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CLINICAL SECTION

The William Houston Medal of the Royal College of Surgeons of Edinburgh 2005

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This paper describes the orthodontic treatment of two cases that were presented by the winner of the William Houston Medal at the Membership in Orthodontics examination of the Royal College of Surgeons Edinburgh in 2005. The first case presentation is a Class II division 1 malocclusion treated by a combination of functional appliance and fixed appliance treatment and the second case presentation is a Class III malocclusion treated by a combination of fixed appliance treatment and orthognathic surgery.

Key words: Clinical case report, William Houston Medal, orthognathic surgery, maxillary surgical expansion, functional appliance

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Introduction

The William Houston Medal is a prestigious prize awarded to the individual achieving the most outstanding examination performance at the Membership in Orthodontics (MOrth) examination of the Royal College of Surgeons Edinburgh. As part of the examination the candidate must submit five clinical cases. Details of two of the cases are presented in this paper.

Case report 1

A male Caucasian patient presented at 12 years old complaining of the prominence of his upper anterior teeth. His medical history was unremarkable.

Extra-oral assessment

On extra-oral examination he presented with a mild Class II skeletal base with average vertical dimensions. There was no apparent facial asymmetry. Soft tissue examination revealed incompetent lips with the upper lip being short and a lower lip trap present (Figure 1).

Intra-oral assessment

Intra-oral examination revealed a full permanent dentition with the exception of the third molars. Oral hygiene was fair and tooth quality was good with the exception of the upper left central incisor which suffered trauma when the patient was shot by an airgun pellet at 9 years of age. The tooth suffered a complicated crown fracture and was subsequently root treated. The crown was restored with a composite restoration.

The mandibular arch form was symmetrical and 'U' shaped, with the lower labial segment retroclined and mild crowding present. The buccal segments were well aligned. The maxillary arch form was symmetrical and rounded, with the upper labial segment proclined and mildly spaced. The buccal segments were well aligned (Figure 2).

In occlusion, the incisor relationship was Class II division 1 with an overjet of 13 mm. The overbite, which was non-traumatic, was increased and complete to the palate. The upper and lower dental centrelines were coincident with the mid-facial axis. The buccal segment relationship on the right side was three-quarters of a unit Class II and on the left side was a half unit Class II. There were no crossbites or mandibular displacement on closure. An increased curve of Spee was present in the lower arch (Figure 2).

Radiographic assessment

The pre-treatment panoramic radiograph confirmed the presence of the complete permanent dentition including all four unerupted third molars (Figure 3). A periapical radiograph of the upper left central incisor demonstrated that the root treatment was adequate, with no sign of periapical pathology or significant root

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Figure 1 (a–d) Case report 1: pre-treatment extra-oral photographs

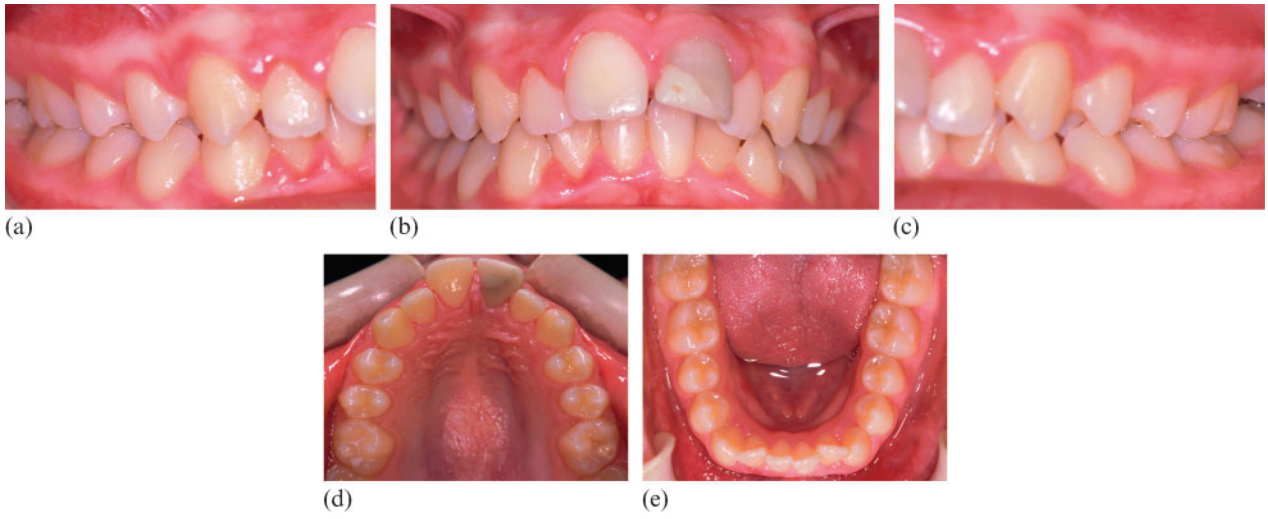


Figure 2 (a–e) Case report 1: pre-treatment intra-oral photographs

Figure 3 Case report 1: pre-treatment OPT radiograph

Figure 4 Case report 1: pre-treatment periapical radiograph of UL1

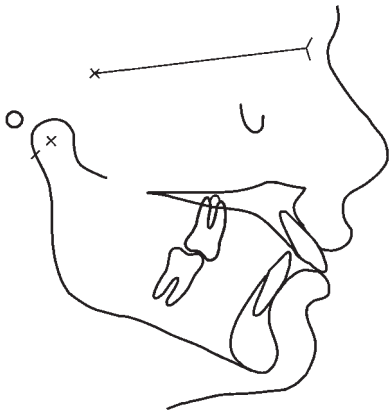


Figure 5 Case report 1: pre-treatment cephalometric tracing

resorption (Figure 4). The coronal portion of the restoration in the upper left central incisor was deficient and this was replaced by the patient's general dental practitioner. Vitality testing was undertaken on the upper right lateral and central incisor and the upper left lateral incisor. The results were within normal limits.

The cephalometric analysis (Figure 5, Table 1) revealed that both SNA and SNB were reduced with an ANB of 2.0°. This indicated a Class I skeletal base. Although SNA was reduced it was not possible to apply an Eastman correction, because the SN to maxillary plane was outside the normal limits. Despite the value of ANB, clinical examination indicated a mild Class II base and this was confirmed by the Wits analysis. The maxillary–mandibular planes angle and face height ratio were average, which confirmed the clinical findings. The lower incisors were of average inclination whilst the upper incisors were proclined by 15°. In summary the cephalometric analysis revealed that the malocclusion was primarily dentoalveolar with a mild skeletal discrepancy.

Table 1 Case report 1: pre-treatment cephalometric analysis.

Variable	Pre-treatment
SNA	77.5°
SNB	75.5°
ANB	2.0°
Wits appraisal	1.5 mm
Upper incisor to maxillary plane angle	123°
Lower incisor to mandibular plane angle	91.5°
Interincisal angle	118.5°
Maxillary mandibular planes angle	25°
SN to maxillary plane	4.5°
Upper anterior face height	46 mm
Lower anterior face height	61 mm
Face height ratio	57%
Lower incisor to APo line	0.5 mm
Lower lip to Ricketts E plane	−2.0 mm

Treatment need

The Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) was 5a, whilst the aesthetic component was 7. The pre-treatment weighted Peer Assessment Rating (PAR) score was 41.

Aims and objectives of treatment

1. to improve the patient's oral hygiene and dental health;
2. correction of the skeletal discrepancy through growth modification;
3. elimination of the lip trap and achievement of competent lips at the end of treatment;
4. achievement of a Class I incisor, canine and molar relationship;
5. alignment and levelling of the dental arches.

Treatment plan

1. oral hygiene instruction to improve dental health;
2. twin-block functional appliance (Figure 6);
3. upper and lower 0.022×0.028 inch pre-adjusted edgewise fixed appliances using the MBT prescription on a non-extraction basis;
4. retention using a lower bonded retainer, lower pressure formed removable retainer and an upper Hawley removable retainer.

Treatment progression

The total treatment time was 27 months. The incisor and buccal segment relationships were rapidly corrected to Class I and the facial profile improved after 8 months of full time wear of the twin-block functional appliance (Figures 7 and 8). The bite blocks were trimmed and the appliance worn at night only for a period of three months.

Eleven months into treatment both upper and lower fixed appliances were bonded. After seven months of the fixed appliance phase upper and lower 0.019×0.025 inch stainless steel rectangular archwires were placed. Class II inter-maxillary elastics were used at night only to maintain the functional appliance correction and every effort was made to minimize the adverse effects. The inter-maxillary elastics were used only after 0.019×0.025 inch rectangular stainless steel archwires were placed. An increased curve of Spee was placed in the upper arch to minimize upper incisor extrusion. Lingual crown torque was placed in the lower incisors to minimize proclination and, in the lower molars, buccal

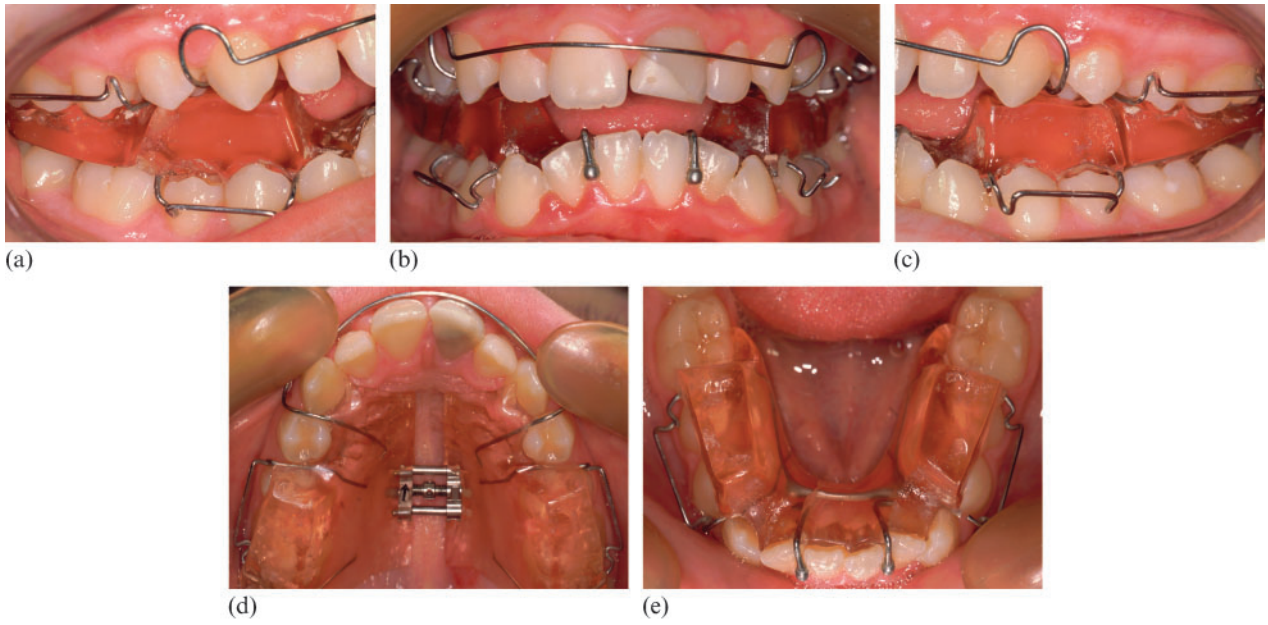


Figure 6 (a–e) Case report 1: intra-oral images showing the twin-block functional appliance design

crown torque was placed to prevent lingual rolling. Interproximal enamel reduction, followed by elastic chain to close space, was carried out in the lower labial segment over three visits. Following a period of finishing, the fixed appliances were debonded (Figures 9 and 10). A lower bonded retainer was placed from canine to canine and a lower pressure-formed removable retainer and an upper Hawley removable retainer provided.

Treatment changes

The cephalometric superimposition and analysis (Figure 11, Table 2) show the changes as a result of the functional appliance. Interpretation of treatment changes in an actively growing patient is complicated. The clinician must be aware of the changes that may be expected as part of normal growth and those that may be attributed to the treatment effect.

The cephalometric analysis found that SNA increased by 1.5° and SNB increased by 2°. This resulted in a small decrease in ANB of only 0.5°. The increase in SNB may be due to favourable mandibular growth or as a result of the functional appliance. The increase in SNA may be attributed to the growth pattern of the patient. Changes in the inclination of the upper incisors could influence the position of A point. Wits analysis found a decrease of 2.5 mm indicating a favourable change. The reliability of identifying the functional occlusal plane may

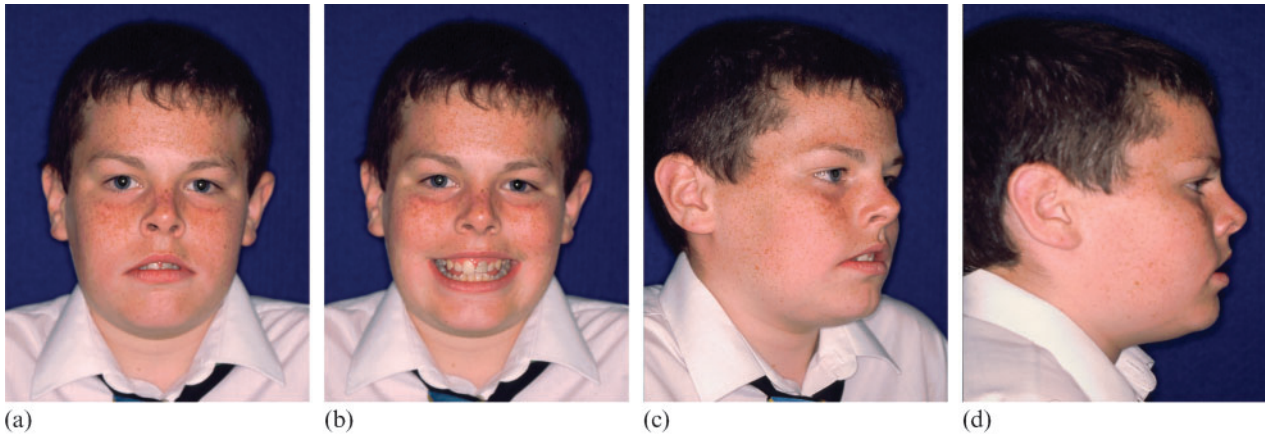


Figure 7 (a–d) Case report 1: post-functional extra-oral photographs

Figure 8 (a–e) Case report 1: post-functional intra-oral photos

Figure 9 (a–d) Case report 1: post-treatment extra-oral photographs

Table 2 Case report 1: post-functional cephalometric analysis and change from pre-treatment cephalometric analysis.

Variable	Post-functional	Change
SNA	79°	1.5°
SNB	77.5°	2°
ANB	1.5°	−0.5°
Wits appraisal	−1 mm	−2.5 mm
Upper incisor to maxillary plane angle	105°	18°
Lower incisor to mandibular plane angle	96°	4.5°
Interincisal angle	134°	15.5°
MM angle	27°	2°
SN to maxillary plane	5.5°	1°
Upper anterior face height	48 mm	2 mm
Lower anterior face height	67.5 mm	6.5 mm
Face height ratio	58.5%	1.5%
Lower incisor to APo line	2.5 mm	2.0 mm
Lower lip to Ricketts E plane	−2.5	−0.5 mm

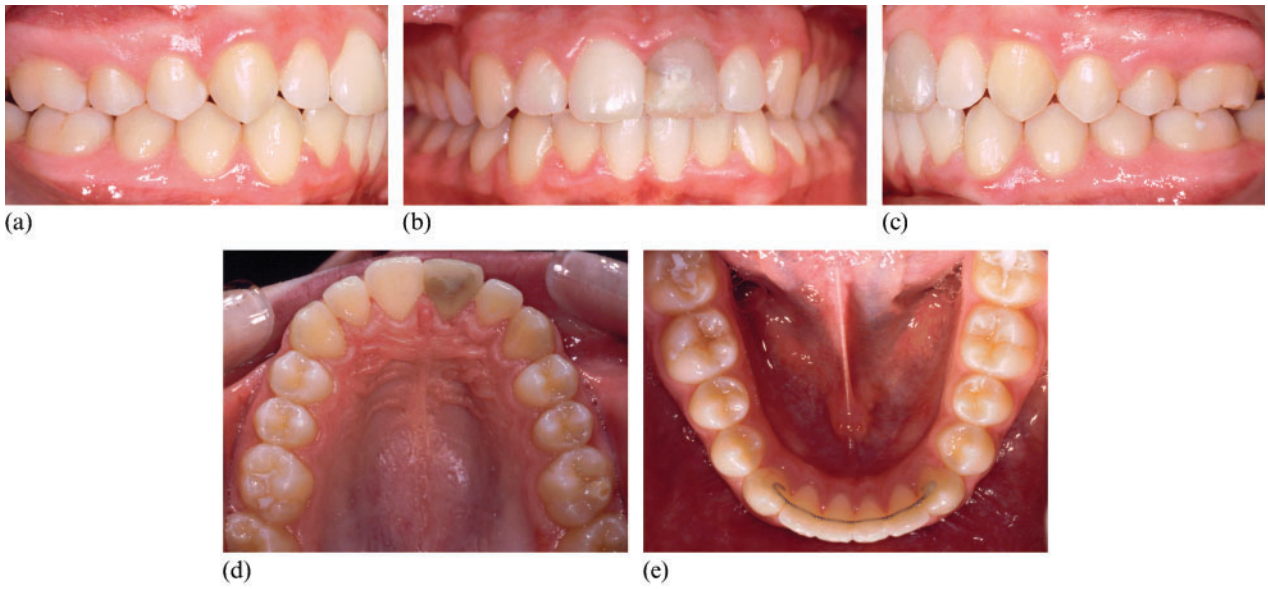


Figure 10 (a–e) Case report 1: post-treatment intra-oral photographs

account for the changes seen with the Wits analysis. The maxillary mandibular planes angle, lower anterior face height and the face height ratio increased. This most likely reflects the vertical growth pattern of the patient.

Significant changes in the inclination of the incisors occurred as a result of the functional appliance treatment. As expected the lower incisors proclined by 4.5° and the upper incisors retroclined by 18°.

In summary, there appears to be a small amount of favourable skeletal change although the greatest changes seen were dentoalveolar. The overjet was successfully reduced and the buccal segment relationship corrected.

The cephalometric superimposition and analysis (Figure 12, Table 3) show the overall treatment changes after the fixed appliance phase of treatment. The final cephalometric radiograph was taken mid-way through the fixed appliance phase of treatment. As would be expected only relatively small skeletal changes have taken place since the functional appliance phase, resulting in further reduction of ANB of 0.5°. Overall ANB reduced by 1.5° which was mainly due to an increase in the value of SNB. The increase in the value of SNB was probably due to a combination of the functional appliance and favourable mandibular growth.

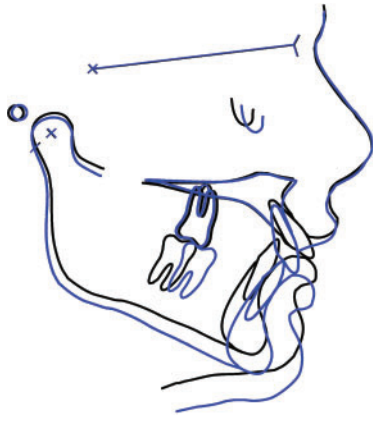


Figure 11 Case report 1: pre-treatment and post-functional cephalometric superimposition, registered on sella–nasion line at sella

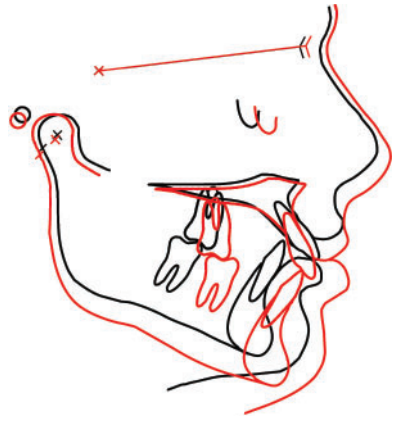


Figure 12 Case report 1: pre-treatment and mid-fixed appliance cephalometric superimposition, registered on sella–nasion line at sella

In the vertical dimension both the upper and lower anterior face height increased and this would be expected with normal growth. The face height ratio increased only by 1.5% and the maxillary mandibular planes angle increased slightly.

The main indication for taking the mid-fixed appliance radiograph was to assess the amount of lower incisor proclination. As was expected the lower incisors have proclined further due to the mild crowding and space required to level the increased curve of Spee in the lower arch. Following the functional appliance phase the lower incisors proclined a further 6°. Interproximal reduction of the lower incisors was then undertaken to reduce the lower incisor proclination. The upper incisors were slightly retroclined during the functional appliance phase and during the fixed appliance phase returned to normal inclination.

In summary, the overall treatment change following functional and fixed appliance treatment was mainly due to dentoalveolar change. A small amount of skeletal change was seen which was probably due to a combination of the functional appliance and favourable mandibular growth. It would have been interesting to take a further cephalometric radiograph to assess the effect of the interproximal reduction on the inclination of the lower incisors. This would not have been clinically justifiable and beneficial for the patient, because the retention regime of a lower bonded retainer had been decided at the beginning of treatment. It is expected that the proclination of the lower incisors reduced with interproximal reduction.

Table 3 Case report 1: mid-fixed appliance cephalometric analysis and change from pre-treatment cephalometric analysis.

Variable	Mid-fixed	Change
SNA	78°	0.5°
SNB	77.5°	2.0°
ANB	0.5°	−1.5°
Wits appraisal	−1 mm	−2.5 mm
Upper incisor to maxillary plane angle	110.5°	−12.5°
Lower incisor to mandibular plane angle	102°	10.5°
Interincisal angle	121°	2.5°
MM angle	27°	2°
SN to maxillary plane	3.5°	−1°
Upper anterior face height	49.5 mm	3.5 mm
Lower anterior face height	70 mm	9 mm
Face height ratio	58.5%	1.5%
Lower incisor to APo line	5 mm	4.5 mm
Lower lip to Ricketts E plane	0 mm	2 mm

Occlusal Indices

Table 4 shows the changes in IOTN and PAR achieved as a result of treatment.

Prognosis

Despite the interproximal enamel reduction the lower incisors will have been proclined as a result of treatment. Long-term bonded retention will be required in the lower arch due to the proclination in the lower labial segment. The patient demonstrated excellent oral hygiene throughout the fixed appliance treatment and should have no problems maintaining oral hygiene around the lower bonded retainer. A well-intercuspated, Class I occlusion has been achieved with competent lips which will promote stability of the buccal segment and overjet correction.

Treatment rationale

In many respects the patient was an ideal candidate for functional appliance treatment. He presented with a mild Class II skeletal discrepancy, average vertical dimensions, mild crowding and proclined upper incisors, with the lower incisors of average inclination. The functional appliance was used to try and correct the skeletal discrepancy, and correct incisor and buccal segment relationships to Class I. As a result of the potential skeletal and dentoalveolar changes produced by the functional phase, a more favourable soft tissue environment was created with elimination of the lip trap and the lower lip acting labially to the upper incisors.

It may have been possible to treat the patient with extractions and fixed appliances and avoid the functional appliance phase. Extractions were not considered for a number of reasons. The patient and mother were keen to avoid extractions as part of orthodontic treatment due to concerns about the prognosis of the

Table 4 Case report 1: occlusal indices at the start and finish of treatment.

Index	Parameter	Value
Index of treatment need		
Dental health component	Start	5a
	Finish	1
Aesthetic component	Start	7
	Finish	1
Peer assessment rating (PAR)	Start	41
	Finish	2
	Change	39
	%Change	95%

Figure 13 (a–d) Case report 2: pre-treatment extra-oral photographs

upper left central incisor. Both mother and patient did not wish to have extractions of healthy premolar teeth as part of treatment, knowing that some time in the future there may be the possibility of losing the upper left central incisor. Treatment involving extractions in the upper arch would have required careful anchorage management. The functional appliance was very effective in anchorage management. The overjet and buccal segment relationships were corrected rapidly to Class I.

Another option would have been to consider extractions following the functional appliance treatment. In the upper arch there was no crowding and, at the end of functional treatment, the upper incisors were retroclined. Extractions in the upper arch would have resulted in further retroclination of the upper incisors which would have been unfavourable. Space analysis indicated that there was only mild crowding in the lower arch and although the curve of Spee was increased, it was felt that extractions were not indicated.

Proclination of the lower incisors was anticipated following both the functional appliance treatment and the subsequent non-extraction fixed appliance phase. Interproximal reduction of the lower labial segment was planned to minimize the lower incisor proclination. The patient was informed that long-term bonded retention would be required in the lower labial segment.

Case report 2

A female Caucasian patient presented at 16 years old complaining of her facial appearance and the appearance of her teeth. She also reported difficulties with speech and eating certain foods. Her medical history was unremarkable.

Extra-oral assessment

On extra-oral examination she presented with a moderate Class III skeletal base with an increased Frankfort–mandibular planes angle. There was obvious maxillary hypoplasia, paranasal hollowing and flatness of the malar bones bilaterally. There was no apparent facial asymmetry. Soft tissue examination revealed incompetent lips with increased gingival show on smiling (Figure 13).

Intra-oral assessment

Intra-oral examination revealed a full permanent dentition with the exception of the third molars. Oral hygiene was fair and tooth quality was good. The mandibular arch form was symmetrical and 'U' shaped, with the lower labial segment retroclined and mild crowding present. The buccal segments were well aligned. The maxillary arch form was narrow and 'V' shaped, with the upper labial segment of average inclination and mildly crowded. The buccal segments were well aligned (Figure 14).

In occlusion, the incisor relationship was Class III with a reverse overjet of 2 mm (Figure 14). The overbite was reduced. The upper and lower dental centrelines were coincident with the mid-facial axis. The buccal segment relationship on the right and left side was a full unit Class III. The entire maxillary arch was in crossbite with the lower arch. There was no displacement on mandibular closure.

Radiographic assessment

The pre-treatment panoramic radiograph confirmed the presence of the complete permanent dentition with the exception of the maxillary third molars (Figure 15).

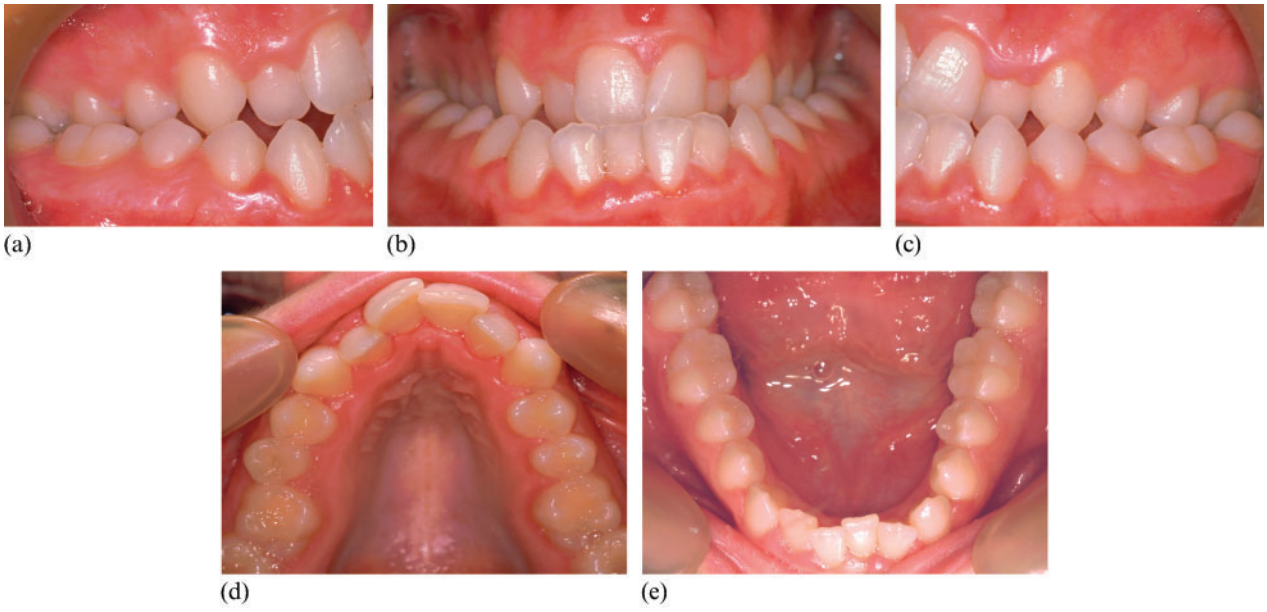


Figure 14 (a–e) Case report 2: pre-treatment intra-oral photographs

The cephalometric analysis (Figure 16, Table 5) revealed the value of SNA was reduced whilst SNB was within normal limits resulting in an ANB of −2.5°. This indicated a moderate Class III skeletal base that was primarily due to maxillary retrusion. It was possible to apply an Eastman correction, which resulted in an ANB of 0.5°. Even after applying the Eastman correction the skeletal relationship remained Class III and this was confirmed by the Wits analysis. In the vertical dimension, the maxillary mandibular planes angle was increased although the face height ratio was within normal limits. The lower incisors were found to be retroclined by 8.5° after a correction was applied for the increased maxillary mandibular planes angle. The upper incisors were of average inclination.

Cephalometric analysis confirms the clinical findings of a Class III skeletal discrepancy due mainly to maxillary hypoplasia. The lower incisors were retroclined as they were compensating for the underlying skeletal discrepancy.

Treatment need

The dental health component of the IOTN was 4m, whilst the aesthetic component was 6. The pre-treatment weighted PAR score was 41.

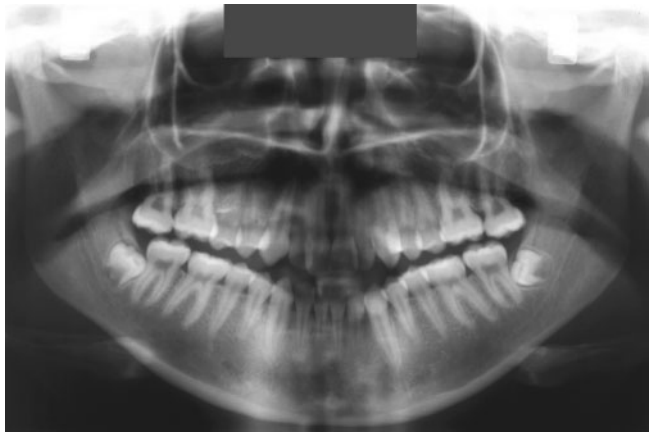


Figure 15 Case report 2: pre-treatment OPT radiograph

Figure 16 Case report 2: pre-treatment cephalometric tracing

Aims and objectives of treatment

1. to improve the patient's oral hygiene and dental health;
2. correction of the antero–posterior, vertical and transverse skeletal and dental discrepancy to improve aesthetics, dental health and function;
3. relief of crowding, alignment and levelling of the dentition;
4. achievement of a Class I incisor, canine and molar relationship.

Treatment plan

1. oral hygiene instruction to improve dental health;
2. non-extraction, alignment, decompensation and levelling of the upper and lower arches using 0.022×0.028 inch pre-adjusted edgewise fixed appliances using the MBT prescription.
3. bimaxillary orthognathic surgery. Le Fort I maxillary advancement of 5 mm and impaction of 4 mm. Mid-palatal split of the maxilla to correct the transverse discrepancy. Bilateral sagittal split osteotomy for mandibular setback of 5 mm. Bilateral malar onlay bone grafts using autogenous bone;
4. post-surgical orthodontics;
5. retention using a lower bonded retainer from canine to canine and lower pressure-formed removable retainer. In the upper arch a bonded retainer was placed on the upper central incisors and an upper Hawley removable retainer was provided.

Table 5 Case report 2: pre-treatment cephalometric analysis.

Variable	Pre-treatment
SNA	77.5°
SNB	80°
ANB	−2.5°
Wits appraisal	−2.0 mm
Upper incisor to maxillary plane angle	106°
Lower incisor to mandibular plane angle	77°
Interincisal angle	143.5°
Maxillary mandibular planes angle	33.5°
SN to maxillary plane	6.0°
Upper anterior face height	49.5 mm
Lower anterior face height	69 mm
Face height ratio	58%
Lower incisor to APo line	3 mm
Lower lip to Ricketts E plane	−2.0 mm

Treatment progression

The patient was referred for oral hygiene instruction prior to commencing treatment and she received regular supportive treatment throughout.

During the initial phase of pre-surgical orthodontic treatment, problems were encountered with fractured bonds and splitting of the molar bands in the upper arch. This was due to the crossbite of the upper arch. To prevent this, glassionomer cement was bonded to the occlusal surface of the lower first molars and removed when the patient was in heavier archwires. Otherwise the pre-surgical phase of treatment progressed well. In the upper arch the aim was to minimize dental expansion and create space between the upper central incisors for the mid-palatal split (Figure 17). A full-sized archwire was placed in the lower arch to fully decompensate the lower incisors.

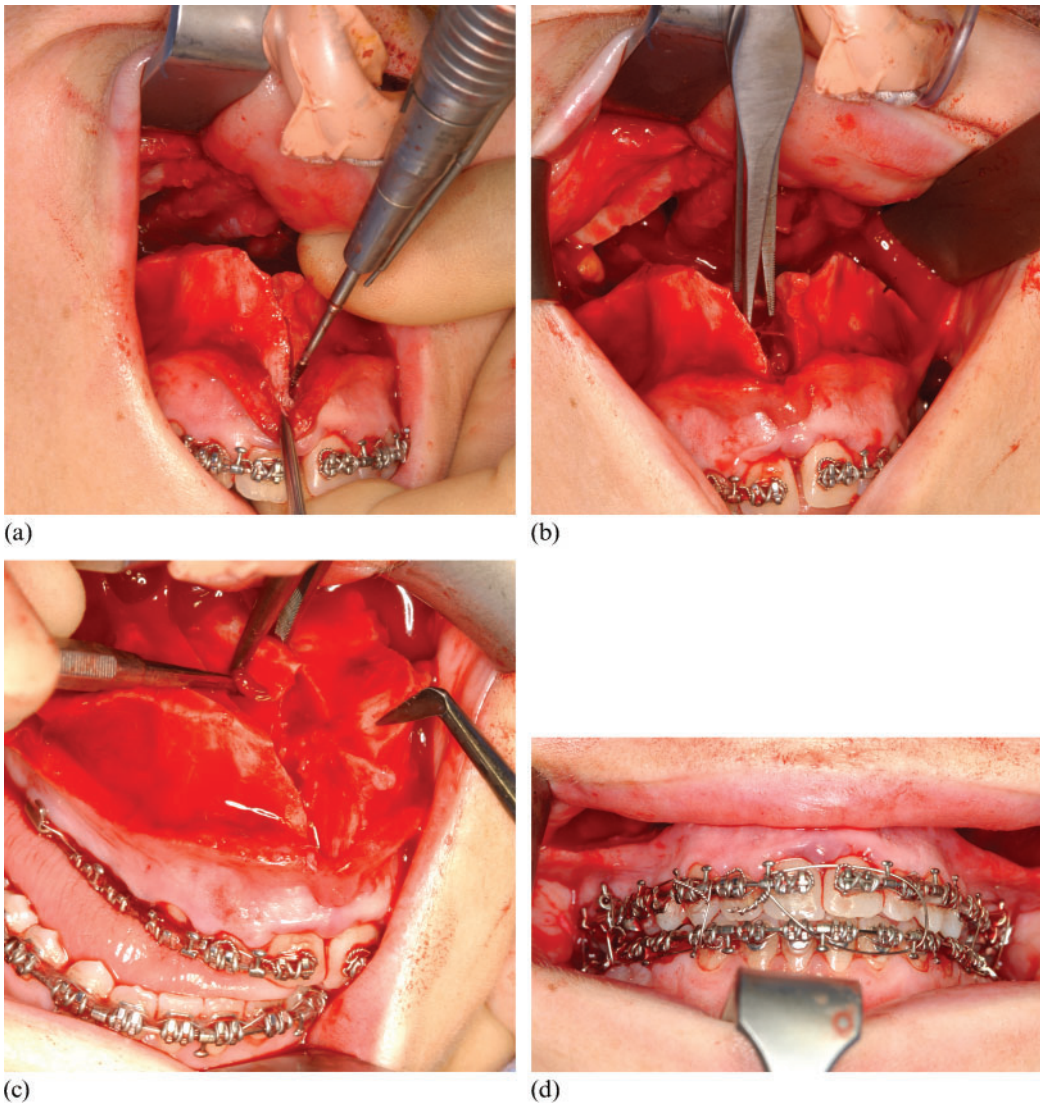
The patient's surgery was planned using a computer software package, CASSOS (Computer-Assisted Simulation System for Orthognathic Surgery) 2001 software (SoftEnable Technology Ltd, Hong Kong). A facebow recording was taken and model surgery carried out. Surgery was performed 14 months into treatment.

During the immediate post-operative phase the patient was placed in inter-maxillary elastics. The sectioned upper archwire was replaced with a continuous nickel titanium archwire to align the maxillary segments. To prevent any relapse of the transverse expansion a 1.0 mm diameter stainless steel jockey arch was placed in the molar tubes (Figure 18). The jockey arch was removed when a continuous 0.019×0.025 inch stainless steel wire was placed with expansion (Figure 19). Vertical triangular elastics were used in the buccal segments to improve the intercuspation during finishing.

The fixed appliances were debonded six months after the surgery with a total treatment time of 21 months (Figures 20 and 21).

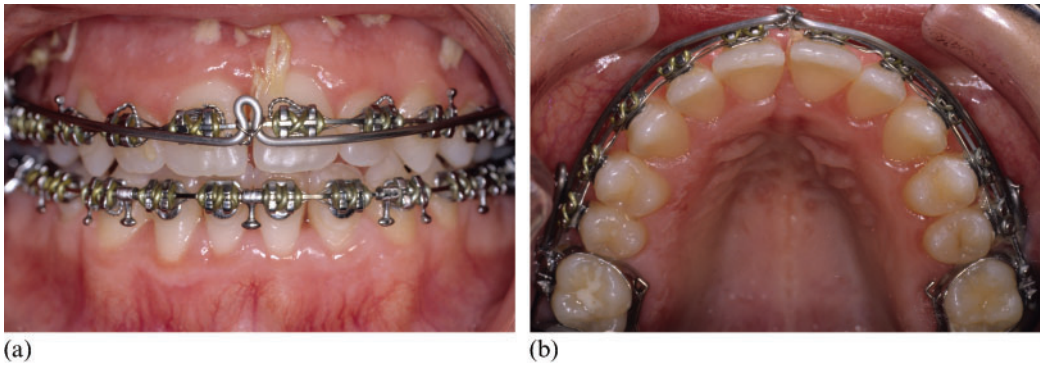
Treatment changes

The cephalometric superimposition and analysis (Figure 22, Table 6) show the changes achieved during the pre-surgical phase of orthodontics. The value SNA remained unchanged but SNB decreased by 2°. This was due to the bite opening effect of the pre-surgical orthodontics and the proclination of the lower incisors. The bite opening effect, as demonstrated by the increase in the maxillary mandibular planes angle and increase in lower anterior face height, resulted in a rotation of the mandible and posterior positioning of B point. The upper incisors were of average inclination on the pre-treatment lateral cephalometric



(a) (b) (c) (d)

Figure 17 (a–d) Case report 2: intra-operative images showing the maxillary surgical expansion



(a) (b)

Figure 18 (a,b) Case report 2: maxillary jockey archwire placed immediately post-surgery

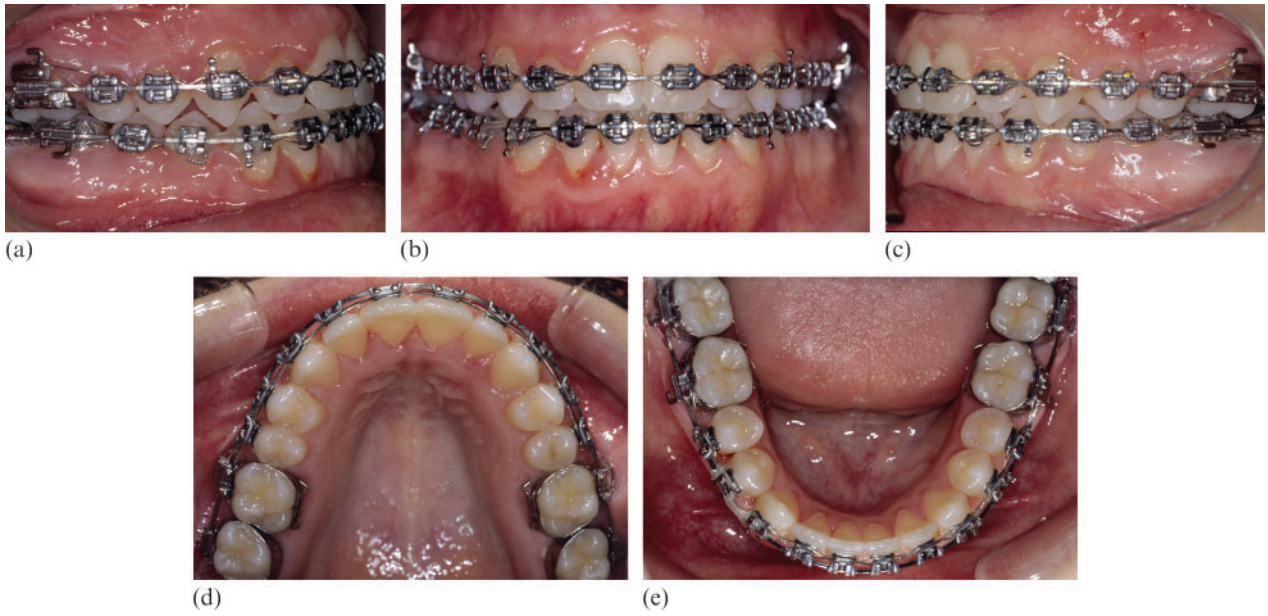


Figure 19 (a–e) Case report 2: post-operative occlusion

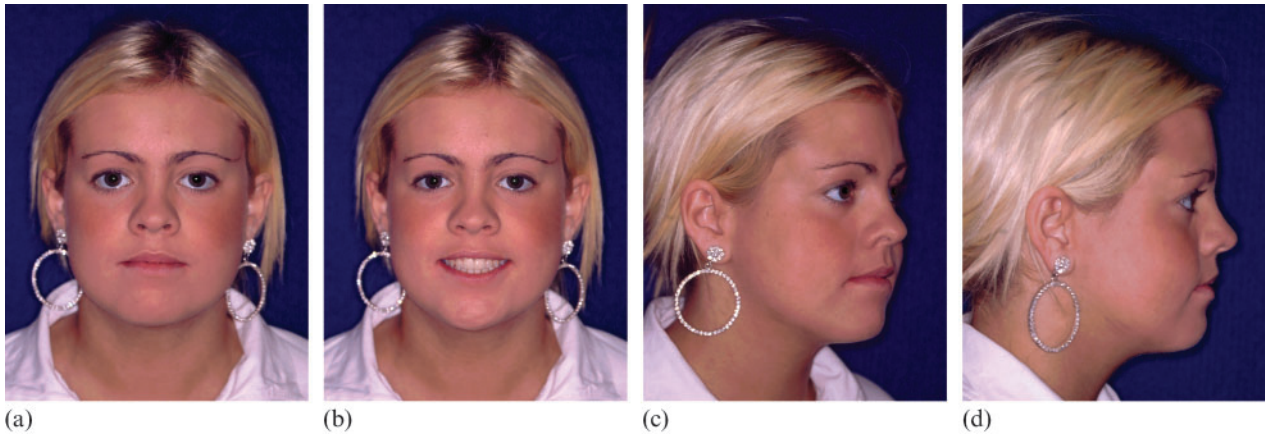


Figure 20 (a–d) Case report 2: post-treatment extra-oral photographs

Table 6 Case report 2: post-surgery cephalometric analysis and change from pre-treatment cephalometric analysis.

Variable	Pre-surgery	Change
SNA	77.5°	0°
SNB	78°	−2°
ANB	−0.5°	2°
Wits appraisal	−1 mm	1 mm
Upper incisor to maxillary plane angle	107°	1°
Lower incisor to mandibular plane angle	91°	14°
Interincisal angle	126°	−17.5°
MM angle	35.5°	2.0°
SN to maxillary plane	6°	0°
Upper anterior face height	49.5 mm	0 mm
Lower anterior face height	71.5 mm	2.5 mm
Face height ratio	59%	−1%
Lower incisor to APo line	7.0 mm	4 mm
Lower lip to Ricketts E plane	3.5 mm	5.5 mm

radiograph and proclined by only 1°. The lower incisors were decompensated by 14°. The changes in lower incisor to APo line and lower lip to Rickets E plane reflect the decompensation of the lower incisors achieved.

The cephalometric superimposition in Figure 23 and analysis (Table 7) show the changes achieved at the end of treatment. Overall, SNB decreased by 1° and SNA increased by 2° resulting in an increase in the value of ANB of 3°. The ANB value post-treatment indicated a mild Class III skeletal base although the Wits analysis indicated a Class I skeletal relationship. The vertical dimensions remained increased although the cephalometric superimposition reveals the planned impaction of the maxilla anteriorly was successful. The soft tissue profile on the post-treatment radiograph shows a significant improvement and has resulted in a very pleasing profile for the patient.

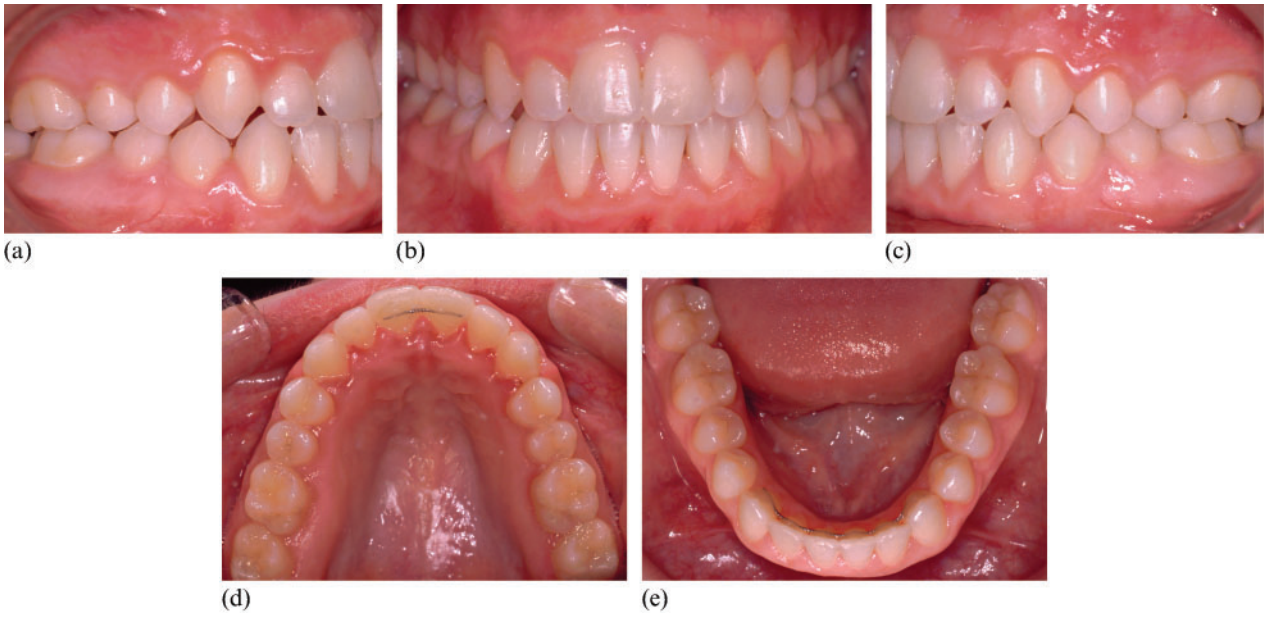


Figure 21 (a–e) Case report 2: post-treatment intra-oral photographs

Occlusal indices

Table 8 shows the changes in IOTN and PAR achieved as a result of treatment.

Prognosis

The transverse expansion of the maxilla will be prone to relapse. The surgeon placed autogenous bone grafts, harvested from the iliac crest between the maxillary segments to help minimize relapse. The placement of the jockey arch in the headgear tubes in the upper arch maintained the surgical expansion during the first two months after the surgery. A good intercuspation of the buccal segments was achieved and this should also prevent relapse. The patient wore the upper Hawley style retainer full time for one year and this helped maintain the arch expansion. After one year the upper Hawley retainer was replaced with a pressure-formed removable retainer. The lower bonded retainer will prevent relapse of the crowding in the lower labial segment.

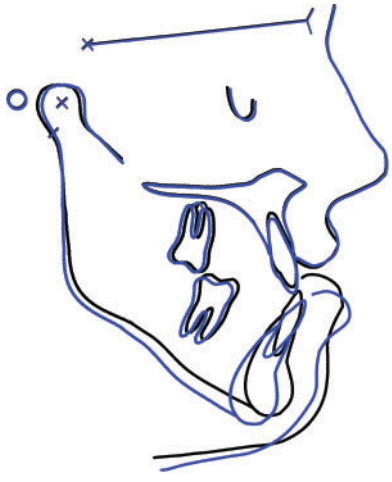


Figure 22 Case report 2: pre-treatment and pre-surgery cephalometric superimposition, registered on sella–nasion line at sella

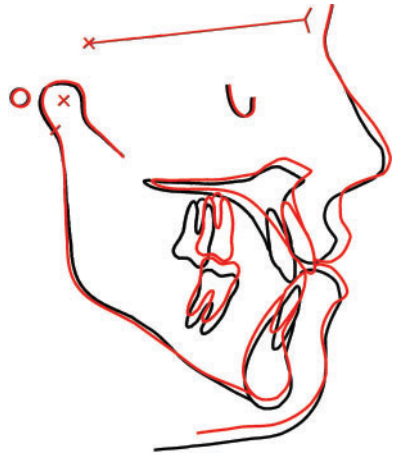


Figure 23 Case report 2: pre-treatment and post-treatment cephalometric superimposition, registered on sella–nasion line at sella

Table 7 Case report 2: post-treatment cephalometric analysis and change from pre-treatment cephalometric analysis.

Variable	Post-treatment	Change
SNA	79.5°	2°
SNB	79°	−1°
ANB	0.5°	3°
Wits appraisal	0 mm	2 mm
Upper incisor to maxillary plane angle	106°	0°
Lower incisor to mandibular plane angle	91°	14°
Interincisal angle	129°	14.5°
MM angle	3.5°	−3°
SN to Maxillary plane	3°	−3°
Upper anterior face height	46.5 mm	−3 mm
Lower anterior face height	68.5 mm	0.5 mm
Face height ratio	59.5%	1.5%
Lower incisor to APo line	4.5 mm	1.5 mm
Lower lip to Ricketts E plane	−1.0 mm	1.0 mm

Treatment rationale

Due to the skeletal aetiology of the malocclusion orthognathic surgery was indicated to correct the malocclusion. Despite the aetiology of the skeletal discrepancy being maxillary hypoplasia the surgical planning determined that bimaxillary surgery was required. The pre-treatment and post-treatment cephalometric superimposition (Figure 23) shows that the antero–posterior position of the mandible remained largely unchanged despite the mandibular setback. This may be explained by the anti-clockwise auto-rotation of the mandible as a result of the advancement and impaction of the maxilla. The auto-rotation of the mandible caused a more severe skeletal discrepancy hence the need for the mandibular surgical procedure.

Table 8 Case report 2: occlusal indices at the start and finish of treatment.

Index	Parameter	Value
Index of orthodont treatment need		
Dental health component	Start	4m
	Finish	1
Aesthetic component	Start	6
	Finish	1
Peer assessment rating (PAR)	Start	41
	Finish	3
	Change	38
	% Change	93%

The patient was particularly concerned about the 'lack of cheek bones' and it was agreed to place autogenous malar bone grafts harvested from the iliac crest at the time of surgery.

The option of accepting the compromise of a bilateral posterior crossbite was discussed, but the patient was keen on achieving the optimal result and was warned of the risks of surgical relapse following surgical expansion of the maxilla. Figure 17 shows intra-operative images of the maxillary surgical expansion.

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