



# The prosthodontic management and considerations of patients after bariatric surgery: A narrative review

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## ABSTRACT

The oral health needs of patients who have received bariatric surgery are often overlooked. Although bariatric surgery is an effective modality for treating obesity, detrimental oral health sequelae are frequently observed and often neglected. Nutrient deficiencies, changes in salivary pH, gastroesophageal reflux, erosion, xerostomia, caries, wear, and hypersensitivity are all post-operative consequences seen in this patient population. These complications can lead to an accelerated deterioration of the oral cavity and subsequent extensive dental treatment. In some cases, the accelerated deterioration lends them with a terminal dentition. Pre-operative patient education and clearance in conjunction with multidisciplinary care is essential for these patients. In patients with post-operative complications, however, proper prosthodontic management is crucial. This review presents the prosthodontic management and rehabilitation considerations of patients who have received bariatric surgery.

## 1. Introduction

Obesity is a multifactorial disease resulting from an abnormal or excessive fat accumulation that poses a risk to health [1]. A body mass index (BMI) higher than 25 is classified as overweight, over 30 is categorized as obese, and over 40 is morbidly obese [1]. Obesity rates continue to rise and are associated with various other comorbidities such as type 2 diabetes mellitus, sleep apnea, hypertension, dyslipidemia, and coronary heart disease [2,3]. Adverse effects in the mouth have also been associated with obesity, such as periodontal disease, caries, and tooth loss [4,5].

Bariatric surgical procedures are a common therapeutic treatment for obesity [3]. These surgical procedures are defined as being either restrictive and/or malabsorptive [3,6]. Whereas, restrictive procedures result in a reduction of stomach volume, malabsorptive procedures involve a reduction of intestinal mucosa available for nutrient absorption [3]. When performed alone, or in conjunction with one another, these procedures ultimately lead to a decrease in food intake absorption; leading to subsequent weight loss with the goal of an improvement in obesity-related comorbidities [3,7]. Although bariatric surgery is effective for weight loss, post-surgical manifestations include micronutrient and macronutrient deficiencies, renal problems,

hyperparathyroidism, osteoporosis, gastroesophageal reflux, and oral cavity alterations [7–10]. This sudden deterioration and neglect of the oral cavity post-operatively can cause an abrupt decline in the overall oral health and condition of the dentition [11–14]. Sufficient patient education from medical providers prior to surgery and multidisciplinary management involving the dental provider can help improve oral conditions after surgery [11]. This review presents the prosthodontic management and rehabilitation considerations of post-bariatric surgery patients.

## 2. Background

### 2.1. Oral health changes

Bariatric surgery provides many benefits, however, it can also have a detrimental effect on oral health through various pathways [12]. Five main post-surgical pathways are affected in the patients who have undergone bariatric surgery. Namely, (1) frequent meals, (2) gastroesophageal reflux, (3) decreased caries protection in saliva, (4) decreased buffering of saliva, and (5) erosion/wear.

Post-operatively, patients are instructed to have small frequent meals throughout the day [15]. Enamel has a critical pH value of around 5.2 at

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which it begins to dissolve [16]. More frequent meals ingested throughout the day will affect the remineralization process and overall pH of the oral cavity and thus hinder the protective mechanisms of the saliva. Saliva has an important role in that it provides a buffering capacity to neutralize acidic environments [17].

An increased prevalence of gastroesophageal reflux and vomiting is also seen after bariatric surgery [11]. Gastric fluid can have a pH value of below 2.0, [18], which further contributes to an overall acidic environment in the oral cavity [11]. When there is prolonged or frequent acidity present, as is commonly seen in patients with gastroesophageal reflux disease (GERD) and bulimia, pathognomonic erosion often occurs [11,16,17]. Erosion can be due to extrinsic or intrinsic sources [17]. Whereas, frequent ingestion of acidic drinks, foods, or medicines are extrinsic source while GERD and vomiting would be an intrinsic source [17]. In patients who have undergone bariatric surgery, the sources are likely both extrinsic and intrinsic. Abrupt severe erosion into the dentin or pulp may also cause hypersensitivity, which has been observed in patients who have completed bariatric surgery [11]. The overall disturbance in the pH of the mouth also contributes to increased wear, which is seen in patients after bariatric surgery [7,13].

Saliva is a biological factor in preventing not only the progression of erosion [17,19], but also caries [20]. Saliva not only eliminates acids by swallowing, but also by providing calcium, fluoride, and phosphate which are essential for remineralization of the teeth [17]. Due to a reduced dietary intake, inadequate supplementation, and malabsorption, patients may experience micro- and macronutrient deficiency after bariatric surgery [4]. Nutrient deficiencies can contribute to altered saliva composition and flow rate, and thus affecting the overall remineralization and buffering capability of the saliva [21–23]. Xerostomia can be very detrimental to the oral environment, as seen in patients with Sjogren's syndrome and post-radiation cancer patients [24–27]. Xerostomia can rapidly aggravate the oral conditions and accelerate the progression of caries and infection. However, there is conflicting evidence as to the effect of salivary flow rate in this particular subset of patients. Some research suggests that these patients even experience an increase in salivary flow rate due to a reduction in the number of medications taken for comorbidities after bariatric surgery [28].

## 2.2. Oral health-related quality of life (OHRQoL)

While improvements in general health-related quality of life have been widely reported in patients who have received bariatric surgery, [29] setbacks with oral health after surgical treatment has been shown to negatively impact patients' oral health-related quality of life after surgery (OHRQoL) [30]. In a 2020 study, the categories affecting oral health that showed the highest impact were physical pain and functional limitations, which were reported in greater than 80 % of the participants [30]. Other problems with oral health that were also reported by the majority of participants in the study were difficulty masticating and tooth hypersensitivity [30]. Having fewer than 20 teeth was related to mastication problems, seen in 23 % of men and 15 % of women participants [30]. Astonishingly, only 8.4 % of individuals reported not having any impact at all on OHRQoL after bariatric surgery [30].

## 3. Prosthodontic management

### 3.1. Pre-operative initiatives

Given the various oral health implications seen with patients who have undergone bariatric surgery, pre-surgical clearance by the dental provider should be a part of the patient workup prior to surgery. Ideally,

bariatric surgeons begin this educational dialogue, but also include the dental provider as part of the multidisciplinary team in order to establish dental care prior to surgery [7]. This pre-surgical clearance should include the following: full mouth radiograph series, clinical exam, and determination of restorability of the dentition. In the event that a prosthodontic reconstruction is indicated, then a complete prosthodontic workup is advised. This is because if patients present with poor oral conditions prior to surgery, it is likely that conditions may get worse after surgery as patients appear to be more susceptible to caries, erosion, and wear [7].

Once determination of a baseline condition of the dentition is established, oral health education should be simultaneously provided. Patients should be advised on clinical protocols to reduce acidic intakes, better control the dental biofilm, be given mouth rinses, and instructed not to brush teeth immediately after gastroesophageal reflux or vomiting episodes as that can further deteriorate the teeth [7]. These pre-operative appointments should be approached similar to the pre-radiation cancer clearance patients, who are also highly susceptible to post-intervention oral health changes.

Nutritional deficiencies are seen in approximately 30 % of people who complete bariatric surgery [31]. Therefore, patients should be encouraged to intake vitamin and mineral supplements [19]. Namely, calcium, vitamin D, vitamin B<sub>12</sub>, vitamin K, iron, vitamin C, folic acid, zinc, copper, manganese, and magnesium [8]. Nutritional counseling and supplementation as preventative measures are essential in order to prevent the development of metabolic consequences seen from bariatric surgery, and their effects on oral health [31].

Bariatric surgery patients are a particularly vulnerable population with regard to how quickly the onset of dentition deterioration occurs. Therefore, timely diagnosis and management of oral health before and after surgery is very important [15]. Patients who have received bariatric surgery are also encouraged to have smaller, more frequent meals, to masticate slowly and for longer periods of time in order to minimize nausea and vomiting [15]. All of which further contributes to making the oral cavity more susceptible to complications and side-effects. Regular dental visits and monitoring prior to surgery could help prevent or diagnose and identify the need for oral rehabilitation before further deterioration of the dentition occurs.

### 3.2. Prosthetic goals and considerations

Prevention remains the most important goal of the oral health needs in patients undergoing bariatric surgery. However, in patients with a pre-existing need for dental intervention, or patients that have experienced post-surgical destruction of the oral environment, prosthodontic rehabilitation may be needed. It is important to remember that patients that have undergone bariatric surgery, the breakdown in the oral cavity is likely rapid and multifactorial. Therefore, discretion of whether surgical and/or prosthodontic intervention is needed should lie with the dental professional overseeing the patient's care.

Considerations prior to prosthodontic intervention in this particular patient subset are unique in that the challenges that these patients face are different than those of the unaffected patient. In addition to the effects that occur upon the teeth themselves (e.g. erosion, wear, and caries), patients often experience disruptions to the occlusal masticatory system overall. These can include masticatory function impairment, occlusal instabilities, and occlusal discrepancies as a result of changes to the overall dentition and maxillomandibular relationship. A comprehensive evaluation while taking into consideration these particular factors (and other dental concerns that the provider deems appropriate) is needed in order to determine a custom patient-centered treatment

plan.

Typically, comprehensive prosthodontic treatment plans involve the use of either removable or fixed prosthodontic therapeutic modalities. For the purposes of this manuscript, the use of removable prosthodontics in this population will not be discussed because upon removal of suitable abutment teeth (and without the use of suitable implant abutments), these patients become categorically similar to their unaffected counterparts.

### 3.3. Fixed therapy

The need for fixed prosthodontic intervention in patients who have received bariatric surgery typically falls into two categories: (1) the need to address primary/secondary decay as a result of a high caries risk, or (2) the need to restore vertical dimension as a result of lost/missing tooth structure from gastroesophageal reflux or wear. Often times, these two diagnoses may intersect and consideration of both is critical.

In patients that require intervention due to high caries risk (albeit primary or secondary decay), careful consideration should be made to post-intervention surveillance of abutment teeth to monitor for secondary decay. Since these patients pose a high risk for primary and secondary decay, consideration of whether saving abutment teeth that exist in this harsh oral environment is the correct treatment plan. In patients that require intervention due to missing tooth structure, maintenance of existing dentition is usually recommended since the reason for prosthodontic intervention is typically additive in the areas of replacing missing tooth structure. If abutment teeth are deemed restorable, the location of the restorative margin should take into consideration patient specific factors, such as the presence of severe erosion. In instances of severe erosion, subgingival margin preparation may prevent erosion of tooth structure in the future [16].

In patients that require intervention due to both high caries and missing tooth structure, surgical intervention should be considered after a thorough examination of the restorability of the dentition. The factors responsible for the condition of the dentition in these scenarios are typically ones which the patient cannot mitigate completely. Namely, repeated intrinsic acid attacks are an unfortunate sequelae that is often unchangeable. Therefore, in these combined situations, it is often deemed that the surgical approach is more appropriate as the dentition is typically considered terminal at this point. When it is determined that the dentition is terminal beyond repair, the primary treatment of choice is a fixed implant-supported prosthesis. Zirconia complete arch implant-supported prostheses have been shown to have lower plaque accumulation [32]. However, restorative material should also be determined based off the individuals presenting risk factors. Ultimately, the decision of whether surgical and/or prosthodontic intervention is needed should lie with the dental professional overseeing the patient's care.

### 3.4. Surgical therapy

Once it has been determined that the patient has a terminal dentition, a few key factors should be taken into consideration for this patient subset: (1) nutrient deficiency, (2) subsequent bone metabolism, and (3) early soft-tissue healing. Patients who have received bariatric surgery are known to experience nutrient deficiencies due to a multitude of factors [4]. Improper dietary intake, malabsorption, or inadequate supplementation are all reasons that could affect their nutritional status [4]. Adequate nutritional status is not only integral for wound healing, but the downstream effects that occur as a result of consequent hormonal changes may have a direct effect on the predictability of implant placement [4,33].

Since this lack of essential nutrients alters the body's ability to undergo normal wound healing [4], it can be expected that the early stages of surgical intervention would also subsequently be affected. Namely, it is the authors' experience that the acidic oral environment delays the initial wound healing phases. Whereas, the long-term healing may be unaffected; the short-term soft tissue healing typically tends to occur at a relatively slower pace than their unaffected counterparts. For this reason, surgical measures can be taken to mitigate the potential for altered wound healing. Primary closure, for example, is recommended in this patient subset in order to encourage healing by primary intention rather than secondary intention. Post-surgical antimicrobial mouth rinses are also recommended, as newer alternatives are emerging the market on a daily basis. It is our understanding, however, that no current literature discusses the difference in the long-term implant survival between patients who have undergone bariatric surgery and their unaffected counterparts.

Although further research is needed to confirm that there is no empirical difference in long-term implant survival clinically, this does not nullify the need to take into consideration their altered bone metabolism. This occurs due to both hormonal changes that occur downstream to key vitamin and mineral absorptions [4]. Vitamin D is absorbed in the ileum and jejunum and has a direct effect on the metabolic cascades of bone metabolism [4]. Although more robust data is needed, preliminary results elude to the idea that vitamin D deficiency could be linked to early implant failure [34–36]. Fretwurst et al. reported that the patients of their study had successful osseointegration after Vitamin D supplementation; whereas, previously they had failed [34].

Our medical colleagues have long recognized the need for supplementation and compensation for altered hormonal balances after bariatric surgery [8]. One of the areas that they have frequently addressed supplementation is when patients who have undergone bariatric surgery display signs of osteoporosis as a result of altered bone metabolism [8]. If patients begin medication for osteoporosis (e.g. oral/IV bisphosphonates), the dental team must be aware of the associated potential complications: such as medication-related osteonecrosis of the jaw (MRONJ) [37]. When the dental provider is part of the multidisciplinary team, pre-operative counseling and preventive care could potentially save patients from otherwise dire complications such as MRONJ. This may also be avoided if surgical and prosthodontic rehabilitation can be done prior to starting these medications.

### 3.5. Maintenance

Since there is no standardization in the treatment protocols for patients who have received bariatric surgery, further high level research is needed in order to address the long-term oral manifestations that occur. Particular attention must be made to monitoring these patients for both primary and secondary decay. For the dental provider that is responsible for maintenance, it would be useful to standardize the maintenance regimen for these patients in the dental office. One possible way of standardization is to follow caries management by risk assessment (CAMBRA) protocols, as outlined by Featherstone et al [38]. In particular, these patients would fall under the extreme risk category. A list of associated interventions are outlined in this protocol, as well as recommended intervals for radiographic monitoring [38]. It is important to note that CAMBRA protocols are not the only protocols outlined [39–41], or established in today's literature. Therefore, it is prudent that the dental provider use these standardizations [38–41] to tailor to their patient's specific needs.



4. Case examples

4.1. Diagnostic cases



(a)



(b)



(c)



(d)

**Fig. 1.** A 63-year old male, 5 years post-operative from bariatric surgery. (a) Initial intra-oral presentation exhibiting severe wear, erosion, caries, and occlusal instability. (b) Maxillary occlusal view of initial intra-oral presentation exhibiting generalized wear and erosion. (c) Mandibular occlusal view of initial intra-oral presentation exhibiting generalized wear and erosion. (d) Initial panoramic radiograph.



(a)



(b)

**Fig. 2.** A 31-year old female patient, 7 years post-operative from bariatric surgery. (a) Initial intra-oral presentation exhibiting generalized decay, infection, xerostomia, and occlusal instability. (b) Initial panoramic radiograph.



(a)



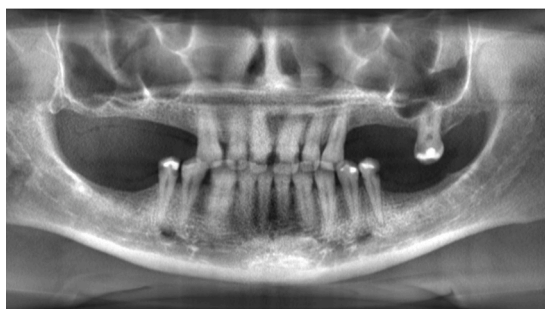
(b)

**Fig. 3.** A 37-year old female, 8 years post-operative from bariatric surgery. (a) Initial intra-oral presentation exhibiting generalized decay, xerostomia, erosion, and lack of posterior support. (b) Initial Panoramic radiograph.

#### 4.2. Treatment case



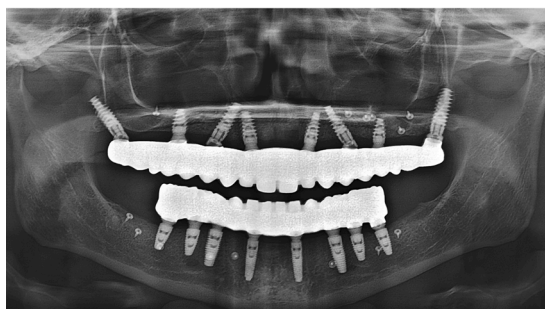
(a)



(b)



(c)



(d)

**Fig. 4.** A 37-year old female, 8 years post-operative from bariatric surgery. (a) Initial intra-oral presentation exhibiting generalized decay, xerostomia, erosion, and lack of posterior support. (b) Initial panoramic radiograph. (c) Intra-oral view of completed prosthodontic complete mouth rehabilitation. (d) Panoramic radiograph of completed prosthodontic complete mouth rehabilitation.

#### 5. Conclusion

Bariatric surgery is an effective treatment for obesity and can be effective at achieving weight loss and reducing comorbidities. However, several consequences are observed post-operatively such as

gastroesophageal reflux, vomiting, nutrient deficiencies, and osteoporosis. In addition, the surgery can have a detrimental effect on the oral cavity such as the development of caries, erosion, wear, xerostomia, and hypersensitivity. Due to the consequences and instructions observed after surgery, patients may experience an increasingly acidic environment in the mouth. Patients are also advised to eat smaller and more frequent meals throughout the day, which further contributes to altering the buffering capacity of the saliva. This consequently further damages the dentition.

Patients who have completed bariatric surgery often find accelerated damage to their oral cavity, ultimately affecting their OHRQoL. Dental providers should be included in the multidisciplinary team for the pre-surgical clearance, diagnosis, management, and educational intervention for these patients prior to undergoing bariatric surgery. With the proper education intervention efforts, patients may be able to avoid (or at the least minimize) the complications that are seen post-operatively. However, some patients who have undergone bariatric surgery can still find themselves with a severely damaged or even terminal dentition, post-operatively. Guidelines on the dental prevention, management, and treatment of post-bariatric surgery patients is lacking. Therefore, further research is necessary to examine the long-term effects of bariatric surgery on the oral health of this patient population. Ultimately, very close surveillance is needed in this patient population. This would include the maintenance and monitoring of any damage to the oral cavity; as the damage is often multifactorial and irreversible.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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