The Impact of Morbid Obesity on Patient Outcomes after Total Knee Replacement Arthroplasty: *A Matched Prospective Study*

Prateek S. Joshi, Jawahir A. Pachore

Department of Orthopaedic Surgery, Shalby Hospitals, Ahmedabad, Gujarat, India

Abstract

Context:

There are currently no published studies analyzing outcomes of total knee arthroplasty (TKA) in Morbidly Obese (MO) Indian patients

Aim:

To compare short-term outcome of TKA in MO with Non Obese (NO) patients

Settings and Design:

Prospective matched case-control study of 40 TKA in each MO and NO patients from September 2012 to June 2013

Methods and Material:

All 40 NO and MO patients who underwent TKA were followed up for 12 months & clinical and radiological outcomes were evaluated.

Statistical analysis:

SPSS Version 21.0 (Levene's Test, Chi- square test and students T test).

Results:

Mean age of MO was 61 and NO was 64 years. Females were predominant in both groups with 62.5% in MO and 60% in NO group. Average BMI in NO was 27.5 and was 44.2 in MO group. Mean ICU stay & hospital stay was 0.15 and 0.25 days & 5.17 and 5.22 days in NO and MO groups respectively. Fixed bearing posterior stabilized implant was used in 90% and 70% in MO and NO group respectively. In 40 MO 7(17.50%) had no comorbidity. 33(82.50%) had different illnesses. In 40 NO 11(27.50%) had no comorbidity and 29(72.50%) had comorbidities. In MO VAS score improved from 7.38±0.78 to 2.51±1.35 and in NO from 7.49±0.85 to 1.62±0.95. In MO WOMAC score improved from 17.75 ± 5.82 to 75.05 ± 8.57 and in NO from 22.57 ± 7.45 to 82.05 ± 7.16. The functional Score of MO and NO improved from 16.25 ± 5.15 to 68.87 ± 16.89 and from 20.62 ± 9.21 to 80.75 ± 8.43 respectively. Knee Score of MO patients and NO improved from 14.63 ± 6.32 to 61.13 ± 6.82 and from 20.55 ± 9.55 to 70.48 ± 6.22 respectively. In NO, average varus of 2.02^0 changed to average valgus of 4.5^0. In MO group average varus of 2.35^0 changed to average valgus of 2.57^0. In MO patients, 33(82.50%) had no complications. 4(10%) had Restricted Flexion while 4(10%) had Superficial wound Infection. In 40 NO 38(95%) had no complications, in rest 5% patients, 1 (2.50%) had MI and 1(2.50%) had Superficial Infection.

Conclusion: Anticipation & prevention of technical difficulties & complications leads to better outcome of TKA in MO patients

Key terms: total knee arthroplasty, obesity, morbidly obese, joint arthroplasty.

I.   INTRODUCTION

The Quetelet index, also known as body mass index (BMI), is defined as weight in kilograms divided by height in meters squared[1]. It relates well with body-fat percentage and is preferred method for assessment of magnitude of potential health risks associated with excessive body weight[2]. Obesity is defined as BMI more than 30kg/m2 where normal BMI is 18.5to25kg/m2, overweight being 25 to 30kg/m2 and morbid obese defined as BMI more than 40kg/m2[1]. Morbid Obese people have many orthopaedic problems like osteoarthritis (OA)[3], low back pain, gout, poor mobility. Prevalence of osteoarthritis in obese patients is more in comparison to normal weight people [2,4,6]. Thus many people undergoing total knee arthroplasty (TKA) are obese and a subset of them are Morbidly Obese (MO)[2,4,6]. BMI, being an indicator of obesity, can be a reliable predictor of surgical outcome in TKA[5]. There are several studies in the literature evaluating the results of TKA in the obese patient[7-15], few have described the results in the MO and no published study has evaluated outcomes of TKA in MO patients in Indian population

In order to assess the influence of morbid obesity on the outcome of TKA, we have designed a prospective study comparing short-term clinical and radiological outcome of TKA in MO and matched group of Non Obese (NO) patients.

II.   SUBJECTS AND METHODS

Ours is a prospective case control study involving 40 patients in each MO (15-male, 25-female) and NO group (16-male, 24-female) out of total 4514 TKA surgeries performed between September 2012 to June 2013. All patients were operated between September 2012 to June 2013 at our tertiary care referral orthopaedic centre. MO patients (BMI>40kg/m^2) who underwent unilateral primary TKA for osteoarthritis were included in case group. Patients with BMI less than 30kg/m2 undergoing primary unilateral TKA for osteoarthritis were included in control group. Patients undergoing either bilateral TKA or revision TKA or with aetiology other than Osteoarthritis were excluded from both groups. After written informed consent all the patients were evaluated clinically in detail. Data was collected from history, thorough physical examination, blood & other investigation parameters. Their pre-operative VAS, WOMAC score, ASA score, KSS scores were recorded *[Fig. 1]*.

Figure 1: Preoperative clinical photograph

The VAS is a psychometric response scale. Operationally, it is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end. The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimetres from the left hand end of the line to the point that the patient marks. The WOMAC (Western Ontario and McMaster Universities Arthritis Index) score measures five items for pain (score range 0–20), two for stiffness (score range 0–8), and 17 for functional limitation (score range 0–68). ASA (American Society of Anesthesiologists) classification is a system for assessing the fitness of cases before surgery. The categories included are as below.

1. Healthy person.
2. Mild systemic disease.
3. Severe systemic disease.
4. Severe systemic disease that is a constant threat to life.
5. A moribund person who is not expected to survive without the operation.
6. A declared brain-dead person whose organs are being removed for donor purposes.

Knee society score (KSS) is scoring system which includes Knee score (0-100) and Functional score (0-100). Knee score includes pain, range of motion, stability, deformity whereas functional score includes walking distance, climbing stairs & need for walking aid. Pre-operative standing weight bearing AP X-rays and lateral X-rays were taken. Coronal plane alignment was measured with goniometer clinically and with computer software from X-rays. Patients in control group were matched as much closely as possible to study group with relation to age, sex, pre-operative VAS score, KSS, WOMAC score. After written informed consent all patients were operated by senior arthroplasty surgeons under spinal anaesthesia [Fig. 2].

Figure 2: Intraoperative surgical preparation

Cefuroxime 1.5 gm half hour before surgical incision and 12 hourly for next two doses followed by oral cefuroxime 500 mg for next five days were administered. We didn't use antithrombolytic agents to reduce surgical blood loss in any patients. Post-operatively all Patients were started on physiotherapy protocol involving knee mobilization and DVT prevention exercises. In high risk patients Inj. Clexane 0.4ml SC was given for a week post operatively followed by oral rivaroxaban once a day 10 mg for three weeks. Sutures were removed 2 weeks after surgery. Post operative X-rays were done to assess implant position, coronal plane alignment with help of computer software.

All patients were followed up immediate post op period and 12 months post op period. At 12 months post op period all patients underwent detailed clinical and radiological evaluations. VAS, WOMAC, KSS scores were recorded. Any complication occurring from the time of operation till post op 12 months was recorded.

All data was analyzed using SPSS Version 21.0. Statistical test used were Levene's Test for Equality of Variances, Chi-square test and students T test.

III. RESULTS

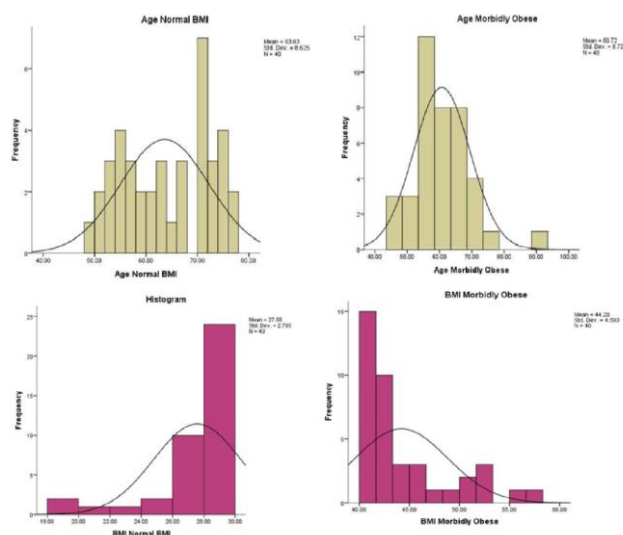Results are summarized in *Fig. 3, Fig. 4 , Table I ,II & III.*

Figure 3: Age and BMI distribution in both groups

MO group had more (but not statistically significant, p=0.0707, p>0.05) varus deformity than NO group patients. Post operative alignment in normal weight group patients was more towards ideal valgus alignment in comparison to MO group.
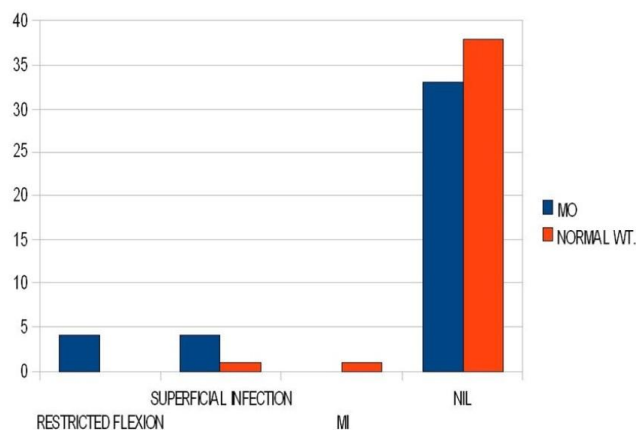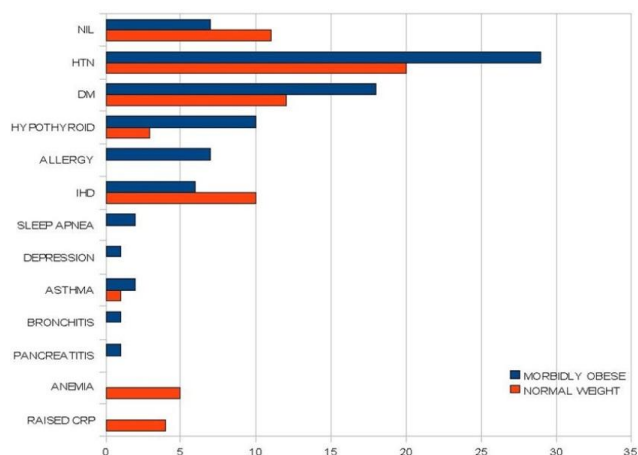
Figure 4: Co-morbid illness and complications in both groups

This difference was statistically significant (p<0.05). Across all 40 subjects, on average, alignment was observed to have changed from varus to valgus after operation. Comparing Pre op and Post op alignment for both groups, alignment was found to change by 4.92 degrees towards valgus in MO patients while in NO patients it was found to change by 6.57 degrees towards valgus, which was statistically significant (p<0.05).

Table I: Results

Results	Non-Obese	Morbidly Obese	P value
Age	64(49-77) years (Median- 64, Mean- 63.62, Mode-70)	61(46-92) years (Mean-60.72, Mode-55, Median-59.50)	-
Gender	M-16(40%) F-24 (60%)	M-15 (37.5%) F- 25(62.5%)	-
BMI	27.58 kg/m2 (Range- 18.7-29.97, mode 29.80, Median 28.61)	44.20 kg/m2 (Range- 40-57, Mode- 40.01, Median- 42.21).	-
Tourniquet	7	3	>0.05
Drain	3	3	1.00
Side	R-21 L-19	R- 22 L-18	1.00
Abbreviations	M- male F- female R-right L- left		

Table II: Results

Results	Non-Obese	Morbidly Obese	P value
Hospital stay	5.225 days	5.175 days	0.69
ICU stay	0.15 days	0.25 days	0.52
Pre-op alignment	Varus of 2.02 Val 8 Neu 8 Var 24	Varus of 2.35 Val 6 Neu 4 Var 30	0.07
Post-op alignment	Valgus of 4.55 Val 40	Valgus of 2.57 Neu 7 Var 1 Val 32	<0.05
Implant	FB PS 28, RPPS 6, STEMMED 4 ALL POLY 2	FBPS 36, CRMB 1 STEMMED 1 ALL POLY 2	-
Co-morbidity	29	33	>0.05
Complication	2	7	<0.05
Abbreviations	val- valgus	FBfixedbearing	
	var- varus		
	neu - neutral	RP- rotating platform	
	MB mobile bearing	CR- cruciate retaining	

IV. DISCUSSION

We are witnessing an obesity epidemic throughout the world which is expected to worsen in future. In India, according to ISHKS joint registry[16], 34,478 TKAs across India since October 2006. Out of 34,478 TKAs, average body mass index was 29.1 (Range: 18.1 to 42.9). This trend suggests that in near future arthroplasty surgeons are more and more likely to have MO patients as candidates for knee replacement surgery. Obese patients have an estimated risk of between 9-13% of

developing osteoarthritis of the knee for each additional kilogram of body mass. With each 5 kg of weight gain, their risk of developing osteoarthritis increases by 35% [17].

Table III: Results

Results	Non-Obese	Morbidly Obese	P value
ASA	1 20	1 2	-
	2 20	2 36	
	3 0	3 2	
VAS	Pre-op 7.49±0.85	Pre-op 7.38±0.78	0.552
	Post-op 1.62±0.95	Post-op 2.51±1.35	0.001
WOMAC	Pre-op 22.57 ± 7.45	Pre-op 17.75 ± 5.82	0.002
	Post-op 82.05 ± 7.16	Post-op 75.05 ± 8.57	0.0001
FUNCTIONAL SCORE	Pre-op 20.62 ± 9.21	Pre-op 16.25 ± 5.15	0.011
	Post-op 80.75 ± 8.43	Post-op 68.87± 16.89	0.0001
KNEE SCORE	Pre-op 20.55 ± 9.55	Pre-op 14.63 ± 6.32	0.002
	Post-op 70.48 ± 6.22	Post-op 61.13 ± 6.82	0.0001

In our study too mean age of patient undergoing TKA was lower in MO group (61 years, range 46-92 years) than in NO group (64years, range 49-77 years).

Fifty per cent of middle-aged obese healthy women with unilateral radiographically demonstrated knee OA developed osteoarthritis in the contralateral knee within two years, a 5-fold higher incidence than NO women in the same age range[18,19]. In our study, out of total 40 patients, there were 25 females in MO group and 24 females in NO group, hence confirming significantly high prevalence of OA in female population.

MO patients who undergo TKA face larger number of associated comorbidities than NO individuals and hence more postoperative complications and worse outcomes. Miric[20], Namba[21] & Nuñez[22] studied TKA in obese populations and they came to conclusion that obese patients have significantly high co-morbid illnesses, hence, inferior results with more complications post operatively. In our study, 33 MO patients had comorbidities whereas 29 patients had comorbidities in NO group. In MO, more patients were in ASA grade 2 and 3 in comparison to NO group (MO- ASA grade II in 36, grade III in two and I in two; in NO- ASA grade I in 20 and II in 20), however they were not statistically significantly more, which suggests that overall prevalence of comorbid illnesses was significantly high in both groups. In our study mean hospital (MO-5.22 NO-5.17 days, p=0.689) and ICU stay (MO-0.25 NO-0.15 days, p=0.516) remained statistically not different among both group.

In 1998 Winiarsky[23] studied 40 MO patients who underwent TKA, 22% presented problems with wound healing, 10% developed infection and 8% had an avulsion, from the tibial insertion, of the medial collateral ligament during surgery. In our short term study we found significant superficial wound infection in 10% of MO patients in comparison to 2.5% of NO patients (p<0.05). All patients with superficial wound infection were treated with repeated dressing. Culture from wound was negative for bacterial growth in all four cases. None required joint debridement. Four MO patients had restricted knee flexion at 12 months which was partially attributed to excess fat accumulation at posterior aspect of calf and thigh. One NO patient with past history of IHD had myocardial infarction post operatively. He was treated by intervention cardiologist. None of patients from both groups had MCL avulsion, patella tendon avulsion, neuro-vascular injury.

In our study, anatomical axis was more towards varus in MO (pre-op average alignment was varus of 2.35° ,Valgus in 6 Neutral in 4 Varus in 30 patients, Post-op average alignment was valgus of 2.57°,Neutral in 7 Varus in one and Valgus in 32 patients) than in NO(pre-op average alignment was Varus of 2.02°,Valgus in 8 Neutral in 8 & Varus in 24 patients and post-operative average alignment was Valgus of 4.55° with all 40 patients having valgus). Varus anatomical alignment in MO was statistically significant (p<0.05) in comparison to NO group.

Winiarsky[23] found significantly worse (p<0.00005) outcomes after TKA in MO patients compared to the other categories of patients. However, in our study both groups didn't have statistically significantly different pre-operatively VAS and Knee functional score but WOMAC and knee score were statistically different. Postoperatively VAS, WOMAC, functional and knee score were statistically significantly better in NO group than MO group. However, there was statistically significant improvement in MO group in all four categories from pre-operative to post-operatively. Good outcome in our study is probably because of short duration of follow-up. Long term outcomes remain to be studied.

Recommendations:
- Inform patients of the greater risks associated with surgery in presence of morbid obesity.
- Use of intramedullary tibial cutting guides, low pressure tapered tourniquet cuffs which are easier to fit to the patient's thigh, and devices that enable the leg to be held in different degrees of flexion slotted-base leg positioner, short tibial rods (45-50 mm) which increase the area of contact and reduce the load of the bone under the tibial plate, either posterior stabilized implants or, in the event of instability or extreme axial deviation, rotating hinge prostheses, trabecular metal tibial components that provide early anchoring of the tibial implant to the bone
- Being careful towards soft tissue- MCL, patellar tendon, preventing injuring them, femur cut first if dislocating tibia is difficult.

- Special attention towards DVT prevention postoperatively.

V. CONCLUSION

Although TKA in MO patients is technically difficult and is known to have more complications and inferior results, the surgery should not be denied to them as they will still have significant subjective improvement in lifestyle after the surgery. Better knowledge of technical difficulties, complications and their prevention by surgeon will lead to satisfactory outcome of TKA in MO patients.

Limitation of our study:
Short duration is the limitation of our study. Long term studies involving multiple centres are required to come to more comprehensive conclusion regarding outcome of TKA in morbidly obese patients in Indian population.

REFERENCES

[1]   WHO. Obesity: preventing and managing the global epidemic.Geneva: World Health Organization 2000.

[2]   Bray GA. Overweight is risking fate. Definition, classification, prevalence, and risks. Ann N Y Acad Sci1987;499:14.

[3]   Sturmer T, Gunther KP, Brenner H. Obesity, overweight and patterns of osteoarthritis: the Ulm Osteoarthritis Study. J Clin Epidemiol 2000;53:307.

[4]   Gillespie GN, Porteous AJ. Obesity and knee arthroplasty. Knee 2007;14:81.

[5]   Jarvenpaai J, Kettunenz J., Kroger H. Obesity may impair the early outcome of total knee arthroplasty: A prospective study of 100 patients. Scandinavian Journal of Surgery 99: 45–49, 2010.

[6]   Bourne R, Mukhi S, Zhu N, et al. Role of obesity on the risk for total hip or knee arthroplasty. Clin Orthop Relat Res 2007;465:185.

[7]   Spicer DD, Pomeroy DL, Badenhausen WE, et al. Body mass index as a predictor of outcome in total knee replacement. Int Orthop 2001;25:246-9.

[8]   Stern SH, Insall JN. Total knee arthroplasty in obese patients. J Bone Joint Surg [Am] 1990;72-A:1400-4.

[9]   Mont MA, Mathur SK, Krackow KA, Loewy JW, Hungerford DS. Cementless total knee arthroplasty in obese patients: a comparison with a matched control group. J Arthroplasty 1996;11:153-6.

[10]   Griffin FM, Scuderi GR, Insall JN, Wayne Colizza W. Total knee arthroplasty in patients who were obese with 10 years follow-up. Clin Orthop 1998;356:28-33.

[11]   Stickles B, Phillips L, Brox WT, Owens B, Lanzer WL. Defining the relationship between obesity and total joint arthroplasty. Obes Res 2001;9:219-23.

[12]   Deshmukh RG, Hayes JH, Pinder IM. Does body weight influence outcome after total knee arthroplasty: a 1-year analysis. J Arthroplasty 2002;17:315-19.

[13]   Foran JRH, Mont MA, Etienne G, Jones LC, Hungerford DS. The outcome of total knee arthroplasty in obese patients. J Bone Joint Surg [Am] 2004;86-A:1609-15.

[14]   Foran JRH, Mont MA, Rajadhyaksha AD, *et al.* Total knee arthroplasty in obese patietns: a comparison with a matched control group. J Arthroplasty 2004;19:817–24.

[15]   Amin AK, Patton JT, Cook RE, Brenkel IJ. Does obesity influence the clinical outcome at five years following total knee replacement for osteoarthritis? J Bone Joint Surg [Br] 2006;88-B:335-40.

[16]   Pachore JA, Vaidya SV, Thakkar CJ, Bhalodia HP, Wakankar HM. ISHKS joint registry: A preliminary report. Indian J Orthop 2013;47:505-9.

[17]   Powell A, Teichtahl AJ, Wluka AE, Cicuttini FM. Obesity: a preventable risk factor for large joint osteoarthritis which may act through biomechanical factors. Br J Sports Med 2005; 39: 4-5.

[18]   Felson DT, Anderson JJ, Maunmark A, Walker AM, Meenan RF. Obesity and knee osteoarthritis. The Framingham study. Ann Intern Med 1988; 109: 18-24.

[19]   Nevitt MC. Obesity outcomes in disease management: Clinical outcomes for osteoarthritis. Obes Res 2002; 10: 33-7.

[20]   Miric A, Lom M, Kahn B, Rozenthal T, Bombick D, Sculco TP. Perioperative morbidity following total knee arthroplasty among obese patients. J Knee Surg 2002; 15: 77-83.

[21]   Namba RS, Paxton L, Fithian DC, Stone ML. Obesity and perioperative morbidity in total hip and total knee arthroplasty patients. J Arthroplasty 2005; 20(7 (Suppl 3): 46-50.

[22]   Núñez M, Lozano L, Núñez E, Sastre S, Luis Del Val J, Suso S.Good quality of life in severely obese total knee replacement patients: a case-control study. Obes Surg 2011; 21: 1203-8.

[23]   Winiarsky R, Barth P, Lotke P. Total knee arthroplasty in morbidly obese patients. J Bone Joint Surg Am 1998; 80: 1770-4.

AUTHORS

First Author- Prateek S. Joshi

M.B.B.S., Diploma Orthopaedics, DNB trainee, Department of Orthopaedic Surgery,

Shalby Hospitals, Ahmedabad, Gujarat, India.

Second Author- Jawahir A. Pachore

M.B.B.S., Diploma Orthopaedics, FCPS, DNB, Mch Orth(Liverpool), Department of Orthopaedic Surgery,

Shalby Hospitals, Ahmedabad, Gujarat, India.

Correspondence Author- Prateek S. Joshi

Email- prateekortho@yahoo.com

Phone no- +91 9574233369