Non-surgical orthodontic treatment of anterior open bite

ABSTRACT
A 16-year-old Chinese girl presented with an anterior open bite malocclusion on a skeletal Class I base. She had an increased lower facial height and ratio, an acute nasolabial angle and incompetent lips, a V-shaped upper arch, anterior crowding, and an increased overjet. The upper incisors were proclined and the lower incisors were ahead of the A-Pogonion line. The treatment plan included extraction of the upper first premolars and the lower second premolars with use of a pre-adjusted edgewise, fixed appliance treatment.

Key words: Malocclusion; Open bite; Orthodontics

Introduction
Anterior open bite (AOB) is a malocclusion described as ‘failure of the incisor teeth to overlap’ 1. In Hong Kong the prevalence of AOB is 1.5% 2. Diagnosis and treatment of AOB has been widely reported in the dental literature 3,4. Anterior open bite is principally caused by increased vertical facial proportions, parafunctional habits (such as digit sucking), and the influence of the lymphoid tissues (e.g. adenoids) on airway, mandibular, and tongue postures 4,5.

Open bites can be classified as either a skeletal open bite or a dental open bite. A skeletal open bite is usually characterized by vertical maxillary excess, excessive eruption of posterior teeth, downward rotation of the mandible, and normal or excessive eruption of anterior teeth 1. A dental open bite is characterized by normal facial proportions with or without a history of parafunctional habits. A dental open bite has a better prognosis than a skeletal open bite 5.

There are many studies proposing the cephalometric diagnosis of AOB. Cangialosi 6 suggested that patients with AOB had increased posterior-to-anterior facial height and upper-to-lower facial height ratios. In addition, the Sella-Nasion (SN)-to-mandibular plane, the gonial and the maxillary-mandibular plane angles were all increased in the open bite group. The classical study 6 emphasized the great variation that can occur in the dental and skeletal morphology in patients with open bites. Dung and Smith 7 also defined some measurements for diagnosis of an open bite tendency, which included SN-to-mandibular plane angle of 40° or less, a posterior-to-anterior facial height ratio of 0.58 or less, and an upper-to-lower facial height ratio of 0.7 or less. The cephalometric analysis of open bite
proposed by Kim \(^8\) (‘Kim’s Analysis’) includes two factors: the overbite depth indicator used for an appraisal of the vertical component, and the anteroposterior dysplasia indicator for the horizontal component. These factors are used to determine the open bite tendency and Class II or III skeletal pattern tendencies, respectively.

Depending on the age of the patient and severity of the open bite, four treatment modalities are usually employed: (1) advice about cessation of early problems or parafunctional habits; (2) interceptive treatment; (3) camouflage treatment using orthodontics only; and (4) a combined orthodontic and surgical approach \(^3\).

Case report

The patient was a 16-year-old Chinese girl who complained of malaligned front teeth and the inability to bite with them (Figure 1). She had a convex profile with an acute nasolabial angle and increased lower facial height. Her lips were incompetent at rest and required mentalis muscle strain to achieve lip competence. Intraorally, the patient had 28 permanent teeth with missing third molars. Tooth 45 was discolored and asymptomatic. Tooth 12 was macrodontic and there was anterior Bolton ratio discrepancy. The upper central incisors were rotated distolabially. The overjet was increased at 5 mm, and the AOB was 2 mm from teeth 12 to 22. The molar relationship was Class I and the canine relationship was half-unit Class II. There were arch length deficiencies of 5 mm and 0.5 mm in the maxillary and mandibular arches, respectively. The upper arch was V-shaped while the lower arch was parabolic in shape. The midlines were coincident with the facial midline.

A panoramic radiograph confirmed the absence of teeth 18, 28, 38 and 48, and tooth 45 was endodontically treated (Figure 2a). A cephalometric analysis revealed Class I skeletal base relationship (Wits analysis) with an increased mandibular plane angle and lower facial height proportion. The upper incisors were proclined at 131°. The lower incisors were slightly retroclined and were ahead of the average A-Pogonion line. Both upper and lower lips were normal with respect to the Ricketts’ esthetic-plane.

An additional Kim’s analysis \(^8\) indicated that she had a Class III tendency (i.e. >81°) and borderline AOB tendency (<65° is classified as AOB tendency).

Treatment plan

The treatment objectives were as follows: (1) to control the eruption of upper molars; (2) to normalize the overjet
Non-surgical orthodontic treatment of anterior open bite and overbite by retraction and tipping of the incisors; (3) to relieve crowding and aligned teeth; (4) to harmonize the arches by arch form coordination; (5) to improve the anterior Bolton ratio; and (6) to improve lip competence.

The treatment plan involved extraction of teeth 14, 24, 35 and 45, with maximum anchorage in both arches. The orthodontic treatment plan aimed to restrain vertical maxillary growth and minimize downward and backward rotation of the mandible. The overjet and open bite can be reduced by retracting the upper incisors using tipping movements, flattening the occlusal plane, and minimizing the eruption of posterior teeth and the bite wedging effect. The resultant Bolton excess in the upper arch can be reduced by slenderizing the enamel of the upper anterior teeth.

**Treatment progress**

This patient’s orthodontic treatment began with the insertion of a transpalatal arch and delivery of high-pull headgear exerting 350 g per side for 12 to 14 hours per day of wear. After extraction of the premolars, banding and bonding were done with the fitting of 0.022-inch pre-adjusted edgewise appliance slots with Roth prescription (Ormco Corporation, USA). All the teeth, with the exception of the upper incisors, were bonded. The initial arch wires were 0.014-inch nickel titanium (NiTi) (Ormco Corporation). A 0.018-inch Australian stainless steel (SS) arch wire (G&H Wire Company, USA) with NiTi opening coils between the upper canines was used to distalize the canines and create space for the incisors. As spaces were created in the upper anterior segment, the transseptal fibers and lip pressure aligned the incisors and tipped them back respectively, without the need of bonding brackets. Second molars were bonded early to maximize the anchorage. After 8 months of treatment, lateral incisors were aligned into the arch and the AOB was reduced. 0.017 x 0.025-inch NiTi arch wires (Ormco Corporation) were used to level the occlusal planes and to establish torques. Space closure was carried out using sliding mechanics with 0.019 x 0.025-inch SS arch wires (Ormco Corporation) and NiTi closing coil springs. The patient wore the high-pull headgear until the extraction spaces were almost closed, and Class I molar and canine relationships, and a positive overbite, were achieved. Use of inter-arch Class II elastics was minimized to avoid extrusion of the lower molars. 0.017 x 0.025-inch TMA arch wires (Ormco Corporation) were used for finishing and detailing. The total treatment time was 22 months. Debonding and placement of fixed 0.0175-inch multistrand SS wire (G&H Wire Company) retainers from canines to canines, and across the extraction spaces, was performed. Removable wrap-around retainers were delivered. The final records are shown in Figures 3 and 4.

**Figure 3** (a) Pretreatment and (b) post-treatment intraoral frontal views; and post-treatment (c) upper occlusal and (d) right buccal views showing the buccal and lingual fixed retainers

**Figure 4** (a) Pretreatment and (b) post-treatment intraoral photographs showing correction of the overjet and overbite
Outcome

The open bite malocclusion was corrected and a functional occlusion was established. The profile also improved as the facial convexity was reduced and the lip incompetence eliminated following retraction of the incisors. The patient was very cooperative, wearing the headgear as instructed and thus contributed to treatment success. Her mandibular plane angle remained unchanged during treatment (Table 9). A positive overbite was achieved while minimizing the eruption of posterior teeth. Her interincisal angle has now been normalized. There was no abnormal finding in the post-treatment panoramic radiograph (Figure 2b).

Cephalometrically, her jaw base relationship improved to 3.3° and her Wits appraisal value was at -3.0 mm, indicating a Class I skeletal base. Vertically, her mandibular plane angle was unchanged at 45°. Her lower facial height and ratio were reduced slightly, indicating no detrimental effects to the vertical dimension.

Overall superimpositions showed that there was minimal growth of the maxilla and mandible during treatment, and lips profile significantly improved (Figure 5a). Maxillary superimposition on maxillary stable structures indicated that there has been retroclination and palatal tipping of the upper incisors (Figure 5b). Eruption of the upper molars and incisors was controlled by the high-pull headgear effect. Mandibular superimposition indicated a combination of retroclination and lingual tipping acted on the lower incisors, with only slight extrusion (Figure 5c). The lower molars showed 1 to 2 mm of eruption and 3 mm of mesial movement. Minimal condylar growth was seen during the treatment.

The stability prognosis is good provided the patient’s

<table>
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<th>Variable</th>
<th>Normal</th>
<th>Pretreatment</th>
<th>Post-treatment</th>
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<tr>
<td>SNA (°)</td>
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<td>SNB (°)</td>
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<td>ANB (°)</td>
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<td>Wits appraisal (mm)</td>
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<td>UI/MxPl (°)</td>
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<td>LI/MnPl (°)</td>
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<td>Lower lip to E line (mm)</td>
<td>4.0</td>
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* Values are expressed as mean (±standard deviation), unless otherwise specified
† ANB denotes A pt-Nasion-B pt; A Po A pt-Pogonion line; LAFH lower anterior facial height; LI lower incisor; MM maxillary-manibular plane; MnPl mandibular plane; MxPl maxillary plane; SNA Sella-Nasion-A pt; SNB Sella-Nasion-B pt; TAFH total anterior facial height; UAFH upper anterior facial height; and UI upper incisor

Figure 5  (a) Overall superimposition of pretreatment (solid lines) and post-treatment (dotted lines) lateral cephalometric radiographs registered on anterior cranial base. (b) Maxillary superimposition of pre- (solid lines) and post-treatment (dotted lines) cephalometric radiographs registered on the anterior border of the zygomatic process. (c) Mandibular superimposition of pre- (solid lines) and post-treatment (dotted lines) cephalometric radiographs registered on Björk and Skieller’s stable mandibular structures
growth pattern is favorable; the mandible is unlikely to rotate further downward and backward. A normalized interincisal angle achieved by proclination of the incisors should contribute to incisal relationship stability. Fixed retainers in the posterior teeth will also prevent the eruption of the posterior teeth and relapse of the open bite.

Discussion

The use of high-pull headgear during the initial treatment stage was important for preventing the extrusion of upper posterior teeth and reinforcement of anchorage. The effects of high-pull headgear for reduction of vertical eruption of upper molars have been reported\textsuperscript{12-14}. The patient cooperated well with the headgear program so a conservative approach, omitting the use of micro-implants for orthodontic anchorage and vertical control of molars, was used. The superimposition indicates minimal eruption of the upper molars during the treatment.

In this case, the previously root canal–treated lower second premolars were extracted. Under normal circumstances, all the first premolars in a Class I molar relationship would be extracted. Extraction of the lower second premolars creates a maximum anchorage requirement. We were able to achieve this with the placement of a lower lingual holding arch and banding of the lower second molars early in the treatment. Aras\textsuperscript{15} has shown that in open bite cases, extraction of teeth further back in the arch, i.e. first molars or second premolars, rather than first premolars, can achieve a reduction in the maxillary mandibular plane during treatment, which assists in the reduction of the open bite.

Long-term stability of AOB extraction treatment for permanent dentition has been documented\textsuperscript{16}. After a mean period of 8 years, 74.2% of the sample had a “clinically stable” open bite correction. Lopez-Gavito et al.\textsuperscript{17} has reported that 10 years after treatment, more than 35% of the group had an AOB relapse of 3 mm or more. In the case we have reported, stability has been improved by using fixed retainers along the posterior teeth that should prevent eruption and treatment relapse.

Acknowledgment

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References

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