

Outcome Of Total Knee Arthroplasty in Patients of Osteoarthritis with Varus Deformity

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ABSTRACT:

Varus deformity is a communal manifestation of advanced knee osteoarthritis and presents technical challenges during TKA (Total Knee Arthroplasty) because of soft-tissue and altered limb alignment imbalance. This prospective observational study evaluated the functional and radiological outcomes of primary TKA in 30 patients with osteoarthritis and varus deformity treated at a tertiary care centre between July 2024 and March 2026. Functional outcome was assessed using the Oxford Knee Score (OKS), while radiological evaluation included postoperative limb alignment, component positioning, implant stability, and complications. Patients were followed for 12 months after surgery. The mean OKS improved significantly from 17.11 ± 3.42 preoperatively to 44.50 ± 2.63 at the final follow-up ($p < 0.001$), indicating substantial improvement in pain relief and knee function. Neutral mechanical alignment was achieved in 86.7% of patients, with only three patients demonstrating mild residual varus and one patient showing residual varus greater than 5° . No patient developed valgus overcorrection, and radiographs confirmed stable implant fixation without loosening or component failure. Only one superficial wound infection was observed, with no deep infections, thromboembolic events, implant failures, or revision surgeries. Primary TKA is a safe and effective procedure that provides reliable deformity correction, excellent functional recovery, favourable radiological outcomes, and improved quality of life in patients with varus osteoarthritis.

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1. Introduction

Osteoarthritis (OA) is the most prevalent chronic degenerative joint disease worldwide, and a leading cause of pain, physical disability and diminished quality of life, especially in older people. Progressive degeneration of the articular cartilage, remodeling of subchondral bone, formation of osteophytes, synovial inflammation and periarticular tissue changes all contribute to a reduction in joint function and structure (Lories & Luyten, 2011). Over the past few decades, the prevalence of OA has significantly risen around the world, as a result of longer life expectancy, obesity, and sedentary lifestyle of older people. Consequently, OA is now a key public health issue, and the clinical, economic and social burden of OA is an important burden on healthcare systems globally. Radiographic evidence of OA indicates joint degeneration, but there is a poor correlation between imaging findings and clinical symptoms; many people show extensive radiographic evidence of OA without clinical symptoms and others may have relatively mild radiographic changes with significant clinical symptoms (Lories & Luyten, 2011). Therefore, structural and patient reported outcomes (PRO) are necessary to assess disease severity and efficacy of therapy.

Knee OA is the most common site of OA, and is a significant source of disability due to its role in weight-bearing and mobility. As the knee joint breaks down, it becomes painful, less flexible, affected by range of motion, walking ability and daily activities decrease. The burden of knee OA is especially large in developing countries like India, where the unique occupational activities of squatting, kneeling, climbing stairs and manual labor are still prevalent, and will hasten the degenerative changes in the joint. Further, demographic ageing has led to a progressive increase in the number of patients who need to undergo surgery for advanced knee OA. Advanced disease often presents with significant pain, narrowing of the joint space, the development of osteophytes, deformity, functional impairments and loss of independence and quality of life, especially in women (Lories & Luyten, 2011).

Once conservative treatments have failed to provide sufficient pain relief or function, Total Knee Arthroplasty (TKA) has emerged as the treatment of choice for end-stage knee OA. Since the advent of the total condylar knee prosthesis, considerable improvements have been made in the design of implants, biomaterials used for manufacture, surgical techniques, instruments, and peri-operative rehabilitation, which have turned TKA into one of the most successful reconstructive procedures in current orthopaedics (Insall et al., 1976; Murray, 1991; Ranawat, 2002; Gkiatas et al., 2022). Contemporary TKA consistently achieves significant pain relief, functional mobility, enhanced quality of life and excellent long-term implant survivorship in the proper patient (Lombardi Jr et al., 2009; Lützner et al., 2011). In addition, improvements in the surgical technique, such as the medial parapatellar and subvastus approaches, have resulted in better postoperative recovery and acceptable functional results (Khan et al., 2021).

Varus deformity is the most common angular deformity seen in advanced knee OA and may pose unique technical challenges for TKA. As progressive medial compartment cartilage loss occurs, the mechanical load shifts across the medial side of the knee leading to ligament imbalance, bone loss, flexion contracture and progressive deformity. When dealing with severe varus deformities, careful preoperative planning, precise bone cuts, and proper soft tissue management and restoration of limb alignment are essential to attain satisfactory clinical results, and ultimately, long-term stability. Previous studies have shown that patients with severe varus deformity could obtain the same postoperative results as patients with less severe deformities with proper surgery (Karachalios et al., 1994; Teeny et al., 1991). Likewise, a series of later studies showed that the degree of varus deformity preoperatively is not a negative factor on functional outcomes after posterior-stabilized TKA if the deformity can be properly corrected and soft tissue balancing performed (Mullaji et al., 2005; Lee et al., 2011). These results show that good management is more a question of

surgical accuracy than of the size of the deformity.

There is a need for reliable self-report patient-reported outcome measures (PROMs) that can measure improvement in pain, mobility, and functional performance. Of these, the OKS has become widely used due to its simplicity, validity, responsiveness, and capacity to capture patients' perspectives on functional recovery after TKA. Other validated instruments like the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Knee Injury and Osteoarthritis Outcome Score (KOOS) are important and useful for assessing knee function, however, OKS is one of the most commonly used outcome measures in arthroplasty research because of its sensitivity to clinically meaningful changes after surgery (Bellamy et al., 2002; Roos & Toksvig-Larsen, 2003; Boonstra et al., 2008). However, patient-reported improvement in conjunction with radiologic assessment is still important to assess the overall success of TKA in patients with a varus deformity.

Although there has been tremendous improvement in the surgical management of TKA, in many tertiary centres in India information on the combined functional and radiological results of TKA in patients with varus deformity is limited. The importance of prospective data collection within a particular institution is for assessing postoperative recovery, implant alignment, complication rates, and satisfaction rates within the local population. Hence this prospective study was conducted to measure the functional and radiological outcomes of TKA performed in patients with OA and varus deformity in a tertiary care centre in Chennai by using serial OKS, radiological alignment and clinical outcome after TKA at one year follow up.

Research Objectives

- To evaluate the functional outcomes of total knee arthroplasty in patients with osteoarthritis and varus deformity using the Oxford Knee Score.

- To assess the radiological outcomes and prosthesis alignment following total knee arthroplasty.

- To determine the postoperative complications and overall clinical outcomes during the one-year follow-

2. Methodology

2.1 Study Design and Setting

From July 2024 to March 2026, the “Department of Orthopaedics” at “Sree Balaji Medical College and Hospital (SBMCH)”, Chennai, conducted prospective observational cohort research. The functional and radiological outcomes of primary TKA in patients with osteoarthritis (OA) and varus deformity were studied in this study. The Institutional Ethics Committee granted ethical permission prior to enrollment, and all procedures were carried out in compliance with the Declaration of Helsinki (2013 revised). Prior to surgery and study inclusion, each individual provided written consent.

2.2 Study Population

Using a convenience sampling approach, 30 patients undergoing primary TKA consecutively were enrolled during the study period. Males and females aged 50–80 years with symptomatic unilateral and bilateral knee OA who had clinically and radiologically documented varus deformity which was affecting their daily activities despite optimal conservative care of the knee were eligible. Grade III or IV of the “Kellgren–Lawrence” classification was used for the radiographic severity. Patients who suffered from inflammatory arthropathies, rheumatoid arthritis, post-traumatic arthritis, septic arthritis, valgus deformity, compromised extensor mechanism, revision TKA, medical contraindications to surgery, refusal to provide informed consent or inability to complete follow-up were excluded. All patients enrolled completed the planned 12-month follow-up.

2.3 Preoperative Clinical and Radiological Assessment

A thorough examination of gait, active and passive range of motion, coronal and sagittal

limb alignment, ligament stability, neurovascular examination and associated comorbidities was conducted for all participants and standardized preoperatively. To determine the disease's severity based on the "Kellgren-Lawrence" classification, anterior and lateral weight-bearing x-rays of both knees were taken. To determine mechanical axis deviation and to plan for surgery, full-length lower-limb scanograms were obtained. The OKS was used to assess functional status; this is a validated patient-reported outcome measure with 12 questions that assess pain and functional ability, with a higher score denoting better knee function (709-721). A blinded assessor conducted baseline OKS assessment prior to surgery.

2.4 Surgical Procedure and Postoperative Rehabilitation

All procedures were performed or supervised by experienced arthroplasty surgeons with a standardized surgical technique. After limb exsanguination and inflation of the tourniquet, a standard midline incision and medial parapatellar arthrotomy was performed to expose the knee joint. Distal femoral resection was performed using intramedullary alignment guide with 5°–6° valgus; proximal tibial resection was done with extramedullary guide perpendicular to the mechanical axis at a posterior slope of 3°–5°. The femoral rotational alignment was established using the posterior condylar axis and verified using Whiteside's line and the trans epicondylar axis. To restore an equal flexion and extension gap, the soft tissues in the medial compartment were sequentially released as needed. All patients received cemented posterior-stabilized prostheses and layered closure of the wound with a suction drain. All patients received a second-generation cephalosporin for 24 hours and low molecular weight heparin for 14 days postoperatively following the institutional protocol. Quadriceps strengthening exercises and ankle-pumping exercises commenced on the day of surgery and assisted ambulation was started on the first postoperative day. Starting on the second postoperative day, complete weight bearing was allowed as tolerated. After 48 hours, suction drains were taken out, and patients with

satisfactory wound evaluations were released between 5 and 7 days after surgery. Follow-up assessments were carried out at 1, 3, 6, and 12 months following surgery.

2.5 Outcome Measures and Statistical Analysis

The main outcome was functional improvement, as determined by the Oxford Knee Score preoperatively and at the follow-up visits after surgery. Secondary outcomes were radiological evaluation of the alignment of the prosthesis, position of the components, cement mantle quality, implant stability and presence of loosening/sub-sidence. During the follow-up period, postoperative problems were documented, including wound complications, periprosthetic infection, thromboembolic events, periprosthetic fracture, or implant-related issues. The data was analyzed using SPSS version 25.0. Continuous variables were presented as mean $\pm$ standard deviation while categorical variables were presented as frequency and percentage. The paired t-test was used in the analysis of the difference between the baseline and follow-up assessment (Oxford Knee Scores), and a subgroup analysis was conducted for those with Kellgren–Lawrence Grade IV OA. A two-tailed p-value of <0.05 was considered statistically significant.

3. Results

3.1 Baseline Demographic and Clinical Characteristics

Table 1 summarizes the study population's baseline clinical and demographic features. The cohort's mean age was 62.96 ± 8.15 years, with 16 men (53.3%) and 14 females (46.7%).

The age group of the patients (709-721 years) had the highest number (43.3%). Sixteen patients (53.3%) had surgery on the left knee and 14 patients (46.7%) had surgery on the right knee. Advanced osteoarthritis was the most common (26 patients—86.6%—Kellgren–Lawrence Grade IV and 4 patients—13.4%—Kellgren–Lawrence Grade III). The most frequent presentation was moderate varus deformity (10° - 20°) (60.0%), followed by mild (20.0%) and

severe (20.0%) varus deformity. The most common comorbidities documented were hypertension and diabetes mellitus consistent

with the common clinical profile of patients undergoing TKA.

Table 1. Baseline demographic and clinical characteristics of the study population (n = 30).

Characteristic	Category	n	%
Gender	Male	16	53.3
	Female	14	46.7
Age group (years)	51–60	12	40.0
	61–70	13	43.3
	>70	5	16.7
Operative side	Left	16	53.3
	Right	14	46.7
Kellgren–Lawrence grade	Grade III	4	13.4
	Grade IV	26	86.6
Varus deformity	Mild (5° – $<10^{\circ}$)	6	20.0
	Moderate (10° – 20°)	18	60.0
	Severe ($>20^{\circ}$)	6	20.0

3.2 Functional Outcome Following Total Knee Arthroplasty

Consistently better functional recovery was seen in the post-operative period (Table 2). The mean Oxford Knee Score increased from 17.11 ± 3.42 before surgery to 28.40 ± 4.11 at one month, 35.60 ± 3.87 at three months, 40.80 ± 3.14 at six months, and 44.50 ± 2.63 at the final 12-month evaluation. The overall mean was a 27.39-point improvement from baseline which was

significantly greater than the Oxford Knee Score's least clinically significant variation.

The most marked improvement was in the first three postoperative months, followed by a slower but steady rate of improvement until the end of follow-up. There was significant functional improvement at each postoperative evaluation relative to the preoperative baseline (all $P < 0.001$), supporting the large amount of functional recovery that occurs after TKA.

Table 2. Functional outcome measured using the Oxford Knee Score during follow-up (n = 30).

Follow-up interval	Mean OKS $\pm$ SD	Mean improvement from baseline	<i>p</i> -value
Preoperative	17.11 ± 3.42	—	—
1 month	28.40 ± 4.11	+11.29	<0.001
3 months	35.60 ± 3.87	+18.49	<0.001
6 months	40.80 ± 3.14	+23.69	<0.001
12 months	44.50 ± 2.63	+27.39	<0.001

3.3 Radiological Outcomes and Postoperative Complications

Radiological evaluation at 12 months has shown good restoration of lower-limb alignment in most patients (Table 3). Twenty-six patients (86.7%) had neutral mechanical alignment of less than or equal to 3° varus or valgus, three patients (10.0%) had mild residual varus alignment, and one patient (3.3%) had more than 5° residual varus alignment. Notably, none of the patients experienced valgus overcorrection. The serial post-operative radiograms showed that the

femoral and tibial components were in a stable position and there was no unilateral loosening, subsidence, cement mantle defect or implant failure. The low complication rate was also observed in the clinical follow up. One patient (3.3%) was treated for a superficial wound infection without complications and the condition cleared up completely after the wound was cared for and antibiotic treatment. Over the study period there were no deep infections, thromboembolic events, fractures of the periprostheses or revision procedures.

Table 3. Radiological and clinical outcomes at the 12-month follow-up (n = 30).

Outcome	n	%
Neutral alignment ($\pm 3^\circ$)	26	86.7
Residual varus (3° – 5°)	3	10.0
Residual varus ($>5^\circ$)	1	3.3
Component loosening	0	0.0
Implant failure	0	0.0
Cement mantle deficiency	0	0.0
Superficial wound infection	1	3.3
Deep infection	0	0.0
Revision surgery	0	0.0

3.4 Representative Clinical Cases

A total of three representative cases are demonstrated to show the clinical and radiographs results after primary total knee arthroplasty for the varus deformity (Table 4). Case 1 was a 70-year-old man with bilateral osteoarthritis, and with the varus deformity being the predominant deformity on the left, underwent left TKA. Case 2 was a 56-year-old female, who presented with severe right-sided varus deformity for right TKA. A 64-year-old woman with bilateral osteoarthritis and right varus deformity underwent right TKA for case 3.

Pre-operative X-rays and scanograms revealed that all three patients had advanced degeneration of the medial compartment with marked coronal plane malalignment. Immediate postoperative imaging showed correct positioning of the implants and correct restoration of mechanical alignment, and the serial follow-up radiographs showed that there was no implant loosening or migration. Postoperative clinical photographs also revealed correction of the varus deformity, well-healed surgical wounds, and restoration of complete knee extension with good flexion, in keeping with the good functional results noted in all patients.

Table 4. Summary of representative clinical cases demonstrating correction of varus deformity following total knee arthroplasty.

Case	Patient characteristics	Operative knee	Key preoperative findings	Twelve-month outcome
Case 1	70-year-old male; bilateral OA (Left > Right)	Left	Advanced OA with approximately 10° varus deformity and medial mechanical axis deviation	Neutral alignment, stable implant fixation, corrected deformity, full range of motion
Case 2	56-year-old female; bilateral OA (Right > Left)	Right	Severe varus deformity with combined femoral and tibial malalignment	Restored mechanical alignment, stable prosthesis, excellent functional recovery
Case 3	64-year-old female; bilateral OA	Right	Advanced OA with marked varus deformity and medial compartment collapse	Maintained implant stability, corrected alignment, excellent postoperative knee motion

4. Representative Case Illustrations

4.1 Case 1

Primary left total knee arthroplasty was performed on a 70-year-old man had varus deformity, which was more noticeable on the left knee, and bilateral osteoarthritis. Preoperative radiography revealed progressive tricompartmental osteoarthritis with significant medial joint space narrowing compartment (Figure a), and clinical examination revealed left sided varus deformity (Figure b). Full-length standing scanogram showed medial mechanical axis deviation, decreased mLDFA and MPTA,

increased JLCA and tibiofemoral varus angle of 10°, which were indicative of significant deformity (Figure c). Postop X-rays showed acceptable implant placement and restoration of the limb alignment (Figure d). Radiographic analysis showed that the mechanical axis was corrected with good component orientation. Radiographs at 12 months showed stable and well-fixed prosthesis without loosening or subsidence (Figure e). Clinical evaluation showed varus correction, good healing of the surgical incision, and full flexion/extension of the knee, signifying excellent functional recovery (Figure f).

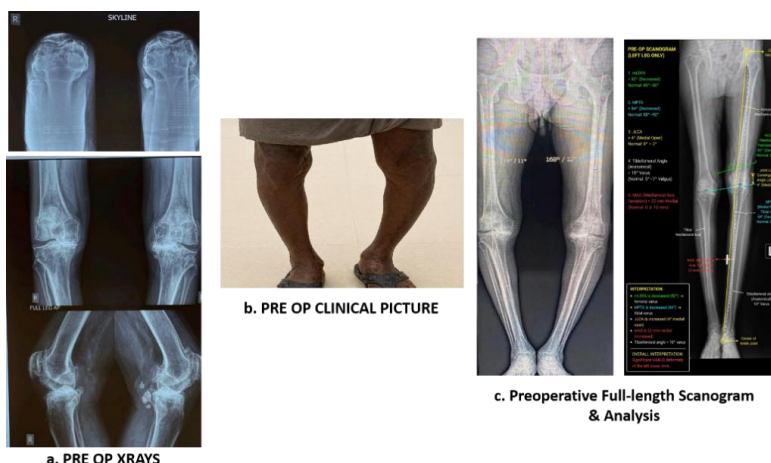




Figure 1. Preoperative and postoperative evaluation of Case 1 (70-year-old male with bilateral osteoarthritis and left-sided varus deformity undergoing left TKA).

(a) Anteroposterior weight bearing, lateral, and skyline radiographs demonstrating advanced bilateral knee osteoarthritis with severe medial compartment degeneration, osteophyte formation, and varus deformity, more pronounced in the left knee. (b) Preoperative clinical photograph showing marked left-sided varus deformity in the standing position. (c) Full-length standing scanogram with mechanical axis analysis demonstrating medial mechanical axis deviation, decreased mLDFA and MPTA, increased JLCA, and an anatomical tibiofemoral varus angle of 10° , confirming significant left lower-limb varus deformity. (d) Immediate postoperative anteroposterior and lateral radiographs demonstrating satisfactory positioning of the cemented total knee prosthesis. (e) Postoperative radiographic analysis confirming restoration of mechanical alignment, appropriate component positioning, and correction of the varus deformity. (f) Twelve-month postoperative clinical photographs demonstrating a well-healed surgical incision, corrected lower-limb alignment, full knee extension, and satisfactory knee flexion with excellent functional recovery

4.2 Case 2

Primary right total knee arthroplasty was

performed in a 56-year-old woman with bilateral knee osteoarthritis who had a more significant varus deformity on the right. Preoperative radiographs showed advanced tricompartmental osteoarthritis with significant medial compartment constriction of the joint space and osteophyte development and varus deformity was more marked in the right knee (Figure a). An obvious right-sided varus alignment was noted on clinical examination (Figure). Standing scanogram (full length) revealed the existence of medial mechanical axis deviation, mLDFA of 78° , MPTA of 72° , and JLCA of 14° , which indicated that the varus deformity of the right knee was severe (Figure c). Early postoperative X-rays revealed a well-positioned implant with the lower leg realigned (Figure a). Postoperative analysis showed correction of the mechanical axis and correct alignment of the components (Fig. b). The 12-month follow-up radiographs showed that the prosthesis was well fixed and stable without signs of loosening or subsidence (Figure a). On clinical assessment, varus deformity was corrected, surgical incision was well-healed and knee flexion was satisfactory with no restriction in full extension (excellent functional recovery) (Figure b).

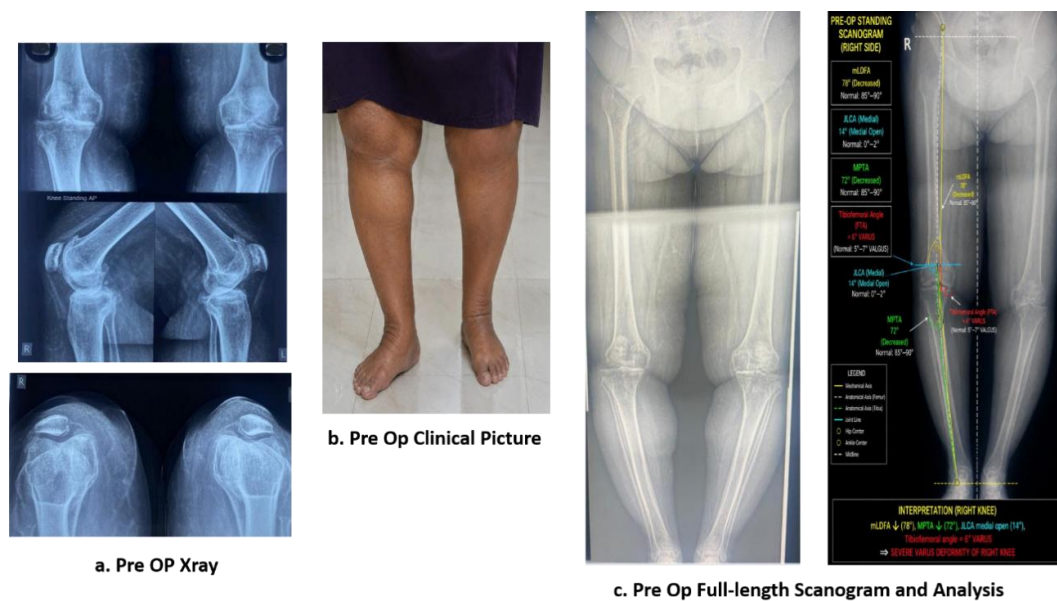


Figure 2. Preoperative evaluation of Case 2 (56-year-old female with bilateral osteoarthritis and right-sided varus deformity). (a) Weight-bearing anteroposterior, lateral, and skyline radiographs demonstrating advanced bilateral knee osteoarthritis with severe medial compartment joint-space narrowing, osteophyte formation, subchondral sclerosis, and varus deformity, more pronounced in the right knee. (b) Preoperative clinical photograph demonstrating obvious right-sided varus deformity in the standing position. (c) Full-length standing scanogram with mechanical axis analysis demonstrating medial deviation of the mechanical axis, decreased mechanical lateral distal femoral angle (mLDFA, 78°), decreased medial proximal tibial angle (MPTA, 72°), increased joint line convergence angle (JLCA, 14°), and an anatomical tibiofemoral varus angle of 6°, confirming severe right knee varus deformity.

4.3 Case 3

The patient was a 64 yrs old female with bilateral knee osteoarthritis and marked varus deformity at the right knee who underwent primary right total knee arthroplasty. Pre-op X-rays showed advanced tricompartmental arthritis with significant narrowing of the medial compartment joint space and varus deformity (Figure a). Clinical examination revealed an obvious right-sided varus alignment (Figure b). Standing scanogram showed a medial mechanical axis deviation, decreased mLDFA (77°), decreased MPTA (75°), and increased JLCA (12°), suggesting severe right knee varus (Figure c).

Postoperative X-rays taken immediately after surgery showed that the implant was properly placed and the lower limbs were aligned (Figure a). Post-op analysis showed correction of the mechanical axis and correct alignment of the components (Figure b). Radiographs at 12-month follow-up showed no evidence of prosthesis loosening or subsidence with a stable and well-fixed prosthesis (Figure a). The varus deformity was corrected, the surgical incision was well healed and good function of the knee with full extension and flexion was clinically achieved (excellent functional recovery) (Figure b).

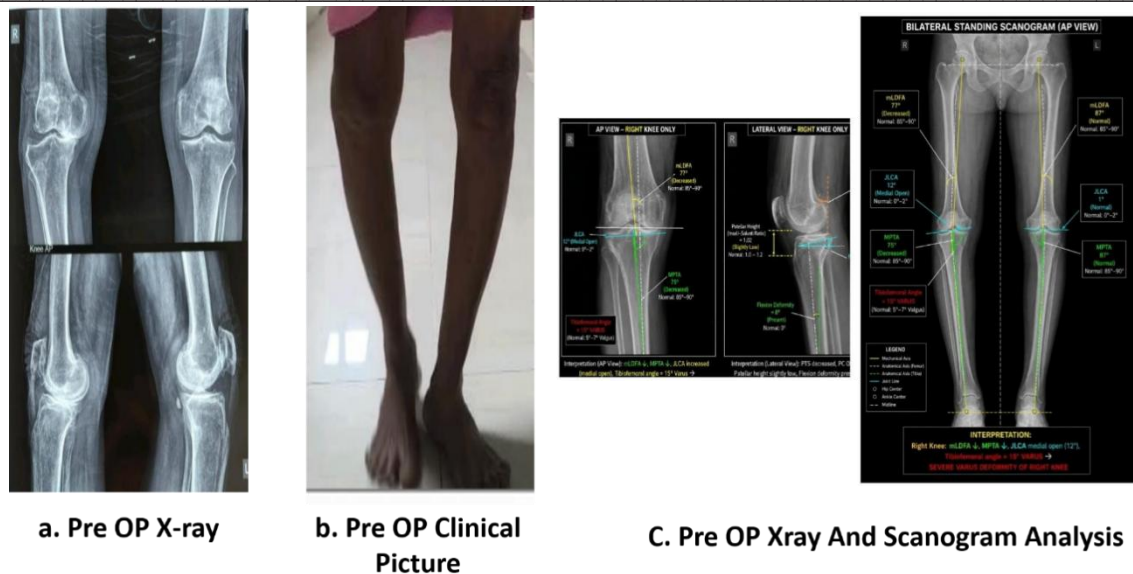


Figure 3. Preoperative evaluation of Case 3 (64-year-old female with bilateral osteoarthritis and severe right-sided varus deformity). (A) Weight-bearing anteroposterior and lateral radiographs demonstrating advanced bilateral knee osteoarthritis with severe medial compartment joint-space narrowing, osteophyte formation, and varus deformity, more pronounced in the right knee. (B) Preoperative clinical photograph demonstrating marked right-sided varus deformity in the standing position. (C) Full-length standing scanogram with deformity analysis demonstrating medial mechanical axis deviation, decreased mechanical lateral distal femoral angle (mLDFA, 77°), decreased medial proximal tibial angle (MPTA, 75°), increased joint line convergence angle (JICA, 12°), and an anatomical tibiofemoral varus angle of 15°, confirming severe right knee varus deformity

5. Discussion

The present prospective study showed that in patients with osteoarthritis complicated by a varus deformity, primary total knee arthroplasty was associated with excellent functional recovery, a satisfactory restoration of the lower-limb alignment, and a low complication rate. This study population was mostly patients with advanced Kellgren–Lawrence Grade IV OA and moderate varus deformity who are the typical clinical presentation of patients requiring arthroplasty. Even in the advanced stage of the disease, patients had significant improvement in pain and knee function after surgery, supporting the use of TKA as the treatment of choice in end-stage varus OA. This is in line with the existing literature showing that TKA has a good reliability in improving functional outcomes in patients with a pre-operative varus deformity if correct deformity correction is combined with adequate soft tissue balancing (Vandekerckhove et al., 2016).

One important observation in the present study was progressive improvement with regards to Oxford Knee Scores during the follow-up period. The mean score rose from a preoperative level of 17.11 to 44.50 at 12 months, which was more than the minimal clinically important difference and was clinically important. The highest levels of functional recovery were seen in the first three postoperative months, and further recovery was seen until final follow-up. This is consistent with the systematic review and meta-analysis by Wan et al. (2022), who found that patients with varus OA who undergo TKA can obtain significant postoperative functional benefits from both neutral mechanical alignment and mild residual varus alignment (Wan et al., 2022). The observed, consistent improvement in functional scores in the present study further suggests that good restoration of joint mechanics, along with uniform rehabilitation, has a positive effect on long-term recovery in the

first postoperative year.

Radiological evaluation revealed restoration of neutral mechanical alignment in 86.7% of patients, with three patients having mild residual varus alignment and one having a residual varus alignment $> 5^\circ$. Importantly, no patient had valgus overcorrection and during follow-up all the implants remained radiographically stable without signs of loosening, subsidence or component failure. These results are indicators of the success of thorough preoperative planning, careful bone resections and sequential soft-tissue balancing to achieve desired coronal alignment. In addition, recent evidence suggests that surgeons should be cautious of overcorrecting from varus to valgus as this may negatively impact the post-op knee biomechanics and patient-reported outcomes (PROs) (Gurusamy et al., 2024).

There is still significant controversy as to what the best postoperative alignment should be for a varus knee. Some studies have proposed that minimal varus may be better at reproducing the constitutional alignment without affecting clinical outcomes. Vanlommel et al. (2013) showed better functional results after slight undercorrection in patients with varus knees and Nishida et al. (2017) reported more favorable postoperative functions in patients who had residual mild varus deformity after surgery. (Vanlommel et al., 2013; Nishida et al., 2017). In a similar manner, Magnussen et al. (2011) found no difference in short-term clinical outcomes between the two groups and Zhang et al. (2020) found similar medium-term outcomes between the two groups as well (Magnussen et al., 2011; Zhang et al., 2020). In addition, recent meta-analysis showed that there were no significant differences between the functional outcomes of undercorrected (residual mild varus) and neutral alignment. (Han et al., 2022) This indicates that a slight undercorrection may be acceptable in carefully selected patients.

On the other hand, there is still no definite information on evidence that supports intentional residual varus. Meneghini et al., 2017 and Saragaglia et al., 2019 reported that there was

no clinical benefit of preplanned residual varus following TKA, and there was no clear benefit of slight residual varus in patients with severe varus preoperatively (Meneghini et al., 2017; Saragaglia et al., 2019). The results of the present study corroborate this evidence in a balanced manner. Neutral position was obtained for most of the patients, while the number of patients with mild varus had satisfactory functional recovery; this was not complicated by implant-linked complications up until the first postoperative year. Thus, restoring a well-balanced knee, whilst maintaining stable fixation of the components, seems to be more important than obtaining a rigid alignment target in every patient.

Low rates of complications were also found in the present study and further support the safety and efficacy of primary TKA in VKA. Superficial wound infection occurred in only one patient and was treated with conservative methods, no deep infection, thromboembolic events, implant loosening, periprosthetic fracture or revision surgery were encountered in the follow-up period. The good clinical and radiological results suggest that with a standardized approach to surgical technique, attention to soft-tissue balance and a structured program of postoperative rehabilitation, very good early results can be achieved in patients with advanced osteoarthritis and substantial varus deformity. The relatively small sample size, single centre design and 12 month follow up mean that it is difficult to assess long-term implant survivorship, however the data contributes to the emerging evidence that TKA is an effective procedure for correcting varus deformity whilst achieving excellent functional recovery in appropriate patients.

6. Conclusion

The functional and radiologic outcomes were excellent for primary TKA performed on patients with OA with varus deformity. Over the 12 months follow-up significant improvements were recorded in the Oxford Knee Scores following the procedure, suggesting a high level of pain relief and recovery of knee function. The surgical technique and rehabilitation protocol

were standardized and proved safe and reliable, with most patients maintaining mechanical neutrality following surgery and no revision surgery performed, and only a small number of patients experiencing postoperative complications. Patients with more advanced Kellgren–Lawrence osteoarthritis (Grade IV) also had good functional outcomes, which is important because there may be a tendency to defer surgery when advanced changes are present on the radiogram but are not clinically indicated. While a small number of these patients continued to have mild varus alignment, good clinical results were seen in the absence of implant-

related complications, and the current evidence suggests that the balance of alignment and soft tissue stability is more important than strict adherence to one alignment target. In summary, the results confirm that total knee arthroplasty is a good option for correction of a varus deformity, restoration of lower limb function, and improvement in the patient's quality of life in those with advanced knee osteoarthritis. Further studies on the long-term effects of postoperative alignment on implant survivorship and functional outcomes are needed in larger multicentre studies with longer follow-up.

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