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Obesity, bariatric surgery and periodontal disease: a literature update

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Abstract. **Obesity is linked to other systemic diseases, such as diabetes mellitus, dyslipidemia, and arterial hypertension. These comorbidities increase the risk of developing cardiovascular disease risk. Adipose tissue is a true endocrine organ and releases various pro-inflammatory cytokines. Periodontal disease (PD) is a chronic inflammatory disorder of the gingiva and bone support (periodontal tissues) that surrounds the teeth. The relationship between obesity and an increased risk of developing PD is already known in the literature. Many studies correlated the cardiometabolic risk with periodontal disease. Bariatric surgery is a way to reduce the adipose tissue in obese patients, that meet specific criteria. It has been observed that this type of surgery usually reduces both the systemic inflammation and the cardiometabolic risk. Some authors have hypothesized that, as a result, the progression of periodontal disease is also reduced. Five articles are analyzed in this systematic review. In these papers, the periodontal health before and after the bariatric surgery was compared. However, the conclusion of the previous studies demonstrated a scarce literature and did not confirm the reduction of periodontal disease after bariatric surgery, but a reduction of cardiometabolic risk. Therefore, periodontal disease in no way influences the reduction of cardiovascular risk after bariatric surgery.**

Key Words:
Bariatric surgery, Periodontal disease, Oral health, Obesity, Cardiometabolic risk.

Abbreviations

BGL, Blood glucose level; BMI, Body mass index; BOP, Bleeding on probing; BS, Bariatric surgery; CAL, Clinical level attachment; CPI, Community periodontal index; CRP, C-reactive protein; DM, Diabetes mellitus; DMFT, Decayed, missing, filled teeth; MESH, Medical Subjects Headings; OB, Obesity; PD, Periodontal disease; PI, Periodontal index; PICO, P: patient problem/population, I: intervention, C: comparison, O: outcome; PPD, Probing pocket depth; RYGB, Roux-en-Y gastric bypass; SUPP, Suppuration; TNF-α, Tumor necrosis factor-α.

Introduction

Obesity (OB) has become a very important burden in the 21st century and today is one of the most common pathological conditions, being an etiologic factor of various chronic disorders, such as cardiovascular disease, diabetes mellitus (DM), stroke, arterial hypertension, and certain types of cancer[1-5]. This chronic disease causes an abnormal accumulation of body fat. It has a multifactorial etiology, based on genetic, behavioral, social, metabolic, and endocrine factors. The prevalence of OB in the world has reached 600 million individuals. The World Health Organization estimates that 1.9 billion adults are overweight. OB is diagnosed using the Body Mass Index (BMI). A patient is considered obese[6] when the BMI is > 30 kg/m^2. The principal methods to lose weight are nutritional dietary treatment, physical activity, pharmacological treatment, and bariatric surgery (BS)[7,8]. Surgery is indicated when the BMI is > 40 kg/m^2 or > 35 kg/m^2 if the OB is accompanied by important comorbidity[9-11]. BS is a set of surgical procedures performed to reduce the BMI of patients. The principal types of BS are sleeve gastrectomy, adjustable gastric band, biliopancreatic diversion with duodenal switch and gastric bypass[12]. The surgery causes an alteration of dietary habits, but also a large spectrum of gastrointestinal complications, such as vomiting, anemia, mineral and vitamin deficiencies (like vitamin B12, vitamin D, calcium and folic acid)[13].

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Obesity is a cardiovascular risk factor that has been surely proved. Obesity can cause diabetes, hypertension and dyslipidemia. All these three consequences could increase the risk of a cardiovascular disease by creating atherosclerosis plaques. Nowadays, studies have demonstrated a link between obesity's lifespan and a cardiovascular risk: by considering the same amount of fat volume, a long-term obesity's lifespan increases the risk of a cardiovascular diseases. For the reason above, reducing the fat volume is an important step that would help to restore the right physiology of the body.

Similarly to OB, periodontal disease is classified as a chronic inflammation of the gingiva and bone surrounding the teeth. Several studies have correlated OB with periodontal disease and, although numerous researches have investigated the link between obesity and periodontium disease, the literature is currently still scarce[14].

Periodontal disease is associated to a cardiovascular risk factor, especially during the creation of atherosclerosis plaques.

The aim of this systematic review is to investigate the influence of BS on onset, severity and progression of periodontal disease and on the improvement of cardiovascular conditions after bariatric surgery.

This work aims to assess cardiovascular risk implemented through bariatric surgery and improvement of periodontal conditions. Therefore, the patient undergoing bariatric surgery needs for a multidisciplinary team approach to restore various sites damaged by adipose tissue, including periodontal tissue. All this is to reduce cardiovascular risk.

The Function of Adipose Tissue

Adipose tissue releases several endocrine factors (such as leptin) and pro-inflammatory cytokines, such as tumor necrosis factor α (TNF-α) interleukin-1β and interleukin-6, inter-cellular adhesion molecule 1, monocyte chemotactic protein 1, leptin, adiponectin inducing a state of chronic low-grade systemic inflammation which characterizes OB (Figure 1).

These molecules regulate glucose homeostasis, food intake and inflammation levels. The excess of adipokines released by adipose tissue promotes the macrophages change into an inflammatory status M2. Also, the macrophages release all the previous molecules, contributing in the pro-inflammatory status. The adipose tissue also influences the T-cell that prevents the recruitment of macrophages. Another mechanism of the inflammation is the cross-reactivity between adipocytes and macrophages towards the cross-linked of free fatty acid. The adipocytes release these acids, which, in turn, activate the macrophages through *via* tool like a receptor[4]. In response, macrophages release TNF-α, which contributes to the pro-inflammatory status and promotes the further release of free fatty acid. In addition, leptin and adiponectin module the immune reaction. In particular, leptin helps in differentiating the macrophages and promotes the activation of both the natural killers and the release of the pro-inflammatory cytokines. IL-1 induces inflammation towards the development of T-helper cells 17, which activate the pro-inflammatory reaction. Moreover, IL-6 is an important mediator of inflammation. It is secreted by various types of cells, such as T-cells, B-cells, monocytes, fi-

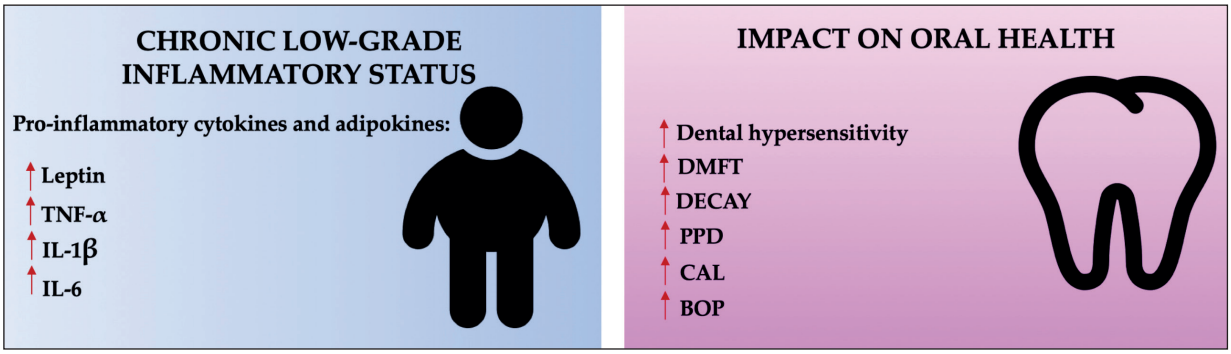

Figure 1. Relation between chronic low-grade inflammation and oral health. TNF-α, tumor necrosis factor-α; IL-1β interleukin-1β, IL-6 interleukin; DMFT decayed, missing, filled teeth; PPD, probing pocket depth; CAL, clinical level attachment; BOP, bleeding on probing.

broblast, keratinocytes, etc. IL-6 also induces the expression of some genes involved in cells differentiation and apoptosis. In fact, Il-6 is responsible of the differentiation of T-cells, macrophages, megakaryocytes, and stimulates the liver cells to produce phase acute protein[15].

The Periodontal Disease and Obesity

The periodontal chronic disease was correlated with OB, according to several authors[14,15]. Nascimento et al[16] have proposed a model that considers the life-course epidemiology that can impact on the onset of chronic diseases. The first model examines patients who had been obese and/or overweight at a young age and further increased of weight during adulthood. These patients showed the worsening of the Clinical Attachment Levels (CAL) and consequently worse periodontal conditions. In fact, the subsequent weight gain exacerbates a reduced activity of the patients' immune system. The second model, on the other hand, examines patients who were obese and/or overweight at a young age and who lost weight in adulthood. These patients, despite having a normal weight in adulthood, still have damage to the periodontal tissue. However, the decrease in pro-inflammatory cytokines in adulthood induces an increase in the immune response against pathogens. The third model examines patients who presented normal weight during young age and increased their weight during adulthood. These subjects show better periodontal conditions than those who had obesity in youth, but worse than patients who never showed obesity and/or overweight. In fact, the increase in levels of pro-inflammatory cytokines in adulthood is less harmful than that observed at a young age; as late exposure to the pro-inflammatory environment does not affect the biological properties of the periodontal tissue. The fourth model examines normal-weight patients throughout the entire life. These subjects show the best periodontal conditions compared to the previous groups of patients[17].

This study shows that the duration of exposure to the proinflammatory environment negatively affects the onset and severity of periodontal disease. Even a moment of life can influence the progress of this pathology[18].

Among the main risk factors for the onset of periodontal disease, there are smoking and obesity.

Genco et al[19] showed that the increase in BMI is directly related to the CAL. However, these authors reported that the waist circumference higher than 102 cm for man and 88 for woman is a risk factor for the development of periodontal disease in the 18-34 age group. Instead, the same authors highlighted that compensatory hyperinsulinemia, a typical condition observed in obese patients, induces dyslipidemia by altering the plasma concentrations of total cholesterol, HDL/LDL ratio, triglycerides and free fatty acids. The free fatty acids increase the hepatic gluconeogenesis and worsen the insulin resistance. The elevation of blood glucose causes the progression of periodontal disease. Furthermore, it has been shown that the concentrations of circulating pro-inflammatory cytokines, including TNF-α, are higher in patients with accumulation of adipose tissue in the abdominal area compared to those with peripheral adipose tissue[20-26].

The Influence of Bariatric Surgery on Oral Health

Oral health in patients after BS is very controversial. The diet after BS must be changed because the gastric capacity and the absorption of nutrients decrease. The dietary recommendations include the consumption of a greater number of meals per day (from four to six). Meals should be eaten over a duration of about 20 minutes and should be separated from the consumption of liquids. The reason for this recommendation is to permit the decrease in gastric volume and to give the patient the possibility of achieving a sense of satiety and an increase of gastrointestinal absorption. The type of food changes too. After BS, patients tend to choose softer foods, causing a decrease in mechanical dental cleansing. All these factors contribute to an increased risk of caries[27]. Other cariogenic factors after BS include the frequent gastrointestinal reflux and vomiting episodes, which increase the PH of the mouth.

The principal periodontal indexes used are the Probing Pocket Depth (PPD) (the distance between the gingival margin and the coronal surface), the CAL (the distance between the cement enamel junction and the more coronal surface of the gingiva), the Bleeding On Probing (BOP) (the bleeding that is induced by a probe inserted into the gingival sulcus) and the Community Periodontal Index (CPI) (five codes evaluating the severity of the following parameters: bleeding, gingival calculus and pocket depth)[28]. The studies about oral health in BS patients are controversial because they show contrasting results. Oral health, in general, changes after BS because of a decreased salivary flow and the continued episodes of vomiting can lead to teeth abrasion and mucosal ulceration.

Methods

The study was conducted utilizing the main scientific databases (PubMed, Medline, and Web of Science). The time window considered for the electronic search was from 1st March 2007 to 1st March 2019. The term "bariatric surgery" was first combined with "periodontal disease" and then independently with "cardiometabolic risk" using the connector "AND". The web search was assisted using MESH (Medical Subjects Headings). The criteria for this review are described in PRISMA flow diagram. The purpose of this review is to answer to the following questions using a PICO method (P: patient problem/population; I: intervention; C: comparison; O: outcome):

1) in obese patients who have undergone BS, is there a greater risk (compared to healthy patients) of worsening the periodontal status?
2) In obese patients after BS, does periodontal health improve or worsen the periodontal condition after bariatric surgery?
3) Is periodontal disease still a cardiovascular risk factor after bariatric surgery?

The following inclusion criteria were used: articles in English, human studies and clinical trials.

Two independent people searched with the same keywords all articles and selected the article founding. The risk of bias in this phase was solved by an independent author that conducted the same search.

The phase of screening was carried out by the two independent researches that excluded the article duplicated. The articles found in this phase were 21. 15 articles were excluded because duplicates and they did not respect the topic proposed in this review.

The phase of eligibility was conducted by other two reviewers. These authors compared the article founding and selected the article that asked the PICO. Articles which did not contain data regarding periodontal disease, oral health and cardiometabolic risk were excluded. The authors first read the abstract of all articles, excluded those which did not respect the inclusion criteria, and after they read the complete test of the remained articles.

In this phase the risk of bias was solved by an independent author, completely external and unknown to the authors. The number of articles remaining in this phase was 5. One article was excluded because it did not use the periodontal index and only concerned oral health.

The synthesis of data is carried out by the authors. All data were extracted. The author read first the abstract of all articles, and after the complete text of the articles. All the reviewers extracted the data regarding periodontal health, bariatric surgery and cardiometabolic risk. Articles which did not contain the data and the previous keywords were excluded. All doubts, regarding the included articles, were solved by contacting the author (Table I).

Results

Two independent scientists searched the previously mentioned keywords, read the titles and summarized the abstracts of 21 articles. During an initial reading, they excluded the articles that did not respect the topic. Therefore, 6 articles that responded to the key characteristics were selected. These remaining articles were read and 1 of them was excluded because it did not conform to the inclusion criteria established. The complete text of the 5 remaining articles was read, and all were found to respect the inclusion criteria. In conclusion, 5 articles were included in the present review. The scientists extrapolated the following data: periodontal index, number of patients, mean age, sex, BMI, blood glucose levels (BGL), c-reactive protein (CRP) and type of BS. Only the systemic

Table I. Process of papers searching flow diagram.

Identification of articles	Papers identified through principal database (PubMed, Medline, WOS) No. 21
Screening time	After an initial read of titles and abstract No. 6
Eligibility	A full text reading and a check of inclusion or exclusion criteria No. 5
Included	Studies included No. 5

and periodontal indexes that allowed to answer to the questions posed by the PICO were taken into consideration from the analyzed studies.

Sales-Peres[29] evaluated the periodontal changes after BS. The authors recruited 110 obese patients with a BMI>40 kg/m^2 or ≥35 kg/m^2 with comorbid conditions and followed them pre-operatively and after 6 and 12 months post-BS. The authors recorded and collected data on socio-demographic factors, BMI, smoking habits and BGL. Two expert dentists measured PPD, CAL and BOP, at baseline, at 6 and at 12 months after surgery. The enrolled patients had a mean age of 38.5 years. The periodontal index showed the following results at baseline: BOP was 24.6% (SD: 23.4), PPD was 1.77 mm (SD: 0.47) and CAL was 1.86 mm (SD: 0.60). The BOP changed from 24.6% at baseline to 32.0% at 6 months, and to 30.8% at 12 months and these results were statistically significant. The PPD varied, but not significantly, from 1.77 mm pre-operatively, to 1.74 mm at 6 months, and to 1.70 mm at 12 months. Whereas the CAL varied from 1.86 mm pre-operatively to 1.89 mm at 6 months, and then to 1.88 mm at 12 months[29].

Sales-Peres et al[30], evaluated the change in gingival bacterial flora after BS in 50 patients. In particular, the authors investigated the following bacterial species: *Porphyromonas gingivalis, Tannerella forsythia, Treponema denticola, and Prevotella intermedia*.

The method used to quantify the bacterial species was the quantitative Real Time-Polymerase Chain Reaction (qRT-PCR). The authors recruited and examined 50 patients at baseline (before surgery), 6 months and 12 months after surgery, and recorded the following systemic data: CRP, BMI and BGL. Two expert dentists measured the PPD, CAL and BOP. In addition, the samples of crevicular fluid were collected to evaluate the bacteria with standardized absorbent paper strips during the morning in the deepest site in every sextant, at baseline and after surgery. The systemic data measurements pre- and post-operation revealed a statistically significant reduction of CRP and glucose levels. The periodontal index, PPD and CAL showed an increase, especially after 6 months, with a p-value of 0.001. *P. gingivalis* increased after 6 months with a p-value of 0.028, but other types of bacteria decreased significantly ($p > 0.050$)[30].

In a cohort study, De Moura-Grec et al[31] evaluated the oral health before and after BS. The examiners recruited and studied a group of 59 patients that needed a Roux-en-Y gastric bypass (RYGB). The following systemic data were recorded before and after 6 months: BMI, CRP and BGL. Salivary flow, PPD and dental wear were measured. The systemic results were the following: BMI was 49.31 ± 8.76 kg/m^2 pre-surgery and 35.52 ± 8.12 kg/m^2 after surgery with a p-value < 0.001, the levels of CRP and BGL decreased with a p-value < 0.001. The periodontal index showed a significant increase of periodontal pockets and pocket depth (respectively with $p = 0.022$ and $p < 0.001$)[31].

Marsicano et al[32] evaluated the oral health in a group of patients who underwent BS. The authors recruited and examined a group of 50 severely obese patients, and compared them with 52 patients who needed BS. The following oral parameters were measured: dental caries with DMFT index, periodontal health with CPI index, dental wear and saliva. The results were the following: the value of DMFT was 16.11 ± 5.19 in the study group and 16.06 ± 6.29 in the control group with no statistical difference ($p > 0.05$), the CPI value was 3.05 ± 0.84 for the surgical group and 2.66±1.25 in the control group with no significant difference ($p > 0.05$). The periodontal pockets showed a statistically significant prevalence between the two groups ($p = 0.021$)[32].

Pataro et al[33] analyzed the periodontal conditions in obese patients, before and after BS. The examiners recruited and enrolled 345 participants aged between 18 and 60 years. Dentists recorded the periodontal index. All the samples were divided into three groups, according to surgical timing. The three groups were divided according to the following features: pre-operative (PRE-OP) with a sample of 133 patients, post-operative1 (POS-OP1) that represented a 6-month post-operative period with a sample of 72 patients, and post-operative2 (POS-OP2) that represented a post-operative period greater than 6 months with a sample of 140 patients. The prevalence of periodontitis, which was diagnosed by the presence of CAL > 4 mm in two or more teeth, was found to be 81.45%. The prevalence of periodontitis was different in the three groups examined with a p-value of 0.0040. The authors compared the presence of periodontitis with the principal periodontal indexes (BOP, CAL, PPD, SUP, PI). The statistical analysis revealed that only bleeding on probing had a significant correlation with periodontal disease ($p < 0.001$)[33].

Discussion

Periodontal disease is a chronic inflammatory condition and has the same pathways of other sys-

temic diseases. The link between PD and OB is clear. This pathologic condition worsens the periodontal health because the adipose tissue releases pro-inflammatory cytokines that prevent the progression of PD. Other systemic diseases, such as cancer, premature births, cardiovascular disease and stroke are linked to periodontal disease. Obesity also is a risk factor of cardiovascular disease. Periodontal pathogens have been detected in several tissues and organs of the cardiovascular system, including human cardiac tissue, pericardial fluids, heart valves and in atherosclerotic lesions. Periodontitis has an association with cardiovascular disease and this association is bi-directional. One reason for this correlation is that both the diseases have the same risk factors, including obesity, diabetes mellitus, smoking and inflammation. Another possible mechanism of correlation is oral bacteria dissemination into the bloodstream. In fact, periodontal pathogens could target arteries, thus creating an altered vascular smooth muscle cells function. This is the principal mechanism of atherosclerotic plaques formation. Moreover, an augmentation of inflammatory mediators such as CRP is due to oral bacteria invasion. Also, the periodontal pathogens inhibit the bioavailability of nitrous oxide. Nitrous oxide controls the platelet aggregation and the expression of adhesion molecule. This is a primary mechanism of atherosclerotic plaque formation.

Sales-Peres et al[29] compared BMI before and after surgery with the main periodontal indexes such as BOP, CAL and PPD. This study showed a significant association only between the reduction of BMI and the increase in BOP. Furthermore, an enhancement of gingival bleeding and only minor changes in periodontal pocket depth and attachment loss emerged. These periodontal changes were not associated with BS per se, but with surgery-related gastrointestinal complication[25].

Sales-Peres et al[30] analyzed the periodontal health before and after BS and investigated the count of periodontopathogenic bacteria. The study showed that all periodontal indexes (CAL, PPD, and BOP) worsened after 6 months post-surgery. The quantification of DNA showed the presence of four relevant periodontophatogens in the gingival fluid[30]. According to Socransky et al[34], these bacteria are responsible for the periodontal destruction and of the progression of the disease. Only *Porphiromonas gingivalis* increased during the first 6 months after surgery and decreased after 12 months. Other periodontogenic bacteria showed a strict enhancement, but were not statistically significant.

De Moura-Grec et al[31] evaluated the oral health in 59 patients before and after 6 months of BS, using a control group of 51 non-obese patients. During the study, the authors evaluated clinical parameters such as BMI, CRP and BGL. The study showed a significant reduction of BMI and CRP. After 6 months the periodontal parameters worsened, in particular the PPD. While improving clinical systemic condition, BS did not ameliorate the periodontal disease[31].

Marsicano et al[32] took into consideration two groups of patients. The first was composed of 52 subjects that needed BS, the second of 50 patients with severe OB. The study evaluated the oral health of these patients, especially using the DMFT and CPI index for periodontal health. A relevant and statistically significant presence of periodontal pocket was observed.

Periodontal disease is an oral condition that influences and is, in turn, influenced by systemic pathologies such as DM, cardiovascular diseases, and OB. New links between periodontal disease and systemic diseases have been discovered because the pathogenic pathways (pro-inflammatory cytokines) are the same.

In fact, many studies[35-39] have shown that inflammation is one of the main cardiovascular risk factors and that chronic inflammatory diseases increase ischemic heart disease and cardiovascular mortality. In this regard, BGL, a cardiometabolic risk factor, causes the progression of periodontal disease and BGL is influenced by the severity of this pathology. In the same way, the reduction of adipose tissue should slow down the progression of periodontal disease but most studies did not confirm our theory[40-45]. Only one study (Sales-Peres et al[29]) did not show a change in periodontal index before and after surgery. The remaining studies testify the worsening of oral health, especially of all periodontal indexes. The explanation to this condition is the malabsorption of some important nutrients, causing deficiencies of iron, calcium, folate, and vitamins B12, C, A, D, E and K. Vitamin A is important to avoid the epithelial repair and is a potent antioxidant. Vitamins B12 is important for cell differentiation and reparation. Vitamin C is important for collagen synthesis and to prevent the damage of the reactive oxidative species (ROS). ROS are produced during a periodontal inflammation and cause destruction of the support tissues. Vitamin D is important for the absorption of important minerals in the intestine. Also, it has an anti-inflammatory effect by regulation of cytokines. Vitamin E is a

fat soluble and it is a very important antioxidant. Low levels of vitamin D and antioxidants are correlated with a greater cardiovascular risk[46-50]. Vitamin K has an important role on the synthesis of the coagulation factors. It also had an importance in bone metabolism. For these reasons, Vitamin E is essential in periodontal health. Iron prevents the oxidation and the making of ROS.

These nutrients, as well documented by the scientific literature, are important to maintain a good state of the periodontium[51]. Also, gastroesophageal reflux and vomiting are important adverse effects of BS that impact the enamel of teeth and alter the oral PH. The low PH can expose dental tubules, causing dentin hypersensitivity. Another explanation for the reduction of periodontal health is the frequent meal and soft food intake due to the reduced gastric capacity[31,51]. The soft food does not allow the cleansing of the tooth surface, which causes an increase of caries and periodontal disease. An important study by Sales-Peres et al[30] showed an increase of the red complex such as *P. gingivalis* after 6 months post-surgery. *P. gingivalis* is a Gram-negative oral anaerobic bacterium. Together with *Treponema denticola* and *Tannerella forsythia*, *Porphiromonas gingivalis* forms the "red complex" responsible to periodontitis. *P. gingivalis* can invade the periodontal tissue and escape to the immunity response. *P. gingivalis* adheres to cells surfaces and activates the cellular autophagy. This bacterium survives into cellular phagolysosomes and uses the previous bacterial product death to replicate itself. The destruction of the periodontium is due to the virulence factors and to the activation of the immune system. The principal virulence factors are fimbriae capsules, lipopolysaccharides, gingipain, etc. Especially lipopolysaccharide, a component of bacterial membrane, activate the immune system and cause bone resorption and destruction[52-55]. Some studies[56,57] identified it as responsible for various systemic diseases such as Alzheimer's disease, esophageal cancer and rheumatoid arthritis. This bacterium activates the inflammatory system and is a risk factor. In Alzheimer's disease, the *P. gingivalis* lipopolysaccharide causes neural inflammation and antibodies against this bacterium are discovered in joint membrane[58].

The reduction of body fat leads to a decrease of cardiovascular risk because there is a decrease of systemic inflammation and a decrease of all disease linked to obesity (hypertension, diabetes). This comorbidity is the cause of cardiovascular diseases. It is now certain that the loss of fat mass with bariatric surgery decreases the risk of cardiovascular death[59]. PD is a causal factor in cardiovascular events. Bariatric surgery therefore has a dual mechanism of action: the reduction of fat mass and improvement of cardiometabolic risk and the increase in periodontal health. For this reason, the collaboration of a multidisciplinary team is required to manage the patient after bariatric surgery and evaluate the systemic effects of excess fat.

Conclusions

The dentist's role is to prevent possible adverse effects through preventive oral measures. Different techniques of bariatric surgery can influence the effects on periodontal health. The most important factor, in fact, that worsens periodontal health is the malabsorption of the main nutrients. Furthermore, the higher prevalence of *P. gingivalis* after surgery is a greater risk factor for oral pathology. *P. gingivalis*, in fact, is responsible for activating the immune system and destroying the periodontium. This bacterium generally contributes to the creation of a systemic inflammatory state.

Therefore, the nutritionist plays a key role in the reintroduction of nutrients and with the setting of an anti-inflammatory diet and with foods that promote the cleansing of oral tissues[34].

Numerous studies have shown that systemic inflammation is one of the main cardiometabolic risk factors and, for this reason, periodontal disease is linked to obesity and cardiovascular diseases[59]. However, bariatric surgery does not cause an increase in periodontal health. Therefore, periodontal disease continues to be a cardiovascular risk factor even after surgery. Indeed, the change in eating habits contributes to worsening periodontal health[47]. BS therefore reduces the risk of cardiovascular disease but does not reduce the incidence of periodontal disease.

Therefore, after surgery, dentistry should agree on a therapeutic plan together with the nutritionist and cardiologist to improve periodontal and systemic conditions, reducing the cardiometabolic risk with home and professional oral hygiene. In conclusion, albeit with little scientific evidence, it can be assumed that a reduction in systemic inflammation, after surgery, may also improve oral health, as it reduces cardiovascular risk. However, more investigations are needed in the future to better understand the action of bariatric surgery on periodontal health.

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Conflict of Interests

Authors declare that they have no conflict of interests.

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