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What's inside:

- Two generations, one passion for Dentistry
- Skeletal Class III malocclusions corrected with orthodontic camouflage
- Minimally invasive treatment on a stable basis

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by **Dr Eileen M.Y Koh** and **Dr Kim Chuan How**

Skeletal Class III malocclusions corrected with orthodontic camouflage

Class III malocclusion (British Standards Institute) is defined as lower incisor edges are lined anteriorly to cingulum plateau of upper incisor[1]. The overjet may be either reduced or reversed. Angle described it as one in which lower first permanent molar is mesially positioned relative to upper first molar [2-3]. The skeletal Class III malocclusion is characterized with mandibular prognathism, maxillary hypoplasia or both. Clinically, these patients presented with concave facial profile, retrusive nasomaxillary area and prominent lower third of face. The lower lip is often protruded relative to the upper lip. The upper arch is usually narrower than lower arch. This skeletal discrepancy may have unfavorable impact on aesthetics, which is frequently aggravated by the presence of accentuated facial asymmetries.

The etiology of Class III malocclusion is not completely understood. However, there is a familial and racial tendency to mandibular prognathism [3-5]. Evidence gained from population studies, especially family and twin studies, has shown that genetic factors play an important role in the etiology of malocclusions [5]. On the other hand, research on siblings and even identical twins suggests a significant role for environmental factors besides genetic factors in the development of occlusion [5]. In addition, the prevalence of Class III malocclusion varies among different races and populations where the highest prevalence is among Asians and lowest in Caucasians [6].

Class III malocclusion treatment is a considerable clinical challenge. Successful treatment depends on identifying the true nature of the malocclusion and on evaluating the probable growth changes[7]. Treatment options include (1) growth modification involving chin cup to restrain mandibular growth and rapid maxillary expansion (RPE) and reverse headgear to protract the maxilla, (2) orthodontic camouflage involving tooth extractions, (3) orthognathic surgery [7-8]. In most severe cases, orthognathic surgery is preferred to overcome the skeletal discrepancy and improve facial aesthetic [1, 8]. However, the diagnosis and treatment plan for orthognathic surgery required a systematic multidisplinary team approach [9]. The risks and complications of orthognathic surgery should be carefully assessed [9, 10]. On the other hand, patient's view and expectation of treatment outcomes is wise not to overlook during treatment planning.

This article reports the use of self-ligating bracket (SLB) to treat a highly complex severe skeletal III high angle case on a non surgical orthodontic compensation, the treatment involve also the integration of implants, bone graft and prosthodontic resulting in a satisfactory clinical outcome. The SLB orthodontic principle as well as the mechanics as well as the basic surgical principle of implants would be discussed.

Fig 1: Pre-treatment extra-oral photos. A) Frontal, B) Lateral, C) 45° angle showing the Class III mandibular prognathism, acute nasolabial angle and facial asymmetry with the chin deviated to the right of the facial midline

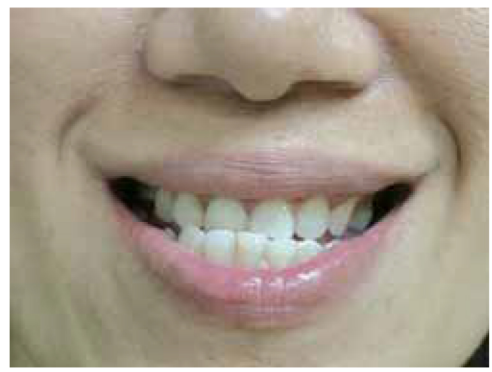

Fig 2: Patient's smile shows upper dental midline off to the right and excessive lower incisor display. Dark buccal corridor smile bilaterally due to missing right premolar and narrow upper arch

History and Etiology

A 52-year-old Chinese female sought for orthodontic treatment due to dissatisfaction of her facial aesthetics and teeth alignment where her maxillary anterior incisors are behind her mandibular incisors and asymmetrical face. Generally, she is in good health with no significant medical health problem. She had sought for many orthodontic consultations and was advised for orthognathic surgery. Patient was unwilling to go for surgical correction and had pleaded us to attempt a non-surgical orthodontic compensation. We agreed to treat her on the proviso that she consents for publication after the treatment.

Clinically, patient presented with a Class III skeletal pattern and concave profile (Figure 1). Her lower lip is protrusive relative to her upper lip and mandible deviates to the right side. Her lips are competent in rest position. When she smiled, her upper and lower teeth incisor display was excessive and her upper edentulous premolar areas were obvious (Figure 2). Intraorally (Figure 3), her incisor relationship is Class III with negative overjet of -3 mm and increased overbite. Upper midline shifted 2mm to the right side and lower midline shifted 3mm to the left side. She has bilateral posterior crossbites, hypodontia of one lower incisor and clinically missing tooth 16, 14, 25 and 36. Her oral hygiene is good and present dentition is moderately restored. Tooth 11 was root-treated and crowned. Canine relationship on both sides is Class III while the molar relationship class is not available due to missing first molars (16, 26, 36). Her maxilla is hypoplastic and her mandible is prognathic. The upper incisors are proclined attempting to compensate the skeletal discrepancy. Thus giving rise to an acute nasolabial angle that compromises the facial aesthetic in the lateral profile.

Radiographic investigation (Figure 4) revealed an impacted 25 lying apical to the root of 24, which is asymptomatic and devoid of root resorption on 24. Her alveolar bone height is normal with no other abnormality detected. The pre-treatment lateral cephalometric analysis (Table 1) showed patient has a concave profile, the maxilla was significantly retrognathic relative to the cranial base (SNA=72°) and the mandible is prognathic (SNB=84°). The ANB (-12°) indicated a severe skeletal Class III relationship. It is worth noting that there was anterior mandibular displacement on closure which tended to exacerbate the negative ANB angle. The upper incisors were proclined (UI. MX= 139°) and the lower incisors were of normal inclination (L1.MD= 96°). The maxillo-mandibular plane angle and the lower anterior facial height proportion is increased to 36° and 58% respectively.

Treatment Objectives

1. To correct bilateral cross bites and eliminate mandibular displacement on closure
2. To correct the reverse OJ and OB
3. To surgically remove the impacted premolar, graft the bone and restore with implant
4. To create space and evenly distribute the space for prosthodontic restoration and aesthetic enhancement
5. To align the teeth and level the canted occlusal plane
6. To correct the dental midline to coincide with the facial midline and symmetricize the archform
7. To correct the concave facial profile

Treatment Plan

Since the patient strictly refused to undergo orthognathic surgery, therefore the treatment plan is to camouflage orthodontic treatment. As the SLB is reportedly known to have orthopedic effect in treating dento-skeletal discrepancy, it was decided to develop the maxillary arch and constrict the mandibular arch by using self-ligating system in order to compensate the skeletal discrepancy. The impacted premolar tooth 25 will be removed surgically.

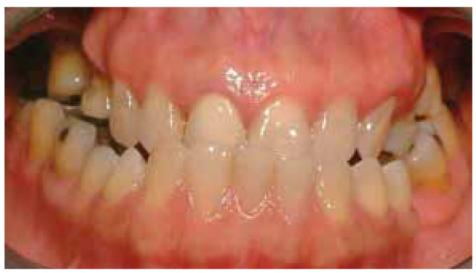

Fig 3: Pre-treatment intra-oral photos. Marked negative OJ, bilateral posterior crossbite, severe rotation of tooth 24 and 27. Note despite of one mssing lower incisor, the reverse overjet persists indicating severe skeletal III malocclusion

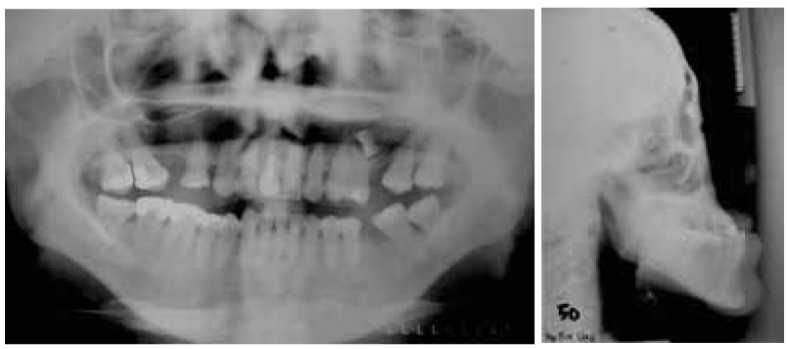

Fig 4: Pre-treatment radiographs A) Panoramic B) Lateral Cephalometric. Notice the position of impacted 25 is very high. The sagittal discrepancy shows severe hypoplastic maxillary and hyperplastic mandible on a high maxillo-mandibular plane angle

The upper missing teeth (tooth 16, 14 and 25) will be replaced with narrow diameter implants because there are insufficient ridge widths due to chronic bone resorption whereas the lower edentulous area (tooth 36) will be closed by orthodontic traction. This treatment plan is to integrate aesthetics, function and stability in optimizing the occlusion. From the macro-aesthetic effect, we also plan to improve the smile by increasing the upper incisor display and concealing the lower incisor exposure.

Treatment progress and discussions

The treatment was begun with 014 CuNiTi using Damon 2 System. Posterior bite block were added to eliminate occlusal interference and allow unhindrance archform development concomitant with downward and backward rotation of mandible to enable "jumping the bite" of the reverse overjet (Figure 5).

The space gained from arch development is used to upright proclined upper incisors and this has made possible the correction of reverse overjet without further proclining the upper incisor inclination (10,11). It is important to note that early progression of rectangular archwire using superelastic copper NiTi does have a significant effect in archform development that harmonize with the perioral musculature. This form of arch development is often misconstrued as arch expansion. For arch expansion refers to dentoalveolar tipping of the teeth with excessive buccal crown torque whereas arch development refers to 3D bodily movement of the teeth buccally and thus relatively more physiological and stable in nature. The upper archform was developed progressive from 014 CuNiTi to 16x25 CuNiTi over 14 months of treatment.

The lower archform was developed and coordinated with the upper from 014 CuNiTi to 16x25 CuNiTi. Once archform was developed, it was then coordinated by constriction with lingual root torque using rectangular stainless steel archwire progressing from 16x25 SS to 19x25 SS with lingual root torque (Figure 6).

The patient was reviewed every 6 weeks, during which time, the rotation (1st order), mesial tipping (2nd order) of 17,18,27,28,37,38 were uprighted and the lingual crown torque (3rd order) were built in for upper incisor as well as upper premolars and molars while lingual root torque were built in for lower incisors, premolars and molars.

The surgical removal of impacted 25 was done on the 6th month after anterior cross bite has been correct (Figure 7). The tooth was cut into 2 pieces to facilitate removal and conserve amount of alveolar bone removed. The socket was packed with alloplastic bone grafting material and resorbable collagen membrane to support the bone graft. The flap was sutured using 5/O black silk. Sutures removed after 7 days. The placement of bone graft and collagen membrane is to allow deposition of new bone in the sockets during healing. The graft material will prevent unwanted soft tissues to grow in the sockets and at the same time preserve the volume of alveolar bone. The use of collagen membranes for protection of bone graft showed evidence of better soft tissues healing process (12).

On the 11th month, narrow diameter implant was inserted on the upper left side to replace tooth 16. Another 2 narrow diameter implants were inserted replacing tooth 14 and 25 on 17th month, 6 months after surgical removal of impacted 25. This is to allow sufficient bone healing process to take place to ensure success of implant. Referring to OPG taken on 16th month (Figure 8c), the placement of implant 14 is slightly too near to 13, therefore the tooth 13 was moved mesially by orthodotic intervention to create premolar space.

The prosthetic procedures took place after de-bond on 25th month. EMAX crown on 11 and porcelain-fused metal crowns on 16,14, and 25 were fabricated.

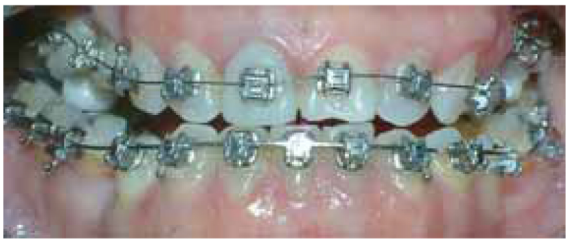

Fig 5: showed placement of posterior bite block to correct the anterior crossbite on the 6th week after bonding. The posterior bite block is to effect downward and backward mandibular rotation to enable the upper incisor to "jump over" the bite

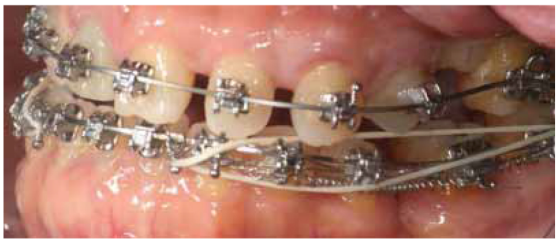

Fig 6: showed photos taken on the 6th month after bonding. Anterior crossbite was corrected. Tooth 24 and 27 were de-rotated despite impaction of 25. At the lower arch, 16X25 ss arch wire were used and light NiTi close coil springs were placed from 7s to 3s on both sides. It is helpful to use very light Road Runner elastic to affect light closing force

Treatment results

The most significant change in the treatment outcome is the sagittal relationship improvement of the skeletal profile. The SNA angle has been improved from 72° to 80°. The SNB angle has been improved from 84° to 81°. The MMPA angle is only increased marginally by 1° due to downward and backward rotation of mandible. Upper incisor proclination has been upright from 139° to 119° while the lower incisor was uprighted from 96° to 89° (Figure 12). The skeletal Class III was reduced from -12° to -1°. This significant change in ANB angle can be explained by the backward and downward rotation of the mandible couple with some orthopaedic bone remodeling of the A and B point (13). The extent of orthopaedic remodeling is not certain and require more studies to evaluate further. The facial profile has also shown significant improvement, the procumbent lower lip has rolled behind the upper lip and the acute nasolabial angle due to proclined upper incisors has been improved significantly due to lingual crown torque of the upper incisors (Figure 9).

On the frontal profile, the dark buccal corridor smile has been eliminated due to lateral arch development and the off centre upper incisors have been centralized with the facial midline. The lower incisors have been intruded and so it appears not so prominent during smile; this has a significant aesthetic impact as the relative display of the lower incisor does give rise to an aging appearance during smile.

The concave facial profile has been improved to a straight facial profile (Figure 9) and the hypoplastic maxilla shows a significant improvement and the cheek (zygomatic) area is now more visible.

The bilateral posterior cross bite had been fully corrected (Figure 10). This is attributed to symmetrical archform development with the SLB bracket system and the constant force delivery system of superelastic archwire technology. A stable posterior occlusion was established.

In the lower arch, the archform was constricted with lingual root torque of incisors, premolars and molars. The lingual root torque has uprighted these teeth while constricting the lower archform to coordinate interarch relationship with the upper, thus correcting the bilateral crossbite. This has also improved the root parallelism (Figure 8 and 11).

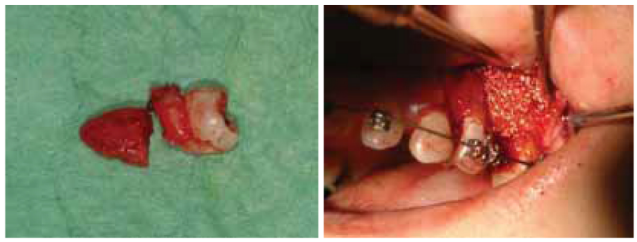

Fig 7: showed surgical removal procedure of impacted tooth 25. The tooth was cut into 2 pieces to facilitate removal and conserve amount of alveolar bone removed. The socket was packed with alloplastic bone grafting material and resorbable collagen membrane to support the bone graft. The flap was sutured using 5/O black silk.

Conclusions

All problems perceived by a clinician might not be problems in the patient's eyes. Therefore, all treatment options including those that are ideal and compromised should be explained to the patient in order for the patient to make a final decision. The treatment that this patient received satisfied her needs despite its limitations. Both the patient and the orthodontist were satisfied with the outcome. The patient's main concern was addressed and treated to her satisfaction. A pleasant facial appearance and esthetic smile were established. Last but not least, the malocclusion was treated to a satisfactory and stable result.

In a nutshell, the treatment outcomes remind us of the potential of SLB system to achieve adequate and acceptable results in many patients who might otherwise be consigned to surgery. **DA**

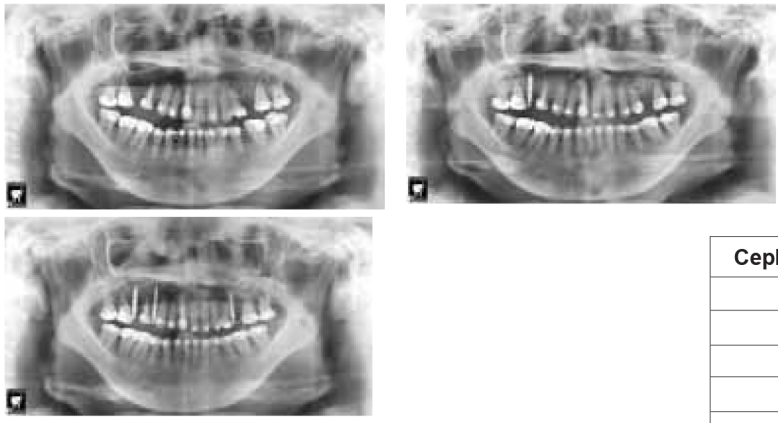

Fig 8 Panoramic radiographs A) Post-surgical , B) 11th month, one implant was inserted to replace missing 16, radiopacity at the area of previous impaction 25 indicated deposition activity of bone; C) 15th month, 3 narrow diameter implants were inserted due to insufficient bone width.

Cephalometric Value	Pre-treatment	Post-treatment
SNA	72°	80°
SNB	84°	81°
ANB	-12°	-1°
Mx.MdPA	36°	37°
U1.Mx	139°	119°
L1.Md	96°	89°
LAFH%	58%	59%

Table 1

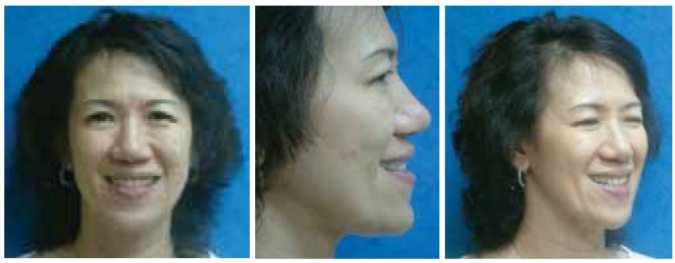

Fig 9 Post-treatment photos. A) Frontal, B) Lateral, C) 45 ° angle with static and smile profiles. Notice there is significant improvement on the Class III profile. The upper incisor display was improved while the lower incisors were intruded and concealed. The upper incisor was centralized to coincide with the facial midline and the dark buccal corridor smile was filled with full face smile

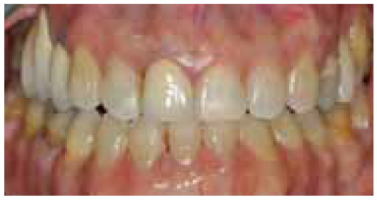

Figure 10 Post-treatment intra-oral photos. Bilateral crossbite and reverse overjet have been fully corrected. Missing teeth have been restored with implants. The vertical bone resorption results in an elongated tooth appearance which could have disguised with pink porcelain. The lower left atrophic edentulous space has been closed with SLB free friction light traction force

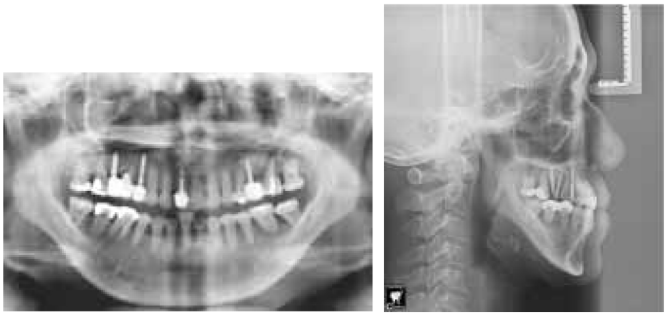

Fig 11 Post-treatment radiographs. A) Panoramic, B) Lateral Cephalometric. Notice there is significant improvement on the skeletal III profile due to vertical downward and backward rotation of the mandible

Fig 12 Pre and post-treatment cephalometric tracing. The SNA angle has been improved from 72° to 80° . The SNB angle has been improved from 84° to 81°. The MMPA angle only increase marginally by 1° due to downward and backward rotation. Upper incisor proclination has been upright from 139° to 119° while the lower incisor was uprighted from 96° to 89°

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