Journal of Orthodontics, Vol. 32, 2005, 75–84

CLINICAL SECTION

Three-part bi-maxillary osteotomy: a case report involving resorbable plates

David Waring
FTTA in Orthodontics, Liverpool University Dental Hospital

Jayne Harrison
Consulant in Orthodontics, Liverpool University Dental Hospital

Mark Boyle
Consultant in Oral & Maxillofacial Surgery, Liverpool University Dental Hospital

This case report describes a patient who presented with a severe class 2 skeletal discrepancy together with a Class II malocclusion and a large anterior open bite. The malocclusion and skeletal discrepancy were managed with a combination of orthodontic and orthognathic treatment.

The orthognathic surgery was undertaken following orthodontic decompensation using sectional mechanics to allow a segmental bimaxillary osteotomy and genioplasty to be performed. Although the discrepancy was severe using this combination of treatment, a successful outcome, both facially and occlusally, was achieved.

Key words: Orthognathic, resorbable plates, 3-part maxilla

Received 04 June 2004; accepted 24th January 2005

Introduction

Skeletal anterior open bites (Figure 1) are generally considered to be amongst the most difficult orthodontic cases to treat. An anterior open bite (AOB) is defined as 'that condition where the upper incisor crowns fail to overlap the incisal third of the lower incisor crowns when the mandible is brought into full occlusion'.[1] The types of treatment for correction of an anterior open bite are usually based on orthodontics alone or a combination of orthodontics and orthognathic surgery.[2] Orthodontic treatment alone relies on favorable growth of the patient, optimum patient compliance with treatment, and intrusion and extrusion of the posterior and anterior teeth, respectively. The orthodontic treatment modalities for mild AOBs have historically included posterior bite blocks, vertical pull chin-cup head gear, extraction therapy and multiple loop edgewise arch wire therapy. However many of these techniques result in an unstable occlusion and unsuccessful long-term treatment outcome.[3]

Figure 1 A severe anterior open bite

In addition to the difficulty of correcting a severe open bite orthodontically, it can be even more difficult to keep it corrected because of the distance that the teeth would have to be moved and the tendency of the elongated teeth to rebound apically after they have been brought into occlusion. There is only a limited capacity to over-treat an open bite orthodontically by creating an increased overbite, as when the teeth come into contact, they can go no further. This means that any relapse tendency results in a re-opening of the bite.[4] In these cases, the only successful treatment option is a combination of orthodontics and orthognathic surgery to correct the malocclusion and underlying skeletal discrepancy.

The type of orthognathic surgery that can be used to correct a skeletal open bite depends on the occlusal planes and magnitude of the overbite, the relative antero-posterior position of the jaws and any transverse discrepancy of the maxilla. The surgery carried out can vary from relatively straightforward single jaw surgery to complex three-dimensional jaw surgery.[2]

Address for correspondence: David Waring, Department of Orthodontics, Liverpool University Dental Hospital, Pembroke Place, Liverpool, L3 5PS. Email: dtwaring@hotmail.com

DOI 10.1179/146531205225020934

(a) (b)

(c) (d)

Figure 2 (a–d) Extra-oral presentation with a convex profile and retrusive chin point

Often the key decision in planning treatment is whether a one part Le Fort I maxillary osteotomy is sufficient or whether the maxilla requires sectioning to allow differential movements of the anterior and posterior segments. When this type of three-dimensional maxillary osteotomy is required it is important that the surgical and orthodontic phase of treatment are co-coordinated, and the location of any inter-dental cuts is determined at the start of the treatment. During the pre-surgical orthodontics the objectives should be to level within, but not across, the segments—the surgery will level across the segments—and to maintain or create appropriate re-separation of the osteotomy sites.[4] Although blunt dissection between the apical thirds of the teeth either side of the osteotomy sites can be performed, the creation of space to allow for the surgical cuts is more common and can be established by alteration in the orthodontic mechanics.

In addition the pre-surgical orthodontics should:

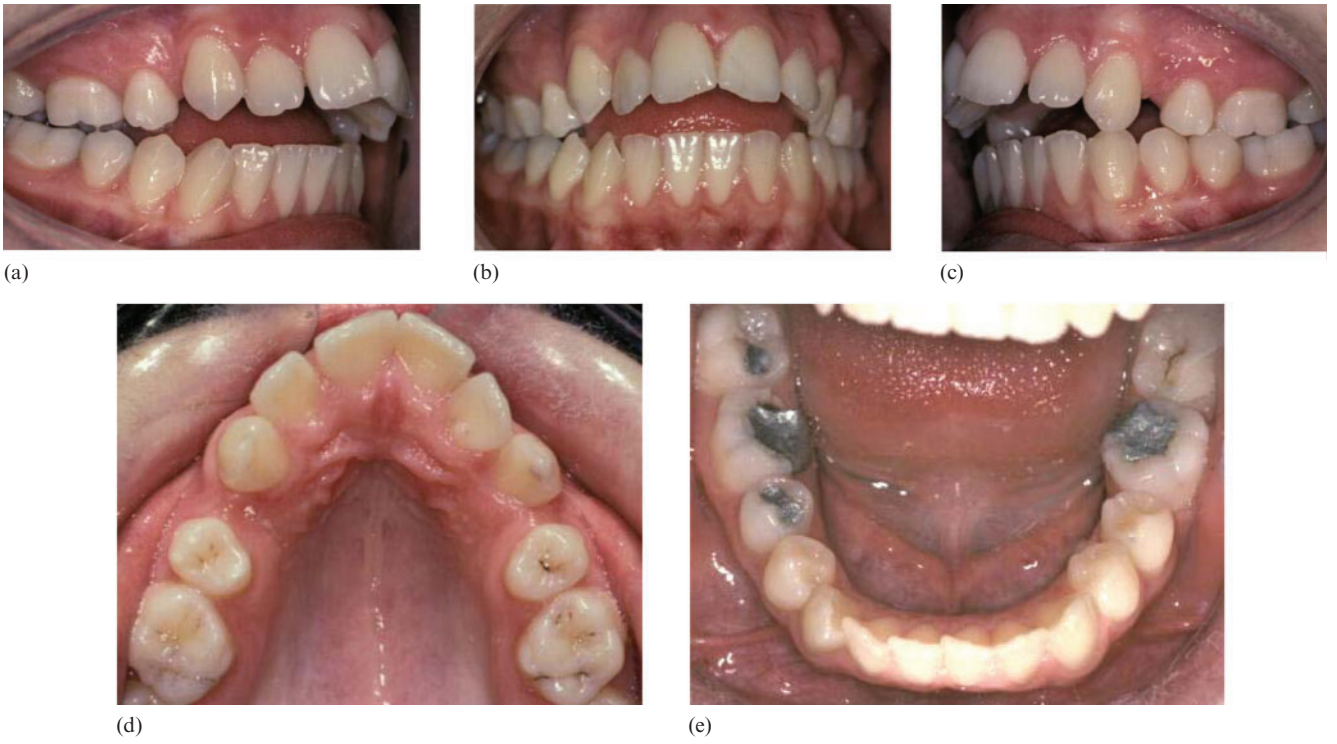


Figure 3 (a–e) Intra-oral views demonstrating the extent of the AOB. An increased overjet is also evident, with spacing in the upper arch as a result of previous loss of premolars

- reduce any movement of the teeth in the direction of the surgical correction because orthodontic relapse will compromise the total correction;
- maximize surgical movements to enable optimal facial form to be achieved;
- provide good occlusal fit to assist with location of the segments during surgery;
- provide means of attachment for post-operative intermaxillary elastics.

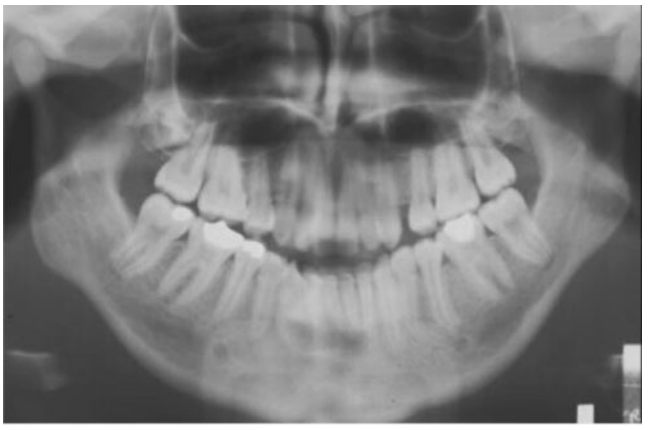
In addition to potential orthodontic relapse, the surgical movements are also prone to occasional adverse movement and subsequent relapse. Historically, surgical correction of maxillary transverse discrepancies have been liable to adverse relapse.[5] This is in part due to the inability to plate the palatal vault as any infection would necessitate a further osteotomy to remove the infected plate. The introduction of resorbable poly-L-lactic/polyglycolic acid bone fixation devices[6] has allowed placement of a plate across the palatal vault. However, no confirmed studies have fully assessed the stability of maxillary expansion using resorbable plates, but some studies have indicated that this type of fixation does provide acceptable stability for other osteotomy procedures.[7] Fixation of the palatal vault could feasibly provide transverse stability and reduction in relapse without the potential for infection to occur.

Case report

A female patient, aged 15 years and 9 months was seen on the orthodontic clinic following referral from a local specialist orthodontic practitioner. At initial consultation she expressed her concerns about the appearance of her anterior teeth and the fact that her 'front teeth could not meet together'. She also felt her chin was too far back in facial profile. She was very keen for treatment to correct the above discrepancies (Figure 2 a–d). Her medical history was benign and jaw function was normal, without any signs or symptoms of TMJ dysfunction.

On clinical examination the patient presented with a severe Class II skeletal pattern with marked mandibular retrognathia and a mild transverse maxillary deficiency. Her lips were incompetent and she had an acute naso-labial angle. Her vertical dimensions and Frankfort–mandibular planes angle were both increased. Both her upper and lower lips lay beyond Ricketts E-plane. This may be a reflection of the extreme retrusion of her soft tissue pogonion landmark.

Intra-orally (Figure 3a–e) she had missing upper first premolars and the lower first molars were heavily restored. Her upper occlusal plane had a pronounced curve of Spee with distinct and separate occlusal planes in the buccal and anterior segments. Her overjet measured 13 mm and she had an AOB measuring



(a)

(b)

Figure 4 (a,b) Pretreatment OPG and lateral cephalogram confirming the clinical findings and available as a baseline measurement

6 mm. She had left and right Class II buccal segment relationship with a tendency towards a bilateral buccal crossbite. She had moderate crowding of 6 mm in the lower arch and moderate spacing in the upper arch resulting from previous loss of upper first premolars.

At her initial visit radiographs were taken (Figure 4a,b). The OPG (Figure 4a) was used to assess the developing dentition and the presence of any third molars, as this may have an impact on surgery if a bilateral sagittal split was to be performed. A cephalometric radiograph (Figure 4b) confirmed that she was bi-maxillary retrognathic and also provided baseline measurements (Figure 5) of her tooth angulations prior to starting the fixed appliance phase of treatment. Her ANB was increased at 8° (or 11° with an Eastman correction) and the mandibular–maxillary planes angle significantly increased at 49°, indicating the severity of the skeletal discrepancy. Her upper incisors were at an average inclination, although in relation to the mandibular–maxillary planes angle the lower incisors were significantly compensated at 90°. In the vertical plane she had an increased lower face height, again indicating a severe vertical skeletal discrepancy.

Orthodontic treatment

The aims of orthodontic treatment were to decompensate her incisors, and align and level the arches with fixed appliances prior to orthognathic surgery. Her upper arch was treated by a non-extraction approach, but in the lower arch her heavily restored lower first molars were extracted to provide space to relieve the crowding and retrocline her lower incisors thus maximizing the surgical movements of the mandible.

Segmental leveling

Her upper arch was levelled segmentally (Figure 6a–e). This created 3 separate planes that were levelled surgically and allowed differential impaction with the buccal segments being intruded more than the anterior segment. In this way, her AOB could be reduced without increasing the upper anterior tooth show. The orthodontic mechanics allowed tipping of her canine roots mesially to create space for the surgical cuts (Figure 6a,c). This can be achieved by using the contralateral canine brackets, which cause the root to tip mesially, as opposed to the normal distal angulation to the canine root. Alternatively, second order bends may be placed in the archwire to tip the root mesially.

Following the loss of her lower first permanent molars, the space was closed using standard orthodontic space closing mechanics. Nickel titanium springs were used to close space with the aim of retracting the lower incisors and increasing the overjet, thus maximizing the surgical movements. No pre-surgical intermaxillary elastics were used as this may have extruded the anterior segments.

Orthognathic treatment

Maxilla

Prior to the surgery, and following study model and radiographic assessment (Figure 7), the amounts of each impaction were determined at the planning stage by study model surgery. A 3-part Le Fort I maxillary osteotomy was performed to allow differential

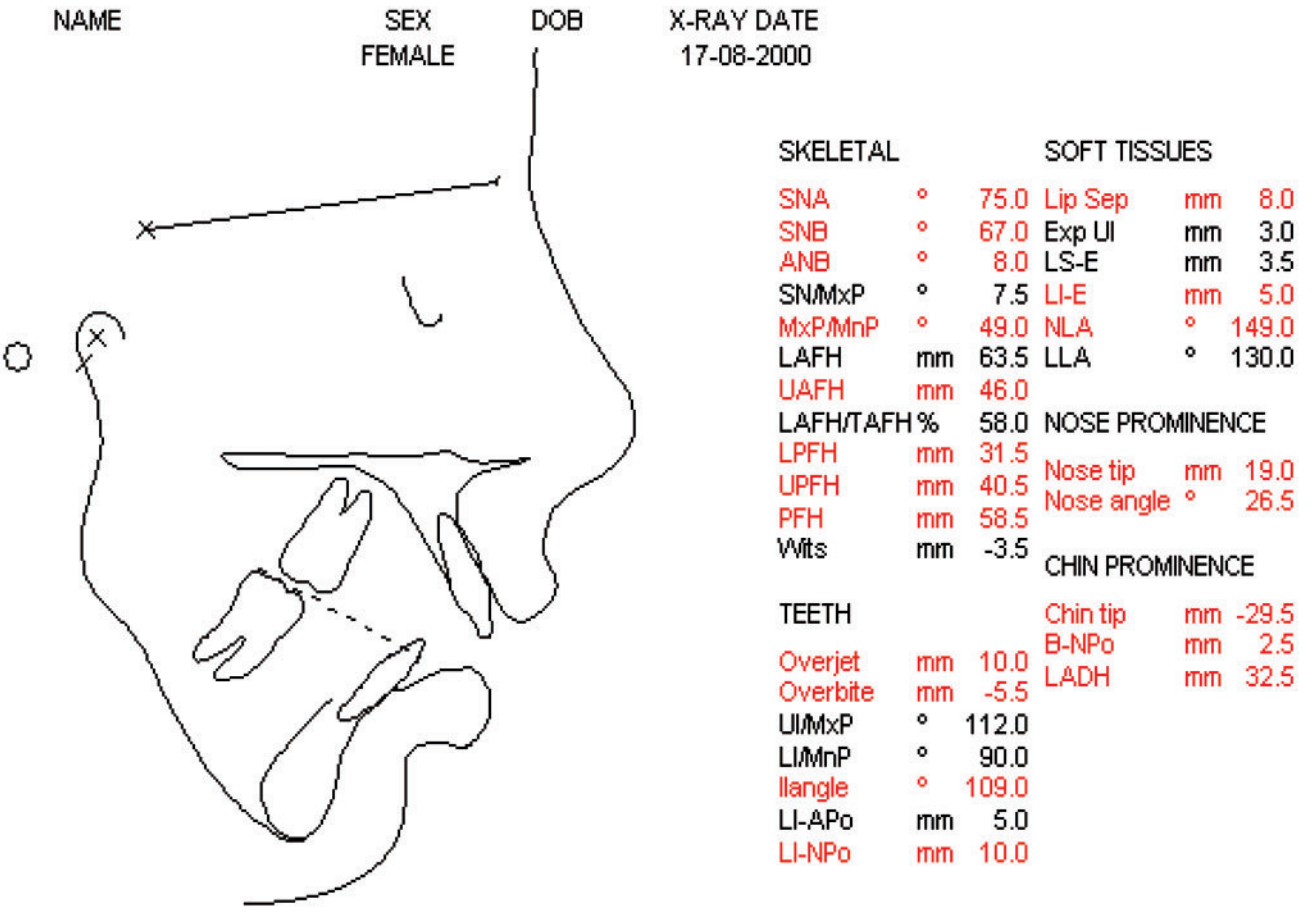


Figure 5 Cephalometric analysis prior to orthognathic planning

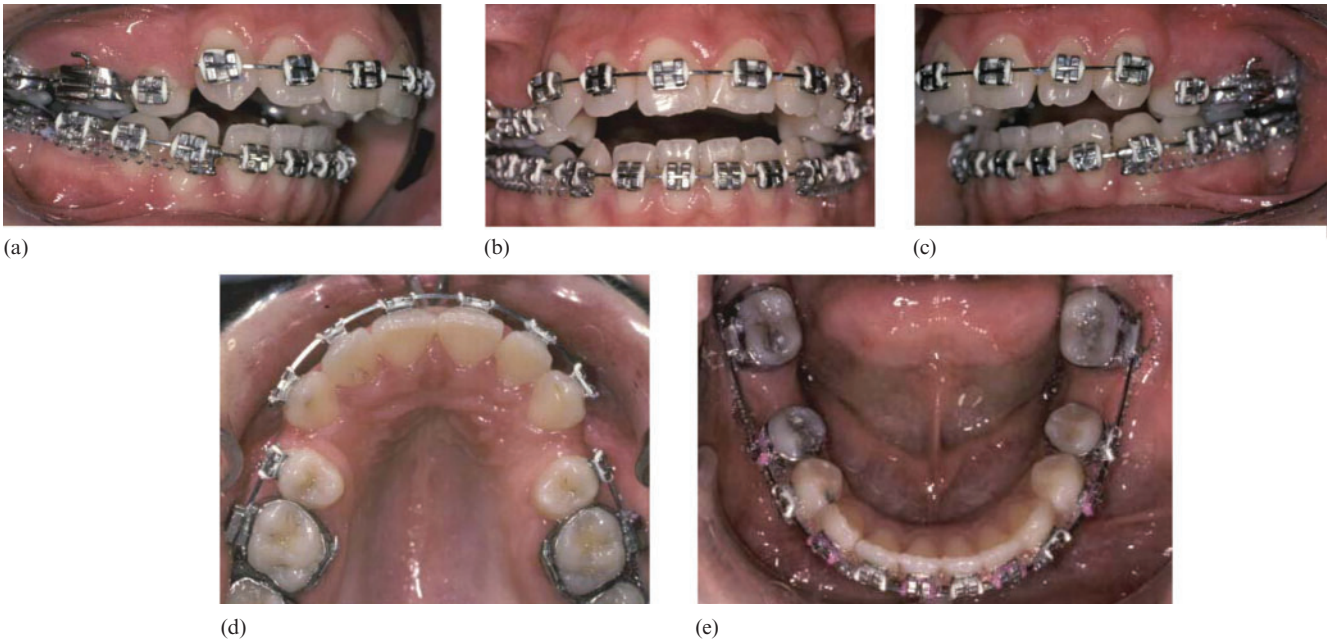


Figure 6 (a–e) Segmental mechanics used to create separate leveling in the upper arch prior to impaction of the segments

Figure 7 Pre-surgical lateral cephalogram taken to assess orthodontic treatment effects and assist with surgical planning

impaction of her maxillary anterior and posterior segments 5 and 7 mm, respectively. Her maxilla was also advanced 2 mm anteriorly and expanded posteriorly 4 mm to correct the transverse discrepancy. Resorbable plates were placed across her palate to maintain stability of the surgical cuts and reduce the potential for relapse. Titanium mini-plates were used for the buccal fixation.

Mandible

A bilateral sagittal split osteotomy was undertaken to allow her mandible to be advanced by 5 mm. This, along with the predicted autorotation, corrected her antero-posterior discrepancy and established Class I incisal relationship. An advancement genioplasty was carried out to correct her retrusive chin. Traditional titanium mini-plates were used to stabilize these movements.

During the surgical procedures the positions of her maxillary segments were located using an intermediate bite wafer with a final wafer to site her mandible in the new occlusal position.

(a)

(b)

Figure 8 (a,b) Post-operative radiographs. Titanium plates used in the mandible and for the advanced genioplasty. A resorbable plate was used across the palatal vault

Outcome

The post-operative period was uneventful and orthodontic treatment was initiated after a 6-week healing period. The aims at this stage were to correct any further leveling (with continuous archwires), detail the occlusion and arrange retention. Radiographs were taken prior to debond (Figure 8a,b) to assess the final tooth positions (Figure 9) and assist in determining final space closure mechanics. The cephalometric analysis revealed an ANB of 4°, indicating a significant improvement in the antero-posterior skeletal discrepancy. Her SNA and SNB values had both increased as a result of the maxillary impaction and mandibular advancement.

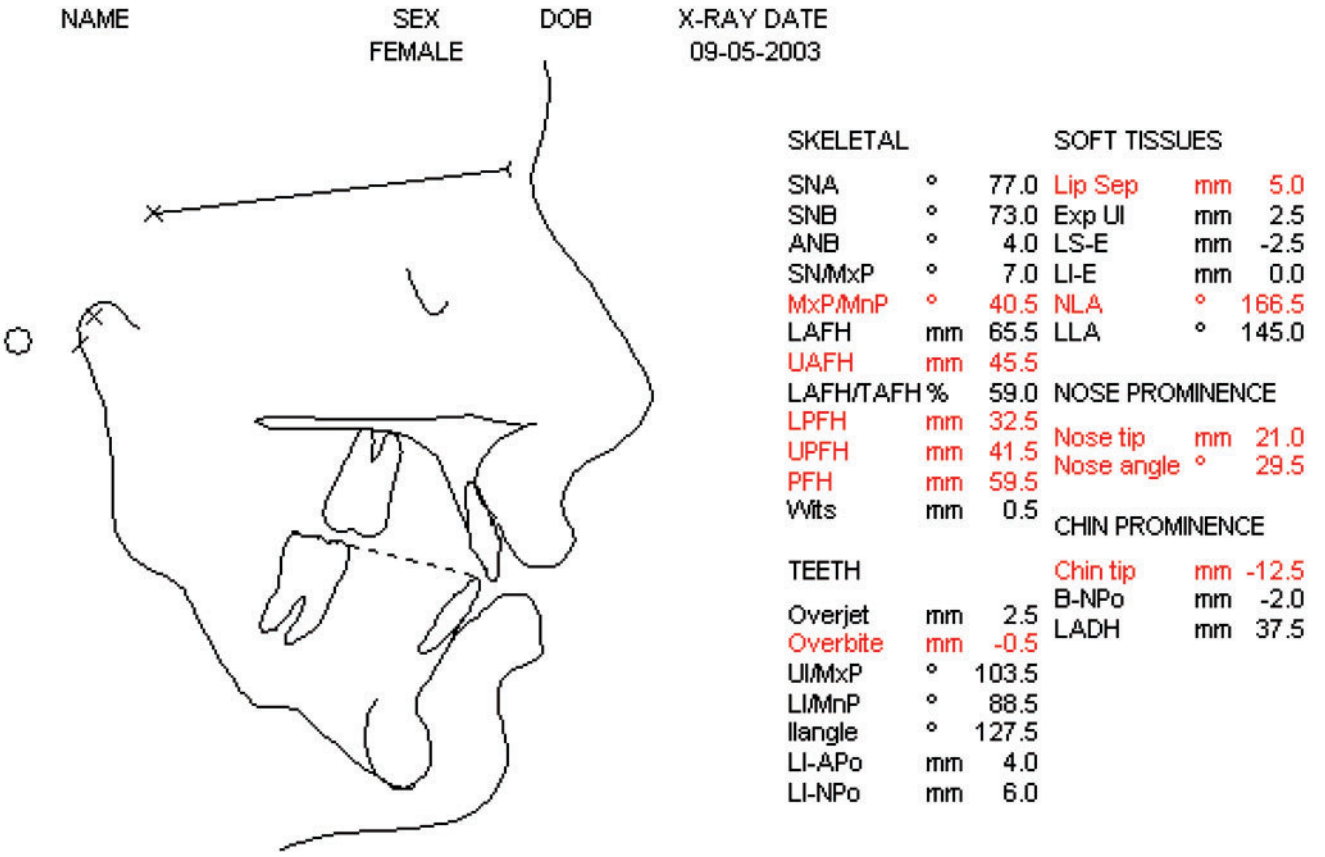


Figure 9 Cephalometric analysis following the bi-maxillary surgery, prior to debond of the fixed appliances

Both her upper and lower incisors had been retroclined, possibly as a result of the space closure, but appeared clinically acceptable. Figure 10 shows the superimposition of the pre- and post-surgical cephalometric analysis, demonstrating the beneficial effects of the orthodontic and orthognathic treatment.

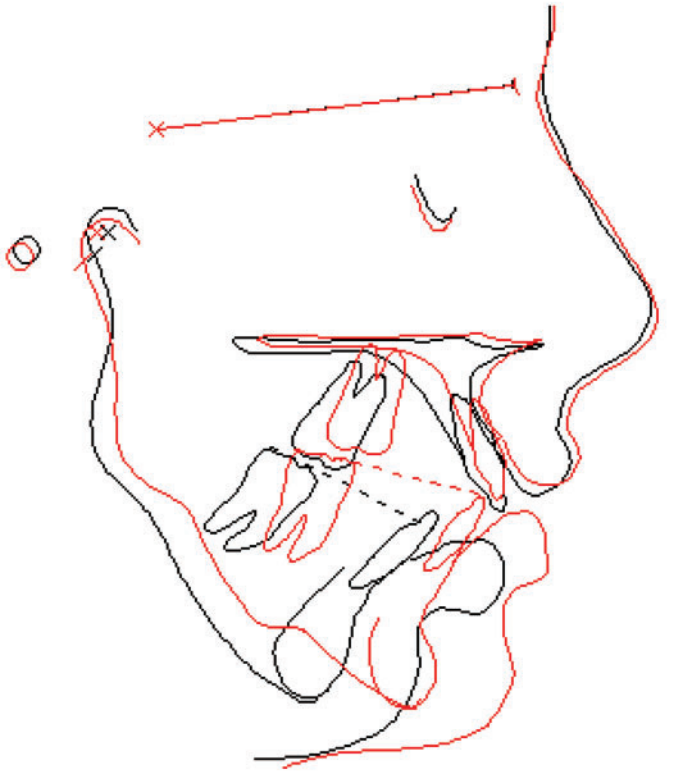
Her appliances were removed and retainers fitted 6 months post-surgery. The final extra- and intra-oral views (Figures 11 and 12) demonstrate an excellent occlusal relationship with an acceptable overbite. The surgical procedures have achieved an overall improvement in her facial form, with a Class I skeletal pattern.

Conclusion

The orthognathic approach to the correction of an AOB, together with a severe antero-posterior skeletal discrepancy, often involves complex and demanding treatment methods. This case report demonstrates the successful orthognathic treatment of this type of case using fixed appliances together with a segmental maxillary osteotomy, mandibular advancement and genioplasty, as well as a combination of resorbable, titanium mini-plates.

References

1. Mizrahi E. A review of anterior open bite. *Br J Orthod* 1978; **5**: 21–7.
2. Conley RS, Legan HL. Correction of severe vertical maxillary excess with anterior open bite and transverse maxillary deficiency. *Angle Orthod* 2002; **72**: 265–74.
3. Lopez-Gavito G, Wallen TR, Little RM, Joondeph DR. Anterior open-bite malocclusion: a longitudinal 10-year postretention evaluation of orthodontically treated patients. *Am J Orthod* 1985; **87**: 175–86.
4. WR Proffit, HW Fields. Contemporary Orthodontics, 3rd edn. St Louis: Mosby, 1999.
5. WR Proffit, RP White, Sarver DM. Contemporary Treatment of Dentofacial Deformity. St Louis: Mosby, 2002.
6. Edwards RC, Kiely KD, Eppley BL. The fate of resorbable poly-L-lactic/polyglycolic acid (LactoSorb) bone fixation devices in orthognathic surgery. *J Oral Maxillofac Surg* 2001; **59**: 19–25.
7. Shand JM, Heggie AA. Use of a resorbable fixation system in orthognathic surgery. *Br J Oral Maxillofac Surg* 2000; **38**: 335–7.



SUPERIMPOSITION
Sella-Nasion @ Sella
09-05-2003 ON 17-08-2000R

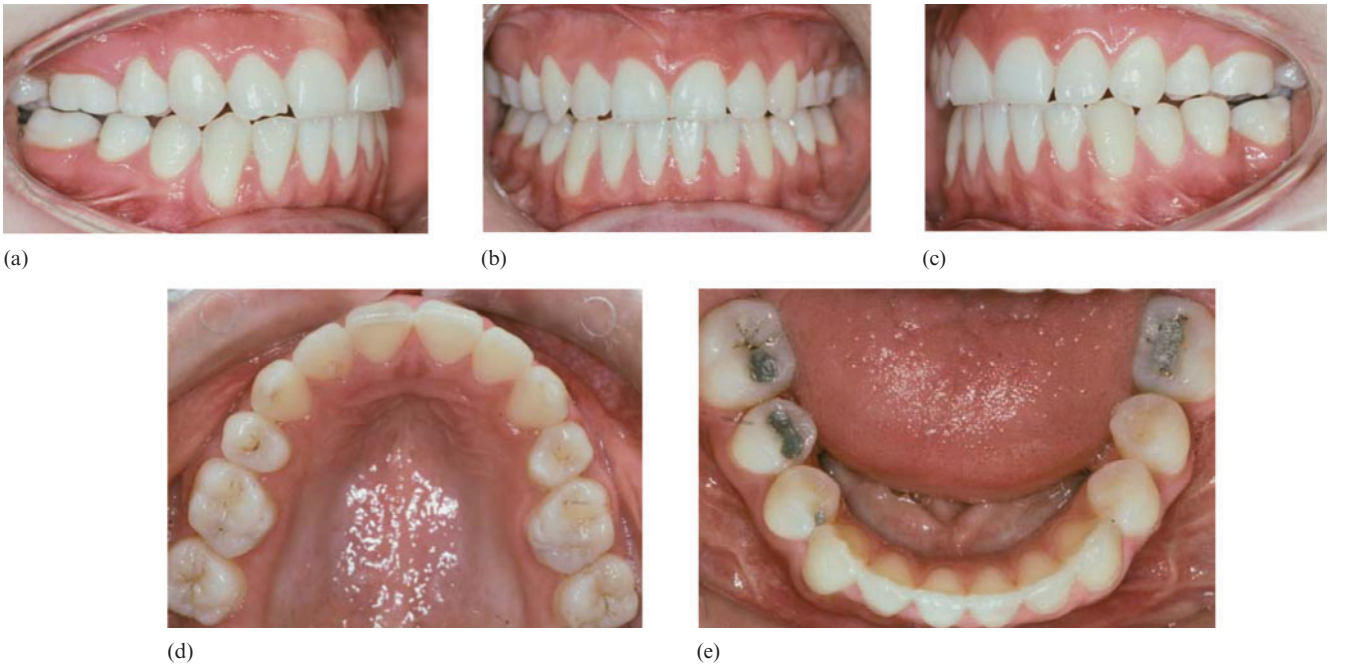
SKELETAL			SOFT TISSUES		
SNA	°	2.0	Lip Sep	mm	-3.0
SNB	°	6.0	Exp UI	mm	-0.5
ANB	°	-4.0	LS-E	mm	-6.0
SN/MxP	°	-0.5	LI-E	mm	-5.0
MxP/MnP	°	-8.5	NLA	°	17.5
LAFH	mm	2.5	LLA	°	15.0
UAFH	mm	-0.5			
LAFH/TAFH	%	1.0	NOSE PROMINENCE		
LPFH	mm	1.0	Nose tip	mm	2.0
UPFH	mm	1.5	Nose angle	°	3.0
PFH	mm	1.0			
Wits	mm	3.5	CHIN PROMINENCE		
			Chin tip	mm	17.5
TEETH			B-NPo	mm	-4.5
Overjet	mm	-7.5	LADH	mm	4.5
Overbite	mm	5.0			
UI/MxP	°	-8.5			
LI/MnP	°	-2.0			
Ilangle	°	18.5			
LI-APo	mm	-1.0			
LI-NPo	mm	-4.0			

Figure 10 Superimposition (on SN, registered at sella) of the pre- (black) and post-surgical/near end of treatment (red) cephalometric analysis demonstrating the skeletal and dental corrections achieved by the orthodontic and orthognathic phases of treatment

(a) (b)

(c) (d)

Figure 11 (a–d) Post-operative extra-oral views. A Skeletal I antero-posterior pattern was achieved with an acceptable tooth show on smiling



(a) (b) (c)

(d) (e)

Figure 12 (a–e) Post-operative intra-oral occlusal views. An acceptable Class I buccal and incisal relationship was achieved. Full space closure was accomplished