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CLINICAL SECTION

Skeletal class III and anterior open bite treatment with different retention protocols: a report of three cases

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The treatment of skeletal class III and anterior open bite can be unstable and orthodontists frequently observe relapse. Here, we report on the management of three patients with skeletal class III profiles and open bites treated by orthodontic camouflage. Each received a retention protocol involving the use of two separate appliances during the night and day accompanied by myofunctional therapy. Long-term follow-up revealed a stable outcome.

Key words: Anterior open-bite, orthodontic relapse, orthodontic retention

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Introduction

The stable correction of anterior open bite malocclusion remains a challenge for orthodontists.[3–10] According to Denison, the rate of relapse may vary from 35 to 42% in orthodontically treated patients. In treatment resulting in molars intrusion, the rate of relapse ranges from 17 to 30%: whilst in treatments with incisor extrusion, relapse may be even greater, reaching sometimes 40% of treated cases.[3,11] Relapse is usually due to loss of the extrusion and/or intrusion obtained; however, the extent to which the open bite reappears will depend upon the case and the overcorrection reached.[11,19]

Currently, there are three options for the movement of teeth to correct open bite malocclusion non-surgically:[5,8,12,13,14]

- intrusion of the posterior teeth;
- extrusion of the anterior teeth;
- a combination of both

Excessive extrusion of the anterior teeth must be avoided, because it is considered unstable after treatment; however, some level of extrusion nearly always occurs during alignment and levelling procedures and at the finalization stage. As correction of an anterior open bite frequently involves the extrusion of anterior teeth, except in cases of skeletal anchorage and surgery, special attention should be directed to the anterior labial region during retention.[6,11,12,15,16]

There has been a suggestion that relapse in these cases is in part due to soft tissue activity. Myofunctional therapy has been advocated to raise awareness among patients and their parents, improving the swallowing reflex, speech and chewing; and guiding the lips and tongue.[5] In open bite cases, the main aim is to eliminate tongue interposition during swallowing and rest and to position the tip of the tongue at the incisive papilla during swallowing and in the posterior region of the mouth at rest. Moreover, myofunctional therapy aims to establish labial competence and maintain an ideal balance of forces over the anterior teeth. This treatment must be performed with muscle exercises and tasks to integrate the newly acquired normal functions, including swallowing and speech; and retention of acquired patterns. This work must be done once a day and supervised at least once a week by a professional.[18]

The protocols for retention after anterior open bite treatment are similar to those for other malocclusions.[1] Conventional removable retainers or retainers with tongue grids are used, and patients are occasionally sent for myofunctional therapy in order to avoid abnormal tongue posture after treatment.[10] However, the high incidence of relapse after open bite treatment indicates that retention protocols currently used are often ineffective.[17] Thus, in this report, we present outcome from three patients with skeletal class III open bite who have been treated by camouflage and retained using a myofunctional approach. These patients are representative of nine patients we have treated this way and subjected to a different retention protocol, all of whom appear to have a long-term stable result. We recognize that this is a low level evidence for this

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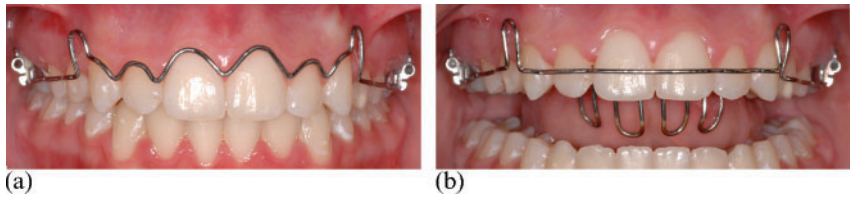

Figure 1 Conventional wraparound retainer with a tongue grid (a) and modified retainer adapted at the cementoenamel junction of the anterior teeth (b)

approach and the way to investigate this further would be through prospective clinical trials.

Description of the retainers and protocol

In all the patients, the lower arch was retained using bonded retainer from the lower right canine to the lower left canine with a 0.0195-inch stainless steel twist-flex wire.

All patients were advised to undertake lip and tongue muscle exercises once a day, which was supervised once a week by a speech and language therapist. The aim of the lip exercises was to improve the tone of the muscles and consisted in closing lips, protracting and retracting, shifting laterally, handling a spatula between the lips protruding and handling the spatula between the lips at rest. The aim of the tongue exercises was to re-educate the posture and consisted in shifting the tongue laterally, elevating the tongue against the palate, protracting and retracting the tongue, raising and lowering the tip of the tongue, sweeping the palate with tongue in the A–P direction, vibrating the tongue, pushing the tip of the tongue against a spatula and pushing the cheeks with the tongue. The exercises were repeated 30 times once a day.

Daytime wraparound retention with modified contour (Figure 1a)

It is recommended that patients wear this retainer during the day. It has a 0.8-mm stainless steel wire that contours around the gingival margin of the anterior teeth. The aim is to reduce relapse due to intrusion or protrusion of the anterior teeth (Figure 2).

Night-time wraparound retention with tongue grid (Figure 1b)

It is recommended that patients wear this retainer during the night while sleeping. The retainer consists of a conventional removable appliance made with a 0.9-mm stainless steel labial bow placed at the middle third of the crown and with a tongue grid fixed on the acrylic portion to discourage abnormal tongue posture, which is hopefully corrected by the muscle exercises during the day.

Patients are advised to use both retainers full time for a period of at least 18 months. We have chosen 18 months, on average, as a safe time to use the retainers. In this way, there are at least 6 months more than the usual period for fibres to become reorganized. We believe that this increased time in retention is important to avoid relapse; however, it is based only on our clinical experience and there is no scientific evidence for it. After that, the patients are advised to use only the night-time retainer while asleep. This has to be done for a further 6 months on an average.

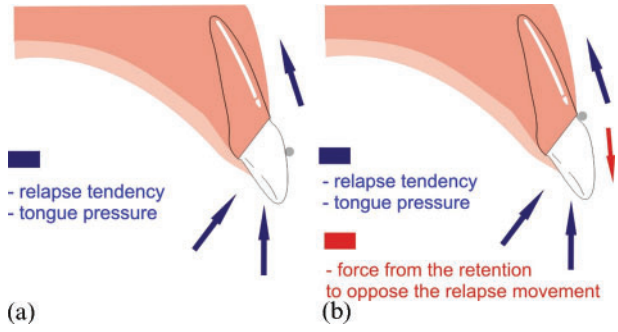

Figure 2 Drawings showing the differences between the action of the two retainers — conventional (a) and modified (b)

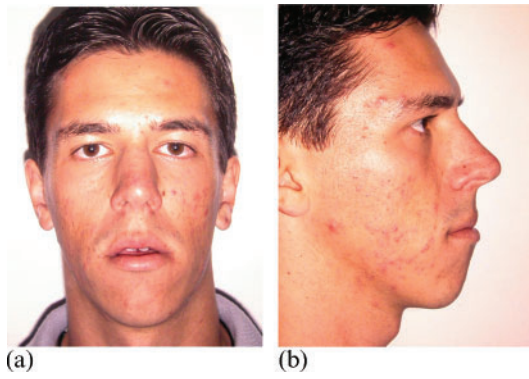

Figure 3 Case 1 — pre-treatment facial photographs: (a) frontal and (b) profile

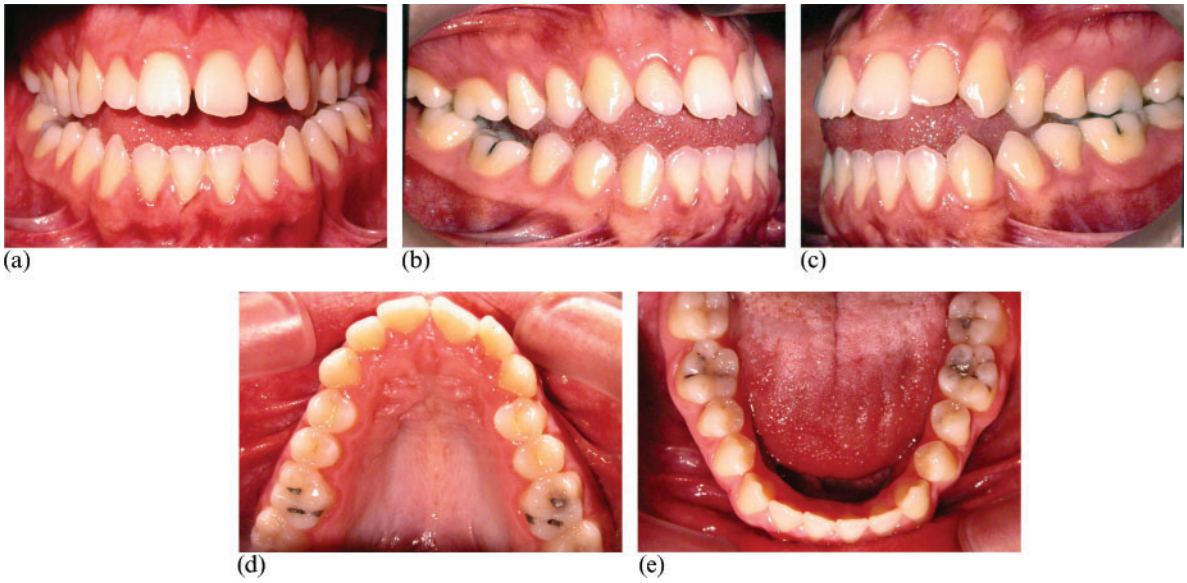

Figure 4 Case 1 — pre-treatment intra-oral photographs: (a) frontal, (b) right side, (c) left side, (d) upper occlusal and (e) lower occulsion

Case reports

Case 1

A 23-year-old man showed an accentuated vertical facial pattern, a class 3 facial profile and the absence of a lip seal during rest (Figure 3). Clinical examination revealed a class III incisor and molar relationship, with a 6-mm-wide anterior open bite and a posterior crossbite, associated with a lateral mandibular deviation on closure and a lower midline deviation of 3 mm to the left (Figure 4).

The patient and his parents did not want orthognathic surgery, which could have improved the facial aesthetics and obtained an ideal stable occlusion; therefore, he was treated by orthodontic camouflage. Two removable transpalatal bars were cemented to the first and second upper molars and transversally activated once a month for 6 months to enable slow maxillary expansion. During this period, the patient used a vertical chin-cup with 400 g of force on each side for 12–14 h a day. After the expansion period, the omega loops of the transpalatal bars were filled with acrylic resin and kept away from the palate to allow the tongue pressure to act as an auxiliary for molar vertical control. Simultaneously, upper and lower 0.022×0.028-inch standard edgewise fixed appliances were placed on the teeth. After alignment and levelling, full-time anterior vertical elastics with 80 g of force and 0.020-inch stainless steel archwires with a reverse curve of Spee in the lower arch and accentuated curve of Spee in the upper arch were used for 4 months to close the open bite, either by posterior teeth intrusion or anterior teeth extrusion. During the finishing stage, full-time class III elastics with (150 g of force) with 0.019×0.025-inch stainless steel archwires were used and some slight cusp reduction was performed on the posterior teeth to better distribute the contacts and improve the intercuspation.

The results obtained after 32 months of treatment showed good camouflage of the skeletal malocclusion, molar and canine class I relationships, correction of the crossbite by expansion, and closure of the open bite, with a good overjet and overbite (Figures 5 and 6). The pre-treatment and post-treatment lateral cephalograms and total superposition showed that there was no

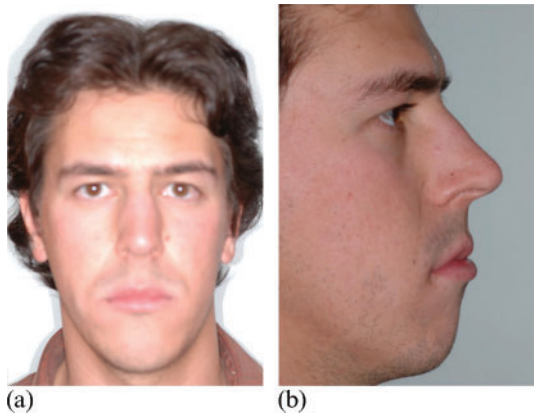

Figure 5 Case 1 — post-treatment facial photographs: (a) frontal and (b) profile

Figure 6 Case 1 — post-treatment intra-oral photographs (a) frontal, (b) right side, (c) left side, (d) upper occlusal, (e) lower occlusal, (f) daytime wraparound retention and (g) night-time wraparound retention

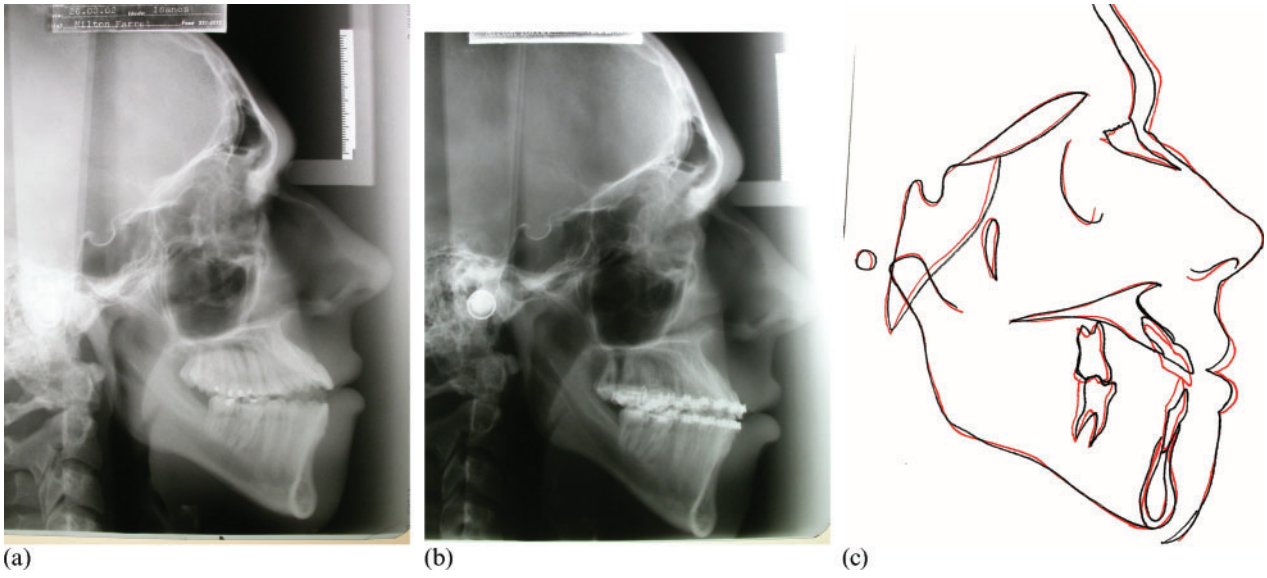

Figure 7 Case 1 — pre-treatment and near end of treatment lateral cephalograms and total superposition (a) initial lateral cephelogram, (b) nar end of treatment lateral cephalogram and (c) total superposition

Figure 8 Case 1 — 2 years post-retention intra-oral photographs: (a) frontal, (b) right side and (c) left side

mandibular rotation, the molars were uprighted without extrusion and the incisors were extruded to close the open bite (Table 1 and Figure 7). The retention followed the new protocol using the two retainers described previously and myofunctional therapy with 30-min daily perioral muscle exercises, and tasks to improve the tongue posture and to reduce harmful habits.

Stable results were observed at recall 4 years after the end of treatment, i.e. 2 years after the end of retention (Figure 8).

Case 2

This patient was a 16-year-old boy whose facial analysis revealed an increased vertical facial growth pattern, a

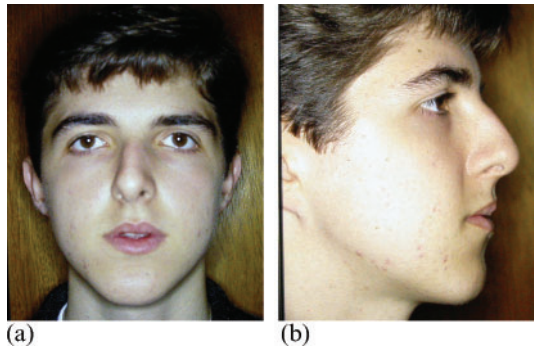

Figure 9 Case 2 — pre-treatment facial photographs: (a) frontal and (b) profile

Table 1 Cephalometric measurements for case 1.

		Patient 1	
Measurements	Norms (SD)	Initial	Near end of treatment
SNA	82° (3)	73°	74°
SNB	80° (3)	76°	78°
ANB	2° (2)	−3°	−4°
Facial convexity (NA.APog)	0° (2)	−8°	−10°
Facial angle (PoOr.NPog)	87° (3)	91°	90°
Y axis	59° (6)	75°	72°
SN.GoGn	32° (3)	46°	44°
1-NA (°)	22°	40°	36°
1-NA (mm)	5 mm	16 mm	18 mm
1-NB (°)	25°	27°	21°
1-NB (mm)	5 mm	11 mm	8 mm
Inter-incisal angle	131° (5)	115°	128°
Ul-S line	0 mm (2)	1 mm	2 mm
Ll-S line	0 mm (2)	4 mm	5 mm
IMPA	90° (4)	83°	78°
FMA	25° (3)	35°	34°
FMIA	65° (4)	62°	68°

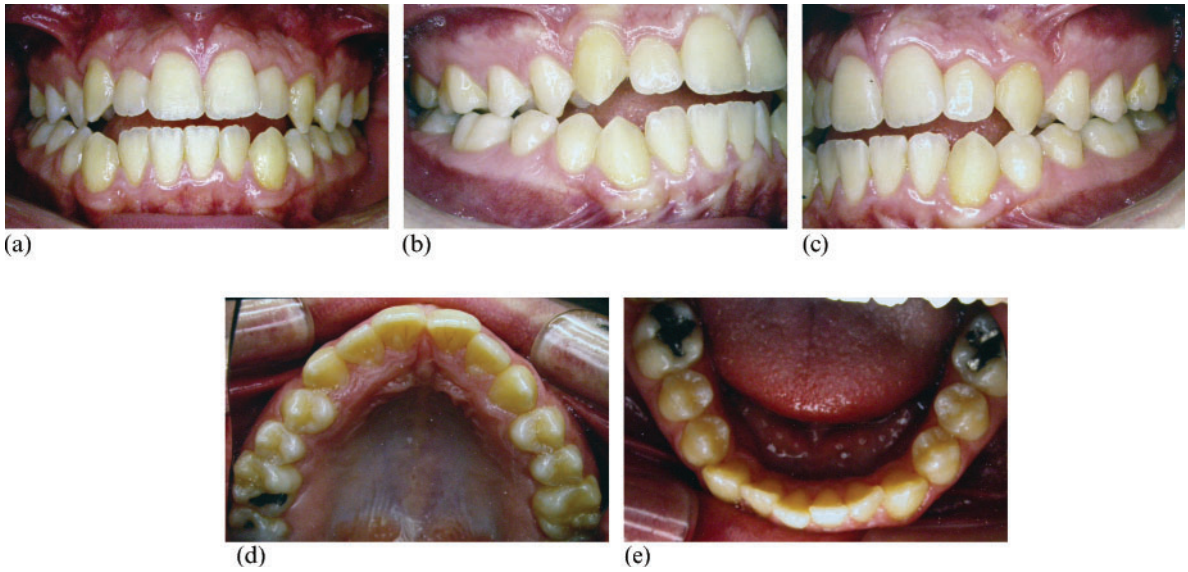

Figure 10 Case 2 — pre-treatment intra-oral photographs: (a) frontal, (b) right side, (c) left side, (d) upper occlusal and (e) lower occlusal

class 3 profile and an accentuated mandibular prognathism, with a facial asymmetry revealing a deviation of the mandible to the right (Figure 9). Intra-oral examination revealed a class III incisor and molar relationship, a lower midline deviation of 4 mm to the right, a negative overjet, and a 2-mm-wide anterior open bite (Figure 10).

The patient and his parents chose a non-surgical approach and therefore, we orthodontically camouflaged the malocclusion. To improve the intercuspation and create a positive overbite, treatment involved alignment and levelling using 0.022×0.028-inch standard edgewise fixed appliances and 0.012-inch nickel–titanium to 0.019×0.025-inch stainless steel archwires with a transpalatal bar in the upper arch, used to maintain the intermolar width. After that, a sliding jig with full-time class III elastics (150 g of force) were used first only on the left side until the class I molar relationship was reached. Then, intermaxillary class III elastics were used on both sides and full time vertical elastics (80–100 g of force) were worn for 2 months. These were designed to improve the overbite and intercuspation in the anterior region from the upper incisors to the lower incisors with a square shape and the posterior region with an 'N' shape from the lower second premolar to the upper canine in each side. By the end of treatment molar class I and canine class I relationships was achieved, the skeletal malocclusion was camouflaged by maintaining the inclination of the lower incisors, and an overbite and overjet were attained with coincident midlines (Figures 11 and 12).

The cephalograms and total superposition showed that the patient had an accentuated vertical growth of the face, the molars were uprighted and the open bite was closed with upper incisor extrusion (Table 2 and Figure 13). The same protocol for retention as that used in the previous case was employed and analysis 8 years after the treatment, i.e. 6 years after the end of retention, revealed good stability (Figure 14).

Case 3

An 11-year-old girl with a class 3 facial profile, an increased lower anterior facial height, a class III molar relationship with an end-to-end incisor relationship, a left posterior crossbite, and midline deviation was referred to us for treatment (Figures 15 and 16). For

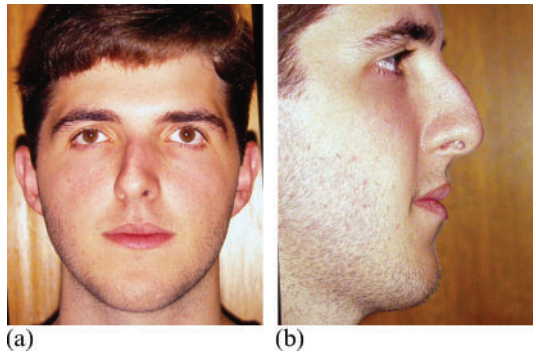

Figure 11 Case 2 — post-treatment facial photographs: (a) frontal and (b) profile

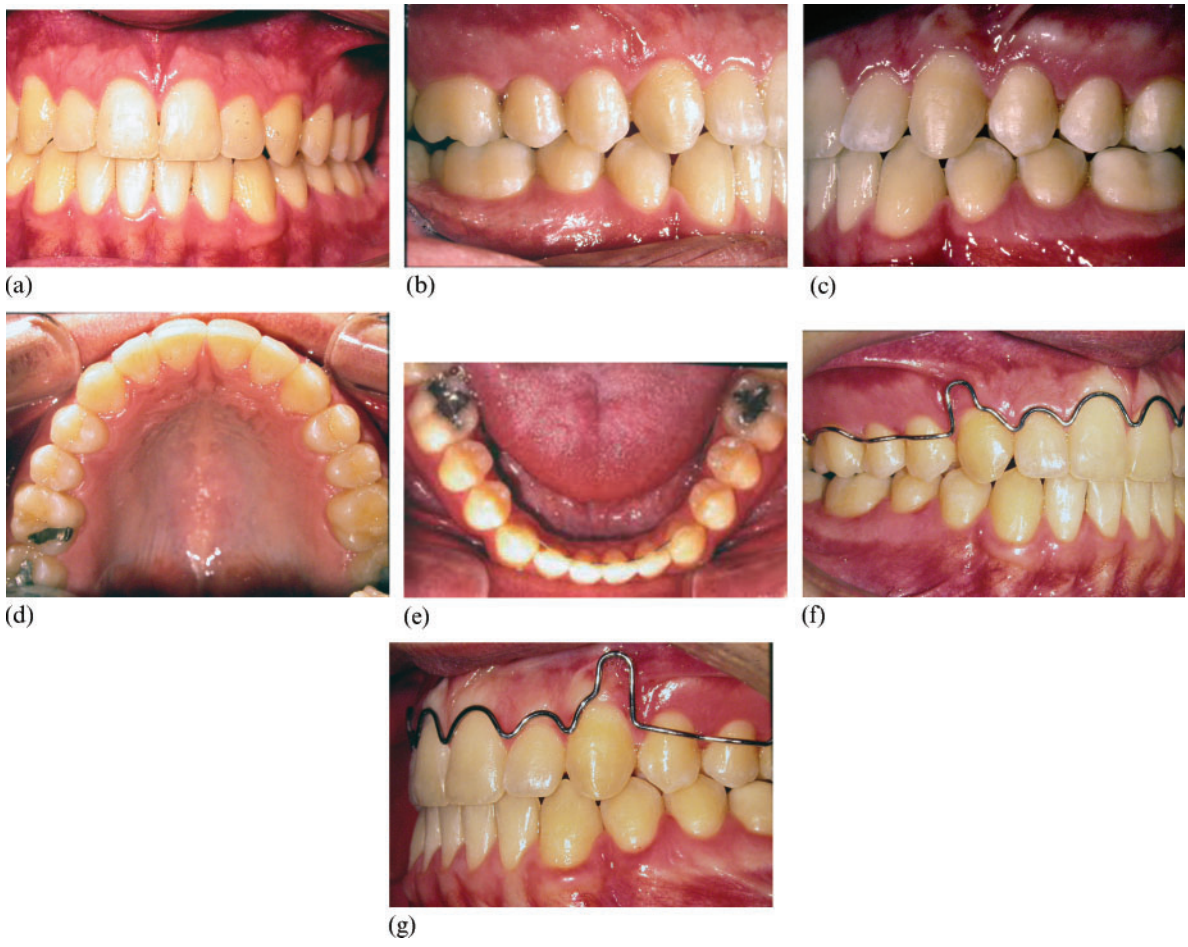

Figure 12 Case 2 — post-treatment intra-oral photographs: (a) frontal, (b) right side, (c) left side, (d) upper occulsal, (e) lower occlusal, (f) and (g) daytime retention

Table 2 Cephalometric analysis for case 2.

Measurements	Norms (SD)	Patient 2	
		Initial	Near end of treatment
SNA	82° (3)	80°	79
SNB	80° (3)	79°	79
ANB	2° (2)	1°	0
Facial convexity (NA.APog)	0° (2)	1°	4
Facial angle (PoOr.NPog)	87° (3)	92°	89
Y axis	59° (6)	60°	60°
SN.GoGn	32° (3)	38°	40°
1-NA (°)	22°	24°	25°
1-NA (mm)	5 mm	5 mm	5°
1-NB (°)	25°	16°	7°
1-NB (mm)	5 mm	6 mm	5 mm
Inter-incisal angle	131° (5)	139°	150°
Ul-S line	0 mm (2)	−2.5 mm	−2.5 mm
Ll-S line	0 mm (2)	−0.5 mm	0 mm
IMPA	90° (4)	79°	67°
FMA	25° (3)	30°	31°
FMIA	65° (4)	71°	82°

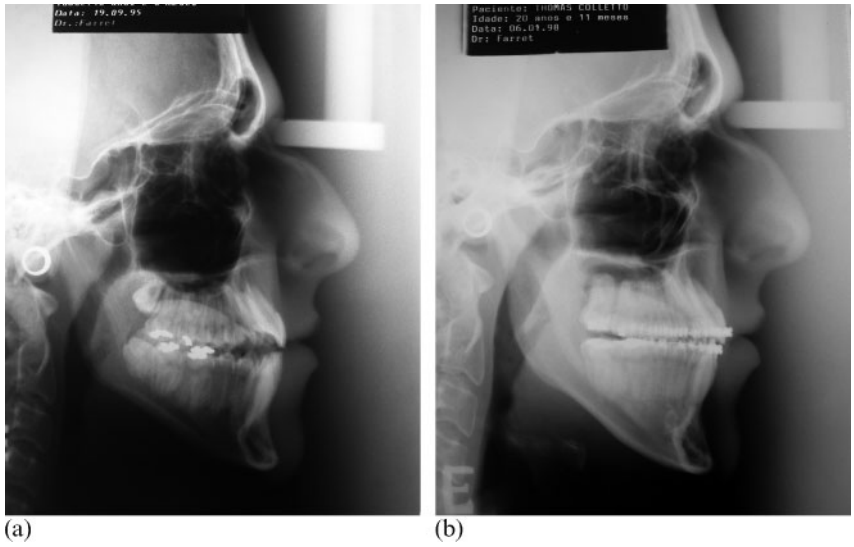

Figure 13 Case 2 — pre-treatment and near-end of treatment lateral cephalograms and total superposition: (a) initial lateral cephalogram and (b) near end of treatment lateral cephalogram

6 months, she was treated using rapid maxillary expansion with a Haas expander (two activations a day) and a protraction facemask with 450 g of force on each side. Subsequently, the patient was given a full-time removable appliance with a tongue grid to encourage closure of the anterior open bite. After 4 months, a standard edgewise fixed appliance was placed and alignment and levelling was performed from 0.014-inch nickel–titanium archwires to 0.019×0.025-inch stainless steel archwires. After 6 months, 0.019×0.025-inches stainless steel archwires were placed and the patient was asked to wear full-time class III and vertical elastics from the upper second molar to a hook welded on the lower arch wire between the lateral incisor and canine to improve intercuspation. At the end of the treatment, after 28 months, molar and canine class I was established on the right side and a slightly class III relationship remained on the left side, however, with a good intercuspation and good occlusal function (Figures 17 and 18). The new retention procedure was followed.

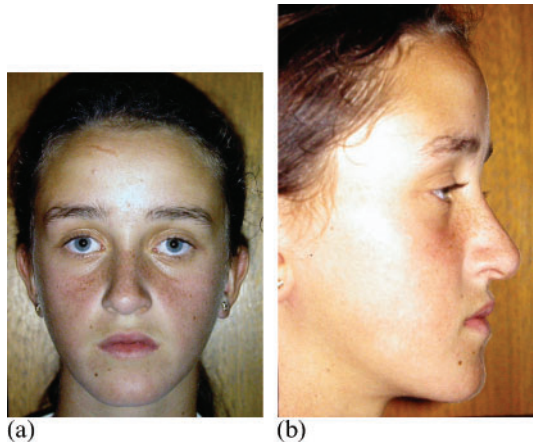

Figure 15 Case 3 — pre-treatment facial photographs: (a) frontal and (b) profile

Figure 14 Case 2 — 6-year post-retention intra-oral photographs: (a) frontal, (b) right side and (c) left side

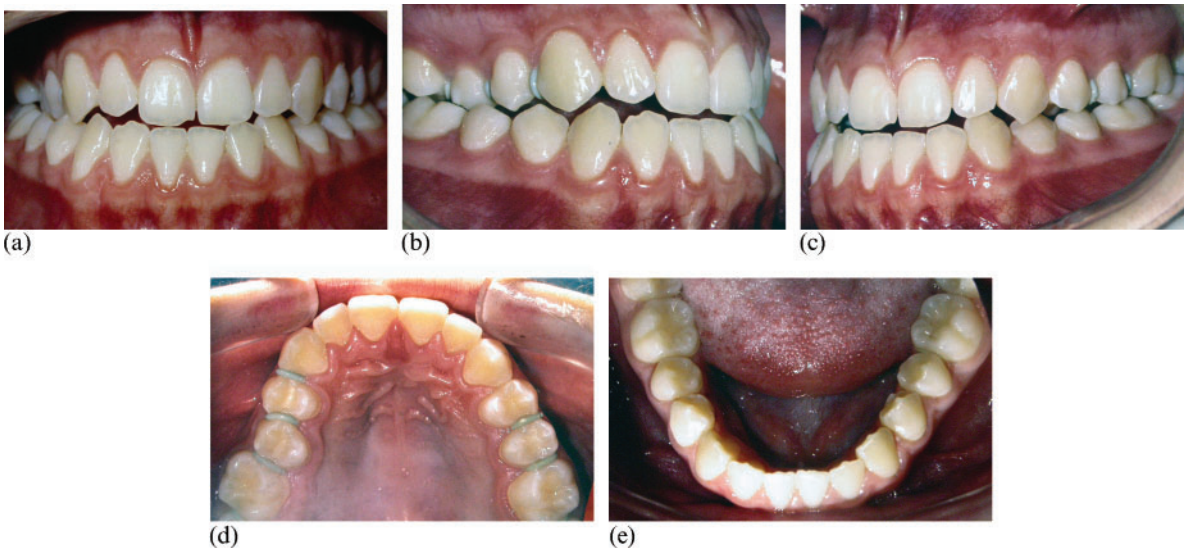

Figure 16 Case 3 — pre-treatment intra-oral photographs: (a) frontal, (b) right side, (c) left side, (d) upper occlusal and (e) lower occlusal

The cephalograms and total superposition showed the patient had increased vertical growth of the face and a marked clockwise rotation of the mandible. Moreover, the open bite was closed through clockwise rotation of the maxilla and upper incisor extrusion (Table 3 and Figure 19). Analysis 7 years after treatment, i.e. 5 years after the end of retention, revealed stable results and an improvement in the intercuspation and overbite (Figure 20).

Discussion

There are four factors that can influence the choice of retention protocol: the malocclusion, facial growth pattern, treatment type and retention time. According to Baek,[3] any positive overbite will tend to reduce following open bite treatment and it may sometimes reach around 20% of that obtained during treatment; however, this may not be considered a true relapse unless it again reverts to a negative overbite.[19]

Figure 17 Case 3 — post-treatment facial photographs: (a) frontal and (b) profile

Reorganization of the trans-septal fibres after treatment takes approximately 6–12 months.[2,19,20] It has been found that short retention periods lead to a higher incidence of relapse.[1,2] On the basis of this finding, patients with open bites should wear their retainers daily, as long as they can, for at least 12 months after the treatment and then, only during the night for a stipulated period established according to the malocclusion and the treatment performed. As open bite is a malocclusion with a high incidence of relapse and because of the extended extrusive movements in treatment, the retention period must be sufficiently long.[1,2]

The basis of a different retention protocol in open bite treatment is the high incidence of relapse reported in the relevant literature and observed in our clinical experience. However, this protocol has certain limitations, such as unavoidable relapse due to posterior tooth extrusion, which can occur in certain cases, e.g. mouth breathers,[1,2] patients only treated with posterior tooth intrusion and patients with skeletal malocclusions who are treated by camouflage.[3,5,7] The recently discovered concept of skeletal anchorage provides the orthodontists with the option of performing pure intrusion of the posterior teeth as an alternative treatment to avoid orthognathic surgery in skeletal open bite cases and accelerate the treatment in moderate open bite cases.[11,12]

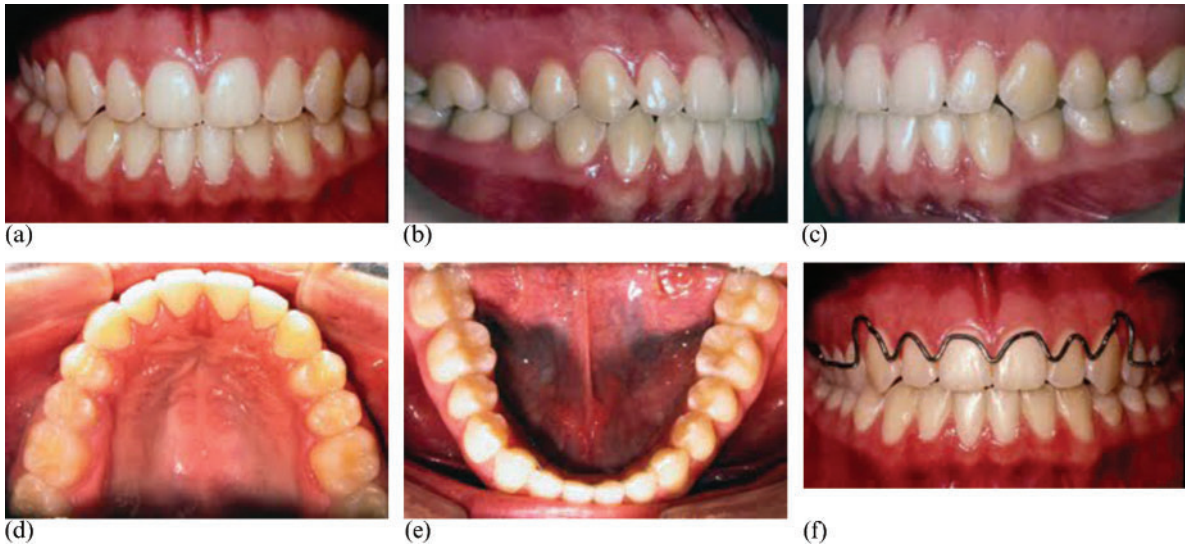

Figure 18 Case 3 — post-treatment intra-oral photographs P: (a) frontal, (b) right side, (c) left side, (d) upper occlusal, (e) lower occlusal and (f) daytime wraparound retention

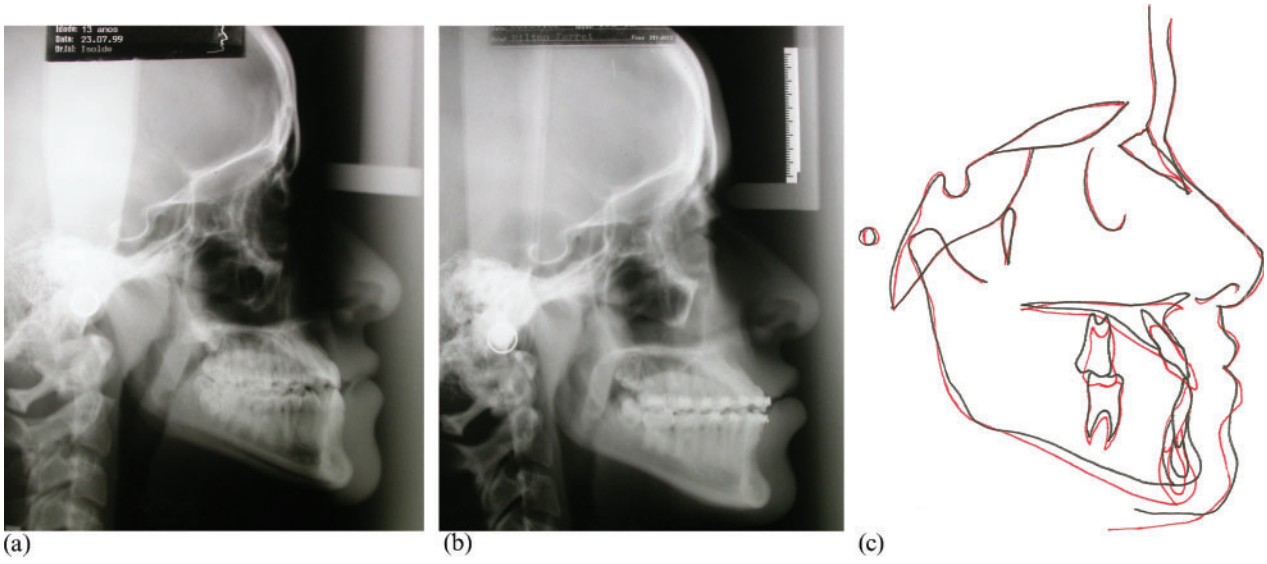

Figure 19 Case 3 — pre-treatment and near end of treatment lateral cephalograms and total superposition: (a) initial lateral cephalogram, (b) near end of treatment cephalogram and (c) total superposition

Figure 20 Case 3 — 5 years post-retention intra-oral photographs: (a) frontal, (b) right side and (c) left side

Table 3 Cephalometric analysis for case 3.[22]

		Patient 3	
Measurements	Norms (SD)	Initial	Near end of treatment
SNA	82° (3)	78°	79°
SNB	80° (3)	81°	81°
ANB	2° (2)	−3°	−2°
Facial convexity (NA.APog)	0° (2)	7°	8°
Facial angle (PoOr.NPog)	87° (3)	99°	101°
Y axis	59° (6)	49°	51°
SN.GoGn	32° (3)	32°	37°
1-NA (°)	22°	31°	31°
1-NA (mm)	5 mm	7 mm	9 mm
1-NB (°)	25°	11°	24°
1-NB (mm)	5 mm	2 mm	4 mm
Inter-incisal angle	131° (5)	141°	126°
Ul-S line	0 mm (2)	−2 mm	−1 mm
Ll-S line	0 mm (2)	0 mm	2 mm
IMPA	90° (4)	79°	86°
FMA	25° (3)	16°	20°
FMIA	65° (4)	85°	74°

However, there are patients in whom the orthodontist cannot use mini-screws or mini-plates because they refuse surgery[21] or the patient has a reduced vertical facial growth pattern and intrusion of the molars may worsen the facial profile through counter-clockwise rotation of the mandible.[3,11] Besides, pure intrusion of posterior teeth with mini-plates has a relapse rate ranging from 20 to 30% of the intrusion obtained.[3,5,11,12] Therefore, incisor extrusion may be necessary alone or in combination with molar intrusion to make the anterior teeth more visible during smiling and at rest. On this basis, an effective protocol for retention is desirable in these cases.

These three cases demonstrate adequate stability with this retention protocol, which we believe is suitable for open bite patients treated with incisor extrusion; however, it is essential to have total patient compliance during the retention period. There is no robust evidence to support the use of myofunctional therapy and all aspects of this retention protocol need to be rigorously investigated using appropriate research methods before any of the various aspects (e.g. therapy and tongue cribs) can be definitely recommended.

Conclusion

In this report, we present three patients with skeletal class III profiles and open bite treated by orthodontic camouflage and a new retention protocol. All the treatment showed excellent clinical stability several years out of retention. Prospective clinical studies are necessary to compare conventional retention with this proposed retention protocol.

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