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Original article

Differences in bite force between dolichofacial and brachyfacial individuals: Side of mastication, gender, weight and height

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ABSTRACT

Purpose: Due to the bite force importance in functionality of the masticatory system, this study aimed to characterize it in dolichofacial and brachyfacial individuals.
Methods: A sample comprised by 190 patients was divided into two groups: 90 severe dolichofacial, and 100 severe brachyfacial individuals classified according to the VERT index and the face height ratio (Jarabak quotient). Bite force was measured by using an adjusted digital dynamometer and proper methodology.
Results: The sample met the parametric assumptions and presented statistical significance when right and left sides of dolichofacial and brachyfacial individuals were compared. However, within the same group, no differences between the left and right sides were found. Generally, bite force was higher for male, left masticator, age between 41–50 years, weighing over 100 kg and between 1.81 and 1.90 m tall.
Conclusions: Based on the results of this cross-sectional study, it was possible to conclude that the bite force in severe brachyfacial individuals was significantly higher than in severe dolichofacial individuals, being influenced by gender, weight and height.

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1. Introduction

Bite force (BF) is an indicator of the functional status of the masticatory system [1], and is related to the facial morphology, occlusion, neuromuscular mechanism and variables such as gender, age and body type [2–5]. The BF produced during clenching in maximum voluntary contraction is the result of the action of at least six jaw elevator muscles and is related to the function of the masticatory system [3,6,7]. The variance in BF may be explained by differences in muscle size and thickness, sarcomere length-tension relation, craniofacial morphology, vertical jaw relation, facial height and inclination, shape and length of the jaw, and it is influenced by the dental region assessed as well as occlusion type [8,9]. It is also known that maximum bilateral BF is significantly lower than the maximum unilateral BF, and differences between the left and right sides should not exist. Furthermore, unilateral clenching leads to different response of the temporal muscle when compared to the masseter muscle [10].

Facial typology is related to dental occlusion, facial harmony, orofacial muscles, as well as the shape and configuration of the craniofacial structures, influencing chewing, swallowing, breathing and speech. There are countless facial typology classifications in the literature, among which Tweed [11], that assessed the vertical dysplasia of the face using the Frankfort Mandibular-Plane Angle (FMA); Jarabak [12], who categorized facial morphology based on three different patterns, defined by the facial height ratio (FHR) or Jarabak quotient [12]; and Ricketts [13], based on the VERT index, using five measurements (mandibular plan, facial axis, anterior lower facial height, mandibular arch and facial depth) to determine ideal values for a harmonic face, according to the individuals' age. The results of facial pattern could be summarized in: severe dolichofacial (below −2.0), dolichofacial (below −0.5), mesofacial (between −0.49 and +0.49), brachyfacial (above +0.5) and severe brachyfacial (above +1.0). Taking into account the importance of the influence of the musculature on craniofacial development, as well as to establish a baseline for future comparisons, the objective of this cross-sectional study was to assess bite force according to facial typology and other specific variables such as gender, age, weight and height.

2. Materials and methods

During the years of 2012 and 2013 a total 4033 patients of the Orthodontic Clinic of São Leopoldo Mandic Faculty (Campinas, Brazil) were screened and 190 consenting individuals met the inclusion criteria of this study: general good health, good oral hygiene, first four permanent molars having made their eruption, regardless of age, being classified either as DL or BR based on the VERT index (Ricketts) and the FHR (Jarabak quotient). The exclusion criteria comprised individuals that were in active orthodontic treatment and/or possessed temporomandibular disorders symptoms [14]. Patients were allocated into two groups; 90 severe dolichofacial individuals (Vert<or=−2; DL), and 100 severe brachyfacial individuals (Vert>or=+1; BR). Sample size was defined based on previous studies in the literature [15–17]. The study was approved by the local Ethical and Research Board, protocol number 2012/0160, and all participants agreed to sign an informed consent.

BF was measured with the use of a digital dynamometer (IDDK—Kratos Equipamentos Industriais Ltda, Cotia, Brazil) adapted to the oral conditions. BF measurements were conducted with the individuals in a sitting position, corresponding to the meatus-orbital plane, parallel to the ground in a comfortable chair, with their arms outstretched alongside their bodies and hands placed open on their thighs. Before any measurements were recorded, volunteers received detailed instructions, and tests were performed with the volunteers biting into the equipment to ensure the reliability of the procedure [18].

The device's biting pads were placed on the occlusal face between the upper and lower first molars, right and left alternately. The volunteers were then asked to bite into the device with maximum force. Three BF peak measurements (Newton—N) were collected from each side of the mouth with an interval of 10s between them. The highest BF measured on each side was registered. New measurements were conducted one month later in all volunteers, and the highest BF registered in the measurements on each side was considered for this study (Fig. 1).

Since the sample met the parametric analysis assumptions (Bartlett and D'Agostino-Pearson tests), errors with normal distribution, and homogeneity of variances, the data were compared with the use of appropriated statistical tests for each circumstance. Age, weight, height and BF presented normal distribution and were compared by using two-way ANOVA, followed by Tukey post hoc. Chi-square test was used to compare gender proportions. The intraclass correlation coefficient (ICC) was applied to ensure reliability regarding the agreement rate measurement of BF (left and right) taken at six periods according to the facial type. Pearson correlation coefficient was used whenever possible to verify the association between BF and remaining variables. Facial type dependency in relation to the remaining variables was observed through simple logistic regression (Backward Stepwise—Wald). Level of significance of 0.05 was used (*BioEstat* 5.0, GraphPad Prism 6.0 and SPSS 21.0).

3. Results

Among the 190 patients considered in the analysis, 100 were classified as severe brachyfacial individuals (BR, short face) and 90 as severe dolichofacial individuals (DL, long face). The sample was composed by 93 females (48.9%), and patients' mean age, weight and height were 23.9±9.2years, 68.5 ±16.6kg, and 1.67±0.1m, respectively. All individuals were equally paired between the two test groups according to age (23.3±8.7 for DL and 24.5±9.6 for BR, p=0.3645) and height (the same height for both groups, p=0.7490). Despite higher for BR (70.4±17.6) than for DL (66.4±15.2, p=0.0987), the overall weight was not quite significantly between groups.

Concerning the masticatory side, 50% of BR patients possessed bilateral bite preference; 33.3% bilateral, predominantly right; 13.7% bilateral, predominantly left; and 2.9% only bite on the right side. Among DL individuals, 44.0% possessed

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