

**CLINICAL
SECTION**

The J.K. Williams Gold Medal of the Royal College of Surgeons of London and Glasgow 2007

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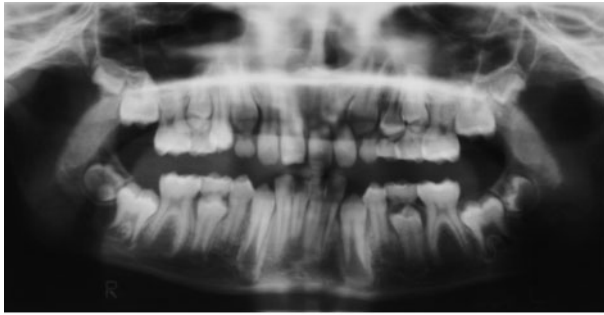
Introduction

The J.K. Williams Gold Medal is a prestigious prize awarded to the individual achieving the most outstanding

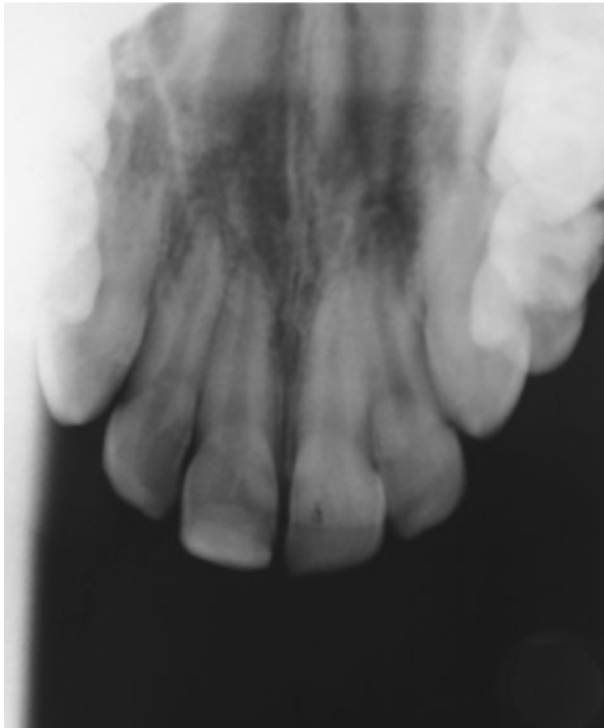
examination performance at the Intercollegiate Membership in Orthodontics examination of the Royal College of Surgeons of England and Glasgow. The prize is only awarded if the examiners believe the candidate's



Figure 1 (a-i) Case report 1: pre-treatment extra-oral and intra-oral photographs



(a)



(b)

Figure 2 (a,b) Case report 1: pre-treatment panoramic and upper anterior occlusal radiographs

performance is of a sufficiently high standard. As part of the examination, which includes clinical cases, diagnostic tests, and oral examinations, the candidate must present five personally treated, fully documented cases on which the candidate is examined orally. Details of two of the treated cases are presented in this paper.

Case report 1

A male Caucasian patient presented at 11 years 9 months with a Class II division 1 malocclusion. He was concerned that his front teeth 'stuck out'. His medical history was unremarkable. He had sustained an uncomplicated enamel-dentine fracture to the upper



Figure 3 Case report 1: pre-treatment lateral cephalogram

right central incisor aged 9 years which had been restored with composite and was asymptomatic.

On extra-oral examination, the patient presented with a moderate Class 2 skeletal pattern with mandibular retrusion (Figure 1). He had a reduced Frankfort-maxillary planes angle and reduced lower facial height proportion. The tone of the soft tissues was evaluated as flaccid. The patient's lips were incompetent with an interlabial gap of 7 mm at rest. Both lips were protrusive to Rickett's E-plane. The nasio-labial angle was acute. On frontal examination, there was no facial symmetry.

Clinical assessment of the temporomandibular joints was unremarkable and no mandibular displacement or deviation was evident.

Intra-oral examination revealed that the patient presented in the late permanent dentition and demonstrated good oral hygiene (Figure 2). A composite tip replacement was noted at UR1. This restoration was short relative to the adjacent central incisor. The tooth yielded a positive response to pulp sensibility testing. A localized area of enamel hypoplasia was present at LR6, presenting as a discrete area of brown discoloration. It was non-carious.

The mandibular arch was narrow in relation to the maxillary arch and there was mild lower arch crowding, localized to the lower labial segment. Clinically, the



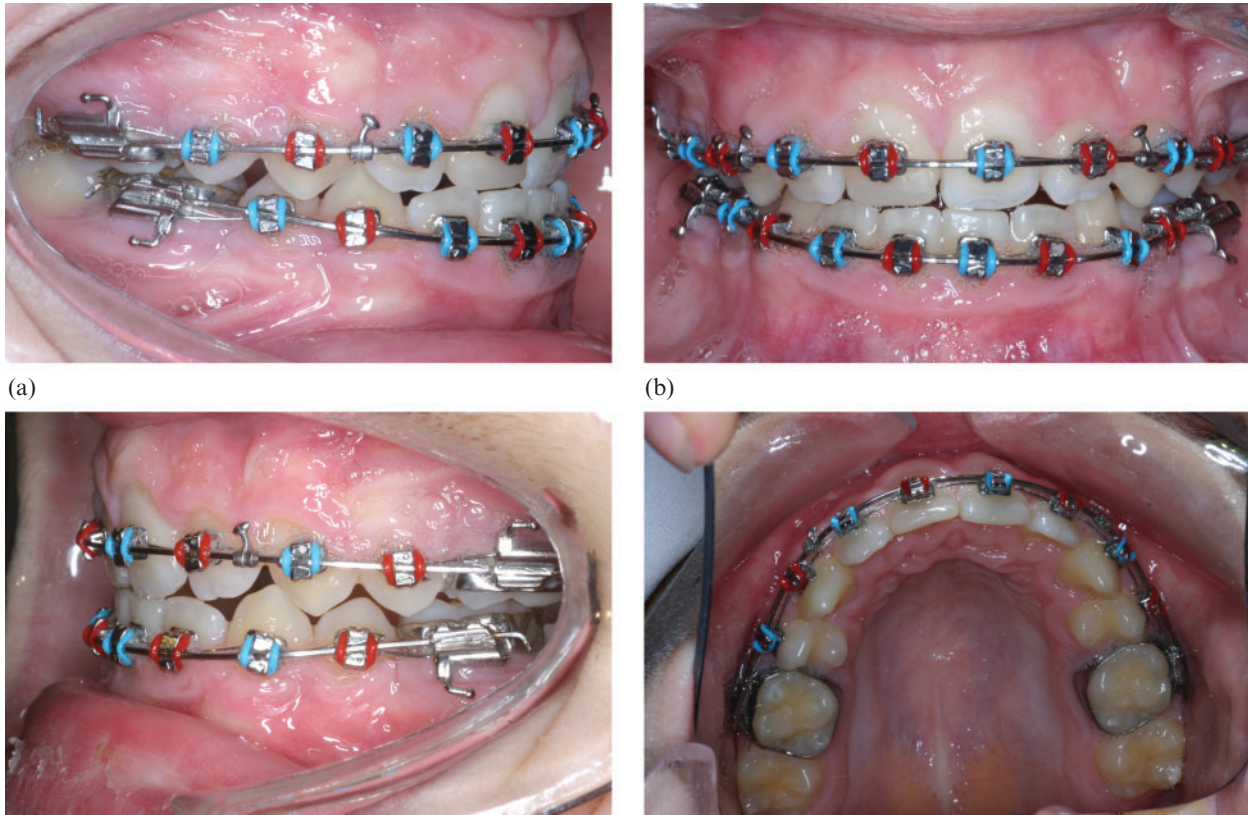
(a) (b)

Figure 4 (a,b) Case report 1: modified monobloc functional appliance



(a) (b) (c)

Figure 5 (a-c) Case 1: end of functional appliance phase intra-oral photographs



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

Figure 6 (a-e) Case report 1: upper and lower Tip-Edge Plus appliances, stage III with 0.0215 × 0.028 inch shiny bright base archwire with 0.014 inch NiTi auxiliary wire

lower incisors were markedly proclined relative to the mandibular base. The lower canines displayed increased mesial tip. The curve of Spee was increased.

The maxillary arch was broad and well-aligned. The upper second deciduous molars were present. Clinically, the upper incisors were at normal inclination to the Frankfort plane.

In occlusion, the patient had a Class II division 1 incisor relationship with an overjet of 8.5 mm. The overbite was increased at 7 mm and complete to the palate. The buccal segment relationship was a full unit Class II on the left and 3/4 Class II on the right. The canine relationship was 1/2 unit Class II on the left side and 1/4 unit Class II on the right. A transverse arch discrepancy was observed, on the left side. A centreline displacement was noted, with the upper displaced 1 mm to the right and the lower 1 mm to the left of the mid-facial axis.

The dental health component (DHC) of the index of treatment need (IOTN) was 4a and the aesthetic component (AC) was 8.

Radiographic examination with a dental panoramic tomogram (DPT) (Figure 2a) confirmed the presence of all the permanent teeth including all third molars. No caries was noted and bone levels were normal. An upper anterior occlusal (Figure 2b) demonstrated a root length of UL1 comparable to UR1. The periapical tissues were normal.

A pre-treatment lateral cephalogram was obtained (Figure 3) and analysed (Table 1). This confirmed the clinical impression of a moderate Class II skeletal base with an ANB of 7.5 degrees. The mandibular-maxillary planes angle (MMPA) was reduced at 22 degrees and the lower facial height proportion (LFH) reduced at 50%. Dentally, the upper incisors were at normal inclination (110 degrees) and the lower incisors were very proclined at 109 degrees and 5 mm ahead of APog.

The aims of treatment were:

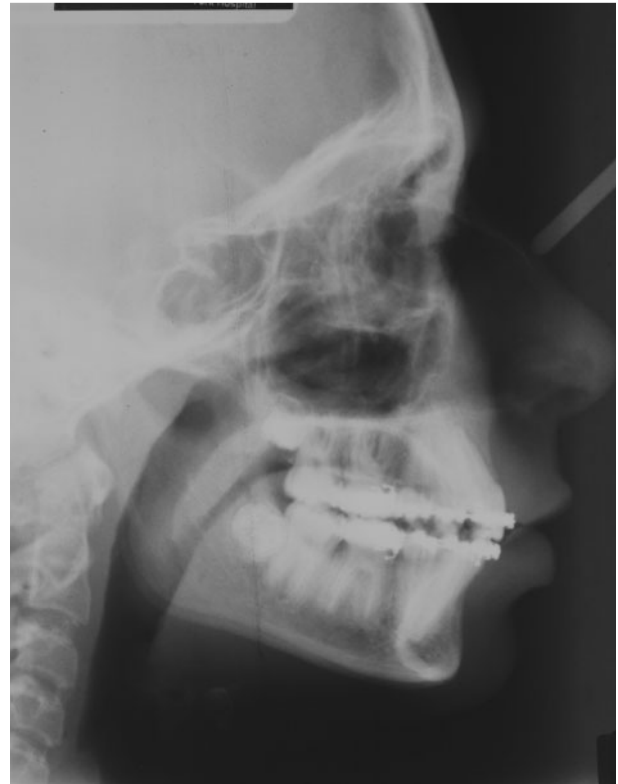
1. maintain meticulous gingival and dental health;
2. sagittal correction to reduce the overjet and correct buccal occlusion;
3. correct transverse discrepancy;
4. reduce the overbite and align;
5. correct to Class I incisors, Class I canines and Class I molars with the functional goal of a mutually protected occlusion.

A two-stage treatment was undertaken which comprised of:

1. fit modified 'Hybrid' functional appliance;
2. following retentive phase, reassess;
3. monitor root resorption of UR1 with interim radiograph;
4. extraction of mandibular and maxillary second premolars;



(a)



(b)

Figure 7 (a,b) Case 1: near end of treatment panoramic and lateral cephalometric radiographs

5. fit upper and lower Tip-Edge Plus appliances;
6. retain with upper and lower Hawleys with soldered bows.

The functional appliance used was a modified monobloc (Figure 4) designed according to the 'component' approach.¹ The salient design features were:

1. protrusive bite to encourage sagittal correction;
2. buccal shields to encourage lower arch transverse development, aided by absence of lingual shields;
3. occlusal platform relieved during treatment to maximize posterior vertical development for overbite reduction and Class II correction;

Table 1 Case report 1: cephalometric analysis

| Variable | Pre-treatment | Post-functional | Near end | Treatment change |
|-------------|---------------|-----------------|----------|------------------|
| SNA (°) | 80 | 80 | 79 | -1 |
| SNB (°) | 72.5 | 74 | 74 | 1.5 |
| ANB (°) | 7.5 | 6 | 5 | -2.5 |
| Sn/MxP (°) | 10 | 12 | 12 | 2 |
| MMPA (°) | 22 | 21.5 | 22 | 0 |
| LFH (%) | 50 | 52 | 54 | 4 |
| UI/MxP (°) | 110 | 110 | 104 | -6 |
| LI/MnP (°) | 109 | 114 | 101 | -8 |
| LI/APo (mm) | +5 | +9 | +3 | -2 |
| UI/LI (°) | 126 | 111 | 133 | 7 |

4. lower labial bow to reduce lower incisor proclination.

The registration for the functional appliance was an edge-to-edge bite with 7 mm separation in the buccal segments. It was worn successfully full-time. After 6 months of treatment a further intra-oral radiograph was taken to assess UR1 and no significant root shortening was noted. At 8 months, the incisors were Class I and the molars corrected to 1/4 Class III (Figure 5). At this stage, a period of nights only wear for three months allowed settling of the lateral open bites after which stage records were taken.

Second premolar extractions in the second phase of treatment addressed the space requirements for the relief of crowding and for lower incisor retraction. Upper and lower Tip-Edge Plus appliances were used to facilitate lower incisor retraction. Initially only the upper and lower incisors and canines were bonded and 0.016 inch round Australian Special Plus stainless steel wires were placed with anchor bends mesial to the first molars. The lingually displaced lower lateral incisors were ligated to the archwire by power thread passed through the vertical slot. Light (3/8" inch diameter) Class 2 elastics (Pink, Tru-force™, TP Orthodontics) were used full-time. Stage I objectives of alignment with overbite and overjet reduction were met quickly after three months.

Pre-stage II included bonding the premolars and placing 0.020 inch round Australian Special Plus stainless steel wires with smooth bite opening sweeps. Space closure was commenced with E-links to the cuspid circles and the light Class 2 intermaxillary elastics continued full-time. An interim radiograph taken after 6 months of fixed treatment showed no root resorption of UR1. After five months of stage II, space closure was complete and a pre-stage III visit involved derotating the molars with a step-out and toe-in on the 0.020 inch wire.

Stage III involved placing co-ordinated upper and lower pretorqued 0.0215×0.028 inch 'shiny bright' stainless steel base archwires with gentle bite-opening curves. These were not tightly cinched to allow for a slight ingress of space necessary for torque correction. An auxiliary 0.014 inch nickel titanium wire was threaded through the horizontal slots ('deep tunnels') and into the molar gingival tubes (Figure 6). The patient was directed to wear the Class 2 elastics as required to maintain the sagittal correction. After four months of stage III the auxiliary wire had progressed to 0.018 inch NiTi. In the lower arch this was ligated over the buccal attachments to ensure full uprighting of the lower first premolars.²

After 6 months of stage III mechanics, a near end of treatment DPT confirmed that root uprighting and a lateral cephalogram that torquing had occurred (Figure 7a,b). The second molars were banded and a 0.018×0.025 inch nickel titanium wire was placed to align. Final detailing was achieved with upper and lower 0.021×0.025 inch braided stainless steel archwires and anterior settling elastics. Active treatment was completed at 25 months and upper and lower Hawley retainers with soldered bows were placed to facilitate vertical settling (Figure 8).

Case 1 assessment

Case 1 had a moderate skeletal discrepancy with mandibular retrusion and reduced vertical proportions. The upper incisors were at normal inclination, but the lower incisors were very proclined. He had Class II buccal segments, an increased overbite and a tendency to bilateral lingual crossbite. His treatment was complicated by a history of trauma affecting UR1.

The skeletal Class 2 discrepancy with mandibular retrusion resulted in the increased convexity of profile,



Figure 8 (a-i) Case report 1: post-treatment extra-oral photographs

lip incompetence, increased overjet and Class II buccal segments. The very proclined lower incisors represented excessive compensation for the skeletal Class 2 base. The flaccid soft tissues may have failed to control the lower incisor position.

The marked sagittal discrepancy, age of the patient and a desire to minimize sagittal movement of the previously traumatized UR1 indicated that a functional phase was desirable. This would greatly ease the significant anchorage demands and any favourable mandibular growth would be very helpful. The hybrid appliance utilized a philosophy of 'component approach' to achieve the various treatment aims. The buccal screens allowed some transverse development, and the monobloc design

with an occlusal platform that was trimmed encouraged molar eruption. The fitted lower labial bow was to reduce proclination of the lower incisors.

Following the functional phase, the SNA remained unchanged, suggesting some maxillary restraint, and the SNB increased by 1.5 degrees. There was, thus, a reduction in ANB by 1.5 degrees. The superimposition showed that mandibular growth had not been significant during the functional phase. The upper incisor inclination was maintained at pre-treatment values and the lower incisors proclined by 5 degrees. However, the superimposition showed that there was also bodily movement of the lower incisor forward in the symphysis. This explains the increase from the lower incisor edge to

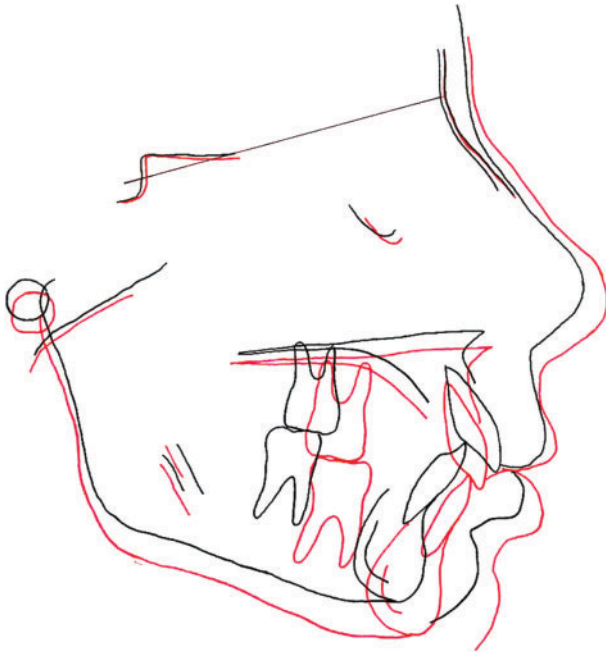


Figure 9 Case report 1: pre-treatment (black) and near end of treatment (red) cephalometric superimpositions

A-Po line of +4 mm, greater than expected for the amount of proclination. Significant lower incisor labial movement and proclination occurred following the functional phase. Although the novel design of functional appliance allowed effective correction in all three planes, a disadvantage with any monobloc appliance is lower incisor proclination. Lower labial capping may have reduced this rather than a labial bow.

Following a support phase, a full assessment was made. Second premolar extractions in the second phase of treatment were necessary to address the space requirements for relief of crowding and the retraction of the lower incisors. Upper and lower Tip-Edge Plus appliances would facilitate lower incisor retraction. The use of an inclined plane was not deemed necessary due to the overcorrection achieved. Furthermore, the anchor bends present during stage I would maintain the overbite reduction. Light Class 2 elastics from the start would aid maintenance of the sagittal improvements. The light forces involved with Tip-Edge Plus were especially useful in this case with a previously traumatized central incisor.

There was an overall reduction in ANB of 2.5 degrees. This comprised of a reduction of one degree in SNA which may be due to the modest palatal movement of the upper incisors and forward movement of nasion. There was an increase in lower facial height proportion of 4%. The MMPA remained unchanged, suggesting growth in the anterior and posterior heights was equal.

Overall, the lower incisors had been retroclined by 8 degrees to 101 degrees, on a reduced MMPA of 22 degrees. The superimposition confirmed root torquing movement and lingual movement of the lower incisor edge had occurred (Figure 9). Thus, the Tip-Edge appliance, combined with the loss of second premolars, was very effective at controlling the lower incisors. The upper incisors were retroclined by six degrees during the fixed phase, but remain within normal range at 104 degrees. The upper incisors were slightly upright at the end of treatment, despite working up to a 0.018 inch NiTi auxiliary wire. Remaining longer in stage III may have allowed further torque to have been expressed. The final incisor inclinations can be interpreted as camouflage for the Class 2 base.

At the end of treatment significant improvements facially, skeletally and dentally were observed. Lip competency was achieved. A good static and functional occlusion was obtained. The buccal occlusion on the right was not as well interdigitated as the left. The use of Hawley retainers with a soldered bow was chosen to facilitate occlusal settling. The pre-treatment PAR score of 45 reduced to 3, representing a 93% improvement. The patient has been returned to his dentist for restoration of UR1. No significant root resorption was recorded on the near end of treatment DPT. The overall prognosis for the sagittal correction is good as the occlusion is interdigitated and lip competence has been achieved.

Case report 2

A female Caucasian presented at 13 years and 3 months complaining about the irregularity of her front teeth. Medically she was healthy but she did report a history of chronic nasal obstruction.

The extra-oral examination revealed a mild Class 2 skeletal base with an increased Frankfort-mandibular planes angle and increased lower facial height proportion. A mandibular displacement on closure was noted which produced a mandibular asymmetry, with her chin point displaced to the left of the mid-facial axis. The lips were mildly incompetent and the smile width was narrow. There were no signs or symptoms of temporomandibular joint dysfunction.

Intra-orally, the patient presented in the permanent dentition with satisfactory gingival and dental health. An isolated labial enamel opacity was noted at LL2.

The mandibular arch was U-shaped with mild crowding localized to the lower incisors. The lower incisors appeared upright relative to the mandibular plane. The maxillary arch was constricted and severely crowded.



Figure 10 Case 2 (a-i): pre-treatment photographs

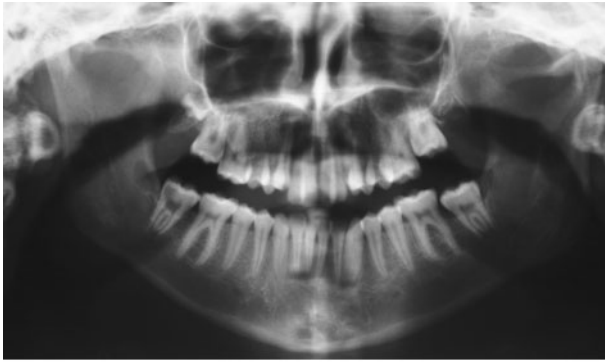
The upper canines were buccally displaced and the central incisors rotated. The incisors were of normal inclination. The upper molars displayed increased buccal inclination, interpreted as transverse compensation for the skeletal constriction.

In occlusion, she presented with a Class II division 1 malocclusion with a maximal overjet of 8 mm. Her overbite was reduced and incomplete. Her buccal segment relation was half unit Class II bilaterally at the molars and canines. Transversely, a unilateral buccal crossbite affected the mandibular premolars and first molar on the left side and a cusp to cusp relationship existed between the second premolars and first molars

on the right. A lateral displacement of 2 mm to the left was apparent on closure, with initial contact UL6 and LL6. This produced the centreline discrepancy with the lower midline displaced to the left of the midfacial axis by 2 mm (Figure 10).

The IOTN DHC of the was 4a and the ac was 8.

A radiographic examination with a DPT (Figure 11a) confirmed the presence of all the permanent teeth including third molars. No caries was noted and bone levels were normal. Assessment of the lateral cephalogram confirmed the clinical impression of a Class 2 skeletal base relationship with the ANB corrected to +6.5 degrees (Figure 11b). Bimaxillary retrusion



(a)



(b)

Figure 11 (a,b) Case 2: pre-treatment DPT and lateral cephalogram

relative to the cranial base was present as illustrated by McNamara values of A-point to Nasion-perpendicular (Nperp) of -4 mm and Pogonion to Nperp of -11 mm. An increase in LFH% was recorded (58%) and the MMPA was at the upper range of normal at 30 degrees. Dentally, the upper incisors were within normal range at 110 degrees and the lower incisors retroclined at 84 degrees on a 30 degree base. Both lips were retrusive to E-plane by -5 mm. The adenoids and tonsils were noted to be prominent. The cephalometric analysis is presented in Table 2.

The aims of treatment were:

1. expand the upper arch to correct the buccal crossbite;
2. relieve crowding and align;
3. reduce overjet;
4. maintain positive overbite;
5. correct to Class I incisors, Class I canines and Class I molars;
6. maintain lower incisor position.

The treatment plan was as follows:

1. fit Rapid Maxillary Expansion appliance (banded design with Hyrax screw);
2. support phase;
3. transpalatal arch (TPA) to maintain the transverse gains;
4. extract UL4, UR4, LL5, LR5;
5. upper and lower pre-adjusted edgewise appliance (0.022×0.028 inch slot) using the MBT prescription;
6. space closure limiting the use of intermaxillary elastics;
7. retention with upper and lower removable retainers.

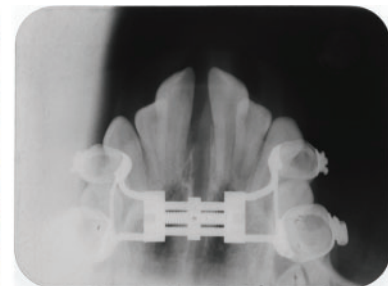
A banded design RME with Hyrax screw was fitted to the upper first molars and first premolars (Figure 12a). The patient was instructed to turn the screw twice a day. The patient was reviewed weekly and expansion was completed when the palatal cusps of the upper premolars and molars approximated the buccal cusps of the lowers (Figure 12b). An upper anterior occlusal



(a)



(b)



(c)

Figure 12 (a-c) Case 2: intra-oral post-expansion photographs and upper anterior occlusal radiograph

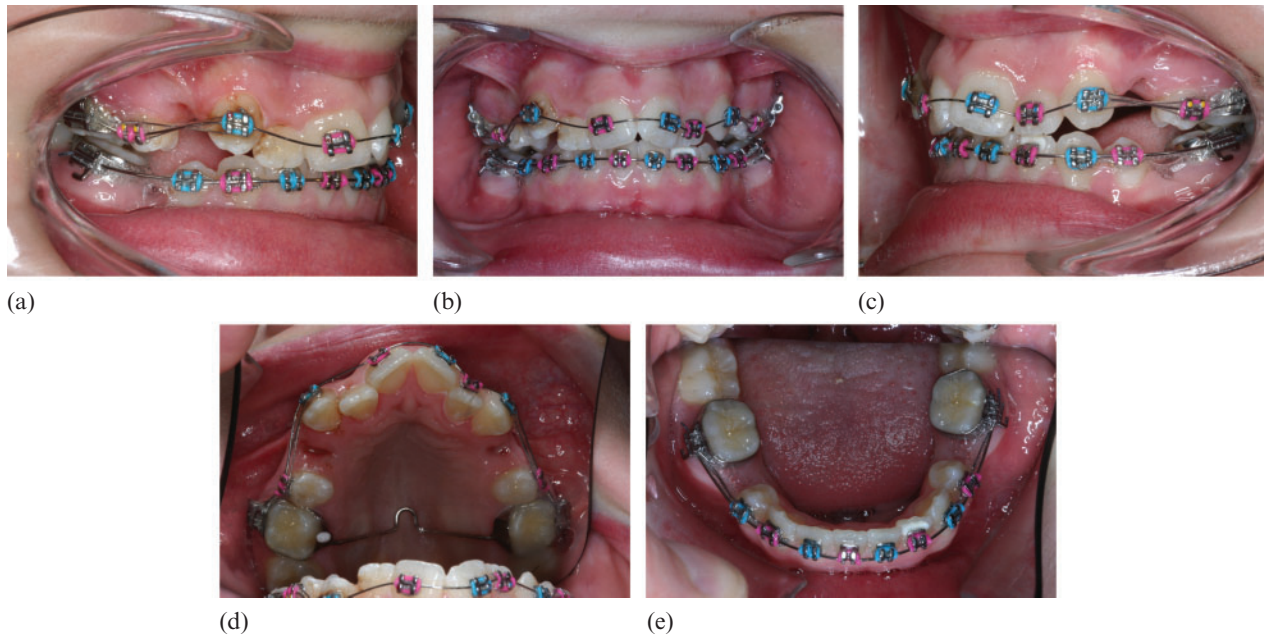


Figure 13 Case 2: following upper bond-up 0.014 inch NiTi initial archwire. Lower 0.016 NiTi

taken at two weeks confirmed separation of the midpalatal suture (Figure 12c).

Once the expansion was completed, the screw was sealed with composite to prevent unwinding of the mechanism. Following a review of the expansion phase, premolar extractions were prescribed to relieve the crowding, reduce the overjet, minimize lower incisor proclination and treat to Class I molars. A TPA was placed and the extraction of the upper first premolars and lower second premolars arranged. The lower appliance was placed one visit before the upper appliance, to allow a sufficient post-expansion phase in the upper arch. In all, a period of three months was allowed for closure of the diastema and bony infilling along the suture before the upper appliance was placed (Figure 13). Upper and lower

bands and bonds with MBT prescription were placed, omitting the second molars initially. Lacebacks (0.09 inch) were placed in all four quadrants together with 0.014 inch super-elastic nickel titanium aligning archwires. Four months into fixed treatment 0.018 inch round stainless steel wires were in place. Nickel titanium pushcoil was applied and activated to open space for the instanding upper right lateral incisor. Once sufficient space was created, a bracket was placed, inverted to increase the labial root torque.³ After 10 months of fixed appliances, co-ordinated 0.019 × 0.025 inch posted stainless steel archwires were *in situ* and the TPA removed. Space closure was undertaken using 9 mm nickel titanium coil-springs in all four quadrants. At 15 months, all the spaces were closed and progressive buccal root torque was placed in the upper buccal segments, progressive lingual crown torque in the lower buccal segments and labial root torque placed at the upper lateral incisors. After a further three months, the upper molar inclination had been corrected. The lower second molars were banded to allow alignment. Near end of treatment radiographs (Figure 14) were taken to assess root angulations and incisor inclination and the necessary corrections made during finishing stage.

Upper and lower round 0.016 inch Australian stainless steel finishing archwires were placed with the upper archwire expanded to maintain the expansion. Artistic finishing bends were placed to detail the occlusion (Figure 15). Preformed Kobayashi ligatures (0.09 inch) were placed on the premolars and box elastics with asymmetric strengths placed to improve the

Table 2 Case report 2: pre-treatment and post-treatment cephalometric analysis

| Variable | Pre-treatment | Near end | Treatment change |
|-------------|---------------|----------|------------------|
| SNA (°) | 76 | 75 | -1 |
| SNB (°) | 72 | 73 | 1 |
| ANB (°) | 4 | 2 | -2 |
| Sn/MxP (°) | 10 | 11 | 1 |
| MMPA (°) | 30 | 26 | -4 |
| LFH (%) | 58 | 58 | 0 |
| UI/MxP (°) | 110 | 110 | 0 |
| LI/MnP (°) | 84 | 87 | 3 |
| LI/APo (mm) | -2 | -1 | 1 |
| UI/LI (°) | 133 | 135 | 2 |



(a)



(b)

Figure 14 (a,b) Case 2: near end of treatment panoramic and lateral cephalometric radiographs

interdigitation of the occlusion and centrelines prior to debonding. After 23 months of treatment the appliances were removed and she was retained with an upper Hawley with a soldered bow and a lower Essix retainer (Figure 16).

Case 2 assessment

This patient presented with a moderate Class 2 skeletal discrepancy with mandibular retrusion. She presented

with an increased MMPA and LFH proportion. This was reflected intra-orally by the tenuous overbite. The buccal crossbite on the left side, crossbite tendency on the right side and resulting mandibular displacement was a manifestation of skeletal maxillary constriction. The upper molars had partially compensated for this as evidenced by their increased buccal inclination. This constriction coupled with a tooth size arch length discrepancy combined to produce severe upper arch crowding.

The relative contribution of mouth breathing to skeletal 'high angle' cases is controversial.⁴ It is interesting to note the enlarged adenoids and tonsils radiographically and the history of nasal obstruction in this case.

Crossbite correction by upper arch expansion was indicated to remove the mandibular displacement, partially address the space requirements in the upper arch and achieve a 'six keys' occlusion. Upper arch expansion might also contribute to an improvement in smile aesthetics. The mode of expansion was a banded RME due to the degree of expansion required and in order to achieve a more stable skeletal expansion compared with slower expansion techniques. A bonded RME design with buccal capping would have been an alternative design particularly in this high angle case, however, the banded design proved very easy to manage.

Due to the high relapse potential of expansion, overcorrection was achieved during the expansion phase with the palatal cusps of the upper molars expanded to approximate the buccal cusps of the lower molars. This was to maximize the amount of skeletal expansion gained. A three month period of retention allowed bony infill. During the fixed appliance phase, a TPA was used until stainless steel working archwires were in place to support the expansion.

Following expansion, a space requirement remained for the relief of crowding and overjet reduction. Lower arch extractions prevented the lower incisors proclining, helping to achieve a positive overbite at the end of treatment. They also provided space for progressive lingual crown torque to be placed in the buccal segments. Lower arch extractions facilitated the attainment of Class I molars.

The near of end cephalometric analysis demonstrated that the sagittal discrepancy has improved modestly with a reduction in ANB by two degrees. This was due to a reduction in SNA and a slight increase in SNB. A-point is likely to have remodelled posteriorly with the overjet reduction. Interestingly, there was a reduction in MMPA by four degrees. As there has been no change in the LFH%, this suggests more growth posteriorly. The dental inclinations remained near their initial

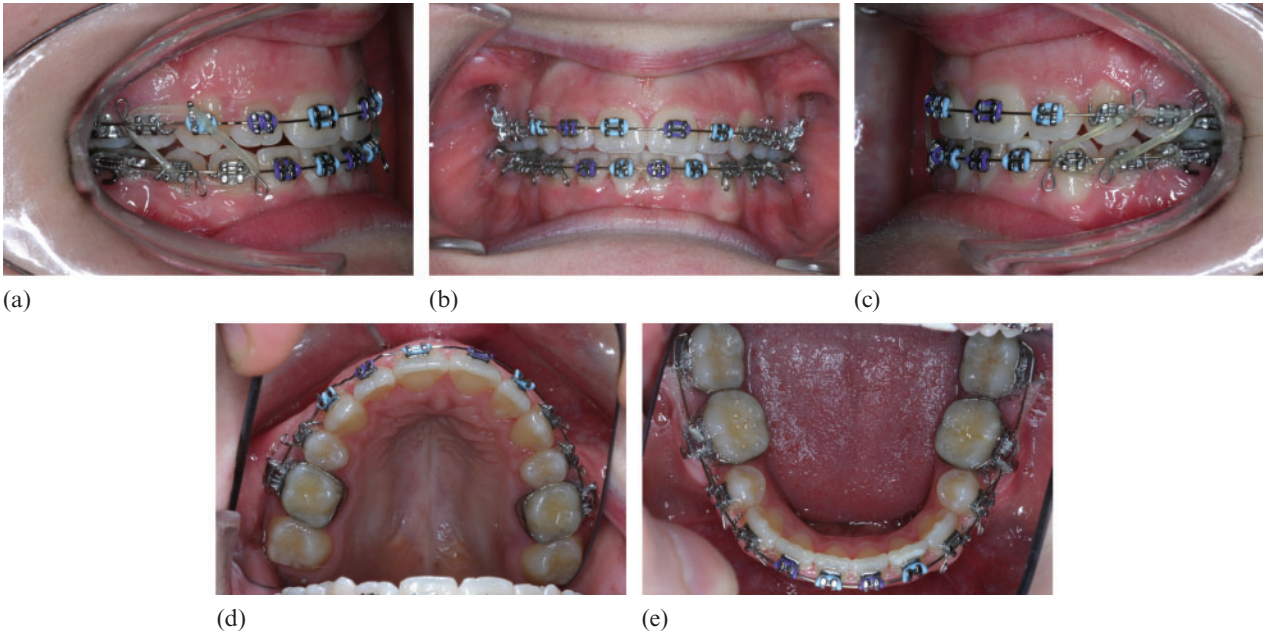


Figure 15 (a-e) Case 2: upper and lower 0.016 inch stainless steel finishing wires with artistic bends and box elastics



Figure 16 (a-i) Case 2: post-treatment intraoral photographs



Figure 17 Case report 2: pre-treatment (black) and near end of treatment (red) cephalometric superimpositions

pre-treatment values. Both lips have become more retrusive to E-plane, due to continuing nasal growth. These effects are illustrated in the cephalometric superimpositions shown in Figure 17.

Facially, there has been a significant widening of her smile. The upper incisors are within the control of the lower lip. Dental alignment has improved, with attainment of Class I incisors, Class I canines and Class I

molars. The overjet was completely reduced. There was adequate buccal root torque in the upper posterior segments. This is important to reduce the tendency to transverse relapse. Importantly, a positive overbite anteriorly has been achieved, which might contribute to the stability of the initially instanding upper lateral incisors. The pre-treatment PAR score of 49 was reduced to 3 which represents an improvement of 94%. The near end of treatment radiograph suggested a small amount of resorption affecting the upper lateral incisors. There was no obvious decalcification. Long-term retention has been advised in view of the initial rotations and expansion achieved. UR2 remained undertorqued and slightly rotated at the end of treatment despite bracket inversion, added labial root torque and finishing bends. Better bond position and longer time with added labial root torque would have been beneficial.

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