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Analysis of Bite Force Measurement for Stomatognathic

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Abstract: An analysis examines the biting force with proposes measuring maximal voluntary bite forces associated with the chewing muscle's size. Bite forces must be reliable and accurate to be used clinically using a pressure force sensor. The cross-sectional area of a muscle determines the maximum force it can produce. The force exerted by the masticatory muscles during tooth occlusion can be up to ±700 N. The cross-sectional size of various jaw muscles, measured with a computed tomography scanner or magnetic resonance imaging (MRI), is widely associated with maximum bite force. It can be recorded to evaluate the function and effectiveness during the occlusion. Bite force has been used in dental research to measure the effectiveness of various dental operations. In stomatology, measuring bite force is critical, and choosing the suitable measurement method and apparatus is essential for accurate results.
Results: Successfully aimed to design for efficient, reliably reproducible measure and to compare the results in a small population with obtained results revealed that males had a significantly higher bite force than females.
Conclusions/Recommendations: This study is helpful for stroke patients for measuring the bite force after the rehabilitation activity.

Keywords: Bite force, clinical, cross-sectional, maximum bite force, CT scan, MRI, occlusion, stomatology.

1.0 INTRODUCTION

The magnitude of the maximum voluntary biting force is the consequence of the combined action of the jaw elevator muscles modified by jaw biomechanics, it is an indicator of the functioning condition of the stomatognathic system [1].

The teeth, periodontal tissues, and articulatory system are believed to be the three components of the stomatognathic (or masticatory) system. The way teeth are designed to touch each other affects the efficiency and function of the stomatognathic system [2][3], so a good grasp of occlusion is vital for optimum dental health. Every strength exerted during biting activity is aided by the jaw muscles. The stomatognathic has various characteristics that distinguish it from other individuals. Several factors determine the amount of maximal voluntary bite force.

The bite force is the force exerted by the masticatory muscles during tooth occlusion. It can be recorded to evaluate the function and efficacy of the masticatory system. Bite force has been used in dentistry research to assess the effectiveness of various dental procedures. Bite forces must be reliable and accurate to be used clinically. Reliable measurements produce no systematic mistakes and just minor random errors between measurements.

Jaws were once assumed to be frail, incapable of exerting or maintaining considerable bite force. Some claim that humans have evolved to eat smaller meals because of evolution. Or that it has reduced the evolutionary necessity for strong jaws. Some even believe that weedy jaw muscles facilitated the evolution of larger brains by making it easier for them to evolve. Human jaws are not weak, and these notions have a fatal flaw [4].

2.0 RELATED STUDY

Variable factors of bite force

Age: Muscle strength may deteriorate because of regular ageing along human development process [5]. Indeed, the jaw closing force affect adults and growth, remains relatively constant and then begins to drop in adulthood, around 35 years of age [6].

Gender: The composition of muscle fibers in males and females may be influenced by hormonal variations [5]. Other author state, men's means were approximately 30% higher than women's when all subjects and measurements were compared [7].

Maximal bite force

Bite forces are the activity of jaw elevator muscles and mouth muscles, which is one sign of the masticatory system's functioning status [5]. The maximal bite force of healthy individuals' natural teeth can be up to 700 N for both gender [8]. It indicated that edentulous patients increased their masticatory efficiency after rehabilitation [9]. This meant the participants with stable prostheses had better mastication.

Voluntary selection

The bite force measurement was tested on a group of students, in the age category of the young adult. All test volunteers completed a prior survey, and the selection of test volunteers was made based on the following criteria:

1) The test was voluntary were young adults, ages 18 to 25 years old.
2) The test voluntary possessed a complete set of teeth and;
3) Normal test voluntary with no stomatognathic issue and/or;
4) The test voluntary had jaw surgery or any clinical support and/or;
5) Habit is clenching or grinding teeth (bruxism).

Table 1: Mean of age in each category.

Gender / Category	Male	Female
Normal	22	24
Bruxism	22	22
Clinical Support	22	22

In the following procedural steps, all test volunteers were appropriately informed about the purpose, content, and precautions before participating in this study were taken to avoid tooth injury. This risk was minimized which the sole danger being a dental fracture during occlusion.

The correct positioning manner also plays a role in obtaining the correct measurement. For each test, volunteers will be asked to do the static occlusion method and give the maximal bite. In dental contact, the contact between teeth is referred to as occlusion. In more technical terms, it is the connection between the maxillary (upper) and mandibular (lower) teeth when they approach each other during chewing or at rest. Static occlusion refers to the contact between teeth when the jaw is closed and motionless. The highest measurement will be taken at the 3rd second after the volunteer makes the strongest bite.

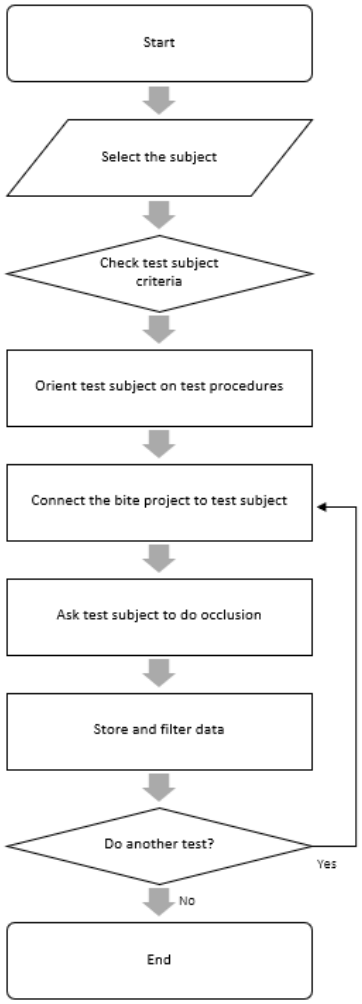

Figure 1: Flow of collecting data

Flexiforce sensor

A mechanical device that provides a variable resistance value after pressuring it is a force sensor. The sensor was made up of two parts for measuring bite force: a piezoresistive load cell and an electrical device for sensing changes in the sensor resistance.

Table 2: Dimension of sensor used.

Thickness	0.208 mm
Length	70 mm
Width	5 mm
Sensing area	15 mm

3.0 RESULTS

Comparison of the bite force among voluntary measured in different stomatognathic considerations was not significantly different among the three categories. The distribution of the mean maximum bite force for the whole sample is shown in Table 3.

Table 3: Mean of maximal bite force for each category.

	Normal		Bruxism		Clinical S.	
No	M	F	M	F	M	F
1	634	588	545	370	590	542
2	615	561	529	425	610	474
3	710	634	499	321	-	-
4	590	483	555	365	-	-
5	676	587	-	-	-	-
6	673	500	-	-	-	-
7	655	604	-	-	-	-
Mean	650	565.0	532	370.25	600	508

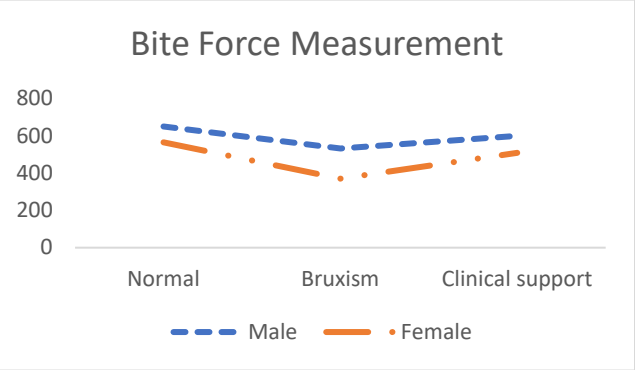

Figure 2: The mean force of Stomatognathic consideration.

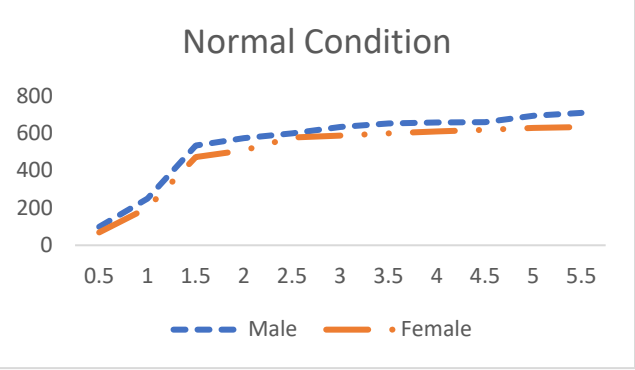

Figure 3: Highest bite force of normal condition in 5 seconds.

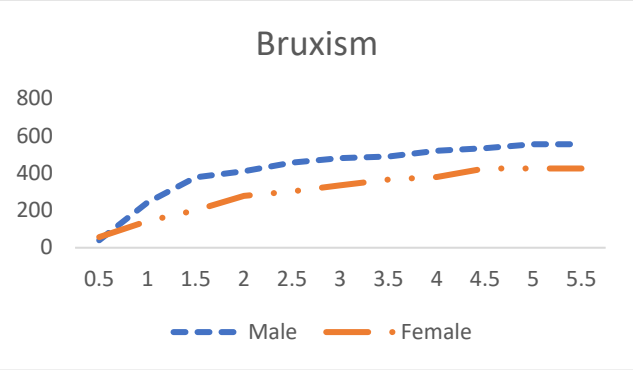

Figure 4: Highest bite force of bruxism in 5 seconds.

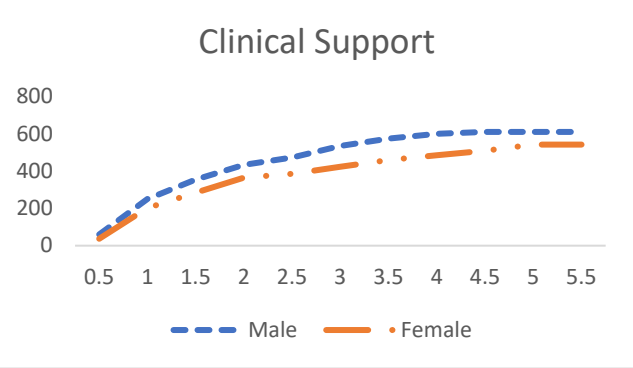

Figure 5: Highest bite force of clinical support in 5 seconds.

4.0 DISCUSSION

Volunteer test subjects with normal cranial measurements, a complete set of teeth, good dental health, and no heavy tooth restoration in any of the dental regions were employed in the investigation. An orthodontist defines these conditions, as well as any others that may exist. As a result, the study does not address the test subjects' validity. The system filters data based on the magnitude of the bite force collected.

5.0 CONCLUSION

Considering the difference in device for measuring stomatognathic forces in previous studies, this analysis also aimed to design for efficient reliably reproducibly measure and comparing the results in small population. The analysis successful with obtained results revealed that males had a significantly higher bite force measurement than females. This study can be recommendation to different stomatognathic consideration. Bite force measurement has proven to be a viable means of evaluating the biomechanical properties of the masticatory system as well as prosthetic therapy. When comparing biting force measurement in study, however, additional important parameters should be considered.

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