Relationship of body mass index to maximum bite force in a sample group from Nepalese population

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Abstract

Statement of problem: The force generated by masticatory apparatus can be called as bite force in normal functions of jaws. Various factors such as age, sex, built, periodontal support etc. can affect the bite force.

Purpose: To evaluate the impact of body mass index (BMI) over bite force in Nepalese adult individuals.

Materials and Method: Total 384 adult volunteers from Eastern Nepal were enrolled in the study to record bite force and BMI. Statistical analysis was done at 95% confidence interval with the level of significance at 0.05.

Results: The mean maximum bite force (MMBF) of Nepalese adult population was approximately 273N. The BMI had no significant impact on MMBF.

Conclusion: The study found the MMBF of Nepalese adult population and within its limitations, the study did not establish BMI as a predictor of MMBF.

Keywords: Mean maximum bite force, BMI, Masticatory efficiency, Age, Gender, Masticatory apparatus.

Introduction

Bite force is defined as the force generated between maxillary and mandibular teeth by an act of the jaw elevator muscles.[1] It is one of the determinants of the functional state of the masticatory system, which is determined by the central nervous system, feedback from muscle spindles, mechanoreceptors and nociceptors, which in turn is modified by the craniomandibular biomechanics that influence and coordinates the movement of the jaw elevator muscles.[2] It is utilised to know the beneficial effect of prosthetic rehabilitation, and also in identification of the disorders in stomatognathic system.[3,4]

Several parameters such as craniofacial morphology,[2] age,[5] sex,[6] periodontal support of the teeth,[7] and the type of measuring devices[8] can influence the measurements of bite force determination. Also, for recording various devices like bite fork, force sensing resistors,[8,9] strain gauge transducers,[10] foil transducers[11] can be utilised.

In the current study, the role of body mass index (BMI) over maximum bite force is evaluated. There are many studies[12-17] pertaining to BMI. The results of them were contrasting and thus this study aims to test the hypothesis that the BMI has an impact on MBF in a study sample from Nepalese population.

Materials and Method

The study was carried out in 384 adult dentate participants with a full set of teeth till the second molar, without considering the presence or absence of the third molar teeth from Nepalese population. The exclusion criteria were that the participants had no known craniofacial abnormality, no known temporomandibular disorders upon general evaluation, no evidence of wasting disease occurring in the teeth, the absence of carious lesions in the molars, no past history of orthodontic treatment or prosthodontic rehabilitation. The study was ethically permitted by Institutional Review Committee of B. P. Koirala Institute of Health Sciences.

A bite force measuring device was customised for the purpose of measurement of the bite force of the participants. This device had miniature load button of LLB (Load Button Load Cell) series as biting element and stainless steel Clamp Probe paired with FUTEK's Handheld Digital Display (IHH500). The measured force was displayed in Newton(N) digitally.

The participants were seated comfortably in a dental chair in an upright position and then the bite force measurement method was demonstrated. The measuring device was kept straight and parallel to the floor. Instructions to the participants were given and asked to bite with the hardest force on the gauge without any movement of the head. The bite force measurement was made on both sides of the first molar teeth. Three readings of the bite force was taken from each participant, the reading was made in an interval of three minutes for the relaxation of muscle fatigue. To measure the bite force and reduce the inter-observer bias single investigator was allotted to perform and record the score.

Body height was measured with a measuring scale on a wall when patient stood in an erect position without shoes with a precision of 0.1 cm, and weight was recorded in kilograms with a weighing scale. The

BMI was calculated using the formula; BMI = weight (kg)/height (meters^2)

Results

The data collected were entered into Microsoft Excel program and transferred to SPSS software to perform the statistical analysis. With 95% confidence interval the level of significance was kept as $p \leq 0.05$. The results of the observations made from the study population showed that mean maximum bite force (MMBF) was 273.01N on right and 273.70N on left side. While comparing between the bite force at left and right side of the jaw there was no statistically significant difference.

Mean maximum bite force was found to be 314.94N in males and 223.69N in females. There was no statistically significant difference in observations made between genders. The results of the study are depicted in Tables 1-3.

Table 1: Mean and significance of bite force between left and right side

	Number of subjects	MMBF±SD	p-value
Right bite force	384	273.01±49.57	0.488*
Left bite force	384	273.70±49.17	

p>0.05 indicating not significant

Table 2: Mean and significance of bite force between genders

Parameters	Number of subjects	MMBF±SD	Minimum	Maximum	p-value
Gender					
Male	209	314.94±14.29	221.00	343.50	0.773*
Female	175	223.69±18.86	181.50	343.50	

p>0.05 indicating not significant

Table 3: The effect of BMI in MMBF

Parameters	Number of subjects	MMBF±SD	Minimum	Maximum	p-value
BMI					
Normal	367	272.18±48.54	181.50	343.50	0.112*
Overweight	17	277.18±46.60	191.50	321.50	

p>0.05 indicating not significant

Discussion

The present study was conducted amongst Nepalese population. The separation of teeth was 15 mm in all participants during the recording of the bite force. Several authors[18,19] found that the magnitude of force increased when jaw opening was up to 15 -20 mm of the interincisal opening which roughly equals to the optimal length of elevator muscles.

Gender and BMI were found to be predictor of MBF in Saudi Arabian study sample as higher BMI was correlated with higher MBF in the participants who were dentate as well as who had fixed prostheses.[20] Gender difference during the measurement of bite force was observed in some studies[9,10] unlike the observations in the present study. The difference was not significant, may be due to larger but unequal sample of male and female participants.

The bite force of the Taiwanese sample population showed that it was higher in obese girls and overweight boys. The mean serum testosterone was correlated to increase in BMI.[21] Their findings contrast to the present study as no significant effect of BMI over the maximum mean bite force was observed. There are several studies[3,14-16] which agree with this finding indicating no significant impact of BMI on bite force.

However, lower weight was significantly correlated to MBF values in one of the studies.[14] There are several published studies[12,13] in weight and built which have similar findings, but none of these studies were able to establish BMI as a predictor of MMBF.

Conclusion

Within the limitations of the measured variables of this study, it was found that the mean maximum bite force in studied population sample was 273N. The right or left side has no significant impact on MMBF, and also there was no statistically significant impact of BMI over MMBF in Nepalese population.

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