Journal of Orthodontics, Vol. 33, 2006, 7–21

CLINICAL SECTION

BOS MOrth Cases Prize 2004

J. O. H. Uÿs
Orthodontic Department, Seacroft Hospital, Leeds, UK

This paper describes the clinical orthodontic treatment of 2 cases that were successfully entered for the 2004 American Orthodontics MOrth Cases Prize. The first case is that of a patient presenting with a Class III malocclusion treated with rapid maxillary expansion and protraction headgear followed by fixed appliance therapy. The second case demonstrates the use of fixed appliances to correct a moderate Class II division I malocclusion.

Key words: Pre-adjusted edgewise appliance, protraction headgear, rapid maxillary expansion appliance, transpalatal-combination appliance

Received 25th July 2005; accepted 20th September 2005

Introduction

The American MOrth Cases prize is awarded annually for the 2 best MOrth examination cases exhibited as a clinical demonstration at the British Orthodontic Conference. Applicants must have passed the MOrth at one of the Royal Colleges and can enter within 2 years of passing the MOrth examination. The 2 cases discussed were successfully entered at the British Orthodontic Conference in Harrogate 2004.

Case report 1

A 10 year 6 month old Caucasian female presented with a Class III malocclusion. She was concerned that her lower teeth were biting the wrong way around. The patient was fit and well, with no relevant medical history. She had had previous unsuccessful upper removable appliance therapy by her general dental practitioner to correct her incisal relationship. There was no family history of Class III skeletal base relationships.

Extra-oral assessment

The patient had a mild Class III sagittal skeletal relationship with a straight profile and a mild degree of mid-face retrusion. The patient's vertical skeletal proportions were normal and there was no apparent transverse discrepancy. Her lips were competent at rest and her incisor show was reduced at maximum smile. The naso-labial angle was obtuse (Figure 1a–d). Clinical assessment of the temporomandibular joints was unremarkable.

Intra-oral assessment

The patient demonstrated good oral hygiene. Examination of the enamel surfaces revealed a number of chalky white marks. A restorative-pediatric opinion was sought and a diagnosis of amelogenesis imperfecta suggested.

The lower arch form was normal with some mild dental irregularities confined to the lower labial segment. Both the lower canine teeth displayed mild disto-lingual rotations.

The maxillary arch form was normal with both upper permanent canines unerupted and palpable buccally. The upper right second premolar (UR5) was unerupted and palpable palatally. Both upper first permanent molars were rotated mesio-palatally. The upper arch was severely crowded (Figure 2a–e).

The patient presented with a Class III incisor relationship. She had a reverse overjet of 2.5 mm. The overbite was increased and complete to tooth. The upper centerline was displaced to the right by 2 mm and the lower centerline coincident with the patient's facial midline. The buccal segment relationship was Class I on the left and ¾ of a unit Class II on the right. The patient had both a unilateral buccal and an anterior crossbite affecting all the erupted teeth with the exception of the UR4 and UR6 (Figure 2a–e).

There was an initial contact between the upper and lower left central incisors on closure from which the patient displaced forwards and upwards into maximum intercuspation. The pre-treatment PAR score[1] was 50 and the DHC of the IOTN[2] recorded as 5i in relation to the impacted UR5.

Address for correspondence: H. Uÿs, Orthodontic Department, Seacroft Hospital, York Road, Leeds, LS14 6UH, UK.
Email: hermanuys@hotmail.com

DOI 10.1179/146531205225021339

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

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

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

Radiographic assessment

The orthopantomogram confirmed the presence of all permanent teeth. No pathology was associated with the unerupted and impacted teeth. Small radiolucent areas were noticed in relation to the occlusal surfaces of both the lower first molar teeth (Figure 3).

The Eastman (ANB=−1.5°) and Wits (−6.5 mm) cephalometric analyses (Table 1) suggested a mild to moderate Class III skeletal base relationship. The position of pogonion relative to the nasion-perpendicular (+3 mm) supported the diagnosis of a Class III skeletal base relationship. In view of the mandibular displacement and the lateral cephalogram taken with the mandible in the retruded contact position (Figure 4), the vertical skeletal assessment needed to be interpreted with caution. The cephalometric analysis suggested that the patient had normal vertical skeletal proportions. Simulated mandibular displacement from the retruded contact position into maximum intercuspation allowed the mandible to be displaced forwards and upwards with an expected but small reduction in the vertical dimension. Dentally, the upper labial segment was proclined (115°) and the lower labial segment retroclined (85°). The inclination of the upper and lower labial segments demonstrated dento-alveolar compensation for the sagittal skeletal discrepancy. The lower labial segment was positioned anterior relative to the A-Pogonion reference line (+2.5 mm). Both the lower lip (2 mm) and upper lip (6 mm) were retrusive relative to the E-line. The naso-labial angle was obtuse (118°).

Figure 3 Case report 1: pre-treatment panoral radiograph

Aetiology

The genetically inherited sagittal skeletal discrepancy contributed to the presenting malocclusion. There was some dento-alveolar compensation[3] camouflaging the Class III sagittal skeletal discrepancy. The dento-alveolar compensation seemed, however, insufficient to allow the patient to occlude and achieve a Class I incisor relationship. As a result, the patient displaced her mandible forwards into a more 'comfortable'

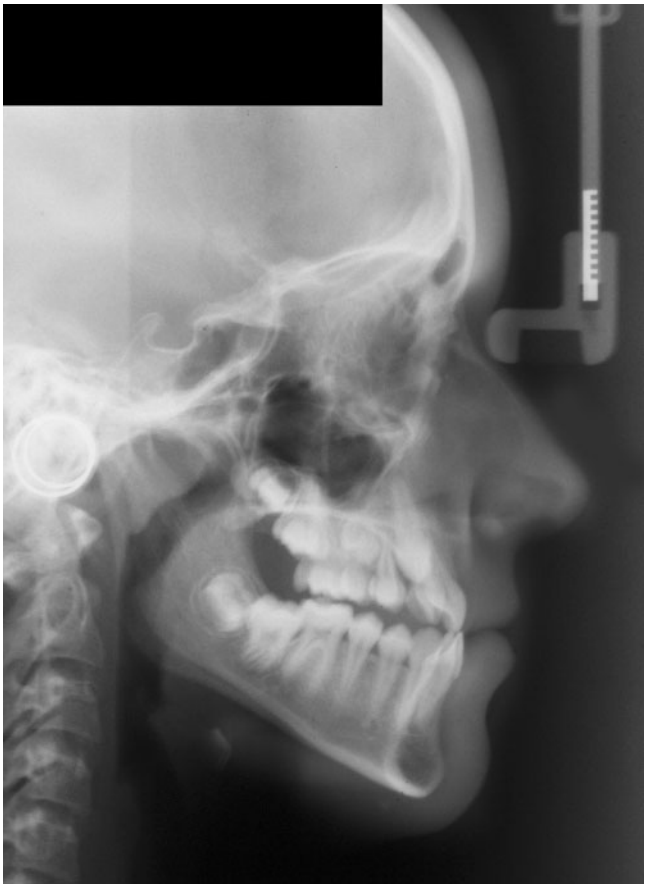


Figure 4 Case report 1: pre-treatment lateral cephalogram

position that resulted in a Class III incisor relationship. A transverse jaw size discrepancy also existed between the maxilla and mandible. The forward mandibular displacement further accentuated the transverse discrepancy.

The upper arch was severely crowded. This could be attributed to a hypoplastic maxilla in addition to a tooth-jaw size discrepancy. The upper arch crowding was further accentuated through the mesio-palatal rotation of the upper first permanent molars. The patient had lost her upper deciduous second molars prematurely, with subsequent mesial drifting and palatal rotation of the upper first permanent molars.

Aims of treatment

1. To address the patient's dietary habits and inadequate dental health.
2. To encourage maxillary development through growth modification.
3. Correction of the mandibular displacement.
4. Correction of the anterior crossbite (establish a positive overjet and overbite).
5. Correction of the transverse discrepancy.
6. Reassess crowding and space requirements.
7. Level and align the dental arches.
8. Maintain a positive overjet and overbite.
9. Residual space closure and midline correction.
10. Detail and occlusal settling.
11. Retention and monitor growth.

Treatment plan and rationale

The patient presented with a mild sagittal and transverse skeletal discrepancy, but with normal vertical skeletal dimensions. The extra-oral assessment and clinical impression of mild mid-facial deficiency could be potentially addressed through growth modification.[4] There was evidence of pre-existing dento-alveolar

Table 1 Case report 1: cephalometric analysis

Variable	Pre-treatment	Post Protraction	Pre-end	Change
SNA°	80°	86°	84.5°	+ 4.5°
SNB°	81.5°	81°	82°	+ 0.5°
ANB°	− 1.5°	5.0°	2.5°	+ 4°
Wits Appraisal mm	− 6.5 mm	− 2 mm	− 1 mm	+ 5.5°
Upper incisor/max plane angle°	115°	115.5°	123°	+ 8°
Lower incisor/mand plane angle°	85°	82°	88°	+ 3°
Interincisal angle°	133°	133°	123°	− 10°
MM angle°	25.5°	29°	26°	+ 0.5°
Upper anterior face height mm	51 mm	51 mm	53 mm	+ 2 mm
Lower anterior face height mm	64 mm	64 mm	67 mm	+ 3 mm
Face height ratio %	55.6%	55.6%	55.8%	+ 0.2%
Lower incisor to APog line mm	2.5 mm	0 mm	3 mm	+ 0.5 mm
Lower lip to Rickets E plane mm	− 3.0 mm	− 4.5 mm	− 3.5 mm	− 0.5 mm

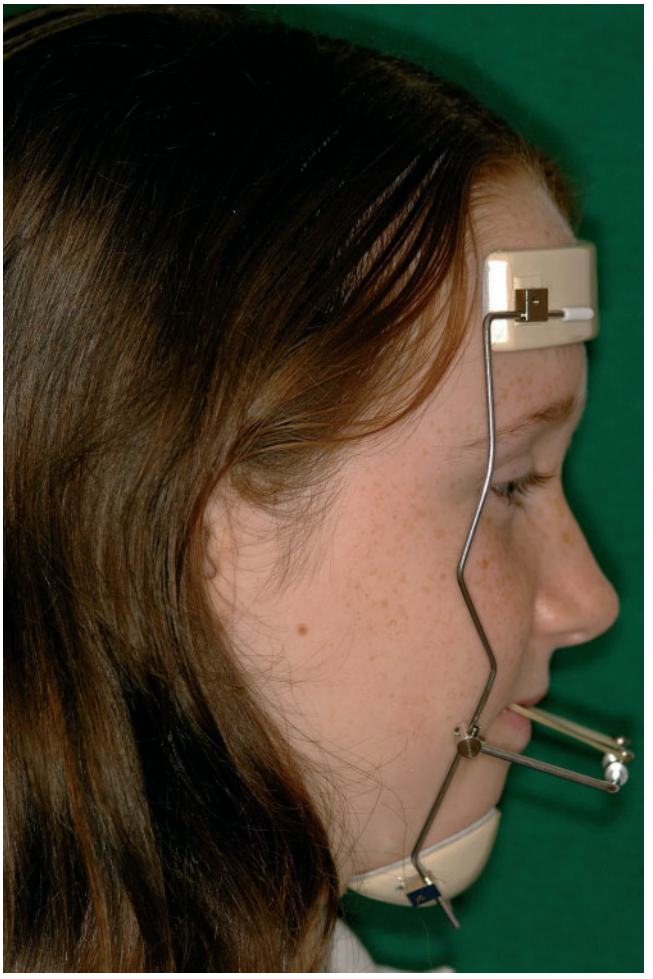


Figure 5 Case report 1: protraction headgear

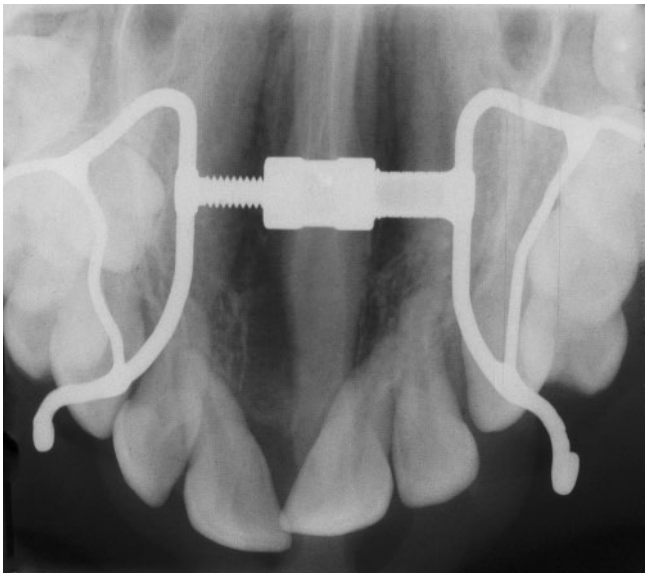


Figure 6 Case report 1: anterior occlusal radiograph, post-RME

compensation to camouflage the Class III skeletal base relationship. The patient was still actively growing, and treatment options were influenced by the potential for further and potentially adverse mandibular growth. In view of the mild midface deficiency, sagittal development of the maxilla could improve the facial and dental features. Protraction headgear usually introduces a downward and backward mandibular rotation in order to establish a positive overjet.[4] Additionally, the patient required transverse expansion of the upper arch to correct the crossbites. A bonded rapid maxillary expansion appliance (RME) was designed, which incorporated hooks buccal to the premolars to facilitate protraction facemask application (Figure 5). The RME was prescribed with posterior buccal capping to limit adverse vertical changes and development. Over-correction of the transverse dimension was planned in order to accommodate and limit post-treatment relapse.[5] In view of the significant rotation of the upper first permanent molars, a Quadhelix appliance could achieve molar derotation, whilst maintaining the expanded upper arch dimensions. Upper and lower pre-adjusted fixed edgewise appliances were indicated to address local dental irregularity and establish good buccal interdigitation. The UR5 was palatally positioned and excluded from the dental arch. The extraction of the UR5 was anticipated, but delayed to allow for eruption and subsequent extraction under local anesthetic. Limited use of intermaxillary traction and exclusion of the second molar teeth were planned to avoid adverse vertical changes with subsequent loss of overbite.

Treatment progress

The patient was referred back to her general dental practitioner to assess the need for restorations to the lower first permanent molars. The patient received intensive oral hygiene instruction with specific dietary advice prior to appliance placement.

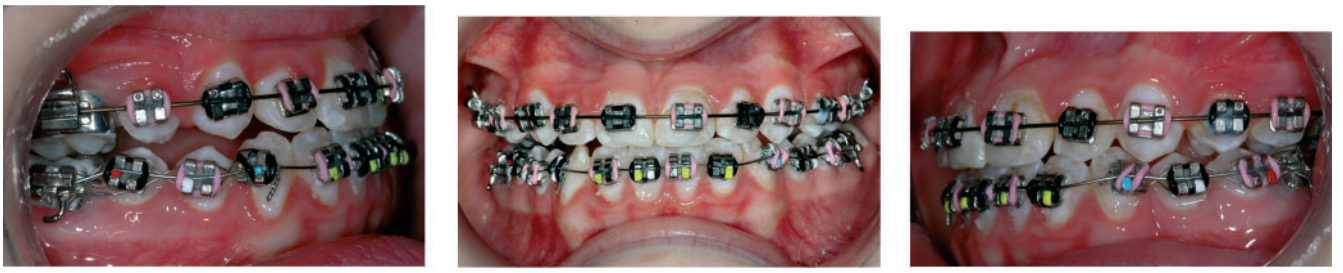
The RME appliance was then cemented and the patient instructed to turn the midline screw once daily. Protraction headgear was fitted a week later and the patient was advised to wear the appliance for 12–14 hours each day (Figure 6). The applied force measured 350 g on each side. Over-expansion was achieved (8.5 mm) and a positive overjet established after a 6 month treatment period (Figure 7a–c). A quadhelix appliance replaced the RME appliance and the facemask was discontinued. The quadhelix appliance corrected the molar derotation whilst maintaining the upper arch expansion (Figure 7d). Upper pre-adjusted

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

Figure 7 (a–d) Case report 1: post-RME and protraction headgear treatment

fixed edgewise appliances were bonded (0.022 × 0.028-inch, Andrews' prescription) and an initial 0.014-inch nickel titanium (Ni-Ti) aligning arch wire placed. The lower arch was bonded at the next appointment (Figure 8a–c). The quadhelix appliance was discontinued once an expanded 0.018-inch upper stainless steel (SS) archwire could be placed. Progressive leveling and alignment allowed placement of the final working arch wires, upper 19 × 25-inch and lower 17 × 25-inch SS, approximately 5 months later. Bilateral upper buccal root torque and individual labial (UR2 & UL2) root torque was added and full-time bilateral class III intermaxillary elastic traction was introduced during the final stages. Upper asymmetric powerchain was used to facilitate space closure and centerline correction. Near-end-of-treatment radiographs were obtained to assess root paralleling and incisor angulations (Figures 9 and 10). Further finishing involved a tip back bend prescribed for UR6. The upper and lower fixed appliances were debonded after 20 months of appliance treatment (Figures 11a–d and 12a–e).

In view of the upper arch expansion, an upper Hawley retainer was indicated over an extended retention period. Upper and lower Hawley retainers were fitted and the patient was advised to wear the retainers full-time initially. The patient will need long-term follow-up to monitor her future mandibular growth. The patient has been referred to the pediatric dental clinic for some micro-abrasion to 'soften' the more severe enamel opacities.



(a) (b) (c)

Figure 8 (a–c) Case report 1: pre-adjusted edgewise fixed appliance treatment

Case discussion

The patient experienced favorable skeletal changes during the facemask treatment period (Figure 13), but these changes reduced during the latter stages of treatment (Table 1). The re-introduction of the facemask therapy during the later stages of fixed appliance therapy could have been considered to reinforce the skeletal treatment effects and to limit dento-alveolar compensation. The need for lower arch extractions could have been considered in view of the inclination of the upper labial segment (Table 1). This needs to be balanced against the potential for further adverse mandibular growth and the associated risks of prolonged treatment in relation to dental health. The lower arch dimensions have experienced small increases; namely, the intercanine width (+1 mm) and intermolar width (+0.5 mm).

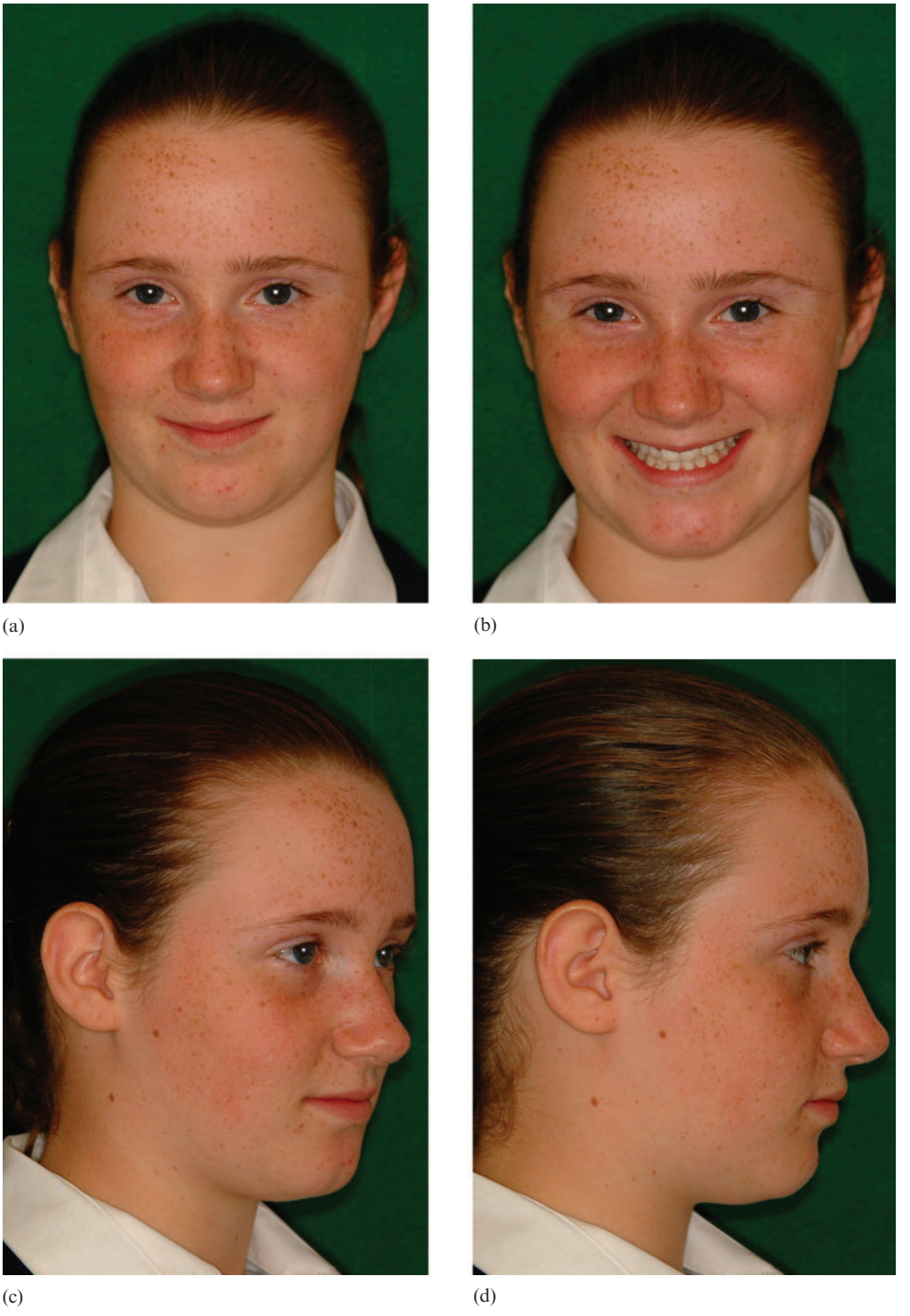
Lower arch anchorage was managed with lacebacks, bendbacks, and swapping of the lower left and right canine brackets. The lower canine bracket tip values were as a result reversed and assisted in maintaining the lower labial segment position. Intermaxillary elastics were limited to the latter stages of treatment to limit adverse changes to the vertical component. A group function occlusal scheme has been established bilaterally. Figure 14 illustrates the pre-treatment and near-end-of-treatment cephalometric radiographic changes. The post-treatment PAR score was 4.

Figure 9 Case report 1: near-end-of-treatment panoral radiograph

Case report 2

A female Caucasian patient presented at 13 years and 5 months of age. She described her dental appearance as 'having teeth everywhere' and wanted her teeth straightened. The patient was fit and well with no relevant medical history.

Figure 10 Case report 1: near-end-of-treatment cephalometric radiograph



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

Figure 11 (a–d) Case report 1: post-treatment extra-oral photographs

Extra-oral assessment

She presented with a mild Class II skeletal pattern. The vertical and transverse skeletal relationships were normal. The patient's lips were mildly incompetent and the patient showed 2 mm of gingival tissue at maximum smile (Figure 15a–c). The temporomandibular joint assessment was normal with no signs or symptoms reported.

(a) (b) (c)

(d) (e)

Figure 12 (a–e) Case report 1: post-treatment intra-oral photographs

Figure 13 Case report 1: post-RME and protraction headgear lateral cephalogram

Figure 14 Case report 1: pre-treatment and near end of treatment cephalometric superimposition

(a) (b) (c)

Figure 15 (a–c) Case report 2: pre-treatment extra-oral photographs

Intra-oral assessment

The patient demonstrated good oral hygiene and presented in the late mixed dentition. The mandibular arch form was U-shaped. The lower arch was moderately crowded (7 mm) with the canines buccally displaced.

The maxillary arch form was tapered. Both first and second right deciduous molar teeth were still present. The arch was severely crowded (8.5 mm). The canine teeth were buccally displaced and the lateral incisors palatally positioned. The upper labial segment appeared proclined and the canines were mesially angulated. The upper central incisors had small labial enamel concavities close to the gingival margins. The periodontal examination in relation to these anomalies was unremarkable (Figure 16a–e).

In occlusion, the patient had a Class II division I incisor relationship with an overjet of 6 mm. The overbite was normal and complete to tooth. The patient's upper centerline was displaced to the right by 1.5 mm. The buccal segment relationship was Class I bilaterally. The canine relationship was 3/4 of a unit Class II on the left and a 1/4 of a unit Class II on the right side. The upper right permanent lateral incisor (UR2) was in anterior crossbite with the LR2 and LR3 (Figure 16a–e).

The patient had an initial contact on closure involving the upper and lower permanent lateral incisors on the right side. The patient displaced her mandible slightly forwards into maximum intercuspation. The DHC score of the IOTN[2] was 4a and the pre-treatment PAR[1] score was 58.

Radiographic assessment

The panoramic radiograph confirmed the presence of all the permanent teeth with good root length and normal bone levels (Figure 17). The upper left lateral incisor had a curiously curved root. A pre-treatment cephalogram (Figure 18) was obtained, and the cephalometric analysis confirmed the normal sagittal and vertical skeletal proportions. Dentally, the upper labial segment was proclined. The lower labial segment was normally inclined and positioned on the A-Pogonion reference line (Table 2). The upper lip was positioned distal to and the lower lip rested on Ricket's line.[6]

Aetiology

The patient's malocclusion was the consequence of severe upper and moderate lower arch crowding. The dental crowding was likely the result of a jaw base:tooth size discrepancy. The upper incisor proclination, the increased overjet, the palatally displaced upper permanent lateral incisors, as well as the buccally positioned UR3 were all manifestations of the upper arch crowding. The anterior crossbite was the result of the palatal displacement of the upper right lateral incisor (UR2). This had allowed the upper centerline to move across to the right. The palatal position of the UR2 resulted in the anterior mandibular displacement on closure.

(a) (b) (c)

(d) (e)

Figure 16 (a–e) Case report 2: pre-treatment intra-oral photographs

Aims of treatment

1. Relieve the upper and lower dental arch crowding.
2. Level and align the dental arches.
3. Correct the anterior crossbite and associated mandibular displacement.
4. Overjet reduction.
5. Space closure and centerline correction.
6. Detail the occlusion.
7. Retention.

Treatment plan and rationale

The treatment aims were based on the pre-treatment lower labial segment position and lower arch form. Space was required to enable lower arch alignment

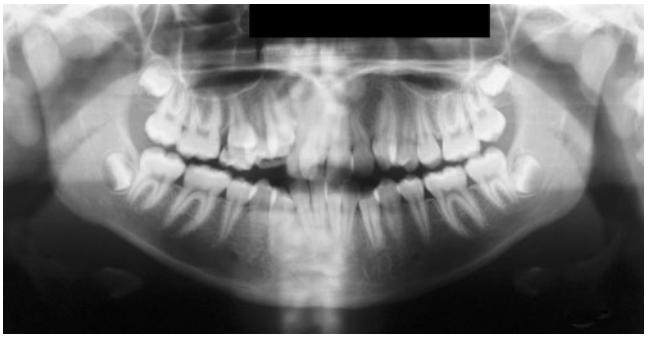


Figure 17 Case report 2: pre-treatment panoral radiograph

Figure 18 Case report 2: pre-treatment lateral cephalogram

(a) (b) (c)

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

without adverse lower incisor proclination and the altering of her dento-alveolar equilibrium. The lower arch was therefore treated on an extraction basis. Similarly, the degree of upper arch crowding necessitated upper arch extractions. The extractions provided space to achieve a Class I buccal segment relationship and correction of the incisor relationship. The upper arch was severely crowded with a significant anchorage requirement. The upper arch anchorage was reinforced with a transpalatal-Nance combination appliance.[7]

The location and severity of the arch crowding as well as the anchorage needs influenced the extraction pattern. Upper first premolar extractions helped the anchorage balance and allowed for some spontaneous improvement of the buccally displaced upper permanent canines. The extraction of the mandibular second premolars provided sufficient space for lower arch alignment, but also maximized the mesial movement of the permanent first molars.

Correction of the anterior crossbite first required adequate space to be made available. A lower removable appliance with full occlusal coverage allowed the occlusion to be 'opened up' temporarily with simultaneous anterior crossbite correction. An upper fixed appliance was to be used to move the UR2 across the bite and to enable sufficient labial root movement.

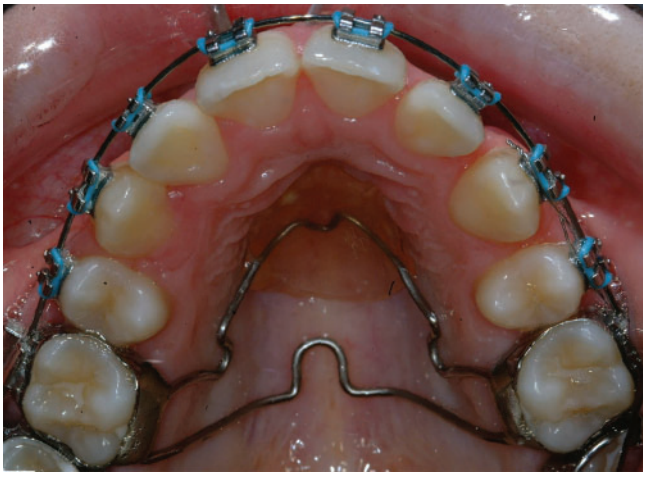


Figure 20 Case report 2: TPA-Nance combination appliance

Treatment progress

The patient received oral hygiene instruction prior to appliance placement. The TPA-Nance appliance was

Table 2 Case report 2: cephalometric analysis

Variable	Pre-treatment	Pre-end	Change
SNA°	82°	82°	0°
SNB°	78°	78°	0°
ANB°	4°	4°	0°
Wits Appraisal mm	− 2 mm	− 1 mm	+ 1 mm
Upper incisor/max plane angle°	121°	113°	− 8°
Lower incisor/mand plane angle°	92°	92°	0°
Interincisal angle°	122°	129°	+ 7°
MM angle°	25.5°	26.5°	+ 1°
Upper anterior face height mm	57 mm	58 mm	+ 1 mm
Lower anterior face height mm	71 mm	71.5 mm	+ 0.5 mm
Face height ratio %	55.5%	55.2%	− 0.3%
Lower incisor to APog line mm	1 mm	1 mm	0 mm
Lower lip to Rickets E plane mm	0 mm	0.5 mm	+ 0.5 mm

(a) (b)

(c) (d)

Figure 21 (a–d) Case report 2: post-treatment extra-oral photographs

fitted to the upper first permanent molars prior to the upper arch extractions. Upper and lower pre-adjusted edgewise fixed appliances were bonded (0.022 × 0.028-inch slot, Andrews' prescription) and initial 0.014-inch Ni-Ti aligning arch wires ligated (Figure 19a–c). Laceback ligatures (0.10 mm) were initially applied to all 4 quadrants. The upper right lateral incisor (UR2) and lower left lateral incisor (LL2) were initially excluded and the space maintained with bumper sleeve. Arch wire progression to 0.018-inch SS

Figure 22 (a–e) Case report 2: post-treatment intra-oral photographs

allowed the placement of active SS pushcoil to open space for the correction of the anterior crossbite. An inverted bracket was bonded to the palatally displaced UR2. The base arch wire, 0.018-inch SS was then used in conjunction with a 0.014-inch Ni Ti 'piggyback' arch wire that engaged the UR2. A lower removable bite-raising appliance was introduced for full time wear. The anterior crossbite was corrected over a single visit (8 weeks) and the lower removable appliance discontinued. The TPA-Nance appliance (Figure 20) was removed after 15 months of fixed appliance treatment. Asymmetric upper and symmetric lower arch space closure, with elastomeric chain, was initiated on passive working arch wires (0.019×0.025-inch SS). Individual palatal root torque to the UR1 and labial root torque to both upper lateral incisors was introduced after space closure. Further detailing involved individual torque (UR5) and continuous upper buccal root torque (UL5–UL7). A palatal offset bend was also prescribed to the upper left central incisor (UL1). The patient's appliances were debonded after 25 months of appliance therapy (Figures 21a–d and 22a–e).

Upper and lower Essix® retainers were provided and the patient was advised to wear them initially (for the first 6 months) on a full time basis.

Case discussion

The patient co-operated well and maintained good oral hygiene throughout the course of treatment. The treatment plan enabled the orthodontic aims to be achieved without compromising the pre-treatment position of the lower labial segment. The lower arch dimensions experienced only minor changes with a reduction of the intercanine and intermolar widths by less than 1 mm. The intercanine width reduction was anticipated in view of the pre-treatment position of the lower canine teeth. Excellent patient co-operation facilitated anterior crossbite correction in 8 weeks. The correction of the anterior crossbite eliminated the mandibular displacement without a significant effect to the patient's dental and skeletal relationships (Table 2). The pre-treatment and near end of treatment cephalometric superimposition demonstrated treatment and growth changes (Figure 23). The patient experienced some vertical growth during treatment.

The inclusion of the second molars assisted in overbite control and further reinforced anchorage. A Class I incisor and buccal segment relationship, with good buccal interdigitation, was achieved. Near-end-of-treatment radiographs (Figures 24 and 25) were obtained to assess root position and incisor inclination. The inverted UL2 bracket and further torque adjustments contributed to favorable root and crown positions. Both left and right lateral excursions of the mandible are now canine-guided with absence of any working/non-working side interferences. The patient's third molars are currently unerupted and asymptomatic. The post-treatment PAR score was calculated at 1. The overall reduction of 98% suggested a 'great improvement'.

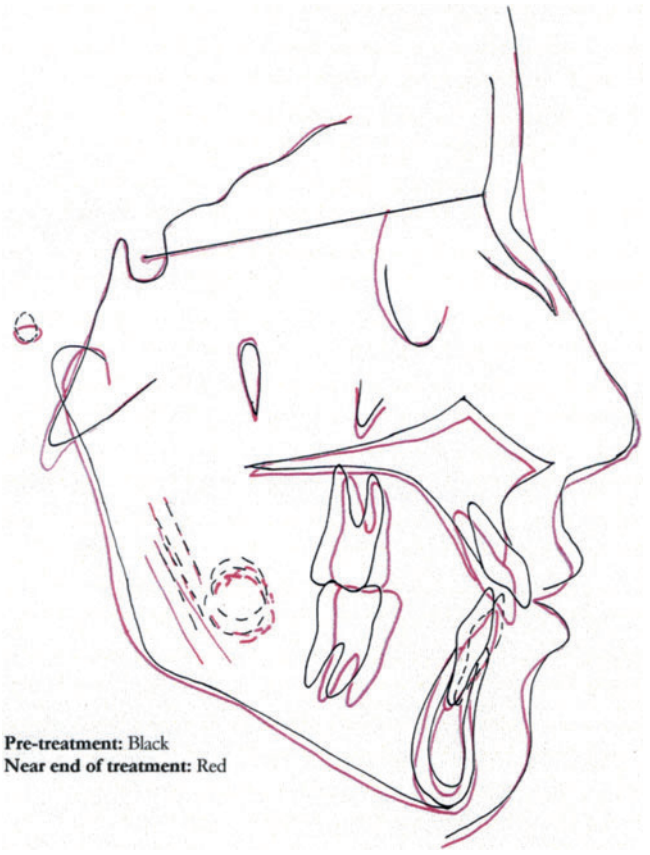


Figure 23 Case report 2: pre-treatment and near-end-of-treatment cephalometric superimposition

Acknowledgements

I would like to express my sincere appreciation to all the clinical supervisors, and the staff at Leeds Dental Institute and Seacroft Hospital, Leeds, for their support, especially Mr David Morris whose enthusiasm and clinical expertise deserves special mention.

®Essix is a trademark of Raintree Essix, Inc., 4001 Division St, Metairie, LA 70002, USA

Figure 24 Case report 2: near-end-of-treatment panoral radiograph

Figure 25 Case report 2: near-end-of-treatment lateral cephalogram

References

1. Richmond S, Shaw WC, Roberts CT, Andrews M. The PAR Index (Peer Assessment Rating): methods to determine outcome of orthodontic treatment in terms of improvement and standards. *Eur J Orthod* 1992; **14**: 180–7.
2. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. *Eur J Orthod* 1989; **11**: 309–20.
3. Solow B. The dentoalveolar compensatory mechanism: background and clinical implications. *Br J Orthod* 1980; **7**: 145–61.
4. Ngan P, Hagg U, Yiu C, Merwin D, Wei SH. Soft tissue and dentoskeletal profile changes associated with maxillary expansion and protraction headgear treatment. *Am J Orthod Dentofacial Orthop* 1996; **109**: 38–49.
5. McNamara JA Jr, Baccetti T, Franchi L, Herberger TA. Rapid maxillary expansion followed by fixed appliances: a long-term evaluation of changes in arch dimensions. *Angle Orthod* 2003; **73**: 344–53.
6. Ricketts RM. Perspectives in the clinical application of cephalometrics. The first fifty years. *Angle Orthod* 1981; **51**: 115–50.
7. Cobo JM, Diaz B, de Carlos F. Maintaining anchorage with a combination Nance-Goshgarian transpalatal arch. *J Clin Orthod* 1998; **32**: 681.