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Challenges considering total knee replacement in obese individuals: A comparative prospective study

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Abstract

Introduction: Obesity has been linked to the development of knee osteoarthritis(OA). Total knee replacement (TKR) may be associated with a poor outcome and higher failure rate in obese patients. The purpose of the study was to compare the technical problems, peri-operative morbidity, clinical and functional results of TKR's performed in obese versus non-obese patients with the same prosthesis.

Methods: A prospective study was conducted in which we included patients undergoing unilateral/bilateral TKR for primary osteoarthritis. The patients were assessed clinically, functionally and radiologically pre-operatively and post-operatively using knee society score (KSS). We compared non-obese, obese, morbidly-obese patients using statistical analysis.

Result: We had 105 non-obese(151 knees) and 148 obese patients(151 knees). The mean BMI(kg/m²) of non-obese, obese and morbidly-obese patients were 24.29, 33.66 and 41.66 respectively. Pre-operative Knee Clinical score(KCS) 31.77 and Knee functional score(KFS) 39.19 in obese patients was much lower than pre-operative KCS 39.58 and KFS 47.9 in non-obese patients. Post-operative mean KCS and KFS in obese patients were 80.55 and 78.23 while in non-obese patients it was 89.58 and 86.29 respectively. Statistically there was a significant difference ($P < 0.001$) in all the categories amongst obese, non-obese and morbidly-obese. Complications included a superficial infection, deep infection, wound dehiscence and DVT.

Conclusion: Knee arthroplasty in obese(especially morbid) patients results in an overall lower functional score and more wound complications than the non-obese. However, change of pain score & satisfaction were comparable with the non-obese patients. All the obese patients had significant improvements in quality of life compared to their pre-operative status.

Keywords: Arthroplasty, replacement, knee, obesity

Introduction

Obesity as a medical condition is currently at historic epidemiologic levels and is rising [1]. Obesity has been linked to the development of knee OA [2]. A high bodyweight increases the stress transferred through the prosthesis to surrounding bone [3]. This suggests that TKR may be associated with a poor outcome and a higher failure rate in obese patients, owing to higher peak stresses and cyclical loading across the knee joint. The literature is divided over the outcomes in obese patients. Some reports have found similar results for obese and non-obese patients [4, 5] whereas others describe obesity as having a negative influence on outcome [6, 7]. Some suggest that female gender and absolute bodyweight influence the outcome in the obese. [8] The purpose of the study was to compare the technical problems, peri-operative morbidity, clinical and functional results of TKR's performed in obese versus non-obese patients with the same prosthesis.

Materials and Methods

A prospective study was conducted at our institute after Ethics committee approval, comparing obese with non-obese patients admitted with osteoarthritis of knee undergoing primary cemented total knee replacement. Patients were classified according to WHO classification of obesity with BMI < 30 kg/m² non obese, BMI > 30 kg/m² were classified as obese and BMI > 40 kg/m² as morbidly obese [9]. 253 patients with 302 knees involved, consented and underwent total knee replacement in Orthopaedic Department in our hospital.

The patients were assessed clinically, functionally and radiologically pre-operatively using knee society score (KSS). In the study, we included patients undergoing unilateral or bilateral cemented TKR for primary osteoarthritis within the age group range of 50-80 years. Patients who had secondary osteoarthritis, undergoing revision TKR and patellar resurfacing were excluded from the study. All the patients were informed regarding the nature of the study and consented for entering the study group.

A standard operative technique was used and all the patients were operated by one surgeon with a posterior stabilised TKR of the same company. The patients undergoing bilateral TKR underwent the same in the same sitting. Postoperatively, the patients were started on intravenous antibiotics and deep vein thrombosis prophylaxis in the form of subcutaneous low molecular weight heparin. Patients were taught active quadriceps exercises and knee bending was initiated as per pain tolerance. The following day, the patient was made to walk walker-assisted full weight bearing within the limits of pain. Post-operatively the patients were assessed clinically, functionally and radiologically using the Knee Society Score^[10]. (Knee functional score- KFS and Knee Clinical score- KCS) at 1 month, 3 months and 6 months.

Statistical Analysis

1. Statistical analysis was performed using student-t test to compare the differences between obese and non obese patients.
2. One way Anova to compare three groups- non obese, obese and morbidly obese.

Results

Patients were divided into non obese (BMI <30 kg/m²) and

obese (BMI > 30 kg/m²). We had 105 non obese (151 knees) and 148 obese patients (151 knees) out of which 9 patients were morbidly obese and were included in the obese group for study purposes. The age range of the patients was 54-76 years. Average age of patients undergoing TKR in obese patients was 61.38 years which was much lower as compared to non obese patients (66.96 years). We had 176 female patients and 76 male patients which puts 70% of patients as females.

50 patients underwent bilateral replacements while the unilateral group showed predominance for the right knee in 60% patients. The mean BMI of non obese patients was 24.29 kg/m² and obese patients was 33.66 kg/m². Mean BMI of morbidly obese patients was 41.66 kg/m².

The average tourniquet time in the non-obese group was 103.97 minutes (range 67-135 minutes) and in obese was 113.9 minutes (range 86-145 minutes), while that of morbidly obese patients was 120.35 minutes (range 95-150minutes).

Pre-operative KCS (mean 31.77) and KFS (mean 39.19) in obese patients was much lower than pre-operative KCS (mean 39.58) and KFS (mean 47.9) in non-obese patients. Post-operative mean KCS and KFS in obese patients was 80.55 and 78.23 while in non-obese patients it was 89.58 and 86.29 respectively.

On statistical analysis, there is a significant difference (P value <0.001) in all the categories between obese, non-obese and morbidly obese. (Table1, 2)

Complications seen in our study included a deep infection in a non-obese patient and one obese patient with superficial infection which subsided with oral antibiotics. One obese patient had wound dehiscence proximally which was secondarily sutured. One obese patient had deep vein thrombosis.

Table 1: Student t test comparing outcomes in non-obese and obese patients.

	Obesity	Number	Mean	Standard Deviation	t	df	P value
Preop- KCS	Non-Obese	151	39.58	5.117	10.923	300	<0.0001
	Obese	151	31.77	7.098			
Preop-KFS	Non-Obese	151	47.9	6.925	11.5116	300	<0.0001
	Obese	151	39.19	6.204			
Postop-KCS	Non-Obese	151	89.58	8.535	11.3227	300	<0.0001
	Obese	151	80.55	4.816			
Postop-KFS	Non-Obese	151	86.29	8.941	9.4784	300	<0.0001
	Obese	151	78.23	5.408			
Tourniquet Time	Non-Obese	151	103.97	12.682	6.9946	300	<0.0001
	Obese	151	113.9	11.979			

Table 2: 3 way anova test to compare outcomes in non-obese, obese & morbidly obese patients.

	Obesity	Number of knees	Mean	Standard Deviation	Variance	F(Anova)	P value
Preop- KCS	Non-Obese	151	39.58	5.117	2411.4	66.397	<0.0001
	Obese	142	32.57	7.01			
	Morbidly Obese	9	24.33	0.577			
Preop-KFS	Non-Obese	151	47.9	6.925	3055.9	71.271	<0.0001
	Obese	142	40.18	6.204			
	Morbidly Obese	9	30	5			
Postop KCS	Non-Obese	151	89.58	8.535	3151.29	69.059	<0.0001
	Obese	142	81.32	4.355			
	Morbidly Obese	9	73.33	2.309			
Postop KFS	Non-Obese	151	86.29	8.941	2458.3	53.778	<0.0001
	Obese	142	78.75	5.379			
	Morbidly Obese	9	73.33	2.887			
Tourniquet Time	Non-Obese	151	103.97	12.682	4190.16	28.212	<0.0001
	Obese	142	113.9	11.979			
	Morbidly Obese	9	120.33	2.517			

Discussion

It has been suggested that the development of osteoarthritis of knee specially in obese people results from both biomechanical and metabolic mechanisms^[10]. Increasing the load on articular cartilage has been shown to be associated with the risk of osteoarthritis^[11], but there have been no definitive studies on the load difference between obese and non-obese subjects. Mechanically induced inflammation in the cartilage causing tissue damage may play an important role, and excess body mass may be a triggering factor^[12]. Varus alignment had been shown to correlate with an increased BMI and risk of osteoarthritis in knees^[13].

In our study of 253 patients, 105(41%) were non-obese and 148(59%) were obese. Out of 148 obese patients, 9 patients were morbidly obese which comprises 4% of total group. Among which 70% were female and 30% males which infers that the obesity is more common in females in our country. Right sided TKR were more commonly seen as compared to left side.

The mean age in obese group was 61.38 years and non obese group was 66.96 years. Morbidly obese patients underwent TKR at mean age of 58 years. As the weight increases forces acting on knee joint increases leading to abnormal stresses and early degenerative changes which explains the younger mean age in obese patients, especially morbid obese patients.

Mean BMI in non-obese patients observed was 24.29 and mean BMI observed in obese patients was 33.66. Morbidly obese patients had a mean BMI of 41.66. Previously published studies in the literature have shown an association between an increasing BMI and the development of OA. Manek *et al.* reported a strong association between a high BMI and the presence of OA of the knee in female twins with a mean age of 54.5 years^[14].

In our study the mean tourniquet time observed in obese patients (113.9 minutes) was on an average 10 minutes more than that of non-obese patients (103.97 minutes), while in morbidly obese patients, it was 16 minutes more than non-obese. The difference in the tourniquet time was statistically significant in our study. Bradley *et al.* have been able to quantify this as a linear relationship with each point increase in BMI resulting in an increased theatre time of 1.46 minutes.^[15] Gadinsky *et al.* concluded that obese and morbidly obese patients necessitate increased operative time when compared with patients with a normal BMI^[16].

The increased operative duration posed by obese patients may cause problems for proper operating room scheduling because longer surgeries require more materials and longer hours for hospital staff. Therefore, during surgery, a longer midline incision allows better access, and an extended subfascial dissection creates a pocket, into which the extensor mechanism can evert without increasing the tension on the patellar tendon or putting pressure on the skin. In our study, we had 2 obese patients who had patellar tendon injury and one had difficulty in closure of patellar tendon. A reduced femoral valgus angle (3°-5°) should be considered if there is excessive medial adipose tissue, otherwise impingement may occur during walking and may cause anterior knee pain. There is also chance of intra-operative fracture of a femoral condyle or tibial plateau due to size of the leg and the relative force of retraction for exposure especially in patients with osteoporosis or rheumatoid arthritis. Several reports have been published which look at the effect of obesity on the rate of complications after knee arthroplasty^[17].^[20] Complications that have been reported include prolonged wound drainage, superficial and deep infections, patellar dislocation, deep vein thrombosis, and other medical

complications. Although some studies have found no significant difference in the rate of post-operative complication between the obese and the non-obese groups, several larger series have shown that there is a difference, and that a BMI of 35 has significantly higher peri-operative morbidity^[21].

Thromboembolic disease has been a major concern for orthopaedic patients for decades, and prevalence has been shown to increase with patient immobilization and surgical trauma. Altintas *et al.* demonstrated in their analysis that the most common risk factors for venous thromboembolism (VTE) in orthopaedic patients are obesity and prolonged immobilization.^[22] Multiple reports identify obese patients as being at elevated risk for thromboembolic disease (TED) in the post-operative period^[23]. We had one patient who had DVT which was confirmed by clinical examination and ultrasound radiography. The Knee Society Score system separates findings in the operated knee with findings in the patients function. The system is subdivided into a knee clinical score that rates only the knee joint itself and a knee functional score that rates the patient's ability to walk and climb stairs.

In our study there was significant improvement of KCS and KFS following TKR. There is statistically significant difference in pre-operative and post-operative scores of knee society scores in all groups. Despite the varied conclusions regarding the difference between the morbidly obese, obese, and non-obese groups, the most important result is that the postoperative scores was significantly better than the pre-operative score in all the patients. Although the absolute score may not be as good in the non obese group, the improvement from preoperative state is comparable. In literature various other studies have got similar results^[4, 18, 21].

In the morbidly obese patients, there is more consensus that the functional outcome is worse than the non-obese patients after knee arthroplasty. Since morbidly obese patients have more chronic co-morbidities, these may have contributed to lower functional score. However, a separate comparison of knee scores was performed by some of the authors in their reports, and showed that despite a poorer functional score, morbidly obese patients often have comparable knee scores to the non-obese patients^[23].

Conclusion

The evidence available has shown that knee arthroplasty in the obese patients results in an overall lower functional score and more wound complications than the non-obese, especially in the morbidly obese patients. However, the change of knee score, pain score, and satisfaction are all comparable with the non-obese patients, and the obese patients all had improvements significant enough to enjoy a much better quality of life compared to their pre-operative status.

Declarations

Ethics approval: Obtained prior to initiation of study.

Consent for publication: All authors consent to publication of this study.

Availability of data and material: Not applicable

Competing interests: The authors have no competing interests

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Authors contributions: Dr Deepesh Daultani: Primary investigator and paper compilation, Dr Karan Doshi: Data and literature collection, Dr M Ajith Kumar and Dr Shantharam Shetty: Primary Surgeons, Dr Shailesh Pai : paper compilation

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