ORIGINAL ARTICLE

Early orthodontic treatment of skeletal open-bite malocclusion with the open-bite bionator: A cephalometric study

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Introduction: This study was designed to evaluate the effectiveness of the open-bite bionator in growing subjects with increased vertical dimensions. **Methods:** The records of 20 subjects with high-angle skeletal relationships (MPA ≥25°) were examined. Cephalometric measurements were compared with those obtained from 23 sets of records of an untreated group matched according to age, sex, vertical skeletal relationships, and time intervals between records. Lateral cephalograms were analyzed before the start of treatment (mean age; 8.3 years) and after therapy and retention, with a mean period of observation of 2.5 years. **Results:** The treated group had a significantly smaller palatal plane-mandibular plane angle (−1.9°) and a greater overbite (+1.5 mm) associated with a significantly smaller overjet when compared with the control group. **Conclusions:** Based on the analysis of this sample, early treatment of skeletal open bite with the open-bite bionator appears to produce a modest effect that mainly consists of significant improvement in intermaxillary divergence. No favorable effects on the extrusion of posterior teeth were found. (Am J Orthod Dentofacial Orthop 2007;132:595-8)

The management of malocclusions characterized by skeletal open bite is always difficult, especially in adults.[1,2] Early treatment in the mixed dentition was proposed by several authors to reduce the time of therapy needed in the permanent dentition.[3-11] Cozza et al,[12] in a systematic review of the literature, found only 7 scientific studies on this issue, and their quality level was insufficient to draw any evidence-based conclusions. One proposed treatment protocol is the open-bite bionator.[8] This appliance is a particular kind of bionator with posterior bite blocks to inhibit the extrusion of the posterior teeth. In the anterior region, the acrylic portion extends from the lower lingual part into the upper region as a lingual shield. The labial bow is placed at the height of correct lip closure, thus stimulating a competent seal relationship.[13] Weinbach and Smith[8] studied the effects of the open-bite bionator and reported good control of the vertical dimension with significant mandibular growth. However, in that study, the design of the appliances was variable (some patients wore high-pull headgear during the night), the tested sample was not composed of all hyperdivergent patients, and there was no control group.

Our aim in this study was to analyze the dentoskeletal changes after orthodontic treatment of skeletal open-bite malocclusion with the open-bite bionator in a group of 20 subjects in the mixed dentition compared with a control group (CG) of untreated subjects at the same stage of development to test the efficacy of this early functional therapy.

MATERIAL AND METHODS

The treated group (TG) was obtained from a group of patients treated in the Department of Orthodontics at the University of Florence in Italy. These patients were treated with an open-bite bionator for about 18 months; then the appliance was worn at night as a retention appliance.

Lateral cephalograms of the TG were analyzed regardless of treatment results. The patients had the following features: (1) initial mandibular plane angle relative to the Frankfort horizontal (MPA) 25° or greater[14]; (2) 2 consecutive lateral cephalograms of good quality with adequate landmark visualization and

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minimal or no rotation of the head, taken before treatment (T1) and after therapy and retention (T2); and (3) no permanent teeth extracted before or during treatment.

The TG included 20 subjects, 9 girls and 11 boys. The average ages were 8.3 years ± 10 months at T1 and 10.8 ± 1.5 years at T2. The mean duration of observation was 2.5 ± 1.2 years. The sample included 6 subjects with Class I occlusion and 14 subjects with Class II malocclusion.

The open-bite bionator has posterior acrylic bite blocks to prevent extrusion of the posterior teeth.[13] The construction bite is as low as possible, but a slight opening allows the interposition of posterior acrylic bite blocks for the posterior teeth to prevent their extrusion. The acrylic portion of the lower lingual part extends into the maxillary incisor region as a lingual shield, closing off the anterior space without touching the maxillary teeth. This portion of the appliance is intended to inhibit tongue movements.

The palatal bar has the same configuration as the standard bionator, to move the tongue into a more posterior or caudal position. The labial bow is placed at the height of correct lip closure, thus stimulating the lips to achieve a competent seal.

All patients in this study were asked to wear the appliance 24 hours a day (except during eating and playing certain sports) until the end of treatment. Their compliance with these instructions, however, varied.

A CG of 23 subjects was selected from the archives of the University of Michigan Elementary and Secondary School Growth Study. These subjects had T1 and T2 cephalograms available. The sample consisted of 13 girls and 10 boys. The average ages were 9.1 ± 1.6 years at T1 and 11.8 ± 1.3 years at T2. The mean duration of observation was 2.8 ± 1.1 years. The CG matched the TG as to hyperdivergent facial pattern (MPA ≥25°), mean ages at T1 and T2, and mean observation period.

The T1 and T2 cephalograms were hand traced by 1 investigator (G.B.), and another investigator (E.D.) verified the landmark locations. Any disagreements were resolved by retracing the landmark or the structure to the satisfaction of both observers.

Computer-assisted analysis of the serial lateral cephalograms of the 2 groups was performed by a digitizing tablet (2210; Numonics, Londsdale, Pa) and digitizing software (Viewbox, version 3.0; dHAL Software, Athens, Greece). The magnification factor of the cephalograms was standardized at 10%.

A cephalometric analysis consisting of 36 variables was generated.[15] Maxillary and mandibular superimpositions allowed the measurement of the movements of the maxillary and mandibular molars and incisors.

To superimpose the maxilla along the palatal plane, the superior and inferior surfaces of the hard palate and the internal structures of the maxilla superior to the incisors were used as landmarks. From this superimposition, the movement of the maxillary incisors and molars in the maxilla could be assessed. The mandibular superimposition was performed by using the mandibular canal and the tooth germs posteriorly and the internal structures of the symphysis and the anterior contour of the chin anteriorly. This superimposition allowed the measurement of the movement of the mandibular teeth in the mandible.

Statistical analysis

The data from the cephalometric analyses of the 2 groups were analyzed with the Shapiro-Wilk test; it indicated lack of normality for sample distribution. Therefore, the data were compared with a nonparametric test (Mann-Whitney U test) for independent samples ($P < .05$).

The homogeneity between 2 samples for ages at T1 and T2, and observation period allowed comparison of dentoskeletal changes (T2-T1) between the groups (Mann-Whitney U test). All statistical computations were performed with software (version 12.0; SPSS, Chicago, Ill).

The error of the method was evaluated on 20 cephalograms that were retraced and remeasured 1 month later. No systematic errors were found with the paired *t* test.[16] Random errors were estimated with Dahlberg's formula.[16] The errors for linear measurements ranged from 0.1 mm for pogonion to nasion perpendicular to 1.2 mm for condylion-gonion. The errors for angular measurements ranged from 0.4° for ANB angle to 1.4° for the interincisal angle.

RESULTS

Descriptive data and statistical comparisons for the increments from T1 to T2 of the skeletal and dental measurements for the 2 groups are given in the Table.

In the skeletal measurements on the sagittal plane, a significant difference between the 2 groups was found for pogonion to nasion perpendicular that was greater in the TG. In the vertical plane, the TG had a significant reduction in the palatal plane-mandibular plane angle (−1.9°) when compared with the CG.

The TG showed a significantly greater increase in overbite (1.5 mm more than the CG) that was associated with a significantly greater reduction of the overjet.

In the TG, the maxillary incisor exhibited a significant increase in the sagittal position (U1 horizontal, >1.2 mm),