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Deep bite: a case report with chewing pattern and electromyographic activity before and after therapy with function generating bite

ABSTRACT

Aim The purpose of this case report is the concurrent evaluation of the masticatory pattern and the electromyographic activity, recorded during mastication, before and after therapy of deep bite malocclusion. 

Case report An 11-year-old boy, affected by deep bite (overbite = 5 mm) was treated by the use of a functional appliance (Function Generating Bite for Deep bite correction = FGB-D). Mandibular movements during mastication of a soft and a hard bolus were recorded both before and 10 months after correction of the malocclusion. Electromyographic activity (EMG) of the masseters and anterior temporalis muscles were recorded at the same time. Chewing cycles and EMG activity were recorded with the K7 I kinesiograph (Myotronics Inc., Seattle, WA-USA). Before therapy a higher EMG activity was recorded for both masseters and anterior temporalis muscles in comparison with the results after therapy.

Results The results showed a great decrease of the EMG activity of masseter and anterior temporalis muscles. Moreover, the height and width of the chewing cycles in the frontal plane increased after therapy.

Conclusion The functional improvement showed after therapy with FGB-D showed that the functional appliance is able to correct the dental malocclusion and the masticatory function. The orthodontic treatment should consider not only the repositioning of teeth within the dental arches but also the effects on function, especially when the malocclusion involves the muscular and skeletal structures.

Keywords chewing cycles; deep bite; EMG activity; functional appliance; masticatory muscles.

Introduction

Deep bite is a malocclusion characterised by an increased overbite of the upper incisors on the lower ones (more than 4 mm). It was defined by Strang [1950] as “the overlapping of the upper anterior teeth over the lowers in the vertical plane”. Recently it has been defined as an increased vertical overposition of the anterior teeth, frequently associated with a reduced facial vertical dimension [Daskalogiannakis, 2002].

Deep bite is one of the most common malocclusions, sometimes difficult to treat with success, and with frequent relapses. The prevalence ranges from 21.6% in a sample of 4724 children and adolescents from Colombia aged 5 to 17 years [Thilander et al., 2001], to 46.2% in a sample of 1975 German children aged 6 to 8 years [Tausche et al., 2004].

The aetiopathogenesis of deep bite may be dental, skeletal and functional. Skeletal deep bite is the consequence of an altered growth of the upper and lower maxillary bones. When there are functional (or dysfunctional) factors, as a lower or upper hyperactive lip, an altered development of the alveolar bone occurs [Nielsen, 1991]. Some authors [Pepicelli et al., 2005] have found a correlation between craniofacial morphology and mandibular muscles. Patients with short vertical facial height [Benington et al., 1999] show an increased cross-sectional area of the masticatory muscles, increased electromyographic (EMG) activity and higher maximum bite force than patients with longer face [Moller, 1966; Sassouni, 1969]. Orthodontists should establish the cause of the malocclusion in order to start a proper treatment planning to obtain stable results over time.

Deep bite, like other malocclusions [Ahlgren, 1967; Gibbs et al., 1971], can influence the chewing pattern, although few papers have been published in literature on this subject. However Sheppard [1965] and Alexander et al. [1984], found that chewing cycles in subjects with deep bite were altered. Recently, Buschang et al. [2007] showed that in the frontal plane chewing patterns of deep bite patients are reduced compared to that of healthy subjects, while in the sagittal plane the mandible moves more posteriorly during opening and maintains its posterior position throughout the chewing cycles.
Currently there are no studies about EMG activity recorded simultaneously with the masticatory pattern in patients with deep bite malocclusion. Knowing that the skeletal and muscular assessment are deeply involved in deep bite, the purpose of this case report is evaluation of the masticatory pattern and the electromyographic activity recorded simultaneously during mastication, before and after therapy of deep bite malocclusion.

Case report

A 11.2-year-old boy with a deep bite malocclusion (5 mm overbite) referred to the Department of Orthodontics and Gnathology – Dental School, University of Turin, Italy. Informed consent was obtained from the parents before the beginning of treatment.

Medical history

Absence of systemic or hereditary diseases in the family.

As for recent and remote medical history, the patient underwent tonsillectomy and adenoidectomy at 4 years of age.

Occlusion analysis

Molar Class II, overjet: 5 mm, overbite: 5 mm, asymmetrical midlines, mixed dentition, interposition of lower lip.

Lateral cephalometric analysis sottotitoletto blu corsivo AN^B = 4° (normal range = 2°±2), SN^GoGn = 41° (normal range = 32°±4), interincisal angle is 112° (normal range =135±5°), Jarabak ratio PostHt / AntHt = 56%, and Bjork SUM = 401° (Fig. 1).

Therapeutic considerations

A function Generating Bite for Deep bite correction (FGB-D) (Fig. 2) with a lip bumper-like vestibular lower shield was used to correct the deep bite malocclusion. The appliance consists of posterior metal bite planes, a double anterior bite plane and a resin palatal plate. The double anterior bite corrects the overbite by the simultaneous intrusion of the lower and upper incisors. The result is a physiologic activation of the appliance with intermittent forces. The lower lip-bumper prevents lower lip interposition during swallowing and corrects the overjet. The metal posterior and anterior bite planes let the mandible move without tooth interferences. The resin palatal plate induces reconditioning of the tongue.

The patient wore the appliance night and day, except during the meals and sport activity. The deep bite was corrected in ten months and the patient was 12 when the active treatment ended. Of course, a functional retention is crucial because during the developmental age bones and muscles will adapt and the occlusal correction will be stable over time.

Chewing cycle examination

Chewing pattern and EMG activity of masseter and anterior temporalis muscles were concurrently recorded during chewing to evaluate the influence of deep bite on masticatory function.

The examination was made before (Fig 3. A, B) and 10 months after (Fig. 3 C, D) orthodontic treatment of the deep bite.

A K7-I kinesiograph (Myotronics Inc, Seattle WAS-USA) was used to record the masticatory pattern and the EMG activity of the masseter and anterior temporalis muscles.

The examination protocol entailed deliberate chewing on the right side and on the left side, followed by free chewing. Each modality was repeated three times, first with a soft bolus (chewing gum) and then with a hard bolus (wine-gum). The subject was invited to maintain an upright seated position and to look at a point about 1 m in front of him. The electrodes were positioned on the belly of the muscle to avoid interferences with the areas of muscular innervation [Castroflorio et al., 2005].

The kinesiograph was interfaced with a computer for data storage and subsequent analysis. The raw data were analysed using a customised program developed at the University of Turin [Piancino et al., 2008a; Piancino et al., 2009].
FIGG. 3  

A: chewing cycles before therapy during chewing a soft bolus on the right side; 1) mean pattern on sagittal plane, 2) mean pattern on frontal plane, 3) superimposed single chewing cycles on sagittal plane, 4) superimposed single chewing cycles on frontal plane.  

B: electromiographic activity before therapy while chewing a soft bolus on the right side; 5) right anterior temporalis activity, 6) left anterior temporalis activity, 7) right masseter activity, 8) left masseter activity.  

C: chewing cycles after therapy while chewing a soft bolus on the right side; 9) mean pattern on sagittal plane, 10) mean pattern on frontal plane, 11) superimposed single chewing cycles on sagittal plane, 12) superimposed single chewing cycles on frontal plane.  

D: electromiographic activity after therapy while chewing a soft bolus on the right side; 13) right anterior temporalis activity, 14) left anterior temporalis activity, 15) right masseter activity, 16) left masseter activity.
Results

The most important result obtained is the great decrease of the EMG activity of masseter and anterior temporalis muscles. Baseline vs. ten months after therapy the spike of the EMG activity of the tested muscles was of 231 vs. 125 µV for the right anterior temporalis, 260 vs. 125 µV for the left anterior temporalis, 230 vs. 151 µV for the right masseter and 127 vs. 48 µV for the left masseter during chewing a soft bolus on the right side (Fig. 3).

The height and width of the chewing cycles on frontal plane increased after therapy (height: 12 mm before, 16 mm after correction; width: 2 mm before, 4 mm after therapy).

Discussion

Evaluation of the masticatory function, in the case reported, showed a higher muscular activation of both masseters and anterior temporalis before therapy with respect to the recordings after therapy. The coordination of the muscles activity between the bolus side and the contralateral side [Piancino et al., 2008a] was normal, being the masseter of the side of the bolus higher than the contralateral. The chewing pattern also showed a difference in the frontal plane being the width and the height greater after therapy and the direction of closure less vertical, meaning that, in this case, the deep bite involved the neuromuscular structures and functions that improved after therapy.

The improvement of both the chewing pattern and the muscular activation, after therapy with FGB-D, showed that in this case the functional appliance was able to correct the dental malocclusion improving the masticatory function. Previous studies on deep bite patients during clenching, demonstrated that the functional therapy with function generating bite appliance (FGB) also improves muscles symmetry and the TMJ tracings [Castroflorio et al, 2005; Piancino et al., 2008b; Reverdito et al., 2011].

Conclusion

The reduction of muscular activity in the case presented, at an early stage of development, is of clinical relevance for a better bone growth, avoiding excessive muscular forces which overload both the skeletal and the dentoalveolar structures. The orthodontic treatment should consider not only the repositioning of teeth within the dental arches, but also the effects on function, especially when the malocclusion involves muscular and skeletal structures, as in the case of deep bite.

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References