

## Advanced caries in a patient with a history of bariatric surgery

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**Purpose.** *The rate of bariatric surgery in the United States has risen significantly in the past decade as the prevalence of extreme obesity continues to increase. Although bariatric surgery is an effective therapeutic modality for extreme obesity, it is associated with risk factors and select oral health conditions. This case study describes a patient with a significant increase in dental caries after having gastric bypass surgery. It was hypothesized that bariatric patients may be at an increased risk for caries due to the need for more frequent and prolonged meals throughout the day.*

**Methods.** *Dietary, bacterial, and salivary risk assessments were completed 5 years postsurgery. A 7-day food record was analyzed using Nutrition Calc Plus + 2.0 software and a plaque index was measured. In vitro test kits were used to evaluate the cariogenicity of the plaque as well as the quantity, quality, and buffering capacity of the patient's saliva. Clinical exams and dental radiographs were used to evaluate caries activity pre-and post-surgery.*

**Results.** *On average, the patient typically consumed fermentable carbohydrates 5 times per day with 12% of her calories from sucrose. The plaque index and cariogenicity were high. The patient demonstrated low salivary production with poor buffering capacity and viscous saliva. The caries activity was noticeably higher postsurgery versus presurgery.*

**Conclusion.** *The present case study supports the hypothesis that recommended postsurgical meal patterns may place the patient at an increased risk for dental caries, particularly in the presence of other risk factors. More research is needed to further evaluate this relationship.*

**Keywords:** dental caries, risk assessment, bariatric surgery, case study

### Introduction

The rate of bariatric surgical procedures has increased significantly within the past decade. In fact, from 1998 to 2002, the number of gastric bypass surgeries has increased almost 6 fold.<sup>1</sup> This increase in popularity has been attributed to the current obesity epidemic, improvements in surgical techniques, and patient outcomes.<sup>2</sup> Although gastric bypass surgery is recognized as an effective treatment for severe obesity, it is associated with select nutritional and metabolic risk factors<sup>3</sup> as well as oral health conditions.<sup>4,5,6</sup>

This case study presents an adult female patient with a history of gastric bypass surgery who was treated for advanced caries at The Ohio State University Dental Clinic. Several caries risk factors were identified including the frequent consumption of refined carbohydrates and xerostomia. Standard dietary recommendations for bariatric patients include small frequent meals (4-6/day), thorough and slow chewing, and sipping of fluids throughout the day.<sup>7</sup> It was hypothesized

that the need for frequent and prolonged meal times increased the patient's risk for dental caries, particularly in the presence of xerostomia. Multiple risk factors were assessed including a 7-day diet record, cariogenicity of plaque, and the production and buffering capacity of saliva.<sup>8</sup> Outcomes for each risk factor will be described relative to the patient's preventive and restorative treatment plans.

## **Review of the Literature**

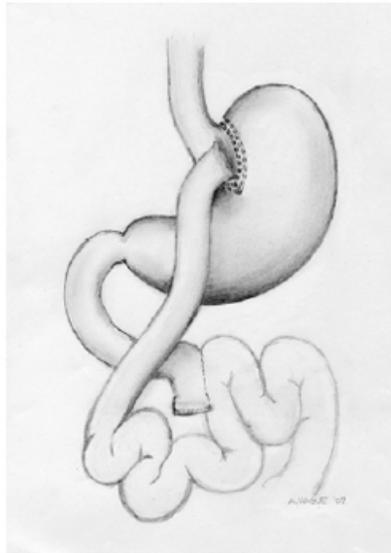
Obesity is defined as an excess of body fat and is classified using the body mass index (BMI). The current classification system for obesity includes class I (30.0 - 34.9 BMI), class II (35.0 - 39.9 BMI), and class III ( $\geq 40$  BMI).<sup>9</sup> Although the prevalence of obesity in general has increased dramatically among United States adults within the past few decades,<sup>10</sup> extreme obesity ( $\geq 40$  BMI) has demonstrated the greatest increase compared to other classes.<sup>11</sup> It is currently estimated that class III obesity affects 1 in 20 Americans. Such findings represent a major public health concern since extreme obesity is associated with numerous comorbidities.<sup>9</sup>

Bariatric surgery is recommended for adult patients with class III obesity, and class II obesity with comorbidities, provided more conservative forms of treatment (ie, diet, exercise, behavioral and psychological) have not been successful.<sup>12,13</sup> Although experts agree that noninvasive weight loss programs should represent initial treatment for extreme obesity, the long-term effectiveness of such programs has proven unsuccessful for most patients.<sup>14</sup> Subsequently, bariatric surgery has become the "standard of care" for extreme obesity.<sup>15,16</sup> In fact, it is now recognized as the only therapeutic modality that results in sustained weight loss and improved comorbidities.<sup>17</sup>

The Roux-en-Y gastric bypass (RYGB) is the most common type of bariatric surgery performed in the United States. Weight loss via the RYGB procedure involves bypassing the distal stomach, duodenum, and proximal jejunum to reduce nutrient absorption and gastric volume<sup>16</sup> (Figure 1). With RYGB surgery, the stomach is reduced to a capacity of 15 to 50 mL, which requires patients to consume small frequent meals and sip liquids throughout the day.<sup>3</sup> The general guidelines include the consumption of foods and liquids at separate times, allowing at least 30 minutes apart from each other.<sup>7</sup> In addition, the consumption of small meals should take at least 20 minutes to allow satiation and to foster thorough chewing.<sup>7,18</sup> Although such meal patterns help to decrease post-surgical complications, the patterns do increase the frequency of substrate exposure which may present an increased risk for dental caries.<sup>19,20</sup> Dehydration is also a common concern due to the reduced gastric capacity.<sup>18,21</sup> Inadequate water intake contributes to xerostomia, which can increase caries activity.<sup>8,22</sup> To date there is very little research on the effect(s) of gastric bypass surgery on oral health. Heling et al (2006) evaluated dental complications among patients following gastric restrictive bariatric surgery (n=113) and found that 37% of patients reported eating more sweet foods, 20% reported improved oral hygiene, 34% reported greater frequency of dental visits and 37% reported increased hypersensitivity. Burge et al (1995) evaluated changes in patients' taste after RYGB (n=14) and noted an increased acuity for sweet and bitter tastes. Tichansky et al (2006) evaluated changes in taste among patients who underwent RYGB (n=82) and adjustable gastric banding (n=28) surgery. The investigators noted that the majority of subjects perceived a decrease in the intensity of taste and that subjects who underwent RYGB surgery perceived greater change in taste than the gastric banding subjects. To date, no known research has been conducted to examine the effect of diet/meal patterns among bariatric patients on the incidence of dental caries. This case study will examine risk factors for dental caries in a patient who underwent RYGB 5 years ago. The patient histories were reviewed and the risk assessments were completed in 2007.

**Figures**

**Figure 1. Roux-en-Y gastric bypass**



**Patient History**

*Medical*

The patient was a 48-year-old Caucasian female. The patient's height was 5'4" and her body weight was 220 pounds (BMI=38). The vital measurements were within normal limits. Her medical history included RYGB surgery, gallbladder removal, and gastritis. The bypass surgery was performed in 2002 to treat class III obesity (BMI=52). The patient reported taking no prescribed medications or vitamin/mineral supplements and indicated that her last physical exam was several years ago. She noted a history of vitamin B12 deficiency and lactose intolerance associated with the gastric bypass surgery. The patient also reported smoking approximately 2.5 packs of cigarettes per week for the past 9 years.

*Dental*

The patient has been a patient of record at The Ohio State University College of Dentistry since 1997. She initially presented to the OSU Emergency Dental Clinic in 1997 with a toothache due to a broken filling. All of her teeth were present at that time, except for third molars. A panoramic radiograph taken in 2001 showed two endodontically treated maxillary molars. Several class I and II amalgam restorations were noted in the posterior teeth and no restorations were present in the anterior teeth (Figure 2).

**Figure 2: Panoramic radiograph 3/2001**



Due to financial constraints and anxiety associated with dental treatment, the patient initially sought dental care only when she experienced problems and/or discomfort. Between 1997 to 2005, the patient sought emergency treatment for several different conditions including reversible and irreversible pulpitis, a cracked tooth, acute apical periodontitis, and broken fillings. Although the patient did not maintain regular dental care for many years, regular care was initiated by the patient in 2005 and has been maintained since then.

Although the patient was diagnosed with numerous carious lesions from 1997 to 2007, the amount of decay, broken fillings, and the number of extractions (due to caries and/or non-restorability) increased significantly after the gastric bypass procedure in 2002. Prior to the bypass surgery (between 1997 to 2002), interproximal and/or recurrent decay was diagnosed on teeth numbers 3, 14, 19, and 31. After the bypass surgery (between 2002 to 2007), interproximal and/or cervical decay was diagnosed on teeth numbers 2, 4, 5, 11, 12, 15, 18, 19, 28, 29, and 30. Recurrent decay was diagnosed on teeth numbers 13 and 20. Bitewing radiographs taken one year apart depicted a significant increase in caries activity on teeth numbers 5 and 30. Additionally, tooth number 4 was extracted due to fracture (Figures 3 & 4).

**Figure 3: Bitewing radiograph 8/2004**



**Figure 4: Bitewing radiograph 8/2005**



A significant increase in the rate of decay was also observed in teeth numbers 19 and 20 in a 6-month period despite initiating a prescription strength fluoride toothpaste in October of 2005 (*Prevident 5000 Plus*, Colgate Oral Pharmaceuticals, NY) (Figures 5 & 6).

**Figure 5: Periapical radiograph 8/2005**



**Figure 6: Periapical radiograph 2/2006**



At the patient's next preventive recare appointment in August 2006, a restorative exam revealed decay on teeth numbers 2, 15, 19, 28, and 29. Nine months later, more decay was noted on teeth numbers 5, 11, and 19. All areas of decay were found on cervical and interproximal surfaces. To date, 8 teeth have been extracted due to caries and nonrestorability; 6 of them were extracted after the gastric bypass procedure (Figures 7 & 8). The patient reported no history of taste change or dental hypersensitivity after the gastric bypass procedure.

**Figure 7: Maxillary arch 2/2007**



**Figure 8: Mandibular arch 2/2007**



## **Risk Assessments**

### ***Diet***

Prior to the gastric bypass procedure, the patient reported eating 3 main meals daily without regular snacks. The patient's meal pattern after the surgery included 3 small meals throughout the day with regular snacks in the morning and afternoon. Snack foods were typically fruit juice, bananas, muffins, crackers, beer, potato chips, pastry, and/or granola bars. The patient reported that she sipped fruit juice throughout the afternoon several times a week. Although her meal size decreased dramatically, the patient reported no significant difference in the type of foods consumed pre- and post-surgery-once she advanced to solid foods-except for high fat meats which she found hard to digest postsurgery.

The patient completed a 7-day food record, which was analyzed for nutrient content using Nutrition Calc Plus + 2.0 software (McGraw Hill Companies, Dubuque, Iowa). Her caloric distribution was 14% protein, 45% carbohydrate, 36% total fat, and 5% alcohol based on an average intake of 2067 kcal. The patient's water and total carbohydrate intake were less than adequate at 60% and 67% of recommended levels, respectively. Although her total carbohydrate intake was low (235 g), her daily average sugar intake was relatively high (64 g) and represented 12% of her total calories. The patient consumed, on average, an adequate number of servings for grains, meat, and beans but consumed less than the recommended number of servings for milk (30%), vegetable (49%), and fruit (60%).

Although the patient's oral soft tissues were normal in appearance, the patient was referred to her physician to evaluate a possible nutritional deficiency due to her high risk status and her lapse in medical care. A biochemical assessment revealed a vitamin B12 and iron deficiency, which was treated via supplementation along with a daily vitamin/mineral supplement. Because of her daily vitamin and mineral supplements, the analysis showed the patient's intake was at or above the recommended amount for vitamins and minerals with the exception of calcium (67%), magnesium (53%), and potassium (36%).

### ***Plaque***

The patient presented with generalized plaque-induced mild gingivitis with localized moderate periodontitis and minimal bleeding on probing. The patient's plaque index was evaluated using a 2-tone disclosing solution (*Plaque-Check+pH*, GC America Inc., Alsip, Ill) to determine plaque maturity. The plaque index before brushing was 64%. Mature plaque (present for more than 48 hours) was found generalized in the cervical area. Newly formed plaque was found generalized on interproximal surfaces. The patient's oral hygiene regimen included brushing 2 to 3 times per day with a fluoridated toothpaste and flossing 1 time per day. An in vitro test kit (*Plaque-Check+pH*, GC America Inc., Alsip, Ill) was used to evaluate the acidogenicity of the patient's plaque. The test assessed total acid production using a sugar substrate and a green pH indicator. Research for this product has demonstrated a significant correlation between cariogenic bacteria in dental plaque and its acidogenicity.<sup>23</sup> The plaque sample was evaluated based on the manufacturer's instructions. A sample was harvested from the proximal surface of a posterior tooth. The sample site was dried with an air syringe to avoid contamination with saliva. The plaque sample was subjected to a sucrose challenge for one second and allowed to ferment for 5 minutes. The green pH indicator turned a vivid red within 5 minutes indicating high cariogenicity (ie, pH of 5.0 to 5.8) of the plaque sample.

### ***Saliva***

An in vitro salivary test was used to evaluate the quantity, quality, pH, and buffering capacity of the patient's saliva (*Saliva-Check*, GC America Inc., Alsip, Ill). The saliva sample was evaluated based on the manufacturer's instructions. The patient was asked not to smoke, consume food or drink, brush her teeth, or use a mouth wash for at least one hour prior to her appointment. The saliva sample was collected at the beginning of the appointment to prevent confounding results. The patient's saliva production was low at rest (>60 seconds for visible production) and at stimulation (.62 mL/min) via visual assessment of secretions from the mandibular labial glands and from chewing paraffin wax, respectively. The pooled saliva and stimulated saliva were collected separately to measure the patient's resting and stimulated pH. Test strips were placed in each sample for 10 seconds and evaluated for color change based on the kit's reference chart. The pH of the sample at rest and at stimulation were relatively low at 5.6 and 6.2, respectively (range=5.0 to 7.8). The ability of the

saliva to neutralize different acid concentrations was also determined via a test strip. The buffer test score indicated a very low buffering ability of the saliva with a score of 2 (range=0 to 12). The viscosity of the saliva was frothy/bubbly, based on visual assessment in the oral cavity. The patient reported a feeling of chronic "dry mouth" since 2005 and noted that it often interfered with chewing. To ease the symptoms, the patient frequently used an artificial saliva spray, a piece of candy, or a cough drop.

## **Treatment Plan**

### ***Preventive***

To decrease the patient's risk for caries, recommendations were made to: a) increase complex carbohydrates and reduce the consumption of simple sugars throughout the day;<sup>20</sup> b) include cariostatic food factors such as proteins, cheeses, and phytates (phosphorus-containing compounds found in the outer husks of cereal grains) particularly when consuming acidogenic foods;<sup>19</sup> c) increase water consumption; d) stimulate salivary flow via fibrous foods;<sup>20</sup> e) increase the frequency of brushing and flossing after meals/snacks; f) continue the daily use of 1.1% sodium fluoride toothpaste (Prevident 5000 Plus, Colgate Oral Pharmaceuticals, NY); and g) maintain a 4-month recare schedule to monitor for evidence of remineralization or further demineralization.<sup>24</sup>

### ***Restorative***

The patient's restorative treatment plan from 2005 was modified in accordance with the detection of new carious lesions, additional tooth fractures, and extractions. This modified treatment plan took into account the patient's dental history, current caries risk level, prevention of disease, and fracture of weakened tooth structure.<sup>24,25</sup> The working treatment plan included: a) extractions for teeth numbers 4, 12, 13, 30, and 31; b) root canal therapy for tooth number 20; c) amalgam or composite fillings on the crowns and/or root surfaces of teeth numbers 2, 5, 15, 19, 28, and 29; d) crowns for teeth numbers 19 and 20; and e) removable partial dentures for the maxillary and mandibular arches. The established treatment plan was completed with the exception of the crown for tooth number 19 and the mandibular partial denture, which was scheduled for a later time.

## **Discussion**

The most significant dietary factor in the etiology of caries is the frequent consumption of sugar and other fermentable carbohydrates.<sup>20,26</sup> Although the patient reported no dramatic change in the types of foods consumed before and after the bypass surgery, there was a difference in the pattern of foods/beverages consumed following the procedure. The primary difference included 5 meals/snacks daily versus 3 main meals. Meals/snacks included cariogenic foods such as bananas, muffins, crackers, potato chips, beer, granola bars, pastries, and chronic sipping of fruit juice.<sup>19,20</sup> Such foods are reflective of the patient's high average sugar intake (12%). Ingesting more than 10% of calories as sugar and consuming fermentable carbohydrates more than 4 times a day represent an increased risk for dental caries.<sup>27</sup> Since the dietary "rules" for bariatric patients include eating 4 to 6 times per day<sup>7,28</sup> and sipping fluids frequently throughout the day to prevent dehydration,<sup>7</sup> the risk for caries may be increased if fermentable carbohydrates are routinely consumed.

Lactose intolerance is a common condition among bariatric patients due to the diminished production of lactase. The dietary recommendations for this condition include avoidance of cow's milk.<sup>7</sup> Postsurgically, the patient reported suffering from lactose intolerance. Consequently, her intake of dairy products and calcium was low at 30% and 67% of her recommended amounts, respectively. Milk-derived factors such as calcium phosphate and casein are considered anticariogenic since they appear to protect the enamel against demineralization.<sup>20</sup> Reduced exposure to these protective effects may have added to the patient's risk of decalcification.

Dental caries is a multifactorial disease that includes not only dietary factors but also host and bacterial factors.<sup>20</sup> The patient's low salivary production and buffering capacity represent significant risk factors for dental caries.<sup>8,27</sup> Factors that may have contributed to the patient's low salivary production and buffering capacity included her low water consumption (60% of recommended) and cigarette use.<sup>29</sup> Although it is unclear why the patient first recognized the signs of dryness approximately 3 years after gastric bypass surgery, it is probable that xerostomia contributed to the increased rate of decay due to diminished natural cleansing of the oral cavity and buffering of plaque acids.<sup>30</sup> This risk was compounded by the frequent use of regular cough drops and candy to ease the symptoms of xerostomia. The patient also demonstrated a high plaque index (64%) with high cariogenicity. Five minutes after a sucrose challenge, the plaque sample pH was within the range of decalcification at 5.0 to 5.8. Such cariogenic plaque represents an increased risk for dental caries when the frequency of fermentable carbohydrate consumption is increased.<sup>19</sup>

Dietary recommendations for the patient included reducing sucrose consumption to less than 10% of calories and selecting more nonfermentable carbohydrate snacks. Water was recommended as a substitute to sipping fruit juice to help reduce substrate exposure, increase hydration, and help ease the symptoms of xerostomia.<sup>30</sup> Based on MyPyramid, at least 5 servings of whole fruit and vegetables were recommended to increase nutrient intake and stimulate salivary flow via fibrous foods.<sup>31</sup> To help increase the patient's calcium intake, 3 daily servings of dairy products with low lactose (eg, cheese and yogurt) were recommended. An increase in dairy products may contribute to caries protection and also help reduce the risk of osteoporosis, which represents a significant risk among bariatric patients.<sup>3</sup>

## **Conclusion**

The likelihood that a dental health professional will provide care for a patient with a history of bariatric surgery will increase as the prevalence of extreme obesity continues to increase in the United States.<sup>32</sup> Subsequently, there is a need to better understand oral health implications associated with bariatric surgery. The present case study lends support to the hypothesis that bariatric patients may be at an increased risk for dental caries due to a smaller stomach volume and the need for smaller, more frequent meals/snacks throughout the day. The increased risk of dehydration and lactose intolerance among bariatric patients may also contribute to caries activity due to the occurrence of xerostomia and reduced exposure to anticariogenic factors in milk. More research is needed with an adequate sample size and controls for multiple risk factors to gain a better understanding of the relationship between recommended meal patterns for bariatric patients and dental caries risk. Further supportive evidence would stress the need for more preventive dental care among this population. Preoperative nutritional counseling and oral hygiene instruction may prove especially beneficial in helping to reduce the risk of dental caries. The delivery of preventive care to help the patient maintain a healthy dentition and good chewing function is especially important in a population already at nutritional risk.

## **Acknowledgements**

## **Notes**

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