

# Evaluation of oral health status and salivary flow rate in obese patients after bariatric surgery

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## ABSTRACT

**Objectives:** The aim of this study was to identify the prevalence of dental caries, periodontal diseases and tooth wear in bariatric patients, and relate the oral health conditions to saliva flow.

**Methods:** Fifty-two patients who had undergone bariatric surgery (Roux-en-Y gastric bypass) and 50 severely obese patients indicated for bariatric surgery were submitted to clinical examinations with regard to dental caries (DMFT index), periodontal condition (CPI index), dental wear (DWI index – Dental wear index) and saliva flow. The data were statistically analyzed by the Student's-t, Mann-Whitney, Spearman Correlation and Chi-square ( $\chi^2$ ) tests at 5% significance level.

**Results:** The DMFT index was  $16.11 \pm 5.19$  in the surgical group and  $16.06 \pm 6.29$  in the control group ( $P > .05$ ). The mean CPI was  $3.05 \pm 0.84$  for the operated group and  $2.66 \pm 1.25$  for the obese patients with no significant difference between them ( $P > .05$ ). There was statistically significant difference between the groups for the presence of periodontal pockets ( $P = .021$ ). All the patients presented some degree of tooth wear, however, with no significant difference between the two groups ( $P = .82$ ). The mean saliva flow values of the surgical group and control group were  $0.64 \pm 0.46$  mL/min and  $0.66 \pm 0.49$  mL/min, respectively. There was no significant difference in saliva flow and all oral conditions analyzed ( $P > .05$ ).

**Conclusion:** The prevalence of oral diseases was similar in severely obese patients who were candidates for bariatric surgery and in patients who had been submitted to bariatric surgery. Nevertheless, there was higher prevalence of periodontal pockets in the operated group. (Eur J Dent 2012;6:191-197)

**Key words:** Oral health; tooth erosion; periodontal diseases; dental caries; xerostomia; obesity; bariatric surgery

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## INTRODUCTION

Obesity is a chronic disease recognized as a global epidemic that has spread in both developed and third world countries,<sup>1</sup> having taken on epidemic proportions, in the U.S.A. and internationally.<sup>2,3</sup> In the last decade, the prevalence of obesity has increased significantly in Brazil.<sup>4</sup>

Obesity causes or exacerbates many health problems, both independently and in association with other diseases. It is associated with the development of type 2 diabetes mellitus, coronary heart disease, an increased incidence of certain forms of cancer, respiratory complications (obstructive sleep apnea) and osteoarthritis of large and small joints.<sup>1,3</sup> Obesity is related to several aspects of oral health, such as caries, periodontitis and xerostomia.<sup>1,5</sup>

Bariatric surgery is one of the therapeutic modalities considered capable of offering acceptable results, favoring rapid and effective long-term weight loss, and a reduction in the risks of morbid or co-morbidities in obesity class III and obesity class II, associated with severe co-morbidity.<sup>1,4</sup> The success of bariatric surgery among morbidly obese patients has been recognized by the loss of excess weight, control of co-morbidities and improved postoperative quality of life.<sup>6</sup> Bariatric surgery has become safer or more effective for achieving meaningful and sustainable weight loss. However, most of the currently performed operations result in dramatic changes in gastrointestinal anatomy, physiology, or dietary habits, which may result in gastrointestinal complications, gastritis, malnutrition, nausea and vomiting, anemia, dehydration, vitamin and mineral deficiencies (calcium, iron, folic acid, vitamin B12 and D) among others.<sup>7,8</sup>

Some studies have shown that there could be an increase in the patient's risk for dental caries, periodontal diseases, xerostomia and dentin hypersensitivity after bariatric surgery.<sup>8-12</sup> However, the dental aspects and side-effects of bariatric surgery have not been adequately reported in the medical literature because there are few studies and the majority are case reports.<sup>8</sup>

The mouth is anatomically and physiologically an integral component of the alimentary tract and the potential negative effects of gastric surgery may manifest in the oral health area as tooth wear, dental caries, periodontal diseases, and mucosal alterations.<sup>8,9,11-13</sup>

The aim of this study was to compare the prevalence of dental caries, periodontal diseases and dental wear in bariatric patients and morbidly obese patients and to correlate the conditions of oral health with saliva flow.

## MATERIALS AND METHODS

This study was approved by the Ethics and Research Committee of the Clinical Hospital of the Faculty of Medicine of Ribeirão Preto, University of São Paulo, Brazil. (Proc. 5855/2007). An informed consent form was signed by the patients before starting the investigation.

This research was a cross-sectional study in which the sample was composed of 102 patients with a mean age of  $37.6 \pm 10.0$  years, assisted in the Faculty of Medicine Hospital Clinic of Ribeirão Preto. They were distributed into 2 groups: G1 - the experimental group with 52 patients who had undergone Roux - en - Y Gastric Bypass (RYGB) surgery, and G2- the control group with 50 severely obese patients selected for bariatric surgery.

These patients were nonsmokers and only four patients had undergone periodontal treatment; however the periodontal treatment had been performed 2 years before this study was conducted.

Stimulated saliva was collected after patients' chewed paraffin wax for 5 minutes, and spat the saliva into a small cup, after which it was measured with a syringe. The saliva flow was classified as normal ( $>1.0$  mL/min) and as hyposalivation ( $<1.0$  mL/min)<sup>10</sup>.

Clinical examinations to observe the mean number of decayed, missing or filled teeth (DMFT Index) and periodontal condition (CPI index) were performed in accordance with the World Health Organization criteria.<sup>14</sup>

The dental wear index was obtained by a modification of the TWI (Tooth Wear Index) described by Sales-Peres et al<sup>15</sup> The criteria for examination were: (0-Normal: no evidence of wear; 1-Incipient: tooth wear in enamel; 2- Moderate: tooth wear in dentin; 3- Severe: tooth wear in pulp or secondary dentin; and 4- Restored: tooth wear leading to restoration; 9- Not assessed).

The clinical examinations were performed by a previously calibrated dental examiner.

Both descriptive and analytical approaches to data analysis were used. Data were analyzed in a personal computer using Statistica Version 7. De-

scriptive results were analyzed as relative frequencies. The data were analyzed using the Student's-t test, Mann Whitney, Spearman's correlation and Chi-square ( $\chi^2$ ) tests to verify the association of saliva flow with tooth wear, periodontal diseases and bariatric surgery. The level of significance was  $P < .05$ .

## RESULTS

Fifty-two operated patients and 50 obese patients were studied. There were no significant differences between the experimental group (13 men and 39 women) and the control group (14 men and 36 women) as regards gender, and mean age G1- 39.6 $\pm$  9.6 years and G2- 35.55 $\pm$  10.2 years, respectively.

The period that had elapsed between surgery and the survey was 16.9 $\pm$ 20.7 months.

There was no statistically significant difference between the two groups for the stimulated salivary flow rate median 0.65 $\pm$  0.47 mL/min (G1- 0.64 $\pm$ 0.47mL/min and G2- 0.66 $\pm$ 0.49 mL/min;  $P > .05$ ). The majority of patients presented hyposalivation.

The mean DMFT index for both groups of patients was 16.08 $\pm$ 5.72. After bariatric surgery it was

16.11 $\pm$ 5.19 and for the obese patients 16.06 $\pm$ 6.29 (Tables 1 and 4). No statistically significant difference was found for the DMFT Index ( $P=0.96$ ).

There was no correlation between saliva flow and DMFT index ( $r=.06$ ,  $P=.58$ ).

The mean CPI was 2.86 $\pm$ 1.08 (G1- 3.05 $\pm$ 0.84 and G2- 2.66 $\pm$ 1.25). Periodontal diseases were shown to be present in 73.1% of the sextants of surgical patients and in 48.1% of those of obese patients (Table 2).

The prevalence of periodontal pockets was 88.45% in the G1 and 70.00% in the G2 ( $P=.02$ ). There was no correlation between reduced saliva flow and CPI ( $r=-0.1$ ,  $P=.34$ ) (Table 4).

As regards oral hygiene, 66% of patients reported brushing their teeth 2-3 times a day, 17% brushed their teeth more than three times a day and only 13% reported brushing only once a day.

All patients (control and patients surgical group) had some degree of dental wear (Tables 3 and 4). No statistically significant difference was found between the groups as regards the DWI index ( $P=.82$ ), saliva flow and tooth wear ( $r=.04$ ,  $P=.70$ ).

Univariate analysis revealed that only the factor presence of periodontal pockets was significantly

Table 1. Mean DMFT index distribution according to components in the groups.

	Decayed	Filled	Missing
Operated	2.28 $\pm$ 2.37	8.73 $\pm$ 5.90	5.00 $\pm$ 5.92
Obese	2.00 $\pm$ 2.22	9.02 $\pm$ 6.32	5.06 $\pm$ 6.68
Total	2.15 $\pm$ 2.29	8.87 $\pm$ 6.08	5.03 $\pm$ 6.27

Table 2. CPI according to components in the groups.

Group	CPI score*					
	0	1	2	3	4	X
G1	25.6%	25.3%	26.3%	17.0%	4.5%	1.3%
G2	38.3%	14.7%	15.7%	13.0%	4.7%	13.6%

CPI score\*: 0 -healthy; 1 -bleeding; 2 -calculus; 3 -pocket 3.5-5.5mm; 4 -pocket  $\geq$ 6mm; X -exclude sextant (less than 2 teeth)

Table 3. Dental Wear Index (DWI).

Degree	Incisors		Canines		Premolars		Molars	
	GI n(%)	GII n(%)	GI n(%)	GII n(%)	GI n(%)	GII n(%)	GI n(%)	GII n(%)
0	15(3.6)	17(4.3)	5(2.4)	6(3.0)	9(2.2)	10(2.5)	13(2.1)	32(5.4)
1	123(29.6)	179(44.8)	81(38.9)	79(39.5)	269(64.7)	244(61.0)	304(48.7)	273(45.5)
2	224(53.8)	150(37.5)	105(50.5)	88(44.0)	36(8.6)	59(14.8)	15(2.4)	26(4.3)
3	4(1.0)	4(1.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
4	0(0.0)	0(0.0)	2(1.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
9	50(12.0)	50(12.5)	15(7.2)	27(13.5)	102(24.5)	87(21.7)	292(46.8)	269(44.8)

\* DWI degree: 0- normal; 1- incipient; 2- moderate; 3- severe; 4- restored; 9 - could not be assessed

associated with patients who had undergone bariatric surgery (OR=3.29; P<.039) (Table 4).

### DISCUSSION

Nutritional factors are implicated in systemic and oral diseases, including overweight and obesity, hypertension, type 2 diabetes, cardiovascular disease, osteoporosis, dental caries, gastrointestinal disorders and most cancers, including oral cancers.<sup>16</sup>

Frequently, less aggressive therapies do not have satisfactory results in diseases caused by poor nutritional habits, such as morbid obesity, for which the most effective treatment is bariatric surgery. The growing number of bariatric procedures has increased the need to fully understand their side-effects. Bariatric surgery results in several anatomic and physiological alterations. In this study the surgery evaluated was RYGB, which is restrictive and disabsorptive bariatric surgery; however, the restrictive component has a greater clinical significance. Exclusion of the duodenum and a segment of the jejunum, in addition to inadequate ingestion of foods can cause iron, folic acid, vitamin B12, A, D, E and K deficiencies.<sup>7</sup> Nausea and vomiting are commonly occur after bariatric surgery. In most cases dysfunctional eating habits, such as overeating, eating too fast, or not chewing food well may cause these complications.<sup>6,7</sup>

The oral condition of obese patients may change after bariatric surgery, because this procedure may have side-effects that can cause alteration in

the oral cavity. The relationship between dental aspects and the side-effects of bariatric surgery have not been adequately reported in the medical literature because there have been few studies and the majority of these have been case reports.<sup>8</sup>

The risk of dental caries increases if there is high frequency of sugar consumption, particularly when the sugar is retained in the mouth for long periods of time. The effect of sugar or other carbohydrates on dental caries may be reduced by fluoride application and good oral hygiene, however, a reduction in sugar intake should be the primary approach as this has many health benefits.<sup>16</sup>

In this study, the DMFT index was similar in both groups (Table 1), and although the caries index was low when compared with the epidemiological survey conducted by the Brazilian Ministry of Health.<sup>17</sup> This survey showed that 35 to 44 year-old people had DTMF of 20.30, in the same range as the index in the obese patients in this study, who had a reduced rate.

One study reported that there was a difference in the pattern of foods/beverages consumed after the bariatric surgery procedure. The primary difference included 5 meals/snacks daily versus 3 main meals.<sup>12</sup> This situation increases the patient's risk of dental caries and periodontal diseases, particularly in the presence of xerostomia.<sup>7, 11</sup>

The result of this study differ from the findings of Hague et al<sup>11</sup>, who followed-up a patient who had an increase in caries activity and low salivary production after bariatric surgery (Table 4).

Table 4. Univariate analysis for patients has undergone or will undergo bariatric surgery.

Factors		Groups		Univariate analysis		
		Bariatric	Obese	Odds ratio	95% CI	P- Value
Saliva flow	Normal	13	12	0.95	0.38-2.34	0.910
	Hyposalivation	39	38			
Active dental caries	No	15	18	1.39	0.60-3.19	0.575
	Yes	37	32			
Dental wear	Enamel	11	12	1.18	0.45-3.10	0.920
	Dentine	40	38			
Dental wear - anterior teeth	Enamel	11	12	1.15	0.45-2.91	0.957
	Dentine	40	38			
Dental wear - posterior teeth	Enamel	30	24	0.70	0.32-1.54	0.498
	Dentine	22	25			
Periodontal diseases	No	1	5	5.67	0.64-50.34	0.189
	Yes	51	45			
Periodontal pocket	No	6	15	3.29	1.16-9.33	0.039*
	Yes	46	35			

Although patients submitted to bariatric surgery may be considered a group at high-risk for dental caries, because the frequency of feeding and type of food can be associated with the formation of bacterial plaque, shown to be the primary etiologic agent in dental caries and periodontal diseases,<sup>18</sup> the DTMF index was similar in the two groups.

Several recent studies have suggested that periodontitis occurs more frequently in obese individuals than in subjects with a normal body weight.<sup>5,19</sup> According to Goodson<sup>20</sup> overweight individuals appeared to have more severe periodontal diseases, when evaluated by plaque, bleeding on probing and pocket depth.

In this study no difference was found between the operated group and the obese group as regards CPI, however there was significant difference for pocket depth ( $P < .05$ ) (Table 4). The difference between the two groups with regard to alveolar bone loss may be associated with vitamin or mineral deficiencies, such as hypocalcemia, after bariatric surgery.<sup>7</sup>

Studies have verified that the vitamin D status may be reduced after bariatric surgery, even when supplemental calcium and vitamin D are prescribed, and bone loss frequently occurs because patients may present metabolic bone disease (osteomalacia and osteoporosis).<sup>21,22</sup> Osteoporosis may influence the bone loss in chronic periodontitis and may be a co-factor in alveolar bone loss, thus osteoporosis may be a possible risk factor for periodontal disease.<sup>23</sup>

Any acid with a pH below the critical pH of dental enamel (5.5) can dissolve the hydroxyapatite crystals in enamel. Gastric reflux may have a pH below 2.0 and thus the dental erosion potential increases when unstimulated salivary flow is low.<sup>8,24</sup> Vomiting and other gastric disorders are important risk factors for tooth wear. Although vomiting, common in bariatric patients, can be considered a risk factor for tooth wear,<sup>6,7</sup> the dental wear index was similar for the two groups (Table 3 and 4). Helling et al<sup>8</sup> verified that 37% of 113 patients reported greater dental hypersensitivity after bariatric surgery. Tooth wear can expose dentinal tubules and this may cause dental hypersensitivity.

Saliva has many protective functions for hard and soft tissues and contains a wide variety of antimicrobial substances that are effective against bacteria, viruses and fungi. Saliva also contains

other chemoprotective factors that help to neutralize microbial damage and render environmental toxins less harmful.<sup>25,26</sup>

Obesity has been associated with reduced flow rate of stimulated whole saliva and dental caries.<sup>27</sup> The obese patients in this study presented reduced saliva flow and according to Bond et al<sup>28</sup> there is a reduction in stimulated saliva of patients indicated for bariatric surgery, when compared with normal-weight individuals. Moreover, saliva flow has been related to inadequate water intake in patients undergoing bariatric surgery.<sup>7,11</sup>

However, in this research a reduction in saliva flow was found in both groups. Whether obesity has a direct or indirect negative effect on salivary flow rate is unclear. Based on this question, proinflammatory cytokines derived from adipocytes and macrophages, which have accumulated in adipose tissue<sup>27</sup> may negatively affect the function of salivary glands due to chronic low-grade inflammation in the gland. Moreover, the authors have reported enhanced levels of proinflammatory cytokines in crevicular fluid in obese adolescents when compared with normal-weight subjects<sup>29,30</sup> indicating a hyperinflammatory reaction in the periodontal tissue as well.

The data of the present study showed that there was no correlation between reduced saliva flow and oral diseases, although some researchers have found a close relationship between saliva volume and the development of periodontal diseases, dental caries and tooth wear.<sup>12,31</sup> Nevertheless, in Table 4 significant difference between G1 and G2 is shown for periodontal pockets, as the bariatric patients had more disease than the obese. This is in agreement with the proposal postulated by Mooder et al<sup>27</sup> in a study conducted with adolescents.

Oral health and nutrition may have a synergistic bidirectional relationship. Oral infectious diseases and systemic diseases with oral manifestations cause an impact on the functional ability to eat, affecting diet and nutrition status.<sup>32</sup> Poor oral health and tooth loss have negative impacts on speech functions and the ability to consume healthy foods.<sup>18</sup> Likewise, nutrition and diet may affect the development and integrity of the oral cavity as well as the progression of oral diseases.<sup>32</sup>

Bariatric surgery is very important for health; however a multiprofessional staff is necessary in order to attend patients suitably. In this multipro-

professional team, a dentist would be better able to improve the oral health of these patients.

## CONCLUSION

Bariatric patients showed a prevalence of oral diseases similar to that of obese patients, nevertheless there was a more prevalent condition of periodontal pockets in bariatric patients. The maintenance of healthy periodontal conditions may be considered a good strategy for morbidly obese and bariatric patients.

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