Obesity Surgery (2020) 30:1574–1579
https://doi.org/10.1007/s11695-019-04334-0

REVIEW

Oral Health Implications of Bariatric Surgery in Morbidly Obese Patients: An Integrative Review

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Published online: 15 January 2020

Abstract

Background To identify the implications of bariatric surgery on the oral health of patients with morbid obesity.

Methods Two reviewers independently performed a search of the electronic databases: MedLine, PubMed, SciELO, LILACS, and Scopus, for clinical trials in humans and cohort studies. The search strategy used was *Bariatric Surgery* and *Oral Health* or *Mouth Disease* and *Humans* and *Periodontitis*. A total of 26 articles were obtained, and after title screening and full reading, 8 articles were included in this review.

Results Increased food intake at shorter intervals and increased frequency of regurgitation in these patients were associated with the increased development of dental caries, dental erosion, and increased salivary flow rate.

Conclusion Intense oral control is recommended for the prevention and early treatment of these conditions and to avoid nonsystemic effects in these patients.

Keywords Bariatric surgery · Oral diseases · Periodontitis

Introduction

Obesity is a chronic, complex, multifactorial disease resulting from excessive fat storage, which can be triggered by several factors including altered metabolism, genetics, diet, and a sedentary lifestyle [1]. Obesity in Brazil has increased from 11.8% in 2006 to 18.9% in 2016, according to worldwide estimates, and is considered a public health problem [2].

According to the World Health Organization (WHO) [3], obesity is diagnosed through body mass index (BMI) assessments, obtained by calculating the relationship between body weight (kg) and squared height (m^2), where individuals with BMI ≥ 30 kg/m^2 are classified as obese, while those presenting BMI ≥ 40 kg/m^2 are categorized as morbidly obese [3]. In addition, this disease is strongly associated with an increased risk of comorbidities, including type 2 diabetes mellitus, hypertension, hyperlipidemia, arteriosclerosis, arthritis, sleep apnea syndrome, endocrine dysfunctions, and periodontal disease [4].

Bariatric surgery (BS) is the main indication for morbid obesity treatment, both in Brazil and worldwide [5], and consists of a set of medical techniques or procedures with the initial goal of reducing the patient's stomach size, i.e., reducing storage food absorption capacity, with an ultimate goal of weight loss and the reduction and/or cure of correlated diseases [6]. This surgery can be performed using the techniques of inflatable gastric banding and gastrojejunal gastroplasty [7]. The latter associates a reduction of both the gastric reservoir and its emptying by a containment ring and is currently the most frequently used technique in the Brazilian Unified Health System (SUS) [8].

Some of the consequences of BS, observed in patients regardless of the surgical technique used, include hyperparathyroidism, osteoporosis, chronic regurgitation, micro- and macronutrient deficiencies, renal problems, and oral cavity alterations [9, 10]. In addition, oral cavity alterations related to the development of dental caries, wear, hypersensitivity, and periodontal disease have also been reported in BS patients [4, 9–12]. Factors associated with vitamin D deficiency,

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xerostomia, and gastroesophageal reflux may be related to these complications. In this context, the purpose of this review was to identify oral health implications in BS patients presenting morbid obesity and associated factors.

Methodology

The studies used to discuss the main implications of BS on oral health in patients presenting morbid obesity and associated factors were obtained through an online search of the electronic databases SciELO (Scientific Electronic Library Online), LILACS (Latin American and Caribbean Literature in Health Sciences), MedLine (Medical Literature Analysis and Retrieval System Online), PubMed (Public Medicine), and Scopus (Elsevier).

The search was performed using the following search strategy: *Bariatric Surgery* and *Oral health* or *Mouth Disease* and *Humans* and *Periodontal Disease* or *Periodontitis*, in Portuguese, English, and Spanish, up to October 29, 2019. Human studies and cohort studies concerning obese BS patients, comprising microbiological analyses or not, which analyzed the repercussions of this surgery on oral cavity health, were included. Animal studies, in vitro studies, literature reviews, case reports, case series, and case controls were excluded.

Assessments were carried out by two independent reviewers in order to verify if the selected articles met the inclusion criteria. In case of disagreements, a third evaluator was consulted regarding the decision to include or not include an article in the review. After reading the selected articles, relevant information was collected and typed into a database according to the following criteria: authors, objectives, study characterization, sample, follow-up, results, and conclusion (Table 1).

Results

Twenty-six studies were identified, nine were indexed by the PubMed database, six by MedLine, seven by SciELO, and four by Scopus. After the exclusion of duplicate articles, 23 articles were obtained. After a first analysis, based on title and abstract screening, 15 studies were excluded, with 8 articles remaining. After assessing the inclusion and exclusion criteria of these articles, all studies were included (Fig. 1).

Regarding study design, four articles (50%) reported clinical trials and four (50%) reported cohort studies. All articles were in English and were published from 2011 to 2017. Four studies assessed the oral health of BS patients, addressing aspects such as salivary flow rate, the presence of periodontal pockets and dental caries, as well as the severity of tooth wear. Another study considered the microbiological characteristics of periodontal disease, while the three remaining studies evaluated impacts of BS on clinical periodontal parameters (Table 1).

Discussion

Obesity is a chronic, multifactorial disease, resulting from excessive fat storage, which can be triggered by several factors including altered metabolism, genetics, diet, and a sedentary lifestyle [1]. BS is the preferred treatment for this condition, comprising a set of medical techniques or procedures, which lead to restriction or malabsorption of consumed food. This can lead to a series of systemic alterations, as well as oral cavity complications [7]. However, although the relationship between oral complications and BS has been discussed, there exists a paucity of studies identifying the effects of bariatric surgery on the oral health of morbidly obese patients. Of the eight studies included in this review, only four were ECTs [13–16], and four were Cohort studies [11, 12, 17, 18]. Moreover, the results of these studies were contradictory, and further studies addressing the correlation between these conditions are needed.

Marsicano et al. (2012) [14] assessed oral health status in a group of 52 BS patients, while Cardozo et al. (2014) [17], evaluating 39 participants, observed that BS patients, regardless of the surgical technique applied, presented oral cavity changes, including active dental decay, tooth wear, salivary flow alterations, and periodontal disease. However, these findings were not statistically significant among BS patients and obese patients. Greater periodontal pocket depth was the prevalent condition in the group of BS patients, with statistical relevance, and this may be associated with vitamin or mineral deficiencies, such as hypocalcemia after bariatric surgery, as pointed out by Mooder et al. (2011) [19].

Lakkis et al. (2012) [13] and Jaiswal et al. (2015) [15], when evaluating the periodontal condition of BS patients, reported decreased probing depth, gingival bleeding index, gingival index, and clinical insertion gain. The authors suggested that improvements in inflammatory markers related to obesity, particularly decreases in C-reactive protein (CRP), tumor necrosis factor-α (TNF-α), interleukin −6 (IL-6), and leptin, were associated with weight loss, while an increase in the anti-inflammatory marker adiponectin was also reported. Additionally, Lakkis et al. (2012) [13] observed that biomarker decreases are also associated with decreased insulin resistance, leading to lower blood glucose levels and lower inflammatory responses after nonsurgical periodontal therapy in BS patients, compared to obese patients. The authors attributed this factor to the significant reduction in leptin, which plays an important role in the progression of inflammatory processes and, therefore, has been implicated in the pathogenesis of autoimmune inflammatory conditions, such as diabetes and rheumatoid arthritis. The decrease in leptin observed after periodontal therapy may explain the improved responses to periodontal treatment after BS [20].

On the other hand, Sales-Peres et al. (2017) [18] reported an increase in gingival bleeding in BS patients after follow-up,

Table 1 Studies evaluating oral health bariatric surgery implications in morbidly obese patients

Authors	Study type	Objective	Sample	Follow-up	Results	Conclusions
Marsicano et al., 2011	Cohort study	Assess oral changes in bariatric patients	$n = 54$ (T_0); $n = 24$ (T1); $n = 16$ (T2)	6 months	No statistical differences between the assessed periods for DMFT, periodontal pockets, and salivary flow were detected. A significant difference in tooth wear prevalence and severity was noted ($p = 0.012$)	Changes in lifestyle may increase the severity of preexisting oral problems after BS
Lakkis et al., 2012	Clinical study	Assess whether BS-associated weight loss improves responses to nonsurgical periodontal therapy	TG = 15; CG = 15	6 weeks	Significant differences between groups ($p < 0.05$) were observed. Greater clinical insertion gain and greater PD, BPI, and GI reductions were observed in the TG	A better response to nonsurgical periodontal therapy was identified in the TG
Marsicano et al., 2012	Clinical study	Identify the prevalence of the main oral alterations in BS patients and their relation with salivary conditions	TG = 52; CG = 50	Not identified	Lower salivary flow and a higher presence of dental caries, wear, and periodontal disease were found in the TG, in relation to the CG, albeit nonsignificant	The TG showed a prevalence of oral diseases similar to the CG
Cardozo et al., 2014	Cohort study	Assess BS impacts on oral health	$n = 39$	6 months	A statistically significant decrease in the number of medications taken daily and dry mouth sensation was reported, as well as an increased rate of stimulated salivary flow	A decrease in dry mouth sensation and improvement of oral health status in patients submitted to BS was detected
Moura-Grec et al., 2014	Cohort study	Assess oral health conditions before and after BS	TG = 59; CG = 51	6 months	Salivary flow was increased after BS. A significant increase in PD and periodontal pockets ($p < 0.001$) was observed. Greater dentin wear ($p = 0.002$) and a decrease in enamel wear were also observed ($p = 0.019$)	BS had a negative impact on oral health conditions
Jaiswal et al., 2015	Clinical study	Assess oral hygiene effects of diet modifications and maintenance, after BS, on the periodontal state	$n = 224$	6 months	Statistical differences for BI and VPI were noted for the TG ($p < 0.001$). Improvements in CIL and PD before and after BS were not statistically significant ($p > 0.05$)	A fibrous diet and adequate periodontal care may aid in improving the oral hygiene status of BS patients
Pataro et al., 2016	Clinical study	Compare the frequency of oral periodontopathogens and *H. pylori* in the mouth and stomach of obese BS individuals, with or without periodontitis	$n = 154$	4 years	BS group with periodontitis: high frequency of *P. gingivalis*, *T. denticola*, and *T. forsythia*. Obese group with periodontitis: high frequency of *H. pylori* and periodontopathogens. Obese and BS groups without periodontitis: higher frequency of *C. rectus*	Obese individuals presented high frequencies of periodontopathogens and *H. pylori*
Sales-Peres et al., 2017	Cohort study	Assess if weight loss after BS is associated with changes in periodontal parameters	$n = 110$	12 months	BMI was not associated with initial PD and loss of clinical insertion or with changes in these periodontal outcomes	Weight loss was associated with increased gingival bleeding, peaking at 6 months after BS

BS = bariatric surgery; DMFT = index expresses the mean number decayed, missing, and filled teeth in a group of individuals; PD = probing depth; BPI = bleeding at probing index; BI = bleeding index; GI = Gingival index; TG = test group; CG = control group; VPI = visible plaque index; LCI = clinical insertion level; BMI = body mass index

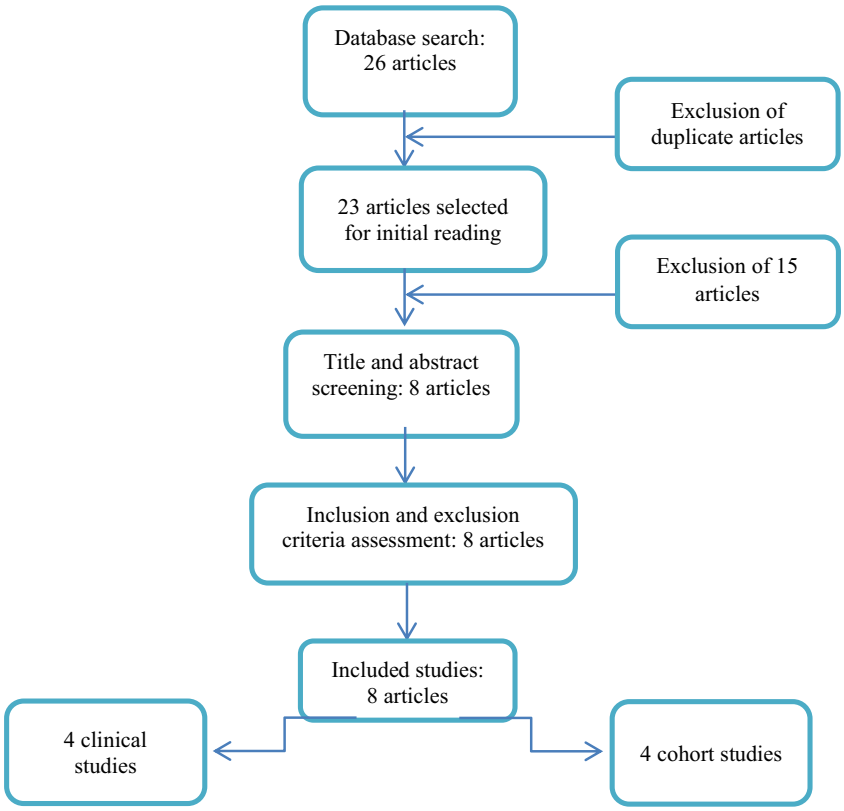

Fig. 1 Integrative review flowchart depicting article selection from the assessed databases from a total of 26 articles

suggesting no correlations between decreased inflammatory processes, as a consequence of weight loss, and periodontal disease. This could be explained by changes in postsurgical food patterns, as BS patients display reduced gastric capacity. As a result, a frequent intake of soft foods in small portions occurs in these patients, associated with greater adherence capacity to the dental surface throughout the day. Moreover, recent reports have found an increased presence of *Porphyromonas gingivalis* at 6 months after BS, suggesting that changes in microbial dental biofilm quantity and composition are a common event in bariatric patients [18].

Marsicano et al. (2012) [14] and Marsicano et al. (2011) [11] observed an increase in periodontal pocket depth at 3 months after BS, as also reported by Moura-Grec et al. (2014) [12] and Pataro et al. (2012) [21]. The BS technique involves the reduction of gastric capacity and the placement of a restrictive ring, resulting in desirable food intake decreases. Exclusion of the duodenum and jejunum segments, in addition to inadequate food intake, may lead to nutrient absorption deficiencies, such as calcium, iron, folic acid, and vitamins B12, A, D, E, and K. This may result in the development of bone diseases, such as osteoporosis and, possibly, periodontitis [11, 12, 14]. Increased food intake frequency may also be related to the development of gingivitis and worsening of periodontal diseases in bariatric subjects due to an increased dental biofilm accumulation index [11].

Dental wear was reported in several studies [14, 15, 17, 18] and is explained by the frequent occurrence of oral pH imbalance during the day, due to increases in the number of daily meals necessary for a balanced diet, thus maintaining an acidic environment for much of the day. In addition, BS patients also present higher gastroesophageal reflux, corroborating the findings of Jaiswal et al. (2015) [15]. These authors, when assessing a group of 224 patients, observed an increase in the gingival bleeding index and periodontal disease evolution and noted that a fibrous diet and better mechanical biofilm control constituted the main preventive measures against oral diseases in bariatric patients. The increased food intake by these patients was also associated with a higher caries incidence [11].

Given these findings, we highlight the importance of oral monitoring of patients that will undergo bariatric surgery, before and after surgery. Prior dental treatment should aim at the diagnosis, treatment, and control of periodontal disease and dental cavity and noncarious cervical lesions, especially dental erosion. After surgery, the patient should be advised regarding the need for greater control of the dental biofilm, which should be performed after all meals [22]. In addition, a reduction in the intake of acid foods is recommended, and teeth should not be brushed immediately after regurgitation to avoid removing dissolved dental tissue [4, 12].

Decreased salivary flow is a major oral health problem in obese patients, since other conditions can develop due to pH imbalances. The reduction in salivary buffering function can result in decreased dental structure protection, which leads to an increased susceptibility to the development of dental caries and bad breath [17, 22]. The assessed studies [11, 12, 14] indicate that BS patients displayed increases in salivary flow, due to a statistically significant reduction in the number of medications used against hypertension, diabetes, hyperlipidemia, and depression. At 3 months after surgery, a decrease in the dry mouth sensation (xerostomia) and increases in stimulated salivary flow rates were noted, leading to improvements in patient oral health, as reported by Cardozo et al. (2014) [17].

In addition, alterations in the intestinal and oral microbiota of BS patients were noted. Damms-Machado et al. (2015) [23] observed changes in the bacterial species essential for adequate functioning of the small intestine, resulting in low energy absorption potential of the intestinal microbiota, with a lower fermentation capacity after dietary interventions, as well as poor bile acid circulation. Pataro et al. (2016) [16] observed a high frequency of periodontopathogens and *H. pylori* in the oral cavity and in the stomach of obese patients. After BS, microbial changes were observed in both oral and stomach environments, with a high frequency of *P. gingivalis*, *T. denticola*, and *T. forsythia* associated with periodontitis [16]. The authors suggested the need for longitudinal follow-up of obese patients, since these bacteria play a fundamental role in the development and progression of periodontal disease [16].

The studies assessed here demonstrated the main effects of BS on the oral health of morbidly obese patients. Although some oral complications, such as the presence of active tooth decay and wear and salivary flow improvements, are established complications in this specific group of patients, data regarding associations with other characteristics, such as the presence of periodontal disease, are still conflicting and further evidence to support a correlation between these associations is needed.

It is important to discuss and suggest a clinical protocol as an essential criterion for the prevention of biofilm-dependent oral diseases, caries, and periodontal disease, through the mechanical control of the biofilm. This can be achieved by the brushing of the tooth surfaces, frequent flossing, and a balanced diet, in conjunction with follow-up by the dentist before and after surgery, in order to promote a multiprofessional and complete planning for the bariatric patient. The oral health professional, in turn, who is familiar with the most common bariatric procedures performed and their mechanisms of actions, risks, and benefits, is in a position to advise patients about the oral complications that may occur and, thus, act to prevent and treat these complications.

Conclusions

Patients undergoing bariatric surgery appear to be more susceptible to tooth decay, tooth erosion, and increased salivary flow rates. However, for periodontal disease, the results are divergent. Thus, we suggest that bariatric surgeons should be aware of the oral complications that may develop in this group of patients. The inclusion of the dentist in the multidisciplinary team and the establishment of a dental biofilm control protocol before and after the surgical procedure is of importance to prevent the possible complications observed in this study.

Acknowledgments We are grateful and appreciate the recognition and guidance from teachers of the Contemporary Periodontics discipline of the Postgraduate Program in Dental Sciences (PPGCO) in helping to define the criteria for our research strategy, as well as the interpretation and framing of our results.

Funding Information The authors would like to thank the Coordination of Improvement of Higher Education Person (CAPES) for funding and supporting the preparation of this manuscript.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Statement of Informed Consent Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

Statement of Human and Animal Rights This article does not contain any studies with human participants or animals performed by any of the authors.

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