

## Original Research Article

# Functional outcome of mild and moderate residual varus in posterior stabilized total knee arthroplasty in primary osteoarthritis knee: a prospective study

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### ABSTRACT

**Background:** Total knee arthroplasty (TKA) is one of the most commonly done orthopaedic surgical procedures for treating severe arthritis of the knee joint caused by osteoarthritis or inflammatory arthritis. The current clinical investigation, done at the Sanjay Gandhi Institute of Trauma and Orthopaedics in Bengaluru, provided the short-term functional result of mild and moderate residual varus in posterior stabilized TKA. The aim was to evaluate the efficacy of mild and moderate residual varus in total knee replacement for primary OA knee in terms of pain relief, range of motion and stability of the joint.

**Methods:** 30 total knee replacements were performed. All patients were examined pre- and post-operatively using the knee society clinical and functional score. The average pre-op KSS knee score was 38.7, with a functional score of 23.3. The most common reason for TKR was osteoarthritis. The follow-up time ranged from 6 to 12 months.

**Results:** By the knee society clinical, functional score method, 96.6% of our patients received an outstanding assessment after scoring 80 points or higher. The mean post-operative KSS knee score is 86.57, and the knee society functional score is 92. 92% of patients had little/no pain after surgery, and walking ability increased and was unlimited in 80% of patients.

**Conclusions:** After a short term follow up of 1 year in a research population of 30 with pre-operative osteo arthritis of the knee, with post-operative mild to moderate varus alignment showed better clinical results.

**Keywords:** Osteoarthritis knee, Total knee arthroplasty, Residual varus

### INTRODUCTION

TKA is one of the most commonly done orthopaedic surgical procedures for treating severe arthritis of the knee joint caused by osteoarthritis or inflammatory arthritis. Osteoarthritis accounts for more than 90% of total knee replacements. The most common chronic joint condition is likely to be osteoarthritis. Because of the ageing population and the obesity epidemic, the prevalence of osteoarthritis is increasing. The most prevalent clinical symptoms that may lead to treatment include pain and loss of function. Treatment may

involve non-pharmacological, pharmacological, and surgical treatments.<sup>1</sup> Soft tissue interposition arthroplasty, resection arthroplasty and surface replacement arthroplasty are only a few of the surgical procedures that have evolved. Different forms of prosthesis were created for surface replacement arthroplasty to address the complex knee kinematics. Total knee arthroplasty success is determined by patient selection, perioperative treatment, implant design, and surgical technique. The advantage of this treatment is mainly based on pain reduction, functional results, patient satisfaction, and implant longevity. These

variables are affected by implant size, joint line reconstruction, soft tissue balancing and limb orientation.<sup>2</sup> The 10-year survival rate for cemented TKA ranges from 91 percent to 99 percent, while the 15-year survival rate ranges from 91 percent to 96 percent. Many writers have now reported long-term survival rates of well over 75% after 15 to 20 years of follow-up.<sup>3</sup> 40% of the population over the age of 50 suffers from knee arthritis. 80 percent of whom require arthroplasty for discomfort, instability, and limited range of motion. With an increase in average life expectancy (69.25 years) and an increase in the incidence of knee arthritis due to age-related degeneration and post-traumatic injury, the number of patients receiving TKA has also grown.

One of the criteria for effective total knee arthroplasty (TKA) is the restoration of neutral limb alignment. Several published studies show that insufficient leg alignment restoration has a negative impact on implant survival. 4 and 5 If implant failure is to be avoided in the medium or long term, the prevailing view is that an overall mechanical femorotibial alignment (FTMA) of  $0\pm 3\text{°}$  should be the goal of surgery. Malalignment outside of this safe zone has been blamed for higher point loading of the polyethylene, resulting in dissatisfied patients.<sup>4,7</sup>

The impact of limb alignment on patient satisfaction has been hotly debated in the literature. Several investigations have found that deviation from neutral alignment is linked to poor functional outcomes.<sup>2,7</sup> Other researchers found that individuals with severe varus alignment prior to surgery who were restored to neutral alignment following TKA had discomfort and had poorer clinical scores.<sup>7</sup> Restoring their normal alignment while still under treatment may be a more physiological alternative for those patients than returning to neutral alignment.<sup>7,8</sup> Some researchers have begun to look for new alignment strategies that can improve TKA's therapeutic efficacy. Kinematic alignment (KA), for example, is a procedure that tries to restore the physiological kinematic axis of knee joints and has currently achieved good 10-year follow-up and clinical outcomes.<sup>9</sup> The notion of KA might be used as a reference during TKA in all abnormalities, and the knee could be left in mild varus to retain the original lower extremity alignment and decrease the extent of soft tissue release. Such a way could potentially improve patient satisfaction after TKA.

Furthermore, it was revealed that a higher rate of varus limb alignment following MA than after KA with both patient specific and manual instruments, and that utilizing conventional instrumentation had the greatest varus mean MA and varus outliers.<sup>10</sup> The current clinical investigation provided the short-term functional result of mild and moderate residual varus in posterior stabilised total knee arthroplasty performed at our institute between November 2019 and June 2021.

### ***Aim and objectives***

Aim and objectives of current study were to assess the functional outcome of mild and moderate residual varus in posterior stabilized total knee arthroplasty.

### **METHODS**

#### ***Source of data***

Patients of age group more than 50 years admitted with OA knee and operated with posterior stabilized total knee arthroplasty in Sanjay Gandhi Institute of Trauma and Orthopedics.

#### ***Study design, duration and location***

It was a hospital-based prospective observational study, conducted at Sanjay Gandhi Institute of Trauma and Orthopedics, Bangalore from November 2019 to June 2021.

#### ***Sample size***

We estimated based on the outcome, the mean Lysholm score at follow up as  $96.3\pm 2.8$  (92-100) among patients with OA undergoing TKA from the study by Lee et al considering SD of 2.8 at 5% alpha error and at 95%. Confidence level of sample size of 77 was obtained and will be included in the study. Formula used to calculate sample size was,

$$\text{sample size} = \frac{Z_{1-\alpha/2}^2 SD^2}{d^2},$$

where,

$Z_{1-\alpha/2}$ =standard normal variate as mentioned in previous section,

SD=standard deviation of variable; value of standard deviation can be taken from previously done study or through pilot study,

D=absolute error or precision as mentioned in previous section,

z at 15% alpha error=1.96,

SD=2.8,

d=1% error,

thereby N=30.

Thus 30 subjects were included in the study.

#### ***Inclusion criteria***

Inclusion criteria for current study were age more than 50 years, patients operated for primary osteo arthritis knee

grade 3 and 4 (Kellgren and Lawrence classification), TKA with varus knee and patients who had given the written consent.

### Exclusion criteria

Exclusion criteria for current study were age less than 50 years; infected TKA; patients with post traumatic and post infectious osteo-arthritis; TKR for RA knee and other inflammatory arthritis of knee and patients not willing to give written consent for the study.

After informing the patient about the diagnosis and all possible treatment choices as well as the relative benefits and drawbacks of each option, patients willing to undergo knee replacement are told about the projected functional improvement and range of motion. The patients were informed about the risks of TKA as well as the specific surgical problems. If the patient met the inclusion criteria, he or she will undergo a preoperative general examination, knee grading and investigations as indicated below. If considered required, a cardiologist's fitness was obtained. If the patient was deemed to be surgically fit, written agreement for surgery and the study was obtained. The recommended intervention was carried out on the patient.

### Intervention

TKA of femoral and tibial component of affected knee joint using cemented prosthesis under epidural or general anesthesia.

### Choice of prosthesis

Posterior stabilized TKR prosthesis: any peri-operative complications were recorded. Patients were assessed with postoperative X-ray in immediate postoperative period and at subsequent follow up and patients are subjected to knee society scoring in the postoperative period. Plain radiograph of full-length lower limb in weight bearing position. A CT scanogram and plain radiograph was taken post-operatively to measure the alignment of the prosthesis.

### Statistical analysis

Data from the case record proforma were entered into Microsoft Excel spreadsheet version 2016 and analyzed using IBM-SPSS version 24. Frequency and proportion (percentages) expressed the categorical data. The normality of continuous data was decided by plotting histograms. Normally distributed continuous variables were expressed as mean and SD (standard deviation). For determining the statistical differences in categorical data, a Chi square test was applied. For normally distributed continuous data, a student t test was applied,  $p < 0.05$  was considered significant for all statistical comparisons.

## RESULTS

The present study gives our experience with the posterior stabilized TKR with residual mild and moderate residual varus. In 30 patients who underwent total knee replacement at Sanjay Gandhi Institute of Trauma and Orthopedics, Bangalore between November 2019 to June 2021. The main indication for TKR was osteoarthritis (OA). The follow up period was 12 months. Pre-operatively every patient assessed clinically, functionally, and radiologically. The patients were assessed for pre-operative KSS knee and functional score. The functional disability was recorded according to knee society clinical rating systems in terms of pain, range of motion, instability and functional capacity. 30 patients were included in the study who are above 50 years of age (Table 1).

**Table 1: Distribution of age, gender and flexed flexion deformity (FFD).**

Variables		N	%
Age (years)	50 to 60	13	43.3
	61 to 70	11	36.7
	>70	6	20
Gender	Females	20	66.7
	Males	10	33.3
FFD	Absent	13	43.3
	Present	17	56.7

Most of the patients were between the age group of 50 and 60. 66.7% of the patients are females (Table 1). Total 17 of the subjects had flexed flexion deformity pre operatively (Table 1). Post-operative only one of the subjects had fixed flexion deformity and 2 of the subjects developed superficial infection. None of the patients had any other complications like deep infection, DVT. The pre-operative HKA angle was 8.07 which was 2.80 post operatively (Table 2).

There was a significant increase in the range of motion of the knee post operatively at the end of 3 months when compared to pre-operative. Pre-operative mean range of motion was 98.17. The mean range of motion at the end of post-operative third day was 91.17 which was little lower when compared to the pre-operative range. But there was a gradual increase in the range over the weeks and mean ROM was 103.83 at the end of 4 weeks and 108.67 at the end of 3 months and the values were significant (Table 3). The pre-op mean KSS knee score was 38.77 which improved to 86.57 at the end of 12 months post TKA. The average pre-op KSS functional score was 23.3 which improved to 92 at the end of 12 months post op follow up (Table 4). The mean pre op WOMAC score was 39 which improved to 89.1 at 12 months follow up post-surgery (Table 5). The post-operative varus alignment from 1-3° is considered as mild varus and between 4-6° is considered moderate varus. In 30 patients included in the study 22 of them had mild and rest moderate post-operative alignment. In mild group the

mean value was 91.82 and standard deviation of 4.011 and for moderate group had a mean value of 91.10 and a standard of 4.629 with a mean difference of -0.682 with a

p value of 0.74 (Table 6). At the end of 12 months post TKA 96.67% of the patients had excellent outcome and the rest 3.3% of the subjects had good outcome (Table 7).

**Table 2: Comparison of HKA angle (pre and post) using paired sample t test.**

Variables	N	Minimum	Maximum	Mean	SD	Mean diff.	P value
Pre-OP HKA angle	30	2	15	8.07	3.503	5.26	0.00
Post-OP Varus HKA	30	1	6	2.80	1.375		

**Table 3: Comparison of the ROM among different time intervals using repeated measures ANOVA.**

ROM	N	Minimum	Maximum	Mean	SD	P value
Pre-OP	30	85	115	98.17	8.251	0.00
POD 3	30	80	100	91.17	5.826	
4 weeks	30	95	110	103.83	4.292	
3 months	30	15	120	108.67	18.191	

**Table 4: Comparison of the KSS knee score and KSS functional score among different time intervals using repeated measures ANOVA.**

Variables	KSS knee score	N	Minimum	Maximum	Mean	SD	P value
KSS knee score	Pre-OP	30	15	63	38.77	11.144	0.00
	3 months	30	51	80	66.87	7.181	
	6 months	30	65	92	80.27	6.57	
	12 months	30	79	95	86.57	4.158	
KSS functional score	Pre-OP	30	-20	40	23.3	15.632	0.00
	3 months	30	30	80	53.83	11.867	
	6 months	30	60	90	79.33	9.353	
	12 months	30	80	100	92	4.842	

**Table 5: Comparison of WOMAC scores (pre and 12 months) using paired sample t test.**

Variables	N	Minimum	Maximum	Mean	SD	Mean diff.	P value
WOMAC Pre-OP	30	32.60	46.40	39.023	3.17	-50.14	0.00
WOMAC 12 months	30	83.6	92.4	89.167	2.06		

**Table 6: Comparison of the 12 months functional KSS scores based on post-op varus HKA using independent sample t test.**

Post-OP varus HKA	N	Minimum	Maximum	Mean	SD	Mean diff.	P value
Mild	22	80	100	91.82	4.011	-0.682	0.74
Moderate	8	80	100	91.10	4.629		

**Table 7: Functional outcome of patients studied at 12 months.**

Result	%
Fair	0
Good	3.33
Excellent	96.67

**DISCUSSION**

Correct positioning and alignment of components during primary total knee replacement is widely accepted to be an important predictor of patient satisfaction and implant

durability. The effect of residual varus on survival rate and function in patients with varus knee osteoarthritis was considered an important issue for successful primary total knee arthroplasty. However, the influence of residual mal-alignment on clinical and functional outcomes after

TKA was unknown. Therefore, the purpose of this study was to investigate the relationship between postoperative limb alignment and clinical outcomes in patients who underwent primary TKA. The main finding of this study was that patients with TKA due to varus osteoarthritis who were corrected into their natural alignment with a remaining slight varus have superior functional results. Knees that were left in mild varus (1-3°) significantly better subjective and functional outcome scores compared with knees that were corrected to moderate varus correction (4-6°). All the patients who underwent primary total knee arthroplasty had favorable outcomes at the end of one year of follow up. This impression was further supported by the fact that KSS knee score in 96.6% of the patients included in the study had better outcome that is score more than 80. The average pre-operative HKA varus angle of the study group was 8.07 minimum being 2° and maximum of 15° varus which was corrected to an average of 2.8°, minimum being 1° and maximum 6° of varus alignment. The average range of motion pre-operatively was 98° of flexion which improved to an average of 120.5° of flexion after the procedure of total knee arthroplasty with an average improvement of 22° of flexion. These improvements were also seen in the study done by Nishida et al in 2016. The maximum improvement of flexion was seen in between the duration of first 4 weeks of surgery. After 4 weeks the improvement was gradual and the end of 12 months of follow up the average range of motion was 120°. In the study 53% of patients had FFD pre operatively. One patient had FFD of 15°, 8 of them with 10° and 7 with 5° of FFD. Post operatively only one patient had 10° of FFD. Similar results were found in the study of Hanusch et al.<sup>11</sup>

The pre-operative average KSS knee and functional score were 38.7 and 23.3 respectively which improved to 86.5 and 92 respectively which were similar results in a study conducted by Baker et al.<sup>12</sup> The highest improvement in KSS knee and functional score was seen in the first 12 weeks of surgery, then after the improvement in score was gradual and 96.5% of the patients had a score more than 80 which was excellent according to the scoring system. Only one of the patients among the study group had a score below 80, 79 which was also came under good result also. Pre-operatively the average KSS knee score was 38.7 with a minimum score of 15 and maximum 63 (SD-11.144).

After 3 months post-surgery the average score increased to 66.8 (minimum-50 and maximum-81, SD-7.181). At 6 months post-operative the average score was 80.27 (minimum-65 and maximum-92, SD-6.57) showing that most of the patients had good score at the end of 6 months itself. At 1 year follow up the average KSS knee score was 86.5 (minimum-9 and maximum-95, SD-4.158). Similarly pre-operative KSS functional score was 23.3 with a minimum score of 20 and maximum of 40 (SD-15.63). After 12 weeks post-operatively the mean score was 53.8 (minimum-30 and maximum 80, SD-11.86). At 6 months the mean score was 79.3 (minimum-

60 and maximum -90, SD-9.353). The highest improvement in the functional score was seen in the first 3 months after surgery. At 1 year follow up the mean KSS functional score was 92 with a standard deviation of 4.842 (minimum-80, maximum-100). In a short term study conducted in 30 patients operated with posterior stabilized total knee arthroplasty with post-operative residual mild varus had a mean functional KSS score of 91.82 and moderate varus had a mean functional KSS of 91.10 at the end of 12 months follow up after surgery. So the patients with mild residual varus had a better functional KSS score when compared to the moderate group. These results were similar to the results in a study conducted by Kyohei et al in 2016.<sup>7</sup> These results were also similar to the results derived by Erik Schiffner et al in the varus group where KOOS in the post-operative varus group had better score than neutral group.<sup>13</sup> The pre-operative mean WOMAC score was 39.023 (minimum-32.6 and maximum-46.4, SD-3.17) at 12 months post-op it was 89.167 with a minimum score of 83.6 and maximum score of 92.4 (SD-2.06). Out of 30 patients involved in the study 22 of them had mild varus post operatively i.e., less than or equal to 3° of varus and remaining 8 of them had moderate varus that is between 3 and 6 degrees of varus alignment. The mild group had a mean KSS functional score of 91.82 (minimum -80 and maximum 100 SD-4.011) and the moderate group 91.10 (minimum -80 and maximum 100, SD-4,629).

The mild varus group had a better KSS functional score at the end of 12 months than the moderate group, but both of them had score more than 80 which was excellent outcome according to the grading system of the scores calculated. At 3 months post-surgery 6.6% of the patients had excellent outcome, 26.6% had good, 56.6% of the patients had fair and the rest 10% had poor functional KSS score. Similarly at 6 months post-surgery 70% of the individuals had excellent, 20% had good and remaining 10% had fair functional outcomes. Finally at 12 months after surgery 96.6% of the individuals had excellent results.

### **Limitations**

One of the limitation of the study was the small sample size. Prospective large RCTs can be performed to further validate the results.

### **CONCLUSION**

TKA is a highly successful operation. TKA alignment has been established as critical in preventing early implant failure and patient unhappiness. One of the criteria for successful total knee arthroplasty is the restoration of neutral limb alignment. Several published studies show that insufficient leg alignment restoration has a negative impact on implant survival. The influence of residual malalignment on clinical and functional outcomes, on the other hand, is less well understood. According to some authors, a modest under repair of the



malformation may be useful from a functional standpoint. This study concluded that after a one-year short-term follow-up in a research group of 30 people with pre-operative osteoarthritis of the knee and post-operative mild to moderate varus alignment exhibited better clinical effects. As a result, this study implies that under correction is connected with better outcomes than restoration to neutral.

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