

Is Obesity Significantly Related to Early Onset and Progression of Knee Osteoarthritis?

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ABSTRACT

Obesity is a modifiable risk factor that is associated with osteoarthritis (OA). The pathogenesis is multifactorial which includes mechanical, humoral, and genetic factors. We discuss the role of obesity in this article in the early onset and progression of knee OA and whether there is a correlation with arthroplasty and the prevention of obesity with OA in the obese population.

Keywords: Obesity, Osteoarthritis, Progression.

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Knee osteoarthritis (OA) is classified as a degenerative disease of the joint with localized loss of cartilage and associated inflammation.¹ Clinically, it presents as pain, stiffness, limitation in movement, and joint deformities. It is one of the leading causes of disability in the elderly population and substantially impacts the quality of life.²

One of the important risk factors associated with OA is obesity. This article assesses the impact of obesity on the onset and progression of knee OA.

PATHOGENESIS

The association of obesity causing overloading of the weight-bearing joint and resultant wear and tear of the cartilage is obvious.³ However, this association with obesity is not as direct and several factors including mechanical, humoral, and genetic factors contribute to the pathogenesis of knee OA.

Mechanical factors cause OA due to the increased axial pressure on the joint. Moyer et al.³ showed this relationship showing an association between body mass and dynamic knee loading. These abnormal loads alter the composition and mechanical properties of hyaline cartilage ultimately leading to erosion of the cartilage. Messier et al.⁴ in their study of gait analysis of 142 overweight individuals with knee OA observed that each pound of weight loss resulted in a four-fold reduction of load exerted on the knee joint.

Even in other joints, an association of OA with obesity has been documented. Studies have shown an increased risk of hand OA by 2–4 times in obese people as compared to normal-weight people.⁵ Osteoarthritis develops when a breakdown of cartilage is faster than it is produced. Obesity has been seen to be associated with higher levels of insulin-like growth factor-1 (IGF-1) levels and proinflammatory cytokines due to the compression of the mechanoreceptors at the surface of chondrocytes.⁶ These are understood to cause additive oxidative stress, inflammation, and tissue breakdown at the knee joint. Additionally, adipose tissue found in abundance in obese patients secretes leptin, resistin, and adiponectin which may influence cartilage homeostasis and have a role between obesity and OA of the knee.

There is also a growing understanding of the genetic basis of OA; however, there are conflicting views regarding its association with obesity. Spector et al.⁷ found a correlation in twins while Manek et al.⁸ concluded that the association was unlikely to be mediated by shared genetic factors.

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EARLY OBESITY AND OSTEOARTHRITIS DEVELOPMENT

It is a known fact that childhood obesity predicts adult obesity. Whitaker et al.⁹ showed that adolescents who are overweight are 18 times more likely to become obese in their early adulthood as compared to normal-weight people. Several studies have identified that the ideal window of opportunity to prevent obesity is during adolescence and young adult life.¹⁰ Wills et al.¹¹ suggested that obesity from childhood had an accumulative effect on knee OA development. The body mass index (BMI) in young people (as early as 15 years) was associated with an increased risk of OA at 53 years. They concluded that prolonged exposure to high BMI throughout adulthood carried the highest risk of knee OA. However, a study by Manninen et al.¹² observed that the pattern of weight gain is important, with a higher risk of knee OA requiring arthroplasty seen in patients with a shift from normal to overweight in adult life when compared with being constantly overweight.

CORRELATION OF OBESITY WITH OSTEOARTHRITIS

Blagojevic et al.¹³ conducted a systematic review and observed that all studies showed obesity as a risk factor for knee OA. They demonstrated that the risk of developing OA increased in proportion with an increase in weight. A study by Gelber et al.¹⁴ observed that there was a three-fold increase in the risk of OA for the patients in the obese group when compared with the normal-weight group in the younger population. The Framingham Osteoarthritis study

(mean age 37 years) showed that patients in the heaviest weight quintile had a 50% increase in the risk of radiographic knee OA at 36 years of follow-up.¹⁵ Hart et al.¹⁶ assessed BMI at 54 years and observed that BMI was predictive of incident osteophytes but not joint space narrowing. These results suggest that bodyweight in the early years may be a more important risk factor than weight in later years of life.

Varus malalignment is an important risk factor for the progression of knee OA.¹⁰ Sharma et al.¹⁷ observed that the severity of OA correlated with higher BMI in patients with varus knees but not in those with valgus knees.

Obesity has seen to be associated with an increase in the symptoms of knee pain which may or may not correlate radiologically. Webb et al.¹⁸ in a community-based study observed a three- to four-fold increase in knee pain with a rise in the BMI. Somers et al.¹⁹ observed that patients with higher BMI (borderline and morbidly obese) had significantly higher levels of pain when compared with a group of overweight patients.

Sahyoun et al.²⁰ in their study showed that each unit in age-adjusted BMI was associated with a 4% increase in the incidence of OA. They also observed that the risk of OA was higher in those obese individuals who gained weight than those who were able to maintain their weight. Also, a loss of 10% of the body weight in the obese group reduced the risk to that of the non-obese population.

Coggon et al.²¹ conducted a population-based case-control study and observed that the odds ratio for developing OA with BMI <20 was 0.1 (95% CI 0.0–0.5) when compared with the odds ratio of 13.6 (95% CI 5.1–36.2%) with BMI >35. They also said that the odds ratio increased to 78 with risk factors, such as, previous knee injury, previous meniscectomy, or the presence of Heberden nodes. They also observed that the risks associated with obesity tended to be higher in women when compared with men.

A case-control study by Holliday et al.²² recruited 1,042 knee OA patients and 1,121 controls and reported that patients with BMI >30 had an adjusted odds ratio of 7.48 for knee OA (95% CI 5.45–10.27) when compared with BMI <25. Also, they observed that a greater duration of being overweight was associated with a higher risk of OA. Consequently, it appears that the severity of OA and its incidence rises linearly with increasing BMI.

CORRELATION WITH ARTHROPLASTY

The need for arthroplasty has been used as a marker of the severity of OA in obese patients by some studies. Lohmander et al.²³ in their cohort of >25,000 patients between 45 years and 73 years of age found a significant relationship between BMI of >30 kg/m² and need for hip or knee arthroplasty.

Several studies have found BMI to independently predict the need for arthroplasty at an earlier age group. Gandhi et al.²⁴ in their study using univariate analysis observed that patients with BMI >35 kg/m² had an arthroplasty 7–8 years earlier than those with normal weight. Changulani et al.²⁵ observed that arthroplasty was undertaken at a younger age with an increase in BMI; however, statistical significance was seen with BMI >35 kg/m². Bourne et al.²⁶ observed that a change from an individual's baseline BMI confers a greater risk, with an increase of 1 kg/m² of BMI resulting in a 10.5% risk of arthroplasty and a 5 kg/m² of BMI resulting in almost doubling the risk. Leyland et al.²⁷ demonstrated that the index BMI was predictive of arthroplasty, with a 40% increase in risk in overweight patients and a 2.7 times higher risk in patients with BMI >40 kg/m².

The major issue with doing arthroplasty at an earlier age is that these patients may require revision surgery. These patients are also at a higher risk of perioperative complications which further increase the risk of reoperation. Nevertheless, there is also published data²⁸ that suggest higher BMI does not predict earlier failure of arthroplasty.

OBESITY REDUCTION AND ITS EFFECT ON OSTEOARTHRITIS

Weight reduction is considered as a functional treatment for knee OA and is especially important in obese patients as it will lead to a reduction in the joint load and inflammation. However, there is little prospective data to confirm this assumption.

Christensen et al.²⁹ in their review observed that a loss of 5% of the body weight over 20 weeks resulted in symptomatic relief. The Framingham Knee Osteoarthritis Study¹⁵ found that a reduction in BMI of approximately 5.1 kg over 10 years reduced the risk of developing OA by over 50%. However, they did not address the effect of weight loss after the onset of symptoms.

Messier et al.⁴ in their series of 252 patients with a BMI ≥28 reported that patients underwent dietary weight loss and physical therapy regime and a 5% loss in weight over 18 months resulted in an 18% improvement in function. However, there were no radiological changes observed.

Another aspect is the surgical treatment of obesity. Bariatric surgery has been shown to improve the health-related quality of life and improvement in cardiovascular parameters. Abu-Abeid et al.³⁰ in their prospective study concluded that surgery is an effective and rapid mean of reversing the radiological sign of early changes associated with OA. Most studies report symptomatic and structural improvement with significant weight loss; however, a smaller degree of weight loss also benefits people and modifies the trajectory toward progression to clinically significant OA.³¹

CONCLUSION

Obesity is a modifiable risk factor that correlates with the early onset and progression of knee OA due to associated mechanical and humoral factors. Prevention and management of obesity is the primary intervention required and knee arthroplasty remains a viable option even in morbidly obese as it improves the functional outcome and quality of life.

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