ORIGINAL RESEARCH PAPER

Orthopaedics

STUDY OF FACTOR RESPONSIBLE FOR RANGE OF MOTION OF KNEE AFTER TOTAL KNEE ARTHROPLASTY

KEY WORDS: Total Knee Arthroplasty (TKA), Revision and fixation, alignment study.

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ABSTRACT

BACKGROUND: Total knee arthroplasty has been proven one of the most successful moperations of all medicine with very good and long lasting functional outcome in patients.The Knee joint arthroplasty is the standard treatment for severe dysfunction of the knee aiming to make the knee pain free as well as to stabilise it with an appropriate range of motion. Arthroplasty depends on objective and subjective parameters.

MATERIAL AND METHODS: A prospective study comprising of twenty six cases who underwent total knee arthroplasty had been carried out in the Department of orthopaedics All india institute of medical science patna Bihar.

CONCLUSIONS: Total knee arthroplasty is the standard treatment for severe destructive arthritis of the knee with an aim to provide stable, painless and mobile joint. preoperative arc of flexion, mediolateral laxity and preoperative tibiofemoral varus/valgus angle have a significant influence on the postoperative flexion, which means they are important factors for predicting the outcome range of motion of the knee after a total knee arthroplasty.

INTRODUCTION

Total knee arthroplasty is one of the common elective surgeries and is the standard treatment for severe dysfunction of the knee aiming to make the knee pain free as well as to stabilise it with an appropriate range of motion. Range of motion of knee directly affects the patient's physical activity.[1] Risk factors, assessment studies mentioned various factors affecting range of motion of total knee arthroplasty including age, weight, BMI, preoperative flexion, FFD, TF angle, surgical techniques, implant design, postoperative physiotherapy.[2] This study is to assess predisposing factors affecting range of motion after total knee arthroplasty.

The postoperative functional recovery of range of motion of total knee arthroplasty depends on objective and subjective parameters.To select some specific predisposing parameters for comparison and to correlate the postoperative functional recovery depending on these specific parameters of total knee arthroplasty.

Primary total knee arthroplasty continues to be a highly successful procedure, resulting in good pain relief and functional improvement, Contraindications include nonfunctional extensor mechanism, neuromuscular disease vascular disease of the affected extremity, and active infection.

MATERIALS AND METHODS

A prospective study comprising of twenty six adult patients who underwent total knee arthroplasty and who met the inclusion criteria had been carried out in the Department of Orthopaedics All india institute of medical science Patna Bihar.

A precise history was elicited and the patients were then assessed clinically to evaluate their general and local condition. Outcome study with the help o preoperative and postoperative scoring was done. The rehabilitation treatment protocol was followed till postoperative day 6. Parameters like range of motion of the knee joint, pain, muscle strength of quadriceps, tibiofemoral angle and functional improvement were studied.

Inclusion Criteria

Age more than 50 years of either sex, accepted health volunteers and cruciate substituting type of knee implant was used in all cases.

Exclusion Criteria

Age less than 50 yrs., neuromuscular disorders hindering mobility, low endurance due to associated cardiopulmonary comorbidities and those patients with associated crippling joint condition.

RESULTS

The mean age (mean± SD) of patients was 63.54±8.51 years with range 51.00-81.00 years and the median age was 63.00 years. Higher percentage [11(42.3%)] of patients were observed in age group 61-70 years (Table 1). Higher percentage 18(69.2%) patients were female in this study (Table 2). In 15(57.7%) patients, left side was operated and in 11(42.3%) patients right side was operated (Table 3). Commonest aetiology was osteoarthritis (53.8%) followed by rheumatoid arthritis (46.2%) (Table 4). The mean basal metabolic rate (BMI) (mean± SD) of patients was 26.3869±2.7302 Kg/metre2 with range 20.8900- 32.0500 Kg/metre2 and the median BMI was 26.7950 Kg/metre2 (Table 5). Difference of mean max flexion according to Pre-op, Post-op 3 months and Post-op 1 year was statistically significant (p<0.0001) (Table 6). Difference of mean flexion arc according to Pre-op, Post-op 3 months and Post-op 1 year was statistically significant (p<0.0001) (Table 7).

Difference of mean fixed flexion deformity (FFD) according to Pre-op, Post-op 3 months and Post-op 1 year was statistically significant (p<0.0001) (Table 8). Mean preoperative extension lag was 2.3077 degrees and postoperative extension lag was 4.0385 degrees. P value was 0.0610. It concludes that difference in extension lag was insignificant (Table 9). Difference of mean TF angle according to Pre-op, Post-op 3 months and Post-op 1 year was statistically significant (p<0.0001) (Table 10). Difference of mean Knee Society Score (KSS) according to Pre-op, Post-op 3 months and Post-op 1 year was statistically significant (p<0.0001) (Table 11). Difference of mean Laxity M/L on valgus/varus stress according to Pre-op, Post-op 3 months and Post-op 1 year was statistically significant (p<0.0001) (Table 12).

		Mean	SD	Minimum	Maximum	Median	p-value
Age	51-60	111.5000	13.7538	90.0000	130.0000	112.5000	0.9193
	61-70	109.0909	7.3547	95.0000	120.0000	110.0000	
	71-80	111.2500	13.1498	100.0000	125.0000	110.0000	
	81-90	105.0000	.0000	105.0000	105.0000	105.0000	

Table 1. Age Distribution

Sex	Frequency	Percent
Female	18	69.2%
Male	8	30.8%
Total	26	100.0%

Table 2. Sex Distribution

Side	Frequency	Percentage
Left	15	57.7%
Right	11	42.3%
Total	26	100.0%

Table 3. Laterality

Aetiology	Frequency	Percent
Osteoarthritis	14	53.8%
Rheumatoid Arthritis	12	46.2%
Total	26	100.0%

Table 4. Aetiology Distribution

		Number	Mean	SD	Minimum	Maximum	Median	p-value
BMI	18.5–24.9	8	108.7500	11.5728	90.0000	125.0000	110.0000	**0.8834**
	25.0–29.9	16	110.6250	11.0868	95.0000	130.0000	107.5000	
	30.0–34.9	2	112.5000	3.5355	110.0000	115.0000	112.5000	

Table 5. BMI Distribution

P=0.8834, statistically not significant

		Mean	SD	Minimum	Maximum	Median	p-value
Max Flexion	Pre-op	99.2308	9.3480	85.0000	115.0000	97.5000	<0.0001
	Post-op 3 months	112.5000	8.7464	95.0000	130.0000	110.0000	
	Post-op 1 year	110.1923	10.6283	90.0000	130.0000	110.0000	

Table 6: Mean Max Flexion According to Pre-op, Post-op 3 Months and Post-op 1 Year

p<0.0001, statistically significant.

		Mean	SD	Minimum	Maximum	Median	p-value
Flexion Arc	Pre-op	86.7308	11.2198	65.0000	105.0000	85.0000	<0.0001
	Post-op 3 months	111.1538	9.3067	95.0000	130.0000	110.0000	
	Post-op 1 year	106.1538	11.6024	85.0000	125.0000	105.0000	

Table 7. Mean Flexion Arc According to Pre-op, Post-op 3 Months and Post-op 1 Year

p<0.0001, statistically significant.

		Mean	SD	Minimum	Maximum	Median	p-value
FFD	Pre-op	10.3846	2.9171	0.0000	25.0000	10.0000	<0.0001
	Post-op 3 months	.0000	.0000	0.0000	0.0000	0.0000	
	Post-op 1 year	.7692	0.0175	0.0000	10.0000	0.0000	

Table 8. Mean FFD According to Pre-op, Post-op 3 Months and Post-op 1 Year

p<0.0001, statistically significant.

		Mean	SD	Minimum	Maximum	Median	p-value
Ext. Lag	Pre-op	2.3077	1.0573	0.0000	10.0000	0.0000	0.0610
	Post-op 3 months	1.5385	0.0884	0.0000	10.0000	0.0000	
	Post-op 1 year	4.0385	1.2472	0.0000	10.0000	5.0000	

Table 9. Mean Extension Lag According to Pre-op, Post-op 3 Months and Post-op 1 Year

p=0.0610, statistically not significant.

		Mean	SD	Minimum	Maximum	Median	p-value
TF angle	Pre-op	186.7308	3.1440	180.0000	195.0000	185.0000	0.0001
	Post-op 3 months	177.6923	2.9089	170.0000	180.0000	180.0000	
	Post-op 1 year	177.3077	3.5301	170.0000	180.0000	180.0000	

Table 10. Mean Tibiofemoral (TF) Angle According to Pre-op, Post-op 3 Months and Post-op 1 Year

p<0.0001, statistically significant.

		Mean	SD	Minimum	Maximum	Median	p-value
KSS Score	Pre-op	102.5000	6.3325	95.0000	115.0000	103.0000	<0.0001
	Post-op 3 months	171.5769	4.3004	164.0000	180.0000	171.0000	
	Post-op 1 year	166.6538	4.8162	160.0000	178.0000	165.0000	

Table 11: Mean KSS Score According to Pre-op, Post-op 3 Months and Post-op 1 Year

p<0.0001, statistically significant.

		Mean	SD	Minimum	Maximum	Median	p-value
Laxity M/L on Valgus-Varus Stress	Pre-op	6.7308	2.4667	0.0000	15.0000	7.5000	<0.0001
	Post-op 3 months	1.5385	0.3534	0.0000	5.0000	0.0000	
	Post-op 1 year	1.5385	0.3534	0.0000	5.0000	0.0000	

Table 12. Mean Laxity M/L on Valgus-Varus Stress According to Pre-op, Post-op 3 Months and Post-op 1 year

p<0.0001, statistically significant.

DISCUSSION

Total knee arthroplasty is mainly performed after an adequate trial of conservative therapy such as physiotherapy, NSAID and modification of daily activities, with the objectives of providing pain free, stable, mobile joint and to correct deformity. In this study, we evaluated the predisposing factors affecting range of motion of knee after total knee arthroplasty. The sample size of this study was 26 patients with mean age being between 63.54+/-8.51 years with range of 51 to 81 years. Higher percentages (11%) of patients were in the age group of 61 to 70 years. According to the age, patients were divided into 4 groups and correlation was assessed between these age groups and the respective postoperative range of motion of knee. P value came out to be 0.9193 showing that there was no significance between age and postoperative 1 year arc of flexion. Out of the 26 patients, 18 (69.2%) were females. Left side surgeries were more common (57.7%). Mean BMI of the patients was 26.3869+/-2.7302 kg/m2 with a range of 20.89-32.05 kg/m2. 4 groups were formed on the basis of BMI classification of overweight and obesity and each group was compared with their respective mean postoperative range of flexion to assess the significance. P value was 0.8834. This shows that there is no remarkable correlation between these two factors. Inference is that regardless of high BMI, postoperative range of motion can still be better following total knee arthroplasty. Regarding demographic factors like age and BMI, this study was supported by Kotani et al (2005)[3] and DJ Schurman et al (2005)[4], but was not supported by Li Ph et al (2007)[5] and Farahini et al (2013).[6] DJ Schurman et al (1985)[7] conducted 2 years postoperatively. Farahani et al (2013)[6] found significant correlation between age and postoperative flexion. (p value- 0.04). Difference of postoperative 1 year mean flexion arc according to aetiology, rheumatoid arthritis or osteoarthritis was not significant. (p value- 0.8396) in our study.

It is in contrast to the belief that postoperative flexion would be less in rheumatoid arthritis patients. This disparity may be due to lesser number of samples of each group in this study. There was significant increase in preoperative mean maximum flexion, mean flexion arc when compared to postoperative 1 year mean maximum flexion and mean flexion arc. Preoperative mean maximum flexion was 99.2308 and postoperative 1 year was 110.1923.

Difference of mean maximum flexion according to Pre-op, Post-op 3 months and Post-op 1 year was statistically significant (p<0.0001). In the studies of Farahani et al,[6] preoperative range of motion among the patients comprised mean flexion of 101.6° ± 14.3°, mean flexion arc of 97.9° ± 31.3°, and mean extension of 5.7° ± 4.8°; whereas mean postoperative values were 106.3° ± 11.1° for flexion, 100.2° ± 25.6° for flexion arc, and 1.4° ± 3.1° for extension. There were significant differences between all the average measures for the range of motion before and after the arthroplasty, where the difference in mean flexion was 4.7° (P < 0.001), flexion arcs 2.3° (P = 0.03), and extensions -4.3 (P < 0.001). Ryu J et al (1993)[8] and Li Ph et al (2001)[5] observed that postoperative range of motion was significantly increased in those with good preoperative range of motion supporting the observations of this study. In contrast, DJ Schurman et al (2005)[4] observed that patients with preoperative flexion of more than 100 degrees had lost flexion at followup whereas those with preoperative flexion of less than 100 degrees gained flexion. Parsley et al noted a similar decrease in range of motion postoperatively in patients with more than 105 degrees of flexion. But there was no significant correlation between preoperative maximum flexion and postoperative 1 year arc of flexion in this study as measured by statistical comparative studies (p value – 0.198511). In contrast, Farahini et al (2103)[6] found significant correlation between preoperative maximum flexion with postoperative range of flexion. Mean fixed flexion deformity decreased significantly from 10.8396 to 0.7692 postoperative 1 year. (P value<0.0001). The correlation between FFD preoperative and flexion arc 1 year was moderately negative. Value of R2 (the coefficient of determination) was 0.0321. The p value was 0.406386 (p value>0.05). Inference is that fixed flexion deformity doesn't affect postoperative range of motion. Mean preoperative extension lag was 2.3077 degrees and postoperative extension lag was 4.0385 degrees. P value was 0.0610. It concludes that difference in extension lag was insignificant. In the study of Farahani et al (2013),[6] the extension lag significantly reduced from 5.7+/-4.8 degrees to postoperative 1.4+/-3.1 degrees. (p value <0.001). Tibiofemoral angle significantly decreased from 186.7308 degrees to 177.3077 degrees (p value <0.0001). The correlation between flexion arc 1 year and preoperative tibiofemoral angle was significant. (p value<0.05). R value was -0.1793 showing that there was negative correlation between preoperative tibiofemoral angle and postoperative arc of flexion. The mean of tibiofemoral angle at 1 year was 177.3077 and median was 180 degrees signifying that the resultant tibiofemoral angle was within 180 degrees to 5 degrees of valgus (175 degrees) which is standard as per Knee Society Score. Though the implant was same for all the patients but the difference in tibiofemoral angle was there due to different preoperative varus and valgus deformities of knees of different patients. Kawamura et al (2001)[10] found negative correlation between tibiofemoral angle and flexion arc. Farahani et al (2013)[6] too found negative correlation (r was- 0.285) (p value- 0.007). The mean of tibiofemoral angle was 181.6° ± 11.4° before the arthroplasty, which was remarkably decreased to 176.6° ± 3.3° postoperatively (P < 0.001). Li Ph et al (2007)[5] reviewed records of 242 patients and found that tibiofemoral angle did not significantly correlate with the flexion arc which is not compatible with this study. KSS score remarkably increased postoperatively with preoperative score being 102.5 and postoperative score being 166.6538 (p value <0.0001). This finding corroborates with that of Farahani et al (2013)[6]. But the correlation with the flexion arc is not significant (R2 =0.0006) (p value>0.05). Mean mediolateral laxity preoperatively was 6.7308 degrees which remarkably reduced to 1.5385 degrees 1 year post surgery. There was a significant negative correlation between mediolateral laxity and postoperative 1 year arc of flexion. conclude that those with lax joints would have lesser range of motion. Knee joint replacement suggest that many people continue to have painful joints after surgery, the proportion of people with an unfavourable long term pain outcome ranges. There was also remarkable decrease in synovitis and effusion postoperatively (p value- 0.0008). In two of our cases, effusion persisted after 3 months due to infection. Debridement was done and the infection healed but the postoperative 1 year arc of flexion was reduced. Mean quadriceps power preoperative was 4.2692 which increased significantly to 4.7692 (p value 0.001) following successful rehabilitation protocol. Mean VAS preoperative was 6.2692 and postoperative 1 year was 0.3077, the result was significant showing that there was remarkable decrease in postoperative pain. The limitation of this study was the fewer number of patients which significantly affected the outcome vis- à-vis other similar studies. This study followed the patients for one year and the results of the above- mentioned factors at the end of one year of the surgery built up the postoperative values, which was a limiting factor for the study since long-term results could have been different, at least for some of the studied variables. On the other hand, the most effective clinical outcomes of the knee joint arthroplasty present themselves almost one year after the surgery, which makes this study valid enough to assess the factors influencing postoperative range of motion. Knee replacement for osteoarthritis.

CONCLUSIONS

Total knee arthroplasty is the standard treatment for severe destructive arthritis of the knee with aim to provide stable,

painless and mobile joint. Progress in the knee implant design and the surgical techniques for total knee replacement achieved successful results in reducing the pain and providing with a stable joint; The postoperative range of motion is one of the major criteria of the patient's satisfaction of the arthroplasty, the present study revealed that all the preoperative measures of the range of motion, including maximum flexion, arc of flexion, and extension was significantly enhanced after the surgery.

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