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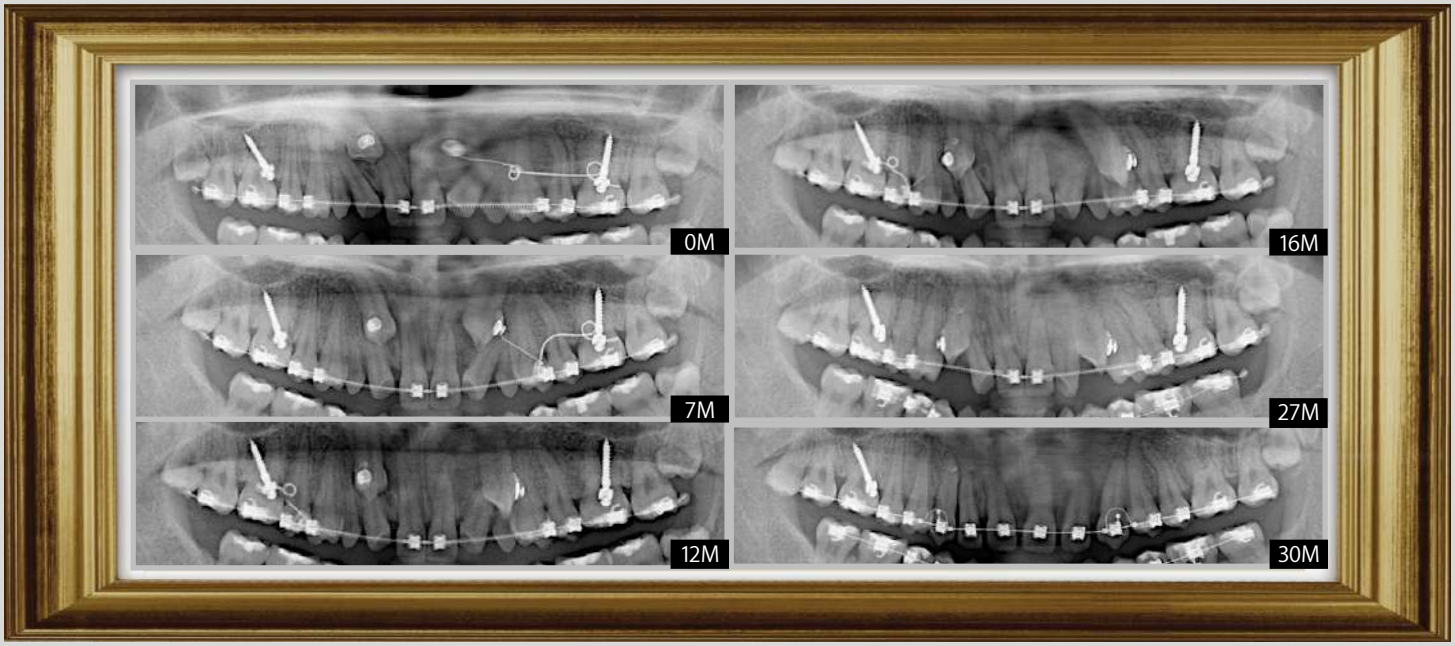

A panel of progressive panoramic radiographs documents the recovery of impacted U3s. The impacted teeth were pulled out using 3D lever arms anchored by an OrthoBoneScrew® on each side. Note that there were no brackets bonded on the maxillary lateral incisors between 27 to 30 months to prevent root resorption.

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2023
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

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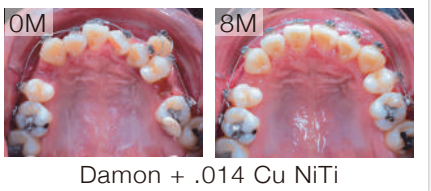
Damon Master

(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 and result 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.

2023

Module 1 - **4/13**
Module 2 - **5/11**
Module 3 - **6/8**
Module 4 - **6/29**
Module 5 - **7/13**
Module 6 - **7/27**
Module 7 - **8/10**
Module 8 - **8/24**
Module 9 - **9/7**
Module 10 - **9/21**
Module 11 - **9/28**



Damon + .014 Cu NiTi

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 turn excellent finishing into attainable goals.

Finishing XV

Module 1 - **4/18**
Module 2 - **5/16**
Module 3 - **6/13**
Module 4 - **7/11**
Module 5 - **8/15**
Module 6 - **9/12**
Module 7 - **10/3**
Module 8 - **11/7**
Module 9 - **12/19**
Module 10 - **1/9**/24'
Module 11 - **3/12**

Damon Clear

Screws & Aligners

International Workshop English Class

The workshop demonstrates how to incorporate TADs and minor surgeries in complex orthodontic treatment, combining world-class lectures, model and surgical hands-on practices, and clinical observation.

course@newtonsa.com.tw
+886-3-573-5676 #218 Annie

2024

Class - **11/12-14**

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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In June, I was invited by Invisalign Singapore to participate in a panel discussion session as one of the three key speakers. To prepare for this, ten questions were sent to us and we were asked to return our replies to the organizer. On the night before the session, I arrived in Singapore, and the moderator, Gigi, met me and told me that my responses were too brief compared to the other two speakers', which were all well-written paragraphs, and she hoped that I could add some supplementary details. This got me a little nervous, especially since what I had written down was basically all I wanted to and had to say! Although a teleprompter had been prepared to remind us of what we had written, I was skeptical about whether this was a good idea or not. Despite Gigi's best efforts to teach an old dog new tricks, I decided to stick to my way, made some minor changes and additions to my original draft, and Shufen, my trusted right and left hand, and wife, printed the draft out so I could take it with me on stage. Phew!

As it turned out, the teleprompter monitor was too far away for us to clearly decipher all the words. Even our youthful and exuberant moderator, Gigi, had difficulty reading the text properly off the monitor. In the end, those nice, short and sweet, one-sentence answers of mine came to be the most suitable form of response in an event like this. I could even use them as a guide and expand my answers to cover a wider range of issues. Does this mean that I am a better speaker than the others? Most certainly not, they were most articulate speakers and excellent orthodontists who happened to fall prey to unexpected technological circumstances. The expectation of a teleprompter led the other speakers to prepare for the session in a specific but relatively confined way. By contrast, armed with short answers and my knowledge and experience, I just confronted and transcended the problems with an open mind.

My favorite part of the trip was actually the Gardens by the Bay, which were adjacent to the hotel we stayed in. I went there every morning during our stay, appreciating all the high-tech, sustainable designs of a spectacular botanical collection from reportedly all around the world. On the last morning, a long-time student of mine, Dr. Chao Pan, accompanied me. One particular type of tree caught his attention, and he enquired if I knew what they were. Without consulting any form of teleprompter I replied: "I can't tell you their exact name, but I know they are similar to the Betel tree." Upon googling their photo, he was surprised to find out that in Mandarin Chinese the trees are known as the fake Betel. This just goes to show that we can never know the correct answers to all questions, but our existing knowledge is there to help us delve a little deeper into everything.

Similarly, in our orthodontic practices, there is never just one correct plan for treating each case. Our skills, experience, and knowledge are our trusted weapons. Therefore, instead of elevating certain methods as the most powerful ways, or idolizing one person as the "Guru", good orthodontists should keep an open mind when facing patients' problems so as not to confine the potential and evolution of our collective weapons.

The three keys to learning orthodontics, as I realized on this trip to Singapore, are: (1) an open mind, (2) international perspectives, and (3) English skills. Singapore really did fascinate me! Though a tiny country, they have the confidence to show the world that they can replicate all the gardens on earth (and even better than the originals). Moreover, despite a population of over 70% of ethnic Chinese, English is available to its people from all walks of life. It is simply mind-blowing. I hope we orthodontists can collectively start improving our ability in these three aspects, and they, I believe, will be the most powerful weapons along our path to glory.

Non-Extraction Treatment with Bite Turbo for Pseudo-Class III Malocclusion in Adult

Abstract

Introduction: *A 42-year-old female presented with chief complaints of protruded chin, crowded anterior teeth, and poor smile esthetics.*

Diagnosis: *Cephalometric analysis showed a skeletal Class III tendency (SNA, 80˚; SNB, 83˚; ANB, -1˚) with normal mandibular plane angle (SN-MP, 38˚). An intraoral assessment revealed end-on Class III malocclusion on the left side with anterior crossbite (UR1, UR2, and UL1), and the lower midline was deviated 0.5 mm to the right. Mild crowding was present in the upper and lower anterior dentition. The Discrepancy Index (DI) was 24.*

Treatment: *A Damon® system appliance with passive self-ligating brackets was applied to correct the dental malocclusion. Posterior and anterior bite turbos were used to correct the anterior crossbite. Interproximal reduction (IPR) was used to relieve crowding. Space closing and midline correction were also accomplished with elastics. The active treatment time was 18 months. The dentition was aligned, and all spaces created by IPR were closed.*

Results: *Retraction of the lower anterior segment and lower lip was achieved to improve the profile. After 18 months of active treatment, this pseudo-Class III malocclusion was corrected to an excellent Cast-Radiograph Evaluation (CRE) of 10 points and a Pink and White esthetic score of 6. No root resorption nor periodontal problems were noted.*

Conclusion: *This case report demonstrates the use of a passive self-ligating appliances to resolve pseudo-Class III malocclusion in an adult patient without the intervention of orthognathic surgery. (J Digital Orthod 2023;71:4-21)*

Key words:

Skeletal Class III, non-surgical treatment, anterior crossbite, torque selection, bite turbos, interproximal reduction

The dental nomenclature for this report is a modified Palmer notation with four oral quadrants: upper right (UR), upper left (UL), lower right (LR), and lower left (LL). From the midline, permanent teeth are numbered 1-8, e.g., a lower right first molar is LR6.

Introduction

Angle defined Class III malocclusion as an abnormal jaw relationship where all mandibular teeth occlude more mesially by the width of one bicuspid or more in normal occlusion.[1] The etiology of this condition is classified into three categories: functional, skeletal, and dental. Functional malocclusion is associated with abnormal tongue placement or neuromuscular conditions, while skeletal malocclusion occurs when the maxilla is underdeveloped and/or the mandible is overdeveloped. Dental malocclusion, on the other hand, is caused by ectopic palatal eruption of maxillary incisors or early loss of lower deciduous molars.[2] Class III malocclusions of dental origin often require a significant functional shift of the mandible to achieve posterior occlusion, which is why they are described as pseudo-Class III.[3] When the mandible position is closed and presented in centric relation (C_R), the incisors exhibit an end-to-end relationship,

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Resident, Beethoven Orthodontic Center (Center left)
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Publisher, Journal of Digital Orthodontics (Center right)
W. Eugene Roberts,
Editor-in-Chief, Journal of Digital Orthodontics (Right)

and molars are usually Class I. Pseudo-Class III patients with an acceptable, orthognathic profile in C_R usually have a good prognosis following conservative treatment to resolve the anterior crossbite.[3,4]

This case report documents the conservative management of an adult skeletal Class III malocclusion complicated with an anterior crossbite and deep bite (Fig. 1). Conservative camouflage treatment was the patient's preference.

Fig. 1: *Pre-treatment facial and intra-oral photographs in centric occlusion (C_O)*

Diagnosis and Etiology

A 42yr-4mo-old female presented for orthodontic consultation with chief complaints of anterior crossbite and crowding (Fig. 1). No contributing medical or dental histories were reported. The facial profile was slightly less convex than normal. The patient had an uneven smile, with the left side slightly higher (Fig. 1). The plaster casts revealed an anterior crossbite from UR2 to UL1 (Fig. 3). The overjet was -1 mm, and the overbite was 6 mm. Mild crowding (2 mm) was found in the mandibular arch. The occlusion revealed an asymmetrical molar relationship: Class I on the right and end-on Class III on the left (Fig. 3). The lower midline was shifted 1 mm to the right.

There were no signs nor symptoms of temporomandibular disorder (TMD). The panoramic radiograph showed the LL8 was impacted (Fig. 4).

The pre-treatment cephalometric radiographs and intraoral examination revealed: (1) an orthognathic profile in C_R position, (2) 3 mm anterior functional shift, and (3) anterior teeth were edge-to-edge in C_R (Fig. 2). The cephalometric analysis (Table 1) documented an ANB angle of -1˚, a SN-MP angle of 38˚, and lingually-tipped maxillary and mandibular incisors (U1-SN 93˚, L1-MP 75˚). The American Board of Orthodontic (ABO) Discrepancy Index (DI)[5] was 24 points (Worksheet 1). As suggested by Lin's 3-Ring Diagnosis, conservative treatment was feasible.

Treatment Objectives

1. Maintain the straight profile in C_R position.
2. Correct Class III malocclusion on the left side.
3. Correct the anterior crossbite.
4. Create an ideal overjet (OJ) and overbite (OB).

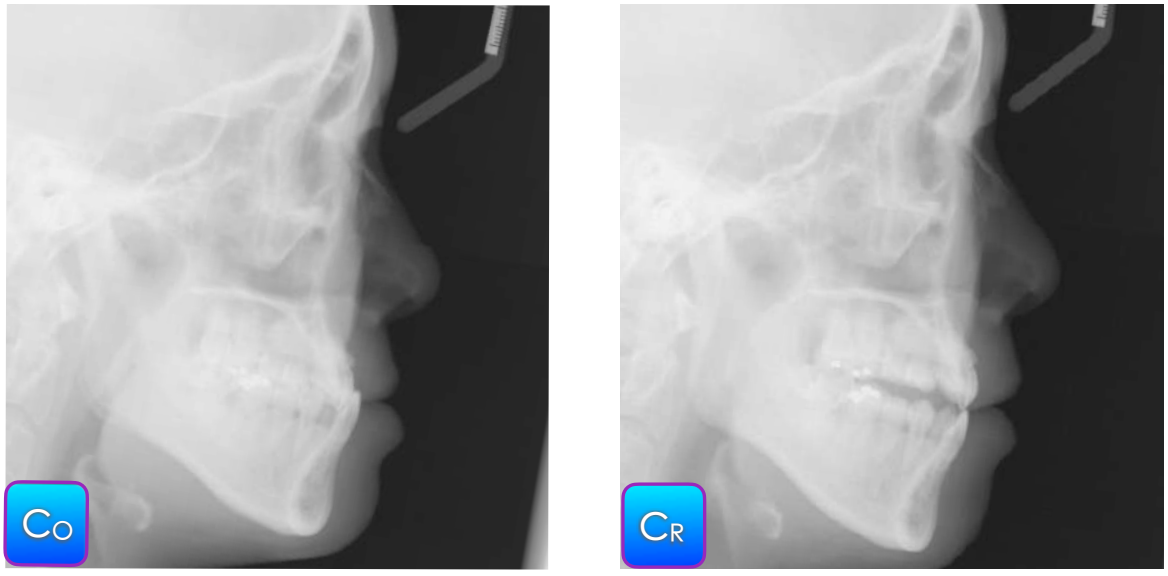

Fig. 2:
Pre-treatment cephalometric radiographs are compared in centric occlusion (C_O) and centric relation (C_R). In the C_R position, the incisors are in an end-to-end relationship, and the facial profile is acceptable.

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

Fig. 4: *Pre-treatment panoramic radiograph*

5. Increase the axial inclination of the maxillary incisors.

Treatment Plan

The plan for this camouflage treatment was to resolve the Class III relationship by retracting the lower arch and correcting the anterior crossbite. Extraction of LL8 and interproximal reduction (IPR) were scheduled to relieve the crowding and retract the lower lip. Anterior and posterior bite turbos were planned to assist with the correction, and Class III elastics would rectify the molar relationships.

Treatment Alternatives

Extraction of the four premolars is a viable approach to correct the anterior crossbite and relieve the crowding. The advantages of this option are a straighter facial profile and reduced time for relieving the crowding. However, the patient preferred a non-extraction option.

CEPHALOMETRIC SUMMARY			
	PRE-TX	POST-TX	DIFF.
SKELETAL ANALYSIS			
SNA° (82°±4)	80°	82°	2°
SNB° (80°±4)	81°	80°	1°
ANB° (2°±4)	-1°	1°	2°
SN-MP° (32°±6)	38°	40°	2°
FMA° (25°±6)	31°	33°	2°
DENTAL ANALYSIS			
U1 TO NA mm (4mm±3)	2.5	4	1.5
U1 TO SN° (104°±4)	93°	100°	7°
L1 TO NB mm (4mm±3)	4	2	2
L1 TO MP° (90°±4)	75°	74°	1°
FACIAL ANALYSIS			
E-LINE UL (-1mm±2)	-3	-2	1
E-LINE LL (0mm±2)	2	0	2
%FH: Na-ANS-Gn (53%±3)	55%	56%	1%
Convexity:G-Sn-Pg' (13°)	2°	7°	5°

Table 1: *Cephalometric summary*

Treatment Progress

A 0.022-in slot Damon Q® fixed appliance (Ormco, Glendora, CA) with passive self-ligating (PSL) brackets was selected along with all specified archwires and orthodontic auxiliaries.

Before active orthodontic treatment, the patient was referred to extract LL8. Two weeks later, Damon Q® 0.022-in PSL brackets (Ormco, Glendora, CA) were bonded on the lower teeth with a 0.014-in CuNiTi archwire engaged. Standard torque was selected for the brackets. At the same time, posterior bite turbos were bonded on LR6 and LL6 (Fig. 5).

After one month of aligning and leveling the lower arch, the upper dentition was also bonded with PSL brackets. Low torque brackets were used on the upper anterior teeth to counteract the side effects of Class III mechanics. At the same appointment, anterior bite turbos were constructed with flowable resin on the LR2, LR1, and LL1 to open the intermaxillary space for correction of the anterior crossbite after alignment of the lower incisors (Fig. 7).

Early light short Class III elastics (Quail, 3/16-in, 2 oz; Ormco) were used for 2 months to correct the anterior crossbite. In the 3rd month of treatment, the overjet and overbite were well improved, and thus the bite turbos were removed.

In the 5th month, both archwires were changed to 0.014x0.025-in NiTi. Class III elastics (Quail, 3/16-in, 2 oz; Ormco) were used bilaterally from U6s to L3s for four months to achieve Class I molar relationship.

In the 9th month, a panoramic film revealed that root parallelism could be improved (Fig. 6); therefore, the brackets on UR1, UR2, UR7, UL1, and LR5 were rebonded. At the same time, unilateral elastics (Fox, 1/4-in, 3.5-oz; Ormco) from UR3 to LR6 and LR7 were used to correct the midline discrepancy. In the 11th month, IPR was performed to reduce the black triangles (Fig. 8), and a power chain was stretched from LR6 to LL6 to facilitate space closure.

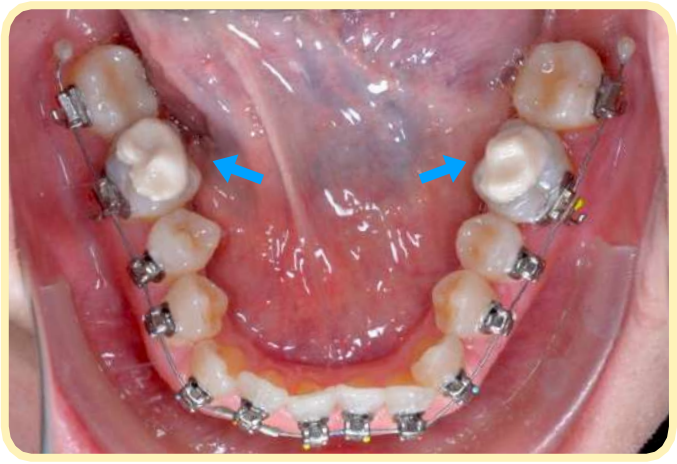

Fig. 5:
Posterior bite turbos (glass ionomer cement (GIC) II) (blue arrows) were bonded on the mandibular arch to open the bite.

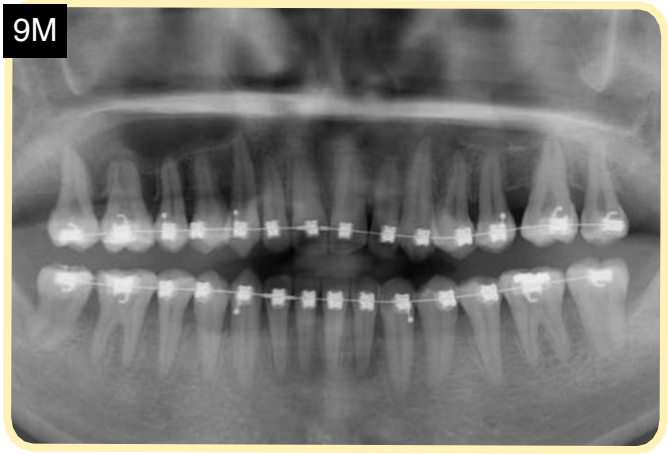

Fig. 6:
Panoramic film in the 9th month (9M) shows discrepancy in root parallelism.

Fig. 7:
Anterior bite turbos (flowable resin) were bonded on the LR2, LR1, and LL1 to open the bite. Early light short Class III elastics (Quail, 3/16-in, 2-oz; Ormco) were used to correct the anterior cross bite.

In the 12th month, the spaces were closed and the leveling and alignment was completed. Both archwires were changed to 0.016x0.025-in SS. In the 15th month, IPR was performed again to reduce the black triangles from LR2 to LL2. In the 17th month, the archwires on the posterior teeth were cut off, and short elastics were used to close the posterior open bite (Figs. 16 and 17). After 18 months of active treatment, all fixed appliances were removed, and fixed retainers were bonded on the lingual surfaces of all incisors in the maxillary arch, as well as from canine to canine in the mandibular arch. Upper and lower clear overlay retainers were delivered, with the posterior parts cut off to facilitate occlusal settling (Fig. 9).

Results Achieved

Facial esthetics and the anterior crossbite were significantly improved after 18 months of active treatment (Fig. 11). The molar relationships were corrected to Class I. The posttreatment panoramic radiograph documented acceptable root parallelism (Fig. 13). The superimposed cephalometric tracings

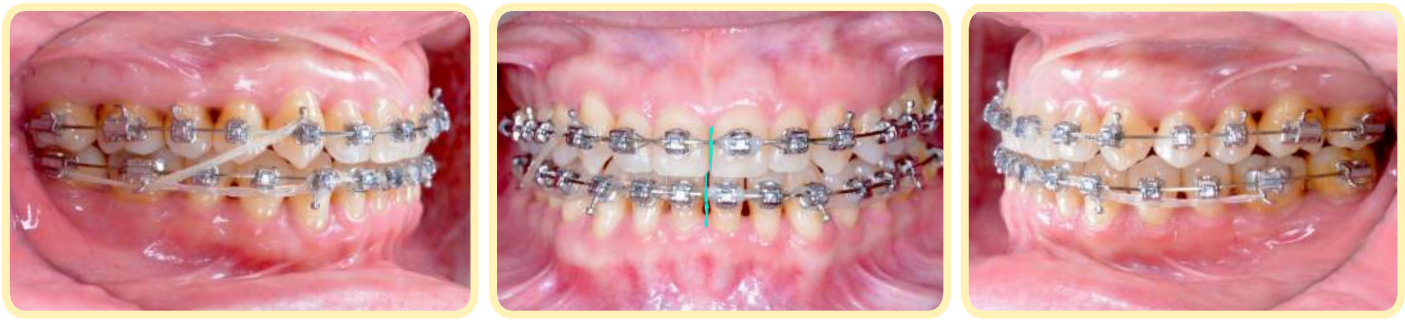

Fig. 8:
In the 11th month, a power chain was applied between LR6 and LL6 to close IPR spaces, and unilateral elastics (Fox, 1/4-in, 3.5-oz; Ormco) from UR3 to LR6 and LR7 were used to correct the midline deficiency.

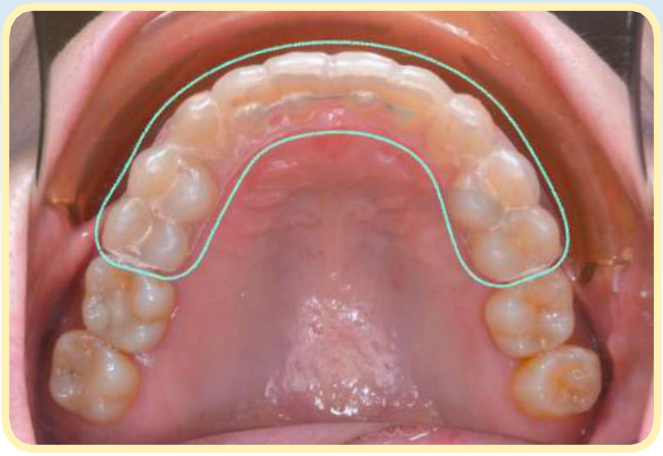

Fig. 9:
The clear overlay retainer on the molars was removed to facilitate occlusal settling.

showed proclined maxillary incisors (1.5 mm) as a result of anterior crossbite correction (Fig. 12). The axial inclination of the upper incisors (U1-SN) increased 7˚ after treatment (93˚ to 100˚), and the axial inclination of the lower incisors (L1-MP) was maintained (75˚ to 74˚). The lower lip was retruded following the retraction of the anterior segments. The mandibular plane angle (SN-MP) was well-maintained (Table 1). The Cast-Radiograph Evaluation (CRE)[6] score was 10 points, as shown in the supplementary Worksheet 2. The Pink and White dental esthetic score was 6 points (Worksheet 3).[7] The patient was pleased with the final results. The treatment was concluded in only 18 months without orthognathic surgery. Full treatment progress is documented in Figs. 15-18.

Retention

To prevent relapse of crowding, a fixed retainer was placed on the lingual surfaces from UR2 to UL2 and LR2 to LL2. Two ESSIX® overlay retainers (Dentsply Sirona, Harrisburg, PA) were provided to retain the leveling and alignment of the dentition. The patient was instructed to use the overlay retainers full time for the first month and only while sleeping thereafter.

Fig. 10:
Use Lin's 3-ring diagnosis to distinguish pseudo- from skeletal Class III malocclusions. The three diagnostic criteria in C_R are facial profile and ANB angle (left), a near Class I buccal occlusion in C_R (center), and functional shift $C_R \rightarrow C_O$ (right).

Fig. 11: Posttreatment facial and intraoral photographs

Discussion

In the treatment of Class III malocclusions, camouflage treatment is often challenging for orthodontists. The orthodontists need an accurate diagnosis and an appropriate treatment plan to achieve favorable non-surgical outcomes. Lin's 3-ring diagnosis is the most effective guide to distinguish pseudo- from true skeletal Class III malocclusions (Fig. 10).[8]

Profile

Most patients with pseudo-Class III malocclusion could perform a functional shift and have orthognathic facial profiles in C_R, even if their ANB angles exceed -2°. These patients tend to respond favorably to dentoalveolar treatment.

Classification

A positive prognostic indicator for conservative treatment is to check if the patient could achieve Class I occlusion in C_R.

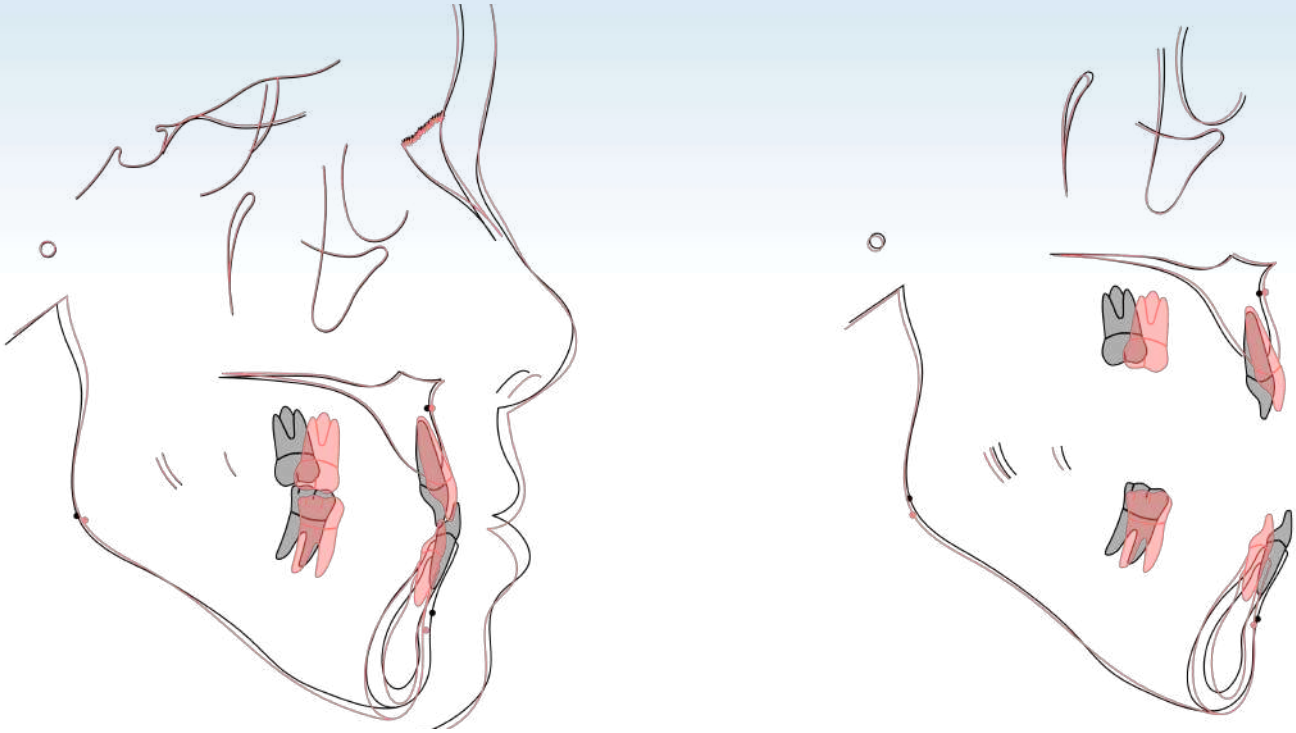

Fig. 12:
Superimposed cephalometric tracings (black: pre-treatment; red: posttreatment) show that the pre-treatment Class III molar relationship was corrected to Class I due to Class III elastic mechanics. Inevitable lingual tipping of the lower incisors occurred due to Class III mechanics; however, 1˚ is well acceptable.

Fig. 13:
Posttreatment panoramic radiograph. Note marginal ridge discrepancy between LL6 and LL7 was compromised.

Fig. 14: *Posttreatment cephalometric radiograph*

Functional Shift

The presence of occlusal interference is associated with the point of initial contact while lower incisors completing to C_O. Anterior incisors presenting $C_R \rightarrow C_O$ shift is another positive indicator for conservative treatment prognosis. Assessing the ANB angle on a cephalometric radiograph taken with the occlusion in C_R provides a more accurate evaluation of the skeletal issue. A Class III malocclusion with an anterior functional shift is more likely to respond positively to conservative therapy. In this case, patient's mandible had fully grown before treatment, and her orthognathic facial profile in C_R position implied a good prognosis with camouflage treatment; therefore, it could be considered a viable option (Fig. 10).

Deep Bite Correction and Anterior Crossbite

For the anterior crossbite correction, posterior bite turbos were placed on the occlusal surfaces of the mandibular molars to open the bite at the beginning of the treatment procedure (Fig. 5).[9] One month later, anterior inclined bite turbos were constructed with flowable resin to open the intermaxillary space for correcting the anterior crossbite, as well as improving the upper incisors. Once sufficient intermaxillary space was created, CuNiTi archwires worked efficiently to align and level the dentition without occlusal interference.[10]

Posterior Bite Turbos

Bite turbos, which are designed to help correct bite issues, can be positioned in the anterior or posterior segments of either arch. Nevertheless, certain limitations should be taken into account when considering this treatment option. Specifically, it is not advisable to place bite turbos on (1) weak teeth, such as upper lateral incisors, (2) teeth that have undergone endodontic treatment or have periodontal issues, (3) teeth with extensive restorations or temporary crowns, (4) isolated teeth that are subject to high stress, and (5) teeth that are intended to be moved as part of the overall treatment plan.[11]

The protocol for bite turbos was necessary to correct the anterior crossbite.[12] This is because these devices serve a number of important functions, including (1) avoidance of premature occlusal contact on brackets, (2) minimizing wear on the teeth, especially in patients who have parafunctional habits, (3) promoting arch development, and (4) creating the necessary interocclusal space for successful correction of the crossbite. By following a well-designed protocol for the placement and use of bite turbos, orthodontic professionals can help patients achieve improved dental function and esthetics, while minimizing the risk of complications and other adverse outcomes.[13]

Anterior Bite Turbos

When it comes to solving anterior crossbites, utilizing bite turbos on the lower incisors can be an effective treatment approach. Flowable resin is often the ideal material for constructing lower anterior bite turbos, as it allows for easy adjustment and manipulation to achieve the desired bite opening. Additionally, the vertical dimension of the bite turbo should be carefully

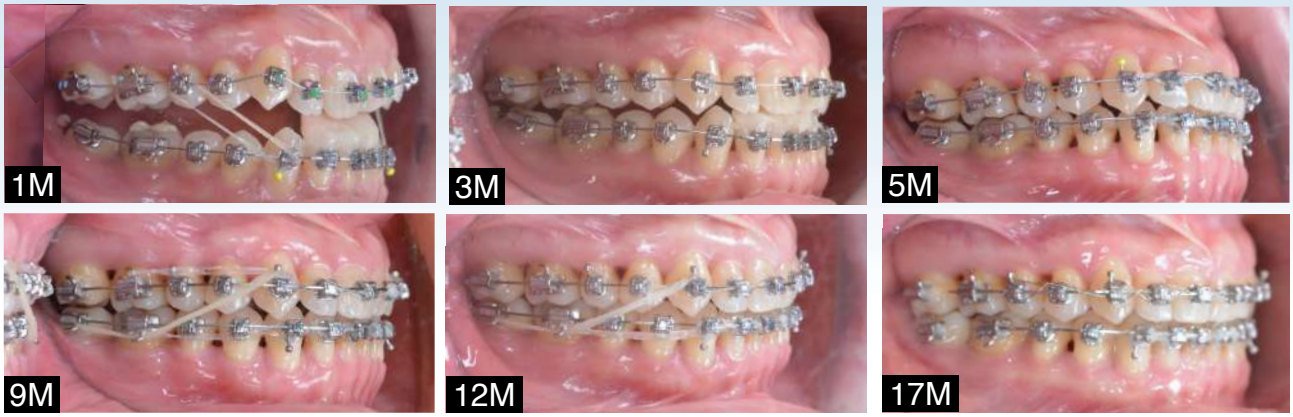

Fig. 15:
Treatment progression - right buccal view: anterior bite turbos were used to correct the anterior cross bite as shown in the first month (1M).

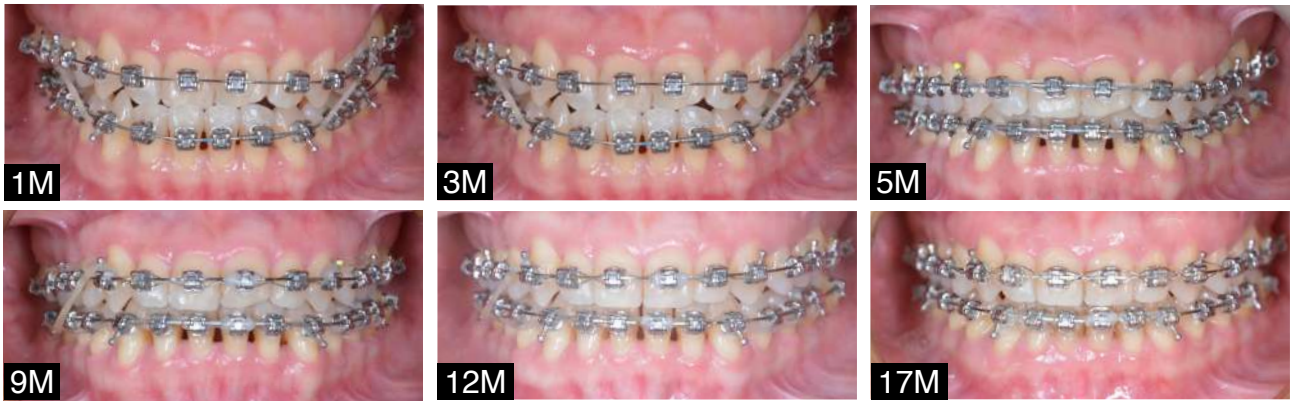

Fig. 16: *Treatment progression - frontal view: in the 11th and 15th months, IPR was performed to reduce the black triangles.*

Fig. 17:
Treatment progression - left buccal view: in the 17th month, the archwires on the posterior teeth were cut off (blue arrows), and early light short Class III elastics (Quail, 3/16-in, 2-oz; Ormco) were used to close the posterior open bite.

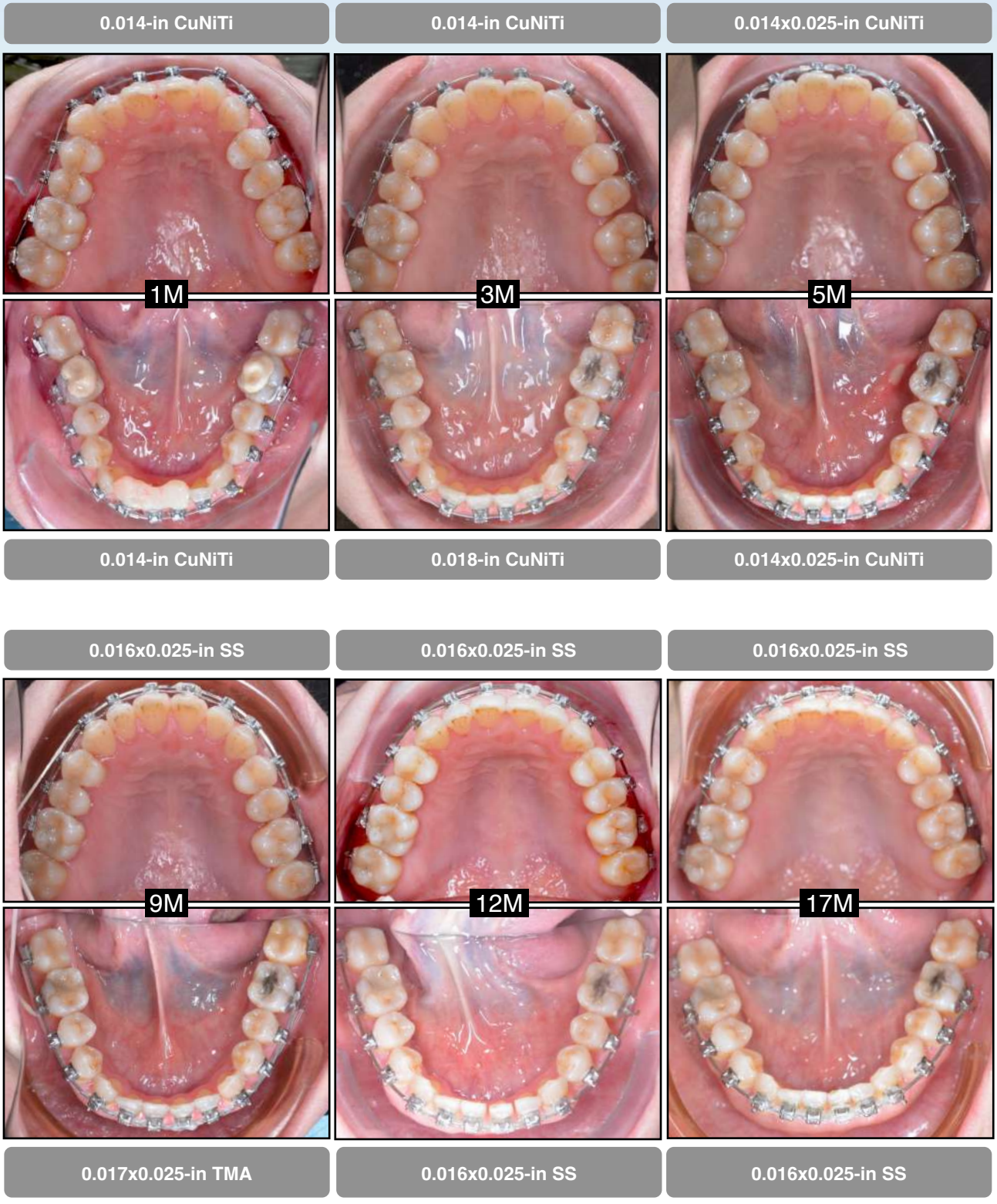

Fig. 18: Treatment progression - upper and lower occlusal views with archwire sizes specified in grey labels

Fig. 19:
This patient's UL1 was worn at the disto-incisal angle (left; green arrow), and was arranged to be repaired with composite resin after the crossbite was corrected (right; red arrow).

designed to open the intermaxillary space, ensuring proper occlusion and alignment during the active orthodontic treatment. By using anterior bite turbos in Class III situation, orthodontic professionals can help patients achieve improved dental function and esthetics.[14]

An anterior inclined bite turbo is a good treatment choice for the patients with:[15]

- retroclined maxillary anterior teeth with an anterior crossbite with or without functional shift,
- well-aligned mandibular anterior teeth without proclination,
- normal to deep overbite, and
- average to horizontal growth patterns.

Anterior inclined bite turbos are fixed onto lower anterior teeth with flowable resin. Appropriate angulation between the inclined plane and the upper anterior teeth should be determined by the vertical discrepancy between the maxillary and the mandibular arches. Most anterior dental crossbites can be corrected within 3–4 weeks using an inclined plane.[16]

When the occlusion is disoccluded, ensure the bite opening is bilateral and comfortable for the patient. In this case, the bite turbo opened the bite to accelerate the initial stage of the orthodontic treatment. At the same time, intermaxillary Class III elastics were used with the whole maxillary dentition acting as anchorage to retract the mandibular dentition. Only three months were required to correct the anterior crossbite with the bite turbos and Class III elastics acting together to level and align multiple teeth efficiently.

Tooth Attrition

Tooth attrition often accompanies an anterior crossbite, as the affected teeth are subject to wear from mandibular movement. If the correction of anterior crossbite fails then the teeth can result in

Fig. 20: *One-year (left), two-year (middle), and four-year follow-up photographs (right) show the occlusion was settled naturally (yellow arrows).*

continued attrition. Although this patient had worn disto-incisal angle on UL1, it was decided to delay restoration until the anterior crossbite was corrected (Fig. 19). This approach ensures that the restoration will not be subject to the same forces that caused the initial wear, leading to a more favorable long-term outcome.

Posterior open bite after active treatment

A posterior open bite (POB) is a dental condition characterized by the failure of one or more teeth in the posterior buccal segments to reach occlusion, while there is an incisal contact.[17] In this case, uprighting of the lingually inclined upper anteriors and correcting the anterior crossbite may change the position of the temporomandibular joint and the angle of the occlusal plane, which caused the posterior open bite.[18] The way to solve the POB after the treatment was to trim the upper clear retainer to uncover the posterior teeth that were not in occlusion (Figs. 9 and 20).

Conclusions

The successful treatment for challenging skeletal malocclusion was completed in only 18 months without orthognathic surgery. By using both anterior and posterior bite turbos combined with Class III elastics, the patient was treated to an acceptable result. One of the main issues after active treatment - the posterior open bite, was effectively resolved by trimming the posterior parts of the clear overlay retainer. However, to ensure the ongoing stability and maintenance of the occlusion, long-term follow-up was necessary. The use of clear retainer, coupled with careful monitoring every 6 months allowed for a successful outcome in this complex case.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 24

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 = 10

OVERBITE

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

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 = 2

CROWDING (only one arch)

1 - 3 mm.	=	1 pt.
3.1 - 5 mm.	=	2 pts.
5.1 - 7 mm.	=	4 pts.
> 7 mm.	=	7 pts.

Total = 1

OCCLUSION

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

Total = 2

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 = 6

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)	_____ x 1 pt.	=
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.	=
Addl. treatment complexities	_____ x 2 pts.	=

Identify:

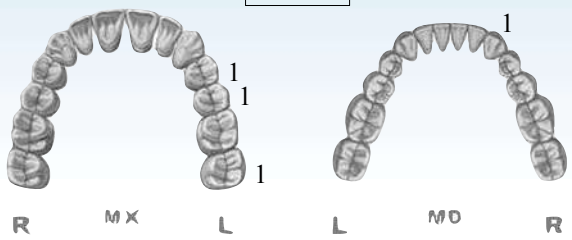
Total = 0

Cast-Radiograph Evaluation

Total Score: 10

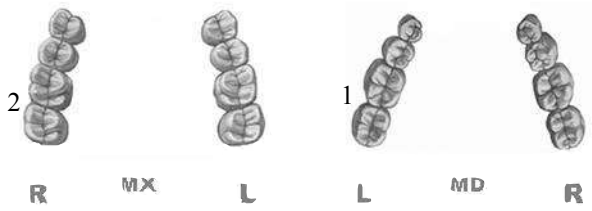
Alignment/Rotations

4



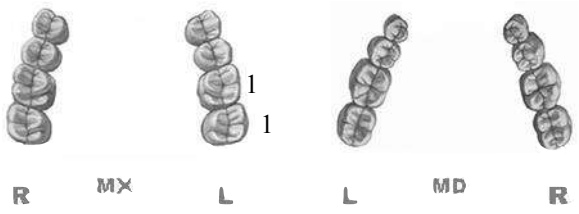
Marginal Ridges

3



Buccolingual Inclination

2

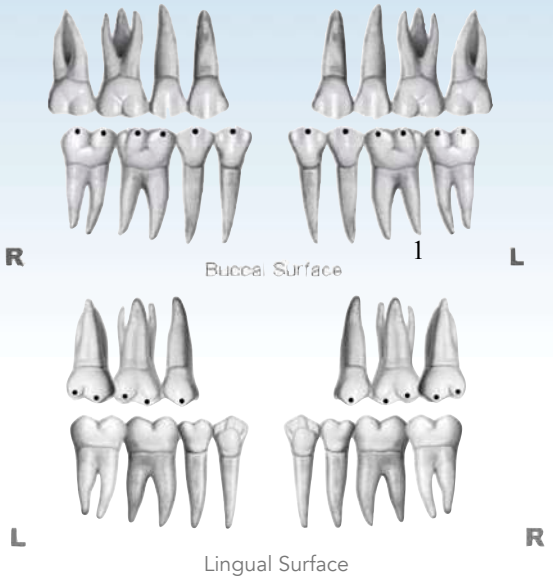


Overjet

0

Occlusal Contacts

1

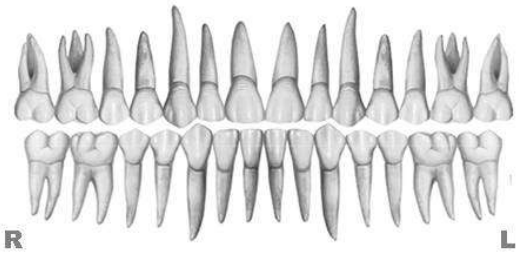


Occlusal Relationships

0

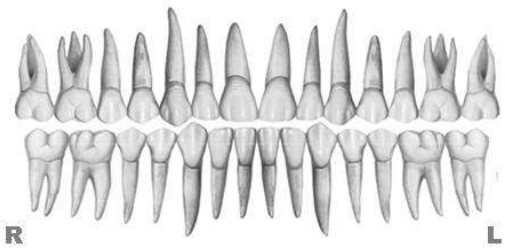
Interproximal Contacts

0



Root Angulation

0



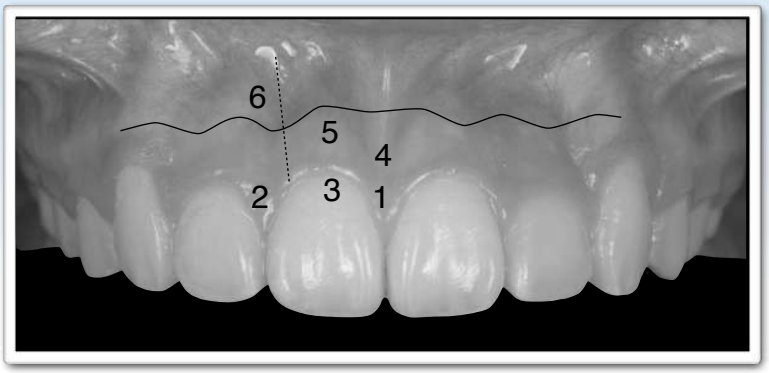
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink and White Esthetic Score

Total Score = 6

1. Pink Esthetic Score

Total = 2

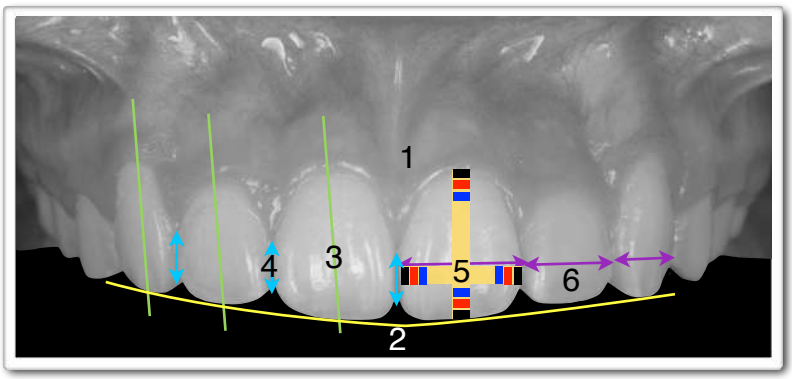


1. M and D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

1. M and 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

2. White Esthetic Score (for Micro-esthetic)

Total = 4



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	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	(0)	1	2
6. Tooth to Tooth Proportion	0	(1)	2

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Dr. Chris Chang

DDS, PhD. ABO certified, Angle Midwest member, director of Beethoven Orthodontic Center, Taiwan

Dr. Chang 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.

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Lecture topic: Screws & Aligners

DAY 3 **VISTA & 4 other minor surgeries for orthodontic practice**

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DAY 4 **Keynote workshop**

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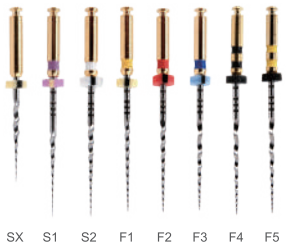

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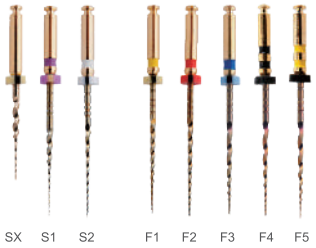

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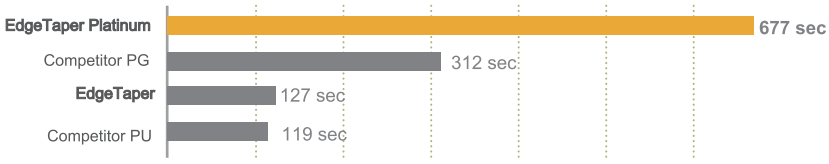

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F4	BLACK	ETF431
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SX19mm,S1,S2,F1,F2,& F3: 31MM	ETP31MM

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F2	RED	ETF225HT
F3	BLUE	ETF325HT
F4	BLACK	ETF425HT
F5	YELLOW	ETF525HT

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F1	YELLOW	ETF131HT
F2	RED	ETF231HT
F3	BLUE	ETF331HT
F4	BLACK	ETF431HT
F5	YELLOW	ETF531HT

Insertion Torque and Success of Extra-Alveolar Mandibular Buccal Shelf Miniscrews for Self-Ligation Mechanics

Abstract

Objectives: *1. To assess the correlation between insertion torque and the success rate of miniscrews inserted in mandibular buccal shelf (MBS) region, and 2. to evaluate the impact of the cortical bone thickness, length of endosseous engagement, insertion angle and surface angle on the insertion torque of MBS miniscrews.*

Material and Methods: *128 stainless steel (SS) 2x12-mm MBS miniscrews were placed bilaterally in 64 consecutive patients (24 males and 40 females; mean age 19.5±5 years) and loaded with 10-14 oz (283-397 g) immediately. Insertion torque values were compared between failure and success groups at an interval of six months. Cortical bone thickness, length of endosseous engagement, insertion angle, and surface angle were measured blindly through cone beam computed tomography (CBCT) images.*

Results: *The overall success rate was 89.1%. The insertion torque value was lower in the failure (16.1±7.0 Ncm), compared to the success group (20.1±6.3 Ncm). The success rate was directly related to torque values; however, the t test failed to show any statistical significance. Cortical bone thickness and insertion angle revealed significant positive correlations with insertion torque, but only on the left side. Length of endosseous engagement and surface angle had no significant effect on the insertion torque value.*

Conclusions: *MBS is a region with relatively dense bone quality, where a relatively high insertion torque of the miniscrew is guaranteed compared to inter-radicular miniscrews. Therefore, primary stability of MBS miniscrews is adequate for ensuring success as orthodontic anchorage units. (J Digital Orthod 2023;71:26-39)*

Key words:

Miniscrews, insertion torque, primary stability, success rate, extra-alveolar orthodontic anchorage, mandibular buccal shelf (MBS)

Introduction

By providing absolute anchorage with a predictable survival rate, orthodontic miniscrews have been constantly altering the strategies to treat challenging malocclusions over the past two decades.[1-4] In terms of insertion site, inter-radicular (I-R) placement is more common but risks and difficulties such as root damage,[5-7] displacement under loading,[8-10] and interferences with path of tooth movement are often encountered.[11,12] These problems are especially prominent in the posterior mandible, which leads to increasing failure rates reported by multiple reviews.[13-15] Therefore, miniscrews inserted in the mandibular buccal shelf (MBS) have been proven to be a reliable source of extra-alveolar (E-A) anchorage for retracting the entire mandibular arch to correct severe crowding, protrusion, and skeletal malocclusion without orthognathic surgery (Figs. 1 and 2).[16-18]

Lexie Y. Lin,
Resident, Beethoven Orthodontic Center (Left)
Chris H. Chang,
Founder, Beethoven Orthodontic Center
Publisher, Journal of Digital Orthodontics (Center)
W. Eugene Roberts,
Editor-in-Chief, Journal of Digital Orthodontics (Right)

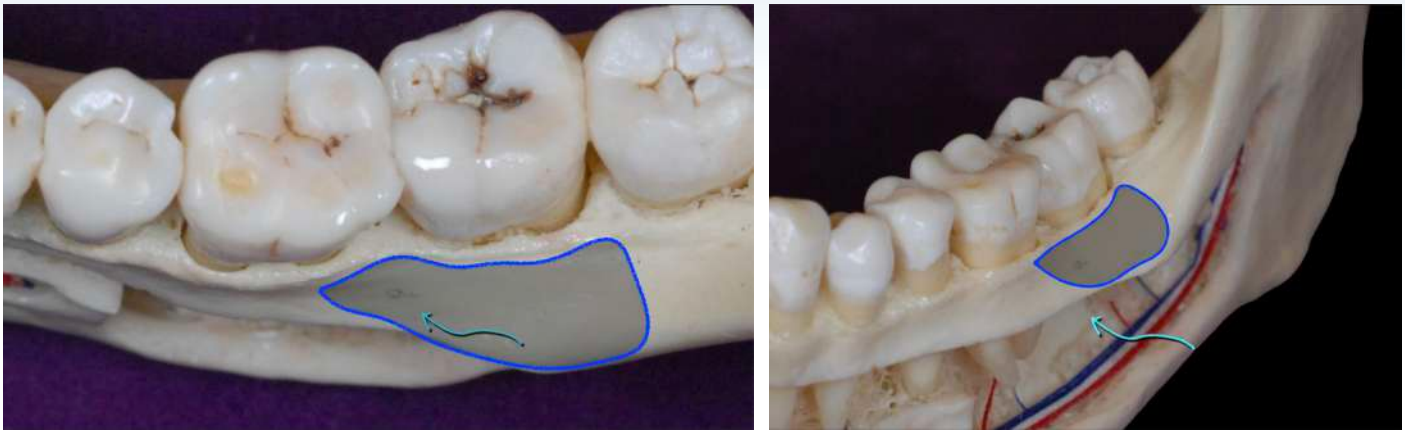

Fig. 1:
An occlusal view (left) and a lateral view (right) of a human mandible show the available area for mandibular buccal shelf miniscrew insertion.

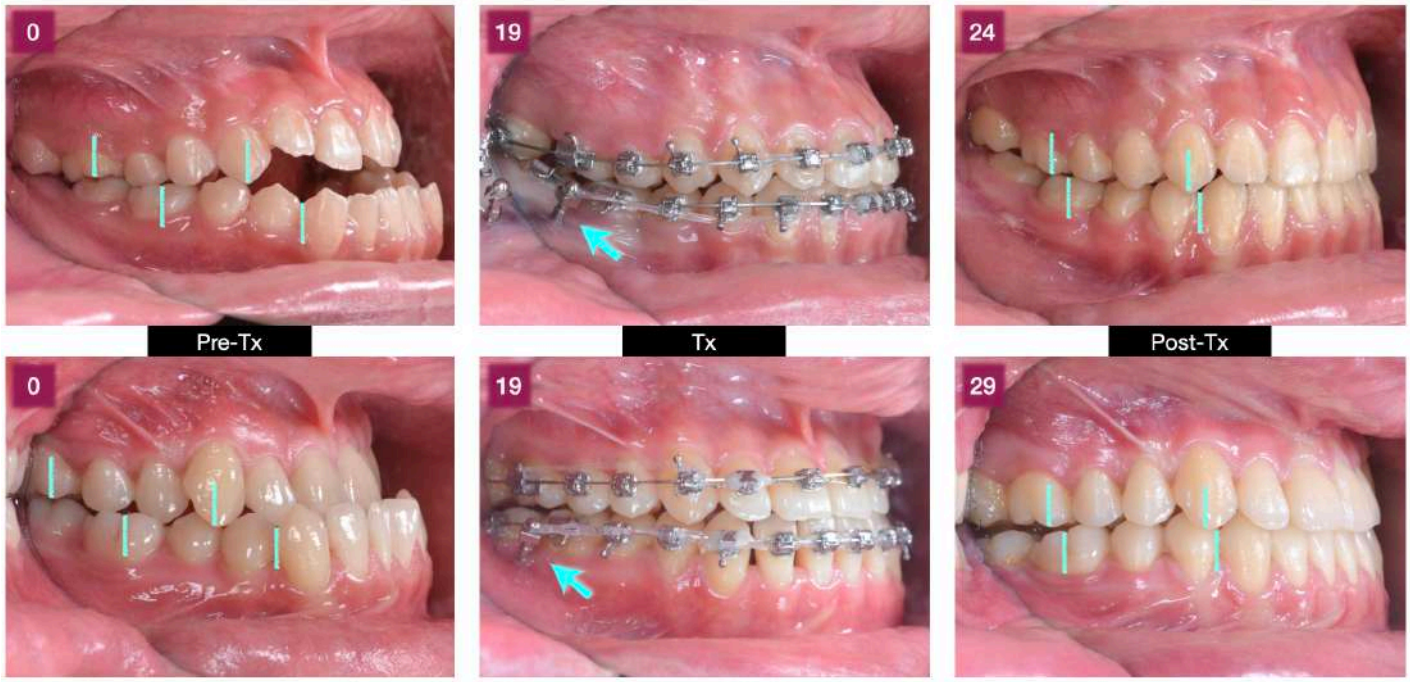

Fig. 2:
A panel of six right buccal intraoral photographs show the pre-treatment (Pre-tx), treatment (Tx), and post treatment (Post-Tx) records for two full-cusp Class III malocclusions (upper and lower panels) treated with MBS miniscrews for elastic chain anchorage (blue arrows). The months of treatment are marked in the upper left corner of each picture. The major mechanics provide both retraction and an intrusive moment on the posterior mandibular segment which are favorable in treating open bite cases.

Due to the demand of immediate loading, primary stability is of utmost importance.[14,19] Screw failure typically occurs in the first few weeks after placement, so the mechanical interlock of a miniscrew with bone is the critical factor for clinical success.[20] Attempts to improve the primary stability include smaller diameter pilot drills or self-drilling methods,[21-24] selection of sites with thicker cortical bone and denser trabecular bone,[25,26] and modified screw designs.[27-29] Among these reports,[21-29] insertion torque is the most frequently used non-invasive quantitative assessment of screw stability. The amount of insertion torque, which is the force to insert a miniscrew, mainly results from the frictional resistance between bone-screw contact.[30,31] 5 to 10 Ncm is generally the recommended range of torque values for I-R miniscrews.[9,31,32] Torque level beyond this range might indicate the existence of root contact and compromise the success.[33] However, the correlation between primary failure rate and insertion torque for E-A miniscrews remains unclear. Moreover, the factors influencing the magnitude of insertion torque in the MBS region have not been thoroughly explored.[11]

It is therefore necessary to understand at what levels torque strains remain physiologic and can guarantee the stability of these E-A miniscrews. The purposes of this study were to compare the primary stability of successful and dislodged groups of MBS miniscrews by using insertion torque measurements, and to explore the validity of a subjective assessment of primary stability through cone beam computed tomography (CBCT) images after miniscrew placement. It was hypothesized that the insertion torque under a certain level would lead to higher MBS miniscrew failure.[34] In addition, cortical bone thickness might be the most important overall factor to determine the insertion torque of MBS miniscrews.[26]

Material and Methods

This study was approved by the Indiana University institutional review board and ethics committee (approval No. 1408974880) in Indianapolis, United States. It is a follow-up of hard tissue research in comparison to the soft tissue research conducted by Chang et al. in 2015.[11] MBS miniscrews were installed in a consecutive series of 64 patients (24 males and 40 females; mean age 19.5±5 years), who were treated with Damon Q® passive self-ligating (PSL) brackets (Ormco Corporation, Brea, CA), and all agreed to take CBCT (KaVo 3D eXam plus, Germany) after the procedure in addition to cooperating with this study. A total of 128 OrthoBoneScrews® (iNewton, Inc., Hsinchu City, Taiwan) (Fig. 3) were placed bilaterally in the MBS area in a private practice by the same senior orthodontist from 2015 to 2018.

A cylinder-shaped 2x12-mm stainless steel (SS) miniscrew was placed as parallel as possible to the mandibular molar axis without raising a flap. The optimal position for MBS miniscrews is lateral to the lower first and second molar contact area, approximately 5-7 mm below the alveolar crest. After local anesthesia, a sharp dental explorer was used to sound to the bone in the preferred location, usually near the mucogingival junction. This dent helps to prevent slippage of the self-drilling miniscrew inserted with a screw driver. At least 5

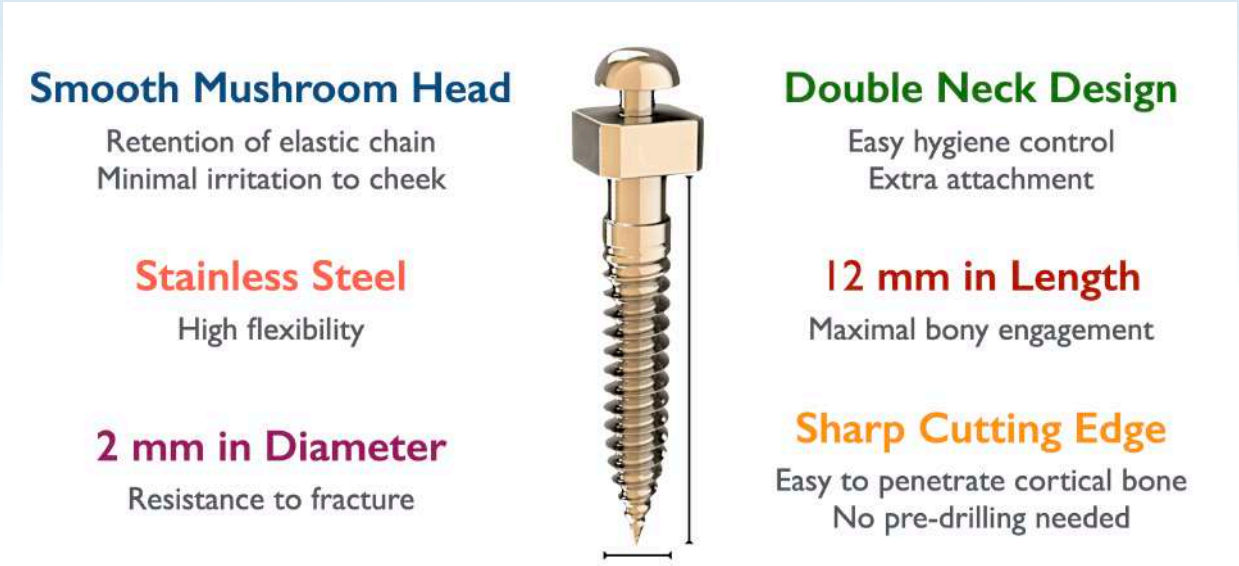

Fig. 3:
Design specifications for a 2x12-mm stainless steel miniscrew allow for a self-drilling procedure in the mandibular buccal shelf area.

mm of the screw head was left above the level of the soft tissue to facilitate oral hygiene. A strain-gauged manual torque wrench (iNewton, Inc., Hsinchu City, Taiwan) was used to measure the primary stability during the final tightening of the miniscrew. All miniscrews were immediately loaded using pre-stretched power chains (Ormco, Glendora, CA) to deliver a relatively uniform retraction force of approximately 10-14 oz (283-397 g), which were reactivated every 4 weeks.

These MBS miniscrews were checked at every monthly appointment for 6 months. The 6-month assessment interval was selected because primary stability decreases mostly during the first 6 month period after placement. Secondary stability would not overlap with primary stability, because the material of the miniscrew used in the study does not undergo osseointergration. Success is defined as the capability of sustaining the function of orthodontic anchorage, with the absence of inflammation and clinically detectable mobility; whereas the definition of failure is spontaneous loss, severe clinical mobility of the miniscrew requiring replacement, or infected, painful, pathological changes in the surrounding soft tissues. Finally, two of the co-authors were assigned to blindly and individually measure the statistics using CBCT slice view images to evaluate the placement protocol. Measurements including: 1. cortical bone thickness, 2. length of endosseous engagement, 3. insertion angle relative to the lower first molar axis, and 4. acute surface angle relative to the mandibular buccal shelf contour (Fig. 4). The t test were used to assess the measurements data. To explore the possible correlations between parameters, the Pearson correlation analysis were performed. Probability ($p<0.05$) was the minimum level of significance for all tests. The statistical analyses were

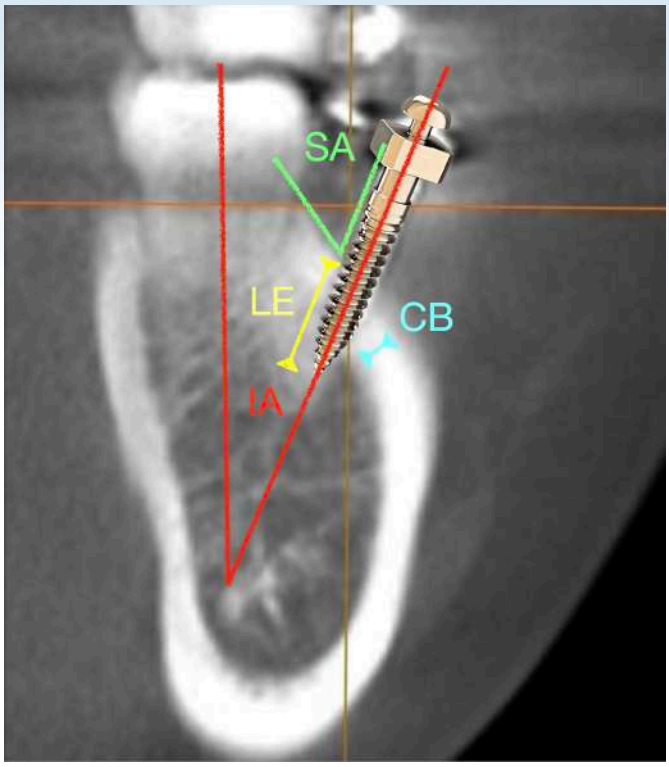

Fig. 4:
A CBCT slice view reveals the position of a MBS miniscrew. The cortical bone thickness (CB) and length of endosseous engagement (LE) were measured. The insertion angle (IA) is delineated between the MBS miniscrew and the mandibular first molar axis, while the surface angle (SA) is shown relating to the buccal shelf bone contour in an acute angle.

carried out with the SPSS statistical package (version 24.0, IBM).

Results

Retrospective analysis of the 128 MBS miniscrews revealed that 14 miniscrews (10.9%) failed within 6 months. Bending or fractures of the miniscrews was not observed in either group during placement. The mean insertion torque value of the failure group were 16.1±7.0 Ncm, while it was 20.1±6.3 Ncm for the success group. Although the success rates seemed to elevate with increasing torque values (Table 1), the t test failed to show any statistical significance on both sides between the groups ($p>.05$), so the hypothesis was rejected (Fig. 5).

On the other hand, Tables 2 and 3 show a positive association between insertion torque and cortical bone thickness (1.8±0.8 mm), but was only significant on the left side ($p<0.05$). The average length of endosseous engagement was 4.7±1.5 mm, and the insertion torque difference was insignificant ($p>.05$). However, there were interesting findings among other variables: the insertion angle showed a highly statistical significance to insertion torque on the left side ($p<0.01$), but not on the right side ($p>0.05$); the surface angle measurements were basically symmetrical in each patient, even though there was a wide range of buccal shelf slopes. It can be inferred from this data that a right-handed practitioner inevitably tends to place miniscrews in different angles bilaterally. The 14 failed miniscrews were collected from a total of only 8 patients. The bilateral failure suggests there may be other factors, such as genetic predispositioin, age or oral hygiene, which have a greater impact on the MBS miniscrew failure than primary stability.

Discussion

The present study is the preliminary research seeking to define the importance of insertion torque to the success of MBS miniscrews, although its relevance to placement specifications should not be overlooked. A major finding was a lack of

Table 1. Success Rates According to Different Insertion Torque Values

Insertion torque (Ncm)	Success	Failure	n	Success rate (%)	*p*
=< 7	4	2	6	66.7%	0.193
8 t0 14	14	3	17	82.4%	
15 to 21	44	5	49	89.8%	
>= 22	52	4	56	92.8%	
Total	114	14	128	89.1%	

Table 1: Success rates of miniscrews according to different insertion torque values

Table 2. Means and Standard Deviations of Bone Morphologic Features

	Right		Left	
	Mean	SD	Mean	SD
Cortical bone thickness (mm)	1.82	0.81	1.80	0.86
Length of engagement (mm)	4.56	1.41	4.94	1.57
Insertion angle (°)	36.89	9.74	33.32	10.36
Surface angle (°)	60.78	12.16	57.68	16.11

Table 2: Means and standard deviations of bone morphologic features

Table 3. Correlations between Bone Morphologic Features and Insertion Torque Value

	Pearson correlation coefficient	
	Right	Left
Cortical bone thickness (mm)	0.165	0.268*
Length of engagement (mm)	-0.041	-0.061
Insertion angle (°)	-0.044	0.336**
Surface angle (°)	-0.044	0.194

* $p < .05$ ** $p < .01$

Table 2: Correlations between bone morphologic features and insertion torque value

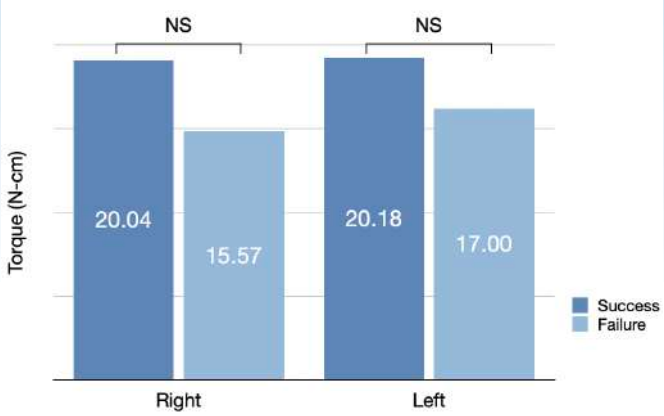

Fig. 5:
There was a tendency for higher mean insertion torque in the success groups on both sides, but the differences were not statistically significant.

significant difference between the insertion torques of the successful and the dislodged groups on either side (Fig. 5). The result indicates that, within the restraints of this study, less primary stability does not appear to be a decisive factor for MBS miniscrew failure. It can be reasoned that the posterior mandibular bone quality, quantity, and geometry result in the MBS being a favorable site selection to provide sufficient stability for the miniscrews. However, oral hygiene control remains an important contributing factor towards MBS miniscrew success, since soft tissue inflammation was the most common reason for the removal of MBS miniscrews.

These findings are not in contradiction to those of other empirical studies, although there are certain important differences regarding other aspects. It is generally recommended to control the insertion torque within the range of 5-10 Ncm for I-R miniscrews.[31,32] As reported by McManus et al.,[9] the mean resistance to movement for miniscrews with a placement torque >5 Ncm was significantly greater than for screws with a placement torque <5 Ncm. A related issue concerns higher insertion torque value indicated for miniscrews with root contact than for those without.[33] The adverse effects refer to orthodontic tooth movement and the survival of miniscrews could be expected if the screw-to-root contact had existed. E-A concept is best achieved by firmly seating screws for intraoral anchorage in basilar bone.[35]

The E-A concept can be mainly divided into two applications: infra-zygomatic crest and buccal shelf placement. A recent study shows that the critical insertion torque for miniscrews inserted in the infra-zygomatic crest (posterior maxilla region) is around 8 Ncm.[36] Previous research has indicated that functional demands on the mandible could result in its developing thicker cortical bone and higher bone density when compared to the maxilla.[9] Therefore, it would be intuitive to expect a greater mean insertion torque for miniscrews placed in the posterior mandible region. In the samples used in this study, due to the fact that a MBS miniscrew with an insertion torque below 8 Ncm is relatively rare (<5%), the finding lends some credence to the explanation of why the critical torque range for MBS miniscrew success cannot be defined. It might be speculated that almost all MBS miniscrews could be placed within the safe torque zone because their predominant position is where the compact alveolar bone exists.

A surprising finding was that the cortical bone thickness was not coherently significantly correlated with the miniscrew insertion torque value. The authors suggest that, unlike many inert materials, bone is not homogeneous, and cortical bone thickness does not reflect bone density or quality.[9] Even though the success rates seemed to be obviously related to the cortical bone thickness in previous observational studies, such as Motoyoshi[37] and Liu et al.,[38-40] it is now hypothesized that cortical bone thicker than 1.0 mm does not necessarily improve the insertion torque value and success rate. The same explanation could also be applied to the absence of significant correlation between the length of endosseous engagement and insertion torque.[39] With regard to the surface angle, our findings echo those of Wilmes[41] and show that the higher torque values were measured when the miniscrews were inserted slightly obliquely at an angle between 60° to 70°. As presented, the insertion angle on the left side was the parameter which showed a highly statistically significant difference in the insertion torque, which might also lead to the marginal statistical significance of the cortical bone thickness on the same side, since different angles would result in different bone thickness engaged.[42] Thus, the better performance on the right side seems to be indicative of the fact that the practice of insertion angle control on the left side could be rectified with a slight increase.

The present study contributes to the field's understanding of the reliability of MBS miniscrew for its good primary stability and high success rate (89.1%). Most people's common impression is that miniscrews inserted into the posterior mandible tend to suffer more failures (16.5-33.3%) than those inserted in the maxilla (6.6-17.2%);[43-46] however, the findings in the present data provide empirical evidence to clarify the "myth". By changing the location from the I-R space to the buccal shelf, one of the major risk factors contributing to the failure of miniscrews - root contact - is ruled out.[47] Moreover, assuming there is adequate soft tissue clearance (approximately 5 mm), miniscrews can be positioned in the attached gingiva or movable mucosa with equal success.[11] Higher insertion torque can be constantly achieved without undue concern about the patient's cortical thickness or the practitioner's clinical skills in the MBS region. Therefore, if oral hygiene and soft tissue inflammation are well managed, practitioners can expect minimal MBS miniscrew failure.[48,49]

Despite demonstrating advantages of MBS miniscrews, the present study does have some limitations. First, not everyone is comfortable using miniscrews as intraoral anchorages.[50-52] This "knowledge to action" gap severely limits MBS miniscrew usefulness in clinical research.[53,54] Particularly challenging is the lack of awareness to differentiate between I-R and E-A TSADs.[17] Furthermore, when learning to use MBS miniscrews, both insertion technique and clinical effectiveness requires a serious time investment.[55] The problem is compounded by the fact that relatively few specialists can actually apply MBS miniscrews

well, making it more difficult for novices to find someone to ask for constructive advice.

This kind of instruction is still very much in the early adoption stage and deserves future investigations. Much more is needed about the various ways clinicians use MBS miniscrews, which could further strengthen the case for placing miniscrews in the MBS. The previous publication by Chang et al.[11] in 2015 and this retrospective study provide qualitative soft as well as hard tissue basis for subsequent research. It is hoped that future studies will yield additional data to improve our understanding of the clinical capacity of MBS miniscrews with different orthodontic appliances, e.g., clear aligners.

Conclusions

- High insertion torque can be achieved for most of the miniscrews placed in the mandibular buccal shelf region. There is no significant torque difference between the success and failure groups. Therefore, the adequate primary stability allows immediate loading of up to 300 g with a good rate of clinical success.

- There is no significant correlation between insertion torque and cortical bone thickness or the length of endosseous engagement.

- To achieve a higher insertion torque, a surface angle ranging from 60° to 70° is advisable; while the insertion angle relative to the lower molar's axis is suggested to be controlled at around 35°, especially on the left side for a right-handed practitioner.

- The risk of root contact is eliminated by extra-alveolar placement. If primary stability is well controlled, the clinical challenge is to minimize miniscrew failure by proper oral hygiene management.

Clinical Applications

- Class III camouflage treatment (Fig. 2): Class III with anterior cross-bite, and/or severe open bite may require extensive orthognathic surgery. Patients and parents concerned about expense and complications may request an alternate approach. Conventional alternatives including extractions and/or extensive inter-maxillary elastics may still undergo challenging processes and result in compromised outcomes. On the other hand, MBS miniscrews are effective for managing severe skeletal and Class III malocclusions. Rather than extracting teeth, E-A anchorage corrects crowding by retraction of buccal segments to increase arch length. At the same time, it minimizes the use of inter-maxillary elastics and decreases the iatrogenic incisor tipping.

- Recovery of mandibular impacted teeth (Fig. 6): When discovering an impacted tooth, if spontaneous eruption is not achieved in a timely manner by correcting the perceived cause, orthodontic guidance and/or surgical intervention may be indicated. In general, the recovery of impactions is a challenging problem with longterm ramifications. The use of the 3D lever arm, anchored by a MBS miniscrew, is particularly useful for dealing with severely impacted teeth. The SS lever arm can be adjusted

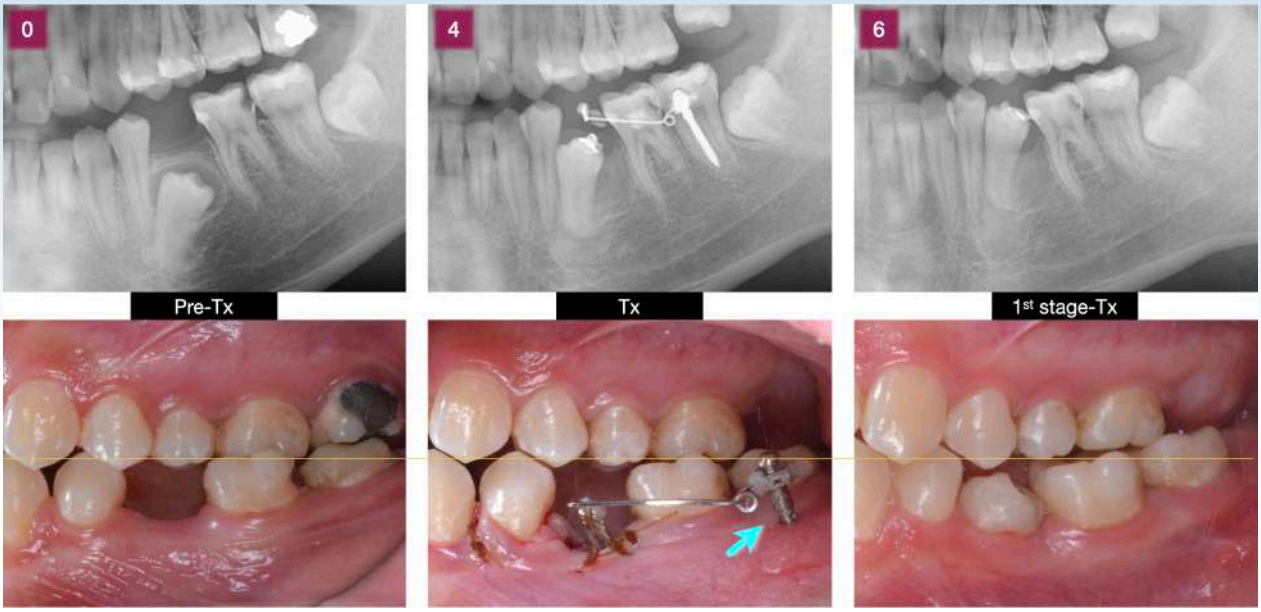

Fig. 6:
A six-image panel of clinical radiographs (upper) and photographs (lower) is divided into three columns marked with the months in treatment in the upper left area. Pre-Tx (0mo), Tx (4mo), and completion of first stage treatment (1st stage-Tx, 6mo). Alignment and finishing is accomplished with clear aligner therapy. The center panel shows the active mechanics for recovery of the impacted second premolar with a dilacerated root. Surgical removal of the impaction risks nerve damage, so orthodontic recovery with a MBS bone screw (blue arrow) anchored lever arm (0.019x0.025 SS wire) is an attractive option.

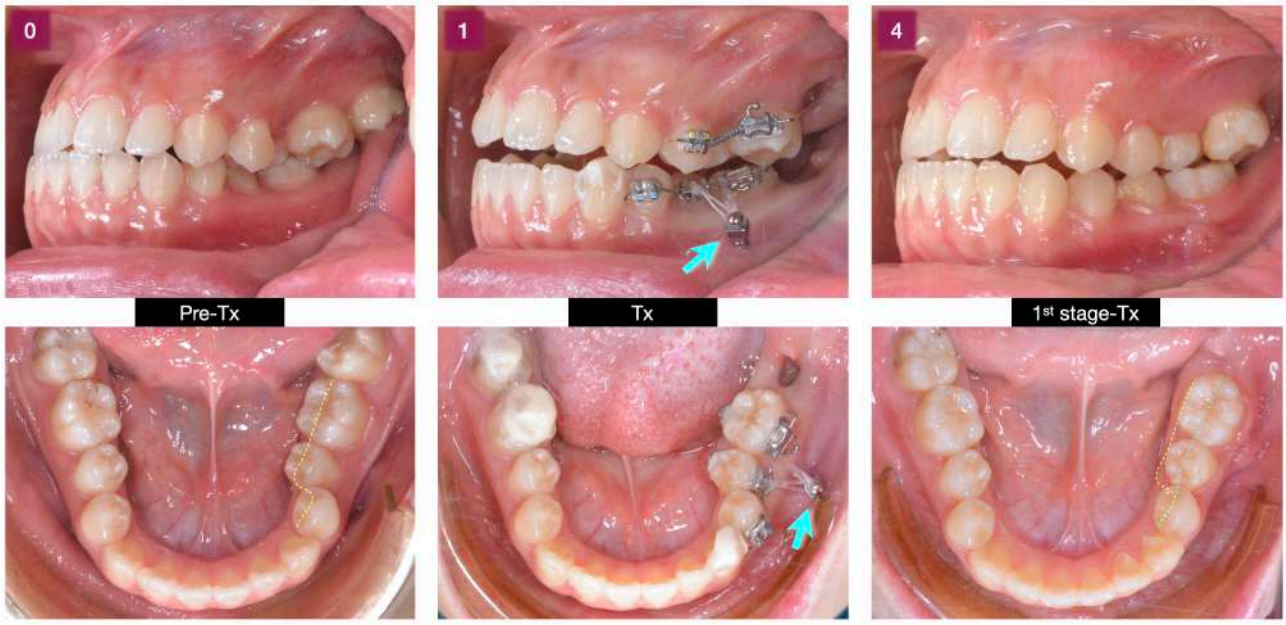

Fig. 7:
The correction of a full buccal cross-bite of the upper left first molar (UL6) is shown in a panel of six intraoral photographs. The month of treatment is marked in the upper left of each column depicting the Pre-Tx (0mo), Tx (1mo), and end of first stage treatment (4mo). The upper panel is a series of progressive left buccal views, and the lower panel is a corresponding series of lower occlusal photographs. The mechanics shown in the Tx column are occlusal bite turbos on the lower left first and second molars, and the elastics from the lower left second premolar and first molar are anchored with a MBS bone screw (blue arrows). The intermaxillary occlusion will be finished with clear aligner therapy.

for sequential movement in all planes of space without disturbing adjacent teeth

- Correction of lingually collapsed buccal segments (Fig. 7): Efficient treatment of full buccal cross-bite for an entire posterior segment (unilateral or bilateral) usually requires orthognathic surgery, bite-plates (turbos) and/or extensive use of TSADs in both arches. The preferred alternative for managing a unilateral scissors-bite is to reverse the etiology of excessive extrusion by opening the bite on the contralateral side with a glass ionomer bite turbo, then intruding and uprighting the teeth in crossbite with elastic modules anchored by a MBS miniscrew.

Acknowledgement

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Surgical Procedures, Mechanics, and Problems in Recovering 51 Impacted Maxillary Canines for 46 Patients with the OBS-3D Lever Arm Appliance

Abstract

Objective: *Assess recovery for consecutive impacted maxillary canines (I-U3s).*

Materials and Methods: *Based on three-dimensional (3D) imaging, 51 I-U3s were recovered from 46 patients: 11 male, 35 female, mean age 16.5 years (range 10-36 yr). Orthodontics prepared a path for movement of the I-U3s as needed. Minimally invasive surgery uncovered the I-U3s and removed bone to the level of CEJ. 3D anchorage was provided with a 2 mm diameter stainless steel (SS) OrthoBoneScrew® (OBS). A rectangular slot secured a custom SS wire segment (OBS-3D lever arm) to align the I-U3.*

Results: *Impaction locations were according to side (22 right, 29 left), and surface (32 labial, 19 palatal). I-U3s were optimally aligned in an average of 11.7 months (M), but six more severe labial impactions required up to 17M, and six complete transpositions required 27-30M. Moderate root resorption (<2 mm) on the adjacent lateral incisor was noted for four I-U3s (3 labial, 1 lingual). Gingival recession affected 19 recovered canines (11 labial, 8 palatal); all were moderate (Miller Class I) except for one severe problem (Miller Class III).*

Conclusions: *The OBS-3D lever arm is a biomechanic system that enhances the probability of success by controlling treatment duration and complications. Root resorption on adjacent lateral incisors is best avoided by not bonding a bracket on them during the recovery process. (Reprint from J Digital Orthod 2020;59:24-33) (J Digital Orthod 2023;71:46-55)*

Keywords:
Maxillary canine, impaction, transposition, bone screw, 3D lever arm, gingival recession, root resorption

Introduction

Dental nomenclature for this report is a modified Palmer notation, i.e. quadrants are upper right (UR), upper left (UL), lower right (LR) and lower left (LL), and permanent teeth in each quadrant are numbered 1 to 8 from the midline. In 1975, Archer[1] defined an impacted tooth as completely or partially unerupted with an unfavorable position relative to an obstacle (tooth, bone, or soft tissue) that probably prevented eruption. With the exception of third molars, maxillary permanent canines (U3s) are the most common impactions. There is a variable prevalence among ethnic groups from 0.27% in Japanese[2] to as much as 2.4% in Italians.[3] Females are 2-3 times more frequently affected than males.[3-6] Early diagnosis and treatment is recommended to avoid severe displacement and complete transposition.[5,6] Abnormal position and/or lack of a canine eminence between age 8-10 years are early signs of potential impaction.[7]

Closed eruption and an apically positioned flap are viable approaches,[5,6] but using an archwire as anchorage can result in distortion of the arch,

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particularly if the canine is or becomes ankylosed.[8] A stainless steel (SS) endosseous OrthoBoneScrew® (OBS) (*i*Newton, Inc., Hsinchu City, Taiwan) has a rectangular hole (tube) to receive a 0.019x0.025-in SS wire (OBS 3D lever-arm) (Fig. 1). The purpose of this study was to assess the OBS 3D lever arm appliance relative to treatment time, success rate, and complications for a consecutive series of impacted upper canines (I-U3s).

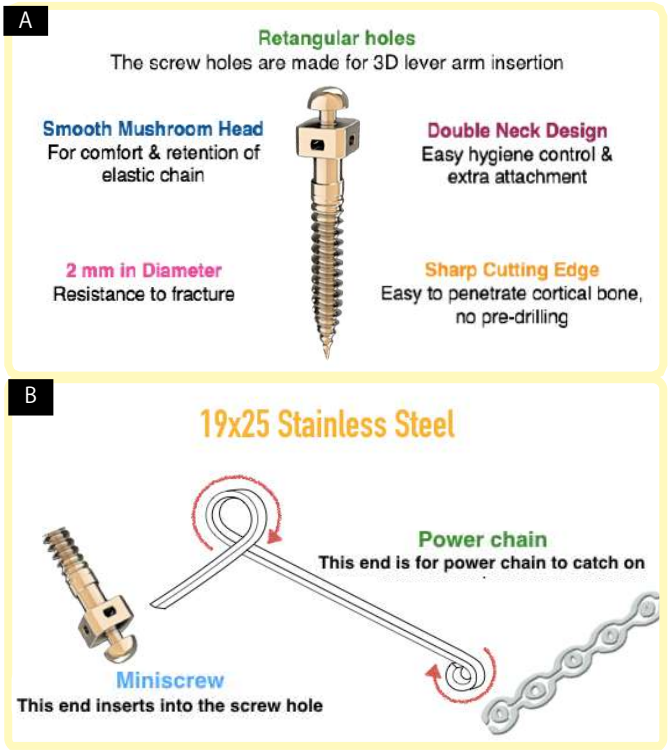

Fig. 1:
A. A 2x14-mm SS bone screw has a rectangular hole (tube) designed to insert a 3D lever arm.
B. A 3D lever arm is formed from a 0.019x0.025-in SS wire as shown.

Material and Methods

The Institutional Review Board (IRB) of Taiwan Medical Research Ethics Foundation (protocol number: MIC1/19-S-004-1) approved this retrospective study that resulted in 46 consecutive patients with 51 I-U3s. They were treated from 2013-2016 and were all evaluated with cone-beam computed tomography (CBCT) (Fig. 2). The OBS 3D lever arm appliance (Fig. 3) was used for all

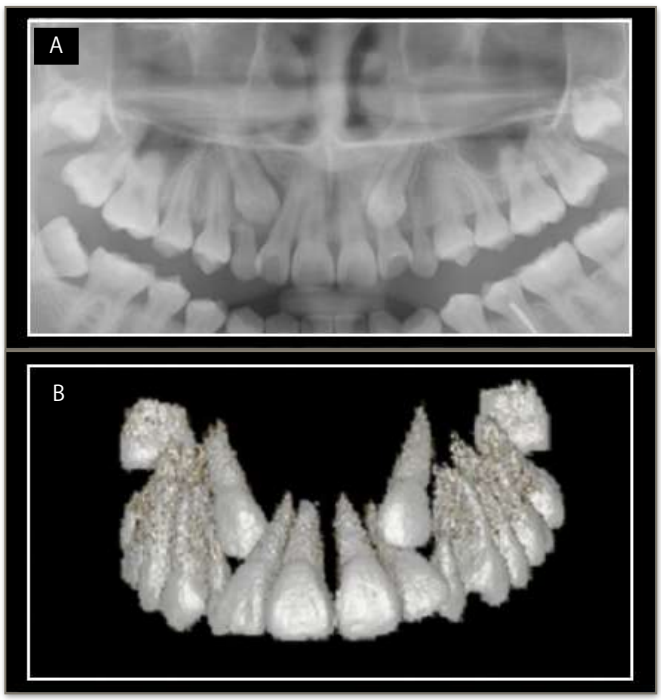

Fig. 2:
A. A panoramic radiograph is a 2D image that is unreliable for determining the relationship of impactions to the roots of adjacent teeth.
B. A CBCT image shows important details in 3D for locating, uncovering, and applying mechanics to recover I-U3s.

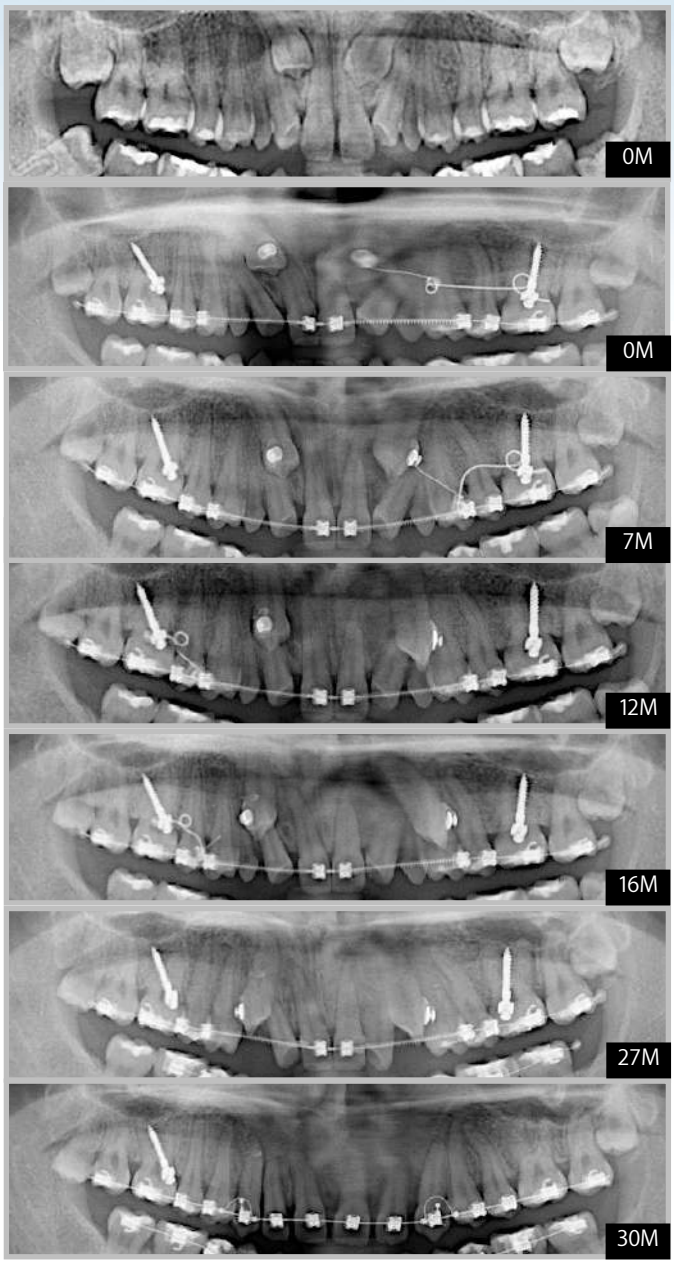

Fig. 3:
A vertical panel of progressive panoramic radiographs documents the recovery of I-U3s from the upper pretreatment image (0M) and the immediate post-operative view (second 0M) to the completion of active treatment at thirty months (30M). Note there are no brackets bonded on the maxillary lateral incisors until after 27 months (27M) to avoid root resorption. See text for details.

patients, but the surgical exposure varied depending on the location and orientation of the impaction. Pretreatment consultation included a thorough discussion of potential problems such as swelling, temporary facial disfigurement (Fig. 4), and root resorption (Fig. 5).

Palatal impactions were managed conventionally,[6] but labial impactions were exposed with the vertical incision subperiosteal tunnel access (VISTA).[9] The crown of an endosseous I-U3 was located with a surgical explorer.[10] After the crown was exposed, an eyelet was bonded at least 2 mm occlusal to the cementoenamel junction (CEJ),[11] and all overlying bone was carefully removed to the level of the CEJ (Fig. 6).[12] At the planned location on the infra-zygomatic crest (IZC), a 2x14-mm OBS was installed with the desired orientation of the rectangular tube (Figs. 1B and 3). The custom lever

Fig. 4:
A. A postoperative complication is shown after a complex surgical intervention to initiate recovery of a transposed I-U3. Note the lip, cheek, and orbital swelling with discoloration one week post-operatively. No additional treatment was indicated.
B. One week later, the complications were almost resolved.

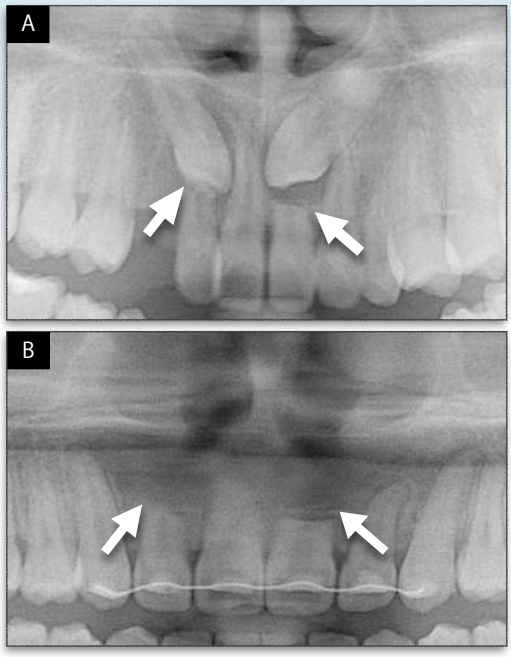

Fig. 5:
A. Pre-treatment radiography shows that I-U3s are associated with extensive root resorption (white arrows) on the UR2 and UL1.
B. Posttreatment radiography reveals that the root resorption is arrested but the loss of root structure is permanent (white arrows).

arm was activated in the prepared plane[13] with a power chain from the impaction to the distal end of the 3D lever arm and both ends were retained with polymerized resin. After activation, the soft tissue flap was closed, and a post-operative panoramic radiograph was exposed (Fig. 3). Details for the surgical and mechanical procedures are published.[14-17] All clinical procedures for the current sample were performed by the senior author.

Results

From 2013-2016, 46 consecutive patients (11 male, 35 female, mean age 16.5yr, range 10-36yr) presented with 51 impacted maxillary canines: 41 unilateral, 5 bilateral; 22 right side, 29 left side; and 32 labial, 19 palatal. Surgery was uneventful for all patients except one who sustained facial bruises and swelling that resolved in 7 days (Fig. 4). All 51 I-U3s were successfully recovered and optimally aligned in occlusion. Treatment time after the initial alignment of the I-U3 was a mean of 11.7M (Fig. 7), but the more difficult problems like labial impactions with complete transposition required up to 37M of comprehensive treatment. Four I-U3 patients (3 labial, 1 palatal) experienced mild root resorption (<2 mm) on the adjacent lateral incisor. Gingival recession occurred on 19 canines, (11 labial

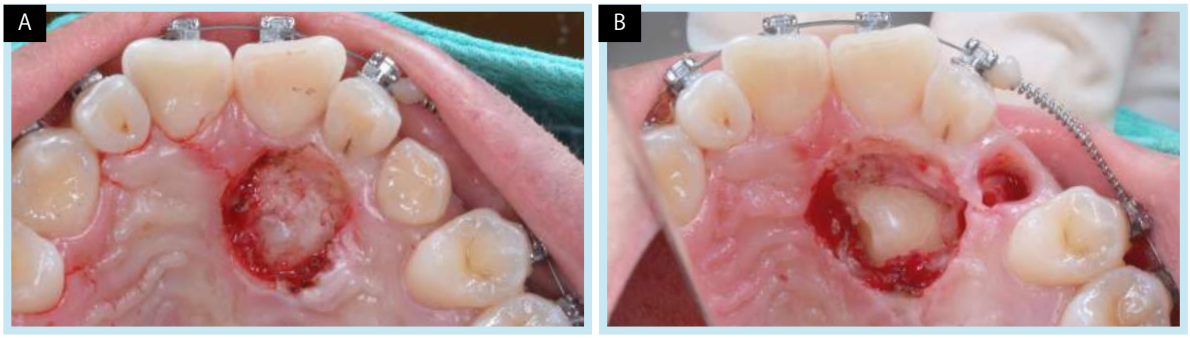

Fig. 6:
A. The crown of an impacted canine is evident after the overlying soft tissue is removed.
B. All bone was carefully removed down to the CEJ in the path of expected tooth movement.

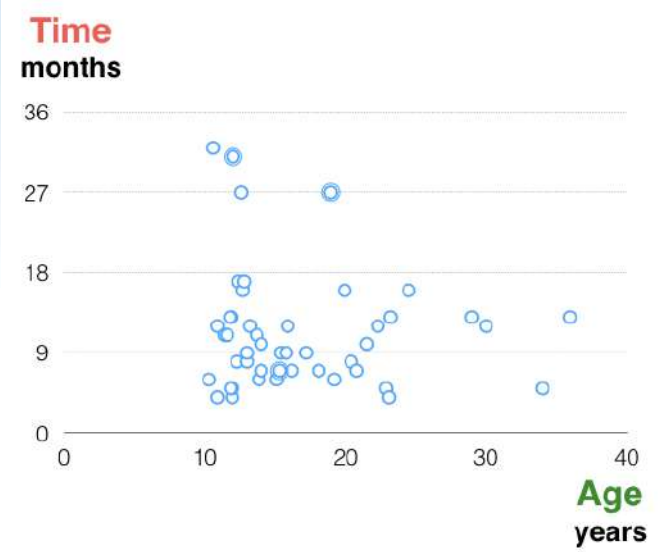

Fig. 7:
Treatment time in months after the bracket is bonded in the ideal position or on a previously impacted U3 is plotted relative to the age of the patient. See text to details.

and 8 palatal impactions); all were modest (Miller Class I),[16] but one was a Miller Class III (Fig. 8).

Discussion

Recovering complex I-U3s may be associated with migration of neighboring teeth, loss of arch length, dentigerous cysts, and external root resorption of the impaction or neighboring teeth (Fig. 5).[6,8,12] Extracting I-U3s presents another array of undesirable outcomes such as asymmetry, lack of desired canine function, occlusal interference, eccentric mandibular closure, temporomandibular joint disorder, compromised dental esthetics and/or unstable dental alignment.[6,8,10-12] The OBS-3D lever arm method was designed to simplify the mechanics and limit undesirable outcomes.[13] IZC OBSs are reliable fixtures (failure rate ~7%),[17] and case reports have established the principles for OBS-3D lever arm mechanics, but the performance of the method for a series of complex I-U3s is unknown.

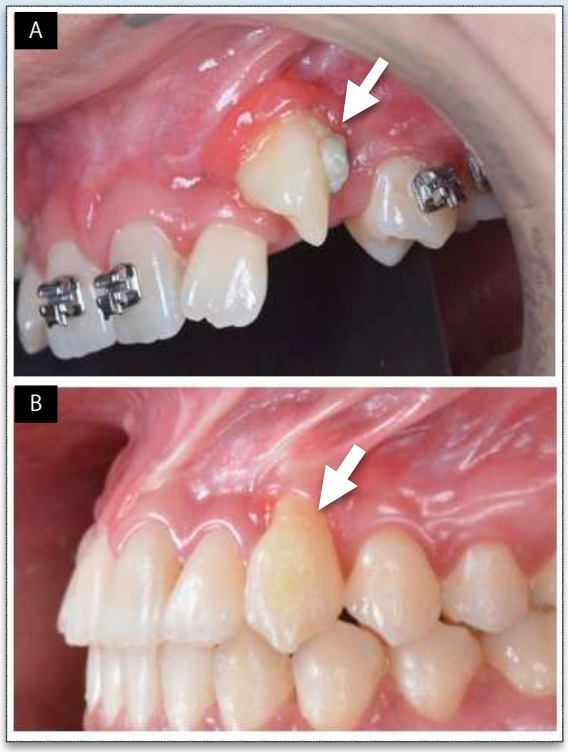

Fig. 8:
A. Plaque accumulation leads to inflammation (red) of the marginal gingiva particularly near an attachment (white arrow).
B. Gingival recession (white arrow) is noted on the labial surface of the UL3. See text for details.

Intuitively, more rapid I-U3 recovery is expected in younger patients,[18] but the current study revealed that the average treatment time (11.7 months) was similar for children and adults (Fig. 7). In contrast to a previous report with a smaller sample (n=30) of primarily palatal impactions,[18] the current study found that the position of the I-U3 was the prime determinant for duration of treatment. The current sample (n=51) was primarily labial impactions (32), which are usually more difficult than palatal impactions and are prone to complications,[5,6,8,10-12] particularly for a transposition.[19-22-24] Patients with complete transpositions were consistently more difficult to treat, and required extended treatment duration (>17 months) (Fig. 7).

Most prevalence studies report about two-thirds of I-U3 are palatal.[20] However, I-U3s in Chinese are two-thirds labial (facial) which probably reflects a high prevalence for midface deficiency.[21] In 1995, Peck[22] reported an international sample of transposed I-U3s as: 1) first premolar 71%, 2) lateral incisor 20%, and 3) all other teeth 9%. Tooth transposition is almost always in the maxilla, and it affects ~0.4%[24] of the population worldwide, but the anomaly is more common in Europeans (2%)[25] and Chinese (0.81%).[21] In comparison, 67% of the current Taiwanese sample (n=51) showed multiple types of I-U3 transposition: coronal (21), radicular (2), and complete (11).[23] Transposition with the lateral incisor (17) was the most common,[24] but 12 involved both the central and lateral incisors, and 5 were transposed with the first premolar. The high prevalence of difficult I-U3 transpositions suggests preferential referral to the senior author's clinic.

Complications associated with the surgically-assisted I-U3 recovery include gingival recession,[26] ankylosis,[8,27] root resorption,[28] and poor control of axial inclination.[6,18] Inadequate torque control is a common problem when an I-U3 is aligned. Bracket torque selection is helpful, but torquing auxiliaries are commonly required. One of the more refractory complications is the control of soft tissue inflammation.[20,26,27] Oral hygiene is very difficult particularly for patients with high impactions and unfavorable soft tissue contours (Fig. 8). Plaque accumulation produces inflammation and the soreness discourages effective hygiene. Persistent inflammation results in gingival recession. In addition, the problem may be associated with positioning the eyelet too near the CEJ (Fig. 8). Moderate recession can usually be restored with periodontal surgery, but severe recession and loss of labial bone threatens the long-term outcome for a recovered canine.[26,27] The only patient in the present series with severe gingival recession (Miller Class III)[16] was a labial impaction with massive loss of buccal bone at the time it was surgically uncovered (Fig. 8). Despite severe gingival recession at the end of treatment, the affected U3 was well aligned and functioned normally, but soft tissue correction[9] may be necessary in the future.

Root resorption associated with U3 impactions in Asians has a high incidence, up to 49.5%.[28] The adjacent lateral incisor root is the most commonly

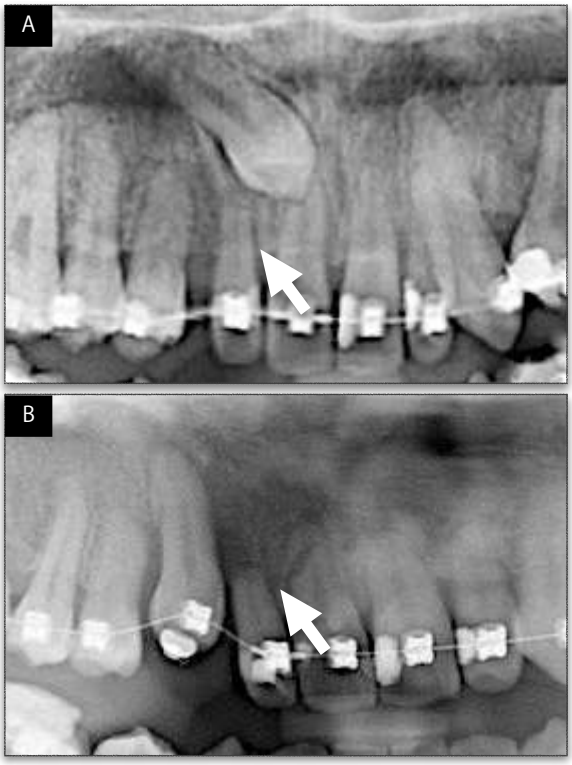

Fig. 9:
A. UR1 and UR2 (white arrow) are bonded with brackets and engaged on the archwire.
B. Severe root resorption (white arrow) is noted on the UR1 and UR2 after the impacted UR3 is retracted and extruded into the arch. See text for details.

affected tooth (Fig. 9).[29] In comparison, the prevalence of lateral incisor resorption for the present sample was much lower (4/51 or 7.8%). This positive outcome was associated with not engaging a tooth near an impaction on the archwire (Fig. 3), so that the root is free to move out of the way as the impaction is recovered.[24] Once the canine is properly positioned in the arch, then a full fixed appliance is indicated to achieve final alignment.

Retention is often a difficult problem for recovered impactions because a relapse tendency due to stretched gingival supracrestal fibers.[30] Supracrestal fiberotomy[31] and a bonded fixed retainer are recommended for reliable retention.

Conclusions

Surgically assisted recovery of I-U3s with a OBS-3D lever arm is a reliable procedure with few complications. CBCT imaging is used for prospectively planning minimally invasive surgery and applied mechanics. Careful removal of bone to the level of the CEJ is required prior to applying traction. Progress should be carefully monitored radiographically. Retention is best accomplished with supracrestal fiberotomy followed by a fixed retainer.

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Case No.	Sex	Side R or L	Facial (F) or Palatal (P)	Time (months)	Age at surgery	Transpose with	Complications
1	F	L	F	11	13Y7M		gingiva recession I
2	F	R	F	32	10Y6M	4	
3	F	R	F	27	12Y6M	1, 2	gingiva recession I
4	F	L	F	12	22Y3M	4, 5	gingiva recession I
5	F	R	P	16	19Y9M	1, 2	
6	F	R	F	8	12Y3M	2	
7	F	R	P	8	13Y	2	
8	F	R	P	12	13Y2M	1, 2	
9	F	R	P	10	21Y5M	2	
10	F	R	P	7	18Y1M	2	
11	F	L	F	13	11Y1M	1, 2	
		R	F	5	11Y1M	2	UL1, UR2 root resorption (origin, not iatrogenic)
12	F	R	F	4	11Y11M		
13	F	L	F	9	15Y8M		
14	F	L	F	12	10Y9M	2	
15	F	L	P	12	15Y9		
16	F	L	F	27	18Y10M	2	oozing left side gingiva recession I
		R	F	27	18Y10M	2	
17	F	R	P	13	29Y	1, 2	gingiva recession I lateral incisor root resorption
18	F	L	P	6	15Y1M	2	gingiva recession I
19	F	L	F	7	14Y	2	gingiva recession I
		R	F	10	14Y	2	
20	F	R	P	11	11Y4M	1, 2	gingiva recession I
21	F	R	P	5	11Y9M	2	
22	F	L	F	9	17Y2M	1, 2	lateral incisor root resorption
23	F	L	F	5	22Y9M		gingiva recession I
24	F	L	F	9	15Y4M	2	gingiva recession I
25	F	R	F	13	11Y8M	2	

Table 1A: (continued on the next page)

51 maxillary impactions in 46 patients are classified according to sex, side (right or left), position (facial or palatal), total treatment time (months), age at time of surgery, transposition with an adjacent tooth or teeth (1-8), and complications including gingival recession (Miller type I, II, or III).

Case No.	Sex	Side R or L	Facial (F) or Palatal (P)	Time (months)	Age at surgery	Transpose with	Complications
26	F	R	F	7	15Y3M		
		L	F	7	15Y3M		gingiva recession I
27	F	R	P	16	24Y5M	1, 2	gingiva recession I
28	F	R	F	4	23Y1M	2	gingiva recession I
29	F	L	F	4	10Y11M		
30	F	R	F	6	10Y3M		gingiva recession lateral incisor root resorption
31	F	L	P	7	16Y2M	1, 2	gingiva recession I
32	F	L	F	6	19Y2M	4, 5	gingiva recession I
33	F	L	P	5	34Y		gingiva recession III
34	F	L	P	7	20Y8M		
35	F	L	P	8	20Y4M	1, 2	
36	M	L	F	17	12Y8M		gingiva recession I
37	M	L	F	17	12Y4M	4	gingiva recession I
38	M	L	P	16	12Y7M		gingiva recession I
39	M	R	F	31	12Y		
40	M	L	F	6	13Y9M		
41	M	L	P	5	11Y11M	1, 2	
42	M	L	F	12	30Y		gingiva recession I lateral incisor root resorption
43	M	L	F	11	11Y6M	4	swelling
44	M	R	F	9	13Y	1, 2	gingiva recession I
45	M	L	P	13	23Y2M	2	
46	M	L	P	13	35Y11M	2	gingiva recession I
Total				**598**			

Table 1B: (continued from the previous page)

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* TADs made of Ti alloy have a lower failure rate compared to SS when placed in thin cortical bone. These results are consistent with a biocompatibility-related tendency for less bone resorption at the bone screw interface.
Reference: Failure Rates for SS and Ti-Alloy Incisal Anchorage Screws: Single-Center, Double Blind, Randomized Clinical Trial (J Digital Orthod 2018;52:70-79)

** The overall success rate of 93.7% indicates that both SS and TiA are clinically acceptable for IZC BSs.
Reference: Failure rates for stainless steel versus titanium alloy infrazygomatic crest bone screws: A single-center, randomized double-blind clinical trial (Angle Orthod 2019;89(1):40-46)

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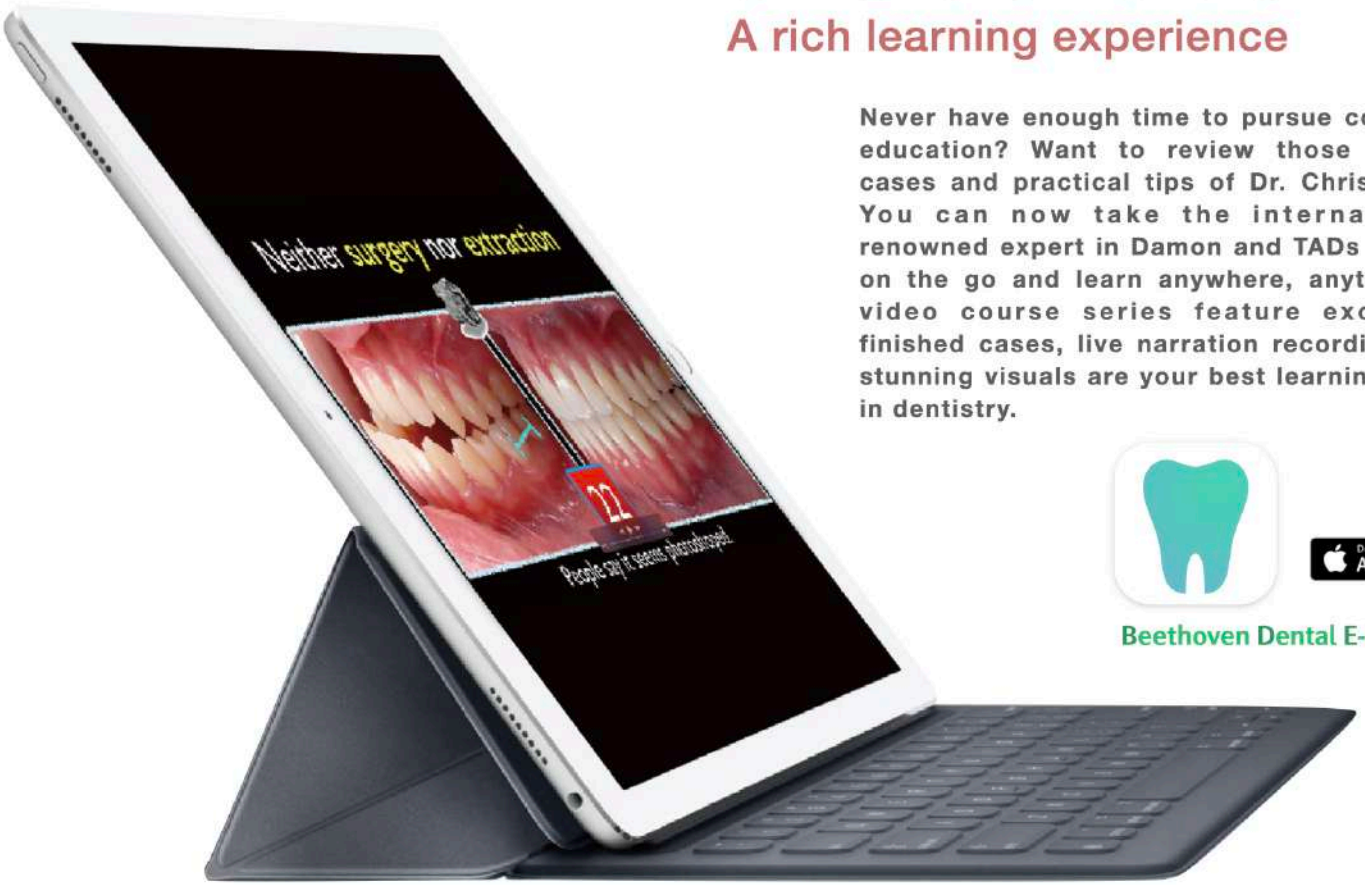

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(14 seasons)

non-narrated

Implant Forum

Implant Forum
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non-narrated

Assistant

Assistant

non-narrated

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E-Ortho

non-narrated

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全新改版的 2023 年貝多芬高效 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，本年度亦特別加入最新的**數位矯正與隱形牙套**的內容，並邀請了貝多芬牙科集團各院院長演講**特別矯正專題**。

此外，透過數位影片反覆觀看，結合矯正與電腦教學，課堂助教協助操作，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。

名額有限，一年僅有一次機會在台完整體驗 Damon 矯正大師課程，錯過只能等明年囉！

Module 1 - 4/13

1. Selecting your ideal first case
2. Bonding position
3. Bonding + BT + ceph tracing
4. TADs + space closing + hook + spring
5. Finishing bending & fixed retainer

Practice: Clinical photography (黃亭雅, 陳韻如醫師)

Module 2 - 5/11

1. Four stages of efficient orthodontic treatment
2. Simple and effective anchorage system
3. Extraction vs. non-extraction analysis

Practice: Patient photo management (金牛頓工程師)

Module 3 - 6/8

1. Soft & hard tissue diagnostic analysis
2. Big overjet correction
3. Damon diagnosis & fine-tuning

Practice: Ceph tracing (金牛頓工程師)

Module 4 - 6/29

1. Excellent finishing
2. Retention & relapse

Practice: Ceph superimposition & measurement (金牛頓工程師)

Module 5 - 7/13

1. Simplify your system
2. Extraction vs. non-extraction

Practice: Case report demo (陳俊宏醫師)

▲ **Computer training (Mac): 1:30-3:00 pm**

Module 6 - 7/27

1. Class III correction
2. Class II correction

Topic: Early orthodontic treatment (曾淑萍醫師)

Module 7 - 8/10

1. Upper impaction
2. Lower impaction
3. Gummy smile correction

Topic: Modified VISTA (蘇荃璋醫師)

Module 8 - 8/24

1. ABO DI, CRE workshop (林彥君醫師)
2. Open bite

Topic: Modified 2X4 appliance in ortho treatment (徐玉玲醫師)

Module 9 - 9/7

1. Implant-ortho combined treatment
2. Asymmetry

Topic: Impacted cuspid treatment (張譯文, 張瑜珍, 黃亭雅, 陳韻如醫師)

Module 10 - 9/21

1. Minor surgeries in orthodontics
2. Digital orthodontics

Topic: Ortho-viewed interdisciplinary treatment (徐重興醫師)

Module 11 - 9/28

1. Aligner & TADs
2. Keys to aligner learning

Topic: Pre-aligner treatment (林詩詠醫師)

▲ **Special lecture: 1:30-2:30 pm**

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貝多芬德國先修班心得
Feedback on Beethoven's Clinical Education Program

林森田 醫師
森源牙醫診所

十年前的某天，無意間看到一張傳單上面寫著：熱愛矯正學、熱愛學矯正，當時對矯正一知半解的我糊裡糊塗地便參加了張慧男醫師（以下簡稱張醫師）的矯正基礎班，越上課，越發現矯正的有趣（以及困難），十年前的決定徹徹底底地改變了我牙科工作的型態，聽到張醫師要與德國的矯正研究所合辦課程，只花了三分鐘便決定參加，因為相信張醫師對課程的要求還有強迫症，一定是一場收穫滿滿的旅程。

陳俊宏 醫師
貝多芬齒顎矯正中心

經師易得，人師難求。

四年前還對矯正懵懂的我，有幸在張醫師的引導下，踏入牙科的最高殿堂；而今在張醫師跟貝多芬集團的努力之下，除了讓我能跟國際一流的矯正醫學接軌外，更讓我能與世界上最優秀的學校與同學共同學習，一起為矯正醫學齊心努力！

回首來時路，能下定決心跟張醫師學習是繼我決定娶我太太後，人生中最重要的決定了！

宋昱彣 醫師
慈美牙醫診所

謝謝張醫師跟高老師，提供給學員這麼好的案例，除了案例本身矯正治療無可挑剔，還有這麼完善的資料搜集以及長達8年的追蹤，再再彰顯張醫師與高老師除了在矯正領域博大、精深，更於診所管理上有非凡的成效。

也謝謝貝多芬團隊提供參加德國碩士班的機會，我們才有練習寫作的契機：從完整的課程規劃、住院醫師們不藏私的教學分享以及JDO期刊內不同主題都有精彩的文章可以參考，讓我們在摸索寫作的階段，有一個正確的方向、完善的指引。研究所的學長看到我撰寫的案例報告*後，來跟我說覺得能寫出文章是不容易的事，但這個班級裡面大家都已經寫出至少一篇文章發表了，能接受這樣的training，真的是難能可貴。

站在各個巨人的肩膀上視野真的有所不同，自己只是太幸運，剛好有這樣的機會。實在是得之於人者太多，真的是非常非常謝謝大家。

＊宋醫師於先修班撰寫之第一篇案例報告將於AJO-DO Clinical Companion 中正式發表。

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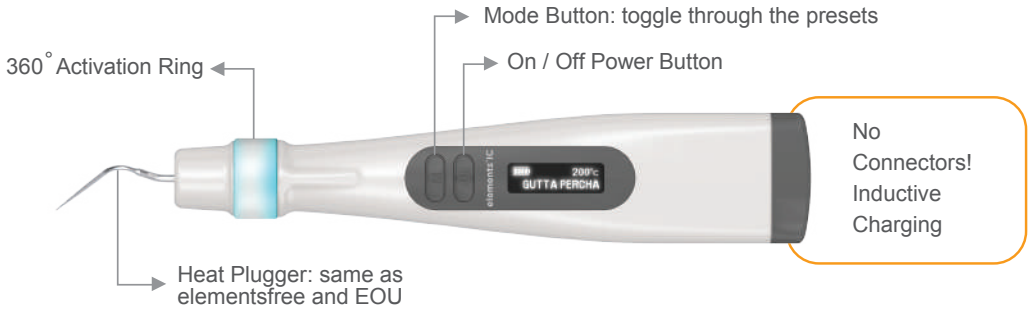

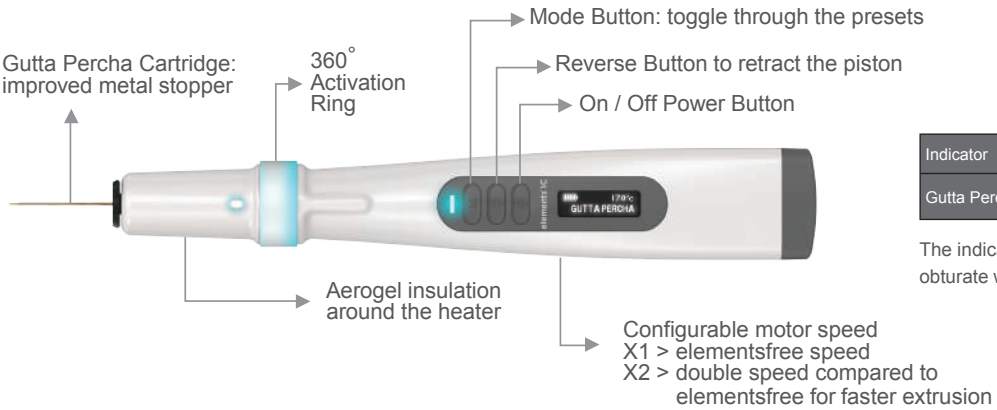

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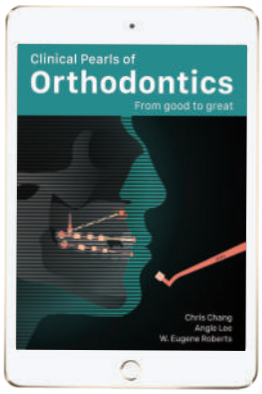

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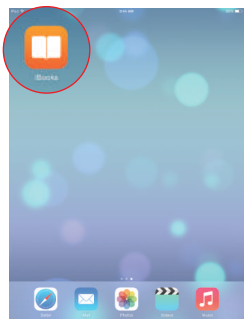

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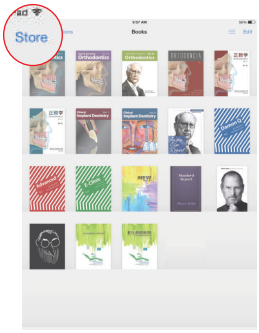

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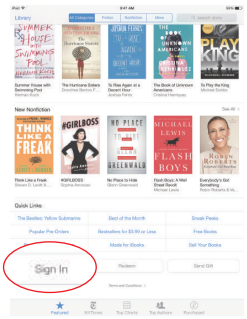

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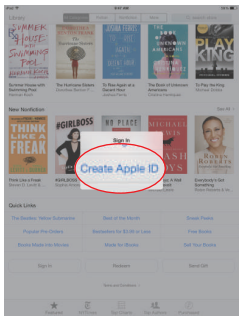

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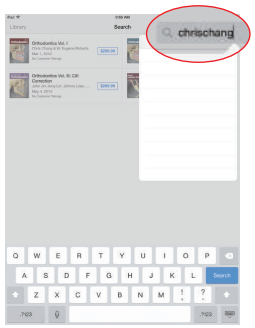

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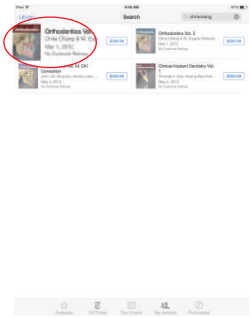

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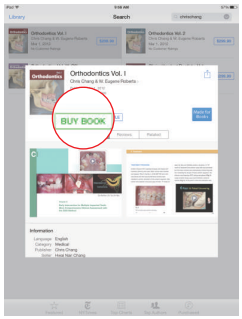

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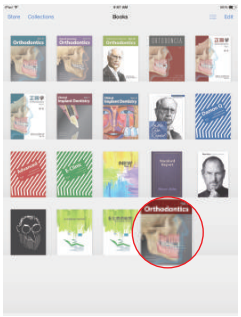

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2023-2024 第十五年度

貝多芬 矯正精修班

時間：週二上午 09:00-12:00

地點：金牛頓教育中心（新竹市建中一路 25 號 2 樓）

上課日期：

2023　4/18、5/16、6/13、7/11、8/15、9/12、10/3、11/7、12/19

2024　1/9、3/12

- **09:00 ~ 10:00　精選文獻分析**
- **10:00 ~ 10:30　精緻完工案例**
- **10:50 ~ 12:00　臨床技巧及常犯錯誤分享**

全新的第十五年度 2023-24 貝多芬精修班，是由國際知名講師張慧男醫師主持，並偕同貝多芬牙醫團隊住院醫師群共同主講。

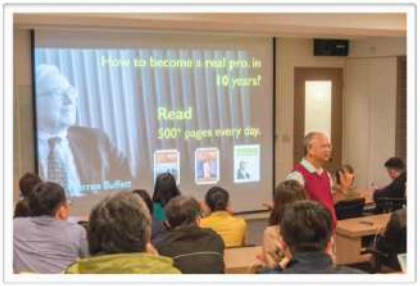
每月一次的課程之中，包含了：

1. 精選矯正權威期刊 AJODO 的文章做文獻分析與評讀。
2. 精緻完工 ABO 案例報告，其中因應數位矯正的世界趨勢，Insignia 與 Invisalign 病例為課程探討的主要內容之一。
3. 分享臨床上常犯的錯誤以及解決方法。

2023-24 貝多芬精修班內容豐富精彩，讓您經由每個月一次的課程，在面對各式的臨床案例時，更能游刃有餘、得心應手。

學習目的：

研讀最新趨勢文章可以窺知世界文獻公認的治療方式，而藉由評論文章的優缺點不僅能夠訓練判斷與思考能力，更可以清楚比較作法上的不同，達到完整理解治療方向、內容與穩定性的目標。



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Dr. John JJ Lin, Taipei, Taiwan

"I'm very excited about it. I hope I can contribute to this e-book in someway."

Dr. Tom Pitts, Reno, Nevadav, USA

"A great idea! The future of textbooks will go this way."

Dr. Javier Prieto, Segovia, Spain

"No other book has orthodontic information with the latest techniques in treatment that can be seen in 3D format using iBooks Author. It's by far the best ever."

Dr. Don Drake, South Dakota, USA

"Chris Chang's genius and inspiration challenges all of us in the profession to strive for excellence, as we see him routinely achieve the impossible."

Dr. Ron Bellohusen, New York, USA

"This method of learning is quantum leap forward. My students at Oklahoma University will benefit greatly from Chris Chang's genius. "

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"Dr. Chris Chang's innovation eBook is at the cutting edge of Orthodontic Technology... very exciting! "

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"Dr. Chang's technique is absolutely amazing and cutting-edge. Anybody who wants to be a top-tiered orthodontist MUST incorporate Dr. Chris Chang's technique into his/her practice."

Dr. Robert S Chen, California, USA

"Dr. Chris Chang's first interactive digital textbook is ground breaking and truly brilliant! "

Dr. John Freeman, California, USA

"Tremendous educational innovation by a great orthodontist, teacher and friend."

Dr. Keyes Townsend Jr, Colorado, USA

"I am awed by your brilliance in simplifying a complex problem."

Dr. Jerry Watanabe, California, USA

"Just brilliant, amazing! Thank you for the contribution."

Dr. Errol Yim, Hawaii, USA

"Beyond incredible! A more effective way of learning."

Dr. James Morrish Jr, Florida, USA

New Release!

Dr. Chris Chang's favorite part of his trip to Singapore in June was the Gardens by the Bay right next to the hotel he stayed in. After almost 3 years without going overseas due to COVID, Dr. Chris was also happy to catch up with one of his most dedicated students, Dr. Chao Pan.