

CLINICAL
SECTION

The Gold Medal of the Conjoint M. Orth. Examination of the Royal College of Surgeons of Edinburgh and the College of Dental Surgeons of Hong Kong, Surgical Orthodontic Cases

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The Conjoint Gold Medal was awarded to the candidate who scored the highest overall mark in Part II of the Membership of Orthodontics examination held by the Royal college of Surgeons of Edinburgh and the College of Dental Surgeons of Hong Kong. It is the intermediate examination for the orthodontic specialty training pathway in Hong Kong. Part of this examination involved the presentation of a fully documented fixed appliance case and a multidisciplinary case, and three other cases with condensed case histories. This article described two surgical orthodontic cases presented during the 1999 and 2002 examinations by the award winners.

Key words: Clinical case report, asymmetry, mandibular prognathism, combined surgical orthodontic treatment

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Case report 1

History and clinical examination

The patient was a 20-year-old Chinese female with a chief complaint of protruding lower anterior teeth (Figure 1a–i). Her sister also had similar dentofacial deformity.

She had a straight lateral profile, paranasal deficiency, acute nasolabial angle, protruding lower lip and a flat chin. The frontal view showed that the upper face was symmetrical and the chin was deviated to the left side by 5 mm. The upper dental midline coincided with the facial midline and the lower dental midline was shifted 2 mm to the left. The lips were competent at rest. The upper lip length was 21 mm. The lower lip was normal. The incisor show was 1 mm at rest and 8 mm on smiling. There was a slight anterior mandibular shift and the temporomandibular joints had clicking on both sides.

Intraorally, oral hygiene was fair and there was generalized marginal gingivitis. Enamel hypoplasia was present on the incisors and the first molars and there was generalized tetracycline staining. She had multiple fillings of the posterior teeth. The lower arch was

symmetrical and parabolic in shape with a mild curve of Spee. The anterior segment was well aligned and LL5 and LR5 were rotated distolingually. The upper arch was symmetrical and U-shaped. The molar relationship was Class III on both sides. The canine relationship was Class III on the right side and Class I on the left. The incisor relationship was Class III with anterior crossbite from UR2 to UL2. The overjet measured at UR1 was –2 mm. The overbite was 2 mm (20%).

Radiographic analysis

The orthopantomogram (Figure 2) confirmed the presence of 32 permanent teeth. LR6 was root-treated and a periapical radiograph showed the extrusion of filler through the root apices. There were amalgam overhangs on UR6, UL6.

Cephalometric analysis (Table 1, Figure 3) revealed a normal skull base angle and a Class III skeletal relationship with prognathic mandible. The upper incisors were proclined and the lower incisors were retroclined. Vertically, there was balanced facial proportion despite a reduced mandibular plane angle. The upper lip was retruded and the lower lip protruded.



Figure 1 (a-i) Case 1: pre-treatment photographs

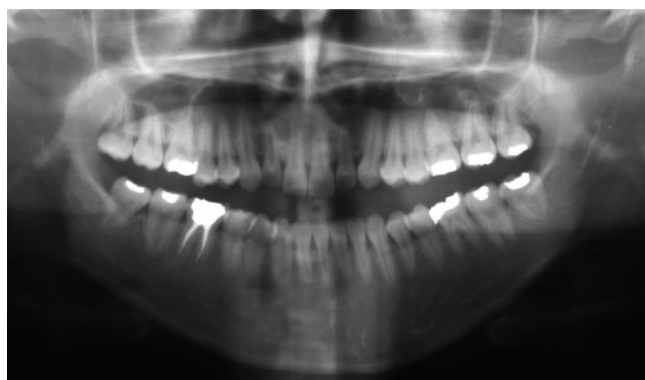


Figure 2 Case 1: pre-treatment orthopantomogram

Diagnostic summary

A 20-year-old Chinese female presented with a chief complaint of protruding lower anterior teeth. She had a straight lateral profile, paranasal deficiency, with protruding lower lip and the chin was deviated to the left. The diagnosis was a Class III malocclusion on a Class III skeletal base relationship with mandibular prognathism and skeletal asymmetry. There was a mandibular displacement and the lower dental midline was shifted to the left. The lower incisors were retroclined and the upper incisors were proclined. The teeth were hypoplastic and LR6 was root-treated. The treatment need (IOTN)¹ was moderate (3) based on the dental



Figure 3 Case 1: pre-treatment lateral cephalogram

health component. The pre-treatment weighted Peer Assessment Rating (PAR)¹ score was 43.

Treatment plan

The aims and objectives of treatment were:

- to normalize overjet and overbite;

- to correct the anterior crossbite;
- to align teeth and harmonize arches;
- to eliminate the mandibular shift.

The treatment plan involved a combination of orthodontics and orthognathic surgery to correct her skeletal discrepancies. The orthognathic surgical treatment in the mandible² included a Hofer osteotomy with extractions of LL4, LR4 to retract the labial segment and to close the space created by lower incisor decompensation, and genioplasty to advance the chin. In the maxillary arch, a segmental Le Fort 1 osteotomy³ with extractions of UR4, UL4 was performed. Pre-surgical orthodontics was carried out for alignment and incisor decompensation. After surgery, post-surgical orthodontics was carried out to establish the final occlusal relationship. Extractions of first permanent molars were also considered as an alternative because they were either restored or root filled. However, after consultation with the surgeons, this was considered less favourable because of the difficulty of arch coordination during surgery and posterior crossbites might result.

Treatment progress

The patient underwent full surgical assessment and planning by the surgeons and the orthodontists. After the surgeons confirmed that the mandible asymmetry had been stable using Technetium-99 bone scan technology, pre-surgical orthodontic treatment was started.

The treatment began with the fitting of upper and lower pre-adjusted edgewise appliances of 0.022-inch slot. The initial archwires were 0.016-inch nickel titanium (NiTi). After 7 months of treatment,

Table 1 Case 1: cephalometric analysis: pre-treatment, immediate pre-surgical and post-surgical, and post-treatment

Variable	Normal	Pre-treatment	Pre-surgical	Post-surgical	Post-treatment
SNA	82±3	81.0	81.2	82.4	82.0
SNB	79±3	83.9	84.3	82.6	82.4
ANB	3±2	-2.9	-3.1	-0.2	-0.4
WITS (mm)	-4.5	-10.0	-11.4	-9.4	-7.7
UI/M × PI angle	118±6	130.5	132.0	120.9	122.2
LI/MnPI angle	97±7	88.3	99.5	85.4	85.8
UI/LI angle	115±8	119.9	108.5	131.2	129.8
MM angle	26±5	21.3	20.0	22.6	22.1
UAFH	54	58.3	57.7	57.3	56.5
LAFH	64	73.1	72.1	75.2	75.8
LAFH/TAFH%	55%	56%	56%	57%	57%
LI/APo (mm)	5.5	10.1	15.2	4.0	4.1
Lower lip to E line (mm)	4	8.8	8.0	0.2	-0.9

Source of normal values: Cooke.⁴

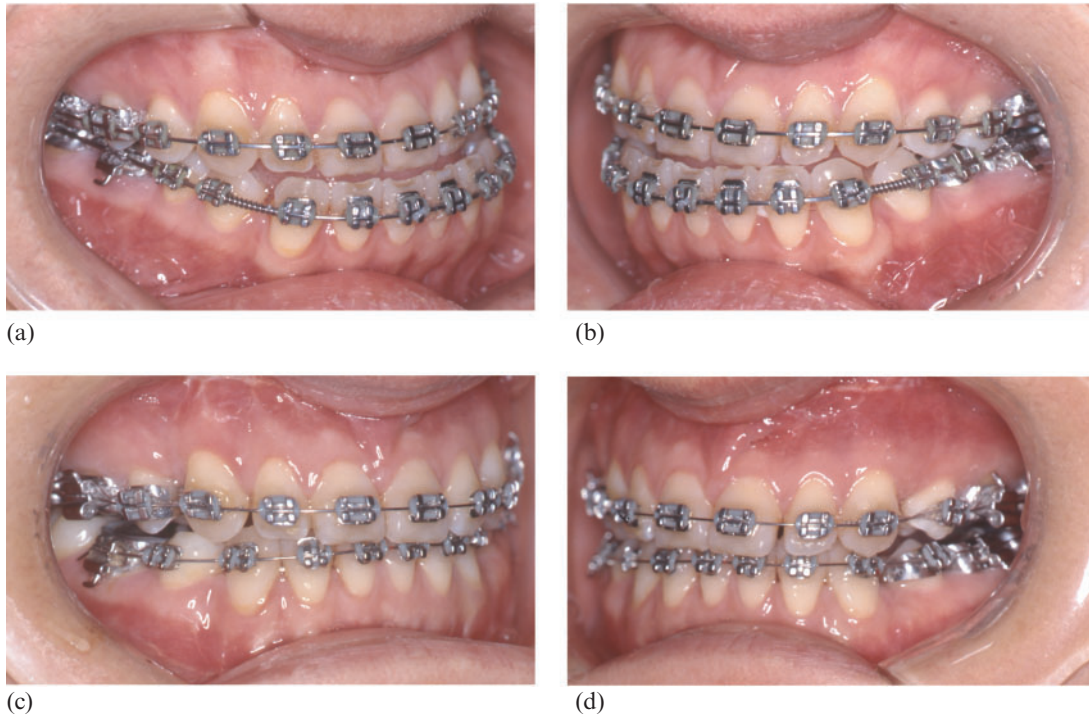


Figure 4 (a-d) Case 1: mid-treatment photographs

0.018-inch Australian stainless steel (Special Plus) archwires were placed for further alignment and levelling. As spaces were created during decompensation, NiTi open-coil springs were placed between LL3, LL4 and LR3, LR4 to redistribute the spaces distal to the lower canines. At the end of pre-surgical orthodontic treatment, upper and lower 0.019 × 0.025-inch stainless steel archwires were inserted with passive coil springs to maintain the spaces distal to the lower canines. Decompensation of the incisors was shown in Figure 4a,b. Orthognathic surgery was performed under general anaesthesia after 12 months of pre-surgical orthodontic treatment. On the upper arch, a four-piece segmental Le Fort I osteotomy was performed to slightly advance the maxilla. On the lower arch, an anterior segmental Hofer osteotomy was performed to retract the lower anterior segment and a genioplasty was performed to advance the chin.

After surgery, the midlines were off and there were spaces distal to the surgical cuts. UR8, UL8 were extracted during the surgery and UL6 was root treated afterwards. Post-surgical orthodontic treatment began 3 months after surgery. The teeth were initially aligned with 0.014-inch NiTi archwires. The upper canines were laced back for gentle space closure and to prevent movement of bone segments (Figure 4c,d). UL3 and LR3 were retracted with power chains on 0.019 × 0.025-inch stainless steel archwires. Then space closure was

carried out with sliding mechanics using NiTi closed coil-springs between the molars and the Gurin hooks. The midline discrepancy was corrected by using Class II elastics on the left side, Class III elastics on the right side and anterior oblique elastics (lower left Gurin hook to upper right Gurin hook). The whole treatment was completed in 27 months (12 months pre-surgical orthodontics, 3 months for surgery and bone healing and 12 months post-surgical orthodontics). After debond (Figures 5a-i, 6 and 7), a modified upper Hawley retainer and a lower fixed lingual retainer from LL5 to LR5 were fitted.

Superimposition of lateral cephalometric radiographs

Pre-treatment and immediate pre-surgery (Figure 8a,b): Superimposition along the anterior cranial base showed that there was no growth. There was an increase in reverse overjet and protrusion of the lower lip. Superimposition along the palatal plane showed slight proclination of the upper incisors and distalization of the upper molars. Superimposition on mandibular stable structures showed that the lower incisors were proclined as they were decompensated.

Post-surgery and post-treatment, (Figure 8c,d): Superimposition along the anterior cranial base showed that there were minimal skeletal changes. Superimposition on



Figure 5 (a–i) Case 1: post-treatment photographs

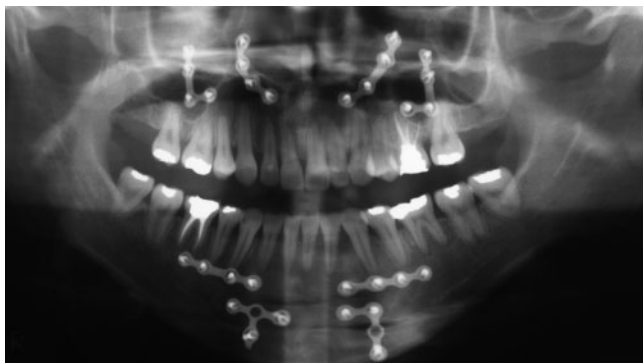


Figure 6 Case 1: post-treatment orthopantomogram

the maxilla using the key ridge and bone plates as guides showed palatal movement of the upper incisors. Superimposition on the mandible, using stable structures and bone plates as guides, showed that the lower incisors were slightly proclined.

Results achieved

Pre-surgical orthodontics took approximately 12 months. Teeth were aligned and the lower anterior teeth were proclined as they were decompensated. Excess space was redistributed distal to the canines. Three months were allowed for surgery and bone

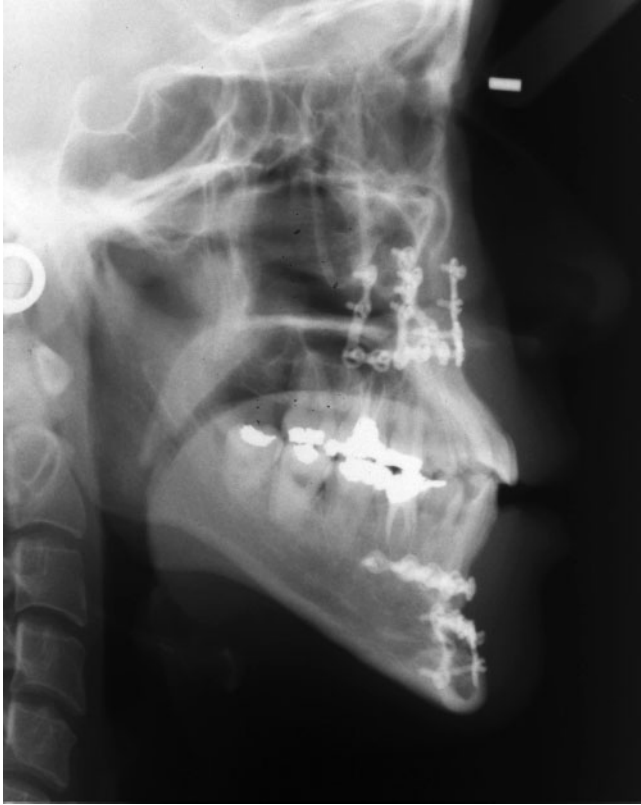


Figure 7 Case 1: post-treatment lateral cephalogram

healing. After surgery, the occlusion was not satisfactory as spacing between the bony segments and the centre lines were not co-ordinated. Post-surgical orthodontics took 12 months to complete. The whole treatment was completed in 27 months.

All objectives of treatment had been achieved (Figure 5a–i). Buccal segment and incisor relationships were Class I, with the overjet slightly over-corrected at 3 mm. Maxillary incisor proclination was reduced. Teeth were well aligned with good occlusal interdigitation. The face was symmetrical and the centerlines were coincident. There was a significant improvement in facial profile as mandibular prognathism was reduced and the lower lip retracted. The post-treatment PAR score¹ was 0, giving a 100% reduction in the weighted PAR score.

Case report 2

History and clinical examination

The patient was a 19-year-old Chinese female with a chief complaint of facial asymmetry and reverse bite (Figure 9a–i). The patient had noticed progressive jaw deviation to the right since 14 years of age. There was no history of injury to the head or jaw and no family history of Class III malocclusion. A Technetium-99 bone scan at age 18 years revealed left unilateral condylar hyperplasia of the mandible. A repeated

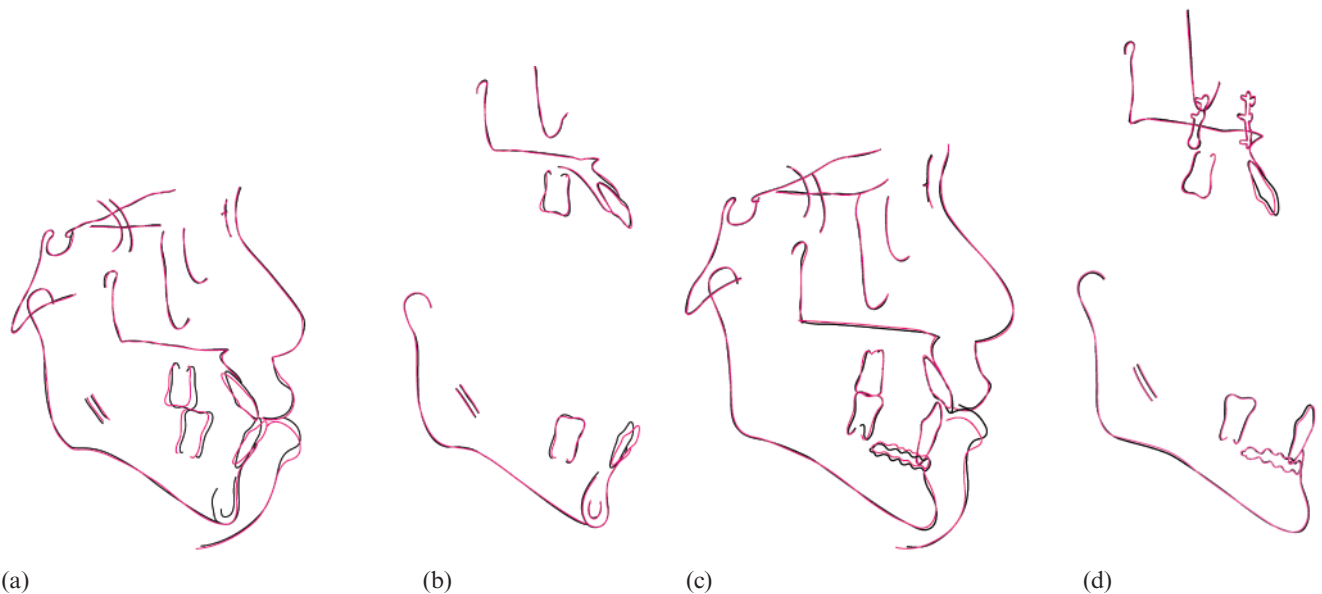


Figure 8 Case 1: superimpositions, black: pre-treatment; red: post-treatment. (a,b) Pre-surgical orthodontics, start and after decompensation. (a) On the cranial base along natural reference structures; (b) on the palatal plane along natural reference structures; and on the mandible along natural reference structures. (c,d) Post-surgical orthodontics; (c) on the cranial base along natural reference structures; (d) on the palatal plane along natural reference structures and bone plates; and on the mandible along natural reference structures and bone plates



Figure 9 (a–i) Case 2: pre-treatment photographs

examination at age 19 years showed that the growth activity of the left condyle had stabilized.

On the frontal view, the patient had asymmetry in the lower third of her face with the chin point deviated to the right. The maxillary occlusal plane was canting down to the left. The facial proportion was normal. Her lips were competent at rest with the upper lip slightly short. The profile was straight with a slightly acute nasolabial angle and the labiomental fold was reduced. There was no sign or symptom of temporomandibular joint dysfunction.

Intra-orally, the frenal attachments were normal and the tongue was of normal size and function. There were thin attached gingivae overlying the lower incisors and LL1 had associated gingival recession. Oral hygiene was generally satisfactory. There were several restored molars

and caries were detected on UL7 occlusal surface and LL6 buccal surface. The teeth were generally small and exhibited generalized mottling and staining. The patient was in the permanent dentition stage with 27 permanent teeth present. The third molars were not present and UR6 had been extracted due to caries at an early age.

The mandibular arch was tapered and asymmetrical. The lower incisors were upright and heavy facets were present on LR4 and LR5. The maxillary arch was parabolic in shape and symmetrical. UR2 and UL2 were microdontic, leading to mandibular anterior tooth size excess. UR1 and UR2 were upright. UR7 and UL5 were rotated. Both the maxillary and mandibular arches were generally well aligned.

The molar relationship was Class III on the left and unclassified on the right. The canine relationship was



Figure 10 Case 2: pre-treatment orthopantomogram

Class II on the right side and Class III on the left. The incisor relationship was Class III with an anterior crossbite from UR1 to UL2. The overjet measured at UR1 was -1.5 mm. The overbite was 2 mm (33%). The maxillary midline was coincident with the facial midline while the mandibular midline was deviated to the right by 4.5 mm. There was a lateral mandibular displacement to the right due to a premature contact between UR3 and LR3, leading to a crossbite of the right buccal segment at maximum intercuspation. In

centric relation, the mandibular midline was deviated 4 mm to the right.

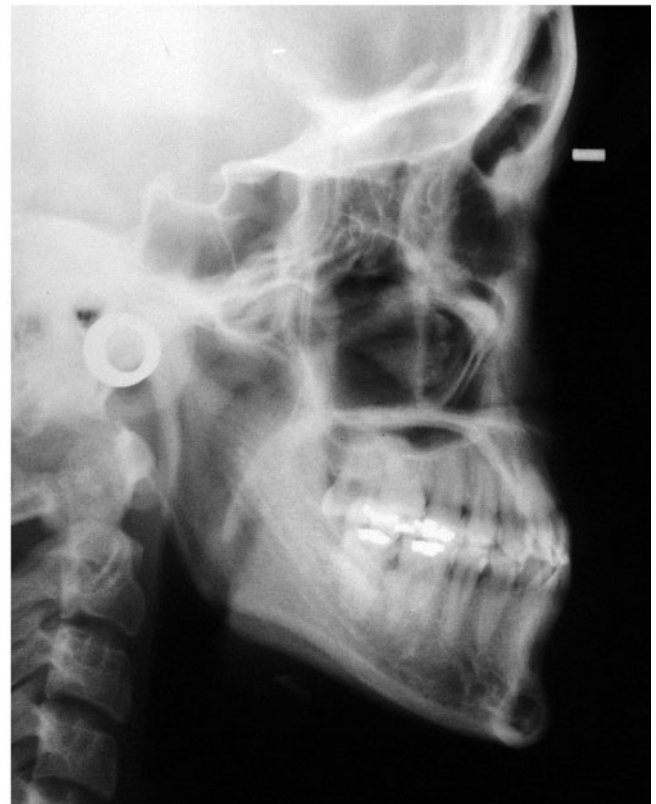
Radiographic analysis

The panoramic radiograph (Figure 10) confirmed the presence of 27 permanent teeth, with UR6 and third molars absent. The alveolar bone level and the root length on all teeth were normal. The left mandibular condyle was elongated leading to an increased ramus height. The right mandibular condyle was flattened, but it was most likely an adaptive change to the asymmetrical jaw growth. The posteroanterior skull radiograph (Figure 11a) confirmed the canting of the maxillary occlusal plane.

Cephalometric analysis (Table 2, Figure 11b) indicated a Class III skeletal base relationship (ANB angle and Wits appraisal) due to a prognathic mandible (SNB angle). Lower anterior facial height was reduced, although the inter-maxillary plane angle was normal. Upper incisors were at an average inclination and lower incisors were markedly retroclined leading to an increase in interincisal angle, suggesting dentoalveolar compensation for the prognathic mandible. The lips were retrusive to the E-plane.



(a)



(b)

Figure 11 Case 2: (a) pre-treatment posteroanterior skull radiograph; (b) pre-treatment lateral cephalogram

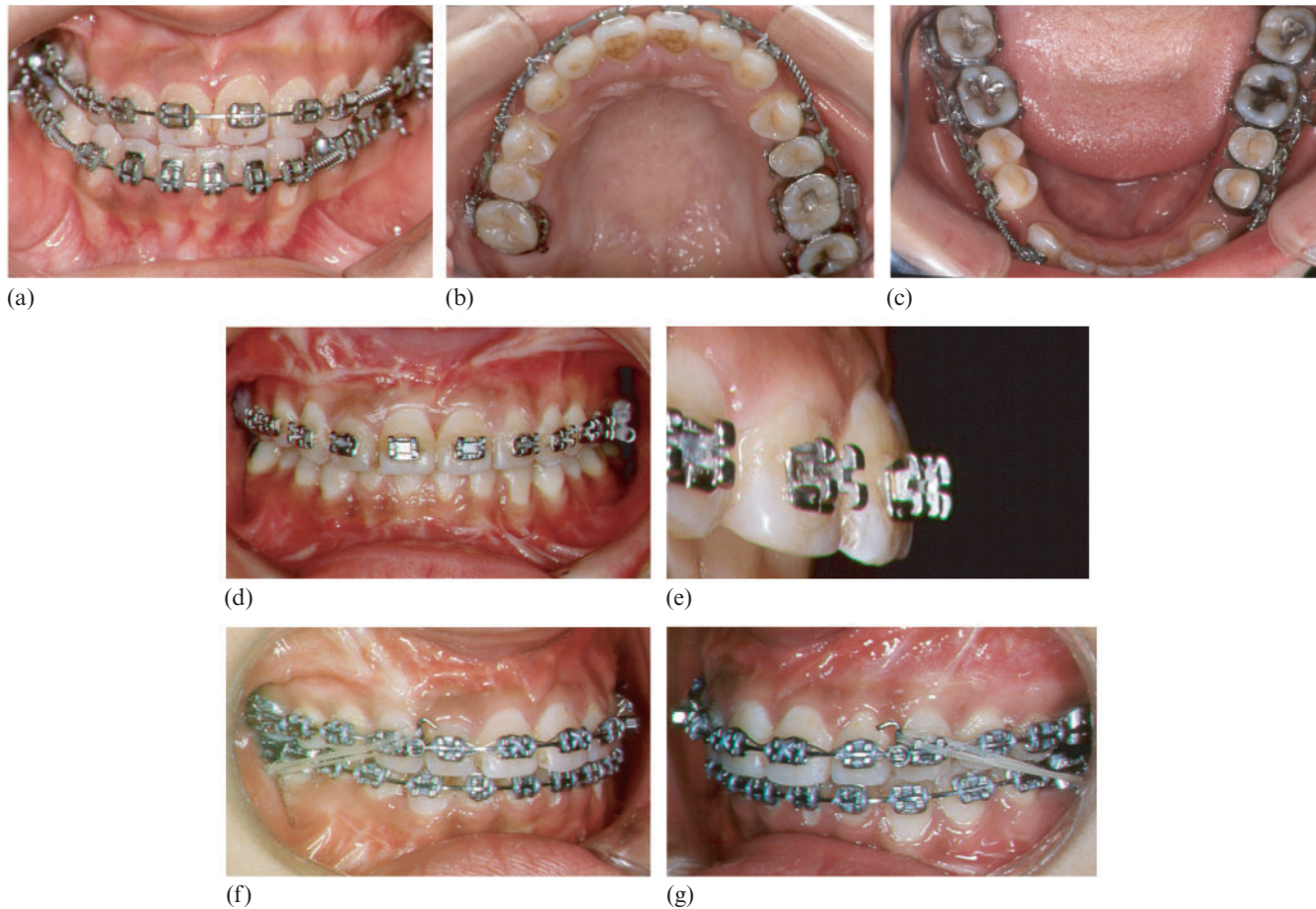


Figure 12 (a–g) Case 2: mid-treatment photographs

Table 2 Case 2: cephalometric analysis: pre-treatment, immediate pre-surgical and post-surgical, and post-treatment

Variable	Normal	Pre-treatment	Pre-surgical	Post-surgical	Post-treatment
SNA	82 ± 3	82.7	82.7	82.9	82.7
SNB	79 ± 3	82.8	82.4	79.7	80.1
ANB	3 ± 2	-0.1	0.3	3.2	2.6
WITS (mm)	-4.5	-7.7	-7.1	-5.3	-6
UI/MxPl angle	118 ± 6	113.4	125.4	109.6	115.1
LI/MnPl angle	97 ± 7	75.5	93.3	90.1	90.4
UI/LI angle	115 ± 8	147	118.9	133.2	127.4
MM angle	26 ± 5	24.1	22.4	27.1	27.1
UAFH	54	56.7	57.2	57.1	56.5
LAFH	64	63.2	62.6	63.5	61.6
LAFH/TAFH%	55%	53%	52%	52.5%	52%
LI/APo (mm)	5.5	2.7	6.9	2.2	3.1
Lower lip to E line (mm)	4	-0.1	2.6	-1	-1.8

Source of normal values: Cooke.⁴



Figure 13 (a–i) Case 2: post-treatment photographs

Diagnostic summary

A 19-year-old Chinese female with left unilateral condylar hyperplasia presented with the chief complaints of facial asymmetry and reverse bite. She had a straight profile with retrusive lips. She had a Class III malocclusion on a Class III skeletal base relationship attributed to mandibular prognathism. Vertically, there was maxillary occlusal plane canting and a reduced lower facial height. Transversely, the mandibular midline and chin point were deviated to the right. There was a lateral mandibular displacement due to occlusal interference leading to a crossbite from UR1 to UR7 at the intercuspal position. The lower incisors were markedly retroclined leading to an increased interincisal angle. UR2 and UL2 were microdontic and UR6 was

extracted. UL7 occlusal surface and LL6 buccal surface were carious. The treatment need (IOTN)¹ was great (4c) based on the dental health component. The pre-treatment weighted Peer Assessment Rating (PAR)¹ score was 36.

Treatment plan

Aims and objectives of treatment were:

- Improvement of facial aesthetics through correction of the sagittal, vertical and transverse skeletal discrepancies.
- Removal of the dentoalveolar compensation.
- Correction of the reverse overjet and elimination of the mandibular displacement so normal overjet and overbite could be obtained.



Figure 14 Case 2: post-treatment orthopantomogram

- Coordination of maxillary and mandibular midlines.
- Alignment of the teeth and coordination of the arches so good occlusal interdigitation could be achieved.

The treatment plan involved a combination of orthodontics and orthognathic surgery to correct her skeletal discrepancies. The orthognathic treatment in the mandible included vertical subsigmoid osteotomies (VSO)² for correction of the skeletal asymmetry, a Hofer osteotomy to retract the labial segment and to close the space created by lower incisor decompensation, and symphyseal split to constrict the arch. In the maxillary arch, Le Fort 1 osteotomy³ was performed to remove the occlusal cant. Pre-surgical orthodontics was carried out for alignment and incisor decompensation. After surgery, post-surgical orthodontics was carried out to establish the final occlusal relationship.

Treatment progress

As a repeated bone scan had shown that the condylar hyperactivity had ceased, it was decided that treatment could be instituted. Thorough oral hygiene instruction and dietary advice were given and UL7 and LL6 carious lesions were restored before pre-surgical orthodontics was commenced. Upper and lower pre-adjusted edge-wise fixed appliances (0.022 × 0.028-inch slot) were fitted (Figure 12a–c), with Roth's prescription for upper incisors and molars, and Andrew's prescription for the remaining teeth. The initial archwires were 0.016-inch nickel titanium (NiTi) for leveling and alignment. As the attached gingiva in relation to the lower incisors was thin, care was taken to maintain torque control during decompensation by slowly progressing through a sequence of 0.018-inch stainless steel, 0.016 × 0.022-inch titanium molybdenum alloy (TMA) and 0.017 × 0.025-inch TMA archwires. 0.017 × 0.025-inch stainless steel archwires were used for stabilization before surgery. The space created by decompensation was distributed distal to the canines by NiTi open-coil springs between



Figure 15 Case 2: post-treatment lateral cephalogram

adjacent teeth (Figure 12a–c). The microdentic UR2 and UL2 were built up prior to surgery.

Surgery was performed after 14 months of pre-surgical orthodontic treatment. As planned, vertical subsigmoid osteotomies were performed to correct the mandibular asymmetry, with more setback on the left side than on the right. A lower anterior segmental Hofer osteotomy was used to retract the labial segment and to close the space created by lower incisor decompensation. A symphyseal split osteotomy was used to constrict the arch, rather than to create space. In the maxillary arch, a Le Fort 1 osteotomy in four pieces was performed to remove the occlusal cant. Intermaxillary fixation was required for stabilization and the patient was immobilized for 6 weeks. After surgery, the facial asymmetry was greatly improved and a positive overjet was achieved (Figure 12d,e). As the archwires and many brackets were removed during surgery to facilitate accurate positioning of the interocclusal wafer, there was recrowding of the lower incisors and the overjet and overbite were increased. When a satisfactory range of jaw motion was achieved, three months after surgery, post-surgical orthodontics was instituted. Class II elastics were used to reduce the overjet and to improve the buccal segment relationship (Figure 12f,g). Upper and lower 0.017 × 0.025-inch TMA archwires were used

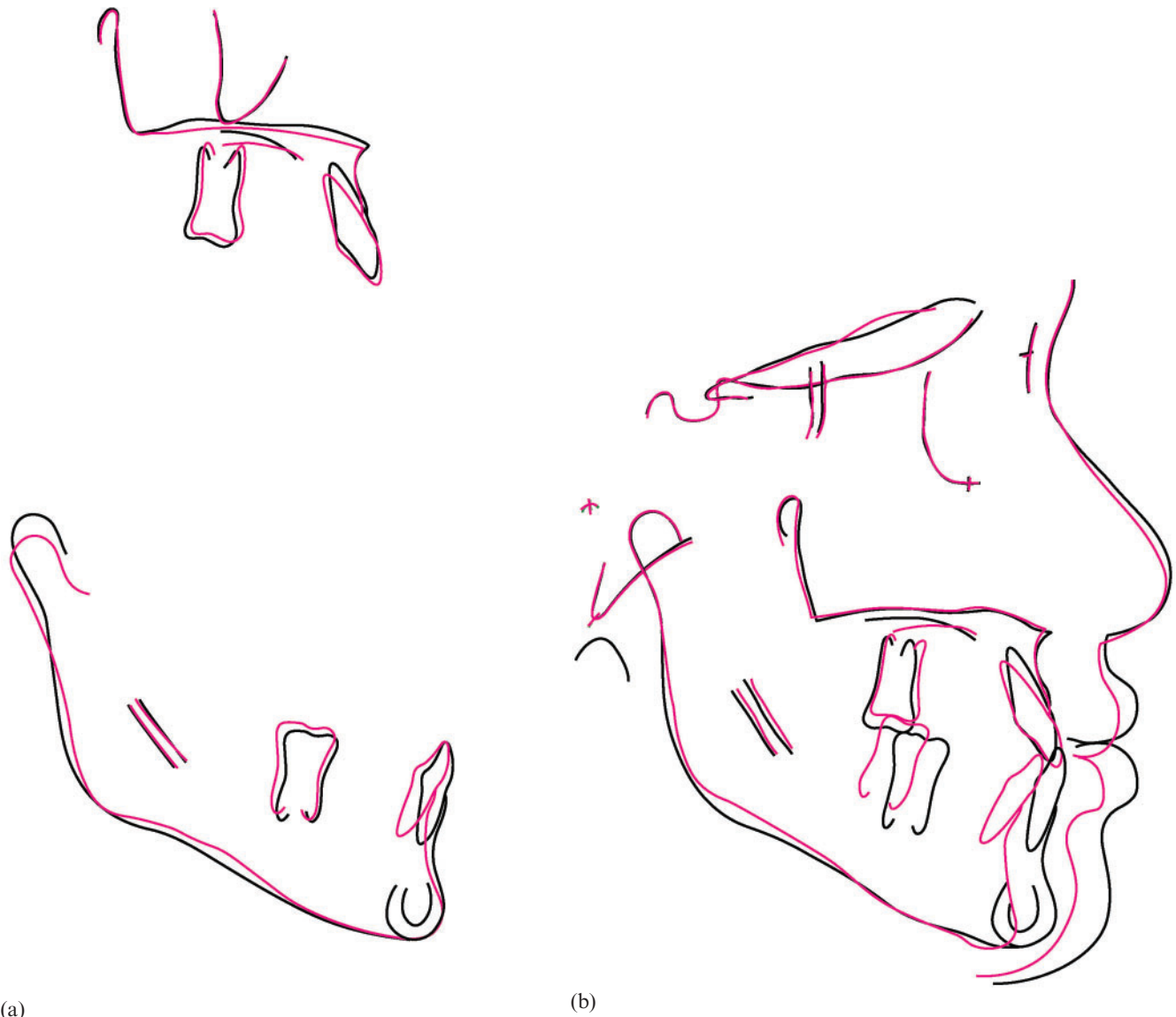


Figure 16 Case 2: superimpositions before and after combined surgical orthodontic treatment. Black: pre-treatment; red: post-treatment. (a) on the palatal plane along natural reference structures; and on the mandible on mandibular stable structures. (b) overall superimposition along anterior cranial base

for finishing and detailing. At the completion of active treatment (Figure 10a–i), an upper wraparound retainer and a lower fixed lingual retainer with 0.0175-inch multistrand stainless steel wire for the labial segment were fitted. The patient was then referred for UR2 and UL2 porcelain veneers. Throughout the treatment, the patient's oral hygiene status was monitored. The final records are shown in Figures 13,14 and 15.

Superimposition of cephalometric radiographs

Cephalometric superimposition (Figure 16a,b, Table 2) showed that the skeletal base relationship

was normalized. As the mandible was set back and the anterior segment was retracted, the ANB angle increased from -0.1 to 2.6° . Upper and lower incisors were within the normal angulations and the interincisal angle was significantly reduced.

Some autorotation of the mandible had taken place as the maxillary canting was corrected, which was reflected by a reduction of the lower facial height proportion. However, the inter-maxillary plane angle increased and this was probably due to a change in location of the landmarks for the mandibular plane as a result of surgery.

Results achieved

Pre-surgical orthodontics took approximately 14 months. The lower incisors were proclined from 76 to 93° as they were decompensated. Post-surgical orthodontics also took 10 months. The whole treatment was completed in 27 months (14 months pre-surgical orthodontics, 7 months for surgery including 3 months for bone healing, and 10 months post-surgical orthodontics).

All objectives of treatment had been achieved (Figure 13a–i). Normal overjet and overbite were obtained at the end of treatment, with good occlusal interdigitation and arch alignment. Molar and canine relationships were Class I. Centre lines were coincident and the mandibular displacement was eliminated. The mandibular incisor angulation was normalized, thereby reducing the interincisal angle. There was improvement in gingival recession in relation to tooth LL2. Facial symmetry was achieved and mandibular prognathism was reduced. There was an improvement in facial profile with the lower lip retracted and the labiomental fold more pronounced. The post-treatment

PAR score was 0, giving a 100% reduction in the weighted PAR score.¹

Acknowledgements

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