CME CREDIT

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Tending to the musculoskeletal problems of obesity

ABSTRACT

When an overweight or obese patient complains of musculoskeletal problems such as knee or back pain, it may be an oversimplification to say that the excess weight caused the problem and that losing weight will solve it. Nevertheless, weight loss can help and is worthwhile for cardiovascular health and other reasons.

KEY POINTS

Osteoarthritis of the knee is the best documented musculoskeletal sequela of obesity.

High body mass index may be associated with acute back pain, but the evidence seems to indicate this may be true only for the highest levels of weight.

Weight loss can make a substantial difference in most musculoskeletal symptoms.

If the obese patient has no cardiovascular contraindications, then a regimen of both resistance training and aerobic exercise (30 minutes at least 3 days a week) should be advocated for weight loss.

Encourage obese patients to use portion control and a balanced diet plus exercise rather than going from one extreme or trendy diet to another. Offering patients direct dietary supervision and suggesting that they join a support group may contribute to successful weight loss.

OBESE PATIENTS OFTEN HEAR that any ache or pain they have is due to their excess weight and will resolve with weight loss. The truth is more subtle.

A causative relationship between excess weight and musculoskeletal problems has been difficult to establish for many conditions. Nevertheless, weight loss can make a substantial difference in most musculoskeletal symptoms, as well as help prevent heart disease and metabolic syndrome.

The National Health Assessment and Nutrition Examination Survey for 1999 through 2002 found that about 65% of American adults were overweight or obese: 30% were overweight, ie, they had a body mass index (BMI) of 25 kg/m^2 or greater, and 35.5% were obese (BMI ≥ 30 kg/m^2).[1] Given the high prevalence of overweight and obesity, it would be helpful to briefly review weight-related musculoskeletal conditions and the impact of weight loss on these conditions to better prepare us to offer patients sensible, effective weight-loss strategies and other treatments aimed at relieving and resolving musculoskeletal symptoms.

OSTEOARTHRITIS OF THE KNEE

Osteoarthritis of the knee is a leading cause of disability in people over age 65, and its impact on the public health is substantial.[2] The risk of osteoarthritis, specifically of the medial tibiofemoral or patellofemoral compartment (but not the lateral compartment), increases with increasing BMI,[3–5] even in people within the upper tertile of normal BMI (22–24.9 kg/m^2) compared with those in the lower tertile,[6,7] and the effect of BMI on knee osteoarthritis risk is greater in women than in men.[8,9]

Also of note is that the BMI in young adulthood (the 20s and 30s) is almost as strong a predictor of knee osteoarthritis in later life as the BMI at the time arthritis is diagnosed.[5,10]

Mechanical factors in the development of osteoarthritis

The increased risk of knee osteoarthritis in obesity is not just a matter of weight, as the incidence of ankle and hip osteoarthritis is not higher in these people.[5] Rather, mechanical factors may explain the relationship of weight to osteoarthritis of the medial and patellofemoral compartments.

Under normal gait conditions, 60% to 80% of the greatest forces in the lower extremity are across the medial knee joint space during the stance phase.[11] When these forces (the external peak knee adduction moments) are increased, they can increase the severity of knee osteoarthritis and contribute to its progression[12,13] and, eventually, the need for total knee arthroplasty.[14]

The risk of osteoarthritis of the knee increases with increasing BMI

Weight contributes to the total knee compressive load, which is about four times the body weight in the setting of knee osteoarthritis. For each 1 lb of additional weight, the compressive forces across the medial compartment increase by 4 lb. Assuming 1,200 strides per mile, this translates to an additional 4,800 lb per mile walked.[15]

Malalignment increases the risk of progression

Excess weight exerts a major impact on the progression of knee osteoarthritis only in those who already have some degree of malalignment of the knee.[16,17]

Determining whether malalignment is present helps in evaluating the patient's risk. Sometimes varus angulation (bow-leg) and valgus angulation (knock-knee) may be apparent by simple observation. Obtaining precise measurements of the angle with a goniometer is difficult, especially in an obese person. Instead, a standing, full-limb radiograph of the affected leg may be more revealing, as it shows the angle between the mechanical axis of the femur and the tibia,[18] which can be easily measured by the radiologist without the use of sophisticated equipment. A mild to moderate (3°–6°) varus malalignment indicates that the patient is at high risk for progression of knee osteoarthritis, which is compounded by excess weight.

Quadriceps weakness

Muscle contractions have a great deal to do with the forces that are transferred across a joint, and quadriceps muscle weakness is known to be a risk factor for the development of knee osteoarthritis.[18,19] Because of their sedentary lifestyle, obese people are often thought to have weak muscles. In fact, muscle strength and energy expenditure are normal in obesity when adjusted for fat-free mass and compared with age-matched and sex-matched controls.[20]

CARPAL TUNNEL SYNDROME

Obese people are two times more likely to develop carpal tunnel syndrome than are people of average weight, and women are three times more likely to develop it than are men.[21] Type 2 diabetes is an independent risk factor.

Two case-control studies—one of 3,391 cases in the United Kingdom that met clinical criteria[22] and another of 300 cases in patients presenting for an independent medical examination for hand pain and paresthesias that met electrodiagnostic criteria[23]—showed that obesity is strongly associated with carpal tunnel syndrome, with odds ratios of 2.0 and 2.91, respectively. Furthermore, in another case-control study of 791 patients with electrodiagnostically confirmed carpal tunnel syndrome, obesity was an independent risk factor (odds ratio 1.85), second only to female sex, and independent of diabetes mellitus.[21]

Obesity and median nerve compression

The pain, numbness, and tingling of the fingers characteristic of carpal tunnel syndrome are the result of compression of the median nerve. This can result when the carpal tunnel becomes narrowed or when the tendons become enlarged.

In obese people, adipose tissue can compress the median nerve. In addition, they have to alter their center of gravity to accommodate their pannus (abdominal fat): ie, when arising from a chair, they generally have to move their feet closer under their body and use their arms to push out of a chair. This extends the weight-bearing wrist, which may put additional pressure on the median nerve.

ROTATOR CUFF TENDINITIS

The same adaptive movements obese people use to get out of a chair can also contribute to rotator cuff problems. In a case-control study comparing 311 patients who required rotator cuff surgery with the general population, the risk was 25% higher for overweight patients, 80% to 120% higher for moderately obese patients, and 300% higher for patients whose BMI was 35 or above.[24]

In addition, some experts believe that atherosclerosis and decreased blood flow to the rotator cuff render it more vulnerable to trauma, and atherosclerosis is a common comorbid condition in obesity.

LOWER BACK PAIN

The literature on overweight and lower back pain requires cautious evaluation, given the absence of uniform classification criteria for low back pain, and given that many studies did not control for other factors such as smoking, occupation, and depression.

In a longitudinal study that used magnetic resonance imaging of the lumbar spine, being persistently overweight (BMI > 25) was associated with disk degeneration (risk ratio 4.3; 95% confidence interval 1.3–14.3), but no clinical correlations were made.[25]

In a cross-sectional study of middle-aged Japanese men and women with chronic low back pain,[26] substratified according to a positive or negative straight-leg-raising test, BMI did not correlate with back pain. However, women with low back pain and a negative straight-leg-raising test had a significantly higher waist-to-hip ratio than did female controls or women with low back pain and a positive test.[26]

A Danish study of 29,424 twins found a moderately positive association between obesity and recurrent or chronic low back pain.[27]

In a cross-sectional study of almost 13,000 men and women in the Netherlands, a BMI greater than 25 carried a 14% to 48% higher risk of low back pain lasting more than 12 weeks or of symptoms of intervertebral disk herniation in women but not in men.[28]

A study using data from the National Health and Nutrition Examination Survey for 1988 through 1994 found that in both men and women the prevalence of low back pain increased as the BMI increased, but it could not determine causality.[29]

In a prospective cohort study in a group making claims for workmen's compensation, obesity was associated with an 80% higher risk that acute low back pain would persist and become chronic.[30]

Also, a meta-analysis indicated a weak association between BMI and low back pain in 32% of studies, but in none was the risk ratio of obesity for low back pain greater than 2.0.[31]

In general, the association of low back pain with obesity was stronger in large population studies than in smaller studies or those that focused on occupation. Although one might think of weight, work, and low back pain as going together, the finding of a higher prevalence of low back pain in the general population than in the working population suggests a "healthy-worker" effect—ie, healthier people tend to stay in the workforce, and disabled people are underrepresented.

Moderate varus malalignment increases the risk of progression of osteoarthritis

The data to date suggest that if there is an association between BMI and acute back pain, then it exists only for the highest levels of weight. It also seems that obesity is not a strong risk factor, and significant interactions from other factors have not been ruled out.

WEIGHT LOSS RELIEVES MUSCULOSKELETAL SYMPTOMS

Weight loss can make a substantial difference in most musculoskeletal symptoms. In the Framingham study, a weight loss of 11.2 lb was associated with a 50% decrease in the risk of developing symptomatic knee osteoarthritis.[8] In a Danish study, 89 obese patients (mean BMI 35.9) with symptomatic knee osteoarthritis who lost 11% of their body weight over 8 weeks experienced a 50% decrease in their pain, whereas a control group on a conventional but monitored diet who lost 4% of body weight had no improvement in their pain.[32] There was no exercise treatment arm in this study.

The Arthritis, Diet, and Activity Promotion trial[33] was an 18-month study of 316 obese older adults with medial compartment knee osteoarthritis, comparing diet plus exercise against diet alone, exercise alone, or a healthy lifestyle.[33] Exercise consisted of both aerobic and resistance training, and the diet was based on that used in a controlled study, the Trial of Nonpharmacologic Interventions in the Elderly (TONE).[34] Treatment started quite intensively, with frequent visits to nutritionists and exercise counselors. Diet plus exercise had the best results: the mean weight loss was 5.2 kg, and knee-pain scores decreased significantly. The study showed that in the setting of regular exercise even a small amount of weight loss can have a significant impact on clinical outcome.

DIET: ENCOURAGE PORTION CONTROL AND BALANCE

Overweight people with arthritis can and should exercise

Dieting is a frustrating vicious circle for many overweight people, and "yo-yo" dieting is common, ie, seeking "magic" foods and diets, going on and off diets, and jumping from one new diet to the next.

Clinicians can offer overweight patients a better way by encouraging them to use portion control and balance, rather than extreme or trendy diets. Offering patients direct dietary supervision and suggesting that they join a support group may contribute to successful weight loss.

The US Preventive Services Task Force has published guidelines for the management of obesity,[35] and an evidence-based review of these guidelines is available at the Web site of the Agency for Healthcare Research and Quality, **www.ahrq.gov/clinic/serfiles.htm**.

EXERCISE

Exercise serves a number of purposes. It is necessary for energy expenditure, cardiac health, and strengthening of muscles—in the case of patients with knee osteoarthritis, the quadriceps, hip girdle, and torso muscles.

Muscle conditioning works

Even in the obese, muscles can be strengthened and conditioned. If the patient has no cardiovascular contraindications, then a regimen of both resistance training and aerobic exercise (30 minutes at least 3 days a week) should be advocated for weight loss.

In addition to the Arthritis, Diet, and Activity Promotion trial,[33] the Fitness and Seniors Trial[36] of older adults with knee osteoarthritis tested aerobic and resistance exercise and found that both produced a modest improvement in disability and pain scores compared with no exercise.

Tailoring the program

Overweight people with arthritis can and should exercise, as long as the regimen is tailored to the patient's preferences and tolerances. For example, if the arthritic knee is too painful for weight-bearing exercise, the patient may tolerate cycling or exercising the upper extremities using weights to increase energy expenditure. The Arthritis Foundation offers both land and water exercise programs that are appropriate for the overweight arthritic patient (**www.arthritis.org**).

Which muscle groups to target

Quadriceps strengthening can improve pain and function scores in patients with knee osteoarthritis.[37,38] However, a recent study showed that those with stronger quadriceps muscles and greater varus malalignment at baseline had greater radiographic progression of their knee osteoarthritis.[39]

There is evidence that weakness of the ipsilateral hip abductor (gluteus medius) also contributes to increased knee forces.[40] And the gastrocnemius, soleus, and trunk muscles play a major role in stabilizing the knee or the body in relationship to the knee during gait,[13] as shown in electromyographic studies.

As the quadriceps is only one muscle group that stabilizes the knee, in patients with varus malalignment it may be prudent to do generalized conditioning exercises.[40]

DRUG THERAPY OPTIONS

Drug therapy includes orlistat (Xenical) and sibutramine (Meridia) for long-term use. One can reasonably expect to lose 3 to 5 kg with these drugs. They should be used along with a plan of diet and exercise.[41]

GASTRIC BYPASS SURGERY

The evidence of benefit

Four studies have looked at how major weight loss after gastric bypass surgery affects baseline musculoskeletal symptoms.

McGoey et al[42] reported a prospective study of 105 patients who lost a mean of 44 kg. The prevalence of back pain decreased from 62% to 11%, hip pain from 11% to 2%, knee pain from 57% to 14%, ankle pain from 34% to 2%, and foot pain from 21% to 1%.

Peltonen et al[43] looked at work-restricting musculoskeletal symptoms in the general population compared with those in 2,010 surgically treated obese patients ages 37 to 60, and those in 2,037 age-matched and sex-matched obese patients not undergoing surgery. Obese patients had more work-restricting neck, low back, hip, knee, and ankle pain, and the prevalence increased with BMI. Patients who underwent vertical banded gastroplasty had a significant decrease in work-restricting low back pain at all five sites.

Melissas et al[44] found that the prevalence of low back pain in a bariatric surgery population with a baseline BMI of 46.7 was 58% and decreased to 20% after a mean weight loss of 83 kg, even though the patients were still in the obese range (BMI of 34).

Hooper et al[45] In this recent study, my colleagues and I evaluated 48 obese patients at baseline and at 6 to 12 months after gastric bypass surgery (average weight loss after surgery 41 kg) and compared them against published rates for the general population. Overall, our patients had a higher prevalence of musculoskeletal pain than the general population. Before surgery 79% had upper-extremity pain, but this decreased to 40% 6 to 12 months after surgery. Before surgery 100% had lower-extremity pain, but this decreased to 37% at the end of the study period. In addition, 25% had fibromyalgia syndrome before surgery, but this decreased to only 2% by the end of follow-up. Our patients did not have a higher prevalence of cervical or lumbar spine findings compared with population controls. Unresponsive sites included the shoulder, hip, and trochanteric bursa. Pain, function, and quality-of-life scores all improved significantly.

Candidates for gastric bypass surgery

For patients whose BMI is 35 or above and who could not lose weight on a closely monitored trial of diet, drug therapy, and exercise for weight loss and have a comorbid medical condition, gastric bypass surgery offers the possibility of losing 70% of excess weight over 12 to 18 months and the ability to maintain that weight loss for at least 10 years.[46]

Surgical options

The most common procedures are gastric stapling with a Roux-en-y gastrojejunostomy and vertical banded gastroplasty. The Roux-en-y procedure is associated with greater degrees of weight loss but is irreversible.

Follow-up care

After gastric bypass surgery, patients must be followed long-term for malnutrition, vitamin deficiency, and bone loss. We routinely prescribe monthly intramuscular injections of vitamin B_{12} and daily oral calcium and vitamin D supplementation for these patients.

After gastric bypass, check long-term for malnutrition, vitamin deficiency, bone loss

Avoid prescribing nonsteroidal anti-inflammatory drugs, even selective cyclooxygenase 2 (COX-2) inhibitors, in these patients because of the risk of gastrointestinal bleeding, which, if it occurs distal to the stapling or banding, requires major surgery and has a high morbidity rate. Patients can use acetaminophen, tramadol, or opiates.

Monitor bone changes. After gastric bypass surgery, along with rapid and substantial weight loss, there is an increase in bone turnover markers and a decline in femoral bone mineral density (BMD).[47] These changes probably reflect a decrease in estrogen, decreased compressive forces on the bones, and a decrease in adipocyte-produced interleukin 6.[48]

As most obese patients have such high baseline BMD levels, the decrease does not usually fall into an osteopenic range. However, if prevention or treatment of osteoporosis is indicated, oral bisphosphonates should not be prescribed: with the residual gastric pouch volume restricted to 30 mL, the risk of esophageal reflux and injury would be too great. The US Food and Drug Administration has recently approved intravenous ibandronate (Boniva) for the treatment of postmenopausal osteoporosis,[49] and this agent presumably can be used safely in patients who have undergone gastric bypass surgery.

SURGICAL TREATMENT OF MUSCULOSKELETAL CONDITIONS

Knee osteoarthritis

Obese patients may undergo knee surgery (osteotomy or joint replacement). However, some surgeons are reluctant to do total or partial knee arthroplasty on patients weighing more than 200 lb because of concerns about increased perioperative morbidity and the long-term durability of the arthroplasty. Long-term studies are needed to determine if obesity is associated with an increased need for revision surgery. However, an 8-year follow-up study of 840 total hip replacements and 911 total knee replacements did not indicate a greater need for revision in obese patients,[50] and 10-year outcomes in 285 patients with 326 knee arthroplasties were not worse in obese vs non-obese patients.[51]

Carpal tunnel syndrome

Surgical correction of carpal tunnel syndrome may be indicated if the pain is severe enough, if motor weakness is occurring, and if the electrodiagnostic criteria are met.

Low back pain

Surgery for low back pain in overweight and obese patients should follow the same stringent indications as used in nonobese patients. There is no indication that obesity confers a worse surgical outcome.

USE OF SPLINTS, INSERTS, BRACES

Wearing shoes with even moderate (1.5-inch) heels increases torque in the knee joint and should be avoided.[52] Lateral sole inserts have been advocated to correct the varus knee but have not been uniformly effective in clinical trials.[53] Adding an ankle strap to prevent ankle valgus and pronation may be more effective, and hopefully, future prototypes will address this.

To correct the varus forces, unloading braces can be used and are effective.[54] A recent Cochrane Database Review indicates that most studies of insoles and knee braces are methodologically lacking, but there is some evidence for success with lateral wedge insoles with subtalar strapping, and there is evidence that unloader braces may be slightly more effective than a neoprene sleeve.[55]

In addition, many obese people have pes planus (flat feet) and require arch supports, which would not be compatible with a lateral wedge support.

Night-time splints may be very effective for treating carpal tunnel syndrome.

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