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Digital smile design is an art. It requires an appreciation of art. Renown Spanish artist, Luis Bolumar (foreground), shows us the way in Newton's A Education Center and art gallery, accompanied by famous digital orthodontists Xin Guan (left) and Yang Song (2nd left). Chris Chang (right) appreciates.

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熱愛學矯正

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

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Damon Master

(Thu) 9:00-5:00 中文授課

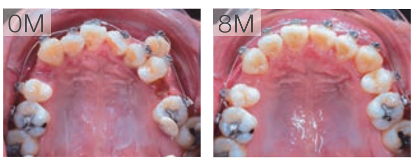
The Beethoven Damon Master Program, created by Dr. Chris Chang, is a two-year clinical program. Its hands-on orientation features case study-based diagnosis, analysis, treatment planning andresult evaluation. Combining in-class teaching assistants, after-class video review and chair-side observation,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

Year 1 2019

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

Year 2 2019-20

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



Damon + .014 Cu NiTi

Excellent Finishing

(Tue) 9:00-12:00 中文授課

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

Finishing X

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

Damon Clear

Damon, OBS & VISTA International Workshop

English Class

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

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2018

Class 1 - 5/22-25 Class 2 - 12/04-07
Insignia workshop - 9/9-10

2019

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

Damon + Bite Turbo + Early Light Short Elastic

每次上課請依最新一期 JDO 公告為主

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Why Angle Society? (*Part 2.*)

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

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

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

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

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

As I have never met Dr. Angle, I am not sure what he would do, none of us do, but I suspect he would be leading us digitally marching along the path to glory!!

Chris Chang DDS, PhD, Publisher of JDO.

Periodontics and Orthodontics: Low Forces, Expansion, Protraction and Control of Gingival Recession

Abstract

***Background**: The periodontal aspects of orthodontics are reviewed with an emphasis on arch expansion and management of crowding in the lower anterior segment.*

***Gingival Recession**: Gingival biotype (width of keratinized tissue) and bone morphotype (thickness of labial bone) are the critical diagnostic factors for prevention and treatment of gingival recession. Optimal post-treatment conditions are: 1. dentition positioned in the center of the alveolar ridge, 2. axial loading, 3. circumferential bone support 1–2mm below the cementoenamel junction (CEJ), and 4. alveolar bone at least 1mm thick on the labial and lingual surfaces of the root.*

***Arch Expansion**: For non-extraction treatment of crowding, increasing arch width helps control labial tipping of the incisors. Recent animal studies reveal that very low archwire force (5cN or g-force), interacting with the resistance cheeks and lips, results in moment that produces buccal translation of molars and the alveolar process. These data help explain the mechanism of slow arch expansion with passive self-ligating (PSL) brackets and small diameter copper nickel titanium (CuNiTi) archwires.*

***Gingival Grafting**: Gingival grafts are not indicated for moderate recession problems related to poor alignment that can be corrected with orthodontics. Free gingival grafts can prevent further recession but combined soft tissue and bone grafts with enamel matrix derivative are required to restore the periodontium. Periodontal grafts can be performed before, during or after orthodontics.*

***Conclusion**: Very low force is necessary for expansion of the alveolar process. Prospective surgical augmentation is indicated if tooth movement poses a significant risk for gingival recession. Prevention is preferred over surgical intervention. (J Digital Orthod 2018;52:4-19)*

Key words:
Gingival biotype, bone morphotype, free gingival graft, combined soft and hard tissue graft, very low forces, archwire expansion, prevention, gingival recession

Introduction

Gingival recession is defined as the displacement of the marginal soft tissue in an apical direction, relative to the cementoenamel junction (*CEJ*). Labial, lingual and interproximal areas may be affected.[1] The resulting root exposure may be unesthetic, sensitive to cold, and/or susceptible to root caries.[2,3] There is an age-related increase in this problem both in severity and prevalence, as evidenced by 88% of adults 65 years of age or older experiencing gingival recession.[4] Recession occurs under both high and low standards of

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Examiner, Journal of Digital Orthodontics,
Director, Jin-Jong Lin Orthodontic Clinic (Center left)

Dr. Nancy Nie-Shiuh Chang,
Periodontist, Jing-Jong Lin Orthodontic Clinic (Center Right)

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

oral hygiene.[5,6] The labial of mandibular incisors and buccal of maxillary molars are the most frequently affected surfaces,[7] but all buccolingual (*facially*) prominent teeth are susceptible.[8] The etiology for gingival recession is multifactorial and orthodontic tooth movement may be a factor.[1,9,10] Several studies have demonstrated a relationship between gingival recession and orthodontics,[11-13] but controversy persists.[14] Periodontal disease,[15] gingival recession[4,5] and alveolar bone dehiscences[16] are endemic problems for adults. Gingival recession during or after orthodontic treatment is a significant clinical problem, so preventative measures are very important. At the pre-treatment consultation, particularly for Class III malocclusion, it is important to explain the potential for long-term mucogingival and occlusal problems, even for malocclusions treated at an early age.[10,17] The purpose of present article is to evaluate beneficial and detrimental effects of orthodontic treatment on gingival tissue.

International dental nomenclature can be confusing, so a modified Palmer notation is preferred. Quadrants are upper right (*UR*), upper left (*UL*), lower right (*LR*) and lower left (*LL*). Permanent teeth in each quadrant are numbered 1 to 8 from the midline.

Gingival Biotype and Bone Morphotype

The optimal conditions for periodontal health are: 1. each tooth well aligned in the center of the alveolar ridge, 2. axial loading, 3. circumferential bone support 1–2mm below the CEJ, and 4. alveolar bone at least 1mm thick on the labial and lingual surfaces of the root. Recession is defined as an apical migration of the gingival margin in an apical direction along the root surface. Patients with good oral hygiene may have gingival recession on the buccal or labial surfaces.[9] Poor oral hygiene is commonly associated with generalized recession.[15] Two important anatomical factors for gingival recession are: 1. gingival biotype which is the soft tissue dimension, particularly width, and 2. bone morphotype, defined as the thickness of the buccal plate of bone.[16,17] It is important to appreciate that gingival recession is a clinical manifestation of an underlying alveolar bone problem. Alveolar bone dehiscence is not necessarily associated with gingival recession, but it is a high risk condition. On the other hand, gingival recession is always related to a loss of alveolar crest.[16,17] There is a correlation between gingival recession and bone dehiscence, confirmed by surgical exposure.[18] These data are consistent with strict physiologic and anatomic boundaries for periodontally healthy teeth, i.e. the alveolar envelope.

It is commonly believed that the alveolar envelope defines the limits of tooth movement.[4-8] If violated, periodontal support and alveolar bone level are compromised. However, it is still unclear if these boundaries can be expanded therapeutically without adversely affecting the periodontium. No specific relationship between the amount of orthodontic tooth movement and gingival recession is established. Moreover, human studies have shown that near 87% of buccal bony walls are <1mm.[19,20] A cone beam computed tomography (*CBCT*) study in Asians documented that the frequency of dehiscence ranged from 9.9-51.6% for anterior to 3.1-53.6% for posterior teeth, respectively.[21] Those data suggest that the alveolar envelope may not be adequate to support orthodontic treatment for many patients. However, orthodontic movement, including incisor proclination, does not always result in gingival recession.[22,23] Thin bony width alone is not sufficient to predict further gingival recession, so the importance of the gingival biotype (*soft tissue envelope*) is a critical consideration.

The thickness but not the apicocoronal height of keratinized tissue is the important factor.[13,24] In addition, a weak positive correlation has been reported between gingival biotype and bone morphotype (*thickness of labial bone*).[25] A patient may have a thick, wide band of keratinized gingiva that is supported by deficient alveolar bone. Patients with a thin periodontal biotype are more prone to gingival recession after orthodontic treatment.[26] A thick gingival biotype may reduce the prevalence of orthodontically-induced gingival recession, even though there is a thin bone morphotype. Thus, when gingival biotype is thin, all types of orthodontic movement are risky.[24]

Expansion and Protraction

There are a number of predisposing risk actors for gingival recession associated with orthodontic treatment.[27] Buccolingual tooth position and tooth movement in the frontal plane affects gingival margin stability via thickness and width of keratinized gingiva.[13,28] There is usually a wider band of keratinized gingiva when teeth are positioned to the lingual rather than labial. Buccolingual tooth position affects the spatial distribution of gingival tissue. Orthodontic tooth movement in a facial direction, that thins the facial soft tissue, can result in bone dehiscence; subsequent gingival inflammation or toothbrush abrasion can result in gingival recession.[24,29] On the contrary moving teeth lingually tends to thicken both the gingival margin and labial plate of bone so the periodontium is more resistant to gingival recession (*Fig. 1*).[13,30]

There is an increasing trend toward nonextraction treatment in orthodontics.[31] Rather than removing teeth, crowding is managed by increasing the arch length with expansion of the buccal segments, and labial tipping of anterior teeth. Rapid maxillary expansion is directed at a skeletal increase in arch length, but heavy loads are applied to the teeth anchoring the expander. This problem is associated with increased risk of gingival recession and alveolar dehiscence.[32] Extraction therapy is designed to avoid unfavorable tooth movement outside the alveolar envelope, particularly arch expansion and incisor

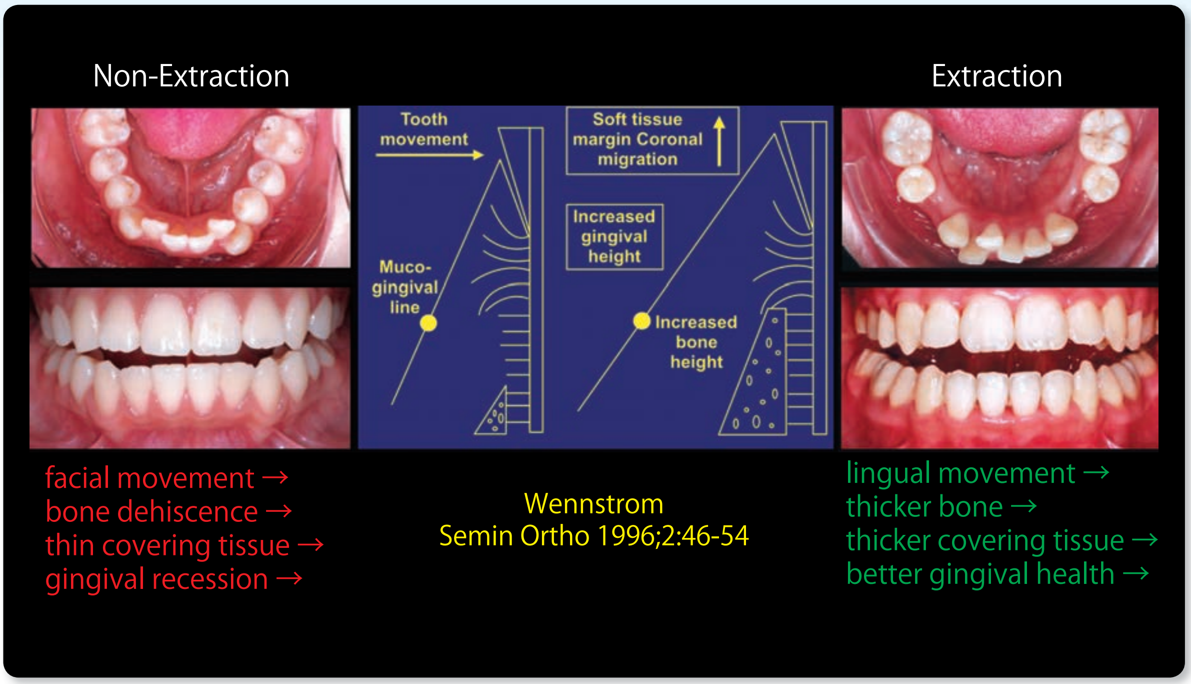


Fig. 1:

Center: *Wennstrom's diagram (1996) demonstrates the mechanism for gingival thinning as lower incisors are moved labially, and conversely for thickening as they are moved lingually.*

Left Panel: *Non-extraction treatment of lower anterior crowding thins the gingiva tissue and labial bone risking gingival recession. The biologic process is described with red font.*

Right Panel: *Following extraction of first premolars, the canines are retracted to create arch length to resolve crowding of the incisors (right panel). This approach, in addition to closure of the residual first premolar space, results in the most prominent incisors being retracted and aligned over the apical base of bone. The biologic process is described with green font. See text for details.*

proclination (*flaring*) (*Fig. 1*). An important aspect of treatment planning is to simulate the tooth movement required, with a wax set-up or 3D digital alignment. The risk of developing mucogingival problems should be assessed prospectively.[33]

Biomechanics

The magnitude of an orthodontic load affects the mechanical response of the dentoalveolar tissues, i.e. a tooth moving 'through' rather than 'with' bone.[34,35] Moving a tooth through bone is a concept that relates to applying heavy or tipping forces that cause necrosis (*hyalinazation*) of the periodontal ligament (*PDL*) in the path of tooth movement.[36] The localized PDL hyalinization halts tooth movement[35,37] until undermining resorption restores the continuity of the PDL.[34,36] On the other hand, a light bodily load (*force balanced with a moment*) is designed to translate a tooth, or an entire arch, while minimizing PDL necrosis.[38] This approach results in continuous, frontal bone resorption in the path of tooth movement (*compression side*), as well as bone apposition on the tension side of the PDL.[35]

In addition the subperiosteal surfaces of the facial aspect of the alveolar process are osteogenic, in the path of tooth movement (*concave flexure*), and osteoclastic on the trailing surface due to convex flexure and disuse atrophy.[36]

Clinical application of heavy tipping loads (*forces and/or moments*) tend to tip a tooth or teeth, and concentrate force at the cervical region of the periodontium, i.e. alveolar bone crest and epithelial attachment. Mechanical overload of these sensitive periodontal tissues can result in gingival recession, particularly if teeth are moved outside the anatomic boundaries of the alveolar process (*alveolar envelope*).[37]

Moving teeth beyond the alveolar envelope is often desirable clinically, but it is a challenging bone physiology problem. Numerous anecdotal case reports[39] and clinical presentations, as shown later in this review, suggest light archwire force can expand arches without periodontal damage. Comparison of conventional twin to PSL brackets revealed that both fixed appliances have similar effects on tooth movement, except PSL brackets tended to tip maxillary molars to the buccal.[40] In a follow-up study there was no significant difference in the arch expansion achieved with PSL compared to conventional brackets.[41] Those studies[40,41] focused on a relative comparison of two bracket types, but the level, duration and nature of the loads delivered by expanded archwires were unclear for specific patients.

Because of the absence of animal studies evaluating histologic changes, it is not clear if very light loads (≤5*cN*) are effective for moving teeth. Recently, Utreja et al.[42] provided the first bone label data relative to expansion of the maxillary arch with a very light (“*physiologic*”) load (≤5*cN*). Maxillary buccal segments expanded bilaterally, with little if any buccal tipping of the molars. Histologically, there was no evidence of PDL necrosis. Subperiosteal bone apposition was documented with bone labels on the buccal surfaces of the alveolar process, as well as within the mid-palatal suture. These data demonstrate that very low force is capable of maxillary dentoalveolar expansion, at least within the limits of the study. However, the loads were much lower (≤5*cN*) than the “*low forces*” typically utilized for conventional fixed appliances (≥25*g-force*).[34,36,43] Maxillary expansion, sutural growth and buccal tooth movement with the 5cN load[42] was similar to the physiologic increase in width that occurs during growth.[44,45] In understanding very low force expansion, it is important to note that the tipping force of 5cN passing through the center of molar crowns was opposed, by a resisting force at the cusp tip from the soft tissue resistance of the cheek; these mechanics produce a mechanical couple that tends to translate the molars buccally.[42] This favorable “*physiologic*” load acts on the entire dentofacial complex, resulting in a growth-like effect.[44,45] These data suggest that the issue for “*physiologic*” arch expansion is not about the type of bracket,[40,41] but about the applied load.[42] The only common fixed orthodontics appliances that routinely strive for arch expansion with loads ≤5cN are PSL brackets activated with small diameter copper nickel titanium (*CuNiTi*) arch wires.[38,39] Theoretically any bracket can be used to apply a very small force, but the PSL concept is important for uniform load applications to specified teeth, because the wire sliding in the PSL brackets prevents binding which can easily negate or double the load to a particular tooth.[43]

Management of Crowding

During the era of relatively high therapeutic force (*1900-1980*), the stability of arch expansion was controversial. Edward H. Angle was a proponent of non-extraction treatment to expand crowded arches to achieve optimal dentofacial esthetics. He reasoned that orthodontic expansion would become stable during retention because the skeleton adapts to the functional loading of an ideally aligned dentition.[43] By the 1940s, Angle's prominent student Charles Tweed concluded from a study of 100 consecutive patients that arch expansion was unstable, and he supported premolar extraction to avoid flaring of incisors and relapse of crowding.[43] Rapid palatal expansion is common mechanics for correcting palatal constriction, but periodontal compromise remains a concern.[32,36,43] PSL brackets have no advantage in treatment duration or outcomes over conventional straight-wire appliances for management of crowded Class I malocclusion.[46] It is clear that any fixed appliance can be utilized to apply a buccal force,[40,41,43] but a uniform load within the desired therapeutic range is critical for "*physiologic*" expansion of the arch.[39,42]

There are no well documented clinical reports on the periodontal effects of arch expansion with light-force archwires, but there are numerous anecdotal reports.[39] From a soft tissue perspective, PSL brackets are used for the treatment of periodontally compromised patients,[47] but plaque accumulation beneath relatively high-profile PSL brackets must be carefully monitored.[48,49] Based on stability concerns, extraction-based orthodontic therapy (*Fig. 2A*) for management of dental crowding has prevailed for over 50 years. After very low load-detection archwires were introduced, interest returned to slowly expanding arches to treat crowding (*Fig. 2B*).[39] Light, controlled orthodontic forces were directed at

■ *Fig. 2:*

(A) The left panel shows three frontal intraoral photographs documenting conventional extraction treatment of a crowded malocclusion. The upper image is pretreatment, and the middle view shows incisor alignment as space is opened with an open coil spring. The lower photograph reveals the final result with periodontal compromise in the lower incisor region as evidenced by gingiva recession and loss of interproximal papillae. Free gingival grafts (pink patches) were preformed to limit progression of the mucogingival problem.

(B) The right panel of three progressive photographs documents treatment with PSL brackets and low force CuNiTi archwires. Although there was thinning of the gingiva and modest gingiva recession, the dentition was healthy and stable.

promoting an optimal periodontal response to avoid gingival recession. Clinically, traditional brackets with stainless steel (*SS*) archwires and open coil springs deliver higher loads compared to small diameter CuNiTi wires designed for PSL brackets. Heavy force and excessive tipping may contribute to periodontal compromise (*Fig. 2A & Fig. 3A*). PSL brackets were developed to deliver relatively uniform, light forces to move teeth.[39] Theoretically, light loads favors the movement of teeth with bone (*Fig. 2B & Fig. 3B*).[34-36]

Patients with malocclusions often present with varying degrees of periodontal deficiency, such as thin gingival biotype and unfavorable bone morphotype. This situation constitutes an anatomic risk for gingival recession. Some types of orthodontic tooth movement may move teeth outside the alveolar envelope. Periodontal support is compromised by dehiscence and/or gingival recession. A comprehensive evaluation of the gingival biotype and bone morphotype relative to the orthodontic treatment plan is essential, prior to initiating any type of tooth movement. Prospective periodontal grafts may be indicated for patients with pre-existing mucogingival problems, or for a treatment plan that risks attachment loss during or after orthodontic treatment.

Fig. 3:

(A) A panel of three intraoral photographs shows treatment of lower incisor crowding with traditional edgewise appliances. The top two views are pretreatment frontal and occlusal images, respectively. The lower image shows an over-expanded space in preparation for rotation and alignment of the LL1. Note thinning of the labial gingiva tissue in the lower incisor region.

(B) A panel of three intraoral photographs documents treatment with a PSL appliance for severe crowding of lower incisors with a deep curve of Spee. The top two views are pretreatment frontal and occlusal images, respectively. The lower image is the post-treatment frontal view of the lower incisors, following arch expansion and alignment with a PSL appliance. Note the healthy appearance of the gingiva.

Gingival Grafting

No graft indicted

A 9-year-1-month-old girl presented with anterior crossbite of the lower right central (*LR1*) and lateral incisors (*LR2*) (*Fig. 4A*). Mild gingival recession and thin gingival tissue were noted on the labial surface of the LR1. A gingival graft was considered prior to orthodontics because the thin gingival biotype was probably associated with a compromised bone morphotype.[16] Comprehensive clinical evaluation revealed a Class I molar relationship, good facial profile, and moderate crowding. The etiology of LR1 gingival recession was attributed to labial tipping and occlusal trauma, associated with the crossbite (*Fig. 4B*). Since the problem could be effectively managed by correcting the crossbite and aligning the LR1 in the center of the ridge, a gingival graft was not indicated. Conservative, non-extraction treatment with a PSL appliance produced an optimal dentofacial correction with a good longterm prognosis (*Figs. 4C and 4D*). Gingival grafts are not indicated for moderate recession problems associated with malaligned teeth that can be readily corrected with orthodontics.

■ *Fig. 4A:*
"Treatment timing? Grafting of LR1 (41) before of after ortho" is a presentation slide presenting the question: Do we need to preventively graft the low gingival tissue in this case? Pretreatment evaluation of lower anterior gingival recession in a 9y1m old patient focused on the need for a free gingival graft on the LR1 (#41) prior to orthodontic treatment.

■ *Fig. 4B:*
The same patient (Fig. 4A) is shown in a panel of six images including a facial profile photograph (upper left), a panoramic radiograph (upper right), and four intraoral photographs.

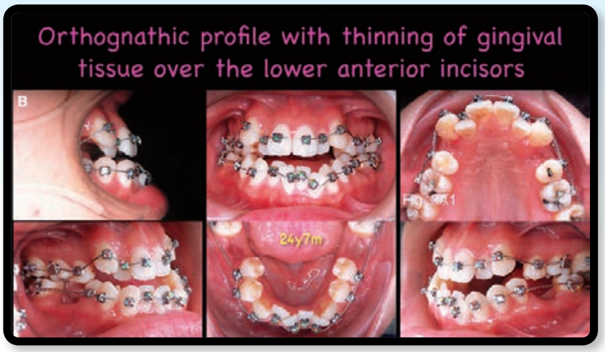
Grafting after orthodontic treatment

A 24-year-7-month-old female presented with anterior open bite, Class III molar relationship, and severe crowding in both arches. The facial profile was acceptable in centric relation (C_R), and the patient was opposed to orthognathic surgery (*Fig.*

■ *Fig. 4C:*
A panel of six progressive frontal photographs document the non-extraction alignment (left vertical panel) from the start (9y1m), through active treatment (9y8m), to the finish (10y2m). The right vertical panel documents follow-up from 12-18y. The LR1 gingival recession noted at 9y1m is improved at the finish (10y2m), and remains stable through 18 years. See text for details.

■ *Fig. 4D:*
The patient (Figs. 4A-C) is shown at the 18y follow-up in a panel of six images which includes a facial profile photograph (upper left), a panoramic radiograph (upper right), and four intraoral photographs. See text for details.

5A). No CBCT imaging was available for evaluating the bone morphotype (*thickness*) in 3D, but similar Class III malocclusions show decreased labial wall thickness and an increased prevalence of alveolar bone dehiscence in the mandible (*42.6%*).[50] Class III compensated malocclusions (*Fig. 5A*) may have periodontal problems related to lingual tipping with labial root torque of the mandibular incisors. Compromised alignment relative to the apical base of bone is associated with a high prevalence of alveolar bone dehiscence. A pre-orthodontic grafting procedure was considered, but the gingival biotype of lower anterior area was adequate, so grafting was delayed until after orthodontic alignment. Following extraction of lower first molars and upper first premolars, PSL brackets with light orthodontic force were used to retract the lower premolars and canines to correct lower anterior crowding. The wire was engaged in all lower anterior brackets from the beginning of treatment (*Fig. 5B*). In retrospect, it may be wise to bypass the most displaced teeth in the initial alignment to avoid excessive localized loads. IPR was performed as needed, and the malocclusion was corrected (*Fig. 5C*). There was concern about alveolar bone dehiscence leading to gingival recession, so a combined connective tissue and bone particle graft was performed after fixed appliances were removed (*Fig. 5D*). It is important to prospectively discuss any surgical interventions planned before, during or after orthodontic treatment. The best option for the



■ *Fig. 5B:*
"Orthognathic profile with thinning of gingival tissue over the lower anterior incisors" is documented with six intraoral photographs obtained during the active treatment at 24y7m of age. See text for details.

■ *Fig. 5A:*
"Warning for possibility of gingival recession!" is a slide illustrated with a panel of five images, including a facial profile photograph (upper left), frontal view of the dentition (top center), panoramic radiograph (upper right), as well as both right and left buccal intraoral photographs in the two lower photographs, respectively.

■ *Fig. 5C:*
"Warning of possibility of gingival recession!" is a statement illustrated at age 27y with five post-treatment images, including a facial profile photograph (upper left), frontal view of the dentition (top center), a panoramic radiograph (upper right), and both right and left buccal intraoral photographs in the two lower photographs, respectively. See text for details.

present patient was to delay the surgery because the gingival biotype was deemed adequate to maintain the gingival attachment during treatment. However, after alignment (*Fig. 5C*) the patient felt uncomfortable brushing the labial surface of the LR1 because the gingival tissue was thin and transparent. It was clear there was insufficient periodontal tissue to support long-term stability. Grafting of bone and soft tissue was performed (*Fig. 5D*) to ensure a long-term harmonious esthetic and optimal outcome.

Fig. 5D:
A combined connective tissue, bone particulate, and enamel matrix derivative graft was performed to augment the buccal soft and hard tissue of lower anterior teeth. See text for details.

The grafting procedure (*Fig. 5D*) for combined soft and hard tissue augmentation was: 1. subperiosteal flap elevation, 2. subepithelial connective tissue graft, 3. xenograft (*Bio-Oss® Geistlich Pharma AG, Wolhusen, Switzerland*) and 4. enamel matrix derivative (*Emdogain® Straumann Holding AG, Basel, Switzerland*). This combined approach allows for an improved esthetic result and helps ensure longterm periodontal stability (*Fig. 5E*).[51]

Grafting before orthodontic treatment

A 12-year-2-month-old girl was concerned about the crowding and poor masticatory function. The clinical evaluation revealed a bilateral Class III molar relationship with anterior cross-bite and an openbite tendency (*Fig. 6A*). Since the facial profile was acceptable in C_R, a conservative non-extraction approach was indicated and the patient was treated with a PSL bracket appliance. Duration of active treatment was about 19 months. The fixed appliances were removed at age 13-year-9-

Fig. 5E:
A panel of six intraoral photographs document the start (24y7m), finish (27y) and follow-up (29y11m) for the treatment of the patient shown in Figs. 5A-D. Three progressive frontal images are on the left, and right buccal views are on the left. Note the excellent gingival health and soft tissue contouring almost three years post-operatively. See text for details.

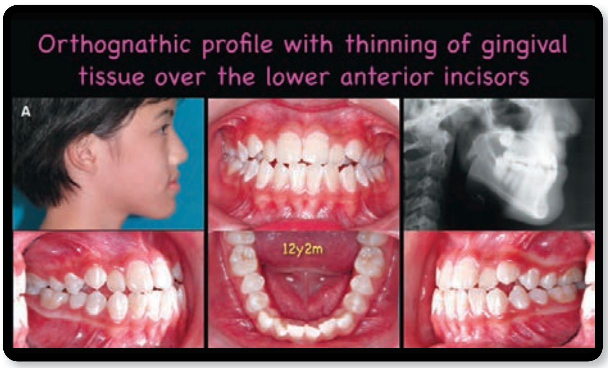


Fig. 6A:
"Orthognathic profile with thinning of gingival tissue over the lower anterior incisors" is illustrated in panel of six images including a facial profile photograph (upper left), a panoramic radiograph (upper right), and four intraoral photographs. See text for details.

Fig. 6B:

A panel of six progressive intraoral photographs, frontal views of both arches, show orthodontic treatment and management of gingival recession at the following intervals:

- ***12y2m** - Initial (upper left)*
- ***13y4m** - PSL brackets fixed appliance (center left)*
- ***13y9m** - Finish (lower left)*
- ***15y2m** - Occlusion relapses to an edge to edge incisal relationship. Lower 2nd premolars is extracted.*
- ***21y11m** - Anterior cross bite is improved but gingival recession is noted on LR6, LR1, LR4, LL1, LL3, LL4 and LL6.*
- ***24y1m** - Prior to follow-up orthodontic treatment, soft tissue and hard tissue grafts were place as needed.*

Fig. 6D:

A panel of six left buccal intraoral photographs show the same progressive sequence as Fig. 6B

- ***12y2m** - Initial (upper left)*
- ***13y4m** - PSL brackets fixed appliance (center left)*
- ***13y9m** - Finish (lower left)*
- ***15y2m** - Occlusion relapses to an edge to edge incisal relationship. Lower 2nd premolars are extracted.*
- ***21y11m** - Anterior cross bite is improved but gingival recession is noted on LR6, LR1, LR4, LL1, LL3, LL4 and LL6.*
- ***24y1m** - Prior to follow-up orthodontic treatment, soft tissue and hard tissue grafts were place as needed.*

Fig. 6C:

A similar panel of six right buccal intraoral photographs show the same progressive sequence:

- ***12y2m** - Initial (upper left)*
- ***13y4m** - PSL brackets fixed appliance (center left)*
- ***13y9m** - Finish (lower left)*
- ***15y2m** - Occlusion relapses to an edge to edge incisal relationship. Lower 2nd premolars are extracted.*
- ***21y11m** - Anterior cross bite is improved but gingival recession is noted on LR6, LR1, LR4, LL1, LL3, LL4 and LL6.*
- ***24y1m** - Prior to follow-up orthodontic treatment, soft tissue and hard tissue grafts were place as needed.*

months (*Figs. 6B-D*). Eight years later at age 21-year-2-months, the Class III malocclusion had relapsed and mucogingival problems were noted labial to the lower incisors. The stability problem was deemed genetically-mediated late mandibular growth, resulting in lingual tipping of lower anterior teeth and labial prominence of the roots (*loss of torque*). In the lower arch, progressive gingival recession was noted from premolar to premolar, in addition to a thin gingival biotype probably associated with dehiscence buccal to the first molars (*Figs. 6B-D*). The patient desired retreatment, so the first priority was to augment the mucogingival defects prior to any additional tooth movement. Since gingival recession is an alveolar bone problem, a combined soft and hard tissue augmentation procedure was planned

■ *Fig. 6E*:

A progressive panel, of four paired frontal and left buccal photographs, document free gingival grafts in preparation for comprehensive periodontal augmentation: UL is the preoperative view, UR is the surgical preparation to the graft sites, LR shows free gingival grafts suture into position, and LR documents the post-operative outcome.

■ *Fig. 6H*:

A vertical panel of buccal and front images document: preoperative condition (21y11m, upper three views), post-operative outcome (24y1m, center three views), and follow-up orthodontic alignment (25y1m, lower three views). Note that the healthy periodontal condition resists gingival recession during the follow-up course of orthodontic treatment (lower 3 view panel).

■ *Fig. 6F*:

A similar progressive panel of four paired frontal and left buccal photographs document a composite connective tissue, bone and enamel matrix graft in the same areas prepared with the free gingival grafts in Fig. 6E (1-6 area): UL the flap is reflected, UR graft materials are placed, LR shows surgical closure and suturing, and LR documents the post-operative outcome.

■ *Fig. 6G*:

The same sequence as illustrated in Fig. 6F is performed on the lower right side for teeth LR1-6.

utilizing a stepped approach. A free gingival graft form the LL1-6 was the initial procedure (*Fig. 6E*). Three months later a hard and soft tissue root coverage procedure was performed from LL6 to LR6 with three simultaneous grafts, as previously described (*Figs. 6F and 6G*). The improvement in the level of gingival margin and the thickness of keratinized tissue is seen at age 24-year-1-month (*Fig. 6H*) compared with pre-surgical condition (*Figs. 6B-6D*). Augmented buccal bone provides a scaffold for improved soft tissue contouring. The patient's excellent hygiene during the second course of orthodontic treatment maintained the augmented periodontal tissue (*Fig. 6H*).

Grafting during orthodontic treatment

A 25-year-2-month-old female was referred for a second opinion (*Fig 7A*). Compared to her pre-treatment records (*Fig. 7B*), the arches were being aligned with an edgewise appliance to decompensate particularly the lower dentition, prior to orthognathic surgery. Open coil springs, used to open space in the lower anterior region, had tipped the incisors anteriorly. Thin facial gingiva was noted particularly on the LL1-4. The patient was re-evaluated with the three-rings diagnosis method for differential diagnosis of Class III malocclusion.[52] Her good (*orthognathic*) facial profile in C_R indicated the skeletal Class III malocclusion could be resolved conservatively with PSL brackets and bone screw anchorage. After a careful discussion, the patient agreed to the alternative approach that involved 2 infra-zygomatic crest (*IZC*) and 2 mandibular buccal shelf (*MBS*) bone screws (*Figs. 7C and 7D*). Bone screws in all four posterior quadrants were utilized as anchorage to retract and align both arches over the apical base of bone.[52,53] The lower arch was then retracted and posteriorly rotated to correct the Class III intermaxillary discrepancy.[38] The thin gingival biotype and bone morphotype of lower anterior incisors was compromised by the previous course of treatment. Periodontal augmentation as previously described was indicated to correct the gingival recession.

Fig. 7A:
A transfer patient with a severe Class III malocclusion is shown in a panel of six images including a facial profile photograph (upper left), a panoramic radiograph (upper right), and four intraoral photographs. Because the patient has good orthognathic profile, conservative treatment is indicated. See text for details.

Fig. 7B:
The original records are provided for the transfer patient shown in Fig. 7A. Note the good facial profile in C_R, Class III relationship, open bite, deep curve of Spee, and lower anterior crowding.

Skeletal Class III malocclusion with crowding usually requires extractions for optimal alignment of the dentition, and orthognathic surgery to resolve the skeletal discrepancy.[43] However, many Class III patients can be managed conservatively with an appropriate differential diagnosis, PSL brackets, and extra-alveolar bone screw anchorage.[38] Buccal segment retraction with bone screw anchorage and IPR are used to correct crowding.

Conservative treatment for Class III malocclusion is directed at avoiding extractions, orthognathic surgery, and gingival recession. IZC and MBS bone screws are effective anchorage for optimal nonextraction alignment, and intermaxillary correction as needed.[38,39,52,53] The ultimate goal of the clinician is to provide a long-term solution that is both stable and healthy. To minimize the risk of gingival recession and maximize the benefit of orthodontic treatment, the orthodontist and periodontist must both be aware of the risk factors for mucogingival problems before, during and after orthodontic treatment. Dental alignment must be directed at not only the crowns of the teeth, but also the roots and supporting periodontium. The potential risk for mucogingival problems involves assessment of anatomical conditions, hygiene issues and the proposed orthodontic treatment. Patients should be aware of the specific risks for the treatment proposed, and any other therapeutic measures that may be required. It is recommended that these details be part of the pretreatment consultation and informed consent process.

Fig. 7C:
The crowded Class III malocclusion at 25y2m is shown in facial profile and right buccal segment radiographs (left two images). Two IZC and two MBS bone screws were used as anchorage to align the dentition at 26y10m (right two images). Note the improvement in the facial profiles as the malocclusion is corrected.

Fig. 7D:
The original malocclusion is shown at 25y2m in the two frontal photographs on the left. Treatment progress at 26y10m shows improved alignment, but moderate gingival recession is noted on the LL1-3. Post-treatment follow-up is indicated to determine if surgical intervention is required. See text for details.

Conclusion

Detailed analysis of the potential risk for mucogingival complications is mandatory prior to performing any type of orthodontic treatment. Arches can be expanded with low loads and PSL brackets. Pre-orthodontic gingival augmentation is not recommended for problems that are likely to improve with orthodontic alignment, but prospective surgical intervention is wise when orthodontic tooth movement entails a risk for gingival recession. Gingival recession can usually be corrected surgically, but the preferred strategy is prevention.

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	Session A	Session B
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Keynote optional	05/24	12/06

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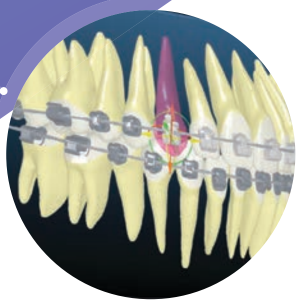

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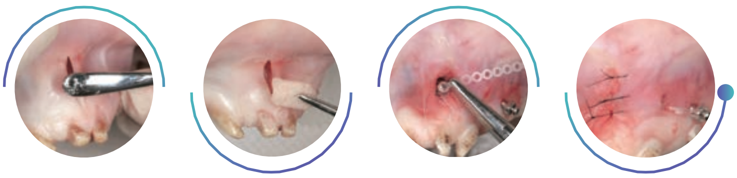

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Chris’ Lecture:
Optimized Orthodontic Treatment with Damon system

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

Chris’ Lecture:
CBCT–enhanced treatment plannning for Insignia

Day **3** **Cl III Lecture by Dr. John Lin, VISTA Lecture & workshop**

*The topics for VISTA workshop:

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Damon, OBS & VISTA

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KEYNOTE

THE LECTURERS

Dr. Chris Chang

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

Dr. John Lin

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

Asymmetric Oligodontia and Acquired Class III Malocclusion: Space Management and Site Development for an Implant-Supported Prosthesis

Abstract

History: *A 26-year-old male presented with a severe, asymmetric Class III, partially edentulous malocclusion that was associated with decreased facial height due to a midface deficiency. The chief complaints were poor masticatory function and compromised dentofacial esthetics.*

Diagnosis & Etiology: *A decreased vertical dimension of occlusion (VDO) was associated a deep overbite (8mm), deviated maxillary dental midline (3.5mm to the right), skeletal Class III (ANB -5˚), asymmetric absence of six permanent teeth (UR4, UR5, UL5, LR4, LR5, and LL5), and two retained deciduous teeth. The probable etiology for the anterior crossbite was ectopic eruption to the palatal of the upper central incisor(s). Severe deepbite reflected the absence of multiple posterior teeth, and the upper midline deviation was due to the loss of both upper premolars on the right side. The patient was a good candidate for camouflage treatment because in centric relation (C_R) the facial profile was acceptable, molars were near Class I, and the incisors occluded in an end-to-end relationship.*

Treatment: *The upper deciduous lateral incisor was extracted and the space was closed. A full fixed appliance was bonded on all permanent teeth as well as the lower right deciduous second molar. Space was created in the UR4 area for an implant-supported prosthesis (ISP). The anterior crossbite was corrected by bonding bite turbos on the posterior teeth, placing an open coil spring in the UR4 area, and utilizing Class III intermaxillary elastics. In the 29th month of treatment, the UR4 implant was placed, and all fixed appliance were removed when the ISP was delivered. Retention was a lower fixed 3-3, and clear overlay retainers in both arches.*

Outcome: *Following 33 months of interdisciplinary treatment, this difficult malocclusion, with a Discrepancy Index of 66 points, was treated to a Cast-Radiograph Evaluation score of 15 points and a Pink and White esthetic score of 4 points. The patient was very pleased with the treatment outcome. (J Digital Orthod 2018;52:24-46)*

Key words:

Multiple missing teeth, oligodontia, skeletal Class III pattern, Class III molar relationship, dentofacial asymmetry, asymmetric mechanics, interdisciplinary treatment, open coil spring, bite turbos, Class III intermaxillary elastics, implant site development, 2B-3D rule

Introduction

The dental nomenclature for the current case report is a modified Palmer notation for both the deciduous and permanent teeth. The four oral quadrants are upper right (*UR*), upper left (*UL*), lower right (*LR*) and lower left (*LL*). Relative to the midline in each quadrant, deciduous teeth are designated from a to e, and corresponding permanent teeth are numbered from 1 to 8. For example, an upper right first premolar is UR4, and lower right second deciduous molar is LRe.

Dr. Joy Cheng,
Lecturer, Beethoven Orthodontic Course (Left)

Dr. Chi Huang,
Lecturer, Beethoven Orthodontic Center
Editor, Journal of Digital Orthodontics (Center left)

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

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

Hypodontia denotes the lack of development of one or more teeth. Oligodontia designates a hypodontia with six or more congenitally missing teeth, excluding the third molars.[1,2] The relative frequency of the missing teeth varies between ethnic groups, but teeth commonly absent are the mandibular second premolar, the maxillary lateral incisor, the maxillary second premolar, the mandibular lateral incisor, and the mandibular central incisor.[3]

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

Patients with hypodontia often present with a number of associated traits such as decreased mandibular plane angle (*MPA*), lower facial height (*LFH*), vertical dimension of occlusion (*VDO*), and lip protrusion. Increased overbite is a common dental manifestation often associated with decreased axial inclination of the lower incisors, increased interincisal angle, extrusion of the lower incisors, and a deep curve of Spee.[4]

Increased numbers of missing teeth is directly related to edentulous spaces, permanent tooth displacement, severe deepbite, and the need for complex interdisciplinary treatment. Space closure options are increasingly unrealistic when there are multiple missing teeth. Orthodontic treatment typically focuses on space distribution and preprosthetic alignment to facilitate a restoration of the occlusion.[4] The current patient (*Figs. 1-7*) presented with decreased midfacial height oligodontia, dentofacial asymmetries and an acquired (*collapsed*) Class III malocclusion (*decreased MPA but increased LFH*). This usual combination of traits reflects a severe decrease in midfacial height. Orthodontic treatment with a full fixed appliance, implant site development, and implant-supported prosthesis (*ISP*) focuses on esthetic and functional rehabilitation of the occlusion.[5]

Diagnosis and Etiology

A 26-year-old male pursued orthodontic evaluation with a chief complaint of compromised dentofacial esthetics. The intermaxillary relationship was examined with the teeth in maximum intercuspation, centric occlusion (*Co*), and with the mandibular condyles seated in the fossa, i.e. centric relation (*Cr*). In Co the clinical examination revealed a prognathic profile, protrusive lower lip, and an anterior crossbite (*Figs. 1 and 2*). In Cr the incisors were end-on, molars were near Class I, and the facial profile was acceptable. Temporomandibular joint (*TMJ*) morphology was normal in the open and closed positions, but the condyle was anterior and inferior to the fossa consistent with a functional shift into anterior crossbite (*Fig. 3*). There were no signs nor symptoms of TMJ dysfunction. In Co facial form

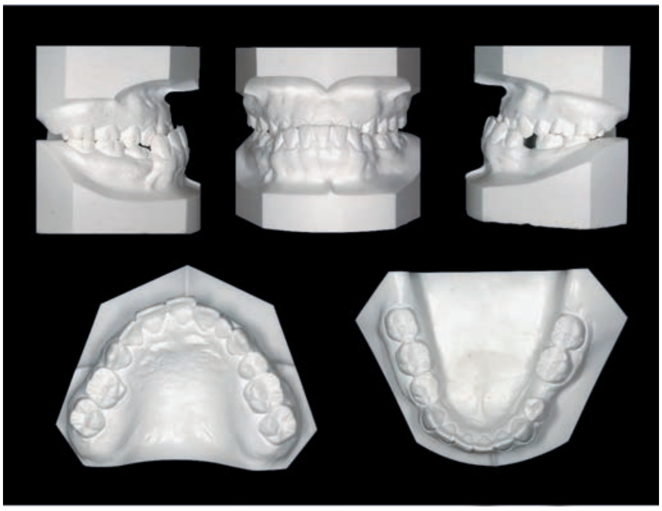


Fig. 2: Pre-treatment study models (casts)

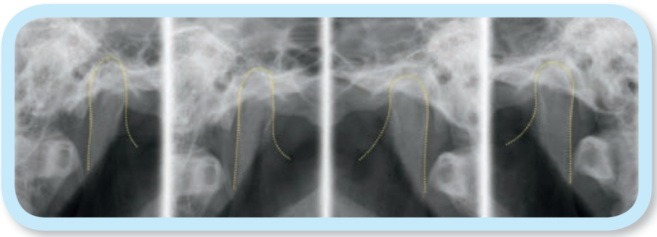


Fig. 3:
Transcranial radiographs of the temporomandibular joints (TMJs) prior to treatment are shown from the left: Right TMJ closed, Right TMJ open, Left TMJ open, and Left TMJ closed.

was relatively symmetric in the frontal plane (*Fig. 1*), but the profile was markedly concave (*G-SN-Pg' -6°*). Upper lip prominence was severely deficient, -5.5mm to the E-Line (*Fig. 4 and Table 1*).

Plaster casts (*Fig. 2*) revealed a Class I molar relationship on the right side and an end-on Class III molar relationship on the left. The canine relationships were Class III bilaterally (*Fig. 2*), and there was an anterior crossbite from canine to canine. The maxillary arch form was rotated counterclockwise (*Fig. 5*) consistent with the congenital absence of both upper right premolars (*Fig. 6*). Despite an edentulous space in the area of LL5, the lower arch remained symmetric (*Fig. 1*). The lower dental midline was coincident with the facial midline, but the upper dental midline was shifted 3.5mm to the right (*Fig. 1*).

Fig. 4:
Pre-treatment cephalometric radiograph in centric occlusion (Co). Note the relative midface deficiency is due to decreased midface height and overclosure of the mandible (flat MPA).

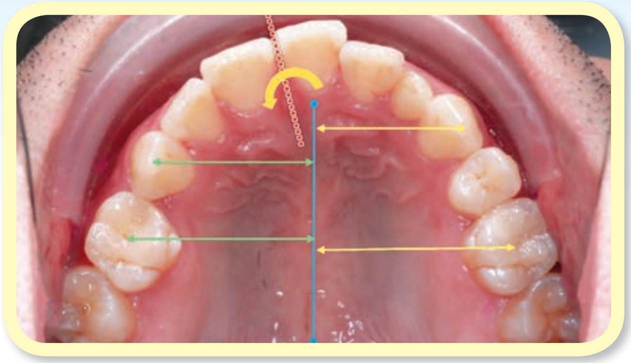


Fig. 5:
Canine and molar positions were asymmetric due to the pattern of the congenitally missing teeth. The right side of the patient's maxilla is underdeveloped as shown by the colored arrows relative to the midline (blue line). Using the mid-palatal raphae (red dotted line) as a reference, the anterior maxillary arch is rotated counterclockwise (yellow curved arrow).

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	82°	83°	1°
SNB° (80°)	87°	85°	2°
ANB° (2°)	-5°	-2°	3°
SN-MP° (32°)	26°	27°	1°
FMA° (27°)	19°	20°	1°
DENTAL ANALYSIS			
U1 To NA mm (4 mm)	6.5 mm	10 mm	3.5 mm
U1 To SN° (104°)	107°	117°	10°
L1 To NB mm (4 mm)	4.5 mm	3 mm	1.5 mm
L1 To MP° (90°)	80°	87°	7°
FACIAL ANALYSIS			
E-LINE UL (2-3 mm)	-5.5 mm	-4 mm	1.5 mm
E-LINE LL (1-2 mm)	-1 mm	-2.5 mm	1.5 mm
%FH: Na-ANS-Gn (56%)	58%	59%	1%
Convexity: G-Sn-Pg' (13°)	-6°	-2°	4°

Table 1: Cephalometric summary

The panoramic radiograph (*Fig. 6*) documents significant dental problems contributing to the malocclusion: 1. six congenitally missing permanent teeth (*UR4, UL5, UL5, LR4, LR5, LL5*), 2. two retained deciduous teeth (*ULb, LRe*), and 3. a 7mm atrophic edentulous ridge in the area of the LL5. The cephalometric evaluation (*Table 1*) revealed decreased facial convexity (*-6°*), increased LFH (*58%*) relative to total facial height (*Na-Gn*), and a prognathic mandible (*SNA 87°, SNB 82°, ANB -5°*).

Fig. 6: Pre-treatment panoramic radiograph

The mandibular plane angle was flat (*SN-MP 26°, FMA 19°*), and the lower incisors had a decreased axial inclination (*80°*). With the mandible positioned in centric relation (C_R), the incisors were in an end-to-end occlusion and the facial profile was acceptable, which indicates that conservative camouflage treatment was a viable option (*Fig. 1*). The American Board of Orthodontics (*ABO*) Discrepancy Index (*DI*) was 66 as shown in the subsequent worksheet. The most significant problems were the anterior crossbite (*38 points*) and congenital missing teeth (*12 points*).

Treatment Objectives

The principal objectives for the treatment plan were to improve the prognathic facial profile, achieve a Class I molar relationship, correct the anterior crossbite, and optimize the intermaxillary relationship with space management. Additional

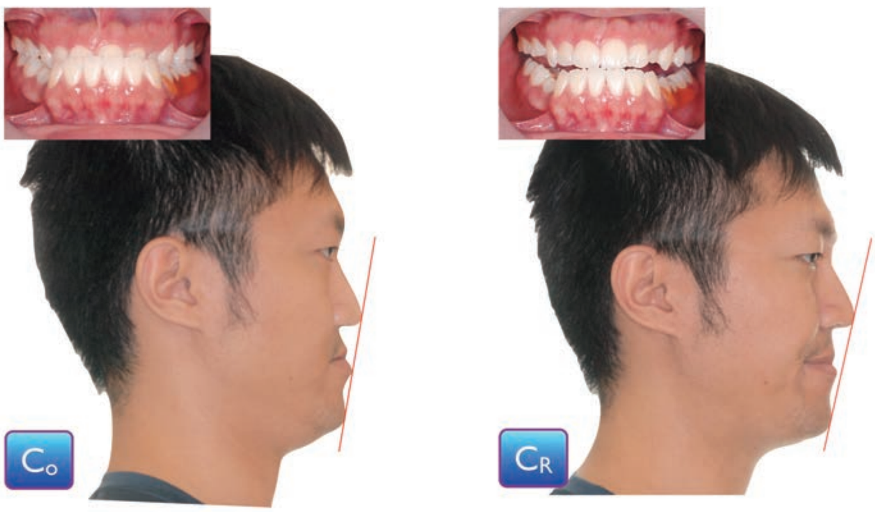


Fig. 7:
With the mandible positioned in centric relation (C_R), the incisors were in an end-to-end occlusion and the facial profile was acceptable.

esthetic goals were correction of the dental midline discrepancy and improvement of maxillary anterior alignment.

Treatment Alternatives

To resolve the midline and interdigitation discrepancies, asymmetric space closure was required in both arches. Because of the large sagittal discrepancy (*ANB -5°*), orthognathic surgery to set back the mandible was the initial treatment option. The second treatment plan was a conservative, camouflage approach involving proclination of the upper anterior segment and retraction of the lower arch. After considering the pros and cons of each option, the patient preferred the second treatment option including an ISP to restore the UR4. He realized that the retained deciduous molar (*LRe*) will eventually require replacement with ISP, but he could only afford one ISP at present.

Treatment Progress

A 0.022-in Damon Q® (*Ormco, Glendora, CA*) passive self-ligating (*PSL*) fixed appliance was selected. The archwire sequence and applied mechanics is documented in the wire sequence chart (*Table 2*). For the lower arch, low torque brackets were bonded upside down to achieve increased torque on the lower incisors, and high torque brackets were placed on the lower canines. The mesiodistal width of the restored LRe was reduced to 7.5mm to serve as a future implant site.[6] The initial archwire was 0.014-in copper-nickel-titanium.

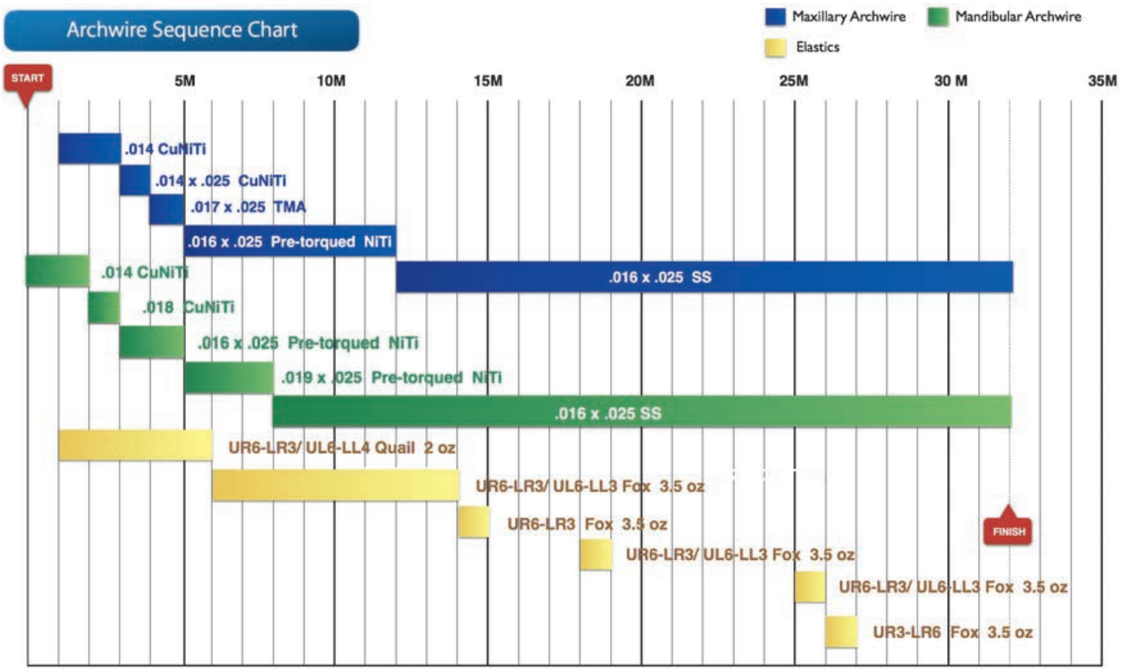
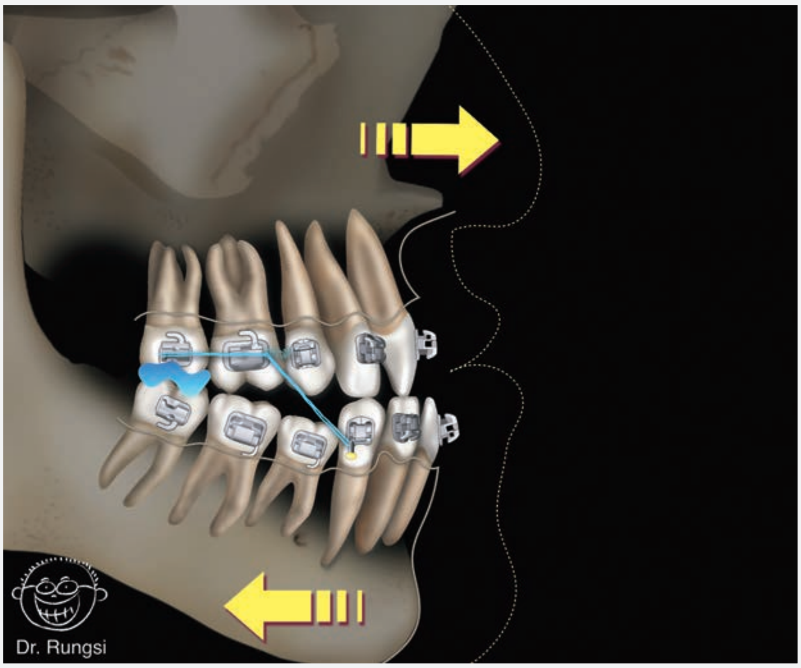


Table 2: Archwire Sequence Chart

One month later, the maxillary central incisors were bonded with standard torque brackets and the canines were bonded with high torque brackets. The initial archwire was 0.014-in copper-nickel-titanium. Posterior bite turbos, made with Fuji II® type II glass Ionomer cement (*GC America, Alsip IL*), were installed bilaterally on the maxillary second molar occlusal surfaces to create intermaxillary space. An open coil spring (*Ormco, Glendora, CA*) activated 2mm was used to create an implant site in the UR4 area, and power chains were used to close the edentulous LL5 space. An additional open coil spring was used to open the UR4 implant site, increase the axial inclination of the upper anterior segment, and retract the UR posterior segment. Early light short Class III elastics (*Quail, 3/16-in, 2-oz; Ormco*) were used to correct the sagittal discrepancy. Collectively, these mechanics corrected the anterior crossbite (*Fig. 8*).

In the 3rd and 4th month, the maxillary archwire sequence was 0.014x0.025-in CuNiTi and 0.017x0.025-in TMA. To increase the axial inclination of the upper incisors, a 0.016x0.025-in pre-torqued NiTi was inserted for 7 months. After 16 months of active treatment, the anterior crossbite was corrected, and the UL space was closed. Bite turbos were progressively removed beginning at the 21st month of treatment to allow posterior contact, as



■ *Fig. 8:*
The collapsed Class III malocclusion associated with asymmetric missing teeth was corrected with three mechanical interventions: open coil spring to prepare an UR4 implant site, Class III elastics, and bite turbos. Collectively these mechanics tended to protract the maxillary arch and retract the mandibular arch, as shown with the yellow arrows.

the curve of Spee in the lower arch was corrected.

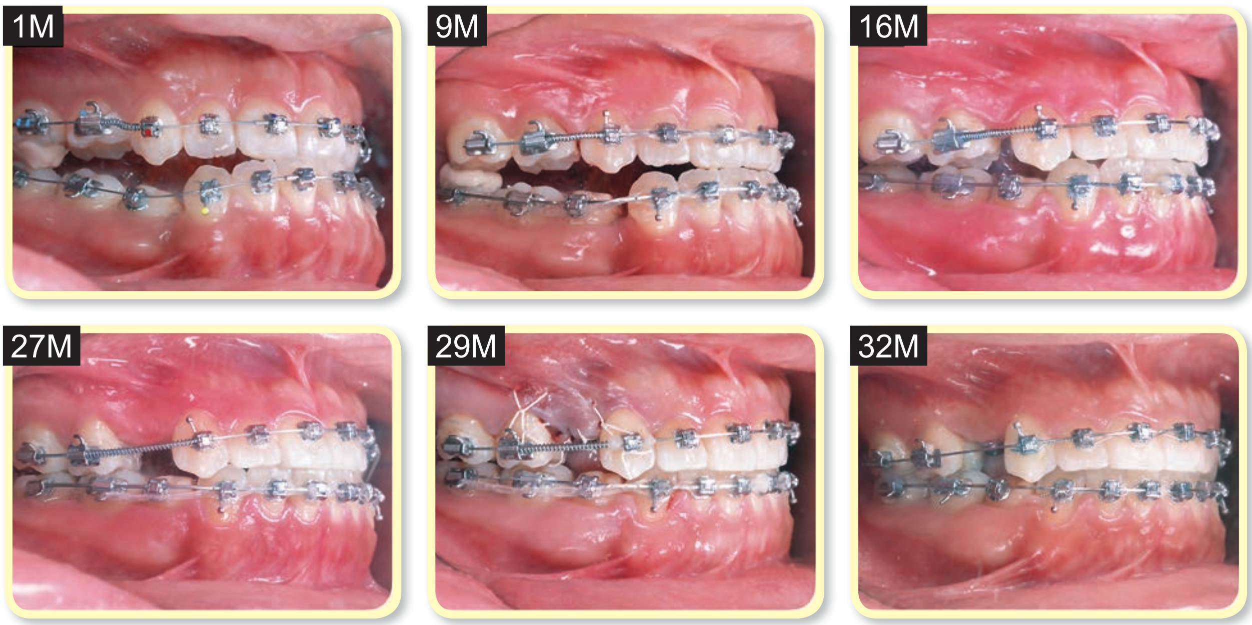
From 2-8 months, the sequence for the lower archwire was 0.018-in CuNiTi, 0.016x0.025-in pre-torqued NiTi, and 0.019x0.025-in pre-torqued NiTi. In the 8th month, the archwire was changed to 0.016x0.025-in SS with 15° of lingual root torque because the upside-down low torque brackets and pre-torqued NiTi wire were insufficient to control the axial inclinations (*Table 2*).

At 27 months, the upper dental midline was coincident with the incisive papilla. The space for implant site was 7.5mm,[5] and the occlusion was optimally interdigitated as the lower space was closed (*Figs. 9-11*).

Implant Placement

A cone-beam computed tomography (*CBCT*) scan was used to evaluate the bone volume and distribution in the implant site (*Fig. 12*). A slice from the center of the implant site was selected and the alveolar bone mass was measured: height 12.6mm, width 9mm. The fixture selected was a Nobel Replace Conical Connection NP Ø3.5xH10mm with a Healing Abutment Conical Connection NP Ø3.6xH5mm (*Nobel BiocareTM, Switzerland*).

Under local anesthesia, a #15c scalpel blade was used for a crestal incision on the palatal side of the ridge. A sulcular incision was performed on the buccal surface with a #12 blade from the distal line angle of UR3 to the mesial line angle of the UR6, and a full



■ *Fig. 9*:
Correction of the anterior crossbite is shown in monthly intervals: first (1M), ninth (9M), sixteenth (16M), twenty-seventh (27M), twenty-ninth (29M), and thirty-second (32M).

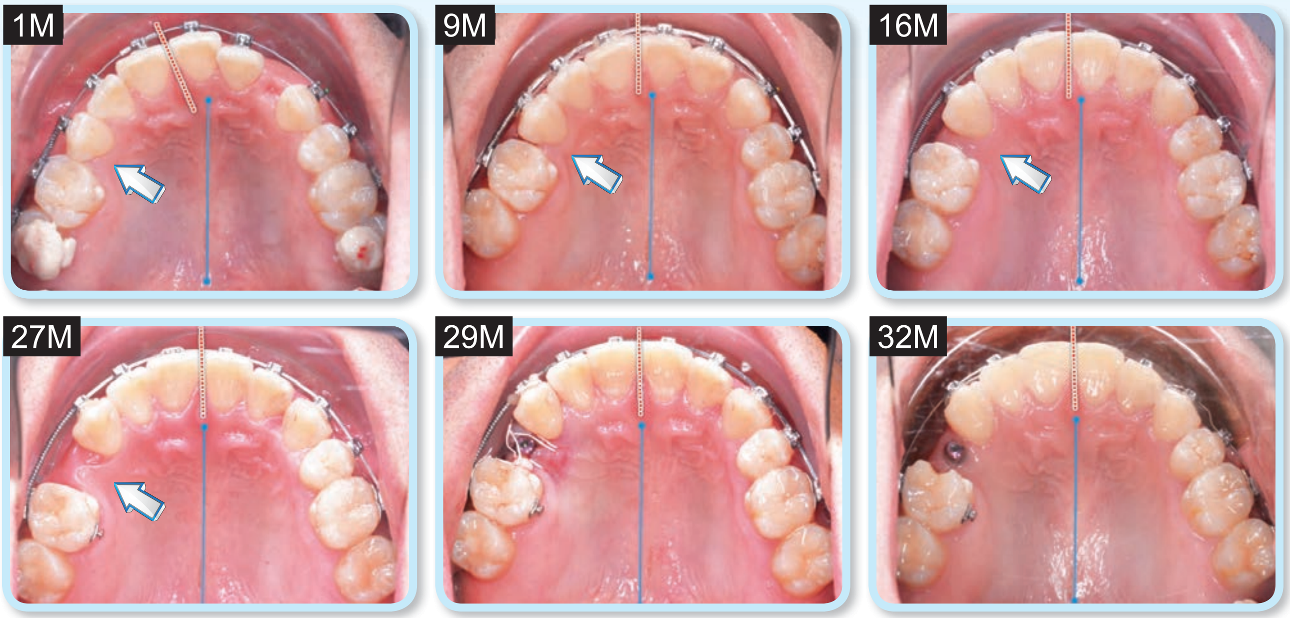


Fig. 10:
Maxillary midline correction and UR4 implant site development is shown in monthly intervals: first (1M), ninth (9M), sixteenth (16M), twenty-seventh (27M), twenty-ninth (29M), and thirty-second (32M). The palatal midline (blue line) and raphae (red dotted line) are shown in relation to the implant site (white arrow).

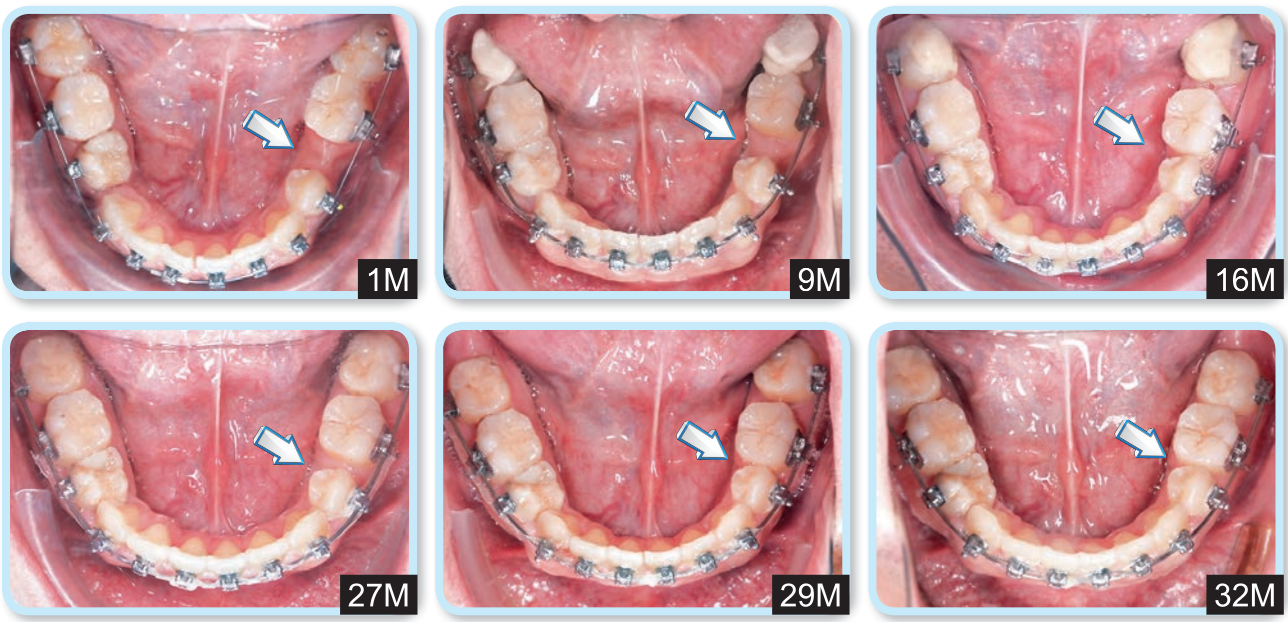
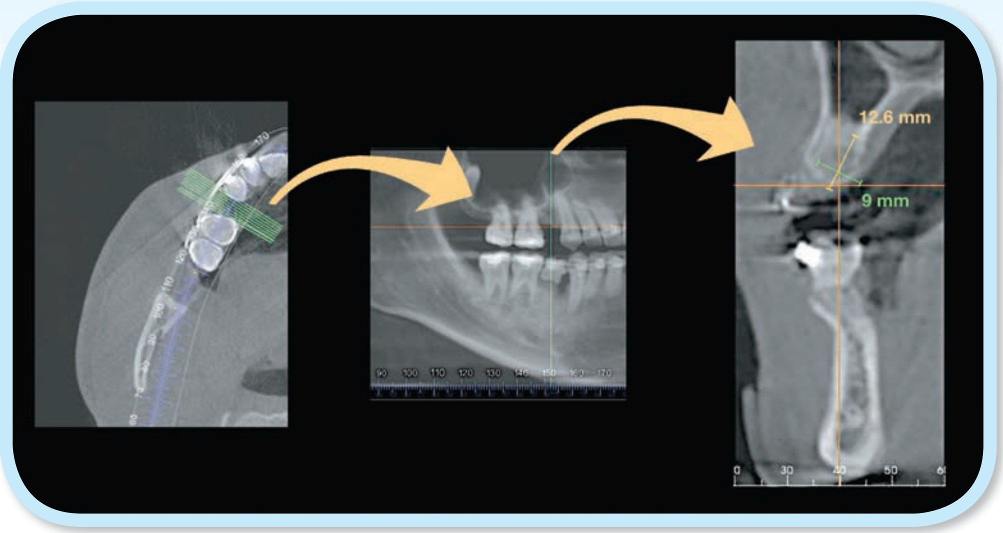


Fig. 11: *The white arrow points to progress as the LL5 space is closed from one (1M) to thirty-two months (32M).*



■ *Fig. 12*:
A CBCT scan shows the dimensions of the implant site in the axial (left), sagittal (middle) and frontal views (right). The alveolar bone volume was assessed as height 12.6mm, and width 9mm in the frontal image (right).

thickness soft tissue flap was reflected. Exposure of the bone revealed an adequate ridge to place a 3.5mm diameter implant. The initial lancer drill produced an osteotomy that was fitted with a guide pin to evaluate the insertion path with a periapical radiograph. The osteotomy was excessively oriented to the mesial, so it was adjusted prior to placing the implant. Following the specifications of the implant manufacturer, the fixture was installed in the center of the ridge according to the 2B-3D rule, which is defined as 2mm of buccal bone thickness, and fixture depth 3mm apical to the expected crown margin (*Figs. 13 and 14*).[7] As shown in Fig. 13h, the fixture was connected with a healing abutment (*Ø3.6xH5.0mm*), and the flap was sutured with interrupted 4-0 GORE-TEX® (*Flagstaff, AZ*). After 1 week, the sutures were removed.

Implant Prosthesis Fabrication

Four months after surgical placement, the implants were uncovered, and excessive gingival tissue was removed using a dioxide laser (*Epic X, Epic, Verona, WI*). The healing abutment was replaced by a Snappy Abutment 5.5 Nobel Replace NP 1.5mm (*Nobel Biocare™, Switzerland*). A snap-on impression coping was used for abutment level impression with a closed tray. After the impression, a healing cap was fitted to prevent soft tissue overgrowth of the abutment. Two weeks later, the crown was delivered and the marginal fit was checked with an explorer and periapical radiographs. The progressive prosthetic procedures are shown in a panel of 12 photographs (*Fig. 15*).

Following 33 months of interdisciplinary treatment, maxillary and mandibular clear overlay retainers were delivered to wear full-time for the first six months and nights only thereafter. A fixed retainer was bonded from lower right canine to lower left canine.

Treatment Results

The facial profile was improved and facial esthetics were more harmonious. A near ideal dental alignment was achieved: normal overbite and overjet, and bilateral Class I buccal segments. The anterior crossbite was corrected, resulting in a pleasant smile arc with a more youthful facial appearance (*Figs. 16 and 17*).

The post-treatment panoramic radiograph demonstrated adequate root alignment. Additional resorption of the LRe root was noted, but the tooth remained stable (*Fig. 18*). Superimposed cephalometric tracings revealed increased axial inclination of the maxillary incisors, slight retraction of the maxillary molars, retraction of the lower lip and a less prognathic profile (*Figs. 19 and 20*). The

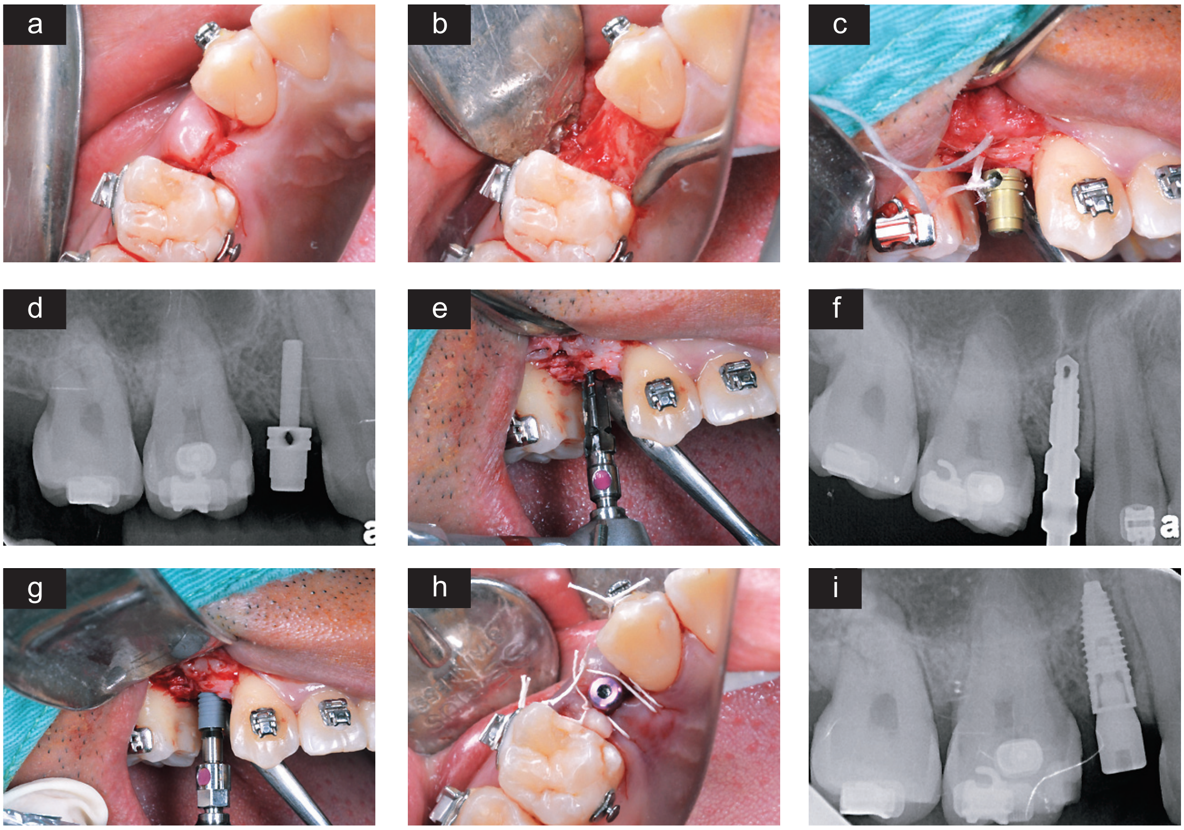


Fig. 13:
The implant surgical procedure is illustrated: (a) mid-crestal and sulcular incisions were performed for flap reflection, (b) occlusal view of the exposed osseous ridge, (c) guide pin was placed in the osteotomy, (d) a periapical film was exposed with the guide pin to check the insertion path and orientation of the osteotomy, (e) osteotomy is completed, (f) periapical film was exposed with the final drill in place to check the insertion path, (g) 3.5x10mm implant fixture is inserted, (h) healing abutment (3.6x5.0mm) is installed, and the flap is sutured with direct loop interrupted 4-0 GORE-TEX®, and (i) periodical radiograph of the final result.

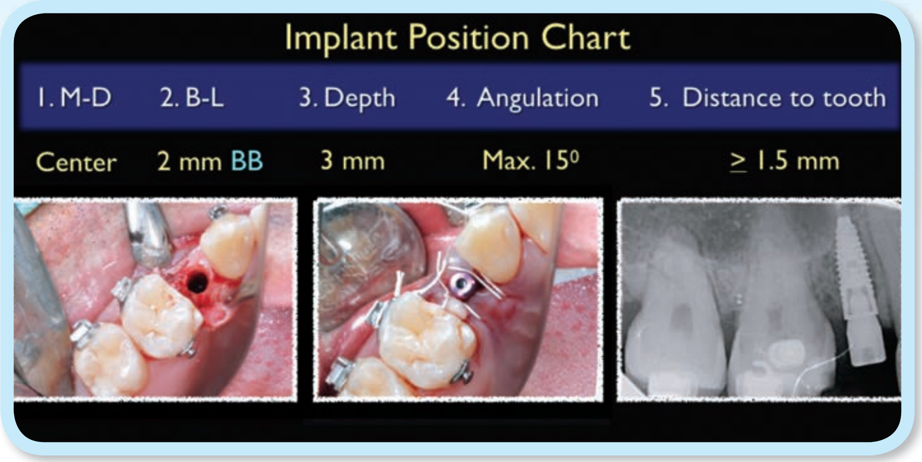


Fig. 14:

The implant position chart, composed of two intraoral photographs and a periapical radiograph, documents the five parameters for placement of the UR4 fixture. Left Image: 1. M-D center of the site in the mesial-distal (M-D) position, and 2. buccal-lingual (B-L) position with 2mm buccal bone thickness. Center Image: 3. implant fixture is positioned 3mm below the future crown margin. Right Image: 4. angulation (less than 15˚), and 5. distance from adjacent teeth is at least 1.5mm.

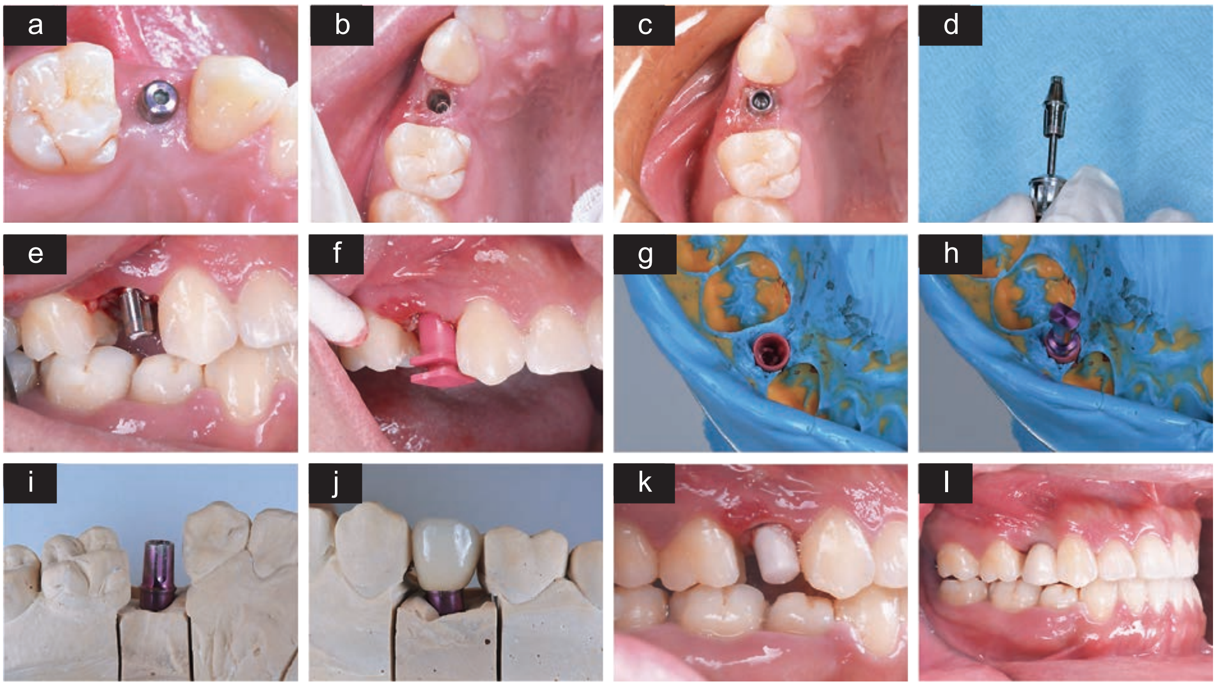


Fig. 15:

The prosthetic procedure is: (a) healing cap in place, (b) removal of healing abutment, (c) excessive gingiva above the fixture is removed with a dioxide laser (Epic X, Epic, Verona, WI), (d) Snappy Abutment 5.5 Nobel Replace NP 1.5mm is chosen, (e) abutment is fitted and placed (f) Snappy Abutment 5.5 Impression Coping NP is inserted into the soft tissue sulcus, (g) pick-up impression with polyvinyl siloxane shows the pink outline of the impression coping, (h) Snappy Abutment 5.5 Abutment Replica NP is "snapped" into the coping that was embedded in the impression, (i) impression is poured in type IV dental stone to prepare a working cast, (j) final prosthesis is fabricated and fitted on the working cast, (k) healing cap supports the soft tissue during healing, and (l) permanent crown is viewed from the buccal aspect.

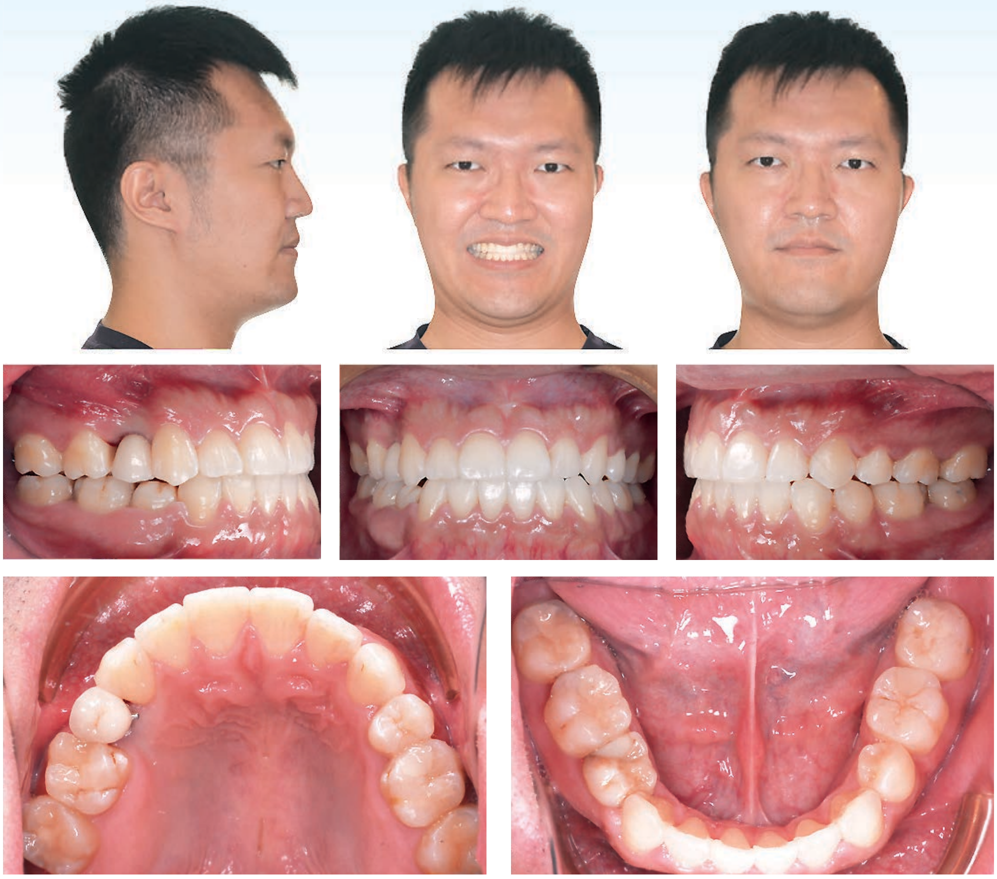


Fig. 16: Post-treatment facial and intraoral photographs

Fig. 17: Post-treatment study models (casts)

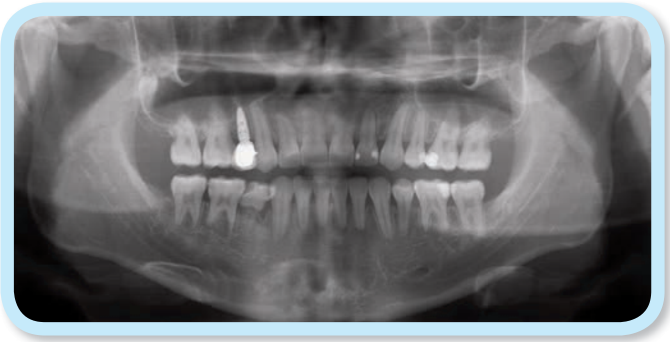


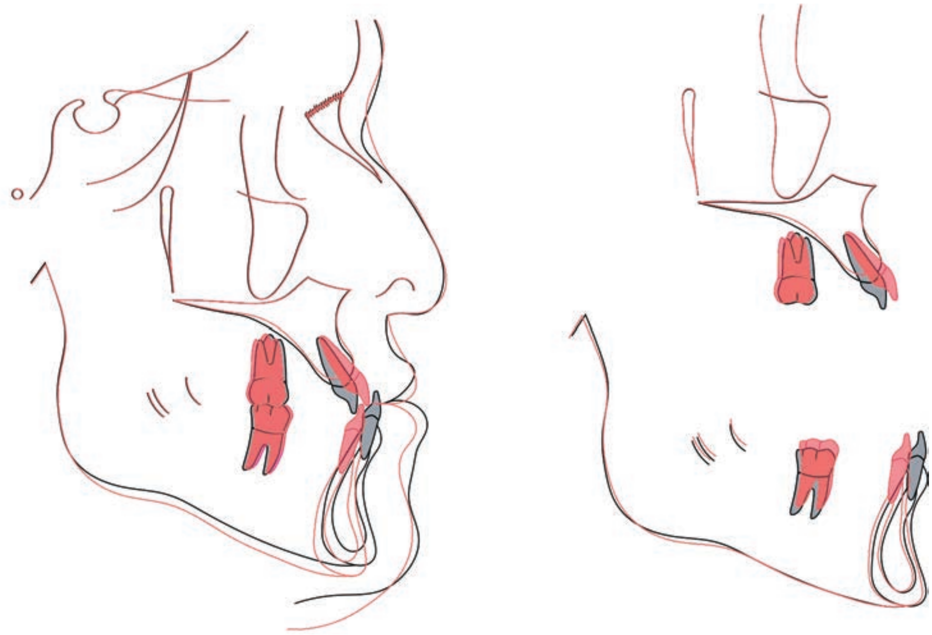
Fig. 18: Post-treatment panoramic radiograph

■ *Fig. 19*: *Post-treatment cephalometric radiograph*

ABO Cast-Radiograph Evaluation (*CRE*) score was 13 points (*Worksheet 2*). The major CRE discrepancies were alignment (*3 points*), bucco-lingual inclination (*6 points*), and occlusal relationships (*3 points*).

Discussion

Asymmetric oligodontia, ectopic eruption and a prognathic skeletal pattern (*ANB -5°*) resulted in severe dentofacial malocclusion requiring carefully coordinated interdisciplinary treatment. The patient preferred conservative treatment, so a careful differential diagnosis was essential to determine whether a non-invasive approach was indicated or even feasible. Space management with orthodontics required careful application of asymmetric intermaxillary mechanics. Three important aspects of case management are discussed in detail as follows:



■ *Fig. 20*:
Superimposed tracings of the initial (black) and finish (red) cephalometric films reveal the skeletal and dental changes that occurred during treatment.

Correction of a Collapsed Class III malocclusion with Anterior Crossbite

1. Examination

The 3-Ring Diagnosis, developed by Dr. John Lin,[8] is an effective method for diagnosing Class III malocclusions that are amenable to conservative therapy. There are three favorable indicators: an orthognathic profile (*acceptable facial balance*) in centric relation, buccal segments that are approximately Class I, and a functional shift into maximal intercuspation. Other favorable factors are a less than average mandibular plane angle and no open bite (*Fig. 21*).[9]

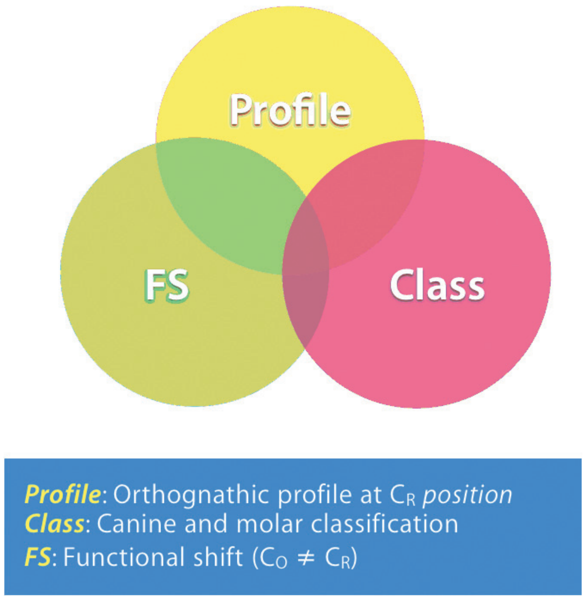


Fig. 21:
The Class III diagnostic system of Dr. John Lin evaluates the facial profile and molar classification in CR, as well as the functional shift from CR to Co. If the profile is acceptable in CR, the molars are in or near Class I, and there is a significant functional shift, the patient can usually be effectively managed with conservative camouflage treatment.

2. Diagnosis

The functional shift was an important consideration. In centric relation (CR), there was an end-on occlusion of the incisors, the facial profile was acceptable, and the ANB angle decreased three degrees. These positive factors revealed that conservative camouflage treatment of the acquired Class III malocclusion was a viable option.[10]

3. Treatment

Camouflage treatment often results in increased axial inclination of the maxillary incisors and decreased axial inclination of the mandibular incisors, particularly if there is an underlying Class III skeletal discrepancy (*Fig. 22*).[8] Orthodontic mechanics for predictable anterior crossbite correction includes proper bracket torque selection, bite turbos, light-force Class III elastics, and open coil springs.[10]

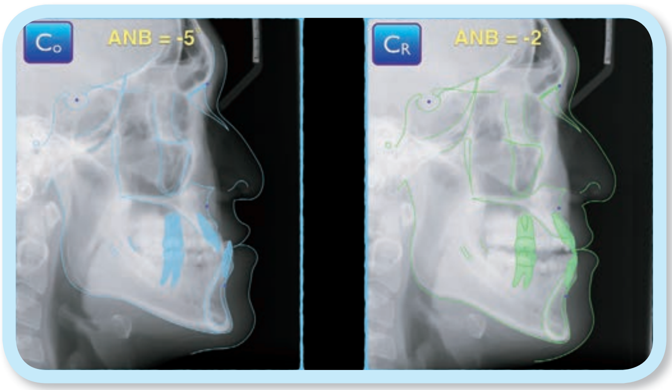


Fig. 22:
Tracings superimposed on cephalometric films, exposed in centric occlusion (Co) and centric relation (CR), are shown as left and right images, respectively. The Co tracing in blue reveals an -5° ANB angle when the patient is in maximum intercuspation (Co). The CR tracing in green documents that ANB has increased to -2° and the incisors have an end-on occlusion.

Bite turbos were bonded on the posterior teeth to create intermaxillary space. Early light short elastics were utilized to increase the axial inclination of the maxillary anterior teeth and retract the mandibular anterior teeth. In addition to making space for the implant site development, the open coil spring tipped the maxillary incisors anteriorly and retracted the maxillary posterior teeth. If a rectangular archwire and pre-torqued brackets fail to correct the axial inclination, a pre-torqued archwires such as a 0.016x0.025-in NiTi or a 0.019x0.025-in NiTi (*Ormco, Glendora, CA*) are recommended.[8,11]

The pre-treatment angle of L1-MP was 80°, and the side effect of Class III elastics was to decrease the axial inclination of the mandibular incisors. Upside down low torque brackets bonded on the lower anterior teeth were insufficient for controlling axial inclinations. Therefore, a 9 month sequence of progressive pre-torqued archwires was used: 0.016x0.025-in NiTi archwire, a 0.019x0.025-in NiTi, and a 0.016x0.025-in stainless wire. The latter archwire had 15° of lingual root torque to complete the desired root retraction of the mandibular incisors.

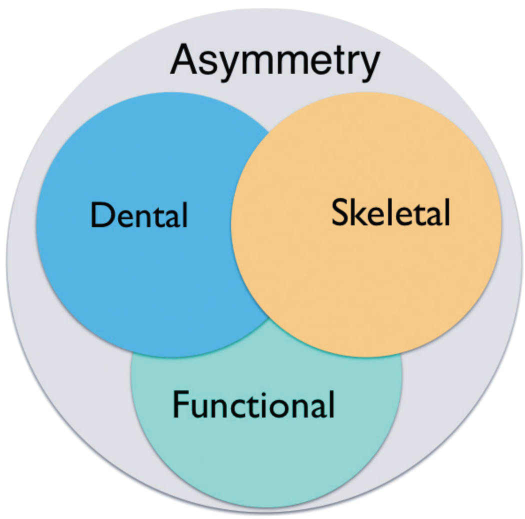
4. Evaluation

For the conservative correction of Class III skeletal malocclusions it is wise to limit maxillary incisor inclination to ≤120° to the sella-nasion (*SN*) line, and mandibular incisor inclination to ≥80° relative to the mandibular plane (*MP*). The post-treatment U1-SN angle was 117° and L1-MP was 87°, so the treatment results were within established guidelines.[12]

Dentofacial Asymmetries

1. Examination

Dentofacial asymmetries can be categorized as dental, skeletal or functional. A thorough clinical dental midline examination with a radiographic survey is necessary to determine the extent of the skeletal, dental, and functional involvement (*Fig. 23*).[13-15] A comprehensive evaluation includes assessment of the dental midlines in the following positions: mouth open, C_R (*centric relation*), initial contact, and C_O (*centric occlusion*). True dentoskeletal asymmetries, if uncomplicated by other factors, will exhibit similar midline discrepancies in C_R and C_O. On the other hand, asymmetries due to occlusal interference may result in a mandibular functional shift following initial tooth contact.



■ *Fig. 23:*
Dentofacial asymmetries may be dental, skeletal and/or functional.

In addition to the clinical evaluation, the differentiation between various types of asymmetry in the frontal plane is best assessed with radiographs. The most precise examination is the postero-anterior (*P-A*) projection and the second most useful examination is a panoramic view. When referring to the P-A projection, the zygomatico-frontal suture is an effective horizontal reference line and crista galli delineates the vertical reference line. Panoramic radiography is useful for detecting gross pathology, missing dentition, supernumerary teeth, and abnormal form of the mandibular ramus and condyle bilaterally.[10]

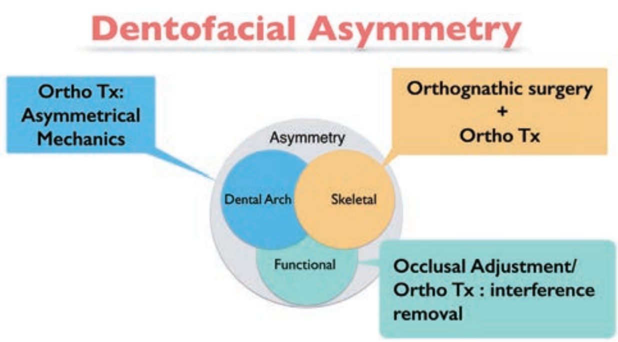
2. Diagnosis

Functional shifts are assessed according to the dental midline relationship from the open mouth to Co position (*Fig. 24*). The open mouth relationship with the jaws relaxed assesses the dentoskeletal asymmetry if any. At initial contact, inclined planes of interfering cusps move the mandible in a lateral and/or P-A direction. The full functional manifestation of the shift is in maximal intercuspation (*Co*). The panoramic radiograph revealed that the shape of the mandibular rami and condyles were symmetrical (*Fig. 6*), so skeletal asymmetry was ruled out. Six congenitally missing teeth were distributed asymmetrically in both arches (*Fig. 6*). A maxillary occlusal photograph shows the asymmetric position of multiple teeth bilaterally (*Fig. 5*). Therefore, it was concluded that the dentofacial asymmetry of this patient was predominately of dental origin.[10]

3. Treatment

To achieve an optimal result (*Fig. 25*), differential management for each type of dentofacial asymmetry is indicated. The present patient has a complex problem involving skeletal, dental and functional elements as follows: anterior crossbite, skeletal Class III (*prognathic mandible*), bilateral canine Class III relationships, and a left molar Class III

■ *Fig. 24*:
A shift in the dental midline from mild to severe is observed from left to right as the mouth is closed: mouth opening —> initial tooth contact —> Co.



■ *Fig. 25*:
Dentofacial asymmetry is due to one or a combination of factors: dental arch, skeletal or functional. The usual treatment for each factor in the inner circle is shown in the adjacent box of the same color.

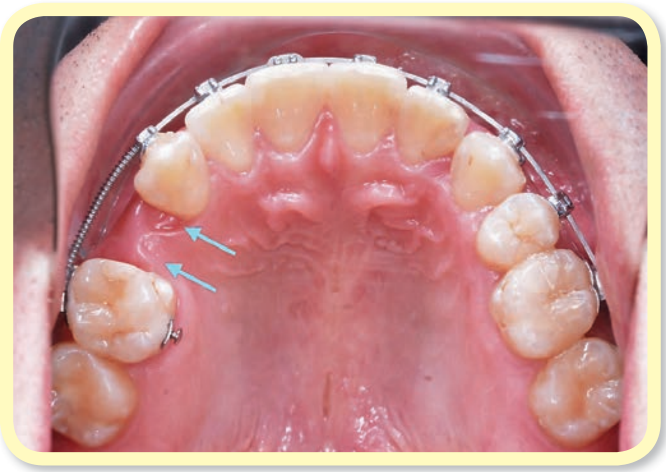
occlusion. In order to achieve a camouflage Class I occlusion, the maxillary arch was expanded and the mandibular arch was constricted. Asymmetrical space closure and opening mechanics often result in midline change.[16] In the maxillary arch, the space between the UR3 and UR6 was created to place an implant, whereas the extraction space of the ULb (*maxillary deciduous lateral incisor*) was closed. In the mandibular arch, the space between the LR4 and LR6 was eliminated. The differential closure of lower space benefited correction of the anterior crossbite by retracting the lower anterior teeth.

Implant Site Development

Implant site development usually requires bone formation in both the vertical and horizontal planes. In the vertical direction, orthodontic extrusion relocates the periodontal attachment in a coronal direction. In the horizontal plane, orthodontic movement forms bone as the alveolus is moved with the tooth. Bodily tooth movement is a viable option to bone grafting, particularly for atrophic edentulous sites associated with missing permanent teeth. Implant sites can be prepared in the anterior or posterior segments.[17-19]

Horizontal implant site development creates a significant amount of new bone that is stable in both the horizontal and vertical directions. Kokich[18] explored the dimensional ridge stability after canine retraction in subjects with congenitally missing maxillary lateral incisors. Twenty patients were followed for 5 years after opening upper lateral incisor spaces for implants and the loss of bone mass in the buccolingual dimension was less than 1%. Another report[19] evaluated bone loss in implant sites and found a mean width decrease of 4.2%, but the height decreased only slightly, about 0.07mm. For the present patient, the implant site was developed between two teeth (*UR3 and UR6*) which introduced the variables of tipping the incisors anteriorly and simultaneously retracting the molars. The 7.5mm space was opened slowly over 27 months (*Figs. 9 and 10*). The bone volume (*height 12.6mm x width 9mm*) was sufficient for a successful implant placement (*Figs. 12-15*).

Atherton's patch is a gingival depression that occurs as space is opened when the epithelial lining of a gingival sulcus is everted and repositioned on the crest of the alveolar ridge.[20,21] The red patch disappears spontaneously as the affected gingiva matures. During orthodontic site development,



■ *Fig. 26:*
Two blue arrows show Atherton's patches. The patch distal to the UR3 is wider than the one on the mesial of the UR6 because the canine was moved furthest.

the interproximal papilla remains adjacent to the tooth that is not moving. Moving both the upper right canine and the upper right first molar results in Atherton's patches adjacent to both teeth. The patient was not concerned about this temporary esthetic problem because he was warned about it in advance.

To provide adequate space for implant placement, orthodontically generated implant sites require that roots of adjacent teeth be parallel or slightly divergent. Root positioning is a more complex problem for incisors that are tipped anteriorly because of the "*wagon-wheel effect.*"[22] The position of the roots should be evaluated radiographically before the fixed appliances are removed. For the present patient, a compressed open coil spring was used to create the space for the implant. A resin ball was added to the archwire between the brackets to reactivate the open coil spring.[23]

■ *Fig. 27: One-year follow-up facial and intraoral photos document a stable outcome.*

Conclusion

An acquired Class III malocclusion with six congenitally missing permanent teeth (*oligodontia*) was corrected with differential space management, Class III intermaxillary elastics, and bite turbos bonded on the posterior teeth. Asymmetric mechanics corrected the functional shift and midline discrepancy. The implant site was created with relatively slow space opening and the ISP was stable at one year follow-up.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 66

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 = 38

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 = 1

OCCLUSION

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

Total = 2

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB ≥ 6° or ≤ -2° = 4 pts.

Each degree < -2° 3 x 1 pt. = 3

Each degree > 6° ____ x 1 pt. = ____

SN-MP

≥ 38° = 2 pts.

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

≤ 26° = 1 pt.

Each degree < 26° ____ x 1 pt. = ____

1 to MP ≥ 99° = 1 pt.

Each degree > 99° ____ x 1 pt. = ____

Total = 8

OTHER (See Instructions)

Supernumerary teeth		x 1 pt. =	
Ankylosis of perm. teeth		x 2 pts. =	
Anomalous morphology		x 2 pts. =	
Impaction (except 3rd molars)		x 2 pts. =	
Midline discrepancy (≥3mm)		@ 2 pts. =	2
Missing teeth (except 3rd molars)		x 1 pts. =	
Missing teeth, congenital	6	x 2 pts. =	12
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 = 14

Cast-Radiograph Evaluation

Case # **Patient**

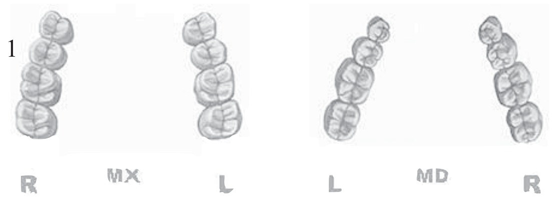
Total Score: 15

Alignment/Rotations

3

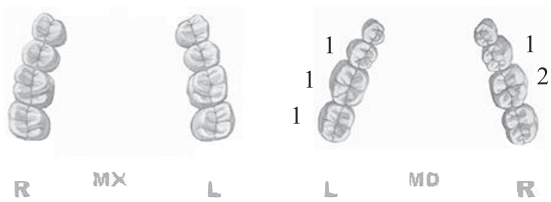
Marginal Ridges

1



Buccolingual Inclination

6

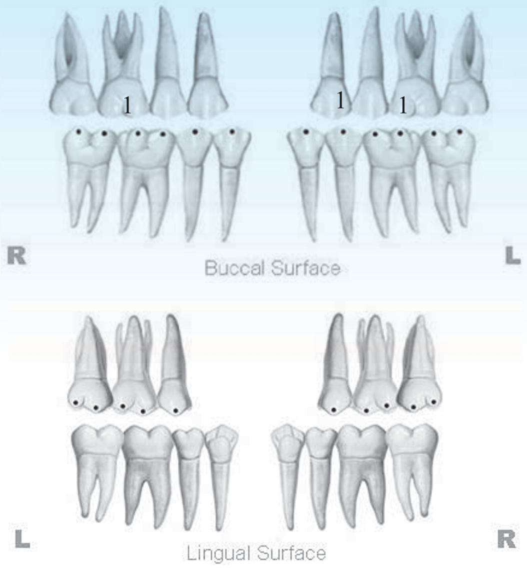


Overjet

0

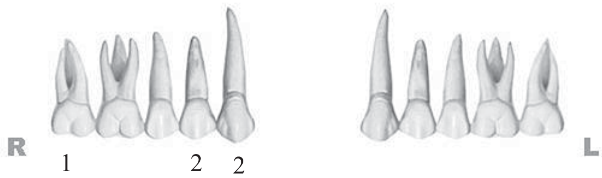
Occlusal Contacts

0



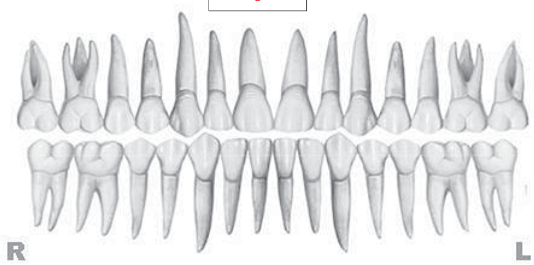
Occlusal Relationships

5



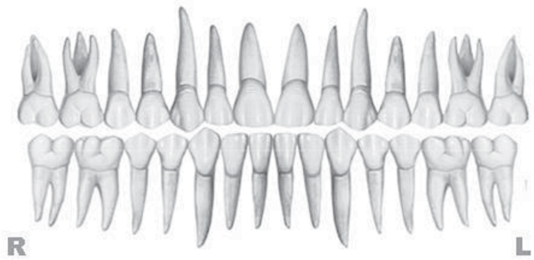
Interproximal Contacts

0



Root Angulation

0



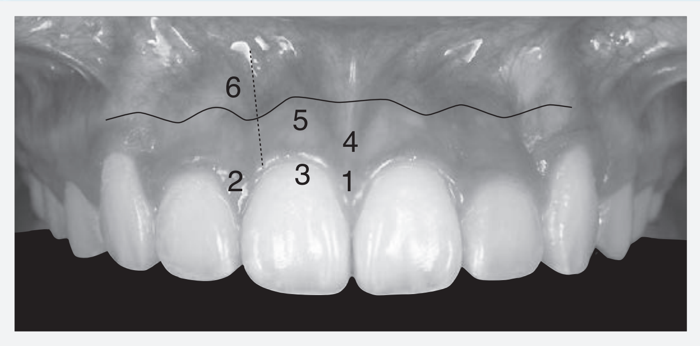
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 4

1. Pink Esthetic Score

Total = 0

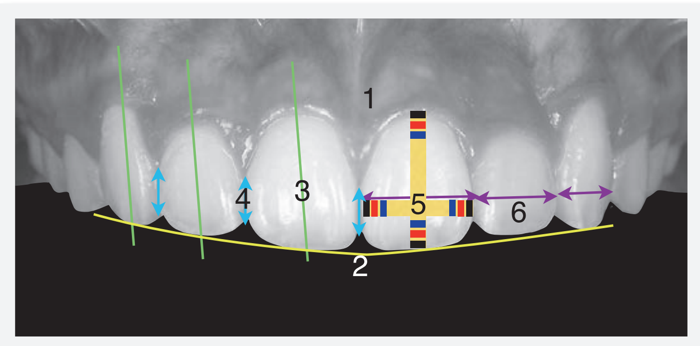


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

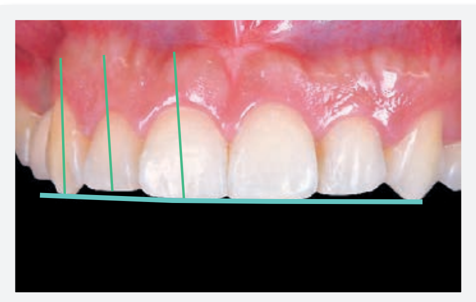
1. M & D Papilla	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

2. White Esthetic Score (for Micro-esthetics)

Total = 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 (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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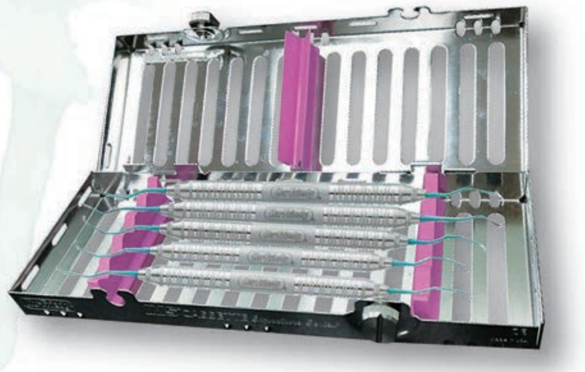

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2018~2019 第十年度

貝多芬 矯正精修班

時間：每月中週二上午 9:00-12:00
地點：金牛頓教育中心（新竹市建中一路25號2樓）

上課日期：

8/14、9/4、10/16、11/13、

2019
1/8、2/26、3/19、4/16、5/14、6/25、7/23

- 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

全新的第十年度 2018-19 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。

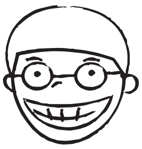
2018-19 貝多芬精修班內容豐富精彩，讓您經由每個月一次的課程，在面對各式的臨床案例時，更能游刃有餘、得心應手。

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＃219，詹雅婷

2019 Keynote Workshop



講師 ⨯ 金牛頓工程師

技巧班 7/25 (四)

強化你的 Keynote 簡報力

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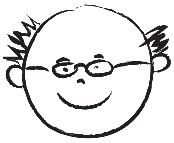
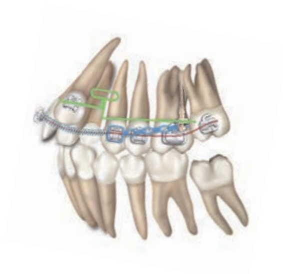


講師 ⨯ 張慧男醫師

大師班 8/15 (四)

賈伯斯的簡報秘訣與設計要素

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



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Skeletal Class II Malocclusion with Convex Profile, Horizontal Impaction and Gummy Smile: Substituting Third for Second Molars

Abstract

History: *A 25-year-old female sought orthodontic consultation to evaluate the poor esthetics of her maxillary anterior dentition.*

Diagnosis: *The patient presented with a convex facial profile (24˚), increased lower facial height (58%), protrusive lips (4mm/5mm to the E-line), maxillary incisors extruded to the occlusal plane, deep bite (4mm), Class II occlusion (full cusp on the right, end-on on the left), and a maxillary dental midline shifted 3mm to the left. Upper incisor display was irregular, the smile arc was not visible, and there were unesthetic exostoses underlying the maxillary anterior gingiva. Cephalometrics revealed a protrusive maxilla (SNA 89˚), intermaxillary discrepancy (ANB 8˚), and a high mandibular plane angle (38˚). All 32 teeth were present, but the lower right third molar (LR8) was horizontally impacted, and two lower molars (LR7, LL6) had a history of endodontic treatment with extensive restorations. The American Board of Orthodontics (ABO) Discrepancy Index was 34.*

Treatment: *Both maxillary second molars (UR7, UL7) and the compromised molars (LR7, LL6) were extracted, the LR8 was uprighted, and space was closed with power chains in all four quadrants. Class II elastics and bite turbos on the maxillary central incisors were applied to correct the intermaxillary relationship. Miniscrews were placed in each infrazygomatic crest (IZC) and between the upper central and lateral incisors. A surgical crown lengthening procedure was performed to enhance maxillary anterior esthetics.*

Outcome: *With 38 months of active treatment, this difficult malocclusion (DI 34 points), was treated to a good result as evidenced by an ABO Cast-Radiograph Evaluation (CRE) score of 28 points and a Pink and White esthetic score of 5 points. Two-year follow-up evaluation documented the stability of the correction. (J Digital Orthod 2018;52:50-66)*

Key words:
Uprighting an impacted third molar, Class II malocclusion, self-ligating brackets, bite turbos, temporary anchorage devices, infrazygomatic crest (IZC), surgical crown lengthening

Dental nomenclature for this case report is a modified Palmer notation. The quadrants are upper right (*UR*), upper left (*UL*), lower right (*LR*) and lower left (*LL*). Relative to the midline, permanent teeth in each quadrant are numbered from 1 to 8. Third molars (*8s*) are the most frequently impacted teeth because they are the last to erupt, so there is often inadequate space particularly in the lower arch.[1] For most patients third molars erupt by about age 20, but even normal emergence may be delayed until the age of 25, particularly for L8s. The latter are often problematic because their developmental angulation proceeds from horizontal, to mesioangular, to a vertical (*upright*). The most common configuration associated with eruption failure occurs during the rotation from mesioangular to vertical. To avoid mesioangular or horizontal impaction, sufficient space is required mesial to the anterior border of the ramus to allow the L8 to rotate distally and erupt normally.[1]

Dr. Joy Cheng,
Lecturer, Beethoven Orthodontic Course (Left)

Dr. Angle Lee,
Director, Beethoven Orthodontic Center (Center left)

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

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

Extraction of third molars is often a dilemma, particular if there are missing or compromised teeth in the arch. Impacted third molars may be affected by a pericoronitis infection, pain, pathology such as dentigerous cysts, development of periodontal lesions on the distal surface of second molars, root resorption, caries in inaccessible areas, and TMJ-related symptoms.[2] Extracting third molars may result in complications such as post-operative pain, swelling, airway compromise, nerve damage, mandibular fracture, and life threatening infections.[2-5]

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

Premolars are often extracted to correct Class II malocclusion. If third molars are present, extraction of second molars and substitution with third molars may be a viable option. Second molar extractions provide substantial space to resolve crowding and protrusion, but anchorage supplementation with TADs may be necessary. When molar substitution is well managed, third molars spontaneously erupt and provide excellent replacements for missing first or second molars.[6-8]

For the present case, four third molars, one of which was horizontally impacted, were successfully substituted for the adjacent second molars. Because of the patient's severe malocclusion, four maxillary miniscrews were required for anchorage to correct bimaxillary protrusion and crowding. The TADs also helped control the tendency for a gummy smile due to Class II elastics.

Etiology and Diagnosis

A 25-year-old female was dissatisfied with the alignment of her anterior dentition. Facial photographs showed symmetry in the frontal plane, a convex profile, bimaxillary protrusion, and an upper dental midline shift 3mm to the left (*Fig. 1*). There were no signs nor symptoms of temporomandibular joint (*TMJ*) dysfunction. The full smile was unesthetic due to an uneven incisor display, bulbous gingival contours, and a smile arc that was obstructed by the lower lip. Intraoral examination showed a Class II molar occlusion, full cusp on the right side, and end-on on the left. The LL8 had erupted into lingual crossbite. Slight crowding was found in the lower arch, but there was about a 6mm discrepancy in the upper arch. Overbite and overjet were 4mm (*Figs. 1 and 2*).

Panoramic radiography (*Fig. 3*) revealed horizontal impaction of the LR8. The LR7 and LL6 were compromised with endodontic treatment and extensive restorations. A lateral cephalometric radiograph (*Fig. 4*) and quantitative analysis (*Table 1*) showed a protrusive maxillary (*SNA 89°*) and severe intermaxillary discrepancy (*ANB 8°*). There was a high mandibular plane angle (38°), convex facial profile

■ *Fig. 2: Pre-treatment study models (casts)*

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

Fig. 4: *Pre-treatment cephalometric radiograph*

(24°), and protrusive lips (*UL to E-line: 4mm, LL to E-line: 5mm*). The American Board of Orthodontics (*ABO*) Discrepancy Index (*DI*) was 34, as shown in the first worksheet at the end of this report.

Treatment Objectives

1. Reduce lip protrusion.
2. Align both arches in a Class I occlusion.
3. Improve smile esthetics.
4. Correct the dental midline deviation.

Treatment Alternatives

The convex profile, high mandibular plane angle, and dental crowding resulted in a complex orthodontic problem that was best managed with extractions. The first option, extraction of all 4 first premolars and all 4 third molars, presented two concerns: 1. axial inclination of maxillary incisors (*U1 to SN*) was normal, so closure of first premolar extraction sites could result in loss of torque (*distal tipping*) of the maxillary anterior segment, 2. extracting the horizontally impacted third molar risks complications such as alveolitis (*dry socket*), other post-operative infections, hemorrhage and/or nerve damage. The second alternative was the extraction of only four molars: both U7s, the LR7 and LL6. With this option all four, healthy third molars are retained and moved mesially to substitute for molars

CEPHALOMETRIC SUMMARY			
SKELETAL ANALYSIS			
	PRE-Tx	POST-Tx	DIFF.
SNA° (82°)	89°	88°	1°
SNB° (80°)	81°	81°	0°
ANB° (2°)	8°	7°	1°
SN-MP° (32°)	38°	38°	0°
FMA° (25°)	31°	31°	0°
DENTAL ANALYSIS			
U1 To NA mm (4 mm)	2 mm	1 mm	1 mm
U1 To SN° (104°)	104°	101°	3°
L1 To NB mm (4 mm)	9 mm	8 mm	1 mm
L1 To MP° (90°)	96°	93°	3°
FACIAL ANALYSIS			
E-LINE UL (-1 mm)	4 mm	3 mm	1 mm
E-LINE LL (0 mm)	5 mm	3 mm	2 mm
Convexity: G-Sn-Pg' (13°)	24°	24°	0°
%FH: Na-ANS-Gn (53%)	58%	57%	1%

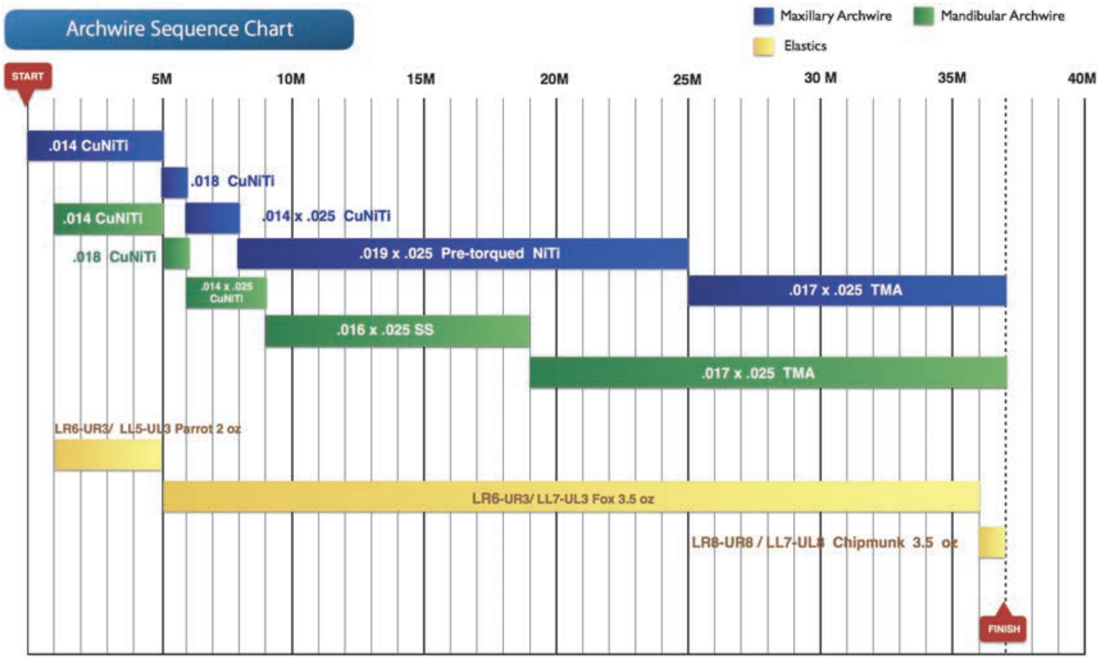
Table 1: Cephalometric summary

that were missing or extracted. Although this option required TAD anchorage, it did preserve four healthy teeth, helped control axial inclination of the incisors, and also facilitated correction of the midline. After a thorough discussion, the patient was opposed to extracting 8 teeth (*option 1*), and preferred option 2 because only 4 teeth would be lost. She did accept the necessity for TAD anchorage.

Treatment Progress

The four molars (*UR7, UL7, LR7, LL6*) were extracted prior to beginning active treatment. A Damon Q™ 0.022-in slot self-ligating appliance (*Ormco®, Glendora, CA*) was bonded on all teeth in both arches. The Zoo-Series Elastics™ and all arch wires utilized for treatment of the current patient were produced by the same manufacturer. The arch sequence (*Table 2*) for the upper arch was: 0.014-in CuNiTi, 0.018-in CuNiTi, 0.014x0.025-in CuNiTi, 0.019x0.025-in pre-torqued NiTi, 0.017x0.025-in TMA. For the lower arch, the archwire progression was 0.014-in CuNiTi, 0.018-in CuNiTi, 0.014x0.025-in CuNiTi, 0.016x0.025-in SS, 0.017x0.025-in TMA.

At the beginning of the treatment, brackets were bonded from 6-6 in the upper arch and high-torque brackets were utilized on the incisors and canines. One month later, fixed appliances were bonded from 6-7 in the lower arch and low-torque brackets were utilized on the incisors and canines. Anterior bite turbos (*BTs*) were added to the palatal surfaces of both maxillary central incisors. Class II elastics (*Parrot 5/16-in, 2-oz*) were applied from U3s to L6s



■ Table 2: Archwire sequence chart

bilaterally (*Fig. 5*). In the 5th month of treatment, the crown of the LR8 had emerged into the oral cavity. Brackets were bonded on all four third molars, and Class II elastics loads were increased to Fox 1/4-in, 3.5-oz.

Space was closed for all extraction sites with power chains (*Clear Generation II™, Ormco®, Glendora, CA*). In the 14th month, lingual buttons were bonded on the LR5, LR8, LL4 and LL7, and bilateral power chains were used on the buccal and lingual to close space. In the 29th month, lingual buttons were bonded on UR4, UR8, UL4, and UL8, and power chains were used on the buccal and lingual surfaces for space closure (*Figs. 6 and 7*).

■ *Fig. 5: In the first month of treatment, Class II elastics were used from UR3 to UR6, and UL3 to LL5.*

■ *Fig. 6:*
Maxillary arch correction is shown in a progressive series of occlusal photographs from the start of active treatment at zero month (0M) to the end of active treatment at thirty-eight months (38M).

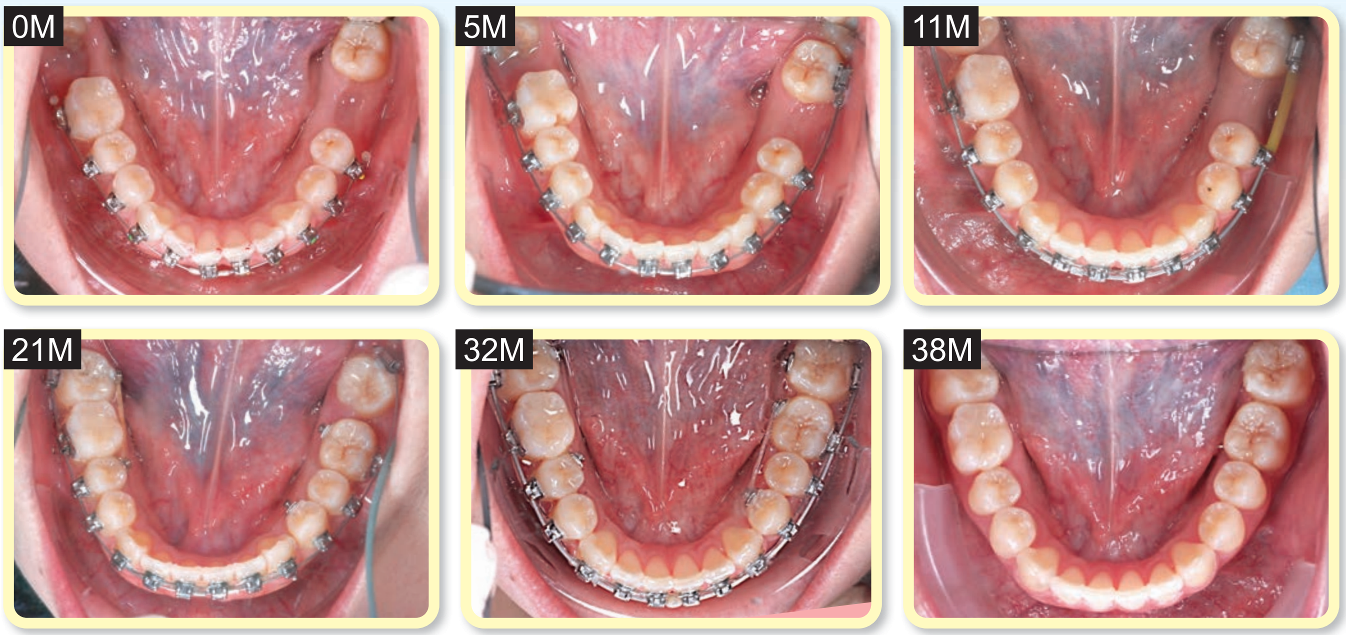


Fig. 7:
Mandibular arch correction is shown in a progressive series of occlusal photographs from the start of active treatment at zero month (0M) to the end of active treatment at thirty-eight months (38M).

The first treatment priority was to close as much extraction space as possible and then reposition the bracket about >90° of rotation on the LL8 in the 23rd month (*Fig. 8*). Due to limited crown exposure and uncertainty about the final position of the third molars, repeated bracket repositioning was required during treatment.

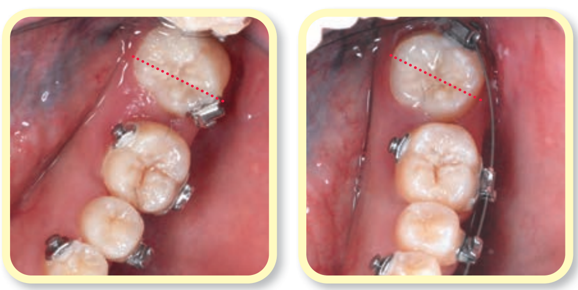


Fig. 8:
Left photograph shows the bracket on the LL8 before repositioning, relative to the desired midsagittal plane (red line). The right image shows the bracket after it is repositioned.

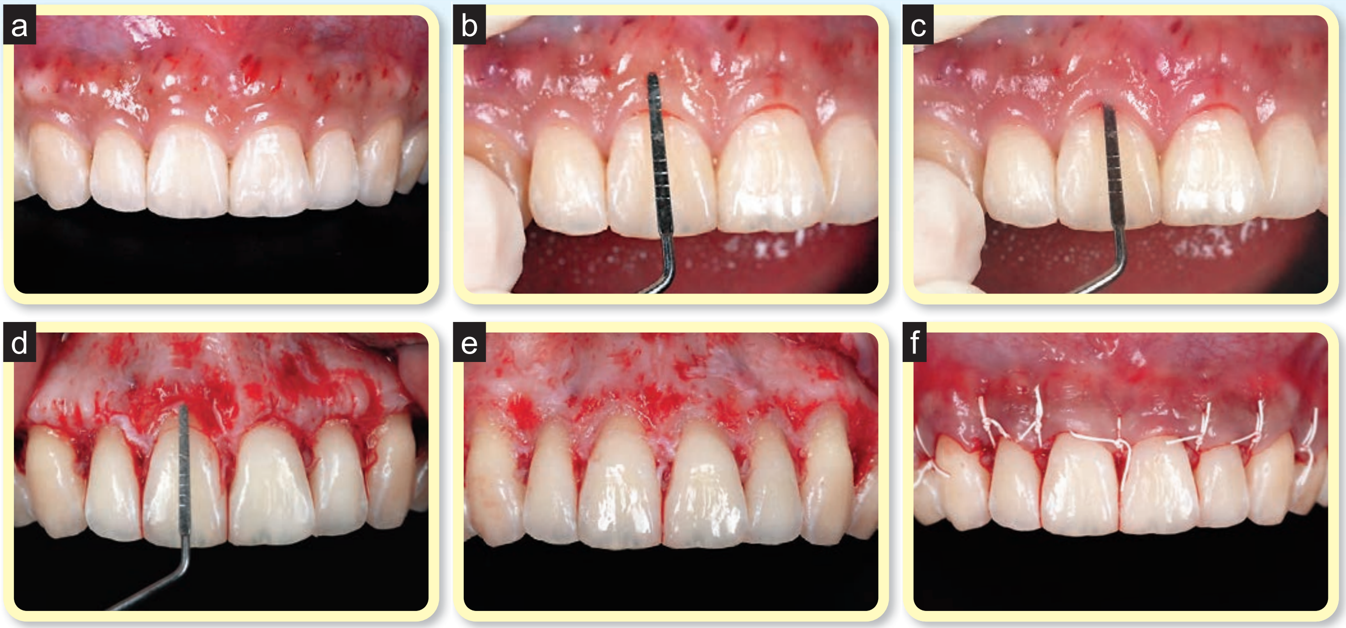
Preliminary alignment of both arches was achieved by 31 months, so the next priority was to address the convex profile and excessive gingival display. A 2x12mm miniscrew (*OBS®, iNewton Dental Ltd, Hsinchu, Taiwan*) was placed in each IZC to anchor intrusion and retraction of the entire maxillary arch. At the same appointment, two 1.5x8mm miniscrews made by the same manufacturer, were inserted bilaterally between the roots of the upper central and lateral incisors. Intrusive loads of 2-oz were applied bilaterally to correct the gummy smile, optimize maxillary symmetry, and offset the extrusive component of the Class II elastics (*Figs. 9 and 10*).

After 38 months of active treatment, all fixed appliances and bone screws were removed. The

■ *Fig. 9*:
Thirty-one months into treatment facial convexity is still a problem as documented in a lateral cephalometric radiograph (left) and facial profile photograph. Excessive gingival display with the lips parted is shown in a frontal view (right).

■ *Fig. 10*:
Two miniscrews are placed between the central and lateral incisors. They anchor forces to the archwire of 60~80gm (cN) per side. Two IZC miniscrews were inserted and loaded with 28gm (cN) per side.

periodontium in the maxillary anterior area was carefully evaluated and classified according to the level of the mucogingival junction (*MGJ*) and alveolar bone crest. It was classified as type IB: gingival width was within normal limits, but bone height was excessive.[10] Under a local anesthetic, a full-thickness mucoperiosteal flap was reflected, and crestal bone was removed with a #5 round carbide bur to establish a uniform 2mm zone between the alveolar crest and CEJ (*Fig. 11*). Following the osteoplasty procedure, the tissue was repositioned slightly coronal to the CEJ and sutured with #4 Gore-Tex® sutures (*Gore Medical Products, Flagstaff, AZ*).[11]



■ *Fig. 11:*

The crown-lengthening surgical procedure is documented as follows: (a) pre-treatment the short clinical crowns with excessive gingival display and bulky bone structure surrounding the root area, (b) the width of keratinized gingival was evaluated, (c) bone sounding under local anesthetic located the alveolar crest of bone, (d) bone was removed at the alveolar crest with a #5 round carbide bur, (e) a uniform 2mm biological zone was established for soft tissue attachment between the CEJ to the alveolar crest, (f) the flap was repositioned and sutured.

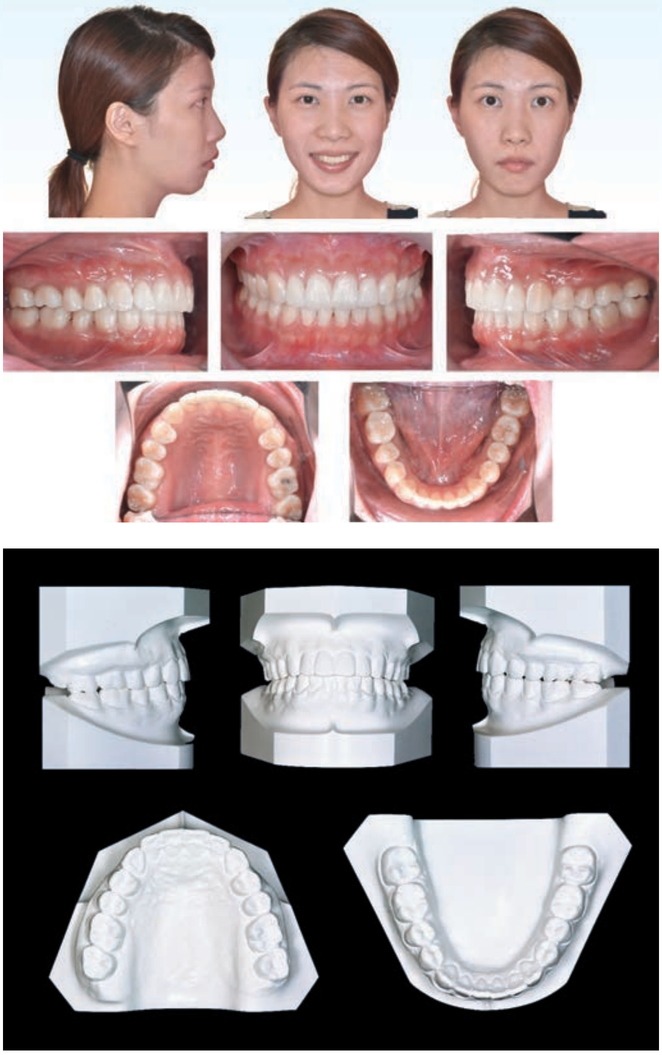
The stitches were removed one week post-operatively. A lingual fixed retainer was bonded from UR2 to UL2, and clear overlay retainers were constructed. The patient was instructed to wear the removable retainers full time for the first 6 months and nights only thereafter. Home care and retainer maintenance instructions were provided.

Treatment Results

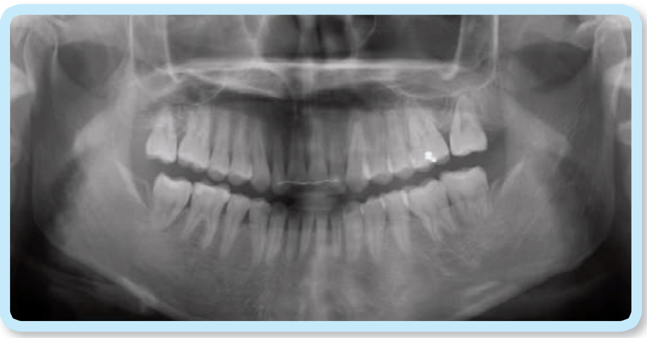
Retraction of the upper and lower lips significantly improved the patient's facial profile (*Figs. 13 and 15*). Surgical crown lengthening resulted in improved crown ratios and an esthetically pleasing maxillary anterior segment (*Fig. 12*). Panoramic radiograph documented acceptable root alignment (*Fig. 14*). Cephalometric superimpositions revealed the

■ *Fig. 12:*

Upper image is a frontal view of the maxillary anterior segment documenting esthetics prior to crown lengthening procedure. Lower image shows the one month post-operative results.



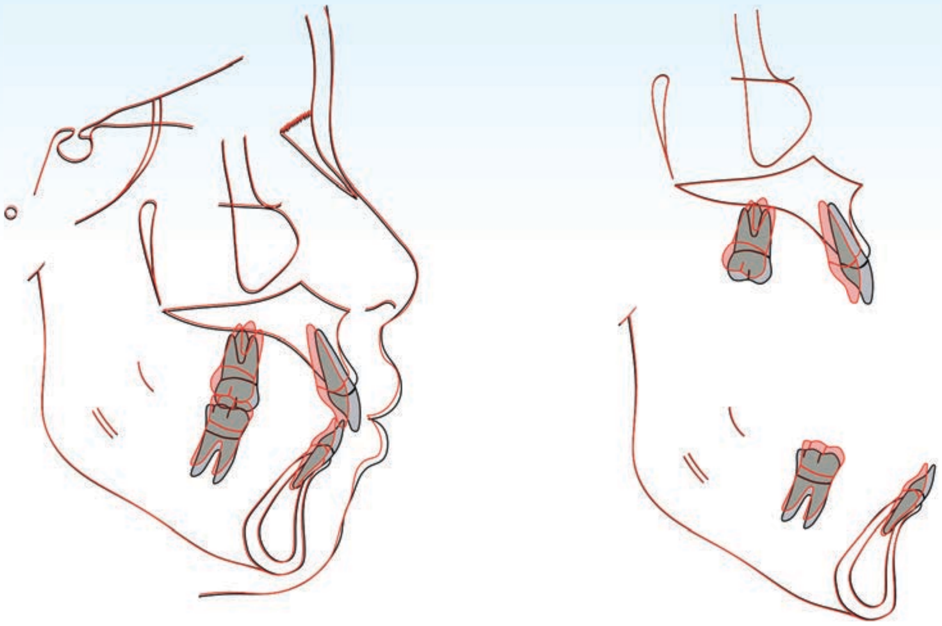
■ *Fig. 13*:
Post-treatment outcomes are shown in facial images, intraoral photographs, and study models (casts).



■ *Fig. 14*: *Post-treatment panoramic radiograph*

maxillary incisors were retracted about 3mm, without a compromise in the axial inclinations. Mandibular incisors were bodily retracted about 2mm (*Fig. 16*). The overbite and overjet were ideal. A Class I molar relationship was achieved on the right, but the buccal interdigitation was about 2mm Class II on the left. Both arches were well aligned with healthy third molars were substituted for second molars. The ABO Cast-Radiograph Evaluation (*CRE*) score was 28 points, as shown in the second work sheet at the end of this report. The major discrepancies were occlusal relationships (*8 points*), alignment (*4 points*), and occlusal contacts (*4 points*). The Pink & White dental esthetic index was scored at 5 points, as shown in the third worksheet. The patient was satisfied with the treatment results, and the outcome was stable 2 years later (*Fig. 17*).

■ *Fig. 15*: *Post-treatment lateral cephalometric radiograph*



■ *Fig. 16*:
Superimposed cephalometric tracings before (black) and after treatment (red) document the dentofacial changes resulting from 38 months of active therapy.

■ *Fig. 17*: *Two-year follow-up facial and intraoral photographs*

Discussion

Impacted third molars present risks when extracted,[1-5] so retaining them is often a good option. Patients with missing or compromised first and second molars may be good candidates for third molar substitution.[6-8] Furthermore second and third molars can be moved anteriorly to replace a missing first molar.[9] Premolars are the teeth of choice for most extraction treatment plans, but molar extraction can be a viable option. Second molar extraction often results in spontaneous eruption of the adjacent third molar, and the posterior space may be useful for correcting anterior crowding and protrusion. However, substantial anchorage demands may require TADs.

Removing compromised first or second molars, instead of healthy premolars and third molars, is highly recommended in the following circumstances: 1. first or second molars are severely damaged, ectopically erupted or rotated, 2. posterior crowding and/or blocked-out teeth, and 3. third molars have a favorable position, size and shape.[7] The present patient meets the first and third of these criteria (*Figs. 1-3*).

Panoramic radiography suggests that the mesiodistal size of the third molars is suitable for substitution of the second molars (*Figs. 3 and 14*), but even small discrepancies can affect interdigitation. On average, the maxillary third molars are 0.7mm smaller than the adjacent second molars, and the mandibular third molars are 0.55mm larger than the respective lower second molars.[12] This small tooth size discrepancy may compromise occlusal relationships (*interdigitation*), as shown in Fig. 13. These minor intermaxillary discrepancies have little functional significance because occlusion and periodontal health are usually satisfactory after substituting third molars for second molars.[13]

De-la-Rosa-Gay reported a total of 96.2% maxillary and 66.2% mandibular third molars erupted in good positions after extraction of the adjacent second molars. A successful third molar position was defined as having proximal contact with the adjacent first molar and an angle between the molars of no more than 35˚. Spontaneous eruption is an important advantage for molar substitution that is related to the stage of tooth development. Nolla,[14] proposed a 1960 method for assessing tooth development that was recently revalidated with a large modern sample.[15] Spontaneous eruption of third molars is likely for a Nolla developmental stage 1-8 (*Fig. 18*), but is increasingly unlikely for mandibular third molars in older patients, particularly with a more mature Nolla developmental stage.[6]

A logistic regression model predicts the probability of favorable third molar eruption by using the variables of initial angle between the first and third molars, jaw, sex, age, and the developmental stage of the third molar.[16] Successful eruption is more likely

Development of the tooth

1. Presence of follicle
2. Initial calcification
3. Third of crown formed
4. Two thirds of crown formed
5. Crown almost fully formed
6. Crown fully formed
7. Third of root formed
8. Two thirds of root formed
9. Root almost formed
10. Closed apex

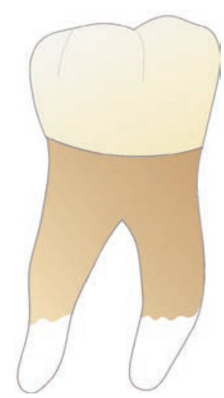


Fig. 18:
Nolla stages of tooth development are useful for determining the developmental stage for third molars. For the molar illustrated (right), the stage of development is 8. Two thirds of root formed as highlighted with the red rectangle (left).

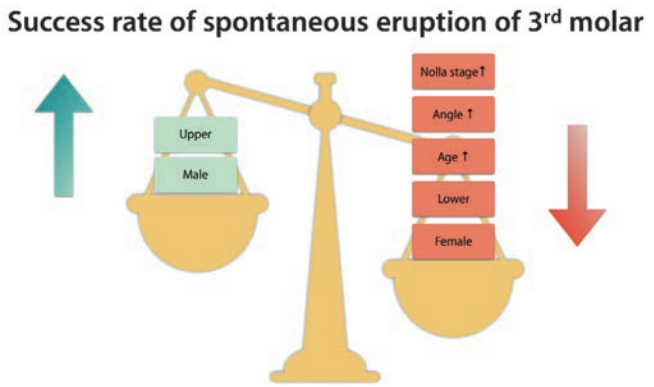
for males, the upper arch, cases with a small initial angle between the first and the third molars, earlier developmental stages, and younger patients (*Fig. 19*).

There are three advantages for extracting second molars and substituting third molars. First, third molar eruption is facilitated by second molar extraction, thereby avoiding the need for surgical exposure. Second, there is less distal tipping of the anterior teeth during space closure compared to premolar extraction. Third, the extraction site(*s*) are less invisible.[7]

The principal disadvantages for substituting third molars are the unpredictable eruption and final position of the teeth. An additional phase of fixed mechanics may be necessary for alignment, which considerably extends the total treatment time.[7] The average time for spontaneous eruption of third molars is four years,[6] but orthodontic treatment is indicated as soon as sufficient clinical crown is exposed for bonding of a bracket (*Fig. 8*). If the third molar fails to erupt, surgical uncovering is usually necessary to expose the crown.[17,18]

Another significant problem when substituting lower third for second molars is that the large space created by the second molar extraction is distant from the crowded and/or protrusive incisors. TADs may be necessary, but retraction of the anterior segment and the tendency for natural mesial migration assists in closing large posterior extraction spaces.[7,8] Using buccal and lingual force facilitates the extraction space closure and prevents third molars from rotating distal out (*Fig. 20*).[18]

Although the results for the current patient are satisfactory, the final lip protrusion (*UL to E-line: 3mm, LL to E-line: 3mm*) is less than ideal (*UL to E-line: -1mm, LL to E-line: 0mm*). In retrospect, placing the IZC miniscrews earlier in treatment enhances the anchorage for incisor retraction, but it's difficult to determine if TADs are actually necessary before the arches are aligned (*Fig. 9*).



■ *Fig. 19*:
Probability for successful spontaneous eruption of a third molar after second molar extraction can be estimated by listing the positive factors (Upper arch, Male) shown in green, and the negative factors (high Nolla stage, excessive molar angle, increased age, Lower arch, Female) shown in red. Each patient must be individually assessed relative to initial molar angle, jaw, sex, age, and third molar developmental stage.

■ *Fig. 20*:
Bilateral closure of upper second molar spaces is facilitated by using equal (balanced) forces, applied with power chains on the buccal and lingual surfaces. Balanced forces help control undesirable rotations and archwire binding during space closure.

Conclusions

1. Substituting a horizontally impacted LR8 for a compromised LR7 was a superior outcome compared to extracting a sound premolar.

2. Aligning the horizontally impacted LR8 avoided a number of potential surgical risks.

3. Effective management of third molar substitution resulted in substantial retraction of the incisors and reduction of lip protrusion.

4. Balanced buccal and lingual loads are effective mechanics for closing large posterior spaces.

5. IZC and incisal miniscrews supplement maxillary anchorage for retracting incisors, decreasing lip protrusion, and controlling the extrusive component of Class II elastics.

6. Crown lengthening improved maxillary anterior esthetics by correcting the height to width ratio of the incisors and smoothing bulky exostoses under the labial gingiva.

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 34

OVERJET

0 mm. (edge-to-edge)	=	1 pt.
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 = 2

OVERBITE

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

Total = 2

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 = 4

OCCLUSION

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

Total = 6

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° 2 x 1 pt. = 2

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 = 8

OTHER (See Instructions)

Supernumerary teeth	________	x 1 pt. =	________
Ankylosis of perm. teeth	________	x 2 pts. =	________
Anomalous morphology	________	x 2 pts. =	________
Impaction (except 3rd molars)	Aligned	x 2 pts. =	2
Midline discrepancy (≥3mm)		@ 2 pts. =	2
Missing teeth (except 3rd molars)	________	x 1 pts. =	________
Missing teeth, congenital	________	x 2 pts. =	________
Spacing (4 or more, per arch)	________	x 2 pts. =	________
Spacing (Mx cent. diastema ≥ 2mm)		@ 2 pts. =	-
Tooth transposition	________	x 2 pts. =	________
Skeletal asymmetry (nonsurgical tx)		@ 3 pts. =	________
Addl. treatment complexities	4	x 2 pts. =	8

Identify: Close 4 extracted spaces without severe crowding + Deep curve of Spee

Total = 12

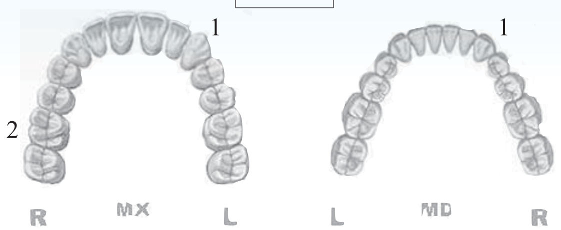
Cast-Radiograph Evaluation

Case # **Patient**

Total Score: 28

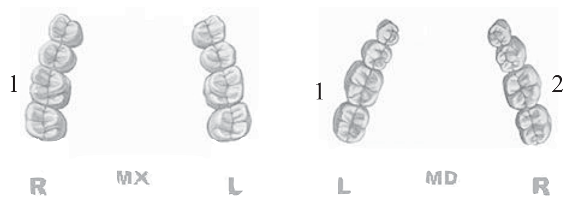
Alignment/Rotations

4



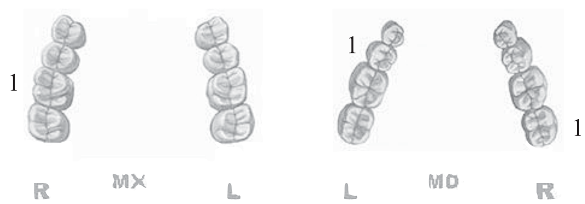
Marginal Ridges

4



Buccolingual Inclination

3

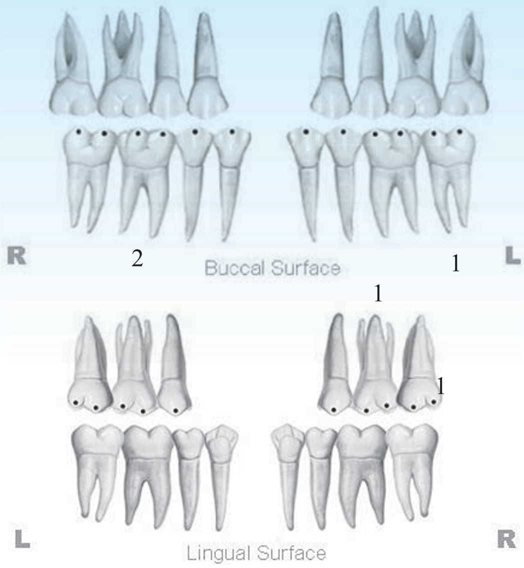


Overjet

3

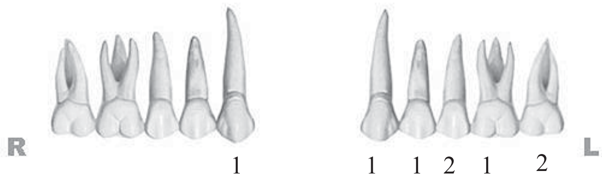
Occlusal Contacts

4



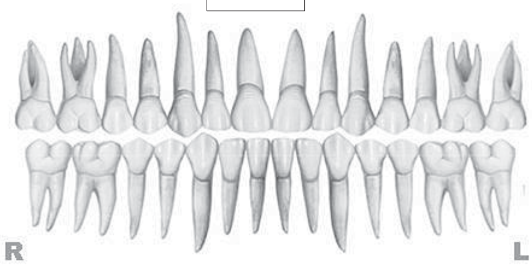
Occlusal Relationships

8



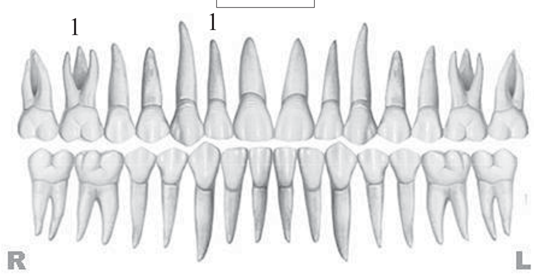
Interproximal Contacts

0



Root Angulation

2



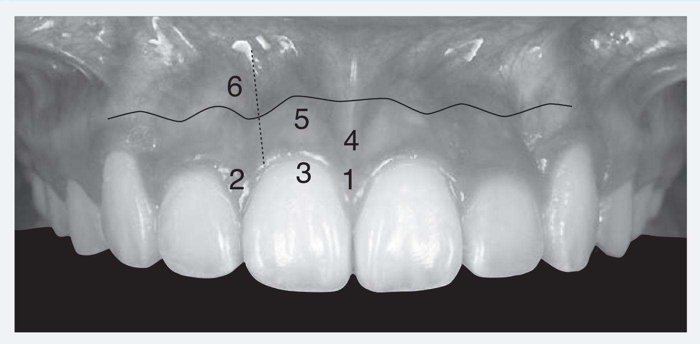
INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 5

1. Pink Esthetic Score

Total = 3

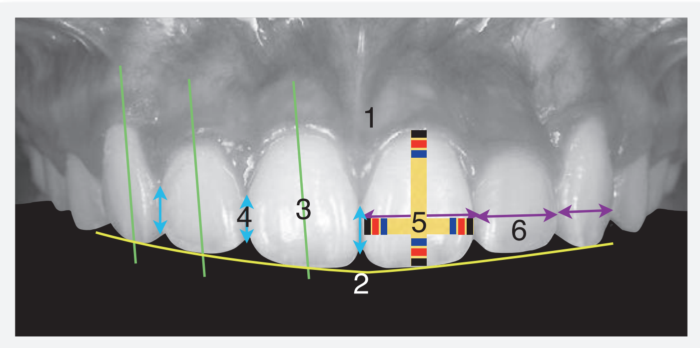


1. M & D Papillae	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

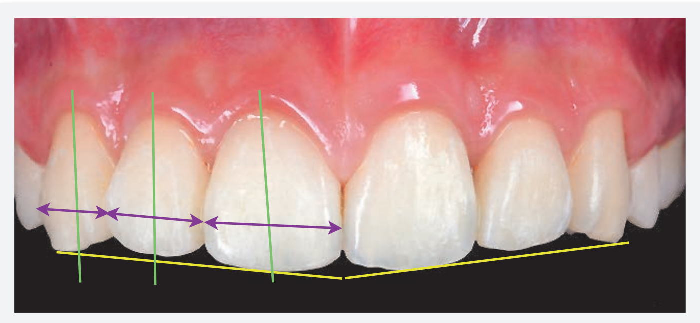
1. M & D Papilla	0	1	2
2. Keratinized Gingiva	0	1	2
3. Curvature of Gingival Margin	0	1	2
4. Level of Gingival Margin	0	1	2
5. Root Convexity (Torque)	0	1	2
6. Scar Formation	0	1	2

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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4. Contact Area (50%, 40%, 30%)	0	1	2
5. Tooth Proportion (1:0.8)	0	1	2
6. Tooth to Tooth Proportion	0	1	2

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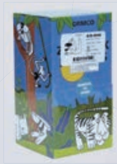

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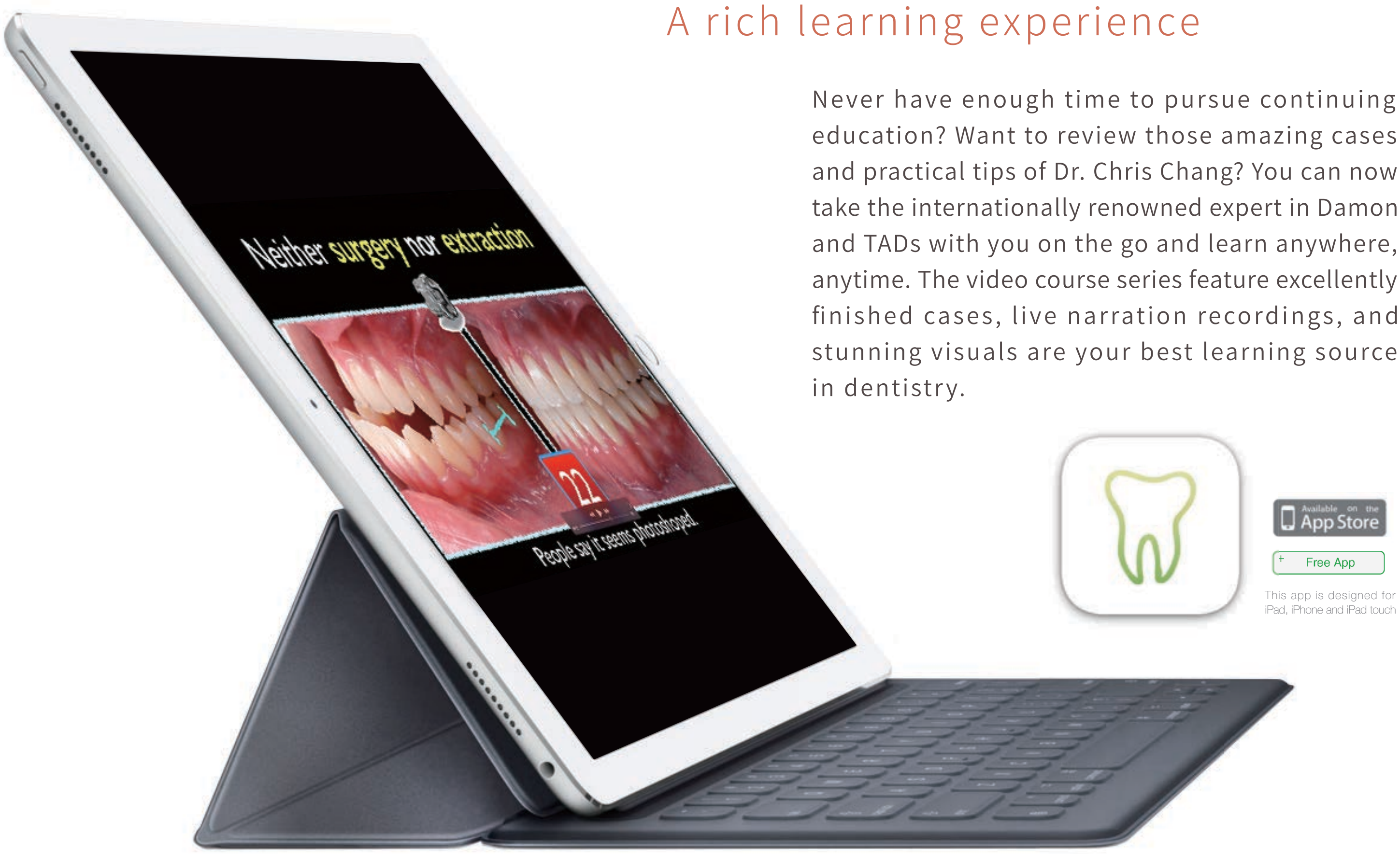

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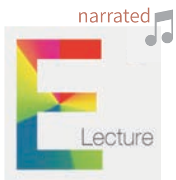

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Failure Rates for SS and Ti-Alloy Incisal Anchorage Screws: Single-Center, Double Blind, Randomized Clinical Trial

Abstract

Objective: *Compare the 6 month failure rates for stainless steel (SS) and titanium alloy (Ti) miniscrews placed between the roots of maxillary central and lateral incisors. The null hypothesis was that there is no statistical difference in the failure rates for screws made of SS or Ti.*

Materials and Methods: *Over a three year period (2014-17), 320 consecutive 1.5x8mm miniscrews (OBS®, iNewton Dental Ltd, Hsinchu City, Taiwan) were placed bilaterally between central and lateral incisor roots in 160 consecutive patients (26 males,134 females, mean age 25.9 yr, range 10-58 yr). All of the screws served as temporary anchorage devices (TADs) to intrude the maxillary anterior dentition. Half the TADs were made of 316LVM surgical stainless steel (SS) and the other half (160) were composed of Ti6Al4V titanium alloy (Ti). All the miniscrews were placed by the same orthodontist with a double blind, split mouth design. Torque was measured when each screw was seated to provide an index of primary stability. All TADs were immediately loaded with 2-oz (57g, 55 cN), and used for at least 6 months as anchorage to intrude the maxillary anterior segment. Anchorage loss due to a loose screw was defined as a failure.*

Results: *The overall failure rate was 7.2% for incisor anchorage screws placed in cortical bone about 0.6mm thick. For the right and left sides combined (n=160 for each material), 18/160 SS (11.25%) and 5/160 Ti (3.125%) failed. A chi-square test revealed the difference in failure rates was statistically significant ($p \leq 0.05$). Torque levels indicating primary stability were relatively consistent (5.8-6.1N-cm), and appear to be unrelated to TAD failure. The hypothesis was rejected because Ti alloy has a superior success rate to SS as a material for incisal miniscrews.*

Conclusions: *TADs made of Ti alloy have a lower failure rate compared to SS when placed in thin cortical bone. These results are consistent with a biocompatibility-related tendency for less bone resorption at the bone screw interface. (J Digital Orthod 2018;52:70-79)*

Key words:
Incisors screws, gummy smile correction, stainless steel, titanium alloy, randomized clinical trial, double blind, split mouth, failure rate, biocompatibility

Introduction

Gummy smile or excessive gingival exposure when smiling is a common chief complaint relative to dentofacial esthetics. Orthognathic surgery may be indicated for severe discrepancies, but orthodontic treatment with miniscrew anchorage and conservative periodontal surgery produces a desirable, less invasive outcome (*Fig. 1*).[1,2]

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

Dr. Chi Huang,
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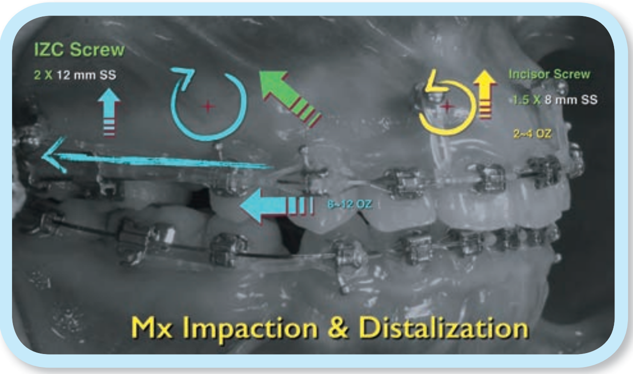
Editor-in-chief, Journal of Digital Orthodontics (Right)

Temporary anchorage devices (*TADs*) are common sources for orthodontic anchorage,[3-9] but there is controversy over the most desirable material for a particular site. Incisal screws are a promising new approach for intrusive anchorage in the maxillary anterior region (*Figs. 2 and 3*). Stainless steel (*SS*) is a well established material for orthopedic devices, but titanium alloy (*Ti*) is recognized as a more bone biocompatible material for constructing osseointegrated implants.[7] If a TAD, not designed to integrate, is placed in thick bone, SS may be a superior material because it is stronger (*less brittle*) compared to Ti.[9] However, biocompatibility may be an issue for thin cortical bone sites. Ti may be preferred because of enhanced bone biocompatibility, particularly with respect to nickel sensitivity. There are no reported studies investigating the material of choice for maxillary anterior TADs. The null hypothesis was that there is no statistical difference in the failure rates between SS and Ti miniscrews.

■ *Fig. 1:*
Excessive gingival exposure when smiling (left) is conservatively corrected (right) with orthodontic intrusion, anchored with maxillary anterior incisal bone screws, and periodontal crown-lengthening surgery.

Materials and Methods

A total of 320 consecutive 1.5x8mm (*Fig. 3*) (*OBS®, iNewton Dental Ltd, Hsinchu City, Taiwan*) miniscrews were placed bilaterally between central and lateral incisor roots of 160 consecutive patients (*26 males and 134 females, mean age 25.9 yr, range 10-58 yr*). All the screws were placed in the same center by the same orthodontist over a three-year period (*2014-17*). The TADs were screwed to place with a torque wrench to standardize the engagement with supporting bone and ensure initial stability (*Fig. 4*).

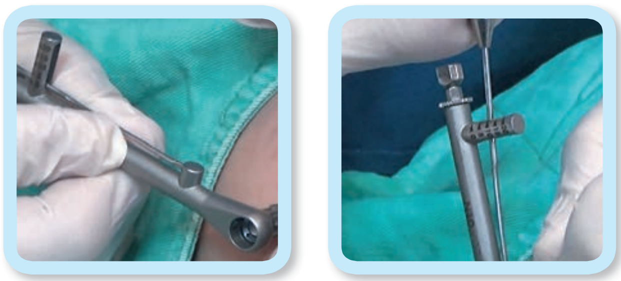


■ *Fig. 2:*
The chain of elastics from the infrazygomatic crest (IZC) bone screw to the cuspid bracket has distal and vertical components (blue arrows) that produce a clockwise moment (blue curved area) around the maxillary center of resistance (small red cross). The maxillary anterior miniscrew anchors an intrusive force (yellow arrow) that creates a counterclockwise moment (yellow curved arrow) tending to flare the maxillary incisors. The presumed resultant for all the applied loads is the green arrow to intrude and retract the entire maxillary arch.

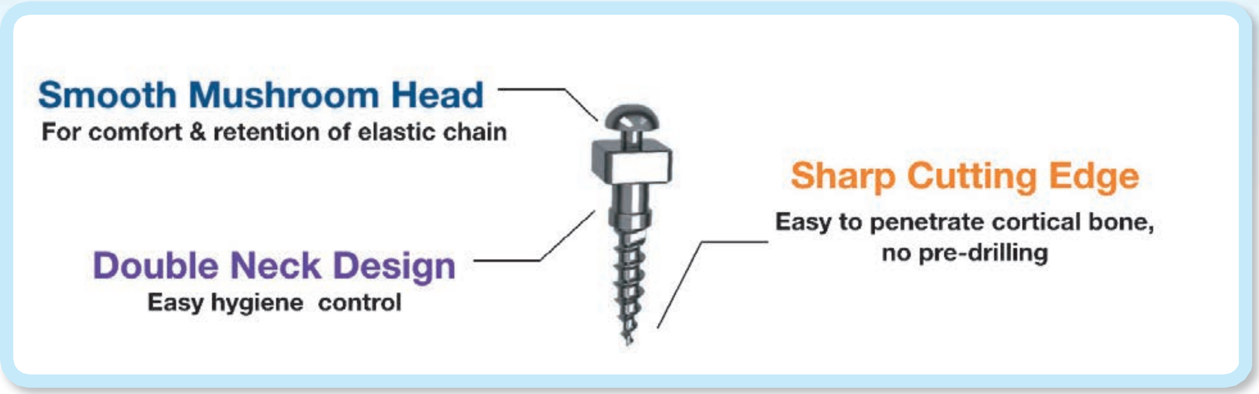
An alternating, randomized split mouth design was utilized for miniscrews as specified in Fig. 5. Half of the screws (*160*) were made of 316LVM surgical stainless steel (*SS*) and the other half (*160*) were composed of Ti6Al4V titanium alloy (*Ti*). Code numbers were assigned to pairs of miniscrews (*one SS and one Ti*), with a specification for which screw to install on each side. Only the data assessor (*statistician*) knew the actual code for each patient.

The blinded, alternating placement method insured that uniform numbers of screws of each type were tested on the right and left sides throughout the study. According to the code, one pair of screws was randomly selected for each patient. Neither the clinician, staff nor patient was aware of the screw composition for TADs placed on each side (*double blind randomized design*). At the end of the study the data were decoded according to side (*right or left*) and material type (*SS or Ti*), and were then sorted

■ *Fig. 3:*
A randomized split mouth design compared the failure rate for miniscrews made with SS and Ti alloy.



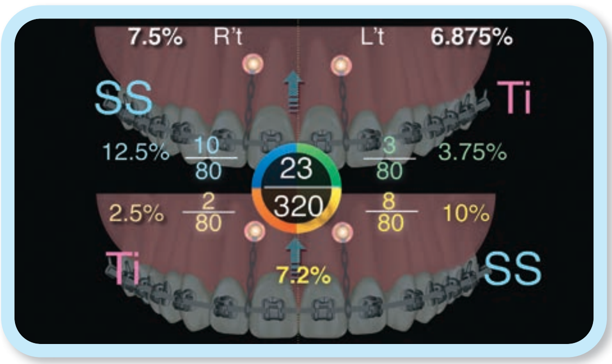
■ *Fig. 4:*
The torque value to seat each incisal bone screw was measured with a clinical torque wrench.



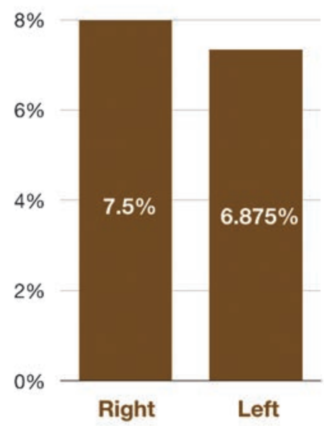
■ *Fig. 5:*
Specifications are illustrated for 1.5x8mm miniscrews designed to be inserted between central and lateral incisors with a self-drilling technique.

into four groups of 80 miniscrews each: left SS, left Ti, right SS, and right Ti. Failure rates were calculated for each of the four groups (*Fig. 6*), and tested for significant differences using a chi-square test, with $p<0.05$ as the minimum standard for significance. All failures were plotted according to the right and left sides (*Fig. 7*), divided according to material type (*Fig. 8*), and then subdivided according to side (*Fig. 9*).

In Fig. 10, the average torque values are shown for all miniscrews (*Total*), for those that failed (*Failure*), as well as for screws placed on the right and left sides. In addition average torque levels are documented for all titanium alloy (*Ti*) miniscrews and for those that failed (*Failure Ti*). Furthermore, failure rates for all stainless steel (*SS*) TADs are compared to those that failed (*Failure SS*) (*Fig. 11*).



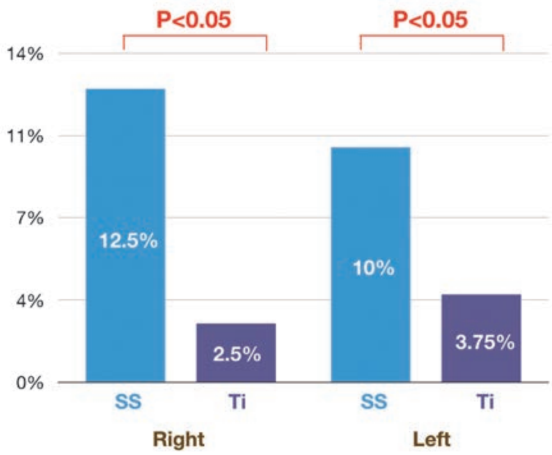
■ *Fig. 6:*
Failure rates of SS and Ti miniscrews are illustrated in multiple colors for the right and left sides respectively. The upper image is for SS on the right and Ti on the left. The lower image summarizes data for the opposite configuration. The overall data is shown in the center: 23 failures out of 320 miniscrews (7.2%).



■ *Fig. 7:*
The combined failure rate for the right side was 7.5% (12⁄160), and comparative data for the left side combined was 6.875% (11⁄160). The difference was not statistically significant.

■ *Fig. 8*:
The overall failure rate for all screws was 7.2% (23/320), which was divided into 11.25% (18/160) for SS, and 3.125% (5/160) for Ti. The red bracket shows that the difference was statistically significant (P<0.05).

■ *Fig. 10*:
Average torque values were nearly equal: all miniscrews 6.0 N-cm, all failures 5.8 N-cm, all right side TADs 6.1 N-cm, and all left side TADs 6.0 N-cm. There were no statistically significant differences.



■ *Fig. 9*:
For the right side, 12.5% (10/80) SS screws failed, but only 2.5% (2/80) Ti screws failed. For the left side, 10% (8/80) SS screws failed, and 3.75% (3/80) Ti screws failed. The red brackets document the differences were statistically significant (P<0.05) on both sides.

■ *Fig. 11*:
Average torque values were sorted according to the material composition of the miniscrews: all Ti 6.1 N-cm, Failure Ti 5.9 N-cm, all SS 5.9 N-cm and Failure SS 5.7 N-cm. There were no statistically significant differences.

Because of anatomic limitations, most of the incisor screws (*95%*) were placed in movable mucosa, mucosal type was not considered as a variable. After achieving local anesthesia, a sharp dental explorer was sounded through the soft tissue to mark the desired skeletal site for the incisor miniscrew. A self-drilling TAD was inserted into the site with no pre-drilling or water cooling and was subsequently screwed into the bone perpendicular to the bone surface between the central and lateral incisors (*Figs. 3 and 12*). All final engagements of TADs into osseous sites were measured with a torque wrench (*iNewton Dental Ltd, Hsinchu City, Taiwan*) as shown in Fig. 4. The final position of the screw platform for all screws was in light-contact with the soft tissue. Pre-stretched elastomeric chains,[10-12] anchored by the incisal TADs, were applied to intrude the maxillary incisors (*Fig. 3*). To avoid iatrogenic problems, all miniscrews were immediately loaded with only about 2-oz (*57g, 55cN*) of force[13-15] for at least 6 months. Failure was defined as a lack of TAD anchorage due to a miniscrew coming loose within 6 months.

The patients were instructed in oral hygiene procedures to control inflammation. The pre-stretched power chains were replaced every 4 weeks. The stability of the incisor screws was tested at every appointment for 6 months. Consent for participation in this study was obtained from all patients (*and the parents if the patients were adolescents*) before their recruitment.

Results

Fig. 6 illustrates the regional differences in failure rates for each material: 1. overall 23/320 (*7.2%*), SS 10/80 (*12.5%*) on the right, SS 8/80 (*10%*) on the left, Ti 2/80 (*2.5%*) on the right, and Ti 3/80 (*3.75%*) on the left. For all failures combined (*$n=320$*), 7.5% were on the right and 6.875% were on the left (*Fig. 7*). Dividing the total failure data (*7.2%*) according to material type, revealed a statistically significant (*$P<0.05$*) increase in SS failures (*11.25%*) compared to Ti (*3.125%*) (*Fig. 8*). For TADs placed on the right side, failures were 10/80 (*12.5%*) SS and 2/80 (*2.5%*) Ti. Left side results were 8/80 (*10%*) SS and 3/80 (*3.75%*) Ti (*Fig. 9*). Chi-square analysis revealed that the lower failure rates for Ti compared to SS were statistically significant (*$p\leq.05$*) overall (*Fig. 8*) and on both sides (*Fig. 9*). These data indicate Ti is superior to SS as the material of choice, so the hypothesis was rejected.

The overall torque average value was 6.0 N-cm. The average torque for the right and left sides were 6.1 N-cm and 6.0 N-cm, respectively. The corresponding levels for screws that eventually failed was 5.8 N-cm, which was not a statistically significant difference (*Fig. 10*). Dividing the data according to material, there was a slight mean decrease of 0.2 N-cm between the average and failure TADS for each material (*Fig. 11*), but that small difference was not statistically significant. (*$P>0.05$*).

Discussion

Gummy smile refers to excessive gingival display during full smile. Orthodontic intrusion[16,17] with TAD anchorage and/or surgical crown lengthening improves the smile display.[1,2] Failure of TADs extends treatment time, increases clinical effort and is inconvenient for the patient. Potential factors that may explain the advantage of Ti over SS are:

1. **Screw specification**: A double neck design and with an insertion stop superior to the threads provides for optimal mucosal clearance to prevent food impaction and inflammation (*Fig. 5*).[18,19] Light contact of the alveolar mucosa allows for hygiene to remove plaque and food debris that would otherwise result in inflammation and swelling. The thick platform supporting the head of the TAD was designed to control overgrowth of inflamed mucosa. The design and installation procedure was identical for the SS and Ti screws, and no difference in tissue reactions was evident when the code was broke, so screw specification (*Fig. 3*) did not appear to be related to TAD failure with either material.

2. **Movable mucosa (MM) or attached gingiva (AG)**: Although AG is usually preferred when installing an interradicular TAD,[5,6,8] soft tissue type had no effect on the failure rate of extra-alveolar (*E-A*) TADs placed in the infra-zygomatic crest (*IZC*)[18] or mandibular buccal shelf (*MBS*).[19] Soft tissue clearance up to 5mm below the TAD platform is beneficial to prevent food impaction and permit optimal hygiene. However, such a large space between the mucosa and the base of the screw platform is inappropriate for incisal miniscrews because the TAD prominence would be uncomfortable for the patient. The double neck design (*Fig. 5*) with light contact of the alveolar mucosa proved adequate for oral hygiene and did not irritate the lip (*Fig. 12*). The vast majority (*95%*) of incisal TADs for this study were located in MM. Soft tissue irritation was minimal, so mucosal type did not appear to be an important factor relative to TAD failure.

3. **Insertion technique**: Indeed, a surgical technique can affect the failure rate.[19] The difference in failure rate between the right and left side was attributed to the doctor's hand position, especially for the hand approaching the posterior buccal shelf area of the mandible. It was more difficult to place a MBS screw on the left side for a right-handed surgeon. For the present study of maxillary incisal screws, the small difference between the right side 7.5% (*12/160*) and the left side 6.875% (*11/160*) was not statistically significant, and was probably due to the chance alone.

4. **Applied load**: According to Dellinger,[13] light force (*50-100g*) provided optimal intrusion of a tooth with minimal tissue damage, particularly root resorption.[14,15] All TADs (*SS and Ti*) in this study were loaded with similar forces (*2-oz, 57g, 55cN*). The applied load was adequate for dental intrusion, but did not appear to be a factor in TAD failure.

5. **Cortical bone engagement**: Screw torque values as fixtures are seated is an indirect measurement of primary stability[20] relative to cortical bone engagement.[21] When a TAD is installed at an angle to the supporting plate of cortical bone, there is increased bone contact at the screw interface, which enhances the mechanical interlocking.[21-23] The torque value in seating a fixture is directly related to cortical bone thickness, and 1mm of cortical bone engagement is sufficient for the primary stability of most TADs.[24,25] However, cortical bone thickness for the anterior buccal plate of bone is only about 0.5-0.6mm (*Figs. 12a*).[26,27] This is an important consideration because even a 0.5mm difference in cortical bone thickness (*interface bone contact*) can impact the success rate.[25] Cortical bone thickness for posterior teeth is >1mm (*Figs. 12b & c*),[28,29] and the failure rate for E-A bone screws is <10% at all sites. Since torque values were similar for all incisal TADs (*Figs. 10 and 11*), primary stability associated with cortical bone engagement does not appear to be an important factor in TAD failure.

6. **Material (SS or Ti)**: Maxillary incisal miniscrews made of SS rather than Ti alloy have higher failure rates (*Figs. 6, 8 and 9*). None of the five mechanical and tissue factors analyzed above appears to affect incisal screw failure, so a material affecting on bone physiology at the screw interface may favor Ti alloy. Huja et al.[30] documented intense bone remodeling (*>50%/yr*) within 1mm of a Ti miniscrew interface. Francis et al.[31] noted the intense remodeling within 1mm of the interface was inversely related to the diameter of the screw. Gabser et al. (*2007*)[32] noted a short term decrease in bone resorption at the osseous interface of Ti compared to SS screws, and there was a higher

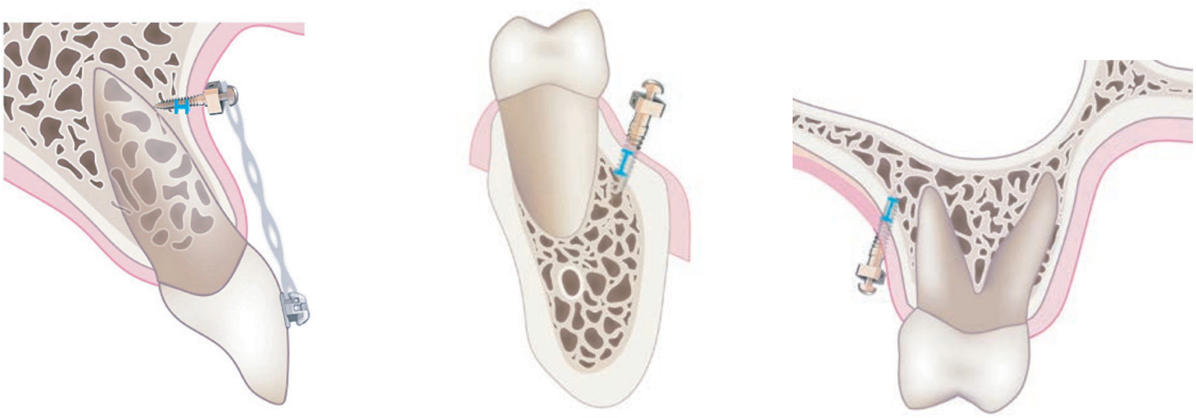


Fig. 12:

Cortical bone thickness is demonstrated with blue bars for three bone screw sites:

Maxillary incisor area (left), Mandibular buccal shelf (middle), and Infrazygomatic crest (right).

The average thickness of cortical bone engaging the screw at each site is marked with blue bars. Note that bone thickness is considerably less in the maxillary anterior region (left).

prevalence of reactionary cells (*inflammation*) adjacent to SS screws. Furthermore, Ti screw fixation of a metatarsal fracture is more successful in achieving an osseous union compared to SS screws.[33] These data suggest that Ti alloy may have a slight advantage in bone biocompatibility compared to SS. When the bone is thick such as in the posterior maxilla, there was no significant difference in the failure rate between Ti and SS for infrazygomatic crest (*IZC*) bone screws.[34] However, when the bone site is thin, a slight advantage in resisting bone resorption at the miniscrew interface may explain the significantly enhanced short-term (*6 mo*) success rate for Ti alloy compared to SS (*Figs. 6, 8 and 9*).

Conclusion

1. Overall failure rate for incisal screws placed in the anterior maxilla was 7.2%, which is similar to the reliability of bone screws placed in either the mandibular buccal shelf or infrazygomatic crest.

2. There was a significantly lower failure rate for Ti alloy (*3.125%*) incisal bone screws, compared to identical screws made of SS (*11.25%*).

3. A slight biocompatibility advantage for resisting bone resorption at a miniscrew interface may explain the higher success rate of Ti alloy compared to SS in thin cortical bone.

Acknowledgment

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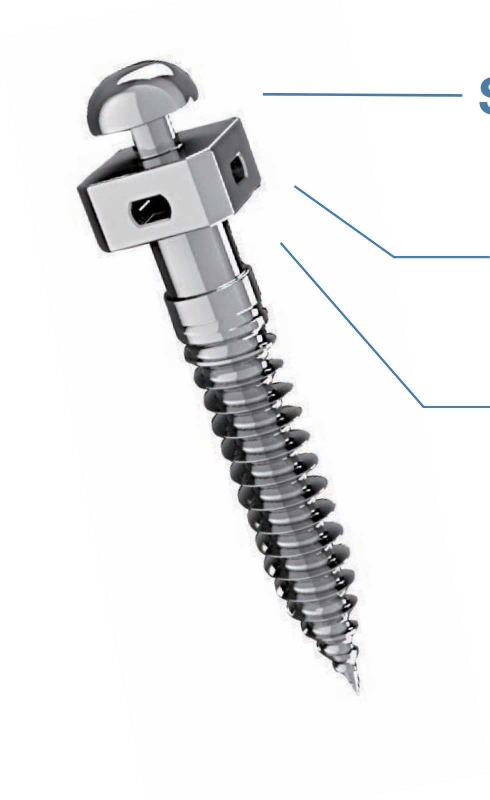

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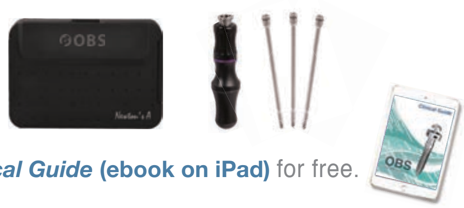

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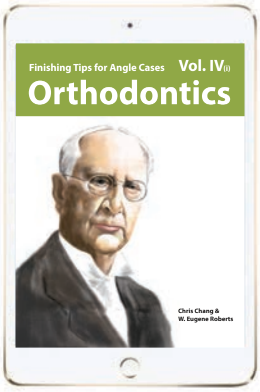

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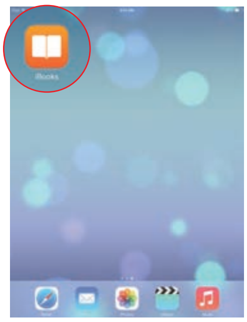

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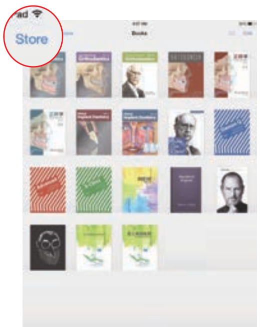

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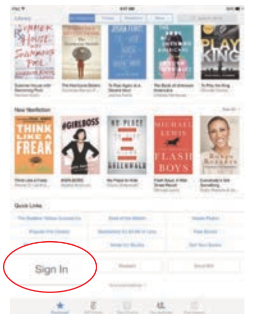

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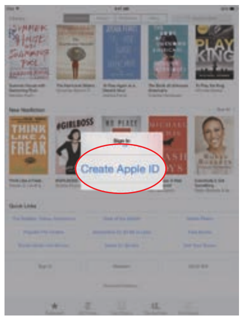

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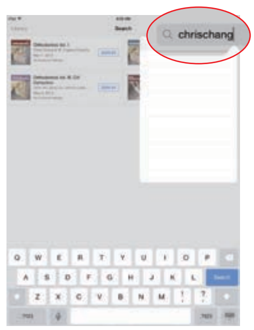

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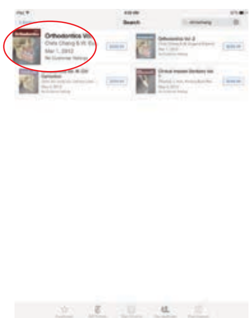

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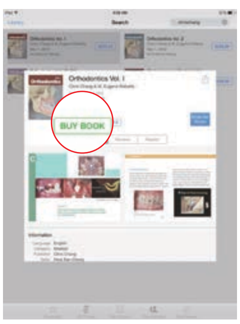

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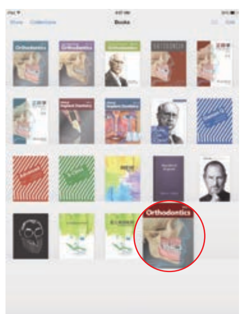

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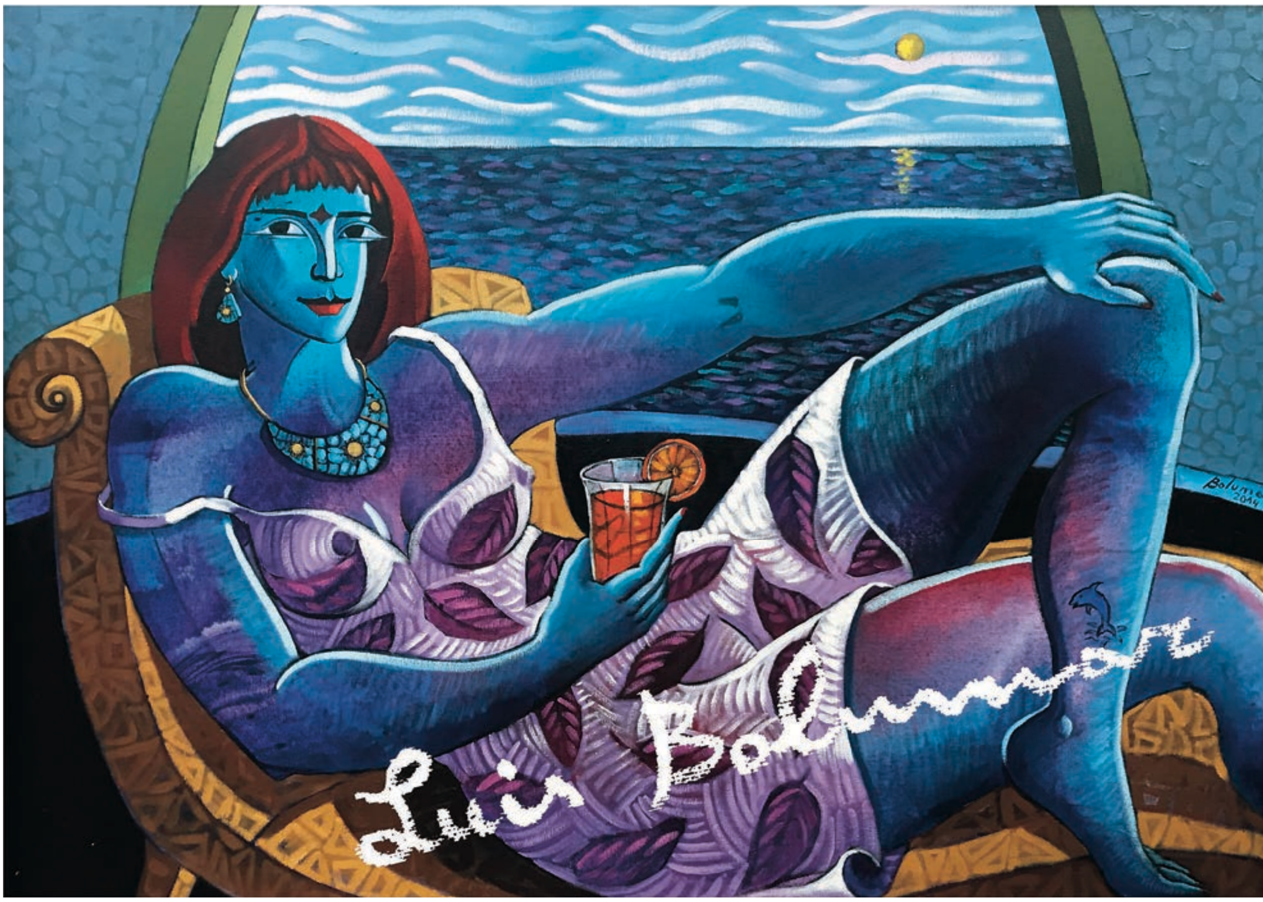
Lecturer:
Dr. Rungsi Thavarungkul,
Thailand

Newton's A course@newtonsa.com.tw

Requirements: MacBook with the lastest system and Keynote version



Naranjada al Amanecer (*Orange Juice at Dawn*)

Words from Mr. Luis Bolumar

2018

It is an honor to be here, in Hsinchu, showing my first painting exposition. It could be not possible without Dr. Chang and Shufen.

I am really excited to see all the paintings I painted in Spain again in Taiwan. I did my best in each of them.

I am satisfied and pleased with the great success that my paintings have garnered here in Taiwan and I hope their textures, colours and different shapes move you like the way they did to me.

Once more, it proves that art is a universal language, where there are no frontiers.

Thank you Dr. Chang and Shufen for your trust in me.

Thanks!

Luis Bolumar,
Spain

金牛頓現場報導：科技與藝術的完美結合

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余承勳 Chester Yu

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黃思涵 Tzu Han Huang

「牙齒矯正在您那裡真正做到了科學藝術的統一。令我印象深刻的不僅是您專業的造詣，還有對生活情趣的追求，希望以後也能達到您的境界。」來自北京的宋揚醫師，在十月四日活動結束後，對張慧男醫師留下敬佩的文字。

有中國牙醫界「神鵰俠侶」之稱的關心、宋揚醫師，受到金牛頓的邀請，特地趁著假期，來到新竹與台灣的牙醫師分享牙科上累積的心得與成果。關心與宋揚醫師皆為中國第一批利用隱適美技術診療病人的醫師，兩位醫師雖然年輕，在中國隱適美領域裡已擁有極高的知名度和多項個人紀錄。其中關心醫師是中國最先開展隱適美技術和首位在國際學術會議進行隱適美專題演講的中國醫生，國際優秀病例庫中她的病例獲選數量居中國首位，曾經有三例病例入選隱適美亞太區十佳病例。

本次特別邀請關心與宋揚醫師分享隱適美複雜案例處理，內容亦包括大家非常好奇該如何利用 G6 方案處理第一小臼齒拔牙的問題，以及與其他牙科領域聯合治療案例。整天演講下來，受到參與的醫師極佳的評價，最後Q & A時間醫師提問欲罷不能，希望能夠趁這難得的機會尋求兩位大師答疑解惑。「演講內容深入淺出」、「邏輯清晰」、「受益良多」等都是課後參與醫師所留下的評語，甚至還有醫師希望有機會可以參與關心、宋揚醫師的大師班或是實作受訓班，或是在未來還有機會能夠參與兩位醫師的其他課程。

1. 張慧男醫師、畫家 Luis Bolumar、關心醫師與宋揚醫師（由右至左）合照。
Drs. Chris Chang, Mr. Luis Bolumar, Xin Guan and Yang Song (from right to left).

2. 張慧男醫師致贈紀念品給關心與宋揚醫師。
Dr. Chang (right) presented souvenirs to Dr. Xin Guan (center) and Dr. Yang Song (left).

3. 關心醫師現場演講。
Dr. Xin Guan lecturing.

4. 宋揚醫師現場演講。
Dr. Yang Song lecturing.

5. 關心、宋揚醫師、畫家與參與學員於課間合照。
Mr. Bolumar (center), Dr. Xin Guan (center right) and Dr. Yang Song (second one on the right) photoed with the class.

畫作展覽空間
Exhibition space

Live coverage from Newton's A: The perfect synergy of art and technology

"You truly achieved the unity of art and science through your work in orthodontics. What struke me the most is not only your professional achievement but the artistic pursuits in life. I hope one day I'll be able to reach your level." This quote was shared by Dr. Yang Song (宋揚) from Beijing, China after his lecture in Newton's A on October 4th, 2018.

The Chinese golden couple in orthodontics, Drs. Xin Guan (關心) and Yang Song were invited by Newton's A to share with Taiwanese dentists their clinical pearls during their holidays. They were the first group of pioneers in adopting Invisalign technology in China. Although both of them are still young in age, they are both amongst the highest profiled clinicians in this field and maintained multiple personal records. Dr. Xin Guan is the first Invisalign user in China and the first Chinese doctor who gave presentation on Invisalign in international conferences. The number of her cases featured in the international case selections ranked the first in China, three of which were chosen as the top 10 cases in Asia.

Newton's A was delighted to invite Drs. Xin Guan and Yang Song to share their clinical secrets in complex Invisalign case treatment, including how to use G6 protocols to manage first premolar extraction and other interdisciplinary treatment cases. Doctors who attended the full-day lecture gave very enthusiastic responses to their presentations and the Q&A session was extended so all questions raised by the audience could be fully answered. Many of the participants gave comments, such as "*clear logic,*" "*great content but still very accessible,*" "*come back next time*" on their feedback form. Some even expressed interests in attending their advanced, hands-on workshop in the future.

除了演講本身深受好評之外，金牛頓也特別趁著張慧男醫師的西班牙畫家好友 Luis Bolumar 首次來台訪問的期間，於演講會場舉辦畫家在亞洲第一次的畫展。

四年前張醫師於西班牙參觀國際植牙界大師 Fernando Rojas-Vizcaya 醫師的診所時，愛上其診所牆上所陳列的畫作，Fernando 醫師特地帶著張醫師拜訪畫家 Luis Bolumar 本尊，張醫師參觀完 Bolumar 的畫室，因為太喜愛畫作裡面地中海的陽光所映照出台灣很難看到的藍色，立刻購入了畫室裡一部分的畫作，近年又陸續購入了許多作品，目前已經累積了上百幅收藏。

利用十月四日活動的機會，原本以賣場與教育中心為導向的金牛頓藝術科技，在這天轉變為極富藝術氣息的展覽空間。本次畫展特別展出了張醫師收藏裡面的大部分作品，包括令人著迷的地中海藍色代表作「Naranjada al Amanecer (*Orange Juice at Dawn*)」（圖見第 85 頁）以及許多具有典型 Bolumar 線條的人像油畫與版畫。Bolumar 也特別在現場實況展演作畫過程，讓參與的醫師們大開眼界！

金牛頓開業以來，第一次結合牙科演講與藝術展覽活動在醫師們的驚嘆聲中完美結束。至於當初怎麼會有這樣的活動構想呢？「牙醫要培養美感」，張慧男醫師深刻地體會，「因為牙科是科技結合藝術的工作」，一般人要怎麼培養美感？張醫師有一個非常簡單的方法：「你可以用浸潤式的方式，讓眼睛所看到的地方或是生活中都充滿藝術品，久而久之，慢慢地你就有了藝術的涵養。」

右上圖：畫家 Bolumar 親自從西班牙帶來一幅自畫像作為給張醫師的贈禮。

Upper right figure: Mr. Bolumar presented his self-portrait to Dr. Chang as a gift of friendship.

畫家 Bolumar 親自設計的「來台訪問」展示立牌及展覽現場實況。

Sign of Mr. Bolumar's first visit to Taiwan, designed by Mr. Bolumar; and Live scene during the exhibition.

On that day, in addition to dental lectures, Newton's A also hosted the first art exhibition in Asia of the Spanish painter, Mr. Luis Bolumar whose biggest supporter in Asia is the CEO of Newton's A, Dr. Chris Chang.

Dr. Chang fell in love with Mr. Bolumar's work when he visited his friend and internationally renowned implantologist, Dr. Fernando Rojas-Vizcaya's clinic and saw his paintings there. Dr. Rojas-Vizcaya later took Dr. Chang to visit the artist in his studio and Dr. Chang couldn't leave the place without bringing home a few Mr. Bolumar's pieces in memory of that mesmerizing Mediterranean blue on that gorgeous day of light. Over the years he has acquired over 100 pieces of Mr. Bolumar's portraits of Spanish women and still objects.

On the day of the exhibition Newton's A's showroom previously used for 3C products was transformed to an art exhibition space. Most of Dr. Chang's collections were displayed including the first piece that caught his eyes, Naranjada al Amanecer (*Orange Juice at Dawn*) (*Page 85*) and many of Mr. Bolumar's signature female portraits and prints. One of the highlights of that day was when Mr. Bolumar demonstrated his sketch techniques in front of the audience. The doctors were very amazed by this rare opportunity to see an international master in action.

Newton's A's first dental lectures and art exhibition concluded successfully as the attendees left with glee. When asked, "*what made you come up with this ingenious idea to combine these two seemingly unrelated events?*", "*cultivating an esthetic taste is a must for dentists,*" Dr. Chang responded. He went on to elaborate that "*dentistry is a profession to combine art and technology.*" When probed further, "*how can one cultivate a sense of esthetics?*" Dr. Chang provided a quick solution: "*immerse yourself in an artistic environment, making everything you see or experience be filled with art. Over time you will naturally acquire an artistic taste.*"

畫家Luis Bolumar（前）現場實況作畫，張慧男醫師、宋揚醫師與關心醫師（由右至左）饒富興致地觀看。

Mr. Bolumar gave a live demonstration while Drs. Chris Chang, Yang Song and Xin Guan observing.

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Feedback from the International Damon, OBS & VISTA workshop, Mar 2018

Attending Dr. Chang's Damon, OBS & VISTA Workshop was an excellent experience. The workshop was extremely useful and very practical. The workshop included a series of lectures with chair-side observation sessions, one model practice and one surgical hands-on session. The session were really informative as Dr. Chang shared his ideas and protocols and it was amazing to be able to gain first hand experience and learn about placing OBS on so many patients in different locations with biomechanics involved in different malocclusions. The stunning part was really to see even the very difficult cases handled with ease and smooth clinical workflow process.

I would highly recommend this workshop. What you can expect is great insights from Dr. Chang on placing OBS and beyond-his creativity and understanding in orthodontic practice is unmatched. Dr. Chang and his team of resident doctors are highly efficient and it would definitely add value to your treatment planning for future cases. The hospitality was like the cherry on top, a wholesome experience and should be on every orthodontists' must-do list.

Siju George,
India

Feedback from the International Insignia workshop, Sept 2018

I enjoyed Chris' presentation which is very informative, inspirational and full of fun as always. Mr. Michael Bray sharing Insignia in an engineer perspective gives me an in-depth understanding of the science behind this wonderful appliance.

Even though it was the second time I did the chair-side observation, it was still very informative and educational. We can ask whatever we want to know during patient treatment from Chris and other young doctors. New ideas and new clinical tips were helpful.

I would like to say my heartfelt thanks to Chris for inspiring me once again since the international workshop I took in 2015. Digital orthodontics have been implemented with great results. As Chris said it is the golden opportunity to join this ever-evolving industry. It is our duty to integrate this digital work flow and use all the technologies in order to offer the best possible treatment to patients. I will be happy to embrace the future and become the early majority and not the laggards.

Chung Kwai Hung,
HONG KONG

"The Era of Digital Orthodontics has arrived!" as stated clearly by our honorable mentor, Dr. Chris Chang at the beginning of this Insignia Workshop. Be it Insignia (digital Damon) or Spark (Clear Aligner), Ormco as the leader in this industry is always innovative to take the lead.

In this workshop, we are glad to have Mr. Michael Bray, the chief Ormco engineer behind this great Insignia project, giving us the whole bioengineering concept on Insignia. Dr. Chris and his Beethoven residents team also showed successful cases, tips, steps etc on handling Insignia.

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Dr. Chen Ye Hong,
MALAYSIA

As usual, Chris managed to make the topic easy to understand and the learning process fun. Not to mention the dedicated teaching assistants who are so knowledgable and helpful. The templates and ebook are very useful too for revision and reference. I believe digital dentistry is the way to go and digital assisted planning and customised brackets with 3D printed positioning jig will help solve many, if not all of the problems we are facing in fixed Orthodontics. Of course the customised arch wires that come with the system are of great help too.

Dr. Neoh Leong Seng,
MALAYSIA

International Beethoven Workshop

Dental Clinic Established 1996

2018 Session A: 05/22-25 (Full) Session B: 12/04-07 (Full)
Additional session: 03/13-16 (Full)

@Taiwan

Since 2009, Beethoven International Damon, OBS & VISTA Workshop has received over 350 participants from more than 30 countries. This three-day advanced hands-on course combines practical lectures and in-office clinical learning and has attracted orthodontic practitioners worldwide to strengthen their skills and knowledge in the Damon System, TADs and minimally invasive surgeries. In addition to clinical development, participants will be exposed to clinic management and staff training of a world-class orthodontic centre. The optional Keynote workshop will help improve your ability to master professional digital communication. Come join us and be part of a community of excellence.

Course Schedule

Day 1	Chair-side observation
Day 2	Lecture, Model workshop, Chair-side observation
Day 3	VISTA Lecture, Lecture by Dr. John Lin, VISTA workshop
Day 4	Keynote workshop by Newton's A team

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KEYNOTE

Dr. Rungsi Thavarungkul, Thailand
Lecturer, Advanced Keynote Workshop

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

THE LECTURERS

Dr. Chris Chang

CEO, Beethoven Orthodontic and Implant Group. He received his PhD in bone physiology and Certificate in Orthodontics from Indiana University in 1996. As publisher of ***International Journal of Orthodontics & Implantology,*** he has been actively involved in the design and application of orthodontic bone screws.

Dr. John Lin

President of the Jin-Jong Lin Orthodontic Clinic. Dr. Lin received his MS. from Marquette University and is an internationally renowned lecturer. He's also the author of Creative Orthodontics and consultant to ***International Journal of Orthodontics & Implantology.***

FEES

Day 123	USD 2,700	Early bird rate: USD 200 off (advanced registration 2 months prior to the course date)
Day 4	USD 600	Early bird rate: $100 off (advanced registration 2 months prior to the course date)

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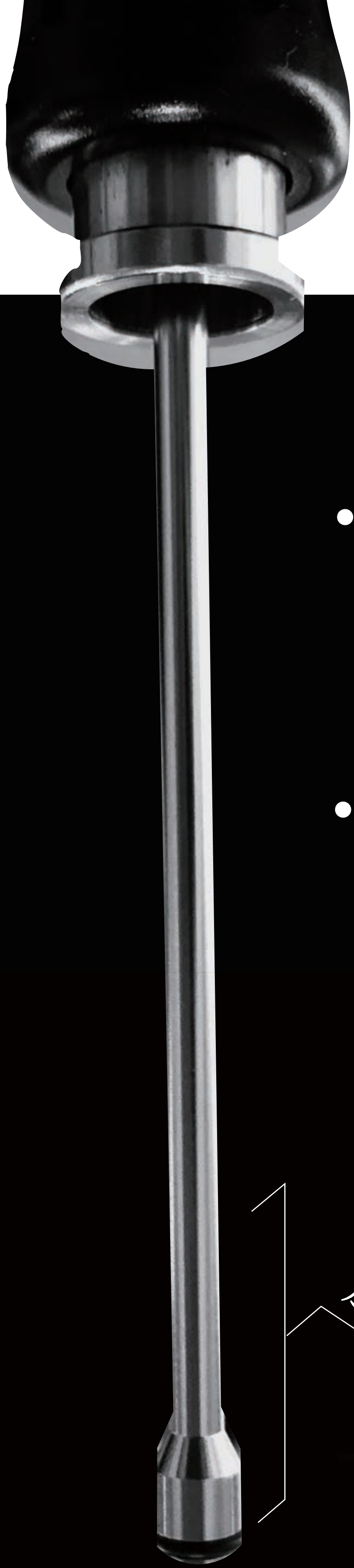

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日期

資格賽 / 貴賓配對賽：2019 年 1 月 1 日
預　賽：2019 年 1 月 2、3、4日
決　賽：2019 年 1 月 5 日

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資格

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報名

12/1 日前向新竹市體育會高爾夫委員會報名。
電話：03-5385155；傳真：03-5380951
E-mail：cuber@yiyutech.com.tw

主辦單位：Beethoven 貝多芬齒顎矯正中心　承辦單位：新竹市體育會高爾夫委員會

協辦單位：寶山高爾夫俱樂部　Newton's A 金牛頓藝術科技　安徒生 安徒生兒童牙醫診所　NEWTON 金牛頓植牙中心　彼得潘兒童青少年牙醫診所　Beil 貝爾牙醫診所

"From this book we can gain a detailed understanding of how to utilize this ABO system for case review and these challenging clinical cases from start to finish."

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

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

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

Dr. Don Drake, South Dakota, USA

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

Dr. Ron Bellohusen, New York, USA

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

Dr. Mike Steffen, Oklahoma, USA

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

Dr. Doraida Abramowitz, Florida, USA

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

Dr. Robert S Chen, California, USA

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

Dr. John Freeman, California, USA

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

Dr. Keyes Townsend Jr, Colorado, USA

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

Dr. Jerry Watanabe, California, USA

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

Dr. Errol Yim, Hawaii, USA

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

Dr. James Morrish Jr, Florida, USA

The Insignia Global Users Meeting, September 21 – 22, 2018, Amsterdam, Netherlands. Dr. Chris Chang gave a lecture on the digitally designed bracket system, Insignia™, and shared his insights on the future of digital orthodontics.