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CLINICAL SECTION

The British Orthodontic Society Medal of the Intercollegiate M.Orth. of the Royal College of Surgeons of London and Glasgow 2001 and the William Houston Medal of the M.Orth. of the Royal College of Surgeons of Edinburgh 2001

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Introduction

The BOS medal of the Intercollegiate M.Orth. of the Royal College of Surgeons of London and Glasgow, and the William Houston Medal of the M.Orth. of the Royal College of Surgeons of Edinburgh 2001 are prestigious prizes awarded to the individuals who obtain the most outstanding performances in Part II of the examinations. This year, for the first time, both awards were presented to the same individual. This report discusses two of the cases treated by the winner of both medals, which were presented at both examinations. The first of these is a Class III malocclusion treated with a combined orthodontic and surgical approach, the second is a severe Class II division 1 case treated with a twin-block and fixed appliances.

Case Report 1

A female Caucasian patient presented at 16 years and 5 months of age. She complained that her upper anterior teeth were crooked and were biting the 'wrong way round'. She was also unhappy with her facial appearance and, in particular, the prominence of her chin.

She presented with a Class III incisor relationship upon a Class 3 skeletal base with increased vertical proportions and competent lips. Frontal examination demonstrated acceptable facial symmetry and balance and dental centrelines were coincident with the mid-facial axis. There was no lateral or anterior mandibular displacement upon closure.

The lips were competent at rest. The upper lip was assessed as short at 14 mm with reduced vermillion show. There was 2 mm of gingival show on smiling. The lower lip was mildly everted with excess vermillion show. Alar base width was assessed as slightly wider than the inter-canthal distance.

There were no signs or symptoms of TMD.

Intra-oral examination revealed a good standard of oral hygiene; the upper and lower left first permanent molars were restored with two surface amalgams and the upper right first molar with a small composite restoration. There were no active carious lesions.

In the maxillary arch the labial segment was moderately crowded with palatally displaced lateral incisors. Both upper central and lateral incisors were in crossbite, and were proclined relative to the maxillary plane. The upper buccal segments were mildly crowded with palatally inclined first premolars.

In the mandibular arch the labial segment was mildly crowded and retroclined relative to the mandibular plane. There was a mildly increased curve of Spee measuring 2 mm at its deepest part. The lower second and third molars were lingually inclined relative to the rest of the buccal segments.

In occlusion the incisor relationship was Class III with a maximal reverse overjet of 4 mm, and a reduced and incomplete overbite. The molar relationship was a full

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unit Class III on both sides. There were bilateral anterior and posterior crossbites (Figure 1a–h).

The Dental Health Component (DHC) of the Index of Treatment Need (IOTN) was 4b and the Aesthetic Component (AC) was 6.

Radiographic examination confirmed the presence of all permanent teeth including unerupted upper third molars and no carious lesions were detected (Figure 2a,b)

The cephalometric analysis confirmed the clinical findings of a severe Class 3 skeletal antero-posterior relationship with an ANB of –6 degrees (corrected to –4.5 degrees) and a Wits of –11.5 mm. The lower face height proportion was increased at 58 per cent and, although the clinical impression was of a high maxillary-mandibular planes angle, this was in fact measured at 25 degrees. The upper incisors were proclined at 117 degrees and the lower incisors were retroclined at 74.5 degrees to the maxillary to the mandibular planes, respectively. Both values suggested dento-alveolar compensation for the skeletal 3 base, resulting in an increased inter-incisal angle of 147 degrees. Despite the retro-

Fig. 1 (a–h) Case 1: pre-treatment photographs.

clination of the lower labial segment the lower incisal tip was still placed 3 mm in front of A–Po line. The cephalometric analysis is presented in Table 1.

The aims of treatment were:

1 To improve facial appearance and address the patient's concern regarding the prominence of her chin.
2 Obtain a positive overjet.
3 Correct anterior and posterior crossbites.
4 Resolve the crowding and align the upper and lower arches.
5 Establish a stable Class I incisor, molar, and canine relationship with appropriate functional goals.
6 Produce a good buccal segment inter-digitation.

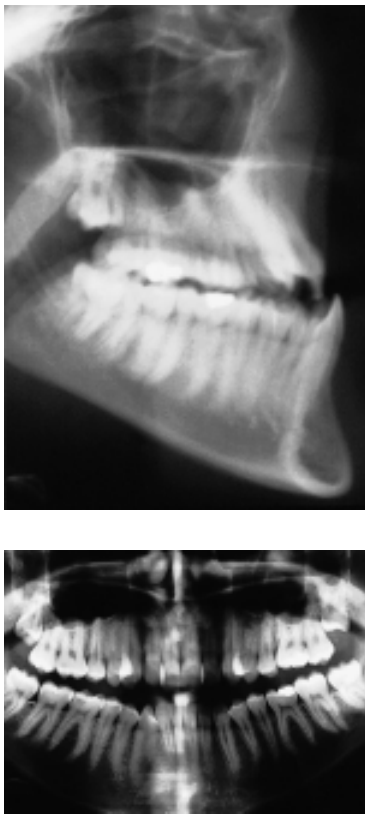


Fig. 2 (a,b) Case 1: pre-treatment lateral cephalometric and panoramic radiographs.

The treatment plan was as follows: a joint orthodontic/orthognathic surgical approach including a pre-treatment joint clinic appointment with the maxillo-facial surgical team.

1 Extraction of both upper first permanent molars.
2 Pre-surgical orthodontics with the pre-adjusted edgewise appliance (0.022 × 0.028 inch slot) with Roth prescription bands and brackets with the aims to decompensate the incisors to normal values, level the curve of Spee, co-ordinate the arches, and provide alignment and closure of residual space.
3 Bimaxillary surgery involving a mandibular setback and maxillary advancement with intrusion.
4 A period of post-surgical detailing and seating of the occlusion.
5 A retention regime with upper and lower removable retainers.

Due to difficulty with the extraction of the upper left first molar by the general dental practitioner the treatment plan was revised to continue with no further extractions. Roth prescription bands and brackets were placed on all fully erupted teeth in the upper and lower arches, and 0.014 inch super-elastic nickel titanium archwires were ligated to begin alignment and levelling. A ligature was laced from the upper right first molar to the upper left second premolar to help maintain the upper dental centreline.

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

	Pre-treatment	Post pre-surgical orthodontics	Post-treatment	Treatment change
SNA (°)	78	77	81.5	+3
SNB (°)	84	83	80	–4
ANB (°)	–6	–6	1.5	+7.5
WITS appraisal (mm)	–11.5	–11	–2	+9.5
S–N/MxP (°)	9	9	7.5	–1.5
MMPA (°)	25	26	28	+3
LFH (per cent)	58	60	59	+1
UI/MxP (°)	117	114	112	–5
LI/MdP (°)	74.5	92	94	+19.5
LI–A–Po (mm)	+3	+6	+0	–3
UI–LI (°)	147	132.5	134	–13

Six months into treatment 0.020 inch Australian stainless steel archwires were in place with the upper arch expanded to improve post-operative correlation of the arch widths. After 9 months of treatment 0.019 × 0.025 inch archwires were *in situ* with continued expansion of the upper arch. Space closure was started in the upper left quadrant with power chain. Upon closure of the space additional continuous buccal root torque was placed in the upper buccal segments to counteract the crown tipping resulting from arch expansion.

Fifteen months into treatment all the space was closed, the arches were decompensated, aligned, levelled, and correlated, and there was a minimal loss of the upper centreline to the left by 1 mm (Figure 3a–c). A joint clinic appointment was arranged with up to date radiographs and study models to plan the surgical procedure. Provisional surgical planning was carried out using a digitized cephalometric radiograph and surgical planning software. Final planning was achieved by the use of study models articulated from a face bow recording.

After 18 months of treatment the patient underwent bi-maxillary osteotomies. Using a Le fort 1 procedure the maxilla was advanced 4 mm on both sides and moved *en-bloc* to the right by 1 mm, with intrusion of 2 mm all round. A bilateral vertical subsigmoid procedure was used to set back the mandible 5 mm on the right and 6 mm on the left. Wire inter-maxillary fixation was used for 6 weeks, after which time new co-ordinated 0.019 × 0.025 inch stainless steel archwires were placed with Class II box elastics in the buccal segments.

Final seating and detailing was achieved with first and second order bends on upper 0.016 inch round and a lower 0.019 × 0.025 inch braided stainless steel archwires with vertical elastics.

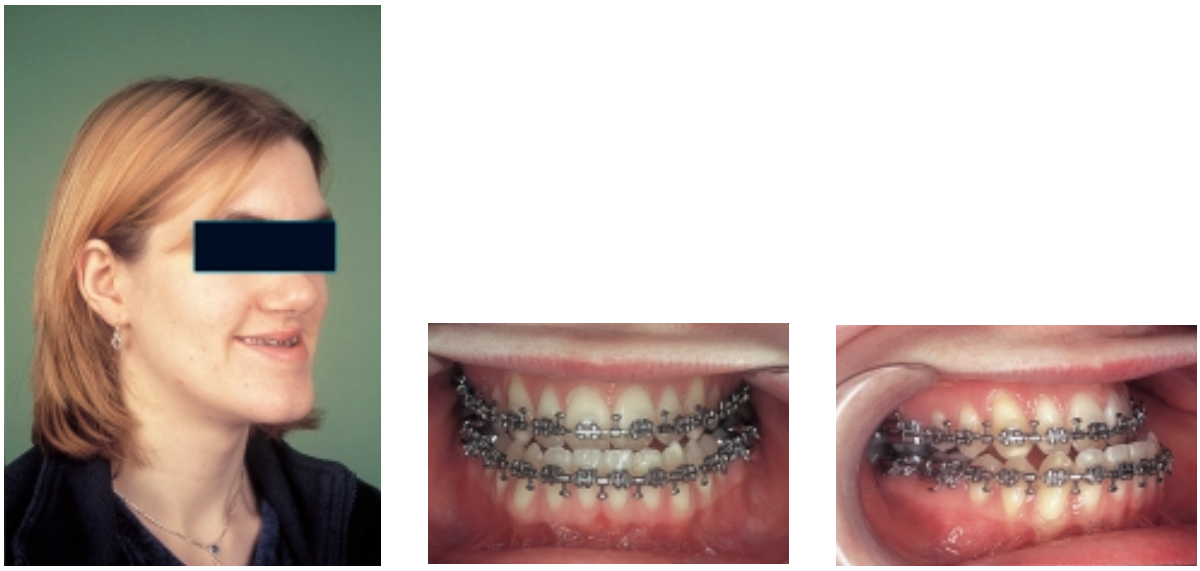
Treatment was completed after a period of 1 year and 11 months when appliances were debonded, and modified upper and lower Hawley type removable retainers were placed (Figures 4a–b and 5a–h).

Case 1 assessment

The pre-treatment antero-posterior skeletal discrepancy had resulted in both the reverse overjet and the crossbite due to poor co-ordination of the transverse widths of the arches. As a consequence, the upper arch was constricted and crowded. The increased vertical proportions contributed to the reduced overbite.

Dento-alveolar compensation had resulted in retroclination of the lower labial segment with mild crowding. The proclination of the upper labial segment masked some of the upper arch crowding and reverse overjet.

The patient was a non-growing female patient with a significant skeletal discrepancy in the antero-posterior and vertical planes. A joint orthodontic and surgical treatment was planned so as to address the patient's concerns, achieve an occlusion with good function,



(a) (b) (c)

Fig. 3 (a–c) Case 1: post pre-surgical orthodontics photographs.

Fig. 4 (a,b) Case 1: pre- and post-surgical lateral cephalometric radiographs.

aesthetics, and stability, and to improve facial aesthetics. Extraction of upper first permanent molars was planned to provide additional space for alignment and to allow retraction of the upper labial segment to maximise surgical movement, whilst also removing a restored tooth. However, after complications with the extraction of the upper left first molar, it was decided to avoid further extractions and accept a small dental centre line discrepancy. This would be corrected at surgery by asymmetric surgical movement of the maxilla, which would not compromise facial symmetry.

After orthodontic decompensation the cephalometric analysis demonstrated no overall change in the ANB angle, but SNA was reduced by 1 degree. Despite proclination of the lower labial segment the SNB reduced by 1 degree due to a downward and backward repositioning of the mandible. This caused a small increase of the skeletal vertical proportions, which may have been due to some late vertical growth or associated with expansion of the upper arch. The upper and lower incisors had decompensated, with the lower incisors having been advanced a further 3 mm relative to the A–Po line. Adequate orthodontic decompensation allowed for significant surgical movements. At treatment finish there had been a change in the ANB angle of 7.5 from –6 to +1.5 degrees.

The upper and lower incisors have been placed at a better inclination relative to the maxillary and mandibular planes. At the end of treatment the lower incisor edge was lying on the A–Po line, representing a 6-mm change after decompensation. The inter-incisal angle was brought within normal limits at 134 degrees.

At the end of treatment the primary aetiological factor involved in this patient's presenting malocclusion was addressed. The relative mandibular protrusion, maxillary retrusion, and occlusal features were corrected to within normal limits with orthodontics and bi-maxillary surgical movements (Table 2). The soft tissue pattern was now well balanced and there had been a marked aesthetic improvement. The chin point however was still mildly prominent in relation to Ricketts Zero Meridian and there had been a small increase in the alar base width. These aspects of facial form were discussed with the patient prior to treatment. At 23 months post-surgery the patient is very happy with the result and does not wish to have any secondary surgical procedures to alter these features.

There was no clinically obvious enamel decalcification, or radiographic evidence of root resorption. There was a degree of gingival recession particularly

Table 2 Case 1: pre- and post-treatment occlusal changes.

	Pre-treatment	Post-treatment
Overjet (mm)	–4	2
Overbite (mm)	1	3
Incisor relationship	III	I
Molar relationship	III	I
IOTN aesthetic component	6	1
IOTN dental health component	4b	2g
PAR score	42	2
PAR reduction (%)		95
Category of improvement		Greatly improved

Fig. 5 (a–h) Case 1: post-treatment photographs.

associated with the upper right canine, which was a result of fastidious oral hygiene and toothbrush trauma. At 2 years post-surgery the patient has a small residual area of paraesthesia associated with the left side of the lower lip, but reports that this does not cause her any functional deficit or inconvenience.

The relapse potential of the surgical movement was anticipated by slight over correction of the discrepancy with the surgical movements, which increased the skeletal ANB angle to 1.5 degrees. Stability was enhanced by good final occlusal inter-digitation and crossbite correction by upper dental arch expansion, together with the changes to the A–P arch co-ordination.

The patient elected to continue part-time wear of her retainers indefinitely and the occlusal relationships remain unchanged 16 months after debond.

Case 2

A male Chinese patient presented at 13 years and 2 months of age. He complained that his top teeth stuck out and that he could not close his lips together.

He presented with a Class II division 1 incisor relationship upon a moderate/severe Class 2 skeletal base with a 13 mm overjet. The malocclusion was complicated by severe upper and lower arch crowding with impaction of the upper right canine, a 4 mm dental centreline discrepancy together with an increased and complete overbite.

Frontal examination demonstrated acceptable facial symmetry and balance. The upper dental centreline was 2 mm to the right of the mid-facial axis and lower dental centre line was 2 mm to the left of the mid-facial axis.

There were no lateral or anterior mandibular displacements upon closure.

There was a lower lip trap behind the upper central incisors, although the lips were potentially competent. The upper lip was significantly protrusive to Ricketts E-plane.

There were no signs or symptoms of TMD.

Intra-oral examination revealed a fair standard of oral hygiene. There were some minor areas of previous decalcification, particularly on the lower canines and first premolars, and the upper right lateral incisor. However, there were no carious lesions or previously restored teeth.

In the maxillary arch the central incisors were proclined and mildly spaced with a midline diastema of 2 mm. The left lateral incisor was palatally placed relative to the central incisors. However, there was potentially severe crowding as the upper right canine was absent from the arch.

The buccal segment on the left was severely crowded with the second premolar partially erupted and palatally displaced. The first premolar was disto-palatally rotated and the first molar was mesio-palatally rotated. The right buccal segment was mildly crowded with rotations of both premolars. There was a large accessory cusp on the buccal surface of the upper right second molar.

In the mandibular arch the labial segment was proclined and mildly crowded. The left buccal segment was severely crowded with buccal displacement of the first premolar. The right buccal segment was also severely crowded with the second premolar partially erupted and lingually displaced.

In occlusion the incisor relationship was Class II division 1 with an overjet of 13 mm and an increased overbite, complete to the incisive papilla, with a 6 mm overlap of the lower incisors. The molar relationship was ¾ unit II on the left and ¼ unit Class III on the right. There was a crossbite associated with the buccally displaced lower first premolar on the left side, and a scissor bite tendency associated with the upper right first premolar. The lower arch curve of Spee was deep and measured 5mm on both right and left sides. (Figure 6a–i).

The DHC of the IOTN was 5i as a result of the impacted canine and the AC was 9.

Radiographic examination confirmed the presence of all secondary teeth excluding upper third molars. The upper right canine was found to be ectopically positioned and impacted. The upper right canine crown tip lay at the level of and further towards the midline than the apical third of the root of the upper right central incisor. The mesial root of the upper right first premolar appeared blunted most likely as a result of resorption from the aberrant eruptive path of the ectopic canine (Figure 7a,b).

Using the technique of vertical parallax, the position of the canine was confirmed as very poor, being palatal to the line of the arch with its cuspal tip towards the midline.

There was no other obvious external resorption or pathology in the 3-|-3 region.

The cephalometric analysis confirmed the clinical findings of a moderate/severe Class 2 skeletal base relationship with an ANB of 7.5 degrees. The lower anterior face height was mildly increased at 59 per cent, but the maxillary–mandibular planes angle was normal at 27 degrees. The upper incisors were severely proclined at 130.5 degrees and the lower incisors were within the normal range for a Chinese individual at 104 degrees.[1] The lower incisors were also placed 4.5 mm in front of the A–Po line, quoted values for a Chinese population (+5 to +9mm). The cephalometric analysis is presented in Table 3.

The aims of treatment were:

1 Improve oral hygiene.
2 Resolve the severe crowding.
3 Attempt to modify the pattern of growth.
4 Correct the overbite, overjet and dental centrelines.
5 Obtain Class I incisor, molar, and canine relationship within a stable soft tissue environment and with appropriate functional goals.

The two-stage orthodontic treatment plan was devised as follows:

1 Hygienist appointments for tooth-brushing instruction and dietary advice.
2 Growth modification with a twin-block functional appliance with high-pull headgear to create a Class 1

Fig. 6 (a–i) Case 2: pre-treatment photographs.

molar and incisor relationship by a combination of skeletal and dento-alveolar changes.
3 Surgical removal of 3|5 and extraction of 5|5.
4 Upper and lower fixed appliance treatment with the pre-adjusted edgewise appliance (0.022 × 0.028 inch slot) using MBT prescription brackets, and Roth prescription bands on the molars with continued use of extra-oral anchorage reinforcement.
5 Space closure with control over the molar relationship.
6 Detailing of the occlusion.
7 A period of retention with upper and lower removable retainers.

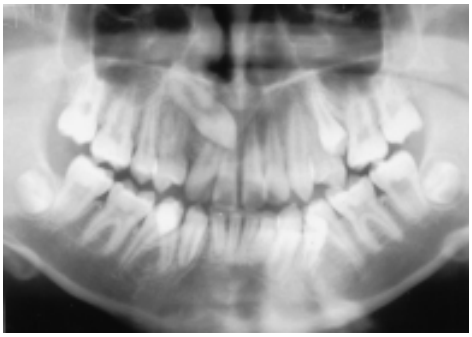


Fig. 7 (a,b) Case 2: pre-treatment lateral cephalometric and panoramic radiographs.

A referral was made to surgical colleagues for the extraction of teeth. In the mean time a modified twin-block appliance (recorded at maximal protrusion) was fitted together with High-pull headgear. The twin-block was worn full time and the headgear was added for a minimum of 12 hours per day. After 8 months of treatment the incisor relationship was edge to edge, the molars were overcorrected to Class III and mid-treatment records were taken (Figure 8a–c). At this stage, lower first and second molars were banded with Roth prescription bands, and the lower arch bonded with MBT brackets (0.022 × 0.028 inch slot). A 0.014 inch super-elastic nickel-titanium archwire was placed with canine lacebacks from the second molars. The lower twin-block was adjusted to allow continued wear of upper and lower appliances on a part-time basis.

The twin-block appliance was ceased completely after a further 3 months. Roth prescription bands were then were cemented to 6|6 7 and the upper arch was bonded with MBT prescription brackets. An upper 0.014 inch super-elastic nickel-titanium archwire was placed with a canine laceback on the left side only to assist dental centreline correction. In the lower arch a 0.016 inch round Australian Special Plus stainless steel archwire was placed and the lacebacks tightened. The High-pull headgear was fitted to the upper first molar bands.

One year into treatment upper and lower 0.018 × 0.025 inch heat activated nickel-titanium archwires were placed. This was followed by co-ordinated rectangular

Table 3 Case 2: pre-treatment, post-Twin-block, and post-treatment cephalometric analysis.

	Pre-treatment	Post Twin-block	Post-treatment	Treatment change
SNA (°)	88	88	87	–1
SNB (°)	80.5	82	82	+1.5
ANB (°)	7.5	6	5	–2.5
S–N/MxP (°)	3.5	1	2.5	–1
MMPA (°)	27	28	28	+1
LFH (%)	59	59.5	60	+1
UI/MxP (°)	130.5	117.5	111	–19.5
LI/MdP (°)	104	120	103	–1
LI–A–Po (mm)	+4.5	+9.5	+6	+1.5
UI–LI (°)	98.5	94.5	120	+21.5

(a) (b) (c)

Fig. 8 (a–c) Case 2: end of functional appliance phase photographs.

0.019 × 0.025 inch stainless steel archwires. Labial root torque was placed in the lower labial segment to improve the lower incisor inclinations. A new laceback was tied from the upper left second molar to the upper left canine and power chain was placed from 3| to 2|.

After 2 years of treatment a laceback was placed from 2| to 7|. Ball hooks were placed on the upper and lower archwires with elastic tiebacks. A Class III elastic was placed on the right and a Class II elastic was placed on the left side to encourage space closure, centreline correction, and improvement of the Class III molar relationship on the right side. Elastic tiebacks were placed in the upper arch and passive tiebacks were left in the lower arch to retain space closure. Final centreline correction was facilitated by inter-proximal reduction of teeth in the upper left quadrant together with use of a left unilateral Class II elastic. Near end-treatment radiographs were taken to assess root positions and incisor angulations to allow correction as appropriate prior to debond (Figure 9a,b).

After 27 months of treatment upper and lower 0.019 × 0.025 inch braided stainless steel archwires were then placed with Kobayashi ligatures on the premolars and seating elastics added to improve inter-digitation prior to debond.

After 2 years and 5 months of treatment appliances were debonded (Figure 10a–i) and an upper modified Hawley and lower Essix removable retainers were fitted.

Case 2 assessment

Case 2 had a moderately severe Class 2 Skeletal antero-posterior discrepancy of the dental bases with both relative mandibular retrusion and mild maxillary protrusion.

There was an element of bi-maxillary dental protrusion, which may have been genetically determined. The presence of the lower lip trap artificially maintained the upper central incisors in a more proclined position than if they were under lip control, while the thick soft tissue drape disguised some of the severity of the Skeletal Class 2 base.

There was severe crowding in the upper and lower arches resulting from a significant tooth tissue discrepancy. This was complicated by asymmetric early loss of a deciduous unit in the lower left quadrant, causing a shift in the lower centreline. The impaction of the upper right canine allowed a shift of the upper centre line to the right. Mesial tipping of the lower right first molar camouflaged the Class II relationship on this side.

In view of the age and gender of the patient, growth modification was an appropriate method of treating the malocclusion. The patient was approaching his pubertal growth spurt and promised good co-operation when shown both the headgear and twin-block appliance. The use of a functional appliance, to facilitate a possible change to the mandibular growth pattern, and high-pull

Fig. 9 (a,b) Case 2: post-twin-block and near end-treatment lateral cephalometric radiographs.

headgear to restrict maxillary growth would attempt to address the underlying skeletal aetiology of the malocclusion. The modified twin-block appliance would also provide some retroclination of the proclined upper labial segment, and would facilitate concurrent use of fixed and functional mechanics during the seamless change to the second stage of treatment.

The severe crowding in all quadrants meant that extractions were indicated. The impacted upper right canine had a poor prognosis for alignment in view of its overlap of the apex of the central incisor root and was therefore included in the extraction pattern. Extractions were planned to co-ordinate with the surgical removal of the impacted canine under general anaesthetic.

After the twin-block stage of treatment there was an improvement in the facial profile. The maxilla had remained unchanged at 88 degrees, suggesting a degree of maxillary restraint. The SNB had increased 1.5 degrees, reducing the ANB angle by 1.5–6 degrees.

There was minimal change to the skeletal vertical proportions. The upper incisors were retroclined by 13 degrees, but the lower incisors were significantly proclined at 120 degrees, and the lower first molars and canines were mesially tipped. Due to the severe crowding there was very little residual space remaining in the lower arch to retract the incisors and upright the buccal segments. By banding the lower second molars early in treatment and placement of –6 degrees incisor brackets and canine lacebacks, it was possible to upright the lower labial segment early in the alignment stage. Additional labial root torque placed in the working arch wire later in treatment allowed further improvement to the inclination of the lower incisors. Concurrent use of the twin-block appliance and round stainless steel archwires permitted early levelling and aligning of the lower arch, whilst maintaining the overall A–P correction. Headgear support was used in the early stages of the fixed appliance treatment to prevent relapse of the upper molar position.

The extraction pattern of 3|5 complicated dental centreline correction. The 3| was approximately 1mm larger than |5 and this meant there was excess space to close on the right side of the arch causing an upper centre line shift to the right towards the end of space closure. This was overcome by inter-proximal reduction of |1 2 3 4 to create sufficient space in the upper left quadrant to correct the discrepancy. This was facilitated by the use of a Class II elastic on the left side during final space closure.

At the end of treatment there was a clinically significant improvement in the skeletal antero-posterior relationship. There was some forward mandibular growth with little increase in the vertical proportions. There was a small reduction in the value of SNA and it is likely that this was associated with dento-alveolar changes due to the retroclination of the upper incisors by 19.5 degrees during treatment, together with anterior growth of nasion. There was an overall reduction of 2.5 degrees in the ANB angle. The lack of forward growth of the maxilla suggests there may have been some helpful maxillary restraint resulting from the headgear effect on both the twin-block and the fully banded appliances. In all, upper incisor retroclination, together with mandibular growth and maxillary restraint con-

Fig. 10 (a–i) Case 2: post-treatment photographs.

Table 4 Case 2: pre- and post-treatment occlusal changes.

	Pre-treatment	Post-treatment
Overjet (mm)	13	2
Overbite (mm)	6	2
Incisor relationship	II div 1	I
Molar relationship	Right ¼ III	Right I
	Left ¾ II	Left I
IOTN aesthetic component	10	1
IOTN dental health component	5i	2g
PAR score	47	2
PAR reduction (%)		96
Category of improvement		Greatly improved

tributed to the correction to produce a Class I incisor relationship (Table 4).

The proclined upper incisors were brought to within the normal range for a Chinese individual. The lower labial segment, which was severely proclined after the functional appliance stage, was returned to both an average inclination and a normal position relative to the A–Po line for this ethnic group. The lower lip trap behind the upper incisors was eliminated and the lips were competent at the end of treatment. The prognosis for stability of the corrected molar relationship was good, as the buccal occlusion was well inter-digitated.

The upper right first premolar was the correct size and shape, and provided an acceptable aesthetic replacement for the extracted ectopic upper right canine.

There was no clinically obvious enamel decalcification post-treatment other than that which was present pre-treatment. The near end-treatment radiographs suggest a minimal degree of root resorption associated with the apices of the upper right central and lateral incisors and the mesial root of the upper right first premolar. This may well have been associated with pre-existing resorption that was not obvious on the pre-treatment radiographs, the surgical trauma to the site or treatment mechanics.

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