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The Impact of Obesity on Total Knee Arthroplasty Outcomes: A Systematic Review

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ABSTRACT

One frequent orthopaedic procedure for treating advanced knee arthritis is total knee arthroplasty, or TKA. Obesity is defined as a body mass index of 30 kg/m2 or greater, and it might have an impact on post-operative problems. Comparing multifactor matched obese and non-obese individuals, we look at the incidence of certain problems, revision rates, and post-TKI care expenses. We predict that patients who are obese will experience worse outcomes than those who are not fat. Obesity was linked to higher rates of medical complications like acute kidney injury, deep vein thrombosis, urinary tract infection, and opioid use, but significantly lower rates of anemia, arrhythmia, cardiac arrest, pneumonia, and transfusion. Surgical complications included wound complications, surgical site infections, need for revision, and higher overall cost of care one year after TKA. Patients who were obese also had far reduced prescription expenditures for treatment. When compared to similar non-obese individuals, the outcomes for obese people were not inherently poorer. However, as obesity is expected to continue rising in prevalence, knowing the problems that might occur after TKA can help inform patients about possible dangers from surgery and direct surgeons in providing care for their patients. Therefore, in order to create new treatments, future research should look at the underlying processes that lead to these issues.

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Introduction

Being 20% or more over the recommended body weight is considered obesity; a body mass index (BMI) of 25.9 to 29 kg/m2 is considered overweight, and ≥30 kg/m2 is considered

obese. Gaining too much weight raises the risk of hypertension, coronary heart disease, type 2 diabetes, myocardial infarction that goes undiagnosed, hyperlipidemia, infertility, and cancers of the colon, prostate, and endometrium. Total knee arthroplasty (TKA) is not a good option for obese individuals with advanced osteoarthritis in their knees and TKA is frequently recommended against them.

Despite the high success rate of TKA, problems can put more strain on the healthcare system and may even necessitate a revision (Canovas dan Dagneaux, 2018; Delanois et al, 2017). Over the past 30 years, the global prevalence of obesity, which is defined as a body mass index (BMI) of 30 kg/m2 or more, has grown by 27.5% among adults (Apovian, 2016). There will be a significant need for safe, efficient TKA with few side effects and low cost as obesity rates rise. Obesity will harm surrounding soft tissues and bones in both biochemical and biomechanical ways (Gkastaris et al, 2020). Obesity can affect renal and cardiovascular health (Kulkarni et al, 2016), in addition to being a risk factor for osteoarthritis in particular (Hennrikus et al, 2021). Owing to these pervasive effects, it is debatable and calls for more research to determine the precise role obesity plays in post-operative outcomes and complication rates following total knee arthroplasty (Martin et al, 2017). We hypothesize that after TKA, obese patients would experience worse results due to increased incidence of complications and higher expenses.

The purpose of this systematic review is to examine the long-term results of TKA in patients who are morbidly obese against those who are not. The revision rate served as the main outcome measure, with the functional result and the frequency of problems serving as additional metrics.

Method

Result And Discussion

The terms "obesity" and "knee arthroplasty" were used to search the MEDLINE database. The majority of the 58 publications on the subject—which provided low-level evidence—were prospective case series, and 3 of them were systematic reviews.

A few studies found no significant differences were found within the morbid obese patients them selves (BMI 40–49.99 to BMI 50–68.2) (Hakim et al, 2019). A "good outcome" is not predicted by BMI ($p > 0.05$) (Razak et al, 2016). BMI was not related to post-op physical function or satisfaction (Christensen et al, 2021). No difference was reported at all endpoints between the 3 BMI groups—normal weight, overweight/ obese, highly/ morbidly obese— ($p > 0.05$) (Dettoni et al, 2018). Obesity ($\beta = 1.54$, 95% CI (0.96 to 2.48), $p = 0.07$) was an independent predictor of inadequate physical activity at 1 year. BMI was not predictive for sedentary behavior ($p > 0.1$) (Hodges et al, 2018). At three years, it was shown that patients who were obese or morbidly obese benefited with TKA just as much in terms of functional outcomes and symptom relief (Collins et al, 2012; Baker et al, 2013). individuals with obesity should not be denied the benefits of TKA because their overall progress was on par with those of individuals with lower BMIs (Ersozlu et al, 2008; Baker et al, 2013).

Although there was a slight connection between BMI and early problems, both obese and non-obese patients receiving TKA had equally low rates of perioperative complications and mid- and long-term survival (Hamoui et al, 2006; Bourne et al, 2007; Suleiman et al, 2012;

Patel et al, 2008; Bordini et al, 2009; Yeung et al, 2011; Collins et al, 2012). It was demonstrated that individuals with normal weight and those who were slightly to moderately obese had comparable mid-term survival rates (Hamoui et al, 2006; Bordini et al, 2009; Yeung et al, 2011). For both obese and non-obese patients, the Kaplan Meier survival (with any reoperation as the end point) was 98% (Bourne et al, 2007).

According to certain research, obese individuals had worse outcomes with TKA. Patients who were obese reportedly scored poorer after TKA (Guan et al, 2006). It has been shown that post-TKA function, quality of life, and satisfaction are negatively impacted by weight and BMI (Mulhall et al, 2007; Jarvenpaa et al, 2012). Patients with diabetes had worse clinical outcomes when they were obese (Moon et al, 2008). Patients who were morbidly obese (>40 BMI) had a substantially worse improvement in Knee Society Scores following TKA than did controls (Samson et al, 2010).

Five years after total knee arthroplasty, patients with morbid obesity had much lower Knee Society Scores than non-obesity patients, although there was no statistical difference between the two groups (McElroy et al, 2013). The post-TKA activity score was substantially lower and the complication rate was greater in obese patients (10.5 vs. 3.8%) (Issa et al, 2013). 3 to 5 years following total knee arthroplasty, a higher BMI raised the chance of a poor clinical result and worse quality of life (Liljensoe et al, 2013). After triple bypass surgery, severe obesity was found to be a separate risk factor for a delayed recovery (Jones et al, 2012).

Individuals who were fat had greater rates of diabetes and hypertension, and they also had a 6.7-fold increased risk of infection compared to non-obese individuals (Namba et al, 2005). An increased risk of infection was associated with morbid obesity or obesity with diabetes (Dowsey & Choong, 2009) Patients who were severely obese (body mass index >40) had a 10% to 30% incidence of problems; in particular, their rate of deep prosthesis infection was 3 to 9 times higher than that of controls (Samson et al, 2010). Patients who were obese had higher rates of infection and deep infection, with odds ratios of 1.90 and 2.38, respectively (Kerkhoffs et al, 2012). Prior to TKA, obese patients should be made aware of the increased risk of prosthetic joint infection (Liabaud et al, 2013; Pruzansky et al, 2014).

Although it was not linked to an increased risk of venous thromboembolism or bleeding, morbid obesity was associated with an increased incidence of early complications, including peripheral oedema, diarrhea, gastrointestinal or abdominal pain, wound inflammation or infection, extrasurgical site infections, and respiratory tract or lung infections (Friedman et al, 2013). Before TKA, obese individuals should be counseled to reduce their weight and consider the advantages of bariatric surgery (Samson et al, 2010). Post-TKA limb alignment is significantly impacted by both preoperative mechanical limb alignment and BMI (Estes et al, 2013). Risk factor for post-TKA deep vein thrombosis was obesity (Guan et al, 2006).

BMI and weight have a detrimental impact on how long primary TKA lasts (Mulhall et al, 2007). At five years, the implant survivability of morbidly obese patients is much lower than that of obese or non-obese patients (McElroy et al, 2013). With an odds ratio of 1.30, revision of the TKA (exchange or removal of the components for any reason) is more common in obese individuals (Kerkhoffs et al, 2012). An independent risk factor for revision total knee arthroplasty within a year is obesity (Bozic et al, 2014). Compared to non-obese patients, morbidly obese people require 7% more hospital resources for unilateral initial total knee

arthroplasty (Kim, 2010). Higher inpatient index surgery and episode of care expenses are linked to obesity (Dowsey et al, 2011).

After TKA, obese individuals had a markedly increased risk of hematomas and DVT, both of which have contradictory findings in the literature to date (Lee et al, 2020; Braekkan et al, 2016; Sloan et al, 2019). Obese individuals had considerably lower chances of anemia, arrhythmia, cardiac arrest, pneumonia, and transfusion. Despite the seeming contradiction, additional research has discovered the "obesity paradox," or the inverse relationship between mortality and BMI, which may account for the decline in the risk of cardiac arrest and arrhythmia (Pouwels et al, 2019). However, even this contradiction is debatable since it may be the result of retrospective data showing that obese individuals were detected earlier or because necessary adjustments for cardiorespiratory fitness were not made, given that a high BMI resulting from muscle is different from one resulting from fat (Ades & Savage, 2010). Moreover, people in the non-obesity group may have been obese at one point in their lives but lost weight as a result of their condition (Flegal et al, 2011.).

Perhaps as a continuation of the "obesity paradox," earlier research has revealed a correlation between obesity and a lower death rate from pneumonia (King et al, 2013; Kahlon et al, 2012). Furthermore, transfusion rates were lower in obese individuals, in line with earlier research.34 Anemia rates were lower in obese patients; nevertheless, the exact connection between obesity and anemia is still unclear (Purdy, 2021).

Consistent with previous research, obese individuals had considerably more revisions at all time periods (Abdulla et al, 2020; Boyce et al, 2019). Many issues can lead to revisions, but the most frequent one is an infection in the periprosthetic joint (Postler et al, 2018). SSI is one of the most frequent side effects seen by obese TKA patients, confirming the link between obesity and a higher likelihood of revision from SSI. Complications following surgery increase the quantity of medical care a patient needs, which raises the expense of healthcare. Surprisingly, obese patients had much lower medication expenditures across the board, while having a significantly higher total cost of care at one year. This might be because non-obese individuals had greater incidence of anemia, arrhythmia, cardiac arrest, pneumonia, and transfusion, among other confounding factors (Aggarwal et al, 2022).

Recent research has looked at how obesity-related changes in lipid metabolism and adipose tissue cause progressive arthritis. Adipose tissue in obesity releases pro-inflammatory cytokines, such as TNF-a and IL-6, which both increase the breakdown of cartilage-destroying matrix metalloproteinases (MMPs) (Thijssen et al, 2015). Adipokines that further worsen cartilage degradation, such resistin and leptin, are also elevated. Furthermore, serum free fatty acids have the potential to exacerbate arthritis and cartilage degradation brought on by oxidized low density lipoproteins. Because all of these microscopic proteins cause low-level, chronic inflammation, which disrupts immune chemotaxis and changes macrophage differentiation, the increased, macroscopic risk of SSI in obese individuals may be explained (Huttunen & SyrjEanen, 2013).

Obese individuals also had considerably greater rates of problems related to wound healing. Since adipose tissue lacks blood vessels, it takes a long time for it to revascularize after damage, which results in decreased oxygen and nutrient perfusion (Blokhin & Lentz, 2013).

This inadequate perfusion leads to oxidative stress, decreased fibroblast collagen synthesis, and further chronic inflammation, all of which compound to obstruct appropriate

wound healing. Obesity-related skin folds may also make it difficult to prepare for surgery and shield some skin from sterilizing in the vicinity of the incision. Additionally, pockets of adipose tissue may develop, providing an opportunity for fluid to accumulate and infection to impede appropriate surgical closure. Additionally, by stimulating clot formation in vascular cells with TNF-alpha and IL-6 cytokines and subsequently reducing fibrinolysis (Blokhin & Lentz, 2013), chronic inflammation also permits aberrant clot formation in the vasculature of the lower limbs, kidneys, and lungs. The literature contains discrepancies because, whereas some studies have showed that obese individuals had a lower incidence of DVT after TKA (Sloan et al, 2019), other research have revealed that obesity is a risk factor for limb illness, including DVT (Davies et al, 2017).

Hypercoagulability would be associated with an increased risk of DVT and a commensurate decreased risk of hematoma. All time frames showed an increase in the risk of hematoma, with a notable rise at 30 days and 1 year. Additionally, conflicting findings have been reported in the literature, which supports obesity's procoagulative propensity while also suggesting that other elements of obesity may mitigate this enhanced hemostasis (Lee et al, 2020; Braekkan et al, 2016).

Obese individuals used narcotics at considerably greater rates, and some writers suggest that obesity increases the amount of pain experienced after surgery (Okifuji & Hare, 2015). The exact source of this discomfort is unknown, however it may be brought on by obesity-related biomechanical stress on the body or persistent inflammation. It would be assumed that obese individuals will have greater care expenditures due to their higher drug consumption.

Obese individuals had considerably lower prescription costs at all three time periods studied and significantly higher overall costs of treatment only after a year. Nonetheless, there is a connection between obesity and a wide range of post-operative problems, including high overall and medication expenses of care (Roche et al, 2018). However, there are a number of confounding factors that make it challenging to account for this association, including variations in socioeconomic position, access to healthcare, payment methods, and other social determinants of health (Biener et al, 2017). Although measures like age, gender, CCI, and ECI help to eliminate confounding variables, they are not perfect and may still introduce errors when determining the actual cost-effect of obesity. Moreover, the "obesity paradox" may inadvertently result in a reduction in the care bills in the initial post-operative phase. It is also possible that some healthy people were classified as fat despite not being obese in the first place because of disparities in age, sex, or height, or because their BMI was higher in muscle tissue than in adipose tissue (Gurunathan & Myles, 2016). Additional straightforward ways for determining BMI include skin fold thickness, waist circumference, the ratio of the waist to hip, and bioelectrical impedance analysis. More sensitive techniques include sophisticated imaging techniques like computed tomography and magnetic resonance imaging (Gurunathan & Myles, 2016).

After a year, it was shown that obese patients had far higher overall healthcare expenses than non-obese patients, while having greater revision rates. Revision surgery is frequently carried out years after the initial treatment, so this is not shocking. One study found that there was an average of 6.2 years between original and revision total knee arthroplasty (Huttunen & SyrjEanen, 2013). Consequently, 30- and 90-day time periods would probably not reflect the significant cost of a revision, falsely decreasing those overall costs of care. Additionally, some

of the consequences that were more common in the non-obese group—like cardiac arrest, for example—can be quite complicated and call for more medical and pharmaceutical intervention, which drives up expenses for the non-obese group (Selby et al, 2017).

As population gets older and obesity becomes more com- mon, the need for primary and revision TKA will likely increase. Obese patients did not have definitively worse outcomes than non- obese patients. Nonetheless, a robust understanding of the post- operative complications associated with obesity will promote educating patients and families about the potential risks of surgery.

Conclusion

While some studies found no negative correlation between obesity and TKA outcomes, others found that obese individuals had worse TKA outcomes. Obesity was found to have a negative impact on the procedure's cost, implant survival, rate of complications, and outcome in three systematic evaluations. With obesity rates rising, it is critical to understand how obesity increases the risk of problems after total knee arthroplasty. In obese patients, incidences of anemia, arrhythmias, cardiac arrest, pneumonia, transfusion, and medication expenses were much lower.

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