Long-term stability of anterior open bite correction in mixed dentition with a new treatment protocol

ABSTRACT

Background The treatment of choice for skeletal open bite is orthognathic surgery combined with pre and post-surgical orthodontics; however relapse can be observed and alternative solutions are sought to avoid surgery whenever possible. A case is reported showing an original treatment protocol in order to obtain aesthetic, functional and stable results.

Case report A 10.2 year old boy with anterior open bite was treated with a Hyrax type rapid maxillary expander on the maxilla (one month) and a lingual arch in the lower jaw; then, grinding of deciduous molars was performed, a lingual grid was positioned and a myofunctional treatment (exercises) was started. The subsequent treatment phase was achieved with a lip bumper and fixed straight wire appliances on both arches. After 24 months of active treatment, retainers were used to maintain the good results achieved, which were unchanged at the long term controls, 3 and 7 years after treatment.

Keywords Occlusal grinding; Open bite; Rapid maxillary expansion.

Introduction

An anterior open bite is a definite lack of contact, in the vertical direction, between the incisal edges of the maxillary and mandibular anterior teeth [Subtelny and Sakuda, 1964]. Several theories have been proposed about the etiology of open bite, including genetics, altered growth patterns, sucking finger habits, oral breathing, labial interposition, enlarged lymphatic tissue, tongue’s thrust and posture [Ferguson, 1995; Ngan and Fields, 1997]. The term “skeletal” open bite is used when the malocclusion is associated to specific morphologic and functional characteristics, such as clockwise rotation of the mandible, short posterior facial height [Arvystas, 1977; Cangialosi, 1984], increased mandibular anterior facial height plane [Graber et al., 1985], downward rotation of the posterior portion of the palatal plane, counterclockwise rotation of the anterior maxilla [Nahoum, 1975], marked antegonial notching [Bell, 1971], and large mandibular plane and gonial angles [English, 2002]. In adult patients with skeletal open bite the treatment of choice is orthognathic surgery combined with pre- and post-surgery orthodontics [Proffit et al., 2000]. However a significant relapse can also be observed with this kind of treatment and many alternative solutions were sought to avoid surgery when possible. These are mainly based on a dentoalveolar compensatory mechanism and may consist of dentoalveolar changes and correction of oral bad habits [Mestrovic et al., 2000]. When this kind of path is chosen, control of the vertical dimension by avoiding the extrusion of both maxillary and mandibular molars is the key to success. To this purpose several treatment means can be used, such as high-pull head-gear [Firouz et al., 1992], chin cups [Pearson, 1986], multiloop edgewise archwire (MEAW) appliances [Kim, 1987], bite blocks [Kiliaridis, 1990], rapid molar intruders (RMI) [Carano and Machata, 2002], miniplates [Sherwood et al., 2002], and occlusal grinding [Janson et al., 2008].

The aim of the present case report was to describe the effects during mixed dentition of deciduous teeth grinding combined with the contemporary control of permanent molars eruption using a maxillary expansion appliance and palatal grid to block the action of tongue muscles on dentoalveolar remodeling.

Case report

A 10.2-year-old male patient presented to the observation to correct the anterior open bite, complaining about a previous orthodontic treatment. The diagnostic and therapeutic steps adopted were the following.

• Collection of diagnostic records: extra-oral and intra-oral photographs, plaster models, orthopantomography, cephalometric analysis on lateral cephalograms [Celli and Deli, 2006].
• Malocclusion correction with: RME appliance, mandibular lingual arch, grinding of deciduous molars, lingual grid, myofunctional exercises, lip bumper and fixed straight wire appliance.
• Collection of the final diagnostic records: extra-oral and intraoral photographs, plaster models, orthopantomography, cephalometric tracing on lateral cephalogram.
• Re-evaluation 3 years after completion of treatment:
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Extra-oral and intra-oral photographs, plaster models, orthopantomography, cephalometric tracing on lateral cephalogram.

• Further re-evaluation 7 years after completion of treatment: extra-oral and intra-oral photographs.

Cephalometric analysis

All lateral cephalograms were taken at pre-treatment (T0), immediately post-treatment (T1) and three years after completion of treatment (T2). The cephalometric tracings were digitised by the authors, using TopCeph® Apple® software analysis.

Diagnosis and treatment plan

The initial examination of this 10.2 year old male patient revealed a severe open bite malocclusion, mouth breathing, muscle deficit, lip incompetence at rest and neutro-occlusion (Fig. 1–6). The patient’s long-standing tongue-thrust habit had contributed to the development of an anterior open bite of 5 mm and an overjet of 10 mm. The patient maintained good oral hygiene and showed no evidence of periodontal disease. Radiographic exams were prescribed: ortopantomography and lateral cephalogram (Fig. 1, 7). Cephalometric tracing revealed a Class III skeletal relationship and a vertical growth pattern.

Treatment objectives were to correct the anterior open bite and achieve ideal overbite and overjet, to correct the transversal discrepancy of the two dental arches increasing the space for the permanent teeth, and to achieve a Class I dental and skeletal relationship.

A Hyrax type rapid maxillary expander (RME) was applied on the maxillary permanent first molars. The device was positioned more occlusal in order to be in contact with the tongue. This procedure allows the tongue’s pressure to control the extrusion of the upper molars. The active arms of the appliance were extended to the canines, embracing them, and had cannulas which permitted the insertion of a lingual grid at the end of the activation period. A mandibular lingual arch was applied to the lower first molars during the initial phase of interceptive orthodontics with the objective to reduce their normal eruption and control the vertical dimension. Subsequently, a lip bumper was used to increase the lower arch length and to procline the mandibular incisors exploiting the functional activity of the tongue and lips on teeth. During the RME treatment, the occlusal surfaces of lower and upper deciduous molars were grounded with a diamond bur (Fig. 8), to anticipate and adjust the contemporary eruption of the permanent first molars, and thus, the vertical dimension. Expansion was completed in one month. Reduction of the open bite could be attributed also to the lingual grid positioned after rapid maxillary expansion (Fig. 9), which prevented the wrong lower tongue posture, and allowed subsequently the setting up of an oral seal during deglutition. After
the first phase of treatment, the patient was instructed to myofunctional therapy in order to correct the wrong position of the tongue at rest and the atypical deglutition.

**Treatment progress**

After the discontinuation phase, maxillary and mandibular arches were bonded with a Straightwire 022" appliance (STEP®, Leone, Florence, Italy) with strategic brackets positioning to close the anterior open bite. The first molars were banded, and a .016” Nickel Titanium (Ni-Ti) archwire was placed for initial alignment (Fig. 10, 11).

Over the following 7 months, the archwires were stepped up to .019” x .025” Ni-Ti, .020” Australian Stainless Steel (SS), .019” x .025” SS. The case was finished with a sectional arch wire .019” x .025” SS on the maxillary arch and a .016” Ni-Ti on the lower arch in combination with intermaxillary elastics which were worn to maintain and consolidate the correction.

**Results**

After 24 months of active treatment, the brackets were debonded, and a fixed retainer was placed on the lower anterior arch, while a wraparound removable retainer was made for the upper dental arch.

Post-treatment facial and intraoral photographs showed good aesthetic and functional results (Fig. 12-16). Occlusal results and root angulations were acceptable (Fig. 17, 18), the overjet was adequate.

Three years after treatment completion the patient maintained a good occlusion and no malocclusion relapse was observed (Fig. 19, 20). The orthopantomography and the lateral cephalogram revealed a good maintenance of the results and a harmonious dentoskeletal development (Fig. 21).

The superimpositions of records before, after treatment and at 3 years of follow up showed an advancement of A-point and an ANS increase (Fig. 22), and all the others cephalometric values were corrected.

Seven years after completion of treatment the patient underwent clinical evaluations, extraoral and intraoral photographs to assess results and the good stability over time in terms of aesthetics, function and absence of relapse (Fig. 23, 24). Radiographs were not taken, because the authors did not considered them as essentials seven years after completion of treatment.

**Discussion**

The main objective of dentoskeletal open bite treatment is mandible counterclockwise rotation, which it is obtained by molars intrusion or control of eruption. The orthodontic treatment of patients with hyperdivergent skeletal phenotype should be performed early, when they show good compliance at 7−8 years of age [English, 2002]. These were the reasons that led us to start the treatment of this patient during the mixed dentition and...
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In the literature many options are described for the early open bite treatment: device to avoid thumb's interposition; palatal expansion; palatal bars and/or mandibular lingual arches to reduce posterior extrusion; high pull; chin cups; deciduous canines extraction and sometimes premolars extraction to allow extrusion and back-tilt of incisors; posterior bite-plates; myofunctional therapy; adenoidectomy and tonsillectomy [McLaughlin et al., 2001].

Some authors suggested different combinations of therapeutic protocols: Fränkel's function regulator (FR-4) appliance combined with myofunctional exercises [Erbay et al., 1995]; removable appliances with lingual grid and high pull chin cup [Quintao et al., 2006]; splints with magnets [Kiliaridis et al., 1990]. However, the majority of these therapeutic protocols require a good compliance by patients and/or have side effects.

In the case reported the authors used a treatment protocol for the correction of open bite composed of a combination of fixed appliance and a progressive vertical reduction (selective grinding) of the deciduous first and second molars that required minimal patient's compliance.

In the early treatment this innovative therapeutic protocol employs a rapid maxillary expander with lingual grid and a mandibular lingual arch on the first permanent molars and first and second deciduous molars progressive vertical reduction. The rapid maxillary expander is positioned more occlusally in order to take advantage of the tongue pressure and therefore control molar extrusion, while its lingual grid has the goal to redirect and stabilise tongue's posture. Rapid maxillary expansion is sometimes criticised in open bite malocclusions since it increases vertical dimension and mandibular post-rotation. However these side effects, which are temporary and reversible, should not prevent its use.
in open bite patients [Bishara and Staley, 1987]. Even though a slight relapse occurs after appliance removal in the long term, particularly in the intercanine width [Gruel et al., 2010], the palatal expansion can be considered stable. This could be mainly due to three factors: young age of the patients, which led to a good orthopaedic result; prolonged retention period, which permitted complete closure of the palatine suture, and correction of the tongue position within the arches following an increase in upper arch diameter [Gracco et al., 2010].

Since anterior tongue rest position plays an important aetiologic role in the relapse of anterior open-bite, lingual grid and myofunctional therapy were also adopted. The effectiveness of the lingual grid has been repeatedly reported in the literature. Its effect changes depending on several parameters, such as length of grid used, patient's age, skeletal class of malocclusion, appliance design. The lingual grid usually causes changes in the anterior tongue rest position, which in turn permits the correct eruption of incisors [Smithpeter and Covell, 2010].

In this case, a mandibular fixed lingual arch was chosen because of its ability to control the vertical development of the mandibular molars [Villalobos et al., 2000]. The authors did not consider the use of high pull imperative, because it requires a good compliance by the patient and it is not indicated in Class III malocclusions. Moreover, this way the eruption control on upper molars is performed quickly and comfortably. The same rationale applies for the chin cup, which could be less effective or not indicated [Lentini-Oliveira et al., 2007]. The authors decided to carry out occlusal adjustments only on the deciduous molars. Grinding is an aggressive and irreversible procedure for the dental tissues, but the progressive vertical reduction on deciduous molars can be considered a transitional and minimally invasive procedure. Selective grinding, to be effective, should be performed during the period of eruption of maxillary and mandibular permanent teeth.

In the case reported a loss of occlusal contact between the upper and lower molars resulted and the deciduous teeth were grounded so that a physical contact of the antagonist permanent molars was established.

Early treatment of open bite should allow for compensatory craniofacial growth and reduce the need for a second stage of treatment that might involve teeth extractions or orthognathic surgery [Ng et al., 2008]. It was interesting and relevant that the simultaneous presence of wide overjet disappeared and a natural harmony to the face of the subject was achieved. Furthermore the good results in terms of facial aesthetics and absence of malocclusion relapse 7 years after completion of treatment were probably due to the contention systems adopted: wraparound removable retainer for the upper dental arch and fixed retainer for the lower anterior dental arch. When incorrect tongue posture is associated with malocclusion, habit correction should be achieved to assist in treatment and improve stability [Celli et al., 2007].

Conclusion

The presented therapeutic protocol gives good results in terms of malocclusion correction, dentofacial aesthetics, no relapse of malocclusion and stability 7 years after completion of treatment. Selective grinding of deciduous teeth permits to obtain fast therapeutic results with minimally invasive and transitional effects for the dental tissues. Its effect, coupled with rapid palatal expansion, mandibular lingual arch, lingual grid and myofunctional exercises, allows bite closure, which is followed and completed by fixed Straightwire appliances. Any functional deficiencies or bad oral habits should be detected and corrected at the end of treatment to ensure long-term stability.

References