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Research Article

Bariatric Orthopaedics: Impact of Obesity on Total Knee Replacement

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Abstract

Introduction: Total knee replacement is a reliable operation for reducing pain and improving function in severe osteoarthritis of the knee. As incidence of obesity is increasing worldwide, there is a debate about the role of Body Mass Index (BMI) in selection of patients requiring total knee replacement. The aim of the study was to evaluate the impact of body mass index on total knee replacement in terms of post-operative improvement in knee range of motion, patient satisfaction and complications.

Materials and Methods: Out of 175 patients who suffered from advance knee osteoarthritis and were candidates for primary total knee replacement from January 2016 to March 2018, 155 patients fit the inclusion criteria. Group 1 included 66 patients who were overweight and class 1 obese while group 2 included 89 patients who were class 2 and 3 obese according to WHO Body Mass Index classification. All patients underwent total knee replacement according to the hospital guidelines. Pre and post-operative range of motion, patient satisfaction and complications were assessed and documented.

Results: There was no statistically significant difference in improvements in post-operative knee range of motion between the two groups up to 2 years of follow up [Mann-Whitney U test p = 0.069]. Similarly, Mann-Whitney U test showed that there is no significant difference between patient satisfaction levels (SF-12 scores) of the two groups (p = 0.09).

Conclusion: There is no significant impact of obesity on outcomes after total knee replacement and BMI should not be used as a factor in selecting patients who qualify for total knee replacement.

Level of Evidence: Level III.

Keywords: *Total Knee Replacement; Obesity; Body Mass Index (BMI); Bariatric Orthopedics*

Introduction

Incidence of obesity is increasing worldwide with about 13% of the population having a BMI above 30 kg/m^2 [20,23]. Obesity has a significant impact on the musculoskeletal system causing osteoarthritis (OA), a degenerative joint disorder characterized by pain, decreased mobility and negative impact on quality of life. In a study, among the major joints, the knee joint was affected majorly (48%) by osteoarthritis [2].

Pathogenesis of osteoarthritis is related to both excessive joint loading and altered biomechanical patterns together with hormonal and cytokine dysregulation. Obesity is associated with a higher rate of joint replacements as well as operative complications. [9] Body Mass Index (BMI) defined by WHO is generally used to classify obesity as mentioned in table 1 [23].

Classification	BMI (kg/m^2)
Underweight	< 18.5
Normal weight	18.5 - 24.9
Overweight	25 - 29.9
Obesity Class 1	30 - 34.9
Obesity Class 2	35 - 39.9
Extreme Obesity Class 3	> 40

Table 1: *Classification of weight status by body mass index (BMI).*

Osteoarthritis can be classified according to Kellgren and Lawrence classification system from Grade 1 with mild narrowing of joint space to Grade 4, identified by the presence of large osteophytes, marked narrowing of joint space and severe deformity of bone contour as shown in table 2 [9,13,16]. Total Knee Replacement (TKR) is a reliable operation for reducing pain and improving function for patients with Grade 4 knee osteoarthritis. The long-term outcome of TKR in obese patients remains a debated issue. Whilst some studies have shown favorable results, others have not, as they reported lower functional scores and increased complication rates [7,11,15,19]. Studies which have attempted to compare the outcomes of primary TKR in obese versus non-obese patients have also shown mixed results [4,5,12 22].

Grade	Description
1	Doubtful joint space narrowing and possible osteophytic lipping
2	Definite osteophytes and possible joint space narrowing
3	Moderate multiple osteophytes, definite narrowing of joint space and some sclerosis and possible deformity of bone ends
4	Large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity of bone ends

Table 2: *Kellgren and Lawrence classification system of osteoarthritis severity.*

The rationale of the study was to compare impact of overweight and Class 1 obesity to class 2 and 3 obesity on patients undergoing total knee replacement. The primary measure was the preoperative and post-operative knee range of motion, patient satisfaction and incidence of complications including infection, aseptic loosening, persistent knee pain and revision for any reason up to 2 years after TKR.

Materials and Methods

The study was conducted after the Institutional Review Board approved the proposal. Retrospectively, the data of 175 patients who had total knee replacement from January 2016 to March 2018 were reviewed. Patients with at least 2-year follow-up and between ages 45 to 80 years were included in the study. Exclusion criteria included: Revision total knee replacements, prior patellectomy, any other joint replacement surgery in the lower limb else TKR, a varus deformity greater than 20 degrees, a valgus deformity greater than 15 degrees and the most important, patients with body mass index more than 50 kg/m^2 and less than 25 kg/m^2. After excluding these patients, 155 patients were left for review.

Upon hospital admission, the height and weight of the patients were noted and they were extracted using the H.O.P.E (Healthcare Open Platform Environment) online system of the hospital. A medial parapatellar approach was used for all the knees after applying standardized tourniquets protocols. The same postoperative pain control was given to all patients including the first 24-hour patient-controlled analgesia and then oral analgesics. They had daily inpatient physiotherapy sessions and started to ambulate on day 1 post operatively. All

the patients had mechanical prophylaxis started immediately and chemoprophylaxis after 12 hours of surgery for deep vein thrombosis and pulmonary embolism. No drains were used for any patient. On discharge they were followed up at orthopedic consultant clinic on the following intervals: 2 weeks, 6 weeks, 3 months, 6 months, 1 year and 2 years after TKR. On each visit, knee range of motion, patient satisfaction (SF-12) and radiographs were recorded to monitor any ongoing complications. The same H.O.P.E online system was used to extract data for patients coming on follow-up. Knee range of motion was assessed by either the physiotherapist or one of the doctors in outdoor clinics.

Obesity was measured using the WHO classification in terms of BMI. Patients with normal BMI (18.5 - 24.9 kg/m^2) were not included in the study. Among the total patients of 155, 34 (21.9%) were overweight, 32 (20.6%) were class 1 obese, 38 (24.5%) were class 2 obese and 51 (32.9%) fell in class 3 obesity (Figure 1). The study group was classified into group 1 (overweight and class 1 obese) and group 2 (class 2 and class 3 obese) for statistical analysis, so group 1 had 66 cases (42.6%) and group 2 included 89 cases (57.4%).

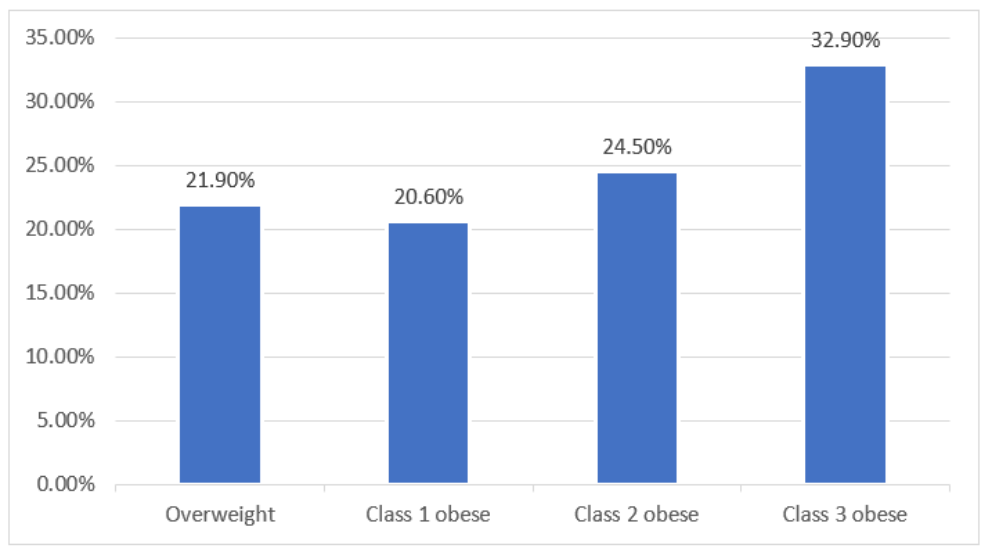

Figure 1: *Showing number of cases according to BMI classification.*

Data was tabulated using spreadsheets. All statistical analyses were performed using SPSS (latest version 25.0). Standard descriptive statistics including means and standard errors was used to summarize the continuous measures. Paired sample t-test was used to measure the follow up outcomes and Mann-Whitney tests were used to compare the differences in outcomes among the groups.

Results

On demographic review of the data, group 1 had 36 (54.5%) female patients and 30 (45.5%) male patients, while group 2 had 70 (78.7%) females and 19 (21.3%) were male patients. The mean age for group 1 was 67.30 ± 6.6 years and for group 2 it was 65.9 ± 6.8 years. Among total of 66 patients in group 1, 48 (72.7%) patients had cruciate retaining and 18 (27.3%) had posterior stabilized total knee system, while among total of 89 patients in group 2, 64 (71.9%) had cruciate retaining and 25 (28.1%) had posterior stabilizing total knee system.

Regarding range of motion of knee joint, which was measured preoperatively and on all follow-up visits, group 1 showed mean range of motion (ROM) 109.92 ± 9.7 pre-operatively and post-operative mean ROM was 112.75 ± 10.2 with a mean difference of 11.83 ± 14.4. This

difference was significant with $p < 0.005$ (Paired sample t-test). In group 2, mean pre-operative ROM was 98.3 ± 10.7 and post-operative mean ROM for group 2 was 113.8 ± 9.3 with a mean difference of 15.4 ± 13.1. This difference was also significant with $p < 0.005$ (Paired sample t-test). Group 1 had an improvement after TKR with a median of 15 (IQR, 0 - 21.2) [Mean = 11.83 ± 14.4]. Group 2 had an improvement after TKR with a median of 15 (IQR, 10 - 25) [Mean = 15.71 ± 13.27]. Eventually, it was clear that there was no significant difference in improvement after TKR among the groups [Mann-Whitney U test $p = 0.069$].

Regarding patient satisfaction using the SF-12, Group 1 patients had a median score of 101 (IQR, 89.7 - 109) and Group 2 patients with a median of 98.3 (IQR, 65 - 106.7). Mann-Whitney U test shows that there is no significant difference between the satisfaction levels of the two groups ($p = 0.09$).

Discussion

Obesity related issues are increasing worldwide due to increase in incidence of obesity. It has affected all the regions of the world from the western world to the Asian countries, including the middle east as it is evident from studies according to WHO. At the moment 13% of the population has BMI above 30 kg/m^2, which reflects the features of an epidemic [20,21,23]. There are many western and Asian studies that show mixed impact of obesity on total knee replacement post operatively. Some of them have mentioned complications related to obesity and some have not [10,11,19]. The purpose of the study was to see the impact of obesity on total knee replacement in the middle eastern population as after globalization and immigrations, orthopedic surgeon can encounter with patients from different communities worldwide.

On review of literature, Naylor., *et al*. in 2008 and Dowsey., *et al*. in 2010 reported poorer recovery after surgery in obese patients. They reported minimal change in the International knee society score in obese patients as compared to the non-obese. They also mentioned higher complication rate in obese patient [8,18]. On the contrary, Matla., *et al*. showed that body mass index had no negative impact on regaining one's functional performance after knee arthroplasty. However, they also showed that patient with BMI more than 35 kg/m^2 showed better results than the non-obese patients. Järvenpää [12] in his prospective study found that obese patients had worse range of motion at 3 months compared with non-obese patients, contrary to findings at 6 months. So, they concluded that obesity may impair the early outcome of total knee replacement only. However obese patients had a higher number of complications in their study.

In view of this these findings, it was seen that many orthopedic surgeons hesitate to offer total knee replacement to patients with severe knee osteoarthritis or they prepare themselves to face more complications in such patients including thromboembolic events, implant failure, periprosthetic fractures and infections.

In our study, we found that patients in class 2 and class 3 BMI -which are severely obese- gained a good median range of motion which was comparable to the overweight and class 1 BMI group and if we considered the mean range of motion it was even better in the class 2 and class 3 group because of relatively less pre-operative range of motion in this group. Similarly, we also evaluated the patients' satisfaction level in both groups using the short form (SF-12) which revealed the median scores to be a bit less in class 2 and class 3 obese group but those were not significant. Regarding the complications of TKR, only one patient developed a delayed periprosthetic infection, in a total of 155 patients; all of whom were followed-up on 2 years after the procedure. The one complication is most likely a result of her ongoing cellulitis and first toe infection (on the same foot). Within a week, she was diagnosed with an acute infection and was treated through debridement, washout and polyethylene exchange. Following the treatment, she was followed-up on 2 years later with solid implants and showed no signs of septic loosening.

Having a view over the limitations to our study, we found two major factors. One was that we compared the overweight and Class 1 obese patients with the class 2 and class 3 obese patients, excluding the patients with normal BMI and even those who were underweight. It was found that there were fewer people within the normal (18.5 - 24.9 kg/m^2) and underweight class (< 18.5 kg/m^2) undergoing total

knee replacement. Secondly, BMI of the patient was calculated on admission i.e. one day before undergoing total knee replacement. It can be expected that during the course of rehabilitation and follow-ups, patients had increased or decreased their weight and would have fallen in a different group. However, on review of the literature, studies have shown minimal changes in BMI during the rehabilitation period from physiotherapy and activity levels [8,14].

Other than these limitations, we also did not consider other factors like diabetes mellites, cardiovascular and neurological issues; which could adversely affect outcomes after total knee replacement as shown by Gillespie., *et al* [10]. A limitation regarding the body mass index (a tool for measuring obesity) itself is that it does not take into account the ratio of muscle, bone tissue and adipose tissue nor the amount of activity a person is doing despite being obese [19].

Based on the previous literature, discussion and results of our study, we suggest that during selection of patients for total knee replacement, obesity alone should not be a considerable factor in anticipating post-operative outcomes and complications. Selection of patients should be individualized, and other factors should be considered. Even advising these patients first to undergo weight reduction will be challenging and difficult as the level of activity is limited due to obesity and already present pain due to osteoarthritis. In figure 2 and 3 we can see some of the serial images of the osteoarthritic knees on regular follow-ups after total knee replacement.

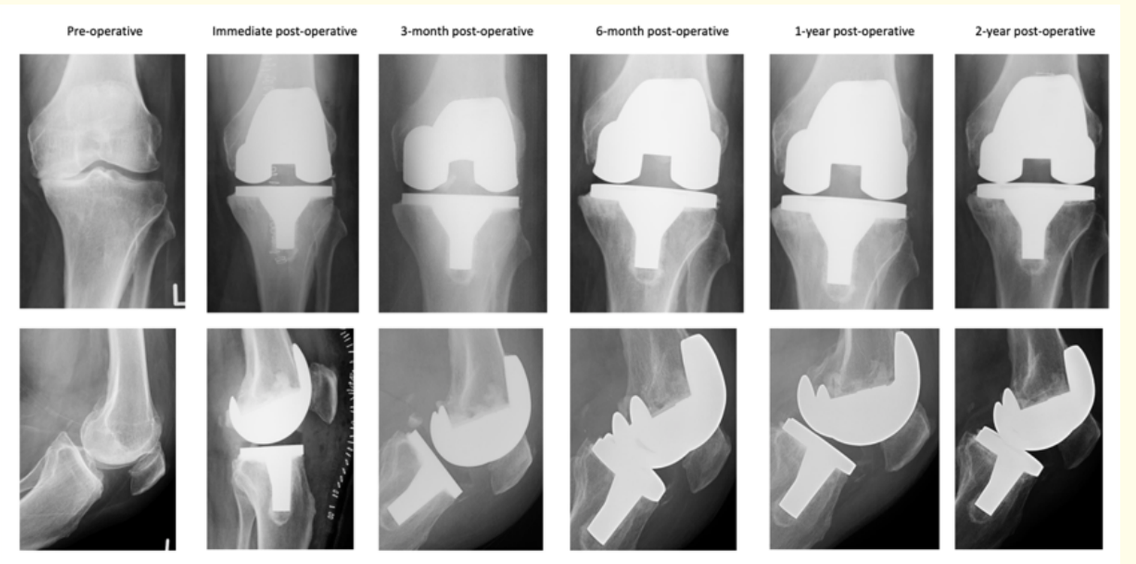

Figure 2: *Serial images of a severe osteoarthritic left knee on follow-ups after posterior stabilized total knee replacement in a class 3 obese patient.*

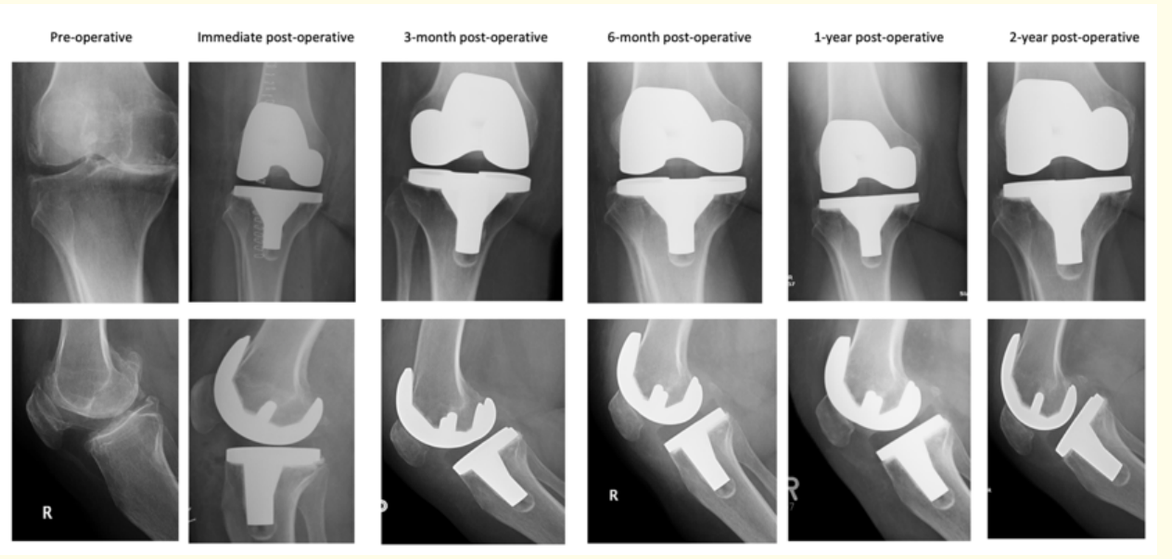

Figure 3: *Serial images of a severe osteoarthritic left knee on follow-ups after cruciate retaining total knee replacement in a class 1 obese patient.*

Conclusion

In view of our study population, there is no significant impact of obesity on outcomes after total knee replacement and BMI should not be used as a factor in selecting patients who qualify for total knee replacement.

Conflict of Interest

None.

Funding

None.

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