The Effects of Bariatric Surgery on Bone Metabolism

Naina Sinha Gregory, MD

KEYWORDS

• Obesity • Bariatric surgery • Adipokines • Gut hormones • Bone turnover markers • DXA

KEY POINTS

- Bariatric surgery seems to have detrimental effects on skeletal health through multiple mechanisms.
- The degree of bone loss seems to be related to the degree of malabsorption created with the varying procedures.
- Malabsorption of calcium and vitamin D in addition to a decrease in mechanical loading contributes to bone loss and changes in bone markers.
- The weight loss following surgery affects levels of adipokines, which have been found to have direct effects on bone metabolism.
- The anatomic changes following these surgeries affect gastrointestinal hormone secretion, which affects bone metabolism.

INTRODUCTION

Most recent estimates reveal that more than one-third (34.9%) of the US adult population is obese (body mass index [BMI], >30 kg/m^2). The subset of adults with extreme obesity (BMI>40 kg/m^2) continues to increase, with most recent estimates of 6.3%.[1] Obesity is associated with increased rates of several comorbidities, including type 2 diabetes, hypertension, dyslipidemia, coronary heart disease, sleep apnea, and stroke. In addition, there is an associated increase in rates of breast, endometrial, prostate, and colon cancers.[2] Bariatric surgery is an effective treatment of obesity and its associated conditions, leading to improvement or complete remission of diabetes, hypertension, dyslipidemia, and sleep apnea.[3] The numbers of these procedures continues to increase, with 179,000 performed in the United States in 2013. Of these, 34.2% were Roux-en-Y gastric bypass (RYGB), 42.1% sleeve gastrectomy

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Division of Endocrinology, Department of Medicine, New York Presbyterian Hospital, Weill Cornell Medical College, 211 East 80th Street, New York, NY 10075, USA
E-mail address: sinhana@med.cornell.edu

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(SG), 14% adjustable gastric banding (AGB), and 1% the duodenal switch.[4] Historically RYGB procedures accounted for most of the procedures performed over the past decade but the number of SG procedures has been steadily increasing.

Obesity has long been considered protective against bone disease, with higher BMI levels associated with increased bone density. However, vitamin D deficiency and increased parathyroid hormone levels are prevalent in obese individuals. The prevalence of vitamin D deficiency in obese individuals varies from 20% to 85%.[5] Possible explanations include lack of sufficient sun exposure and sequestration of vitamin D in adipose tissue.[6] In contrast with the improvement in many obesity-related conditions seen following bariatric surgery, vitamin D deficiency and secondary hyperparathyroidism do not improve and can even be further accelerated, especially with certain surgical procedures that have a significant malabsorptive component.[7]

Early bariatric procedures were more malabsorptive than the ones currently being performed and were associated with significant rates of vitamin and mineral deficiencies. The jejunoileal bypass and biliopancreatic diversion involved more extensive intestinal bypass[8] (Fig. 1). These early procedures were associated with significant skeletal loss attributable in large part to osteomalacia.[9]

The current surgeries being performed are less malabsorptive. In addition, more attention to skeletal health is being performed preoperatively. Vitamin D status is

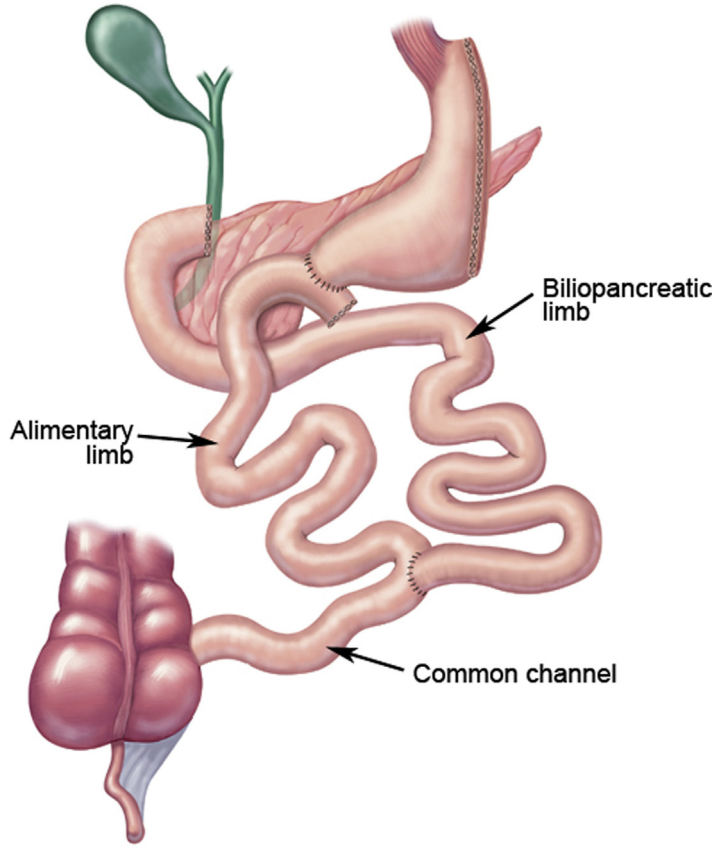

Fig. 1. Biliopancreatic diversion with duodenal switch.