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Original Research Article

Factors affecting post-operative range of motion following total knee arthroplasty in Indian patients

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Abstract: Range of motion is an important determinant of the success of total knee arthroplasty. This study aims to assess the various demographic factors affecting the postoperative range of motion following total knee arthroplasty which include age, sex, body mass index, etiology, preoperative range of motion, the timing of surgery and the choice of implants These results could be used to identify the patients who are prone for decreased range of motion after total knee arthroplasty. The Materials and methods in this Study was conducted on 254 patients undergoing primary total knee arthroplasty, accounting for a total of 354 knees, with a follow up period ranging from a minimum of 6 months, going upto 2 years. The range of motion was assessed periodically and the recordings were statistically analysed to find a correlation with the above mentioned factors. The Results and conclusion was Age and sex of the patient was not found to affect the postoperative ROM. A poor pre operative ROM, BMI >25 and presence of rheumatoid arthritis were found to result in decreased post operative range of motion. The choice of implant (metal backed or all polies) and the timing of surgery (bilateral single sitting vs staggered) did not appear to be statistically significant in influencing post operative ROM.
Keywords:total knee replacement, post operative ROM

INTRODUCTION

Range of motion is an important determinant of the success of total knee arthroplasty. Several studies have demonstrated that patients require an average of 67 degree of flexion for the swing phase of gait, 83 degree to climb stairs, 90 degree to descend stairs, and 93 degree to rise from a seated position. Flexion greater than 105 degree is necessary for kneeling and squatting during activities of daily living and for religious acts [1].

A number of reports have described the factors affecting range of motion after total knee arthroplasty. Among the important factors are preoperative range of motion, tibiofemoralvarus or valgus angle, preoperative knee function score, and postoperative therapy. The importance of other potential factors like influence of patient's age and sex, body weight and etiology of arthritis is less well documented in literature. To our knowledge there are no studies assessing the factors affecting the range of motion after total knee arthroplasty on Indian population which prompted us to undertake this study.

The aims and objectives of this study is to assess the various demographic factors affecting the postoperative range of motion namely age, sex , body mass index , preoperative range of motion , the timing of surgery and the choice of implants These results could be used to identify the patients who are prone for decreased range of motion after total knee arthroplasty.

MATERIALS AND METHODS:

We did a prospective study for all those patients with advanced arthritis of knee, who underwent primary knee arthroplasty at MGM medical college, Navi Mumbai which is a teaching hospital and a referral centre for orthopaedic related problems, between August 2009 to December 2013

354 primary total knee replacements among 254 patients were included in the study. Patients of the age group 50 to 80 years undergoing primary total knee arthroplasty were selected. Preoperative knee scores were calculated by using modified Insall's knee society scoring system, which includes both subjective and

functional components. Proforma was prepared and applied for all the cases. Standing AP and lateral views of both knees and full length AP view of both lower limbs involving hip, knee and ankle, chest x ray and pelvis x ray were taken .Preoperative photographs and videos were recorded for all the cases. Depending upon the physiological age and medical fitness with their associated comorbidities, patients with bilateral advanced arthritis underwent total knee replacement in single anesthesia (bilateral single stage) or staggered with a gap of 2 to 7 days between surgeries or under two separate hospitalisation (bilateral staggered).

PATIENT DEMOGRAPHICS

The average age group of was 63.8years with a range of 50 – 80 years with 50.8% of patient in 60 – 69 year age group. 66.1% of the patients were female and 33.9% were male. The body mass index ranged from 17.6 – 46.7 with 40.9% of patients between 25.1 – 30 group with a mean of 27.5. The preoperative diagnosis was osteoarthritis in 81.1% of patients and 18.9% had rheumatoid arthritis. The duration of hospital stay ranged from 6 -23 days with a mean of 10. 154 patients (60.6%) underwent unilateral knee replacement and 100 patients underwent bilateral knee replacement, out of which 18.1% had single stage and 21.3% had staggered bilateral. Right side was operated in 172 joints and 182 on left side. Fixed flexion deformity ranged from 0 – 40 with a mean of 10.5 and SD of 10.9. Varus deformity ranged between 0 – 30 with mean of 11.8 and SD of 6.1. Valgus deformity also ranged between 0 – 30 with mean of 12.6 and SD of 10.6. Mediolateral instability of <5mm was present in 3.4 %, 5-10mm in 35.8 % and >10mm in 60.8 %. Anteroposterior instability of <5mm was present in 26.5%, 5-10mm was present in 65% and >10mm was present in 35.4 %. Comorbidities were present in 64.6 % of people and 50 % of the patients had hypertension followed with diabetes in 29.9 percent people. Medial release of the knee was required in 49.2% patients and posterior release in 12.7% with 21.7% of patients requiring lateral retinaculum release for maltracking of patella. All poly implant was used in 83.1% of patients and in 16.9% of patients metal backed was used. Augmentation was required in the form of extension rods or bone grafts or wedges in 2.3% of the patients.

POSTOPERATIVE PROTOCOL:

Epidural analgesia consisting of 0.1% sensorcaine and morphine was given continuously using a syringe pump for 3 to 4 days. Intra operative, intra articular cocktail (Morphine, bupivacaine and ketodolac), was used additionally for pain management in all cases. Pain was assessed using visual analague scale (VAS) and analgesics given accordingly. Postoperative pain protocol included oral analgesics for visual analague scale score less than 5 and injectable analgesics for score more than 5. Blood transfusions were given depending on the postoperative hemoglobin levels. Chest physiotherapy and incentive spirometry was started day before the surgery and continued in the postoperative period. The patients were made to ambulate full weight bearing from the first postoperative day with the help of walker. Quadriceps strengthening and knee bending exercises as tolerated were also started from the 1st postoperative day. Skin staples were removed between 10th and 14th postoperative days. .Post operative radiograph (AP and lateral) view was taken to see the prosthetic positioning in both sagittal and coronal planes. Postoperative range of motions and knee scores were recorded during the subsequent follow ups at 3 months, 6 months, 1 year and 2 year. All the patients were available for follow up with a maximum of 2years (12.2%), 1year follow up (66.14%) and a minimum follow up of 6 months (21.66%).

Data analysis -

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using Epidemiological Information Package (EPI 2010) developed by Centre for Disease Control, Atlanta and Excel software. Using these softwares range, frequencies, percentages, means, standard deviations, chi square 'p' values and correlation coefficients were calculated. Kruskul Wallis chi-square test was used to test the significance of difference between quantitative variables and Yate's chi square test for qualitative variables. A 'p' value less than 0.05 is taken to denote significant relationship. A correlation coefficient more than + 0.5 denotes association between the two variables.

RESULTS

At 2 years follow up 120.7 degrees mean range of motion was achieved which is good enough for the patients to manage their activities of daily living. We were able to achieve mean coronal femoral component angle of 95.3 degrees and coronal tibial component angle of 89.8 degrees with a mean valgus alignment of the knee of 5.1 degree.None of our patients in the study had an anterior tibial slope, however the mean was only 2.08 degrees.

Preoperatively there was no significant difference in the range of motion between various age groups. At 3 months (r -0.04, p 0.5075), 6 months (r -0.08, p 0.2493), 1 year (r -0.04, p 0.5992), 2 year (r -0.27, p 0.5151) as per statistical analysis,there was no correlation between age and postoperative range of motion. (Table 1)

Table 1: Preoperatively there was no significant difference in the range of motion between various age groups.

Range of motion at	Range of motion (Mean +SD) in Age group				
	50-59 years	60-69 years	70 & above	'p'	Corr. Coeffi.
Pre operative	92.9 + 22.8	92.9 + 19.5	90.5 + 18.6	0.5075	-0.04
3 months	101.0 + 9.3	98.4 + 9.1	98.4 + 9.1	0.0854	-0.01
6 months	111.4 + 9.2	109.3 + 9.0	109.3 + 9.0	0.2493	-0.08
1 year	116.9 + 8.2	115.4 + 9.9	115.9 + 12.3	0.5992	-0.04
2 years	123.4 + 6.4	119.4 + 8.8	118 + 9.8	0.5151	-0.27

At 3 months (r -0.04, p 0.5075) , 6 months (r -0.08 , p 0.2493) , 1 year (r -0.04 , p 0.5992) , 2 year (r -0.27 , p 0.5151). There was no correlation between age and postoperative range of motion

There was no significant preoperative difference in range of motion in both sexes. Though males had better range of motion at 1 year follow up (p 0.0465), at the end of 2 years, the difference was not statistically significant. (Graph 1).

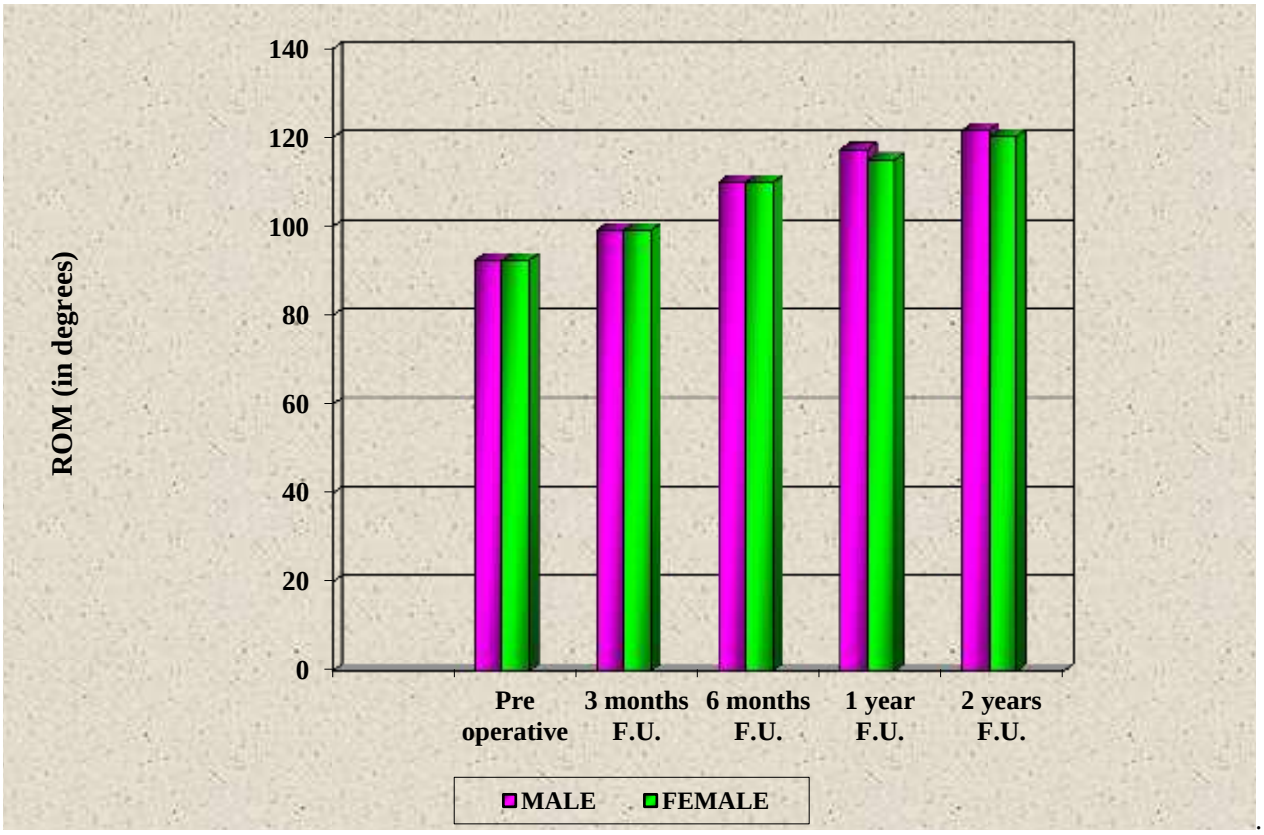
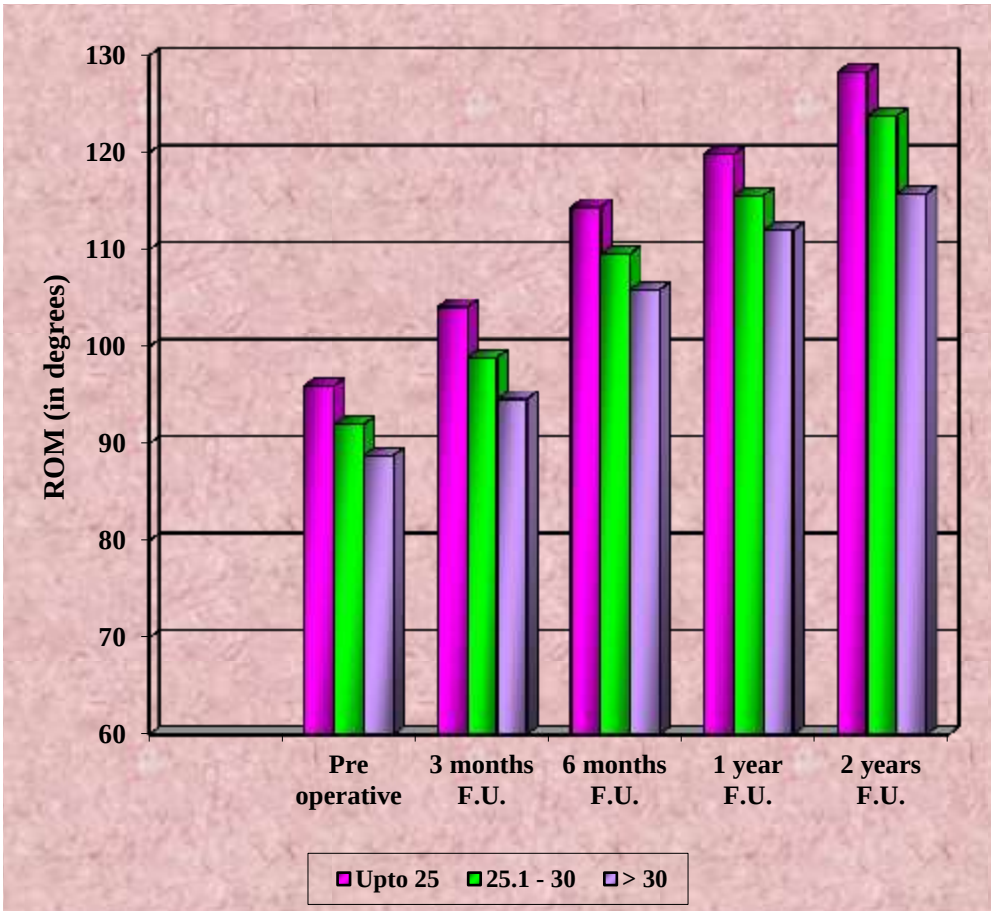


Fig 1: Males had better range of motion at 1 year follow up (p 0.0465), at 2 year the difference was not statistically significant. (P 0.752)

Patients with Body mass index less than 25 had better range of motion at all the points of surgery when compared to patients with Body mass index 25 to 30 and more than 30 group (preoperative p 0.032, 3 months p 0.0082 , 6 months p 0.027 , 1 year p 0.042 , 2 years p 0.0394 . (Graph 2)



Graph 2: Patients with Body mass index less than 25 had better range of motion at all the points of surgery when compared to patients with Body mass index 25 to 30 and more than 30 group

Preoperatively there was a significant difference of range of motion when patients of rheumatoid arthritis were compared to those of osteoarthritis. Rheumatoid arthritis patients continued to have statistically significant decreased range of motion till 6 months after surgery. (p0.0484) At 1 year and 2 year follow up this difference disappeared. (Table 2)

Table 2: Rheumatoid arthritis patients had decreased knee ROM preoperatively and also continued to have statistically significant decreased knee ROM after surgery.

Range of motion at	Range of motion (Mean +SD)			
	Preoperative. Diagnosis			
	Rheumatoid arthritis	Osteoarthritis	'p'	Corr. Coeffi
Pre operative	86.2 + 25	93.8 + 18.8	**0.0444**	0.15
3 months	96.4 + 8.3	99.9 + 9.5	**0.0023**	0.15
6 months	108.2 + 9.4	110.3 + 9.8	**0.0484**	0.09
1 year	113.7 + 9.8	116.6 + 10	0.106	0.12
2 years	118.8 + 5.9	121.4 + 8.6	0.3352	0.16

Patients who underwent bilateral knee replacement , either single stage or staggered had better range of motion at 3 months(p 0.0291 r 0.14) and at 6 months (p 0.0128 r 0.16) , however this difference disappeared at 1year(p 0.585 r 0.13) and at 2 year (p 0.515 r – 0.06)

Table-3: Type of knee replacement and Range of motion

Range of motion at	Range of motion (Mean +SD)				
	Type of knee replacement				
	Unilateral	Bilateral single	Staggered bilateral	'p'	Corr. Coeffi.
Pre operative	90 + 21.3	94.1 + 18.8	94.3 + 19.9	0.2533	0.09
3 months	97.5 + 10	100.9 + 9.4	100.5 + 7.9	**0.0291**	0.14
6 months	108 + 10.6	111.5 + 9.3	111.5 + 8.3	**0.0128**	0.16
1 year	114.5 + 11.1	116.6 + 8	117.5 + 9.5	0.5885	0.13
2 years	119.4 + 5.6	123.6 + 7.5	119.1 + 9.6	0.515	-0.06

Patients who underwent bilateral knee replacement , either single stage or staggered had better range of motion at 3 months(p 0.0291 r 0.14) and at 6 months (p 0.0128 r 0.16) , however this difference disappeared at 1year(p 0.585 r 0.13) and at 2 year (p 0.515 r – 0.06)

The preoperative range of motion had a positive statistical correlation with the postoperative range of motion at all the points of follow up and in all the age groups (3 months ,r 0.7 p <0.001 , 6 months , r 0.68 p <0.001 1year , r 0.71 p<0.001 , 2 years , r 0.61 p <0.001).

At 1 year follow up there was a significant better range of motion in all polyethylene group (p 0.033), but at 3 months , 6 months and 2 years follow up there was no difference in range of motion between the type of implants used .

Table-4: Type of implants and range of motion

Range of motion	Range of motion (Mean +SD)			
	Type of implant			
	All polyethylene	Metal backed	'p'	Corr. Coeffi
Pre operative	91.7 + 20.5	95.5 + 19.3	0.2098	0.07
3 months	99.1 + 9.4	99.7 + 9.3	0.6969	0.02
6 months	109.9 + 9.6	110 + 10.3	0.9903	0.003
1 year	116.3 + 10.1	111.7 + 7.2	0.033	-0.13
2 years	120.9 + 8.4	118.5 + 4.9	0.5842	-0.09

Both all polyethylene and metal backed group fared equally well , but however the number of people who were replaced with metal backed implants were significantly less (16.9%),

DISCUSSION:

The influence of age on postoperative knee range of motion remains controversial. Horikawa*etal.;* [2]found that preoperative range of motion was not correlated with age, but that there was a weak correlation between postoperative range of motion and age (r = 0.277, P 0 .05). Schurman*et al.;* [3] divided 25 patients with preoperative range ofmotion of less than 78 degree into 2 groups: one group of patients 62 years or younger and a second group older than 63 years. The younger group showed a mean postoperative range of motion of 83 degree, whereas the older group had a mean value of 100 degree, demonstrating that the age was a factor. In contrast, Harvey *et al.;* [4] and Anouchi*et al.;* [5] reported no correlation between age and postoperative knee range of motion. In our study, we also found no age-related effect on postoperative knee range of motion. (Table 1). As the average lifespan of the Indian population increases, these results suggest a good outcome of knee arthroplasty in elderly patients especially over the age of 70, who wish to maintain an active lifestyle.

In this study we observed that men had better range of motion at 1 year follow up but however this difference was not significant at 2 years follow up. Our study agrees with the report of Schurmanetal[6], that sex did not appear to be an important factor affecting knee joint range of motion. (Table 2).

There are some reports indicating that obesity has an adverse effect on postoperative knee range of motion due to soft tissue impingement between the femur and the tibia, which restricts flexion of the knee[7,8] Shoji *et al.;* [7] concluded that obese patients accounted for a larger percentage of the patients with a poor range of motion. Lizaur*et al.;* [8] reported that Body mass index was significantly correlated (r = 0.25, P = .023) with postoperative range of motion.

In our study patients with low Body mass index less than 25 had better range of movements at all the points of follow up and was statistically significant. We agree with Naomi *et al.;* [9] that patients with a BMI >25 need to be counselled regarding realistic

outcomes following knee arthroplasty in view of decreased ROM.

Regarding preoperative diagnosis, a number of comparative studies of Osteoarthritis and Rheumatoid arthritis have been conducted[2, 4, 5]. Most, but not all of these studies, have reported a greater improvement rate in range of motion in the Rheumatoid arthritis group who had a poorer preoperative range of motion. In our study, there was significant better range of motion in osteoarthritis group preoperatively and also post operatively at 3 months and 6 months, but however at the 2year follow up there was no statistical difference between the two groups.

Regarding, preoperative range of motion, most reports have demonstrated that a greater postoperative flexion was achieved in patients with greater preoperative range of motion of the knee joint. Kurosaka*et al.;* [10] reported that preoperative range of motion of the knee joint was the most important factor. Our study results have clearly demonstrated positive correlation between preoperative flexion and postoperative flexion at all the points of follow up with a statistically significant relationship irrespective of the age group. We agree with Kurosaka et al that preoperative range of motion significantly affects the postoperative range of motion.

As far as we know, there is no study done on the Indian population, regarding the relationship between postoperative flexion and whether the patient had unilateral, bilateral single staged or staggered bilateral knee replacement. We found better range of motion in patients with bilateral knee replacement either single stage or staggered as compared to unilateral at 3 months and 6 months. This may be attributed to the fact that patients who underwent bilateral knee replacement probably had a prolonged hospital stay and better rehabilitation process as compared to unilateral knee replacements. However there was no difference between these groups at 1 year and 2 year follow ups.

In a comparison of metal-backed and all-polyethylene tibial components of the PFC knee, Rodriguez *et al.;* [11] and David F. Dalury*et al.;* [12] found that the clinical, functional and radiographic results of the implants were equivalent. PacharapolUdomkiat, MD, Lawrence D. Dorr[13] in their study found that the mean flexion for allpolyethylenetibial knees was 120.5° _ 8.0° and for metal backed tibial knees was 118.3° _ 10.4° (P_.300). We had better range of motion in all polyethylene groups at 1year follow up (p 0.033), however there was no statistical difference at 2year between the both groups. We agree with Rodriguez *et al.;*and PacharapolUdomkiat, MD, Lawrence D. Dorr that the results of implants were equivalent in both groups.

CONCLUSIONS

We observed that preoperative range of motion, BMI > 25, and presence of rheumatoid arthritis had a significant bearing on the postoperative range of motion irrespective of their age and sex. The age of the patient, sex, choice of implant and timing of second surgery had no statistical correlation with the post operative range of motion.

RECOMMENDATIONS:

As our study had a maximum follow up of only 2 years, it is recommended that the same patients be followed up for a longer periods to ascertain the fate of various variables evaluated here.

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