

# Lower Jaw Grip Strength in Healthy and Sick Population Measured by Special Force Transducer

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## ABSTRACT

**Introduction:** One of the basic chronic diseases of the MFH domain that is treated on an outpatient basis is temporomandibular dysfunction (TMD). It represents a number of pathological conditions that lead to the dysfunction of the normal function of the stomatognathic system. Observing the etiologic factors of this condition, temporomandibular TM trauma, poor habits such as infantile type of swallowing, tongue depression, and tectogenic disturbance of the myofunctional squamous system are reported in order to reconstruct the defects of neighboring regions. **Material and Methods:** The study included 60 patients divided into 3 groups: Group I without predetermined temporomandibular dysfunction, Group II with TMD, and Group III where one of the muscles of the masticatory group was used during the reconstruction procedure. **Results:** Statistically obtained results show that in group III there is a large difference in post-operative measurement after 6 weeks. **Discussion:** In the mentioned patients divided into three groups, the measurement of the pressure strength expressed in N follows certain states with its measured values, which coincides with comparative studies. **Conclusion:** From the obtained results we conclude that the parameter used, the strength of the lower jaw bite is a significant indicator of the chewing system functioning. **Keywords:** TMD (temporomandibular dysfunction), temporomandibular joint, tongue depression, swallowing type, healthy population, surgical patients.

## 1. INTRODUCTION

Temporomandibular dysfunction (TMD) is the term for a number of pathological conditions that lead to the dysfunction of the normal function of the stomatognathic system.

Diagnostic indicators and symptoms of this pathological condition are most commonly pain in the area of chewing muscles, temporomandibular joint, inability to perform certain functional operations such as opening or closing the mouth, chewing and swallowing, etc. (1, 2).

Etiologically, this disorder is partially caused by the trauma of the joint structures, causing the pain of regional cranio-facial muscles.

Poor myofunctional habits, such as infantile swallowing, tongue depression, and breathing through the mouth, lead to movement of the condyles backwards and causing joint traumas which are occurring 2000 times in one day. These factors may also start in childhood, which may explain the high prevalence of temporomandibular joint (TMJ) dys-

function in younger age.

According to world literature, the prevalence of TMJ dysfunction from 35 to 72% of the total population (3, 4, 5, 6).

In the structural incompatibility of the joint bodies, four groups can be distinguished: deviations in the form of joint bodies, adhesion, subluxation and spontaneous dislocation.

Also, in case of specific muscle mass loss, used to reconstruct defects after removal of tumor mass, the masticatory chewing system is disrupted and the function of chewing muscle is in asynchrony, which is often referred to as a condition called TMD.

This group of patients includes conditions after operative and reconstructive interventions on M. Masseter, M. Buccinator and M. Temporalis.

Indicators of above mentioned conditions are objective clinical signs that lead the therapist to conclude the existence of a certain pathology.

The aforementioned signs include pain during palpation, constraints of

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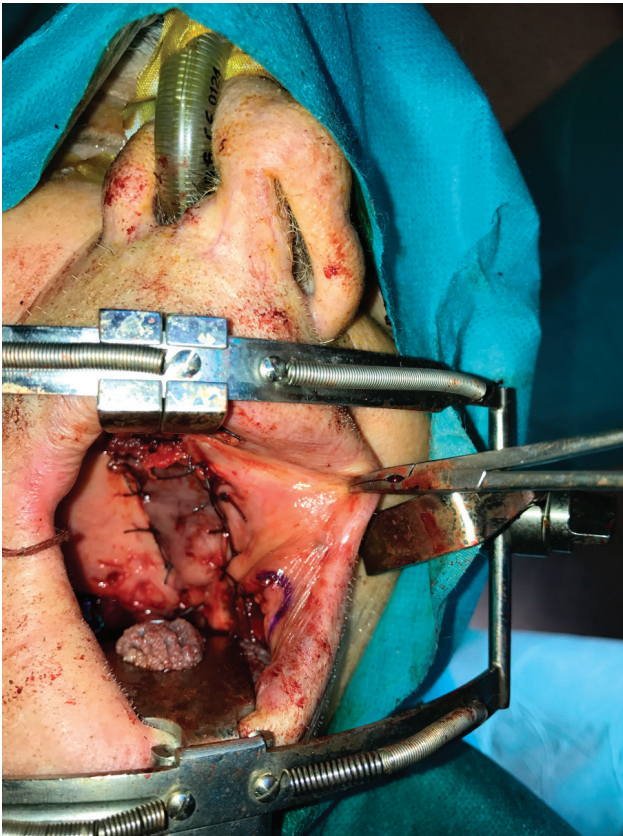


Figure 1. M.buccinator flap (original image, University Clinical Center Sarajevo)

mandibular movements, joint sounds, damaged facets on the incision plates of the teeth, insufficiency of the support apparatus—tooth mobility, pulpitis, headache and migraine, otological symptoms and many other less prominent signs, lower jaw bite strength is the main symptom and quality of the characteristic chewing system.

Described by many authors, the strength of the lower jaw bite, measured by specially constructed devices, is a relevant information on the condition and function of the chewing system (8, 9, 10).

## 2. MATERIAL AND METHODS

### Material

The study was conducted as a clinically manipulative retrospective study. The study included 60 patients divided into 3 groups:

- Group I, without predetermined temporomandibular dysfunction, in which we performed examinations for the purpose of determining the strength of the bite with a specially constructed gauge. By clinical examination, we determined the existence of temporomandibular joint crepitation and the sensation of pain during palpation.
- Group II – patients with TMD.
- Group III, in which one of the muscles of the masticatory group was used during the reconstruction procedure, namely M. masseter, M. buccinator and M. temporalis.

Each group included 20 patients.

The patients involved in this study are at age from adolescence to the elderly age, regardless of sex.

The measured variables were obtained in outpatient basis, on a physiotherapeutic chair with a sophisticated device for measuring the force of the lower jaw bite. Other measurements were performed by clinical examination and noted into the study form.

Measurements were performed at first examination and 6 weeks after.

Inclusion criteria were strictly followed, and we included only those patients who were:

- Patients who have signed an informed consent.
- Patients who had a neat dental status in both jaws or had adequate prosthetics.
- Patients involved in this study are at age between adolescents and the elderly age.
- The sample of patients involved in this study is related to both sexes.

Also, are excluded patients who are:

- Younger than 16 years.
- Who did not sign informed consent.
- Which had previously surgical procedure of the described system.
- Who do not have the proper dental status or adequate teeth prosthetics.

The study was carried out in accordance with the basic principles of the Helsinki Declaration, which refers to the rights of patients involved in biomedical research. During the implementation of this study the identity and all personal data of the patient are permanently protected in accordance with the regulations on the protection of the identification data. No patient is included in this study without previously



Figure 2. Dynamometer with a specifically designed force transducer of the lower jaw bite (original photograph taken by the author)



Figures 3 and 4. The measurements were performed at two-time points: First measurement and 6 weeks after (original photograph taken by the author)

Group	Measurement	Mean	Std. Deviation	t	p
I	1 <sup>st</sup>	184.70	7.57	0.942	0.358
	2 <sup>nd</sup>	184.20	6.71		
II	1 <sup>st</sup>	137.24	7.48	0.290	0.775
	2 <sup>nd</sup>	137.05	8.06		
III	1 <sup>st</sup>	106.38	21.52	-6.084	0.0001
	2 <sup>nd</sup>	165.76	28.83		

Table 1. Comparison of bite force at baseline and second measurement in three groups of patients

Bite force (N) at baseline						
	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
I	20	184.70	7.57	1.69	169.00	198.00
II	20	137.24	7.48	1.63	121.00	156.00
III	20	106.38	21.52	4.70	65.00	148.00
Total	60	142.10	35.08	4.45	65.00	198.00

Table 2. Bite force (N) at baseline. F=16.578; p=0.0001

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
I	20	184.20	6.71	1.50	170.00	196.00
II	20	137.05	8.06	1.76	121.00	156.00
III	20	165.76	28.83	6.29	121.00	199.00
Total	60	161.98	26.24	3.33	121.00	199.00

Table 3. Bite force (N), second measurement after 6 weeks. F=36.500; p=0.0001

signed informed consent.

The results obtained were entered in the study table and statistically processed.

**Methods**

The Occlusal force meter, PCE-FG 200K, manufactured by PCE Deutschland GmbH, was used to measure the force of the bite, with a special, for this purpose constructed, force transducer.

**The technical characteristics of the device are:**

- Maximum force of measurement: 500 N/50kg
- Resolution : 0.1N/10g
- Accuracy: ± 0.4%
- The units of measure : N, g, lb, oz, kg
- Calibration : Calibration with F2 Weights
- Measurement uncertainty: ± 0.05% of the measured value
- Measuring rate: adjustable at 10 values / sec.

**3. RESULTS**

There is a significant difference between the strength of bite in healthy population and patients with TMD, as well as in freshly operated patients. This number expressed in N is closer during the second measurement in groups I and II.

Definitely, there is a decrease in chewing function in the freshly operated patients compared to the first two groups.

Significant increase in Group III, while in the first two groups without any visible changes.

**4. DISCUSSION**

Most studies involving stomatognathic system disorders use the maximum bite force parameter that serves as an indicator of the diseases of the aforementioned system.

Duygu Koc et al. measured the force of the lower jaw bite force for patients with temporomandibular dysfunction. The control group was healthy respondents, and in the discussion

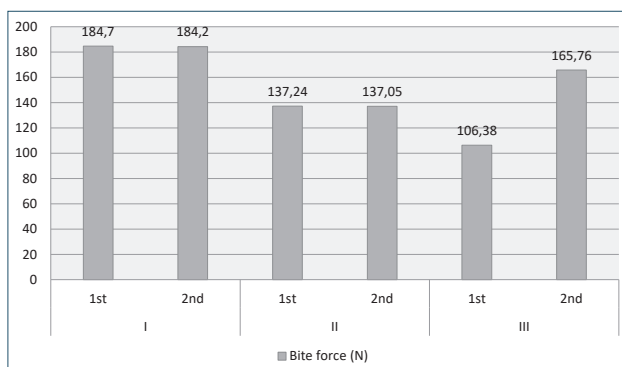


Figure 5. Presentation of the bite force in N in three groups of patients

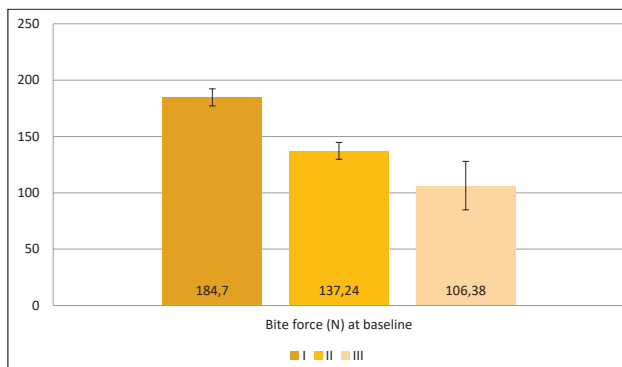


Figure 6. Bite force, baseline, expressed in N

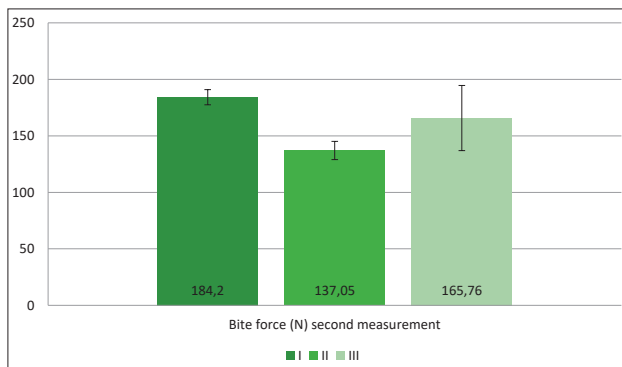


Figure 7. Bite force (N), second measurement after 6 weeks

and conclusions it was stated that the measured force of the lower jaw bite is a valid indicator for the stomatognathic disease. They also state that a multitude of factors are involved in the quality of the measured signal such as pain in the temporomandibular joint, craniofacial morphology and occlusal factors (11).

In our study, the results obtained show a significant difference between the force in the healthy population and the TMD population, which coincides with the above-mentioned study.

Suzana Varga et al. investigated the maximum force at the bite in the molar region at normal occlusion. The sample consisted of 60 patients and the measured force ranged from 178 to 213 N. According to previous studies, the range of bite force in a healthy population with normal occlusion was 184.7 N(12).

In the Group III, the obtained results show significant differences in preoperative and postoperative measurements.

The average postoperative force of the bite was 106.38, while the average force of the bite six-week after in this group

was 165.76 N. In healthy subjects, the average bite force was 184 N, measured in two different time periods, and showed no statistically significant differences.

In patients with TMD, the average bite force had a mean around 137 N measured in a different time period and did not show any statistically significant differences. Comparison of these results with Group I shows significantly lower value, and is the indicator of the function of the stomatognathic system.

In the patient after reconstructive surgery with masticatory muscle blades, the average bite force ranged from 106 to 165 N measured in a different time period, and shows statistically significant differences with the increase during the second measurement, which speaks in favor of the adaptation and synergism of the remaining part of chewing musculature. The results obtained in all three groups are similar to those obtained in previous studies (14, 15, 16, 17).

## 5. CONCLUSION

From the obtained results we can conclude that the parameter used, the force of the lower jaw bite, is a significant indicator of the function of the chewing system.

In a healthy population there is a constant in comparison to the two measurements, and this represented in Newtons is 184, which compared to other studies of the same problem presents a similar result.

The lower values are recorded in case of temporomandibular joint chronic disease compared to the healthy population are verified without any tendency for improvement, which also suggests that in the chronic changes in the TM joint, the value of the lower jaw bite force is lower compared to the healthy population measured in newtons 137.

An impaired function after the application of the muscular flaps to reconstruct the defects of neighboring regions from the group of masticatory muscles, measured in the Nis 106, but with note that this function significantly improves after 6 weeks at an average measured value of 165 N, thanks to the nervous system adaptability to a new situation.

By following the parameter of bite force in different populations and values obtained with a pressure gauge, static dynamometer with dynamic forearm adapted to work with patients made by the author, and comparing our results with the results of other studies, we can safely confirm that the parameter is valid for evaluating the health of the masticatory system in healthy and sick populations.

- **Authors contributions:** all authors were included in all phases of preparation of this article, analyzing results and final proof reading.
- **Conflict of interest:** none declared.

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