

# Masticatory satisfaction, ability, and performance in partially dentate patients after periodontal therapy

*Satisfação, capacidade e performance mastigatória em pacientes parcialmente dentados após terapia periodontal*

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## Resumo

**Introdução:** Entender os efeitos da terapia periodontal é fator essencial no desempenho e satisfação de pacientes parcialmente dentados. **Objetivo:** Avaliar o efeito do tratamento periodontal subgengival na performance ao mastigar e na satisfação e capacidade mastigatória auto-reportadas em pacientes parcialmente dentados. **Material e método:** Pacientes parcialmente dentados com periodontite crônica não tratada (n=11) receberam tratamento periodontal não-cirúrgico e tiveram a sua satisfação, capacidade e performance mastigatória aferidas antes e após o tratamento. A performance mastigatória foi aferida objetivamente pelo método da peneiragem de um alimento simulado após mastigação seguida da medição do tamanho das partículas. **Resultado:** A satisfação e a capacidade mastigatória foram mensuradas a partir de um questionário com base no OHIP-EDENT. O número médio de unidades funcionais anteriores foi de  $10,36 \pm 1,43$  e posteriores de  $6,73 \pm 0,79$ , sem alterações após o tratamento. A performance mastigatória não apresentou diferença ( $p = 0,075$ ) (tamanhos de partícula  $4,23 \pm 1,84$  mm e  $3,90 \pm 0,75$  mm antes e após o tratamento periodontal, respectivamente). A satisfação e a capacidade mastigatória apresentaram valores após o tratamento periodontal superiores ( $p > 0,05$ ) em comparação aos valores prévios aos tratamentos. **Conclusão:** O tratamento periodontal, considerando a manutenção dos pares funcionais do início do tratamento, promove uma melhoria na satisfação e capacidade mastigatória auto-reportadas, sem afetar a performance mastigatória.

**Descritores:** Estudo clínico; mastigação; periodontite; doença periodontal.

## Abstract

**Introduction:** Understanding the effects of periodontal therapy is essential in performance and satisfaction of partially dentate patients. **Objective:** To assess the effect of subgingival periodontal treatment in performance and masticatory satisfaction and ability as reported by partially dentate patients with untreated chronic periodontitis. **Materials and method:** Patients were given nonsurgical periodontal treatment and masticatory satisfaction, ability, and performance were evaluated before and after treatment. Performance was assessed based on sieving chewed standardized chewable material, while satisfaction and ability were analyzed using a questionnaire based on OHIP-EDENT. **Result:** Mean numbers of functional tooth units were  $10.36 \pm 1.43$  anterior and  $6.73 \pm 0.79$  posterior teeth. Masticatory performance did not vary significantly ( $p = 0.075$ ), and mean particle sizes before and after treatment were  $4.23 \pm 1.84$  mm and  $3.90 \pm 0.75$  mm, respectively. Overall satisfaction and ability scores after treatment were higher ( $p > 0.05$ ) compared with scores prior to the periodontal intervention. **Conclusion:** Periodontal treatment improves masticatory satisfaction and ability with no effect on performance.

**Descriptors:** Clinical study; mastication; periodontitis; periodontal disease.

## INTRODUCTION

Controlled by reflex arcs from the nervous system, mastication in humans is a complex process influenced by a balanced relationship between teeth, muscles, and joints<sup>1</sup>. Reduction in the number of functional tooth units (FTUs), also called tooth loss, negatively

affects mastication and trituration patterns, and periodontitis is one of the main causes behind the decrease in the number of teeth<sup>2,3</sup>. Characterized by tooth mobility, the main manifestation of periodontitis is its chronic form, which evolves to loss of the



tooth involved. This process starts with the destruction of the periodontium and loss of insertion, which is often asymptomatic<sup>4,5</sup>.

In view of the specific characteristics of periodontitis, research has looked into the relationship between periodontal diseases and the masticatory process, and found that these conditions may be responsible for dysfunctional mastication. This relationship has been investigated from different research perspectives. While some studies have focused on the correlation between periodontal status and masticatory capacity in the effort to establish a direct link between clinical parameters and mastication<sup>6-12</sup>, others have examined the association of tooth loss<sup>13,14</sup> and/or loss of insertion<sup>15</sup> with masticatory efficiency and bite force. As a rule these studies show that tooth loss and periodontal disease negatively affect overall satisfaction and masticatory ability of individuals.

However, despite the large number of studies published on this subject, there is a knowledge gap concerning the way periodontitis patients assess their own masticatory satisfaction and the effect of periodontal disease on masticatory behavior. In this scenario, the present study evaluated the effect of subgingival periodontal treatment on masticatory performance and self-reported ability and satisfaction in partially dentate patients.

## MATERIAL AND METHOD

This clinical study included chronic periodontitis patients who had lost FTUs and spontaneously looked for dental treatment in the Odontology Service Units of Universidade Luterana do Brasil (ULBRA) in the greater Porto Alegre region, state of Rio Grande do Sul, Brazil. Inclusion criteria were (i) untreated chronic periodontitis, (ii) presence of at least 16 teeth with maximum loss of insertion of 5 mm, (iii) presence of dental occlusion between four and six pairs of posterior teeth, (iv) absence of systemic or neurological temporomandibular disorder, and (v) cognitive skills that enabled the patient to answer the questionnaire used. These criteria were defined based on previous research that assessed the factors associated with mastication in patients with periodontal disease who had lost teeth<sup>10</sup>.

A periodontist examined the patients and selected a sample of 11 individuals based on convenience. The participants were informed of the objectives and ethical issues of the study, and all signed an informed consent form. This study was approved by the Ethics Committee of ULBRA (number 1007-434H).

All patients were treated by a periodontist based on a non-surgical periodontal approach. The following variables were assessed before the beginning of periodontal treatment and 30 days after the last session: (i) number of teeth (clinical examination), (ii) satisfaction and masticatory ability (using a questionnaire), and (iii) masticatory performance (based on the sifting of standardized chewable material morsels). The methods of evaluation are described in detail below.

### *Number of FTUs*

The number of pairs of homonymous posterior occlusal teeth was evaluated counting posterior FTUs, when one pair of premolars is considered one FTU and one pair of molars represents two FTUs<sup>16-18</sup>.

Anterior teeth were classified using the same criterion, when one FTU was defined as a pair of homonymous occlusal anterior teeth.

### *Masticatory Performance*

Masticatory performance was assessed based on particle size after a morsel of standardized chewable material was masticated by each participant. The chewable material used (Optocal) was prepared using condensation silicon (58.3% by weight, Optosil Comfort, Heraeus Kulzer GmbH & Co., KG, Germany), common plaster (10.2% by weight, Mossoró, Empresa e Indústria de Gesso Mossoró SA, Rio de Janeiro, RJ, Brazil), alginate (12.5% by weight, Jeltrate, Detsply Indústria e Comércio LTDA, Petrópolis, RJ, Brazil), solid Vaseline (11.5% by weight, Rioquímica, São José do Rio Preto, SP, Brazil), tooth paste (7.5% by weight, Colgate Palmolive Co, Osasco, SP, Brazil) according to a previous study<sup>19</sup>.

Participants were instructed to chew 12 previously weighed Optocal cylindrical morsels carrying out 40 mastication cycles, with special care not to swallow any portion of the material. After mastication, the chewed material was collected in a beaker of known weight. Excess water was removed and the material was then dried in a stove at 80°C for 1 h. The chewed material was weighed repeatedly upon constant weight (variation below 0.01 g). After, the material was transferred to a desiccator containing silica, which ensured complete humidity removal.

The chewed material was sifted in a shaker with five sieves of decreasing mesh size (4.75 mm, 4.00 mm, 2.80 mm, 2.00 mm, and 1.00 mm)<sup>19</sup>. The fractions retained in each sieve were weighed and expressed as percent fraction of the total material collected and dried. Based on these percent values, mean particle size was calculated as described in a previous study<sup>19</sup>. The sieving procedure was carried out twice for each sample, and mastication ability was calculated as the mean value of the two measurements.

### *Self-Reported Masticatory Ability and Satisfaction*

Satisfaction and masticatory ability were measured using two questionnaires containing questions adapted from OHIP-EDENT<sup>20</sup>. Patients answered 10 questions about perception of satisfaction and 14 questions about their mastication ability in connection with their periodontal condition. Answers were recorded on a visual analogue scale (100 mm). One question about the overall evaluation of previous questions was included in each set of questions about satisfaction and ability. The values obtained were measured and converted in percent numbers for subsequent statistical analysis. The evaluations carried out using the questionnaires were supervised by the same observer, who clarified any doubts taking care not to interfere with answers.

### *Data Analysis*

The correlation between the number of FTUs and satisfaction, ability, and performance scores was assessed using the Spearman correlation coefficient. Performance as well as self-reported masticatory ability and satisfaction before and after periodontal treatment were compared using the Wilcoxon and pairwise Student's *t* tests, respectively, at a 5% significance level.

## RESULT

All individuals presented the same number of FTUs before and after periodontal treatment. The mean numbers of anterior and posterior FTUs were  $10.36 \pm 1.43$  and  $6.73 \pm 0.79$ , respectively. Mean numbers of FTUs were not correlated with satisfaction, ability, and performance before and after periodontal treatment ( $p > 0.05$ ). Masticatory performance did not vary ( $p = 0.075$ ), and mean particle sizes before and after periodontal treatment were  $4.23 \pm 1.84$  mm and  $3.90 \pm 0.75$  mm, in that order.

Table 1 shows the results of self-reported masticatory ability and satisfaction before and after periodontal treatment. In general, scores obtained after periodontal treatment were higher ( $p > 0.05$ ) compared with those obtained before. Six of the nine questions used to evaluate satisfaction had higher scores after treatment, while the scores obtained for three did not vary. In addition, scores for two of the 13 questions about masticatory ability were better after treatment, while the scores for the other questions did not vary with periodontal intervention.

**Table 1.** Satisfaction and masticatory ability before and after periodontal treatment

	Before treatment	After treatment	P
	Median (p25-p75)	Median (p25-p75)	
<b>Satisfaction with mastication</b>			
<i>Do you think pleasure in feeding today differs from what you felt before periodontal disease?</i>	29 (25-95)	78 (49-81)	0.182
<i>Are you happy with your current masticatory condition?</i>	13 (0-44)	74 (44-82)	0.033*
<i>Are you happy with the current esthetic condition of your teeth?</i>	3 (0-50)	50 (27-68)	0.182
<i>Are you happy with your current level of comfort concerning your teeth?</i>	16 (13-35)	68 (47-81)	0.033*
<i>Are you happy with your current level of self-assurance concerning your teeth?</i>	25 (4-35)	63 (48-83)	0.026*
<i>Are you happy with your emotions concerning your oral condition?</i>	24 (13-52)	79 (65-98)	0.021*
<i>Are you happy with your performance at work concerning your oral condition?</i>	30 (15-69)	78 (39-86)	0.050
<i>How would you rank your satisfaction with your masticatory condition?</i>	21 (6-53)	59 (48-86)	0.011*
<i>Do you think that periodontal disease affects your mastication?</i>	88 (12-96)	41 (22-86)	0.260
<i>Based on the quality of your teeth (comfort, self-assurance, and esthetics), how do you rank your current oral condition?</i>	40 (9-50)	70 (60-87)	0.003*
<b>Masticatory ability</b>			
<i>Do you feel that it is impossible to chew foods you like eating?</i>	70 (9-86)	13 (9-55)	0.126
<i>Do you find it difficult to bite some foods included in your daily diet?</i>	41 (6-82)	14 (9-40)	0.213
<i>Do you need to take special measures concerning foods to chew them? (cooking, chopping, soaking).</i>	45 (20-52)	23 (5-49)	0.374
<i>Do you feel that your teeth are firm when you chew harder foods?</i>	35 (10-53)	85 (61-88)	0.062
<i>Do you need to make extra effort to swallow food after chewing?</i>	25 (2-50)	13 (8-24)	0.444
<i>Do you think that you manage to chew foods to bits that are small enough before swallowing them?</i>	38 (18-64)	78 (52-86)	0.053
<i>Do you feel any discomfort in your teeth when chewing?</i>	40 (33-75)	19 (8-50)	0.091
<i>Do you ever have to stop chewing during a meal due to problems with your teeth?</i>	24 (3-59)	11 (2-17)	0.075
<i>Compared with your oral condition before periodontal disease, do you feel that you take longer to chew foods?</i>	57 (23-86)	15 (5-58)	0.062
<i>Do you worry due to the lack of self-assurance concerning stability of your teeth?</i>	51 (3-87)	9 (3-23)	0.045*
<i>Are you ashamed of consuming food in the company of other people?</i>	18 (2-56)	7 (2-27)	0.248
<i>Do you feel annoyed when you have to consume food in the company of other people?</i>	42 (9-55)	12 (2-21)	0.018*
<i>Do you feel prevented from feeding due to your current oral health condition?</i>	18 (0-57)	7 (1-13)	0.553
<i>Based on the answers to the questions above, how do you rank your masticatory ability to chew soft or hard foods?</i>	40 (11-60)	80 (70-84)	0.005*

\*Statistically significant difference between groups.

## DISCUSSION

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Although periodontal treatment did not influence objectively assessed masticatory performance, the intervention in partially dentate patients resulted in individuals expressing an improvement in self-reported satisfaction and masticatory ability. In addition, despite the fact that mean particle size of chewable material did not differ significantly after treatment, participants expressed higher satisfaction and felt more comfortable, self-assured, and less annoyed during mastication due to periodontal intervention.

The results of the present study confirm previously published findings, which underscored the positive effects of periodontal treatment and follow-up on mastication. A study that looked into the effect of loss of bone support due to periodontal disease on the masticatory apparatus demonstrated that the force produced by anterior teeth is negatively affected<sup>15</sup>.

In a study that evaluated bite force, masticatory pressure, and occlusal surface based on parameters like periodontal probe readings, levels of clinically evaluated insertion, gingival bleeding, and presence of crown caries, no relationship with masticatory ability was observed<sup>9</sup>. However, the number of teeth, gender, and diverse age groups of participants may have been an obstacle to proper assessment, since these variables interfere with the relationship between bite force and occlusal surface, reducing the values observed<sup>9</sup>.

Based on groups paired for age, gender, and number of teeth, Alkan et al.<sup>10</sup> studied the influence of these factors on mastication. The results showed that the decrease in periodontal support in absence of inflammation negatively affected masticatory ability (bite force and occlusal surface). The authors also declared that more studies should be conducted to analyze how severity of periodontitis

affects mastication using larger sample populations. Takeuchi, Yamamoto<sup>11</sup> (2008) analyzed the correlation of periodontal status with bite force in patients with chronic periodontitis who had been treated and were at the follow-up stage. The results showed that clinically evaluated mean insertion values were more significant than the percent number of mobile teeth. The inferior bone support observed seemed to be associated with the decrease in bite force and the increase in bite pressure, which was defined by the authors as the force measured per square millimeter on the occlusal surface.

In the present study, despite the fact that masticatory performance measured using standardized chewable material did not improve with periodontal treatment, as a rule the participants expressed improved satisfaction and felt more able to masticate effectively. These results may be explained in view of the improvement in the inflammatory condition of teeth, which possibly exhibited reduced mobility, bleeding, and suppuration after intervention. Despite that, periodontal treatment improves quality of life of periodontal disease patients<sup>21</sup>. Moreover, the conservation of the number of FTUs during treatment added to the stabilization in the ability to masticate the chewable material.

## CONCLUSION

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All in all, periodontal treatment, in view of the conservation of FTUs, affords improved self-reported satisfaction and masticatory ability, without affecting masticatory performance.

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## REFERENCES

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1. Amemiya K, Hisano M, Ishida T, Soma K. Relationship between the flow of bolus and occlusal condition during mastication – computer simulation based on the measurement of characteristics of the bolus. *J Oral Rehabil.* 2002 Mar;29(3):245-56. <http://dx.doi.org/10.1046/j.1365-2842.2002.00910.x>. PMID:11896841.
2. Oppermann RV, Haas AN, Rösing CK, Susin C. Epidemiology of periodontal diseases in adults from Latin America. *Periodontol* 2000. 2015 Feb;67(1):13-33. <http://dx.doi.org/10.1111/prd.12061>. PMID:25494596.
3. Gross AJ, Paskett KT, Cheever VJ, Lipsky MS. Periodontitis: a global disease and the primary care provider's role. *Postgrad Med J.* 2017 Sep;93(1103):560-5. <http://dx.doi.org/10.1136/postgradmedj-2017-134801>. PMID:28698305.
4. Lamster IB, Asadourian L, Del Carmen T, Friedman PK. The aging mouth: differentiating normal aging from disease. *Periodontol* 2000. 2016 Oct;72(1):96-107. <http://dx.doi.org/10.1111/prd.12131>. PMID:27501493.
5. Laudenbach JM, Simon Z. Common dental and periodontal diseases: evaluation and management. *Med Clin North Am.* 2014 Nov;98(6):1239-60. <http://dx.doi.org/10.1016/j.mcna.2014.08.002>. PMID:25443675.
6. Borges TF, Regalo SC, Taba M Jr, Siéssere S, Mestriner W Jr, Semprini M. Changes in masticatory performance and quality of life in individuals with chronic periodontitis. *J Periodontol.* 2013 Mar;84(3):325-31. <http://dx.doi.org/10.1902/jop.2012.120069>. PMID:22548588.
7. Kosaka T, Ono T, Yoshimuta Y, Kida M, Kikui M, Nokubi T, et al. The effect of periodontal status and occlusal support on masticatory performance: the Suita study. *J Clin Periodontol.* 2014 May;41(5):497-503. <http://dx.doi.org/10.1111/jcpe.12241>. PMID:24527750.
8. Pereira LJ, Gazolla CM, Magalhães IB, Ramos-Jorge ML, Marques LS, Gameiro GH, et al. Treatment of chronic periodontitis and its impact on mastication. *J Periodontol.* 2011 Feb;82(2):243-50. <http://dx.doi.org/10.1902/jop.2010.100178>. PMID:20653435.
9. Morita M, Nishi K, Kimura T, Fukushima M, Watanabe T, Yamashita F, et al. Correlation between periodontal status and biting ability in Chinese adult population. *J Oral Rehabil.* 2003 Mar;30(3):260-4. <http://dx.doi.org/10.1046/j.1365-2842.2003.01012.x>. PMID:12588497.



10. Alkan A, Keskiner I, Arici S, Sato S. The effect of periodontitis on biting abilities. *J Periodontol.* 2006 Aug;77(8):1442-5. <http://dx.doi.org/10.1902/jop.2006.060025>. PMID:16881814.
11. Takeuchi N, Yamamoto T. Correlation between periodontal status and biting force in patients with chronic periodontitis during the maintenance phase of therapy. *J Clin Periodontol.* 2008 Mar;35(3):215-20. <http://dx.doi.org/10.1111/j.1600-051X.2007.01186.x>. PMID:18190555.
12. Pereira LJ, Gazolla CM, Magalhães IB, Dominguet MH, Vilela GR, Castelo PM, et al. Influence of periodontal treatment on objective measurement of masticatory performance. *J Oral Sci.* 2012;54(2):151-7. <http://dx.doi.org/10.2334/josnusd.54.151>. PMID:22790407.
13. Iwashita H, Tsukiyama Y, Kori H, Kuwatsuru R, Yamasaki Y, Koyano K. Comparative cross-sectional study of masticatory performance and mastication predominance for patients with missing posterior teeth. *J Prosthodont Res.* 2014 Oct;58(4):223-9. <http://dx.doi.org/10.1016/j.jpor.2014.04.002>. PMID:24951162.
14. Ikebe K, Matsuda K, Kagawa R, Enoki K, Yoshida M, Maeda Y, et al. Association of masticatory performance with age, gender, number of teeth, occlusal force and salivary flow in Japanese older adults: is ageing a risk factor for masticatory dysfunction? *Arch Oral Biol.* 2011 Oct;56(10):991-6. <http://dx.doi.org/10.1016/j.archoralbio.2011.03.019>. PMID:21529776.
15. Johansson AS, Svensson KG, Trulsson M. Impaired masticatory behavior in subjects with reduced periodontal tissue support. *J Periodontol.* 2006 Sep;77(9):1491-7. <http://dx.doi.org/10.1902/jop.2006.050355>. PMID:16945024.
16. Ritchie CS, Josphura K, Silliman RA, Miller B, Douglas CW. Oral health problems and significant weight loss among community-dwelling older adults. *J Gerontol A Biol Sci Med Sci.* 2000 Jul;55(7):M366-71. <http://dx.doi.org/10.1093/gerona/55.7.M366>. PMID:10898252.
17. Hatch JP, Shinkai RS, Sakai S, Rugh JD, Paunovich ED. Determinants of masticatory performance in dentate adults. *Arch Oral Biol.* 2001 Jul;46(7):641-8. [http://dx.doi.org/10.1016/S0003-9969\(01\)00023-1](http://dx.doi.org/10.1016/S0003-9969(01)00023-1). PMID:11369319.
18. Kwok T, Yu CN, Hui HW, Kwan M, Chan V. Association between functional dental state and dietary intake of Chinese vegetarian old age home residents. *Gerodontology.* 2004 Sep;21(3):161-6. <http://dx.doi.org/10.1111/j.1741-2358.2004.00030.x>. PMID:15369019.
19. Pocztaruk RL, Frasca LC, Rivaldo EG, Fernandes EL, Gavião MB. Protocol for production of a chewable material for masticatory function tests (Optocal – Brazilian version). *Braz Oral Res.* 2008 Oct-Dec;22(4):305-10. <http://dx.doi.org/10.1590/S1806-83242008000400004>. PMID:19148384.
20. Allen F, Locker D. A modified short version of the oral health impact profile for assessing health-related quality of life in edentulous adults. *Int J Prosthodont.* 2002 Sep-Oct;15(5):446-50. PMID:12375458.
21. Sonnenschein SK, Betzler C, Kohnen R, Krisam J, Kim T-S. Oral health-related quality of life in patients under supportive periodontal therapy. *Acta Odontol Scand.* 2018 Nov;76(8):572-9. <http://dx.doi.org/10.1080/00016357.2018.1483528>. PMID:29916765.

## CONFLICTS OF INTERESTS

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The authors declare no conflicts of interest.

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