Original Article

MedInform

DOI: 10.18044/MEDINFORM.202292.1498

ISSUE 2, 2022

Evaluation Of The Maximum Bite Force In Individuals With Different Verical Facial Types

Vladimir Bogdanov

Department of Orthodontics, Faculty of Dental Medicine, Medical University – Sofia, Bulgaria

Abstract

Studies on the maximum bite force in subjects with different facial types, age and gender are scarce and the values in some cases are controversial. The aim of this study is to evaluate the maximum bite force in individuals with different facial types and of both genders and to compare them with the results, reported in literature. Material and Methods. The study was performed on 65 subjects - 31 males and 34 females, with mean age 18.4 ± 6.1 years. Maximum bite force was measured by a gnathodynamometer, positioned in the first molar area on the left and right side. The subjects were divided into 3 groups depending on the vertical facial pattern – hypo-, normo- and hyperdivergent. Statistical analysis was performed by using IBM SPSS 23.0 statistical package. Results. Our data show that maximum bite force is lowest in the hyperdivergent facial type compared to hypo- and normodivergent. No difference was found in the maximum bite force between male and female subjects. Conclusion. From the analysis of the data, it can be concluded that there is no statistically significant difference in the maximum bite force between hypodivergent and normodivergent individuals while in hyperdivergent individuals the values were significantly lower.

Keywords: maximum bite force; vertical facial type; hyperdivergent facial type

Introduction

Maximum bite force (MBF) is an indicator of the functional state of the masticatory system (1). In dentistry, it is used to assess the therapeutic effect of prosthetic restorations, to determine reference values, and in research on prosthetic restorations and the masticatory mechanics. A number of studies have confirmed a direct link between masticatory function and maximum masticatory force (2).

According to Carlsson G. et al. (3), chewing efficiency depends not only on the bite force but also on a number of other factors. The MBF in the molar area is 490 N for men and 402 N for women; Bakke M., et

al. (6) measured average bite strength values of 522 N for men and 441 N for women. The large variations of MBF in the different studies are explained by the anatomical and physiological characteristics of the subjects, the place in the dental arch where it is measured and the different test techniques used. Bite force can be measured by various sensors - strain-gauge transducers, piezoelectric transducers and pressure transducers (7, 8, 9). Special attention should be paid to the method and the measuring devices, as they can affect the final values. For greater accuracy, multiple measurements and the use of mean values are also recommended (10).

A study of MBF in individuals with normal occlusion, class I and class II malocclusion and in patients with hypo- and hyperdivergent facial type showed that bite strength varies with vertical facial morphology. There are data that hypodivergent patients show the highest values of bite force compared to the other groups (11, 12).

There is evidence that the MBF varies with different age groups. According to Abu Alhaija E. et al., (13) it is higher in adults with short faces and skeletal deep bites than in individuals with long faces and open bites. These correlations are less pronounced in children (14).

Aim

As the values of the MBF vary significantly in different studies, the aim of the present study is to evaluate the MBF in individuals with different facial types and gender.

Materials and Methods

Fig. 1 Gnathodynamometer GD500.1

The study included 65 subjects with a mean age of 18.4 ± 6.1 years. The criteria for inclusion in the study were: no temporo-mandibular disorders; no pain during clenching the teeth; no missing teeth in the lateral areas and no evidence of an acute inflammatory process. The study did not include individuals who underwent or are undergoing orthodontic treatment or have evidence of bruxism. Lateral cephalometry was performed on each subject and the angle between the mandibular (M) and the SN plane was measured. The subjects were divided into 3 groups according to M / SN angle: Group 1. Hypodivergent - with M / SN angle less than 29°; Group 2. Normodivergent - angle M / SN between 29° and 35 °; Group 3. Hyperdivergent - with angle M / SN more than 35°.

The bite force was measured by a strain-gauge transducer – a gnatodynamometric system GD500.1 with a test range of 0-700 Newtons (N). The horizontal planes of the gnathodynamometer were positioned in the area of the first permanent molars.

The study was performed bilaterally, sequentially to the left and right side with interval of one minute.

Statistical methods:

The statistical analysis of the data was performed using IBM SPSS 23.0 statistical package. To test the distribution for normality - non-parametric Kolmogorov-Smirnov tests and non-parametric Mann-Whitney test - to test hypotheses for the difference between two independent samples. For a significance level at which the null hypothesis is rejected, $p<0.05$ was assumed.

Results

Data are presented in tables 1, 2 and 3. No statistically significant difference in the values was found between hypodivergent and normodivergent individuals on both the left and right (groups 1 and 2). In hyperdivergent patients, the MBF on both the left and right showed significantly lower values compared to hypo- and normodivergent patients (groups 1-3).

Table 1. Maximum bite force in hypo-, normo- and hyperdivergent facial types (groups 1, 2, 3), right side, in Newtons (N)

Group	n	$\overline{X}$ ± SD	P
1	25	374.08±129	1-2 p>0.05
2	26	380.8±133.3	**2-3 p<0.05**
3	14	290.5±114.9	**1-3 p<0.05**

$\overline{X}$ ± SD - mean values ± standard deviation

Table 2: Maximum bite force in hypo-, normo- and hyperdivergent facial types (groups 1, 2, 3), left side, in Newtons (N)

Group	n	$\overline{X}$ ± SD	P
1	25	398.6±127.1	1-2 p>0.05
2	26	420.3±132.0	**2-3 p<0.05**
3	14	308.6±83.4	**1-3 p<0.05**

$\overline{X}$ ± SD - mean values ± standard deviation

Table 3: Comparative analysis of MBF on the right and left side in men and women

Parameter	men (n=31)	women (n=34)	P
	$\overline{X}$ ± SD	$\overline{X}$ ± SD	
MBF right	379,30±126,68	353,85±135,93	p>0.05
MBF left	409,61±121,12	383,20±135,11	p>0.05

$\overline{X}$ ± SD - mean values ± standard deviation

The results show that there is no significant difference in the MBF on the left and right side between men and women in this age interval. For this reason, when estimating MBF in different facial types in groups 1, 2 and 3, both men and women were included.

Discussion

A treatment plan in orthodontics requires a good knowledge and understanding of the physiology of the masticatory muscles and their relationship with different facial types. It has long been of interest to study the masticatory force and its potential role in the development of the masticatory complex. In some cases, the masticatory force should counteract the orthodontic forces (4, 15).

The maximum bite force depends on the position of the measuring device (frontal, unilateral, bilateral), the size, the material, the elasticity and the accuracy of the device, the fear of pain or tooth breakage of the patient, the sensitivity of the teeth, muscles and the mandibular joint (4). According to Shinogaya T. et al., (16) 80% of the occlusal force is distributed in the area of the molars. For this reason in our study, we positioned the sensor in the area of the first permanent molars.

There is a link between occlusal forces and the facial morphology (13). If the ramus of the mandible is straighter and the gonial angle is relatively smaller, this gives a greater mechanical advantage to the masticatory muscles. As the gonial angle increases, the mechanical advantages of the muscles decrease and the equivalent force of the muscle produces smaller force in occlusion, suggesting that the occlusal force reflects the relationship between form and function (17).

Some data show that the bite force varies depending on the vertical facial morphology and individuals with hypodivergent type have higher values of the force compared to hyperdivergent (11, 18). Other studies do not find difference in maximum masticatory force in Angle class I, II and III (19). For this reason, our subjects were not divided on this basis.

In our study, the MBF in the hyperdivergent (group 3) is significantly lower than in the hypo- and normodivergent (groups 1 and 2) both on the left and on the right. According to Proffit W. et al. (20) long-faced individuals have a 50% lower bite force than normodivergent individuals. Our data show that the difference in the maximum strength of the bite between normo- and hyperdivergent is statistically significant, but not so pronounced.

In students with hypo-, normo- and hyperdivergent facial type, aged between 20 and 23 years Abu Alhaija E.S. et al. (13) reports mean value of MBF 573.42 ± 140.18 N. The authors found the highest values in individuals with a short face, while the lowest values were found in individuals with a long face. These data are consistent with the reported by Sasaki K. et al. (21) and Kiliaridis S et al. (22). Our data show that individuals with hyperdivergent type have the lowest values of masticatory force, but our values are lower than those of Abu Alhaija ES, et al. (13) in all three groups. This could be attributed to the fact that we use a metal sensor (fork) between the teeth, and the authors used a soft hydraulic sensor. The differences in the values of MBF in different studies are attributed to various individual and methodological factors. Individual include physical characteristics and craniofacial morphology. Data concerning the dependence on anthropometric variables are also contradictory. While Shiau Y. and Wang J. (23) report that bite force increases with age, height, and body weight, Braun S et al. (24) finds a low correlation between bite strength and anthropometric parameters. With regard to gender differences, the data are also ambiguous. Many authors report higher values in men than in women (25, 26). Factors related to methodological differences include interoclusal distance, location of the meter on the dentition, position of the head during measurement (13). The lack of differences in the bite strength between individuals with and without parafunctional habits has also been reported (27).

Conclusion

From the analysis of the data, it can be concluded that there is no statistically significant difference in the maximum values between hypodivergent and normodivergent individuals both on the left and on the right

side. The masticatory force in hyperdivergent individuals on both sides showed significantly lower values compared to hypo- and normodivergent. The lower forces in hyperdivergent suggest avoiding or using very cautiously devices with pronounced vertical component of the force, because the masticatory force is not effectively opposed. No gender differences were found.

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Corresponding author:

Vladimir Bogdanov
Department of Orthodontics, Faculty of Dental Medicine, Medical University – Sofia, Bulgaria
Address: Georgi Sofiyski 1 str. Sofia, Bulgaria,
phone number: +359 898 488 278
E-mail: vladbogdanov@yahoo.com