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Atypical deglutition: diagnosis and interceptive treatment. A clinical study

ABSTRACT

Aim *The aim of this study was to evaluate the early treatment of atypical deglutition, by analysing the efficacy of the eruptive guide appliance Habit Corrector™.*

Materials and methods *The pre- and post-treatment (T1 and T2) cephalometric data of 2 groups of patients (G1 and G2), both consisting of 25 patients each and treated with Habit Corrector™, were compared. The first group included 10 males and 15 females, aged between 4 and 7 years old, with average age 6.17 years, and therefore undergoing the last phase of primary dentition and the first phase of mixed dentition. The second group included 12 males and 13 females, aged between 8 and 12 years old, with average age 9.19 years old, undergoing the second phase of mixed dentition. The overall duration of the treatment was 12 months.*

Results *The results showed significant differences between the two groups, with respect to overbite, overjet, molar relation, inclination of the upper and lower incisors, position of the jaw. A significant variation between the two groups at T2 was registered for the maxillomandibular relationships: the increase in the growth and degree of mandibular protrusion was of 4.66° in G1 and 2.44° in G2. Significant changes were registered for the position or growth of the upper jaw; the upper facial height almost remained unaltered, with 53.34° for G1 and with 53.96° for G2. A significant variation occurred with the increase in the sagittal relationship between the molars, improved in G1 by 3.14 mm and in G2 by 2.61 mm. A significant decrease of overjet was registered in G1 by 1.94 mm and in G2 by 0.76 m and an increase of overbite in G1 by 3.14 mm and in G2 by 0.88 mm. The inclination of the maxillary and mandibular incisors improved, with an inter-incisive angle of 123° in G1 and 124.2° in G2.*

Conclusion *The clinical results obtained suggest that early intervention in atypical deglutition with Habit Corrector™ is able to produce significant results in primary dentition and in the first phase of mixed dentition, rather than in the late phase of mixed dentition.*

Keywords *Atypical deglutition; Habit Corrector™; Paediatric patient.*

Introduction

Clinically, atypical deglutition is classified in simple or complex [Lescano de Ferrer, 2006]. The former is characterised by contraction of the lips, the chin muscle and elevator jaw muscles, due to the presence of an open bite that forces interposition of the tongue between the dental arches, with the purpose to ensure the anterior seal [Sayin, 2006]. The increase in overjet is typical of these cases, due to the vestibular inclination of the upper incisors and sometimes lingual inclination of the lower incisors [Fellus, 2006]. The complex form is characterised by contraction of labial and facial muscles and of the chin muscle, but not of the elevator muscles [Störmer, 1999]. In this case, stabilisation of the jaw is guaranteed by the mimic muscles and deglutition takes place with separate teeth since the tongue totally falls between the arches and not in a well defined area, as it occurs in the simple form [Polimeni, 1995].

The existing relationship between atypical deglutition and malocclusion, especially the open bite, is currently one of the most debated subject [Maciel CT, 2004; Cristina Tostes Vieira Maciel, 2005].

The opinions and researches on this topic are fairly conflicting, because some authors state that atypical deglutition causes the open bite, while others believe that atypical swallowing is a consequence of it [Maciel, 2005; Fraser, 2006]. In this regard, Proffit underscores that in patients with anterior open bite, as it often occurs in children using pacifiers, it is very difficult to obtain closure of the mouth to prevent spilling of fluids during swallowing; the position of the tongue between the arches and the contraction of the mimic muscles, represent a physiological adaptation with the purpose to restore the anterior seal. Almost every patient with anterior open bite is affected by this type of deglutition, but the contrary is not necessarily true: indeed, the tongue is often in anterior position during deglutition, even in children with good occlusion. Therefore,

according to the author, the anterior position of the tongue can be considered the result of an open bite and not its cause [Proffit W, 2002]. Indeed, the pressure exerted by the tongue during swallowing does not last enough to modify the position of the teeth: its duration is of about one second [Cozza P, 1992]. An average individual swallows about 1000 times a day for a total of about 1000 seconds of pressure and therefore, it is certainly not enough to modify the muscular balance [Cozza, 1992]. The tongue, in addition to assuming an anterior position during swallowing, keeps the same posture also at rest, causing facial and dentomaxillary changes [Cozza, 1992; Ierando, 1999; Cozza, 1999; Lescano de Ferrer, 2006].

Habit Corrector™

Habit Corrector™ is a myofunctional removable appliance, used in paediatric age to prevent and intercept dental and skeletal malocclusions in primary and mixed dentition [Bergersen, 1981].

This appliance was conceived by Bergersen E.O. in 1987 in order to prevent or correct the consequences of an anomalous tongue thrust, to intercept the occurrence and persistence of the open bite, which is often clinically associated to atypical deglutition [Bergersen, 1988]. It was also conceived to re-educate and correct the majority of bad habits such as sucking the finger or the pacifier, atypical deglutition, interposition of the tongue at rest and habitual mouth breathing, often present in young patients and responsible for a number of alterations of functional, dental and/or skeletal nature as the open bite, cross bite and excessive overjet [Bergersen, 1986].

Habit Corrector™ is a preformed appliance, patented as "U-shaped device", consisting of inert, extremely flexible plastic material which well adapts to the occlusal anatomy also in some severe cases of dental and skeletal malocclusions [Bergersen, 1988].

The resistance to wear and the remarkable elastic properties of the construction material, contribute to render this appliance extremely comfortable also for young patients, in order to help its clinical use and render the interceptive therapy easy, quick and effective [Bergersen, 1988].

The device is available in two versions.

- HC-C (close) or closed version, in the form of a single block.
- HC-O (open) or open version, indicated for habitual oral breathing patients, composed by two front parts that are joined at the back [Bergersen, 1988].

What makes the Habit Corrector™ stand out from other similar appliances is its internal morphology, which consists in both arches, of a higher lateral-rear part compared to the front part, that contain inserts for the single teeth at the front and for the molar group at the back [Bergersen, 1988].

The construction bite, in sagittal terms, is based on an incisor-to-incisor ratio, which is important to correct the marked overjet and comes with a tight fissure between upper and lower incisors, such to prevent any type of vertical pressure of intrusive type during its use; this pressure will be instead present in the molar area [Bergersen, 1988]. This helps the intrusion of posterior teeth and the extrusion of the anterior ones, resulting in the closure of the open bite, caused by the bad habit [Bergersen, 1988]. The tongue aspect is also different: a horizontal membrane, located in the lower part of the device, extends by about 1 cm in anterior-posterio direction and its function is to prevent a low posture of the tongue and therefore help myofunctional re-education, together with two small spurs located in the upper retro-incisive area, proper tongue position point [Bergersen, 1988]. Finally, two flaps that have a double function are located in the lower retro-incisive area: forward propulsion of the jaw and repositioning of lower incisors in a vestibular sense in case of lingual inclination [Bergersen EO, 1988].

The treatment with the Habit Corrector™ should be started at about 4-5 years of age [Bergersen, 1988].

Materials and methods

Two groups of patients were selected at the department of Paediatric Dentistry of Azienda Ospedaliera Policlinico Tor Vergata of Rome, during their first paediatric dental visit: Group G1, composed of 25 patients aged between 4 and 7 years of age (10 males and 15 females), undergoing the last phase of primary dentition and first phase of mixed dentition, and Group G2 (12 males and 13 females), also composed of 25 patients aged between 8 and 12 years, undergoing the second phase of mixed dentition. The average age of the sample was 6.37 years for G1 and 9.19 years for G2.

All patients of both groups showed atypical deglution with anterior dentoalveolar open bite.

Inclusion criteria were the following: subject in the last phase of primary dentition, first and second phase of mixed dentition, atypical deglutition, anterior dentoalveolar open bite, dental, skeletal and dental-skeletal malocclusion of Class I or II, crowding of the incisive region in the mandibular arch less than 2 mm, deciduous and permanent overbite less than 2.5 mm and deciduous and permanent overjet greater than 2.5 mm and less than 7 mm.

Exclusion criteria: complete permanent dentition, agenesis of permanent teeth, actual or compensated Class III malocclusion, deep bite, crowding in the incisive region in the mandibular arch greater than 7 mm, overjet greater than 7 mm, excessive inclination of upper incisors, facial hyperdivergence (from mandibular post-rotation), maxillary contraction of basal type and TMJ disorder.

The preliminary phase (T1) consisted for both roups

in recording the clinical parameters in order to assess the presence of bad habits, such as atypical deglutition, oral breathing or finger and/or pacifier sucking. The radiographic documentation was collected, including orthopantomogram of the dental arches and latero-lateral teleradiography of the skull. The study plaster models were recorded and photographs were taken: extra-oral documentation with photographs of the face in front view, front view with smile, lateral view, lateral view with smile and nasolabial-chin and intra-oral profile with photographs in front, lateral, upper occlusion and lower occlusion view (Fig. 1).

The second phase was performed in both groups after the use of the Habit Corrector™.

All patients of both groups were requested to wear the device all night and 2 hours during the day for a period of 12 months.

With regards to the therapeutic protocol, the following monthly clinical checkups, biannual checkups and annual radiographic checkups were performed, including orthopantogram of the dental arches and latero-lateral teleradiography of the skull.

Patients with oral breathing were requested to initially wear the open version of the HC-O appliance, which was then substituted by the closed version HC-C, when the patient was starting to show a good level of adaptation to the appliance (after about two months).

The dentoalveolar and skeletal changes between the two groups, at the beginning of the treatment (T1) and at the end (T2), were evaluated by means of the Student's t-test.

The differences associated to a p-value <0.01 were

FIG. 1A-1C M.R. 7 years and 5 months: frontal facial view (A), lateral view of the face (B) Latero-lateral teleradiography of the skull (C).

FIG. 1D Orthopantogram.

FIG. 1E-1G Intraoral views: left side (E), frontal (F), right side (G).

FIG. 1H-1I Occlusal views: maxillary arch (H) and mandibular arch (I).

taken into consideration as statistically significant in the analysis. The parameters of the skeletal and dental analysis were set in agreement with Ricketts' cephalometric analysis (Table 1).

Results

In the preliminary phase of the study (T1) groups G1 and G2 did not show any significant difference between males and females. Similar initial cephalometric values of the skeletal and dental analyses were recorded for both groups, except for molar relationship values and inclination values of the incisors, which were negative in greater number in G1. During the final phase of the treatment (T2), significant differences were registered between the two groups. Significant values were found for overbite, overjet, molar relation, inclination of upper and lower incisors and jaw position. A significant change among the two groups was registered in the maxillomandibular relationships: in particular the increase in the mandibular growth and degree of mandibular protrusion was of 4.66° in G1 and 2.44° in G2.

No significant changes were recorded for the upper maxillary growth; the upper facial height almost remained unaltered with a value of 53.34° in G1 and of 53.96° in G2. A significant change occurred with the increase of the sagittal relation between molars, which improved in G1 by 3.14 mm and in G2 by 2.61 mm.

A significant decrease of overjet was registered in G1 by 1.94 mm and in G2 by 0.76 mm and an increase of overbite in G1 by 3.14 mm and in G2 by 0.88 mm. The inclination of the maxillary and mandibular incisors improved, with an inter-incisive angle of 123° in G1 and 124.2° in G2 (Fig. 2).

Discussion

Different studies showed that the changes associated to the growth of the paediatric patient are positively influenced by eruptive guide appliance in mixed dentition [Bergersen, 1988; Methenitou, 1990; Keski-Nisula, 2008; Janson, 2000; Bergersen, 1966; Bergersen, 1984; Bergersen, 1985].

In this study, the results show that the eruptive guidance appliance Habit Corrector™ proved to be effective in correcting different aspects in the development of the occlusion, such as overjet, overbite, open bite and molar relationship.

The changes induced by the eruptive guidance device mainly involved the dentoalveolar region. In

GROUP, TREATMENT TIME	G1 T1	G2 T1	G1 T2	G2 T2
AGE (Y,M)	6.37	9.19	6.37	7.4
SKELETAL ANALYSIS				
Angle of facial axis (°)	90.08	89.16	89.92	90.08
Profile convexity (mm)	6.68	4.04	5.92	6.68
Maxillary depth angle (°)	90.72	91.16	90.48	90.72
Facial depth angle (°)	83.3	86.72	84.4	83.2
Angle of the position of the mandibular branch (°)	69.96	72.44	74.62	74.88
Position of porion (mm)	43.72	42.2	42.4	43.72
Angle of lower facial height (°)	46.96	47.68	47	46.96
Angle of the upper facial height (°)	53.56	53.28	53.34	53.96
Angle of mandibular plane (°)	24.72	26.08	25.52	24.72
Angle of mandibular arch (°)	32.84	28.36	31.52	32.84
Posterior facial height (mm)	54.24	56.08	53.68	54.24
Mandibular body lenght (mm)	58.36	66.4	63.02	68.84
SKELETAL ANALYSIS				
Occlusal plane inclination (°)	19.24	21.4	21.78	19.24
interincisal Angle (°)	114.96	125.56	123	124.2
Angle between lower incisor axis and plane A-PO (°)	27.4	23.44	26.44	27.4
Angle between upper incisor axis and plane A-PO (°)	35	31.12	28.5	35
Position of lower incisive than the plane A-PO (mm)	3.26	3.96	1.86	3.26
Position of upper incisive than the plane A-PO (mm)	5.7	4.7	3	5.7
Molar relationship (mm)	2.1	0.79	-1.04	2.1
Overjet (mm)	4.04	2.96	2.1	2.2
Overbite (mm)	-2.12	0.78	1.02	1.66

TABLE 1 Average of cephalometric values of G1 and G2 at the beginning T1 and at the end T2 of treatment.

any case, the treatment with Habit Corrector™ seems to significantly improve the mandibular growth from a skeletal point of view, as shown by the measurement of the position angle of the mandibular area, improved from T1 to T2 of 4.66° in G1 e 2.44° in G2.

At the end of the treatment, the patient showed absence of crowding, Class I dental relationship and harmony in the skull-facial growth. After treatment with Habit Corrector™, there was no need for a second treatment phase, but only the development of the occlusion was followed, until the end of the phase. These results underscore to what extent the eruptive guide appliance Habit Corrector™ mainly affects these parameters during the last phase of dentition and the first phase of mixed dentition, rather than the second phase of mixed dentition. These changes in the occlusion towards a Class I relationship, the decrease in overjet, the increase in overbite and the mandibular growth, are significantly obvious during the last phase of primary dentition and the first phase of mixed dentition, rather than during the late phase of mixed dentition. This proves that the favourable changes induced by the Habit Corrector™ on the skeletal and dentoalveolar components is greater during the early growth phase.

In addition, differently from previous studies that did not show particular changes in the inclination of the incisors, this study shows that the more satisfactory results obtained, particularly in patients of group G1, are related to promptness of intervention. Indeed the treatment of these subjects started during the pre-eruptive phase of the permanent incisors, therefore in the last phase of primary dentition and the first phase of mixed dentition.

FIG. 2A-2C M.R. 8.5 months: frontal facial view (A), lateral view of the face (B), latero-lateral teleradiography of the skull (C).

FIG. 2D Orthopantogram.

FIG. 2E-2G Intraoral views: left side (E), frontal (F), right side (G).

FIG. 2H-2I Occlusal views: maxillary arch (H) and mandibular arch (I).

Conclusion

The deglutition reflex is fairly unpredictable with regards to maturation times. This creates many difficulties in trying to identify the line between physiological and pathological function and therefore in planning a suitable treatment able to correct its causes and ensure a normal growth of the maxillofacial region. Therefore, all those cases at risk affected by child deglutition should be monitored even after eruption of all deciduous teeth, intervening in the first teething phase, to avoid the consolidated acquisition of this bad habit. A re-educational therapy in this phase will ensure the normal growth of maxillary bones.

The early treatment during the last phase of primary dentition and the first phase of mixed dentition by means of an orthodontic-paedodontic eruptive guide appliance, and in particular with Habit Corrector™, can be considered a valid means able to restore the physiological occlusion and growth [Keski-Nisula, 2008; Janson, 2007; Bergersen, 1995; Gottlieb, 2004; Tausche, 2004; Saldarriaga, 2007].

The clinical results obtained suggest that early intervention in atypical deglutition with Habit Corrector™ is able to produce significant results; this device is deemed valid in order to intercept malocclusions (atypical swallowing, open bite).

This study represents the first part of clinical observations that need to be followed-up to evaluate the possible stabilisation of the result. Indeed, this is a new method that is not currently extensively documented in the literature, and therefore it can help the paediatric dentist to early intercept these malocclusions.

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