Unilateral Brodie bite correction in a growing patient using palatal and buccal miniscrews: A case report

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This case report describes a 13-year-old Caucasian male who presented with a Class I dental relationship on a mild Class II skeletal base and an associated unilateral Brodie bite on the right side but an ideal anterior overjet and overbite. The posterior teeth in the first quadrant had supra-erupted due to a lack of opposing occlusion. The treatment comprised two phases, the first of which involved miniscrew-based intrusion of the maxillary right buccal teeth followed by non-extraction, full upper and lower pre-adjusted edgewise appliances during a second phase. A satisfactory occlusal result was achieved in 24 months.

Introduction

First reported in 1952 and named after Alan Brodie, a Brodie bite is a relationship in which the maxillary dental arch is wide and lies entirely buccal to or contains the mandibular dental arch.¹ Brodie bites are relatively rare and record a prevalence of 0.4% to 1% in the deciduous and mixed dentition and 1-1.6% in the permanent dentition.²

A Brodie bite has been reported in families indicating a possible genetic influence.³ Developmental disorders incorporating severe mandibular retrognathia (Pierre Robin syndrome) often present with a bilateral Brodie bite.⁴ Several authors believe that a superior posture of the tongue within the oral cavity can result in a broad maxillary alveolar base and mandibular arch constriction resulting in the Brodie bite.⁵

A simultaneous functional displacement of the mandible can manifest as a unilateral Brodie bite, in which several adjacent posterior teeth vertically overlap in habitual occlusion without contact of opposing occlusal surfaces.⁶ Hence, patients presenting with a unilateral Brodie bite often complain of facial asymmetry⁷ and temporomandibular disorders⁸.

The management of a Brodie bite depends upon several variables related to the amount of remaining growth, the unilateral or bilateral nature of the crossbite, the extent of the vertical overlap of the teeth in crossbite, the vertical relationship and the sagittal relationship. A contraction quad-helix⁹ accompanied by an expansion quad- or bi- helix¹⁰ in the mandibular arch are routinely employed in growing Class I patients to manage a bilateral Brodie bite. A Clark twin-block with a contraction screw in the upper component of the appliance in addition to a modified occlusal coverage can be employed in adolescent Class II patients with a bilateral Brodie bite.
In contrast to a bilateral Brodie bite, a unilateral Brodie bite is a challenging malocclusion to manage. Class I growing patients with a unilateral Brodie bite do not benefit from asymmetric Class II correctors, which may be employed in growing Class II patients presenting with a unilateral crossbite.\textsuperscript{11} The unilateral nature of the crossbite in growing Class I patients makes reciprocal anchorage ineffective and limits the anchorage options using temporary anchorage devices\textsuperscript{8} (TADs) or inter-arch anchorage using cross elastics\textsuperscript{8}. The severity of the Brodie bite related to the vertical overlap of the posterior segments can render cross elastics ineffective. Traditionally, surgery or distraction osteogenesis have been employed as treatment options with a predictable prognosis for bite management in adult patients.\textsuperscript{3,12,13} However, the use of TADs in clinical practice has provided a non-invasive approach to treat a unilateral Brodie bite.\textsuperscript{8,14–17}

**Clinical presentation and diagnosis**

A 13-year-old Caucasian male was concerned with the ‘bite’ on his right posterior teeth as he could not chew food efficiently. The patient was also concerned with his uneven smile. There was no significant medical history and a TMJ examination revealed an opening click in the left joint. An extraoral examination (Figure 1) revealed a mild facial asymmetry and a convex facial profile with a mildly protrusive maxilla and a normally positioned mandible. A smile assessment revealed an occlusal cant with the right side of the occlusion lower than the left side which therefore produced a detrimental effect on the smile arc.

An intraoral examination (Figures 1, 2, 3) revealed an Angle Class I malocclusion with a unilateral (right) Brodie bite but an ideal anterior overjet and overbite. Resulting in an occlusal cant, the occlusion in the right posterior region showed a severe vertical 100% overlap (lateral overbite) due to severe maxillary suprastructure. However, the occlusal intercuspation on the left side was normal. The upper and lower arch forms were asymmetric as a result of buccally tipped upper right posterior teeth and lingually tipped lower right posterior teeth. A further dental examination revealed a bilateral $\frac{1}{4}$ unit Class II canine relationship, mild spacing in the upper arch (2-3 mm) and mild crowding (4 mm) in the lower arch.

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*Figure 1. Pre-treatment photographs.*
Cephalometrically (Figure 4, Table I), the patient had a mild Class II skeletal relationship (ANB 4.7° and a Wits appraisal of 3.1 mm), which was primarily due to a prognathic maxilla (SNA of 88°). The facial form was brachyfacial with a Frankfurt-mandibular plane angle of 20.9° and a Jarabak ratio of 0.73. The upper incisors were mildly proclined at 115.9° to the Frankfurt horizontal plane and 114.7° to the palatal plane. The lower incisors were proclined at 101.6° to the mandibular plane. The patient’s cervical maturation stage was at CS3, indicating that the onset of peak mandibular growth was imminent. The soft tissue profile was convex placing the lower lip in a mildly retrusive position in relation to the E-line (-2.4 mm).

**Treatment objectives**

The treatment objectives involved: (1) the correction of the unilateral right Brodie bite by the simultaneous intrusion and palatal tipping of the maxillary right posterior segment and the buccal tipping of the mandibular right posterior segment; (2) occlusal cant correction by the intrusion of the maxillary right
posterior segment and the maxillary right canine; (3) correction of the upper midline by improving the upper arch form and shifting the upper incisors to the left; (4) correction of the Class II canine relationship by the distalisation of the upper canines into the available distal spacing; (5) correction of the lower crowding without further proclination of the lower incisors using lower anterior interproximal reduction (IPR); finally, (6) maintain the existing ideal anterior overjet and overbite by minimising the reciprocal forces on the left posterior and anterior occlusion.

**Treatment rationale**

The option of surgical treatment was discarded as the patient was a growing adolescent. Appliances relying on reciprocal anchorage (contraction quad-helix in the upper arch or an expansion bi-helix or removable Schwartz plate in the lower arch) were considered but rejected as the Brodie bite was unilateral. Fixed appliances and cross elastics were not preferred as the unilateral (right) Brodie bite was characterised by a minimal buccal overjet and a 100% lateral overbite, which prevented the placement of fixed appliances on the lower right posterior teeth. If a bite block was employed to create an occlusal clearance of 5-6 mm in the right posterior region to facilitate the placement of fixed appliances, it necessitated a left posterior bite plane of similar thickness. This would likely create a large anterior open bite and affect, not only mastication, but also result in iatrogenic extrusion of the upper incisors dictated by the continuous upper arch wire.

It was therefore intended to treat the patient in two phases. Phase I was initially planned by placing a bonded occlusal splint (Figure 5) covering the maxillary posterior teeth along with the placement of two buccal and two palatal miniscrews. The buccal miniscrews were planned for insertion between the teeth 14 and 15, 16 and 17, within the attached gingiva at the level of the mucogingival junction and with a mild (10°-15°) inclination of the screw tips directed towards the root apices. Simultaneously, palatal (paramedian) miniscrews were planned for placement at the corresponding sagittal level as the buccal miniscrews. An intrusive force would be applied using the two groups of miniscrews to attachments (buccal and palatal buttons) on the bonded occlusal splint. However, a buccal miniscrew could not be placed between teeth 16 and 17 due to the accentuated curvature of the buccal roots of tooth 16. Hence, mechanics utilising two palatal and one buccal miniscrew were redesigned utilising a power-chain (ULTRA-CHAIN, 3M, Monrovia, USA) to intrude the upper right posterior segment. Further modifications involved limiting the coverage of the bonded occlusal splint to teeth 14, 15, 16 and bonding a palatal button to tooth 17. A removable bite block was inserted between the anterior teeth and the left posterior teeth to prevent supra-eruption of teeth into the bite opening created by the bonded occlusal splint.

Phase II treatment involved the placement of upper and lower fixed appliances to finish and detail the occlusion. No extractions were planned despite the Class II skeletal relationship as the dentition demonstrated a Class I molar relationship with ideal anterior overjet and overbite.

**Treatment progress**

The Phase-I treatment commenced with the placement of one buccal miniscrew between the root apices of teeth 14 and 15, and two para-median palatal
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UNILATERAL BRODIE BITE CORRECTION: A CASE REPORT

miniscrews (8 mm; Vector TAS, Ormco, Glendora, CA). An anterior palatal miniscrew was placed at a corresponding sagittal level to the buccal miniscrew and a posterior palatal miniscrew was placed at the level of tooth 17. An occlusal splint comprised of buccal and palatal attachments was bonded (Ketac™ Cem, 3M ESPE, St Paul, MN, USA) on to the occlusal surfaces of teeth 14, 15 and 16 and a bondable button was placed on the palatal surface of tooth 17. Using a power-chain from the miniscrews, an intrusive force was applied to the bonded occlusal splint and tooth 17 (Figures 6, 7).

The lack of a posterior buccal miniscrew created difficulty in the application of a balanced intrusive force in the anterior and posterior areas of the occlusal splint. This resulted in excessive intrusion of the 14 and 15 and an unequal intrusion of 16 at the end of Phase-I. This was subsequently addressed with fixed appliances during Phase-II. The total duration of Phase I was approximately 30 weeks.

The Phase-II treatment commenced with the bonding of fixed appliances (022” × 0.28” slot, MBT Prescription, Victory Series™ 3M, Monrovia, USA) in the lower arch, followed 10 weeks later, by the upper arch placement of the fixed appliances. Initial levelling and alignment were achieved using 0.014” super-elastic Nickel-Titanium (NiTi) (3M™ OrthoForm™ III) arch wires in the upper and lower

Table I. Cephalometric summary

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Std</th>
<th>Pre-Rx</th>
<th>Post-Rx</th>
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<td>Mandible</td>
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<td>SNB</td>
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<td>84</td>
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<td>88.9</td>
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<td>NaVert - Po</td>
<td>-8 to -6 mm/-2 to 4 mm</td>
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<td>2.1</td>
<td>4.2</td>
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<td>5</td>
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<td>1.8</td>
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<tr>
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<td>130 + 2°</td>
<td>121.6</td>
<td>114.4</td>
<td>-7.2</td>
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<td>SOFT TISSUE</td>
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<tr>
<td>L Lip - E Line</td>
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<td>1.3</td>
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<tr>
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<td>-4.1</td>
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<td>-8.4</td>
<td>-3.8</td>
<td>4.6</td>
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UNILATERAL BRODIE BITE CORRECTION: A CASE REPORT
arches and simultaneous utilisation of cross elastics (¼”, 2 oz, Ormco® Z-Pak elastics) on the right side to upright the lower right posterior teeth. Over a period of 6 months, interproximal reduction (IPR) of approximately 2-3 mm was performed in the lower arch during initial alignment to alleviate crowding without significant lower incisor proclination.

Subsequently, the arch wires were changed to 0.016” x 0.022” NiTi in both arches as interim wires before progressing to upper and lower 0.017” x 0.025” stainless steel (SS) (3M™) wires. On the SS arch wires, bilateral Class II elastics (¼”, 3.5 oz) were employed to correct the Class II canine relationship by distalising those teeth into the available distal spaces.

Finishing bends were placed in the upper and lower 0.017” x 0.025” SS wires to improve tooth positions and the fixed appliances were removed after 17 months. There was an overlap of Phase I and Phase II treatment by approximately 3 months, as the lower arch was bonded during the middle of Phase I to minimise the overall treatment time. The total treatment duration was 24 months. The patient received upper and lower 3-3 fixed retainers (0.6 mm, SS) and upper and lower Dohner retainers (Figure 10) to maintain the corrected transverse dento-alveolar dimension.

Interpretation of cephalometric changes

The patient was growing and progressed from CVM3 to CVM 4-5 indicating that peak mandibular growth occurred during treatment. Skeletally, the maxilla did not show any significant changes in forward movement (SNA change of 0.3°, A point convexity change of -0.4 mm, Na-Vert-A point change of 0.8 mm). However, the mandible showed a differential forward growth related to remodelling changes at pogonion, a facial angle increase of 3.3° and pogonion forward movement of 4.2 mm in relation to the nasion vertical (Table I, Figures 4, 12, 13).

The basal arch relationship did not change significantly as only a 0.4° improvement was noted in the ANB angle. However, the Wits appraisal showed an improvement of 3.1 mm with B-point moving forward in relation to A point. This could be attributed to a clockwise rotation of the occlusal plane resulting from the intrusion of the upper right posterior teeth.

The mandible grew in a favourable forward and upward direction, seen as a 2.4° increase in the mandibular arc and leading to closure of the mandibular plane angle by 2.2°. The intrusive mechanics in the upper right posterior segment could have also contributed to the reduction of the mandibular plane angle.
Figure 6. Treatment progression shown in frontal photographs (time-period in weeks).
Figure 7. Treatment progression shown in occlusal photographs (time-period in weeks).

Figure 8. Post-treatment photographs.
Dentally, the upper and lower incisors exhibited mild proclination (upper incisors by 3.8° to the palatal plane, lower incisors by 2.9° to the mandibular plane). Upper incisor proclination may have been due to a narrowing of the arch form from the crossbite correction and, despite the IPR, the lower incisor proclination could be due to the unravelling of the lower arch crowding during alignment.

The upper lip did not show any significant changes, while the lower lip improved, moving forward 4.3 mm in relation to the SN vertical. The soft tissue pogonion also moved forward by 4.6 mm and significantly contributed to the reduction of facial convexity.

**Critical appraisal**

The treatment objectives were successfully achieved and produced an overall satisfactory result (Figures 8, 9, 10, 11, 12, 13). The mechanics employed for the...
intrusion and lingual tipping of the upper right posterior teeth during Phase-I treatment were proven to be efficient. The miniscrew-aided superior-medial intrusive force caused the movement of the right posterior dental segment in a superior and palatal direction. This resulted in crossbite correction with a minimal dependence upon later patient cross-elastics compliance.\textsuperscript{15,16,25,26}

The inability to place a buccal miniscrew between the teeth 16 and 17 due to the severe curvature of both buccal roots of tooth 16 prevented the symmetrical use of buccal and palatal miniscrews to balance the intrusive force. It resulted in excessive intrusion of 14 and 15 and satisfactory intrusion of 16 at the end of Phase I. However, levelling of the upper arch was subsequently achieved using the fixed appliances applied during Phase-II treatment.

The upper incisors and lower incisors experienced mild proclination during treatment (upper incisors by 3.8° to the palatal plane, lower incisors by 2.9° to the mandibular plane). The fixed appliances during the final stage of treatment were limited to the teeth 37-45 in the lower arch to prevent interference between the long buccal cusps of the upper right posterior teeth and the brackets on the lower right posterior teeth limiting the control of the lower arch form. However, the mild asymmetry in the lower arch was accepted considering the adequate interdigitation of the right posterior teeth.

A desirable treatment outcome was clinically and radiographically achieved within 24 months, despite losing clinical time to COVID pandemic restrictions. Nonetheless, the occlusion could have been further detailed by improving the mesiobuccal rotation of 13, 45 and the distal root tip of 15. Additional IPR in the upper and lower arches would have improved the final incisor position.
Conclusion
Brodie bite management is a difficult challenge faced by a clinician. In contrast to a bilateral Brodie bite, a unilateral Brodie bite poses additional anchorage concerns and usually warrants sectional surgery. Miniscrews utilised in the management of the presented patient were found to be minimally invasive and effective.

Conflict of interest
The authors declare that there is no conflict of interest.

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