



A Study of Factors Affecting and Outcomes in Difficult Total Knee Arthroplasty

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Abstract: *Background:* This prospective observational study was undertaken to look into the factors that affect the outcome of total knee arthroplasty and the short-term results of total knee replacements in complex knee pathologies. *Methods:* This prospective observational study was conducted between 2021 and 2023 at Owaisi Hospital and Research Centre, Hyderabad. A consecutive series of 12 total knee arthroplasties was performed on 12 patients at our institute using PFC Sigma endoprosthesis. The patients were assessed clinically and radiologically using the INSALL scoring system. *Results:* The average pre-operative range of motion (flexion) was 45°, with a highest of 120° and a lowest of 0°. The average post-operative flexion was 102°, with a highest of 130° and a lowest of 90°. The average extension lag preoperatively was 18°, and the average postoperative extension lag was less than 10°. The average pre-operative knee score was 64.84, with the highest score of 91 and the lowest score of 40. The majority of the patients had a score in the range of 51–100. The average post-operative knee score was 136.84, with the highest score of 160 and the lowest score of 120. A majority of the patients had an improvement in score in the range of 101–150. At 6 months, follow-up relief was excellent in most patients; only 10 patients had anterior knee pain, and all the patients were able to walk more than 50 blocks post-operatively without any walking aid. *Conclusion:* Determining the factors resulting in a difficult knee helps in formulating an appropriate surgical approach, which results in a better functional outcome following total knee arthroplasty.

Keywords: Total knee arthroplasty, Insall Score, TKA Outcomes.

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INTRODUCTION:

Total knee arthroplasty has shown excellent results at long-term follow-up with a small complication rate in many series during the last three decades. However, there are conditions which may affect the outcome of TKA because of the complexity of the surgery or specific states of the affected limb. When the surgeon is dealing with an unusual deformity of the bone or soft-tissue envelope around the knee, the complication rate of TKA can rise to between 5% and 41%^[1,2] which significantly affects the outcome. These conditions are relatively uncommon. The operative training of surgeons should be supported by knowledge of reports describing the specific conditions that lead to difficult procedures.

There are conditions related to the type of patient or local conditions of the knee that can make it a difficult procedure. These include patients with many previous operations and incisions, those with severe coronal deformities, genu recurvatum, a stiff knee, extra-articular deformities, those who have previously undergone osteotomies around the knee

and those with patellectomy. Each condition was analyzed according to the characteristics of the patient, the pre-operative planning, and the reported outcomes.

The goal of TKR is to provide a stable, painless knee with adequate range of motion for daily activities.^[3] The increasing number of revision procedures has led to a better understanding of the different postoperative complications. In a progressively challenging society, the necessity for optimal knee flexion following a TKR is becoming increasingly important. Understanding the kinematics regarding TKR function and how small changes influence knee function is therefore of utmost importance. A high demand to achieve deep flexion exists among our current population of patients. Stiffness is one of the most complex complications, both in terms of pathogenesis and treatment, as it represents a frustrating problem for surgeons and patients. Stiffness is defined as a limitation of ROM (Range Of Movement), often associated with persistent pain.^[4]

Age, gender, BMI, preoperative flexion contracture, preoperative ROM, valgus/varus deformity, surgical technique, type, and position of the prosthesis are just a few of the variables that affect postoperative ROM. This study also found that changes in the posterior tibial slope, proximal tibial cut angle, and posterior femoral condylar offset after surgery were linked to ROM.^[5]

This prospective observational study was therefore undertaken between 2021 and 2023 at Owaisi Hospital and Research Centre, Hyderabad, to look into the factors that affect the outcome of total knee arthroplasty and the short-term results of total knee replacements in complex knee pathologies.

MATERIALS AND METHODS

This prospective observational study was conducted between 2021 and 2023 at Owaisi Hospital and Research Centre, Hyderabad, to look into the factors that affect the outcome of total knee arthroplasty and the short-term results of total knee replacements in complex knee pathologies.

A consecutive series of 12 total knee arthroplasties was performed on 12 patients at our institute using PFC Sigma endoprosthesis. All patients were in regular follow-up. The patients were assessed clinically and radiologically using the INSALL scoring system. Patients between 40 and 80 years of age with clinically severe knee arthritis (osteoarthritis, rheumatoid arthritis, and post-traumatic arthritis) with previous surgeries, severe coronal deformities (genu varum and genu valgum), genu recurvatum, stiff knees, extra-articular deformities post-osteotomy (tibial and femoral) and post-patellectomy were included in the study. Post-operative patients were called for follow-up after one month, three months, six months and yearly thereafter. At each visit, a clinical examination was done to assess the modified INSALL score.

RESULTS

This was a prospective study conducted on 12 patients (12 knees) with knee pathologies who were treated in our institute with total knee arthroplasty between January 2021 and January 2023. All the patients were in regular follow-up with a mean follow-up duration of 6 months.

Age

The mean age of the patients at the time of surgery was 55 years (range 41 – 76 years). The majority of the patients belonged to the 51-60 years age group. (Table 1)

Age	Number of Cases
41-50	3
51-60	5
61-70	3
71-80	1

Table 1: Age Distribution

Diagnosis with Type of Difficulty

Stiff knees, varus knees and valgus knees were seen in three patients. 1 each belonged to the extra articular deformity, post-patellectomy, and post-osteotomy groups. (Table 2)

Difficulty	Number of Cases
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Stiff Knee	3
Varus Knee	3
Valgus Knee	3
Extra Articular Deformity	1
Post Patellectomy	1
Post Osteotomy	1
Table 2: Type of Difficulty	

Sex Distribution

Sex	No of Cases
Female	7
Male	5
Table 3: Sex Distribution	

As shown in Table 3, of the 12 study subjects, there were 7 females and 5 males.

Range of Motion

The average pre-operative range of motion (flexion) was 45°, with a highest of 120° and a lowest of 0°. The average postoperative flexion was 102°, with a highest of 130° and a lowest of 90°.

The average extension lag preoperatively was 18°, and the average postoperative extension lag is less than 10° (Table 4).

Pre-op ROM Flexion	No. of Cases
0	3
Up to 100	7
Up to 135	2
Absent	1
Table 4: Range of Motion	

Knee Scoring System

We used INSALL modified knee score to calculate knee scores.

Pre-Op INSALL Knee Score	No of Cases
0-50	4
51-100	8
101-150	0
151-200	0
Table 5: Pre-Op INSALL Knee Scores	

Post-Op INSALL Knee Score	No of Cases
0-50	0
51-100	0
101-150	10
151-200	2
Table 6: Postop INSALL Knee Scores	

The average pre-operative knee score was 64.84, with the highest score of 91 and the lowest score of 40. The majority of the patients had a score in the range of 51–100. The average post-operative knee score was 136.84, with the highest score of 160 and the lowest score of 120. A majority of the patients had an improvement in score in the range of 101–150.

At 6 months, follow-up relief was excellent in most patients; only 10 patients had anterior knee pain, and all the patients were able to walk more than 50 blocks post-operatively without any walking aid.

Complications

None of the patients had clinically evident DVT, surgical site infections, or cellulitis. Surgical wounds healed well in all cases; delayed wound healing was noted in three cases.

DISCUSSION

Progress in the knee implant design and the surgical techniques for total knee replacement achieved successful results in reducing pain and providing a stable joint; however, enhancing the postoperative range of motion is yet challengeable. The success of the procedure is based on pain relief and the restoration of function

The postoperative range of motion is one of the major criteria of the patient's satisfaction with the arthroplasty, where the patient needs an acceptable flexion of the knee for many of their daily activities.

Age, gender, severity of the disease, preoperative range of motion, flexion and extension lag all have a significant influence on post-operative range of motion.

Age

The mean age of the patient at the time of surgery in our study was 55 years. In a study conducted by Sancheti *et al.*, the mean age was 68.2. The authors did not find any correlation between age and ROM. Schurman *et al.* found that gain in ROM was better in younger patients at 3 months post-surgery. Franklin *et al.* reported that older age groups had a poorer outcome when compared to younger ones. Farahini *et al.* reported univariate analysis showing a good correlation ($r = 0.102$, p -value = 0.04) with post-operative flexion angle. However, multivariate analysis showed no significant correlation. In contrast, Anouchi *et al.* reported no correlation between age and postoperative knee ROM.

Gender

Females (07) outnumbered males (05), as was seen in almost all studies. A study conducted by A. Lizaar *et al.* showed that pre-operative range of motion is greater in men than in women ($p = 0.038$), but the final post-operative flexion was not significantly associated with gender ($p = 0.41$). Farahini *et al.* concluded that gender had no significant relationship with postoperative flexion, which was similar to most of the previous reports.

In our study, we found males had a greater pre-operative range of motion compared to females, which was statistically significant ($p = 0.004$). Males also had a better post-operative range of motion, but it was not statistically significant ($p = 0.49$)

Diagnosis and Difficulty in the Knee

Patients with Stiff Knees

In our study, 3 out of 12 cases were of stiff knees, of which two developed secondary to aggressive OA and one was secondary to trauma leading to multiple surgeries. The preop range of flexion (ROM) was 0–20 degrees. The pre-op and post-op average Insall knee scores were 45 and 116.6, respectively. Cemented PS TKA was performed in all our cases due to the osteoporotic nature of the bone. After a follow-up of 6 months, the average post-op Rom was 0-90 degrees, which was a significant improvement, though not similar to the results in flexible knees.

Montgomery *et al.* reported the results of 82 stiff knees (ROM < 50°) at midterm. Full correction was achieved intraoperatively. The mean ROM at follow-up was 93°. Rajgopal *et al.* reviewed 84 TKAs with OA and severe stiffness preoperatively (mean ROM was 14°; 0° to 20°). The mean ROM at follow-up was 75°.

Patients with Coronal Knee Deformity

Varus Knee

In our study, 3 out of 12 patients had a varus knee due to severe osteoarthritis. Two patients had a waddling gait. TKA was performed using standard tibial bone cuts with thicker polyethylene inserts, and excessive soft tissue releases over the medial side were avoided to maintain an adequate flexion and extension gap. The average preop ROM was 85 degrees, with an Insall score of 85–90. The average postop ROM (flexion) was 0-120 degrees, and the Insall score was 150. In all cases, PS (posterior stabilising) TKA was performed.

Dixon *et al.* had excellent clinical and radiological results in patients with severe varus by downsizing and lateralizing the tibial component, along with the resection of the uncovered medial bone, for the correction of the severe varus deformity. This method causes effective lengthening of the medial structures and thereby helps in the correction of the deformity.

Mullaji *et al.*^[6] described their experience with 173 PS TKAs performed on patients with $> 20^\circ$ of varus deformity. Their technique consisted of a combination of selective soft-tissue medial release and downsizing of the tibial component through a reduction osteotomy of the posteromedial tibial flare. Lee *et al.* concluded that preoperative varus do not have detrimental effects on longevity and clinical outcome, and such cases can be successfully managed. Matsumo *et al.* looked at the influence of intraoperative soft tissue balance and concluded that even in severe varus knees, gap balancing can be adjusted using PS TKA.

Valgus Knee

In our study, 3 out of 12 cases had valgus knee secondary to rheumatoid arthritis (RA). The average valgus deformity was 18 degrees in the coronal plane. In all cases, PS-TKA was done with adequate soft tissue release. Excessive soft tissue balancing was not done to avoid overcorrection leading to instability. The average preop ROM was 86.6, the average postop ROM was 112.3, and the average preop Insall knee score was 55.3 and post-op was 135.

Similarly, Ritter and Faris believed that, with proper attention to ligamentous instability, any deformity could be intraarticularly corrected. Wang *et al.*^[7] also reported no complications in their series of 13 cases where TKA was done in conjunction with intraarticular bone resection. In their series, intraarticular bone resection with soft tissue balancing with TKA achieved satisfactory outcomes in patients with arthritis of the knee.

Patients with Extra Articular Deformity

In our study, 2 out of 12 patients had extra articular deformities. One case was a tibia vara secondary to a stress fracture, and the other case was a tibia vara secondary to HTO (High Tibial Osteotomy). Cemented PS-TKA was performed in both cases. The preop ROM was 0-85 and the postop ROM was 0-115, with a significant decrease in pain and stiffness. The pre- and post-op average Insall scores were 63 and 136, respectively. As the deformity was close to the knee joint, the correction needed was intraarticular.

In patients with OA of the knee and an extra-articular deformity of less than 20° in the coronal plane of the femur and tibia, TKA, along with intra-articular resection and soft tissue balancing, has shown promising results. These results have also been confirmed in those with deformities in the sagittal plane. These studies show that resecting bone inside the joint and using TKA can be done on people with OA. The procedure can fix up to 15° of recurvatum and 16° of procurvatum of the femur, as well as varus deformities. Mullaji *et al.* have so far published the largest series, which includes 34 patients. The results of TKA combined with an osteotomy have been reported by Lonner *et al.*^[8]

In this study, patients with a mean varus deformity of 25° underwent combined surgery, with good overall results.

Patients with Post Osteotomy

In our study, we found one case in which HTO was done due to OA, but due to undercorrection, the OA was severe and involved all the compartments. In this, the plate was removed, which led to a weakened lateral column, which was fixed with TBW and cemented PS-TKA. As a result of the increased preoperative pain and stiffness, the preoperative ROM was 70 degrees and the postoperative ROM was 110 degrees. The preop Insall score was 60, and the postop Insall score was 140.

There are different reports about the clinical outcome and survival rate of TKA performed after previous femoral or tibial osteotomies. Some authors report poorer results, while others report comparable results in patients with and without a previous osteotomy. Parvizi *et al.*^[9] studied the outcome after TKA following a HTO in 115 patients at a mean follow-up of 15.1 years. They showed that the overall functional and radiographic outcomes were slightly inferior, owing to higher rates of malalignment, instability, radiolucent lines, and revision.

Following the opening-wedge HTO, Erak *et al.* found inferior results after subsequent TKA because of persistent pain and a slightly lower clinical score. A systematic review by van Raaij *et al.*^[10] pooled the results of eight randomised controlled trials. They did not find statistically significant differences between those undergoing primary TKA and those undergoing TKA after a HTO. They reported, however, that each paper outlined the increased surgical difficulties represented by the exposure, ligamentous balancing, and longer duration of the procedure in the latter group.

Patient with Post Patellectomy

In our study, there was one case of post-patellectomy secondary to trauma that developed significant OA, for which PS-TKA was done. The preop rom was 0-110 with an extension lag of 10-15 degrees. The post-op rom improved to 120 degrees with no extension lag. The TKA was performed 10 years after the patellectomy.

Joshi and coworkers evaluated pain relief and knee stability in 19 patellectomy patients following total knee arthroplasty. Twenty-one percent reported incomplete pain relief, and 16% had some degree of instability. They reported a “poor outcome” in 26% of the knees with previous patellectomy. The comparison group, with intact patella, reported excellent pain relief; a poor outcome was reported in only 5%. Overall, the investigators noted a higher complication rate in total knee arthroplasty in post-patellectomy patients.

There has been some debate over the type of implant that should be used in patellectomy patients because the patella is perceived as essential for stability. Paletta and Laskin^[11] retrospectively compared patients treated with a posterior stabilised implant with those receiving a posterior cruciate retaining implant and showed that the mean postoperative knee scores were significantly greater in patients with a posterior stabilised implant. In addition, of the seven knees that had a measurable loss of active extension, six were in patients with a posterior cruciate retaining implant.

As demonstrated by Martin and colleagues, there is a direct correlation between postoperative knee scores and the number of years that have elapsed since the patient’s patellectomy. A longer time period between patellectomy and knee arthroplasty is associated with a higher probability of a successful outcome.

Patient with Multiple Previous Incisions

In our study, three patients had a stiff knee. One patient had multiple previous incisions due to multiple surgeries performed 15 years ago and developed a stiff knee with no preop ROM. TKA was performed utilising the median parapatellar approach. The patient developed a surgical site infection, leading to delayed wound healing.

The rate of wound complications after primary TKA following failure of ORIF for the treatment of fractures, including superficial infection, dehiscence, and necrosis in primary TKA, varies between 4.8% and 13%. Saleh *et al.* reported no wound complications in 15 patients, but a sham incision was used in two patients and one required a flap cover. In a study by Casey *et al.*, the complication after the use of prophylactic flap cover occurred in 11 of 23 patients (48%), but soft-tissue cover was achieved, and all patients underwent successful TKA subsequently with no wound complications.

Preoperative and Postoperative Range of Motion

Several studies have shown that high preoperative ROM is associated with a greater postoperative flexion arc achieved by the patient. Kurosaka *et al.* and Harvey *et al.* reported that preoperative ROM of the knee joint was the most important factor, with patients with good preoperative ROM showing a better final outcome. A study by Sancheti *et al.* demonstrated a moderately positive correlation between preoperative flexion and postoperative flexion at 3 months and 6 months, but reduced to a weak positive correlation by the end of 1 year. A positive correlation between preoperative and postoperative ROM is well established. Preoperative ROM had a positive correlation with postoperative ROM, indicating more final ROM in patients with more preoperative ROM. However, preoperative ROM had a negative correlation with gain in ROM, indicating patients with more preoperative ROM did not gain much range (preoperative ROM α postoperative ROM/gain in ROM).

Kawamura and Bourne concluded that preoperative flexion deformity did not correlate with final ROM. Patients with greater flexion deformity had a significant but weak negative correlation with final ROM and a positive correlation with gain in ROM. Thus, the greater the preoperative flexion deformity, the less the final ROM, and the greater the gain in ROM, with $P < 0.0001$ (the preoperative flexion deformity is directly proportional to the gain in ROM and inversely proportional to the final ROM).

In our study, it was concluded that knees with good pre-operative flexion had better post-operative flexion, which was statistically proven by Pearson correlation and very significant with a p-value of 0.001, whereas preoperative flexion deformity was negatively correlated with the final range of flexion, which was significant with a p-value of 0.031.

Scores

Anouchi *et al.* found that the most important factor to predict the ROM was the preoperative knee society scores. Patients with a good preoperative knee society score were shown to have a greater final range of flexion. However, the ones with a lower total knee score and functional score showed a higher gain in ROM from the preoperative value. Other studies show

that in high-flexion implants, there is a weak correlation between the knee score and final flexion angle, but there is a significant correlation between the flexion angle and functional score after 1 year.

In our study, we concluded that both preoperative and postoperative scores positively correlate with better postoperative ROM. Comparatively, males had better knee scores compared to females.

The limitations of our study are that we did not use computer navigation in all cases, whereas various studies have shown that it is of great help in such cases. But relying only on navigation can lead to the wrong placement of the femoral component. This is especially true when the femur is deformed in a way that makes it rotate. In these cases, the trans-epicondylar axis would not be in the normal anatomical location, which would create an uneven flexion gap. CT scannograms were not done due to the non-availability of the CT scans in-house in the initial phase of the study. CT scannograms, in contrast to x-ray scannograms, would have provided a more accurate three-dimensional assessment of the deformity, which could have some bearing on the final outcome.

CONCLUSION

Determining the factors resulting in a difficult knee helps in formulating an appropriate surgical approach, which results in a better functional outcome following total knee arthroplasty.

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