

Original article

Associations of surgical and nonsurgical weight loss with knee musculature: a cohort study of obese adults

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Received January 10, 2015; accepted April 29, 2015

Abstract

Background: Marked weight loss reduces lean body mass and quadriceps thickness. It is unclear whether muscle loss varies according to the method of weight loss.

Objective: This study compared the association of surgical versus nonsurgical weight loss with change in vastus medialis (VM) properties in obese adults.

Methods: Twenty obese patients (body mass index ≥ 30 kg/m²) who lost weight via laparoscopic gastric banding were matched for weight loss with obese patients who lost weight nonsurgically. The thickness and fat infiltration of VM were assessed at baseline and a mean of 2.4 years later.

Results: After adjusting for confounders, the annual change in VM thickness was -2.9% in the surgical group and -5% for the nonsurgical group ($P = .02$). There was also a tendency toward an increased risk for VM fat infiltration to be reduced when weight loss occurred nonsurgically (OR 5.1, 95% CI .8–32.8; $P = .09$).

Conclusions: Compared with nonsurgical weight loss, laparoscopic gastric banding was associated with greater VM muscle thickness loss. Relative to laparoscopic gastric banding, there was also a tendency toward an increased risk for VM fat infiltration to be reduced with nonsurgical weight loss. Close attention to preserving muscle properties at the knee when significant amounts of weight loss have occurred is required. Physical therapy may be important in the management of patients after laparoscopic gastric banding in an attempt to preserve skeletal muscle mass. (Surg Obes Relat Dis 2016;12:158–164.) © 2016 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords:

Obesity; Muscle; Weight; Bariatric; Knee

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<http://dx.doi.org/10.1016/j.soard.2015.04.021>

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Obesity is a risk factor for musculoskeletal diseases, including knee osteoarthritis [1,2]. Although there are growing options for the management of obesity, weight loss is difficult to achieve and maintain via conservative measures such as physical activity and dietary intervention

[3,4]. Laparoscopic gastric banding and other surgical options for the management of obesity are now viable options [5]. However, the varied surgical and nonsurgical weight loss methods may differentially influence a number of body systems, including the musculoskeletal system.

All successful weight loss methods lead to a loss of fat-free mass [6], but there have been concerns that a marked loss of fat-free mass could have deleterious functional consequences [7]. After bariatric surgery, people who lose weight at the greatest rate had accelerated losses of both lean and fat mass [8], and the method of bariatric surgery is of importance [9]. In a systematic review, biliopancreatic diversion (BPD) and Roux-en-Y gastric bypass (RYGB) resulted in a greater percentage of fat-free mass loss than laparoscopic gastric banding, although laparoscopic gastric banding produced less rapid weight loss [9]. In a body composition study, almost 25% of lean body mass was lost in the year after gastric bypass [10]. Given that the maximal force-producing capability of a muscle is a measure of its cross-sectional area [11,12], it is not surprising that there has been a demonstrable reduction in the quadriceps thickness after RYGB [13]. In obese and morbidly obese men, dietary intervention resulted in 11.1% weight loss after dieting and approximately 10% reduction in the lower limb maximal force producing capability, whereas BPD resulted in a loss of 46.3% of the initial body weight 1 year postoperatively and a >30% reduction in the maximal force-producing capability of the lower limb [7]. Whether these functional or structural differences were attributable to the larger magnitude of weight loss with bariatric surgery or were directly related to the method of weight loss remains unclear.

It is also unclear whether large magnitudes of weight loss achieved by different methods are associated with the same change in local muscle properties at the knee. In addition to a reduction in muscle size, the composition of a muscle may also change with weight loss. There is growing interest in intramuscular fat, whereby infiltration of a muscle with fat can impair the functional properties of that muscle [14]. In a small study examining obese women 12 months after gastroplasty, it was reported that the fat content of the quadriceps fell postoperatively [15]. However, in nonbariatric populations, strength training was also found to reduce intramuscular fat compared with a control group [16,17]. Histologic studies have demonstrated concordance between muscle fat detected by magnetic resonance imaging (MRI) and intraoperative specimens of paraspinal muscles [18], with other studies corroborating MRI as a valid method of identifying the amount of fat in skeletal muscle [19,20].

Vastus medialis (VM) is a functionally important quadriceps muscle that acts to stabilize the patellofemoral joint [21,22]. Intramuscular fat infiltration of the quadriceps has been reported to be associated with the maximal isometric force that the muscle can produce [14]. Moreover, increasing size of VM has been shown to be longitudinally

associated with less knee pain, reduced patella cartilage volume loss, and even a reduced risk of total knee joint replacement [23]. Therefore, maintaining VM size and reducing or at least preventing an increase in intramuscular fat is an important outcome for all compartments within the knee joint.

The aim of this longitudinal study was to compare the association of nonsurgical weight loss versus weight loss achieved by laparoscopic gastric banding with changes in the VM size and fat infiltration in an obese cohort of otherwise healthy adults who lost similar amounts of weight.

Methods

Study population

People with body mass index (BMI) ≥ 30 kg/m² were recruited by advertising in the local press, in hospital and private weight loss/obesity clinics waiting rooms, and through community weight loss organizations in Melbourne, Australia. Participants were excluded if there was a history of any joint or neurologic disease that could have affected the musculature at their knee, including any arthropathy diagnosed by a medical practitioner; prior surgical intervention to the knee, including arthroscopy; previous significant knee injury requiring non-weight bearing or requiring prescribed analgesia; malignancy; or contraindication to MRI. The study was approved by the Alfred Hospital Human Research and Ethics committee (HREC), the Monash University Human Research Ethics committee, and the Austin Health Human Research and Ethics committee. All participants gave written informed consent.

Participants were included in the current study if they underwent laparoscopic gastric banding as their bariatric procedure ($n = 20$) or had lost weight via nonsurgical approaches, including nutritional support and lifestyle changes ($n = 20$). Participants who underwent laparoscopic gastric banding also had nutritional support and lifestyle advice as part of their routine care. All surgical patients were advised to take a daily multivitamin containing at least 400 μ g of folate, B12, B1, B6, and thiamine. No protein supplements were advised, but dietary advice was to select protein first and to target high-quality foods. Observational data have demonstrated that such an approach results in a higher proportion of dietary protein [24]. In an attempt to try to negate any potential confounding that different magnitudes of weight loss may have, the 20 participants who lost the greatest amount of weight via nonsurgical methods were included in the final analyses provided they had lost within 2% of the same amount of weight as their surgical counterparts. Nonsurgical methods of weight loss included lifestyle intervention such as diet and exercise,

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