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.

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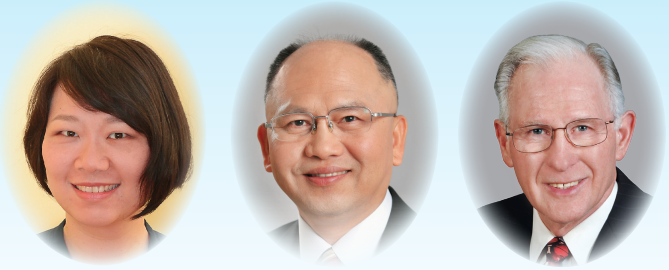

Fig. 1: Pre-treatment facial photographs, 25 y/o male

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

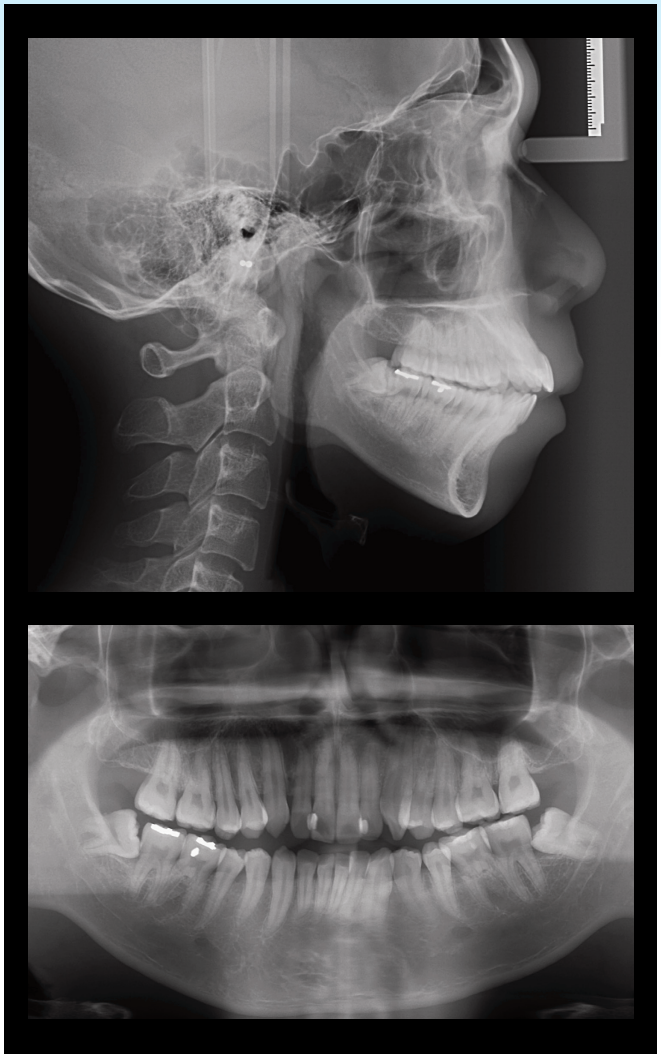

Fig. 5:
Pre-treatment cephalometric and panoramic radiographs document the original dentofacial morphology. The panoramic film reveals two impacted third molars.

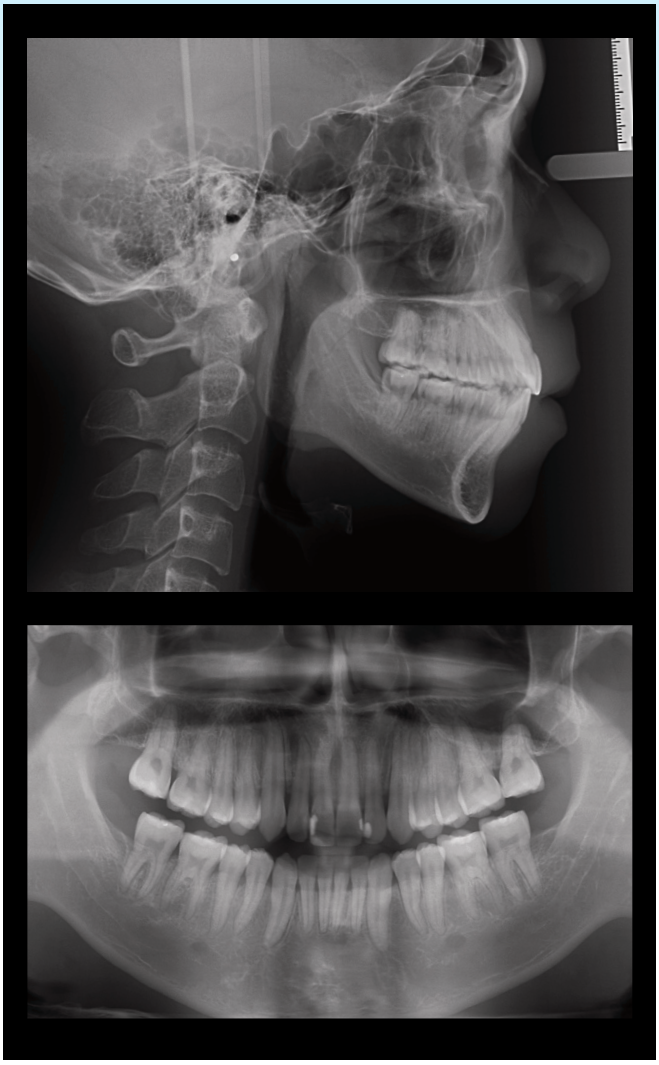

Fig. 6:
Post-treatment cephalometric and panoramic radiographs reveal the dentofacial morphology immediately after Invisalign® attachments were removed.

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*

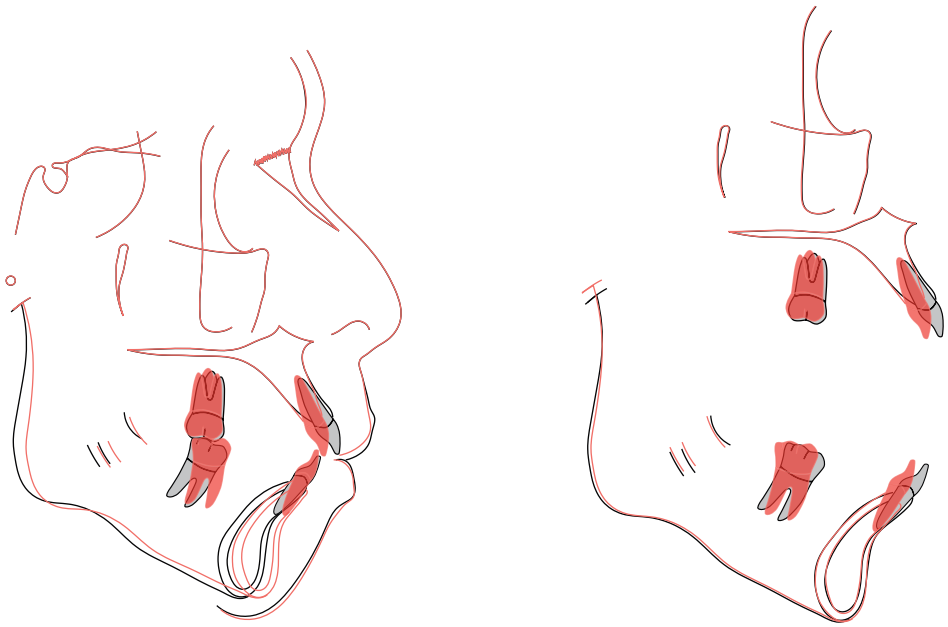

Fig. 7:
Pre- (black) and post-treatment (red) cephalometric tracings are superimposed on the anterior cranial base (left), the maxilla (upper right), and the stable internal structures of the mandible (lower right). Counterclockwise rotation of mandible was revealed. The maxilla superimposition shows 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.

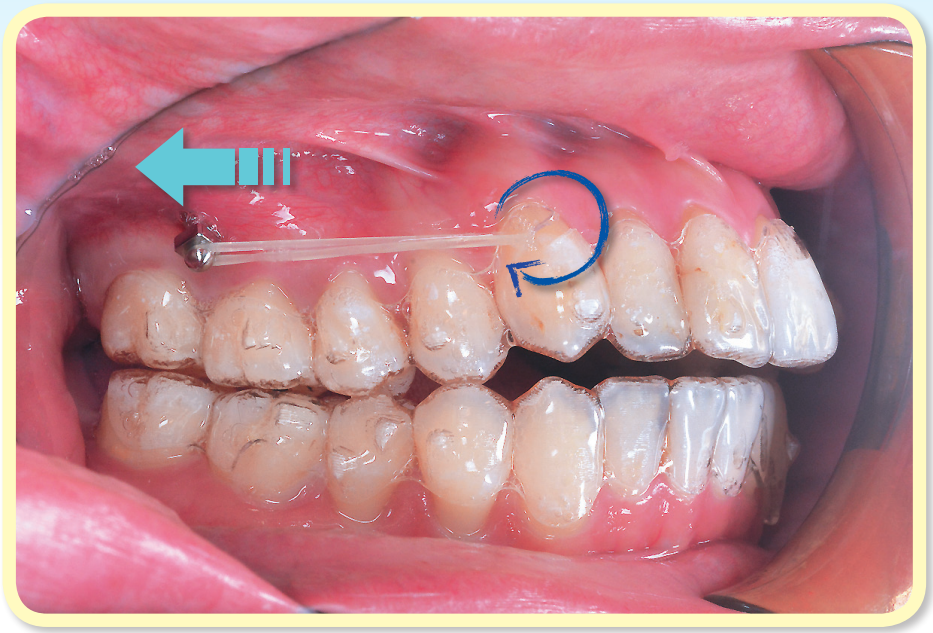

Fig. 8:
The IZC screws were installed bilaterally in the infra-zygomatic crest extra-alveolar area to provide anchorage for maxillary retraction and cause a clockwise moment on the upper arch at the same time. This mechanism can efficiently correct the protrusive incisors and open bite.

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.

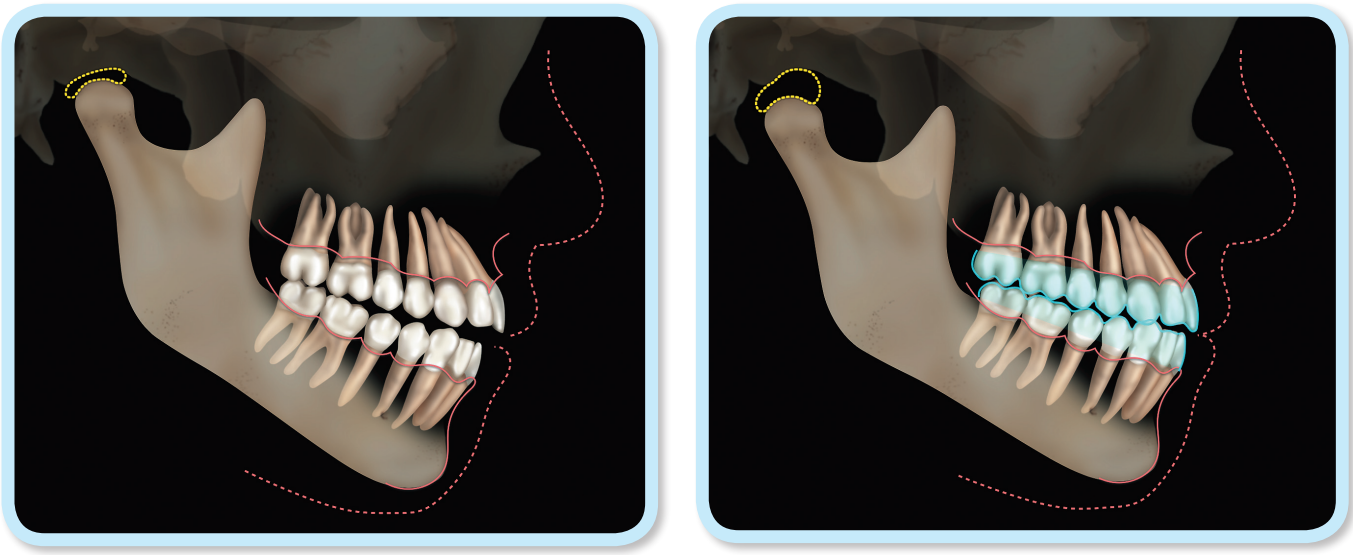

Fig. 11:
The illustration presents the raised vertical dimension (left) plus the biting force with which the posterior teeth (right) forced the mandible to rotate counterclockwise. Meanwhile, the space between condylar head and mandibular fossa was enlarged (yellow dotted lines).

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*).

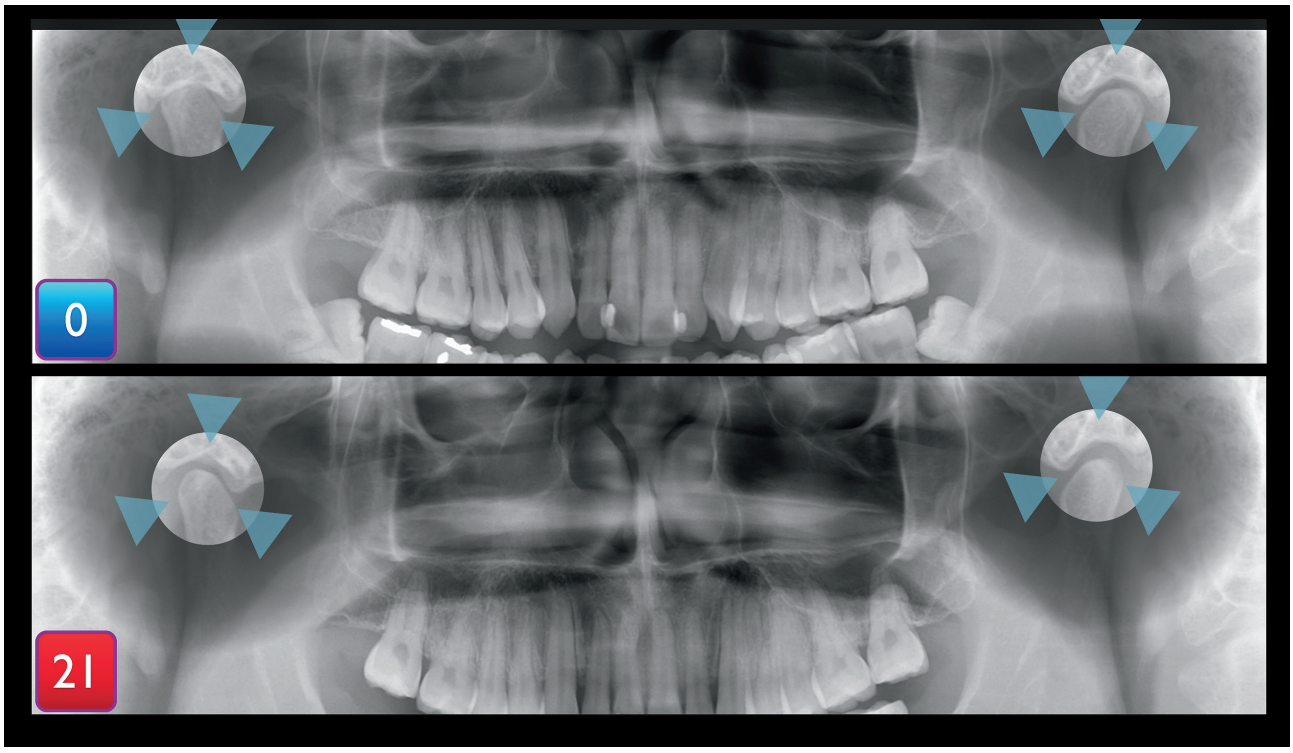

Fig. 12:
Compared to the pre-treatment morphology, the space between condylar head and mandibular fossa (blue triangles) was enlarged bilaterally after 21 months of aligner treatment.

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.

References

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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

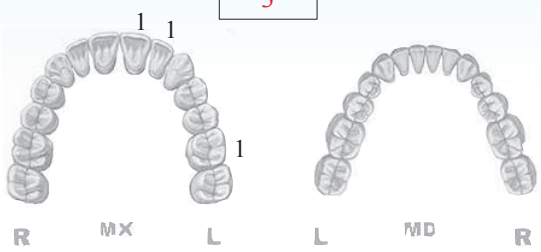
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 16

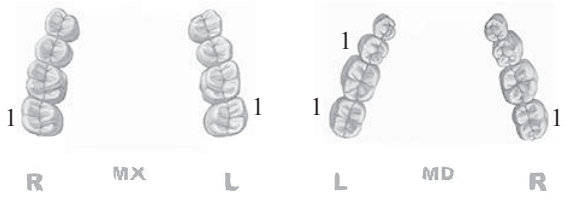
Alignment/Rotations

3



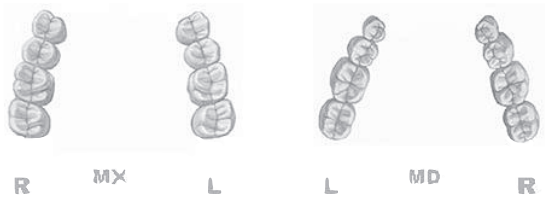
Marginal Ridges

5



Buccolingual Inclination

0

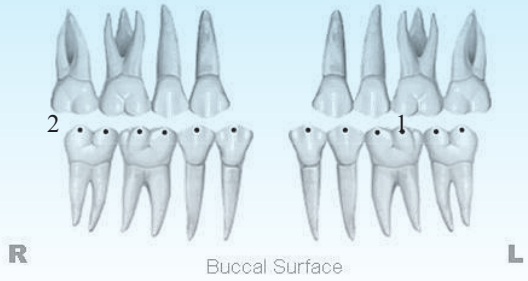


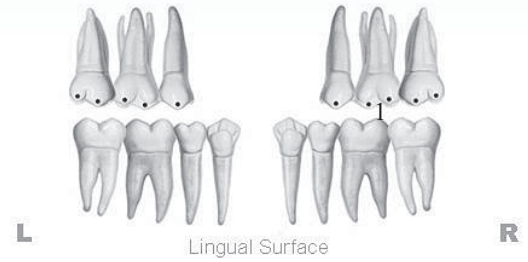
Overjet

2

Occlusal Contacts

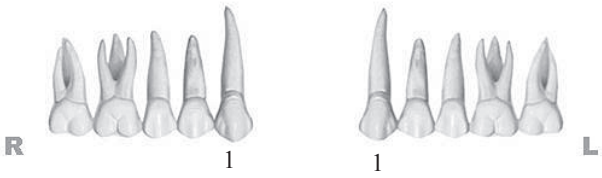
3





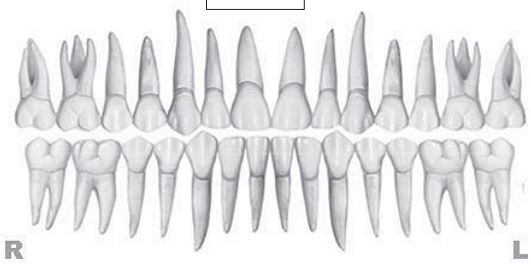
Occlusal Relationships

2



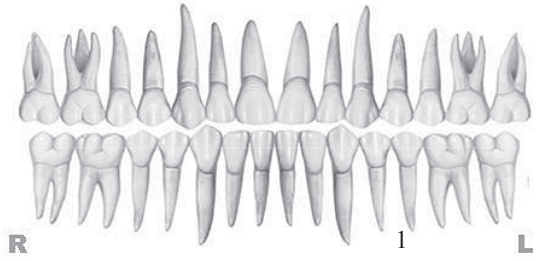
Interproximal Contacts

0



Root Angulation

1



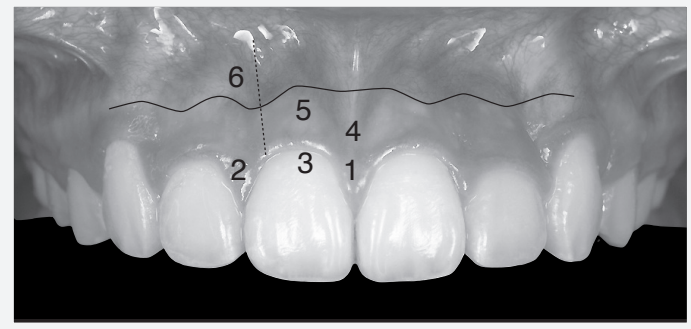
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 3

1. Pink Esthetic Score

Total = 1

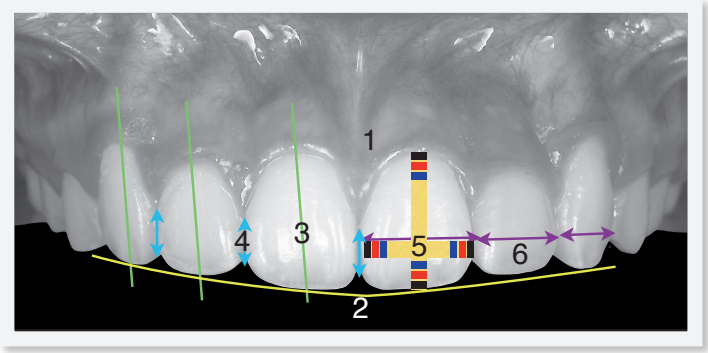


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

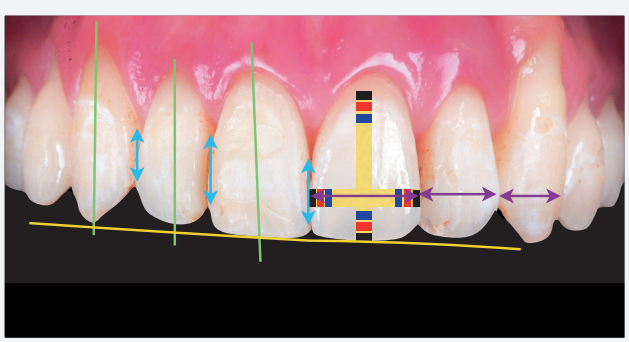
1. M & D Papilla	(0)	1	2
2. Keratinized Gingiva	(0)	1	2
3. Curvature of Gingival Margin	0	(1)	2
4. Level of Gingival Margin	(0)	1	2
5. Root Convexity (Torque)	(0)	1	2
6. Scar Formation	(0)	1	2

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
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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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
- 衛福部部定齒顎矯正 專科醫師
- 隱適美invisalign 隱形矯正 認證醫師
- 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
- 前台大醫院齒顎矯正科醫師
- 前台大國際進階矯正課程講師

陳佳伶 醫師
- 高雄醫學大學 牙醫學系學士
- 彰化基督教醫院 住院醫師
- 高雄醫學大學 齒顎矯正科受訓醫師
- 高雄醫學大學 齒顎矯正碩士
- 中華民國齒顎矯正學會 會員醫師
- 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

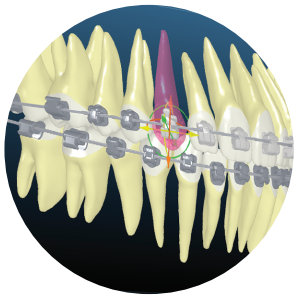
Digital Orthodontics, OBS, VISTA

Digital Orthodontics, OBS, VISTA

Keynote (optional)

2022 Session A Session B dates to be announced

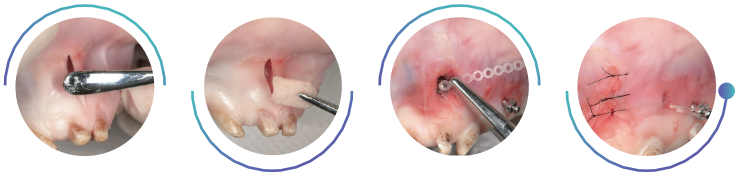
@Taiwan



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.