# 2024 一年一度 Damon Master Program


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全新改版的 2024 年貝多芬高效 Damon 矯正大師系列課程，是由**國際知名講師張慧男醫師親自規劃及授課**，課程特色強調由臨床病例帶動診斷、分析、治療計畫擬定與執行技巧，本年度亦特別加入最新的**數位矯正與隱形牙套**的內容，並邀請了貝多芬牙科集團各院院長演講**特別矯正專題**。

此外，透過數位影片反覆觀看，結合矯正與電腦教學，課堂助教協助操作，讓學員在短時間能快速上手，感染「**熱愛矯正學，熱愛學矯正**」的熱情。

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

**Module 1 - 3/28**

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

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

**Module 2 - 4/11**

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

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

**Module 3 - 4/25**

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

Practice: Ceph tracing（金牛頓工程師）

**Module 4 - 5/16**

1. Excellent finishing
2. Retention & relapse

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

**Module 5 - 5/30**

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

Practice: Case report demo（陳俊宏醫師）

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

**Module 6 - 6/20**

1. Class III correction
2. Class II correction

Topic: Early orthodontic treatment（曾淑萍醫師）

**Module 7 - 6/27**

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

Topic: Modified VISTA（蘇筌瑋醫師）

**Module 8 - 7/11**

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

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

**Module 9 - 7/25**

1. Implant-ortho combined treatment
2. Asymmetry

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

**Module 10 - 8/29**

1. Minor surgeries in orthodontics
2. Digital orthodontics

Topic: Modified 2X4 appliance in ortho treatment（李亮賢醫師）

**Module 11 - 9/19**

1. Aligner design
2. Comprehensive aligner treatment
3. Aligner & its challenges

Topic: Pre-aligner treatment（林詩詠醫師）

▲ **Special lecture: 1:30-2:30 pm**

時間：週四全天（9 am - 5 pm）

地點：金牛頓藝術科技（新竹市建中一路 25 號 2 樓）

**費用含課程視訊*、iPad、課程電子書與材料。**

*贈送之課程視訊提供兩年時間串流觀看。


**報名專線 湧傑 Yong Chieh**

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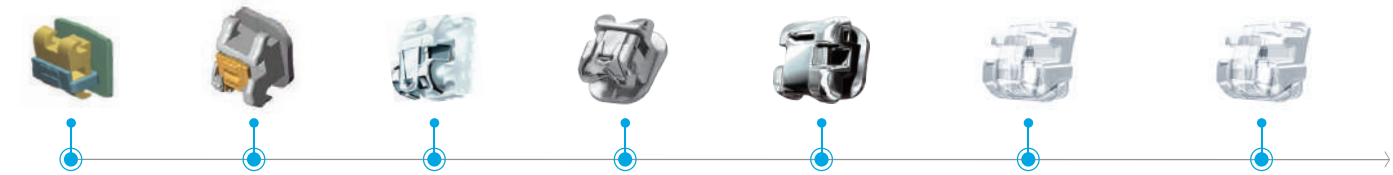

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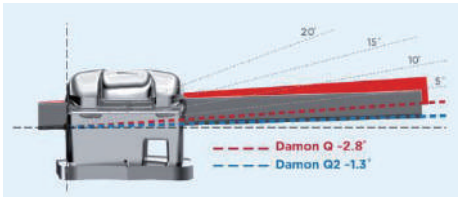


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**C Damon TMA Low-Friction Wire**
size .017 x .025


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- Archwires A x 40條, B x 20條, C x 20條

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YONG CHIEH 湧 傑

**促銷期限 2023/07/25-12/25** 客服專線：北區 (02)2778-8315・中區 (04)2305-8915・南區 (07)226-0030



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# Labially Impacted Maxillary Canine with Class III Malocclusion: Bone-Anchored 3D Lever Arm Mechanics


## Abstract

***Introduction:*** *A 17-year-old female was referred by another dentist to assess her impacted canine.*

***Diagnosis:*** *The patient was skeletal Class I (SNA, 84.5˚; SNB, 81˚; ANB, 3.5˚) with bilateral end-on Class III molar relationships. Her profile suggested a Class III malocclusion since she had a high mandibular angle of 48˚. The upper left deciduous canine (ULc) was present, the UL3 was labially and horizontally impacted, and root resorption of the apex of the UL2 was noticed. The Discrepancy Index (DI) was 47.*

***Treatment:*** *The impacted canine was treated using the vertical incision subperiosteal tunnel access (VISTA) technique and a custom 3D lever arm anchored by an OrthoBoneScrew® (OBS) inserted in the left infrazygomatic crest (IZC) to produce a submucosal space for retracting and extruding the impaction and aligning it into the normal canine position.*

***Outcome:*** *After 30 months of active treatment, the impacted upper left canine was recovered and aligned in an ideal relationship. The Cast-Radiograph Evaluation (CRE) was 16, and the dental esthetic (Pink & White) score was 4.*

***Conclusions:*** *The VISTA surgical exposure is a unique approach for submucosal movement of the impactions. Skeletal anchorage using OBS with a 3D lever arm provides an independent force system for retracting the impaction. (J Digital Orthod 2023;72:26-49)*



***Key words:***
*Impacted maxillary canine, infrazygomatic crest miniscrews, bone screw anchorage, vertical incision subperiosteal tunnal access (VISTA), 3D lever arm, root resorption*


## Introduction

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, and deciduous teeth are delineated a-e.

Tooth impaction has long been an intractable anomaly. Among the different kinds, maxillary canine impactions are the second most common impactions with a prevalence of 0.2-2.8%.[1] Therefore, the etiology and management of maxillary canine impactions are major concerns for clinicians. When treating impactions, spontaneous eruption is preferred over surgical intervention to achieve better keratinized gingiva and less root resorption. Spontaneous eruption can be achieved with selective removal of the deciduous canines, extraction of adjacent premolars, or by creating space using orthodontic mechanics.[2,3] However, if the impacted canine is located in an ectopic eruption site, surgical intervention with orthodontic mechanics may be indicated.[4]

In this present case, an impacted maxillary left canine was located labially overlying the apices of the central and lateral incisors. This case report demonstrates a surgical intervention using the

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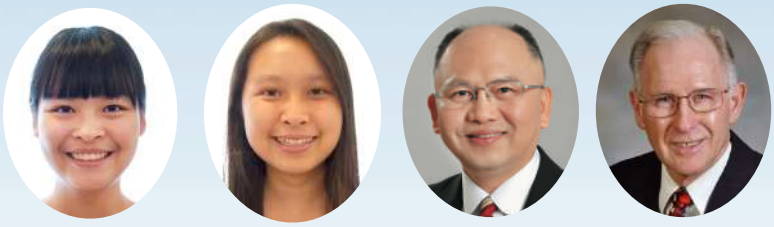
*Founder, Beethoven Orthodontic Center*
*Publisher, Journal of Digital Orthodontics (Center right)*
**W. Eugene Roberts,**
*Editor-in-Chief, Journal of Digital Orthodontics (Right)*



vertical incision subperiosteal tunnel access (VISTA) technique and bone screw anchorage combined with a 3D lever arm to retract the impaction into the arch. With thorough, stepwise surgical details and treatment progress, this challenging case was finished with a satisfying outcome with minimal gingival scarring and root resorption.[5]

## History and Etiology

A 17-year-old female sought orthodontic consultation for her crowded dentition, posterior

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

crossbite tendency, and impacted maxillary canine (Fig. 1). A clinical examination revealed a nice facial profile with a slightly retrusive upper lip. The sagittal relationship was an end-on Class III malocclusion. Crowding was about 9 mm and 6 mm in the upper and lower arches respecitively (Fig. 2). Panoramic and lateral cephalometric radiographs revealed the position of the impacted upper left canine (UL3) (Figs. 3 and 4). A pre-treatment cone beam computed tomography (CBCT) image showed that the impacted UL3 was located labially between UL1 and UL2 (Fig. 5). The root of the ULc was not resorbed, but the root apex of the UL2 was slightly resorbed by the impacted UL3 (Fig. 6).

## Diagnosis

**Skeletal**:

Skeletal Class I: *SNA, 84.5°; SNB, 81°; ANB, 3.5°*

Mandibular Plane Angle: *SN-MP, 48°; FMA, 41°*

***Fig. 2:*** *Pre-treatment study models*

**Dental**:

Occlusion: *end-on Class III molar*

Overjet: *1 mm*

Upper incisors: *Within normal limits (WNL) (U1-NA, 3 mm; U1-SN, 104°)*

***Fig. 3:*** *Pre-treatment panoramic radiograph*

***Fig. 4:*** *Pre-treatment cephalometric radiograph*

*Fig. 5:*
*Pre-treatment CBCT images of the maxillary dentition shows a labially impacted UL3 positioned between the roots of UL1 and UL2.*

| CEPHALOMETRIC SUMMARY | | | |
|---|---|---|---|
| SKELETAL ANALYSIS | | | |
| | PRE-TX | POST-TX | DIFF. |
| SNA° (82°) | 84.5° | 83° | 1.5° |
| SNB° (80°) | 81° | 80° | 1° |
| ANB° (2°) | 3.5° | 3° | 0.5° |
| SN-MP° (32°) | 48° | 48° | 0° |
| FMA° (25°) | 41° | 41° | 0° |
| DENTAL ANALYSIS | | | |
| U1 TO NA mm (4mm) | 3 | 1 | 2 |
| U1 TO SN° (104°) | 104° | 97° | 7° |
| L1 TO NB mm (4mm) | 8 | 5 | 3 |
| L1 TO MP° (90°) | 75° | 72° | 3° |
| FACIAL ANALYSIS | | | |
| E-LINE UL (-1mm) | -2 | -4 | 2 |
| E-LINE LL (0mm) | 1 | -3 | 4 |
| %FH: Na-ANS-Gn (53%) | 47% | 53% | 6% |
| Convexity:G-Sn-Pg' (13°) | 15° | 13° | 2° |

*Table 1: Cephalometric summary*

Lower incisors: *protrusive and decreased axial inclination (L1-NB, 8 mm; L1-MP, 75°)*

Impaction: *Labially impacted UL3, with crown impinging on the UL2 root; slight root resorption of UL2*

**Facial**: *Slightly retrusive upper lip (upper and lower lips were -2 mm and 1 mm to the E-line respectively.)*

The cephalometric summary is in Table 1. The American Board of Orthodontics (ABO) Discrepancy Index (DI) was 47 points as shown in the subsequent Worksheet 1.

## Treatment Objectives

1. Achieve Class I canine and molar relationships.
2. Resolve the labially impacted maxillary canine.
3. Attain ideal overjet and overbite.
4. Improve facial esthetics.

## Treatment Alternative

Three treatment options were proposed using full-fixed appliances:

**Option 1: Extract the impacted canine (UL3) and substitute with premolar (UL4).**

On the contrary, extraction of LL4, LR4, UR4, ULc and surgically removing the impacted UL3 would decrease the duration and difficulty of the treatment. However, substituting the impacted UL3 with the adjacent first premolar would compromise the esthetics and function of the occlusion, which may result in a lack


*Fig. 6:*
*Pre-treatment CBCT images showed slight root resorption of the UL2 by the impacted UL3.*

of occlusal guidance, an unbalanced occlusion, dental arch asymmetry, compromised dental esthetics, and temporomandibular joint disorder.[6]

### Option 2: Non-extraction treatment with modified VISTA and OBS 3D lever arm

Extract only the deciduous canine (ULc), and use the modified VISTA technique combined with a 3D lever arm anchored with an OrthoBoneScrew® (OBS) (iNewton Dental, Inc., Hsinchu City, Taiwan) to align the impacted UL3. However, due to the Class III malocclusion, high mandibular plane angle (SN-MP, 48˚; FMA, 41˚), as well as the crowded arch, this non-extraction approach might result in an anterior open bite and lip protrusion.

### Option 3: Four-bicuspid extraction with modified VISTA and OBS 3D lever arm

Chang's extraction decision table was consulted to assess the necessity for extraction (Table 2).[7] The two main factors favoring extraction of all four first premolars were a high mandibular plane angle (FMA 41°) and >7 mm crowding in the maxillary arch. The extraction could resolve crowded dentition, maintain the lip profile, and correct the Class III malocclusion. The modified VISTA technique would be used to uncover the impacted canine, which would be repositioned using a 3D lever arm and power chains anchored to an IZC OBS. However, this option would probably take the longest time (Fig. 7).

After a thorough discussion of all three options, Option 3 was considered the most suitable treatment plan for both the clinicians and the patient.

| | Ext | Non |
|---|---|---|
| 1. Profile | Protrusive | Straight |
| 2. Md. angle | High | Low |
| 3. Bite | Open | Deep |
| 4. Ant. inclination | Flaring | Flat |
| 5. Crowding | > 7 mm | None |
| 6. Decay/ missing | Present | ? |
| 7. P't perception | Ok | No |
| 8. Etc... | | |

*Table 2: Chang's Extraction Decision Table*

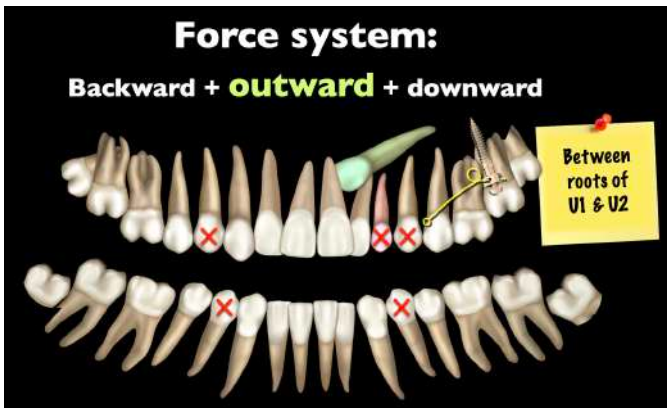



*Fig. 7: Proposed treatment (Option 3) in illustration*

## Treatment Progress

Four first premolars and the upper left primary canine were extracted. A passive self-ligating (PSL) fixed appliance (Damon Q®, Ormco Corporation, Glendora, CA) was bonded on all maxillary teeth except for the UR2 and UL2, and a 0.014-in CuNiTi archwire was engaged in order to start the active treatment. Low-torque brackets were bonded on the UR2 in the 7th month, as well as on the UL2 in the 11th month since by then there were adequate spaces created by open coil springs. Additional labial root torque was applied to UR2 and UL2 using auxiliary torquing springs from the 18th to 21st months (Figs. 8-11).

Two months into treatment, the impacted canine was surgically uncovered since there was adequate space created by extracting the deciduous canine and first premolar. The IZC screws and 3D lever arm independent force system designed by Chang delivered the necessary retraction force for the impacted UL3, without producing undesired side effects on other teeth. Details for the surgical flap and force system design will be discussed later in this report.

The post-operative radiographs monitored the movement of the impacted canine (Fig. 12). After 5 months of activation, the 3D lever arm and IZC screw were removed since the UL3 was up-righted and internally positioned in the arch, coronal to the mucogingival junction. In the 9th month, the UL3 was bonded with a high-torque bracket, and the UL2 was bonded with a low-torque bracket (Fig. 13). Light force archwires (0.014-in CuNiTi) were utilized to align the upper and lower arches. The archwire sequence for both arches are shown in Table 3 and Fig. 11.

It was a priority to prevent further torque loss of the mandibular incisors (L1-MP, 75˚) during closure of the extraction spaces and to compensate for dumping the mandibular incisors by the Class III elastic mechanics, so from the 16th to the 18th months a 0.016x0.025-in pre-torqued (+15°) archwire on the

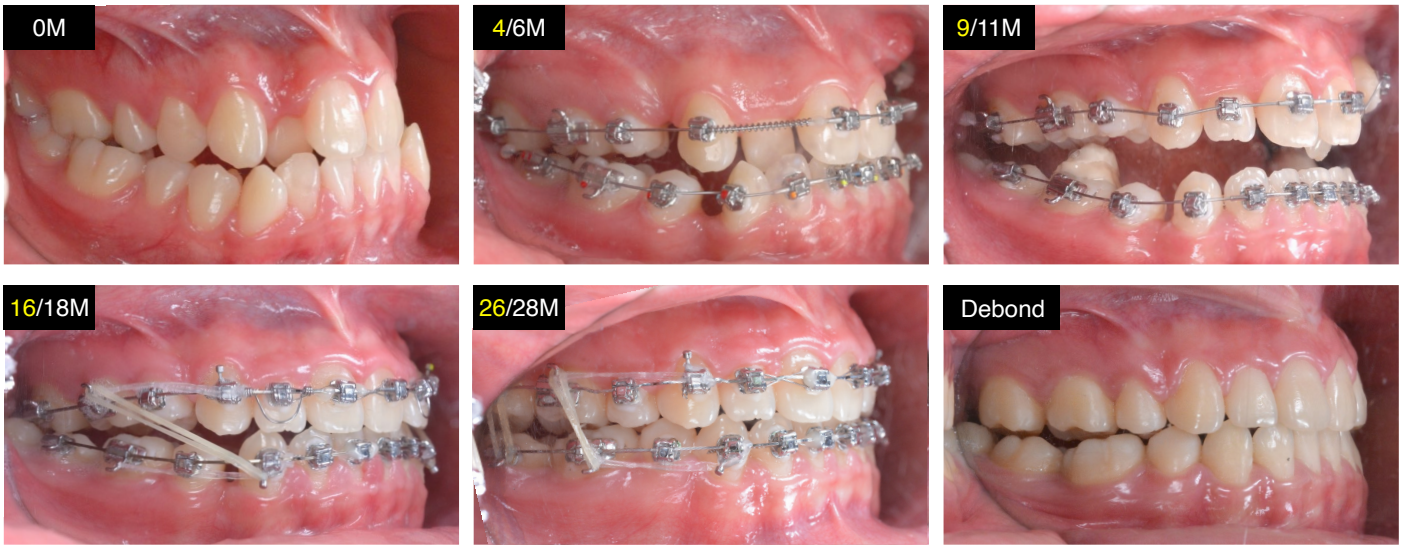



***Fig. 8:***
*Treatment progress - right buccal view. Note the UR2 was not bonded with a bracket until the 5th month. The posterior bite turbos (glass ionomer cement (GIC)) were placed on the occlusal surfaces of L6s to create interocclusal space for blocked-in lateral incisors.*

on the mandibular arch delivered a continuous light force of lingual root torque to the mandibular incisors. For this patient, the mandibular incisors were bonded with standard-torque brackets. Upside-down low-torque brackets could have been bonded on the lower anterior teeth to serve as high-torque brackets to prevent torque loss on the mandibular incisors (Fig. 14).

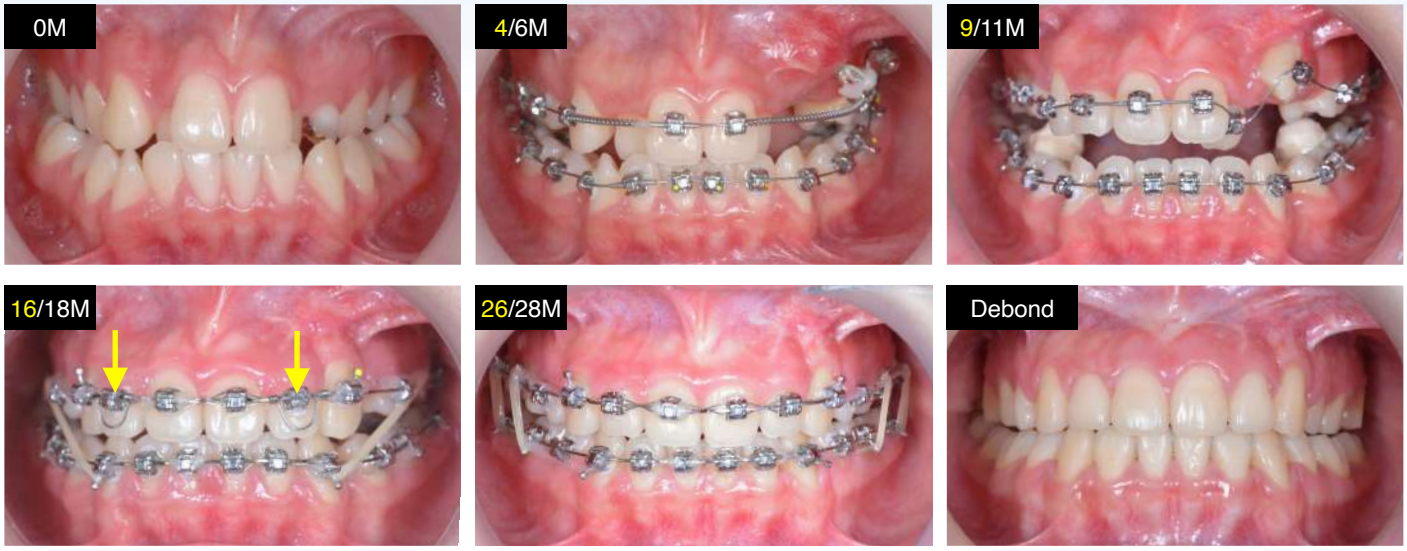



*Fig. 9:*
*Treatment progress - frontal view. Additional labial root torque was applied to UR2 and UL2 using auxiliary torquing springs (yellow arrows) in the 18th month, and Class III elastics (Fox, 1/4-in, 3.5 oz; Ormco) were added. In the 20th month, inter-maxillary elastics (Chipmunk, 1/8-in, 3.5 oz) were used for settling the occlusion.*

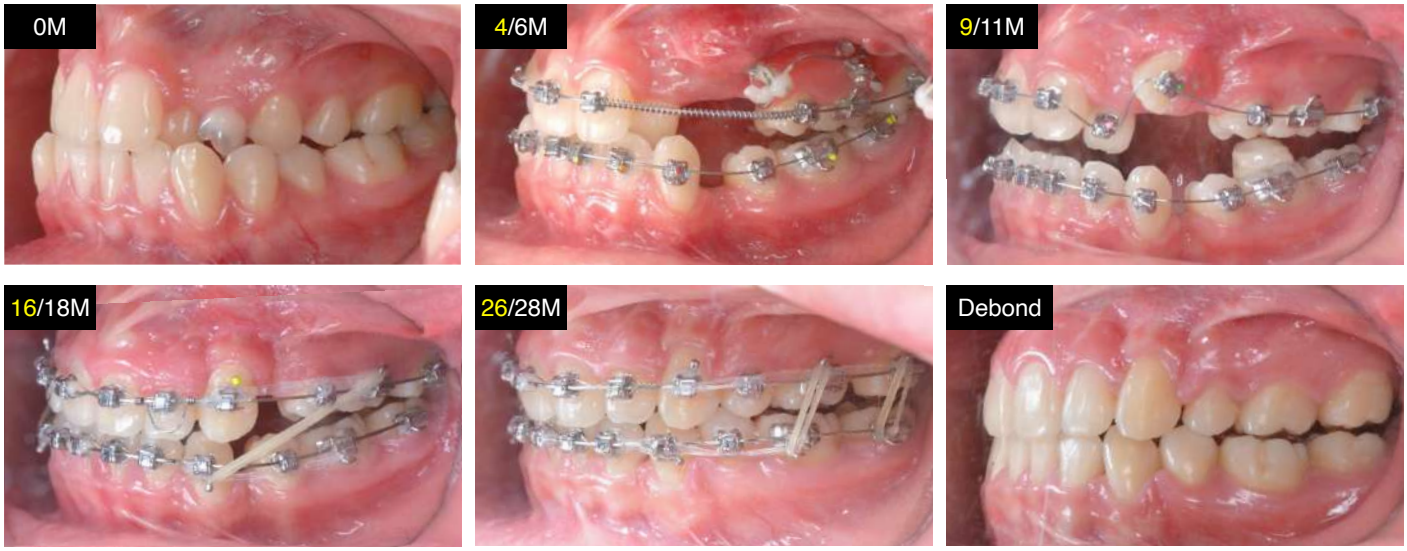



*Fig. 10:*
*Treatment progress - left buccal view. The impacted UL3 was successfully aligned into the arch and was bonded with a high-torque bracket 9 months after surgery.*

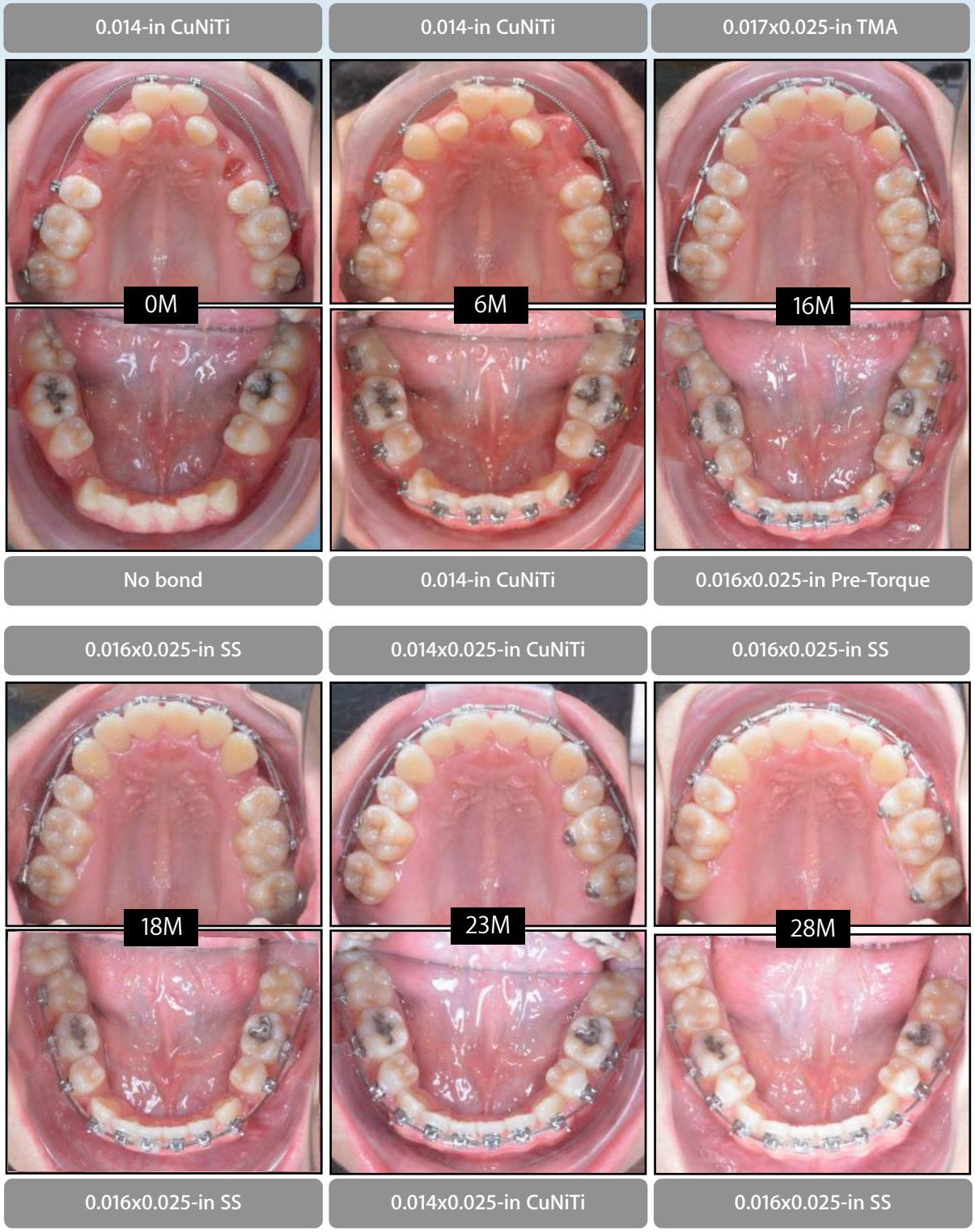



*Fig. 11:*
*Treatment progress from both upper and lower occlusal viewers is specified in months (M), and the archwire sequence is provided from the beginning of the treatment (0M) to twenty-eight months (28M).*

| Months<br>Surgery/Ortho | Archwire | Notes |
|---|---|---|
| **0/0** | | Extraction of LL4, LR4, UR4, UL4, and ULc |
| | U: 0.014 CuNiTi | Bond Damon® appliance on the maxillary teeth from 7-7<br>(*except: UR2, UL2, UL3 not bonded) |
| **0/2** | | **VISTA surgical exposure of UL3 + IZC OBS + 3D lever arm** |
| **1/3** | | Remove suture |
| **2/4** | | Tighten up the power chain of UL3 |
| **4/6** | U/L: 0.014 CuNiTi | Tighten up the power chain of UL3<br>Bond Damon® appliance on the mandibular teeth from 7-7 |
| **5/7** | | Bond Damon® appliance on UR2<br>Remove 3D lever arm and IZC OBS |
| **9/11** | | Bond Damon® appliance on UL2 and UL3<br>GIC (bite turbos) on LL6 and LR6 |
| **12/14** | | Remove GIC from LL6 and LR6 |
| **14/16** | U: 0.017x0.025 TMA<br>L: 0.016x0.025 pre-torqued | Ligature figure 8 ties from 3-3 |
| **15/17** | U: 0.016x0.025 SS<br>L: 0.016x0.025 Pre-torqued | Power chain (PC) from 3-6 |
| **16/18** | U/L: 0.016x0.025 SS | Drop-in hooks and PC<br>Fox (1/4-in, 3.5-oz) from U6 to L3 (bilateral): Class III elastics<br>Torquing spring on UL2 and UR2 for labial root torque<br>Add 15° on the lower archwire from 2-2 |
| **18/20** | | Chipmunk (1/8-in, 3.5-oz) from UL6 and UL7 (lingual) to LL6 and LL7 (buccal) for posterior crossbite correction<br>Buttons on UL6 and UL7 |
| **20/22** | | Chipmunk (1/8-in, 3.5-oz) from UL6 and UL7 (lingual) to LL6 and LL7 (buccal)<br>Remove Torquing spring from UL2 and UR2<br>Torquing spring on UL1 for lingual root torque<br>Expand upper archwire<br>PC |
| **21/23** | U/L: 0.014x0.025 CuNiTi | Chipmunk (1/8-in, 3.5-oz) from UL6 and UL7 (lingual) to LL6 and LL7 (buccal)<br>Rebond UR7, UR4, UL4, LR4, and LL4 |
| **22/24** | U/L: 0.017x0.025 TMA | Chipmunk (1/8-in, 3.5-oz) from UL6 and UL7 (lingual) to LL6 and LL7 (buccal)<br>Expand upper and lower archwire<br>PC |

***Table 3A:*** *Treatment sequence (continued on the next page)*

| Months<br>Surgery/Ortho | Archwire | Notes |
|---|---|---|
| **23/25** | U/L: 0.016x0.025 SS | Expand upper archwire, and constrict lower archwire.<br>Torquing spring on UL2 for labial root torque |
| **26/28** | | **Chipmunk (1/8-in, 3.5-oz) from UL6 and UL7 (buccal) to LL6 and LL7 (buccal) to settle occlusion** |
| **28/30** | | Debond |

***Table 3B:*** *Treatment sequence (continued from the last page)*

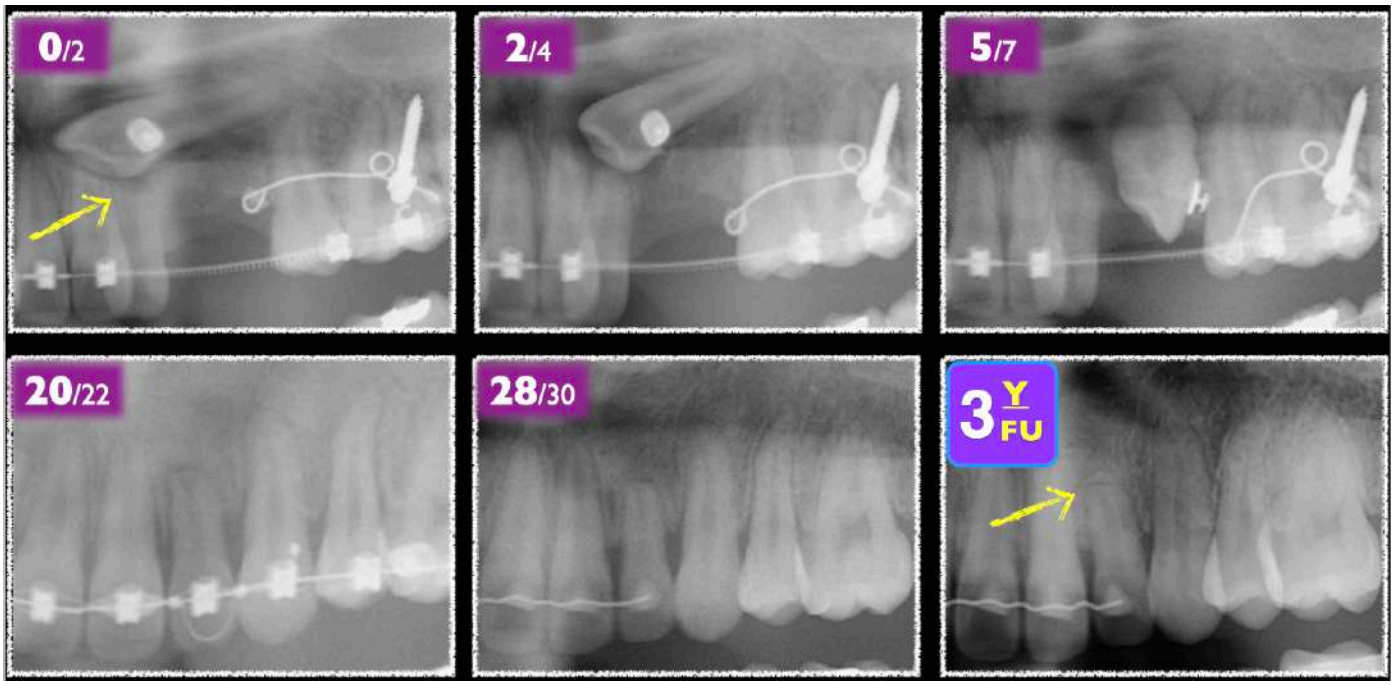



***Fig. 12:***
*A panel of six radiographs shows recovery progress of the impacted UL3. Each radiograph is labelled with the time in months since surgery and initiation of the traction (first number), and the number of months into active treatment (second number). Thus, the upper left view (0/2) is the immediate postoperative radiograph for the surgery performed two months into treatment. Note the UL2 was not bonded with a bracket during traction of the impacted UL3 in the first 7 months of treatment. Only little root resorption of the UL2 was found in the 3-year follow-up.*

For the posterior crossbite correction, maxillary arch expansion and mandibular arch constriction was carried out during the 20th to 23rd months by adjusting the archwires (Fig. 15). In addition, crossbite elastics (Chipmunk, 1/8-in, 3.5-oz) were applied from the lingual buttons on UL6 and UL7 to the buccal side of LL6 and LL7 in the 20th to 24th months (Fig. 16).

In the last month of treatment (30M), the archwires were sectioned distal to the second premolars, and inter-maxillary elastics (Chipmunk, 1/8-in, 3.5-oz)


*Fig. 13:*
*After 5 months of traction and 7 months of active treatment, UL3 is visible underneath the overlaying gingiva (left picture). Note the line of traction for the 3D lever arm is buccal and occlusal which produces outward and downward forces on the impacted UL3. After 9 months of traction and 11 months of active treatment, brackets were bonded on the UL2 and UL3, and a CuNiTi archwire was used to align the arch (right picture).*


*Fig. 14:*
*By positioning the low-torque brackets upside down, high torque was expressed on the mandibular anterior teeth. (Q: torque)*

were hooked from UL6 and UL7 to LL6 and LL7 on the buccal side to settle the occlusion (Fig. 17).

All treatment progress and sequencing details are shown in Table 3.

## Results

After 30 months of active treatment, the maxillary anterior gingivectomy and frenectomy were performed using a diode laser to improve dental


*Fig. 15:*
*Expansion of the maxillary arch can be observed from a comparison of pre- and posttreatment records. (Photo sizes corrected by measuring the second premolar - blue line; pre-treatment arch length - green line; arch expansion after 30 months of active treatment - purple line.)*

keratinized gingival tissue around UL3, but there was no gingival recession. There was no change in the pre-existing root loss of the adjacent lateral incisor nor further root resorption on any other teeth during active treatment (Fig. 19). The dentition was well-aligned with bilateral Class I canine and molar relationships. Even though there was still occlusal fitting left to be improved in the posterior section, it was acceptable to finish at this occlusion and allow the patient's mastication movements to naturally settle the occlusion, which can be observed at the 5-year follow-up (Figs. 20 and 21).

The posttreatment panoramic, cast models, and lateral cephalometric radiographs document the outcome following 30 months of active surgical and orthodontic treatment (Figs. 22-24). Superimposed cephalometric tracings (Fig. 25) showed slight dumping of the maxillary and mandibular incisors. However, this was inevitable after closing the extraction spaces. The facial profile showed retrusive upper and lower lips from the esthetic line. Nevertheless, the patient was satisfied with the facial profile.

The ABO Cast-Radiograph Evaluation (CRE) score was 16 (Worksheet 2) calculated after the 5-year

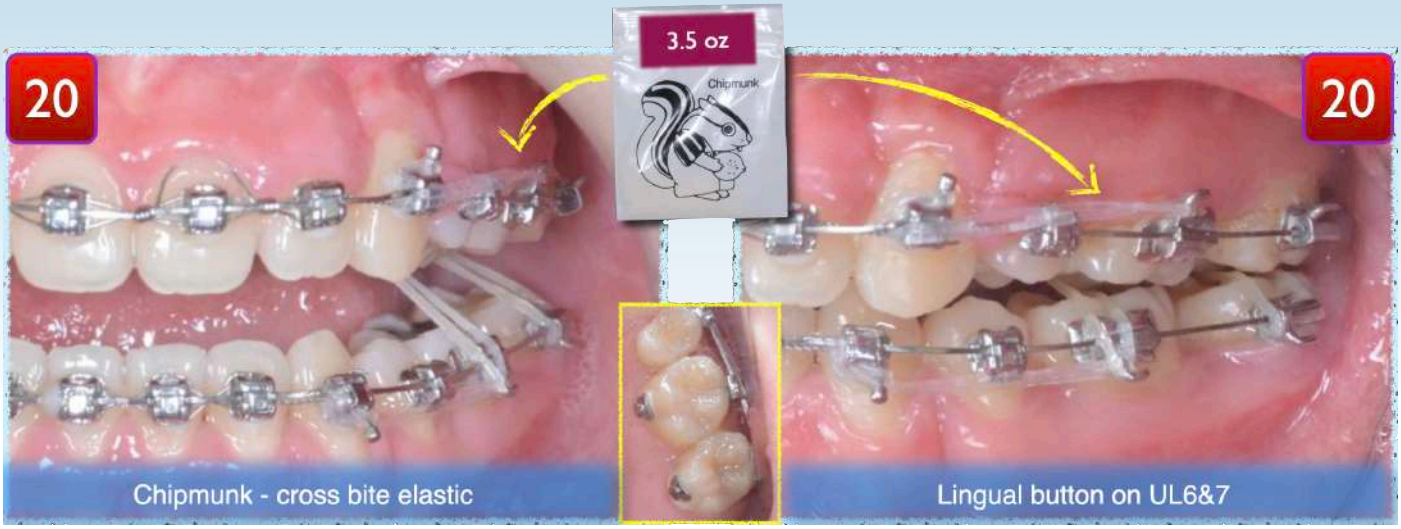



**Fig. 16:**
*Intraoral photographs in the 20th month of treatment from the frontal view (left picture) and left buccal view (right picture). Chipmunk elastics (1/8-in, 3.5-oz) from UL6, UL7 (lingual button) to LL6, LL7 (buccal) were used to correct the posterior crossbite.*


**Fig. 17:**
*Intraoral photograph taken at the 28th month of treatment from the frontal view. Chipmunk elastics (1/8-in, 3.5 oz) from UL6, UL7 (buccal) to LL6, LL7 (buccal) were used to settle the occlusion.*

follow-up; the major CRE discrepancies were posterior crossbite due to the tooth relapsing to its original state.

## Retention

To prevent relapse, an anterior fixed retainer was bonded on the lingual surfaces of the maxillary and mandibular arches from canine to canine. Removable clear overlay retainers were delivered for both arches, and the patient was instructed to wear them full time for the first 6 months and nights only thereafter. Instructions were provided for home hygiene, as well as for maintenance of the retainers.


**Fig. 18:** *Gingivectomy and frenectomy were performed to improve tissue esthetics.*


*Fig. 19:*
*Four pictures show a coordinated panoramic radiograph and intraoral left buccal view of pre-treatment and posttreatment conditions.*

## Discussion

### Delay bonding of the lateral incisors

#### 1. Blocked-in lateral incisors: Create space before bonding

An impaction is usually accompanied with space loss in the dental arch, and adequate space should be provided before attempting to undergo surgical exposure and to align the impacted tooth into position. In the present case, the dental arch was too crowded and the lateral incisors were blocked behind the central incisors. Not bonding the blocked lateral incisors in the early stage not only allowed them to move freely but also made it easier to bond the brackets in a more ideal position later in the treatment. Furthermore, as the UL2 was not engaged on the fixed appliance, it was free to move spontaneously out of the path of movement while the impacted UL3 was being recovered.[5] An effective approach for space development is to use a fixed appliance with an open coil spring. An open coil spring measuring 1-1.5 bracket width longer than the original space was utilized in the 1st month of treatment. Reactivation could be done by changing the open coil spring to a new and longer one at every appointment. However, an easier way is to simply compress the same open coil spring again and fixate it with flowable resin cured on the archwire. Once adequate space was created with the open coil spring, low-torque brackets were bonded on the UR2 in the 7th month and UL2 in the 11th month. Low-torque brackets were selected for labial root movement to control the flaring effect during leveling. Bite turbos (glass ionomer cement occlusal bite raisers) were placed on the occlusal surfaces of the mandibular first molars to create interocclusal space for greater freedom of tooth movement of the blocked-in lateral incisors.[8] The posterior bite turbos were removed three months later when the blocked-in lateral incisors were corrected (Fig. 8).

#### 2. Root resorption control

The most common side effect of treating impactions is root resorption of the adjacent teeth, the incidence of which is reported to be around 27% up to 49.5% (Fig. 26).[9,10] However, in a study where the adjacent teeth were not bonded with the brackets while the canine was moving toward the occlusal plane, the prevalence of lateral incisor root resorption dropped to 7.8%.[11] Therefore, it is suggested to delay bonding brackets on the teeth

**Fig. 20:** *Posttreatment facial and intraoral photographs*

near the eruption pathway of the impacted tooth. Once the tooth is not restrained by a fixed appliance and the traction force of the archwire, its root is free to move out of the way when the impacted canine is emerging, resulting in decreased risk of root resorption.[12] However, pre-existing root resorption cannot be recovered. The full-fixed appliance was later bonded when the canine was properly positioned in the arch for final alignment. In the present case, the UR2 was not bonded with brackets until the 7th month of treatment. The UL2 was bonded with a bracket in the 11th month of treatment. Only a little root resorption was found in the panoramic radiograph (Fig. 12). However, considering that slight root resorption of UL2 was found in the pre-treatment CBCT image, the amount of root resorption was deemed little to none during the treatment process (Fig. 5).

**Fig. 21:** *Facial and intraoral photographs at 5-year follow-up*

**Fig. 22:** *Posttreatment panoramic radiograph*

**Fig. 23:** *Posttreatment study models*

*Fig. 24: Posttreatment cephalometric radiograph*

## Surgery design

### 1. Surgical flap design

The key to selecting the correct surgical flap design is to precisely locate the impacted canine using cone beam computed tomography (CBCT) prior to surgery. CBCT images can help clinicians to (a) plan for proper surgical access, (b) decide whether to perform with buccal or palatal/lingual access, and (c) achieve a clear understanding of the amount of bone surrounding each tooth. After a thorough CBCT analysis (Fig. 5), the surgical approach selected was the vertical incision subperiosteal tunnel access (VISTA) technique devised by Zadeh[12] and modified by Chang.[14] The combined application of the modified VISTA technique with

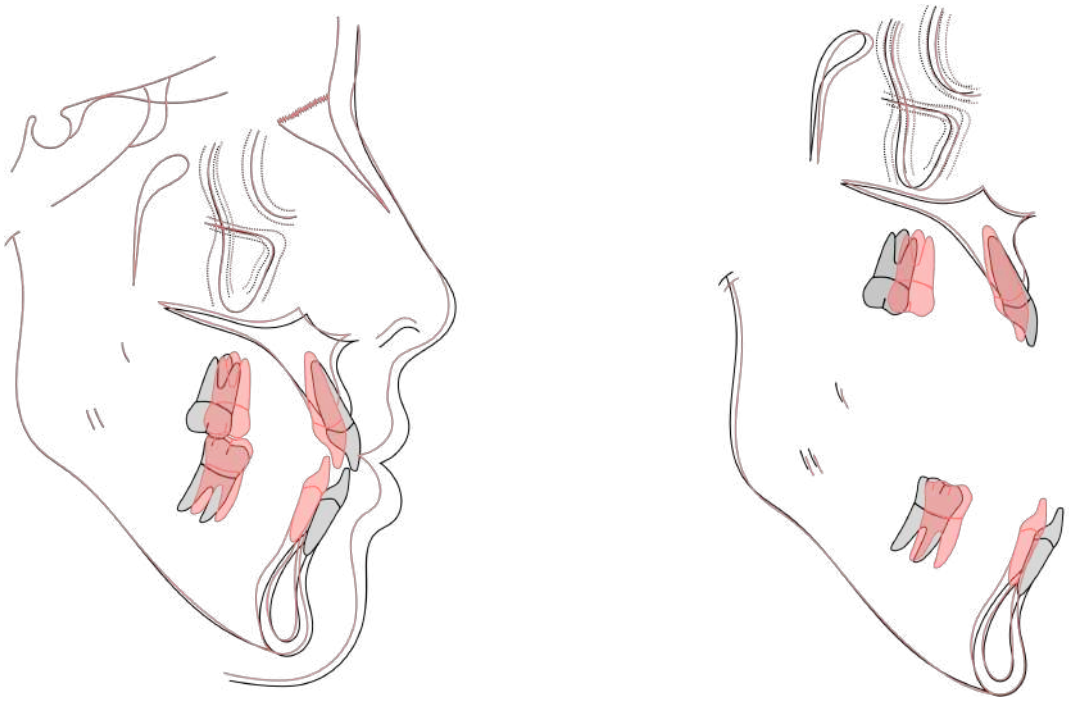


*Fig. 25:*
*Superimpositions of the cephalometric tracings before (black) and after (red) treatment. Retrusion of the lower incisors could be due to closing extraction space with mild crowding on the lower arch. Around 70% of the retraction was done by retracting the lower anteriors in order to improve the Class III lip profile.*

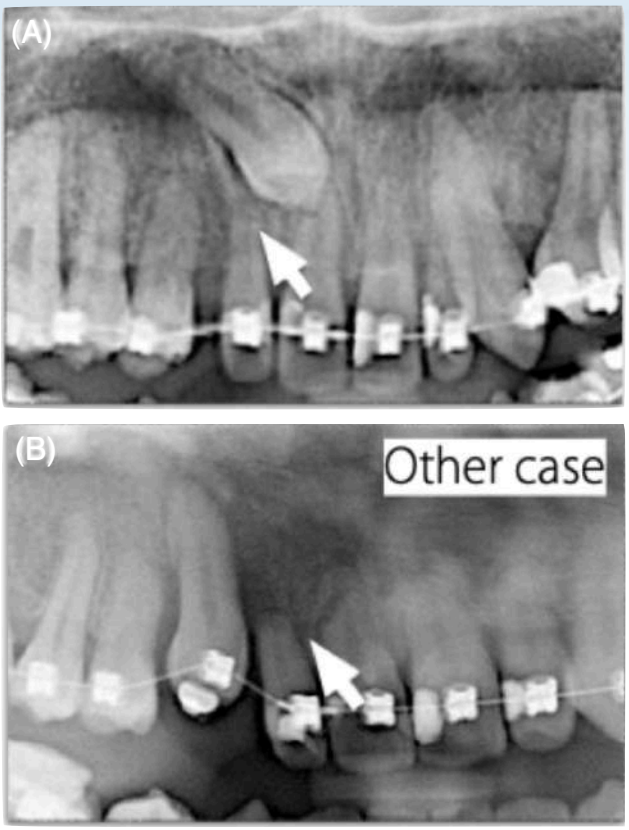



***Fig. 26:*** *Two radiographs from another case showing:*
*(A) The right central and lateral incisors, which are in the eruption pathway of the impacted canine, are bonded with brackets and engaged on an archwire; and*
*(B) severe root resorption (white arrow) of the right central and lateral incisors is noted after the eruption of the impacted canine into the arch.*

IZC OBS anchorage and 3D lever arm mechanics will be discussed in the next section - Mechanics: Force system design.

With this minimally invasive approach, the labially impacted canines were retracted and extruded within the submucosal space. This avoided impingement on the adjacent lateral incisor that might result in extensive root resorption.[15,16]

The following modified VISTA surgical steps were performed (Fig. 27):

1. Periodontal probe was used to locate the impacted canine with the help of CBCT.

2. An initial vertical incision was made with a no. 15 surgical scalpel between the central and lateral incisors to expose the crown of the impacted canine.

3. Mucogingival flap was reflected with a surgical curette and periosteal elevator to detach the periosteum.

4. The surrounding bone around the impacted crown was removed with a #5 carbide round bur down to the cementoenamel junction (CEJ).

5. A second vertical incision was made on the vestibular side of the extraction space for the power chains to exit.

6. The surface of the impacted canine crown was etched and bonding agent was applied in order to bond the button on the labial surface of the exposed enamel.

7. Bone was removed in the proposed path of canine traction which facilitated tooth eruption and up-righting without bone obstruction. Note that it is recommended to remove the bone in the tunnel after bonding the button in order to control the bonding quality, which could be affected by excessive bleeding when removing the bone.

8. An OBS (2x14-mm, OrthoBoneScrew®, iNewton, Dental, Inc., Hsinchu City, Taiwan) was inserted in the left infrazygomatic crest (IZC), and a 3D

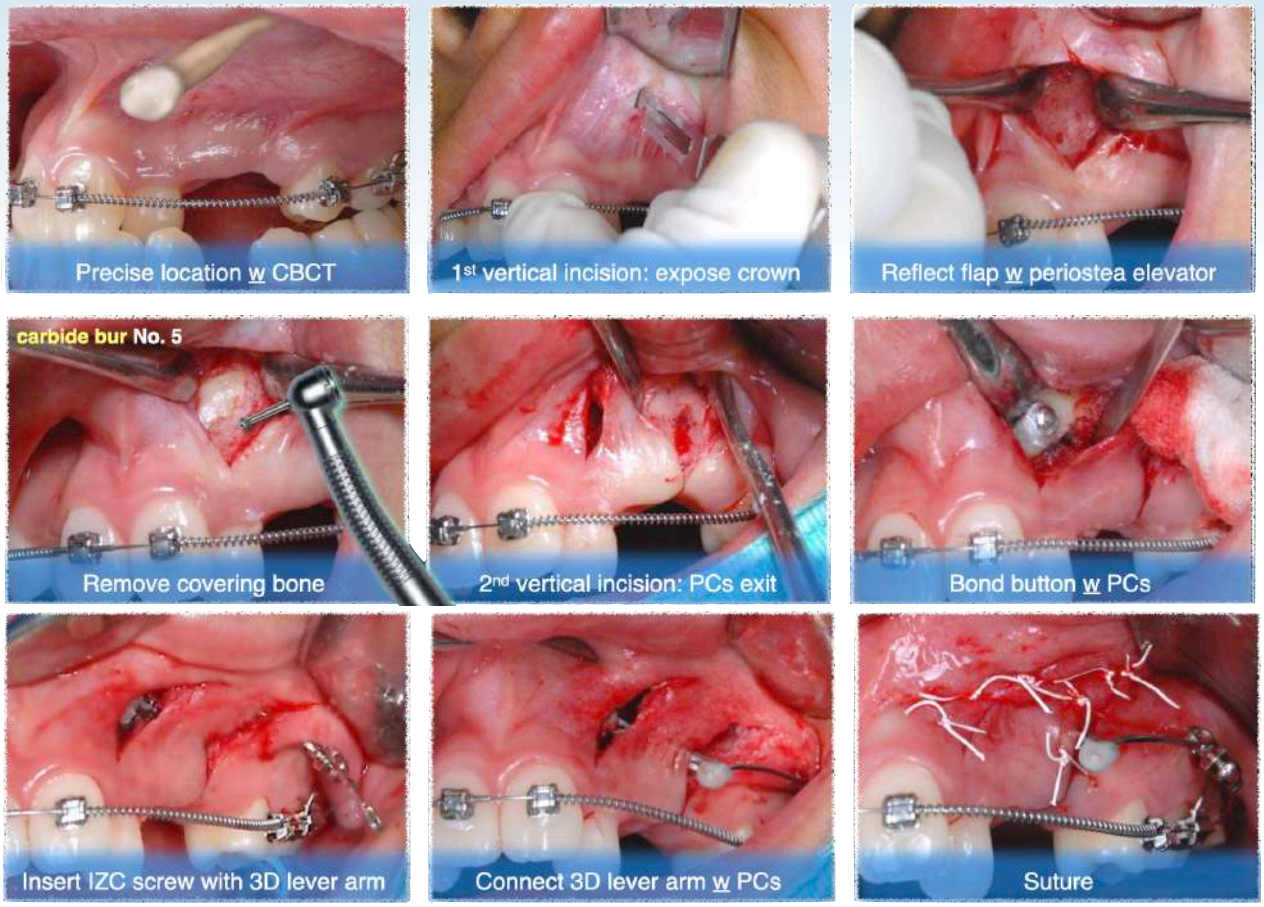



***Fig. 27:*** *The panel of 9 intraoral photographs documents the step-by-step surgical exposure procedure. See text for details.*

lever arm was inserted into the rectangular hole as the anchorage device.

9. Power chains were attached from the button on the impacted canine to the 3D lever arm.

10. The two vertical incisions were sutured to ensure minimal damage of the mucosa.

## 2. Mechanics: Force system design

There are two keys to the force system design: stable anchorage and properly designed mechanics.

(1) Stable anchorage: IZC screw

Stable anchorage is essential for the traction of the impacted tooth. When compared to using teeth and archwires as anchorage, a method which may distort the occlusion and the arch, the use of miniscrews provides an independent anchorage that will not affect any other teeth or the occlusion. Moreover, since the miniscrew is installed inside the bone, it provides a stronger and more stable force for the impaction. The location to insert the miniscrew is around the mucogingival junction (MGJ) of the infrazygomatic crest (IZC) bone, which

is located between the first and second molars (Fig. 28).

(2) Properly designed mechanics: 3D lever arm

The 3D lever arm is made with a 0.019x0.025" SS archwire segment with a helix in the body (for power storage) and a U shape at the end (for power chains to be easily attached). After inserting the 3D lever arm through the dedicated rectangular hole in the head of the miniscrew, it is then activated by connecting the end side (U shape) to the button attached on the crown of the impacted tooth using power chains or ligature wires (Fig. 29).

The force system of the 3D lever arm provided 3D traction: backward, outward, and downward, which is absolutely essential for treating deep impactions. The outward force can avoid direct impingement of the canine crown movement against the root of the lateral incisor, which can further reduce the chance of root resorption of the lateral incisor. The load of the 3D lever arm is adjusted with three jaw pliers or by simply tightening the power chain at each phase of the impaction movement.

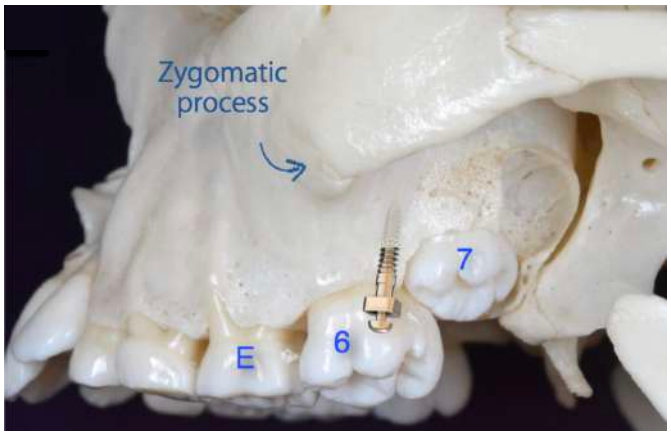



*Fig. 28:*
*The bone screw is inserted around the mucogingival junction (MGJ) of the infrazygomatic crest (IZC) bone that is buccal to the root of first and second maxillary molars*

**Settle the occlusion (5-year follow-up)**

The occlusal contacts achieved were not a perfect result at the end of the treatment (Fig. 20). However, by cutting the posterior part of the clear retainers (Essix ACE®), the occlusal contacts were settled naturally through the occlusal force as noted at the 2-year follow-up (Fig. 30). However, for every plus there is a minus. The progression of the posterior crossbite on the left hand side is shown through 1- to 5-year follow-up (Fig. 30). The reason might be due to cutting the posterior part of the clear retainer at too early a stage, which resulted in the posterior segment returning to its original state. Delayed cutting of the posterior segment of clear retainer or overcorrection by expanding the maxillary arch and wearing criss-cross elastics could have prevented the posterior crossbite from developing.

## Conclusions

A maxillary canine impaction with the canine tip between the roots of central and lateral incisors is a complex and challenging task for orthodontists. The VISTA surgical exposure is a unique approach for submucosal movement of the impaction. A skeletal anchorage using OBS with a 3D lever arm provides an independent force system for retracting the impaction. Root resorption and torque loss during the recovery process can be controlled by delaying bonding the adjacent teeth

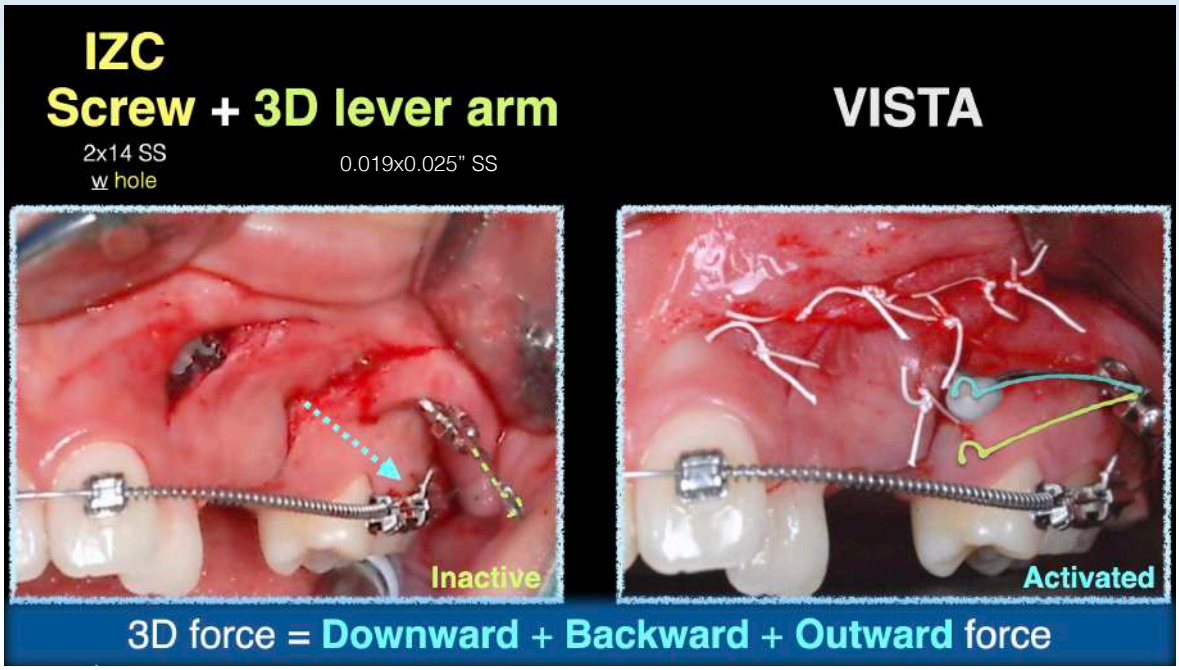



*Fig. 29:*
*Left: inactive 3D lever arm (green dotted line) indicating the direction of the force is downward, backward, and outward (blue arrow). Right: activated 3D lever arm (blue) attached to impacted canine through button and power chains.*

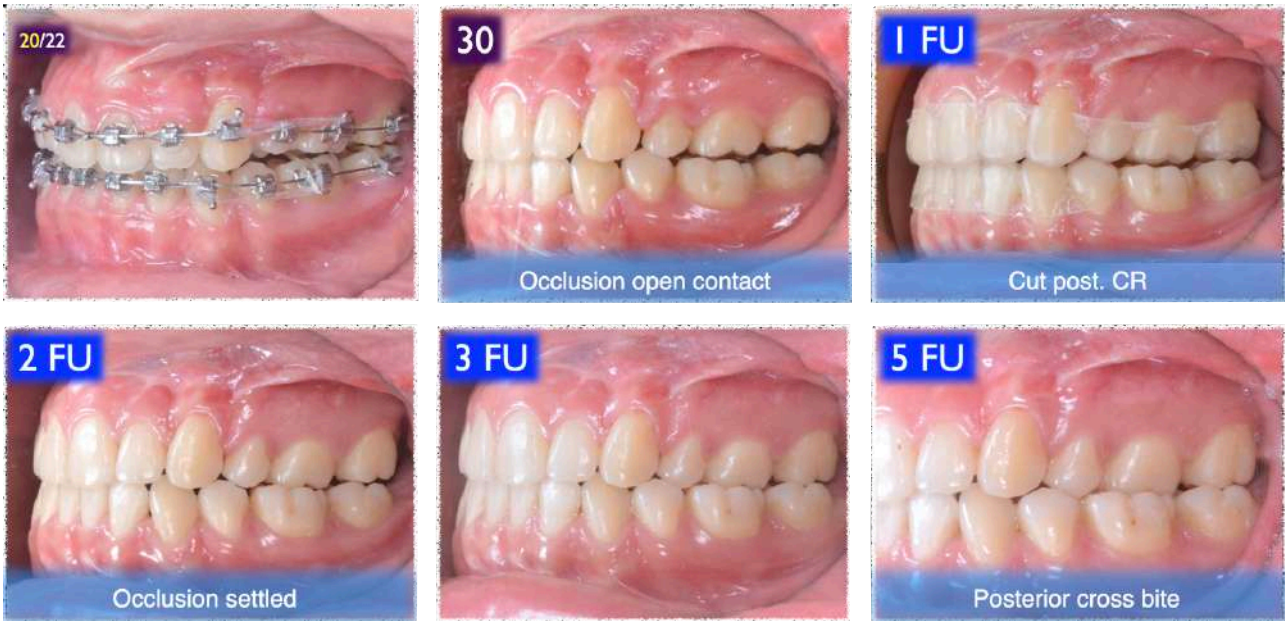



*Fig. 30:*
*The panel of 6 intraoral photographs shows the occlusal contacts settling down naturally through the occlusal force as noted at the 2-year follow-up by cutting the posterior part of the clear retainers at the 1-year follow-up. The posterior crossbite progression was shown through 5 years of follow-up.*

and with bracket torque selection to compensate for the mechanics.

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# Discrepancy Index Worksheet

TOTAL D.I. SCORE **47**

## 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. 9.5mm | = | 5 pts. |

Negative OJ (x-bite) 1 pt. per mm. Per tooth =

Total = **8**

## OVERBITE

| | | |
|---|---|---|
| 0 - 3 mm. | = | 0 pts. 0mm |
| 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. 3mm lower arch |
| 3.1 - 5 mm. | = | 2 pts. |
| 5.1 - 7 mm. 6mm (upper) | = | 4 pts. |
| > 7 mm. | = | 7 pts. |

Total = **7**

## OCCLUSION

| | | |
|---|---|---|
| Class I to end on | = | 0 pts. |
| End on Class II or III | = | 2 pts. per side 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 = **4**

## 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° 10 x 2 pts. = 20

≤ 26° = 1 pt.

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

1 to MP ≥ 99° = 1 pt.

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

SN-MP= 48°
1 to MP= 75°

Total = **20**

## 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. | = 2 |
| Midline discrepancy (≥ 3mm) | @ 2 pts. | = |
| Missing teeth (except 3rd molars) | _____ x 1 pt. | = |
| Missing teeth, congenital | _____ x 2 pts. | = |
| Spacing (4 or more, per arch) | _____ x 2 pts. | = |
| Spacing (Mx cent. diastema ≥2mm) | @ 2 pts. | = |
| Tooth transposition | _____ x 2 pts. | = |
| Skeletal asymmetry (nonsurgical tx) | @ 3 pts. | = |
| Addl. treatment complexities | _____ x 2 pts. | = 2 |

Identify: Surgical exposure and orthodontic traction of the impacted canine into the arch

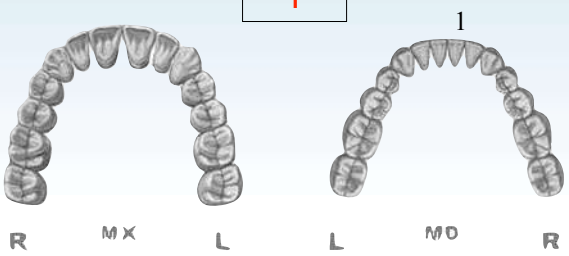
Total = **4**

# Cast-Radiograph Evaluation

**Total Score:** 16

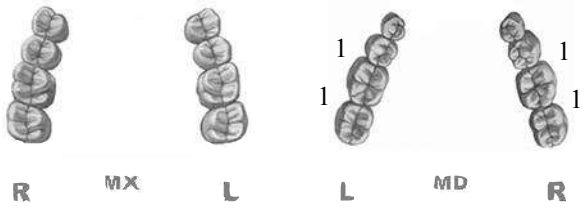
## Alignment/Rotations

1



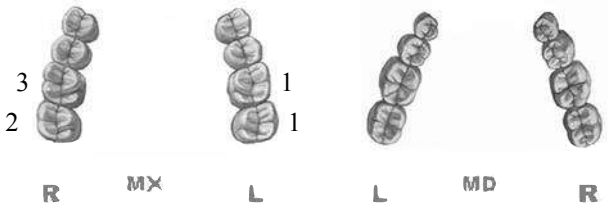

## Marginal Ridges

4




## Buccolingual Inclination

7

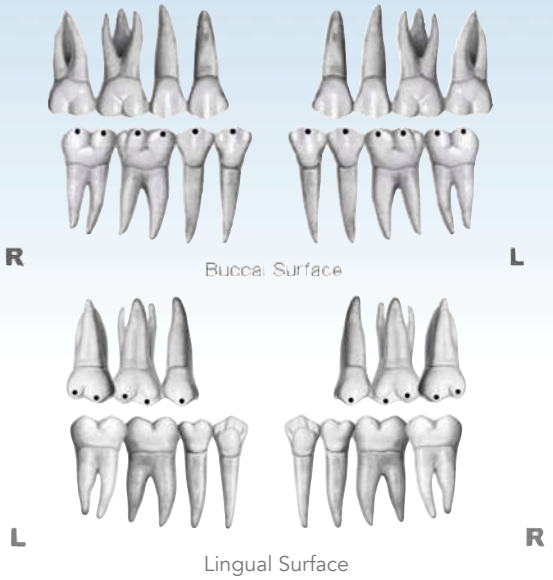



## Overjet

3


## Occlusal Contacts

0

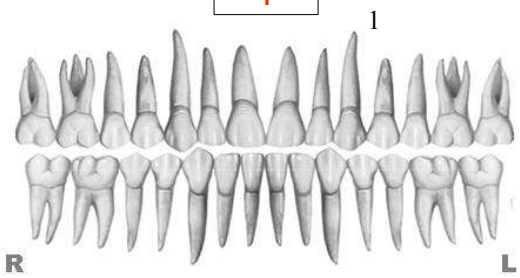



## Occlusal Relationships

0

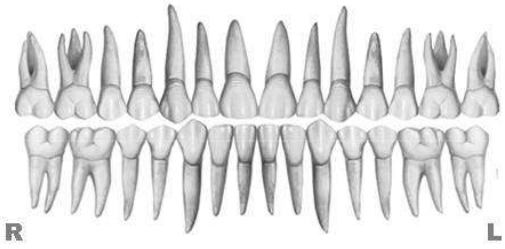

## Interproximal Contacts

1




## Root Angulation

0



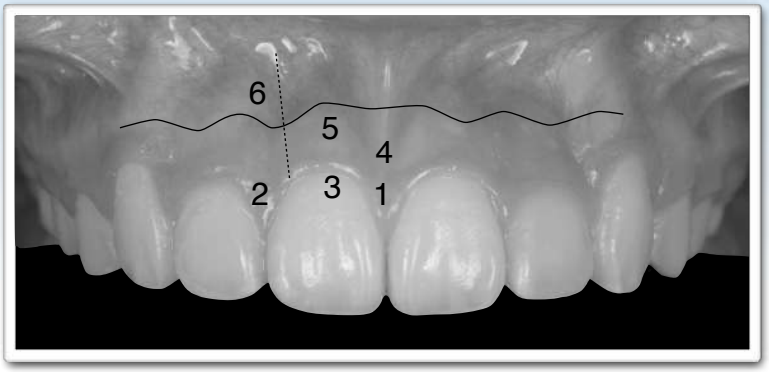

***INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.***

# IBOI Pink & White Esthetic Score

**Total Score =** 4

## 1. Pink Esthetic Score

Total = 0

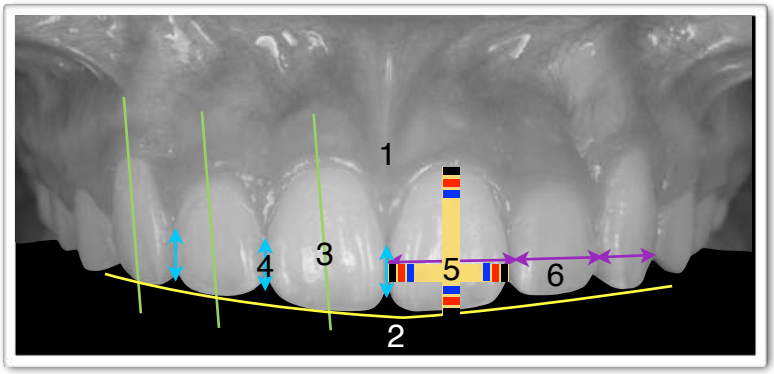



| | | | |
|---|---|---|---|
| 1. M & D Papillae | 0 | 1 | 2 |
| 2. Keratinized Gingiva | 0 | 1 | 2 |
| 3. Curvature of Gingival Margin | 0 | 1 | 2 |
| 4. Level of Gingival Margin | 0 | 1 | 2 |
| 5. Root Convexity ( Torque ) | 0 | 1 | 2 |
| 6. Scar Formation | 0 | 1 | 2 |

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

## 2. White Esthetic Score (for Micro-esthetic)

Total = 4




| | | | |
|---|---|---|---|
| 1. Midline | 0 | 1 | 2 |
| 2. Incisor Curve | 0 | 1 | 2 |
| 3. Axial Inclination (5˚, 8˚, 10˚) | 0 | 1 | 2 |
| 4. Contact Area (50%, 40%, 30%) | 0 | 1 | 2 |
| 5. Tooth Proportion | 0 | 1 | 2 |
| 6. Tooth to Tooth Proportion | 0 | 1 | 2 |

| | | | |
|---|---|---|---|
| 1. Midline | (0) | 1 | 2 |
| 2. Incisor Curve | 0 | (1) | 2 |
| 3. Axial Inclination (5°, 8°, 10°) | 0 | (1) | 2 |
| 4. Contact Area (50%, 40%, 30%) | (0) | 1 | 2 |
| 5. Tooth Proportion | 0 | (1) | 2 |
| 6. Tooth to Tooth Proportion | 0 | (1) | 2 |

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Dr. 林詩詠 Joshua Lin*▲


Dr. Diego Peydro Herrero◆

Dr. 陳俊宏 Chun-Hung Chen*▲


Dr. 張銘珍 Ming-Jen Chang*


Dr. 曾令怡 Linda Tseng*▲


*Ambassador*（大使）：

- * *One who has published 9+ case reports in JDO.*
- ◆ *Keynote speakers for iAOI annual workshops*
- ▲ *Case report(s) published at least once in referral journals.*
- ● *Referral journals/Research paper - 3 points*
  *ABO case report - 2 points*
  *Clinical tip - 1 point*

## Diplomates

Dr. 徐玉玲 Lynn Hsu▲


Dr. 李雙安 Angle Lee▲


Dr. 蘇筌瑋 Bill Su


Dr. 葉信吟 Hsin-Yin Yeh▲


Dr. 徐重興 Eric Hsu▲


Dr. 黃育新 Yu-Hsin Huang


Dr. 黃祈 Richie Huang


Dr. 邱上珍 Grace Chiu▲


Dr. 黃瓊嫥 Sabrina Huang


Dr. 鄭惠文 Joy Cheng


Dr. 林彥君 Lexie Lin▲


Dr. 曾淑萍 Shu-Ping Tseng


Dr. 林曉鈴 Sheau-Ling Lin


Dr. 張倩瑜 Charlene Chang


Dr. 林佳宏 Alex Lin▲


Dr. 林森田 Chris Lin


Dr. 黃登楷 Kevin Huang


Dr. 張馨文 Sara Chang


Dr. 李名振 Major Lee


Dr. 陳惠華 Judy Chen


Dr. 魏明偉 Ming-Wei Wei


Dr. 黃荷薰 Ashley Huang


Dr. 李彥峰 Yen-Feng Lee


Dr. 張銘津 Ariel Chang


Dr. 彭緯綸 Wei-Lun Peng


Dr. 呂詩薇 Julie Lu