

**CLINICAL  
SECTION**

# The William Houston Medal of the Royal College of Surgeons of Edinburgh 2002

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The William Houston medal is a prestigious prize awarded to the individual achieving the most outstanding examination performance at the Membership in Orthodontics examination for the Royal College of Surgeons of Edinburgh. Five clinical cases treated by the candidate are presented as part of the final examination; two of these cases are described below. The first a Class III malocclusion, and the second a Class II division 1 malocclusion, were both treated by orthodontic camouflage.

*Key words:* Clinical case report

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## Case report 1

### *Clinical examination*

A female Caucasian patient presented at 13 years and 3 months of age. She complained of prominent upper 'fangs' and that her teeth were 'biting the wrong way round'. Her medical history was unremarkable.

She presented in the permanent dentition with a Class III incisor relationship on a mild Skeletal III base. The lips were competent and there was an acceptable degree of incisal and gingival display on smiling and at rest, with the upper dental centerline coincident with the mid-facial axis. Evaluation of the soft tissue profile revealed that the upper lip was retrusive and the lower lip acceptably related to Rickett's E-plane, reflecting the underlying skeletal discrepancy. The lip-chin-throat angle was obtuse.

There was a negative overjet of 1.5 mm in the intercusp position (ICP). The patient could just achieve an edge-to-edge incisor relationship in retruded contact position (RCP) followed by a displacement of the mandible in an anterior and left lateral direction upon closure. There were neither signs nor symptoms of TMD.

Intra-oral examination revealed an unacceptable standard of oral hygiene with marginal gingivitis around the buccally displaced maxillary canines. Sealant restorations had been placed in the occlusal surfaces of the maxillary right, and both mandibular first molars and composite restorations in the buccal pits of the mandibular first molars. All were judged to be sound and of good long-term prognosis. Occlusal carious lesions

were present in the maxillary left first molar and both lower second molars.

In the maxillary arch, the anterior segment was severely crowded with a space deficiency of 16 mm. The maxillary canines were completely buccally excluded from the arch, the central incisors were mildly imbricated and the maxillary right lateral incisor was slightly palatal to the line of the arch. The buccal segments were well aligned. The upper canines were distally inclined and the upper incisors appeared upright relative to the Frankfort plane.

In the mandibular arch, the labial segment was moderately crowded amounting to a 4.5 mm space deficiency. The left lateral incisor was mesiolabially rotated greater than 45° and the right lateral incisor was distolabially rotated. The buccal segments were fairly well aligned with mild rotations of the second premolars, but no crowding. The incisors appeared to be at an acceptable inclination relative to the mandibular plane.

In occlusion, the incisor relationship was Class III with edge-to-edge incisal contact in RCP followed by a displacement on closing of 1 mm anteriorly and 2 mm laterally. The upper dental centerline was coincident with the mid-facial axis. In ICP, the overbite was normal and complete, with the lower incisors overlapping 2 mm of the upper incisor clinical crowns. The molar relationship was ¼ unit Class III on the left and Class I on the right. The canine relationship was ¼ unit Class III bilaterally. There was a complete buccal crossbite on the left extending from the lower first premolar to the first molar and a cusp to cusp relationship between the premolars on the right (Figure 1a–i).



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

The Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) was 4d and the Aesthetic Component was 9. There was no Bolton discrepancy.

#### *Radiographic analysis*

Radiographic examination revealed the presence of all teeth including unerupted third molars. The presence of caries was confirmed in the maxillary left first molar and both mandibular second molars, but existing restorations were judged to be of sound condition (Figure 2a).

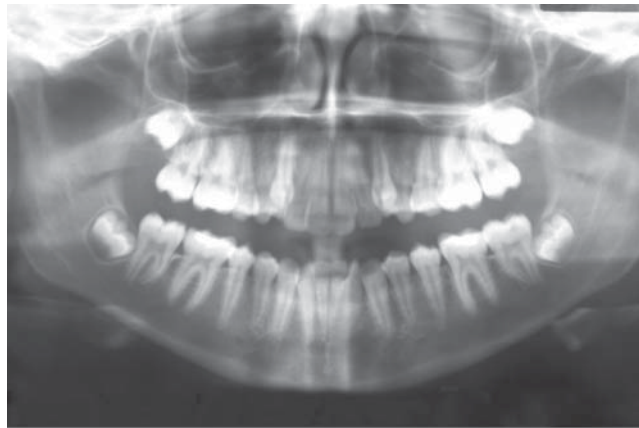
The cephalometric analysis confirmed the clinical findings of a Skeletal III relationship due to maxillary retrognathia (Figure 2b). The ANB difference of  $-2.5^\circ$  was corrected to  $0^\circ$  following the Eastman conversion suggesting a mild antero-posterior discrepancy. This is at variance with the Wits appraisal of  $-9$  mm, which erroneously suggests a severe Skeletal III relationship. Both the maxillary–mandibular planes angle and the face

height proportion were within normal limits at  $30.5^\circ$  and  $56\%$ , respectively. The upper incisor inclination of  $104.5^\circ$  to the maxillary plane was at the lower end of the normal range. The lower incisor inclination of  $88^\circ$  to the mandibular plane and the inter-incisal angle of  $137^\circ$  were both within the normal range. The lower incisal tip was 7 mm ahead of the A–Po line and the lower lip was 2 mm behind Rickett's E-plane. The cephalometric analysis is presented in Table 1.

#### *Treatment plan*

The aims of treatment were:

- to improve oral hygiene and to investigate and restore all carious lesions;
- to eliminate the mandibular displacement;
- to relieve the crowding and align the arches;
- to correct the posterior crossbites;
- to achieve Class I incisor and molar relationships with good buccal segment interdigitation.



(a)



(b)

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

In consultation with the patient and parent, a treatment plan was devised that utilized an extraction-based approach to effect orthodontic camouflage and involved the following stages:

**Table 1** Case 1: pre-treatment and near end of treatment cephalometric analysis

	Pre-treatment	Near end of treatment	Change during treatment
SNA (°)	76	76	0
SNB (°)	78.5	77	-1.5
Corrected ANB (°)	0	1.5	+1.5
WITS appraisal (mm)	-9	-8	+1
S-N/MxP (°)	7	10	+3
MMPA (°)	30.5	30	-0.5
LFH (%)	56	56	0
UI/MxP (°)	104.5	118	+13.5
LI/MdP (°)	88	85.5	-2.5
LI/A-Po (mm)	+7	+4	-3
UI/LI (°)	137	126.5	-10.5

- improvement in dental health with oral hygiene instruction and restoration of caries;
- construction of an upper removable appliance for  $\overline{4}4$  distalization;
- extraction of  $\overline{4}4$  and  $\underline{5}5$ ;
- lower Tip-Edge appliance initially, followed by upper Tip-Edge appliance subsequent to  $\overline{4}4$  retraction;
- Tip-Edge mechanics to level and align the arches and correct the incisal relationship in stage I, close space and begin correction of the buccal crossbites in stage II and acquire correct tip and torque prescription in stage III;
- detail and finishing with seating of the buccal occlusion;
- retention with upper and lower removable retainers.

#### Treatment provided

Treatment commenced with an upper removable appliance to retract  $\overline{4}4$  and a lower Tip-Edge fixed appliance for retraction of the lower canines on a 0.016-inch stainless steel archwire (Figure 3a-c).  $\overline{2}2$  were omitted initially and later aligned with a 0.012-inch superelastic nickel titanium archwire once sufficient space had been created. After 4 months of active treatment,  $\overline{4}4$  had been adequately retracted and the mandibular displacement eliminated. Tip-Edge brackets and bands were fitted in the upper arch and initial alignment with a 0.014-inch nickel titanium archwire, loosely ligated to  $\underline{2}2$ , was commenced. Space closure continued in the lower arch with elastomeric chain on a 0.020-inch stainless steel archwire.

Seven months into treatment, both arches were aligned on 0.020-inch stainless steel archwires with all space closure complete. The overjet was 2 mm and the buccal segments  $\frac{1}{4}$  unit Class III bilaterally. Offsets and toe-ins were placed mesially to all first molars prior to treatment



**Figure 3** (a–c) Case 1: start of treatment. Lower 0.016-inch SS archwire and canine retraction; URA to distalize 44



**Figure 4** (a–c) Case 1: stage III 0.0215 × 0.028-inch SS archwires with Side-Winders

stage III in which customized 0.0215 × 0.028-inch rectangular stainless steel archwires were placed with appropriate expansion and buccal root torque in the upper arch, and additional lingual crown torque in the lower labial segment. Appropriate Side-Winder springs were placed to correct the angulation and inclination of all bracketed teeth (Figure 4a–c).

Stage III mechanics continued for 9 months, during which time radiographs were taken to assess progress towards tip and torque acquisition (Figure 5a,b). Final seating and detailing for the correction of individual root angulations was achieved with second order bends on upper and lower 0.021 × 0.025-inch braided stainless steel archwires with vertical seating elastics. The functional occlusion was assessed prior to debond and RW demonstrated bilateral canine guidance with no working or non-working side interferences on lateral excursion, and no posterior interferences on protrusion.

Treatment was completed after a period of 2 years 1 month when appliances were removed and upper and lower Hawley type retainers were fitted (Figure 6a–i).

#### Case 1 assessment

Orthodontic camouflage of the Skeletal III pattern involving upper and lower arch extractions was considered appropriate since the antero-posterior skeletal discrepancy was mild and RW was not concerned about her facial profile. In addition, the lower incisors were not retroclined, but the upper incisors were upright and there was a normal overbite in ICP.

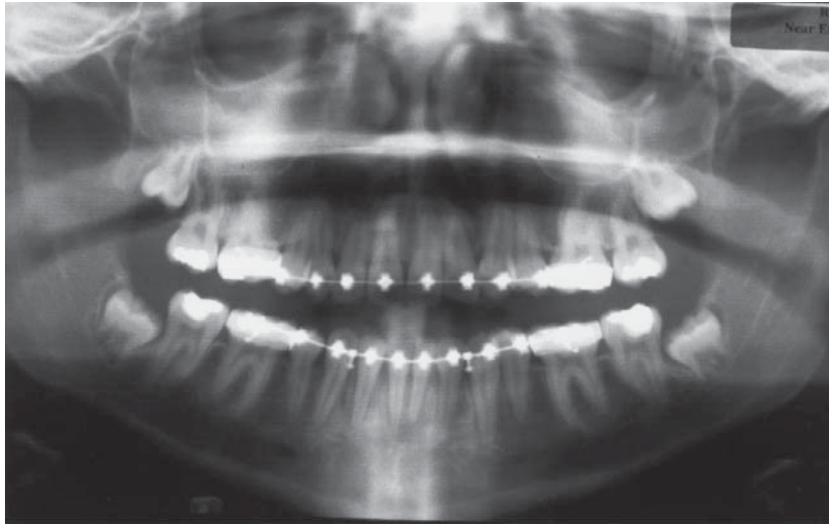
In order to achieve the tooth movements required, it was decided to extract 44 in the lower arch and retract the lower canines during stage I of treatment. In the upper arch, 55 were the teeth chosen for extraction, despite the severe crowding in order to prevent any retraction of the upper labial segment which would worsen the soft tissue profile. The initial phase of 44 retraction was carried out using a removable appliance to reduce anchorage loss in the upper arch.

SNA angle was unchanged during treatment and B point was repositioned more posteriorly producing a reduction of the SNB angle by 1.5°. This reflects the elimination of the mandibular displacement together with favorable downward rotation of the mandible and a small amount of lower incisor retroclination. The cephalometric superimposition tracings are shown in Figure 7a,b. There does not appear to have been any adverse antero-posterior mandibular growth.

The upper lip became more procumbent as a result of the advancement of the upper labial segment and the lower lip was retracted with the underlying change in B point to produce a more balanced lip profile. There was a small amount of downward and forward growth of the nose and chin, but there was no change in the relationship of the lower lip to Rickett's E-plane, remaining at –2 mm relative to this plane.

A 96% reduction in PAR score was achieved with the initial PAR score of 47 points reduced to 2 points post-treatment. This can be categorized as greatly improved.

The pre- and post-treatment occlusal changes are shown in Table 2.



(a)



(b)

**Figure 5** (a,b) Case 1: near end of treatment panoramic and lateral cephalometric radiographs



(a)



(b)



(c)



(d)



(e)



(f)



(g)

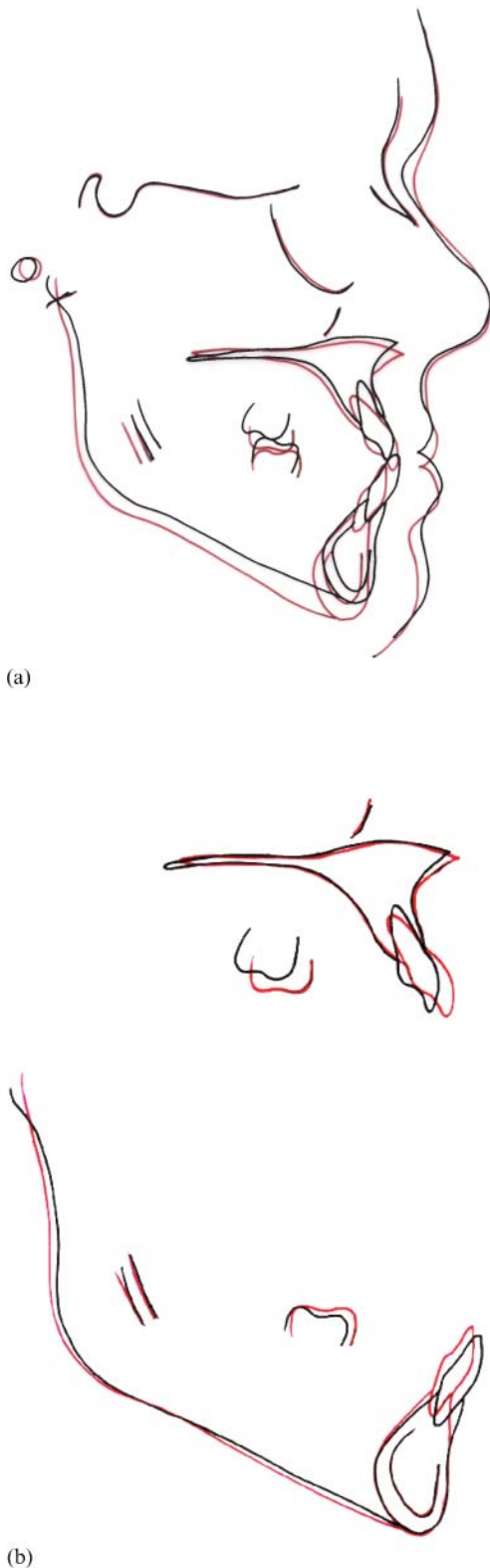


(h)



(i)

**Figure 6** (a-i) Case 1: post-treatment photographs



**Figure 7** (a,b) Case 1: pre-treatment (black) and near end of treatment (red) cephalometric superimpositions. Overall superimposition on anterior cranial base; maxillary and mandibular superimpositions on Bjork's stable structures

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

	Pre-treatment	Post-treatment
Overjet in RCP (mm)	0	2
Overbite in RCP (mm)	0	2
Incisor relationship	Class III	Class I
Molar relationship	Right Class I	Right Class I
	Left ¼ unit Class III	Left Class I
IOTN aesthetic component	9	1
IOTN dental health component	4d	2g
PAR score	47	2
PAR reduction (per cent)		96
Category of improvement		Greatly improved

There was no clinically obvious decalcification, but the near end of treatment radiographs suggest a moderate degree of root resorption had occurred affecting the distal roots of the lower first molars and the lower right central incisor. This may have been related to the orthodontic mechanotherapy, in a susceptible patient.

The buccal segment interdigitation that has been achieved is satisfactory despite the underlying Skeletal III discrepancy and will aid long-term stability in antero-posterior and transverse planes. The lower incisors have been brought under the control of the upper incisors and, although the overbite remains reduced following the proclination of the upper labial segment, it should be sufficient to maintain their position. It is unlikely that there will be any further significant growth in a 16-year-old female and at 9 months post-debond the occlusal relationship remains unchanged. The patient continues to wear upper and lower removable retainers on a part-time basis to reduce relapse potential as an alternative to a bonded retainer in the lower arch.

The third permanent molars will need future monitoring as they continue to develop. The position of the mandibular third molars has improved following the premolar extractions and it is hoped that they will erupt unaided in due course.

## Case report 2

### Clinical examination

A female Caucasian patient presented at 12 years and 2 months of age. She complained that her upper teeth were crooked and stuck out. There was no relevant medical history.

She presented in the permanent dentition with a Class II division 1 incisor relationship on a mild Skeletal II base.

The lips were incompetent at rest due to an increase in overjet, with the upper lip assessed as normal in length. There was an acceptable amount of incisal and gingival display on smiling and at rest, with the upper dental centerline coincident with the mid-facial axis. The nasolabial angle was within normal limits and the lower lip was retrusive relative to Rickett's E-plane, reflecting the underlying mandibular retrognathia.

Intra-oral examination revealed an acceptable standard of oral hygiene, although there were early carious lesions in the occlusal surfaces of the maxillary first molars that required restoration.

In the maxillary arch, the labial segment was severely crowded with a space deficiency of 10 mm. Both central incisors demonstrated marked mesiolabial rotations. The lateral incisors were palatal, the 2| being markedly displaced from arch line and also demonstrated mesiolabial rotations. The buccal segments were generally well aligned, although the left first molar was palatal to the line of the arch. The canines were upright and the incisors appeared mildly proclined relative to the Frankfort plane.

In the mandibular arch, the labial segment was moderately crowded with 2| linguallly displaced. The buccal segments were mildly crowded with the left first molar buccally displaced from the line of the arch. The total crowding within the arch amounted to a 6 mm space deficiency. In addition, the curve of Spee measured 2.5 mm on the left and 1.5 mm on the right at the deepest part. The canines were upright in angulation and the incisors appeared clinically to be at an acceptable inclination to the mandibular plane.

The overjet was 9 mm and the overbite was 4 mm. The upper dental centerline was coincident with the mid-facial axis and the lower dental center line was 1.5 mm to the right. The molar relationship was  $\frac{3}{4}$  unit Class II on the left and a full unit Class II on the right. The canine relationship was  $\frac{3}{4}$  unit Class II on the left and  $\frac{1}{2}$  unit Class II on the right. Localized crossbites were present involving the upper right lateral incisor with the mandibular right canine and between the first molars on the left. There were no displacements and neither signs nor symptoms of TMD (Figure 8a–i).

The Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) was 4a and the Aesthetic Component was 8. There was no Bolton discrepancy.

#### *Radiographic analysis*

Radiographic examination revealed the presence of all teeth including unerupted third molars. The presence of occlusal caries was confirmed in the maxillary first molars (Figure 9a).

The cephalometric analysis confirmed the clinical findings of a mild Skeletal II relationship due to mandibular retrognathia, with a corrected ANB angle of  $5.5^\circ$  and a Wits appraisal of +3.5 mm (Figure 9b). Both the maxillary–mandibular planes angle and the lower anterior face height proportion were within normal limits at  $25^\circ$  and 54%, respectively. The upper incisors were mildly proclined and the lower incisors mildly retroclined at  $114^\circ$  and  $88^\circ$ , respectively. The lower incisor edge was positioned 2 mm behind the A–Po line, just within the accepted range. The inter-incisal angle was also within normal limits at  $137^\circ$ . The lower lip was 6 mm behind Rickett's E-plane, which is considered retrusive. The cephalometric analysis is presented in Table 3.

#### *Treatment plan*

The aims of treatment were:

- to improve oral hygiene and restore the carious lesions;
- to relieve the crowding and align the arches;
- to correct the center-lines;
- to correct the anterior and buccal unilateral crossbite;
- to achieve Class I incisor and molar relationships within a stable soft tissue environment, maintaining the labiolingual position of the lower incisors;
- to achieve a good buccal segment interdigitation.

An extraction-based approach to treatment was planned to effect orthodontic camouflage and involved the following stages:

- improvement in dental health with oral hygiene instruction and restoration of caries;
- combination pull headgear to the upper first molars in conjunction with an upper removable appliance for molar distalization and overbite reduction by relative intrusion;
- extraction of  $\overline{4|4}$  and  $4|4$ ;
- fixed appliance treatment using a pre-adjusted edgewise appliance ( $0.022 \times 0.028$  inch slot) with Andrews non-extraction prescription brackets and Roth prescription bands;
- appropriate mechanics to achieve Class I incisor, canine and molar relationships following overbite correction, space closure and overjet reduction;
- detail and finishing, with seating of the buccal occlusion;
- retention with upper and lower removable retainers.

#### *Treatment provided*

Treatment commenced with combination pull safety headgear attached to Roth prescription bands on the



(a)

(b)

(c)

(d)



(e)

(f)

(g)



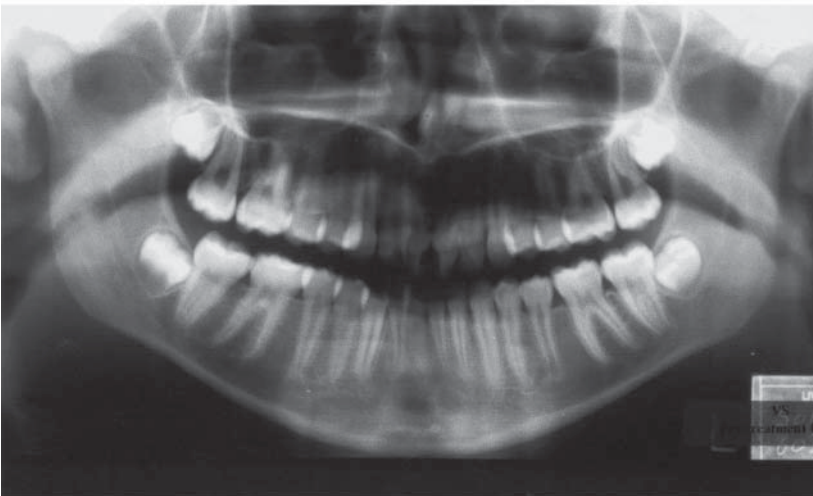
(h)



(i)

**Figure 8** (a-i) Case 2: pre-treatment photographs

**Figure 9** (a,b) Case 2: pre-treatment panoramic and lateral cephalometric radiographs



(a)



(b)



**Table 3** Case 2: pre-treatment and near end of treatment cephalometric analysis

	Pre-treatment	Near end of treatment	Change during treatment
SNA (°)	80	78	-2
SNB (°)	75	75	0
ANB (°)	5	3	-2
WITS appraisal (mm)	3.5	0	-3.5
S-N/MxP (°)	10	11	+1
MMPA (°)	25	25	0
LFH (%)	54	55	+1
UI/MxP (°)	114	109	-5
LI/MdP (°)	88	83	-5
LI/A-Po (mm)	-2	-2.5	-0.5
UI/LI (°)	133	143	+10

upper first molars. An upper removable appliance was fitted with a flat anterior bite plane for overbite reduction and palatal springs mesial to  $\overline{6|6}$  to maintain during the day, the night-time distalization achieved with the head-gear. The lower arch was bonded with Andrews non-extraction prescription brackets, omitting  $\overline{2|1}$  initially. A 0.014 inch superelastic nickel titanium archwire was placed to begin leveling and aligning with initial lacebacks bilaterally. Lower second molars were banded early in treatment to aid overbite correction.

Ten months into treatment, the molar relationship was corrected to Class I and the overbite corrected, therefore the removable appliance was discarded. The upper fixed appliance was placed with a 0.012 inch nickel titanium archwire used for initial alignment. Night-time wear of the headgear was continued to maintain the corrected molar relationship. After 15 months of treatment, coordinated 0.019 × 0.025-inch stainless steel archwires were *in situ* and space closing mechanics were instigated with a combination of elastic chain and traction modules (Figure 10a-d). Class II traction was commenced with TP tan elastics to correct the inter-arch relationship, the canine relationship being  $\frac{1}{2}$  unit Class II on the right and  $\frac{1}{4}$  unit Class II on the left.

After 18 months of treatment, an orthopantomogram and lateral cephalogram were taken for assessment of root positions and incisor inclinations to allow appropriate correction prior to debond (Figure 11a,b). Since the upper and lower incisors were clinically and radiographically upright, palatal root torque  $\overline{2|1|12}$  was added to the upper rectangular archwire and in the lower arch, a 0.020-inch stainless steel archwire was placed. Increased and reverse curves of Spee were added to the upper and lower archwires, respectively, and Class II

traction continued, allowing some controlled advancement of the lower incisors. Space closure continued for a further 6 months in the upper arch using traction modules and tie-backs were used in the lower arch to maintain space closure. When the left buccal segment interdigitation was Class I, Class II traction was continued unilaterally on the right to correct the residual inter-arch discrepancy and lower center-line discrepancy.

Once upper arch space closure was complete,  $\overline{7|7}$  were also banded to improve their alignment and eliminate an occlusal interference from  $\overline{7}$ . Subsequently, upper and lower 0.018-inch stainless steel archwires were placed with second order bends to improve the vertical position of  $\overline{5}$  and  $\overline{5|5}$  and artistic finishing bends to detail  $\overline{2|1|12}$ . The functional occlusion was assessed prior to debond and VS demonstrated bilateral canine guidance with no working or non-working side interferences on lateral excursion, and no posterior interferences on protrusion.

After 2 years and 6 months of treatment, appliances were removed (Figure 12a-i), and a modified upper Hawley and lower Essix removable retainer were fitted.

#### Case 2 assessment

VS was a female patient who presented for treatment during a period of active facial growth, which was likely to be in a favorable antero-posterior direction. She was satisfied with her facial aesthetics and only concerned with her dental malalignment. An extraction-based camouflage treatment was deemed the most appropriate and efficient option, with extra-oral traction to provide molar distalization.

It was necessary to extract the four first premolars in two stages, the upper premolars being extracted when the URA was no longer required. The initial use of an URA, and the delay while  $\overline{4|4}$  were extracted is likely to have lengthened the treatment duration, as it was 10 months before upper fixed appliance therapy was commenced. The simultaneous use of upper and lower fixed appliances from the start of treatment may have been preferable in order to reduce the lengthy treatment duration of 30 months.

The cephalometric analysis carried out towards the end of active treatment showed a small reduction of 2° in SNA, whilst the SNB value remained unchanged. This resulted in a small decrease in the ANB angle to 3°. The Wits value was also reduced to 0 mm. The cephalometric superimposition tracings (Figure 13a-c) show that there was only a small amount of anterior growth of the mandible with a general downward and backward pattern of growth affecting the entire facial skeleton. In the maxilla, this direction of growth, together with a small amount of upper incisor retraction has resulted in



(a)

**Figure 10** (a-d) Case 2: mid-treatment photographs. Combination pull headgear; 0.019 × 0.025 inch SS archwires with initial space closing mechanics



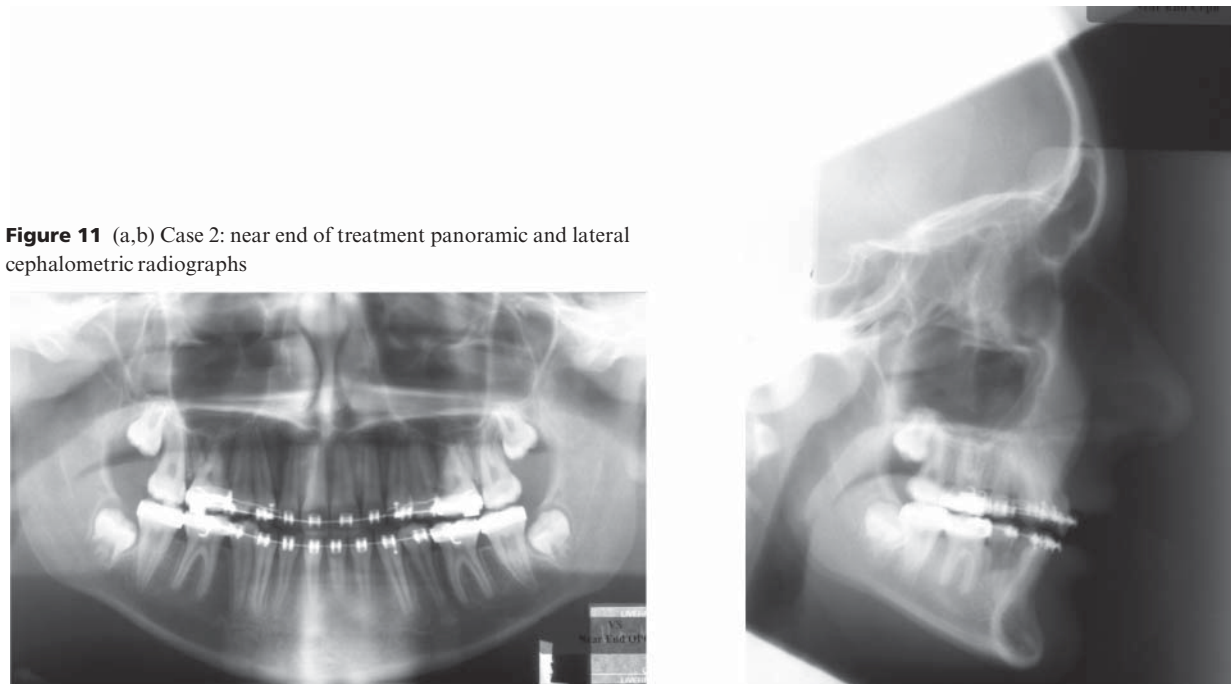
(b)



(c)



(d)



**Figure 11** (a,b) Case 2: near end of treatment panoramic and lateral cephalometric radiographs

(a)

(b)



**Figure 12** (a–i) Case 2: post-treatment photographs

the posterior movement of A point. Anterior growth of the maxilla may have been limited through the use of headgear.

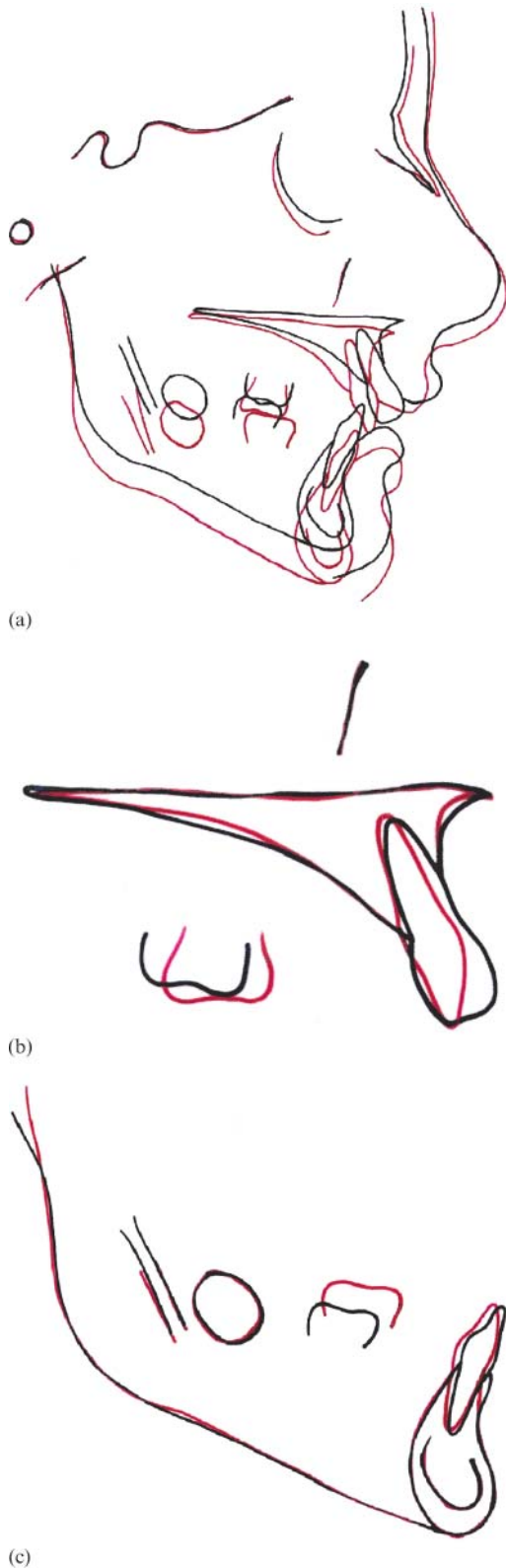
Despite the downward and backward growth rotation, there was no change in the maxillary–mandibular planes angle and only a small increase of 1% in the lower face height proportion to 55%.

The upper incisors were retroclined  $5^{\circ}$  to  $109^{\circ}$  and within normal limits. They did, however, appear upright clinically and labial crown torque was applied to 21|12 in the working archwire for the subsequent 6 months of treatment. The lower incisors were retracted  $5^{\circ}$  to lie 2.5 mm behind the A–Po line. It was therefore planned to subsequently advance the lower labial segment towards the initial labiolingual position using Class II traction

with a lower round stainless steel archwire during the final months of treatment. The inter-incisal angle was correspondingly increased on the near end of treatment cephalogram, but remained within the normal range at  $143^{\circ}$ .

With reduction of the overjet, the lips became competent at rest. The lower lip was retracted 1.5 mm relative to Rickett's E-plane to a position 7.5 mm behind this plane. This reflects the increased prominence of the nose and chin that has occurred, and the downward and backward direction of mandibular growth together with a small amount of lower labial segment retraction.

The initial PAR score of 52 points was reduced to 2 points post-treatment. This 96% reduction can be categorized as greatly improved (Table 4).



**Figure 13** (a–c) Case 2: pre-treatment (black) and near end of treatment (red) cephalometric superimpositions. Overall superimposition on anterior cranial base; maxillary and mandibular superimpositions on Bjork's stable structures

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

	Pre-treatment	Post-treatment
Overjet (mm)	9	2
Overbite (mm)	4	2
Incisor relationship	Class II division I	Class I
Molar relationship	Right 1 unit Class II Left ¾ unit Class II	Right Class I Left Class I
IOTN aesthetic component	8	1
IOTN dental health component	4a	2d
PAR score	52	2
PAR reduction (%)		96
Category of improvement		Greatly improved

There were no clinically obvious areas of decalcification and, although there was some mild gingival hyperplasia at debond, this rapidly resolved. There may have been a small amount of root resorption of the lower incisors, but this area of the panoramic radiograph is radiologically indistinct and this appearance may be artefactual.

The improvements in axial root position and the corrected localized crossbites are likely to be maintained by the good buccal segment interdigitation. The maintenance of overbite correction will be enhanced by the provision of a correct edge-centroid relationship. It is unlikely that there will be any further significant growth in a 15-year-old female and at 9 months post-debond the occlusal relationship remains unchanged. The patient continues to wear upper and lower removable retainers on a part-time basis to reduce relapse potential, although a bonded retainer could have been used as an alternative in the lower arch. The third permanent molars are developing and will need future monitoring, particularly as the mandibular third molars remain crowded.

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