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## Original Research Article

## A prospective study of functional outcome and deformity correction after Total Knee arthroplasty in valgus deformity of knee

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## ABSTRACT

**Background:** Total knee arthroplasty (TKA) has been particularly challenging in patients who present with valgus knee deformity, which constitutes about 10% of cases. The current study seeks to review the functional and radiological outcomes of patients treated with TKA.

**Materials and Methods:** A total of 40 knees in 30 patients with valgus deformity were the subjects of the current study. Most of them (38 knees) had a medial parapatellar approach, while two underwent an anterolateral approach. We assessed the outcome with the Knee Society score (KSS), the Visual Analogue Scale (VAS) for pain, and the radiological alignment through the Hip Knee Ankle Axis (HKA). The measurements are done in 6-week, 3-month, 6-month, and months of an immediate post-operative.

**Results:** There is a very clear improvement in all these measures. The KSS knee scores improved from 54 preoperatively to 92 in one year ( $p < 0.01$ ), and the KSS functional scores also improved significantly from 52 to 87 ( $p < 0.01$ ). The pain intensity scores clearly decreased from the preoperative average of 5.30 to 0 postoperatively ( $p < 0.001$ ). Radiologically, there was improved alignment, with HKA angles decreasing from 9.12 preoperatively to 6.25 postoperatively.

**Conclusion:** TKA significantly improved the functional outcome and reduced pain among patients presenting with a valgus knee deformity. This resulted from a clear improvement seen in the KSS, VAS, and HKA measures. The study continues to show the effectiveness of TKA in improving clinical outcomes among these difficult groups of patients.

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## 1. Introduction

Major cause of disability in older adults and obese populations is osteoarthritis and at the age of 65 years, 50% of the population shows radiographic arthritic alterations in joints.<sup>1</sup> TKA is a surgical treatment that is often performed nowadays, is favourable to the majority of recipients, and is economical in terms of quality-of-life evaluations.<sup>2</sup> Osteoarthritis, rheumatoid arthritis, or any type of arthritic deformity around the knee are indications for its use

in cases of impairment, pain, and restricted function. A successful total knee arthroplasty can reduce structural and functional deficiencies, realign soft tissues, and enhance joint biomechanics.<sup>3</sup>

One of these aspects that has the greatest impact on how long TKA lasts is component and limb alignment. The loading of the knee's articular surfaces is significantly impacted by valgus or varus malalignment, and misalignment can cause an accelerated rate of instability and osteoarthritis progression in the knee.<sup>4</sup>

There are numerous potential causes of the valgus deformity of the knee. Adults who have inflammatory

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arthritis, post-traumatic arthritis, overcorrected high tibial osteotomies for varus correction of tibia malunion, physal arrest, or tibial plateau fracture, or lateral condylar hypoplasia are most likely to develop valgus deformity.<sup>5,6</sup> Due to metabolic diseases such as rickets and renal-osteodystrophy, genu valgus may persist from childhood.

Bony and soft tissue are the primary pathogenic features that contribute to the valgus deformity. Bone variables include metaphyseal femur and tibial plateau remodelling, lateral cartilage degradation, and lateral condylar hypoplasia. Soft tissue variables include lateral tissue tightness, including the gastrocnemius lateral head, tendons of popliteus or hamstrings muscles, iliotibial band and posterolateral part of capsule.<sup>7</sup> Rarely, the biceps femoris' long head is also impacted. Lax medial structures (particularly MCL) can add to the deformity.<sup>8</sup>

Additionally, these abnormalities have the potential to lead to patellar lateral subluxation and tibial external rotation. Valgus correction during total knee replacement is a difficult undertaking because of all these surrounding elements, which coexist at varying degrees of severity. Valgus knee on standing Anterior posterior radiography of the knee is present in nearly 4–5% of the population. 80% of cases of valgus knee are grade-I deformities, 15% are grade-II deformities, and only 5% of valgus knees are grade-III deformities.<sup>9</sup>

The aim of this study is to evaluate the radiological and functional outcome of total knee arthroplasty in valgus knee deformity. The purpose of the study was to assess clinical outcomes with the Knee Society score, Visual Analog Pain Scale, and radiological outcome with Hip-Knee-Ankle Axis (HKA) to look for the alignment correction following a total knee replacement.<sup>10–12</sup>

## 2. Materials and Methods

A total of 40 total knee replacement procedures performed for osteoarthritis knee or rheumatoid knee in 30 patients were studied prospectively in the current study. Patients aged > 45 years with osteoarthritis or rheumatoid arthritis of the knee undergoing TKR were included. The patients with less than 6 months of follow-up, revision total knee arthroplasty, previous supracondylar femur fracture, post-high tibial osteotomy or who were not willing to participate or did not come for follow-up were excluded. The evaluation and documentation of the preoperative deformity status of knee, range of movements of knee, patient's activity level, functional ability and pain assessment were done. A detailed knee examination was performed including important parameters like knee range of motion, fixed flexion deformity if any, valgus deformity correctable or not, and valgus angle was measured using a goniometer. Bilateral knee AP (standing) and lateral x-rays and Hip-knee-ankle radiographs were taken to quantify

the mechanical and anatomical tibiofemoral angle, the mechanical medial proximal tibial angle (mMPTA), the mechanical lateral distal femoral angle (mLDFA), and the joint line convergence in order to assess the deformity radiologically prior to surgery.<sup>13</sup> Correction of valgus deformity after induction is checked.

Decision of implant selection for the procedure was taken considering preoperative stability of knee and existing deformity of knee and incision was anterior midline or anterolateral was used for all the patients. The posterior stabilized implants for TKA in valgus knee were used generally but in severe valgus deformity with mediolateral instability, a higher constrained implant was used. Use of bone cement and Patellar resurfacing was done in all patients. For the deformity correction as required basic soft tissue release was performed.

These patients were followed up at the time of stitch removal, at 6 weeks, 3 months, 6 months and final follow up at 1 year post-operatively. At every follow up visit through clinical examination was performed to check presence of any residual flexion deformity of knee, laxity, extensor lag of knee, deformity and any patellar complains.

For the clinical outcome Knee Society Score (Knee score and functional score) and visual analogue score in preoperative and postoperative valgus knee deformities were evaluated. Radiological assessment was done using Antero-posterior, lateral and skyline view radiographs at time of follow up post 3 months and were checked for femoral notching, femoral or tibial component loosening or malalignment.

## 3. Results

The current study included 30 patients on basis of inclusion and exclusion criteria having valgus knee deformity whom underwent total knee arthroplasty and were follow-up for 1 year. Out of total 30 patients, 10 patients were having bilateral knee involvement and total knee arthroplasty were performed in bilateral knees at same sitting for all of those patients and so 40 total knee arthroplasty procedures were included in current study. Understanding demographic distribution of 21 patients were female (70%) compared to 9 males (30%). The mean age of study population were 64.37 years and mean body mass index was 26.92 kg/m<sup>2</sup>. Regarding comorbidities hypertension was associated in 50% of study population followed by diabetes mellitus amounting 22.5%. ASA grading suggesting majority of patient were having grade II score in 22 patients (73%) followed by grade I in 5 patients (16%), grade III in 3 patients (10%) and no patients in grade IV. In current study 35 knees had grade 1 valgus deformity while 5 knees had grade 2 valgus deformity according to Ranawat classification. Regarding the approach of procedure, 38 TKA were performed using a medial parapatellar approach and 2 TKA were performed using an anterolateral approach.

A PS type of implant design was used in 38 TKA and 2 TKA were performed using a CCK implant design.

Pain was assessed using Visual Analogue Scale and suggesting average VAS score pre-operative was  $5.30 \pm 0.96$ . Significant difference was seen between VAS scores post operatively at 1 year as compared to VAS scores recorded preoperatively with a p value of  $<0.0$ . The average KSS knee score pre- operative was  $54 \pm 7.60$ . Significant difference was seen between KSS knee scores post operatively at 1 year ( $92.02 \pm 2.55$ ) with a p value of  $<0.01$ . The average KSS functional score pre-operative was  $52.07 \pm 5.56$ . Significant difference was seen between KSS knee scores post operatively at 1 year ( $86.97 \pm 2.66$ ) with a p value of  $<0.01$ .

Anatomical and mechanical radiological alignment was assessed pre and post operatively. The average anatomical radiological alignment was pre-operatively  $9.7 \pm 2.61$  and post operatively  $6.25 \pm 0.43$  showing significant improvement with a p value of  $<0.00$ . The mechanical radiological were also assessed showing similar findings as pre-operative mechanical alignment was  $6.35 \pm 261$  and improved significantly at post operatively  $1.22 \pm 1.04$  with a p value of  $<0.00$ . The preoperative and post operative values of mLDFA and mMPTA showing significant difference preoperatively and postoperatively as well (Tables 1 and 2).

**Table 1:** Comparison of pre and post operative dLFA

	mDLFA	Z Value	p Value
Pre-Op	$84.61 \pm 0.64$	-5.51	$<0.01$
Post Op	$87.45 \pm 0.28$		

**Table 2:** Comparison of pre and post operative mMPTA

	mMPTA	Z Value	p Value
Pre-OP	$88.39 \pm 1.01$	-3.50	$<0.01$
Post OP	$87.65 \pm 0.24$		

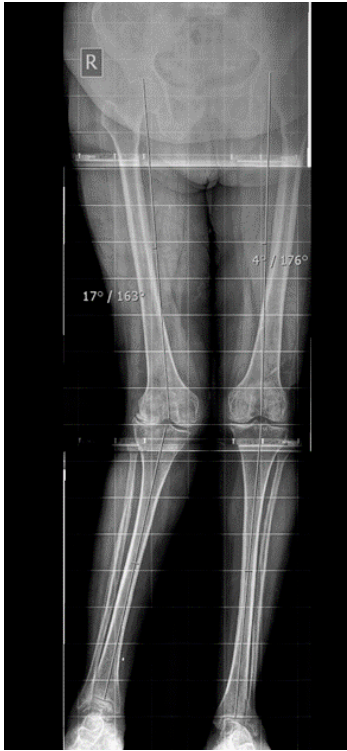
There was no intraoperative complications. There were no cases of infection found and no requirement of revision in any case at final follow up. Deep vein thrombosis (DVT) is considered to be a common complication of total knee replacement but no single such case was seen during the study attributed to early mobilization of patient and vigorous physiotherapy started from post-op day 1. Periprosthetic fractures occur intra-operative in patients with older age, female sex and patients with osteoporotic bone and as a result of surgical insult. Though, there is no such intraoperative complication occurred in this study. No case of arterial or nerve palsy was seen during the study.

4. Discussion

Valgus knee deformity is a challenge in total knee arthroplasty. This deformity described as anatomic valgus angle  $>100$  is observed in 10% of patients undergoing TKA.<sup>14</sup> Literature suggests that total knee replacement in



**Figure 1:** Clinical image of valgus deformity of knee



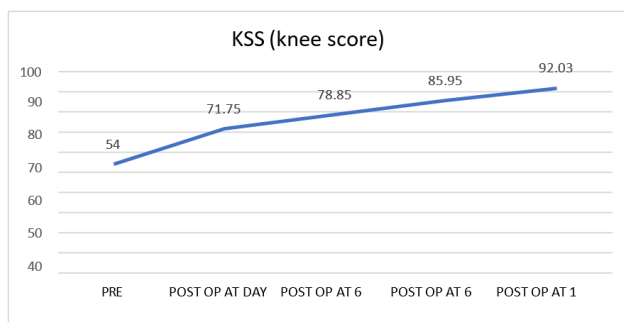
**Figure 2:** Post operative scanogram showing valgus deformity



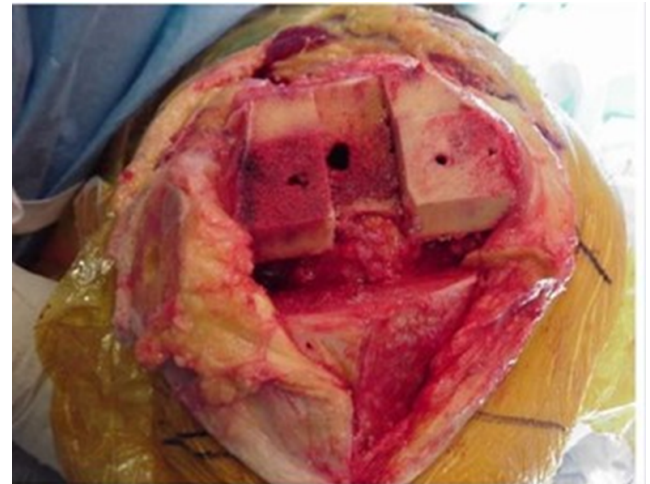
**Figure 3:** Post operative scanogram showing deformity correction



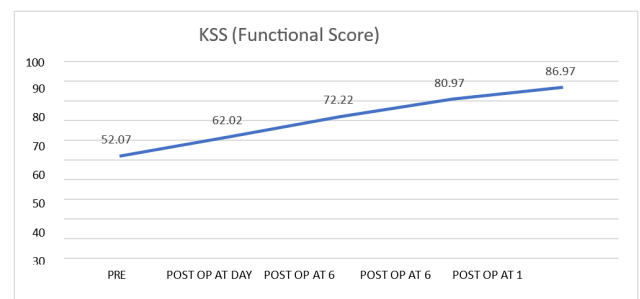
**Figure 4:** Anterior midline incision



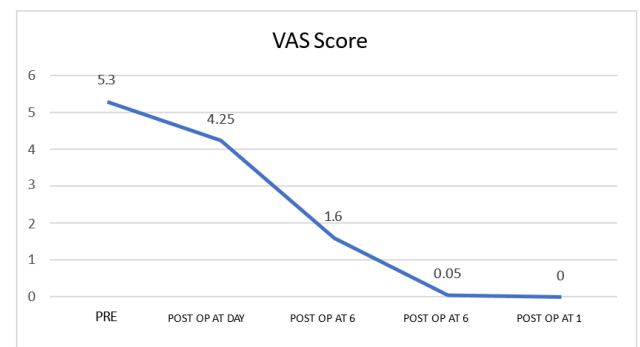
**Graph 1:** Comparison of trend of post-operative KSS (knee score) at different time interval



**Figure 5:** Intraoperative bone cut image



**Graph 2:** Comparison of trend of post-operative KSS (functional score) at different time interval



**Graph 3:** Comparison of trend of post-operative VAS at different time interval

valgus knees have significantly improved the functional outcome and the quality of life like pain relief, deformity correction and increased mobility. A well-positioned implant with a stable construct and restoring the normal mechanical axis of the limb and joint line have shown to have important outcome in total knee replacement.

The current study is a prospective study involving 30 patients with valgus knees underwent total knee arthroplasty aimed to assess the clinical and radiological outcomes of TKA in patients with valgus knees using Knee Society score and scanogram. Results showed that functional and radiological outcomes improved post-operatively for all knees undergoing valgus deformity correction. However, slow progress was observed in patients with Rheumatoid arthritis. The final follow-up outcomes were similar to those without Rheumatoid arthritis, supporting the hypothesis that significant improvement in clinical and radiological outcomes is expected.

The current study is comparable to previous literature showing females found to be higher in number to undergo TKA when compared to males. Male female ratio in TKA in Valgus knee in current study is 9:21 where as in P. Boyer et al.,2009<sup>15</sup> study is 7:56 where is in Ranawat et al.,2005<sup>16</sup> study it is 8:27.

Mean age in current study is 64.37 as compared to 69.4 in P. Boyer et al,2009; 69 in Ranawat et al,2005. 8 patients (26%), undergoing TKA, were noted in the age groups of 51 to 60 years. 19 patients (63%), undergoing TKA were noted in the age group of 61 to 70 years. 2 patients (6.6%) were seen in the age group of 71-80 years, followed by 1 patient (3.3%) in the age group of >80 years. Mean age of the patients undergoing bilateral TKA was noted to be 64.37  $\pm$  6.3 years with minimum to maximum range of 59 to 83 years of age of patients, which is comparable with previous studies.

The mean BMI of patients in current study was 26.92 kg/m<sup>2</sup>. This states the association of higher BMI and obesity playing as a risk factor for OA knee.

Prevalence of Rheumatoid Arthritis in TKA operated with valgus deformity in current study is 26.66% (8 out of 30) where as in P. Boyer et al.,2009 study is 30.3% (20 out of 66) where as in Ranawat et al., 2005 study it is 28.1% (20 out of 71). This data suggests that about one third of valgus knee deformity is contributed by rheumatoid arthritis.

The medial para-patellar approach was used in 38 knees having valgus knee whereas P. Boyer et al.,2009 has used lateral approach in 63 patients with valgus knee. The KSS knee score in current study improved from 54 to 92.02 and KSS functional score from 52 to 87 where as in P. Boyer et al.,2009 the KSS knee score improved from 37 to 91 and KSS functional score improved from 34 to 81 showing no significant difference in both the approaches in the form of KSS score outcome but lateral parapatellar approach is more technically demanding. In current study, lateral parapatellar approach used in 2 of our patients with severe valgus

deformity with fixed flexion deformity in which required more extensive soft tissue release. The functional outcome was initially slow but improved eventually over the period of one year in this group of patients.

In the current study, pie crusting technique is used if desired correction not gained then sequential release of soft tissue from posterolateral side in the form of posterolateral capsule followed by ITB followed by popliteus followed by lateral head of Gastrocnemius release. In P. Boyer et al.,2009 study they used direct lateral incision so sequence of release is ITB followed by LCL followed by popliteus followed by PLC release whereas Ranawat et al.,2005 used pie crusting technique from inside to outside.

In the study done by Tew and Waugh suggests that a postoperative tibiofemoral angle near 7° valgus will contribute to, the highest continuing success rate. In current study, the mean preoperative valgus was significantly improved from 9.7 $\pm$ 2.61 to the postoperative valgus of 6.25 $\pm$ 0.43. So, there is less chance for the failure of components to occur. In the current study, all 30 patients had the femoral component alignment ranges from 6° to 7° valgus to the long axis of the femur with the maximum number of patients having 6° valgus and showing better KSS at postoperative follow-up. The mean mL DFA is 84.61 $\pm$ 0.64 (range 85 to 90) and mean mMPTA is 88.39 $\pm$ 1.01 (range 85 to 90) suggestive of femoral based valgus deformity.

## 5. Conclusion

The present study concluded that performing total knee arthroplasty in patients with valgus knee using PS implant and medial parapatellar approach showed excellent functional outcome in the form of pain relief, increased range of motion, restoration of normal function and less chances of patellofemoral complications and restoration of normal mechanical axis. Postoperatively, patients attained normal radiographic alignment like femorotibial angle. Correct positioning of the components axially and rotationally improves both the functional and radiological outcome.

## 6. Source of Funding

None.

## 7. Conflict of Interest


None.

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