

BITE FORCE IN PATIENTS WHO ARE CANDIDATES FOR GASTROPLASTY

Força de mordida em pacientes candidatos à gastroplastia

Andréa Cavalcante dos **SANTOS**¹, Carlos Antonio Bruno da **SILVA**²

From the ¹Núcleo do Obeso do Ceará and ²Universidade de Fortaleza – UNIFOR, Fortaleza, CE, Brazil.

ABSTRACT - Background: Chewing is composed of structures that must be balanced to achieve optimal function and bite force is one of the components of this function. **Aim:** To analyze the bite force of candidates for bariatric surgeries. **Method:** Was used surface electromyography Miotool 200/400 (Miotec®, Porto Alegre/RS, Brazil) coupled to bite load cell, SDS1000 sensor, to record the maximum force reading during the execution of the bite. The device was integrated with software Miograph 2.0. Inclusion criteria were: morbidly obese patients regardless of gender, age 20-40 years, no absences and/or important dental changes and candidates for gastroplasty. Were studied the bites in left and right lateral position and their intensity measured in kilogram force (kgf). The exclusion criterion was that of patients who had facial deformities and/or occlusal position preventing any collection. **Results:** Were analyzed 39 patients (59 % women), mean age 27.1 (+/-5.7). They had anterior bite force in average 9.1 kgf (min 1.3 and max 22.9 kgf - +/-5.2); left side with average 16.3 kgf (min 1.5 and max 55.6 kgf - +/-11.9); right side with average of 14.0 kgf (min 2.3 and max 45.3 kgf - +/-9.4). **Conclusion:** The bite force was inferior to those described for the general population and the gender did not have any influence on it.

HEADINGS - Bite force. Morbid obesity. Gastroplasty.

Correspondence:

Andréa Cavalcante dos Santos
E-mail: deafono@gmail.com

Financial source: none
Conflicts of interest: none

Received for publication: 30/04/2013
Accepted for publication: 08/08/2013

RESUMO - Racional: A mastigação é composta de estruturas que devem ser equilibradas para obtenção de função ideal e a força de mordida é um dos componentes dessa função. **Objetivo:** Analisar a força de mordida de pacientes candidatos à gastroplastia em Y-de-Roux. **Métodos:** Foi utilizado o eletromiógrafo de superfície Miotool 200/400 (Miotec®, Porto Alegre/RS, Brasil) acoplado à célula de carga de mordida, sensor SDS1000, com o registro da leitura da força máxima durante a execução da mordida. O aparelho era integrado ao software Miograph 2.0. Os critérios de inclusão foram: pacientes obesos mórbidos independentemente do sexo, faixa etária 20-40 anos, sem ausências e/ou alterações dentárias importantes e candidatos à gastroplastia em Y-de-Roux. Foram estudadas as mordidas em posição anterior e laterais direita e esquerda e a intensidade delas medida em quilograma força (Kgf). O critério de exclusão foi o de pacientes que apresentassem deformidades faciais e/ou oclusais impossibilitando quaisquer das posições de coleta. **Resultados:** Foram analisados 39 pacientes (59% mulheres), média de idade 27,1 (±5,7). Eles apresentaram força de mordida anterior com média geral 9,1 Kgf (min 1,3 e max 22,9 Kgf - ±5,2); lateral esquerda com média geral 16,3Kgf (min 1,5 e max 55,6 Kgf - ±11,9); lateral direita com média geral 14,0 Kgf (min 2,3 e max 45,3 Kgf - ±9,4). **Conclusão:** A força de mordida foi inferior àquelas descritas para a população em geral e o gênero não constituiu variável para ela.

DESCRIPTORIOS - Força de mordida. Obesidade mórbida. Gastroplastia.

INTRODUCTION

The mouth, an anatomically complex structure, develops functions for many of the body's integrative purposes. The functional oral patterns can be summarized as digestive (ingestion - involving mastication and swallowing), respiratory, tegumentary (defense), behavioral (communication) and sensibility³.

Of these patterns, chewing is the only physiological act that involves all the senses (sight, smell, taste, touch and hearing)¹³ necessary for nutrition. However, despite often being done automatically, it is becoming the subject

of more observations and studies, due to its abstruse function, as much for its motor diversity as the sensory and neuronal aspects involved.

For healthy conditions to be maintained, fixed and mobile structures are involved, such as bones, joints, glands, muscles, teeth, mucous and neurovascular supply³, in addition to the various types of movements and forces involved in this context.

It is necessary to understand that the mastication process is developed in three stages: 1) incision, when food is seized and cut in the region of the incisors (this phase lasts from 5-10% of mastication); 2) trituration takes place (65-70% of mastication), and finally to the molars; 3) pulverization, generating interocclusal pressure, with the grinding of food during the masticatory stroke (25-30% of the masticatory act)³.

Thus, to ensure a good trituration of food it is fundamental that the masticatory force is concentrated in the premolars and molars, as the longest mastication happens in this region.

The bite force is one of the components of the masticatory function which determines the amount of load destined to break food down and is measured using special equipment called a gnathodynamometer and/or bite load cells^{7,10}.

Although many studies have already addressed bite force, little is found specifically involving patients with morbid obesity, especially those in particular who are seeking surgical treatment to restore their health, reduce comorbidities, and maintain weight loss with greater effectiveness over a more prolonged period.

The bite force is an objective analysis that aims to measure the effectiveness of the muscles in the clenching intensity exercised by the individual and encourage better performance on the part of the stomatognathic system.

The nourishment of these patients permeates many factors which need to be further clarified, both from the aspect of healthier food choices and the muscles that will be used to ensure efficient, good nutrition. The literature^{5,12} is emphatic regarding the need for intervention by Speech-Language Pathology, as the sample showed that the combination of such factors as easily swallowed food concomitant with the self-assertion of the respondents about incorrect mastication reinforces the need for such action.

This study aims to analyze the bite force of obese patients who are candidates for Roux-in-Y gastroplasty.

METHODS

This study used a quantitative, descriptive approach, with a cross-sectional design. The information and test results were collected between October/2012 and March/2013. It was approved by the Ethics Committee of the University of Fortaleza under N°. 114.609/2012. All of the participants signed an

informed consent form.

For the sake of convenience, the research subjects were selected at the Núcleo do Obeso do Ceará (Nucleus for the Obese of Ceará) – NOC, in Fortaleza, Ceará, Brazil. The inclusion criteria selected patients regardless of gender, aged 20 to 40 years and candidates for gastroplasty surgery. Patients with facial and/or occlusal deformities that prevented the positions for data collection were excluded, including anterior bites and right and left lateral positions.

The planning of the age group aimed to make it more reduced and specific for a particular muscular condition so that the group would be more homogenous, in view of the fact that a larger range of ages and effective differences would interfere with the comparison of forces.

To measure the alterations in bite force the Miotool 200/400 – Surface Electromyography (Miotec®, Porto Alegre/RS, Brazil) was used, coupled to a bite force cell, SDS1000 sensor. This sensor registers the maximum force obtained during the bite and is integrated to Miograph 2.0 software.

The technique used was based on protocols which have already been published^{11,10}.

For the sample, the patients were seated on a chair, in a comfortable position with support for the back. The feet were on the floor, the head and trunk were erect and the eye focused on the horizon. They were instructed to perform three bites with maximum force on the load cell and the bite was evaluated on the appropriate equipment. Between each of these bites there was a timed interval of thirty seconds to rest the structure involved and minimize muscular fatigue.

To ensure hygiene and biosafety, after each patient's sample the sensor was placed inside the fingers of new disposable latex surgical gloves.

The action of the bite with maximum intercuspatation was collected in three stages: 1) placing the cell on the lower incisal surface and instructing the patient to perform an anterior bite, located on the central incisors; 2 and 3) in this moment, the location of the cell remained on the occlusal surface of the lower tooth, and the patient was instructed to perform lateral bites on the right and left first molars, respectively.

Regarding the analysis of the data, descriptive statistics were used with the measurements of central tendency, represented by the mean standard deviation and maximum and minimum values. For the investigation Excel. 2010 (Microsoft, 2010) software was used.

RESULTS

The bites of 39 patients were analyzed: 23 (59%) were female and 16 (41%) male. The average age for the women was 27.1±5,7 years and for men it was 26,1±5,2 years.

TABLE 1 – Absolute values for each sample

Patients	Gender	Anterior bite (Kgf)	Lateral bite L (Kgf)	Lateral bite R (Kgf)
01	M	14,9	11,5	2,3
02	F	10,5	13,2	5,1
03	F	14,4	15,8	16,7
04	F	9,7	11,4	10,9
05	F	3,5	8,7	5,4
06	F	7,7	12,2	9,5
07	M	22,9	17,4	21,7
08	M	22,0	36,5	45,3
09	M	6,7	2,2	18,3
10	F	8,4	22,6	23,1
11	F	2,9	14,2	5,3
12	F	16,9	3,2	10,3
13	F	6,2	27,4	23,2
14	M	8,3	19,0	14,8
15	F	13,2	19,3	23,6
16	M	6,6	8,5	25,5
17	M	11,7	11,0	10,2
18	M	15,6	29,4	17,4
19	F	5,7	5,6	6,1
20	F	4,8	11,6	2,8
21	F	1,3	8,8	32,8
22	F	5,5	9,8	17,6
23	M	8,2	7,5	9,7
24	M	7,6	17,8	2,7
25	F	2,7	4,8	15,6
26	M	11,9	14,6	10,0
27	M	5,9	19,8	26,6
28	M	12,7	34,7	4,2
29	F	1,8	1,5	14,3
30	F	9,1	24,5	19,9
31	F	5,0	17,7	3,9
32	F	9,0	45,7	16,4
33	F	7,2	55,6	16,0
34	M	13,6	12,2	10,6
35	F	12,2	16,4	10,1
36	F	5,7	4,6	5,4
37	F	4,6	7,0	5,1
38	M	5,0	30,0	14,3
39	M	21,6	48,8	16,2

According to Table 1, it can be observed that in the sample of the anterior position, 66.7% (n=26) of the patients had a bite force equal or less than 10 Kgf, distributed between 26.9% (n=7) for men and 73.1% (n=19) for women.

These values are also presented in the location of the bite in molars, 79.5% (n=31) with a bite force equal to or less than 21 Kgf, for the lateral left bite, divided between 58% for women (n=18) and 42% for men (n=13).

In the position of the lateral right bite, 79.5% (n=31) were observed with the same standard value of comparison (≤ 21 Kgf), divided between 38.7% (n=12) in men and 61.3% (n=19) in women.

For the next data, the analysis was performed using the ratio of the molar force, taking the average between the left and right laterals and calculating the percentage in relation to the incisors, or vice versa, when they showed greater force.

TABLE 2 – Values related to the location of the concentration to the bite force

Patients	Gender	Average of molars	Force in incisors	> Force in incisors	> Force in molars
1	M	6,9	14,9	*	
2	F	9,2	10,5	*	
3	F	16,3	14,4		*
4	F	11,2	9,7		*
5	F	7,1	3,5		*
6	F	10,9	7,7		*
7	M	19,5	22,9	*	
8	M	40,9	22,0		*
9	M	10,3	6,7		*
10	F	22,9	8,4		*
11	F	9,8	2,9		*
12	F	6,8	16,9	*	
13	F	25,3	6,2		*
14	M	16,9	8,3		*
15	F	21,5	13,2		*
16	M	17,0	6,6		*
17	M	10,6	11,7	*	
18	M	23,4	15,6		*
19	F	5,9	5,7		*
20	F	7,2	4,8		*
21	F	20,8	1,3		*
22	F	13,7	5,5		*
23	M	9,0	8,2		*
24	M	5,2	7,6	*	
25	F	10,2	2,7		*
26	M	11,0	11,9	*	
27	M	16,3	5,9		*
28	M	8,5	12,7	*	
29	F	7,9	1,8		*
30	F	22,2	9,1		*
31	F	10,8	5,0		*
32	F	31,1	9,0		*
33	F	35,8	7,2		*
34	M	12,1	13,6	*	
35	F	13,3	1,2		*
36	F	5,0	5,7	*	
37	F	6,1	4,6		*
38	M	9,7	5,0		*
39	M	18,9	21,6	*	

From Table 2 it was observed that 11 (28.2%) patients had a greater bite force in their incisors than the molars.

TABLE 3 – Values with differentiation by gender

Variable		Average (Kgf)	Min	Max	DP
Force of anterior bite	Female	7,3	1,3	16,9	+4,1
	Male	12,2	5,0	22,9	+5,9
Force of left lateral bite	Female	15,7	1,5	55,6	+13,0
	Male	20,1	2,2	48,8	+12,6
Force of right lateral bite	Female	13,0	2,8	32,8	+7,9
	Male	15,6	2,3	45,3	+10,8

Table 3 shows that morbidly obese patients have a bite force lower than 10 Kgf. This was especially the case for women and the anterior bite force.

Another data, with great value, attributed to women and to the left lateral bite the more frequent position.

DISCUSSION

The findings that 66.7% of the population of the study had a bite force lower than 10 Kgf in their incisors, indicated that according to previous research^{3,6,8}, they have a much lower force than the population as a whole.

The above also applies to the samples of bite force in molars, which verified that in general, the clenching intensity of the bite is lower than the population of the study.

This research observed the convergence of the differing strength of this order (a higher concentration of the clenching intensity of the bite in molars than in incisors) in 11 (28.2%) patients, demonstrating that they require organization and increased strength in the region for the trituration and pulverization of food.

Speaking a little more about bibliographic findings, which are described in chronological order of publication, these underlie the facts that are presented in this study, when it was observed that in some samples, men showing greater force, which differed at other times, when women exhibited a greater clenching intensity.

The maximum bite recorded in men was 19.4 Kgf whilst for women this number reached 15.3 Kgf⁴.

In another study⁶, during the evaluation of the maximum bite force, men had a bite force of 39 Kgf in the molar region and 18 Kgf for incisors, whereas for women the results were 22 Kgf and 11 Kgf, respectively. With more up-to-date numbers, men were observed to have a great bite force (88 Kgf in molars and 28 Kgf in incisors) than women (69 Kgf in molars and 22 Kgf in incisors)⁸, and average bite force higher for men (522-847 N) than for women (441-597 N)^{1, 2,9,11,14}.

Furthermore, it is possible to register variable values for bite force, which may regularly reach 90 Kg for molars and lower numbers for the more anterior regions of the jaw³.

All these findings took into consideration the existence of several studies measuring bite force in populations both without symptoms and dysfunction and several dental pathologies; however, no data was found on the correlation between morbidly obese patients and their bite force, as proposed in this study.

It is noteworthy that different published methodologies were used; the results were sometimes presented in N (Newton), and sometimes in Kgf (kilogram-force) and the sampling equipment varied, which makes it difficult to compare results to trace something around normal or presentable in a morbidly obese population.

CONCLUSION

The bite force was inferior to those described for the general population and the gender did not have any influence on it.

REFERENCES

- Ahlberg, J.P.; Kovero, O.A.; Hurmerinta, K.A.; Zepa, I.; Nissinen, M.J.; Könönen, M.H. Maximal bite force and its association with signs and symptoms of TMD, occlusion, and body mass index in a cohort of young adults. *Cranio*. 2003 Oct; 21(4):248-52.
- Bakke, M.; Holm, B.; Jensen, B.L.; Michler, L.; Möller, E. Unilateral, isometric bite force in 8-68-year-old women and men related to occlusal factors. *Scand J Dent Res*. 1990 Apr; 98(2):149-58.
- Douglas, C.R. *Fisiologia aplicada à fonoaudiológica*. 2ª. ed. Rio de Janeiro: Guanabara Koogan, 2006.
- Garner, L.D.; Kotwal, N.S. Correlation study of incisive biting forces with age, sex, and anterior occlusion. *J Dent Res*. 1973 Jul-Aug;52(4):698-702.
- Gonçalves, Rosa de Fátima Marques; Chehter, Ethel Zimberg. Perfil investigatório de obesos mórbidos submetidos à gastroplastia. *Rev. CEFAC*, São Paulo, v.14, n. 3, junho de 2012.
- Helkimo, E.; Carlsson, G.E.; Carmeli, Y. Bite force in patients with functional disturbances of the masticatory system. *J Oral Rehabil*. 1975 Oct;2(4):397-406.
- Kiliaridis, S., Kjellberg, H., Wenneberg, B. et al. The relationship between maximal bite force, bite force endurance, and facial morphology during growth. A cross-sectional study. *Acta Odontol Scand*. 1993; 51: 323-31.
- Kogawa, E.M. Avaliação da discriminação interoclusal para microespessuras e da força máxima de mordida em pacientes portadores de disfunções temporomandibulares [dissertação]. Bauru: Universidade de São Paulo, Faculdade de Odontologia de Bauru; 2005 [acesso 2013-07-05].
- Könönen, M. et al. Bite force and its associations with temporomandibular disorders in young finnish non-patient population. *J Dent Res. Spec Iss A* 2002 Mar;81:171.
- Nascimento G.K.B.O.; Lima L.M.; Rodrigues C.B.S.; Cunha R.A.; Cunha D.A. Verificação da força de mordida e da atividade elétrica dos músculos masseteres durante a mastigação em laringectomizados totais. *Rev. Bras. Odontol.*, Rio de Janeiro, v.68, n. 2, p. 175-9, jul/dez. 2011.
- Pellizzer, Eduardo Piza; Muench, Antonio. Forças de mordida relacionadas a próteses parciais removíveis inferiores. *Rev Odontol Univ São Paulo*, São Paulo, v. 12, n. 4, p. 401-407, Oct/Dec. 1998.
- Santos, A.C.; Capistrano, S.F.S.; Barroso, L.M.B.S. Análise do processo de alimentação em pacientes obesos. In: RESENDE, J.H.C. *Tratado de cirurgia plástica na obesidade*. Rio de Janeiro: Rubio, 2008. pp. 69-75.
- Santos, A.C.; Moura Júnior, L.G. Atuação fonoaudiológica na cirurgia bariátrica e metabólica. In: KLEIN, D. et al. *Avaliação em motricidade orofacial: discussão de casos clínicos*. São José dos Campos, SP: Pulso Editorial, 2013. p.117-27.
- Waltimo, A.; Könönen, M. A novel bite force recorder and maximal isometric bite force values for healthy young adults. *Scand J Dent Res*. 1993 Jun;101(3):171-5.