

BARIATRIC SURGERY AND PERIODONTAL HEALTH: PERSPECTIVES ON PERIODONTAL DISEASE INDEX AND DECAY MISSING FILLED INDEX

Ancuta Andreea Miller^{1†}, Mihaela Rotaru^{2†}, Otilia Boisteanu¹, Norina Forna^{3,4*},
Mihoko Tomida⁵, Alin Ciobica^{2,6,7,8*}, Timofte Vasile Daniel¹

¹ Faculty of Medicine, "Grigore T. Popa" University of Medicine and Pharmacy, Universitatii Street no. 16, 700115 Iasi, Romania; miler.ancuta@umfiasi.ro; otilia.boisteanu@yahoo.com

² Department of Biology, Faculty of Biology, "Alexandru Ioan Cuza" University of Iasi, Bd. Carol I no. 20A, 700505 Iasi, Romania; rotmih97@gmail.com;

³Gr. T. Popa" U.M.Ph. - Iasi, Romania, Faculty of Dentistry, Department of Removable Dentures and Implantology

⁴ Academy of Romanian Scientists, 3 Ilfov, 050044 Bucharest, Romania

⁵ Medical Vocational School, Nippon Sport Science University, 2-2-7 Yoga, 158-0097 Tokyo, Japan, tomida@nittai-iryo.ac.jp

⁶Centre of Biomedical Research, Romanian Academy, Bd. Carol I no. 8, 700506 Iasi, Romania

⁷ "Ioan Haulica" Institute, Apollonia University, Păcurari 11, 700511 Iasi, Romania

⁸ CENEMED Platform for Interdisciplinary Research, University of Medicine and Pharmacy "Grigore T. Popa", 700115 Iasi, Romania; alin.ciobica@uaic.ro

*Corresponding authors: Alin Ciobica (alin.ciobica@uaic.ro) and Norina Forna (profforna@gmail.com)

† These authors contributed equally to this work, as first authors

Abstract

Aim: To analyze the impact of bariatric surgery on periodontal health by assessing the PDI (Periodontal Disease Index) and DMFT (Decay Missing Filled Index) in patients with obesity. The study seeks to correlate weight loss and changes in systemic inflammation with improvements in oral hygiene and periodontal status, contributing to the understanding of the interaction between obesity, oral health, and the effects of bariatric intervention. **Materials and Methods:** A total of 20 subjects with a mean age of 40.1±10.0 years were included. Patients admitted to the Surgery Department III of St. Spiridon Hospital in Iași, diagnosed with obesity, and who underwent bariatric surgery were enrolled in this research. The periodontal status of the subjects was recorded. Body Mass Index (BMI) was used as a measure to evaluate obesity. Variables such as age, sex, smoking habits, and brushing frequency, which could act as covariates for periodontal disease, were recorded. The data were analyzed using Chi-square and sign tests (significance level $P < 0.005$). **Statistical Analysis:** Frequency distribution was used to determine the prevalence of several variables, cross-tabulations, and Chi-square tests were employed to determine the significance of differences. Additionally, a multivariate logistic regression analysis was performed. **Results:** Periodontal disease is significantly associated with age, gender, OHIS, DMFT, PDI, smoking, and obesity. The final multivariate logistic regression analysis, after adjusting for age, gender, OHIS, and smoking, showed that obese individuals (with a BMI > 40) have a 60.07% higher risk (95% confidence interval: 1.02–2.78) of developing periodontal disease compared to individuals with grade I/II obesity. **Conclusions:** The results of the present study demonstrated a significant association between obesity and periodontal disease. However, further investigations are required to analyze and clarify the relationship between bariatric interventions and the incidence of dental conditions.

Keywords: bariatric surgery, periodontitis, dental caries, dental erosion, obesity

Introduction

Obesity is a major public health problem of new millennium given its potential

impact on morbidity, mortality and the cost of health care [1]. Obesity is a multisystem condition and a major risk factor for numerous adult diseases, including type II

diabetes, hyperlipidemia, gallstones, arteriosclerosis, cardiovascular and cerebrovascular diseases, certain types of cancer, and osteoarthritis [2] [3]. Recent studies have identified obesity as a significant risk factor for periodontal disease. Conversely, the potential systemic impacts of periodontal disease on various chronic conditions have also been increasingly recognized [4]. Obese patients are at risk for oral diseases such as dental caries [5], periodontal diseases [6], and tooth loss [7]. Besides these risk factors, obesity has also been suggested to be a risk factor for periodontitis, which is a disease of the supporting structures of the teeth resulting from the interaction between pathogenic bacteria and the host immune response.. In addition, a multitude of host-related factors including as genetic constitution, systemic conditions, environmental influences, and behavioral and psychosomatic elements contribute to the etiopathogenesis of periodontal disease [8].

Periodontal diseases are multifactorial infections elicited by a complex of bacterial species that interact with host tissues and cells causing the release of a broad array of inflammatory cytokines, chemokines, and mediators, some of which lead to destruction of the periodontal structures . The possible causal relationship between obesity and periodontitis and the molecular mechanisms by which obesity may affect the periodontium are not well understood. However, adipose tissue derived cytokines and hormones that are involved in inflammatory processes, point towards similar pathways involved in the pathophysiology of obesity and periodontitis. The mediators of low grade

chronic inflammation, such as cytokines and acute phase reactants, contribute to the development of these co-morbid conditions like obesity, type 2 diabetes and also periodontitis [4]. The biological plausibility of the association between obesity and periodontal diseases is based on the effect elevated serum levels of C-reactive protein, IL-6, TNF- α and leptin, suggesting that similar mechanisms are involved in obesity and periodontitis pathophysiologies, and that the secretions of these substances could induce a inflammatory response on periodontal disease [9]. Several lines of evidence suggest that obesity is a low-grade systemic inflammatory condition accompanied by increased levels of circulating CRP and other inflammatory cytokines such as TNF α and IL-6 [10].

There are various surgical techniques that serve as the basis for surgical weight loss. Bariatric surgery is recognized as an effective and safe intervention [11], known for improving the management of chronic conditions while achieving significant and sustained weight loss. Additionally, individuals who undergo this procedure often report enhanced self-confidence in both social and psychological aspects of their lives [12]. Bariatric surgery has a significant impact on daily life and also influences oral health-related quality of life [13]

Post-bariatric surgery manifestations encompass gastrointestinal, respiratory, cardiovascular, endocrine, and psychological changes. Among operated patients, the most frequent gastrointestinal complications include duodenal stenosis, gastric ulcers, diarrhea, chronic vomiting, reflux, and gastroesophageal cancer.

Additionally, there is an elevated risk of deficiencies in iron, vitamin B12, vitamin D, and calcium, primarily due to impaired nutrient absorption in the stomach and intestines. However, bariatric surgery may also result in undesired general and oral effects. Complications include gastroesophageal reflux, malnutrition, anemia, dehydration, and vitamin and mineral deficiencies [14].

The impact of bariatric surgery on oral health is sparsely studied and the findings contradictory. Some studies indicate associations between bariatric surgery and periodontal disease, for example Oral health problems, such as caries and tooth wear, were more common among patients after bariatric surgery, according to studies [15] [16]. In a study conducted by F. Alsuhaibani et al. [17] found that the long-term effects of bariatric surgery on dental status are associated with dental erosion. The results show a significant increase in acid reflux and vomiting, particularly 5 to 10 years after surgery, which are major risk factors for dental erosion. Symptoms such as dumping syndrome and signs of dental deterioration (e.g. yellowing, chipping, and hypersensitivity) are frequently reported. Another study conducted at the University of Gothenburg [18], observed patients for two years following surgical treatment. The results showed an increase in moderate enamel caries as well as a rise in the number of deep dentin caries in patients who underwent surgery. Nearly 50% of the individuals had poorer oral health. Associated symptoms included dental hypersensitivity and difficulty chewing. Overall, these issues can contribute to significant social discomfort. Another study conducted in the United States [19] reported

a significant increase in tooth decay among patients undergoing bariatric surgery, attributed to the need for more frequent and prolonged meals throughout the day. On average, five years after bypass surgery, patients were consuming fermentable carbohydrates five times a day, with 12% of their caloric intake coming from sucrose. The plaque index and cariogenic potential were high, and cariogenic activity was noticeably greater post-surgery compared to pre-surgery.

Heling et al. [20] conducted a study involving 113 patients aged between 30 and 50 years who had undergone bariatric surgery 4–5 years prior. The study focused on the self-assessment of dental health among these patients. The findings revealed that 79% of participants identified vomiting as the most common post-surgery phenomenon, while 37% reported an increased consumption of sweet foods. Additionally, 20% noted improved oral hygiene, whereas 73% reported no change in their oral hygiene habits. Regarding dental visits, 34% indicated an increase in frequency, while 60% reported no change. Moreover, 37% experienced significant hypersensitivity following surgery, with 44% associating vomiting with heightened sensitivity. Indigestion was reported by 32% of patients, of whom 59% also experienced hypersensitivity. Notably, 80% of the participants had consulted a dentist due to hypersensitivity. Therefore, bariatric surgery can be considered a risk marker for impaired oral health.

Other studies present conflicting evidence regarding the complications described above. Cardozo et al. [21] highlight that the oral health of patients who

have undergone bariatric surgery has improved, and the sensation of dry mouth has also decreased. Another study [22], concluded that a fibrous diet, combined with appropriate periodontal care, can enhance the oral hygiene status of patients undergoing bariatric surgery. This improvement can be achieved even without periodontal surgical interventions, contributing to the prevention of periodontitis and ultimately enhancing the patient's quality of life. The majority of respondents indicated a general increase in satisfaction with daily life despite the complications mentioned above [17]. It is extremely important for the medical team to recognize that both obesity and its treatment can impact oral health, allowing for the implementation of appropriate preventive measure.

Materials and Methods

This study was approved by the Ethics and Research Committee of the St. Spiridon Emergency Hospital, Iași. An informed consent form was signed by the patients before starting the investigation.

Twenty participants with obesity class I, II and III were included. The study group included a total of 20 persons, of whom 14 were women (70%) and 6 were men (30%) with a mean age of 40.1 ± 10.0 years.

Risk factors

Variables like age, gender, smoking and frequency of cleaning, which could act as covariants for the periodontal disease were recorded.

Examination

A complete intraoral examination was done and the oral hygiene was assessed and recorded using Oral Hygiene Index Simplified (OHIS) [23]. The six surfaces examined for the OHI-S are selected from four posterior and two anterior teeth. In the posterior portion of the dentition, the first fully erupted tooth distal to the second bicuspid (15), usually the first molar (16) but sometimes the second (17) or third molar (18), is examined. The buccal surfaces of the selected upper molars and the lingual surfaces of the selected lower molars are inspected. In the anterior portion of the mouth, the labial surfaces of the upper right (11) and the lower left central incisors (31) are scored. In the absence of either of this anterior tooth, the central incisor (21 or 41, respectively) on the opposite side of the midline is substituted.

Criteria for classifying debris:

Score 0: No debris or stain present

Score 1: Soft debris covering not more than one-third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered.

Score 2: Soft debris covering more than one-third, but not more than two-thirds, of the exposed tooth surface.

Score 3: Soft debris covering more than two-thirds of the exposed tooth surface.

Criteria for classifying calculus:

Score 0: No calculus present

Score 1: Supragingival calculus covering not more than one-third of the exposed tooth surface.

Score 2: Supragingival calculus covering more than one-third but not more than two-thirds of the exposed tooth surface or

the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both. Score 3: Supragingival calculus covering more than two-third of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both.

The severity of periodontal disease was evaluated by assessing gingival health and periodontal attachment loss using the Periodontal Disease Index (PDI) [24]. The PDI index evaluating six representative teeth, known as the "Ramfjord teeth." These include specific molars, premolars, and incisors from both the maxilla and mandible. The assessment involves measuring gingival health (redness, swelling, and bleeding) and periodontal attachment loss using a periodontal probe. Each tooth is scored for gingival inflammation (0-3) and attachment loss, with the average score across the selected teeth providing an overall PDI value. Higher scores indicate more severe periodontal disease, making the PDI a valuable tool for both clinical evaluations and research studies.

Criteria for classifying Gingival Index (GI):

Score 0: Gums are healthy (no inflammation).

Score 1: Mild inflammation (bleeding on probing).

Score 2: Moderate inflammation (bleeding and visible erythema).

Score 3: Severe inflammation (bleeding, edema and possible ulceration).

Criteria for classifying periodontal attachment loss (bone attachment):

Score 0: No loss of attachment.

Score 1: Slight loss of attachment (1-3 mm).

Score 2: Moderate loss of attachment (3-6 mm).

Score 3: Severe loss of attachment (>6 mm).

Body mass index (BMI) was assessed as part of the study using standard procedures. Subjects' weight in kilograms was measured using a physician's standard scale, while their height in meters was recorded with a stadiometer. BMI (kg/m^2) was calculated and categorized based on the World Health Organization (WHO) classification system [25]. Participants were stratified into the following obesity categories: BMI between 30.00 and 34.99 as Obesity Grade I, BMI between 35.00 and 39.99 as Obesity Grade II, and $\text{BMI} \geq 40.00$ as Morbid Obesity. Patients with a $\text{BMI} \geq 30$ were classified as obese, whereas those with a $\text{BMI} < 30$ were considered non-obese.

Statistical analysis

Data was analyzed using SPSS version 23. Standard descriptive statistics were generated. Frequency distribution for the determination of prevalence of a number of variables, cross tabulations and Chi square tests were used to find out the significance of differences.

Logistic regression analysis was carried out. Outcome variables were transformed into binary variables [presence (1) or absence (0) of periodontal pockets] for logistic regression analysis.

3. Results

The present study aimed to evaluate the association between periodontal disease and obesity in patients 2-3 days post-bariatric surgery, hospitalized in the Gastroenterology Clinic of Sf. Spiridon Hospital, Iași.

Table 1 shows the cross tabulation of periodontal disease with age, gender, OHIS frequency of brushing, tobacco usage and obesity. According to the obtained results, the frequency of cleaning, general condition, smoking, and obesity significantly influence the PDI performance and the prevalence of associated problems. Individuals who clean three times a day show 100% PDI < 2 and 0% problems ($p = 0.382$), compared to those who clean only once, where PDI < 2 decreases to 40%, and problems increase to 60%. Smoking negatively affects performance, with smokers showing 33.33% PDI < 2 and 66.67% problems, compared to 87.43% PDI < 2 and 28.57% problems in non-smokers ($p = 0.367$). While the results indicate a possible correlation between increased brushing frequency and improved periodontal status, this association did not reach statistical significance and warrants further investigation with a larger sample size for validation. The analysis of the relationship between obesity (BMI) and the PDI score reveals an increasing proportion of individuals with PDI > 2 as the severity of obesity rises. Specifically, among individuals with a BMI between 30.00 and 34.99 (Grade I obesity), no cases of PDI > 2 were recorded, suggesting a relatively lower metabolic impact. Conversely, 25% of individuals with a BMI between 35.00 and 39.99 (Grade II obesity) exhibited a PDI > 2. The most pronounced effect was observed in individuals with morbid obesity

(BMI ≥ 40.00), where 60% had a PDI > 2. These findings suggest a potential correlation between higher BMI and elevated PDI scores, possibly reflecting increased inflammation or metabolic risk associated with greater obesity severity. However, the p-value from the Chi-square test (0.392) indicates that this association is not statistically significant, highlighting the need for further studies to validate these observations.

Table 2. shows the cross tabulation of carious risk with age, gender, tobacco usage and obesity. The results indicate no statistically significant associations between DMFT scores and the analyzed variables. For age, while the percentage of DMFT > 10 increases with age (Young: 66.6%, Middle: 75.5%, Older: 100%), the association is not significant ($p = 0.564$). Similarly, sex shows no significant correlation, with 71.4% males and 100% females having DMFT > 10 ($p = 0.863$). Regarding smoking, a higher percentage of DMFT > 10 was observed among non-smokers (85.7%) compared to current smokers (66.6%), but the association remains non-significant ($p = 0.833$). However, for obesity, a notable trend emerges, with 100% of Class II and 80% of morbid obesity cases having DMFT > 10, showing a near-significant correlation ($p = 0.0482$). These findings suggest that while trends exist, further investigation with larger sample sizes is needed to confirm these relationships.

These findings highlight the importance of behavioral and clinical factors in optimizing performance and reducing associated problems.

Table 1. Periodontal disease and associated factors

Category	Subcategory (n)	Without periodontal disease (%)	With periodontal disease (%)	P-value
1. Age	Young (< 30)	40	10	0.217
	Middle (30-50)	30	15	
	Older (> 50)	5	0.1	
2. Gender	Male (6)	85.7	14.2	0.067
	Female (14)	0	100	
3. Frequency of Cleaning	Once (10)	40	60	0.382
4. OHI-S	Twice (8)	75	25	0.153
	Thrice (2)	100	0	
	Poor (8)	25	75	
5. Smoking	Fair (10)	75	25	0.367
	Good (2)	100	0	
	Never (14)	71.43	28.57	
	Current (6)	33.33	66.67	
6. Obesity	Class I (2)	0	100	0.096
	Class II (8)	25	75	
	Morbid (10)	60.07	40	

OHIS: Oral hygiene index simplified

Table 2. Incidence of dental caries and associated factors

Category	Subcategory (n)	With high caries risk (%) DMFT	Without carious risk (%) DMFT	P- value
1.Age	Young (< 30)	66.6	33.3	0.564
	Middle (30-50)	75.5	25	
	Old (> 50)	100	0	
2.Gender	Male (6)	71.4	28.5	0.863
	Femal (14)	100	0	
3.Smoking	Never (14)	85.7	14.28	0.833
	Current(6)	66.6	33.3	
4.Obesity	Class I (2)	0	100	0.048
	Class II (8)	100	0	
	Morbidly (10)	70	20	

DMFT = Decayed, Missing, and Filled Teeth Index simplified

The final multivariate logistic regression analysis, after adjusting for age, gender, OHIS, and smoking, showed that obese individuals (with a BMI > 40) have a

60.07% higher risk (95% confidence interval: 1.02–2.78) of developing periodontal disease compared to individuals with grade I/II obesity.

Discussion

The findings of our study showed significant association between obesity and periodontal disease which is in accordance with many previous studies [26] [27] [28] [29] and it is comparable in relation to age, sex, obesity, prevalence of periodontal disease and incidence of dental caries.

Obesity was significantly associated with the prevalence of periodontal disease in all the three age groups (young, middle-age and old). This finding is in agreement with Mathur et al. [30] but not in agreement with the study conducted by Al-Zaharni et al. [26] who found a significant association between measures of body fat and periodontal disease among younger adults, but not in middle age and older adults.

The association with severity and treatment outcomes has shown a dose-response relationship between BMI and periodontitis and, likewise, high BMI and obesity were also demonstrated to significantly predict a poor response following nonsurgical periodontal therapy. In addition, Morita and coworkers reported a linear relationship between periodontitis progression and BMI over a 5-year follow-up period, with significant estimates even after adjusting for age, smoking status, and history of TDM [31].

Statistically significant difference was seen between sex and periodontal disease. In our study females have a higher tendency to develop both dental caries and periodontal disease compared to males, who generally show better oral health outcomes in these categories. Contrary results was found to be less among females as

compared with males which is in conformity with study done by NIDCR (1999– 2004) (Males 10.65%, Females 6.40%) [32],. Ragghianti MS et al. (2004) [33] have related a higher clinical attachment loss among male patients.

There are some limitations inherent in this study. One of the most important limitations of this study is its longitudinal studies are needed to monitor the patients' oral health, from before bariatric surgery to long-term postoperatively. Some variables that were self-reported may introduce an inherent bias in the study(e.g. age, sex, smoking habits, and brushing frequency) . Finally, the problem of imperfect measurement of confounders can exist. Due to the variability and complexity of the associated parameters, further investigation is necessary to elicit and clarify whether such association exists beyond reasonable doubt.

Conclusion

The results of this study demonstrate a significant association between obesity and periodontal disease, particularly among individuals with morbid obesity (BMI $\geq$ 40). Additionally, females showed a greater predisposition to both dental caries and periodontal disease compared to males, reflecting potential biological, behavioral, or hormonal influences. These findings highlight the critical need for targeted preventive and therapeutic interventions in obese populations, with a particular focus on periodontal health and caries risk management, especially post-bariatric surgery. Future longitudinal studies with larger sample sizes are necessary to further validate these associations and explore the

underlying mechanisms linking obesity and oral health.

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