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CLINICAL SECTION

The American Orthodontics BOS MOrth Cases Prize 2005

Nadine Houghton
Orthodontic Department, St Luke's Hospital, Bradford, UK

This paper describes the orthodontic treatment of two cases that were successfully entered for the 2005 American Orthodontics MOrth Cases Prize. The first case is that of a patient presenting with a Class II division 2 malocclusion treated with upper and lower fixed appliances plus headgear. The second case demonstrates the use of a twin-block appliance, followed by fixed appliances to correct a moderate Class II division 1 malocclusion.

Key words: MOrth cases prize, case reports, orthodontics, hypodontia, twin-block

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Introduction

The American Orthodontics BOS MOrth Cases Prize is awarded annually for the best two MOrth examination cases. Candidates are invited to enter from all of the UK Royal Colleges. The cases are usually exhibited at the British Orthodontic Conference but as the 2005 conference was amalgamated with the World Orthodontic Conference in Paris, the cases entered were judged at the BOS office in London. The winning case was awarded the BOS Medal in Paris.

Case report 1

A 14-year-old, fit and well Caucasian female presented with a Class II division 2 malocclusion on a mild skeletal II base with reduced vertical proportions. She had generalized microdontia with developmentally missing upper lateral incisors. Her main complaint was her 'spaced upper teeth'.

Extra-oral assessment

The patient had a mild Class II sagittal skeletal relationship with bimaxillary retrognathia. She had reduced vertical proportions with a reduced Frankfort–mandibular planes angle (FMPA) and lower face height. There was no apparent transverse discrepancy. Her lips were competent at rest but her gingival show was increased at maximum smile (on full smile, she showed 5 mm of horizontal gingivae). She had a high lower lip line. The lower lip was 10 mm behind the E-line. The nasolabial angle was obtuse (Figure 1a–d). Clinical assessment of the temporomandibular joints was unremarkable.

Intra-oral assessment

The patient demonstrated a good level of oral hygiene. The presence of a fleshy labial fraenum was noted with a low attachment (Figure 2b) but there was no blanching of the incisive papilla when the labial fraenum was put under tension.

The mandibular arch was U-shaped with mild lower labial segment crowding (4 mm). The lower central incisors were diminutive in shape and the lower right central incisor (LR1) was rotated slightly. The lower first premolars were also rotated slightly. There was a retained lower left deciduous canine (LLC) and the permanent successor was unerupted but palpable lingually.

The maxillary arch was U-shaped and the upper labial segment showed significant spacing (10 mm). Both upper lateral incisors were developmentally missing. Both upper central incisors had reduced mesiodistal proportions and there was a 3 mm central diastema. Both canines were mesially positioned and they were rotated mesiopalatally (Figure 2a–e).

The patient presented with a Class II division 2 malocclusion. She had a 2 mm overjet and the overbite was increased and complete to tooth. The upper centreline was coincident with the facial midline and the lower centreline was 2 mm to the left. The buccal segment relationship was 1/4 of a unit Class II bilaterally. The canine relationship was 3/4 of a unit Class II on the right. There were no cross-bites or displacements (Figure 2a–e)

Address for correspondence: Miss N. Houghton, Consultant Orthodontist, Orthodontic Department, St Luke's Hospital, Little Horton Lane, Bradford, BD5 0NA, UK.
Email: nadinehoughton@hotmail.com

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

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

The pre-treatment PAR score was 27,[1] and the DHC of the IOTN,[2] recorded as 4h.

Radiographic assessment

An orthopantomogram (Figure 3) confirmed the presence of all permanent teeth apart from the developmentally missing upper lateral incisors. All permanent third molars and the lower left permanent canine were unerupted. The root development of the canine was almost complete and there was advanced root resorption on the deciduous predecessor. No pathology was associated with the unerupted teeth. The cephalometric analysis (Figure 4, Table 1) demonstrates

(a) (b) (c)

(d) (e)

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

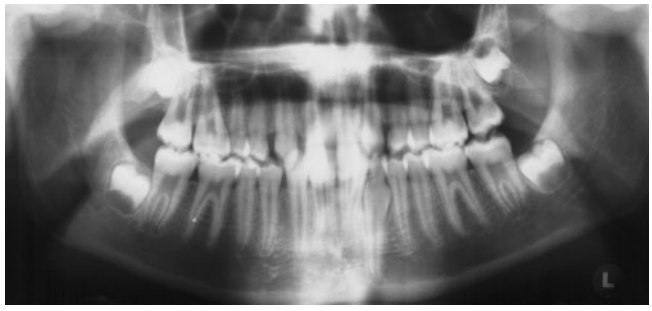


Figure 3 Case report 1: pre-treatment orthopantomogram

the bimaxillary retrognathia tendency of the patient (SNA=75° and SNB=73°). Pogonion is 9.5 mm behind nasion–perpendicular which confirms the clinical impression of a mild skeletal II discrepancy. The cephalometric analysis confirmed the clinical appearance of decreased vertical proportions (MMPA=19°). Dentally, the upper and lower labial segments were retroclined (95 and 80° respectively). The lower labial segment was positioned posterior relative to the A–Pogonion reference line (–5 mm). Both the lower lip (10 mm) and the upper lip (9 mm) were retrusive relative to the E-line.[3] The nasolabial angle was obtuse.

Aetiology

The sagittal skeletal discrepancy was probably genetically inherited, and this contributed to the presenting malocclusion. The reduced vertical proportions contributed to the increased overbite and the high lower lip line resulted in retroclination of the upper labial segment. As the lower incisors were trapped behind the upper incisors, they too became retroclined. The midline diastema and upper severe spacing has resulted from the combination of the upper labial fraenum, the hypodontia and microdontia affecting the upper dentition.[4] The under-developed cingulum plateau of the upper central incisors may have contributed to the deep overbite, as the lower incisors have been unable to establish a good occlusal stop.[5] In the lower arch, a tooth-arch discrepancy has led to lower mild crowding. The crowding related to the lower left permanent canine has led to the lower centreline shift to the left. The crowding and delayed exfoliation of lower left deciduous canine may be factors leading to the impacted successor.

Figure 4 Case report 1: pre-treatment lateral cephalogram

Aims of treatment

1. Accept skeletal pattern and mild asymmetry.
2. Level and align the arches.
3. Correct the overbite and maintain a normal overjet.
4. Correct incisors, canines and molars to Class I (including correct edge–centroid relationship and inter-incisor angle).

Table 1 Case report 1: cephalometric analysis.

Variable	Pre-treatment	Near end of treatment	Change
SNA (°)	75	73	−2
SNB (°)	73	71	−2
ANB (°)	2	2	0
Upper incisor/mx (°)	95	115	+20
Lower incisor/mn (°)	80	90	+10
Interincisor angle (°)	165	135	−30
MMPA (°)	19	20	+1
Face height ratio (%)	50	50	0
Lower incisor to APpog (mm)	−5	−1	+4
Lower lip to Rickets E-plane (mm)	−10	−8	+2

5. Correct the lower centreline.
6. Redistribute space for prosthetic upper lateral incisors.
7. Accept some proclination of the lower labial segment (to reduce the overbite and to relieve lower labial segment crowding).
8. Detailed finishing to achieve a functionally balanced occlusion.
9. Retention to maintain the corrected dental position.

Treatment plan and rationale

The treatment plan was as follows:

1. Extraction of lower left deciduous canine to allow the permanent successor to erupt.
2. Upper removable appliance with a flat anterior bite plane (to reduce the overbite) and a nudger (to distalize the upper first molars). High pull snap-release extra-oral traction with Kloehn facebow and Masel strap (Ortho-Care (UK) Ltd, Bradford, UK) was used to aid molar distalization.
3. Upper and lower pre-adjusted Edgewise appliance (MBT prescription with 0.022×0.028-inch slot). Space creation on 0.018-inch stainless steel wire to create space for the eruption of the lower left canine. Surgical exposure of this tooth could be arranged if it failed to erupt once space had been created. The upper arch had 10 mm of spacing and as the molar relationship was almost Class I, it was decided that space would be created for prosthetic upper lateral incisors and the final molar relationship would be Class I.

Treatment progress

The patient was referred back to her general dental practitioner to extract LLC.

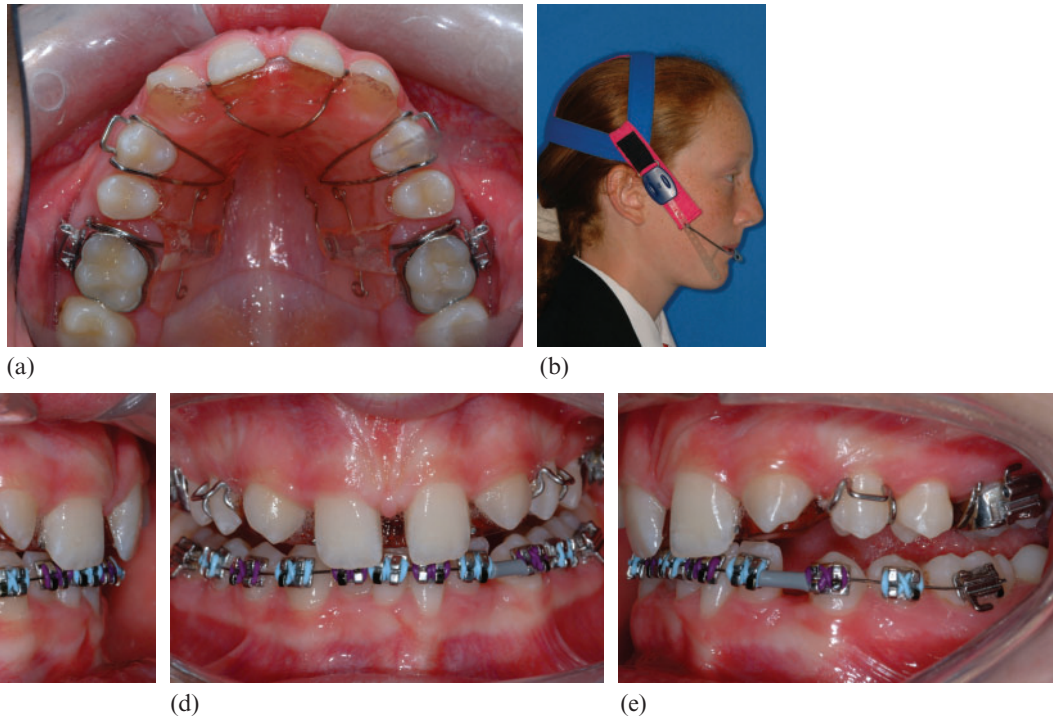
Bands were cemented to the upper first permanent molars and an upper removable appliance (URA) with a nudger was fitted (Figure 5a). A Kloehn facebow was fitted at the same visit with high-pull snap release headgear and a Masel neck strap (Figure 5b). The patient was instructed to wear the URA full time and to wear the headgear for 12–14 hours per day. The applied force was a measured 450 g on each side. Compliance was checked on the subsequent appointment and as a bilateral super Class I molar relationship was evident; the lower pre-adjusted edgewise fixed appliance was bonded (Figure 5c–e) (0.022×0.028-inch, MBT prescription). An initial 0.014-inch nickel titanium aligning wire was placed.

The upper arch was bonded once the overbite was under control and a lower 0.019×0.025-inch stainless steel archwire was in place. Despite adequate space creation, ten months later, the LL3 had still not erupted. A periapical radiograph was taken and no abnormalities were detected. The patient was referred to the Oral Surgery department with a request for the surgical exposure of this tooth. An open exposure was carried out under general anaesthesia five months later with an apically repositioned buccal flap. At her subsequent orthodontic appointment, the tooth had erupted slightly and a bracket was bonded to this tooth. The bracket on the exposed canine impinged upon the base wire, precluding vertical movement and so a flexible 0.012-inch nickel titanium archwire (rather than piggy-back mechanics) was inserted to pick up the exposed tooth Progressive levelling and alignment allowed placement of the final working archwires, upper and lower 0.019×0.025-inch stainless steel (SS). Once these wires were *in situ*, upper prosthetic lateral incisors were attached to the archwire (Figure 6a,b). Mesial and distal palatal wires were attached to the prosthetic lateral incisors to help prevent rotational movement of the prostheses. Upper labial segment palatal root torque was added to correct the incisor inclination of the upper arch. Space closure mechanics were employed in the upper arch and bilateral Class II elastics were worn to help with upper space closure and overjet reduction. Near end-of-treatment radiographs were obtained to assess root paralleling and incisor inclinations (Figures 7 and 8). The upper and lower fixed appliances were debonded after 26 months of treatment (Figures 9a–d and 10a–e).

An upper Hawley retainer was indicated as it could easily incorporate prosthetic lateral incisors as well as maintaining the overbite to the finished occlusion. An upper bonded retainer was also indicated to retain the closed central diastema. A lower bonded retainer was deemed necessary as the lower labial segment was positioned in a potentially unstable position following proclination of 10°. The lower retainer was designed to incorporate LL4 as LL3 needed surgically exposing and could potentially undergo vertical relapse.

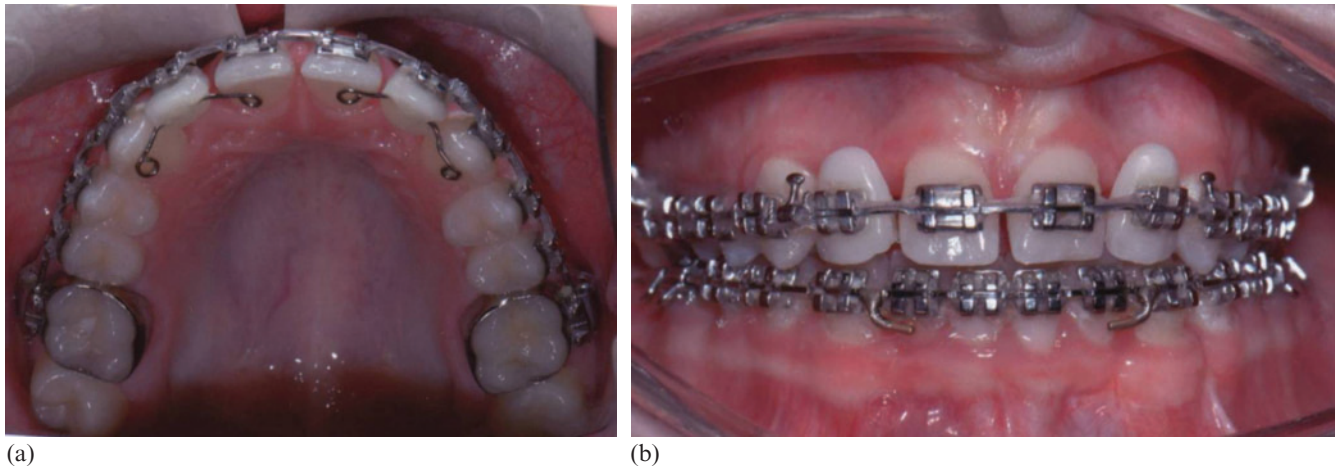
Case discussion

The patient experienced minimal skeletal change during orthodontic treatment. Figure 11 illustrates the pre-treatment and near end-of-treatment cephalometric radiographic changes and shows posterior movement of A and B points. These are dento–alveolar landmarks that remodel in a posterior direction as the incisor roots are torqued back. The headgear may have resulted in



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

Figure 5 Case report 1: (a) URA with nudger, (b) high-pull extra-oral traction, and (c–e) lower pre-adjusted edgewise fixed appliance



(a) (b)

Figure 6 (a,b) Case report 1: pre-adjusted edgewise fixed appliance treatment with prosthetic lateral incisors attached to archwire

Figure 7 Case report 1: near end-of-treatment panoral radiograph

Figure 8 Case report 1: near end-of-treatment cephalometric radiograph

maxillary restraint or maxillary growth may have ceased hence the minimal maxillary skeletal change. The mandible appears to show a counter-clockwise rotation which may be a result of correcting the deep bite by molar extrusion. Nasion–perpendicular showed no significant antero–posterior change. The upper and lower incisor inclination has been altered by 20 and 10° respectively. This has resulted in final inclination values that fall in with Caucasian cephalometric norms. The edge–centroid relationship has been corrected as the upper central incisor centroid is positioned behind the lower incisor tip. The interincisal angle has also been corrected to a normal value of 135°. The correction of the patient's malocclusion has been achieved mainly through dento-alveolar compensation. It is anticipated that she has passed her pubertal growth spurt and therefore any future growth should be at adult levels. Future mandibular growth is unpredictable[6] and so long-term retention may be required to maintain the corrected tooth position. Long-term stability is a concern in this case. There is good bilateral interdigitation and the corrected inter-incisal angle and edge–centroid relationship will hopefully help to reduce the likelihood of relapse.[7] However, she still has a high lip

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

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

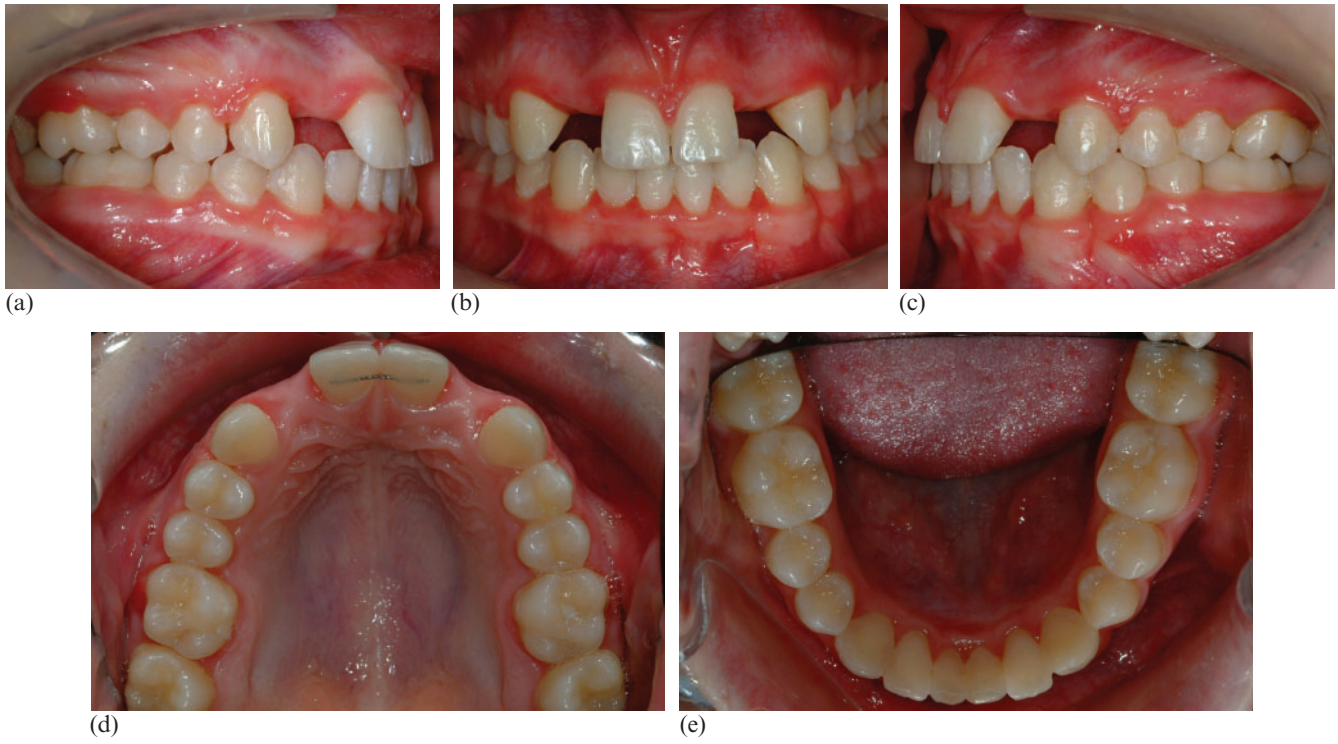


Figure 10 (a–e) Case report 1: post-treatment intra-oral photographs

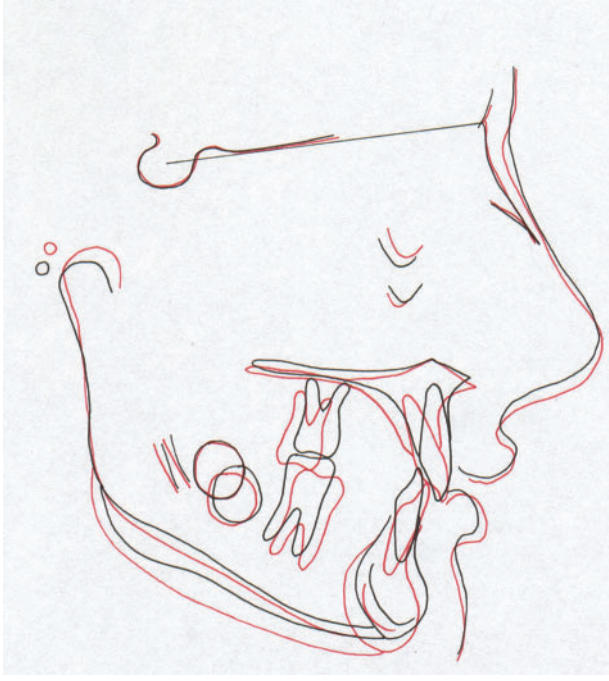


Figure 11 Case report 1: pre-treatment and near-end of treatment cephalometric superimposition (black=pre-treatment; red=near end-of-treatment)

line which could potentially retrocline the upper labial segment if retention is not maintained. The lower incisors have been proclined and are more susceptible to relapse hence the need for a long-term bonded retainer. Similarly, the upper central diastema has a high relapse potential[4] which was the main indication for a bonded retainer on these teeth (Figure 10d).

The near end-of-treatment dental panoramic tomogram shows adequate bone dimensions for future implants to replace the upper lateral incisors (Figure 7). This radiograph also shows that the roots are parallel which is essential if future implants are used. The medium-term restorative option is the placement of resin-bonded bridges from the upper canines to replace the upper lateral incisors. Long-term implants could be placed after the age of 18 years.

The post-treatment PAR 6 and the overall percentage reduction in PAR score was 78%.

Case report 2

A 13-year-3-month-old Caucasian male presented with a Class II malocclusion. He was concerned about the fact

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

Figure 12 (a–d) Case report 2: pre-treatment extra-oral photographs

that his 'front teeth stick out'. The patient was fit and well, with no relevant medical history.

Extra-oral assessment

The patient had a moderate Class II sagittal skeletal relationship and the vertical proportions were within normal limits. There was no facial asymmetry (Figure 12a–c). His lips were habitually competent and were of normal length. The nasolabial angle was normal (Figure 12d). The temporomandibular joint assessment was normal with no signs or symptoms reported.

Intra-oral assessment

Initially oral hygiene was poor but this improved following oral hygiene instruction. Dental health was good with no restored teeth. Lower first molars had stained pits which the patient's GDP was keeping under review.

The mandibular arch form was v-shaped and there was mild crowding (2 mm) of the lower arch. The lower labial segment was normally inclined (Figure 13).

The maxillary arch form was v-shaped. There was mild crowding (2 mm) and the upper incisors were of a normal inclination (Table 2).

In occlusion, the patient had a Class II division I incisor relationship with an overjet of 10 mm. The overbite was slightly increased but incomplete. The upper centreline was displaced to the left by 1 mm. The buccal segment relationship was greater than a full unit Class II on the right and a full unit Class II on the left. The canine relationship was greater than a full unit Class II on the right and 3/4 Class II on the left side. There were no crossbites or displacements.

The DHC score of the IOTN[2] was 5a and the pre-treatment PAR[1] score was 43.

Radiographic assessment

The panoramic radiograph confirmed the presence of all the permanent teeth with good root lengths and normal

Table 2 Case report 2: cephalometric analysis.

Variable	Pre-treatment	Post-functional	Near end of treatment	Change
SNA (°)	81	79	80	−1
SNB (°)	74	76	77	+3
ANB (°)	7	3(4)	3(3.5)	−3.5
Upper incisor/mx (°)	114	101	104	−10
Lower incisor/mn (°)	92	93	91	−1
Interincisor angle (°)	126	136	138	+12
MMPA (°)	28	30	28	0
Face height ratio (%)	55	58	55	0
Lower incisor to APpog (mm)	−3	+2	+2	+5

Figure 13 (a–e) Case report 2: pre-treatment intra-oral photographs

bone levels (Figure 14). A pre-treatment cephalogram (Figure 15) was obtained and the cephalometric analysis confirmed the moderate Class II skeletal discrepancy (ANB=7°). This skeletal relationship is due to mandibular retrognathia, as depicted by the Eastman SNB value of 74°. Dentally, the upper and lower labial segments were normally inclined and the lower incisors were well positioned with regard to A–pogonion reference (Table 2). The upper lip was positioned distal to and the lower lip rested on Rickets E-line.[3]

Aetiology

The patient's malocclusion was the consequence of the Class II skeletal pattern. The skeletal disproportion led to mild lip incompetence (albeit habitually competent) and the upper incisors rested on the lower lip; this may have contributed to the increased overjet and the Class II division I incisor relationship. There was a mild

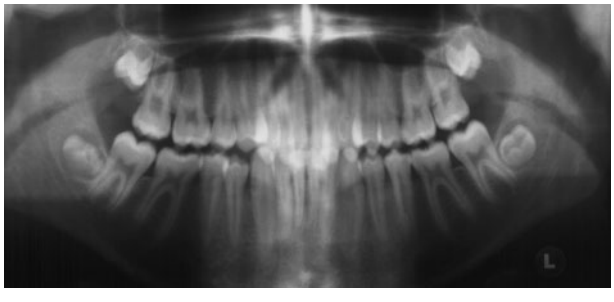


Figure 14 Case report 2: pre-treatment panoral radiograph

Figure 15 Case report 2: pre-treatment lateral cephalogram

(a) (b) (c)

Figure 16 (a–c) Case report 2: twin-block appliance with blocks trimmed to allow molar eruption

dentoalveolar disproportion which led to mild crowding in both upper and lower arches. The centreline shift may have been due to the fact that the upper left lateral incisor was slightly narrower than the contralateral tooth and was palatally displaced. The patient did not have any habits that could have contributed to this malocclusion.

Aims of treatment

1. Improve oral hygiene.
2. Improve skeletal pattern.
3. Establish Class I incisal, canine and molar relationships.
4. Correct overjet and overbite.
5. Expand v-shaped upper arch.
6. Relieve crowding.
7. Level and align the arches.
8. Correct the centrelines.
9. Final detailing to achieve a functionally balanced occlusion.
10. Retention to maintain the corrected position.

Treatment plan and rationale

The patient presented with a moderate skeletal II discrepancy with normal vertical dimensions. As the aetiology of this malocclusion was mainly skeletal (mandibular retrognathia), it was felt that a combination of growth modification and orthodontic camouflage would be the best treatment option for a 13-year-old male. Upper arch expansion was necessary to ensure a correct transverse arch relationship and so a Clark twin-block functional appliance was selected as it enables upper arch expansion as well as antero–posterior correction of the upper and lower arches. Full records are a necessary pre-requisite prior to the fixed appliance phase of treatment. The results of these would determine whether dental extractions are required.

Treatment progress

The patient received oral hygiene instruction prior to appliance therapy and responded well to this with overall improved plaque control.

A twin-block appliance was fitted and the patient was instructed to wear the appliance for 24 hours per day, removing it only for brushing and sport activities. The upper blocks were trimmed towards the end of the twin-block phase to allow for eruption of the buccal segments (Figure 16). After 10 months, the overjet and buccal segments were corrected and the twin-block wear was reduced to night time only. The patient was reviewed three months later and full records were taken in order to plan for the next phase of treatment. Figure 17 shows the occlusion once the functional appliance phase was complete. The post-functional cephalogram is shown in Figure 18 and the cephalometric analysis is illustrated in Table 2. The twin-block was discarded and a phase of upper and lower fixed appliance treatment was deemed necessary on a non-extraction basis (Figure 19). An upper quadhelix appliance was fitted to provide a small amount of extra expansion in addition to that achieved using the twin-block. It also allowed all the expansion to be maintained. Upper and lower pre-adjusted edgewise fixed appliances were bonded (0.022×0.028-inch slot, MBT prescription) and 0° canine torque brackets were selected as all canines were assessed as having buccally positioned roots (Figure 19a–c). All second permanent molars were bonded early in treatment. Initial 0.014-inch nickel titanium aligning archwires were ligated and laceback ligatures (0.01 mm) were placed in all four quadrants. Archwire progression to 0.018-inch SS (special plus) allowed the removal of the quadhelix. The final working archwires were placed six months after bond-up (0.019×0.025-inch SS) and the patient was instructed to wear asymmetric class II elastics (to help with centreline correction). Good elastic wear led to an edge-to-edge incisal relationship and near

Figure 17 (a–e) Case report 2: intra-oral photographs at completion of twin-block phase of treatment

end-of-treatment records were taken at this visit, including a panoramic radiograph and lateral cephalogram (Figures 20 and 21). The pre-treatment and near end-of-treatment cephalometric superimposition is illustrated in Figure 22. Post-treatment photographs are shown in Figures 23 and 24.

Figure 18 Case report 2: post-functional lateral cephalogram

An upper Hawley retainer and lower Essix (Raintree Essix Inc., Metairie, LA, USA) retainers were provided and the patient was advised to wear them initially (for the first six months) on a full-time basis. The Hawley was necessary to retain the expanded upper arch position and the Essix retainer on the lower was used as minimal tooth movement was carried out in the lower arch.

Case discussion

The patient co-operated well and a reasonable level of oral hygiene was maintained throughout the course of treatment. The treatment plan enabled the orthodontic aims to be achieved and the position of the lower labial segment was maintained. The patient experienced favourable skeletal changes during the functional phase of treatment (Figure 21) and these changes were maintained during the fixed appliance phase (Table 2). The patient demonstrated some vertical growth of the mandible which resulted in a downwards and forwards growth pattern (Figure 21). There was also some horizontal growth and possible maxillary restraint during the functional phase of treatment. The correction of his malocclusion was achieved by a combination of

(a) (b) (c)

Figure 19 (a–c) Case report 2: pre-adjusted edgewise fixed appliance treatment

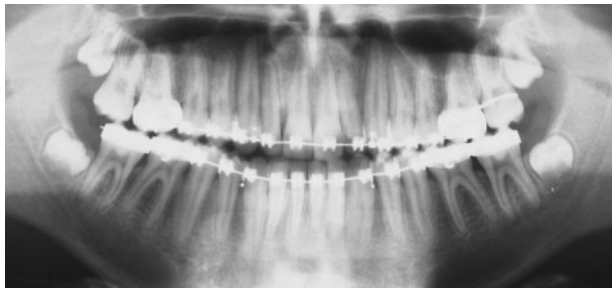


Figure 20 Case report 2: near end-of-treatment panoral radiograph

mandibular growth and dento–alveolar compensation, mainly retroclination of the upper labial segment. It is considered that this patient has passed his pubertal growth spurt and therefore any future growth should be at adult levels. Future mandibular growth is unpredictable and so long-term retention will be required to maintain the corrected tooth position.

The orthodontic aims have been achieved and the long term stability is improved by the good interdigitation of the buccal segments and the minimal lower labial segment change.

Figure 21 Case report 2: near end-of-treatment lateral cephalogram

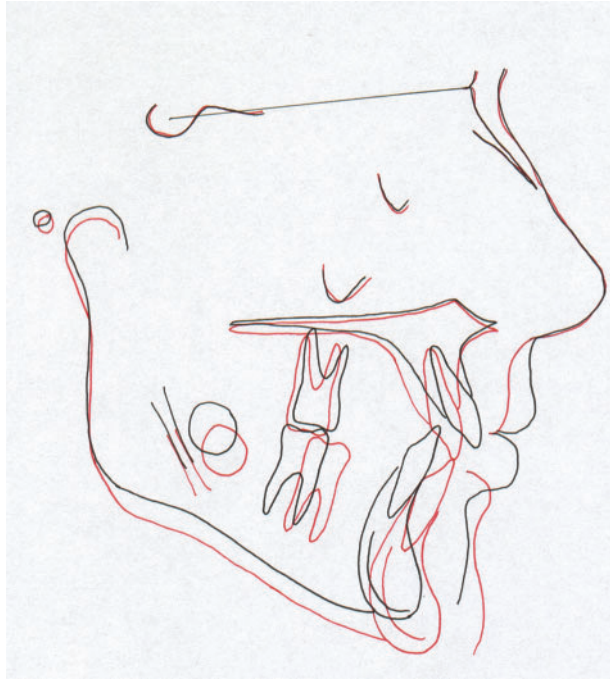


Figure 22 Case report 2: pre-treatment and near end-of-treatment cephalometric superimposition

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

Figure 23 (a–d) Case report 2: post-treatment extra-oral photographs

(a) (b) (c)

(d) (e)

Figure 24 (a–e) Case report 2: post-treatment intra-oral photographs

The post-treatment PAR[1] was calculated at 2. The overall reduction of 95% suggested a 'great improvement'.

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