palatal gingival recession that required labial root torque on the UR1 (*Fig. 9*). One month later, the IPR (*interproximal reduction*) was performed between the UR1 and UL1 to correct a black triangle, and the next month an upper 0.018x0.025-in CuNiTi archwire was placed.

In the 29th month of treatment, a smaller diameter upper archwire (*0.014x0.025-in CuNiTi*) was inserted. Two months later, a Warren torquing spring was activated for UR1 labial root torque (*Fig. 15*). In the 34th month of treatment, IPR was performed between

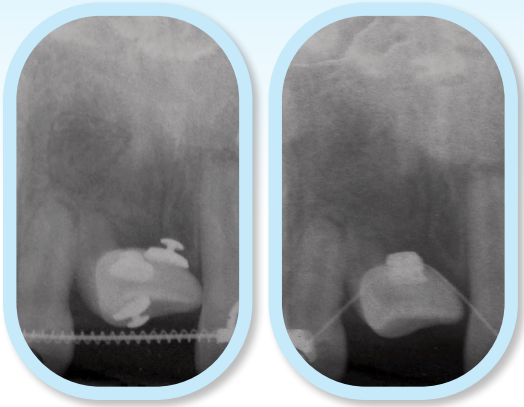

Fig. 14:
Left: After 23 months of treatment, a periapical radiograph shows the root of the UR1 is mesial to the root of the UR2. Right: A PSL bracket is bonded and UR1 and a light continuous archwire is engaged for alignment. See text for details.

LR1 and LR2, and a new UR1 Warren torquing spring was placed on the UR1. The following month an upper 0.018x0.025-in CuNiTi archwire was placed. The archwire was stepped up between the LR3-LL3, and Class III elastics (*Fox 1/4-in, 3.5-oz*) were resumed. One month later, an upper 0.018x0.025-in CuNiTi archwire was placed and the UR1 torquing spring was reactivated.

In the 43rd month of treatment, the UR1 bracket was removed to prevent further apical perforation of the UR1 root. After waiting 3 months for the perforation to heal, a bracket was bonded again on the UR1, and both arches were detailed. Class III, diagonal and cross elastics[7] were applied as needed in preparation for final detailing.[8] After 60 months of active treatment, the CC was resolved so all fixed appliances were removed, and retention was achieved with intermaxillary Hawley retainers (*Fig. 16*).

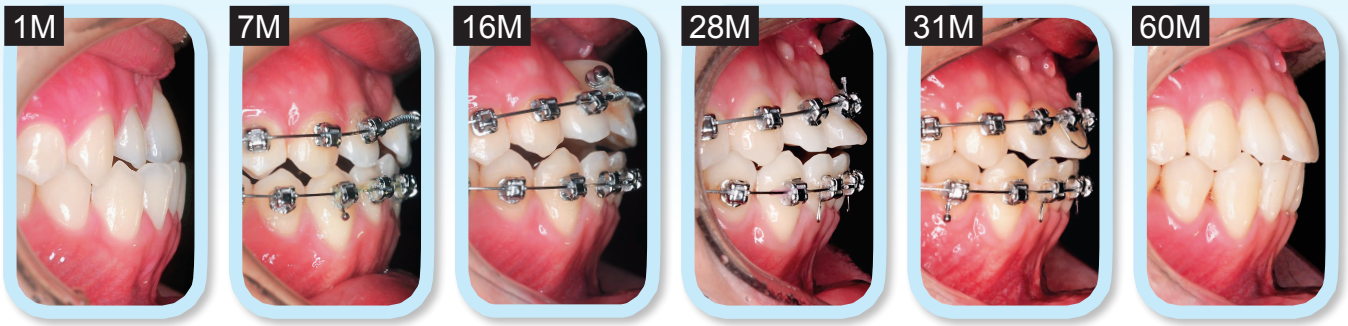

Fig. 15:
A series of intraoral lateral views showing the right incisal area document treatment progress from 1-31 months (1M-31M). See text for details.

Fig. 16:
Removable Hawley retainers were placed after the fixed appliances were removed. See text for details.

Results Achieved

The final results are documented in Figs. 17-21. Sixty months of active treatment resolved a severe malocclusion, complicated by a dilacerated UR1 impaction and anterior crossbite (*DI=28*), to an excellent outcome (*CRE of 17*), as shown in worksheet 2 at the end of this report. With the current non-extraction approach and IZC bone screw anchorage, the LFH (*VDO*) was unchanged, but there was facial improvement associated with a decrease in the FMA, SN-MP and SNB angles (*Table 1*). Maxillary arch expansion to correct anterior crossbite was consistent with a near ideal facial convexity (*G-Sn-Pg' 12°*), but the maxillary incisors were flared (*U1-SN 113°*). The specific treatment objectives[9] are outlined below:

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	80.5°	80°	0.5°
SNB° (80°)	77°	77.5°	0.5°
ANB° (2°)	3.5°	2.5°	1°
SN-MP° (32°)	38°	36°	2°
FMA° (25°)	31°	29°	2°
DENTAL ANALYSIS			
U1 To NA mm (4 mm)	4 mm	6 mm	2 mm
U1 To SN° (104°)	100.5°	113°	12.5°
L1 To NB mm (4 mm)	9 mm	8 mm	1 mm
L1 To MP° (90°)	94.5°	91.5°	3°
FACIAL ANALYSIS			
E-LINE UL (-1 mm)	-1 mm	-1.5 mm	0.5 mm
E-LINE LL (0 mm)	3 mm	2.5 mm	0.5 mm
%FH: Na-ANS-Gn (53%)	59%	59%	0%
Convexity: G-Sn-Pg' (13°)	16°	12°	4°

Table 1: Cephalometric summary

Maxilla (*all three planes*):

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

Mandible (*all three planes*):

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

Maxillary Dentition

- A - P: *Flared incisors, slightly retracted molars*
- Vertical: *Incisors were maintained but molars were intruded*
- Inter-molar / Inter-canine Width: *Maintained / Increased*

Mandibular Dentition

- A - P: *Both incisors and molars were retracted.*
- Vertical: *Incisors were maintained but molars were slightly extruded.*
- Inter-molar / Inter-canine Width: *Maintained*

Facial Esthetics:

- Lip profile and facial convexity were improved (*Figs. 17, 20 and 21*)

Retention

Good stability was expected for the recovered UR1 impaction, so Hawley removable retainers were delivered for both arches. Full time wear was prescribed for the first 6 months and nights only thereafter (*Fig. 16*). The patient was instructed in proper home hygiene care and maintenance of the retainers.

Final Evaluation of Treatment

Near ideal overbite, overjet and Class I interdigitation were achieved as documented with a CRE of 17 points. The most prominent CRE deficiencies were alignment/rotations (*4 points*), marginal ridges (*5 points*) and buccolingual inclinations (*5 points*) (*Figs. 17 & 18*). The UR1 was aligned in a slightly more flared angulation than the adjacent incisors, consistent with controlling the tendency for the dilacerated root to penetrate labial cortical plate. Class III elastics tipped the lower molars distally. The pink and white (*P & W*) dental esthetic score was 5. See Worksheet 3 at the end of this report.[10]

Discussion

Impacted maxillary central incisors are a rare occurrence particularly in the absence of supernumerary teeth.[11,12] Despite its low prevalence, a missing upper central incisor often results in major occlusal and esthetic impairments such as midline deviation, asymmetric anterior maxillary esthetic zone, and anterior crossbite. These problems are readily recognized early in mixed dentition by patients and their parents, so treatment is usually attempted in growing individuals.[12,13] Prognosis for a successful recovery of an impacted UR1 or UL1 depends on the impaction's position, orientation, amount of root formation age, degree of root dilaceration, available space in the arch, and potential for root resorption of adjacent teeth.[14-18]

Fig. 17: Post-treatment facial and intraoral photographs

Fig. 18: Post-treatment dental models (casts)

Fig. 19: Post-treatment panoramic radiograph

Fig. 20: Post-treatment cephalometric radiograph

In the early developmental stages, the permanent tooth germ of the maxillary incisor is situated palatal and superior to the apex of the primary incisor, so trauma to a young child's primary incisors is often an etiologic factor for impaction, but not dilaceration.[15,16] Intrusion or avulsion of primary teeth usually occurs before the age of four, long before the root formation of the succedaneous teeth. Other factors have been implicated in dilaceration such as root canal infection, scar tissue, developmental disorders, lack of space and the effect of anatomical structures (*dense bony walls*).[15-17] Dilacerated roots can curve in any direction, but for horizontally impacted maxillary central incisors the deviation is often anteriorly in the sagittal plane because the

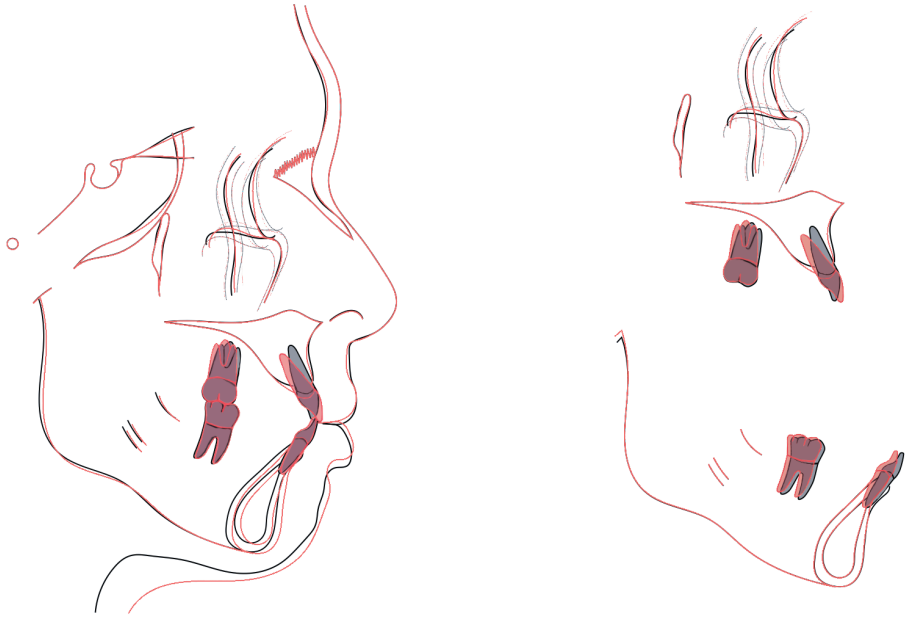

Fig. 21:
Superimposed cephalometric tracings from before treatment (black) and after treatment (red) are superimposed on the anterior cranial base (left), maxilla (upper right) and mandible (lower right). See text for tracings interpretation and treatment details.

developing root tip deviates superiorly when it engages the palatal plate of bone.[19-21]

Orthodontic treatment of the impacted maxillary central incisor should begin as soon as possible, hopefully before the root has completely formed.[13,17] It is rare to attempt to recover and align an inverted impaction of a maxillary central incisor with a dilacerated root in an adult. The curved root complicates the path for extruding the impaction, threatens the roots of adjacent teeth, and prolongs the treatment time.[12-16] Abnormal root shape particularly for spindly roots of severe dilaceration is a risk factor for root resorption.[18,19] CBCT images are essential for evaluating the potential for recovery of a complex impaction. Orthodontists may opt to extract the impaction rather than risk damage to other teeth and labial bone penetration. Even if a severely dilacerated impaction is recovered, root canal therapy and apicoectomy are likely.[20,21] For the current patient, the probability of apical root resorption was a positive prospect because loss of the root tip increased the probability of achieving optimal alignment of UR1.

For complex impactions, gingival health must be carefully maintained throughout the entire sequence of interdisciplinary treatment.[22] The application of IZC bone screws provides favorable 3D anchorage for elastic chains to restrict excessive incisal flaring.[2,23] Similar to the mandibular buccal shelf,[24] the IZC site lateral to the upper molars is advantageous for avoiding the roots of the molars, but there is also adequate space to reposition a bone screw if needed.

For the present patient, IZC bone screws were good anchorage for the well established simultaneous application of elastic chains and Class III elastics.[23,25] It is also possible to use two bone screws in an IZC site for varying anchorage needs (*Fig. 22*). If the roots

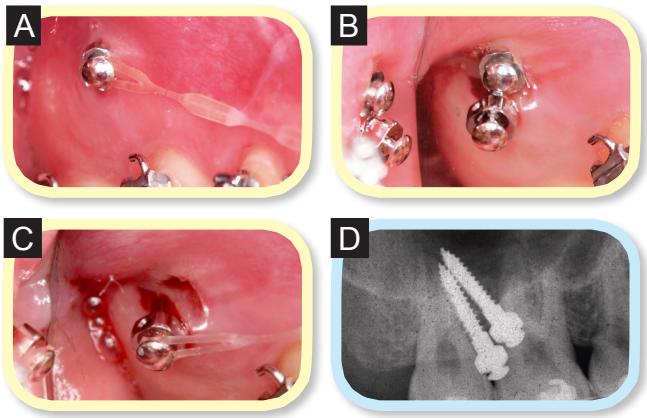

Fig. 22:
A: The head of the initial IZC bone screw was seated too deeply for Class III elastics engagement. B: A new screw was placed behind the original one. C: The new screw was placed more superficial than the original one. D: The head of the inferior screw was used as anchorage for Class III elastics.

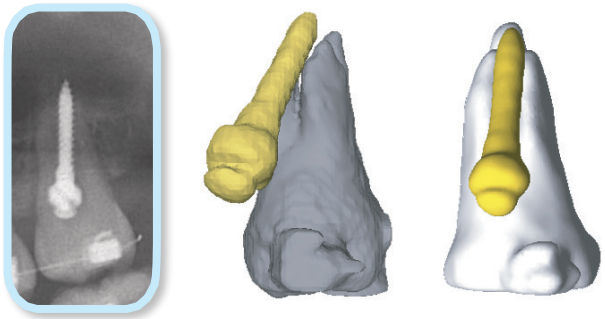

Fig. 23:
Left: The cropped panoramic image of left IZC screw fails to show the proximity of the screw and tooth root.
Center: A CBCT image shows the IZC bone screw is blocking the root from being retracted.
Right: A similar CBCT image shows the second molar mesial buccal root is mesial to the IZC bone screw.

of the molars strike the IZC bone screw during arch retraction,[26] it is necessary to replace the screw in an adjacent site (*Fig. 23*).

There are three common methods for recovering impactions: 1. soft tissue excision, 2. apically positioned flap, and 3. closed eruption technique.[27,28] For the present problem (*Fig. 24*) soft tissue excision was chosen because the impaction was too high for an apically positioned flap which has a relatively high risk for loss of periodontal attachment, gingival scarring and/or recession, and the closed eruption technique was not conducive to a staged traction procedure.[29,30]

The 3D replica of the impaction was useful for clinically guiding the extrusion, uprighting and rotation process (*Fig. 25*). CBCT imaging is precise for measuring arch retraction with IZC anchorage,[31] but the exact size of a complex impaction near adjacent teeth may be influenced by the voxel size and interference of surrounding structures.[32,33]

The calibration of data collected, as well as the clinician's expertise with CBCT software and imaging equipment, can influence accuracy.[32] The actual coronal mesiodistal width of UR1 was 8.85mm when clinically exposed compared to the width of replica which was 9.50mm (*Fig. 26*). Despite the loss of accuracy, the replica shape and size were acceptable

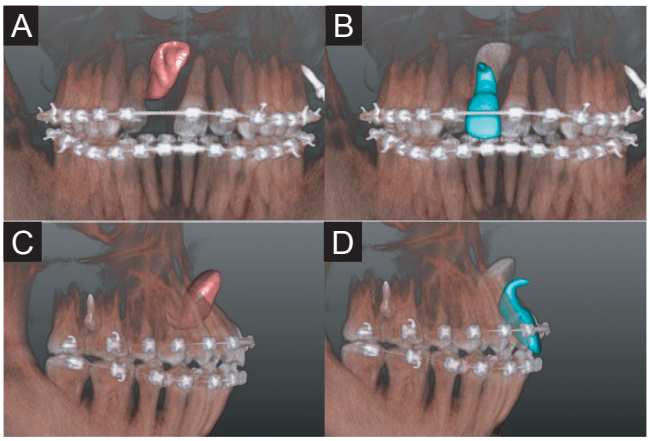

Fig. 25:
A series of three 3D animations the pretreatment position of the UR1 (red) in the frontal view (A) and sagittal view (B). The upper right animation (C) shows the aligned UR1 (blue) in the frontal plane. The lower right illustration (D) is the corresponding sagittal plane. (Courtesy of Dr. Sam Hsu)

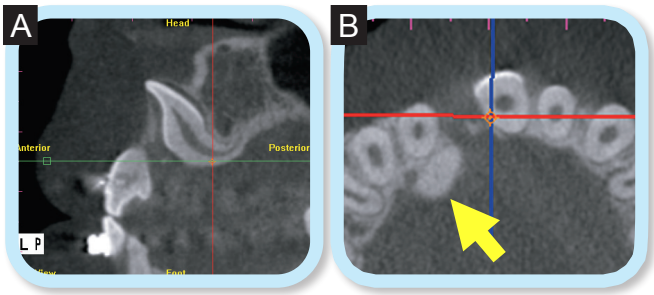

Fig. 24:
A: A pretreatment CBCT image shows the severe dilaceration of the UR1 root in the sagittal plane. B: An axial view of the maxillary arch shows the dilacerated UR1 root is palatal to the root of the UR2 (arrow). See text for details.

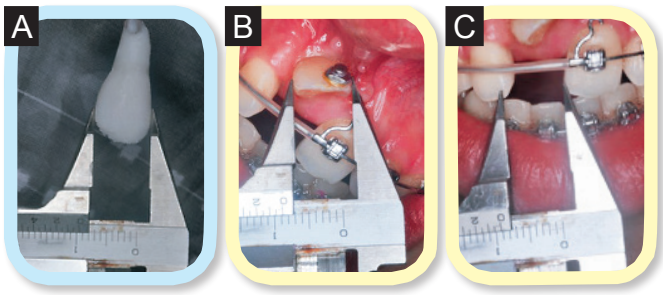

Fig. 26:
A. Measurement of the replica in width. B. Width of the partially erupted impaction. C. Width of the space opened in the arch for UR1 alignment.

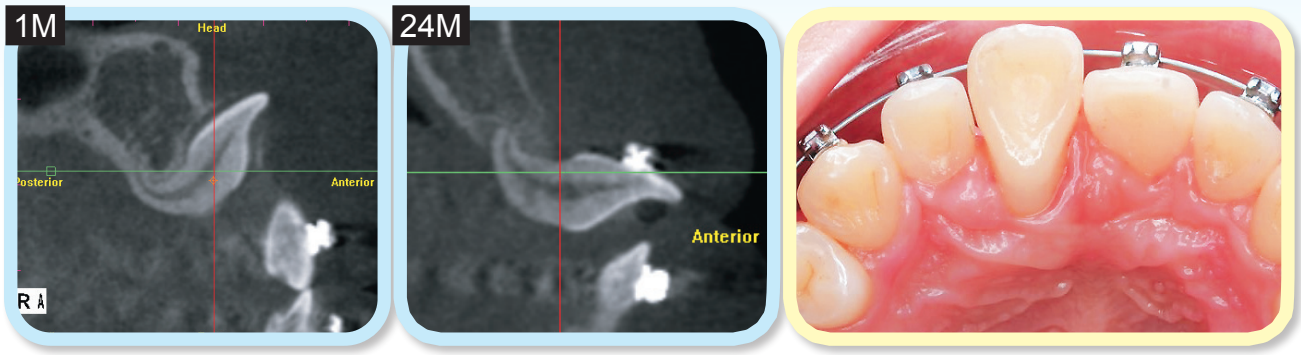

Fig. 27:
1M: The original position of the impacted UR1. 24M: The position of the rotated impaction after 24 months of treatment. The engagement of the thick palatal bone prevented the root from moving as far anteriorly as expected, which resulted in a palatal root dehiscence when the UR1 was aligned. See text for details.

for planning the complex eruption process relative to both soft and hard structure.[27,28]

Throughout the traction process, the periodontist performed regular soft tissue maintenance and provided advice on the pace of tooth movement. The major concern was to control the tendency for the root tip to penetrate the labial plate. Despite regular periodontal care, palatal dehiscence was noted on the UR1 (*Fig. 27*). A rectangular archwire and Warren torquing spring gently applied labial root torque.[34] A CBCT image was taken to monitor the final process of root movement. All of the maxillary incisors showed moderate root resorption. In retrospect, it may have been wise to delay bonding a bracket on the UR2 until after the infringement of the UR1 root was corrected (*Fig. 14*). This approach has proven effective for controlling root resorption on adjacent lateral incisors when maxillary canine impactions are recovered.[35] However, in this instance a decrease in the UR1 root length was beneficial for achieving adequate alignment without problematic labial plate penetration (*Figs. 28 and 29*).[36] Producing an accurate 3D replica[37-39] of complex impactions is useful for determining if recovery and alignment is practical. However, another important consideration

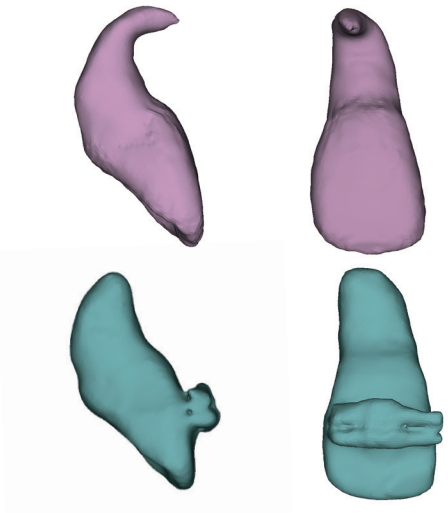

Fig. 28:
Comparison of replicas produced before (violet) and after (green) treatment show the extensive resorption of the UR1 root tip. That expression of root resorption contributed to the successful final alignment of the UR1. See text for details. (Images: courtesy of Dr. Po-Jan Kuo)

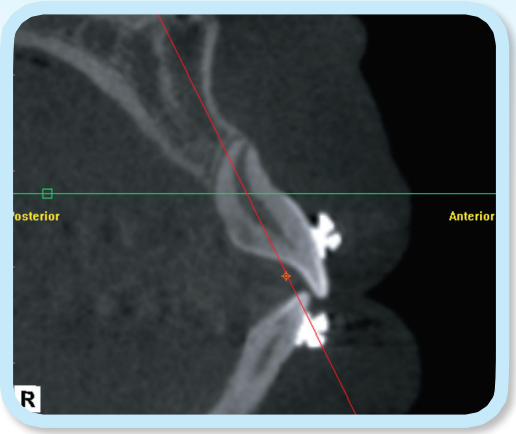

Fig. 29:
The blunted root apex allowed the UR1 to be aligned in a near ideal position.

is the anticipated root resorption of the long tapered end of a severely dilacerated root tip (*Figs. 27-29*).

Conclusions

Recovery of a complex impaction with a compromised shape and unfavorable position is problematic, particularly in an adult. It may be wise to extract the impaction, and compensate with additional extractions, differential space closure, and/or an implant-supported prosthesis. However, a missing maxillary central incisor is an esthetically sensitive problem that is difficult to camouflage with orthodontics and/or restorative dentistry. If the crown of the impaction is well-formed, recovery may be preferable because alignment generates

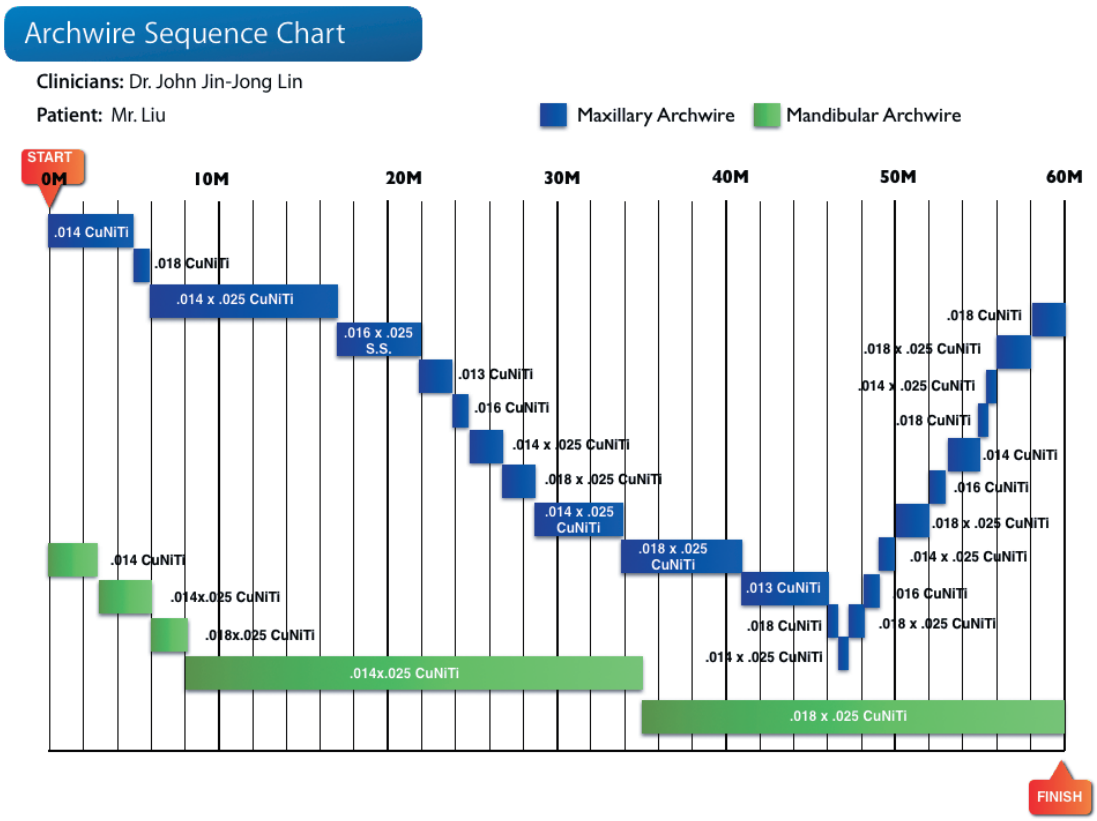

Table 2: Archwire sequence chart

periodontium to provide a more esthetic result. If the root is dilacerated and transposed, iatrogenic damage may occur during recovery, such as root resorption of adjacent teeth, penetration the labial plate of bone, and tooth devitalization. A careful CBCT assessment and a 3D printed replica of the impaction are helpful for determining if a complex alignment is practical. Even so, both the patient and the clinician must be prepared for a long and uncertain clinical course.

Acknowledgment

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 28

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 = 7

OVERBITE

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

Total = 0

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 _____ pts.
Full Class II or III	=	4 pts. per side _____ pts.
Beyond Class II or III	=	1 pt. per mm. additional _____ pts.

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° 3.5° = 4 pts.

Each degree < -2° _____ x 1 pt. = _____

Each degree > 6° _____ x 1 pt. = _____

SN-MP 38°

≥ 38° = 2 pts.

Each degree > 38° _____ x 2 pts. = _____

≤ 26° = 1 pt.

Each degree < 26° _____ x 1 pt. = _____

1 to MP ≥ 99° 94.5° = 1 pt.

Each degree > 99° _____ x 1 pt. = _____

Total = 2

OTHER (See Instructions)

Supernumerary teeth		x 1 pt. =	
Ankylosis of perm. teeth		x 2 pts. =	
Anomalous morphology		x 2 pts. =	
Impaction (except 3rd molars)	1	x 2 pts. =	2
Midline discrepancy (≥3mm)		@ 2 pts. =	2
Missing teeth (except 3rd molars)		x 1 pts. =	
Missing teeth, congenital		x 2 pts. =	
Spacing (4 or more, per arch)		x 2 pts. =	
Spacing (Mx cent. diastema ≥ 2mm)		@ 2 pts. =	
Tooth transposition	1	x 2 pts. =	2
Skeletal asymmetry (nonsurgical tx)		@ 3 pts. =	
Addl. treatment complexities	3	x 2 pts. =	6

Identify: Extremely curved root of UR1
Inverted UR1
Nonextraction Tx for protrusive profile

Total = 12

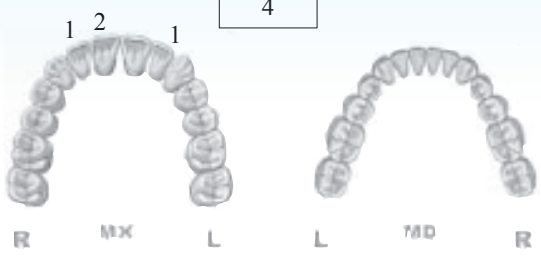
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 17

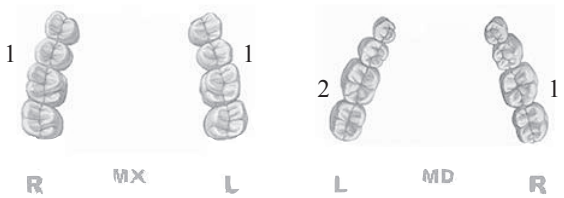
Alignment/Rotations

4



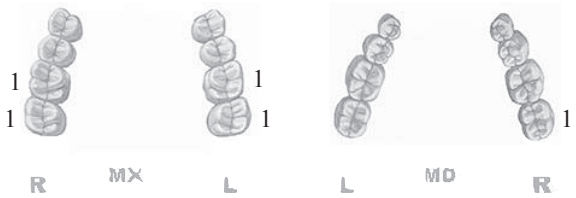
Marginal Ridges

5



Buccolingual Inclination

5

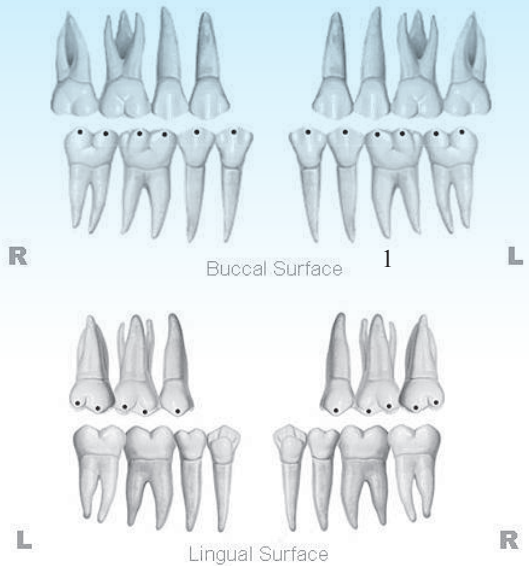


Overjet

1

Occlusal Contacts

1

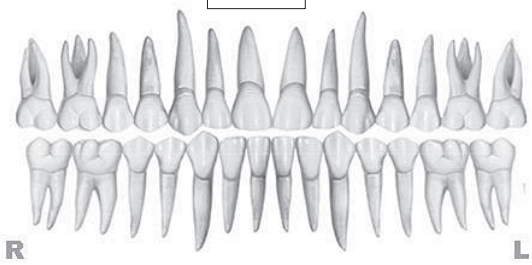


Occlusal Relationships

0

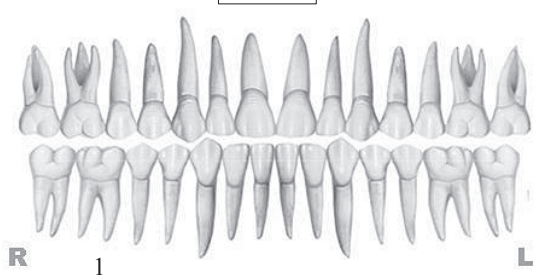
Interproximal Contacts

0



Root Angulation

1



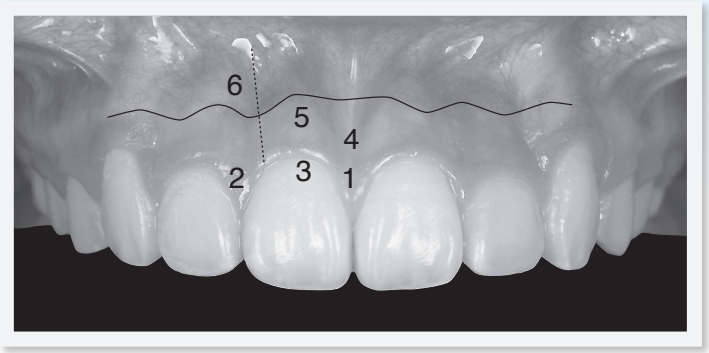
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 5

1. Pink Esthetic Score

Total = 2

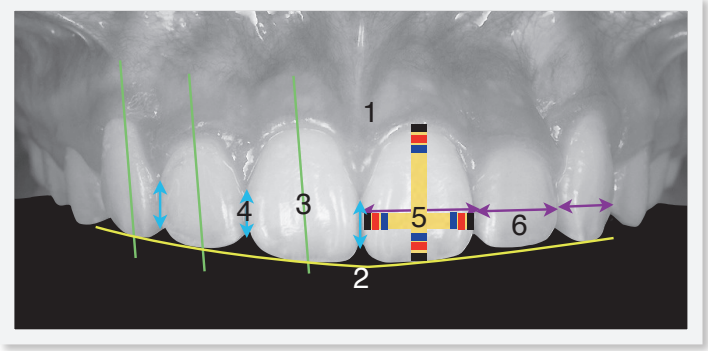


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

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

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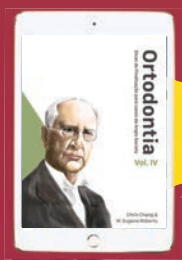

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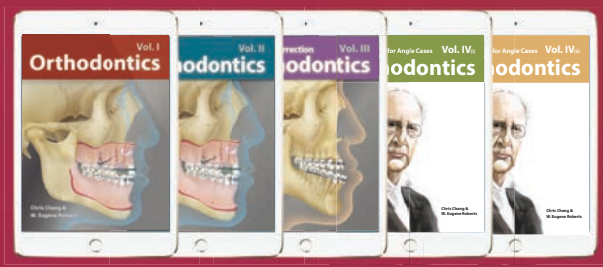

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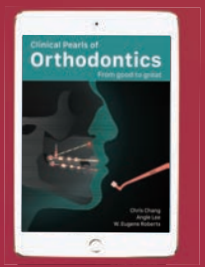

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Congenital Absence of Maxillary Second Premolars: Orthodontics, Sinus Lift Bone Graft, and Implant-Supported Prosthesis

Abstract

History: *Congenital absence of maxillary second premolars is a familial trait with a prevalence of about 1.5% worldwide.*

Diagnosis: *A 15-year-11-month old male presented with a chief complaint (CC) of unattractive smile due to irregular teeth and spacing. Both maxillary second premolars were missing. The upper right second deciduous molar was retained, but there was a partially-closed edentulous space on the left side. Clinical examination revealed a bilateral Class I molar relationship, lingually tipped upper and lower incisors (U1-SN 93.5˚, L1-MP 85˚), upper right canine crossbite, as well as spaces mesial and distal to the lower left canine (LL3). The discrepancy index (DI) was 17.*

Treatment: *Align the dentition, open space for an implant-supported prosthesis (ISP) to restore the upper left second premolar (UL5). Decrease the width of the upper right primary second premolar to 7mm and retain it for as long as possible. Preprosthetic orthodontics treatment duration was 20 months. Implant placement was delayed for 7 months for completion of adolescent facial growth. The UR5 area implant was placed with a simultaneous sinus elevation graft. After a 5 months healing phase, the implant was uncovered, and soft tissue was formed for 2 months with a healing cap. The abutment was placed and adjusted to achieve 2mm of interocclusal clearance. The final crown was delivered 2 weeks later. Interdisciplinary treatment duration including the growth completion delay was 28 months.*

Results: *The dentition was aligned and all spaces were closed except for the UL5 edentulous site that was prepared for an ISP. Following completion of the ISP to restore the UL5, the overall treatment was excellent, as evidenced by a Cast Radiograph Evaluation (CRE) score of 17, and dental esthetics pink and white (P&W) score of 3. (J Digital Orthod 2019;53:30-50)*

Key words:
Interdisciplinary treatment, adolescent treatment, congenitally missing maxillary second premolar, implant placement, 2B-3D rule, sinus lift, osteotome, bone augmentation

Introduction

Dental nomenclature for this report is a Palmer notation: upper right (*UR*), upper left (*UL*), lower right (*LR*), and lower left (*LL*) quadrants. Teeth in each quadrant are numbered 1-8 from the midline. Other than third molars, congenitally missing maxillary second premolars (*U5s*) are the second most common dental agenesis, exceeded by the mandibular second premolars (*L5s*), and followed by maxillary lateral incisors (*L2s*).[1] Long-term absence of an U5 can lead to an atrophic ridge and maxillary sinus pneumatization (*enlargement*). Bone resorption superior and inferior to the osseous site results in inadequate bone height to accommodate an implant. Maxillary sinus elevation is a common method for enhancing an inadequate site to achieve longterm stability of an ISPs.[2]

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Lecturer, Beethoven Orthodontic Center (Left)

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Publisher, Journal of Digital Orthodontics (Center right)

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

Congenitally missing teeth are frequently encountered in young patients, but there is general agreement that implant placement should be postponed until after the adolescent growth spurt is complete. Common methods for estimating remaining growth are radiographic maturation of the hand wrist[3] and cervical vertabrae[4] areas. It is important to determine that adolescent growth is over or nearly so before placing dental implants in esthetically sensitive areas.

Fig. 1: Pre-treatment facial and intraoral photographs

Diagnosis and Etiology

A 15-year-11-month old male sought consultation for his irregular teeth and interdental spaces (*Figs. 1-4*). There is a history of congenitally missing teeth in the family.[1] Extraoral evaluation showed facial symmetry, and a straight profile. Intraoral buccal relationships were a bilateral Class I, but both arches were narrow. There was palatal crossbite of the UR3, a retained deciduous upper right second molar, a missing UL5, and spaces in the left anterior portion of the lower arch. The UL4 was rotated mesial-out and tipped into the edentulous UL5 space. The lower midline was shifted to the right side about 3mm. Pre-treatment cephalometrics revealed a skeletal Class I relationship (*SNA 81.5˚, SNB 80.5˚, ANB 1˚*), lingually-tipped maxillary and mandibular incisors (*U1-SN 93.5˚, L1-MP 85˚*), and retrusive upper and lower lips (*-5.5mm/-3.5mm to the E-Line*) (*Fig. 5 & Table 1*). The panoramic radiograph showed multiple missing teeth: UR5, UL5, UL8 and LL8. The ridge in the missing UL5 area was atrophic and the associated maxillary sinus was enlarged (*Fig. 6*). Temporo-mandibular joint (*TMJ*) radiographs (*Fig. 7*) were within normal limits (*WNL*), and there were no signs or symptoms of temporomandibular disorder (*TMD*). The discrepancy index (*DI*) was 17 points including 4 supplemental points for implant site complexity.[5] For details refer to the first worksheet at the end of this report.

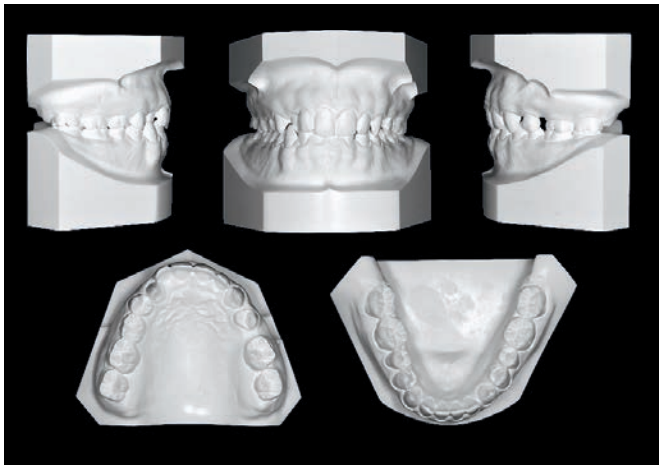


Fig. 2: Pre-treatment dental models (casts)

Fig. 3:
Smile evaluation in the frontal view shows excessive buccal corridors.

Fig. 4:
***Left**: Decreased axial inclination is noted for the upper and lower incisors.*
***Right**: Frontal view of the lower anterior spacing and irregularity.*

Fig. 5: Pre-treatment lateral cephalometric radiograph

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA°	81.5°	82°	0.5°
SNB°	80.5°	81°	0.5°
ANB°	1°	1°	0°
SN-MP°	27.5°	29°	1.5°
FMA°	20.5°	22°	1.5°
DENTAL ANALYSIS			
U1 To NA mm	2 mm	1.5 mm	0.5 mm
U1 To SN°	93.5°	98°	4.5°
L1 To NB mm	0.5 mm	1.5 mm	1 mm
L1 To MP°	85°	84°	1°
FACIAL ANALYSIS			
E-LINE UL	-5.5 mm	-7 mm	1.5 mm
E-LINE LL	-3.5 mm	-5.5 mm	2 mm
%FH: Na-ANS-Gn	58%	58%	0%
Convexity: G-Sn-Pg'	1°	0.5°	0.5°

Table 1: Cephalometric summary

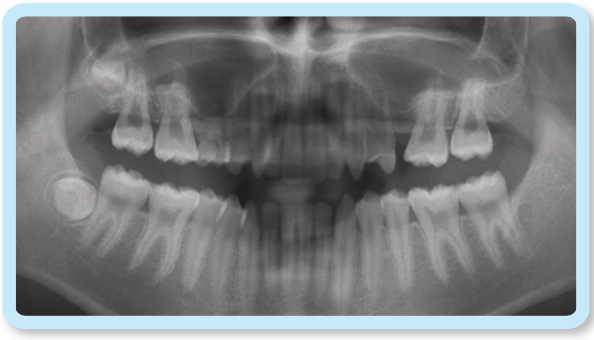


Fig. 6: Pre-treatment panoramic radiograph

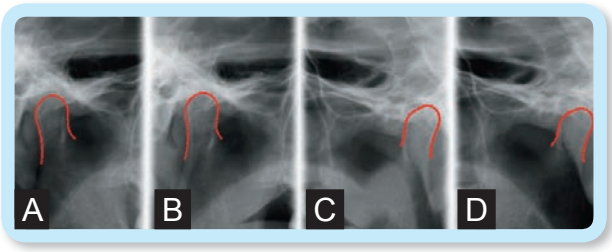


Fig. 7:
Pre-treatment TMJ radiographs are transcranial views of the right side open (A) and closed (B), as well as the left side open (C) and closed (D).

Treatment Objectives

1. Increase the axial inclination of the incisors
2. Relieve maxillary crowding
3. Maintain Class I occlusion
4. Maintain a harmonious straight profile
5. Prepare the UL5 area as an implant site

Treatment Alternatives

An alternate option was to extract the retained primary molar and close the bilateral U5 spaces to achieve Class II molar and Class I canine relationships. The distinct advantage for this approach is avoiding restorative procedures, which has both immediate and longterm implications. Two ISPs will be required at some point due to the limited longevity of the UR primary second molar. All prosthetic procedures require substantial maintenance over a life expectancy of >70 years. In addition to considerable expense, patients experience inconvenience and some degree of compromised esthetics and function. In retrospect, closure of the U5 spaces without compromising the lip profile was a viable option because adequate overbite (*Fig. 5*) was available to provide anchorage to protract the maxillary buccal segments to close the U5 spaces without retracting the incisors.[6] In addition, the sagittal anchorage could be supported by applying lingual root torque to the lower incisors (*Table 1*). Although this treatment alternative is the most cost-effective option for managing the present malocclusion, the use of overbite and lower incisor torque for sagittal anchorage are sophisticated biomechanics concept, that is not obvious to a lay person. The patient was concerned about avoiding a dished-in profile, so an ISP to restore the UL5 was

a lower risk choice from his perspective because decreased lip protrusion was highly undesirable.

Treatment Progress

A fixed 0.022-in slot Damon Q® bracket system (*Ormco, Glendora, CA*) was used with archwires and accessories produced by the same manufacturer (*Fig. 8*). Bracket torque selection for anterior teeth was standard for both arches. In the 1st month of the treatment, the upper arch was bonded except for the UR second deciduous molar, which remained unbonded throughout treatment (*Fig. 9*). UL5 implant site development was initiated with a compressed coil spring between the UL4 and UL6 (*Figs. 10 and 11*). Bite turbos composed of glass ionomer cement (*GC America, Alsip IL*) were bonded on the occlusal surface of LR6 and LL6 to prevent bracket interference and facilitate UR3 crossbite correction (*Fig. 9*). One month later (*2M*), a corresponding series of brackets was bonded on the lower arch, and the initial archwire was a 0.014-in copper-nickel-titanium (*CuNiTi*). After 3 months of leveling and alignment (*5M*), the crossbite was resolved (*Fig. 9*). Two anterior bite turbos were constructed on the palatal surfaces of upper central incisors to open the bite and serve as a guide planes for the lower incisors (*8M in Fig. 11*). L-type Class II elastics (*Parrot 5/16-in, 2-oz*) from the upper canines to the lower 1st and 2nd molars were used bilaterally to correct the sagittal discrepancy, and to extrude the mandibular posterior teeth. The upper and lower archwires were changed to 0.018-in CuNiTi and 0.014x0.025-in CuNiTi, respectively. In the 7th month of treatment, the maxillary archwire was changed to 0.017x0.025-in titanium-molybdenum-alloy (*TMA*). An open coil spring was used to retain the implant space. Elastomeric chains were applied to consolidate both arches. A 0.019x0.025 pre-Q NiTi

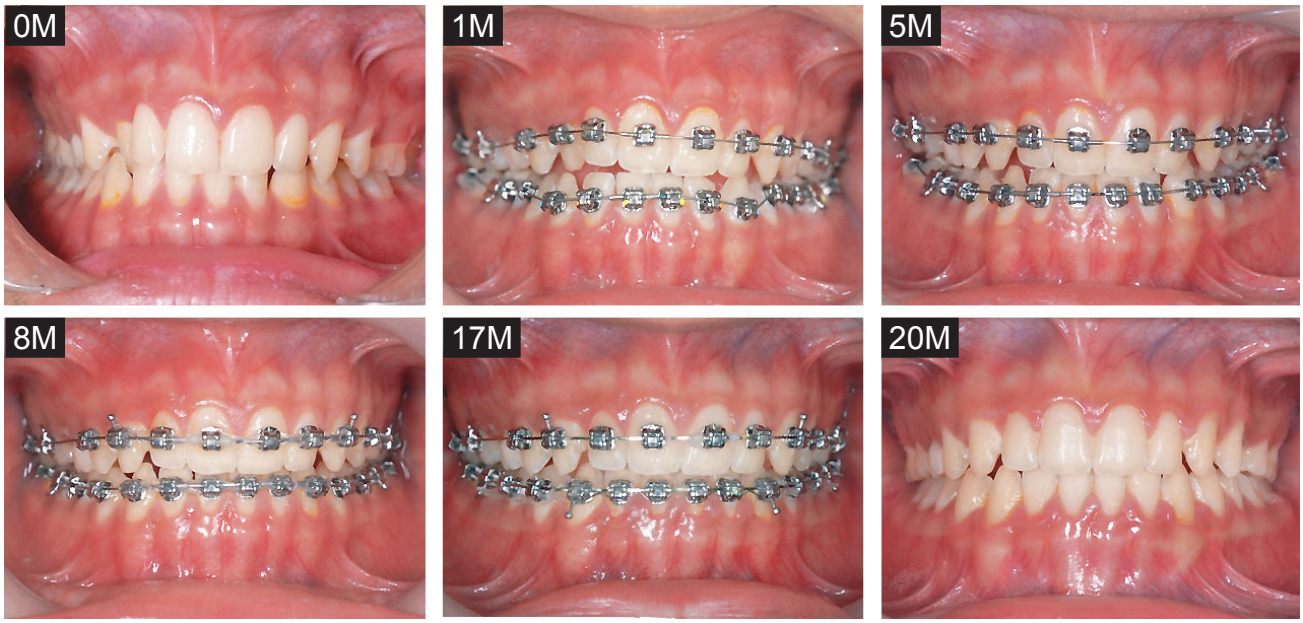


Fig. 8:
A progressive series of maxillary frontal views show treatment progress from start (0M) to the twenty months (20M) finish.

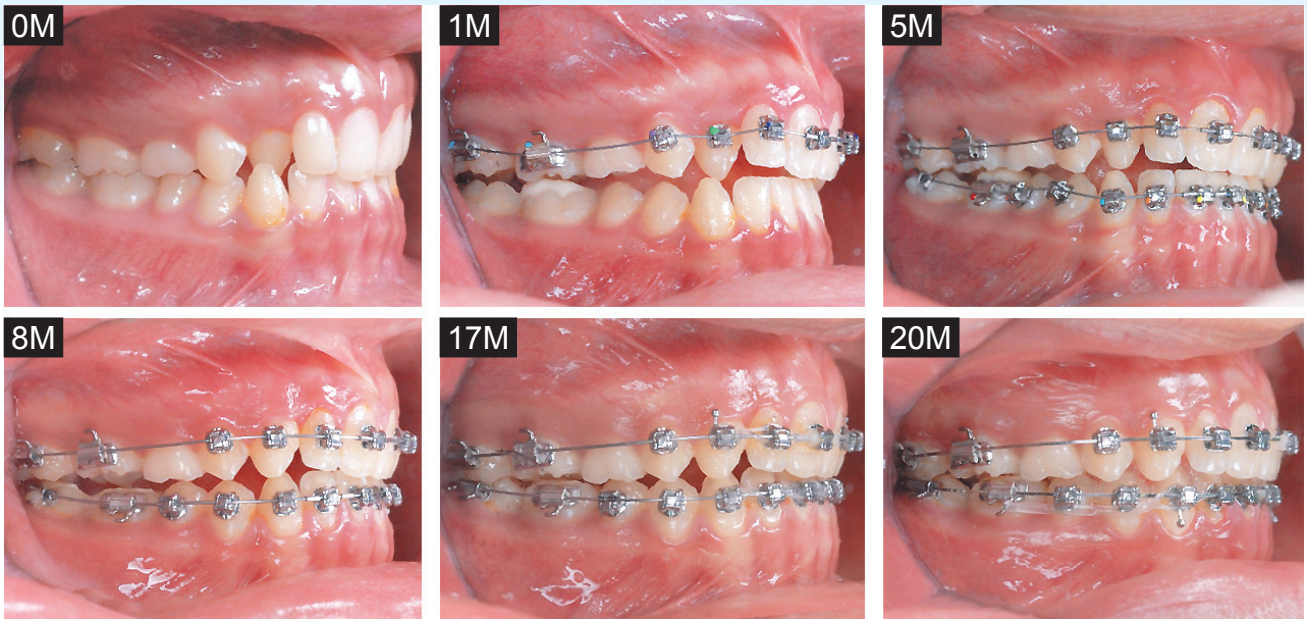


Fig. 9:
A progressive series of right buccal views from the start (0M) to twenty months (20M) document alignment of both arches. Note a bite turbo on the occlusal surface of the LR6 was used to facilitate correction of the UR3 crossbite. There was no bracket bonded on the maxillary deciduous second molar. See text for details.

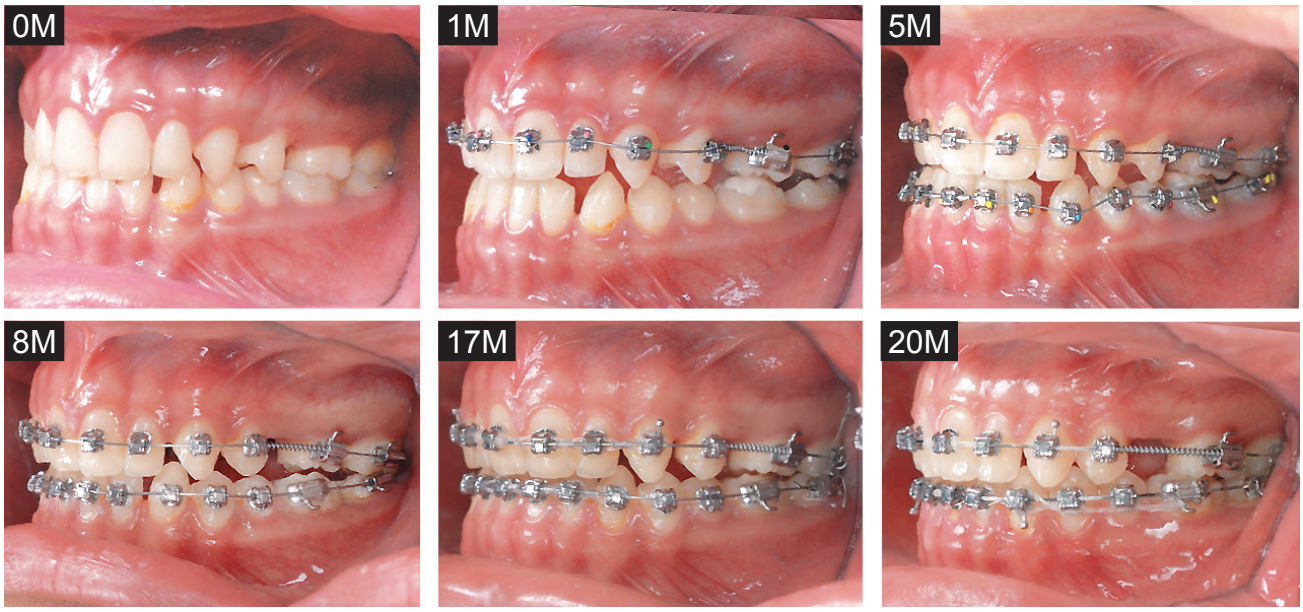


Fig. 10:
A progressive series of left buccal views from the start (0M) to twenty months (20M) document alignment of both arches. See text for details.

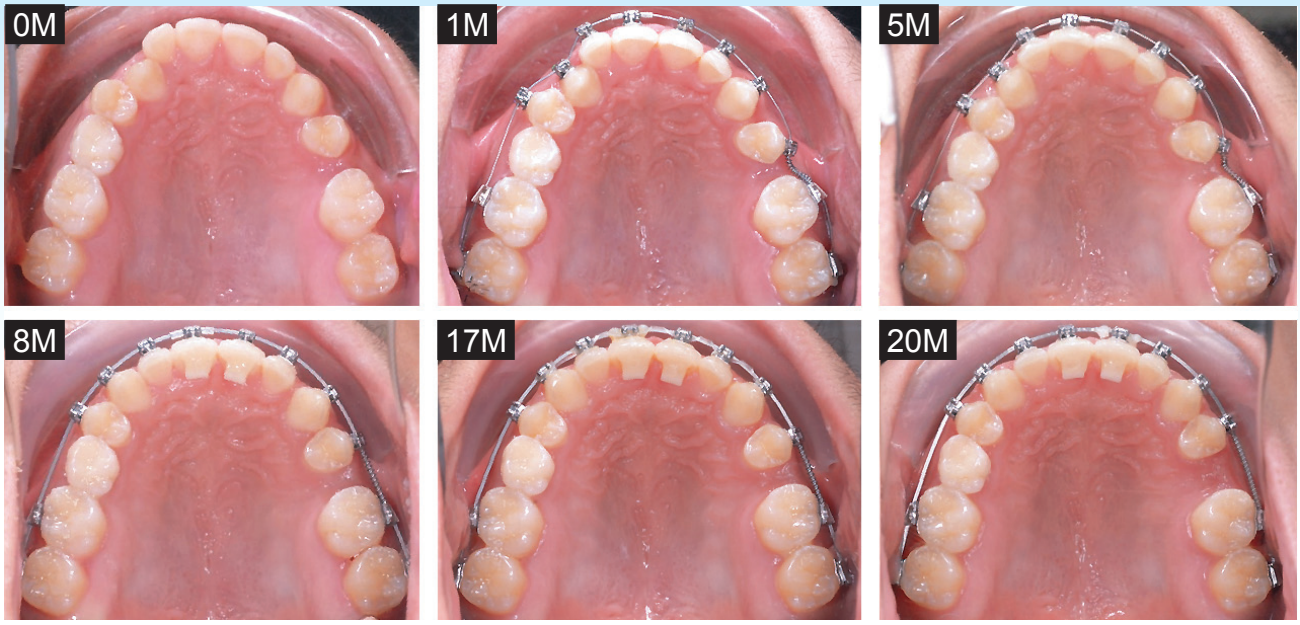


Fig. 11:
A progressive series of maxillary occlusal views from the start (0M) to twenty months (20M) document alignment. Two anterior bite turbos were constructed on the palatal surfaces of upper central incisors to open the bite and serve as guide planes for the lower incisors. See text for details.

wire was used for upper incisor lingual root torque, and a 0.017x0.025-in TMA was used in the lower arch. In the 14th month, both arches were changed to 0.016x0.025-in stainless steel. L-type Class II elastics (*Fox 1/4-in, 3.5-oz*) were applied bilaterally from the upper canines to the lower 1st and 2nd molars. In the last 2 months of treatment, the lower midline shifted to the right about 1mm (*Fig. 8*) with a L-type Class II elastic (*Fox 1/4-in, 3.5-oz*) applied to the right side. The UR deciduous second molar was reduced to 7mm in the mesiodistal dimension to hold space for an ISP to restore the UR5 when the deciduous molar exfoliates (*Fig. 12*). In the 20th month, the lower arch space was closed, maxillary incisor axial inclinations were corrected, and the length of the UL5 implant site was increased from 3 to 7mm. After 20 months of active treatment, all fixed appliances were removed and interim records were obtained (*Figs. 13-17*).

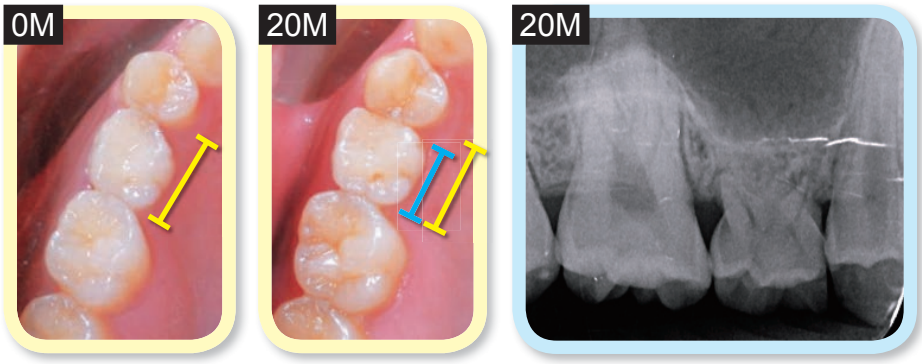


Fig. 12:
***Left**: At the start of treatment (0M) the mesio-distal width of the retrained deciduous molar is 10mm as shown with a yellow bar.*
***Central**: At twenty months (20M) the deciduous molar width was reduced to 7mm as shown by the blue bar in comparison to the original width (yellow bar).*
***Right**: A periapical radiograph exposed at 20M shows the reduced width of the deciduous molar.*

Fig. 13: Post-treatment facial and intraoral photographs

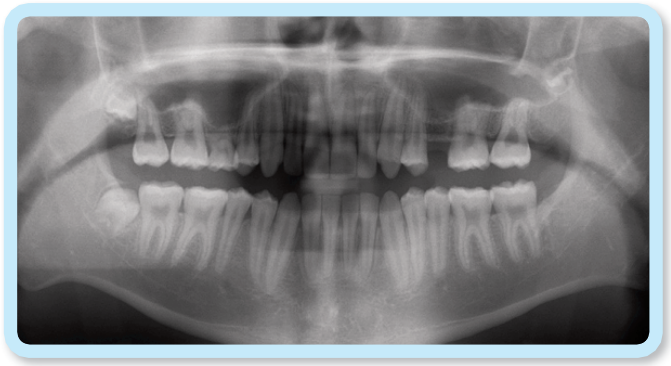


Fig. 14: Post-treatment panoramic radiograph

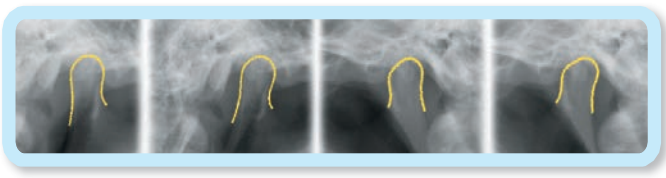


Fig. 15: Post-treatment TMJ radiographs correspond to the pretreatment TMJ views in Figure 7. All morphology is WNL.

Fig. 16: Post-treatment lateral cephalometric radiograph

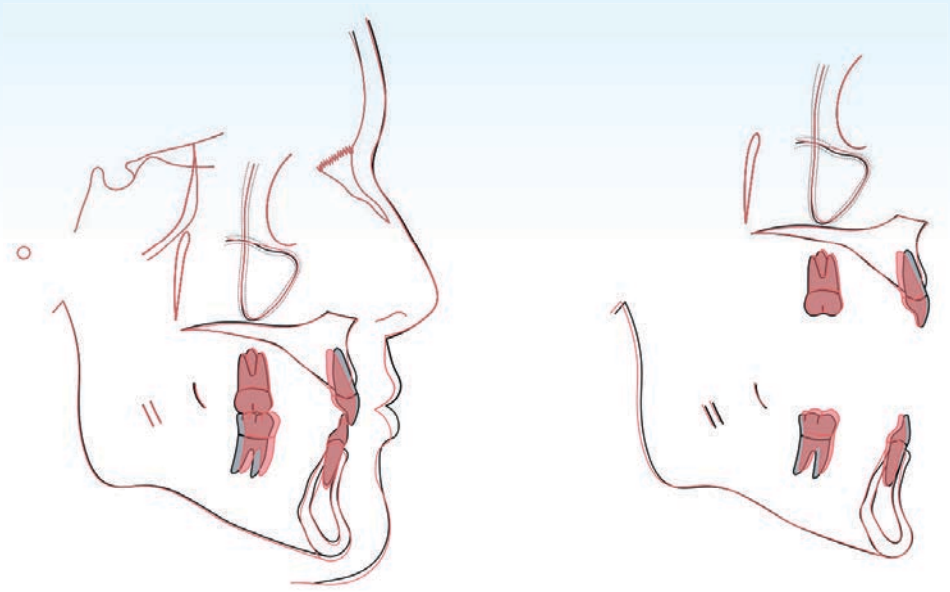


Fig. 17:
Superimposed cephalometric tracings showing dentofacial changes over 20 months of treatment (red) compared to the pre-treatment position (black). See text for interpretation and treatment details.

Retention

Upper and lower clear overlay retainers were delivered for both arches, but no fixed retainers were deemed necessary. The patient was instructed to wear them full time for the first 6 months and nights only thereafter. Instructions were provided for home hygiene as well as for maintenance of the retainers.

Treatment Results

After 20 months of active orthodontic treatment, all spacings were closed except the 7mm long UL5 implant site. The UR3 crossbite and dental midline discrepancy were corrected. The patient was satisfied with the interim result, and was looking forward to the ISP. The post-treatment photographs are documented in Fig. 13. The post-treatment panoramic film (*Fig. 14*) shows some minor axial inclination problems (*LL3, LR3, and LR5*) that were not clinically significant. Post-treatment TMJ radiographs document both condylar heads are symmetrical and well positioned in the fossa (*Fig. 15*). The superimposed cephalometric tracing revealed that upper and lower incisor torque (*axial inclinations*) were acceptable (*Figs. 16 and 17*). Maxillary incisor inclination was increased 4.5 degrees, but the mandibular incisor inclination was increased only 1 degree (*Table 1*). Slight facial growth was noted as evidenced by a 1mm increase in the length of the mandible (*Fig. 17*). The mandibular plane angle was increased 1.5 degrees, consistent with the application of Class II elastics. More retrusive upper and lower lips contributed to a more concave profile. These results were disappointing but still acceptable for a male patient (*Figs. 16 and 17*). The American Board of Orthodontics (*ABO*) cast

radiograph evaluation (*CRE*) score was 17 points, as shown in the supplementary CRE worksheet.[7] The major residual discrepancies were marginal ridges (*4*), overjet (*4*), and occlusal contacts (*3*). Pink and white dental esthetics score was 3 points as detailed in the worksheet at the end of this case report. Discrepancies were incisal curve, contact area, and tooth proportion.[8]

Implant-Supported Prosthesis

Preoperative CBCT imaging assessed the alveolar bone volume at the UL5 site. The edentulous ridge was 10mm wide, but the vertical bone height (*depth*) was only 5mm (*Figs. 18 and 19*). The decreased depth of the implant site was due to extensive surface resorption on the atrophic periosteal ridge and enlargement of the maxillary sinus. Consulting the sinus lift decision making tree (*Fig. 20*) indicated a crestal approach with a standard length implant was appropriate. However, a sinus lift procedure was indicated to increase the osseous depth of the implant site.[9] Under local anesthesia a crestal incision was performed and a full thickness mucoperiosteal flap was reflected. The first lancer drill was positioned at the center of the edentulous ridge and 3mm palatal to the buccal plate. The drill then penetrated to a depth of 5mm and a surgical guide pin was placed in the osteotomy. A periapical X-ray was exposed to check the mesiodistal angulation and ensure there was no penetration of the sinus floor.

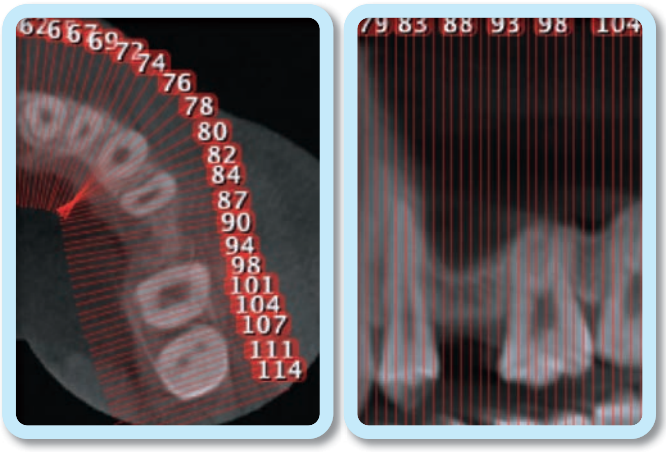


Fig. 18:
A CBCT scan was used to evaluate the available bone at the implant site. Left: horizontal view of the maxilla with the scan cuts individually numbered. Right: midsagittal cut through the UL5 implant site.

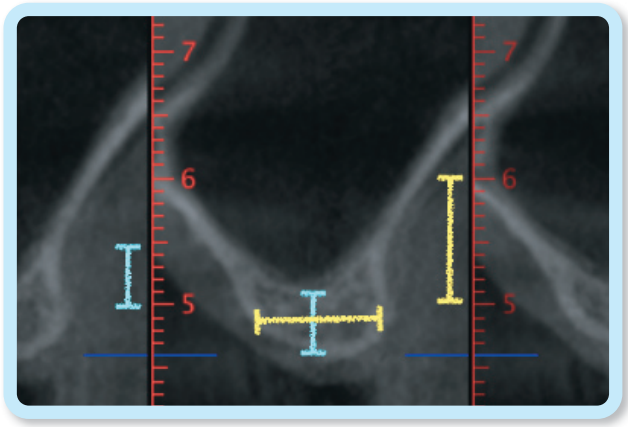


Fig. 19:
A frontal CBCT cut through the UL5 implant site shows adequate ridge width (10mm, yellow line) but there is insufficient depth (5mm, blue line) for a 4x9mm implant.

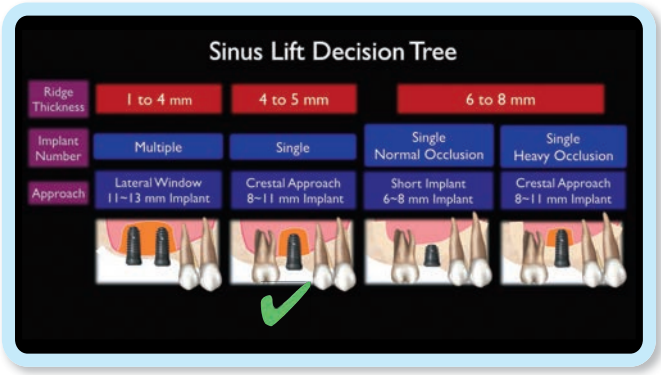


Fig. 20:
The Sinus Lift Decision Tree devised by Dr. Homa Zadeh shows the preferred surgical procedure and implant size according to alveolar bone thickness inferior to the sinus, and the expected occlusal load (Normal or Heavy).

An osteotome was used to gently elevate the sinus floor and the overlying Schneiderian membrane.[10] Freeze-dried bone allograft (*FDBA*) produced by Maxxeus Dental, Kettering OH (*USA*) was gently packed into the space prepared by the sinus elevation procedure. An implant fixture (*4x9mm OsseoSpeed™ TX, Dentsply International, York, PA*) was installed according to the manufacturer's instructions and a cover screw was placed. The soft tissue flap was repositioned and closed with interrupted 4-0 Gore-Tex® (*Flagstaff, AZ*) sutures (*Fig. 21*). A photograph (*Fig. 21g*) shows that the buccal bone thickness was >2mm which is ideal for the long-term success of the implant-supported prosthesis.[11] The prosthetic sequence for forming the soft tissue, placing an abutment, and delivering the implant-implant-retained crown is illustrated in Fig. 22. A periapical radiograph series shows the surgical and prosthetic sequence including the final radiograph documenting

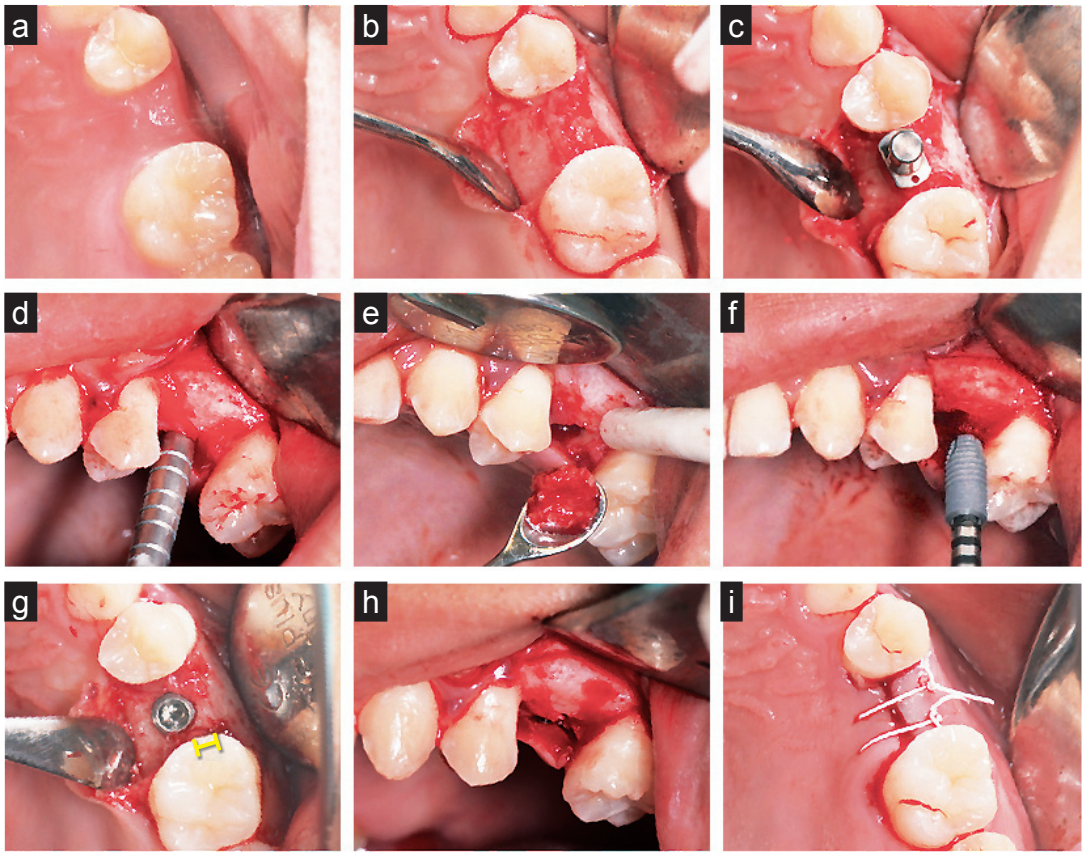


Fig. 21:
Steps involved in the placement of the implant are illustrated as follows: (a) UL5 edentulous site was prepared as a 7mm long implant space, (b) mid-crestal and sulcular incisions were performed for flap reflection, (c) a guide pin was placed to check axial direction and the depth of the initial osteotomy, (d) an osteotome is inserted into the osteotomy for sinus floor elevation, (e) freeze-dried bone augmentation (FDBA) material was packed into the osteotomy, (f) a 4x9mm implant fixture was inserted, (g) occlusal view of implant fixture and osseous ridge with a yellow bar showing the buccal bone thickness is >2mm, (h) buccal view of the osseous ridge with completely submerged implant fixture, (i) the flap was sutured with direct loop interrupted 4-0 GORE-TEX® sutures. See text for details.

the fit of the final prosthesis (*Fig. 23*). The post-surgical panoramic radiograph confirmed the accuracy of implant position and the integrity of the sinus membrane (*Fig. 24*).

After a 5-month osseointegration healing period, second stage surgery was performed to place a healing abutment (*Ø4.5mm x H4.0mm*), and a periapical X-ray was taken to make sure the healing abutment was seated in the correct position. Following 2 months of soft tissue maturation, the healing abutment was replaced with a direct abutment (*Ø5.0mm, 2.5mm height, 2.0mm cuff height*). However, there was an insufficient occlusal clearance for porcelain-fused-to-metal crown fabrication, so a 1.0mm cuff height direct abutment was selected to replace the previous one for prosthesis fabrication. The abutment was trimmed

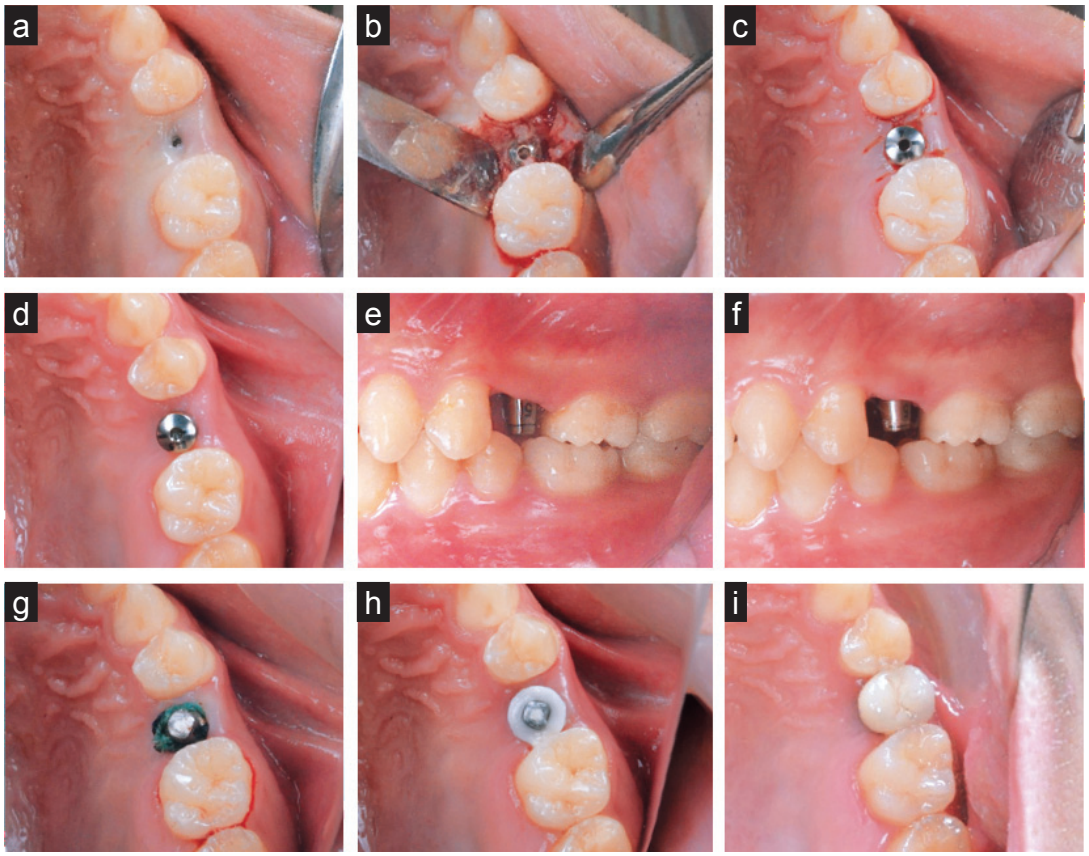
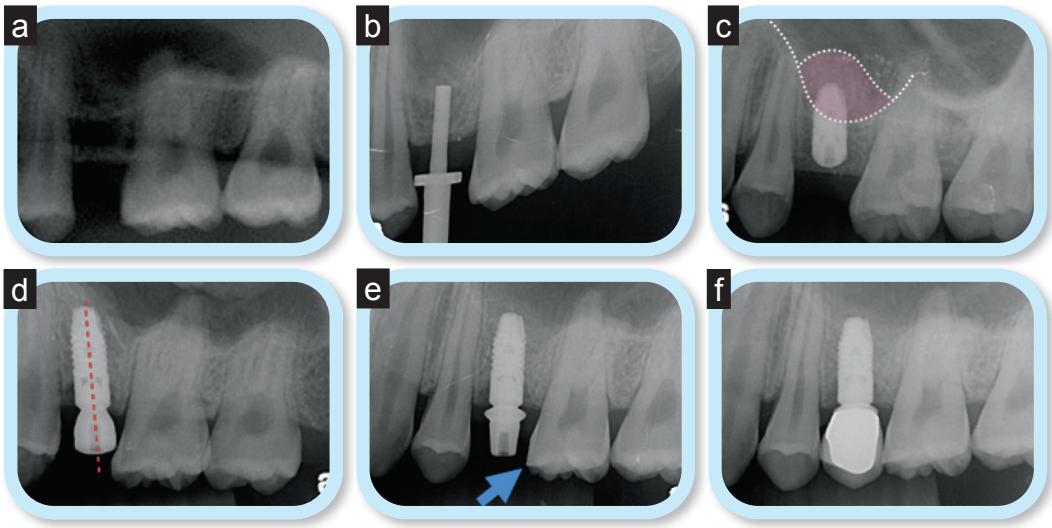


Fig. 22:
A panel of intraoral photographs show the prosthesis fabrication procedure 5 months after implant placement: (a) cover screw exposure was noted, (b) flap reflection for second stage surgery, (c) healing abutment was placed, and the flaps were repositioned and sutured,(d) after 2 months of soft tissue maturation, (e) direct abutment was installed, (f) the abutment was trimmed to obtain ~1.5mm occlusal clearance, (g) a double cord gingival retraction technique was used to make a direct impression, (h) a Tony Cap was used as a substitute for provisional crowns and for soft tissue modeling, and (i) a PFM crown was delivered and luted with temporary cement 2 weeks later. See text for details.

extraorally with a diamond bur. A torque ratchet was applied at 25 N-cm to seat and secure the abutment in the planned position. The inter-occlusal clearance for the post was increased to ~1.5mm for porcelain fused to metal crown fabrication. Before the impression, UL6 mesial surface enamel-plasty was performed to eliminate the undercut that blocked the insertion path of the crown, and to create an ideal contour of contact area. A double cord gingival retraction technique compressed the soft tissue to expose the abutment margin. A direct impression was made with polyvinyl siloxane impression material while the thin compression cord was left in the gingival sulcus. The prepared abutment was then covered by a Tony Cap (*Alliance, Taiwan*), a device that substitutes for a temporary crown relative to soft tissue modeling.

The impression was poured in type IV dental stone, and the cast was mounted on an articulator with a silicon bite record. A porcelain fused to metal crown was fabricated and delivered 2 weeks later. After checking the tightness of the contact area with dental floss and the margin integrity with a dental explorer, the permanent crown was luted with temporary cement (*Fig. 22*). Periapical radiographs from different angles were exposed to ensure the marginal fit of the restoration (*Fig. 23*). New upper and lower clear retainers were prepared after the prosthesis was delivered. Post-treatment records document the final result (*Figs. 25 and 26*).



■ *Fig. 23:*
A series of periapical radiographs document the implant procedure: (a) initial ridge depth, (b) a guide pin shows the insertion path and orientation of the osteotomy, (c) the bone-grafted area superior to the sinus floor is delineated with a white dotted line and shaded in pink, (d) the implant orientation and healing abutment position is shown with a red dashed line, and the fixture was repositioned distally, (e) the direct abutment is shown along with the mesial reduction of the UR6 (blue arrow) that was required to accommodate a crown, and (f) the marginal fit of the restoration.

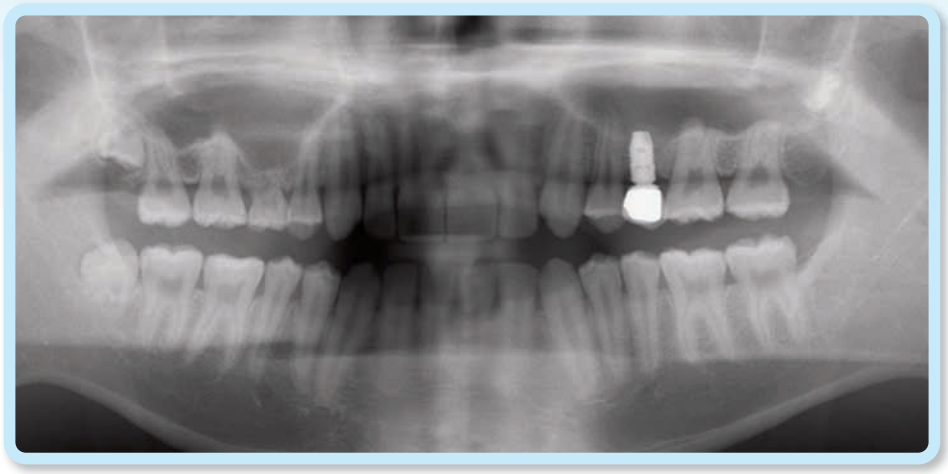


Fig. 24: Post-treatment panoramic radiograph after delivery of the ISP.

Fig. 25: Post-treatment facial and intraoral photographs after delivery of the ISP.

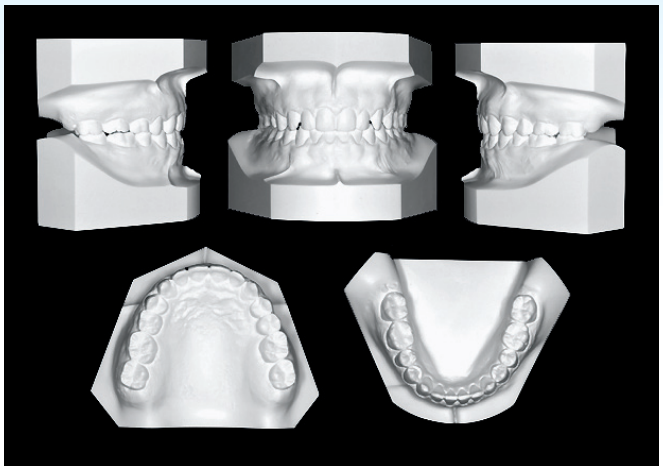


Fig. 26:
Post-treatment dental models (casts) after delivery of the ISP.

Discussion

Sinus lift and implant placement

CBCT imaging was used to assess the implant site (*Figs. 18 and 19*). Since the bone height (*depth*) was insufficient (*5mm*), the sinus lift decision tree was utilized to decide on an appropriate approach for a single implant placement (*Fig. 20*). The UL5 implant placement surgery with sinus lift (*Fig. 21*) was followed in 5 months by the prosthesis construction and crown placement (*Fig. 22*). The radiographic documentation is shown in Figs. 23 and 24. Details for the ISP will be detailed in a following section. Maxillary sinus elevation and grafting are predictable surgical procedures for augmenting an atrophic posterior maxillary implant site. There are two common approaches for maxillary sinus elevation: 1. lateral window (*modified Caldwell-Luc procedure*), and 2. osteotome sinus floor fracture technique (*crestal approach*). The choice of the method depends on the residual bone height, implant length, and amount of grafting required.[12] According to the sinus lift decision making tree (*Fig. 20*), a 4-5mm ridge thickness (*depth*) is suitable for an osteotomy sinus lift technique prior to installing a 8-11mm implant.[13] The current patient had 5mm ridge thickness, so a 9mm implant was indicated for a crestal approach augmented with a sinus lift procedure. Post-operative radiographic examination revealed the implant fixture is distally inclined and is too close to the adjacent UL6. When the plant was uncovered, it was evident it was too superficial.[14] According to the 2B-3D rule,[11,14] the implant head should be 3mm apical to the future margin position of the prosthesis for development of a desirable emergence profile, esthetics, and biological width around the implant.[9] Inserting the implant fixture to the bone level provides adequate height for biological width development, but if the interocclusal clearance is inadequate, the abutment must be trimmed or replaced with a shorter abutment. Under these circumstances, the peri-implant bone resorbs apically at least 1mm to re-establish an ideal biological width. In the long term, gingival recession around the implant may be a problem so a 2.0mm cuff height direct abutment is a better choice to achieve an optimal biologic width to resist recession.

Delayed primary tooth extraction

If the patient is missing a posterior tooth such as a second premolar, it is best to delay the primary tooth extraction as long as possible to enhance preservation of the ridge for a subsequent ISP. It has been documented that extraction of a primary tooth

three years prior to implant placement leads to a reduction of approximately 25% in ridge thickness.[15] Most of this loss occurs on the buccal surface of the ridge, and if the resorption is extensive, implant placement may be compromised.[16] It is advisable to reduce the mesio-distal dimension of the primary molar so that is the same size as a missing second premolar.[17] A primary second molar may retain the space for many years, preserving the alveolar ridge for an eventual implant placement (*Fig. 14*).

Timing of implant placement in growing patient

Congenitally missing teeth are frequently encountered in children. Placing an integrated implant in a growing patient is problematic because the ISP behaves as an ankylosed tooth. When there is a growth-related increase in the vertical dimension of occlusion, natural teeth will extrude to maintain optimal occlusion, leaving an ISP in its original position. The ISP becomes submerged relative to the adjacent teeth resulting in occlusal and gingival irregularity. The apex of a submerged maxillary implant can eventually penetrate the sinus or nasal cavity as the airway expands. Also opposing teeth can super erupt creating substantial occlusal and gingival irregularity which is manifest as esthetic and functional compromise. Replacing the crown of a submerged implant results in excessive length of the crown that compromises esthetics and the crown-to-implant ratio.[18,19] Another long-term complication is opening of contacts between the ISP and adjacent natural teeth.[20,21]

The timing for implant placement in growing patients is best delayed until adolescent facial growth is completed or nearly so. No reliable indicator is available to determine when growth has ended. The time-honored clinical approach is to expose cephalometric radiographs at 6 month intervals and superimpose the tracings. If no appreciable change occurs over the period of 1 year, facial growth is probably complete.[22] However, growth of the craniofacial skeleton is a slow continuous process that continues over a lifetime, but the rate is very slow after the age of about 20 years. Fudalej et al.[19] assessed maxillary central incisor and first molar (*U6*) extrusion following puberty. In males, U6s erupted 2.5mm before age 15, 1.1mm from 15-18 years, and only 0.5mm from 18 to 50 years.[19] Dental esthetics are negatively affected by a submerged ISP because of irregular incisal edges and gingival margins in the esthetic zone. Evian et al.[23] reported passive eruption continues throughout the teen-age years, but Volchansky and Cleaton-Jones[24] found that passive eruption was still not complete at age 20 years. Overall, it is best to plan on some passive eruption even in adults, but it is important to avoid orthodontic intrusion when preparing an implant site because relapse may intensify the submersion effect.[25]

For the present patient, preprosthetic orthodontic treatment was complete at 17y7m, but the delivery of the ISP was delayed until the age of 18y2m. This approach takes advantage of the greatly diminished facial growth after the age of 18 years.[19,23-24] Some passive eruption is expected longterm, but the UL5 region is not a sensitive esthetic area. A modest amount of gingival recession, as well as passive

eruption by adjacent and opposing teeth will probably be acceptable. Despite the possibility of negative outcomes longterm, the patient chose to have the ISP placed as soon as possible after the completion of orthodontic treatment. In consultation with the clinicians, 18y2m was deemed appropriate because the risk of serious longterm complications was minimal.

Conclusions

Partially edentulous growing patients are esthetic and functional challenges longterm. Combining orthodontics and implant prosthetic procedures requires extensive interdisciplinary collaboration. Orthodontic preparation of implant sites is crucial for success in placing fixtures. Atrophic edentulous sites require bone augmentation and/or a sinus lift procedure. The timing an ISP must be chosen with respect to the prospect for follow-up facial growth. ISPs behave like ankylosed teeth, so they must be monitored longterm for submergence and gingival recession.

Acknowledgment

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 17

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 = 3

Total = 3

OVERBITE

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

6mm

Total = 3

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

2mm (upper)

OCCLUSION

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

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

Each degree < -2° _____ x 1 pt. = _____

Each degree > 6° _____ x 1 pt. = _____

SN-MP

≥ 38° = 2 pts.

Each degree > 38° _____ x 2 pts. = _____

≤ 26° = 1 pt.

Each degree < 26° _____ x 1 pt. = _____

1 to MP ≥ 99° = 1 pt.

Each degree > 99° _____ 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 (≥3mm)	@ 2 pts. =	2
Missing teeth (except 3rd molars)	_____ x 1 pts. =	_____
Missing teeth, congenital	2 x 2 pts. =	4
Spacing (4 or more, per arch)	_____ x 2 pts. =	_____
Spacing (Mx cent. diastema ≥ 2mm)	@ 2 pts. =	_____
Tooth transposition	_____ x 2 pts. =	_____
Skeletal asymmetry (nonsurgical tx)	@ 3 pts. =	_____
Addl. treatment complexities	_____ x 2 pts. =	_____

Identify:

Total = 6

IMPLANT SITE

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

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

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), ≥ 7mm to contact point (2 pts) = _

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

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

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

Total = 4

Cast-Radiograph Evaluation

Case # **Patient**

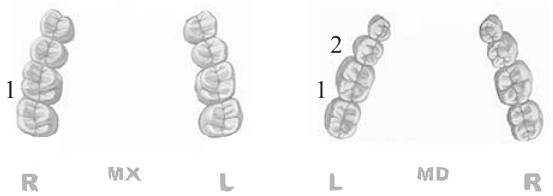
Total Score: 17

Alignment/Rotations

2

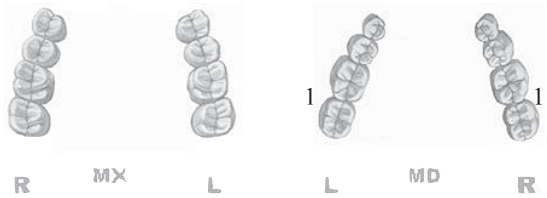
Marginal Ridges

4



Buccolingual Inclination

2

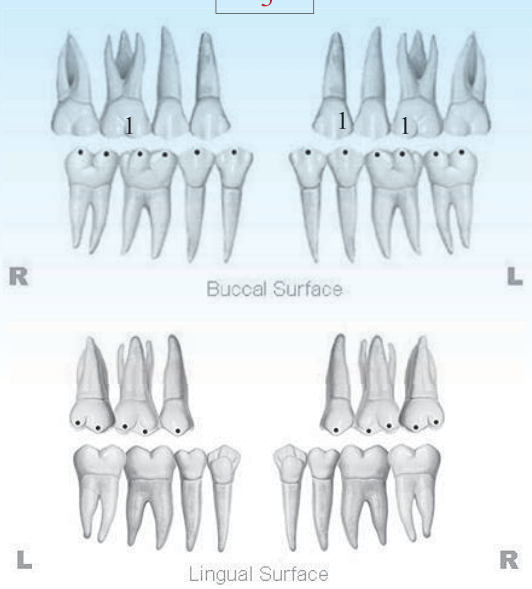


Overjet

4

Occlusal Contacts

3

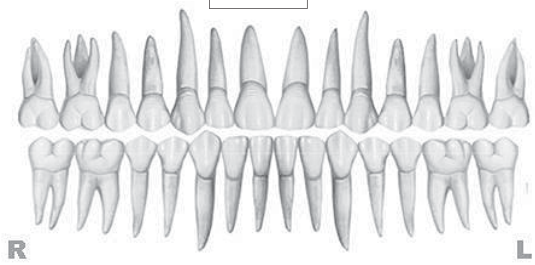


Occlusal Relationships

1

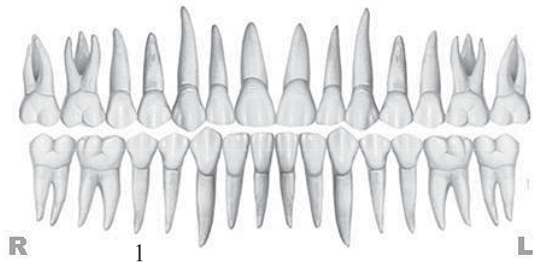
Interproximal Contacts

0



Root Angulation

1



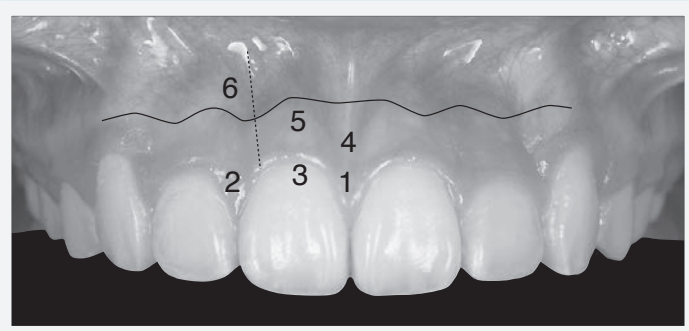
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 3

1. Pink Esthetic Score

Total = 0

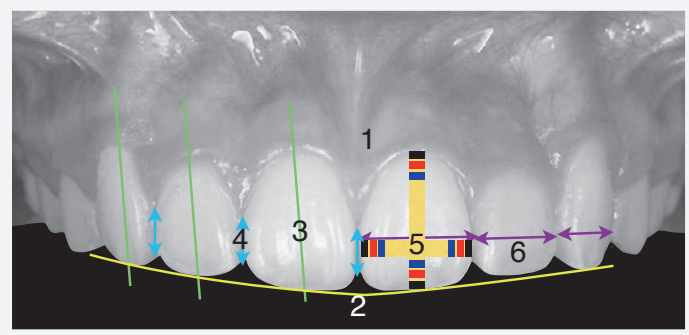


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

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

2019 植牙論壇

10 週年全新課程規劃

限時優惠
(1/31前)

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- 將邀請十多位優秀講師分享最新植牙資訊

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2019 Implant Forum

Full Mouth Reconstruction

2019 第十期

前言

2019 年植牙論壇課程，精彩可期。希望藉由每月一次的進修研討，解答您工作的疑惑，並幫助您在面對全口重建的臨床案例時，能胸有成竹，駕輕就熟。

課程主軸

在這個凡事講求效率的時代，病人總是希望牙科治療能夠兼顧舒適與速度，無論一顆、一排、或是上下全口假牙，病人總希望儘可能快速完成。面對患者的期待，醫師需要具備足夠的智慧及經驗來決定合理的治療計劃及流程。

「快速舒適的全口重建」是 2019 年植牙論壇的主軸，如果遇到全口少牙或無牙的患者，我們能多快提供他們過渡時期的假牙呢？三個月、兩個月，還是一個月？其實只要能遵守一定的手術原則以及專業技工配合下，手術後只要一天，就可以完成固定式過渡時期假牙。無論是美觀或功能上，均可滿足病人期待的舒適及速效。

專題演講

本課程除了繼續由美國矯正學會院士張慧男醫師，國際矯正植牙學會理事長蘇筌瑋醫師將帶領學員進行臨床案例報告與期刊的討論分析外，今年也邀請了許多經驗豐富的醫師進行專題演講。其中，專題演講嘉賓包含 FB 神人蘇裕隆（蘇湖）醫師，將其多年在假牙贋復及前牙美學獨到心得一次公開；以及美國哥倫比亞大學補綴專科暨碩士郭芯妤醫師，將解密全口重建的假牙贋復及牙科數位化的應用；還有美國牙周病學會院士邱上珍醫師，將細說手術皮瓣設計縫合要點，並實際示範操作，讓學員務必能掌握重要的手術原則；此外，前臺灣牙周病學會理事長張迺旭老師，將以其豐富經驗指導我們在植牙這條路上該如何趨吉避凶。

另外，長期指導我們的大家長－前三軍總醫院口腔外科主任、哈佛大學資深研究員的張燕清主任，將繼續提醒我們在植牙領域的種種陷阱和特別考量。誠摯地邀請您參與今年邁入十週年的 2019 年植牙論壇。

本課程贈送部分視訊（不包含專題演講內容及 USC 課程精選）

課 程 規 劃

2019 年 03 月 22 日起 每月一次（禮拜五）

地點：新竹市建中一路25號2樓 （金牛頓藝術科技）　　時間：上午 9:00-12:00

	日期（週五）	USC 課程精選、期刊導讀與特別演講 9:00 - 10:30	植牙案例報告 10:45 - 12:00（30 分鐘 / 人）	
1	3/22	張迺旭 醫師（芝加哥西北大學牙周病學碩士、台北醫學大學口腔研究所副教授） 專題演講：Interdisciplinary treatment plan of severe adult periodontitis: two case reports		
2	4/19	邱上珍 醫師（明尼蘇達大學牙周病學碩士、美國牙周病科專科醫師） 題目：Flap design and suture (含操作，需自備縫合器械＆縫線)		
3	5/31	郭芯妤 醫師（哥倫比亞大學口腔生物學碩士 紐約大學補綴科助理教授） 專題演講：Full arch implant prosthesis		
4	6/21	USC 課程精選：黃育新 醫師（國際矯正植牙學會院士）	蕭浩宜 醫師（美國南加州大學植牙研究所進修）	翁蔚任 醫師（高雄醫學大學牙醫學士）
5	7/26	蘇筌瑋 醫師（高雄醫學大學牙周病學碩士、國際矯正植牙學會理事長） 題目：VISTA & hard/soft tissue application		
6	8/23	黃怡豪 醫師（賓州天普大學口腔生物學碩士、台灣大學牙周病科兼任教授 ） 專題演講：Full-arch rehabilitation		
7	9/27	林森田 醫師（中山醫學大學學士、國際矯正植牙學會院士） 題目：What is All-on-4?	顧傑 醫師（美國南加州大學植牙專科訓練）	黃育新 醫師（國際矯正植牙學會院士）
8	10/18	郭芯妤 醫師（哥倫比亞大學口腔生物學碩士、紐約大學補綴科助理教授） 專題演講：Digital dentistry + Abutment selection		
9	11/29	專題演講：張燕清 主任（波士頓大學口腔生物博士、國防醫學院牙醫系副教授） 題目：Current advanced technology and technique in dental implant		
10	12/27	蘇裕隆 醫師（陽明大學牙醫學士、FB 前牙美學達人） 專題演講：前牙美學	邱上珍 醫師（明尼蘇達大學牙周病學碩士、美國牙周病科專科醫師）	張慧男 醫師（美國印第安那普渡大學齒顎矯正研究所博士）

本課表僅供參考，植牙論壇保留課程變動之權利。

30 分鐘課程視訊免費試聽

1. 掃描 QR Code 並完成註冊。
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2019

時間：

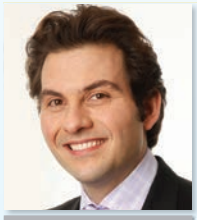
7/27~29, 2019 (六，一 - 演講與實作 workshop)
11/23~25, 2019 (六，一 - 演講與實作 workshop)
2/5, 2020 (三 - 美國可選修的 cadaver workshop)
2/7~2/8, 2020 (五，六 - 美國演講，畢業典禮)
8/24~26, 2019 (六，一 - 演講與實作 workshop)
2/3~2/4, 2020 (一 ，二 - 美國演講)
2/6, 2020 (四 - 美國可選修的 cadaver workshop)
2/9, 2020 (日 - 美國可選修的 cadaver workshop)

地點：

金牛頓藝術科技中心：新竹市建中一路 25 號 2 樓 (2019 年 7 月到 11 月)
Millennium Biltmore Hotel Los Angeles. 506 South Grand Avenue. Los Angeles, CA 90071-2607 (2020年2月)

講 員 陣 容

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2019 Keynote Workshop

講師 >< 金牛頓工程師

技巧班 7/25 (四)

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講師 >< 張慧男醫師

大師班 8/15 (四)

賈伯斯的簡報秘訣與設計要素

由國際知名的牙科講師張慧男醫師主講的一天課程，將以他幽默風趣的演講風格來剖析賈柏斯的美學概念以及演講秘訣，利用實例來說明如何設計出視覺優且知識性豐富的專業演講。

- 名額有限，以繳費順序為依據。
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Dento-Facial Asymmetry Treated with the Insignia™ System and Bone Screw Anchorage

Abstract

History: *A 22-year-old female presented with a chief complaint (CC) of anterior crossbite associated with asymmetry of the face and dentition. Her upper left canine (UL3) was extracted at age 12 yr.*

Diagnosis: *Anterior crossbite with a 3mm anterior functional shift, missing UL3, upper right second premolar (UR5) in buccal crossbite, and 2mm left deviation of the mandible in centric occlusion (Co). The discrepancy index (DI) was 26.*

Etiology: *Ectopic palatal eruption of the upper left central incisor (UL1) resulted in a functional shift and anterior crossbite.*

Treatment: *Insignia™ system appliance with passive self-ligating brackets was constructed for a treatment plan to correct dentofacial asymmetry by extraction of three first premolars (UR, LR and LL). The UR8 was also extracted, and bone screws were to supplement posterior anchorage. Dentofacial asymmetry was corrected with differential space closure favoring mesial movement of molars.*

Outcome: *After 25 months of active treatment, this challenging, asymmetric malocclusion was corrected to a near ideal result with a Cast-Radiograph Evaluation (CRE) of 18, and an excellent dental esthetics (Pink & White) score of 3. (J Digital Orthod 2019;53:56-72)*

Key words:
Insignia™ system, passive self-ligating brackets, digital set-up, archwire sequence, dento-facial asymmetry, asymmetrical mechanics, Class II intermaxillary elastics, IZC screw, temporary anchorage devices (TADs)

Introduction

The dental nomenclature is a modified Palmer notation with four quadrants: upper right (*UR*) and left (*UL*), and lower right (*LR*) and left (*LL*). Teeth are numbered relative to the midline from 1-8 in each quadrant. A 22-year-old female presented with a chief complaint (*CC*): protrusive lower lip, asymmetric dental and facial esthetics (*Figs. 1 and 2*). Radiographic documentation of the original malocclusion is a lateral cephalometric film (*Fig. 3*), panoramic radiograph (*Fig. 4*), and temporomandidular joint (*TMJ*) views (*Fig. 5*) . The patient's malocclusion concerns were associated with a missing UL3, anterior crossbite (*UL1 and UL2*), anterior openbite (*UR2*), posterior buccal crossbite (*UR5*), and an anterior functional shift that resulted in mandibular deviation 2mm left (*Fig. 6*). The abnormal habitual occlusion resulted in asymmetric mandibular condyles (*Fig. 5*), and a relatively protrusive lower lip. The maxillary incisors are in an ideal cephalometric relationship (*Fig. 7*). To correct the dentofacial asymmetry and lower lip protrusion, the patient and her family preferred extractions[1] and bone screws for anchorage, rather than orthognathic surgery. Following 25 months of active treatment (*Figs. 8-13*), a desirable outcome was achieved (*Figs. 14-16*).

Dds. Kristine Chang,
Clerk, Beethoven Orthodontic Center (Upper left)
Dds. Jennifer Chang,
Clerk, Beethoven Orthodontic Center (Upper center)
Dr. Tai Hua Lee,
Resident, National Taiwan University Hospital Hsinchu Branch (Upper right)
Dr. Chris Chang,
Founder, Beethoven Orthodontic Center
Publisher, Journal of Digital Orthodontics (Lower left)
Dr. W. Eugene Roberts,
Editor-in-chief, Journal of Digital Orthodontics (Lower right)

History and Etiology

This developmental malocclusion was probably precipitated by ectopic eruption of the UL1 at about age 6yr. The anterior crossbite of the UL1 resulted in a shift of the mandible anteriorly and to the left to achieve functional occlusion. Inadequate arch development in the UL incisal and canine area resulted in a labial ectopic eruption of the UL3, which was subsequently extracted (*Fig. 2*). In functional occlusion (Co), the molars are in a Class I relationship and the UL incisors in crossbite (*Fig. 1*). The casts are articulated in centric relation (Cr) and both buccal segments are slightly Class II (*Fig. 2*).

Fig. 1: Pre-treatment facial and intraoral photographs in centric occlusion

Fig. 2:
Pre-treatment dental models (casts) in centric relation

Fig. 3: Pre-treatment lateral cephalometric radiograph

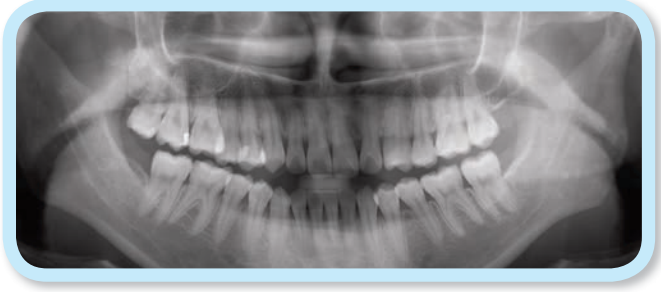


Fig. 4: Pre-treatment panoramic radiograph

The panoramic radiograph reveals a missing UL3 which was extracted at age 12 as part of a treatment plan to correct the malocclusion surgically. The patient's parents declined orthognathic surgery because of the potential for severe complications.[2,3] 10 years later, when the patient was a dental student, she opted to seek conservative treatment for the problem with extractions, bone screws and orthodontics.

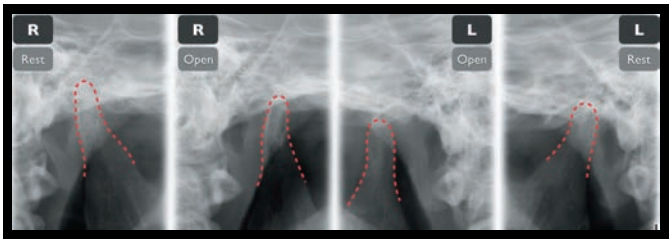


Fig. 5:
Pre-treatment TMJ transcranial radiographs show the right (R) and left (L) sides in the rest and open positions. The mandibular condyles are outlined in red. Note the asymmetric mandibular condyle heads are longer on the right compared to the left side.

Fig. 6:
The dental midlines were coincident, but shifted 2-3mm to the left consistent with the asymmetric heads of the mandibular condyles.

Diagnosis

Skeletal: Bimaxillary Protrusion

- Class I relationship: *SNA 84˚, SNB 84˚, ANB 0˚*
- Mandibular plane angle: *SN-MP 33˚, FMA 25˚*

Dental: Slight Class II in C_R

- Anterior crossbite: *UL1 and UL2*
- Overjet: *-2mm*
- Upper Incisors: *Tipped anteriorly (U1 to NA 3mm, U1 to SN 111.8˚)*
- Lower Incisors: *Tipped posteriorly (U1 to NB 4mm, L1 to MP 85.5˚)*

Facial: Relatively protrusive lower lip

The UL to E-line cephalometric measurements was -4mm, which is consistent with a retruded upper lip, but the latter is almost perfectly position to the nose (*Fig. 7*). However, the mandible is protrusive with a prominent chin, so the relatively protrusive lower lip is actually the problem. Carefully evaluating lip protrusion is a vey important aspect of treatment planning. The American Board of Orthodontics (*ABO*) Discrepancy Index (*DI*) was 26 points as shown in the subsequent worksheet.

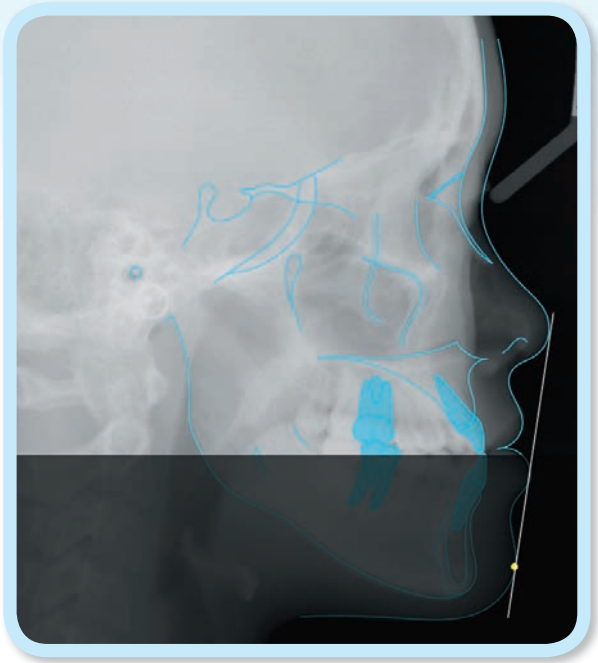


Fig. 7:
Despite the aberrant UL to E-line cephalometric measurement, the upper lip is in an ideal position relative to the nose when the lower third of the face is covered. See text for details.

Treatment Objective

After discussing relevant options with the patient, the following treatment was accepted:

1. Extract the UR8, and three first premolars (*UR4, LR4 and LL4*) to compensate for the missing UL3.
2. Protract UR buccal segment with posterior TAD anchorage.
3. Correct maxillary asymmetry with TAD anchorage and Class II elastics.
4. Move both dental midlines to the right to correct the bimaxillary asymmetry.
5. Establish ideal overjet and overbite.

Treatment Alternatives

First Option: Use conventional molar anchorage to close the UR4 extraction space. With this treatment option, space closure is expected to be 70% by

retracting anterior teeth, and 30% by protracting posterior teeth. The disadvantage with this option was decreasing the protrusion of the upper lip, which was an unacceptable outcome for the patient (*Fig. 8*).

Second Option: Use a right infrazygomatic crest (*IZC*) screw as anchorage to protract the molar. With this treatment option, space is closed 30% by retraction of anterior teeth, and 70% by molar protraction. This option is designed to maintain upper lip support (*Fig. 9*).

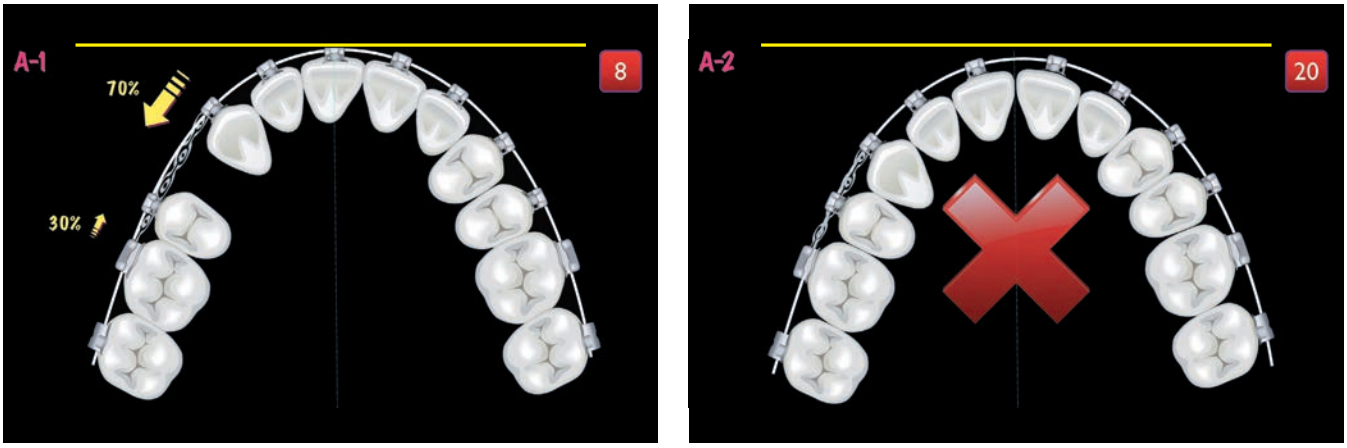


Fig. 8:
A-1: The first option (A-1) is conventional mechanics which results in too much retraction of the incisors. Although the upper arch is well aligned (A-2) there would be an anterior crossbite relationship with the lower arch, which is unacceptable to the patient (red cross).

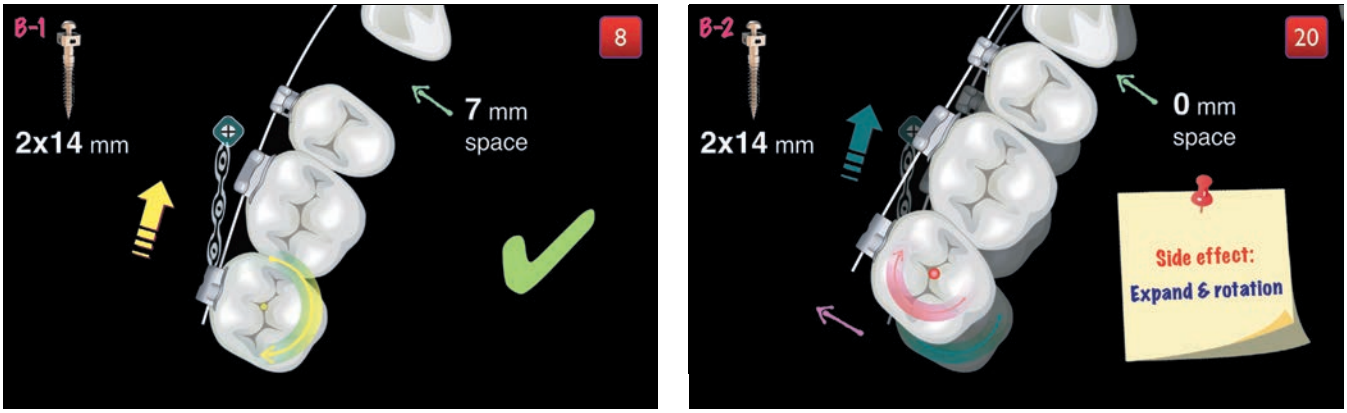


Fig. 9:
B-1: The second option (B-1) uses a 2x14mm IZC bone screw as anchorage to close the 7mm space primarily with molar protraction. A side effect of these mechanics is buccal movement (purple arrow) of the second molar (B-2), which must be controlled with archwire adjustment. See text for details.

Digital Set-up

Things that need to be checked before approval:

1. Extract: UR4, LR4, LL4 and UR8
2. Space Closure: ~70% posterior protraction (*Fig. 10*).
3. Supporting Bone: Maintain the lower dentition over the apical base of bone (*Fig. 11*).
4. Occlusion: Ideal Class I
5. Bracket Positions: In the center of tooth crowns.
6. Alignment: Straight wire planes

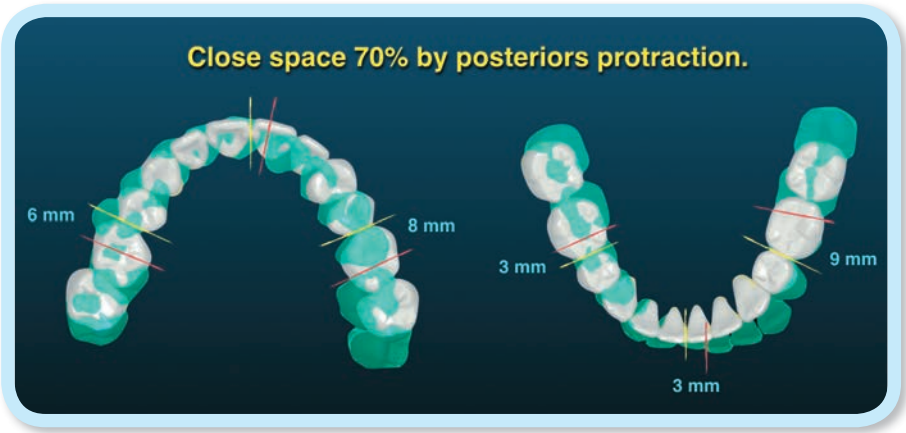


Fig. 10:
Green teeth are the pre-treatment position of the dentition. Pink lines mark the pre-treatment and the yellow lines show the post-treatment mesial surface of the first molar, as well as the midline. The prescribed space closure shown in mm in both arches is 70% posterior protraction and 30% mesial movement of buccal segments. See text for details.

Fig. 11: It is important to confirm that alignment of the lower arch is over the apical base of bone.

Treatment Progress

Two months following the prescribed extractions, all teeth were bonded with an Insignia™ digitally-designed 0.022-in custom appliance, as specified.[4] All treatment and sequencing details are shown in Table 1 and illustrated in Figs. 12 and 13.

Appointment	Archwire	Notes
1 (*0 months*)	U/L: 0.014-in Damon CuNiTi	Bond Insignia™ digitally-designed 0.022-in custom appliance upper and lower from 7-7
2 (*2 months*)	U/L: 0.014x0.025-in Damon CuNiTi	Parrot (*5/16-in, 2-oz*) from U6s to L3s
3 (*4 months*)	U/L: 0.019x0.025-in Damon CuNiTi	6 hooks, power chain (*PC*) + power tube (*PT*) Fox (*1/4-in, 3.5-oz*) from U3s to L6-7s
4 (*6 months*)	U/L: 0.019x0.025-in Insignia SS	Fox (*1/4-in, 3.5-oz*) from U6-7s to L3s Close the spaces 2 180˚ Drop in Hooks + PC
5 (*7 months*)		PC Expand the upper archwire
6 (*8 months*)	U: 0.019x0.025-in Damon CuNiTi	IZC bone screws buccal to UR6 and UL6 Cut the frenum
7 (*10 months*)	U: 0.019x0.025-in Insignia SS	Kangaroo (*3/16-in, 4.5-oz*) from U3s to L6s
8-12 (*12-17 months*)		New PC were used to re-activate space closure mechanics. Kangaroo (*3/16-in, 4.5-oz*) from U3s to L6-7s
13 (*18 months*)	L : 0.014x0.025-in Damon CuNiTi	Fox (*1/4-in, 3.5-oz*) from U3s to L6-7s
14 (*18 months*)	L: 0.019x0.025-in Damon CuNiTi	IPR U3-3 to eliminate the V shape Chipmunk (*1/8-in, 3.5-oz*) from U3 to L4 (*inside*) Fox (*1/4-in, 3.5-oz*) from U3 to L6-7
15-20 (*20-25 months*)	U/L: 0.021x0.025-in Insignia TMA	Detail adjustment

■ Table 1: Treatment sequence

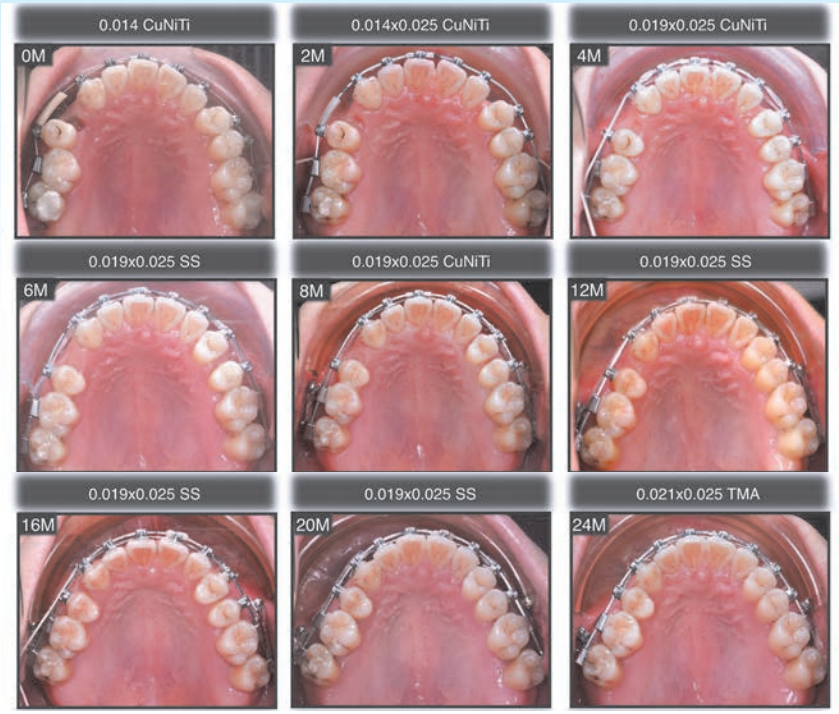


Fig. 12 :

A progressive series of upper occlusal photographs show treatment progress and the archwire sequence for the upper arch in months (0M) from the beginning of the treatment (0M) to twenty-four months (24M).

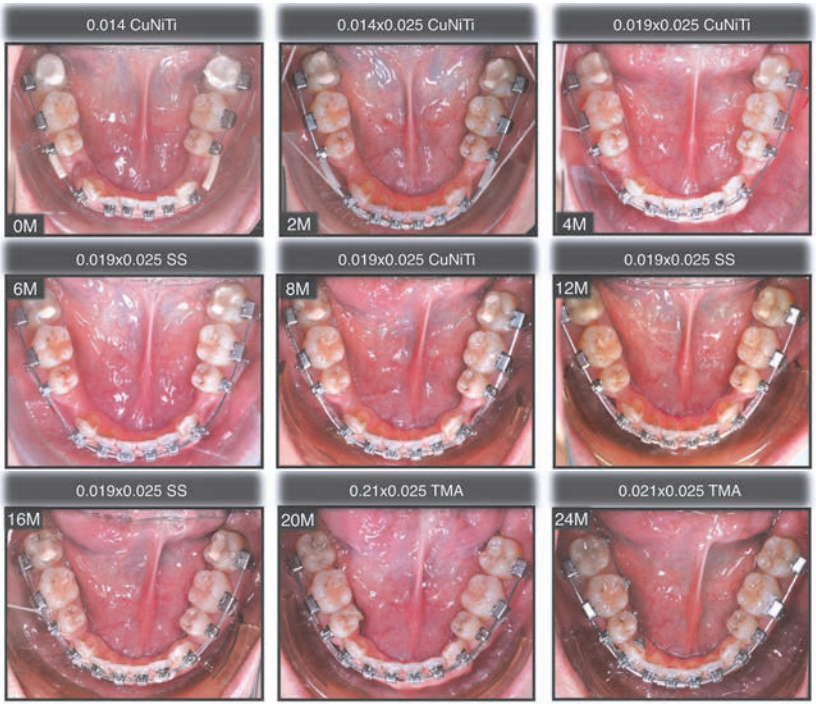


Fig. 13 :

A progressive series of lower occlusal photographs show treatment progress and the archwire sequence for the lower arch in months (M) from the beginning of the treatment (0M) to twenty-four months (24M).

Treatment Result

After 25 months of active treatment, both the patient and the clinician were satisfied with the outcomes (*Figs. 14, 15, 16 and 17*). Post-treatment evaluation revealed the maxillary molars were moved mesially relative to the IZC bone screws, as documented in photographs (*Fig. 18*) and panoramic radiographs (*Fig. 19*).

Fig. 14: Post-treatment facial and intraoral photographs

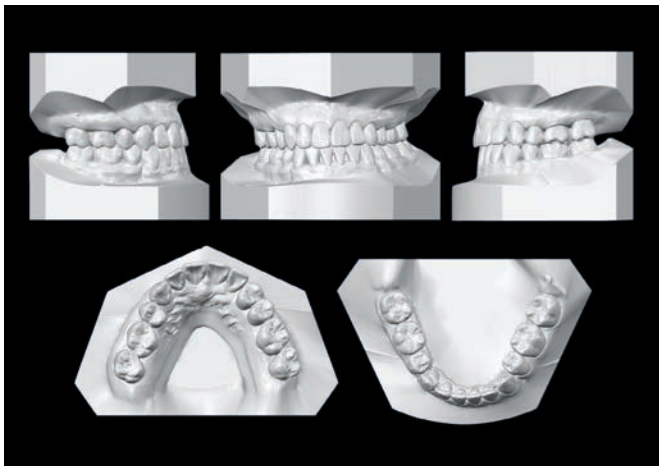


Fig. 15: Post-treatment dental models (casts)

Fig. 16: Post-treatment lateral cephalometric radiograph

Fig. 17: Post-treatment panoramic radiograph

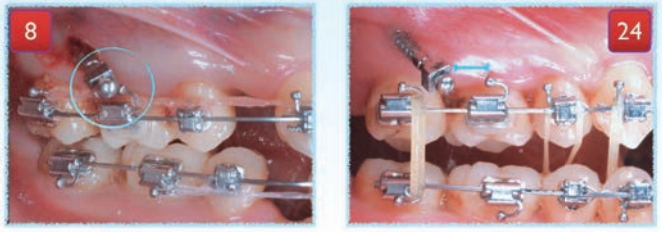


Fig. 18:
***Left**: The blue circle indicates the proximity of the bone screw to the first molar in the 8th month of treatment.*
***Right**: In the 24th month the first molar is moved anteriorly compared to the bone screw. See text for details.*

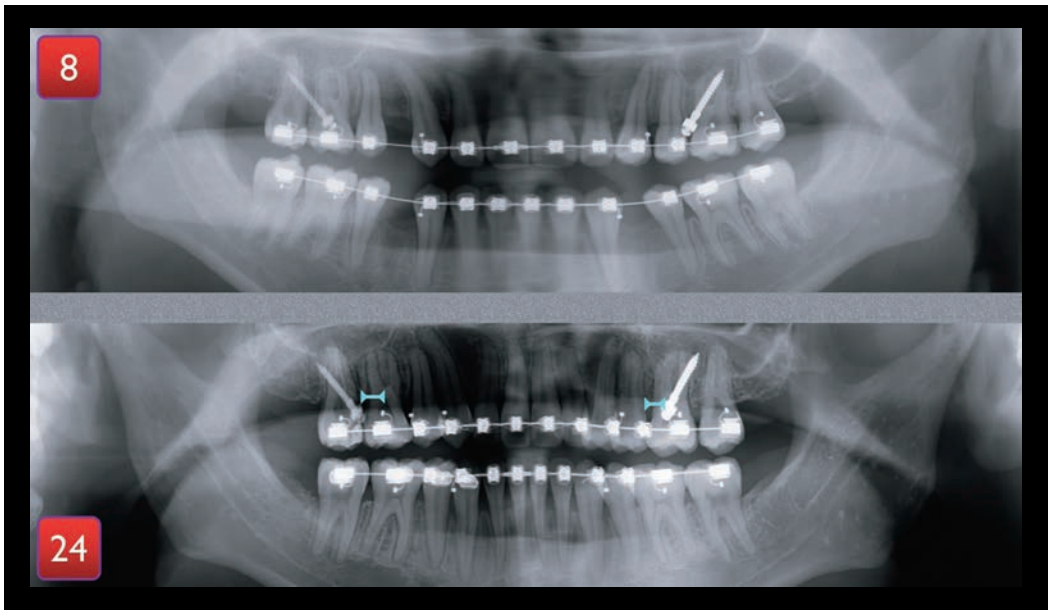


Fig. 19:
Panoramic radiographs from 8th (upper) to 24th month (lower) show mesial movement (blue lines) relative to the bone screws.

Dentoalveolar changes are documented in the superimposed cephalometric tracings before and after treatment (*Fig. 20*). The molars were protracted, while the maxillary incisors and the upper lip were well maintained in the sagittal plane. Lower incisors were retracted to achieve a desirable overjet and overbite relationship. Cephalometric details are summarized in Table 2.

The ABO Cast-Radiograph Evaluation (*CRE*) score was 18 as shown in the subsequent worksheet, which is an excellent outcome for a challenging malocclusion with a DI of 26 points. The major CRE discrepancies were buccolingual inclination (*9 points*), and alignment/rotation (*3 points*).

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	84°	84°	0°
SNB° (80°)	84°	83°	1°
ANB° (2°)	0°	1°	1°
SN-MP° (32°)	33°	30.5°	3.5°
FMA° (25°)	25°	23.5°	2.5°
DENTAL ANALYSIS			
U1 To NA mm (4 mm)	3 mm	2 mm	1 mm
U1 To SN° (104°)	11.8°	105°	6.8°
L1 To NB mm (4 mm)	4 mm	-1 mm	5 mm
L1 To MP° (90°)	85.5°	76°	9.5°
FACIAL ANALYSIS			
E-LINE UL (-1 mm)	-4 mm	-3 mm	1 mm
E-LINE LL (0 mm)	0 mm	-2 mm	2 mm
%FH: Na-ANS-Gn (53%)	56%	56%	0%
Convexity: G-Sn-Pg' (13°)	-1°	0°	1°

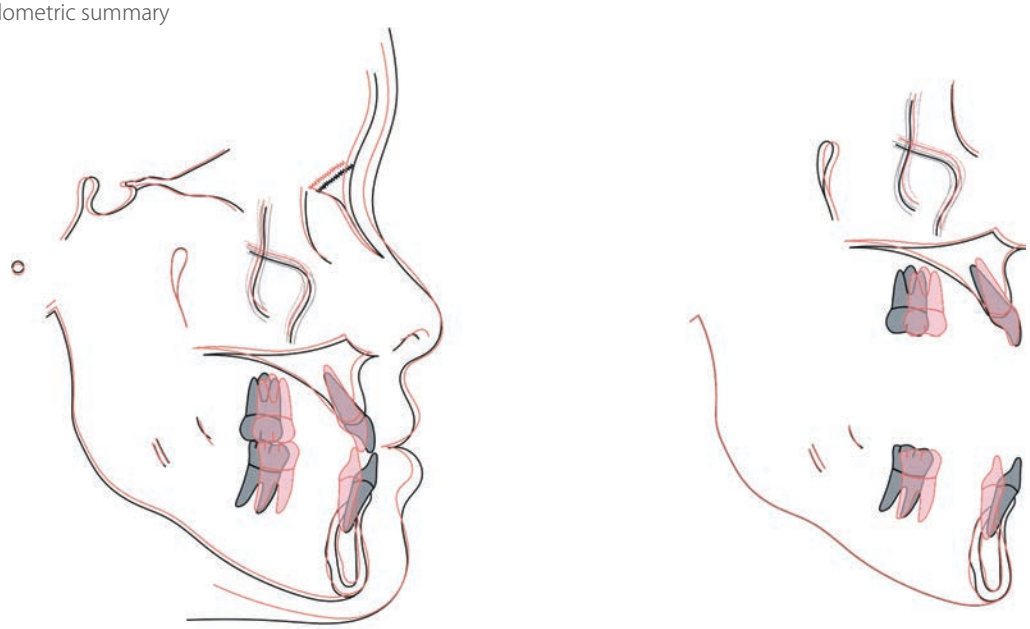
■ Table 2: Cephalometric summary

Discussion

1. IZC screw / Archform

The infrazygomatic crest (*IZC*) bone screws were placed buccal to the roots of the maxillary molars, which provides extra-radicular anchorage for retraction or protraction of individual teeth or the entire arch. This is a very effective anchorage for correcting skeletal asymmetry.[5,6]

For the present patient, the IZC screws were anchorage for closure of the extraction spaces by protracting the molars. The IZC screws were loaded and reactivated every month with pre-stretched power chains.[7] Tying the power chains from the IZC screws to the second molar protracts the buccal segments during space closure, but can induce side effects such as rotation of the second molar and arch expansion (*Fig. 9*). After the IZC screw were inserted (*8 mo*), the force system created the side effect



■ *Fig. 20:*
Superimposed cephalometric tracings showing dentofacial changes over 25 months of treatment (red) compared to the pre-treatment position (black). See text for details.

that expanded the archwire (*Fig. 21*). This problem was easily solved by constricting the archwire during the treatment process (*Fig. 22*).

2. Asymmetry

Patients may have unrealistic expectations regarding the resolution of asymmetry.[8] During the pretreatment consultation, it is important to inform the patient that conservative treatment may result in outcomes that are harmonized, but not necessarily normalized. If a patient insists on a normalized treatment result, the preferred treatment option is orthognathic surgery.

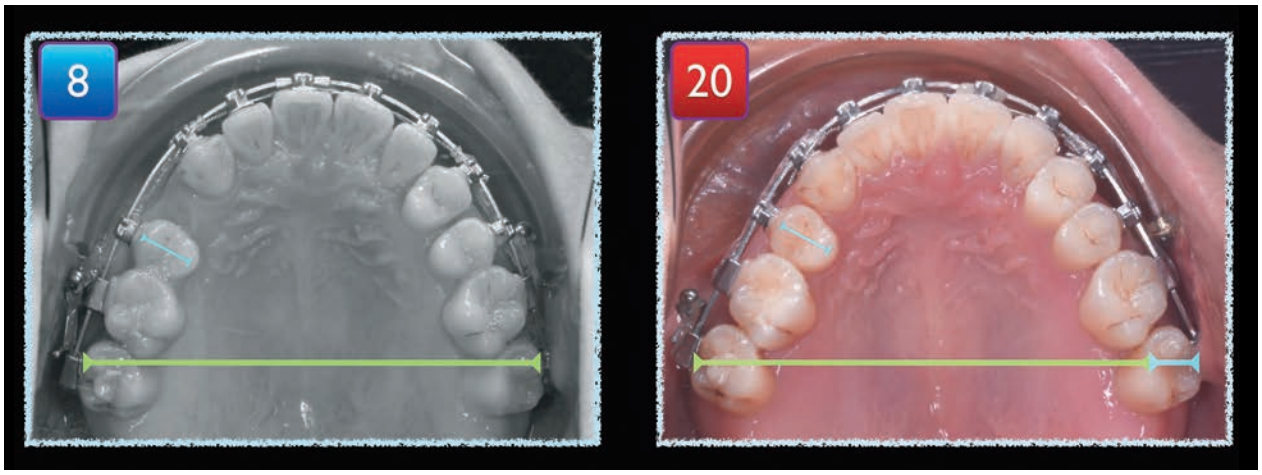


Fig. 21:
***Left**: The green line at 8 months (left) shows intermolar width when protection force is applied to the second molars.*
***Right**: The blue line at 20 months shows the distance that the arch was expanded. See text for details.*

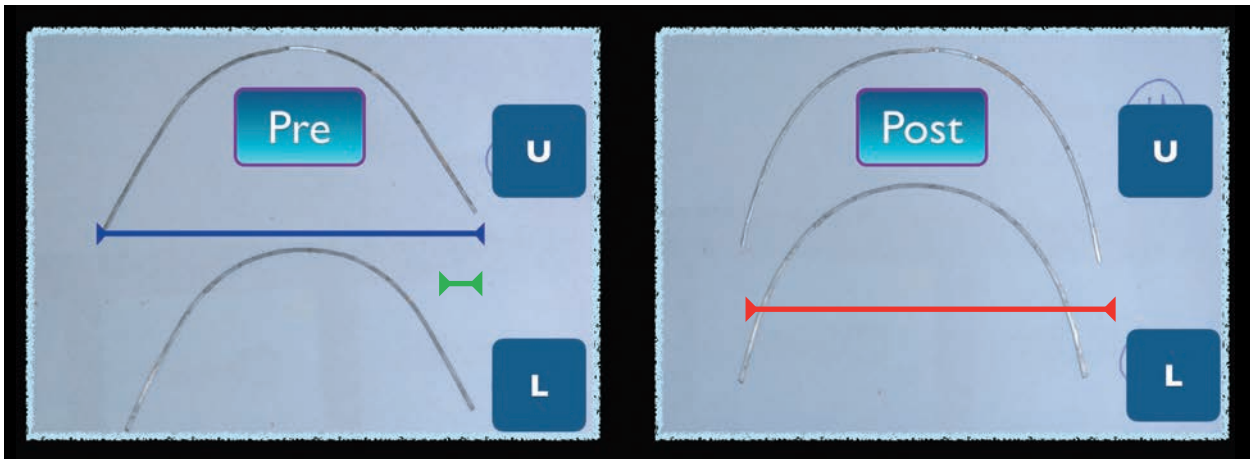


Fig. 22:
***Left**: The blue line indicates the width of the pre-adjusted upper (U) archwire compared to the lower arch (L).*
***Right**: The red line indicates the width of the adjusted archwire in the 24th month. The green line (left) indicates the constriction in width that is required. See text for details.*

The point at which acceptable correction of asymmetry becomes unacceptable is not easily defined. The critical factor is the clinician's sense of balance relative to the patient's perception of an imbalance. Therefore, it is important for the patient, family and clinician to have a clear consensus before treatment is initiated in order to achieve treatment outcomes acceptable to all.[8-10]

The present patient agreed to the non-surgical/orthodontic treatment plan realizing a good outcome is a compromise. IZC bone screw anchorage with power chains is a good differential space closure mechanism for the compensation of asymmetric anterior tooth loss. The midlines were corrected with UL4 substituting for the missing UL3. Class II elastics were useful for moving the lower posterior teeth anteriorly to align the lower dental midline with the upper (*Fig. 23*). From the patient's perspective, this was a very important objective.

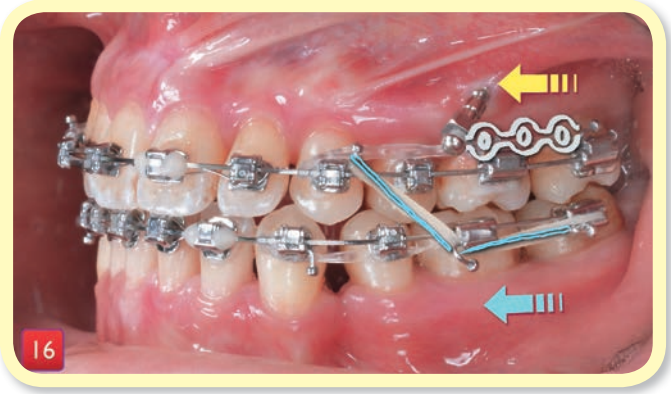


Fig. 23:
The force system in the 16th month (16) shows the IZC bone screw and the power chain in upper arch. The yellow arrow indicates the mesial force in the upper arch and blue arrow shows the space closure force in the lower arch. See text for details.

The patient's asymmetrical facial midlines were associated with skeletal asymmetries of the mandibular condyle heads (*Fig. 5*). For skeletal malocclusions, a dental midline deviation of 3mm is often acceptable.[11] The present patient was particularly concerned, so after 25 months of treatment, the dental midline deviation was reduced to 0mm, and the facial balance was reasonably harmonious. The patient was satisfied, although a mild facial asymmetry was still present. However the asymmetry was consistent with the deviations found in nature.[8]

3. Insignia™ digital set-up

Communication with the technicians preparing the digital set-up may be challenging because the clinicians often provide too much unnecessary information. For example, mechanical decisions such as placing bone screws and use of elastomer elastics should not be provided to the technician. Technicians are charged with providing an ideal set-up based on the last archwire. It is the purview of the clinician to plan supplemental anchorage to achieve the final tooth positions consistent with the final set-up.[4] Important information for the technician is as follows:

1. Extract three premolars: UR4, LR4 and LL4
2. Space closure: 70% posterior protraction of molars

The Insignia™ technician's role is to plan a final ideal occlusion, based on bracket positions and desired

wire planes. The clinician then plans the mechanics to achieve tooth positions consistent the planned set-up at the end of active treatment. It is important to keep it as simple as possible: technicians are not doctors!

Conclusion

Insignia™ is a powerful weapon in the orthodontic arsenal. The full potential requires that an orthodontist understands the precision of the mechanism for achieving the final result with minimal if any adjustments. However, a careful application of supplemental mechanics is necessary to move teeth into the correct relative positions for finishing. Only then can Insignia™ show its true value.

Acknowledgments

Thanks to Dr. Rungsi Thavarungkul for the beautiful illustrations, and to Mr. Paul Head for proofreading the manuscript. Special thanks to Drs. Judy Yeh, Bear Chen, Lomina Lee, Cheng Joy, Connie Huang for their mentorship and assistance with data collection.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 26

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 = 8

OVERBITE

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

Total = 0

ANTERIOR OPEN BITE

0 mm. (edge-to-edge), 1 pt. per tooth
then 1 pt. per additional full mm. per tooth

Total = 5

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 _____ pts.
Full Class II or III	=	4 pts. per side _____ pts.
Beyond Class II or III	=	1 pt. per mm. additional _____ pts.

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 2

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

Each degree < -2° _____ x 1 pt. = _____

Each degree > 6° _____ x 1 pt. = _____

SN-MP

≥ 38° = 2 pts.

Each degree > 38° _____ x 2 pts. = _____

≤ 26° = 1 pt.

Each degree < 26° _____ x 1 pt. = _____

1 to MP ≥ 99° = 1 pt.

Each degree > 99° _____ 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 (≥3mm)	@ 2 pts. =	_____
Missing teeth (except 3rd molars)	1 x 1 pts. =	_____
Missing teeth, congenital	_____ x 2 pts. =	_____
Spacing (4 or more, per arch)	_____ x 2 pts. =	_____
Spacing (Mx cent. diastema ≥ 2mm)	@ 2 pts. =	_____
Tooth transposition	_____ x 2 pts. =	_____
Skeletal asymmetry (nonsurgical tx)	@ 3 pts. =	3
Addl. treatment complexities	_____ x 2 pts. =	_____

Identify:

Total = 4

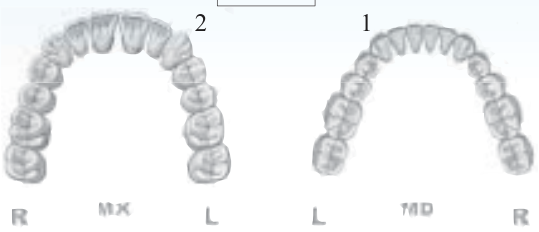
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 18

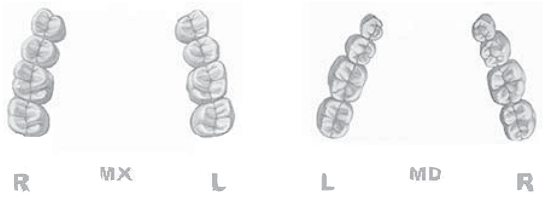
Alignment/Rotations

3



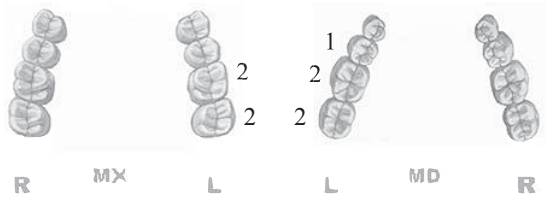
Marginal Ridges

0



Buccolingual Inclination

9

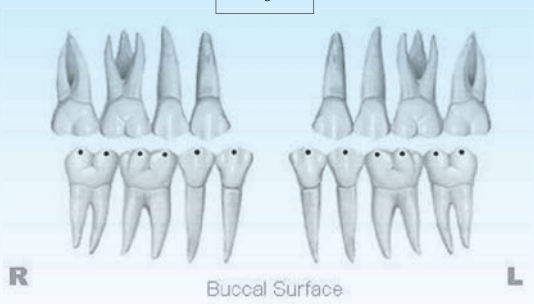


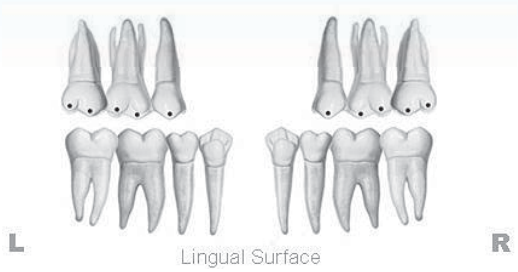
Overjet

2

Occlusal Contacts

0



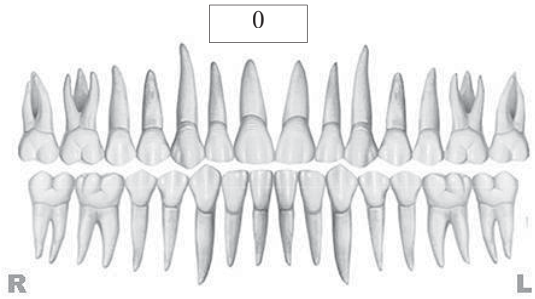


Occlusal Relationships

3

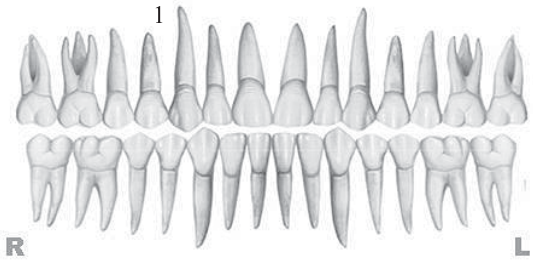
Interproximal Contacts

0



Root Angulation

1



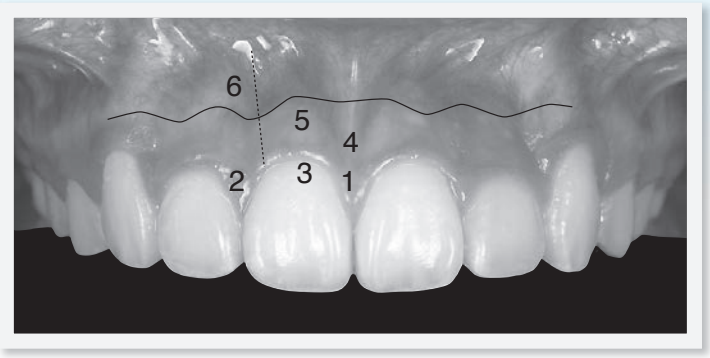
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 2

1. Pink Esthetic Score

Total = 1

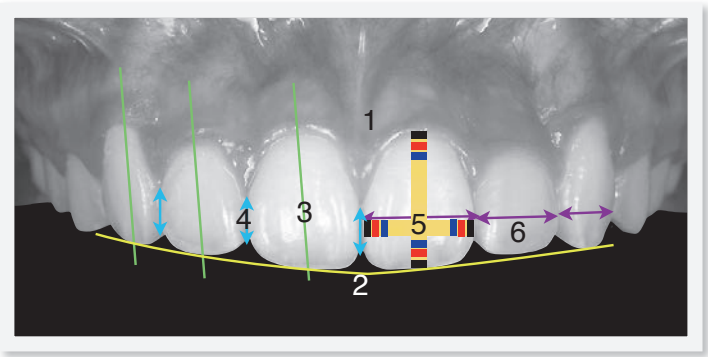


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

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 = 1



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

电子书

Insignia™ 的关键秘诀

贝多芬正畸种植集团将张慧男博士多年来累积的精致完工案例，整理出版成全世界第一套正畸互动电子书《正畸学》，本次抢先全球推出全新电子书《Insignia™的关键秘诀》，让医师，由简入繁，掌握最新世界趋势的数字化精准正畸。

全书章节皆为华人案例，是非常适合华人医师阅读、参考的实用专书。此书分为三部分：

第一部分：
为 Insignia 基本实操研讨課程內容，包含 Approver 软件实操、如何书写有效的 Insignia™ 治疗计划，Insignia 的间接粘结和弓丝序列。

第二部分：
为利用 Insignia 精准正畸的精选案例，所有案例皆通过世界认可的美国正畸学会（ABO）颁布之客观评量标准，包括牙列拥挤（crowding）、双颌前突（bimaxillary protrusion）、不对称（asymmetry）以及结合支抗钉矫治等，将治疗前后过程完整的记录于文章中，并搭配三维研究模型、圖片、X光片与演讲影片，颠覆学习体验。

第三部分：
整理利用 Insignia 精准正畸在临床上常见的问题与解决方法，包含托槽系统高效粘接流程、重新粘接的要点整理以及整合 CBCT 数据提高 Insignia™ 模拟的准确性，让你临床上快速上手、提升效率。

除了领先全球的治疗技术外，透过苹果先进的互动式出版应用程序，让您可以随心所欲的高效学习。打开这本书，您将对正畸有全新的认识。

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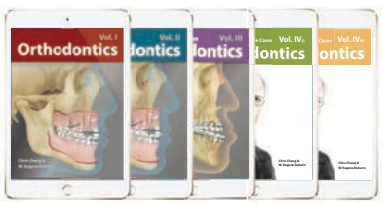

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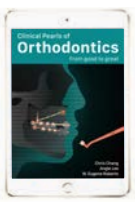


Clinical Pearls of Orthodontics:
From good to great

Dental Clinic Established 1996
Beethoven

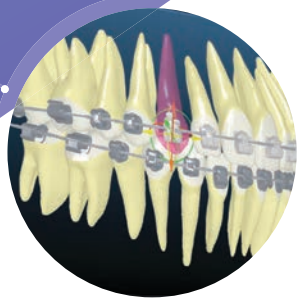
International Workshop

Damon, Insignia, OBS & VISTA

2019

	Session A	Session B
Damon, Insignia, OBS & VISTA	05/21–23	12/03–05
Keynote optional	05/24	12/06

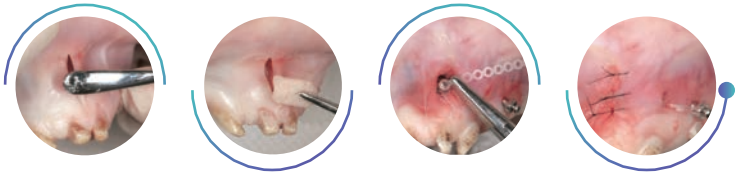
@Taiwan



INSIGNIA

OBS

Beethoven's International Workshop is designed for doctors who provide orthodontic treatment using the Damon and Insignia System. This workshop is consisted of lectures, hands-on workshops as well as chair-side observation sessions. Participants will have the opportunity to observe clinical treatment, didactic lectures, live demonstration and gain hands-on practice experiences involving TAD placement, indirect bonding, CBCT-enhanced digital treatment planning for Insignia.



VISTA Vertical Incision Subperiosteal Tunnel Access

Registration:

Day 123 USD **3,600** Early bird rate: $100 off (advanced registration two months prior to the course date)

Day 4 USD **600** Early bird rate: $100 off (advanced registration two months prior to the course date)

For more information and registration, visit

http://iworkshop.beethoven.tw

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Course Schedule

Day 1

Damon Lecture, OBS model workshop, chair-side observation

Chris' Lecture:
Optimized Orthodontic Treatment with Damon system

Day 2

Insignia Lecture, Insignia Chair-side observation

Chris' Lecture:
CBCT-enhanced treatment plannning for Insignia

Day 3

CI III Lecture by Dr. John Lin, VISTA Lecture & workshop

* The topics for VISTA workshop:

1. VISTA with Screw Placement
2. VISTA with Connective Tissue Graft
3. Suture Technique

Prof. Dr. Paulo Fernandes Retto, Portugal

"Dr. Angle would be glad to know that contemporary orthodontics has a professional as Chris Chang!"

Damon, OBS & VISTA

Day 4

Keynote workshop (Optional)

by Newton's A team

1. patient clinical records management
2. patient communication presentation
3. Basic animations and visual aids

Dr. Rungsi Thavarungkul, Thailand
Lecturer, Advanced Keynote Workshop

"If you think this is a computer course that will show you step-by-step how to use the application, please reconsider. If you want to improve communication in your practice, and with patients, this 8-hour course is definitely worth it."

KEYNOTE

THE LECTURERS

Dr. Chris Chang

CEO, Beethoven Orthodontic and Implant Group. He received his PhD in bone physiology and Certificate in Orthodontics from Indiana University in 1996. As publisher of Journal of Digital Orthodontics-*A journal for Interdisciplinary dental treatment*, he has been actively involved in the design and application of orthodontic bone screws.

Dr. John Lin

President of the Jin-Jong Lin Orthodontic Clinic. Dr. Lin received his MS. from Marquette University and is an internationally renowned lecturer. He's also the author of Creative Orthodontics and consultant to Journal of Digital Orthodontics-*A journal for Interdisciplinary dental treatment*.

Improved Archwire Sequence for Insignia™

Abstract

Archwire sequencing is important for efficient management of malocclusion with a digital appliance. Flexible copper-nickel-titanium (CuNiTi), rigid stainless steel (SS) and adjustable titanium-molybdenum-alloy (TMA) archwires all play a role. There are four phases in Insignia™ progressive archwire therapy: (I) stock light round wires (CuNiTi), (II) rectangular CuNiTi wires, (III) major mechanics with SS, and (IV) finishing with CuNiTi and TMA. This article recommends a revised archwire sequence for Insignia™ passive self-ligation brackets (SLB) based on clinical experience. (J Digital Orthod 2019;53:76-78)

Key words:
Insignia™ system, passive self-ligating bracket, archwire sequence, custom bracket

Insignia Archwire Sequencing			
I	Stock light round wires	0.014-in stock Damon CuNiTi	Start tooth movement, leveling, initial rotation control, arch form development.
		0.016-in / 0.018-in stock Damon CuNiTi	Align severely crowded teeth, prepare for the second phase.
II	Rectangular wires	0.014 x 0.025-in Insignia CuNiTi	Rotation control and alignment.
		0.018 x 0.025-in Insignia CuNiTi	Consolidate anterior spaces.
		0.021 x 0.025-in Insignia CuNiTi	Torque establishment.
III	Major mechanics	0.019 x 0.025-in Insignia stainless steel (SS)	Space closure, anterioposterior dental correction, buccolingual control.
IV	Finishing	0.021 x 0.025-in Insignia CuNiTi	Torque control.
		0.021 x 0.025-in Insignia TMA	Finishing bends.

■ Table 1: Recommended arch wire sequence for an Insignia™ SLB system.

Dr. Hsin-Yin Yeh,
Director, Beethoven Orthodontic Center, Taiwan
Editor, Journal of Digital Orthodontics (Left)

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

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

Introduction

Insignia™ (*Ormco, Glendora, CA*), is a comprehensive orthodontic treatment system produced with computer-aided design (*CAD*) and computer-aided manufacture (*CAM*). A digital design of an ideal alignment (*CAD*) as specified by the clinician is reverse engineered to produce a customized fixed appliance (*CAM*). Based on preferences and clinical experience of the doctor, Insignia™ offers clinical efficiency for controlling and minimizing variables to achieve an optimal outcome. This report recommends an improved archwire sequence for Insignia™ passive self-ligating brackets (*PSL*) (*Table 1*).

Phase I: Stock light round wires (0.014, 0.016/0.018-in CuNiTi)

In the first phase, the intent of the initial round archwires is to apply light loads to malaligned teeth to initiate arch alignment. The intent of the initial archwire is to align teeth and bracket slots just enough to progress to the second phase.

Phase II: Rectangular wires (0.014x0.025, 0.018x0.025, 0.021x0.025-in CuNiTi)

This phase completes rotation control and leveling, initiates 2nd and 3rd order control of root angulations, and closes space in anterior segments. The

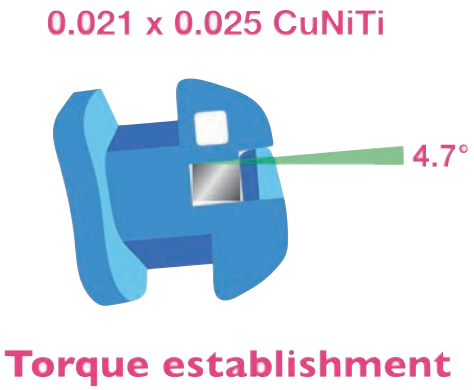

Fig. 1:
Establish torque (3rd order loading) with 0.021x0.025-in CuNiTi archwire because the small play (4.7°) between the archwire and the slot.

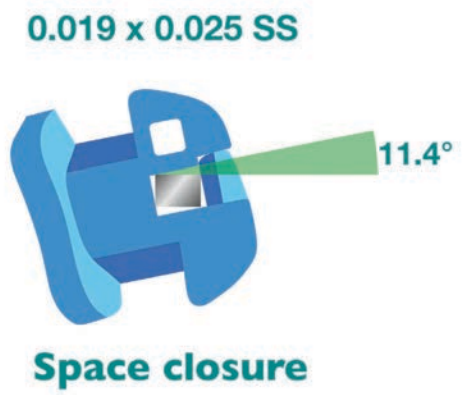

Fig. 2:
Torque loss reflects palatal tipping of incisors, due to decreased 3rd order loading, because the play between the archwire and the slot increases to 11.4°.

0.021x0.025-in CuNiTi archwires are used for third order control (*torque establishment*) as shown in Figure 1.

Phase III: Major mechanics (0.019x0.025-in SS)

This working phase includes posterior space closure, anterioposterior (*A-P*) dental correction, and buccolingual control. Loss of torque is attributed to an inadequate 3rd order load during space closure and A-P correction, that is due to play of 11.4˚ between the archwire and slot (*Fig. 2*).

(A) Posterior space closure

Rounding the Archwire: Smoothing off the sharp corners of 0.019x0.025-in SS archwire in the posterior segments facilitates sliding mechanics by controlling friction (*Fig 3a, 3b*).

(B) A-P dental correction

Elastics: Medium/heavy force (*3.5-4.5-oz*) elastics for Class II or Class III mechanics.

(C) Buccolingual control

Archwire Adjustment: Expand or constrict an 0.019x0.025-in SS archwire to arch widths.

Phase IV: Finishing (0.021x0.025-in CuNiTi, 0.021x0.025-in TMA)

In the fourth phase, large archwires are used to regain any torque (*3rd order correction*) lost during phase III mechanics, while simultaneously detailing the alignment to finish treatment.

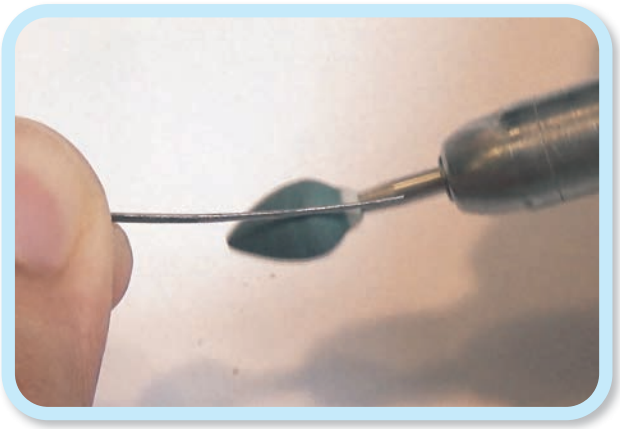

Fig. 3a:
Round the posterior section of the 0.019x0.025-in SS archwire with a green stone bur.

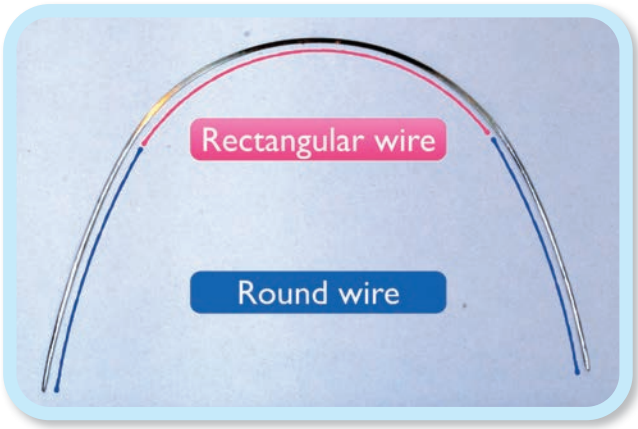

Fig. 3b:
Simulate a "round wire" configuration of the posterior segments to enhance sliding mechanics during space closure.

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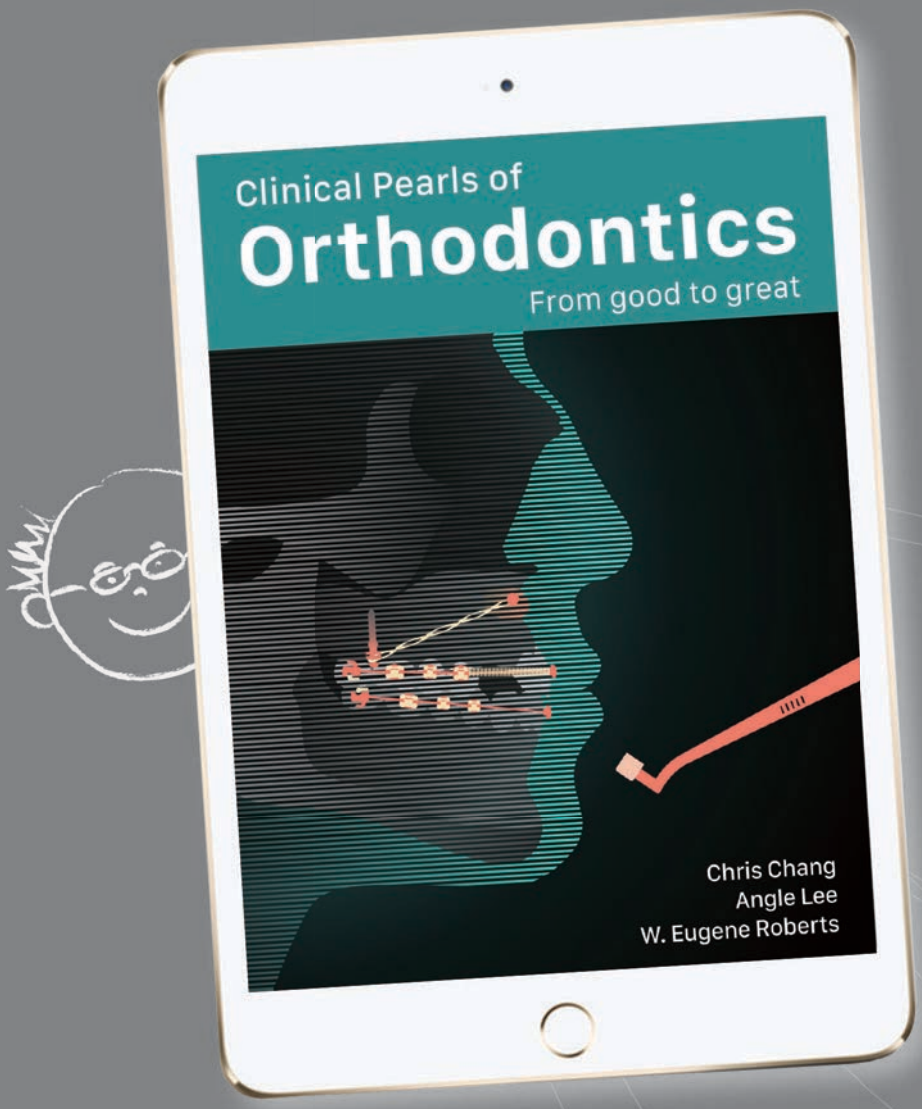

Clinical Pearls of Orthodontics:
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We all know "the devil is in the details" and it's the details that distinguish real pros from the mediocre ones. This book is Dr. Chris Chang's collection of practical tips that will simplify and improve you clinical care.

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Chris Chang, Angle Lee, and W. Eugene Roberts

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Why Angle Society?

I am often asked many questions about my techniques and opinions about treatments, but recently I was asked to share my thoughts about the Angle Society.

I am a member of the Angle Midwest Component and it took me five gruelling years of preparation before being accepted into this prestigious society. In retrospect, I feel the process of qualifying is the real magic, as one learns so much during the process and I appreciate this process just as much as I do rubbing shoulders with the world's best Orthodontists at the Angle Society's meetings.

Fig. 1: An immensely proud day seeing my mentor, Dr. Gene Roberts, receiving his Albert Ketcham Award. Orlando 2016.

Dr. Chris Chang,
Active member, Angle Society Midwest
Founder, Beethoven Orthodontic Center, Taiwan
Publisher, Journal of Digital Orthodontics

Ever since I became interested in Orthodontics, I have been obsessed with Dr. Angle's life, technologies and ideas, which have proven to be a great way of learning our profession. This started 30 years ago and when I was asked recently why there should continue to be an Angle Society I came up with a threefold answer.

Firstly, to be a beacon to all the young doctors so that they can also aspire to become members.

Secondly, to act as an anchor, to prevent us from drifting aimlessly through this ocean full of fascination, mystery and challenges.

Fig. 2: Angle Society members. The 42nd Angle Biennial meeting, Chicago, 2017 — the Shining Hill of our profession.

Fig. 3: There is no better way to gather wisdom from the world's elite than at an informal dinner party.

Thirdly, to function as a port in which members can dock, mingle and return laden with information to their practices.

Becoming a member of the Angle Society truly has affected my life.

It has elevated my appreciation not only of Dr. Angle, but also of the incredibly talented members of the Angle Society. To be able to interact with so many great Orthodontists from different countries and different generations is truly a privilege, as well as a great learning process and never ending inspiration.

Sometimes I ask myself what would be Dr. Angle's vision of his society, were he with us today?

As a pioneer and innovator and someone who spent his life on the cutting edge, would he be content to rest on his laurels and merely stand on this solid foundation? Or, would he rather use this solid foundation to venture into the unknown and always be looking at ways to expand his knowledge and create, try and experiment with new techniques, such as digital?

Would he merely want to tread water, or rather surge forward and open all of our minds, young and old, experienced and freshmen, to further enhance our profession and this society, maybe even becoming more internationally prominent by establishing components in every continent?

As I never could have met Dr. Angle, I am not sure what his answers would be, none of us do, but I suspect he would be digitally leading the way for us to follow.

Fig. 4: Enjoying the great outdoors. Not all holes were made by OBS! Others were created to fill with golf balls.

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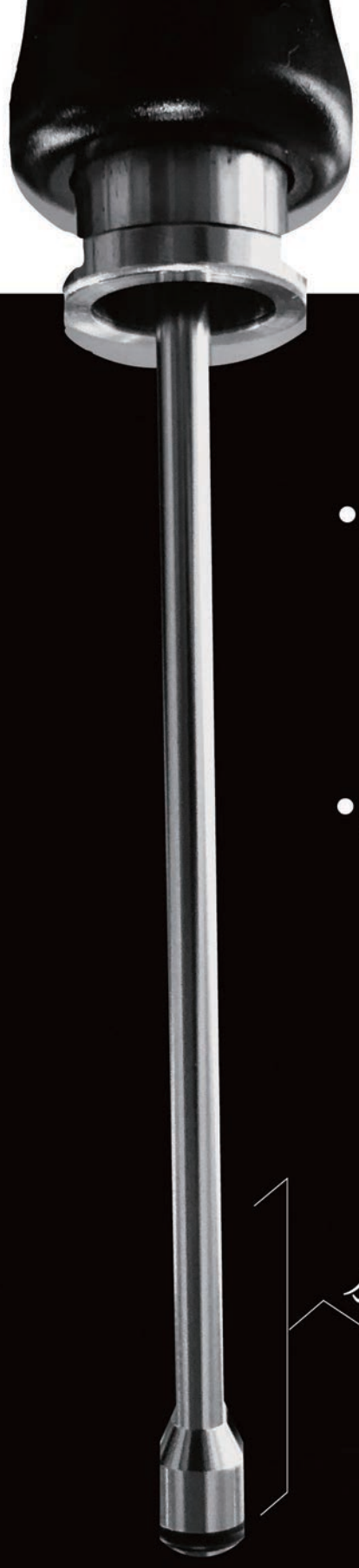

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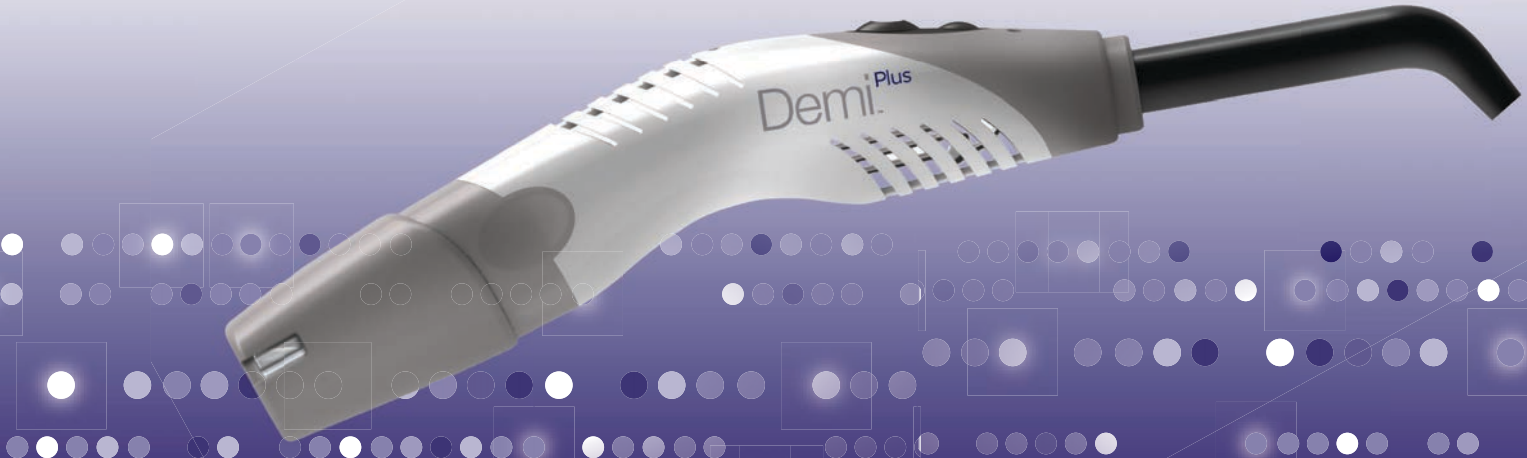

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OBS is a powerful tool for each & every case. Vertical Incision Subperioteal Tunnel Access (VISTA), it's the best approach for labial impacted and transpositioned canine. We all get valuable knowledge about OBS & VISTA technique. Really appreciate Chris & his teams for the support & hospitality.

Dr. Kaung Myint Myat,
MYANMAR

The entire course was run very well. Thoroughly organised, and I learned a lot from the start of the course, right through to the Introductory Keynote Workshop. This is definitely the course to learn and place TADs as a routine part of orthodontics.

All the staff were also excellent in their support, especially Mrs. Chang, Bella, and Chester. Couldn't have been happier with the course that I had attended.

Dr. Brad Chou,
AUSTRALIA

I took a very long flight from the other side of the world to come here and it was worth every mile.

I've been listening to Chris Chang's teaching about OBS, VISTA and Damon for the last 4 years and also using his mini screws. However, being at his workshop has been crucial for me to improve my protocols and treatment plans.

Sitting observation, pig jaw mini screws insertion and even banana suture practice were the perfect ways to clear all my doubts about extra radicular placement of mini screws.

I strongly recommend this course to all orthodontists in the world whom would like to provide easy, effective and a different way of treatment to their patients. I am very grateful to Chris, Shufen, Bella and all staff for giving me the opportunity to have this experience. God Bless you!

Dr. Alberto Diaz Arellano,
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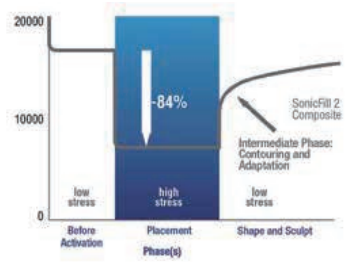

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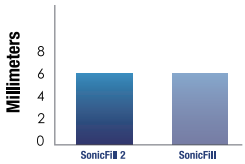

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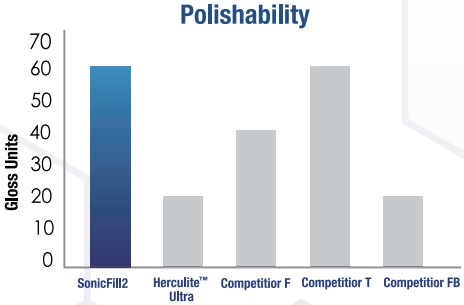

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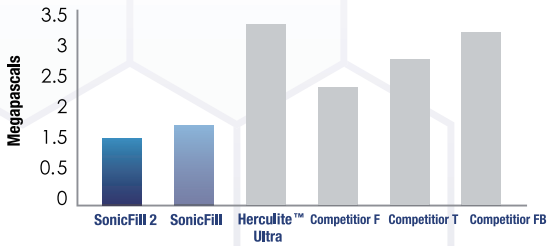

*Shrinkage stress @ 1 min

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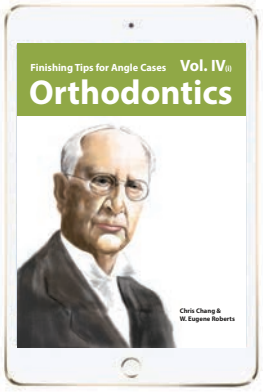

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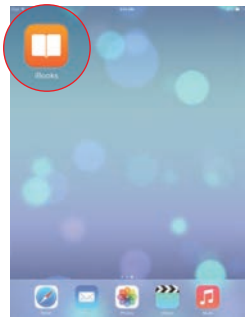

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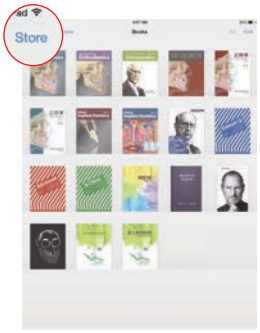

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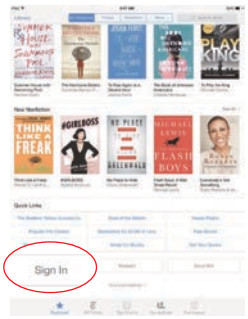

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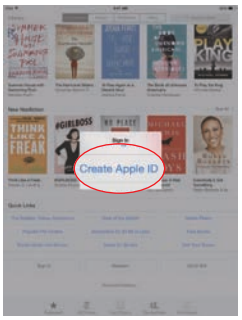

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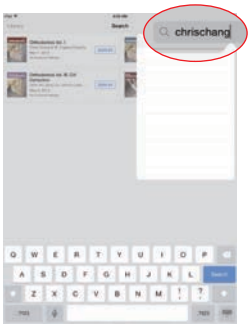

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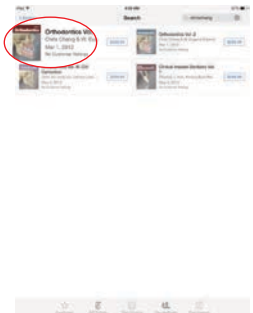

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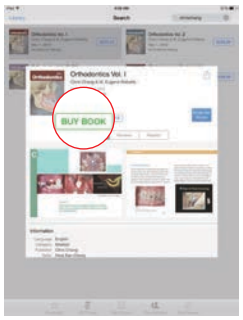

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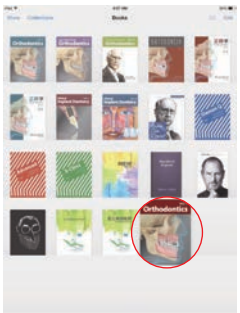

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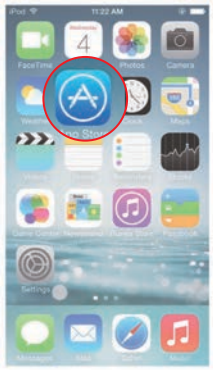

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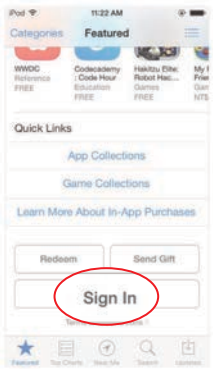

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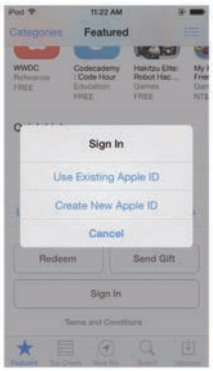

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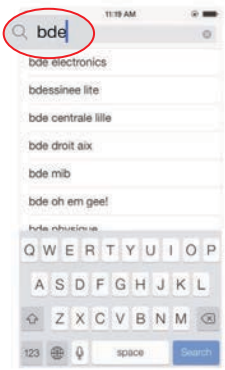

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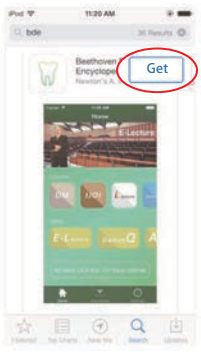

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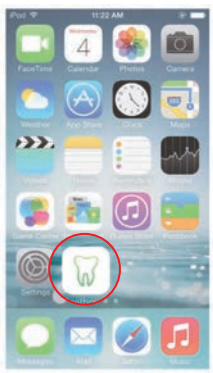

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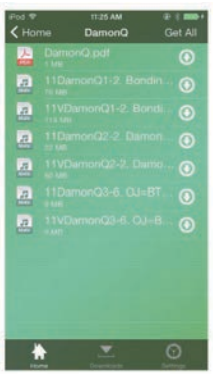

7. Once downloaded, click "BDE" to launch the app.

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