

## Clinical Section

# Early Experiences with the Tip-Edge<sup>®</sup> Appliance

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### Introduction

The Tip-Edge<sup>®</sup> (TP Orthodontics, Inc., 100 Center Plaza, LaPorte, IN 46350, U.S.A.) appliance was developed following an analysis of tooth movements occurring during Begg treatment (Kesling, 1968). Kesling determined that it was necessary for each tooth to tip either mesially or distally, but not in both directions. He found this to be true in the correction of all malocclusions whether they were treated with extractions or not and that all the teeth mesial to the extraction site tip distally whilst those distal to it tip mesially. Kesling designed the Tip-Edge<sup>®</sup> bracket to provide all the benefits of differential tooth movement together with the control required to deliver a predetermined amount of tip and torque as found in pre-adjusted Edgewise systems. He appreciated the ease of manipulation that the edgewise slot conveyed so modified it by removing wedges from two opposite corners of the bracket slot to allow each tooth to tip freely, by a predetermined amount, in one direction and prevent them from tipping in the other direction by the horizontal surfaces of the slot (Kesling, 1988). Following my Postgraduate training in Liverpool, during which time I predominantly used the Straight Wire Appliance<sup>®</sup> ('A' Company, Inc., Johnson & Johnson, 11436 Sorrento Valley Road, P.O. Box 81247, San Diego, CA 92138, U.S.A.), I was fortunate enough to obtain a research senior registrar post with a district general hospital attachment to Glan Clwyd District General Hospital under the supervision of Richard Parkhouse. This gave me an excellent opportunity to extend my clinical skills and learn the Tip-Edge<sup>®</sup> technique under the guidance of its principal exponent in the U.K. I would like to present two of my early cases in this paper. The first an average angle Class II division 1 malocclusion and the second a Class III malocclusion.

### Case Report 1

A 14 year old girl presented complaining that her front teeth stuck out. Her medical history was uncomplicated. She was keen to receive treatment and prepared to wear a fixed appliance.

#### Clinical Examination

Extra oral examination revealed a Class II skeletal base with an average Frankfort mandibular planes angle and

lower face height proportion. There was no facial asymmetry or lateral deviation on closing. The lips were competent with a marked labio-mental fold (Fig. 1a,b). Intra-orally, she presented in the permanent dentition with all teeth, except the third molars, erupted. Her oral hygiene was good, but there was occlusal caries in 6/6. The molar relationship bilaterally was Class II. There was a scissors bite involving 7/1 and lower 7/1. The canine relationship on the right was half a unit Class II and on the left a full unit Class II. The overjet measures 100 mm with the overbite increased and complete. The upper centreline was displaced slightly to the right and the lower slightly to the left of the facial centreline, with a total discrepancy of half a lower incisor width. There was mild crowding in the upper labial segment with 2/2 displaced palatally and 2/1 rotated mesio-palatally. There was mild crowding in the lower labial segment with lower 2/2 displaced lingually. The buccal segments were generally well aligned (Fig. 1c-e).

#### Radiographic Examination

The panoramic radiograph confirmed the presence of all permanent teeth and occlusal caries in 6/6. Cephalometric analysis confirmed the clinical impression of a Class II skeletal base with a corrected ANB angle of 8 degrees and Wits analysis of 7 mm. A point lay on nasion perpendicular and B point was 10 mm behind it. The Frankfort and maxillo-mandibular angles were within normal limits, and the lower facial height 53.5 per cent of the total face height. The upper incisors were at the upper limit of the normal range to the maxillary plane and the lower incisors within normal limits to the mandibular plane. The upper and lower lips both lay behind the aesthetic line (Fig. 1f, Table 1).

#### Treatment aims

1. Investigation and restoration of 6/6.
2. Relieve crowding and align the upper and lower labial segments.
3. Reduce the overbite and overjet to produce a Class I incisor relationship with coincident centrelines.
4. Establish a Class I molar relationship and correct the scissors bite.

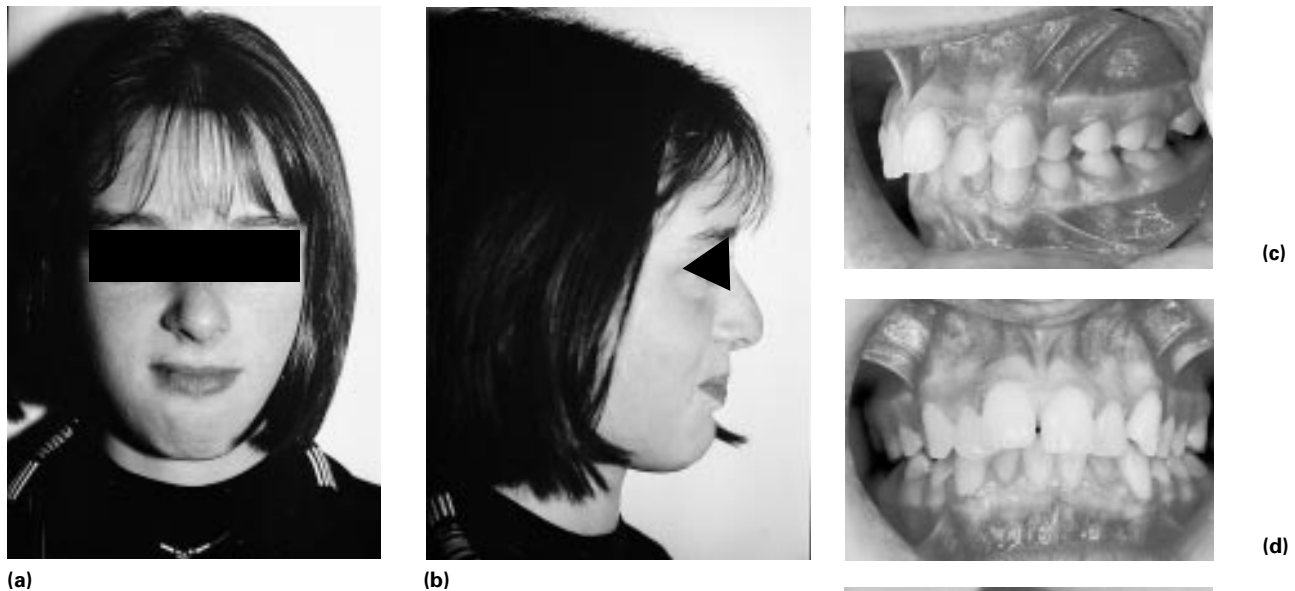
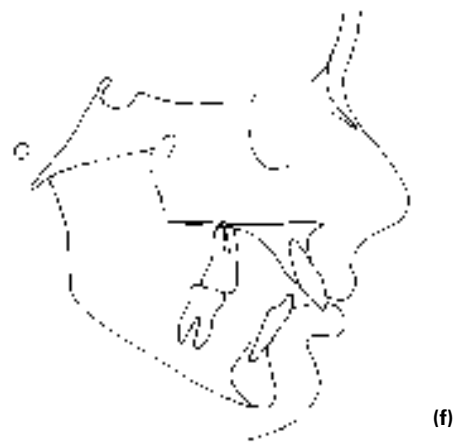


FIG. 1 (a-f) Case Report 1. Pretreatment photographs and cephalometric tracing.

### Treatment plan

1. Investigation and restoration of  $\underline{6}$ / $\underline{6}$ .
2. Extraction  $\underline{4}$ / $\underline{4}$   $\underline{5}$ / $\underline{5}$ .
3. Bond and band upper and lower arches with Tip-Edge<sup>®</sup> appliance initially leaving off the premolar brackets. Place upper and lower 0.016-inch stainless steel archwires, with bite opening bends to the first molars and auxiliary Co-Ax sectional archwires to align the upper and lower labial segments. Start full time Class II elastics (Fig. 2a-c).
4. Discard the auxiliary archwires when the labial segments are aligned and ligate the canines to the circle hooks. Continue with overjet and overbite reduction.
5. When the overjet and overbite are reduced bond the premolars and align them on the 0.016-inch stainless steel archwires, with increased and reverse curves of Spee to maintain overbite reduction. Assess the need for 'brakes' during space closure.
6. Place upper and lower 0.020-inch stainless steel archwires with increased and reverse curves of Spee. Start space closure using elastomers. Check the need for asymmetric mechanics to aid centreline correction (Fig. 3a-c).
7. When space closure is (nearly) complete place 1-mm offsets and 7-10-degree toe-ins to the molars.
8. Place upper and lower 0.0215 × 0.028-inch pretorqued stainless steel archwires with increased and reverse curves of Spee. Place Sidewinder<sup>®</sup> (TP Orthodontics Inc., 100 Center Plaza, LaPorte, IN 46350, U.S.A.) springs to upright and torque the teeth (Fig. 4a-c).
9. Detail and finish with braided 0.0215 × 0.025-inch stainless steel archwires assessing the need to incorporate the right second molars to correct the scissors bite and for seating of the buccal segments.
10. Retain and monitor the development of the third molars.



Treatment involved 21 visits over 30 months. Stage I took 10 months and Stage II a further 7 months, during which time asymmetric inter-maxillary elastics were used to correct the centreline. Stage III took 13 months, and was prolonged due to the amount of root uprighting and torquing required and the need to correct the scissors bite. A short period of triangular inter-maxillary elastics was used to seat the buccal segments. She is now in retention wearing upper and lower Hawley retainers on a night time only basis (Fig. 5a-e).

### Case Assessment

Facial growth has been down and forwards during treat-

TABLE 1 Case report 1. Cephalometric measurements

	Pretreatment	Post-treatment	Mean	Change
SNA (degrees)	75.5	76	82 ± 3	+0.5
SNB (degrees)	70.5	72	78 ± 3	+1.5
ANB (degrees)	5.0	4.0	3 ± 1	-1.0
ANB-corrected (degrees)	8.0	6.5	3 ± 1	-1.5
UI-MAX (degrees)	114	108	108 ± 5	-6.0
LI-Mand (degrees)	92	95	92 ± 5	+3.0
Interincisal angle (degrees)	125	132	133 ± 10	+7.0
LI to A-Pog (mm)	-1	-1	0-2	0.0
MMPA (degrees)	28.5	26	27 ± 4	-2.5
FMPA (degrees)	23.5	25	26 ± 6	+1.5
Lower face height (% of total face height)	53.5	54	50-55	+0.5
Wits analysis (mm)	7	5.5	0	-1.5
Nasion A pt (mm)	0	-2	2	-2
Perpendicular B pt (mm)	-10	-12	-2-3	-2
Upper lip-aesthetic plane (mm)	-4.5	-6	-2 ± 2	-1.5
Lower lip-aesthetic plane (mm)	-2	-4	-2 ± 2	-2



(a)



(b)



(c)

FIG. 2 (a-c) Case Report 1. Stage I.



(a)



(b)



(c)

FIG. 3 (a-c) Case Report 1. Stage II.



(a)



(b)



(c)

FIG. 4 (a-c) Case Report 1. Stage III.



FIG. 5 (a-f) Case Report 1. Post-treatment photographs and cephalometric tracing.

ment and the nose has lengthened (Fig. 5f, Table 1). The maxillary plane, occlusal plane, maxillary mandibular planes angle, and lower face height proportion have all been maintained despite the use of inter-maxillary elastics throughout treatment. Superimposition of the maxillary tracing shows that torque has been regained well during Stage III due to the action of the Sidewinder® springs closing the brackets down onto the full sized arch-wire to allow full torque expression. The lower incisors have proclined slightly during treatment but maintained their position relative to the A-Pogonion line, although there has been considerable remodelling at A point and growth of the chin which will have influenced the position of the reference line. Correction of the molar relationship has been brought about by relatively more mesial movement of the lower molars under the influence of Class II elastics (Fig. 6, Table 1).

The upper and lower lips are further away from the aesthetic plane after treatment, but this is likely to be due to growth of the nose and chin which will have influenced the position of the aesthetic plane.

The overjet has been reduced during treatment predominantly by movement of the upper incisors together with a small amount of favourable mandibular growth. The overbite has been reduced through a combination of intrusion of the upper incisors, molar extrusion, and mandibular growth. The centreline and molar relationship have been corrected by differential movement of the labial and buccal segments. The long-term prognosis for this patient is favourable because the malocclusion has been corrected to a position within the zone of soft tissue balance.

The occlusal changes, as assessed by the Index of Orthodontic Treatment Need (Brooke and Shaw, 1989) and Peer Assessment Rating (PAR) index (Richmond *et al.*, 1992) have been favourable and suggest that the case has been greatly improved by orthodontic treatment (Table 2).



TABLE 2 Case report 1. Occlusal indices

	Pretreatment	Post-treatment	Change
IOTN DHC	5a	2g	
IOTN AC	7	1	
Weighted PAR Score	43	2	41 (95%)

Surgical correction of this malocclusion would have been considered if the patient had expressed concern about her facial appearance or had refused to co-operate with elastic wear. There has been considerable growth of the nose so surgical correction may have produced a more favourable soft tissue profile, but would have posed the risks associated with mandibular surgery.

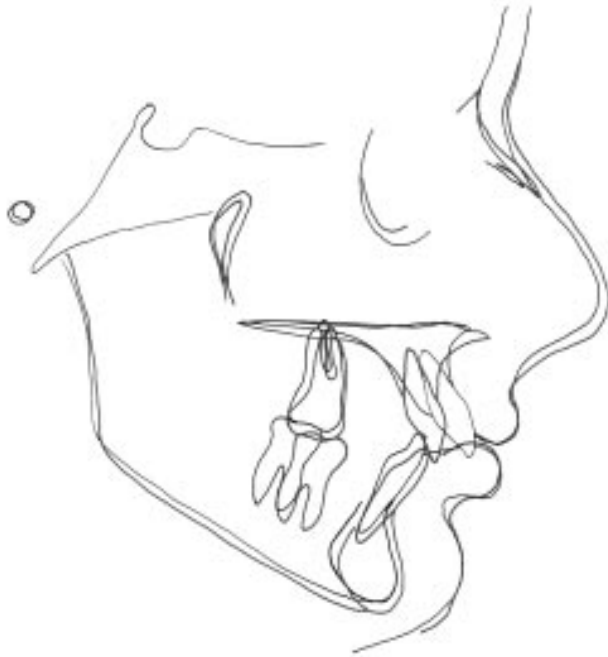


FIG. 6 Case Report 1. Superimposition of pre- (black) and post- (red) treatment cephalometric tracings on De Coster's line.

### Case Report 2

The second case is a 12<sup>1</sup>/<sub>4</sub>-year-old girl who presented complaining that her front were crooked and bit the wrong way round. Her medical history was uncomplicated. She was keen to receive treatment and prepared to wear fixed appliances.

#### Clinical Examination

Extra oral examination revealed a Class III skeletal base with an average Frankfort mandibular planes angle and lower face height proportion. There was no facial asymmetry and the lips were competent. There was a marked

forward displacement on closing. (Fig. 7a-c). Intra-orally, she presented in the permanent dentition with all teeth, except the second and third molars, erupted. Her oral hygiene was good. The molar relation was half a unit Class III bilaterally in intercuspal position. There was a bilateral cross-bite involving all the maxillary dentition except 33 which were displaced buccally. The buccal teeth were upright relative to the maxillary base. The canine relationship on the right was Class I and on the left a third of a unit Class II. There was a reverse overjet involving 2112 in intercuspal position, but she could just get edge-to-edge in retruded contact position (Fig. 7d). The overbite was increased and complete in intercuspal position. The upper centreline was displaced to the left by 2 mm and the lower coincident with the facial centreline. There was severe crowding in the upper labial segment with 313 displaced buccally and 2 palatally with only 2 mm available for 13 between 2-4. The lower labial and buccal segments were generally well aligned (Fig. 7e-g).

#### Radiographic Examination

The panoramic radiograph confirmed the presence of all permanent teeth. Cephalometric analysis in intercuspal confirmed the clinical impression of a Class III skeletal base with a corrected ANB angle of 1.5 degrees and Wits analysis of -5 mm. A point lay 4 mm behind nasion perpendicular and B point was 7 mm behind it. The Frankfort and maxillo-mandibular angles were within normal limits and the lower facial height 52.4 per cent of the total face height. The upper incisors were at average inclination to the maxillary plane, and the lower incisors slightly retroclined relative to the mandibular plane and in relation to the maxillo-mandibular angle. The upper lip lay 6 mm behind and the lower just on the aesthetic line (Fig. 7h, Table 3).

#### Treatment Aims

1. Relieve crowding and align the upper labial segment.
2. Eliminate the premature contact in retruded contact position to allow a positive overjet to be established.

TABLE 3 Case report 2. Cephalometric measurements

	Pretreatment	Post-treatment	Mean	Change
SNA (degrees)	79	79	82 ± 3	0
SNB (degrees)	79	79	78 ± 3	0
ANB (degrees)	0	0	3 ± 1	0
ANB-corrected (degrees)	1.5	1.5	3 ± 1	0
UI-MAX (degrees)	109	114	108 ± 5	+5.0
LI-Mand (degrees)	86	77	92 ± 5	-9.0
Interincisal angle (degrees)	137	137	133 ± 10	0
LI to A-Pog (mm)	+4.5	+3	0 - 2	-1.5
MMPA (degrees)	29	31	27 ± 4	+2.0
FMPA (degrees)	32	34	26 ± 6	+2.0
Lower face height (% of total face height)	52.4	52.9	50 - 55	+0.5
Wits analysis (mm)	-5	-3	0	+2
Nasion A pt (mm)	-4	-4.5	2	-0.5
Perpendicular B pt (mm)	-7	-7	-2 - 3	0
Upper lip-aesthetic plane (mm)	-6	-5	-2 ± 2	+1
Lower lip-aesthetic plane (mm)	0	-2	-2 ± 2	-2

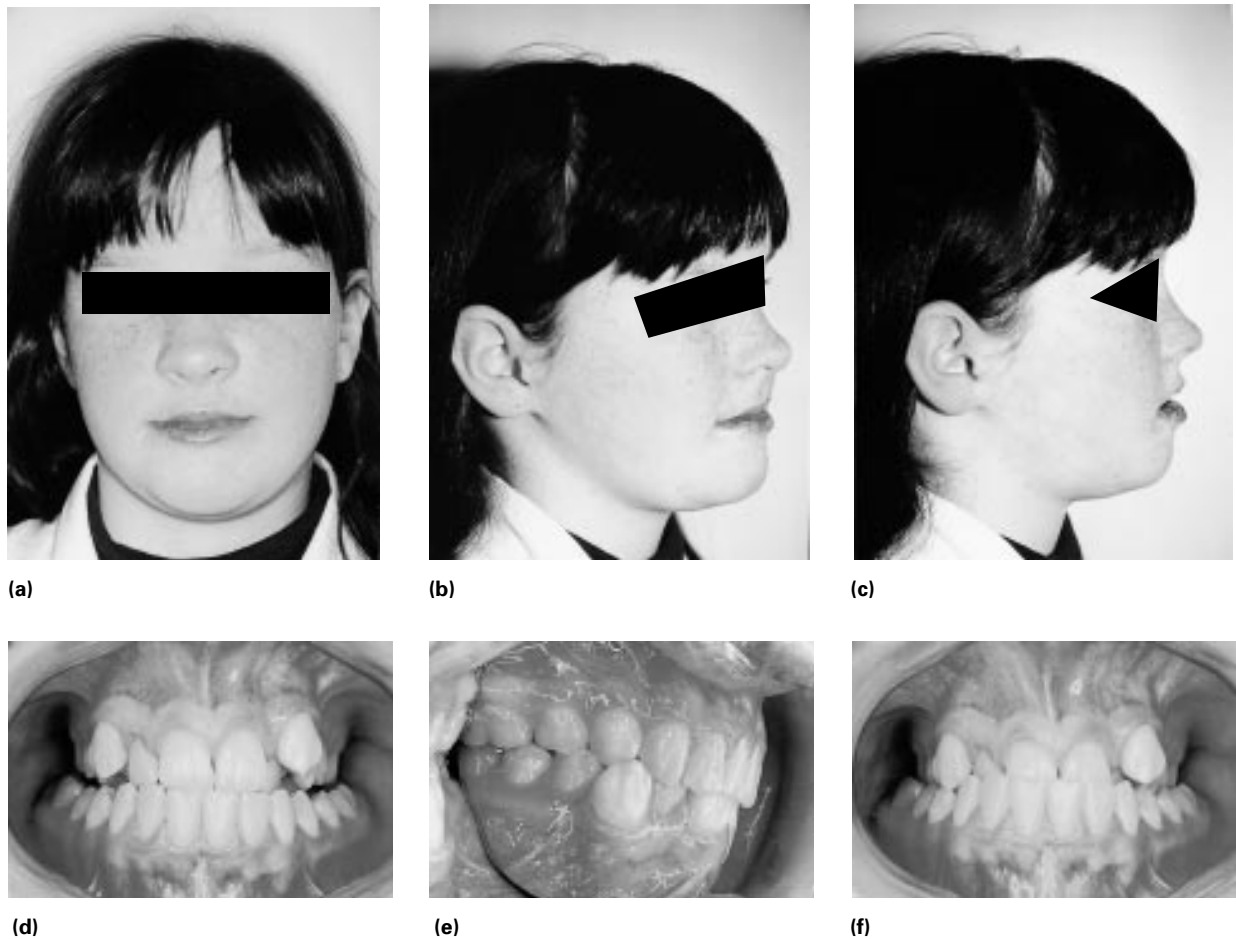


FIG. 7 (a-h) Case Report 2. Pretreatment photographs and cephalometric tracing.

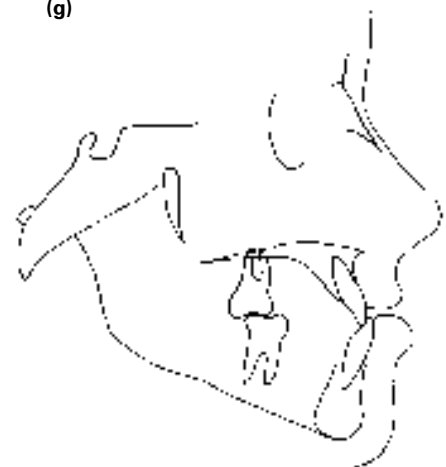
3. Increase the overjet and reduce the overbite to produce a Class I incisor relationship with coincident centrelines.
4. Correct the bilateral cross-bite and establish a Class I molar relationship.

#### Treatment Plan

1. Extraction  $\overline{515}$   $\overline{515}$ .
2. Place a quad-helix appliance to expand  $\overline{6-44-6}$ .
3. Bond and band upper and lower arches with Tip-Edge<sup>®</sup> appliance bonding the premolars from the outset and buttons on  $\overline{212}$  until brackets could be placed in their ideal position. Place a plain upper 0.016-inch stainless steel archwire (to allow a push coil to be used to open space for  $\overline{12}$ ) and a lower 0.016-inch stainless steel archwire with circle hooks (to allow the use of Class III elastics). Start full time Class III elastics (Fig. 8a-c).
4. When the overjet and overbite are correct place upper and lower 0.020-inch stainless steel archwires.
5. Remove the quad-helix appliance once adequate expansion has been obtained and upper and lower 0.020-inch stainless steel archwires are in place. Place



(g)



(h)



FIG. 8 (a-c) Case Report 2. Stage I.



FIG. 9 (a-c) Case Report 2. Stage II.



FIG. 10 (a-c) Case Report 2. Stage III.

'brakes' on  $\underline{3|3}$  to increase the anchorage of the upper labial segment and allow space closure from behind. Assess the need for asymmetric mechanics during space closure to correct the centreline discrepancy. Start space closure with elastomerics (Fig. 9a-c).

6. When space closure is (nearly) complete place 1 mm offsets and 7-10-degree toe-ins to the molars.
7. Place upper and lower 0.0215 × 0.028-inch stainless steel archwires and Sidewinder® springs to upright and torque the teeth. Reduce the Class III elastic wear to be sufficient to maintain the overjet and overbite (Fig. 10a-c).
8. Detail and finish with braided 0.019 × 0.025 stainless steel archwires assessing the need to incorporate the second molars and for seating elastics to settle the buccal segments.
9. Retain and monitor the development of the third molars.

Treatment involved 18 visits over 25 months. The quad-helix was in place 6 months before upper and lower arches were bonded and banded. Stage I took 8 months, Stage II took 5 months, and Stage III only took 6 months including 6 weeks with an upper 0.019 × 0.025-inch braided stainless steel archwire and triangular intermaxillary elastics to seat the premolars. She is now in retention wearing upper and lower Hawley retainers on a night time only basis (Fig. 11a-f).

#### Case Assessment

Facial growth has been down and forwards during treatment (Fig. 11g, Table 3). The Frankfort-mandibular and maxillary-mandibular planes angles have increased slightly during treatment producing an anti-clockwise growth rotation and the lower face height proportion has

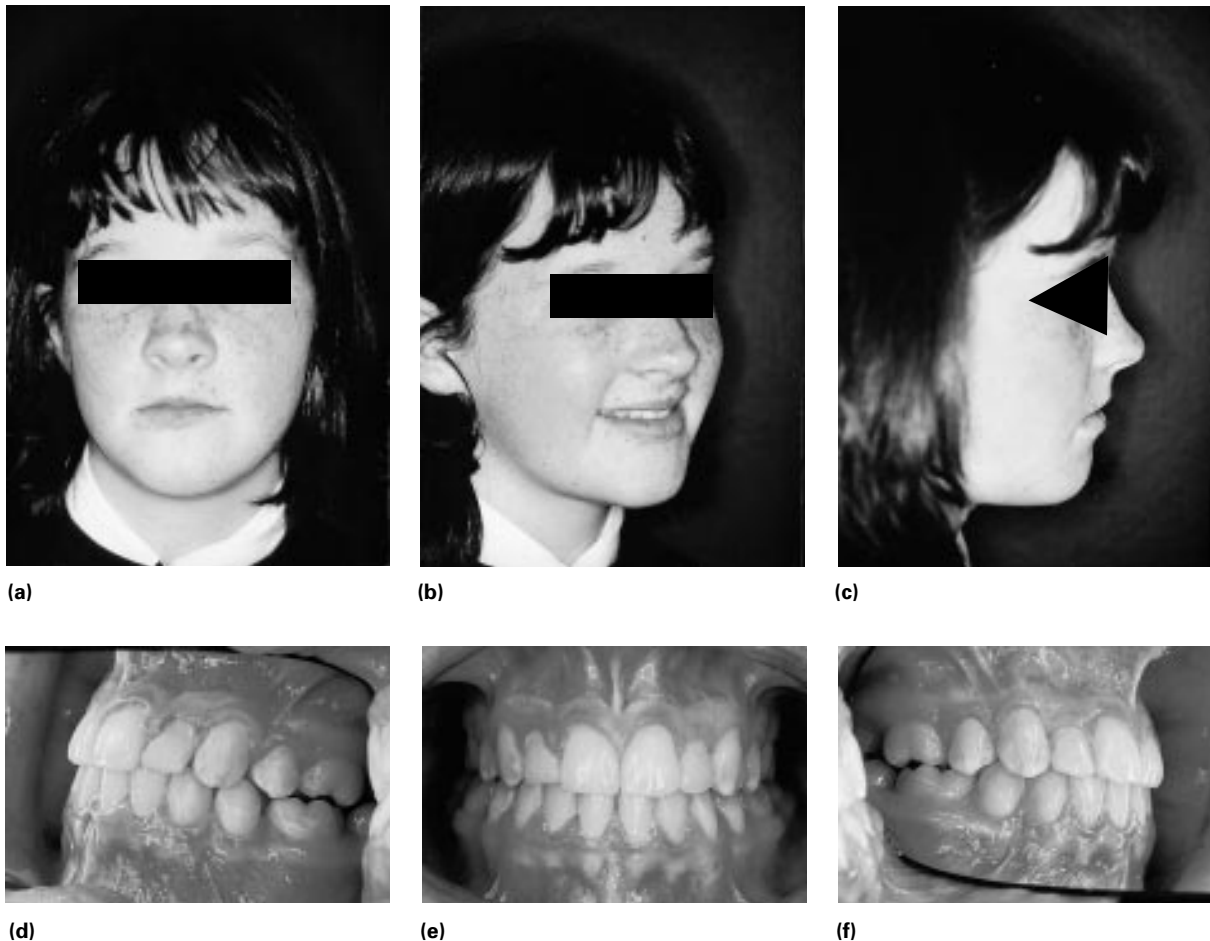


FIG. 11 (a-g) Case Report 2. Post-treatment photographs and cephalometric tracing.

been maintained despite the use of Class III inter-maxillary elastics throughout treatment. The antero-posterior relationship of A and B points have been maintained in relation to sella-nasion and the nasion perpendicular. However, the Wits analysis has reduced, but this may be a reflection of the slight anti-clockwise rotation of the occlusal plane.

Superimposition of the individual maxillary and mandibular tracing shows that the upper incisors have proclined and the lowers retroclined during treatment which has allowed a Class I incisor relationship to be established and the Class III skeletal base camouflaged (Fig. 12, Table 3). Although the upper lip is slightly closer and the lower lip further away from the aesthetic plane after treatment, this likely to be due to the effect of the pre-treatment displacement of the mandible which will have influenced the relative position of the aesthetic plane. The overjet has been corrected predominantly by tipping the incisors together with a small amount of favourable mandibular growth rotation. Overbite reduction has been achieved predominantly due to vertical mandibular growth. The molar relationship corrected once the mandibular displacement had been eliminated. This also improved the facial aesthetics resulting in an acceptable profile and camouflage of the underlying Class



III skeletal base. The growth which occurred during treatment has not been unfavourable but the long-term prognosis for this patient has to be dependent on further mandibular growth. She is now 14<sup>3</sup>/<sub>4</sub> years old and has





FIG. 12 Case Report 2. Superimposition of pre- (black) and post- (red) treatment cephalometric tracings on De Coster's line.

been through her pubertal growth spurt during treatment. Once the mandibular displacement had been eliminated the overjet was maintained with night time only elastics and mandibular growth did not threaten this.

There have been substantial occlusal changes during treatment which have greatly improved the occlusion of this case (Table 4).

TABLE 4 Case report 2. Occlusal indices

	Pretreatment	Post-treatment	Change
IOTN DHC	4c	2g	
IOTN AC	8	1	
Weighted PAR Score	39	2	37 (95%)

The need for surgical correction of this malocclusion was discussed with the patient and her mother before the final treatment plan was made. It was explained that although orthodontic treatment could align the upper labial segment the effect of further mandibular growth on the antero-posterior relation of the incisors was more uncertain and that orthognathic surgery may be required if further growth was adverse. However, it was felt that because she could obtain an edge to edge occlusion in retruded contact position and had an increased overbite, orthodontic camouflage of this malocclusion would be feasible. The family were keen to avoid surgery, and an older sister with a similar malocclusion and skeletal pattern had recently completed orthodontic treatment successfully.

### Acknowledgements

I would like to take this opportunity to thank North West Heath Authority and Glan Clwyd District General Hospital NHS Trust for funding my Senior Registrar training programme which has afforded me this opportunity to extend my clinical experience. I would also like to thank Richard Parkhouse for his expert tuition over the past 3 years and comments made during the preparation of these case reports.

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