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Quail are ground-dwelling birds that are easily alerted and quick to run into hiding. They enjoy an unruly, lively garden where they can observe the surroundings while knowing there is always somewhere to hide in case of danger.

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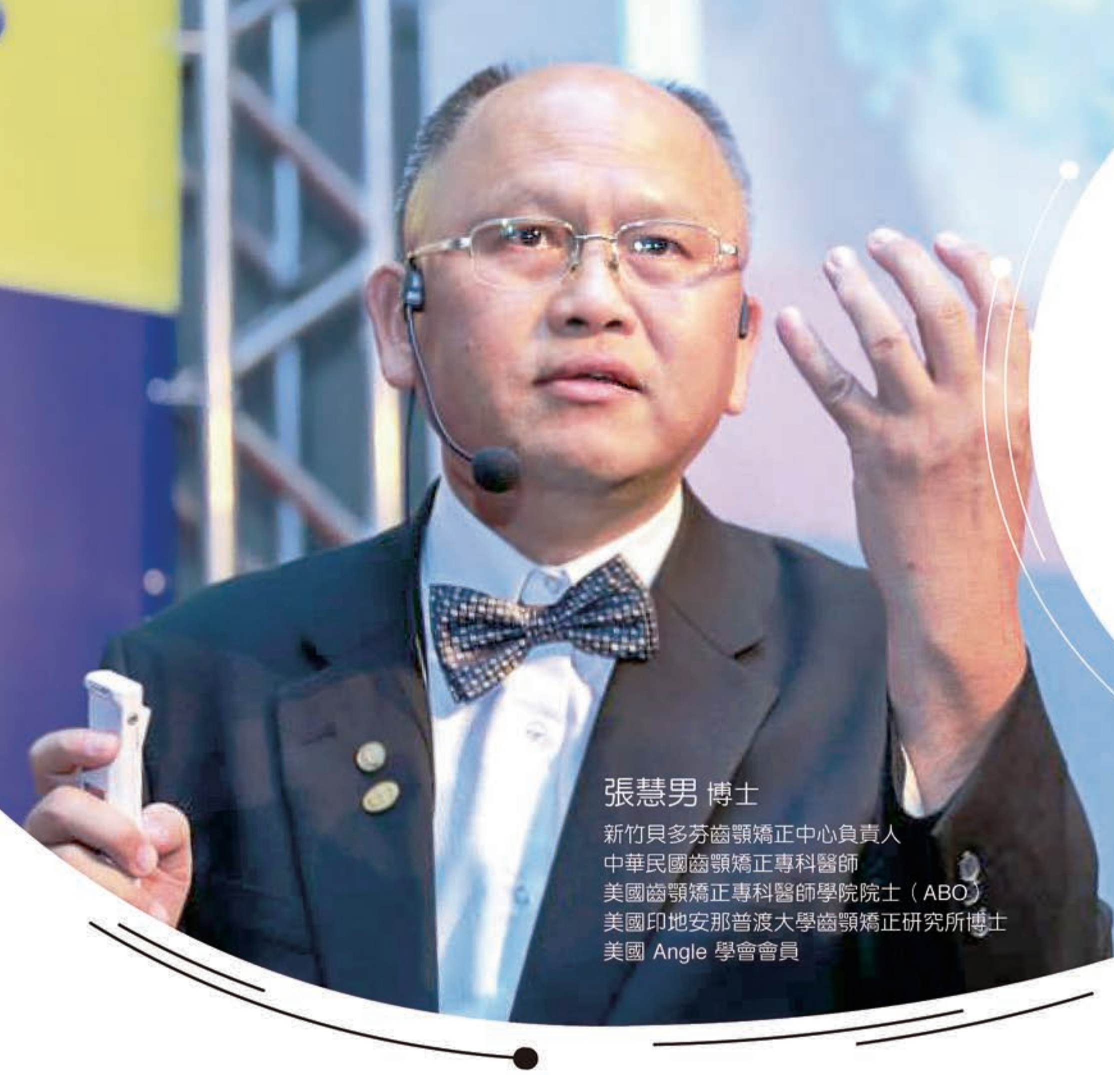


2021-22
熱愛學矯正

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

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.

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.

International Workshop
(Digital Orthodontics, OBS & VISTA)
English Class

The workshop provides a 3 day, advance hands-on program to experienced Damo users. The program includes world-clas lectures, model and surgical hands-o workshops and clinical observation o patient care and clinic management.

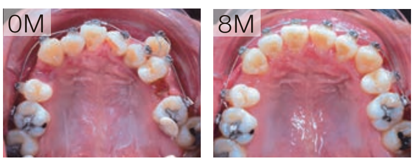
course@newtonsa.com.tw
+886-3-573-5676 #218 Annie

2021	A班	B班		A班	B班
Module 1 -	4/22	7/29	Module 7 -	9/9	12/9
Module 2 -	5/13	8/12	Module 8 -	9/16	12/30
Module 3 -	5/27	9/30	Module 9 -	10/21	1/20/22'
Module 4 -	6/17	10/14	Module 10 -	11/11	2/24
Module 5 -	7/8	11/4	Module 11 -	12/23	3/10
Module 6 -	8/5	11/25			

Finishing XIII

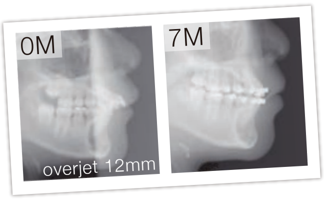
Module 1 - 6/8	Module 7 - 12/14
Module 2 - 7/13	Module 8 - 1/11/22'
Module 3 - 8/24	Module 9 - 2/15
Module 4 - 9/14	Module 10 - 3/15
Module 5 - 10/19	Module 11 - 4/12
Module 6 - 11/9	

2021
~~Class 1 - May 18-21~~
Class 2 - Dec 07-10



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

(本文宣品僅供牙科診所及醫師參考，禁止張貼或擺置於公眾可瀏覽及取閱之處)

I was looking for a star – I found the galaxy

15 years ago, at a time when I spent as much time on a golf course as I did in my practice, a friend suggested that I start a study group of about 20 local doctors to share how and why I was using miniscrews for my treatments. Having started this group, we explored and discussed not only the successes, but also the failures I had encountered, and I made a lot of friends that I wouldn't have made if I had spent all my free-time on the golf course. Over the years, this group, my circle of friends, and the golf courses I have played on have increased exponentially, based not only in Taiwan, but globally.

At the moment of course, international travel is rather problematic, but fortunately the internet has allowed us the opportunity to continue sharing our successes and failures with one another. We are very fortunate to be in touch with one another.

As we all get older, it is an honor to be able to touch the young generation of orthodontists, who in time - like myself - will touch and pass on their accumulated knowledge to the generation younger than them.

As technology advances, we are all able to explore new techniques and tools and this edition of our journal highlights the mechanics involved in aligner treatments and how to combine them with miniscrews to fix Class III and open bite cases. In this issue there are 4 case reports, superbly written by international members of the young generation, and I hope you are as excited as I am to learn how they have started to explore the potential of aligners and miniscrews.

To complete this edition, we continue with a view of Taiwanese lifestyle highlighting quail and a rooftop garden. I hope you enjoy this edition and you remain safe and healthy until we can touch each other again on our path to glory through this amazing galaxy.

Chris Chang PhD, ABO Certified, Publisher of JDO

Non-Extraction Treatment for Class II Open Bite Using the Combination of Aligners and IZC Screws

Abstract

A 25-year-old male presented with a Class II open bite malocclusion with a lower midline shift to the left. The treatment plan was aligner therapy, with two IZC screws for anchorage. The mechanical advantages of aligners can enlarge the TMJ space by increasing the vertical dimension. A spongy device, aligner Chewies, was used to facilitate the counterclockwise rotation of the mandible, which successfully resolved the open bite. Incisor extrusion, a side effect of retracting the upper dentition with IZC screws, was beneficial for opening the bite. (J Digital Orthod 2021;63:4-16)

Key words:

Invisalign®, aligner treatment, open bite, IZC screw

Introduction

Anterior open bite (*AOB*) is characterized by the lack of overlap or contact between the maxillary and mandibular incisors while the posterior teeth are in occlusion. The prevalence of anterior open bite ranges from 1.5 to 11% and varies between ethnic groups, according to age and dentition characteristics.[1] Treatments for open bite range from observation or simply habit control to complex surgical procedures. Correction of this malocclusion was challenging due to difficulties in determining and addressing the etiological factors, as well as the complexity of the required mechanics. The etiology of anterior open bites is complex and multifaceted. They may develop from either oral habits, excessive growth of lymphatic tissues, tongue position, or a genetic predisposition.[2] In some situations, a multidisciplinary approach may be necessary, with orthodontics, surgery and/or speech therapy, to achieve an adequate esthetic, function, and long-term stability. Many researchers contend that vertical discrepancies are more difficult to manage than problems in the anteroposterior dimension. In non-extraction open bite treatments, fixed appliance therapy has the potential to exert unwanted extrusive forces in the posterior that may enhance the open bite and consequently worsen the vertical dimension. Additionally, anterior-posterior (*AP*) elastics used with fixed appliances tend to have extrusive effects that increase the dimension. The advantage of Invisalign in treating open bite malocclusion stems mainly from the full occlusal coverage effect which applies good control for vertical height.

Yulin Hsu,
Instructor, Beethoven Orthodontic Course (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: Pre-treatment facial photographs, 25 y/o male*

■ *Fig. 3: Post-treatment facial photographs after 21 months of active treatment*

■ *Fig. 2: Pre-treatment intra-oral photographs*

■ *Fig. 4: Post-treatment intra-oral photographs*

A 25-year-old male presented with chief complaints of protrusion, crowding, and open bite. The clinical exam revealed a convex profile, protrusive lips, Class II occlusion, crowding, an open bite from canine to canine, and the lower midline shifted 3mm to the left (*Figs. 1 and 2*). No contributory medical or dental history was reported, nor were there any signs or symptoms of temporomandibular disorder (*TMD*). The patient reported he was a mouth-breather since childhood, and asked for an esthetic dentofacial orthodontic treatment. This case report demonstrates correction of an open bite and retraction of the maxillary arch using IZC screws and clear aligners. This treatment procedure was facilitated with a digital custom appliance and one refinement procedure. The successful outcome after 21 months of active treatment is shown in Figs. 3 and 4. Pre-treatment and post-treatment radiographs illustrate the morphology of the mineralized tissues (*Figs. 5 and 6*). Superimposition

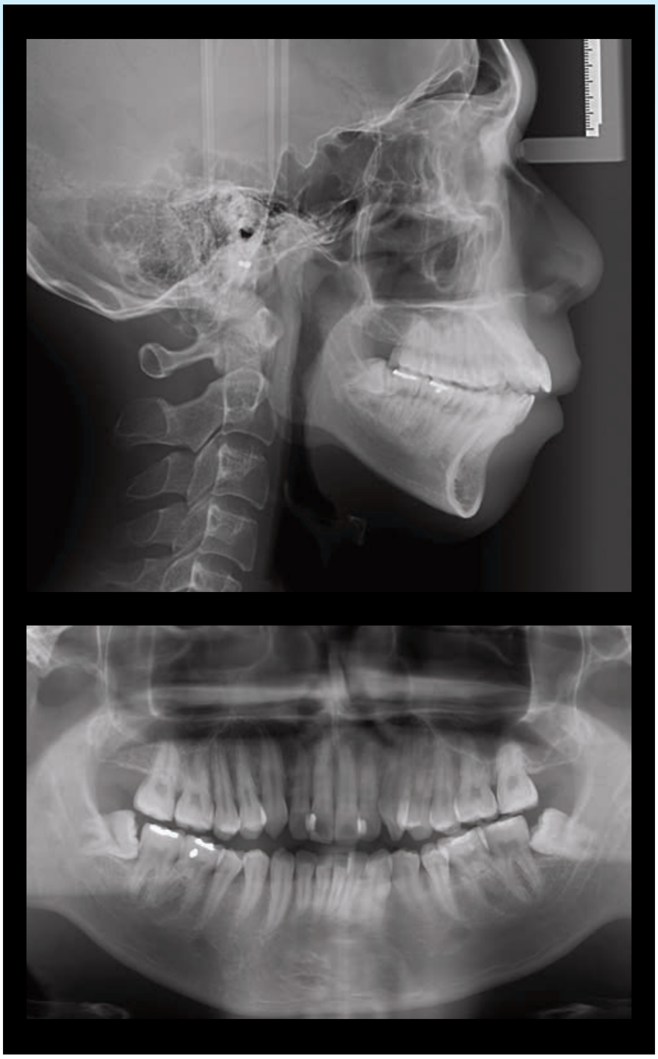


Fig. 5:

Pre-treatment cephalometric and panoramic radiographs document the original dentofacial morphology. The panoramic film reveals two impacted third molars.

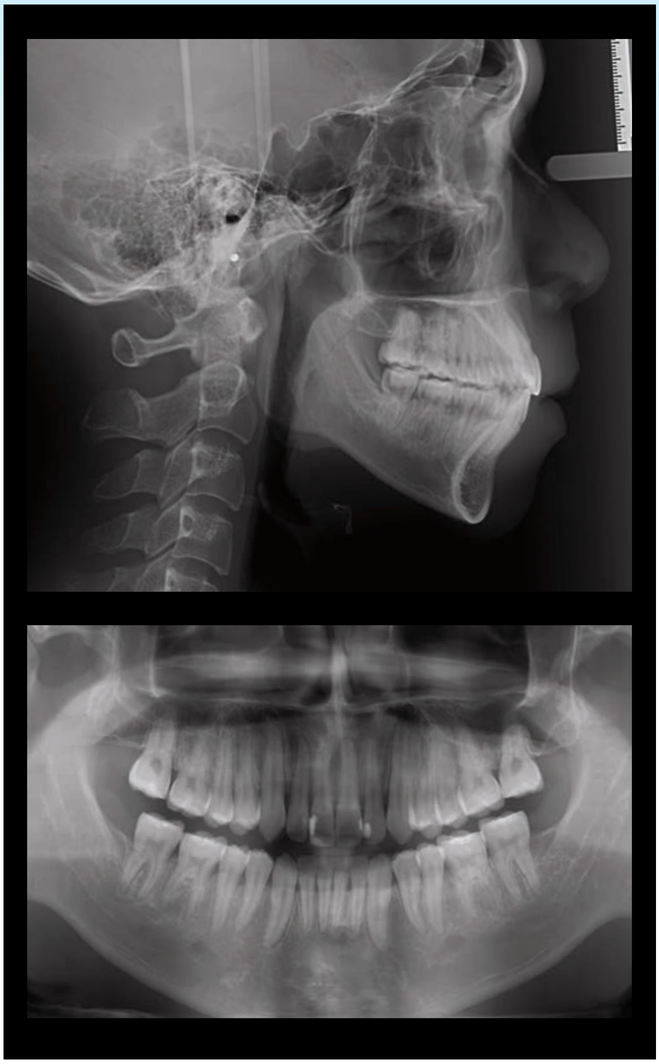


Fig. 6:

Post-treatment cephalometric and panoramic radiographs reveal the dentofacial morphology immediately after Invisalign® attachments were removed.

of cephalometric tracings (*Fig. 7*) and cephalometric analysis (*Table 1*) document the dentofacial aspects of this comprehensive treatment.

The dental nomenclature for this report is a modified Palmer notation. Upper (*U*) and lower (*L*) arches, as well as the right (*R*) and left (*L*) sides, define four oral quadrants: UR, UL, LR and LL. Teeth are numbered 1-8 from the midline in each quadrant, e.g., a lower right first molar is LR6.

Diagnosis

Facial:

- Length: *Long tapered face in the frontal plane*
- Facial convexity: *Convex profile (G-Sn-Pg'=20°) (Fig. 5)*
- Smile: *Flat smile arc*
- Symmetry: *Within normal limits (WNL)*

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	86°	86°	0°
SNB° (80°)	79°	82°	3°
ANB° (2°)	7°	4°	3°
SN-MP° (32°)	36°	32°	4°
FMA° (25°)	29°	25°	4°
DENTAL ANALYSIS			
U1 To NAmm (4mm)	8	5	3
U1 To SN° (104°)	112°	107°	5°
L1 To NBmm (4mm)	11	8	3
L1 To MP° (90°)	97°	90°	7°
FACIAL ANALYSIS			
E-LINE UL (2-3mm)	3	1	2
E-LINE LL (1-2mm)	5	4	1
Convexity: G-Sn-Pg' (13°)	20°	16°	4°
%FH: Na-ANS-Gn (53%)	56%	56%	0

Table 1: Pre- and post- treatment cephalometric analysis

Skeletal:

- Intermaxillary relationship: *Maxillary protrusion (SNA 86°, SNB 79°, ANB 7°)*
- Mandibular plane: *WNL (SN-MP 36°, FMA 29°)*
- Vertical dimension of occlusion (VDO): *Increased (Na-ANS-Gn 56%)*
- Symmetry: *Mandible was deviated about 3mm to the left.*

Dental:

- Classification: *Bilateral Class II canine and molar relationships*
- Overbite: *2mm anterior open bite*
- Overjet: *4mm*
- Impacted Teeth: *LR8 and LL8 (Fig. 5)*
- Crowding: *6mm in the maxillary arch and 5.5mm in the mandibular arch*

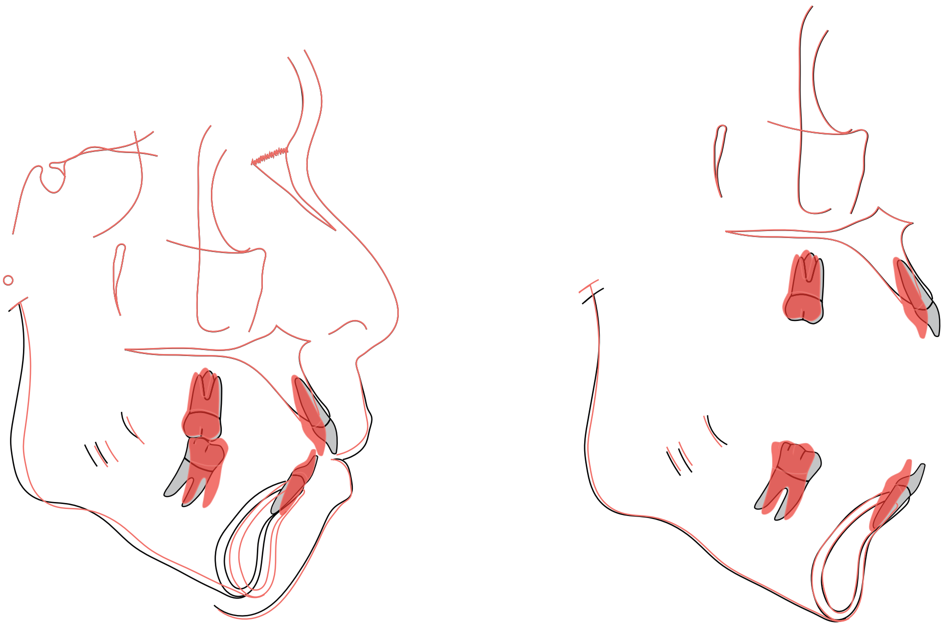


Fig. 7:

Pre- (black) and post-treatment (red) cephalometric tracings are superimposed on the anterior cranial base (left), the maxilla (upper right), and the stable internal structures of the mandible (lower right). Counterclockwise rotation of mandible was revealed. The maxilla superimposition shows upper incisors retracted and tipped palatally, and the upper molars slightly intruded. The mandibular superimposition indicates lingual tipped incisors and molar uprighting.

The ABO Discrepancy Index (*DI*) was 23 as shown in Worksheet 1 at the end of this report.

Treatment Alternatives

One of the treatment options was to extract the four first premolars to solve the problems of crowding, open bite, and protrusive incisors. However, space closure is challenging with Invisalign® and may result in undesirable side effects. In this case, the retromolar space was sufficient for retracting the maxillary arch to correct not only the open bite, but also the protrusion.

The treatment objectives were to:

1. Expand the maxillary arch to relieve crowding.
2. Retract the maxillary arch to correct the open bite and protrusion.
3. Extract LL8 and LR8 to allow full coverage of the mandibular 2nd molars.
4. Apply IPR to the lower anterior teeth to relieve the crowding.
5. Place IZC screws to facilitate maxillary retraction and correct the occlusal plane.

Appliances and Treatment Progress

A digital scan with iTero Element® (*Align Technology, Inc., San Jose, CA*) was performed to start the analysis and planning. Multiple ClinCheck® (*Align Technology, Inc., Santa Clara, CA*) modifications established a reasonable biomechanical design to reach the stated objectives.[3,4]

An initial set of 50 aligners was planned. The duration of use for each aligner was 10-14 days. The treatment began with the delivery of the first 2 aligners. The patient was instructed to wear the clear overlay appliances 20-22 hours per day, and to remove them only while eating or brushing his teeth.

The selected attachments required for optimal tooth movement were:

- Optimized attachment: UR1-UR5, UR7, UL2-UL5, UL7, UL2, UL3, LL4, LL5, LR4, LR5
- Vertical rectangular attachment: UR6, UL6, LL3, LL6, LR6

Attachments, made of Tetric Evoceram composite (*Ivoclar Vivadent, Inc., NY, USA*), were placed during the second visit. After installing the attachments, aligners #3-11 were delivered to the patient with instructions to progress following the numbered sequence every 10 days. The objectives for the first set of aligners were: 1. retract and expand the maxillary arch, 2. align the mandibular dentition using inter-proximal reduction (*IPR*), and 3. close the open bite.

IPR was performed from the mesial zone of LR3 to the distal zone of LL3 prior to aligner #24. The objective of the selective IPR procedure was to relieve the crowding in the mandibular arch.

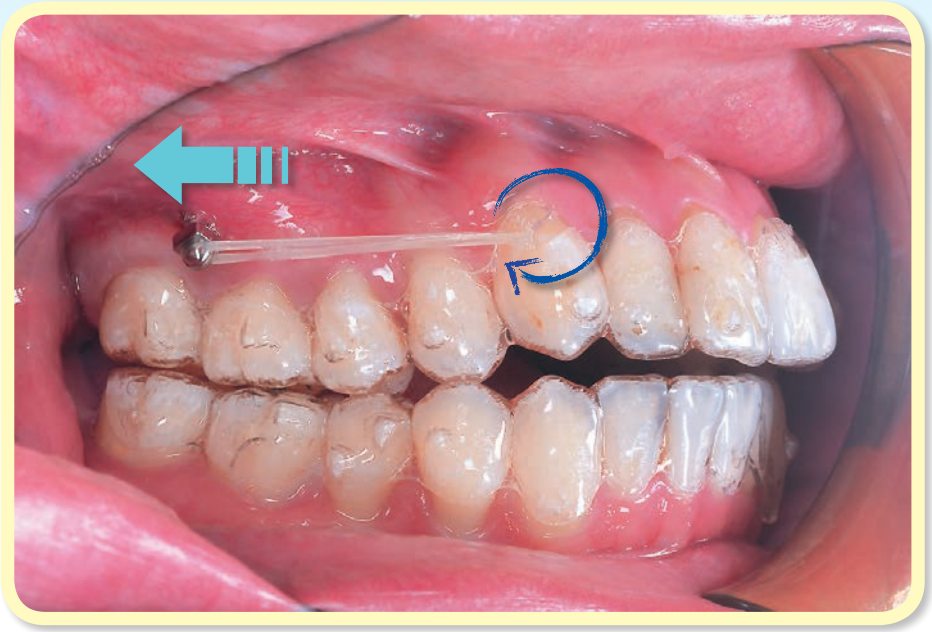


Fig. 8:
The IZC screws were installed bilaterally in the infra-zygomatic crest extra-alveolar area to provide anchorage for maxillary retraction and cause a clockwise moment on the upper arch at the same time. This mechanism can efficiently correct the protrusive incisors and open bite.

In the 8th month of treatment (*23rd set of aligners*), the IZC screws (*OrthoBoneScrew®, iNewton, Inc., Hsinchu, Taiwan*) were placed (*Fig. 8*). During the same visit, elastics (*Chipmunk, 1/8-in, 3.5-oz*) were hooked bilaterally from the upper canines to the IZC screws. The patient was given instructions on how to hook elastics and was requested to keep them hooked at all times except when the aligners were taken off to eat or brush teeth. In the 14th month, both the overjet and overbite were near ideal, and Class II elastics (*Kangaroo, 3/16-in, 4.5-oz*) were introduced bilaterally from the upper canines to the lower first molars. The patient was satisfied with the progress for the first set of aligners (*Fig. 9*). The first refinement involving 14 additional aligners commenced with the following selected attachments:

- Optimized attachment: LR3, LR7, LL7

IPR was performed between the upper and lower central incisors to eliminate dark triangles (*Fig. 9B*). Power ridges were used in aligners #1-14 to increase the axial inclination of the maxillary incisors. Five months later, after a total of 21 months of active, the planned outcome was achieved (*Fig. 4*).

Retention

After 21 months of treatment, all aligner attachments were removed and clear overlay retainers (*Vivera®*) were delivered for each arch.

Fig. 9:
The results of the first set of aligner treatment showed the overbite and overjet were within the normal range, and both arches were well aligned. Dental midlines were aligned, but a dark triangle between central incisors was noted. The interdigitation of UR2, UR3 was not ideal.

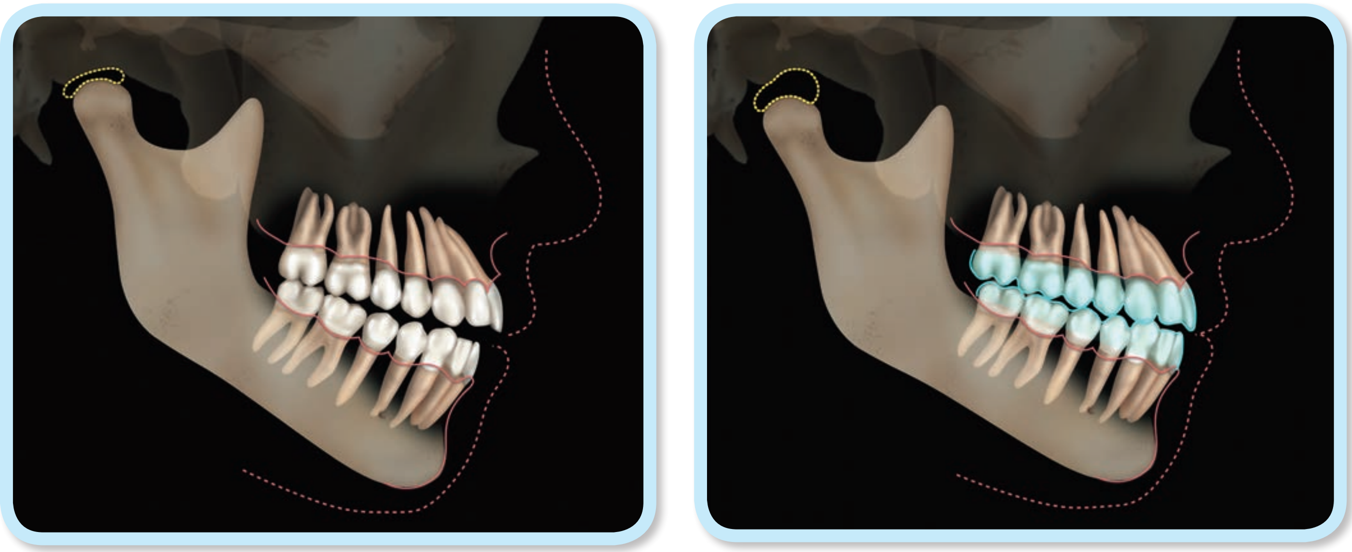
Treatment Results

Post-treatment documentation with photographs (*Figs. 3 and 4*), radiographs (*Figs. 5 and 6*), cephalometric measurements (*Table 1*), and superimposed tracings (*Fig. 7*) indicated that both the overbite and overjet were within the normal range. The upper and lower incisors were retracted so the profile was improved. The lower midline shifted 1mm to the left. Two sets of aligners over 21 months produced a final result that was close to the original 3D ClinCheck® projection.

Discussion

Clear aligners are a good approach for resolving anterior open bite. Schupp,[3] Moshiri,[4] Herrero,[5] and Pinho[6] et al. report successful treatment results using clear aligners to correct anterior open bites. In these reports, the authors suggested open bite correction was enhanced with: expansion of the maxillary arch,[5] and particularly by, the counterclockwise rotation of the occlusal plane.[3-6] The change of the occlusal plane was produced by molar intrusion and incisor extrusion. The explanation is that aligner treatment is a form of indeterminate mechanics since the appliances engage all the teeth simultaneously. The thickness of the acrylic in the occlusal surface of aligners can induce an artificial increase in the vertical dimension, thereby triggering a muscular response that creates a vertical intrusive force in the posterior segments, leading to molar intrusion.[4] However, in the cephalometric superimposition, there was no obvious proof of true molar intrusion (*Fig. 7*).

■ *Fig. 10:*
In the 3rd month, the 2mm overbite was decreased to 0mm. In the initial stage of treatment, the ClinCheck® design was just the retraction of maxillary molars and alignment of mandibular dentition. Neither maxillary expansion nor incisor retraction was planned. This phenomenon indicates that just the wearing of clear aligners is adequate to improve open bite.



■ *Fig. 11:*
The illustration presents the raised vertical dimension (left) plus the biting force with which the posterior teeth (right) forced the mandible to rotate counterclockwise. Meanwhile, the space between condylar head and mandibular fossa was enlarged (yellow dotted lines).

In this present case, the open bite showed a significant improvement in the 3rd month (*Fig. 10*), at which time the treatment progress was on the #9 aligner stage. According to the ClinCheck® design, aligners #1 to #8 should only retract the UR7, UR6, UL7, UL6 and align the mandibular teeth. Therefore, the fact that there was already a noticeable open bite improvement without use of IZC screws indicates that clear aligners alone can assist in the correction of anterior open bites. The key is the increased vertical dimension, which enlarges the temporomandibular joint space. This is consistent with relaxation of the surrounding ligaments, muscles, and even the mandible. The chewing force which was concentrated on the posterior teeth (*no contact on anterior teeth due to the open bite*) caused the mandible to rotate counterclockwise (*Fig. 11*). The cephalometric superimposition indicated rotation of the entire mandible, and a vertical increase of the ramus area which was consistent with the mandible moving slightly downward (*Fig. 7*). The comparison of pre-treatment and post-treatment panoramic x-rays reveals bilateral enlargement of the temporomandibular joint space (*Fig. 12*).

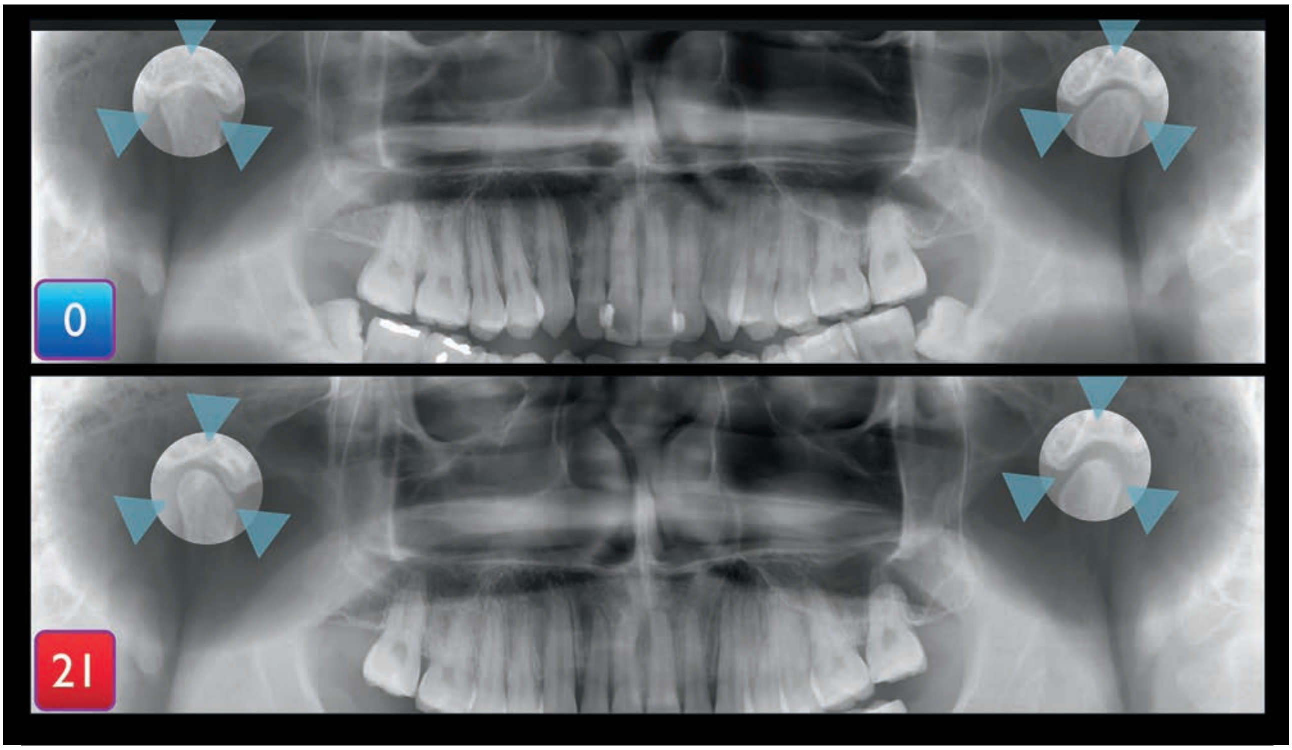


Fig. 12:
Compared to the pre-treatment morphology, the space between condylar head and mandibular fossa (blue triangles) was enlarged bilaterally after 21 months of aligner treatment.

There were two major mechanics used to succeed in this case. The first was to rotate the mandible counterclockwise, which was previously discussed. The second was to use IZC screws to provide anchorage for maxillary retraction. Although many reports indicate that clear aligners are able to retract the whole arch, insufficient anchorage for premolar retraction was observed for the present patient. Whole arch retraction is more efficient and effective using IZC screws (*2x12-mm stainless steel*).[7] Furthermore, the IZC screws created a moment, which intruded the maxillary molars, lingually tipped the incisors to help close the bite (*Fig. 12*).

Conclusions

Clear aligners are a therapeutic modality that can be effectively employed for non-extraction treatments of anterior open bites. Bite closure was mainly achieved by the counterclockwise rotation of the mandible. IZC screws not only served as anchorage for maxillary retraction, but they created a clockwise rotation of the maxillary plane. The combination of clear aligners and IZC screws is a very powerful combinationl for Class II anterior open bite correction.

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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 = 0

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 = 12

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 = 2

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° 1 x 1 pt. = 1

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 = 5

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)	1	@ 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	____	x 2 pts. =	____
Skeletal asymmetry (nonsurgical tx)	1	@ 3 pts. =	3
Addl. treatment complexities	2	x 2 pts. =	4

Identify:
1. Non-surgical orthodontic treatment for anterior open bite
2. Temporary skeletal anchorage devices (TSADs) for full arch retraction

Total = 9

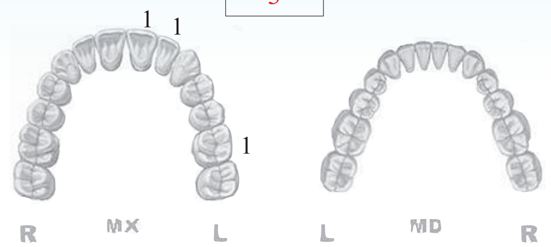
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 16

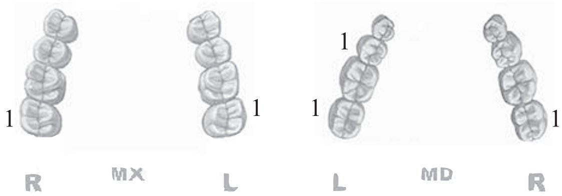
Alignment/Rotations

3



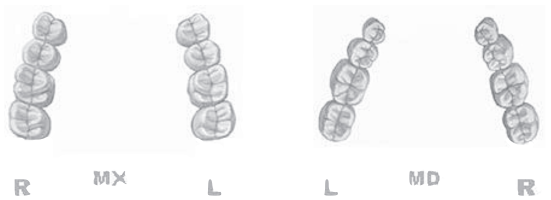
Marginal Ridges

5



Buccolingual Inclination

0

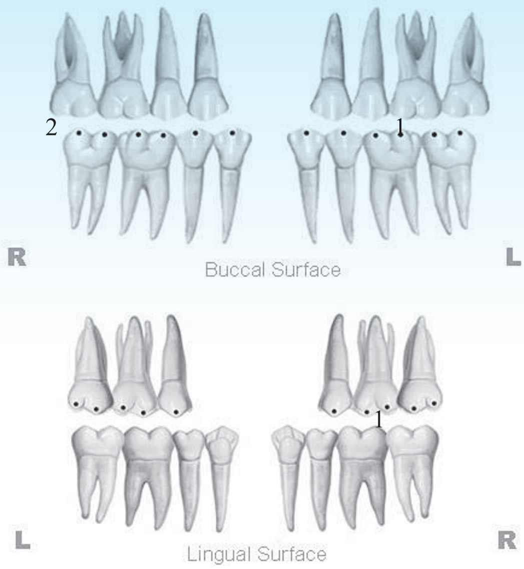


Overjet

2

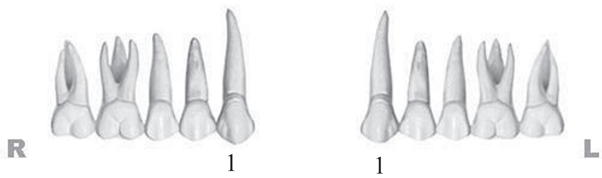
Occlusal Contacts

3



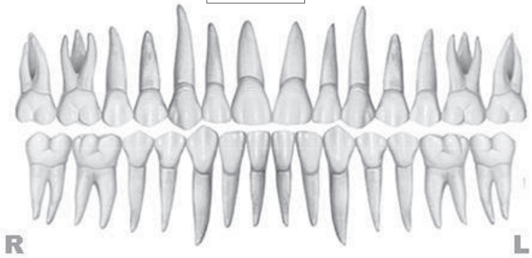
Occlusal Relationships

2



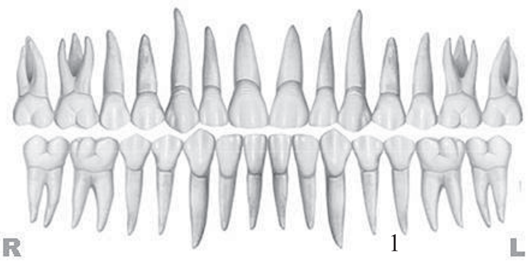
Interproximal Contacts

0



Root Angulation

1



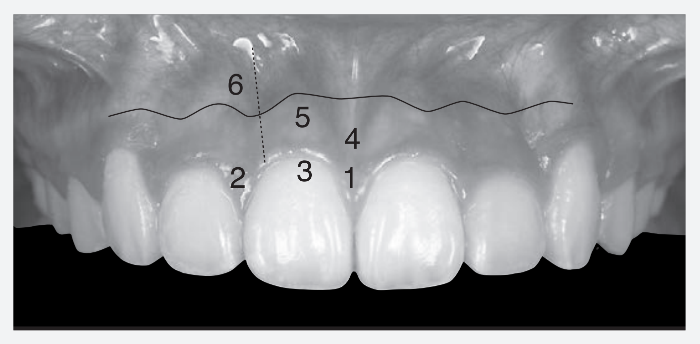
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 3

1. Pink Esthetic Score

Total = 1

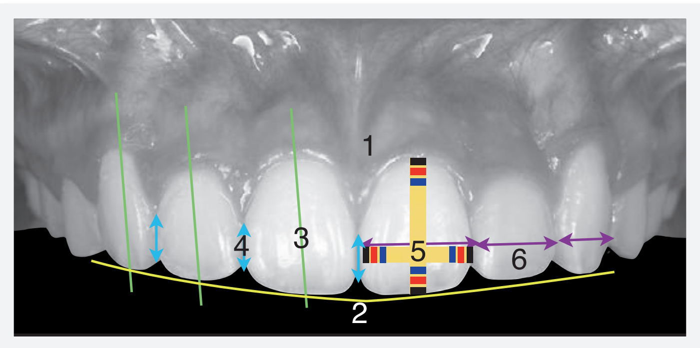


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

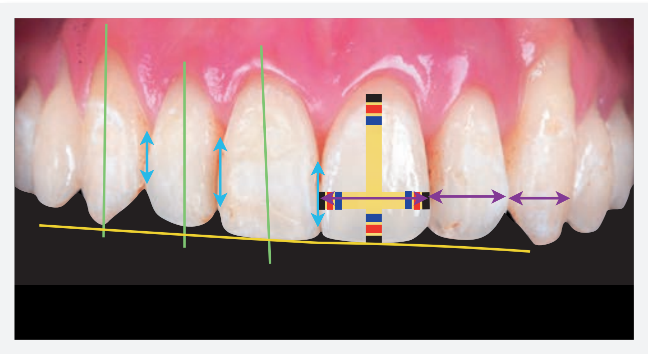
1. M & D Papilla	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

2. White Esthetic Score (for Micro-esthetics)

Total = 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



1. Midline	0	1	2
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6. Tooth to Tooth Proportion	0	1	2

矯正攻略 123

線上課程共計6堂

7/02	Fri.	11:00 -12:00	如何快速診斷，拔牙或是不拔牙	徐子航 醫師
7/30	Fri.	11:00 -12:00	早期矯正介入時機	徐子航 醫師
8/09	Mon.	11:00 -12:00	Tough Impactions Made Easy	林詩詠 醫師
8/27	Fri.	11:00 -12:00	局部矯正	徐子航 醫師
9/16	Thu.	11:00 -12:00	拔牙治療副作用改善	陳佳伶 醫師
9/24	Fri.	11:00 -12:00	挑選case如何趨吉避凶	徐子航 醫師

初學矯正在臨床中經常面臨的決策兩難與不確定，要如何正確判斷和選擇？問題要如何處理和解決？講師群針對不同主題，以實際案例和大家分享討論。學員也有機會在課程中提問自己臨床碰到的問題喔！

講師介紹

林詩詠 醫師
- 中華植體美學醫學會專科醫師
- 國際矯正植牙學會大使（iAOI ambassdor）
- 隱適美專科認證白金菁英級醫師
- 戴蒙矯正系統講師

徐子航 醫師
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- 舒服美SOV 隱形矯正 專業顧問
- 良醫健康網專欄牙醫師
- 中華民國齒顎矯正學會學術委員
- 國立陽明大學牙醫學士
- 國立台灣大學齒顎矯正碩士
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- 世界矯正學會 會員醫師
- 隱適美認證醫師
- 韓國齒顎矯正學會受訓醫師交流醫師

報名資訊

【課程費用】

單堂課程$300，一次報四堂$1000，一次報五堂$1200，一次報六堂$1400 。

課程若分次報名，不另外合併堂數做優惠

【注意事項】

1. 本次視訊課程會用ZOOM視訊軟體，請事先下載，報名時填寫的email即爲ZOOM登入帳號。
2. 課程前一天統一寄發會議連結給所有報名者。(如沒收到可以Line、FB私訊詢問)
3. 報名未出席者恕不退還既收款項提醒：課程使用ZOOM視訊進行，請事先下載軟體唷！

掃描立即報名

Dental Clinic Established 1996

Beethoven

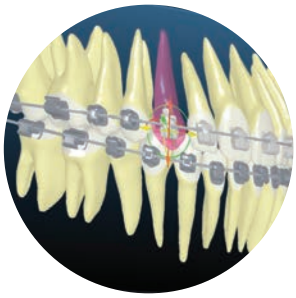
International Workshop

Digital Orthodontics, OBS, VISTA

Digital

	Digital Orthodontics, OBS, VISTA	Keynote (optional)
2022	Session A Session B	dates to be announced

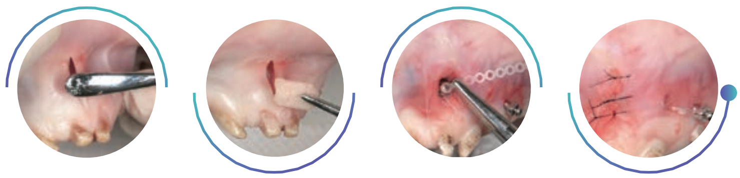
@Taiwan



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

course@newtonsa.com.tw
+886-3-5735676 #218 Annie

Course Schedule

Day **1** Chair–side observation

Day **2** Insignia Lecture, Chair–side observation

Chris' Lecture:
Digital Orthodontics with TAD

Day **3** VISTA Lecture & workshop

Chris' Lecture:
VISTA for Impacted Cuspids

* 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!"

Digital Orthodontics, 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

"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 LECTURER

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.

Invisalign® Treatment for Bimaxillary Protrusion

Abstract

Clear aligners have been increasingly utilized by orthodontists in recent years; however, there are some limitations when treating complex malocclusions and extraction cases with this approach. When clear aligners are the exclusive treatment method, it can be difficult to achieve (1) space closure for four extracted premolars, (2) proper inclination of anterior teeth, and (3) adequate posterior anchorage. The Invisalign G6 solution with mini-screw anchorage has created more options for predictable tooth movement across a wider range of malocclusion types. A 24-year-old female presented with chief complaints of protrusion and crowding of the dentition. Treatment involved extraction of four first premolars followed by aligner treatment using two miniscrews for anchorage. The malocclusion was corrected with no adverse effects, and a normal occlusion was achieved. The patient was extremely satisfied with the treatment results. (J Digital Orthod 2021;63:20-36)

Key words:
Bimaxillary protrusion, premolar extraction, clear aligner treatment, Invisalign aligners, Invisalign G6, mini-screws, space closure, anchorage control, torque control

Introduction

In recent years, an increasing number of adult patients are seeking orthodontic treatment[1-3] and expressing a desire for more esthetic and comfortable alternatives to conventional fixed appliances.[2,4] The field of orthodontics has been revolutionized by technological advancements. In 1997, Align Technology , Inc. (*Santa Clara, California*) introduced Invisalign® as the pioneering clear aligner system for comprehensive orthodontic treatment.[5] The Invisalign appliance involves a series of plastic aligners made of 0.75mm polyurethane material, incorporating computer-aided design (CAD), computer-aided manufacturing (CAM) technology, and specialized laboratory techniques.[6] Patients are instructed to wear a pair of aligners for a period of 1-2 weeks and a minimum of 20 hours per day. Each aligner is programmed to produce a precise movement on a tooth of about 0.15-0.25mm.[5,7] With the development of dental materials and 3D technology, clear aligners have become an increasingly popular choice for patients, especially for those with high appearance or speech demands.

The primary focus of the Invisalign system when it was initially designed was to solve cases of mild to moderate crowding and to close small spaces. Invisalign has continued to evolve with the development of new aligner materials, attachments on teeth, staging of tooth movement, in addition to incorporation of inter-proximal reduction and interarch elastics, to address a wider range of malocclusions.[5,8,9] Thus, clinicians who plan to use clear aligners on their patients must rely on their clinical experience, the opinions of experts, and limited published evidence.[10] Despite its widespread use, clear aligners have limitations when it comes to producing tooth movements such as intrusion of posterior teeth, extrusion of anterior teeth, and root torquing.[8,11-13] Specifically, clinicians have

Chao Pan,
Director, Orthodontic Department, Jiangxi Bybo Dental Hospital
Lecturer, Beethoven Orthodontic Course (Left)

Sophia Shu,
Lecturer, Beethoven Orthodontic Course (Center left)

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

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

encountered difficulties with bodily movement of teeth in extraction cases in which anterior torque loss and tipping of teeth into extraction sites have been problematic.[14,15] Therefore, both molar anchorage control and incisor torque control during space closure are vital for orthodontic treatment of patients requiring extractions.

Considering the complexity of extraction biomechanics with clear aligners, using the ClinCheck® program (*Align Technology Inc., Santa Clara, California*) allows clinicians to plan and design treatment with a predicable outcome. It provides an end-goal guided treatment plan that can be visualized not only at the beginning and the end, but also step by step (*aligner by aligner*)

Fig. 1: Pre-treatment extraoral and intraoral photographs

throughout the treatment.[16] In 2015, the Invisalign G6 approach introduced SmartForce (*optimized anchorage attachment on posterior teeth and optimized retraction attachment on the canine*) and SmartStage (*optimized tooth movement stage*) to provide maximum posterior anchorage while preventing unfavorable tipping of the teeth during space closure.[17,18] In addition, miniscrews can also provide indirect posterior anchorage by holding the molars in position while anterior segments are retracted with clear aligners.[15] By fixing the miniscrews to the attached molars, patients only need to wear the aligners regularly instead of using additional elastic bands for anchorage. This allows the spaces for the extracted first premolars to close effectively with a minimum of anchorage loss. With proper lingual root torque produced by the stiffness of the aligner, bodily retraction (*translation*) of the anterior teeth can be achieved.

The dental nomenclature for this report is a modified Palmer notation. Upper (*U*) and lower (*L*) arches, as well as the right (*R*) and left (*L*) sides, define the four oral quadrants: UR, UL, LR and LL. Teeth are numbered 1-8 from the midline in each quadrant, e.g., a lower right first molar is LR6.

Diagnosis

A 24-year-old female patient presented with a chief complaint of protrusive dental profile, which affected her confidence and willingness to smile. The patient's medical and dental histories were unremarkable. She demonstrated acceptable oral hygiene, and her motive for the consultation was to improve her smile with clear aligner treatment.

Pre-treatment facial photographs showed that the patient had balanced facial proportions and a low smile line (*Fig. 1*). Analysis of the pre-treatment diagnosis records revealed Class I molar relationship (*end-on Class I and Class II tendency*), with a bilateral Class II canine relationship (*Fig. 1*). The patient had bimaxillary protrusion with an overjet and overbite of 5mm and 3mm, respectively. She showed moderate crowding in both arches, and the anterior Bolton ratio was 74.2%. Her mandibular midline was deviated 1mm to the right. The panoramic radiograph showed both mandibular third molars were impacted with a mesial (*horizontal*) orientation (*Fig. 2*). The cephalometric analysis confirmed a normal skeletal relationship (*Fig. 2; Table 1*).

Treatment Objectives

The treatment objectives were to (*1*) reduce the patient's anterior protrusion to improve her lip profile; (*2*) achieve normal overjet and overbite; (*3*) maintain bilateral Class I molar relationship; (*4*) achieve bilateral Class I canine relationship; (*5*) coordinate the deviated dental midlines with the facial midline; and (*6*) align the arches.[18]

Treatment Alternatives

The focus of the current treatment plan was to address the principal concern: protrusion. A non-extraction treatment approach was considered, which involved development of a more rounded arch form with Invisalign aligners,[19] inter-proximal reduction (*IPR*) to relieve the crowding, and extraction of all third molars to enhance the potential for anterior retraction.[19] However, this

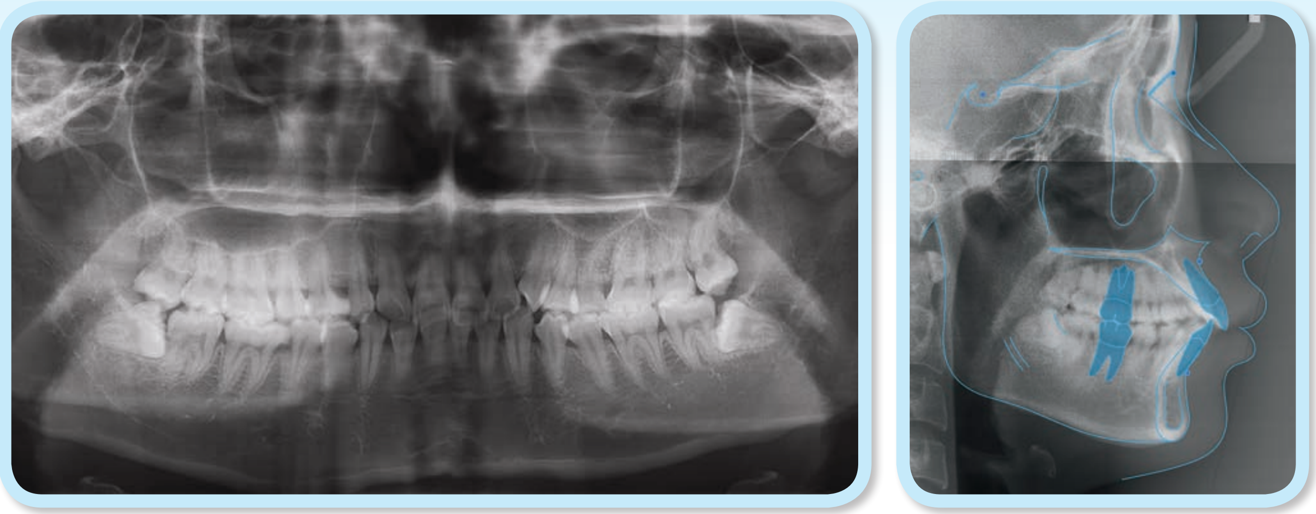


Fig. 2: *Pretreatment panoramic radiograph (left) and lateral cephalometric radiograph with an overlay tracing (right)*

approach was inadequate to effectively address the patient's anterior protrusion. Thus, an alternative approach involving extraction of four first premolars, followed by Invisalign treatment in conjunction with miniscrew anchorage, was chosen. Two 2x12-mm miniscrews were planned to be installed bilaterally in the infra-zygomatic crest (*IZC*) extra-alveolar (*E-A*) area. A stainless steel ligature wire with flowable resin to stabilize the connection between the molar and the miniscrews was used to enhance anchorage of the stabilized molars. Since maxillary wisdom teeth often have no occlussal contact, they may be extracted. However, for additional molar anchorage the upper third molars were included in the posterior anchorage unit.

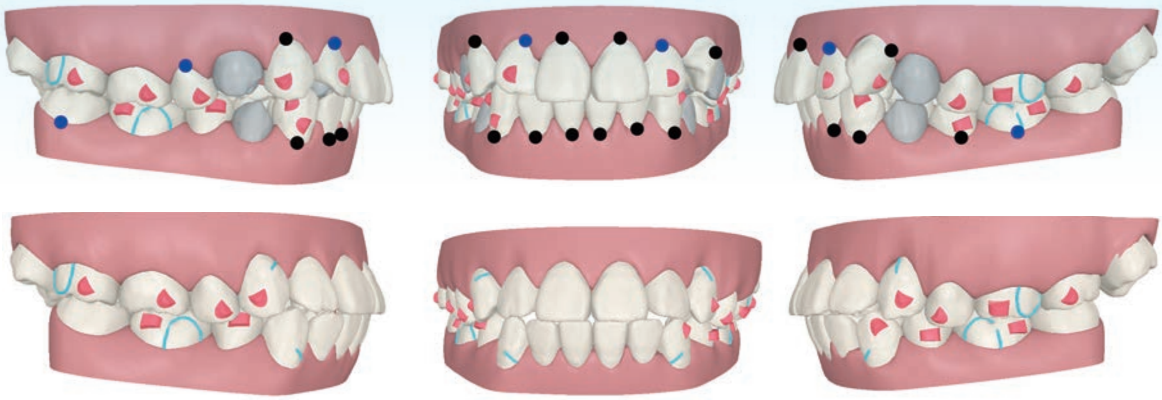
Treatment Progress

The preparation included initial assessment, diagnosis, treatment planning and completion of the pre-treatment records (*e.g., panoramic and lateral cephalometric radiographs, bite registration, photos and polyvinyl siloxane impressions*), all of which had to be sent to Align Technology, where a simulated virtual treatment was formulated by proprietary 3-dimensional CAD-CAM technology. From the virtual treatment set-up, evaluation of the proposed final positioning of the teeth was shown on ClinCheck® (*Align Technology, Inc., Santa Clara, California*). Clinicians can modify and formulate a precise treatment plan by using auxiliary attachments or adjustments for sequential staging.[8] Managing anterior dental inclination and lingual root torque will be discussed later (*Fig. 3*).

This treatment was conducted in two phases, as detailed below. The patient was seen only during the vacations because she lived in a different city; however, a video link was used for conversation and to ensure satisfactory oral hygiene and aligner fit.

Initial Treatment Phase

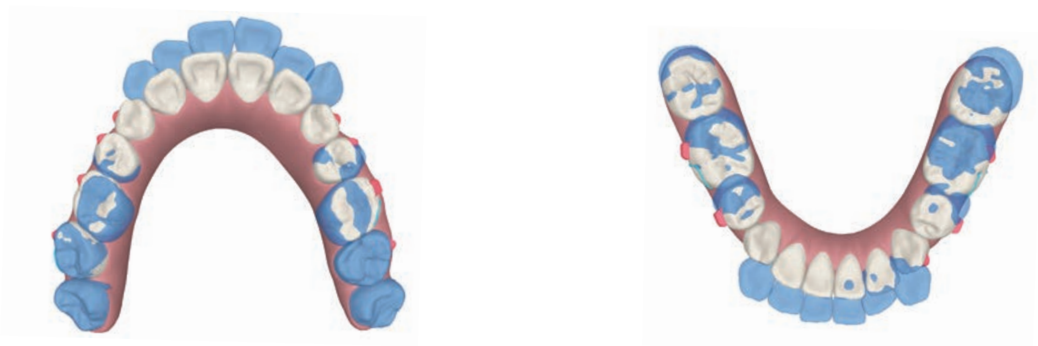
The major goals of the treatment phase were to



■ *Fig. 3*:
Initial treatment phase according to the ClinCheck® treatment plan. Blue dots indicated variably predictable tooth movement (UR5 and LR7 intrusion 0.5-1mm; UR2 rotation 30-40%; UL2 root intrusion >6mm; LL6 intrusion 0.5-1mm); black dots indicated less predictable tooth movement (intrusion for lower incisors >3 mm; root movement for upper right canine > 6 mm; UR1 and UL1 intrusion >3mm).

retract the anterior teeth in both arches (*Fig. 4*), and intrude the upper anterior segment. A total of 83 sets of aligners were used over 20 months. The patient was instructed to change the aligners every 7 days. Optimized Root Control Attachments were used on the canines, and Optimized Anchorage Attachments were placed on the posterior teeth (*Fig. 5*). Pontics replaced the missing teeth. IZC miniscrews were placed when the 23rd set of aligners was delivered, and a buccal button cutout was used on UR7 and UL6 to reserve space for button attachments. A 0.02 inch ligature wire was used to tightly connect the buttons and the miniscrews. The wire surface was covered with flowable resin and was light cured to prevent mucosa irritation (*Fig. 6*).

The tooth movement was similar to ClinCheck® simulations throughout the first series of aligners (*Fig. 7*). Facial and intraoral photographs taken at the completion of the initial treatment phase are shown in Fig. 8.



■ *Fig. 4*:
Initial treatment phase: ClinCheck treatment plan with superimposition (blue: initial arch form, white: simulated arch form after treatment). Maximum anchorage was planned using in the upper arch and moderate anchorage in the lower arch.

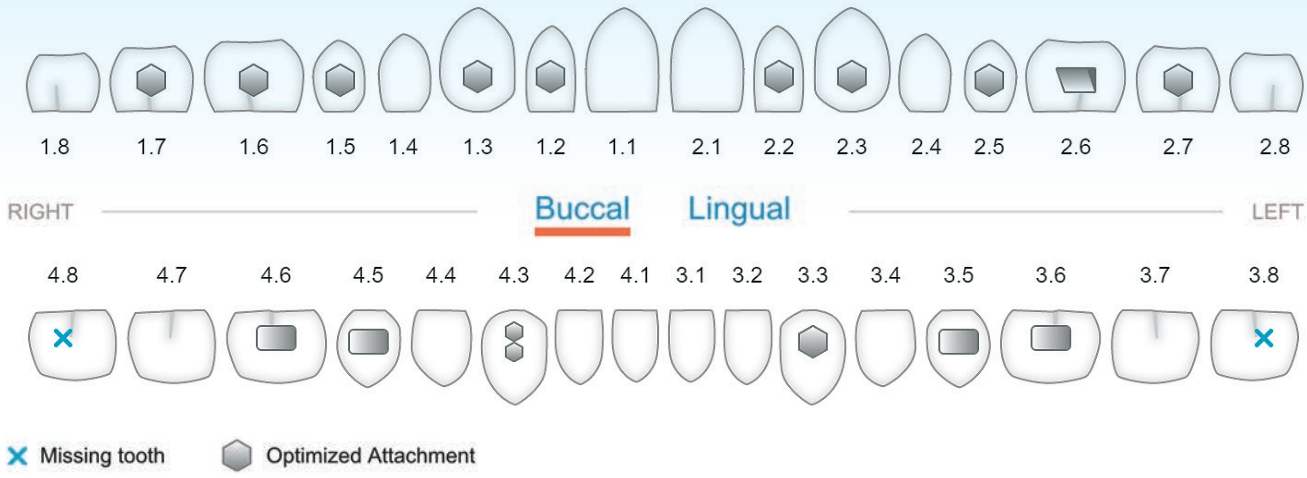


Fig. 5:
Initial treatment phase: Invisalign® treatment sheet. SmartForce® features (optimized attachments) of the Invisalign G6 solution to maximize posterior anchorage and for bodily movement during canine retraction.

Fig. 6:
Two 2x12-mm miniscrews were installed bilaterally in the infrazygomatic crest (IZC) extra-alveolar (E-A) area with the ligature wire covered with flowable resin to connect the molar and miniscrew together in order to enhance molar anchorage bilaterally.

Refinement Phase

Refinement was conducted for correction of the Class II canine relationship on the left side by retracting the upper right quadrant by 1mm (*Fig. 9*).

There were no visible black triangles, so IPR was not necessary. In the finishing stage, heavy occlusal contacts on posterior teeth were corrected. Since both upper canines required further retrusion, a buccal button cutout and Class II mechanics were implemented to attach the elastics from upper canine to mandibular first and second molars.

Retention

Essix retainers for both arches were delivered. The patient was instructed to wear them full time for the first 6 months after the treatment and nights only thereafter. Instructions were provided for home care, as well as for maintenance of the retainers.

■ *Fig. 7:*
A panel of progressive intraoral photographs from the left buccal view are shown in comparison with ClinCheck simulations (left: 5M, 23/83 aligner; center: 14M, 59/83 aligner; right:19M, 83/83 aligner). Lingual buttons were used on the first and second molars bilaterally for Class II elastic anchorage.

■ *Fig. 8:*
Extraoral and intraoral photographs document the results of the initial treatment phase. Neither canines were adequately protruded, and lack of occlusal contact on the molars was noted. Lingual buttons were used on the first and second molars bilaterally for Class II elastic anchorage.

Fig. 9:
Refinement phase: ClinCheck® treatment plan with superimposition. Midline shifted 1mm to the left, both upper canines extruded 1mm, and molars with heavy occlusal contacts.

Treatment Results

The total treatment duration was 25 months with a total of 99 aligners (83+16). Post-treatment records showed that all treatment objectives were achieved, with good esthetics and occlusal results (*Fig. 10*). In addition, good root parallelism was maintained (*Fig. 11*). The upper and lower incisors were retracted and up-righted, improving the patient's lip profile and facial esthetics (*Table 1; Fig. 12*). Normal overjet and overbite were also achieved. Class I molar relationship, within end-on Class I, Class II tendency, and Class II canine relationship were all corrected to Class I. The upper and lower midlines are generally coincident with the facial midline. Overall, good alignment, angulation, and inclination of the dentition was achieved. The patient was highly motivated and compliant in wearing aligners and elastics. She was extremely happy with the treatment results. Arrangements will be made in the future for extraction of the upper third molars.

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	90°	90°	0°
SNB° (80°)	85°	85°	0°
ANB° (2°)	5°	5°	0°
SN-MP° (32°)	22°	22°	0°
FMA° (25°)	20°	20°	0°
DENTAL ANALYSIS			
U1 To NAmm (4mm)	5	0	5
U1 To SN° (104°)	113°	110°	3°
L1 To NBmm (4mm)	9	5.5	3.5
L1 To MP° (90°)	108°	106°	2°
FACIAL ANALYSIS			
E-LINE UL (-1mm)	3	-1	4
E-LINE LL (0mm)	3	-1.5	4.5
Convexity: G-Sn-Pg' (13°)	15°	11°	4°
%FH: Na-ANS-Gn (53%)	56%	55%	1%

Table 1: Cephalometric summary

Fig. 10: Post-treatment extraoral and intraoral photographs

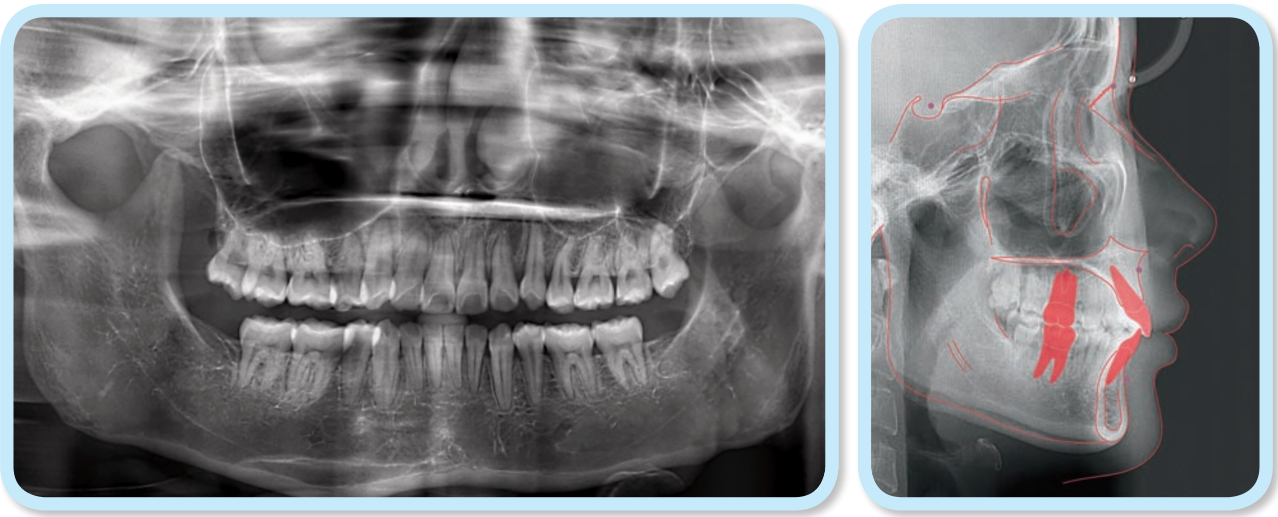


Fig. 11: Post-treatment panoramic radiograph (left) and lateral cephalometric tracing (right). Note the root parallelism.

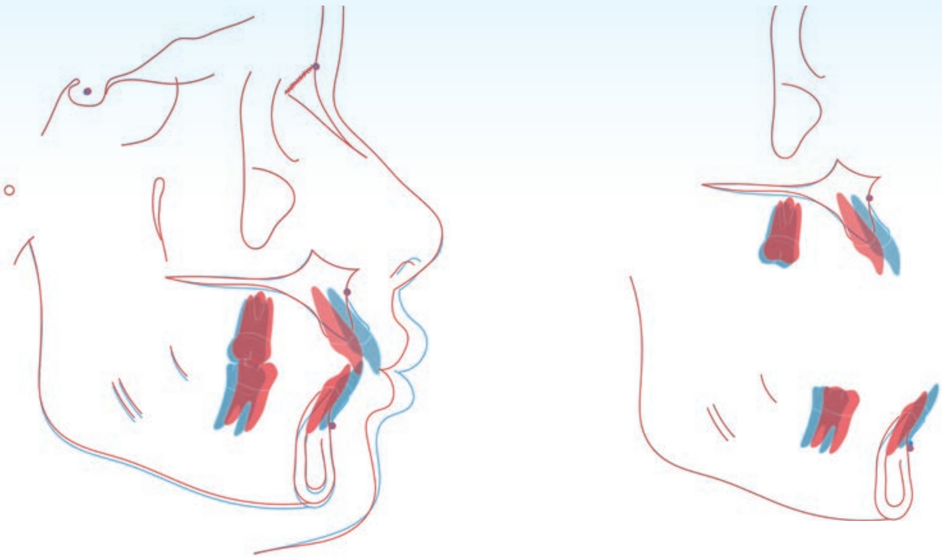


Fig. 12:
Superimposed tracings of the pretreatment (blue) and post-treatment (red) lateral cephalometric radiographs. Bimaxillary protrusion was resolved dramatically.

Discussion

Bimaxillary protrusion and dental crowding are orthodontic problems commonly observed among Asian populations.[20,21] Treatment for these complex issues often involves extraction of the four first premolars to correct bimaxillary protrusion and crowding in patients with Class I malocclusions. Retracting both maxillary and mandibular anterior teeth and closing the extraction spaces can improve lip protrusion and facial profile.[20,22] However, one concern with premolar extraction cases involves maintaining root parallelism of the teeth adjacent to the extraction spaces during space closure. Simon et al.[23] analyzed premolar rotations of >10 degrees, while Nguyen and Chen[24] reported 39% of the predicted rotation on canines and premolars. Uncontrolled tipping plus space closure results in tipping of canines, suggesting that there might be greater difficulties achieving mesiodistal movements for teeth with larger roots. In other words, aligners can easily tip crowns but cannot move roots because of the lack of control on the tipping movement. Using the Invisalign G6 solution with attachments on the tooth surface and timely-staged movements may reduce unwanted tipping and increase the predictability of tooth movement. If rotation control is not adequate, it is recommended to plan overcorrections beyond the ClinCheck program simulation to improve the accuracy of the movement.

The other most common side effects for extraction and retraction patients are lingual tipping and extrusion of the anterior teeth (*Drawstring/ Pendulum Effect*). In order to avoid this problem on the Clincheck treatment plan, simply add more lingual root torque and intrusion of the anterior teeth, as seen in Fig. 13. The image on the left displays a digital model of the final stage of the inital treatment plan. The image on the right shows the actual situation of the anterior teeth in which additional lingual root torque and intrusion was implemented. When using aligner treatment, increasing the lingual root inclination by 5°-10° is necessary when retracting the anterior teeth. This means the retraction distance is directly related to the lingual root torque required. Unfortunately, there is currently no specific formula for calculating the extent of increment. Instead, it can only be monitored and adjusted in a clinical settling. In this case, since the patient had a low smile line, slight exposure or extrusion of the anterior teeth would be acceptable. Therefore, no additional device was necessary for intrusion.

Another concern for premolar extraction cases is during the active retraction of the anterior teeth, which may cause mesial movement of the first molars and unwanted anchorage loss. Newton's third law of motion states that for every type of movement an equal and opposite reactive force is generated.[25] In order to increase anchorage resistance and avoid undesirable side effects on anchoring teeth, temporary skeletal anchorage devices (*TSADs*) such as miniscrews can be used as maximum anchorage to enhance appropriate tooth movement. There are two main methods of connecting miniscrews to the patient's dentition: "*direct anchorage*" (*Fig. 14*) and "*indirect anchorage*" (*Fig. 15*) approach.[26] Direct anchorage mechanics or the direct loading of the miniscrew is comprised by a setup, where an elastic module spans from the miniscrew to the tooth (*or a group of teeth*) that should be moved. With the indirect anchorage approach, the miniscrew serves as an indirect loading mechanism in which a non-elastic element spans from the anchorage screw to the tooth unit that ideally should remain stationary.[27,28] In other words, indirect anchorage utilizes a non-rigid, tightly wound steel ligature tie to keep the miniscrew and the tooth together, which allows resistance of the applied force and maintains the distance between the screw and the tooth in the plane of the force. In cases involving first premolar extraction, using the indirect anchorage mechanism maintains the molar position with an orthodontic miniscrew when performing anterior en-mass retraction.[26,29]

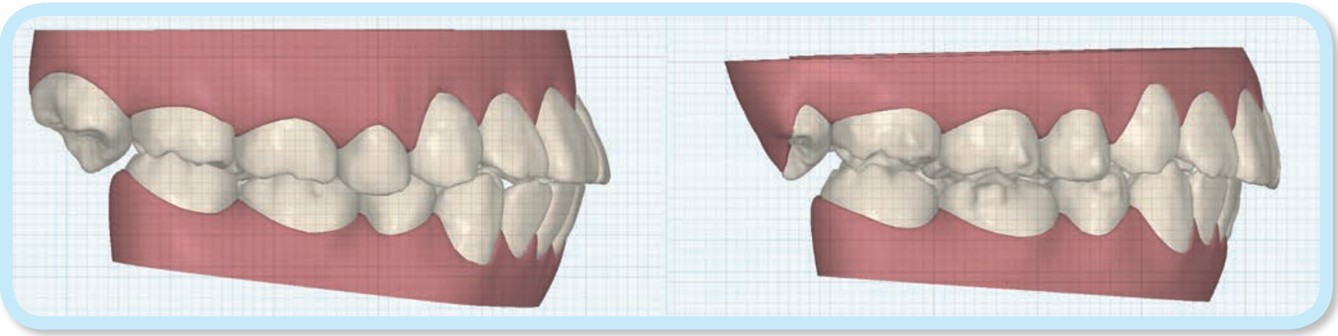


Fig. 13: The left image shows the simulated target position. The right image is the actual situation at the end of the initial stage treatment.

Using indirect anchorage approach, a 0.02 inch ligature wire was covered with light-cured flowable resin as a rigid attachment to connect the miniscrew and the button attachment on the molar as seen in Fig. 15. This treatment has the advantage of allowing the patient to eliminate the complication of wearing elastics; however, there are several disadvantages, which are listed below:

1. Having multiple devices in the mouth simultaneously is a hygiene problem which may elicit gingival inflammation around the miniscrew which results in bone resorption and miniscrew failure.

■ *Fig. 14*:
Direct anchorage approach uses an elastic to connect the miniscrew to the aligner at the canine incision cut.

■ *Fig. 15*:
Indirect anchorage approach using a 0.02 inch ligature wire covered with light-cured flowable resin is used as a rigid attachment to connect the miniscrew and the button attachment on the molar.

2. Even though the connected tooth is expected to be stabilized by the miniscrew, in reality, tooth movement does occur due to routine chewing, which may cause the miniscrew to loosen and fail.

3. Since the fixed tooth is closely connected to the miniscrew, if the miniscrew becomes loose it is difficult to detect mobility until the anchorage is completely lost.

4. When using an aligner to retract the anterior teeth, the reaction force is transmitted to the molars, and subsequently to the miniscrew, which may result in loss of anchorage.

In summary, the best method for enhancing anchorage is to connect an elastic from the aligner through the incision cut to the miniscrew (*Fig. 14*).

Conclusions

Closing extraction space with Invisalign appliances alone can be challenging. However, it is important for the clinician to evaluate the patient carefully to prescribe an appropriate therapy. A thorough understanding of the principles of the applied mechanics and anchorage for each tooth movement is necessary in order to achieve a predictable clinical outcome and to avoid unnecessary side effects.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. The patient has provided consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Acknowledgements

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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 = 3

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 = 2

OCCLUSION

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

Total = 4

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 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. = 4

1 to MP ≥ 99° = 1 pt.

Each degree > 99° 9 x 1 pt. = 9

Total = 15

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 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. =	________
Addl. treatment complexities	________	x 2 pts. =	________

Identify:

Total =

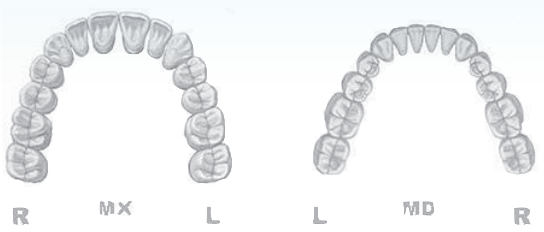
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 20

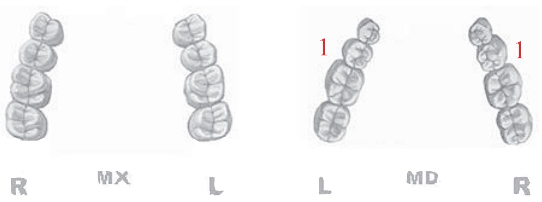
Alignment/Rotations

0



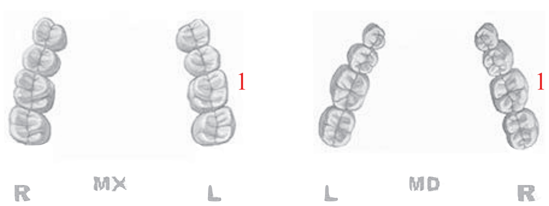
Marginal Ridges

2



Buccolingual Inclination

2

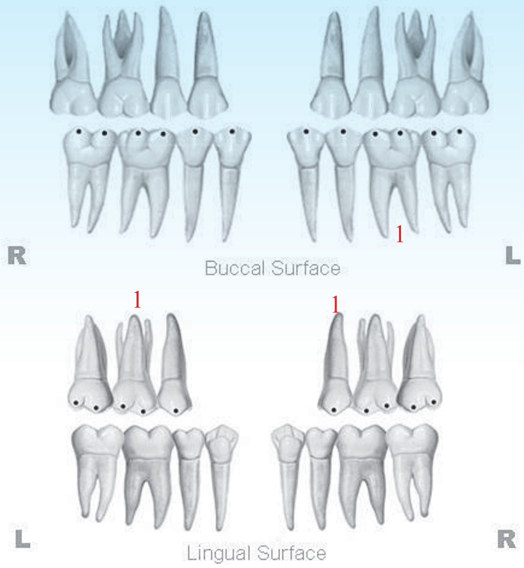


Overjet

5

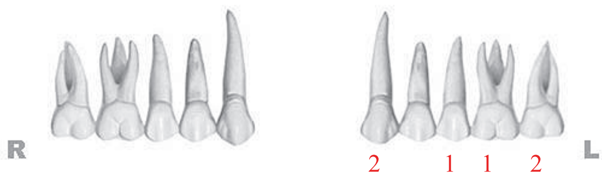
Occlusal Contacts

3



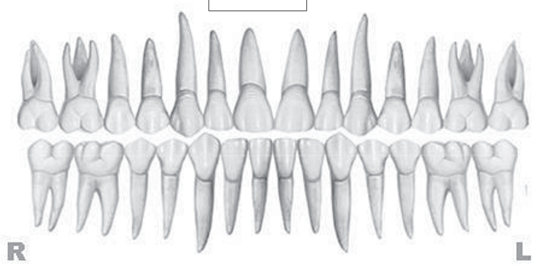
Occlusal Relationships

6



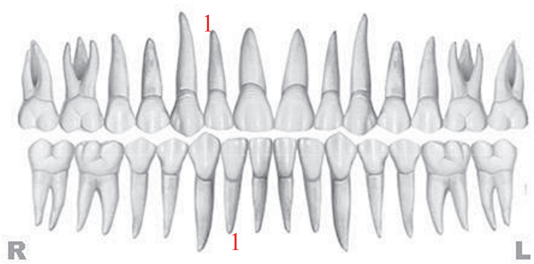
Interproximal Contacts

0



Root Angulation

2



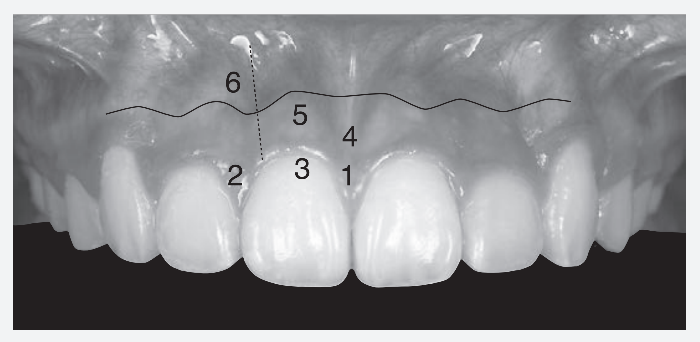
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

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

Total Score: = 2

1. Pink Esthetic Score

Total = 0

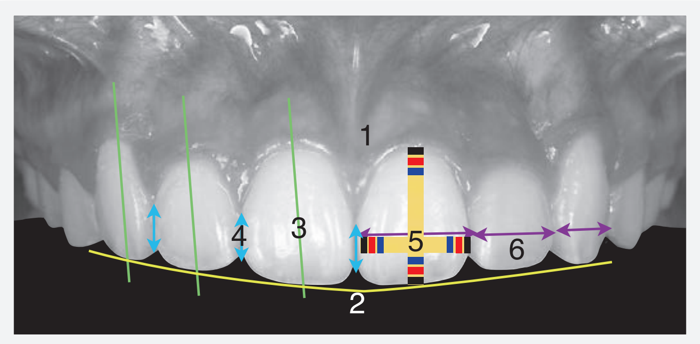


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

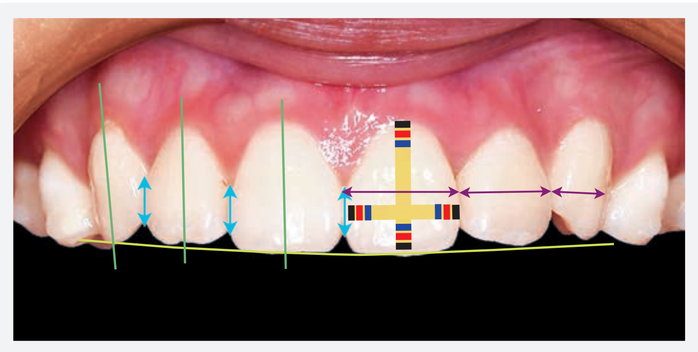
1. M & D Papilla	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

2. White Esthetic Score (for Micro-esthetics)

Total = 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



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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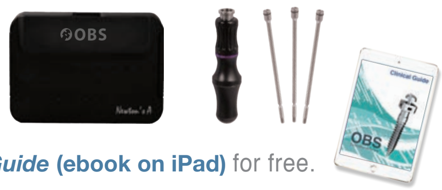

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Reference: Failure Rates for SS and Ti-Alloy Incisal Anchorage Screws: Single-Center, Double Blind, Randomized Clinical Trial (J Digital Orthod 2018;52:70-79)

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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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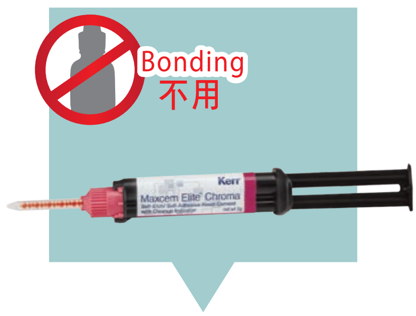

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Aligner Treatment for Class III Malocclusion with Anterior Crossbite

Abstract

***Introduction**: A 19-year-old male came for consultation for a protrusive mandible and an unesthetic smile. He was previously advised against his preference for clear aligner therapy by other orthodontists.*

***Diagnosis & Etiology**: His facial profile was concave, and the cephalometric analysis indicated a skeletal Class III relationship (ANB -2°). The diagnosis was a skeletal Class III malocclusion with an anterior crossbite and an overjet of -2mm. No functional shift was noted. The molar relationships were end-on Class III bilaterally.*

***Treatment**: The treatment plan was to retract the lower arch with aligners. Class III intermaxillary elastics were added to increase anchorage. Occlusal attachments were installed on the LL6 and LR6 to correct the anterior crossbite. In the 9th month, the anterior crossbite was resolved. The patient finished his first set of aligners in the 14th month. A refinement phase was then initiated to improve the final occlusal outcome.*

***Results**: The total treatment time was 19 months. Overall, the case, with a Discrepancy Index (DI) of 11, was treated to a Cast-Radiograph Evaluation (CRE) of 6 and a Pink & White esthetic score of 2. (J Digital Orthod 2021;63:42-56)*

Key words:

Aligner, Class III malocclusion, anterior crossbite, Class III intermaxillary elastics, occlusal attachment

Introduction

The dental nomenclature used in 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, the permanent teeth are numbered 1-8.

Aligners have been evolving for years. In the beginning, they could only treat mild malocclusion cases.[1,2] Considerable effort explored the possibilities and limitations of aligners. Although research in 2017 implied there were still many limitations,[3] the advancement of materials, artificial intelligence, and experience with more difficult cases has considerably extended the capability of aligner treatment.[4-7] Class III camouflage treatment is common but challenging when using braces.[8-10] Aligners combined with Class III intermaxillary elastics is not common. Treatment strategies for correcting anterior crossbites with a deep bite are even more unusual.

This case report describes the non-surgical treatment of a Class III jaw relationship with end-on Class III molar relationship and a Discrepancy Index of 11. With proper design of a Class III mechanism, this interesting case was completed with a normal occlusion and good esthetic results.

Bear Chen,
Associate Director, 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)

History and Etiology

A 19-year-old male sought orthodontic consultation for a protrusive mandible and unesthetic smile. No contributing medical or dental histories were reported. A clinical examination revealed a concave facial profile and lower lip protrusion. From the frontal view, his face was symmetrical. When he smiled, the upper

■ *Fig. 1:*

Pre-treatment facial and intraoral photographs. The facial profile was concave. UR1 and UL1 were blocked in by restorations on the LR1 and LL1. There was an end-on Class III relationship bilaterally.

central incisors were barely visible. Intraorally, the molar relationships were bilateral end-on Class III. The upper central inciosrs were significantly extruded about 4mm to the maxillary occlusal plane. It follows that there was a 4mm discrepancy between the gingival levels of the upper central incisors and lateral incisors. The UL1 was worn away on the disto-incisal angle. A dynamic examination of mandibular motion revealed a functional shift from left to right. The LL1 and LR1 were splinted crowns and all 3rd molars were present (*Figs. 1 and 2*).

■ *Fig. 3:*
Pre-treatment cephalometric radiograph. Overjet was -4mm, and overbite was 6mm. The lower lip was more protrusive than the upper lip.

The cephalometric analysis indicated skeletal Class III (*ANB -2°*) and the FMA were normal (*30°*). The upper and lower incisor axes were both upright (*Fig. 3; Table 1*). The upper lip was 5mm behind the E-line, resulting in a relatively protrusive lower lip.

The patient's mouth opening was 40mm without a deviation. Although the condylar shapes were asymmetrical, the temporomandibular joint (*TMJ*) clinical examination did not reveal any clicking, crepitation, or pain with palpation in the porus acusticus externus. However, a compressed disc space was noted on the right side, indicating a functional shift (*Fig.4*).

■ *Fig. 2:*
Left: The panoramic film showing the endodontically-treated LR1 and LL1 were splinted together with single crowns.
Center: UR1 and UL1 were extruded 4mm. UL2 disto-incisal angle was worn.
Right: In a lateral view, all upper incisors were in full or partial crossbite. The cervical third of the central incisors could barely be seen.

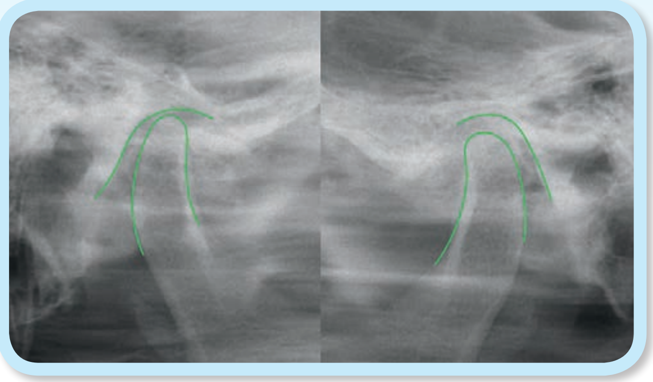


Fig. 4:
TMJ transcranial radiographs show asymmetrical condyle heads. The right one was compressed due to anterior crossbite, which may imply functional shift. To verify that, a C_O/C_R discrepancy test was necessary.

Diagnosis

Skeletal:

- Sagittal relationship: *Skeletal Class III, protruded mandible*
- Mandibular plane angle: *Normal*

Dental:

- Occlusion: *End-on Class III bilaterally*
- Overjet/overbite: *-4mm/6mm*

Facial:

- Convexity: *Concave*
- Lip protrusion: *Protrusive lower lip (3mm)*

The American Board of Orthodontics (*ABO*) Discrepancy Index (*DI*) was 11, suggesting the malocclusion would be more readily treated with fixed appliances, compared to aligners. Details for the DI are shown in the supplementary Worksheet 1.

Treatment Objectives

The treatment objectives were to: (*1*) correct the crossbite, (*2*) establish functional Class I molar and canine relationships, (3) retrude the lower lip, and (*4*) align the upper and lower midlines.

Treatment Plan and ClinCheck

The treatment was designed to first retract the lower arch about 2mm and then expand it 2mm. Incisor

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	82°	82°	0
SNB° (80°)	84°	84°	0
ANB° (2°)	-2°	-2°	0
SN-MP° (32°)	30°	31°	1°
FMA° (25°)	23°	24°	1°
DENTAL ANALYSIS			
U1 To NAmm (4mm)	4	8	4
U1 To SN° (104°)	100°	112°	12°
L1 To NBmm (4mm)	3	1	2
L1 To MP° (90°)	82°	69°	13°
FACIAL ANALYSIS			
E-LINE UL (-1mm)	-5	-5	0
E-LINE LL (0mm)	0	-3	3
%FH: Na-ANS-Gn (53±3%)	52%	53%	1%
Convexity: G-Sn-Pg' (13°)	4°	5°	1°

Table 1:
Pre- and post-treatment cephalometric analysis. ANB remains unchanged. However, the angle of U1 to SN increased 12°, and the angle of L1 to MP decreased 13°. The lower lip was retracted 3mm.

Fig. 5: *ClinCheck*

42 stages were designed to treat the patient. The following goals were prescribed. (1) Expand and retract the lower arch by 2mm and 1mm respectively. (2) Intrude the upper and lower incisors. (3) Perform precision cuts on both lower canines, with cutouts on both upper molars for Class III intermaxillary elastics. (4) Overcorrect the overjet with 0.5mm overbite.

intrusion planned was 4 and 2mm for the upper and lower arches, respectively. Class III intermaxillary elastics were planned for occlusal attachments to correct the anterior crossbite. The aligner treatment was set to finish with a 0.5mm overbite and 0.5mm overjet. 42 stages were designed to solve the malocclusion, 10 days for each stage. Additional aligners could be needed (*Fig. 5*).

Treatment Alternatives

The patient refused fixed appliance treatment although that was clearly the most efficient approach.

Orthognathic surgery would be the best way to correct the skeletal discrepancy and asymmetry, but it is expensive and risky. The patient flatly refused.

Treatment Process

All attachments were bonded in the 2nd stage, and the patient was instructed to use the aligner seater every time he wore the aligners.

By the 11th stage (3rd *month*), the occlusal attachments were prescribed on the LR6 and LL6 to open the occlusion. Meanwhile, the upper central incisors started to flare (*Fig. 6*).

By the 17th stage (6th *month*), the UR6 and UL6 buccal side of the aligners were cut out, and buttons for Class III intermaxillary elastics were bonded. Precision cuts were designed on LR3 and LL3 (*Fig. 7*).

By the 26th stage (9th *month*), the anterior crossbite was corrected, and the molar relationships were Class I (*Fig. 8*).

■ *Fig. 6:*

In stage 11, virtual occlusal attachments were placed on LR6 and LL6 to disocclude the arches. The aligner was strong enough to confront the force of occlusion; therefore, it was not necessary to bond a resin core on the occlusion. Hence, the patient was more comfortable inserting and removingthe aligners. An excellent disocclusion effect due to occlusal attachments is shown in the frontal view on the right.

By the 42nd stage (*14th month*), nearly all the problems were solved (*anterior crossbite, Class III, deep bite*). When the results were compared with ClinCheck®, they were very similar. Because the objective was to overcorrect overjet and overbite, additional aligners were needed for finishing (*Fig. 9*). There were nine additional aligner stages.

■ *Fig. 7:*

Cutouts were made on the UR6 and UL6, and then buttons were bonded. Precision cuts were made on the LR3 and LL3. Class III intermaxillary elastics were prescribed for full-time wear.

After 19 months of active treatment, all appliances were removed, and retention was accomplished with upper and lower clear overlay Vivera® retainers.

Treatment Results

The patient was well satisfied with his esthetic and functional occlusion (*Fig. 10-12*). The Class III malocclusion was successfully resolved, and the protrusion of the mandible improved considerably. No temporary skeletal anchorage devices (*TSADs*) were placed. The anterior crossbite, functional Class I molar position, and canine relationships were successfully established. Excellent dental alignment was achieved as evidenced in the ABO CRE score of 6 points, shown in the supplementary Worksheet 2.

■ *Fig. 8:*

With a correctly designed orthodontic mechanism, the end-on Class III, anterior crossbite, and deep bite were all resolved with 26 stages (9 months).

Fig. 9 :
42 stages were designed to treat the patient, and the result was nearly identical to the ClinCheck®. The patient wore the aligners full time, except when eating and brushing teeth. Good patient compliance was the key to successful treatment.

The superimposed cephalometric tracings show that the proclination and intrusion of the upper incisors, as well as the retroclination of the lower incisors, were the keys to this case (*Fig. 11*). Due to the Class III intermaxillary elastics, the occlusal plane rotated counter-clockwise. Furthermore, the increase of vertical dimension rotated the mandible clockwise. The ANB remained unchanged. The FMA increased 1° (*Table 1*; *Fig. 11*). The post-treatment TMJ transcranial radiographs show the condylar heads returned to a symmetrical morphologic and kinematic relationship (*Fig. 13*). The patient did not report any TMD signs or symptoms before, during, or after treatment. The post-treatment panoramic film shows good parallelism of all teeth except UL4 and UL5 (*Fig. 14*).

Fig. 10:
Post-treatment cephalomatric radiograph shows an orthognathic profile and Class I molar relationship. The anterior overjet was normal.

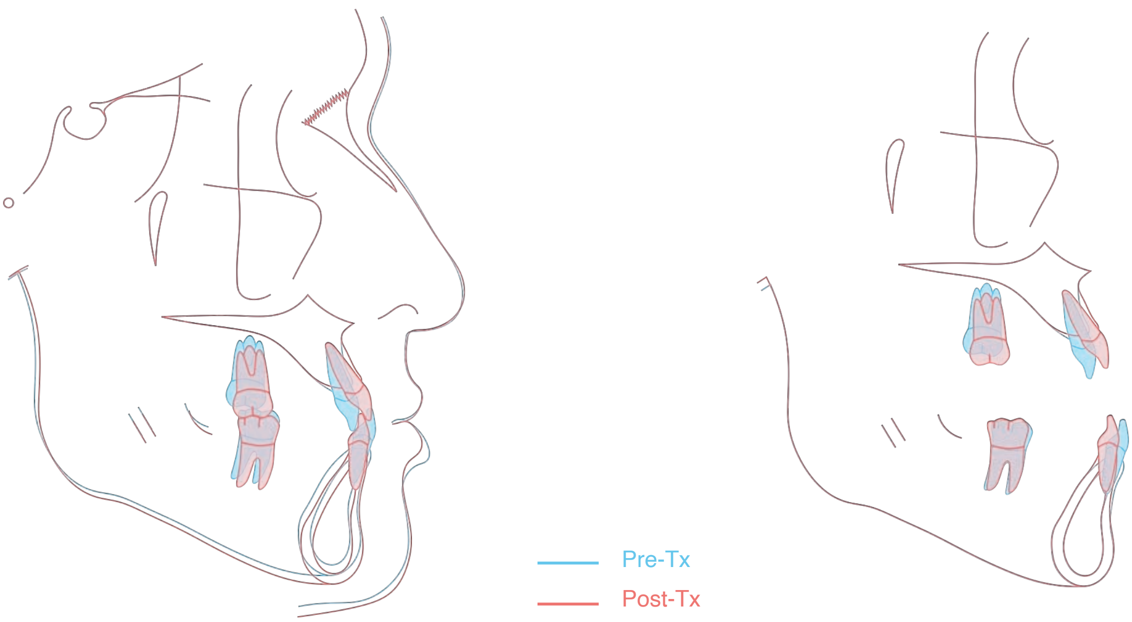
The Pink and White dental esthetic score is 2 points, as shown in the supplementary Worksheet 3.

Discussion

Opening the occlusion is the key to correcting crossbites, both anterior and posterior. When using brackets, glass-ionomer cement can be placed on the occlusal surfaces of the lower posterior teeth to correct anterior crossbites. To increase the efficiency, power ridges help with torque control (*Fig. 15*). An inclined bite plate can be created on the lower incisors. Also, the patient must be instructed to hook Class III intermaxillary elastics and use a tongue depressor everyday (*Fig. 16*).[9,11]

However, when using aligners, a bite plate cannot be used as it is impossible to wear the aligners and bite plate at the same time. Fortunately, an occlusal attachment on teeth can be designed to function as a bite turbo.

The greatest advantage of digital orthodontics is that tooth movements can be predicted. As indicated in the current patient's simulated animation, the duration of the crossbite correction would be from stage 11 to stage 26, so the occlusal attachments on LL6 and LR6 were placed during these stages to open the occlusion. The occlusal attachment is not like other optimized attachments for tooth movement; bonding of occlusal attachments is not necessary. All that was needed was the shape of the



■ *Fig. 11:*

Superimposed tracings indicate that the mandible moved in a clockwise direction due to counterclockwise rotation of the occlusal plane. The upper molars were extruded, and the upper incisors were flared and intruded. The U1-SN angle increased by 12°, and the L1-MP angle decreased by 13°. Although FMA increased, the patient did not complain about any TMJ discomfort.

Fig. 12: Post-treatment facial and intraoral photographs document the outcomes.
After 19 months of active treatment, the anterior crossbite, full-cusp Class III, and concave facial profile were corrected to a satisfactory result, with a good occlusal relationship. Open bite, which is common in Class III camouflage treatment, did not occur. The gingival level of the upper anterior teeth was aligned symmetrically. The curve of Spee was flattened.

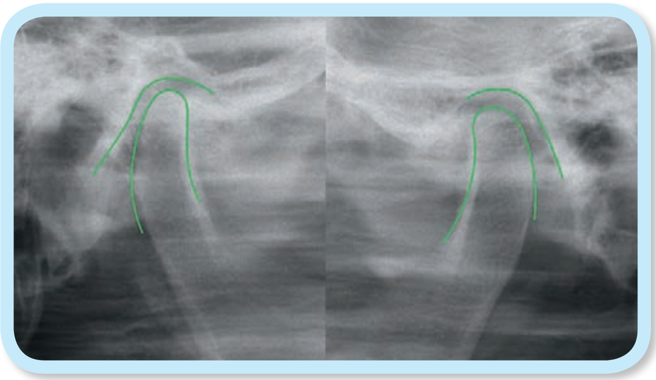


Fig. 13:
TMJ transcranial radiographs show that the right condyle compression was relieved after correction of the anterior crossbite.

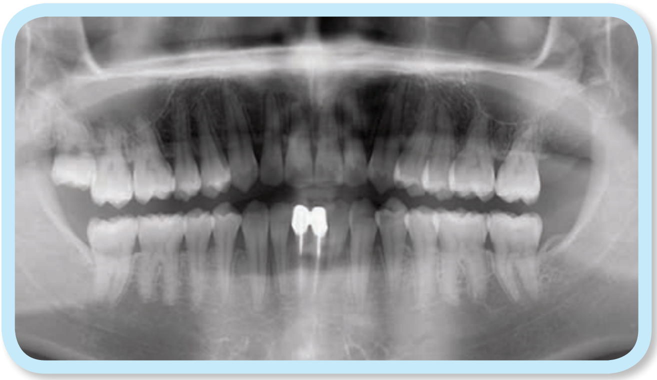
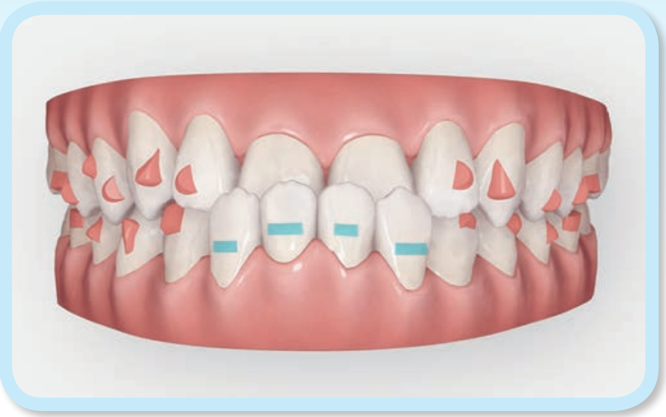


Fig. 14:
Post-treatment panoramic film shows good parallelism of all roots with mild root resorption. Extraction of the UR8 was suggested.



■ *Fig. 15:*
Power ridges are necessary if torque control is critical, especially for Class III and Class II mechanisms with a large scale of movement. For this patient, loss of torque on the lower anterior teeth (caused by Class III intermaxillary elastics) and lower arch retraction was expected, so power ridges were placed on the lower anterior teeth to increase torque.

■ *Fig. 16:*
To treat the anterior crossbite, an inclined bite plate was built on the lower anterior teeth to disocclude the arches. When combining Class III intermaxillary elastics and buccal shelf screws, many severe Class III malocclusions can be treated using camouflage treatment.

occlusal attachment on the aligner to separate both arches during wear. In addition, the patient must be instructed to wear Class III intermaxillary elastics and use tongue depressors daily. With these tools, it took only six months to correct the anterior crossbite.

When crossbite is encountered, it is usually accompanied by tooth attrition, meaning that these teeth are located in the path of mandibular movement. Unless mal-positioned teeth are corrected, attrition will likely reoccur. This patient's disto-incisal angle was worn, but it was decided not to restore it at the beginning of treatment. It was restored after the crossbite was corrected and prior to the 2nd treatment scan (*Fig. 9*).

The major treatment objective was proclining the upper incisors and retroclining the lower incisors.[8] The first step was to retract the lower molars. The aligners utilized other teeth in the same arch to provide anchorage to push the molars backwards up to 2mm. However, the anchorage was not enough to retract the premolars, so additional anchorage was needed from intermaxillary elastics or TSADs.[12] Therefore, the patient was instructed to wear Class III intermaxillary elastics to retract the lower premolars from stage 17 onwards. Since this was a Class III camouflage treatment, every necessary step to compensate for side effects was taken. It was important to control torque loss in the lower anterior teeth; therefore, power ridges were necessary to flare the lower anterior teeth. Nevertheless, the loss of the torque was still quite significant (*82° ⟶ 69°*) (*Figs. 11 and 15; Table 1*).

In 2014, G5 was introduced by Invisalign to resolve deep bites. By combining optimized attachments on the premolars with the pressure area on the incisors' lingual surfaces, a force from the aligners is produced, which can go through the long axis of the incisors. By extruding the premolars and intruding the incisors, the curve of Spee can be flattened and the overbite decreased (*Fig. 17*).[13,14] Using ClinCheck, absolute intrusion of the upper and lower incisors was planned. However, the superimposition (*Fig. 11*) shows the extrusion of the upper molars and the flaring of the upper incisors produced a relative intrusion of the upper incisors. Intrusion was also noted, for intrusion of the upper and lower incisors. It is clear that G5 flattens the occlusal plane by intruding incisors and extruding molars. Absolute intrusion of incisors with no change in the molars as predicted by ClinCheck did not occur.

Conclusions

With proper mechanics, Class III malocclusions with anterior crossbite can be resolved with aligners. There are many differences between braces and aligners, but the treatment principles are the same overall. Orthodontists can therefore explore and extend the possibilities of for orthodontic treatment no matter what type of appliances are used.

Acknowledgment

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Fig. 17:
Left: G5 - Optimized attachments on the premolars were placed to help intrude the anterior teeth.
Center & Right: In ClinCheck, the upper incisors were first flared, and then intruded 4mm. The lower incisors were intruded 2mm.

aligner orthodontics treatment for lower molars distalization. In: Nanda R, Uribe F, Yadav, editors. Temporary anchorage devices in orthodontics. Elsevier. 2020. p.305–19.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 11

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 = 4

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 = 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 = 0

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 = 4

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB $\geq 6°$ or $\leq -2°$ = 4 pts.

Each degree $< -2°$ ________x 1 pt. = ________

Each degree > 6 ________x 1 pt. = ________

SN-MP

$\geq 38°$ = 2 pts.

Each degree $> 38°$ ______x 2 pts. = ________

$\leq 26°$ = 1 pt.

Each degree $< 26°$ ________x 1 pt. = ________

1 to MP $\geq 99°$ = 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)	________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. =	________
Addl. treatment complexities	________x 2 pts. =	________

Identify:

Total = 0

Cast-Radiograph Evaluation

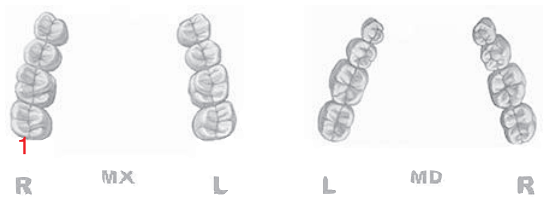
Total Score: 6

Alignment/Rotations

2

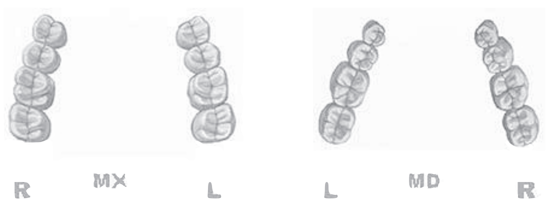
Marginal Ridges

1



Buccolingual Inclination

0

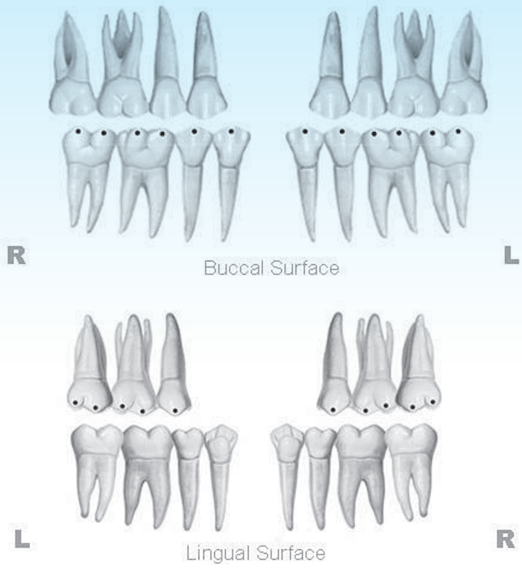


Overjet

0

Occlusal Contacts

0

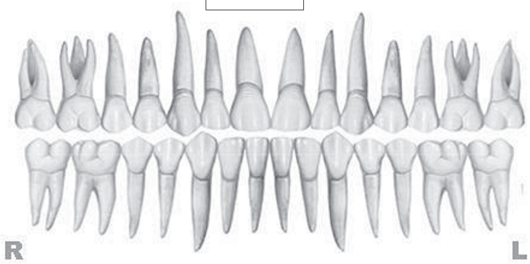


Occlusal Relationships

1

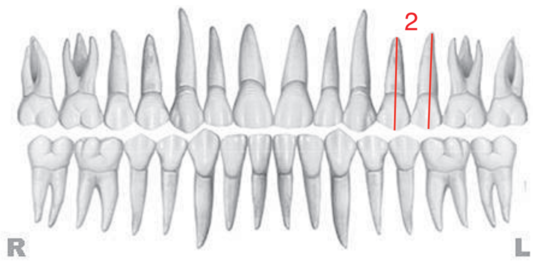
Interproximal Contacts

0



Root Angulation

2



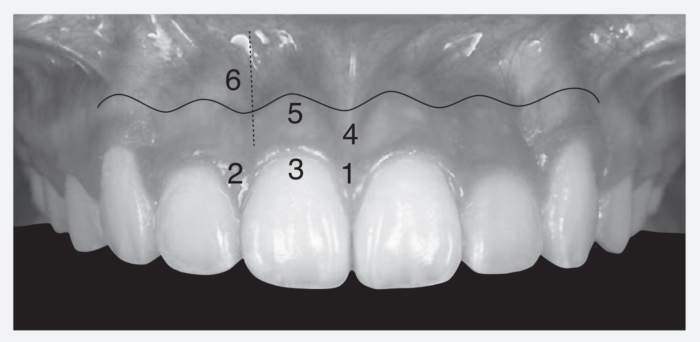
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

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

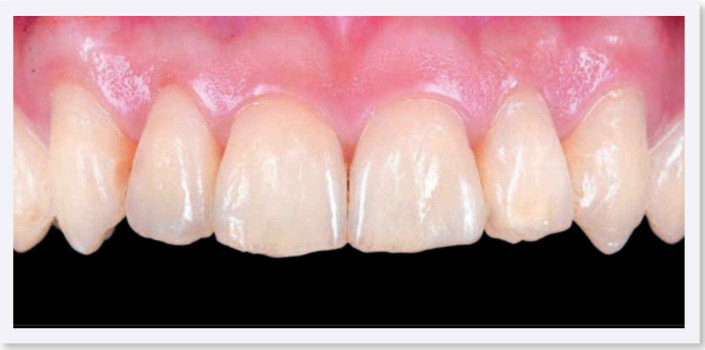
Total Score: = 2

1. Pink Esthetic Score

Total = 1



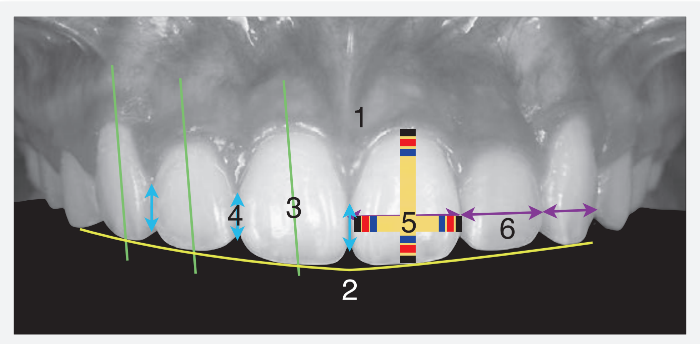
1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2



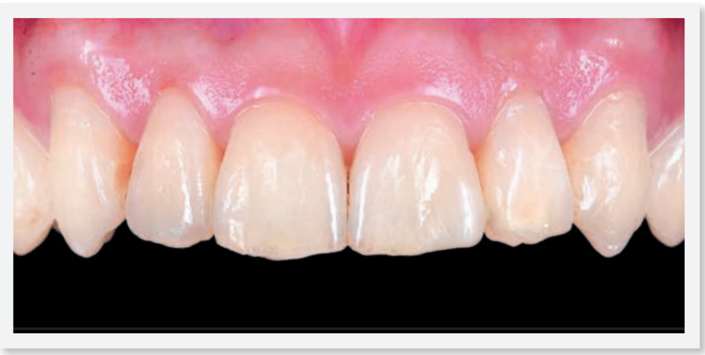
1. M & D Papilla	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

2. White Esthetic Score (for Micro-esthetics)

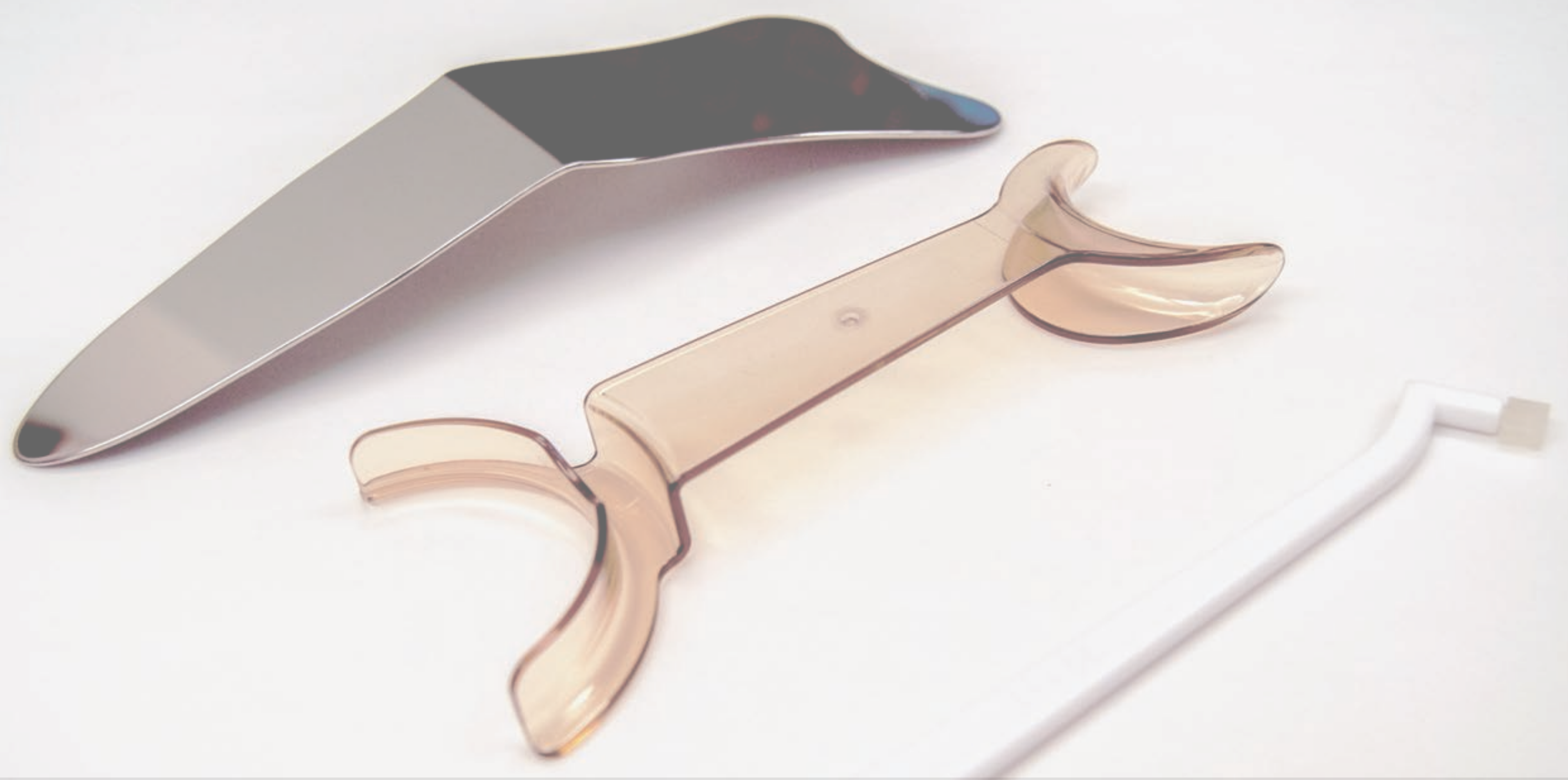
Total = 1



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



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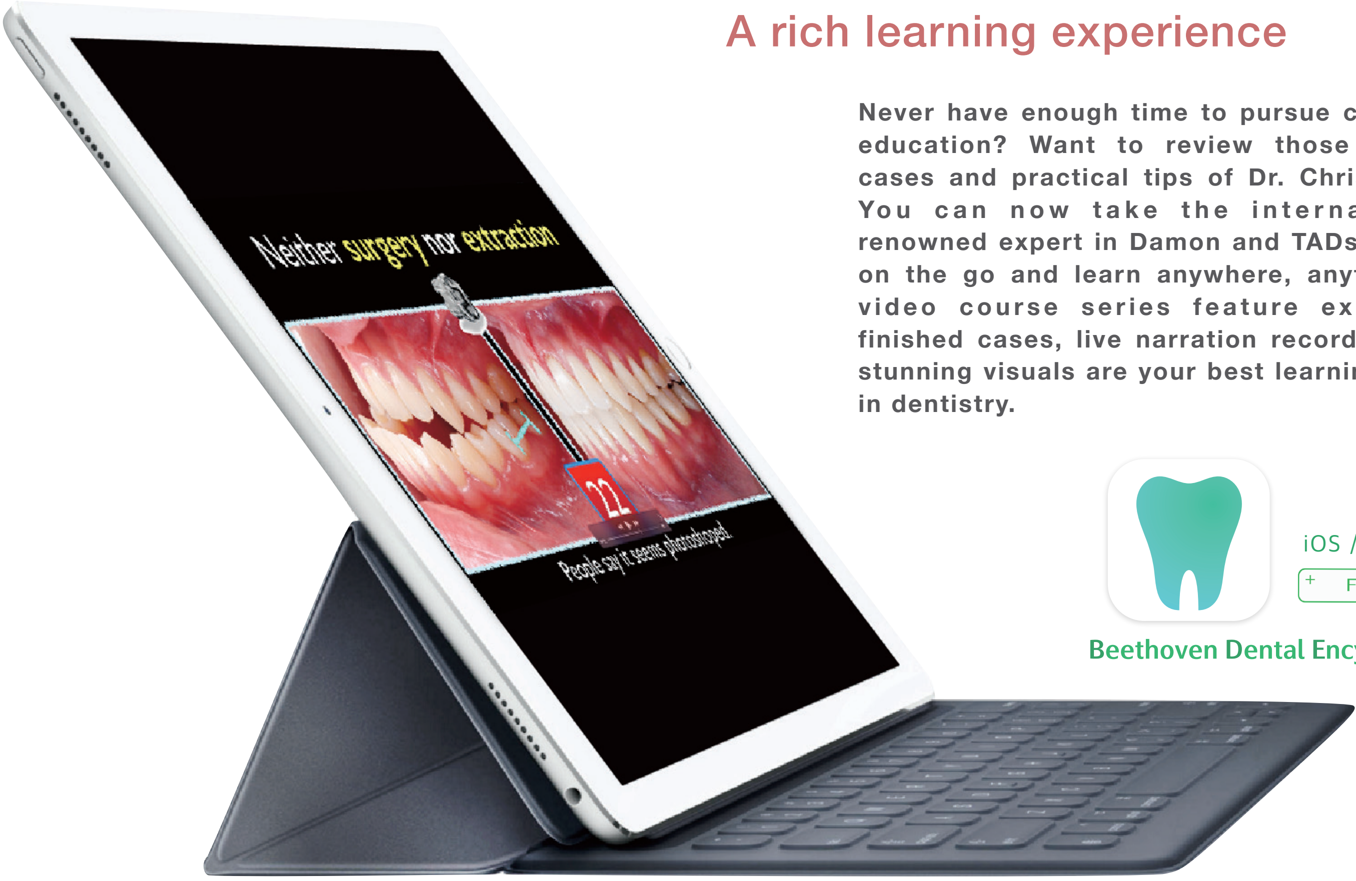

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Series

Series	Type
Damon Master	narrated
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OBS (TAD)	narrated
Finishing (12 seasons)	non-narrated
Implant Forum (9 seasons)	non-narrated
Assistant	non-narrated
E-Ortho	non-narrated
E-Implant	non-narrated
E-Pedo	non-narrated

Note:

1. Most video courses are available in both English and Chinese and are sold separately.
2. Damon Master and OBS (TAD) are renewed annually and each renewal is to be purchased separately with a 50% discount.

2021-2022 第十三年度

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：

2021　6/8、7/13、8/24、9/14、10/19、11/9、12/14

2022　1/11、2/15、3/15、4/12

- 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

全新的第十三年度 2021-22 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。

2021-22 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。

報名專線：03-5735676 #201　蔡佳汶

Non-Surgical and Non-Extraction Orthodontic Treatment for Severe Skeletal Class III Malocclusion with Negative Overjet

Abstract

History: *A 30-year-old male presented for orthodontic consultation with a severe Class III malocclusion, negative overjet, and decreased facial height. The chief complaints were poor masticatory function and compromised dento-facial esthetics.*

Diagnosis & Etiology: *A decreased vertical dimension of occlusion (VDO) was associated with a deep underbite (-7mm), a generalized lingual crossbite on both sides, a deviated mandibular dental midline (1.5mm to the left), and a skeletal Class lll malocclusion (ANB -5.5˚). The probable etiology for the anterior crossbite was functional displacement of the mandible, which led to over-eruption of lower anterior teeth, and developed into a generalized crossbite. The patient was a good candidate for a non-surgical treatment because the facial profile was almost straight with protrusive lower lip despite the reduced VDO which was due to the underbite.*

Treatment: *A non-surgical, non-extraction orthodontic approach with temporary skeletal anchorage devices (TSADs) was planned. A full fixed appliance was bonded on all permanent teeth in both arches. The anterior crossbite and the VDO were corrected by bonding bite turbos, firstly on the lower premolars and later on the lower anterior teeth, so the profile and the facial height of the patient were improved from the beginning, which led to increased patient confidence and cooperation. Early light Class III elastics were introduced from the early stage of treatment, and different patterns of elastics were used during treatment to facilitate palatal expansion in transverse and sagittal planes. Two TSADs were inserted in the buccal shelves to facilitate the A-P plane correction of Class III. The treatment duration was 24 months when all fixed appliances were removed. Retention was with lower and upper fixed 3-3 lingual retainers, and clear overlay retainers on both arches.*

Outcomes: *Following a very conservative orthodontic treatment plan of 24 months this severe Class III malocclusion, with a Discrepancy Index of 72 points, was treated to a Cast-Radiograph Evaluation score of 12 points and a Pink and White esthetic score of 3 points. Both the patient and the clinician were very pleased with the treatment outcome. (J Digital Orthod 2021;63:60-74)*

Key words:

Skeletal Class lll malocclusion, Class lll molar relationship, curve of Spee, VDO, crossbite, TSADs, Bite turbos, Class lll elastics, early light elastics

Introduction

A 30-year-old male presented with chief complaints of reduced facial height, anterior underbite, and a prognathic mandible. He was previously told by three orthodontists that only surgery could solve his problem. Oral soft tissues, periodontium, frena, and gingival health were all within normal limits. Oral hygiene was very good. No significant medical or dental histories were noted.

The dental nomenclature for this report is a modified Palmer notation. Upper (*U*) and lower (*L*) arches, as well as the right (*R*) and left (*L*) sides, define four oral quadrants: UR, UL, LR, and LL. Teeth are numbered 1-8 from the midline in each quadrant, e.g., a lower right first molar is LR6.

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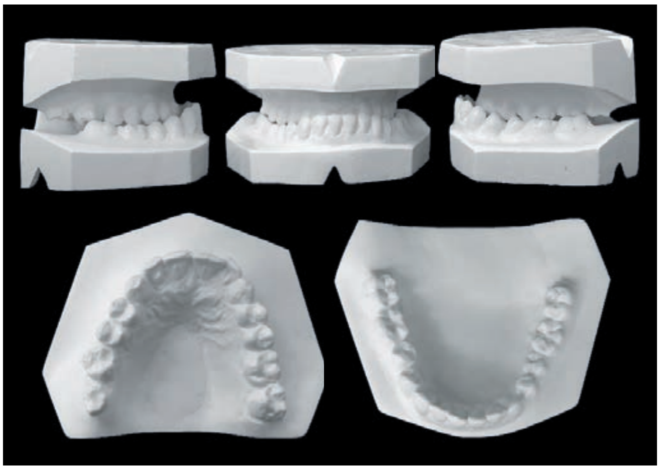
Consultant, Al Mutawa Dental, Manama, Bahrain (Left)
Chris H. Chang,
Founder, Beethoven Orthodontic Center
Publisher, Journal of Digital Orthodontics (Center)
W. Eugene Roberts,
Editor-in-Chief, Journal of Digital Orthodontics (Right)

Diagnosis and Etiology

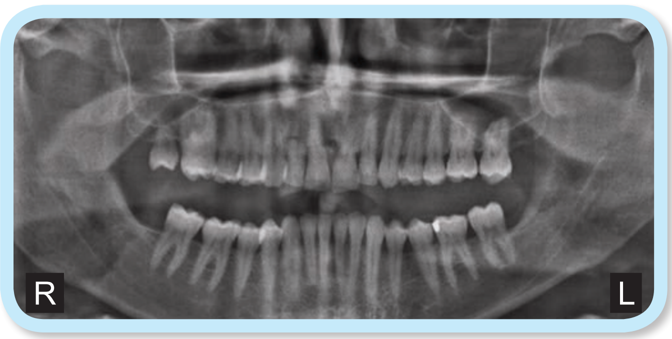
Pre-treatment facial and intraoral photographs (*Fig. 1*) showed a straight profile with protrusive lower lip. The pretreatment intraoral photographs (*Fig. 2*) and study models (*Fig. 3*) revealed bilateral Class III molar relationships. The lower dental midline was shifted 1.5mm to the left of the facial midline. A lingual crossbite of the whole upper arch extended from UR7 to UL7. The UR6 was missing, and the UR7 rotated mesial in. The UR8 was mesially positioned into the UR7 space. In the lower arch, minor crowding of anterior teeth was noted, and the UL2 was rotated. Except for a tiny isolated UR8, all other 3rd molars were missing.

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

■ *Fig. 2: Generalized anterior and posterior crossbite with 11mm of Class III molar discrepancy was noted.*



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



■ *Fig. 4:*
Pre-treatment panoramic radiograph shows unusual root shapes for the maxillary central incisors, which might be related to dilaceration. There were no signs or symptoms.

■ *Fig. 5: Pre-treatment cephalometric radiograph*

The patient complained about occasional pain and discomfort in the temporomandibular joints (*TMJs*). No contributing habits were reported. Pre-treatment panoramic and cephalometric radiographs are shown in Figs. 4 and 5 respectively. Cephalometric analysis showed a skeletal Class III pattern due to a prognathic mandible that was manifest as a -7mm anterior crossbite. The ANB angle was -5.5˚, the SN-MP angle was 29˚, and the lower incisors were inclined 76.5˚ to the mandibular plane. The

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	85.5°	87°	1.5°
SNB° (80°)	91°	89°	2°
ANB° (2°)	-5.5°	-2°	3.5°
SN-MP° (32°)	29°	32°	3°
FMA° (25°)	22°	25°	3°
DENTAL ANALYSIS			
U1 To NAmm (4mm)	4	6	2
U1 To SN° (104°)	102.5°	118°	15.5°
L1 To NBmm (4mm)	2	1	1
L1 To MP° (90°)	76.5°	66.5°	10°
FACIAL ANALYSIS			
E-LINE UL (-1mm)	-10	-10	0
E-LINE LL (0mm)	-6	-8	2
%FH: Na-ANS-Gn (53%)	53%	56%	3%
Convexity: G-Sn-Pg' (13°)	-2.5°	4°	6.5°

Table 1: Cephalometric summary

cephalometric values are summarized in Table 1. The American Board of Orthodontics (*ABO*) Discrepancy Index (*DI*) was 72, as documented in Worksheet 1. The patient was successfully treated with a conservative, non-surgical and non-extraction Class III protocol, with the use of early Class III elastics, anterior bite turbos, and temporary skeletal anchorage devices (*TSADs*) in the buccal shelves. The total treatment period was 24 months. The final result is documented in the post-treatment records (*Figs. 6-10*).

Treatment Objectives

The overall objectives of the current treatment were to improve the vertical dimension of occlusion (*VDO*), intrude the over erupted lower anteriors by retracting the segment and correcting the curve of Spee. Dentoalveolar correction was designed to compensate for the prognathic mandible and to achieve Class I molar and canine relationships with ideal overjet and overbite. The specific treatment objectives were to:

- Maintain the A-P position of the maxilla.
- Maintain the position of the maxillary incisors and molars.
- Retract the mandibular incisors and molars relative to the apical base of bone.
- Correct the anterior and posterior crossbite and align the midlines.
- Establish a normal overjet and overbite in a mutually protected, Class I occlusion.
- Increase the axial inclination of upper incisors to support upper lips for improved facial balance.

Treatment Alternatives

The patient's chief concerns were the anterior crossbite and difficulty in incising food. Because of the protrusive lower lip and the extreme negative overjet (*Figs. 1 and 2*), an orthognathic surgical option was previously suggested by three other orthodontists, but the patient declined that option because it was too aggressive for him. Thus a non-surgical treatment plan was devised to meet the patient's needs:

1. A non-extraction treatment

Fig. 6: Post-treatment facial and intraoral photographs

Fig. 7: Post-treatment dental models (casts)

Fig. 8:
Post-treatment panoramic radiograph shows the same abnormal root shapes for the maxillary central incisors. There were no signs or symptoms so the unusual morphology was deemed clinically insignificant.

Fig. 9: Post-treatment cephalometric radiograph

Fig. 10: Post- treatment smile of the patient

2. Place bite turbos to raise the vertical dimension.

3. Use early short light Class III elastics from the 1st month.

4. Place bilateral bone screws in mandibular buccal shelves to ensure maximal retraction of whole mandibular dentition.

5. Remove appliances and retain with upper and lower fixed retainers, as well as clear overlay retainers.

Treatment Progress

0.022-in Damon Q® brackets with standard torque (*Ormco, Brea, Calif*) were used in both arches. All archwires and elastics were supplied by the same company. After the brackets were bonded, 0.014 CuNiTi archwires were applied to start aligning and leveling teeth. The UR7 was rotated mesial out to functionally replace the missing UR6. Bite turbos (*BTs*) were placed on the occlusal surfaces of LR5 and LL5 to open the bite and increase the VDO. After one month, they were moved to the incisal surfaces of LR1 and LL1. Early light elastics (*Quail 3/16-in 2-oz*) were applied from UR4 and UL4 to LR3 and LL3, respectively. Lingual buttons were bonded on the palatal surfaces of the upper posterior teeth on both sides, and cross elastics were applied to expand the palate and correct the crossbite. The patient was kept on close follow-up intervals to ensure compliance and to assess any pain or complaints related to the TMJs. At three months (*3M*) into treatment, 0.018-in CuNiTi archwires were inserted. Box buccal elastics were also used. At five months into treatment (*5M*), 0.014x0.025-in CuNiTi archwires were placed in both arches. In the lower arch, a power chain was applied to close minor interdental spaces running from LR6 to LL6. The expansion of the upper jaw was due to the cross elastics and the MEAW (*multiloop edgewise arch wire*) effect of Damon wires.[1] The use of elastics was documented in the right buccal and frontal views in Figs. 11a and 11b respectively. In the 7th month, 0.018x0.025-in CuNiTi archwires were used. Elastics (*Moose 5/16-*

Fig. 11a: *The right lateral views show treatment progress over 24 months.*

Fig. 11b: *The frontal views show treatment progress over 24 months.*

in 6-oz) were applied in a full Class III pattern. In the 9th month, the anterior bite was edge-to-edge, and an anterior box elastic was implemented to augment the jump of the bite. In the 10th month, a 0.019x0.025-in SS wire was inserted in the lower arch, and buccal shelf bone screws were installed on both sides to anchor retraction of the whole mandibular dentition (*Fig. 12*). In the 12th month of treatment, the anterior crossbite was completely corrected (*Fig. 13*). In the 15th month of treatment, the upper archwire was changed to 0.019x0.025-in SS. Expansion of the upper archwire was performed to assist in correction of the bilateral posterior lingual crossbite.

In the 18th month of treatment, the lingual crossbite was corrected on the left side, while the right side still remained in crossbite. Buccal spaces were closed on both sides with the aid of elastics (*Moose 5/16-in 6-oz*) applied in a V shape pattern (*Fig. 14*). Cross elastics from UR7 and UL6 to the buccal shelf screws on both sides were introduced to establish adequate transverse relation. The stiff archwire was

■ *Fig. 12:*
In the 10th month of treatment, TSADs were inserted in the mandibular buccal shelves bilaterally.

■ *Fig. 13:*
In the 12th month of treatment, the anterior crossbite was corrected.

■ *Fig. 14:*
V shape elastics (Moose 5/16-in 6-oz) were applied to close the buccal spaces.

not compatible with space closure in the buccal segments. Brackets on the posterior teeth were repositioned more to the gingiva to accelerate extrusion, and 0.018-in CuNiTi archwire was inserted. After 4 weeks, a 0.018x0.024-in CuNiTi archwire was inserted in the upper arch. At 20 months, 0.018x0.025-in SS was inserted in the upper arch to maintain the axial inclination and torque of upper anterior teeth. The wires were sectioned distal to the canines, and elastics (*Chipmunk 3.5-oz, 1/8-in*) were used as two triangles on each side to close the minor buccal spaces for maximum intercuspation and for final settling of the occlusion. All appliances were removed in the 24th month of treatment. Fixed lingual retainers were applied from 3 to 3 in both arches, and clear overlay retainers were also prescribed. The biomechanics associated with the rotation and the retraction of the entire mandibular dentition is displayed in Fig. 12.

Results Achieved

The overall results were pleasing to both the clinician and the patient. Facial harmony and lower lip protrusion were improved (*Fig. 6*). Post-treatment intraoral photographs (*Fig. 6*) and study models (*Fig. 7*) show a Class I relationship bilaterally. Dental midlines were aligned with the facial midline, and ideal overjet and overbite were achieved.

Cephalometric analysis and superimposed cephalometric tracings (*Table 1; Fig. 15*) showed maximal retraction of the whole mandibular dentition with clockwise rotation of the mandible. Inferior movement, as well as rotation of the mandibular occlusal plane caused the opening of

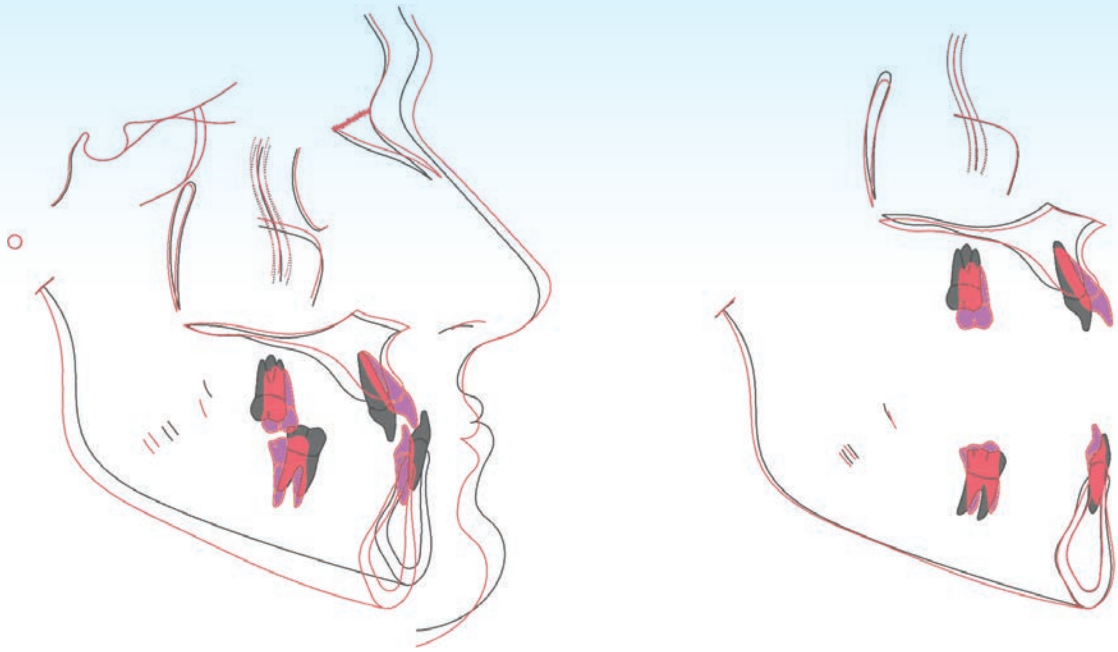


Fig. 15:
Superimposed cephalometric tracings show the dentofacial changes after 24 months of treatment (red) compared to the pre-treatment position (black).

the mandibular plane angle and increased FMA from 22° to 25°, which led to the biggest change in the profile. Post-treatment L1-to-MP angle is 66˚, indicating retroclination in post-treatment cephalograms. No flaring or retroclination of lower incisors was noted in the post-treatment cephalogram. The U1-to-SN angle increased from 102.5˚ to 118˚ as the maxillary arch expanded (*Fig. 15*). This inclination was necessary in order to support the upper lip. Critical assessment of this case with a DI of 72 was Cast-Radiograph Evaluation (*CRE*) and Pink & White scores of 12 and 3 points respectively, as documented in Worksheets 2 and 3 appearing later in this report.

The following discrepancies in the finish were noted:

1. Distal-in rotation of the right maxillary 2nd molar.

2. Marginal ridge discrepancies existed between LR6-LR7 and LL6.

3. Lack of occlusal contact was noted on the right side between the upper disto-buccal cusps of maxillary and mandibular 2nd molars and palatal cusps of maxillary 2nd premolars.

4. Buccolingual inclination of LR5, LL6, and UR7.

5. Inadequate root parallelism existed between UR4, UR5, UL4, and UL5.

6. The gingival margins were uneven for the UR1 and UL1 due to natural enamel defects persisted after treatment.

Discussion

Conservative treatment for a Class III skeletal malocclusion with marked negative overjet and deep bite using a non-surgical, non-extraction protocol has long been challenging to orthodontists. The strategy for treating a Class III malocclusion usually involves proclination of the maxillary incisors and retroclination of the mandibular incisors to improve the dental occlusion, but that approach may not correct the underlying skeletal problem or facial profile. Clinical studies have shown an increase in the ANB angle, little or no change in the vertical dimension, and decreased concavity of the facial profile in such treatments.[2-6] However, little information is available in the literature regarding the possible tooth movements in this type of skeletal malocclusion. In most non-surgical Class III treatment, retraction of the lower incisors is helpful. McLaughlin and Bennet[7] advised not to retract beyond 80° to prevent the risk of dehiscence and lack of bone support. Retraction of the lower incisors to achieve Class I molar relationship can be obtained with the assistance of Class III elastics and/or with bone screw anchorage. With bone screw anchorage, the dental discrepancy can often be effectively treated within limits. Compared to Class III elastics, use of osseous anchorage can avoid proclination of upper incisors, which contributes to more favorable naso-labial angle. In the present case, maximal retraction of the entire mandibular dentition was attained with bilateral bone screws inserted into the mandibular buccal shelves. There were no major unwanted side effects.

The principal limitation for how much the lower arch can be retracted depends on the distance between LR7 and LL7 and the ascending ramus. However, little information is available regarding this problem. In the present case, the patient presented with a relatively low FMA mandibular angle of 22°. The main strategy was to open and rotate the mandible with the aid of bite turbos on the incisal-lingual surfaces of lower central incisors, as well as Class III elastics. The finished FMA angle was 25°, which is within the standard range. Thus, it is possible to correct the current malocclusion because the 7mm negative overjet was decompensated after 9 months.

In summary, the indications of successful correction of a skeletal Class III malocclusion are:

1. a good profile
2. normal A-P position in the maxilla,
3. a U1-to-SN angle within 120˚,
4. slightly acute naso-labial angle, and
5. negative overjet after decompensation of mandibular incisors within 11mm (*average M-D width of mandibular 1st molar*).

Another concern in treating Class III negative deep bite (*underbite*) cases is smile arc enhancement. Class III cases usually have a flat occlusal plane. In this case, the negative deep bite was associated with extruded lower anterior teeth and a deep curve of Spee. When correcting this type of malocclusion with long Class III elastics, extrusion of maxillary molars as well as flaring of maxillary incisors contributes to counterclockwise rotation of the functional occlusal plane, which led to flattening of smile arc. In the present case, Class III, box, and other triangular elastics were used to close the buccal spaces which resulted from an increase in the vertical dimension of the occlusal plane (*VDO*). That effect helped in the extrusion of the mandibular posterior teeth, intrusion of the mandibular anterior teeth, and flattening of the curve of Spee, which resulted in a flattened smile arc. From a biomechanical aspect, the downward rotation and retraction of the entire mandibular dentition contriubuted to the correction of underbite. Usually, orthodontic treatment for malocclusion is performed in sequences of transverse, vertical, and anteroposterior relationships. In the present case, due to an elevation of the VDO with the help of bite turbos, all the above relationships were intended for the correction from the beginning. The correction occurred in the following sequence. Firstly, the vertical relation in the anterior segment was corrected by jumping the bite. Secondly, A-P relation of Class III was corrected to Class I. Thirdly, the transverse relation was improved by correcting the posterior crossbite, and finally, vertical relation of posterior segment was corrected with triangular elastics after sectioning of the wire distal to the canines. Thus, it was necessary for the patient to return every week in the last month of active treatment for adjustments before the appliances were removed. Both the patient and clinician were satisfied with the treatment results. The patient's confidence increased from the first month of treatment with the improvement in the profile due to an increase in the VDO from bite turbos. The patient's motivation and cooperation were also an important factor because the treatment plan involved heavy use of elastics of different sizes and patterns, as well as frequent appointments for close follow-up.

It should be noted that the mandibular arch alignment was similar to the Tweed philosophy of orthodontic finishing. In the denture completion stage of Tweed-Merrifield philosophy,[8] the distal cusps of the 1st and the 2nd molars should be slightly out of occlusion. If the canines and premolars are treated to solid Class I relationships, the ideal occlusion will occur after all treatment mechanics are discontinued. Normal function and other environmental influences active in the post-treatment period will stabilize and finalize the position of the occlusion. In conclusion, significant dental and soft-tissue improvement can be expected in young adult Class III patients treated with non-surgical orthodontics. A wide range of skeletal dysplasias can be corrected with camouflage treatment that involves tooth movement, which is minimally invasive for hard and soft tissues. This approach is capable of solving a wide variety of malocclusions in different age groups.

Intercuspation between upper and lower posteriors was achieved. However, to avoid distally tipped mandibular molars, it is always better to retract the mandibular dentition with a stiffer archwire such as a 0.019x0.025-in SS wire to help prevent rotation of the occlusal plane and tipping back of molars. It was helpful to have progressive panoramic radiographs to identify the early stages of periodontium. However, proper diagnosis, realistic treatment objectives, and efficient mechanics are necessary to prevent undesirable sequelae.

Superimposed tracings of the mandible revealed maximal retraction of anterior teeth and extrusion of molars. These treatment effects contributed to the correction of the anterior crossbite and opening of the vertical dimension.

Conclusions

For decades, similar cases of Class III skeletal and dental malocclusion were treated with a combination of orthodontic and orthognathic surgical approaches, with or without extraction or in the form of camouflage treatment. In this case report, a non-surgical, non-extraction orthodontic protocol was implemented to treat a severe skeletal Class III malocclusion with a negative overjet in an adult male. Three major factors contributed to the success of this case: the use of early light elastics, bite turbos, and TSADs in the buccal shelves. These factors play a major role in the treatment protocols for different classes of malocclusion. Modern approaches for orthodontics are promising not only in solving complicated malocclusion in a minimally invasive manner, but also in achieving favorable results with less treatment time.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 72

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 = 40

OVERBITE

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

Total = 5

ANTERIOR OPEN BITE

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

Total = 0

LATERAL OPEN BITE

2 pts. per mm. per tooth

Total = 0

CROWDING (only one arch)

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

Total = 1

OCCLUSION

Class I to end on	=	0 pts.	
End on Class II or III	=	2 pts. per side	____ pts.
Full Class II or III	=	4 pts. per side	8 pts.
Beyond Class II or III	=	1 pt. per mm. additional	____ pts.

Total = 8

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 7

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB $\geq 6°$ or $\leq -2°$ = 4 pts.

Each degree $< -2°$ ____ x 1 pt. = 4

Each degree $> 6°$ ____ x 1 pt. = ____

SN-MP

$\geq 38°$ = 2 pts.

Each degree $> 38°$ ____ x 2 pts. = ____

$\leq 26°$ = 1 pt.

Each degree $< 26°$ ____ x 1 pt. = 2

1 to MP $\geq 99°$ = 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 pts. =	1
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. =	2
Skeletal asymmetry (nonsurgical tx)		@ 3 pts. =	____
Addl. treatment complexities	____	x 2 pts. =	2

Identify: Rotation of #17

Total = 5

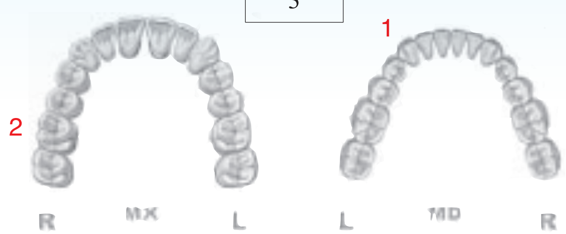
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 12

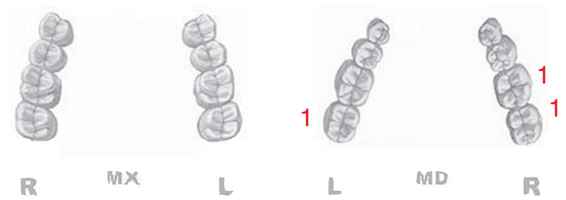
Alignment/Rotations

3



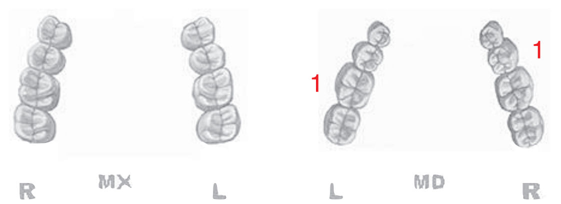
Marginal Ridges

3



Buccolingual Inclination

2

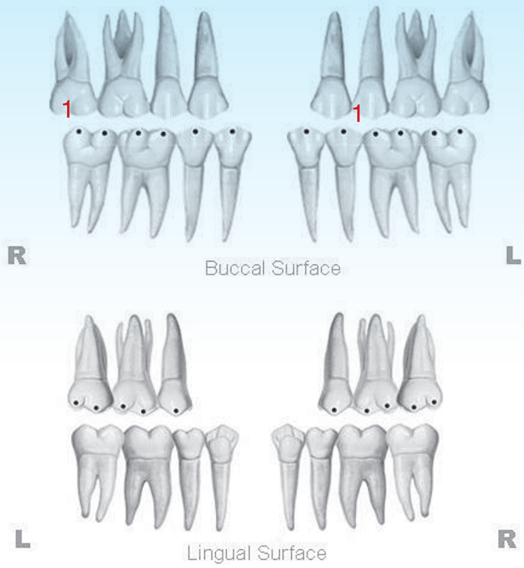


Overjet

0

Occlusal Contacts

2

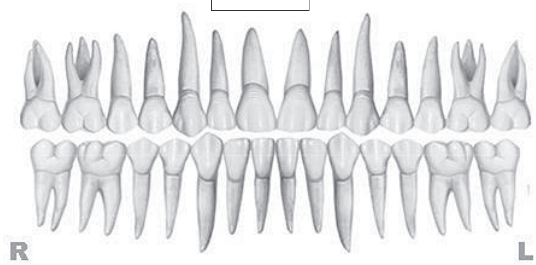


Occlusal Relationships

0

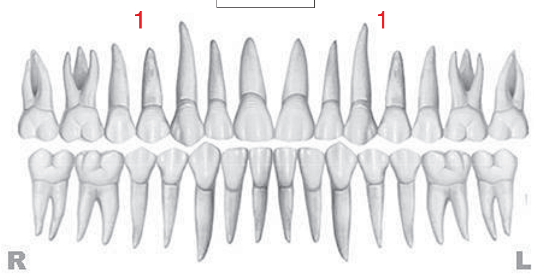
Interproximal Contacts

0



Root Angulation

2



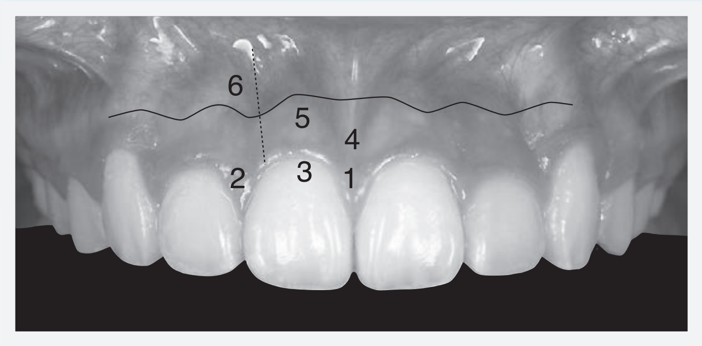
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

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

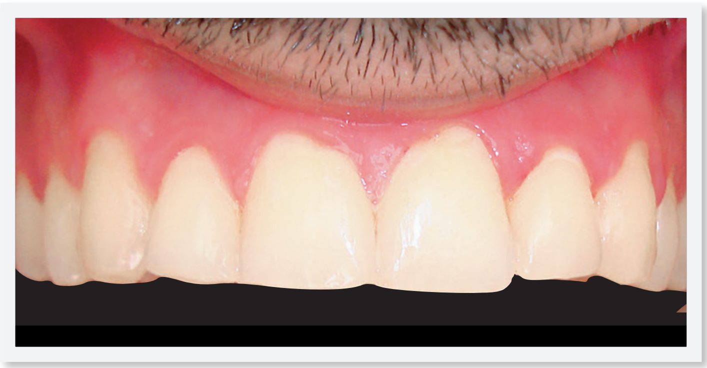
Total Score: = 3

1. Pink Esthetic Score

Total = 1



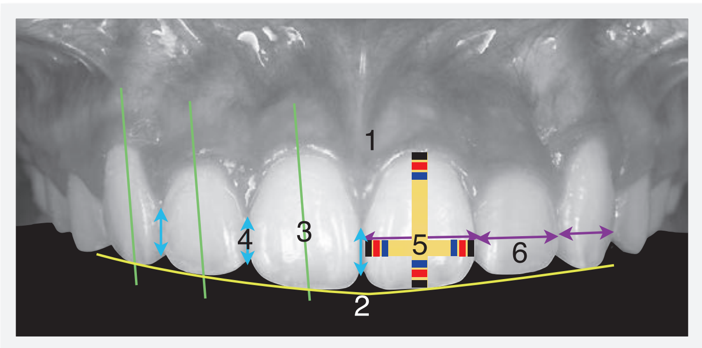
1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2



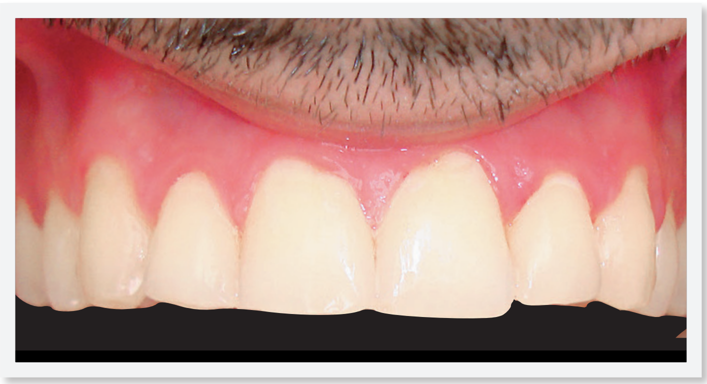
1. M & D Papilla	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

2. White Esthetic Score (for Micro-esthetics)

Total = 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



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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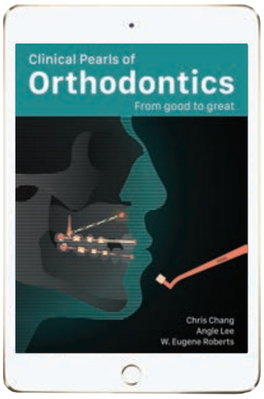

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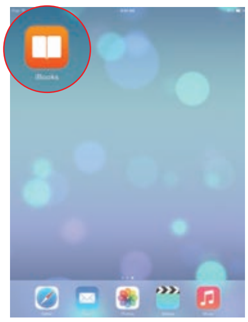

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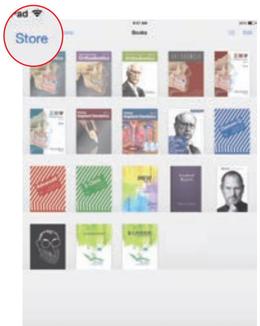
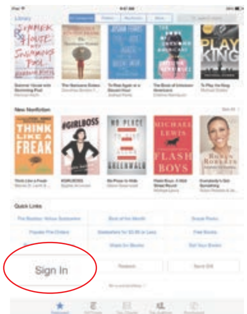
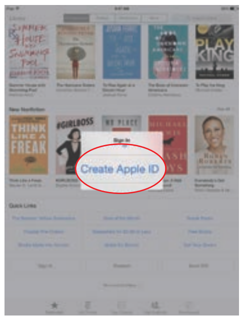


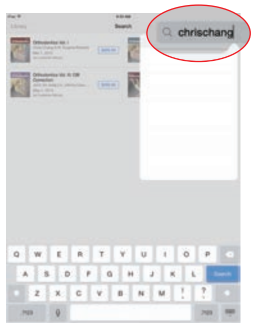
2. Click "Store."



3. "Sign in" with your Apple ID.



4. "Create Apple ID" if you don't have one.



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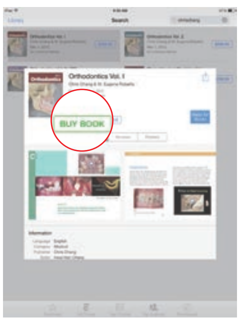
6. Click the book's icon.



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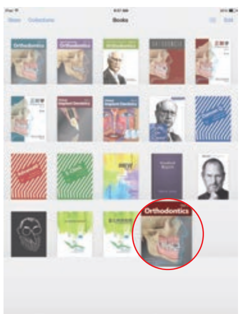

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1	3/19	**陳明時 醫師**（美國 Ohio State University 牙醫學院．碩士、美國德州 M.D. Anderson Cancer Hospital 專科醫師） **主題：** Part I：“Occlusal Scheme”？“Organic Occlusion”! Part II：Comprehensive Treatment Plan Part III：Treatment Planning、Design、Option、Execution Part IV：Claspless RPD replacing Conventional Clasp RPD	
2	4/9	**黃裕新 醫師**（裕見美牙醫診所院長、台灣大學牙醫學系第一名畢業、美國賓州大學學術交流、美國南加大植牙美學專科訓練、美國華盛頓大學全口重建訓練、「裕見。新美學」瓷牙美學講師、 2016 Dentsply 牙體復形競賽全球第三、2015 Dentsply 牙體復形競賽台灣冠軍、Nobel Biocare 產品發表會客座講師、台灣植體醫學會會員） **主題：前牙美學 軟組織的究極進化**	
3	5/28	**邱上珍 醫師**（美國明尼蘇達大學牙周病學碩士、美國牙周病學會院士） **題目：** Implants in Esthetic Zone	**蕭浩宜 醫師**（美國南加州大學植牙研究所進修、新綠牙醫診所院長） **張慧男 醫師**（美國印第安那普渡大學齒顎矯正研究所博士）
4	6/18	**王巍穆 醫師**（基督教安息會台安醫院贋復牙科主任、台北醫學大學牙醫學院兼任講師暨牙科部主治醫師、佛教慈濟綜合醫院台北分院牙科部贋復科主治醫師、德國法蘭克福大學牙醫學院口腔植體學碩士、國立陽明大學口腔贋復碩士、台北榮民總醫院牙科部兼任主治醫師） **題目：** Prosthetic Driven Concept to Create Zero Bone Loss	
5	7/23	**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） **主題：垂直前庭切線骨膜下隧道法**	
6	8/20	**林涵威 醫師**（台大醫學院臨床牙醫研究所碩士、台北醫學大學牙醫學士、衛福部定口腔顎面外科專科醫師、德國 Steigmann Institute 進階植牙訓練、第58屆日本口腔顎面外科大會傑出論文獎） **題目：** All-on-4 Basic Concept	
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10	12/24	**蘇裕隆 醫師**（陽明大學牙醫學士、FB 前牙美學達人） **題目：前牙美學**	**黃育新 醫師**（國際矯正植牙學會院士、台北醫學大學牙醫學系、台灣植牙醫學會專科醫師） **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

A Biographical Portrait of Edward Hartley Angle, the First Specialist in Orthodontics, Part 1

Abstract

Much of what is known about Edward Hartley Angle, MD, DDS (1855–1930), the acknowledged "father" of modern orthodontics, has been derived from secondary sources, accounts written by his contemporaries and others. New historical research using primary sources, largely the recently published four-volume sourcebook of Angle's correspondence and business transactions from 1899 to 1910, gives a broad view of the personality, interests, and activities of this prime mover in the evolution of orthodontics. This three-part article highlights aspects of Edward H. Angle's life and persona, based on new findings culled from his letters and other personal documents. Part 3 presents a biographical chronology of Angle's remarkable life. (Reprinted from News & Trends in Orthodontics 2009;16:8-14, originally reprinted with permission from Angle Orthod 2009;79:1021-1027. Copyright 2009).(J Digital Orthod 2021;63:78-88)

"To arrive at a just estimate of a renowned man's character one must judge it by the standards of his time, not ours."

Mark Twain,
Personal Recollections of Joan of Arc, 1896

Part I

Old letters often tell rich history. At certain junctures in the historical record, details found in the letters of visionary leaders reveal important developments better than a simple recounting of events can. Orthodontics 100 years ago was at just such a critical point. No personality central to the history of orthodontics stimulated as much progress, excitement, and polarity as Edward Hartley Angle, MD, DDS (*1855–1930*), the acknowledged founder of this clinical specialty. Early in the 20th century, he dominated the emergence of "*orthodontia as a science and a specialty.*" This inventive doctor gave malocclusion the primacy and order it needed. He also created the first educational program to train specialists in orthodontics, and he developed the first prefabricated orthodontic appliance system. Thus, the exquisite series of letters, accounts, and patents from the mind and hand of Edward H. Angle, now contained in the Angle Archives and published in 2007 in a four-volume sourcebook, give new life and context to the early history of orthodontics.

Sheldon Peck,

Secretary, The Edward H. Angle Society of Orthodontists (EHASO) and The E.H. Angle Education and Research Foundation.

Clinical Professor of Developmental Biology, The Harvard School of Dental Medicine, Boston, Mass.

Dr. Angle's papers, like the literary remains of other great pioneers, provide clear windows into the writer's remarkable nature, capacities, and limitations, as well as a rich historical panorama of events and relationships during the seminal days of modern orthodontics. The published archives include Angle's correspondence and business papers written between May 3, 1899 and December 19, 1910. It was a time of Angle's most provocative accomplishments and most accelerating prosperity. The bulk of this period includes 9 of Angle's 13 years (*1895 to 1908*) spent in St. Louis, golden years in Angle's professional development and in the history of that city.

In the early 1900s, St. Louis, Missouri, was undergoing a renewal in celebration of its role as the gateway to western expansion of the United States. The centerpiece for its renaissance was the Louisiana Purchase Exposition, better known as the 1904 World's Fair of St. Louis, a 7-month extravaganza attracting nearly 20 million visitors. It was a dazzling show, built in 1,200-acre Forest Park, featuring colossal outdoor neoclassical sculptures, and pavilions designed as Grecian palaces filled with futuristic technologies and other displays of science, art, and optimism. St. Louis was thrust into a global spotlight. So were Dr. Edward Angle and orthodontics.

This was the time, at the turn of the 20th century, that Angle implemented his new school and sought the recognition of orthodontia as a full and independent branch of dentistry. By 1904, the Angle School of Orthodontia was training two classes a year, with many students coming from distant places to learn from the "*world's greatest*" clinical orthodontist. During the 1904 World's Fair, St. Louis was the host city for the Fourth International Dental Congress, attended by many foreign dignitaries. Angle chaired the Congress's highly successful section on "*Orthodontia*," and in the process, he engaged many who became new friends and followers.

To appreciate Angle's times best, we should apply a bit of retrospective context. In 1904 - near the temporal midpoint of the Angle Archives - America and Americans were very different than they are today. It would still be another decade before the dawn of personal income taxes. The average life span in the United States was 49 years in 1904. The leading causes of death were respiratory infections: pneumonia, influenza, and tuberculosis. Only 14% of homes had a bathtub; only 8% had a telephone. A 3-minute call from St. Louis to New York City cost $8, which is equivalent to $176 in today's dollars; Angle's round-trip train ride to New York cost $25 (*$550 in current money*). The average worker's wage was 22 cents per hour, producing a yearly income between

$300 and $600. Competent professionals (*including dentists*) could expect to earn $2000 to $4000 per year. Angle boasted that one of his former students practicing orthodontics in New York City was earning $40,000 annually, an extraordinary income in those days.[3:302]

Further context may be gained with some knowledge of Edward Angle's 44 years of life before the 1899 start of the remarkable record of his letters and accounts contained in the Angle Archives. Thus, the aim of this three-part article is to provide readers with a biographical portrait of Dr. Angle, the man, the writer, the inventor and the professional, incorporating a sketch of his early life and some happenings, insights, and impressions culled from his own words within the precious collection of Angliana, which has been recently published. Part 3 is a chronology of Angle's life with new findings from recent historical research.

The Early Years

Edward H. Angle's early years reflect elements of a classic American success story of his era: a fiercely determined young man of no remarkable heritage serendipitously finding his considerable aptitudes and blazing trails in pursuit of his visionary goals. At various times in his letters, he expressed his admiration for a pantheon of archetypes with traits akin to his own, such as the indomitable messenger in "*A Message to Garcia*," the popular, inspirational short story (*1899*) by Elbert Hubbard, which became required reading for Angle's students.[1:84,151] Samuel L. Clemens (*Mark Twain*),[2:503] poet-storyteller James Whitcomb Riley,[1:564] George Catlin,[1:608] Benjamin Franklin, and Rembrandt van Rijn were among his favorite heroes. All were creative achievers and resolute individualists of humble birth and with great connection to everyday people.

Dr. Angle never forgot his farm-boy life in northeastern Pennsylvania that helped shape many of his qualities and quirks in adulthood. From the southern boundary of District no. 1 of Herrick Township in Bradford County, you could almost see the deep, winding chasm of the Susquehanna River valley. This area was nicknamed "*Ballibay*" in the 1820s by the new settlers from the town of Ballybay, County Monaghan, Ireland. Edward Hartley Angle was born here June 1, 1855 in a modest, white wood-framed house near the crest of a hill on his

Fig. 1:

Edward H. Angle's boyhood home on his parents' farm in District 1, "Ballibay," Herrick Township, Bradford County, Pennsylvania. This farmhouse is still in use, although no longer in the Angle family. The last member of the family to occupy the farmhouse was Neal Angle, Dr. Angle's nephew, who sold the farm in 1946. (Early 1900s photograph, reproduced from the 1938 meeting program of the Angle Society.)

father's 200-acre dairy farm (*Fig. 1*). He is recorded in the 1860 Bradford County census book as "*Hartly,*" the fifth of six children, and third son, to Philip Casebeer Angle and Isabel Erskine Angle. His father's roots were primarily Dutch and his mother was born in Ireland. From childhood, he was called "*Hart*" by his family and close friends. The Angles had a seventh child, William, a bright lad, who died of illness at age 11. Teen-aged Hart was hurt terribly by the loss of his younger brother Willie, his favorite sibling.[1:107–108]

Hart showed no enthusiasm in school or on the farm, to the utter dismay of his unsympathetic father. He was always behind in his learning, especially math, and he avoided farm work as much as he could. He was a natural tinkerer, a whittler, a maker of things. In reminiscences, his wife Anna told about his heavily scarred knees, lifetime reminders of boyhood knife slips. When his father needed a more efficient hay rake, 11-year-old Hart invented one. However, he did not get much appreciation for the new machine, and soon someone else applied for and was awarded the patent for Hart's instinctively clever work. It was an early lesson in life's unfairness that the sensitive boy probably long remembered.

In Angle's letters, we find a man who cherished his boyhood friendships throughout life. He never lost contact with some of his Herrick chums, like Cyrus Camp, Guy Fuller, and Jerry Sanger. His correspondence with them is often in the playful tones of a kid still horsing around the farmyard.[1:187;2:398,502] Angle peppered his letters to his hometown friends with monikers concocted from the names of town fathers with whom the boys occasionally skirted trouble. "*Cy*" Camp was sometimes referred to as "*J. Rufus Avery*" or "*Gideon Squares*" in Hart's jocular letters to him.[1:187,240–242] Angle also showed his self-deprecating humor to old, dear friends in the variety of comical aliases he used in signing his letters: Alexander J. Horatio,[1:523–525] Alonzo Revellen,[1:201–202] Big Foot,[3:261–262] Colossus Doc the Great,[2:622–623] Flat-nosed Hart,[3:279–280] Little Harty Angle,[1:819–820] Old Man Friar,[1:53–54] Uncle Reuben,[2:622–623] and sometimes simply the geometric notation "∠."[2:381–382]

In 1874, at age 18, he was introduced to dentistry with coaxing from his understanding mother Isabel. Recognizing his nascent mechanical skills, she secured a position for Hart with a dentist in nearby Herrick, as an office apprentice. He got on well in dentistry - it appealed instantly to his keen manual and visual senses, his love of tools and his need for orderliness. Two years later, he applied to dental colleges. His scratchy, brief letter of inquiry dated September 6, 1876, to the Baltimore Dental College is the earliest document extant from his hand. In it, he touted his proficiencies in the indispensable texts of the day: Harris's The Principles and Practice of Dental Surgery (*1863*) and Piggot's Chemistry and Metallurgy, as Applied to the Study and Practice of Dental Surgery (*1854*). Although his English constructions and spelling were rather crude for a schooled 21-year-old, young Angle exuded the restless confidence that would mark his entire adult life and would win him success in many adventures to come. He was invited to enroll at Pennsylvania College of Dental Surgery in Philadelphia for their DDS program, then arranged in two 6-month terms spaced over a nominal 2 years and located in a building at the northwest corner of Twelfth and Filbert Streets. Angle alluded to his college experiences years later in friendly letters with classmates E. L. Townsend[2:622] and Charles J. Tibbets.[2:623]

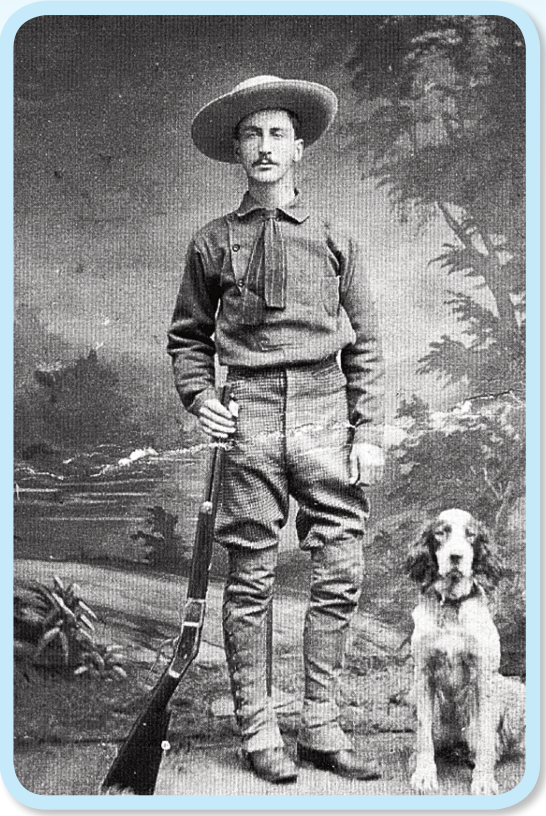
The Young Dentist

After dental school graduation in 1878, Edward Angle went to the Bradford County seat, Towanda, and set up a general practice of mechanical dentistry in the center of town. He became a boarder in the home of Towanda's leading physician, Dr. David Shepard Pratt, a good strategic decision for the bright new dentist in town. Young Dr. Angle advertised in local newspapers, such as The Sullivan Review, and appeared to be rapidly successful. Here in his leisure as an unmarried young professional, Angle developed his first interests in mechanisms for tooth alignment or "*regulation*," considered the main purpose for moving teeth at that time.

In Towanda, Angle experienced declining health that was to plague him on and off for the rest of his life. He was diagnosed with pleural pneumonia. Today, we may understand this chronic respiratory condition as a consequence of tuberculosis. One popular treatment of the day was for the sufferer to move to fresher, cleaner air – to a pristine resort set up for this purpose or to the mountains or the desert. Angle formed special bonds throughout his career with those who shared the same affliction, former student Albert "*Leaf*" Ketcham being the most prominent among them.[2:107–108]

After 3 years of dental practice in Towanda, in the spring of 1881, 26-year-old Dr. Angle abandoned dentistry and took a train to Minneapolis, Minnesota, on a physician's advice, in search of better health. Within a few months, his condition improved and, with his recovery, came renewed confidence and resolve to make something of himself. For his health's sake, Angle was considering permanent retirement from dentistry in favor of work that was less confining and more outdoors. In Minneapolis, he heard that sheep farming in Montana was where the "*big money*" could be made. In the fall, he returned briefly to Pennsylvania to entice some of his old farm buddies from Herrick to join him in setting up a lucrative sheep-raising business. They signed on excitedly, and the lot of his Ballibay cronies - including his older brother Mahlon and close friend Cy Camp - traveled with the freewheeling Hart to the fresh air of the Montana wilderness in search of their "*pot of gold*" (*Fig.* 2).

Angle invested all his savings into their sheep-farming venture, all to be undone by the great blizzard of 1882, a record-breaking deep freeze that killed off the entire herd. The empty-handed boys from Ballibay sullenly returned to Pennsylvania, except for Hart. A defeated Angle, feeling physically better but mentally depleted, hobbled in to Minneapolis by mid-1882 looking for work - again in dentistry.



■ *Fig. 2*:
Studio photograph taken in Minneapolis, Minnesota, of young "Hart" Angle in hunting uniform with an English Springer Spaniel at his side, around the time of his Montana sheep-farming adventures, c. 1881–1883 (26–28 years old)

He got back into general dental practice and soon resumed the creative thinking and tinkering with tooth-regulating appliances that he began in Towanda. Within a couple of years, Angle inquired at the Dental Department of the Minnesota Hospital College in Minneapolis regarding faculty employment. Impressed with what he had to offer, the college administrators tailored a position to suit his skills and their needs. In 1886, 31-year-old Edward Angle was appointed a professor of histology and lecturer on comparative anatomy and orthodontia. A few years later, after the Hospital College merged into the University of Minnesota, he was elevated to professor of orthodontia, a rare position in those days when orthodontia was a neglected part of the prosthetics department at dental colleges. At the same time, he quickly ascended through the ranks to become president of the Minneapolis City Dental Society in 1888. He also was able to maintain his small private dental office, where he experimented more and more with novel approaches in orthodontic mechanisms. In sum, through his resilience, industriousness, and good fortune, Angle seemed to have landed on his feet psychologically and financially from the Montana get-rich-quick debacle a few years earlier.

His big break came in 1887 when Angle was permitted on the speaking program of the Ninth International Medical Congress convened in Washington, DC. On the fourth day of this important Congress, Thursday, September 8, 1887, the section on "*Dental and Oral Surgery*" was called to order at 11 AM in the Universalist Church at the corner of 13th and L Streets. Thirty-two-year-old Dr. Angle was the youngest of the session's speakers and was scheduled last on the day's program. Two prominent authorities on orthodontics directly preceded Angle: Clark Goddard, professor at University of California, San Francisco, and Eugene Talbot, textbook writer and professor from Chicago.

A confident Edward Angle presented his talk, entitled "*Notes on Orthodontia with a New System of Regulation and Retention*," using lantern slides - a relatively new visual aid for lecturing. He demonstrated his classification of tooth movements and his novel orthodontic devices, such as piano wire in a soldered "*pipe*" (*tube*) and the jackscrew and traction screw. The open discussion that followed was sometimes acrimonious. Many well-known dentists in the audience, including John N. Farrar and Victor H. Jackson, accused Angle of falsely claiming originality. They cited others (*including themselves*) who earlier introduced similar appliances. Angle carefully explained how his devices were different and better, indeed "*new,*" but apparently, he did not prevail. The edited paper and subsequent inflammatory discussions were published in the Transactions of the Ninth International Medical Congress under an imposed, truncated, noncontroversial title, "*Notes on Orthodontia.*" This 1887 article commonly has been called the "*First Edition*" of his classic textbook on the treatment of malocclusion. Actually, Angle considered that his first edition was his 14-page chapter appended to Loomis P. Haskell's new book on dental laboratory procedures published in 1887; he titled this version of his Congress paper "*Extracts of Notes on Orthodontia, with a New System by [sic] Regulation and Retention*" and it did not contain the discrediting commentaries.

Years later, colleagues observed that the bitterness Angle developed from the contemptuous treatment he received at this 1887 Congress helped harden him for the professional "*fights*" he was to invite and encounter throughout his adventurous career. To those who would challenge him, his style often seemed abrasive, sometimes brutal; to others, those loyal to him and backing his causes, he was as charming and gentle as a puppy.

The First Specialist in Orthodontics

The year 1892 was a watershed in Angle's professional development: he announced that he would be practicing orthodontia to the exclusion of all other dental therapies. With this decision, he became the first acknowledged exclusive specialist in orthodontics in the world. Until this moment, none of the authorities on orthodontics worldwide and in history ever mustered the vision and confidence to limit their dental or medical practice to only this emerging type of treatment. Angle was no longer on the faculty at the University of Minnesota. He resigned to concentrate his energies on experimentation in orthodontia and the development of marketable, prefabricated ("*ready-made" in his vernacular*), new treatment appliances. He also needed time to work on his textbook's third edition, his first real book, a 51-page work, 20 pages longer than his 1890 edition, which had been published as an appendix in the second edition of Haskell's prosthetics laboratory book. He hired Anna Hopkins, a bright young Minneapolis secretarial school graduate, to help him with his book and practice. It was the beginning of a life-shaping relationship for both of them.

Also by 1892, Edward Angle was beginning to feel stress from his troubled marriage. Florence A. Canning was the sister of John E. Canning, a Minneapolis machinist whom Angle came to know and rely on, the way any inventor needs a toolmaker. It seems that Angle met Florence socially through this business relation. In March 1887, 22-year-old Florence and the 31-year-old dentist married. Less than 9 months later their daughter Florence Isabel Angle was born in Minneapolis, only 3 months after her father's disastrous appearance at the Ninth International Medical Congress in Washington.

Angle's correspondence a dozen years later described a disintegration of this marriage from the start. The couple was grossly mismatched, he the ambitious idea man and she the daydreaming reader of romances.[2:187–188] Angle gradually lost respect for Florence "*Senior*," as he referred to his wife in some letters, and he became by default an absentee father to their sickly daughter "*Florencie*." By July 1900, his personal confidence in his new directions was strong enough to prompt him to move out of their boarding-house apartment in St. Louis.[1:805;2:186] He had his thriving practice, his income-producing books, patents and appliances, his growing international fame, his prospering proprietary school, and perhaps most significantly, Anna Hopkins, his secretary, amanuensis, confidante, and sympathetic soul mate (*Fig.* 3). We can follow his travails as a distant father in his stream of letters trying to influence the upbringing of his daughter to whom he wrote as "*your ol' Padre*"* (*Fig.* 4). It took Angle another 9 years to deliver an acceptable divorce settlement for Florence Senior in May 1908.[3:305] Angle's mother had died a few months earlier, and the delay and particular timing of his divorce may well reflect the determination of a devoted son to shield his devout mother from the shame of his broken marriage. On June 28, 1908, Hart and Anna were married in St. Louis (*at ages*

* References 1:474, 574–575, 795–796; 2:106–107.

Fig. 3:
Edward Hartley Angle, age 43 years, 1898, St. Louis, Missouri, at the beginning of his legendary ascent in international fame and fortune

Fig. 4:
Only known photograph of Dr. Angle's daughter, Florence Isabel Angle (on left), seen with him and an unidentified woman at his 65th birthday party, June 1, 1920, held in the garden at the Angles' home in Pasadena, California. Aged 32 years at the time, she was a schoolteacher in Los Angeles. Never married, Florence died in Morganton, NC 50 years later. (From the Milo Hellman collection in the Angle Society Archives.)

53 and 36, respectively) and within 2 months the newlyweds had moved to New York to begin a new chapter in their lives, as retired gentry.[3:305]

Contemporaneous observers and commentators agreed that Edward H. Angle - whether they liked the man or not - was a pillar of integrity and a model of character, presumably built up from the high values drilled in at home during his childhood. But, he was not without personal faults, some related to his uncontrollable need to defend his honor when he perceived an attack. One of Angle's more blatant weaknesses was his relapse occasionally into verbal abuse, an outspokenness commonplace among the educated and privileged of his time. It was a more benign prejudice than the hardcore racial and religious bigotry that was virulently expressed in society later in the 20th century. At various times in his letters, he disparaged the Irish, Scots, Jews, Christian Scientists, blacks, Easterners, university professors, drunks, women, and "*quack*" colleagues, to name a few easily labeled groups. He would trot out any stereotypical device he could recall to belittle someone who had caused him embarrassment or financial jeopardy. Angle was particularly callous about people whom he perceived as patent infringers, practice deadbeats, clashing colleagues, or "*muttonheads,*" as he sometimes called these disagreeable folks. Frederick B. Noyes, his friend since 1892 and a former student, put it this way: "*When he presented a paper before a society and someone assailed his ideas with elaborate quotations from the literature and citing of authorities, he could not argue. All he could do was to cuss at them, and call them God damn fools, who they probably were, and they didn't like it.*"

In his correspondence with friends, he referred to many people by nicknames, epithets, or code-names he created in jest or loathing. James "*Jason*" N. MacDowell was a classic example of a target for Angle's barbs. Dr. MacDowell, the first professor in orthodontia at the University of Illinois, wrote in 1901 a book "*Orthodontia: a Text Book for the Use of Students in Dental Colleges and a Hand Book for Dental Practitioners*" for dental students that was described best in journal reviews as derivative and uninspired. Angle considered MacDowell a shameless plagiarist and had harsher names for him, such as "*Jase the Degenerate,*" "*Mr. J. Sawdust Brains,*" "*The Oracle,*" "*The Thing,*" "*Idiot,*" and simply "*It.*" He even expressed a few of these pejoratives directly to MacDowell in critical letters.[2:384]

Angle was unforgiving to those who betrayed him. His brother Mahlon's perceived ineptness in their Montana sheep fiasco of 1881-1882 left Hart with a bitter taste. Mahlon was the only Angle child to stay on the family farm and work with father Philip, who died in 1907 at 87 years. Mother Isabel's death the following year at age 84 touched off venomous relations between Mahlon and his siblings. Mahlon was committed to continue his parents' dairy farm in Ballibay, and he was successful in buying out the other children's shared inheritance of the property for a pittance through his "*bellyaching*" and deceit.[3:244–248] Hart, livid over Mahlon's selfish and cheating behavior to the family, soon broke off relations with him for good, referring to Mahlon as "*that brute*" and "*the villain.*"

On the other hand, Edward Angle's good-natured admiration comes through clearly in his letters to long-time friends and loyal supporters. High on his praise list was Dr. Guilhermena P. Mendell from Minneapolis, who in 1902 was the first woman to take the Angle School course. He usually addressed her straightforwardly by her nicknames "*Quane*" or "*Mena*," but often he teased her with the titles "*Colossus of Minneapolis*," "*Old Doc Mendell*," or "*President*."[3:324–325,348–349] He loaned her lantern slides and took the pains to write her detailed instructions on how to give a lecture in the best form possible.[3:266–271]

In Edward H. Angle, we see a self-made man whom his rivals and competitors respected regardless of his points of view. Two of the most influential orthodontists in New York, Edward Augustus Bogue and Victor Hugo Jackson, both of whom Angle considered enemies, thought highly enough of Angle's work to offer him the orthodontia editorship for the International Dental Journal in 1902. Angle eventually declined.[2:730–731]

Edward H. Angle in daily life demonstrated most of the characteristics that today are identified as elements of a hypomanic personality, one associated with highly charged, productive, successful people. He was often demanding, intense, enthusiastic, restless, angry, colorful, consumed with confident curiosity, and obsessed with attention to detail. Habitual overwork is a common problem in these overachievers. In 1902, a month past his 47th birthday, Angle was physically depleted from excessive work.[2:520] He had lost much weight and was suffering from chronic fatigue and a flare-up of his lifelong respiratory illness. He wisely decided to take a vacation, a 2-month rail trip alone to the Pacific coast, seeking to regain his strengths. It worked, and he made new friends and found new supporters in the process of this recuperation.[2:589]

Edward C. Kirk, the distinguished Pennsylvania dean and editor of Dental Cosmos, once said to one of his students who came back from the Angle course wide-eyed and excited, "*What is there about this man Angle that enables him to take you ordinary guys, who were just mediocre students, and just average dentists and make you over into men full of enthusiasm and energy and eager to work*." Along with his mechanical genius, Angle's hypomanic nature - his unwavering devotion to orthodontics and his inspirational manner - was probably instrumental in making all the difference to these young impressionable minds. Besides Dr. Angle's aura for pointing students to lofty goals, he had the sensibility to recognize intrinsic quality in his candidates and to maintain high standards in his selection of students. In other words, the native talent, ambition, and leadership potential of his carefully screened students invariably would guide them to great future careers after their first-rate initiation at the Angle School.

It should not be forgotten that Edward Hartley Angle's personal vision was wide and deep, not simply confined to his profession. He was keen observer of nature in all its forms. The preamble of the citation accompanying the honorary Doctor of Science degree awarded to Dr. Angle in 1915 by the University of Pennsylvania acknowledged his broad intellectual base: "*Lover of art and nature, intimate* *friend of trees and flowers, but preeminently founder of the science of orthodontia....*" Angle exercised his intellectualism with an active sociability. He was a worldly man who enjoyed people and places; he was an outgoing celebrant and conversationalist. In addition, he was a talented artist, not only with intricate line drawings and creations for clinical orthodontics, but also in crafting gold jewelry, such as stickpins set with semiprecious stones, which he often gave as gifts to friends.

Furthermore, Angle was an avid collector of things of the world. He gladly received and studied valuable arts and crafts from friends and his grateful foreign correspondents in South Africa, Japan, and elsewhere.[2:567;3:301–302] Angle asked his well-known orthodontist-friends and mentors for photographs of themselves and other dental celebrities, both earlier and contemporary, to add to his lantern slide collection, which he projected as a historical prelude to his lectures at various meetings.[1:217;2:567,603] He loved American Indian artifacts, arrowheads and tomahawk heads which he challenged his patients and friends to find and trade to him.[1:394,796;2:723–724] He collected animal and human skulls and osteological materials in plentiful supply from archeologists excavating the burial mounds around St. Louis.[1:508] He and Anna nourished for over three decades an extensive collection of American Indian weavings, beadwork, textiles, clothing, and baskets, mostly from the tribes of the Plains and Great Basin areas of the United States (*Fig. 5*). Most of their archeological and ethnographic collections were donated to institutions and museums in their lifetimes. Almost 300 valuable objects of American Indian ethnography were given by Anna Hopkins

Fig. 5:
Edward H. and Anna H. Angle in their Pasadena home, surrounded by a display of American Indian textiles and beadwork in this photograph from the 1920s, which was inscribed and sent as a Christmas card. Collecting Native American arts and crafts was an active pastime for the Angles, who amassed over 300 important ethnographic objects.

Angle from 1930, the year of Edward Angle's death, to 1959, two years after her death, to the museum of Claremont College, now the Pomona College Museum of Art in Los Angeles. It represents a living testament to the broad tastes and intellectual vigor of the Angles.

Reference

Numbers in superscript in this article refer to related Angle letters (volume:page) as published in the comprehensive archival publication cited: Peck S, ed. The World of Edward Hartley Angle, MD, DDS: His Letters, Accounts and Patents. 4 Volumes. Boston, Mass: E. H. Angle Education and Research Foundation; 2007. ISBN 978-0-9779524-0-3; available on a non-profit basis at angle@allenpress.com.

2021 Damon Master Program

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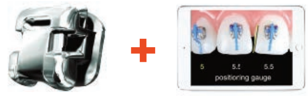

全新改版的 2021 貝多芬高效 Damon 矯正大師系列課程，是由**國際知名講師張慧男醫師親自規劃及授課**，課程特色強調由臨床病例帶動診斷、分析、治療計畫擬定與執行技巧，本年度亦特別加入最新的**數位矯正與隱形牙套**的內容，並邀請了貝多芬牙科集團各院院長演講**特別矯正專題**。

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，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。

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！

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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

Module 2 - 5/13 (A班) | 8/12 (B班)

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

Practice: Patient photo management

Module 3 - 5/27 (A班) | 9/30 (B班)

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

Practice: Ceph tracing

Module 4 - 6/17 (A班) | 10/14 (B班)

1. Excellent finishing
2. Retention & relapse

Practice: Ceph superimposition & measurement

Module 5 - 7/8 (A班) | 11/4 (B班)

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

Practice: Case report demo

▲ **Computer training (Mac): 1:30-2:30 pm**

*B班為特別加開班

Module 6 - 8/5 (A班) | 11/25 (B班)

1. Class III correction
2. Class II correction

Topic: Early orthodontic treatment (曾淑萍醫師)

Module 7 - 9/9 (A班) | 12/9 (B班)

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

Topic: Modfied VISTA (蘇筌瑋醫師)

Module 8 - 9/16 (A班) | 12/30 (B班)

1. ABO DI, CRE workshop
2. Open bite

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

Module 9 - 10/21 (A班) | 1/20/22' (B班)

1. Asymmetry
2. Implant-ortho combined treatment
3. Interdisciplinary treatment-adult complex cases

Topic: Interdisciplinary approach (邱上珍醫師)

Module 10 - 11/11 (A班) | 2/24/22' (B班)

1. Minor surgeries in orthodontics
2. Digital orthodontics

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

Module 11 - 12/23 (A班) | 3/10/22' (B班)

1. Aligner & TADs
2. Keys to aligner learning

Topic: Pre-aligner treatment (林詩詠醫師)

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Chapter 2. Wildlife Habitat for Quail

Ideas lose themselves as quickly as quail, and one must wing them the minute they rise out of the grass, or they are gone.

— Thomas F Kennedy

Fig. 1: Tin basins are set upside-down to serve as a feeding tray, preventing the feed from getting damp from the soil and allowing easy cleaning.

Fig. 2: Quail enjoy an unruly, lively garden where they can observe the surroundings while knowing there is always somewhere to hide in case of danger.

This quote by Thomas F. Kennedy (1858-1917) vividly portraits the nature of quail — easily alerted and quick to run into hiding. The word *quail* is even used as a verb, meaning to feel or show fear, or to want to move away from something out of fear (source: Cambridge online dictionary).

Quail are mid-sized, ground-dwelling birds, with the term covering a wide variety of breeds and species; the most common quail in Taiwan and most East Asian countries is the Japanese quail. An adult quail on average weighs around 10oz (≈130g, with females slightly heavier than males) and measures around 20cm in length. Chicks mature after about 6 weeks and a female adult quail can lay up to 300 eggs in a year, a profitable and abundant resource for farmers and scientific research.

Generally speaking, quail in the wild inhabit grasslands. Since they easily fall prey to other animals, overhead cover such as high grass, broadleaf, and woody bushes is essential for providing hiding places and reducing the efficiency of their predators. The bare ground under these plants also allows quail to move around freely and to build their nests during the breeding season. Moreover, while younger quail may consume insects, the adult quail diet is primarily plant-based. In a nutshell, a lush, unruly garden is an ideal man-made habitat that mimics the wild in which quail live.

To accommodate quail in a suitably realistic living environment, Dr. Chang had his mind set on creating a garden on his rooftop. By doing so, predation that occurs mostly on ground floor level - not only by pests such as snakes and rats, but also by common household pets such as cats and dogs - can be avoided. A core condition for a rooftop garden that is both sustainable and, more importantly safe, lies in the drainage system.

Fig. 3: A mother Texas A&M quail keeping herself alert while her chicks doze off during their stroll in the garden (Watch this quail family in action: https://youtu.be/e_1PvdfUiC0)

Fig. 4: Quail make their nests in bushes or among tall grasses. Around 10-16 eggs would be laid in one clutch, with brown and black speckles on them as disguise.

Fig. 5: The messier, the merrier. The plantation is not set out to fit a specific graphic design as most gardens are. Nature has its own idea of beauty, and the creation is just an eye-brightening ordinary miracle.

Fig. 6: The weight of the different materials making up planting medium has to be taken into consideration during distribution: heavy materials around the edges, and light ones in the center. Stone panels are arranged onto the soil as a walkway after planting is completed.

As Dr. Chang would say in an advocating manner, "No over-retention of water means no leaking!"（不積水，就不漏水！）As long as the garden does not retain excess water, the chances of leakage can be minimized. This also reduces considerably the amount of weight that the building has to bear, ensuring structural stability and residential safety.

The first and foremost barrier at the base of the garden is a waterproof coating, seven layers of it to be exact, to ensure that no water penetrates into the structure of the building. It is crucial that this coating is sloped to guide any excess water to the allocated drainage system. On top of that is a layer of drainage trays, which elevate the planting area, leaving spaces at the bottom not only for excessive water to run through but also to allow air circulation so that any residual water can evaporate. Before loading up the floor with a planting medium, a layer of non-woven cloth is spread all over the drainage trays to prevent soil depletion.

Different materials are required to form the planting medium. *Gravel* - the spaces between which help enhance drainage; *shredded tree bark* - which is light and retains just enough moisture for plants that require more hydration to thrive; and common *garden soil* - to provide the necessary nutrients. In order for the building to hold up to 20 tons of planting medium, these materials are distributed in relation to their weight and the load-bearing capacity of the rooftop structure. Heavy materials, such as gravel, are paved along the edges of the building, where higher structural stability is ensured with the fortification of the walls. The lighter shredded tree bark is concentrated more in the center, beneath which there is relatively less structural support (Fig. 6).

Once the planting medium is ready, the only job left before moving the quail in is to *plant away*! In less than 6 months, the Changs' rooftop has been transformed from a construction site into a flourishing green garden with haphazard splashes of colors. However, for Dr. Chang and his family, even the most fully-bloomed, radiantly-colorful flowers cannot steal the spotlight from their new found love, their restless little residents — quail. In addition to the common Japanese quail, the garden is also home to Italian quail, Texas A&M, and the most beautiful of all, Chinese painted quail. While Italian quail are famous for their golden-colored, playfully-speckled coat, and Texas A&M quail catch onlookers' eyes with their elegant white plumage, Chinese painted quail are relatively low profile but impress onlookers with the navy blue on their back, burgundy-colored chest, and the bold black-and-white pattern on the chin. Being the smallest among the quail family, Chinese painted quail (measuring 2oz, ≈50g, in weight and 14cm in length) are of the least economic value; however, for those with eyes of an artist, they are truly something precious.

"Ideas lose themselves as quickly as quail," said Mr. Thomas F. Kennedy. However, for Dr. Chang, having quail running about in such close proximity has not only added color and vitality to his garden, but has created a temple of inspiration on his rooftop hideaway.

Desk editor of JDO & a wildlife enthusiast*
Annie Chen

* Title bestowed by Dr. Chris Chang
Special thanks to the talented artist, Jenny Chang, for the exquisite paintings.

Fig. 7: Dr. Chang finds his mind at ease, and his thoughts the most active, when immersed in nature. Compared to an office or a study room, the rooftop garden is now his favorite place to prepare his lectures and speeches.

Fig. 8: Chinese painted quail plumage: amazing illustrations by the talented young artist, Jenny Chang. From their iconic black-and-white pattern on the chin, Dr. Chang speculates that the doodles on the package of the Ormco quail elastics (2oz, 3/16") are also inspired by this breed.

Fig. 9: A dreamy ombré dusk sky adds a further touch of enchantment to the endearing rooftop garden.

Fig. 10: A juvenile quail feeding on grains held in Dr. Chang's palm is a sure sign that the quail have become accustomed to their surroundings.

Fig. 11: A fully-fledged, golden-colored Italian quail peeking through some lush vegetation

Fig. 12: Father-daughter bonding time while overlooking a mother Texas A&M quail bonding with her chicks creates an extraordinarily heart-warming scene in the garden.

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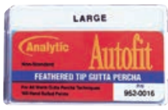

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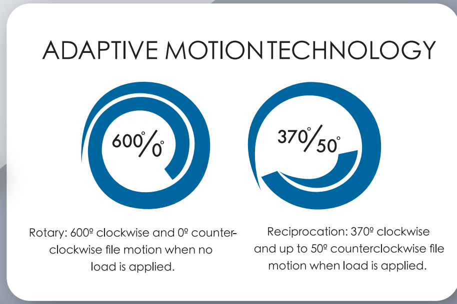

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Dr. Chang live-streaming with the Association of Orthodontists (Singapore) Congress in early July, 2021. The topics covered tips on open bite correction and the future role of brackets in orthodontics.