Is maximal bite force affected in patients with myogenic temporomandibular disorders?

Sara Mohamed Ahmed [1], Elsadat Saad Soliman[2], Doaa Tawfik Hassan[3], Diaa Elsaied[4], Mona Mohamed Ibrahim[5]

[1, 2, 5] Departement of Physical Therapy for Musculoskeletal Disorders and Its Surgery, Faculty of Physical Therapy, Cairo University**,** Cairo, Egypt.

[3]Department of Prosthodontics, Faculty of Dentistry, Minia University, Minia, Egypt.

[4]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Minia University, Minia, Egypt

Corresponding author: Sara Mohamed Ahmed
Affiliation: Demonstrator at the Department of Physical Therapy for Musculoskeletal Disorders, Faculty of Physical Therapy, Cairo University**,** Cairo, Egypt.
Official Email: sara.mohamed@cu.edu.eg

ABSTRACT

Background : *Myogenic Temporomandibular disorders (MTMD) are the most prevalent type of all TMD subtypes. It is a muscular disorder of the masticatory muscle system. Since the bite force is one of the most crucial aspects of the masticatory system's functioning, it is imperative to examine it in patients with myogenic TMD. Purpose: This study aimed to measure the bilateral maximal bite force in myogenic TMD patients and compare it to that of matched healthy subjects. Subjects & Methods: Forty-two participants whose mean age was 27.24 ± 7.70, were enrolled for the current study and assigned into 2 groups, group A (N=21) included healthy controls and group B (N=21) included patients with myogenic TMD. An occlusal bite force meter was used to measure the maximum posterior bite on both sides for both groups. The Mann-Whitney U test is used to compare differences between the both groups. Results: The maximal bite force on the left and right sides varied significantly between the two groups, favoring the healthy controls ($p < 0.001$). Conclusion: Patients diagnosed with myogenic TMD exhibited decreased maximal bite force on both sides when compared to matched healthy controls. It's unclear if this decline is a result of the illness directly or if there are other factors at play. To distinguish between these kinds of observations, longitudinal research is required.*
Keywords: Temporomandibular Disorders; Bite force; Bite force meter; Myogenic TMD

INTRODUCTION

Temporomandibular disorders (TMD) is a general term that incorporates a series of clinical manifestations involving both jaws, the Temporomandibular joint (TMJ), and other related tissues (De Stefano et al., 2022; Okeson, 2019). It is presented by various clinical signs and symptoms for such cases including limitation of mandibular motion, orofacial pain and/or neck pain, unpleasant joint sounds, functional activity constraints (chewing, talking), and psychological problems (Di Fabio, 1998; Dinsdale et al., 2020). Unlike chronic pain conditions, TMD tends to affect younger persons with age ranges from 18 to 45 years (Cook, 2007& Lövgren et al., 2016). It is the second most common source of musculoskeletal pain and restriction after low back pain (De-Pedro-Herráez et al., 2016& Schiffman et al., 2014). Regarding the etiology of TMD, It is recognized that a variety of reasons, including pathophysiological, psychological, and traumatic ones, can trigger TMD symptoms (Dworkin & LeResche, 1992& Okeson, 2019).

Myogenic TMD is the first subtype of all TMD categories according to Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) and it is the most frequent type of all TMD (Harrison et al., 2014& Schiffman et al., 2014). Proper assessment and treatment of myogenic TMD include examinations of the masticatory muscles to obtain the best muscular function. Masticatory muscle can be analyzed utilizing electromyography (EMG)(García-Morales et al., 2003) CT and MRI (Van Spronsen et al., 1989), and bite force assessment which is a mandatory measure for diagnosis of myogenic TMD (Pires et al., 2023).

Occlusal bite force-meter GM10 is the most immediate, simple, and reliable device for bite force measurements of all those methods (Patil et al., 2022).

Dinsdale and his colleagues (2020) highlighted low to very low Information concerning bite force measures in all TMD particularly myogenic type (Dinsdale et al., 2020). Clinical practitioners must have a thorough understanding of muscle power that helps them to develop appropriate clinical decision-making and guides them to orient their attention to improve muscle function for optimization of mandibular function. In light of that, this study aimed to measure the bilateral maximal bite force in myogenic TMD patients and compare it to that of matched healthy subjects

MATERIALS AND METHODS

Study design

Comparative Cross-sectional Observational Study

Participants

The sample was composed of 42 subjects of both genders,the inclusion criteria were (i) ages 18 to 42, among whom 21 subjects in group B (myogenic TMD) and 21 subjects in group A (healthy controls) were selected as age and gender-matched to those in group B. (ii)All subjects had been assessed according to RDC/TMD using the myogenic examination protocol, and (iii) they could only have one lost molar at a time in order to prevent bite force affection. (Hartmann & Cucchi, 2014). They were recruited from the outpatient clinic of Minia Teaching Dental Hospital. The following exclusion criteria were (i) Arthrogenic or disc displacement TMD diagnosed by RDC/TMD (Schiffman et al., 2014); (ii) Acute traumatic injury of TMJ; (iii) artificial teeth or dental implants (Hartmann & Cucchi, 2014); (iv) presenting with two or more lost teeth; (v) Presence of acute toothache or unsatisfactory periodontal health (Todic et al., 2019); (vi) Cognitive deficits; (vii)

Medication intake (analgesics, anti-inflammatory or muscle relaxant drugs). The Myogenic examination protocol for masticatory muscles includes pain and rememorization of symptoms during jaw opening movements or palpation with the pressure of 2-3 pounds for 2 seconds on the masseter and temporalis according to RDC/TMD algorithm Group I Muscle Disorders (myogenic TMD) (Schiffman et al., 2010). The study was conducted at the outpatient clinic of Minia Teaching Dental Hospital between July 2023 and April 2024.

Measurement procedures

Bite Force Measurement

Bite force was measured in each group by using occlusal bite force-meter GM10 which had a digital display indication and a strain gauge probe as shown in (figure 1). The device was placed in the site of the first and/or second molars for recording the posterior bite force of mandibular elevation (figure 2). The bite force probe tip is covered with clay silicone (GAC International) and plastic wrap to avoid harm to the strain gauge and molars (Sathyanarayana et al., 2012). The measurements were taken with a mouth opening of 15-20 mm. To prevent cross-contamination between patients, the clay silicone and plastic wrap were changed after each subject. The instructions for the subjects were to bite as hard as they could three times, with a few minutes break for the right bite and the same process for the left, while they were seated straight-backed and facing straight ahead without head support. Two more trials of the bite force measurement were conducted, with a short break of a few minutes in between. The final score was recorded as the mean of the three measurements on each side.

Figure 1: Occlusal bite force-meter GM10

Figure 2: Measuring RT. post. bite force

Statistical analysis:

Data management and analysis were performed using SPSS for Windows, version 26 (SPSS, Inc., Chicago, IL). Before final analysis, data were assessed for normality assumption, homogeneity of variance, and presence of extreme scores, and the p-value at < 0.05 was considered significant. This analysis was done as a pre-requisite for parametric testing of the analysis of differences.

Comparison between mean scores of the different parameters in the two groups was carried out using the Independent sample Mann-Whitney U Test to determine the significant differences Between groups in bite force for both sides.

Results

Forty-two subjects participated in the current study with 21 subjects in group A (healty controls) and 21 subjects in group B (patients with myogenic TMD).

The mean ± SD of the age was 27.24 ± 7.70 years in both groups. Comparing the mean values of age in the two groups using the Independent sample t-test test showed that there were no significant differences between them (Table 1).

Table 1: Descriptive statistics and Between-group differences for the mean values of demographic data in both groups.

Variables	Mean ± SD		t-value	*P*-value	Sig.
	Group A N = 21	Group B N = 21			
Age (years)	27.24 ± 7.70	27.24 ± 7.70	0.000	1.000	**NS**

*SD= Standard deviation, *t-value=t-statistic, *P-value=probability, *Sig. =Significance, *NS=non-significant.

The gender distribution of both groups A and B revealed that there were 17 females with a reported percentage of 81% while the number of males was 4 with a reported percentage of 19% (Table 2). There was a significant difference between groups in sex distribution ($p < 0.001$).

The distribution of the number of lost molars of group A revealed that there were 13 participants with no loss with a reported percentage of 62% while the number one molar lost was 8 with a reported percentage of 38%. The number of lost molars distribution of group B revealed that there were 8 participants with no loss with a reported percentage of 38% while the number of one molar lost was 13 with a reported percentage of 62% (Table 2). There was no significant difference between groups in the number of lost molar distribution ($p = 1.000$).

The dominant side distribution of group A revealed that there were 11 participants right-handed with a reported percentage of 52.4% while the number of left-handed participants was 10 with a reported percentage of 47.6%. The dominant side distribution of group B revealed that there were 8 participants right-handed with a reported percentage of 38% while the number of left-handed participants was 13 with a reported percentage of 62% (Table 2). There was no significant difference between groups in the dominant side distribution ($p = 0.537$).

Table 2. The frequency and chi-squared test for comparison of sex distribution between groups.

		Group A N = 21	Group B N = 21	$\chi 2$ value	p-value	Sig
Sex distribution	**Females**	17 (81%)	17 (81%)	16.095	< 0.001	**Sig**
	Males	4 (19%)	4 (19%)			
Number of lost	**No**	13 (62%)	8 (38%)	0.000	1.000	NS

molars	**One**	8 (38%)	13 (62%)			
Dominant side distribution	**Rt**	11 (52.4)	8 (38%)	0.381	0.537	NS
	Lt	10 (47.6%)	13 (62%)			

χ^2**:** Chi-squared value *p*-value: Probability value *Sig. =Significance

Between-group differences in the bite force:

Independent sample Mann-Whitney U Test was conducted to study the between-group difference in the bite force (right and left sides) in both groups. There was a significant difference between groups in the bite force both on the left and right sides. Right and left bite forces of the healthy controls were significantly bigger than their similarities in patients with myogenic TMD. ($p < 0.001$). (Table 3 and Figure 3).

Table 3: ***Mean values of Bite force, and between-group differences.***

	Group A N = 21	**Group B N = 21**	**MD**	**Mann-Whitney U test**	**p-value**	**Sig**
	Median (IQ)	**Median (IQ)**				
Rt. Bite force (N)	396 (171)	244 (153)	175.52	54.000	< 0.001	**S**
Lt bite force (N)	412 (133)	193 (114)	192.95	39.000	< 0.001	**S**

* IQ= Interquartile range, *P-value=probability, *S=Significant.

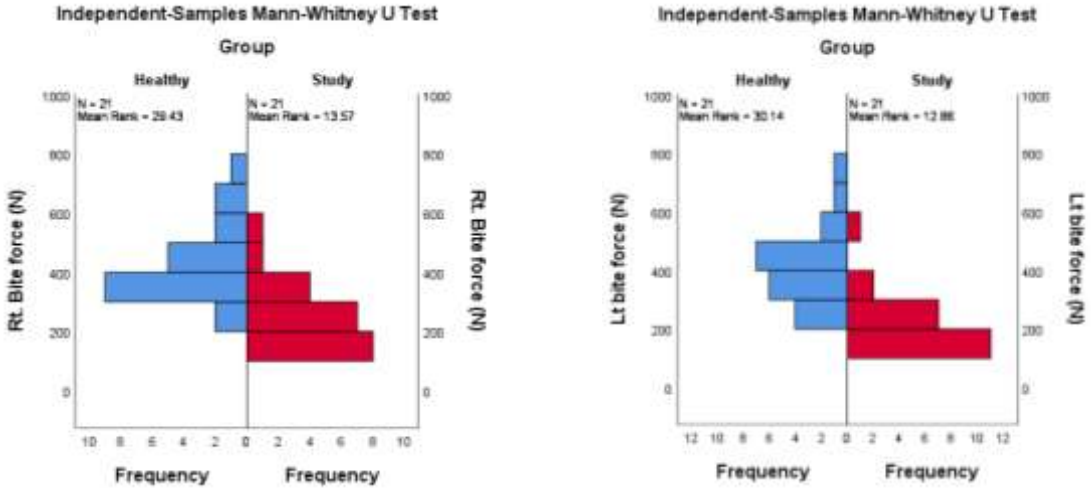

Figure 3: Independent-Sample Mann-Whitney U test for between-group comparison of bite force

DISCUSSION

This study found that there is a significant difference in the maximal bite force between patients with myogenic TMD and healthy controls on both right and left sides, favoring the healthy controls for the both sides. The results comes in agreement with recent articles (Testa et al., 2018; Todic et al., 2019) who reported that TMD significantly lowers the max bite force and action potential of muscles of mastication. on the other hand, Koyano and his colleagues (1995) revealed no significant difference between the

myogenic TMD group and the control group (Koyano et al., 1995). It is suggested the controversy comes from different, personal (age, gender), psychological (stress), physical, and physiological factors (classes of the facial profile in craniofacial morphology, occlusions) as well as different masticatory muscle strength procedures (various force transducers and accurate sites between molars)(Koc et al., 2010).

From the biomechanical point of view, particularly the torque system and classes of lever. The more posterior bite the more force by muscles of mandibular elevation (masseter and temporalis). Also, the separation between jaws during measurement could affect the value of bite force recorded by the measuring device. The occlusal bite force meter applied with a mouth opening of about 20 mm puts the muscles in a pre-stretched position. This enhances the bite force according to the length-tension relationship (Bakke et al., 1990).

Interestingly, malocclusions like an overbite (class II molar occlusion) or an underbite (class III molar occlusion), as well as facial profiles (orthognathic, retrognathic, and prognathic), could influence the maximal bite force (Ahlberg et al., 2003& Bakke, 2006& Kaur et al., 2022).

Harrison and his colleagues (2014) described the myogenic TMD pathological process as directly injured through overuse and\or tensile strain or indirectly injured through muscle guarding and central overactivation causing injury to the musculotendinous unit, delayed onset muscle soreness, muscle guarding, and spasm (Harrison et al., 2014). Based on the concept that the injured muscle is a weak muscle, Warren and his colleagues (2002) research work revealed that the majority of the early strength damage results from a disappointment of excitation-contraction coupling cycles and that a sluggish loss of contractile protein soon after injury (Warren et al., 2002). Another justification possibility is due to the chronicity of that condition, it may have an inhibitory mechanism to masticatory muscles (Bezerra et al., 2012). Another possibility is that the max bite force reduction may be influenced by the presence of pain in the masticatory muscles and inflammation of the TMJ (De Luca, 1997). That pain may produce a "splint" reflex and obstruct the patient's ability to bite against the measuring device (Bakke, 2006). Until now, it is still indistinct how TMD interferes with reduced max bite force. Although, it is suggested to Comprehensively assess the masticatory muscles for appropriate treatment planning.

CONCLUSION

In comparison to matched healthy controls, patients with myogenic TMD had reduced maximal bite force on both sides. It's unclear if this decrease is a direct effect of the illness or a contributing factor. Longitudinal research is necessary to differentiate between such observations.

Recommendation

The relationship between the side of affection with myogenic TMD and the maximal bite force deterioration is suggested for research, as well as the evaluation of mandibular function and oral health quality of life in patients with myogenic TMD and its correlation to bite force.

Ethical approval

This study is reviewed by the ethics committee of scientific research at the faculty of physical therapy, Cairo University (No:P.T.REC/012/004565), approval date (7/2023). The study procedures were demonstrated in detail for every subject before the assessment and they signed a written consent form for approval to participate in the study.

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