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Clinical Section

The Gold Medal Prize in the Conjoint M.Orth. Exam of the Royal College of Surgeons of Edinburgh Held in Hong Kong, 1996

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Introduction

This award was given out in 1996, the year in which the M.Orth. R.C.S.Ed. examination was first held in Hong Kong. A gold medal and certificate were awarded to the candidate who scored the highest overall mark in Part II of the M.Orth. examination. The prize was awarded on the basis that a candidate's performance is of a sufficiently high standard.

The clinical aspect of the examination consisted of three parts. The first part involved the presentation of a fully documented fixed appliance case, a multidisciplinary case with full documentation and three condensed case histories. Part two was a diagnostic test of clinical cases examined by the candidate. The final part was an oral examination on any aspect of orthodontics. This case report details the multidisciplinary case and one of the condensed case histories.

Case Report 1

A 16-year 7-month-old Chinese female presented with two related complaints of a protruding lower jaw and an inability to cut food with her front teeth. The medical history was insignificant. An older sister, who was present with her at the time of the initial consultation, had a Class I profile, and neither parent exhibited mandibular prognathism. However, one paternal uncle was reported to have marked mandibular prognathism. The patient was keenly aware of her problems and was very committed to have them resolved. She had recognised that her problem was severe and did not mind the use of surgery to correct the mandibular protrusion.

Facial examination (Figure 1a–i) revealed a mildly asymmetrical face with the chin point deviated to the right of the facial midline. Vertically, the lower facial third appeared to be elongated with respect to her mid-facial and upper facial thirds. At rest, the lips were incompetent. The mandible appeared prognathic and accentuated the mild paranasal flattening of the midface. Patient's profile was markedly concave and had a prognathic facial type. A reduced nasal bridge prominence was noted and was considered a facial characteristic of the Chinese ethnic group. The naso-labial angle was acute and the labio-mental fold was reduced. The midface appeared to be deficient with respect to the prognathic mandible. The mandibular plane was steep with the lower facial third elongated. There were no signs and symptoms of temporo-mandibular joint dysfunction; the circum-oral and the masticatory musculature were of average tonicity.

The periodontal tissues were healthy and all the teeth exhibited physiological mobility. There was adequate attached gingiva throughout, especially at the lower anterior region. The tongue was of average size and had a good resting postural position. However, the tongue tended to move forwards to create an anterior oral seal during swallowing, which was probably an adaptive response to the anterior open bite.

The upper dental midline was coincident with the facial midline, while the lower midline was deviated to the right by 1 mm. The erupted teeth were from 17 to 27, and from 38 to 48; 18 and 28 were unerupted. The maxillary occlusal plane was parallel to the inter-pupillary line. The curve of Spee was mildly reversed in the lower arch and was increased in the upper arch, tilting upwards at the upper anterior region. Restorations present were buccal pit amalgam restorations on teeth 36 and 46, and occlusal AR on teeth 36, 37, and 46. The right-sided and left-sided molar relationships were both Class III, and so were the canine relationships. The incisor relationship was Class III with a reversed overjet of −6 mm, and an anterior open bite was present with 2–3 mm of vertical incisor separation. Bilateral buccal segment posterior crossbites were observed.

No centric relation-maximum intercuspation (CR-MI) slide was observed. Tooth attrition was generally mild. Right and left lateral excursive movements showed group function contacts.

The maxillary and mandibular arch forms were parabolic and U-shaped, respectively. Both arches were generally symmetrical. In the maxillary arch, moderate anterior crowding was observed with the upper central incisors rotated disto-labially and both upper canines rotated mesio-labially. The mandibular arch was generally well aligned. Both mandibular second premolars showed mild

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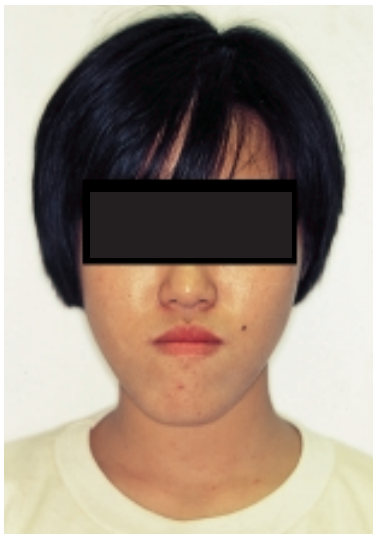

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FIG. 1 (a–i) Case report 1: pretreatment photographs and radiographs.

mesio-lingual rotation and were lingually inclined. The third molars were partially erupted. The upper incisors were proclined while the lower incisors were retroclined. An analysis of space requirements for the maxillary arch showed an additional space of 3 mm was required to align the rotated upper central incisors. Furthermore, to achieve a good upper incisor angulation, the upper incisors needed to be brought back by about 4 mm, which translated into an additional space requirement of 8 mm. Therefore, the total space requirement for the upper arch would be approximately 11 mm. The mandibular arch was not crowded; labial uprighting of the lower incisors would create additional space. The Bolton discrepancy analysis revealed that the over-all ratio was 97·2 per cent, giving a mandibular excess of 5·4 mm. The anterior ratio was 84·8 per cent giving a mandibular excess of 3·3 mm. The excess in tooth size was significant, and could be attributed to the narrower upper second premolars and upper central incisors.

The orthopantomogram revealed all third molars were present with the maxillary third molars possibly impacted. Alveolar bone height appeared normal. There were no signs of periapical pathology.

The pretreatment lateral cephalogram (Figure 1i) showed a reduced antero-posterior width of the mandibular symphysis. The constriction at the alveolar portion of the symphysis would restrict the amount of labio-lingual movement of the lower incisors, and therefore could affect the amount of lower incisor movement during pre-surgical orthodontic decompensation.

Cephalometric analysis is presented in Table 1.

The SNA and SNB values suggested that the antero-posterior skeletal problem was attributed to a prognathic mandible. Both the ANB value and the Wits analysis suggested a severe antero-posterior skeletal discrepancy. In the vertical dimension, the relationship of the anterior craninal base (SN) to the mandibular plane (MP, defined by gonion–menton) and that of the Frankfurt horizontal to the MP suggested a skeletal open bite relationship. Lower anterior facial height was increased with respect to the total facial height at 60 per cent. The gonial angle was markedly obtuse. The posterior facial height (sella–gonion), at 56 per cent with respect to the anterior facial height, was decreased. The values for both posterior and lower anterior facial heights contributed to the steepness of the mandibular plane.

The upper incisors were proclined (e.g. U1–SN), while the lower incisors were retroclined (L1–MP). These abnormal incisor inclinations were probably due to the dentoalveolar compensatory effects arising from the severe antero-posterior skeletal Class III relationship. The lower incisors were displaced anteriorly with respect to the maxillary base (L1—APg) as well as to the cranium (L1–NB). The inter-incisal angulation (U1–L1) appeared normal due to the severe proclination and retroclination of the upper and lower incisors, respectively. Severe facial concavity (i.e. G–Sn–Pg' is −8 degrees) was shown in the soft tissue outline. The lower lip was procumbent as revealed by the E-line.

The patient had a Class III malocclusion on a Class III skeletal base relationship attributed to mandibular prognathism. The vertical skeletal base relationship revealed an open bite pattern characteristic of 'high-angle' cases. The upper incisors were proclined considerably, while the lower incisors were retroclined, which reflected an inadequate attempt at dentoalveolar compensation for the severe vertical and antero-posterior skeletal discrepancy. The presence of a reversed overjet and an anterior open bite revealed the underlying severity of the antero-posterior and vertical skeletal discrepancy, respectively. The posterior crossbites were incidental to the existing antero-posterior discrepancy, as arch width compatibility would improve once the antero-posterior discrepancy was corrected. Significant tooth-size discrepancy was present with excess mandibular tooth structure. Facial soft tissue disharmony was present due to the underlying dental and skeletal discrepancy. Pretreatment Peer Assessment Rating (PAR) score was 43, and the malocclusion was assessed to have an Index of Orthodontic Treatment Need (IOTN) score of 5 for the dental health component and 10 for the aesthetic component.

The aims of treatment were:

1. Improvement of occlusal function, and facial aesthetics through a reduction in mandibular prognathism.

TABLE 1 *Case 1: pretreatment, immediate pre-surgical and post-surgical, and posttreatment cephalometric analysis*

Measurement	Pretreatment	Immediate pre-surgical	Immediate post-surgical	Post-treatment
SNA	88	90	89	89
SNB	94	94	85	87
ANB	−6	−4	4	2
WITS (mm)	−21	−15	−2	0
SN–MP	41	41	39	41
FMA	38	35	36	35
ANS–Me/N–Me	60%	59	60	59
U1–SN	125	107	107	111
U1–FH	127	112	110	116
L1–APg (mm)	11	13	0	2
L1–MP	70	77	77	70
U1–L1	124	135	136	138
Facial convexity G–Sn–Pg'	−8	−8	+3	−1
Upper lip protrusion (mm) Ls to (Sn–Pg')	5	5	8	7
Nasolabial angle CM–Sn–Ls	80	77	70	73
Lower lip to E line (mm)	4	6	6	2
Labiomental fold Si to (Li–Pg') (mm)	3	0·5	7	5

2. Removal of the dentoalveolar compensation through a combination of lower incisor proclination and upper incisor retroclination.
3. Creation of space to align upper anterior teeth and obtain good upper incisor angulation.
4. Elimination of the anterior open bite and reverse overjet so that a good incisor overbite and overjet were obtained.
5. Elimination of posterior crossbite.
6. Achievement of good occlusal interdigitation for improved stability of treatment and function.

Given the patient's personal account that there had been no perceptible increase in her lower jaw protrusion over the last 2 years, it was decided that orthodontic decompensation could begin over the next few months. A treatment plan involving a combination of orthodontics and mandibular setback osteotomy using the Bilateral Sagittal Split Osteotomy (BSSO) procedure was presented to and accepted by the patient and her parents. This combination treatment approach was deemed to be optimal in achieving an aesthetic and stable result, as the skeletal discrepancy was too large to correct by orthodontic camouflage alone.

Extraction of upper second premolars was performed, for the purposes of alignment and upper incisor decompensation. As the anchorage requirement in the maxillary arch was moderate, extraction of teeth 15 and 25 was the ideal extraction plan, as this would facilitate reciprocal space closure. The third molars were also removed prior to the start of orthodontic treatment. The *Tip-Edge* appliance was the fixed appliance of choice for this malocclusion.

During the phases of pre-surgical orthodontic decompensation and alignment, the initial archwires used were the 0·014-inch nickel titanium (NiTi) for alignment and levelling of the upper and lower arches. Further alignment and levelling was carried out with upper and lower 0·016-inch stainless steel Australian special plus archwires with rotation springs to further improve rotational correction of teeth 11 and 21. Upper arch space closure and upper incisor retraction with upper power chain and light Class II elastics (2 oz), respectively, were then initiated.

Subsequent to incisor retraction, upper and lower 0·017 × 0·025-inch titanium molybdenum alloy (TMA) archwires were used for posterior molar control. Further root control and closure of extraction spaces through incisor retraction and mesial molar movement were achieved on an upper 0·019 × 0·025-inch stainless steel archwire. A lower 0·019 × 0·025-inch stainless steel archwire was used for continued root control and decompensation. Class II elastics (3 oz) and upper power chains were used until all spaces were closed. The Class II elastics had the effect of proclining the retroclined lower incisors during space closure. Good mesio-distal root angulation of individual teeth was achieved with 0·014-inch stainless steel sidewinder uprighting springs.

Case 1 Assessment

Throughout the course of treatment, patient had been exemplary in commitment and attendance. Good oral hygiene was maintained throughout treatment. Pre-surgical orthodontic decompensation took approximately 13 months before patient was sent for surgery. Incisor decompensation was obtained by the upper incisors retroclining to a good antero-posterior angulation (U1–SN from 125 to 107 degrees), and the lower incisors proclined from 70 to 77 degrees for L1–MP. Levelling of the upper occlusal plane was achieved as the upper incisors retroclined (Figure 2). Posterior molar root control was achieved with the rectangular archwires. All extraction spaces were closed prior to surgery.

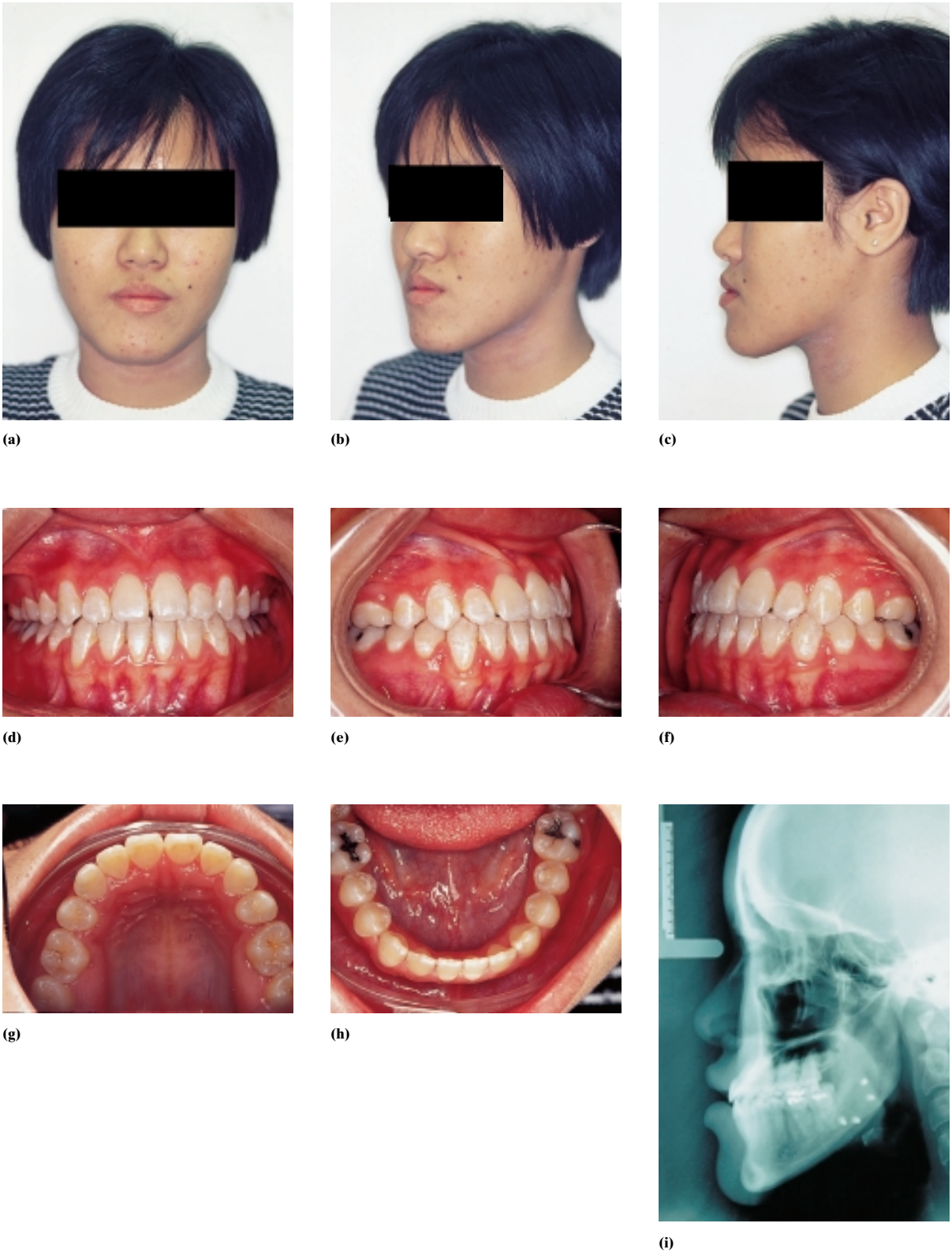
FIG. 2 Case report 1: pretreatment (black) and immediate pre-surgical (blue) cephalometric tracings superimposed on SN at sella.

A straight mandibular setback of 15 mm was carried with the bilateral sagittal split osteotomy (BSSO) procedure. The proximal and distal mandibular segments were fixed rigidly titanium bone screws.

Good incisor relationship was obtained post-surgically. The anterior open bite had been closed and a positive overjet was achieved. Elastic wear (3 oz, 5/16-inch) with a Class III vector was instituted 4 weeks post-surgery, with patient wearing it for at least 3 hours daily for the first week of wear, extending to full time wear from a third week of starting elastic wear. Lower incisor spaces were present after the mandibular setback procedure and this was probably attributed to the encroachment of the tongue space. Power chain elastics were instituted to consolidate the mandibular arch. Moderate strength elastics (3 oz, 5/16-inch) arranged in a triangular and box configurations were used to obtain good occlusal interdigitation.

All six objectives of treatment had been achieved. The anterior open bite had been shut, and the incisors and canines showed a good Class I relationship. Anterior guidance was present at the end of treatment. The molar relationships were in full Class II because of upper second premolar extractions. Canine guidance was present during left and right lateral excursive movements. The periodontal health had been maintained; no signs of gingival recession were observed. The mandibular prognathism had been reduced. Facial profile was now mildly convex. Facial soft tissue harmony was achieved with a well balanced upper and lower lip positions. The labio-mental fold was more pronounced. (Figure 3a–i).

The cranial base superimposition tracing (Figure 4)



(a) **(b)** **(c)**

(d) **(e)** **(f)**

(g) **(h)** **(i)**

FIG. 3 (a–i) Case report 1: post-treatment photographs and radiographs.

FIG. 4 Case report 1: pretreatment (black) and post-treatment (red) cephalometric tracings superimposed on SN at sella.

revealed the following findings: (i) upper incisors were retracted; (ii) upper molars were moved mesially, and the lower molars were uprighted; and (iii) the anterior mandibular segment had been distalized, with a reduction in the gonial angle.

The post-treatment PAR score was zero, giving a 100 per cent reduction in the weighted PAR score, which put the changes in the 'greatly improved' category. At the completion of active treatment, upper and lower wrap-around acrylic retainers with fitted labial bows extending from the first molars were issued.

Case Report 2

A 13-year 3-month Caucasian male presented with a main complaint of crooked upper and lower front teeth. Family history revealed that both parents and an older sister had a similar malocclusion. The patient was allergic to the antibiotics Bactrim and Septrim. Dental history was uneventful.

The patient was observed to have a mildly convex facial profile, an orthognathic facial type, and a prominent chin. The nasolabial angle was obtuse with a gentle upper lip curl. The lower facial third appeared elongated compared with the mid-facial third. The frontal facial examination revealed a generally symmetrical face with the chin point coincident with the facial midline. There were no signs and symptoms of temporo-mandibular joint dysfunction. The circumoral, mentalis and masticatory muscles exhibited average tonicity at rest (Figure 5a–i).

The patient exhibited good oral hygiene and periodontal health. With the exception of all the permanent third molars, the remaining permanent teeth were erupted. The upper midline was coincident with the facial midline but the lower dental midline is deviated to the right by 1·0 mm. Caries status was controlled. A functional slide of the mandible to the right from centric relation to maximum intercuspation was detected.

The overjet was 1·5 mm and the overbite is complete at 50 per cent. A Class I incisor relationship was noted. The right-sided canine and molar relationship were Class I, while the left-sided canine and molar relationships were mild Class III. Crossbites were located between the upper and lower lateral incisors, and between the upper and lower right premolars. The Bolton tooth-size discrepancy was insignificant.

The maxillary arch is asymmetrical and had a V-shaped arch form (Figure 5f). The arch form was constricted at the right quadrant. Space analysis of the maxillary study model revealed the presence of moderate crowding estimated at 6 mm of space deficiency. Both lateral incisors were rotated mesio-palatally. The right premolars were displaced palatally.

In contrast, the mandibular arch was generally symmetrical and had a U-shaped arch form. The lower incisor segment appeared upright. Crowding of approximately 4 mm was determined in the lower anterior segment with the lateral incisors rotated disto-labially and the tooth 41 rotated mesio-lingually.

The pretreatment orthopantomogram revealed no pathology. All the third molars were present but unerupted. The general alveolar bone level was normal. No visible signs of root resorption were detected.

An analysis of the pretreatment lateral cephalogram (Table 2) showed a Class I skeletal base relationship as illustrated by the ANB reading of 1 degree and a Wits value of 0 mm. The steepness of the mandibular plane to the cranial base (SN–MP) was increased at 33 degrees. The lower anterior facial height was also increased at 57·4 per cent. The upper incisors were of average inclination (U1–SN = 101 degrees, U1–FH = 110 degrees) and were not protrusive (U1–NA = 5 mm). The lower incisors were however retroclined (L1–MP = 87 degrees) and were mildly retrusive (L1–APg = 0 mm, L1–NB = 2 mm). Facial convexity, as indicated by the cephalometric parameter, G–Sn–Pg', was decreased at 10 degrees. Upper lip position was normal (Ls–[Sn–Pg'] = 2 mm). The nasolabial angle was obtuse at 117 degrees, and the labio-mental fold (Si–[Li–Pg'] = 6 mm) was increased.

The diagnosis for this patient was that of a Class I malocclusion on a Class I skeletal base (with a Class III

TABLE 2 *Case 2: pretreatment and post-treatment cephalometric analysis*

Measurement	Pretreatment	Post-treatment
SNA	77·5	78
SNB	76·5	78·5
ANB	1	−0·5
WITS (mm)	0	−1·5
SN–MP	33	31
FMA	24	22
ANS–Me/N–Me	57·4%	59·2
U1–SN	101	109
U1–FH	110	119
L1–Apg (mm)	0	3
L1–MP	87	93
U1–L1	138	127
Facial convexity G–Sn–Pg'	10	8
Upper lip protrusion (mm) Ls to (Sn–Pg')	2	1·5
Nasolabial angle CM–Sn–Ls	112	108
Lower lip to E line (mm)	−3	−2·5
Labiomental fold Si to (Li–Pg') (mm)	6	6

(a)

(b)

(c)

(d)

(e)

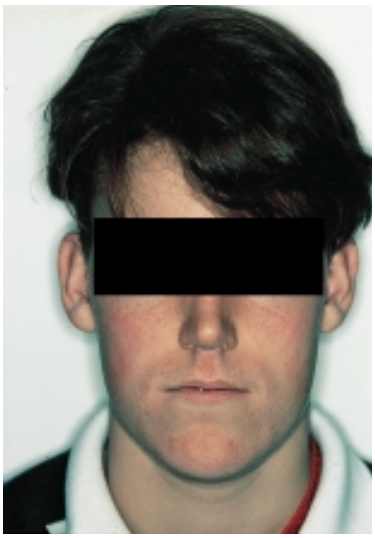
(f)

(g)

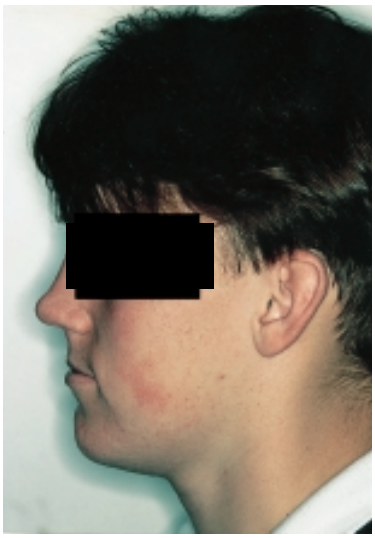
(h)

(i)

FIG. 5 (a–i) Case report 2: pretreatment photographs and radiographs.



(a)



(b)

(c)

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FIG. 6 (a–i) Case report 2: post-treatment photographs and radiographs.

tendency). The lower incisors were retroclined as a compensation to the increased mandibular plane angle. Moderate upper and lower arch crowding was present. Lingual crossbites at the right premolar and lateral incisor regions contributed to the functional shift on maximum intercuspation. The lower midline was deviated to right of facial midline.

The need for orthodontic treatment, as expressed by the IOTN, was a grade of 4d on the dental health component. Pre-treatment PAR score was 42.

The aims of the treatment were:

1. Creation of space for upper and lower arch alignment through arch expansion.
2. Correction of rotations, crossbites.
3. Achievement of proper root inclination and angulation, and coincidental midlines.
4. Reduction of overbite.
5. Achievement of good occlusal interdigitation.

The treatment plan was to adopt a non-extraction treatment approach, using a rapid maxillary expansion (RME) screw to expand the maxillary arch correct the posterior crossbites and obtain adequate space for arch alignment. Subsequent to the phase of maxillary expansion, the Begg fixed appliances would be bonded for alignment and levelling. The rotated lateral incisors would be corrected with rotation springs and force couples. Stainless steel mini-springs of 0·010-inch thickness would be used to upright the lower incisor roots. Retention would involve the use of removable acrylic retainers and gingival pericision procedures for the upper lateral incisors.

The non-extraction programme involving upper arch expansion was aimed at correcting the crossbite and provides space for de-rotation of the upper lateral incisors. Since the lower buccal segment teeth were leaning lingually, uprighting the buccal teeth would provide additional space for the alignment of the lower anterior segment. Extractions of the lower first and upper second premolars would be indicated if the lower incisors became too proclined on alignment.

Case 2 Assessment

The rapid maxillary expansion (RME) appliance, fabricated with a 7-mm screw, was placed and activated two turns per days for 14 days. During that period, the increase in inter-first molar width (measured between mesio-buccal cusp tips) and inter-first premolar width (measured between buccal cusp tips) were 5 and 4 mm, respectively. Activation of the RME appliance was discontinued and upper and lower Begg appliance was bonded 1 month after the start of the rapid expansion.

Alignment of the upper and lower arches were carried out with 0·016-inch stainless steel Australian wire and 0·016-inch NiTi wire, respectively. After palatal buttons were bonded onto the upper lateral incisors, rotation force couples were applied for de-rotation. Subsequent to alignment and levelling of the upper arch, the RME appliance was removed. The main arch wires were progressively moved up from 0·016- to 0·020-inch Australian stainless steel. Stainless steel root uprighting springs of 0·010-inch diameter were then used for uprighting the roots of rotated lower incisors. Similarly, a labial root torque auxiliary, made from 0·010-inch Australian stainless steel, was applied to the de-rotated upper lateral incisors. Pericision was performed on the palatal aspect of the upper lateral incisors two months prior to end of treatment to reduce the chance of rotational relapse. Upper and lower wrap around retainers were given.

At the end of the RME activation, increases in the inter-first molar and inter-first premolar widths were obtained. The buccal segment crossbite was corrected and additional space for the alignment of the upper arch was also obtained. Midlines were coincident after the expansion and the mandibular functional slide disappeared.

Rotational over-correction of the upper lateral incisors was obtained. Lower arch expansion through the proclination of the retroclined lower incisors was also achieved. The increase in lower inter-canine width was 2 mm after 15 months into treatment. Overbite had been reduced substantially as the mandible rotated downwards after the maxillary expansion. Good occlusal interdigitation and arch alignment were obtained at the end of treatment. The post-treatment orthopantomogram and lateral cephalogram revealed good root angulation and inclination, respectively. Total active treatment time was approximately 23 months (Figure 6a–)

Over an 18-month period from the start of active RME treatment, the patient grew 13 cm. Cranial base superimposition tracings between pre-treatment and post-treatment lateral cephalometric radiographs showed that patient experienced facial growth in both the antero-posterior and vertical dimensions (Figure 7). Proclination and extrusion of the central incisors were observed on the maxillary regional superimposition tracing. Similarly, the mandibular regional superimposition revealed proclined lower incisors, and extruded first molars.

The occlusal improvements were attributed to an (i) orthopaedic expansion of the maxillary arch, (ii) orthodontic expansion of the lower arch, (iii) orthodontic tooth movements for rotational correction and root uprighting.

FIG. 7 Case report 2: pretreatment (black) and post-treatment (red) cephalometric tracings superimposed on SN at sella.

Facial growth was significant in the antero-posterior direction. The extrusive effect of the RME and Begg appliances were compensated by an increase in vertical growth at the mandibular condylar region. Oral hygiene was excellent throughout treatment. The post-treatment PAR score was 3, and the percentage improvement in occlusion was 90 per cent, putting the changes in the 'greatly improved' category.

Acknowledgements

The postgraduate training (1992–1994) I received at the Orthodontic Unit of The University of Adelaide has been first rate, and my deepest appreciation goes to Professor Milton Sims (who was then Chairman of the programme), Professor Wayne Sampson (P. R. Begg Chair in Orthodontics) and the many clinical tutors for their instruction. Special thanks goes to Professor Andrew Sandham who was my clinical supervisor during my advanced specialty training in Singapore.