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Assessment of masticatory performance, bite force, orthodontic treatment need and orofacial dysfunction in children and adolescents

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ABSTRACT

Objectives: Few studies have evaluated the relationship between morphological and functional characteristics of the masticatory apparatus in young subjects. Thus, the aim of this study was to evaluate masticatory performance (MP), maximal bite force (BF), orthodontic treatment need and orofacial dysfunction in children and adolescents.
Design: The sample consisted of 316 subjects of both genders, with an age range 6–16 years divided into 4 groups: early mixed, intermediate mixed, late mixed and permanent dentition. MP was evaluated by the individual's ability to comminute a chewable test material in order to determine median particle size (X_{50}) and distribution of particles in different sieves ("*b*"). BF was determined using a digital gnatodynamometer with fork strength of 10 mm. Orofacial function and orthodontic treatment need were screened using the Nordic Orofacial Test-Screening (NOT-S) protocol and Index of Orthodontic Treatment Need (IOTN), respectively. The results were submitted to descriptive statistics, normality test, analysis of variance and stepwise multiple linear regression to test relationship between MP and studied independent variables.
Results: Variance of X_{50} and b between groups was statistically significant. But evaluation of variables that significantly contributed to MP variation showed that age, body mass index (BMI), BF and the presence of sleep bruxism were negatively related to X_{50} and the NOT-S clinical exam scores showed a positive relationship with X_{50}.
Conclusion: In the studied sample, age, BMI, BF and the presence of sleep bruxism were related to better MP; but the increase in NOT-S scores was significantly related to poorer MP.

1. Introduction

Orofacial function is the result of complex integrated activities of the central nervous system and the neuromuscular system. It includes a number of vital actions such as breathing, mastication and swallowing, and acts as the basis for social interaction in terms of speech, emotional communication, facial expression and appearance.[1,2] Mastication is a developmental function and it matures as a result of learning experiences. If adequate, mastication stimulates and provides proper function for the normal development of the maxilla and mandible.[3] In the oral cavity, food is subjected to several mechanical and chemical processes. The food is fractured by

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the teeth, diluted and broken down by saliva, forming a bolus to finally be swallowed.[4] As mastication reduces the food size and prepares it for swallowing and digestion, its performance can be measured by determining the individual capacity to comminute a test food.[5] Sieving of fragmented food particles has proven to be a reliable method for quantifying masticatory performance[6] (MP) after grinding and pulverising a test food.[7,8] Chewable test materials may be preferred to natural foods for measuring MP because of their physical properties, and more reproducible particle size and shape.[5]

Maximum voluntary bite force (BF) measurement is an important tool for assessing the functional state of the masticatory system. BF has been used to evaluate oral function in relation to occlusal factors, malocclusion, oral surgery, temporomandibular disorders and neuromuscular diseases, and has been reported to have a large influence on the MF in subjects with overdentures, in those with full dentures, as well as in subjects with natural dentition.[9] According to English et al.,[10] three main factors may influence MF: the number and area of occlusal contacts, occlusal forces as reflected by maximum bite force and the amount of lateral excursion during mastication.

Orofacial dysfunction is a common feature in many genetic and congenital disorders. It may be acquired as a consequence of various diseases, trauma or parafunctional habits and can be severely disabling. Physical changes localised in specific regions of the body may interfere with overall health, thus affecting the quality of life.[11] The Nordic Orofacial Test – Screening (NOT-S) was developed by Bakke et al.,[12] to evaluate the characteristics and severity of orofacial dysfunction, and it has been translated and culturally adapted to Brazilian Portuguese by Leme.[13]

The possible association between MP and orofacial dysfunction has not been investigated to date. Considering the above information, it is relevant to analyse factors that can affect the operation of biological structures, especially those related to physiological oral functions in young subjects. According to our knowledge, the present study is the first to examine the effects of orofacial dysfunction on mastication, and thus, the purpose was to evaluate the relations between MP, maximal BF and orofacial dysfunction in children and adolescents.

2. Materials and methods

2.1. *Sample selection and clinical examination*

The sample consisted of 316 subjects in the age-range from 6 to 16 years, selected from public schools of Piracicaba, SP, Brazil, after anamnesis and clinical examination. They were divided into 4 groups matched for dentition: early mixed dentition ($n = 20$), intermediate mixed dentition ($n = 73$), late mixed dentition ($n = 89$) and permanent dentition ($n = 134$). The children and their parents consented to participate in the study, which was approved by the Ethics Committee of the Piracicaba Dental School (protocol no. 004/2010).

The parents/guardians provided written information by means of a pre-structured questionnaire. The questions verified the pre-natal, natal and post-natal histories, dental and medical experiences and parafunctional habits (bottle feeding, pacifier use, finger sucking, nail biting, sleep bruxism and enuresis nocturna). The questions could be answered by qualitative (yes/no) and quantitative responses (frequency characteristics).

Presence of malocclusions, lip posture and need for orthodontic treatment (using the IOTN-DHC, Index of Orthodontic Treatment – Dental Health Component) were all evaluated by a single calibrated examiner (ABMM), who performed this evaluation in a reserved room arranged by the staff at each school, using dental mirror with LED light.[14]

The signs and symptoms of sleep bruxism were recorded taking into account the following parameters: sibling or parental report of grinding sounds (at least three times a week); presence of shiny and polish facets on incisors and/or first permanent molars (based primarily on palatal surface and incisal edges and working cusps, respectively) observed in clinical examination, taking into account the time of eruption; and no other medical, mental or sleep disorders (e.g., epilepsy and obstructive apnoea syndrome). The presence of sleep bruxism was confirmed by both the parental report and the presence of tooth wear, since the latter is a cumulative sign.[15]

Body weight and height were also determined and the body mass index (BMI) was calculated as BMI = kg m^{-2}.

The inclusion criteria were the absence of pain of dental origin, premature tooth loss, anomalies of shape, number, structure and/or changes that might compromise the mesiodistal dimensions, tooth decay, trauma, and soft-tissue abnormalities. The exclusion criteria were systemic disturbances in general, ingestion of medicines that could interfere directly or indirectly with muscular activity and uncooperative behaviour.

2.2. *Masticatory performance determination*

Masticatory performance was assessed by the determination of the individual capacity of fragmentation of an artificial food denominated Optosil Silicona.[16] The components were blended and placed in metal moulds with cubic compartments measuring 5.6 mm, under mechanical pressure. The subjects received 17 cubes (3.6 g), which were chewed for 20 mastication cycles, visually monitored by the examiner. The fragmented particles were then expelled from the oral cavity into recipients with plastic sieves covered with a paper filter. The remaining particles were washed with water and disinfected using 70% alcohol dispersion. After drying, the particles were removed from the paper filter, weighed and passed through a series of 10 granulometric sieves with meshes ranging from 5.60 to 0.71 mm, connected in decreasing order and closed with a metal base. The particles were placed in the first sieve of the series and the set was maintained under vibration for 20 min. The particles retained on each sieve were removed and weighed on an analytical scale with a precision of 0.001 g. The distribution of the particles by weight was described by a cumulative function (Rosim–Ramler equation). The degree of fragmentation of the material is then given by the median particle size (X_{50}), which is the aperture of a theoretical sieve through which 50% of the weight of the fragmented material could pass[17]:

$$\mathrm{Qw}(X) = 1 - 2 - (X/X_{50})^b$$