"PROSPECTIVE STUDY OF CLINICAL AND FUNCTIONAL OUTCOME OF PRIMARY TOTAL KNEE REPLACEMENT (TKR) IN OSTEOARTHRITIC KNEE."

By

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Under the guidance of

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ABSTRACT

Introduction: Osteoarthritis is a degenerative joint disease that significantly impacts quality of life, particularly in older adults. Total knee replacement (TKR) has emerged as a definitive surgical intervention for end-stage osteoarthritis of the knee when conservative management fails. This study aimed to evaluate the clinical and functional outcomes of primary TKR in patients with osteoarthritic knees at the Department of Orthopaedics, Shri B M Patil Medical College and Research Centre, Vijayapura, Karnataka, India.

Methodology: This prospective cohort study was conducted from April 2023 to December 2024, enrolling 33 patients who met the inclusion criteria of being over 50 years with incapacitating knee pain due to grade 3 or 4 osteoarthritis (Kellgren & Lawrence classification) after failure of non-operative therapy. All surgeries were performed using the anteromedial parapatellar approach with posterior-stabilized prosthesis design. Preoperative assessment included detailed clinical examination and radiological evaluation. Postoperatively, patients followed a structured rehabilitation protocol and were evaluated at regular intervals (day 5, 3 months, and 6 months) using the Knee Society Score (KSS).

Results: The study included 33 patients with a predominant age group of over 60 years (42.4%), followed by 51-60 years (36.4%). Female patients constituted 60.6% of the study population, and right knee involvement (54.5%) was slightly more common than left. The mean duration of symptoms before surgery was 27.6 ± 26.1 months. Preoperatively, all patients (100%) had poor KSS scores (<60). By day 5 post-surgery, a slight improvement was noted with 6.1% of patients showing fair scores. At the 3-month follow-up, dramatic improvement was observed with 97% of patients achieving excellent scores and 6.1% showing good scores. At 6 months, all patients (100%) had excellent KSS scores, demonstrating optimal functional recovery. There was no statistically significant association between KSS scores at 3 months and either age (p=0.409) or gender (p=0.23).

Conclusion: Primary TKR is a highly effective surgical intervention for osteoarthritic knees with predictable and excellent functional outcomes. The significant improvement in KSS scores from preoperative to 6-month follow-up indicates the procedure's success in alleviating pain and restoring function. The lack of significant association between outcomes and demographic factors suggests that TKR benefits patients regardless of age or gender when properly indicated and performed with appropriate surgical technique and rehabilitation protocols.

Keywords: Total Knee Replacement, Osteoarthritis, Knee Society Score, Functional Outcome, Anteromedial Parapatellar Approach, Posterior-Stabilized Prosthesis

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ABBREVIATIONS

ACL - Anterior Cruciate Ligament

AP - Anteroposterior

ATT - Anterior Tibial Tuberosity

CAM - Clinician Administered Measure

CPM - Continuous Passive Motion

CR - Cruciate Retaining (prosthesis)

DVT - Deep Vein Thrombosis

FJS - Forgotten Joint Score

FTA - Femorotibial Angle

KCS - Knee Clinical Score

KFS - Knee Functional Score

KOOS - Knee Injury and Osteoarthritis Outcome Score

KSS - Knee Society Score

LCL - Lateral Collateral Ligament

MCL - Medial Collateral Ligament

MIS - Mini-Invasive Surgery

OA - Osteoarthritis

OKS - Oxford Knee Score

PCL - Posterior Cruciate Ligament

POD - Post-Operative Day

PROM - Patient Reported Outcome Measure

PS - Posterior Stabilizing (prosthesis)

RA - Rheumatoid Arthritis

ROM - Range of Motion

TKA - Total Knee Arthroplasty

TKR - Total Knee Replacement

VMO - Vastus Medialis Obliquus

WOMAC - Western Ontario McMaster University Osteoarthritis Index

INTRODUCTION

Osteoarthritis (OA) of the knee is one of the most prevalent degenerative joint disorders globally, significantly impacting the quality of life of millions of individuals, particularly those aged 60 years and above. As populations age worldwide, the incidence of knee OA continues to rise, presenting a substantial healthcare challenge. Total Knee Replacement (TKR) has emerged as the gold standard surgical intervention for end-stage knee osteoarthritis, offering remarkable improvements in pain relief, functional recovery, and overall quality of life for affected individuals.[1]

The evolution of TKR since its inception in the 1960s represents one of the most significant advances in orthopaedic surgery. Modern TKR procedures have benefited from continuous refinements in surgical techniques, implant designs, and perioperative management protocols. Current literature suggests that approximately 90% of TKR implants survive for more than 15 years, making it one of the most successful orthopeadic procedures.[2] Despite these impressive outcomes, the growing demand for TKR procedures, coupled with increasing patient expectations, necessitates ongoing evaluation and optimization of surgical techniques and outcome measures.

The decision to proceed with TKR is typically made when conservative management fails to provide adequate relief from symptoms. Key indications include persistent pain, significant functional limitation, and radiographic evidence of advanced joint degeneration.[3] “The success of TKR depends on multiple factors, including patient selection, preoperative planning, surgical technique, implant choice, and postoperative rehabilitation protocols. Understanding these factors and their interrelationships is crucial for optimizing outcomes and patient satisfaction”.

Recent advances in surgical techniques have introduced various approaches to TKR, “including minimally invasive surgery, computer-assisted navigation, and robotic-assisted procedures. These innovations aim to improve accuracy, reduce tissue trauma, and enhance recovery times.[4] However, the relationship between surgical approach and clinical outcomes remains" a subject of ongoing research and debate within the orthopeadic community.

Outcome assessment following TKR has evolved to encompass both objective clinical measures and patient-reported outcomes. Traditional evaluation methods focused primarily on implant survival and basic functional parameters. However, contemporary assessment protocols now include comprehensive evaluation of pain relief, functional recovery, range of motion, patient satisfaction, and quality of life measures.[5] This holistic approach to outcome assessment provides a more complete understanding of the procedure's success from both clinical and patient perspectives.

Postoperative rehabilitation plays a crucial role in determining the success of TKR. Early mobilization and structured physiotherapy programs have been shown to significantly impact recovery trajectories and final outcomes.[6] The timing, intensity, and specific components of rehabilitation protocols continue to be refined based on emerging evidence and understanding of post-surgical healing and recovery patterns.

Despite the overall success of TKR, complications remain a significant concern. These can range from minor issues to severe complications requiring revision surgery. Common complications include infection, instability, stiffness, and persistent pain.[7] Understanding the risk factors and developing strategies to prevent and manage these complications is essential for improving overall outcomes.

Long-term follow-up studies have demonstrated excellent durability of modern TKR implants, with survival rates exceeding 95% at 10 years.[8] However, the increasing life expectancy and higher activity levels of patients receiving TKR create new challenges regarding implant longevity and performance. This particularly affects younger patients who may require revision surgery during their lifetime.

The economic impact of TKR procedures is substantial, both in terms of direct healthcare costs and indirect societal costs related to lost productivity and disability.[9] As healthcare systems worldwide face growing financial pressures, understanding the cost-effectiveness of different approaches to TKR becomes increasingly important. This includes evaluation of various implant options, surgical techniques, and rehabilitation protocols.

Recent technological advances, including the use of patient-specific instrumentation and custom implants, represent potential avenues for improving outcomes. These innovations aim to optimize component positioning and restore natural knee kinematics more accurately.[10] However, their cost-effectiveness and impact on long-term outcomes require further investigation through prospective studies.

The present study aims to contribute to the existing body of knowledge by prospectively evaluating the clinical and functional outcomes of primary TKR in patients with osteoarthritic knees. By analyzing both objective clinical parameters and patient-reported outcomes, this research seeks to identify factors that influence success rates and develop strategies for optimizing results. Understanding these relationships will be crucial for improving patient selection, surgical techniques, and rehabilitation protocols, ultimately leading to better outcomes for patients undergoing TKR.

AIM & OBJECTIVES

Objective:

1. To examine the pre-operative status and post-operative clinical and functional outcomes of primary total knee replacement in patients with primary knee osteoarthritis using KSS (Knee Society Score) at pre operative, post operative 3 and 6 months follow-up.

REVIEW OF LITERATURE

In a study by **Chaudhary C et al**,**[56] (2024)** "a total of 47 knees from 40 patients were analyzed. The mean age of the study population was 65.6 years. Female patients accounted for 67.5% of the sample. The majority of patients (57.4%) achieved an excellent KSS score, followed by very good (25.5%) and good (17%) scores. The mean KSS score significantly improved from 177 points pre-surgery to 225 points post-surgery. The post-operative mechanical axis ranged from 1.1 degrees valgus to 9 degrees valgus, with a mean value of 3.5 degrees valgus. The range of motion improved from 10 to 90 degrees post-operatively, with a mean range of 0-110 degrees."

In this subgroup, **Keshari S et al. (2024)[57]** sought to assess the clinical and functional results of total knee replacement. Fifty patients participated in the research. Patients were assessed both before and after surgery using a scoring method developed by the Knee Society called Knee Score. Both functional and knee scores are computed, with a total of 100 points awarded for each. The average knee clinical score before surgery was 48.2, and it increased to 84.82 after surgery. The average knee functional score before surgery was 66.4, and it increased to 82.64 after surgery. According to the knee clinical score at the 6-month follow-up, 35 patients (70%) had outstanding results, 11 patients (22%) had well results, 2 patients (4%) had fair results, and 2 patients (4%) had poor results. "According to the knee functional score at the 6-month follow-up, 37 patients (74%) had outstanding outcomes, 5 patients (10%) had good results, 2 patients (8%) had fair results, and 2 patients (8%) had bad results. As evidenced by the improvement in the post-operative Knee Clinical Score and Knee Functional Score, they came to the conclusion that Primary Total Knee Arthroplasty enhances patients' functional ability and their capacity to return to their pre-disease state, which is to have a pain-free mobile joint. Additionally, because it takes into account both clinical and functional outcomes after total knee arthroplasty, the Knee Society Score is a useful rating system".

A prospective study by **Wilson MD et al. (2024)** sought to evaluate the radiological, clinical, and survival effects of a novel "kinematic retaining" (KR) implant. At three European centers, 156 patients had TKR surgery with the Physica KR implant for primary osteoarthritis. "For a period of five years, patients were monitored using clinical and radiological assessments. 79.4% and 85.9% of patients achieved good-excellent clinical and functional KSS scores within six months after surgery; at five years, these percentages remained at 76.9% and 79.5%, respectively. At five years, the mean improvement in Knee Society Score (KSS) was 32.8 (from 23 to 40) and 37.4 (from 30 to 50) ($p < 0.01$). A statistically significant improvement was observed in all Knee Injury and Osteoarthritis Outcome Score (KOOS) sub-scores from the mean of 34.7 (SD ± 16.1) before to surgery to 86.6 (SD ± 16.1) at five years. At five years, more than 80% of patients had a good-to-excellent outcome, with an average Oxford Knee Score (OKS) of 43.7 (±5.6). By six weeks following surgery, OKS had dramatically improved ($p < 0.01$) and had stayed stable for the course of the five-year follow-up. After six weeks following surgery, there was a considerable improvement in Visual Analogue Score (VAS) Satisfaction levels. The average VAS between one and five years was more than 85 mm. Following surgery, the Forgotten Joint Score (FJS) rose from 64.5 at 1 year to 79.2 at 5 years ($p < 0.01$). There were no escalating negative radiographic findings observed. During the research period, two patients underwent revisions: one for aseptic loosening and the other for infection. They came to the conclusion that, with an astounding 99.4% survivability rate (95.5–99.9) at five years, this innovative "kinematic retaining" knee prosthesis has demonstrated outstanding clinical and patient-reported improvements".

Thirty osteoarthritic patients, eight of whom were male and twenty-two of whom were female, made up the sample in a study by Navaneeth PK et al.[58] (2022). The "age range of the patients was 45–75 years old. Of these thirty patients, sixteen had problems with the left knee joint and fourteen with the right. After total knee arthroplasty, the mean pre-operative knee clinical score was 36.93, which improved to 84.70 post-operatively. After undergoing total knee arthroplasty, the mean pre-operative knee functional score improved to 71.17 from 16.83. The result was graded according to the knee society score. According to the knee clinical score, we obtained excellent results in 25 instances (83%), good in 3 (10%), and fair in 2 patients (7%) while the knee functional score revealed 8 excellent (27%), 16 good (53%), 5 fair (17%), and 1 poor (3%) results".

In **2021, Gupta KL et al**. carried out a projected investigation. Patients were assessed both before and after surgery using a scoring method developed by the Knee Society called Knee Score. Both functional and knee scores are computed, with a total of 100 points awarded for each. Twenty patients underwent unilateral TKR, and five patients in each group underwent bilateral TKR. Three of the five patients who had bilateral TKR experienced post-operative problems. A post-operative deep surgical site infection occurred in one patient; debridement of the wound was performed, and antibiotics were administered in accordance with the culture and sensitivity report. "The second patient had stiffness in the knee joint. A physiotherapy referral was made for the same patient. It was progressively enhanced over time. The third patient had a satisfactory functional success following surgery, but after a systemic disease, including liver cancer, they started to have trouble walking. The average knee functional score before surgery was 65.8, and it increased to 83.68 on average after surgery. According to KFS, 19 patients (76%) had great results at the 6-month follow-up, 2 patients (8%) had good results, 2 patients (8%) had mediocre results, and 2 patients (8%) had bad results. The average knee clinical score before surgery was 47.4, and it increased to 83.84 after surgery. According to KCS, 18 patients (53%) had great results at the 6-month follow-up, 5 patients (20%) had well results, 1 patient (4%) had acceptable results, and 1 patient (4%) had poor results. According to the improvement in the post-operative Knee Clinical Score and Knee Functional Score, they came to the conclusion that Primary Total Knee Arthroplasty enhances the functional ability of elderly patients over 70 and the patient's ability to return to their pre-disease state, which is to have a pain-free mobile joint".

42 patients with osteoarthritis in their knees who had primary total knee replacements at a tertiary care facility were the subject of a study by **Kandel M et al. (2021).** Quality of life, walking, stair climbing, and SF-36 SCORE were significantly improved following follow-up at 3, 6, and 12 months. "At the 6-month mark, the mean preoperative Oxford clinical score (OCS) was 19.86 ±2.49, but the postoperative score was 42.38 ±1.58. This was a significant improvement. Similarly, at the end of six months, the mean preoperative knee functional score (KFS) was 55.86±2.25, while the postoperative score was 77.00±1.67. Similarly, the average WOMAC score before surgery increased from 93.50±3.13 to 49.50±2.82 after surgery. They came to the conclusion that total knee arthroplasty is the only effective treatment option that can restore the patient to their pre-disease state while also improving their functional abilities. The improvement in the post-operative knee clinical score and knee functional score indicates that TKR is a good way for an OA knee patient to have a pain-free, stable, movable joint".

A prospective observational research involving 20 patients undergoing primary total knee arthroplasty was carried out by Sharma S et al. (2021). Using the Knee

Clinical Score (KCS), the knee's condition was evaluated both before and six months after the procedure. The score was categorized as excellent, good, fair, and bad. At six months after surgery, the patients' average knee clinical score rose from 26.10 ± 5.89 to 76.30 ± 5.18. Before the procedure, the average knee functional score was 30.25 ± 6.97, and following the procedure, it rose to 77.25 ± 6.17. Before the procedure, all of the patients had been assessed as having poor knee functional and clinical grades. Following surgery, 60% of patients had excellent knee clinical grade, 35% had good functional outcome, and 5% had fair knee functional grade. Of them, 50% had excellent knee clinical grade, 40% had good knee, and 10% had fair knee clinical grade. They came to the conclusion that total knee arthroplasty is a dependable surgical procedure for individuals with severe osteoarthritis, and that most patients will experience good to excellent functional results from this procedure.

In their study, **Venkatesan AS et al**.[60] **(2020)** discovered that 76.7% of participants were happy with their results after six months. During the sixth-month follow-up, there was a significant improvement in the clinical (p = 0.000) and functional outcome (p = 0.000) of the AKSS as well as the overall WOMAC scores (p = 0.007). Age also showed a significant difference in AKSS scores, although other factors such as the type of arthritis and the length of sickness did not.

From their point of view, **Figueroa D et al.**[57] **(2019)** reported that the global complication rate was 15.5%, "the reintervention rate was 9.2%, and the revision rate was 2.5%. 9.2% of individuals experienced major problems, whereas 5.1% experienced moderate ones. Ninety percent of patients expressed satisfaction with the operation, and the average Knee Injury and Osteoarthritis Outcome Score was 77 points (14–100). 45.8% of patients exhibited some degree of range-of-motion restrictions at the 2-year follow-up".

In their study, **Khalid Fiyaz M et al[64] (2019)** found that all patients had moderate to severe pain prior to surgery, "24 knees had no discomfort after surgery, and 36 knees had mild pain. After surgery, the pre-operative average flexion of 76˚ was raised to 95.8˚. Prior to surgery, all 60 knees had a low knee score of less than 60. After surgery, 42 knees had outstanding scores (80–100) and 17 had good scores (70–79). Prior to surgery, 3 patients had a fair functional score (60–69) and 38 patients had a low functional score (<60). Twenty-one patients had outstanding scores (80–100) after surgery, eleven had good scores (70–79), six had fair scores (60–69), and three had bad scores (< 60)".

The average pre-op knee clinical score and functional score of 24.7 and 41.2 improved to an average post-op score of 89.9 and 87.8 in a study by **Radhakrishna AM et al.[63] (2017)** at a one-year follow-up of 60 knees. 96.7% of the knees (58 out of 60) had clinical and functional scores ranging from excellent to good. A noteworthy correlation was observed between KFS and KCS. One patient suffered a deep infection, while five patients experienced delayed wound healing. All patients had excellent prosthesis alignment. All patients had their flexion deformities, valgus, and varus corrected.

In a "study by **Kadam RV et al[55] (2016)** the mean preoperative knee clinical score (KCS) was 49.40±13.79 which was increased to a postoperative score of 86.08±5.64 at the end of 6 month. Similarly the mean preoperative knee functional score (KFS) was 32.75±11.79 which was increased to a postoperative score of 84.43±9.59 at the end of 6 month. There was significant increase in KCS and KFC score during follow up at 1, 3 and 6 month interval. There was significant association between knee functional score and knee clinical score at every interval. Total knee arthroplasty improves the functional ability of the patient and the ability of the patient to get back to pre-disease state, which is to have a pain free mobile joint, as reflected by the improvement in the post-op knee clinical score and knee functional score".

Wood A et al.62 (2013) used a cohort of young patients (≤55 years) and a control group of patients ≥56 years, matched for ASA, body mass index, and preoperative condition, to compare American Knee Society and pain scores 10 years after TKR. Twenty-four youthful and twenty-four old knees were examined. With time, all scores increased noticeably. Over a ten-year period, there were no statistically significant changes in knee performance (0.618) or discomfort ($p = 0.436$). The younger group's overall function was consistently higher ($p = 0.004$). We believe that TKR shouldn't be denied to younger individuals based only on their age because it offers comparable results to older patients in terms of pain and function.

There were 18 males and 41 females (M:F = 1:2.3) in the Nigerian study conducted by **Ajiboye, L. et al. (2011)**. Thirty-one right TKRs, twenty left TKRs, and eight staged bilateral TKRs made up the total of 67 TKRs. The mean age of the participants was 59.5 (±8.5) years, with a range of 51 to 70 years. For a variety of reasons, four patients did not finish the research. When compared to pre-operative nKSS, the post-operative nKSS of the remaining 55 patients improved gradually throughout the course of the trial at 6 weeks, 3, 6, 9, and 12 months after surgery (P value < 0.05). Every patient in the study experienced an improvement in their post-operative nKSS, with those who had lower pre-operative nKSS improving more quickly. The decreased pre-operative nKSS and post-operative nKSS on follow-up, however, did not statistically significantly correlate, according to One-way Analysis of Variance (ANOVA) (P value > 0.5).In a study by At five years, the response rate was 86% (Nilsdotter AK et al., 2009). All KOOS and SF-36 scores showed a significant improvement at six months ($P < 0.001$). Following surgery, the proportion of patients engaging in more strenuous sports and leisure-related activities rose. The one-year follow-up revealed the best surgical outcome. The KOOS subscale activities of daily living (ADL) function (82–73) and the SF-36 subscales of body discomfort (72–63), PF (61–51), and vitality (69–59) showed a substantial ($P \leq 0.01$) deterioration at 5 years compared to the 1-year follow-up. Patients with preoperative KOOS subscale scores in the lowest quartile for pain and ADL experienced the biggest gains at 1 year (18–82, 22–80), but they also experienced the worst declines from 12 months to 5 years (82–72, 80–66). Preoperatively, being 10 years older projected ratings for KOOS pain and symptoms at 1 and 5 years to be 5–7 points worse. Preoperative SF-36 scores did not predict postoperative KOOS pain or PF scores after controlling for age, sex, and concomitant conditions.

Even though there is a large amount of research on the functional results of total knee arthroplasty (TKA) in patients with osteoarthritis, a number of important themes show up in the literature. Research continuously shows that most patients see considerable improvements in their quality of life, functional mobility, and pain alleviation, with satisfaction percentages often falling between 80 and 90 percent. Individual patient outcomes still vary widely, though, depending on a number of variables, including age, BMI, comorbidities, pre-operative functional status, and rehabilitation regimens. Despite the improved results of contemporary surgical methods and implant designs, a sizeable minority of patients continue to suffer from chronic pain or less than ideal functional outcomes. In order to maximize functional recovery across a variety of patient populations, this emphasizes the necessity of further research into patient-specific factors that predict outcomes, pre-operative conditioning optimization, rehabilitation protocol standardization, and surgical technique improvement.

OSTEOARTHRITIS OF KNEE

Degenerative joint disease of the knee, commonly referred to as knee osteoarthritis (OA), is usually brought on by articular cartilage degradation and wear and tear. The elderly are most likely to experience it. There are two forms of osteoarthritis in the knee: primary and secondary. Articular degeneration with no discernible underlying cause is known as primary osteoarthritis. An aberrant concentration of force across the joint, as in post-traumatic arthritis (RA), can result in secondary osteoarthritis. Usually a progressive condition, osteoarthritis can eventually cause disability. Each person may experience the clinical signs at varying intensities. But over time, they usually worsen, occur more frequently, and become more incapacitating. "Each person progresses at a different rate as well. Knee stiffness and swelling, discomfort after extended sitting or rest, pain that becomes worse with time, and knee pain that starts slowly and gets worse with exercise are common clinical symptoms. Conservative measures are the first line of treatment for osteoarthritis in the knee, and when they are unsuccessful, surgical" options are considered. There are presently no approved disease-modifying drugs for the treatment of osteoarthritis in the knee, however drugs can help delay the progression of RA and other inflammatory diseases.[11]

ANATOMY AND PHYSIOLOGY OF KNEE JOINT:

The patellofemoral and tibiofemoral joints are the two separate joints that make up the knee. "The intricate pivotal hinge joint that joins the upper and lower leg bones is called the knee. It is the body's largest synovial joint. The knee is a pivotal hinge joint with a movable trocho-ginglymus that allows for flexion", extension, and a little amount of internal and external rotation.

These joints cooperate to support the knee's weight-bearing functions and enable fluid movement. 26–28 Even though the knee joint's structure hasn't altered much throughout the ages, it is susceptible to osteoarthritis and acute injuries. The joints that carry the most weight are the ones that deteriorate the most. The ligaments, muscles, and tendons are the primary components for the stability of the knee.

"The structures around the knee have been classified into three groups by Larson, namely the

* Osseous structures

* Extra-Articular structures and

* Intra-Articular structures"

"Osseous structures :

The osseous structures of the knee consist of three components.

1. **Femoral Condyles:** Two spherical prominences with an eccentric curvature that is more anterior than posterior are called femoral condyles. The lateral and medial condyles are the femur's articular bodies. These diverge slightly posteriorly and distally, with the medial condyle having a more consistent width and the lateral condyle being wider in front than behind. As one moves toward the rear, the condyles' sagittal plane curvature radius decreases. They are flattened anteriorly, increasing the surface area available for weight transfer and contact".

The patella is accepted by the patella-femoral groove on the anterior aspect. The two condyles are separated posteriorly by the intercondylar notch. When viewed from the end, the distal femur has a trapezoidal shape, meaning it is narrower anteriorly than posteriorly, and its medial surface has an angle of inclination of roughly 25 degrees'®. The two condyles' articular surfaces unite anteriorly to create a joint that allows for articulation with the patella. "A deep intercondylar fossa that provides attachment to the knee's cruciate ligaments separates them posteriorly. Although the patella's contact surface is mostly derived from the lateral condyle, it contains portions of both condyles. Proximally, the lateral condyle is longer and wider. The fibular collateral ligament develops from the lateral epicondyle”, which emerges from the lateral condylar surface. The popliteus tendon is located in an oblique groove directly beneath the lateral epicondyle. The medial epicondyle extends more distally and is longer than the lateral condyle. The tibial collateral ligament is attached to its convex medial surface by an epicondyle. The tendon of the adductor magnus muscle attaches into the adductor tubercle, which is located on the proximalmost portion of the condyle.

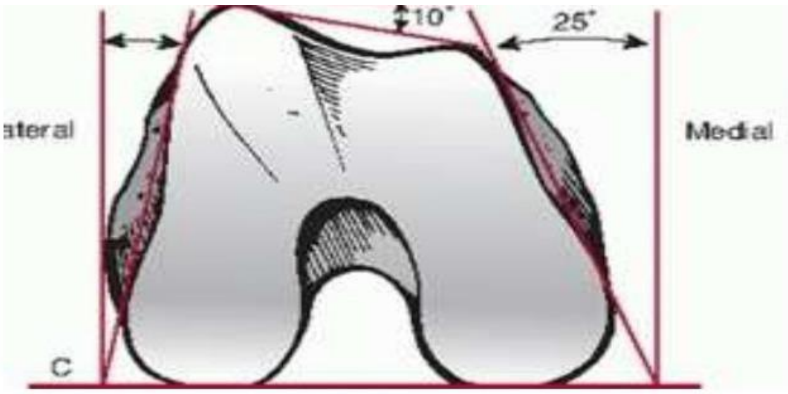


Figure 1 : cross section of distal femur

“Normally, the knee joint is oriented parallel to the ankle and ground. The anatomic axis of the femoral shaft relative to the knee averages about 8 degrees of valgus, with some variability between individuals (range, 5 to 12 degrees)*. The expanded femoral and corresponding tibial condyles are adapted for the direct forward weight transmission. During weight bearing, the two condyles rest on the horizontal plane of the tibial condyles, and the femur shaft inclines inferomedially. This inclination is an expression of the greater width of the body at the hips than the knees”.

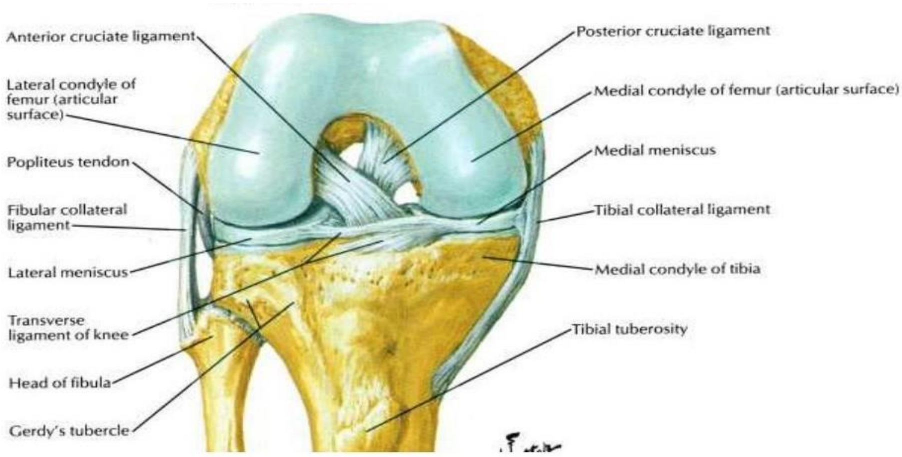


Figure 2: Right knee in flexion (anterior view)

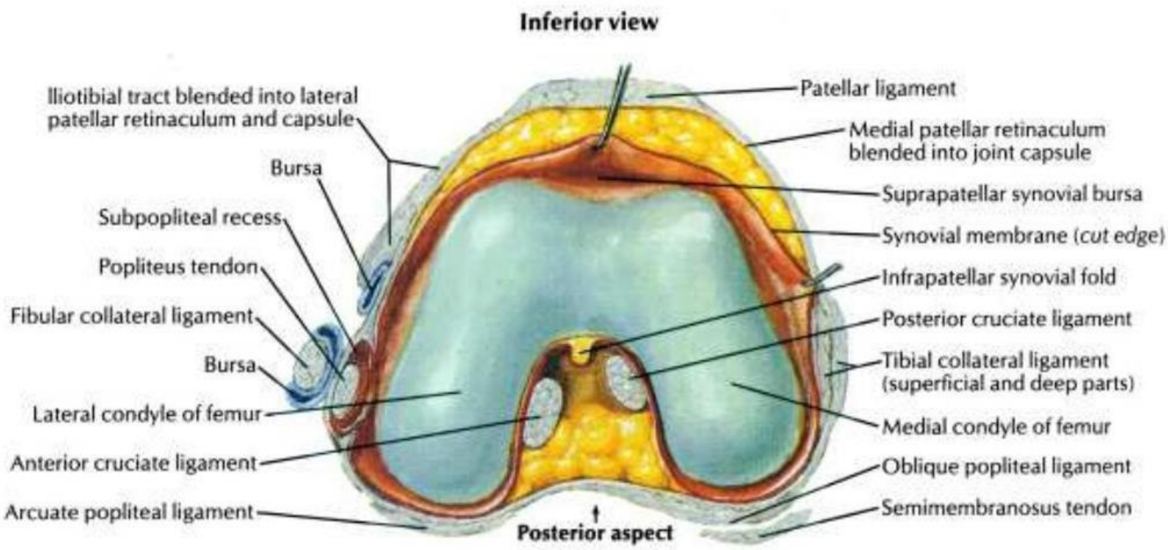


Figure 3: Right knee (inferior view)

2. **Tibial Plateau**: The enlarged proximal end of the tibia forms the tibial plateau. The femoral condyles articulate with them. Their intercondylar prominence is middle. “The Lateral Tibial Condyle is more round, flatter, and shorter from anterior to posterior. The medial condyle is more oval, concave, and longer from anterior to posterior”

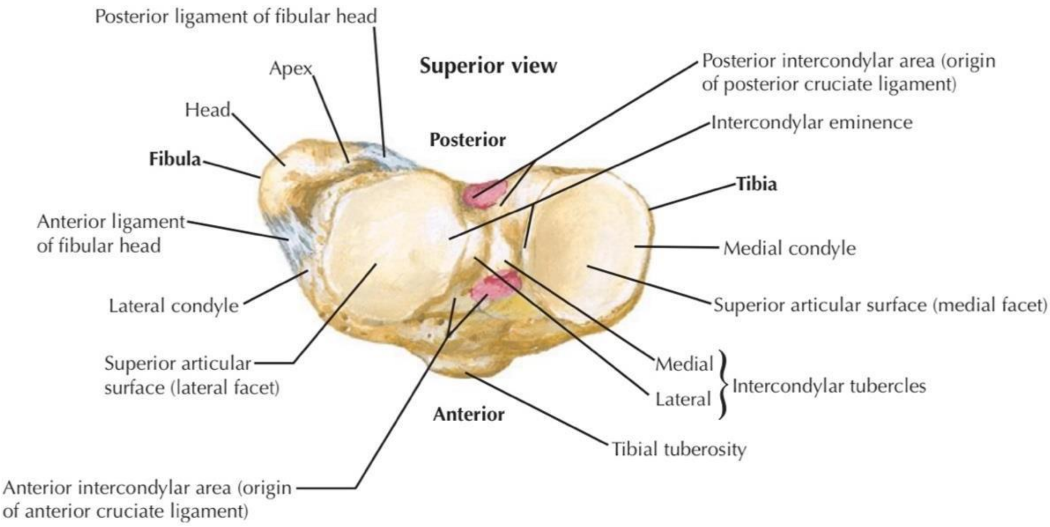


Figure 4: cross-section view of tibial plateau

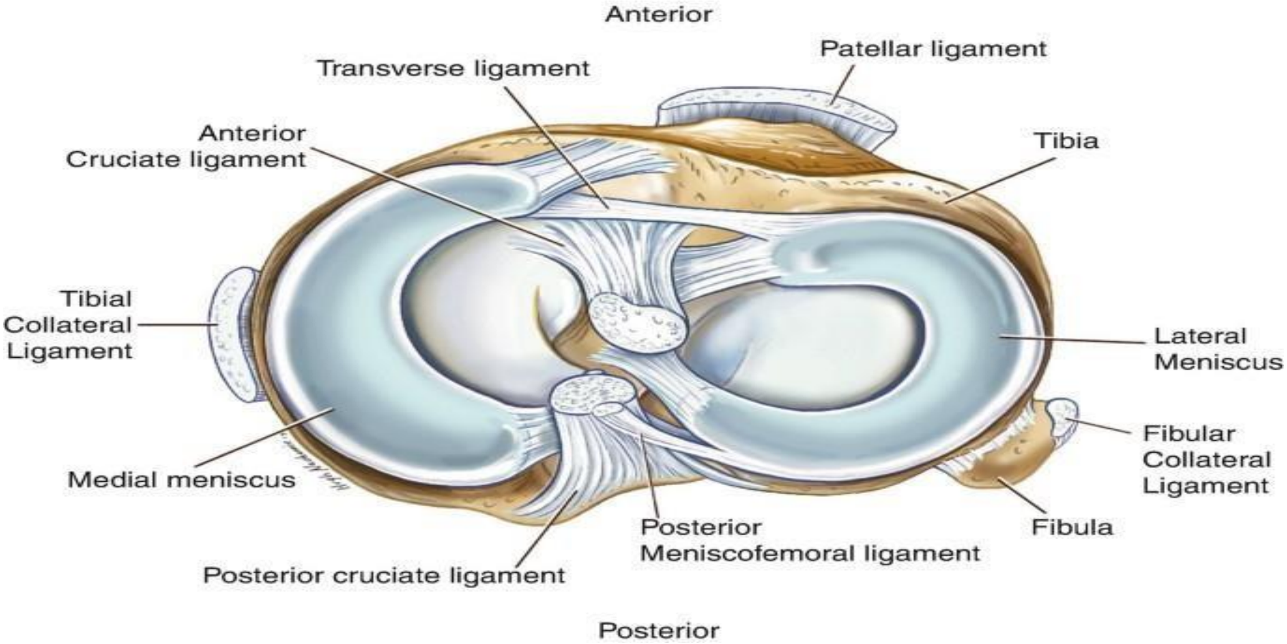


Figure 5: ligament attachments at articular surface

3. Patella: “The patella is a triangle-shaped sesamoid bone that is wider proximally than distally. The articular surface of the patella has a vertical ridge which divides it into a smaller medial and a larger lateral articular facet or surface.”

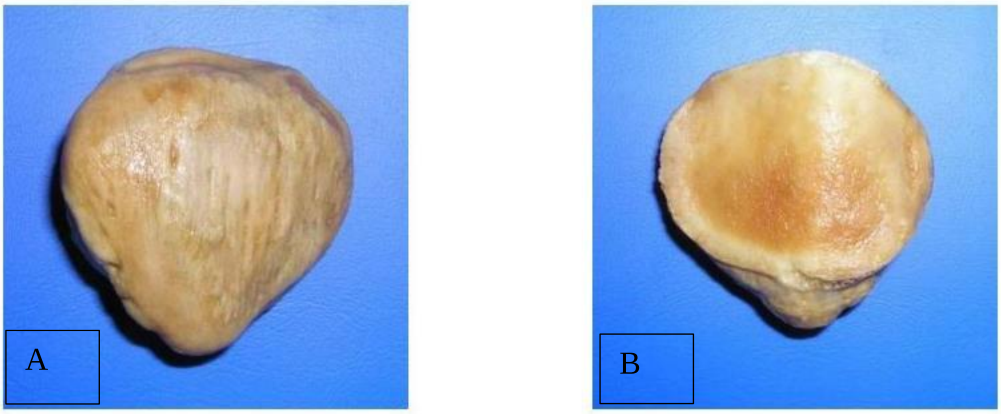


Figure 6 (A) & (B): anterior surface and articular surface of patella respectively

Patellofemoral Joint:

“The lever arm of the extensor mechanism is increased by the patellofemoral joint. Tensile stresses produced by the quadriceps tendon are transferred to the patellar tendon by the patella. Joint reaction forces can reach up to seven times the body weight when deep squatting and the maximal contact force between the patella and femoral trochlea happens at a 45° knee flexion”.

“The patellofemoral joint is dynamically stabilized by the quadriceps muscles, and passive anatomical restrictions include:

- Medial patellofemoral ligament: This is the primary passive restraint against lateral translation at 20° of flexion.
- Medial patella-meniscal ligament: This contributes 10% to 15% of the total restraining force.
- Lateral retinaculum: This provides 10% of the total restraining force”.

Tibiofemoral Articulation:

When walking or climbing, “the tibiofemoral articulation transmits body weight from the femur to the tibia and produces joint reaction forces that are three and four times body weight, respectively. The sagittal plane is where most movement takes place, with hyperextension extending from 10° to hyperflexion of roughly 140° to 150°. However, because the calf and posterior thigh make direct touch, severe flexion is frequently restricted. To maximize knee flexion prior to impingement, the femoral center of rotation and tibiofemoral contact point move posteriorly with greater flexion. Up to 75° of range of motion is necessary for normal gait.

The medial collateral ligament, which resists valgus stress forces, and the lateral collateral ligament, which resists varus stresses, give knee stability in the coronal plane. Furthermore, resistance to stresses directed anteriorly and posteriorly at the knee is provided by the anterior and posterior cruciate ligaments, respectively. External rotatory pressures are resisted by the posterolateral corner structures”.

Extra-Articular Structures:

The musculo-tendinous units and the collateral ligaments are the extra-articular structures that support and affect how the knee joint functions.

The “Tibial Collateral Ligament lies superficial to the medial capsule; it is attached to the medial condyle of the femur and to the posterior-medial tibial metaphysis about 7-10 cm below the joint line. It is the major stabilizer against valgus stress”.

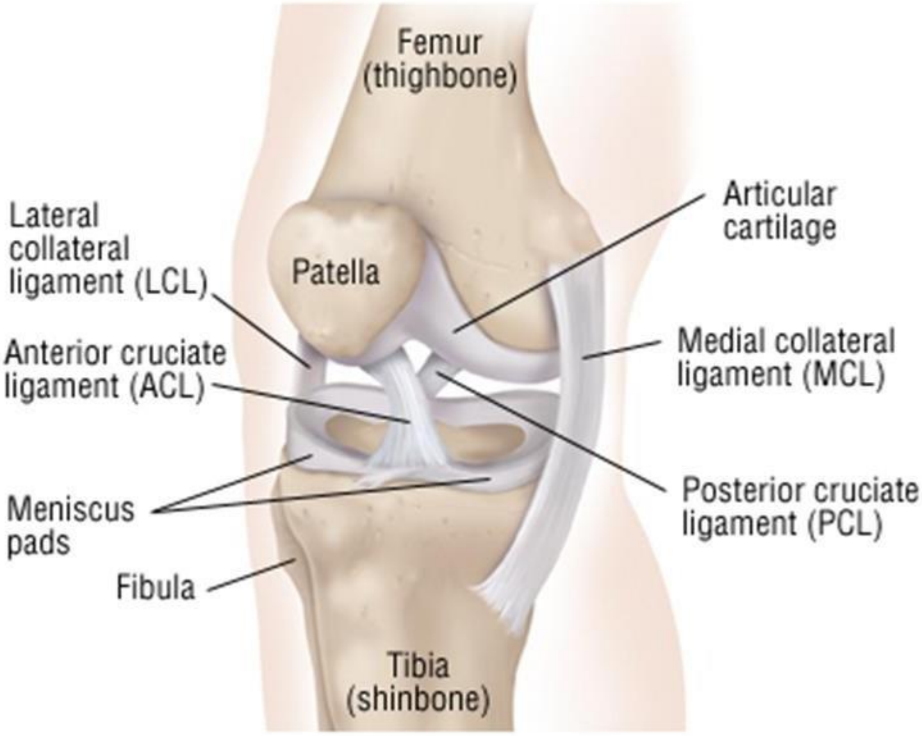


Figure 7: ligament attachment on the medial aspect

“The Fibular Collateral Ligament attached to the lateral epicondyle of femur proximally and to the fibular head distally. It provides the principal stability against varus stress”.

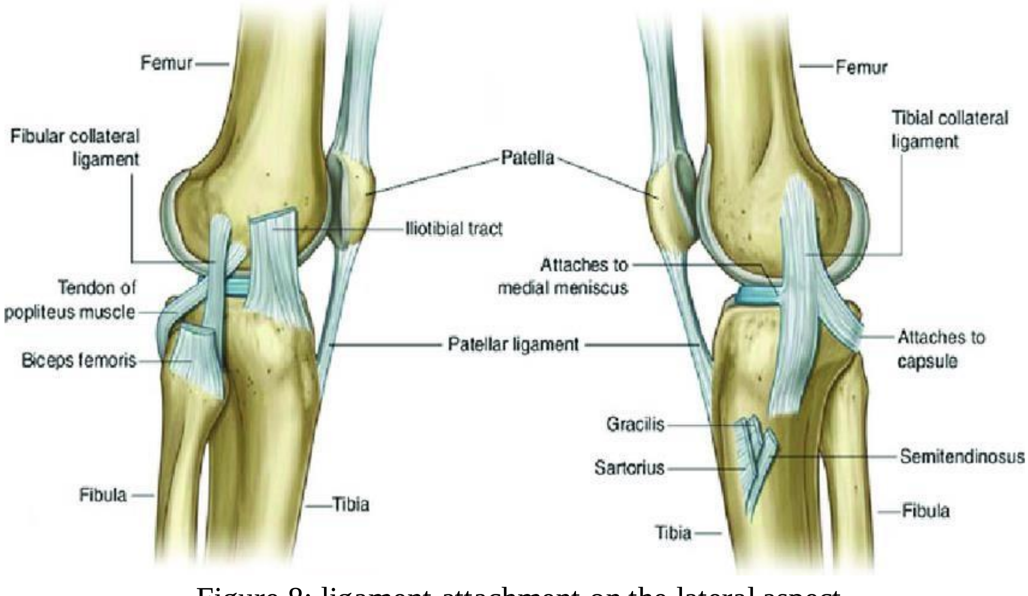


Figure 8: ligament attachment on the lateral aspect

The "Musculo-tendinous Units supporting and stabilizing the knee joint are the Quadriceps mechanism, the Gastrocnemius, the Pes Anserinus, the Hamstrings, the Iliotibial tract and the Popliteus".

Intraarticular structures:

"The Principal Intraarticular structures are the Menisci, Medial and Lateral Menisci, Anterior Cruciate Ligament and Posterior Cruciate Ligament.

The **Menisci** acts as spacers and therefore deepens the joint, reduces the stress on the articular cartilage and prevents mechanical damage to the Chondrocytes. The Menisci are cresentric with triangular cross-section covering 1/2 to 2/3"d of the articular surface of the corresponding tibial plateau by coronary ligaments".

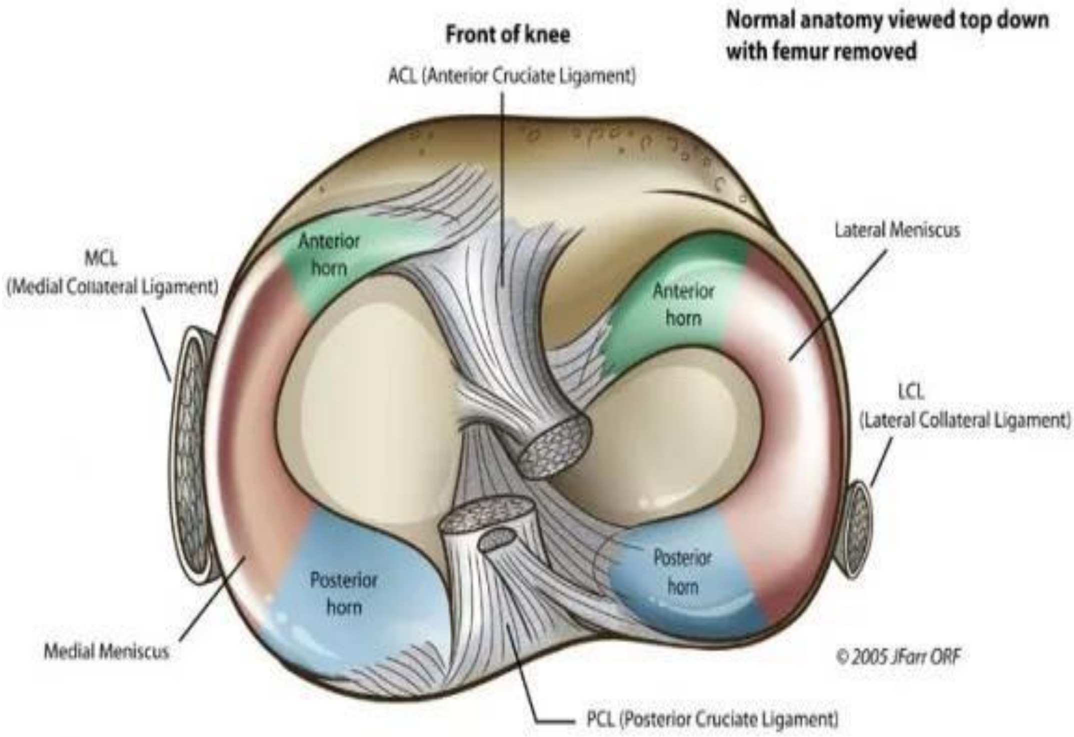


Figure 9: Meniscus attachment

Anterolateral to the anterior tibial spine, the tibia is home to the thick band of fibers known as the anterior cruciate ligament. “The fibers wind on themselves and run obliquely before attaching to a crescentic region on the medial aspect of the posterior femoral condyle”.

Shorter and more vertical is the posterior cruciate ligament. The PCL is twice as thick and twice as strong as the typical ACL. It is composed of “two bundles: the posteromedial bundle, which makes up 35% of the PCL, and the anterolateral bundle, which makes up roughly 65% of the PCL”.

Nerve supply:

“The major nerves supplying the knee joint are

1) Tibial Nerve.
2) Lateral Popliteal Nerve.
3) Infrapatellar branch of Saphenous Nerve”

Anastomosis :

“Five genicular arteries—the Superior Lateral, Superior Medial, Inferior Medial, Inferior Lateral, and middle genicular arteries—as well as the Descending Genicular Artery, a branch of the Femoral Artery, the Descending branch of the Lateral Circumflex Femoral Artery, and the Anterior Tibial Recurrent Artery, a branch of the Anterior Tibial Artery—provide blood to the highly vascularized knee joint”.

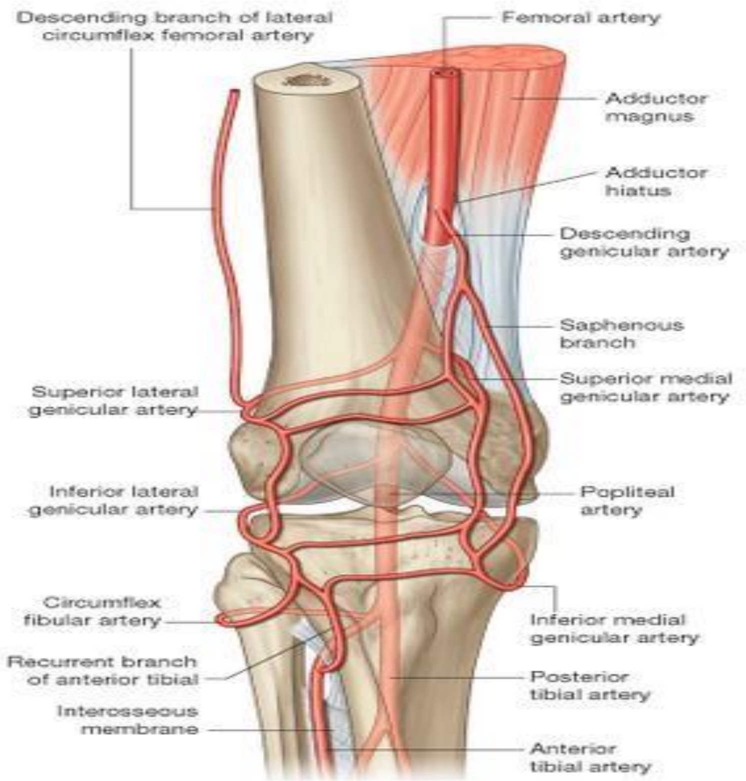


Figure 10: blood supply of knee

Pathophysiology of Osteoarthritis of Knee:[12]

Comprising osseous elements (distal femur, proximal tibia, and patella), cartilage (meniscus and hyaline cartilage), ligaments, and a synovial membrane, the knee is the biggest synovial joint in humans. The avascular cartilage receives lubrication and nourishment from the synovial fluid, which is produced by the latter. Unfortunately, this joint is frequently the site of painful disorders like osteoarthritis (OA) because to its heavy use and tension.

Based on its etiology, "OA is divided into two categories: primary (idiopathic or non-traumatic) and secondary (often brought on by trauma or mechanical misalignment). The 1957 Kellgren–Lawrence (KL) system can also be used to classify the disease's severity based on radiographic evidence. It was once thought that OA was solely a cartilage- degenerative illness, but new research has shown that it is a complex condition with several contributing causes, including trauma, mechanical pressures, inflammation, biochemical reactions, and metabolic abnormalities. It is also known that other tissues are involved besides cartilaginous tissue. At least in the early stages of the disease, the cartilage cannot produce pain or inflammation on its own since it lacks innervation and vascular. Therefore, alterations to the non-cartilaginous elements of the joint, such as the joint capsule, synovium, subchondral bone, ligaments, and peri-articular muscles, are the primary cause of pain. These components are impacted as the disease progresses, and alterations such as bone remodeling, the development of osteophytes, periarticular muscle weakness, ligament laxity, and synovial effusion may become noticeable".

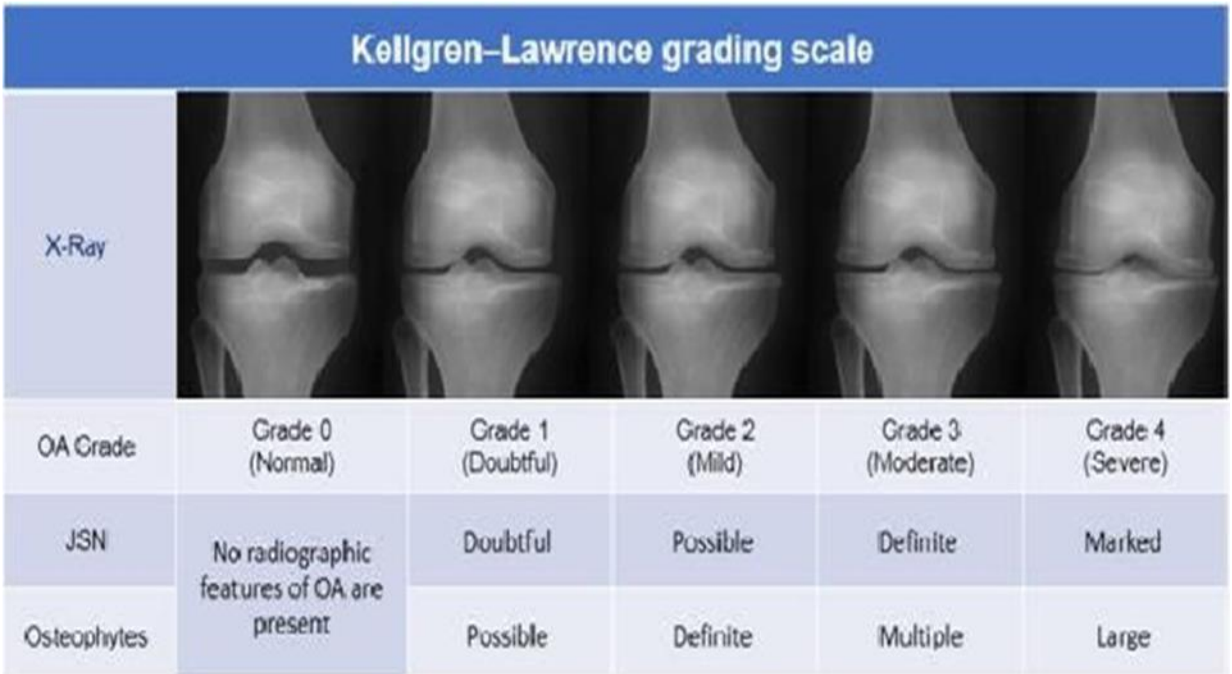


Figure 11: Kellgren and Lawrence grading for OA

It is unclear how inflammation functions, and there is continuous discussion about whether the inflammatory response causes the OA changes or if the inflammation is a byproduct of the OA changes. In contrast to inflammatory arthritis, OA is characterized by low-grade, chronic inflammation that primarily involves innate immune pathways. One typical finding of OA is synovitis, which is the infiltration of inflammatory cells into the synovium. This condition can occur in the early stages of the disease but becomes more common as it progresses and can be correlated with severity. “A number of inflammatory mediators have been identified in the synovial fluid of OA patients, including cytokines (TNF, IL1β, IL6, IL15, IL17, IL18, IL21), growth factors (TGFβ, FGFs, VEGF, NGF), prostaglandins (PGE2), leukotrienes (LKB4), plasma proteins (C-reactive protein, which has been suggested as a marker for the onset and progression of OA), nitric oxide, and complement components. All of these substances have the ability to locally trigger matrix metalloproteinases and other hydrolytic enzymes, such as prostaglandin E and cyclooxygenase 2, which can lead to cartilage degradation consequent to proteoglycan and collagen degradation”.

White blood cells also play a role; often as a defense strategy, extracellular matrix degradation produces specific chemicals known as damage-associated molecular patterns that are identified by innate immune cells, such as mast cells and macrophages. Nevertheless, tissue loss may result from this protracted and dysregulated level of inflammation. One Macrophages have been implicated in the development of osteophytes, a pathological characteristic of OA, in animal studies.

“Numerous growth factors, such as insulin-like, platelet-derived, fibroblast 18, and transforming growth factor B, are among the body's defense measures. Sadly, people with knee OA have altered levels of these growth factors, which can be detrimental to the joint. Total knee arthroplasty (TKA)” surgeries are becoming more common. According to a review of the literature, India performs more joint replacement surgeries than any other country. An estimated two million knee replacement procedures are anticipated to be performed. 13. It is anticipated that these treatments would advance at the fastest rate in the world. Up to 20% of patients are unhappy with the results of total knee arthroplasty (TKA), despite major improvements in prosthetic design, componentry, and patient-specific rehabilitation programs. 14 Leg alignment and implant site accuracy are two of the most crucial predictors of long-term implant longevity, patient satisfaction, and clinical outcomes. and clinical results are leg alignment and implant site precision.

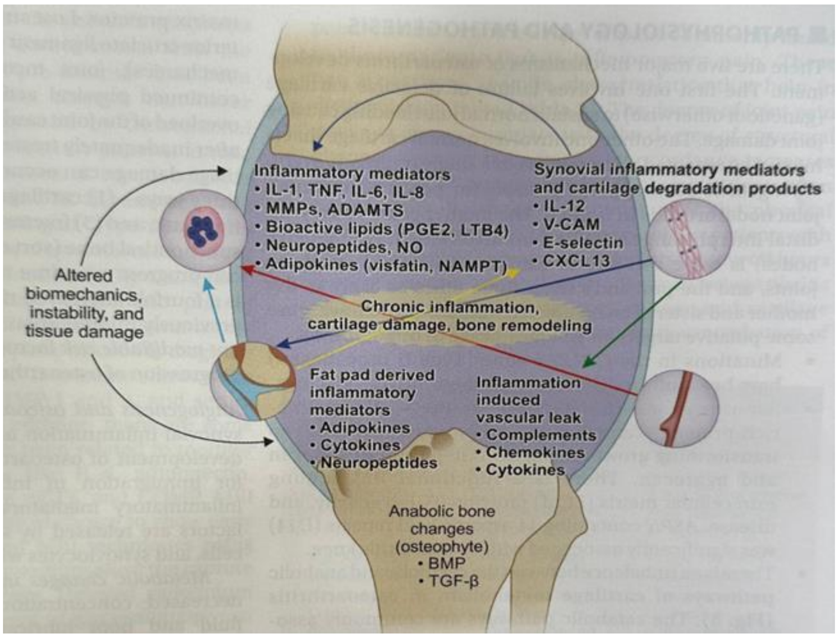


Figure 12: Pathophysiology of OA

"It follows that a functioning complete knee replacement must be correctly aligned, meaning it must lay in the proper axial and rotational planes as well as along the mechanical axis. Unusual wear, premature mechanical loosening, and patellofemoral issues might result from improper alignment. Over the past few decades, advances in knee replacement technology have been made, including patient-specific implants, computer navigation, enhanced recovery programmes, various implant designs and materials, and cutting guides based on computed tomography and magnetic resonance imaging. These developments have all occurred since TKA was first introduced as a surgical option for end-stage knee osteoarthritis".[15-18]

KNEE KINEMATICS

A thorough understanding of the kinematics and behaviour of the various knee structures should be the first step for any surgeon. Without this information, we are unable to decide how best to treat or manage any knee abnormalities. ROTO- TRANSLATION is the term used to describe the movement of the knee, which is a modified hinge joint.[32]

"The knee joint is a complex structure that facilitates essential movements such as flexion, extension, and rotation, which are vital for daily activities and athletic performance. Understanding the detailed kinematics of the knee is crucial for diagnosing and treating various musculoskeletal disorders. Additionally, the quadriceps angle (Q-angle) plays a significant role in knee biomechanics, influencing the distribution of forces across the joint and potentially impacting injury risk."[33]

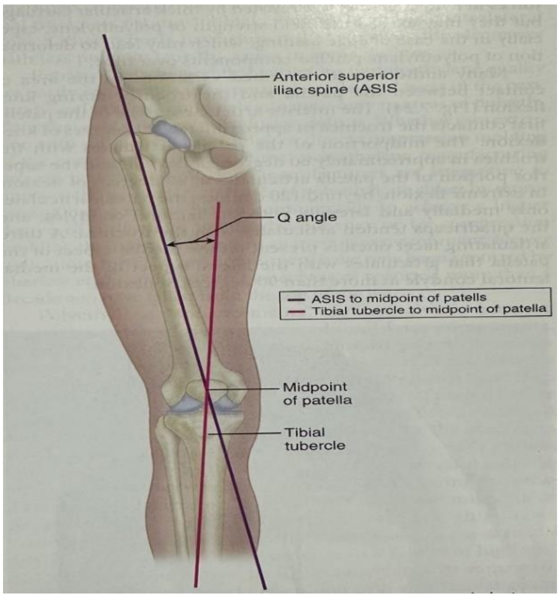


Figure 13: Q angle of knee

The femur, tibia, and patella interact intricately in knee kinematics. The anterior and posterior cruciate ligaments control how the femoral condyles roll and glide across the tibial plateau during flexion and extension. Stability against valgus and varus forces is provided by the medial and lateral collateral ligaments, respectively. The menisci contribute to the intricate kinematics of the knee by improving joint congruency and load distribution. Walking, running, and jumping are all activities that need these synchronized motions. [34]

The angle created between the patellar tendon and the quadriceps muscle's line of pull is known as the Q-angle. It is a clinical tool used to evaluate the patella's possible lateral pull and the knee joint's alignment. A higher incidence of patellofemoral joint disease, such as anterior knee discomfort and patellar dislocation, has been linked to an elevated Q-angle. According to studies, women tend to have a wider Q-angle than men, which could be one reason why female athletes have knee injuries more frequently than male competitors. The Q-angle's clinical importance is still up for discussion, though. According to some study, a greater Q-angle should not be used alone to predict injury risk, even though it may correspond with specific knee diseases. Important roles in knee joint health are also played by elements like muscle strength, neuromuscular control, and general limb alignment. [33, 34]

"A comprehensive understanding of knee kinematics and the implications of the Q-angle is essential for clinicians and researchers. While the Q-angle provides valuable insights into knee alignment, it should be considered alongside other biomechanical and anatomical factors when assessing knee health and injury risk".

Radiology for TKA:[35]

"Vertical Axis: On normal weight-bearing anteroposterior radiographs, a vertical line that extends distally from the center of the pubic symphysis is known as the vertical axis. This axis is used as a reference axis/line from which the other axes are determined".

Mechanical Axis: “By drawing a line from the center of the femoral head to the center of the ankle joint, one can calculate the mechanical axis of the lower extremity. This line has a slope of about 3° in comparison to the vertical axis. This can be further separated into the tibial mechanical axis, which spans from the center of the proximal tibia to the center of the ankle, and the femoral mechanical axis, which” runs from the head of the femur to the intercondylar notch of the distal femur. The hip-knee-ankle angle, which represents the overall alignment of the lower extremity, is the medial angle created between the mechanical axis of the femur and the mechanical axis of the tibia. In normal knees, this angle is often slightly less than 180°. “Depending on the patient's height and pelvic width, the mechanical axis's position typically causes it to pass just medial to the tibial spine, but this can vary greatly (greater pelvic width, as in females, and lower height resulting in increased axis deviation)”.

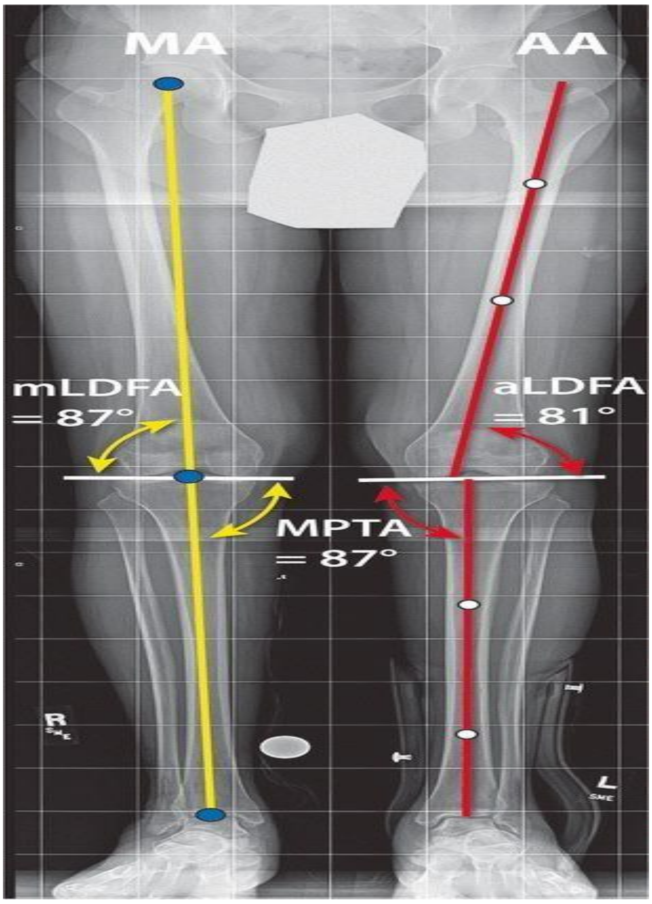


Figure 14: mechanical and anatomical axis of knee

“Long-leg standing radiograph demonstrating the mechanical axis of the lower extremity (MA), mechanical axis of the femur (MA), and anatomic axis of the femur and tibia (AA). The angle between the MAF and AAF is typically between 5° and 7°. The joint line forms an angle (α) that is 93° with the MAT, or 3°of varus”

Anatomical Axis: An axis with respect to the intramedullary canals is the lower extremity's anatomical axis. The femur's anatomical axis is defined using two different techniques. In the first approach, the femur is divided in half by a “line drawn proximal to distal in the intramedullary canal. In the second method, the medial and lateral cortex are equally spaced from the center of the femoral shaft to a position 10 centimeters above the knee joint. A line drawn in the intramedullary canal from proximal to distal splits the tibia in half, forming the anatomic axis of the tibia. The tibia's anatomical and mechanical axis typically line up exactly on anteroposterior examination. But compared to the mechanical axis, the femur's anatomic axis is inclined by about 5 to 7 degrees. Furthermore, femoral or tibial abnormalities, as well as the patient's hip angle, might cause a significant deviation in the anatomic axis. The femorotibial angle (FTA) is the lateral angle between the femur and tibia's anatomic axis on a weight-bearing radiograph. Men's typical femorotibial angle is roughly 178°, while Asian and Caucasian women's averages are 176° and 174°, respectively. However, the femorotibial angle can be significantly impacted by certain circumstances, such as axial limb rotation and flexion deformity”.

Kinematic Axis: Three functional kinematic axes, around which the knee rotates, serve as the foundation for kinematic alignment in total knee replacement. The kinematic axes, in contrast to the previously discussed “axes, are designed to replicate the dynamic motions of the knee. They are made up of the tibia's flexion and extension along the femur's transverse axis, which goes through the middle of a circle that accommodates the femoral condyles. The patella's flexion and extension with respect to the femur is shown on another transverse axis. This axis is parallel to the first transverse axis, proximal, and anterior. The tibia's internal and exterior rotational movements in regard to the femur are controlled by the longitudinal axis, which is perpendicular to the preceding two axes".

First generation

In the most recent 80 years, J. O'Connor developed 6the Four-Bank Link Theory and carried out the first substantial study on knee kinematics. 36 He demonstrated how the "four-bar link" that controls the knee's kinematics is made up of the articulation of the tibia and femur surfaces, as well as the "PLC and ACL. The center of rotation was the intersection of the cruciate ligaments. In his opinion, knee bending results in a rollback and a posterior shift in the center of rotation.
A shift in the axis of rotation from extension to flexion, first posteriorly and then distally, is what causes the knee roll-back. J-CURVE femoral components were developed in the 1980s and 1990s as a result. This new design not only matched the diminishing radii and changing flexion-extension axis, but it also verified the "rollback" and "four-bank link" ideas. Examples of this type of design include Persona, Journey II, and Vanguard; the characteristics and limitations of each implant are identical. These traditional knee implants slip anteriorly (paradoxical motion) due to tibio-femoral incongruity in flexion and the loss of stabilizing structural functions. Each of these problems is well described in the literature.[37] Authors call the forward sliding of the femur on the tibia "paradoxical motion." The patella-femoral or spine/cam contact may be the source of the anterior knee pain and auditory impacts that result from this.[38] This kind of problem, involving engagement at 65° to 70°, was

previously observed in the traditional PS knee (Cam & Post).[39] During this time, numerous kinematic studies have been done in an effort to find a solution by overcoming the Four-Bar Link Theory. A study by D. Eckoff found that "the centre of each cylinder lies on a single axis, but the radius of the cylinder fit to the medial femoral condyle is slightly larger in radius compared to the cylinder fit to the lateral femoral condyle".[40]

Second generation

However, Hollister was the first to deny the O'Connor Theory in 1993. Her study, "The Axes of rotation of the knee,"[41] revolutionized everything by introducing the novel idea of a single axis of rotation. She examined the mobility of six fresh frozen cadaver specimens using internal-external rotation and flexion-extension. The longitudinal and flexion axes were located using a mechanical axis finder. Prior research recorded 3D motion using 2D methods. Originally believed to be in red, the knee's axis is really in black, according to research. "The origins of the collateral ligaments, superior to the cruciate ligaments' intersection, can roughly represent a single flexion-extension axis, refuting the "Four-Bar Link" idea. She also noticed that the center of the tibia is where the longitudinal rotation axis passes". These kinematic principles were supported by other studies conducted over the same time span. In their study, Blaha et al. examined 130 cadaveric femurs.[42] "After the femurs were cross- sectioned and measured from drill hole to distal and posterior condyles every 10°, they bore a Steinmann pin into the flexion/extension axis. After 100°, they discovered round femora". At each interval, the distance between the drill hole and the distal and posterior condyles was almost similar, indicating a continuous flexion-extension axis. The second generation of implants was created between 1990 and 2000 using these novel ideas. Although symmetric rollback was intended by the design of the single radius knee prosthesis, it lacked tibio-femoral congruency and was frequently linked to instability.

Last generation

"In 2000, additional 3D studies of the medial pivoting kinematics led to the current age prosthesis, following the first generation based on 2D studies and the second generation single radius knee design based on 3D femoral only studies". The ideas of medial stability and lateral translation with respect to the tibia embodied the novel insight. Following Nakagawa and numerous others, including Johal and Komisteck, Freeman and Pinskerova were the first to recognize the difference in mean and value between the medial and lateral compartments. They came to the conclusion that the lateral side moves anteriorly and posteriorly to allow for rotation, while the medial side remains stable.

The axis was not situated where the cruciate ligaments crossed. The medial condyle had the tightest arrangement of the helical axes. The epicondylar axis was roughly represented by the average of all axes.[43] Additionally, the lateral tibia's and the medial tibia's concave aspects are shown by the MRI and anatomical observations that underlie the differences between these compartments. [44] "The new generation's medial pivot design is based on the constant radius, the stable pivoting movement patterns on the medial epicondyle, and the arcuate translation on the lateral condyle".

Every structure in nature has a distinct function. The medial meniscus provides stability, the lateral meniscal channel permits 15° of motion, and his anterior lip prevents the anterior slide and his posterior lip prevents the posterior slide. The anterior and posterior slides are stopped by the PCL and ACL, respectively.

“Replicating nature as much as possible is the aim of the new design. consistent strain on collateral ligaments, early range of motion, the restoration of the anatomic patellar track, and a consistent contact area throughout the whole range of motion are all benefits of a constant radius”. [45]

The primary characteristics of medial pivot knees include full range of motion stability, femoral-insert medial conformance, and a constant radius in both condyles as a result of the spherical geometry. Together, these factors provide a stable tension on the collateral ligaments and a repaired flexion/extension axis. “These days, the medial pivoting kinematic is based on the ideas of continuous femoral radius, medial ball-in- socket, and lateral rollback, all of which combine to mimic nature as closely as possible. The goal of the upcoming generation of knees is to significantly enhance function and stability”.

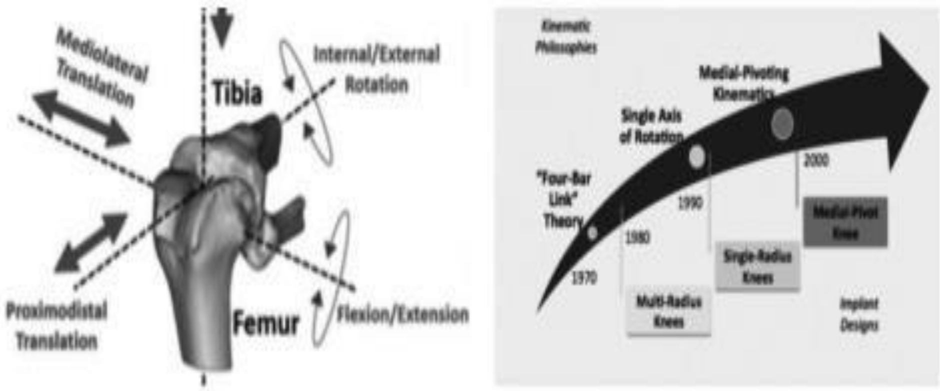


Figure 15: Knee Kinematic

Indications of TKA:

“The most common underlying diagnosis and justification for total knee arthroscopy (TKA) is end-stage, degenerative osteoarthritis of the knee, which accounts for 94 to

97% of knee replacement procedures performed for primary or post-traumatic osteoarthritis.[29] These patients must be suffering from pain and functional difficulties" due to degenerative changes in their knees that have not improved with conservative or non-operative treatment. It is a reliable process that reduces discomfort and improves the patient's functional condition. The following are other indicators that a total knee replacement is required: [30]

- "Grade 3 or 4 OA.
- Age > 60 years.
- When systemic rheumatic diseases, such as rheumatoid arthritis, have caused significant damage to the knee joint
- Old or new trauma causing fractures that cannot be repaired.
- Reconstruction of the proximal tibia and distal femur in cases of skeletal tumors (either primary or secondary metastases)".

Contra-indications of TKA:

"TKA is contraindicated in the following clinical scenarios:

Absolute -

- Active/recent local knee infection or sepsis.
- Extensor mechanism discontinuity.
- Recurvatum deformity.
- Fixed flexion deformity >60 degrees.

Relative –

- skin conditions such as psoriasis within the operative field.

- venous stasis disease with recurrent cellulitis.
- neuropathic arthropathy.
- superobesity (BMI ≥ 45)
- recurrent urinary tract infections
- history of osteomyelitis in the proximity of the knee".

Implant Types:

Since the 1950s, implant kinds have kept changing. In the 1970s, Insall et al. first detailed the many types of knee prostheses. He divided them into two groups: hinged-type parts that compromised the ligaments and condylar replacements that preserved the ligaments.

Four models were presented, each one becoming more complex::[46]

1. "Unicondylar
2. Duocondylar
3. Geometric
4. Guepar"

In "modern arthroplasty, most implants are a derivative of these models that were initially described. They include unicompartmental, cruciate retaining, posterior stabilising, constrained non-hinged, constrained hinged prosthetic components from least complex to the most complex".[47,48]

Cruciate Retaining (CR)[48]

Overall viability necessitates a capable and functional PCL at the expense of the ACL. People with moderate varus/valgus deformities can utilize it. Because it increases the chance of either a short-term or delayed rupture of the PCL, it should be avoided by those with inflammatory arthritis.

Benefits:

- “Fewer patellar complications (theoretical)
- Increased quadriceps strength (controversial, depends in part on surgical exposure utilised)
- Improved stair climbing
- Preserved PCL proprioception (theoretical)
- Lower shear forces on the tibial component
- Improved femoral bone stock preservation
- Preserves near-normal knee kinematics
- Avoids cam-post jump complication that exists in posterior stabilised prosthetic components
- Disadvantages:
- Risk of postoperative PCL degeneration or rupture that can lead to flexion instability
- Tight PCL can lead to increased wear on polyethylene and dysfunctional TKA kinematics”.

Figure 16: cruciate retaining prosthesis

Posterior Stabilising (PS)[48]

Because it "can provide some anteroposterior stability that is lacking because of the weak extensor mechanism, it can be employed in patients with inflammatory arthritis, nonexistent PCL, and those who have had a previous patellectomy. In the PS femoral prosthetic component, the resected PCL is replaced by a box in the femoral component with a post on the polyethylene liner".

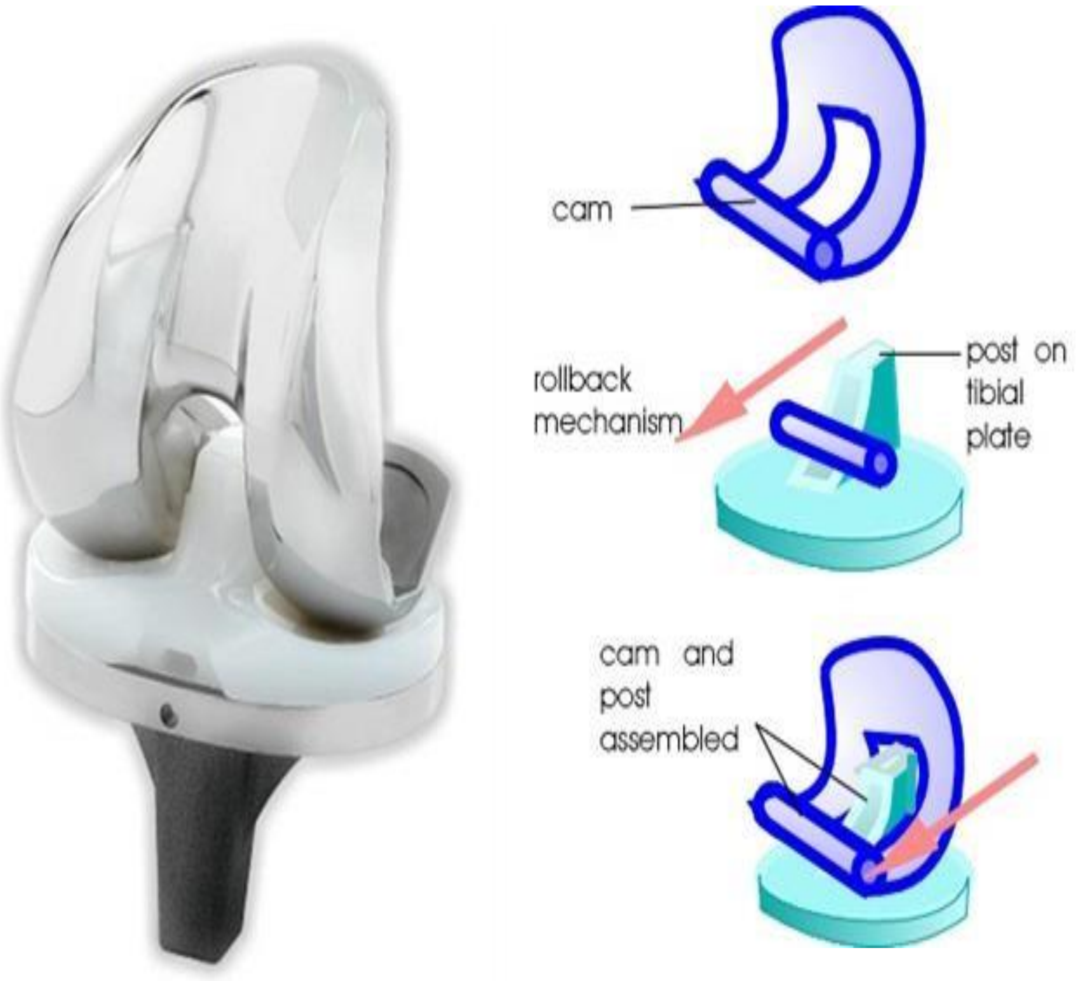


Figure 17: posterior stabilizing prosthesis

- “slightly more constrained prosthesis that requires sacrifice of PCL.
    - resection of PCL increases the flexion gap in relationship to extension gap so posterior must be matched to avoid flexion-extension mismatch
  - femoral component contains a cam that engages the tibial polyethylene post during flexion
  - polyethylene inserts are more congruent, or deeply "dished”
- Indications
  - “previous patellectomy
    - reduces risk of potential anteroposterior instability in setting of a weak extensor mechanism
  - inflammatory arthritis
    - inflammatory arthritis may lead to late PCL rupture
  - deficient or absent PCL
- Radiographs
  - lateral radiograph will show the outline of the cam, or box, in the femoral component
- Advantages
  - easier to balance a knee with absent PCL
  - arguably more range of motion

    - easier surgical exposure
- Disadvantages
    - cam jump
        - mechanism
            - with loose flexion gap, or in hyperextension, the cam can rotate over the post and dislocate
        - treatment
            - initial
                - closed reduction by performing an anterior drawer maneuver
            - final
                - revision to address loose flexion gap
    - tibial post polyethylene wear
    - patellar "clunk" syndrome
        - mechanism
            - scar tissue gets caught in box as knee moves into extension
        - treatment
            - arthroscopic versus open resection of scar tissue
    - additional bone is cut from distal femur to balance extension gap”

Overall, numerous investigations have not shown a discernible difference between posterior stabilizing and cruciate-retaining implants in terms of function, satisfaction, or implant survival.

Constrained Non-Hinged[48]

When there is considerable bone loss, flexion gap laxity, or an LCL or MCL deficit, a varus-valgus restricted design is employed. This implant features a deep femoral box and a large tibial post.

Benefits:

 “Allows for coronal stability in severe coronal bone deformities

Disadvantages:

 Increased femoral bone loss and is a poor option in younger patients unless necessary.

 Increased risk of aseptic loosening due to increased constraint

 Increased polyethylene wear and increased risk of cam fracture”

Figure 18: constrained non hinged prosthesis

Constrained Hinge[48]

"In complicated revision arthroplasty cases with considerable bone loss, ligamentous laxity, or oncologic situations, rotating hinge prostheses are utilized. An axle connects the tibial and femoral components, and the tibial bearing can revolve around the tibial platform. This rotation reduces the danger of aseptic loosening by enabling a lower restriction". Early implants had a high rate of aseptic loosening and were uniplanar, meaning they could not rotate.

Advantages:

 "Very versatile and has application for many salvage cases

Disadvantages:

 Significant bone resection needed for implant

 Although lower with a rotating hinge, still at risk for aseptic loosening due to increased constraint".

Figure 19: constrained hinged prosthesis

SURGICAL TECHNIQUES[49]

For a successful total knee replacement, meticulous planning and Evaluation are a must, and a neatly performed surgery has a better outcome.

Preoperative Planning:

Before surgery, each patient underwent a thorough preoperative evaluation. This includes a thorough physical examination, a comprehensive clinical history, and meticulous documentation of the patient's ambulatory status. Analgesics and physical therapy, emphasizing static quadriceps strengthening exercises, comprised the first conservative care.

It is necessary to rule out any infectious focus, varicose veins, or DVT. Additionally, clinical evidence for ligamentous instability is examined. In order to rule out any inflammatory pathology, blood tests are performed. For each patient, a full-length standing AP (anteroposterior) lateral x-ray was taken.

"Anatomical and mechanical axes were constructed using full-length x-rays, and the amount of varus or valgus deformity was calculated in order to evaluate the radiographs for joint narrowing or any other bone abnormality. All patients gave their proper written consent. All of the patients were informed prior to surgery about the lifestyle changes they would need to make, such as refraining from squatting and sitting with their legs crossed following TKR". Prior to surgery, a medical evaluation was acquired for every patient. All patients were instructed to fast overnight and get antibiotic prophylaxis prior to surgery.

In Operation theatre:

The patient was placed in a supine posture. The table has a sandbag attached to it with plaster to enable a 30-degree knee flexion. Spinal and Epidural anesthesia was used throughout the surgery. "Betadine scrub was used for a thorough first wash, extending from the proximal third of the thigh to the foot. A high-pressure pneumatic bandage was placed over the thigh. With betadine, the limb was carefully prepped and draped".

In terms of mortality, length of surgery, and nerve palsy, Johnson et al.'s systematic evaluation revealed no statistically significant differences between the two.[50] A medial parapatellar arthrotomy is usually performed with a conventional midline incision.

Figure 20 : anterior midline incision

The midvastus, subvastus, and lateral parapatellar approaches are further methods, though. The V-Y turndown, tibial tubercle osteotomy, and quadriceps snip are more extensile techniques.[51] Maintaining broad skin flaps and honoring the medial to lateral blood flow are crucial during the approach. To ensure proper healing at the end of the treatment, a tiny cuff must be maintained during the arthrotomy. A soft tissue release is carried out medially after the proximal tibia's medial soft tissues are skeletonized off of the bone. The lateral side undergoes the same process. A more thorough medial release is the preferred option, nevertheless, given varus abnormalities are present in the majority of cases. It is possible to remove the infrapatellar fat pad entirely or in part. Excision of the ACL and the medial and lateral meniscus will be necessary. Additionally, if a posterior stabilizing implant is wanted, the PCL should be sacrificed. Resurfacing the patella is not always required. But it should be in patients with patellofemoral arthritis or severe anterior knee discomfort. Notably, those who do not have resurfacing had a higher frequency of anterior knee discomfort and a higher revision rate. However, resurfacing increases the risk of problems including fractures or tendon injuries. The two treatments have comparable overall patient satisfaction rates.[52]

"The sequence of steps during knee arthroplasty will be dependent on the technique selected by the operative surgeon. These techniques include":

SOFT TISSUE RELEASE

Varus Knee

"Varus knee is the most common deformity of osteoarthritis knee.

Order of release

Varus knee

1. Deep medial collateral ligament to the posteromedial corner of Knee.
2. All the osteophytes on femur and tibia.
3. Semimembranosus aponeurosis.
4. Superficial medial collateral ligaments.
5. Pes anserinus insertions.
6. Posterior Cruciate ligament.

7. Strip the periosteum of the tibia distally for an additional 4 to 5 cm if medial contracture still persists”.

Valgus knee

1. “Lateral osteophytes

2. Capsular attachments over lateral tibia

3. Lateral patellofemoral ligament

4. Iliotibial band released from gerdys tubercle

5. Popliteus

6. Lateral collateral ligament from femur.

7. Posterior cruciate ligament.

8. Biceps tendon of fibular head.

Flexion contracture

1. Posterior osteophytes removal.

2. Posterior capsule release.

3. Posterior cruciate ligament.

4. Tendinous orgins of gastrocnemius”.

Distal femoral resection

The knee is flexed to 90 degrees after an arthrotomy in which both femoral condyles may be seen clearly. “A drill hole is drilled 1 cm above the intercondylar notch's ceiling, somewhat medial to the notch's apex and anterior to the posterior cruciate ligament's origin”. The guide rod may pass easily because the canal was overdrilled at the entrance.

For the distal resection, two resection slots of 0 o r +3 mm are available. The most noticeable portion of the contacting distal condyle will be 9 mm away from the 0 mm slot. “The +3mm slot will resect 12mm if more distal resection is needed. The resection guide is moved proximally using the pin holes if more distal resection is needed than what can be done with the +3mm slot”.

The distal resection is done through the chosen slot using a saw blade. A flat tool known as a c-guide is used to inspect the distal femur that has been resected.

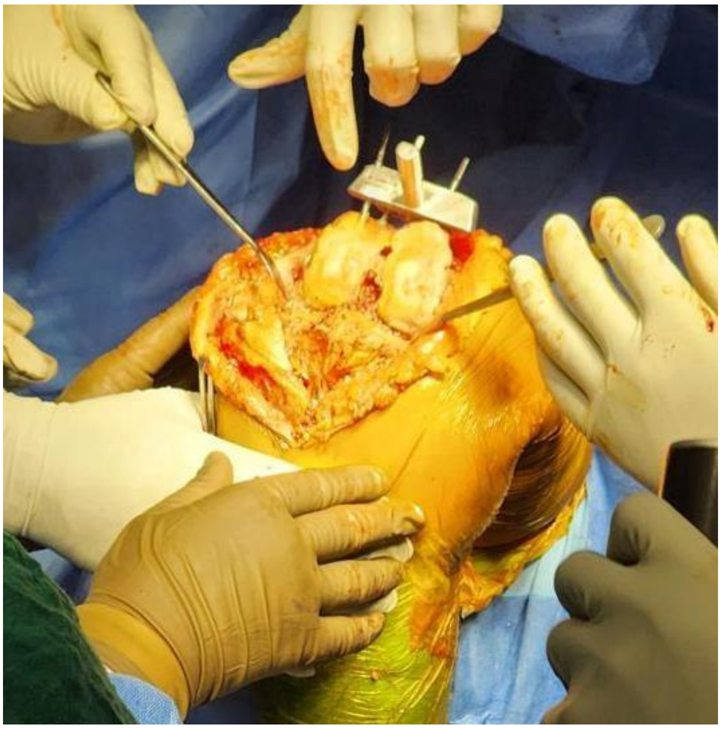


Figure 21: distal femur cuts

FEMORAL SIZING

“Femoral sizing can be done using anterior and posterior referencing. We followed posterior referencing technique”.

Anterior referencing

The main point of reference in this situation is the anterior cortex. The posterior resection changes in size, while the anterior resection is set initially. The lower size should be chosen when the sizing guide shows that the femoral implant falls between two sizes. More bone is removed from the posterior condyles when the smaller size is selected. “To read the next lower size on the stylus, turn the upper hex screw from its lowest position to raise the anterior surface. The drill holes are increased by the same amount as the anterior surface. The anterior surface is thus moved anteriorly by the same amount as the femur's A-P dimension from the next lower implant size. The posterior condyles are further resected in the same quantity”.

Posterior referencing

“Posterior femoral condyles serves as the reference point for posterior referencing technique. The posterior resection remains constant while the anterior resection varies with respect to the anterior cortex. The posterior resection will therefore be equal the posterior thickness of the prosthesis, resulting in a balanced flexion-extension space. In cases where the sizing guide indicates the femoral implant is between two sizes, the larger size should be chosen.

Size Guiding procedure

1. Knee is flexed to 90° so that the posterior condyles will be assesible.

2. The femoral sizing guide must flush against the distal femur. Ensure that the posterior paddles a r e contacting the underside of both posterior condyles.

3. Adjustable shims (1-5mm) can be attached to the posterior paddles of the sizing guide in the event rotational alignment is not appropriate due to deficient posterior condyles”.

Sizing procedure: Posterior Referencing (Fixed posterior resection)

1. "The anterior surface of the sizing guide should be in the lowest level position.

2. Insert two pins through the appropriate holes (L for a left knee, R for a right knee of the sizing guide to secure the guide and prepare holes for the A-P cutting block.

3. The sizing guide stylus should be positioned in such a way that it contacts the lateral ridge of the anterior femoral cortex (highest point on the anterior cortex of the femur).

4. Note the readings on the shaft of the stylus which indicates the size of the component.

5. If the femur is between sizes, choose the larger size"

Extramedullary Tibial Resection:

"Position the spring-loaded arms of the extramedullary jig's ankle clamp around the distal tibia, right above the malleoli, while the knee is bent. The tibial resection block is positioned against the proximal tibia by adjusting its height. With the ankle in a neutral position, the extramedullary jig is positioned parallel to the medial 1/3 of the tibial tuberosity to the axis of the second metatarsal. The jig is secured with two pins, and the stylus is attached to it such that it can cut either 9 mm (from the unaffected lateral tibial plateau). The tibial cut should be made at a neutral or slightly posterior slope in the sagittal plane and 90 +/- 2 degrees to the tibial shaft axis in the coronal plane. A saw and osteotome are used to make the tibial cut, and a tibial tray is used for tibial size."

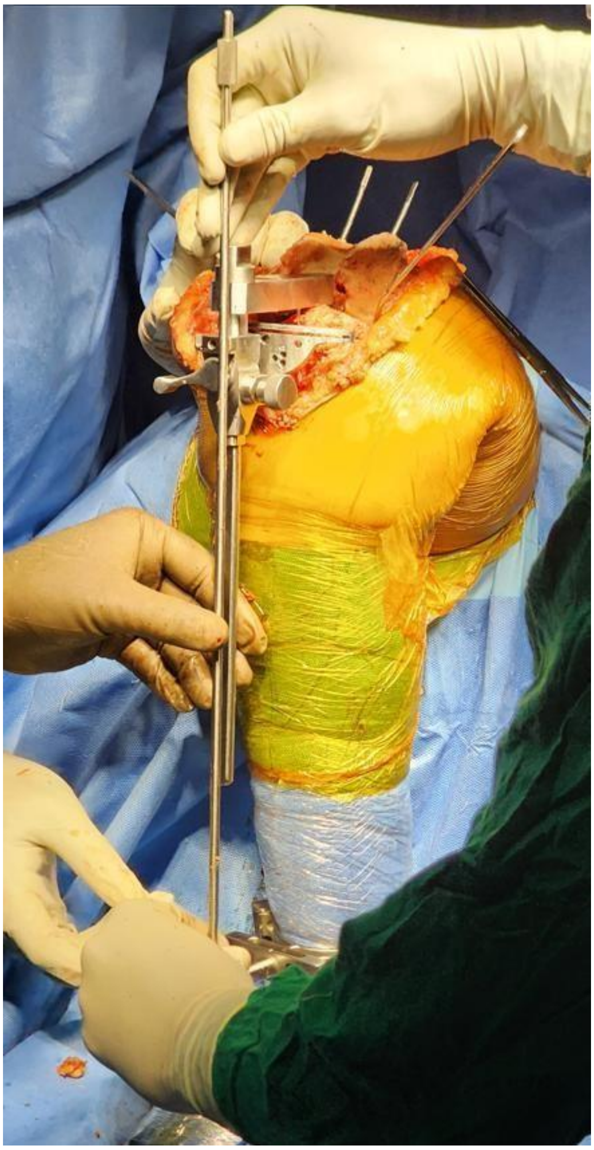


Figure 22: tibial cuts

Femoral Preparation:

A-P Femoral resection

1. "Position the fixed spikes on the A-P cutting block into the predrilled holes.

2. Ensure that the cutting block is flush with the resected distal femur. Several holes in the A-P block allow fixation of the block. Place one pin centrally through the middle holes below the quick-connect attachment. For additional stability, a smooth headed pin may be placed through the holes on the medial or lateral side of the block.

3. Complete the anterior, posterior and chamfer cuts. The block is designed to allow for angling of the sawblade during the cuts. Cuts are taken in such a way that the anterior chamfer cut is taken at the last a s the amount of bone loss will be maximum in anterior chamfer cut.

A spacer block is placed, and flexion and extension gap is checked. Ligamentous stability is similarly checked in varus and valgus. In extension the femoral and tibial alignment rods are inserted and checked for mechanical axis alignment".

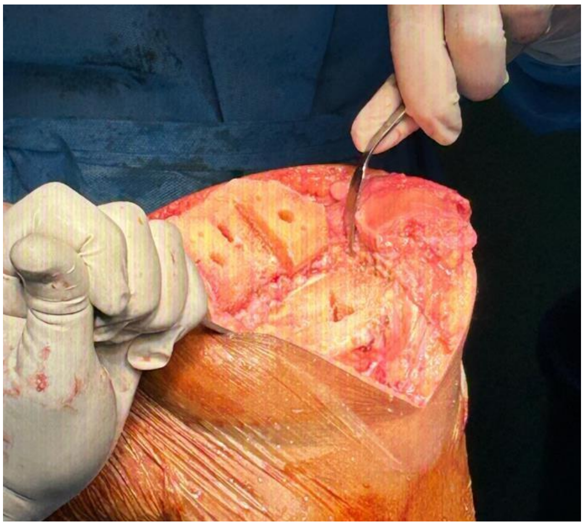


Figure 23: post tibial and femoral resection

Trial Reduction:

Femoral trail component

"Trail femoral component is applied to the resected distal femur and the femoral lock punches are made.

Tibial trail component

1. Attach a quick-connect handle to a stemless trial one size below the femoral component size and place on the cut tibia to assess coverage. As needed additional sizes should be templated using the stemless trials.

2. Once the appropriate size is determined, pin the medial size of the selected stemless trial with a short headed pin.

3. Place a trial insert into the stemless tibial trial tray and perform a trial range of motion to allow the baseplate to centre on the femoral trial. After putting the knee through a trial ROM, the surgeon should note the proper rotation of the trial tibial component on the proximal tibia and mark the tibia for future reference.

4. Using the tibial fin/stem punch, rotational alignment may be set now or at the time of trial placement".

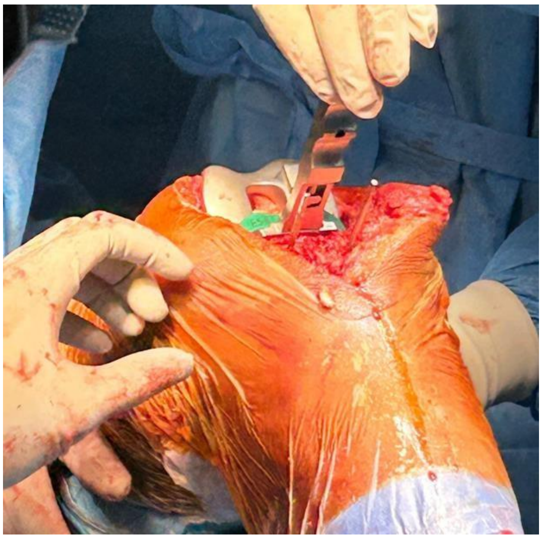


Figure 24: implant trial

Resurfacing of Patella:

The patella is circumferentially cauterized, the osteophytes are removed, and the edges are blunted. If the patella is also going to be replaced, its thickness is measured using a vernier caliper, and the patella's surface is held in place and shaved to leave 13–15 mm of thickness using a jaw clamp. After placing the patellar button jig on the surface and drilling three holes, the trial button is positioned and the patellar tracking is examined. A thorough wash is provided.

Final component implantation:

Once all the debris has been removed, flexing the knee brings the distal femur and tibia's raw surfaces into view. “The femoral and tibial components, as well as the margins of the raw surfaces and implant, are covered with bone cement. Patellar tracking is examined after the trial implant is placed, and the knee is maintained in full extension to let the cement to solidify. After maintaining a drain and immobilizing the knee with a knee brace, the wound is closed in layers”.

Figure 25: final component implantation

POST-OPERATIVE PROTOCOL

Following surgery, the identical antibiotic (Injectable Ceftriaxone sulbactum and Injectable Amikacin) and analgesics/anti-inflammatory drugs were administered to each patient. The location and alignment of the components were evaluated radiologically. Between the 12th and 14th post-operative days, sutures are removed. For the first 48 hours, a knee brace was used to temporarily immobilize each patient. On the second postoperative day, all patients had their initial examination of the wound and drain removal. To avoid bending, a bolster was placed behind the ankle during the first several days following surgery. From the first post-operative day, quadriceps strengthening activities were recommended. “Depending on the patient's compliance, active knee mobilization was initiated on the second or third postoperative day. On the third post-operative day, ambulation with a walker was permitted. By the fifth or sixth post-operative day, all of the patients were forced to bear their full weight. They were released from the hospital between days 7 and 14, and the sutures were removed between days 12 and 14”.

Rehabilitation Protocol:

A “structured rehabilitation program was implemented, beginning immediately post-surgery. This included quadriceps training exercises(static and dynamic), CPM training, early walker mobilization, and progressive physical therapy based on individual patient tolerance and recovery”.

Follow-up Assessment:

“Patients were followed up at regular intervals of 0, 3, and 6 months postoperatively. Each follow-up visit included clinical examination, radiological assessment, and functional scoring using standardized outcome measures. The progression of functional recovery and any complications were documented systematically”.

Different surgical approaches to total knee arthroplasty (TKA):[53]

“Standard Cutaneous Incisions: The two most common incisions in TKA are the midline incision and the medial parapatellar incision. The midline incision, which extends from the base of the patella to the anterior tibial tuberosity (ATT), is preferred due to its ability to preserve skin vascularization, reducing the risk of necrosis. The medial parapatellar incision, though similar in exposure, sacrifices more lateral skin vasculature, leading to increased risks.

At-Risk Incisions: Certain factors increase the risk of necrosis in incisions, including previous scars, rheumatoid arthritis, diabetes, obesity, smoking, and prolonged corticosteroid or NSAID use. To mitigate risks, surgeons should either reuse old scars when possible or ensure at least a 5 cm skin bridge between new and previous incisions. In extreme cases, a "sham procedure" (temporary incision followed by observation) can be performed to assess skin viability before the final surgery.

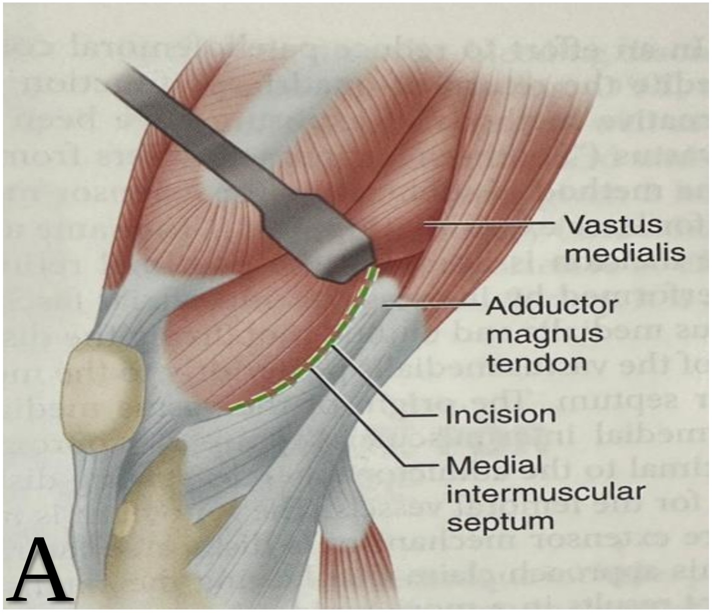
Standard Arthrotomy: The medial parapatellar arthrotomy is the standard approach for exposing the knee joint in TKA. It involves a longitudinal incision along the quadriceps tendon and medial patellar structures. The Insall version, a variation of this approach, allows better lateral patellar displacement or eversion”.

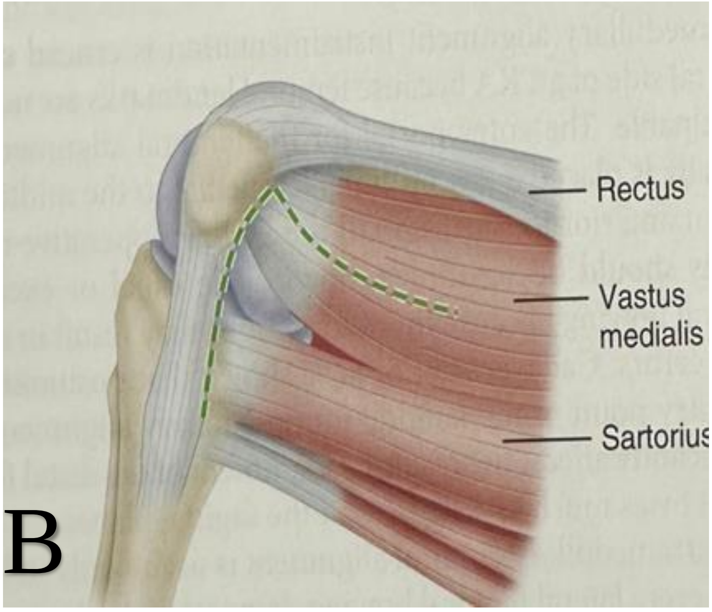
Tissue-Sparing Approaches: Minimally invasive techniques have been developed to preserve soft tissue integrity, including:

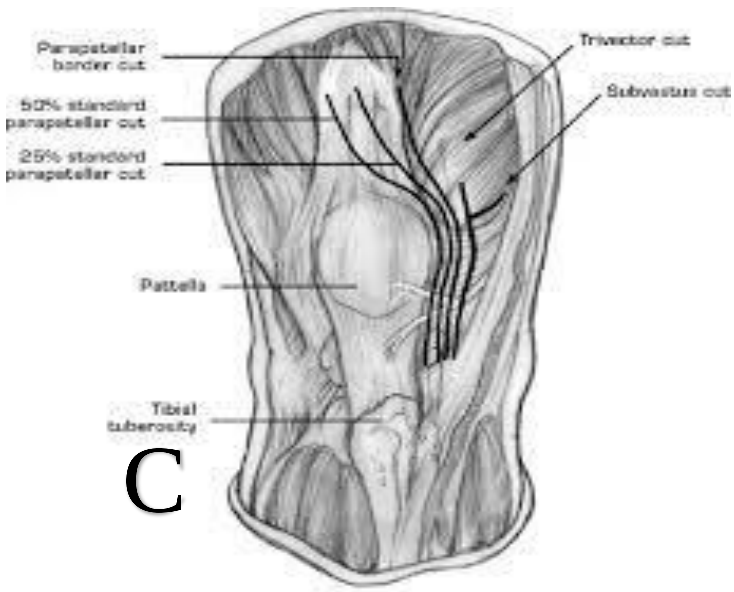
1. “Subvastus Approach – Involves blunt dissection of the vastus medialis obliquus (VMO), minimizing extensor mechanism disruption. It reduces the need for lateral release and improves post-operative recovery but is unsuitable for obese patients or those with stiff knees.

2. Midvastus Approach – A compromise between standard and subvastus approaches involving a small incision in the VMO to reduce muscle trauma while preserving the quadriceps tendon.

3. Trivector Approach – Uses a combination of incisions along the patellar and quadriceps tendons, improving patellar mobility and early post-operative quadriceps recovery”.







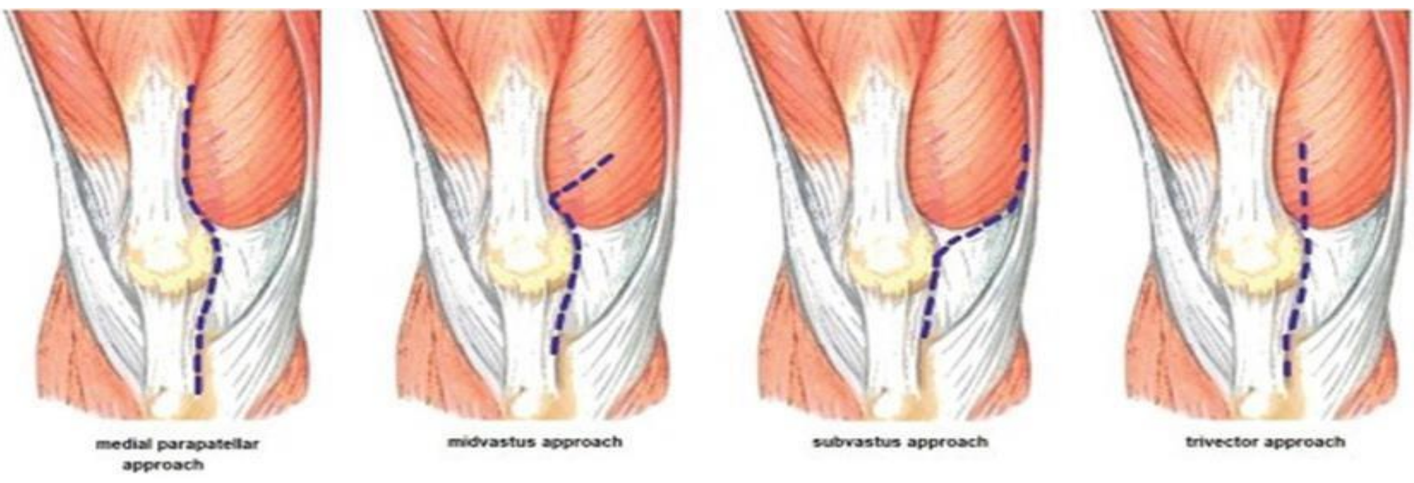


figure 26 :Other Approaches : Subvastus (A), Midvastus(B), Trivector(C)

Extensive Arthrotomies:

“For challenging cases (e.g., fibrosis, obesity, joint stiffness), more invasive techniques may be required:

1. Quadriceps Snip – Extends the medial parapatellar incision diagonally into the quadriceps, improving exposure without affecting post-operative rehabilitation.

2. Inverted V-Shaped Quadriceps Incision – A "V" shaped incision over the quadriceps, allowing better patellar mobilization but requiring a more cautious recovery.

3. Anterior Tibial Tuberosity (ATT) Osteotomy – A technically demanding approach where the ATT is cut and reflected to expose the joint. It provides excellent access but carries a high risk of complications, such as tibial fractures and implant loosening/”

Mini-Invasive Surgery (MIS)

In TKA, MIS seeks to minimize surgical trauma, protect soft tissue, and shorten recovery and post-operative pain. There is disagreement regarding the optimal incision length and patient appropriateness, hence defining MIS is still debatable. Although MIS may have advantages, research indicates that it shouldn't jeopardize long-term implant survival or surgical accuracy. The surgical strategy chosen for TKA is determined by the surgeon's experience and patient-specific circumstances. Even while typical treatments offer consistent exposure, certain patients may benefit more from minimally invasive methods for a quicker recovery. Extensive arthrotomies may be required in complicated instances; however, risks must be carefully evaluated to prevent complications.

OUTCOME ASSESSMENT:[54]

A number of scoring systems, such as the Oxford knee score (OKS), the Forgotten Joint score (FJS), and the Knee Society score, are used to evaluate the results of total knee arthroplasty (TKA). These scores are frequently determined by factors such as knee function, discomfort, and quality of life.

Scoring systems

- **"Oxford knee score (OKS):** A joint-specific patient reported outcome measure (PROM) that is considered the gold standard for evaluating TKA outcomes in England and Wales. The OKS is reliable and reproducible, and it correlates with patient satisfaction.
- **Forgotten Joint Score (FJS):** A popular tool for assessing TKA outcomes, but most studies use it to assess outcomes one year after surgery.
- **Knee Society score:** A scoring system that considers knee alignment, motion, instability, and pain. The maximum score is 100 points.

Other scoring systems Hungerford score, Hospital for Special Surgery score, Bristol score, TKA Outcome Score, and MACTAR scale.

Other outcome measures:

- Timed up and go (TUG) test, which evaluates balance, gait speed, and function."

Knee Society score:[54] The Knee Society created the Knee Society Scoring System (KSS), a straightforward rating system, to measure patient outcomes both before and after total knee arthroplasty (TKA). The KSS is a brief and easy-to-use scale that is administered by clinicians. It is composed of two parts: a Knee Score that evaluates simply the knee joint itself (pain, range of motion, stability, and radiographic alignment), and a Function Score that evaluates the patient's walking distance, stair climbing, and usage of walking aids. Although there is still debate regarding the scale's validity and reliability, it has gained widespread acceptance over time.

In 1989, when TKA was mostly done on patients who had sedentary lives, the KSS was established. Therefore, it was appropriate to evaluate knee function only based on the patient's ability to walk and climb stairs. Nonetheless, the percentage of younger, more active patients having TKA has grown within the past 20 years. Following total knee arthroplasty (TKA), these patients have higher expectations, live longer, and are more demanding when it comes to functional outcomes (e.g. stretching exercises, gardening, kneeling). Because it solely assesses basic and low-demand functional characteristics (such as walking and stair climbing), the KSS has limitations with relation to these qualities. Additionally, research has questioned the scale's responsiveness and dependability, which could obscure functional changes over time or following an intervention. The patient's perspective on expectations, satisfaction, and a wider range of everyday activities (such as housework, gardening, sports, and playing with grandkids) should be included when evaluating the functional result in order to gauge how well medical treatment is working.

Current clinical scales have been improved, and new scales have been created, in order to address the needs of the younger generation of patients. As a result, patient-reported outcome scales (PROMs) such the Western Ontario McMaster University Osteoarthritis Index (WOMAC), Oxford Knee Score (OKS), and Knee Injury and Osteoarthritis Outcome Score (KOOS) replaced clinician-administered measures (CAMs). The Knee Society has updated the KSS by integrating the currently utilized clinician-administered questions with patient-reported questions. Furthermore, more difficult tasks (like kneeling) are evaluated, and the patient's expectations and level of satisfaction are taken into account.

MATERIAL AND METHODS

- **Study design:** Prospective cohort study
- **Study area:** Department of Orthopaedics, Shri B M Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
- **Study period:** Research study was conducted from April 2023 to December 2024.

Sample size: 32

Using G*Power ver 3.1.9.4 software for sample size calculation, The Quadriceps Baseline (Mean=35.3, SD=19.2) and 3 Months (Mean=47.1, SD=24.8) this study requires a total sample size of 31, so to achieve a power of 80% for detecting a difference in Means: t tests - Means: Difference between two dependent means (matched pairs) with 5% level of significance.

Formula used $\mathbf{n=z^2\ p*q/d^2}$

Where,

Z= Z statistic at α level of significance

d2= Absolute error

P= Proportion rate

q= 100-p

- **Inclusion criteria:**

    1. Any individuals over age 50, who suffer from incapacitating knee pain brought on by osteoarthritis.
    2. The failure of non-operative therapy.
    3. Grade 3 & 4 osteoarthritis of knee (Kellgren & Lawrence classification)

- **Exclusion criteria:**

    1. Knee with fixed flexion deformity (>40%).
    2. Revision TKR.
    3. Patients with neurological deficit in the ipsilateral lower limb.
    4. Patient with psychological disorders.
    5. A current history of septic arthritis in the same knee.
    6. Valgus knee.
    7. Ipsilateral hip and ankle joint deformity and impairment.

METHODOLOGY

All patients who met the inclusion criteria were thoroughly informed about the study objectives, procedures, and follow-up requirements. Written informed consent was obtained from each participant before enrollment in the study. Initial evaluation included comprehensive history taking and clinical examination using a standardized proforma. The diagnosis was established through both clinical assessment and radiological findings.

Data Collection and Analysis:

All patient data, including demographic details, clinical findings, surgical details, and follow-up assessments, were recorded in the standardized proforma. The data was subsequently analyzed to evaluate the clinical and functional outcomes of the total knee replacement procedures.

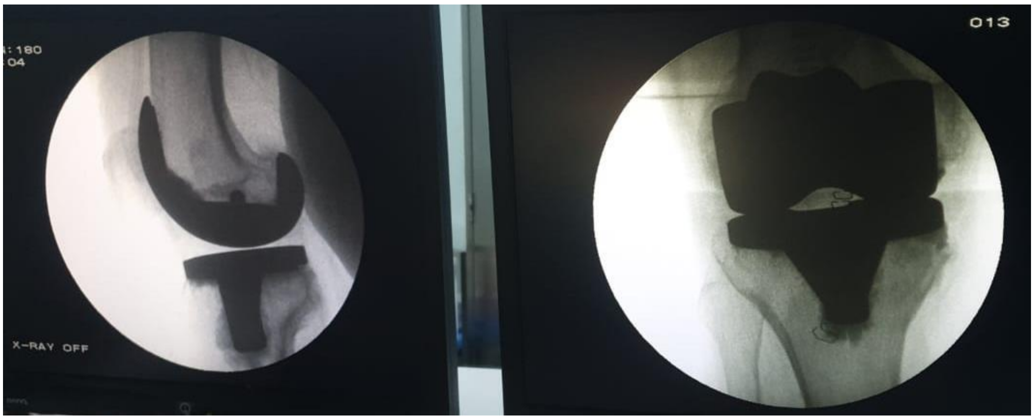
STATISTICAL ANALYSIS

"Data was entered in excel sheet and analyzed using SPSS version 21. Results were presented in tabular and graphical forms Mean, median, standard deviation and ranges were calculated for quantitative data. Qualitative data were expressed in terms of frequency and percentages. Student t test (Two Tailed) was used to test the significance of mean and P value <0.05 was considered significant".

CASE ILLUSTRATIONS

Case 1 : SIDDU IRANNA , 52/M
Diagnosis : Right knee Osteoarthritis.


Figure 27: (A) Pre-operative clinical picture & (B) Pre-operative x-ray



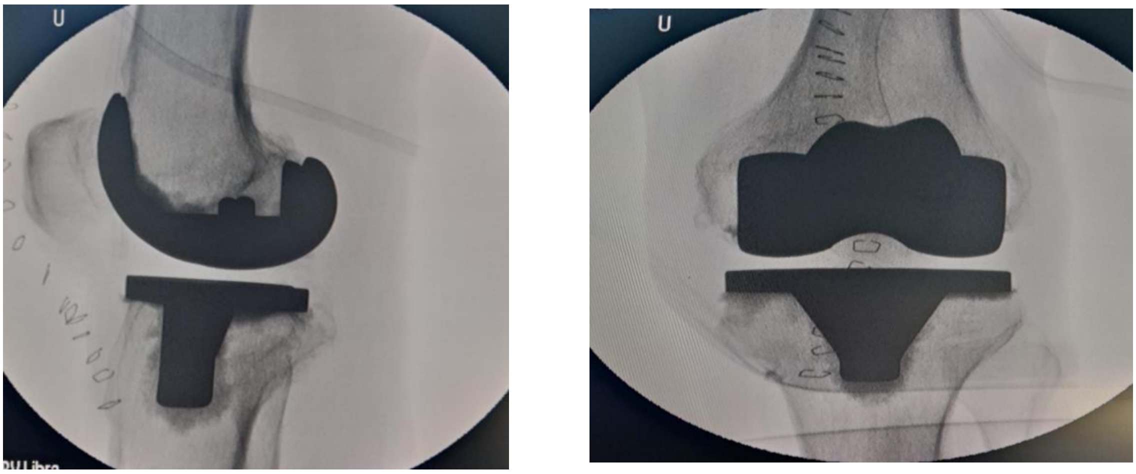
(C) Intra-operative c-arm images

(D) Post operative x ray

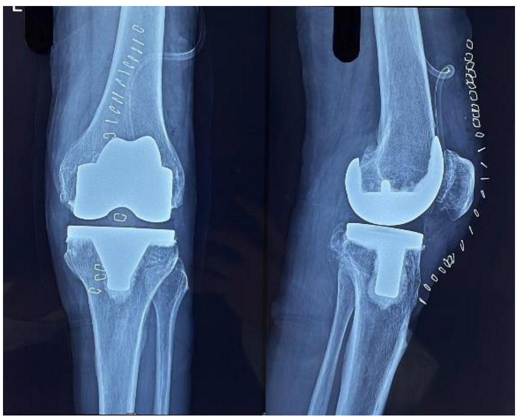
(E)Flexion at 3 months

Case 2 : SADASHIV BIRADAR , 69/M
Diagnosis : Left knee osteoarthritis.

Figure 28: (A) Pre op clinical picture & (B) pre-operative x ray



(C) Intra-operative c-arm images



(D) Post operative x ray

(E)At 3 month follow up

Case 3: ANSUYA AMBAJI , 65/F

Diagnosis: Left knee Osteoarthritis.

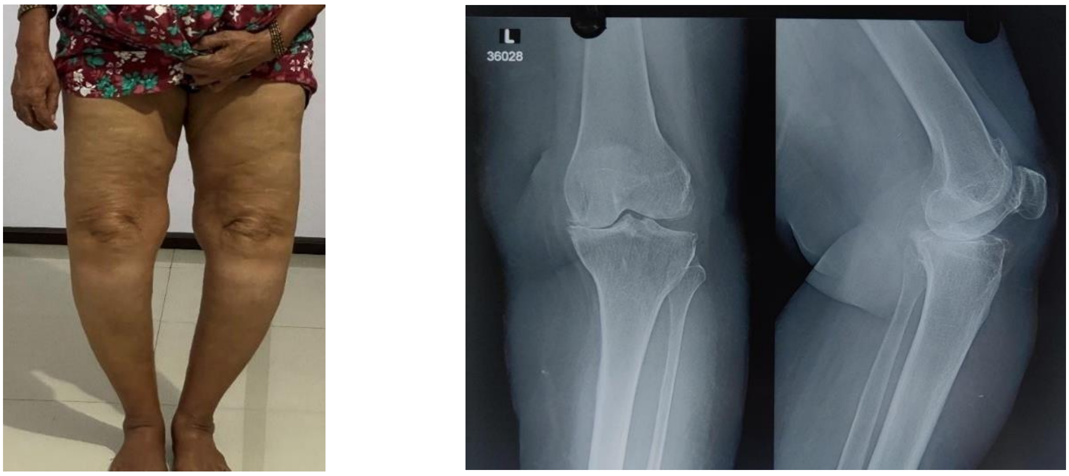
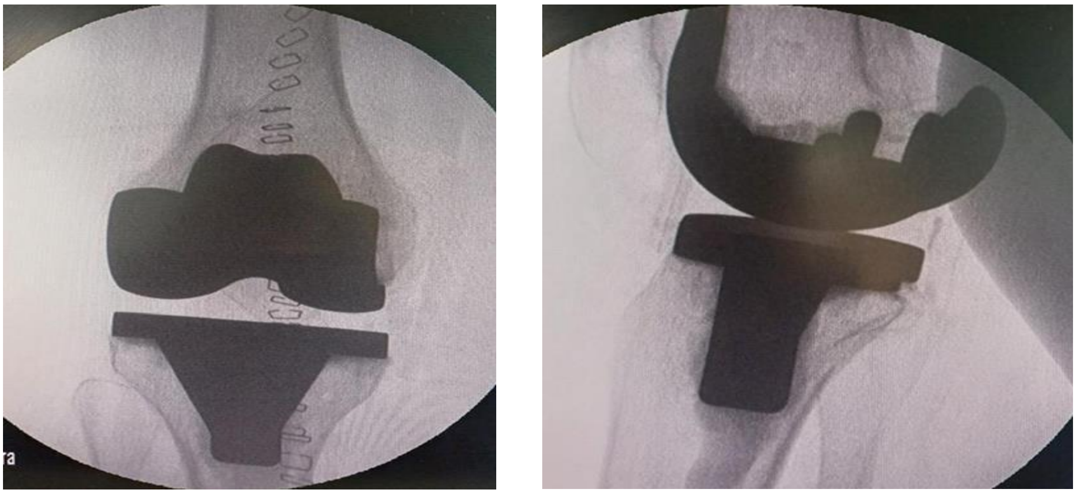
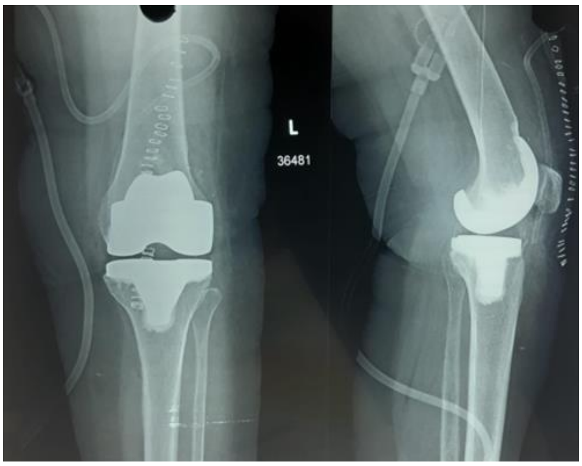


Figure 29: (A) Pre-operative clinical picture & (B) Pre-operative X-ray



(C) Intraoperative c arm picture



(D) Postoperative x ray

(E)At 6 months follow up

Case 4: CHANNAVA KAMATE, 62/F
Diagnosis: Left knee Osteoarthritis.

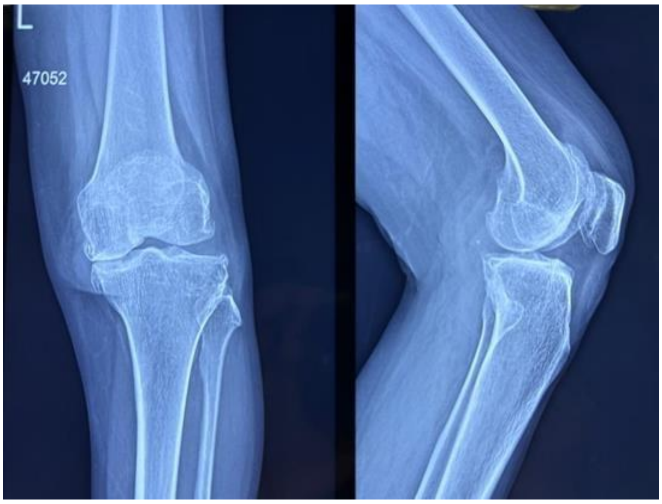
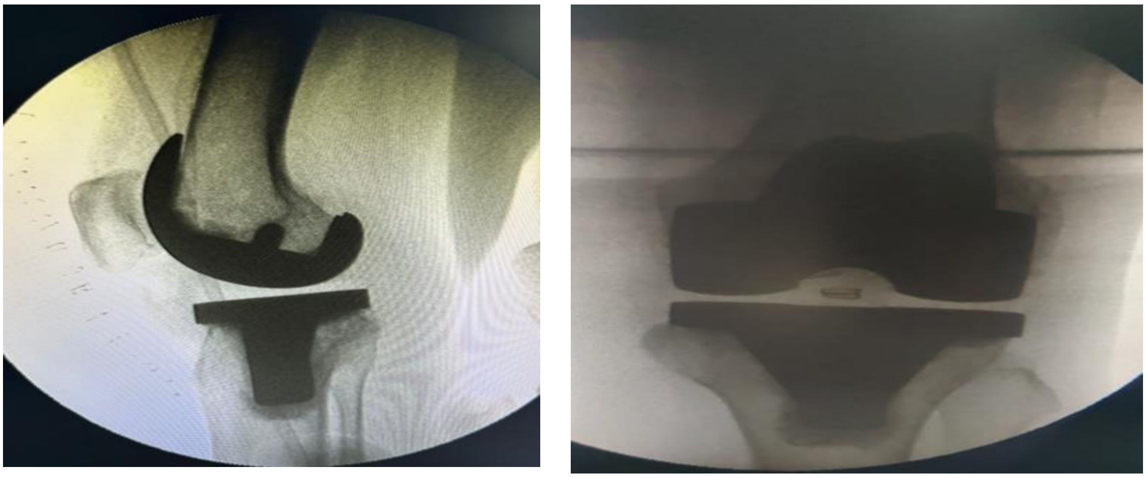


Figure 30: (A) Pre-operative clinical picture & (B) Pre-operative X-ray



(C) Intraoperative C-arm picture

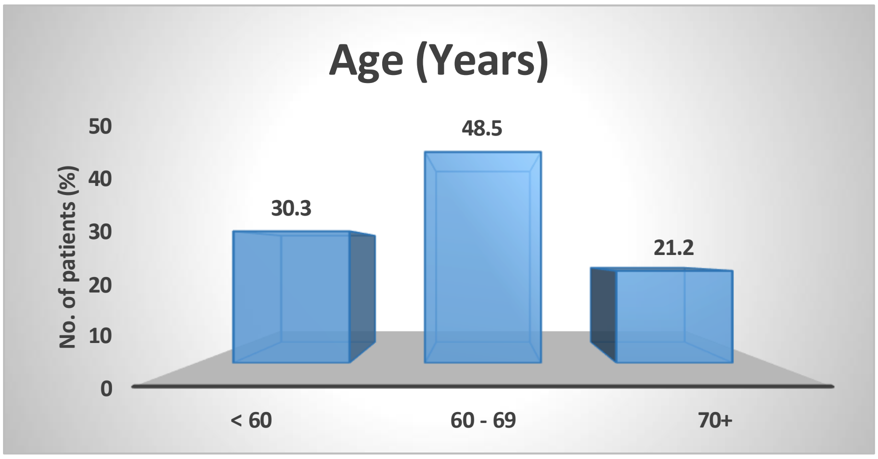
(D) Postoperative x ray (E) At 3 months follow up

RESULTS

Table 1: Distribution of patients according to age

Age (Years)	No. of patients	Percentage
< 60	10	30.3
60 - 69	16	48.5
70+	7	21.2
Total	33	100.0

Table 1 shows the age distribution of patients who underwent total knee replacement, revealing that most patients were older adults, with 21.2% being over 70 years of age and 48.5% between 60-69 years, while middle-aged patients between <60 years constituted 30.3%.

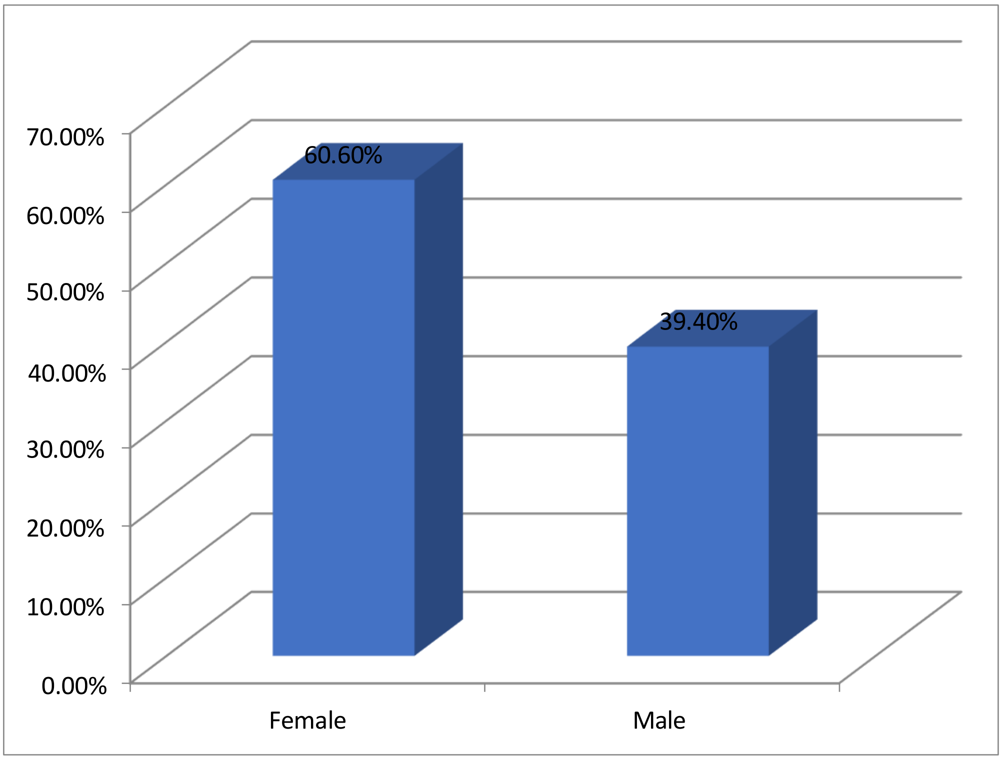


Graph 1: Distribution of patients according to age

Table 2: Distribution of patients according to gender

Gender	No. of patients	Percentage
F	20	60.6
M	13	39.4
Total	33	100.0

Table 2 demonstrates the gender distribution among the study participants, indicating that females were more commonly affected by osteoarthritis requiring knee replacement, comprising 60.6% of the total patients, while males represented 39.4% of the study population.

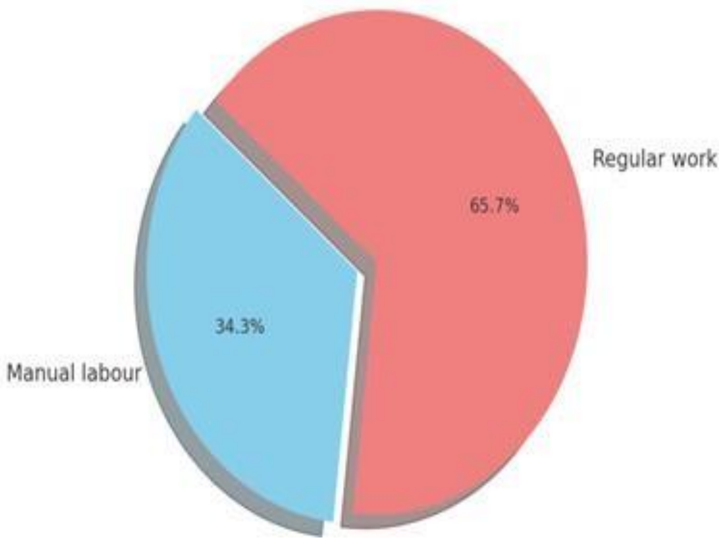


Graph 2: Distribution of patients according to gender

Table 3: Distribution of patients according to occupation

Occupation	No. of patients	percentage
Manual labour	12	36.36%
Regular work	23	69.69%
Total	33	100%

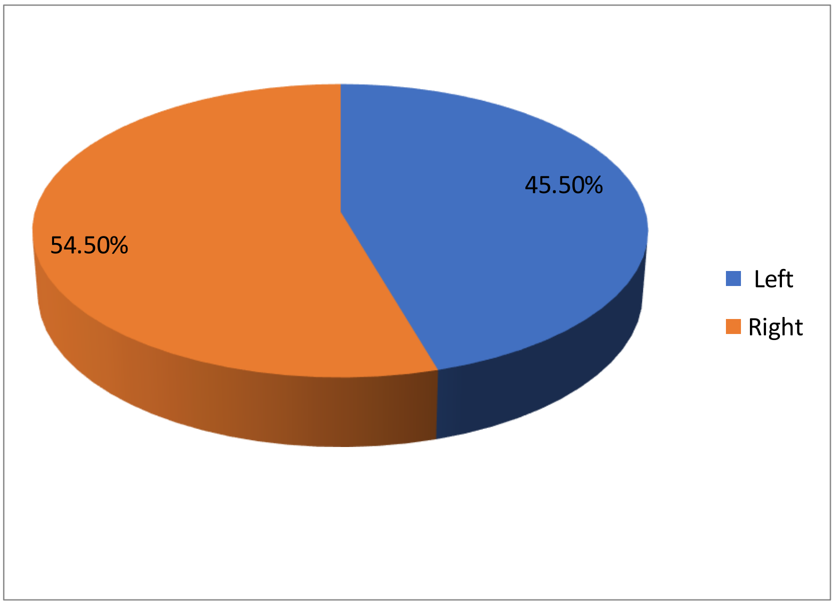
Table 3 demonstrates the occupational distribution among the study participants, indicating that manual labour are less commonly affected by osteoarthritis requiring knee replacement, comprising 36.36% of the total patients, while Regular work individuals represented 69.69% of the study population.



Graph 3: Distribution of patients according to occupation

Table 4: Distribution of patients according to the affected side

Affected side	No. of patients	Percentage
LEFT	15	45.5
RIGHT	18	54.5
Total	33	100.0



Graph 4: Distribution of patients according to affected side

Table 4 presents the distribution of patients according to the affected knee side, showing a relatively balanced distribution with a slight predominance of right knee involvement at 54.5% compared to left knee involvement at 45.5%.

Table 5: Distribution of patients according to duration of symptoms

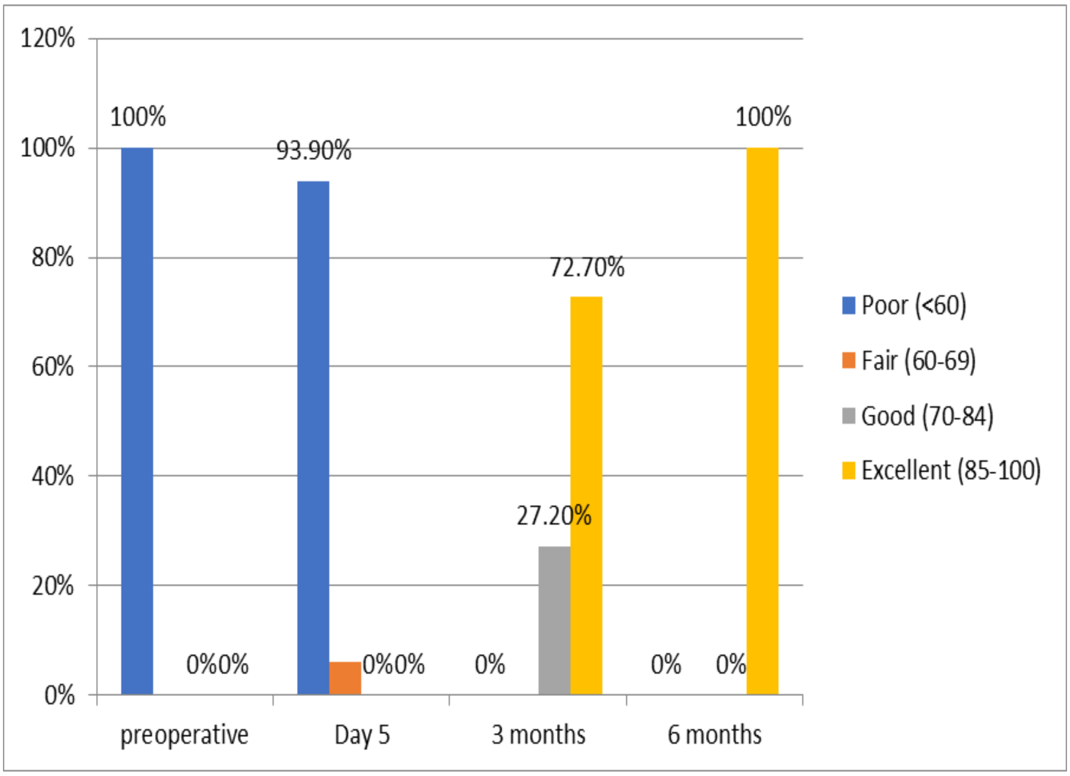
duration of symptoms	
Mean	29.85
SD	26.279

Table 5 provides information about the duration of symptoms experienced by patients before undergoing the knee replacement surgery, with a mean duration of 29.85 months and a standard deviation of 26.279 months, suggesting considerable variation in how long patients lived with symptoms before surgical intervention.

Table 6: Distribution of Knee society scores (KSS) at different intervals

Intervals	Poor (<60)	Fair (60-69)	Good (70-84)	Excellent (85-100)
preoperative	33 (100%)	-	-	-
Day 5	31 (93.9%)	2 (6.1%)	-	-
3 months	-	-	9 (27.2%)	24 (72.7%)
6 months	-	-	-	33 (100%)

Table 6 illustrates the progression of Knee Society Scores (KSS) at different time intervals, showing that preoperatively all patients (100%) had poor scores, with minimal improvement by day 5 post-surgery, where 93.9% still had poor scores. Only 6.1% had fair scores, followed by improvement at 3 months when 72.7% achieved excellent scores and 27.2% had good scores, culminating in all patients (100%) achieving excellent results in 6 months.

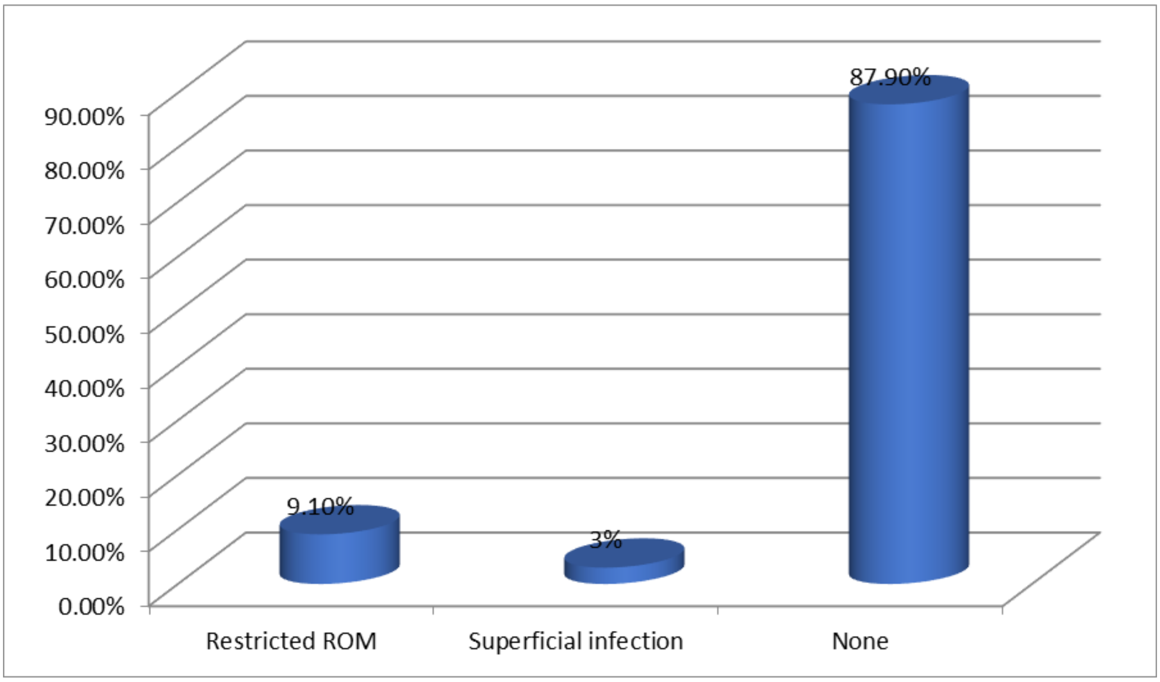


Graph 5: Distribution of Knee society scores (KSS) at different intervals

Table 7: Distribution of patients according to complications

Complications	Frequency	Percentage
Restricted ROM	3	9.1%
Superficial infection	1	3%
None	29	87.9%
Total	**33**	**100%**

Table 7 shows that among the 33 patients studied, the majority (87.9% or 29 patients) experienced no complications, while 9.1% (3 patients) developed restricted range of motion, and 3% (1 patient) had a superficial infection.

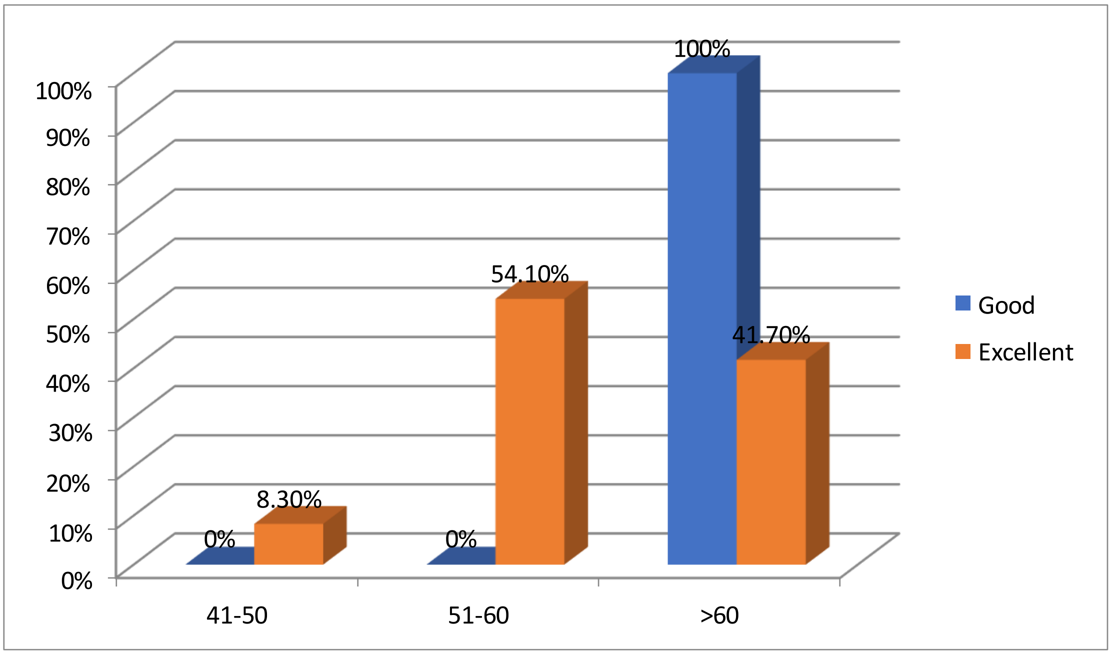


Graph 6: Distribution of patients according to complications

Table 8: Association of KSS score at 3 months with age

Age (in years)	KSS		p-value
	Good	Excellent	
<60	0	2 (8.3%)	**0.007**
60-69	0	13 (54.1%)	
>70	9 (100%)	10 (41.7%)	
Total	**9 (100%)**	**24 (100%)**	

Table 8 examines the association between age and KSS scores at 3 months post-surgery, indicating that the nine patients with good (rather than excellent) scores were both in the over 60 age group and this association was statistically significant (p=0.007).

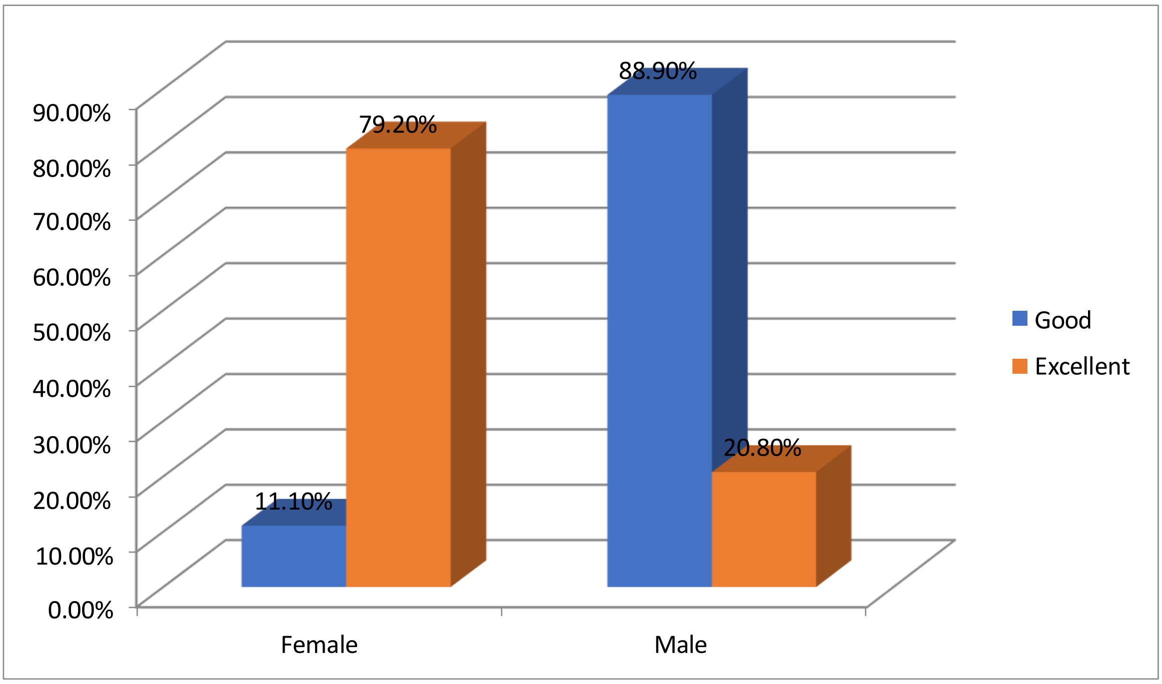


Graph 7: Association of KSS score at 3 months with age

Table 9: Association of KSS score at 3 months with gender

Gender	KSS		p-value
	Good	Excellent	
Female	1 (11.1%)	19 (79.2%)	**<0.001**
Male	8 (88.9%)	5 (20.8%)	
Total	**9 (100%)**	**24 (100%)**	

Table 9 explores the relationship between gender and KSS scores at 3 months .KSS scores at 3 months were rated as "excellent" in 24 patients and "good" in 9 patients, with the majority excellent scores among females (79.2%) compared to males (20.8%) and this association statistically significant (p<0.001).



Graph 8: Association of KSS score at 3 months with gender

Table 10: Post hoc test (Pair wise comparison)

Pairwise comparison	Test statistics	P VALUE
KSS at POD 5-Pre op KSS	.091	.775
KSS at POD 5-KSS at 3 months	-1.636	.000
KSS at POD 5-KSS at 6 months	-2.455	.000
Pre op KSS -KSS at 3 months	-1.545	.000
Pre op KSS -KSS at 6 months	-2.364	.000
*: Statistically significant		

Table 10 shows the results of a post hoc test for pairwise comparisons of the Knee Society Score (KSS) at different time points after a surgical procedure.

- "KSS at POD 5 vs Pre-op KSS - The KSS at POD (postoperative day) 5 is compared to the pre-operative KSS. The p-value is **0.775**, which is **greater than the significance level of 0.05**, indicating **no statistically significant difference** between the two groups.
- KSS at POD 5 vs KSS at 3 months - The KSS at POD 5 is compared to the KSS at 3 months. The p-value is **0.000**, which is **less than 0.05**, indicating a **statistically significant difference** between the two time periods.

- KSS at POD 5 vs KSS at 6 months - The KSS at POD 5 is compared to the KSS at 6 months. The p-value is **0.000**, which is **less than 0.05**, indicating a **statistically significant difference** between these two time periods.
- Pre-op KSS vs KSS at 3 months - The pre-operative KSS is compared to the KSS at 3 months. The p-value is **0.000**, which is **less than 0.05**, indicating a **statistically significant difference** between these two time periods.
- Pre-op KSS vs KSS at 6 months - The pre-operative KSS is compared to the KSS at 6 months. The p-value is **0.000**, which is **less than 0.05**, indicating a **statistically significant difference** between the two groups".

Table 11: Preoperative and Postoperative KSS Scores with Friedman's ANOVA Results

Comparison of	KSS		**Friedman's Analysis of Variance**	Significant value
	Mean	±SD		
Pre op KSS	41.197	7.5931	F=87.500	P=0.001*
KSS at POD 5	38.955	10.3012		
KSS at 3 months	94.152	4.5043		
KSS at 6 months	98.303	1.9801		
*: Statistically significant				

Table 11 presents the mean KSS values done using the Friedman test here to compare the KSS scores at different time points (Pre-op, POD 5, 3 months, and 6 months). The **F value** of 87.500 indicates a high degree of variability between the groups.

The **P value** of 0.001 is statistically significant ($P < 0.05$), indicating that there is a significant difference in the KSS scores at various time points. This suggests that the post-operative changes in KSS over time are meaningful, and the improvements observed from pre-operative to 6 months are not due to random chance.

DISCUSSION

Total knee replacement (TKR) represents one of the most significant surgical advancements in the management of end-stage osteoarthritis of the knee. This procedure has evolved tremendously since its inception in the 1970s, with continuous refinements in implant design, surgical techniques, and perioperative protocols. Despite the widespread adoption of TKR globally, there remains considerable variability in clinical and functional outcomes across different patient populations. Our prospective study aimed to evaluate the clinical and functional outcomes of primary TKR in patients with osteoarthritic knees, with special emphasis on analyzing outcomes based on demographic factors and duration of symptoms. The Knee Society Score (KSS), a validated assessment tool, was used to objectively measure the improvement in knee function at various intervals following surgery. This discussion seeks to contextualize our findings within the broader landscape of current literature, highlighting similarities and differences with other comparable studies, and exploring the implications of our results for clinical practice.

Age Distribution and Its Impact on TKR Outcomes

In our study, patients who underwent TKR were above 50 years of age, with 21.2% being over 70 years of age and 48.5% between 60-69 years, while middle-aged patients between <60 years constituted 30.3%. This age distribution is consistent with the epidemiological pattern of osteoarthritis, which predominantly affects older individuals. Similar age demographics have been reported by Koh et al., who observed that 78% of their TKR cohort was above 55 years of age.[60] The relationship between age and TKR outcomes has been a subject of considerable research interest.

Our findings indicated that at the 3-month follow-up, 72.7% of patients achieved 'excellent' KSS scores (85-100), while 27.2% scored in the 'good' range (70-84). Statistical analysis revealed a significant association between age and KSS scores ($p=0.007$), suggesting that age may be a determinant factor for early postoperative outcomes after TKR

These results align with those reported by Singh et al., who conducted a prospective study of 204 patients undergoing TKR and found no significant difference in functional outcomes between different age groups at 6 months post-surgery.[61] Similarly, Lizaur-Utrilla et al. compared outcomes between younger (<55 years) and older (>65 years) patients and found comparable improvements in function and quality of life after TKR, despite younger patients having higher preoperative expectations.[62]

However, our findings contrast with those of Keeney et al., who reported that advanced age (>75 years) was associated with lower functional scores and slower recovery following TKR.[63] They suggested that diminished physiological reserve and higher prevalence of comorbidities in elderly patients might contribute to these differences. Similarly, Williams et al. demonstrated in their systematic review that while pain relief was consistent across age groups, functional improvements were more modest in patients over 70 years.[64]

The absence of a significant age-related difference in our study might be attributed to our relatively homogeneous patient selection, with strict exclusion criteria for significant comorbidities. Additionally, our standardized rehabilitation protocol, which was consistently applied across all age groups, might have mitigated potential age-related disparities in recovery.

Gender Distribution and Its Influence on Outcomes

Our study demonstrated a female predominance, with women constituting 60.6%

of the study population. This gender disparity in TKR utilization is well-documented in the literature and is generally attributed to the higher prevalence of knee osteoarthritis in women. Srikanth et al., in their meta-analysis, reported that women have a higher incidence and prevalence of knee osteoarthritis compared to men, with a relative risk of 1.81.[65]

Regarding the association between gender and TKR outcomes, our analysis showed that among patients with 'good' KSS scores at 3 months, 11.1% were female and 88.9% were male, while among those with 'excellent' scores, 79.2% were female and 20.8% were male. Statistical analysis revealed a significant association between gender and KSS scores ($p<0.001$).

This finding is congruent with several published studies. Cherian et al. analyzed 5-year outcomes in 2,634 TKR patients and found no significant gender-based differences in functional improvement or implant survivorship.[66] Similarly, MacDonald et al., in their prospective cohort study of 1,703 patients, reported comparable satisfaction rates and functional outcomes between men and women following TKR.[67]

However, our results diverge from some reports in the literature that suggest gender-specific differences in TKR outcomes. Parsley et al. found that women reported higher pain scores and lower function scores than men at 2 years post-TKR, despite similar preoperative scores.[68] They hypothesized that biomechanical differences, including narrower femoral dimensions and higher rates of patellofemoral complications in women, might contribute to these disparities.

The development of gender-specific knee prostheses has been proposed as a solution to address potential anatomical differences. However, the clinical benefit of such implants remains controversial. Cheng et al., in their meta-analysis of 6 randomized controlled trials comparing gender-specific and unisex knee prostheses, found no significant differences in functional outcomes, range of motion, or complication rates.[69] Our study utilized standard unisex implants, and the absence of gender-based outcome differences supports the notion that carefully selected standard implants can provide excellent results regardless of gender.

Laterality of Knee Involvement

Our study revealed a relatively balanced distribution of affected knees, with 45.5% left-sided and 54.5% right-sided involvement. This slight predominance of right knee involvement is consistent with findings from larger epidemiological studies. Sharma et al., in their community-based cohort study of 3,026 individuals, reported a marginally higher prevalence of radiographic osteoarthritis in right knees compared to left knees (23.2% vs. 21.7%).[70]

The predilection for right-sided knee osteoarthritis has been attributed to biomechanical factors, particularly limb dominance. Considering that approximately 90% of the general population is right-handed with concordant lower limb dominance, the right knee may be subjected to greater mechanical stress during activities requiring strength and stability, potentially accelerating degenerative changes. However, the clinical significance of this slight laterality bias remains unclear, as most studies, including ours, do not demonstrate meaningful differences in outcomes based on side of involvement.

Interestingly, bilateral knee osteoarthritis is reported to occur in 30-50% of patients with symptomatic disease. While our current analysis focused on unilateral TKR procedures, the high prevalence of bilateral disease suggests that many patients may eventually require intervention for the contralateral knee. This highlights the importance of comprehensive assessment and long-term follow-up in managing patients with osteoarthritis.

Duration of Symptoms and Its Relationship with TKR Outcomes

The mean duration of symptoms in our cohort was 29.85 months (SD 26.279), indicating considerable variability in the time patients lived with symptomatic osteoarthritis before undergoing TKR. The relationship between symptom duration and postoperative outcomes is complex and multifaceted.

Prolonged symptomatic periods may lead to adaptations in gait, muscle atrophy, and ligamentous contractures, potentially complicating surgical intervention and rehabilitation. Fortin et al. demonstrated that patients with more advanced functional limitation preoperatively had worse functional outcomes after TKR, even after adjusting for demographic and clinical factors.[71] They suggested that earlier intervention might lead to better ultimate function.

However, our study did not reveal a significant correlation between symptom duration and KSS scores at follow-up intervals. “This finding is consistent with research by Lizaur-Utrilla et al., who found that preoperative symptom duration did not” independently predict functional outcomes following TKR in their cohort of 142 patients.[72] Similarly, Judge et al., in their analysis of the Knee Arthroplasty Trial, reported that while worse preoperative function was associated with worse postoperative outcomes, the duration of symptoms per se was not a significant predictor.[73]

The absence of a clear relationship between symptom duration and outcomes in our study may be explained by several factors. First, symptom severity rather than duration might be more relevant for postoperative function. Second, our standardized rehabilitation protocol might have effectively addressed deficits resulting from prolonged symptoms. Lastly, the KSS, while comprehensive, may not capture all aspects of functional recovery that could be affected by prolonged symptomatic periods.

Progression of Knee Society Scores Over Time

Our study demonstrated a clear progression in KSS scores from preoperative assessment through the follow-up intervals. Preoperatively, all patients (100%) had "poor" scores (<60), reflecting the severe functional impairment caused by end-stage osteoarthritis. The immediate postoperative assessment at day 5 showed minimal improvement, with 93.9% still in the "poor" category and only 6.1% improving to "fair" (60-69).

However, by the 3-month follow-up, a dramatic improvement was observed, with 6.1% achieving "good" scores (70-84) and the vast majority (97%) attaining "excellent" scores (85-100). This improvement continued, with all patients (100%) achieving "excellent" scores by the 6-month follow-up.

This temporal pattern of recovery aligns with multiple studies in the literature. Nerhus et al., in their prospective study of 114 TKR patients, documented significant improvements in patient-reported outcome measures at 3 months, with further modest gains until 12 months.[74] Similarly, Kennedy et al. identified 3 months as a critical threshold in recovery after TKR, with most patients achieving substantial functional improvements by this timepoint.[75]

The rapidity and extent of recovery observed in our cohort, with all patients achieving "excellent" scores by 6 months, is particularly noteworthy. Comparable results were reported by Lützner et al., who found that 92% of their patients had achieved their maximum improvement in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores by 6 months, with minimal further changes at 12 months.[76]

Several factors may have contributed to the favorable outcomes in our study.

First, our patient selection criteria might have excluded individuals with comorbidities that could potentially impede recovery. Second, our standardized surgical technique and implant selection, performed by experienced surgeons, likely minimized technical variability. Third, our structured rehabilitation protocol, emphasizing early mobilization and progressive strengthening, may have optimized functional recovery.

However, it is important to note that while KSS provides valuable objective measurements, it may not fully capture patient satisfaction or quality of life improvements. Bourne et al. reported that despite significant improvements in functional scores, approximately 20% of patients were dissatisfied with their TKR outcomes.[77] This highlights the complexity of outcome assessment and the importance of incorporating patient-reported measures in future studies.

Age-Related Variations in TKR Outcomes

Our subgroup analysis of KSS scores at 3 months by age categories revealed an interesting pattern. While most patients across age groups achieved 'excellent' scores, all patients with 'good' scores were from the >60 years category. This difference reached statistical significance (p=0.007), confirming that age-related factors affect early postoperative recovery.

Advanced age has been associated with certain physiological changes that could influence recovery after major surgery, including decreased muscle mass and strength, diminished cardiovascular reserve, and altered tissue healing. Specifically, in TKR, Kennedy et al. demonstrated that patients over 65 years had lower physical function scores and slower recovery during the first 3 months post-surgery compared to younger patients.[78] Similarly, Kauppila et al. reported that advanced age was associated with worse Oxford Knee Scores and health-related quality of life at 6 months following

TKR.[79]

However, other studies have challenged the notion that age negatively impacts TKR outcomes. Williams et al., in their systematic review of 23 studies, concluded that while older patients may have lower absolute postoperative function scores, the magnitude of improvement from baseline is comparable across age groups.[64] This suggests that relative gain, rather than absolute function, might be a more appropriate metric for evaluating age-related differences in outcomes.

The minimal age-related differences observed in our study might be attributed to several factors. First, our standardized perioperative protocols, including pain management and rehabilitation, might have mitigated potential age-related disparities. Second, our careful patient selection might have excluded elderly individuals with significant comorbidities that could adversely affect recovery. Lastly, the KSS, while comprehensive, might not be sensitive to subtle functional differences that could exist between age groups.

Gender-Based Analysis of TKR Outcomes

The gender distribution in our study (60.6% female, 39.4% male) reflects the typical epidemiological pattern of knee osteoarthritis, which disproportionately affects women. Numerous theories have been proposed to explain this gender disparity, including hormonal factors, differences in cartilage composition, and biomechanical variations related to pelvic width and lower extremity alignment.

Our analysis of KSS scores at 3 months by gender revealed that among patients with 'good' scores, 11.1% were female and 88.9% were male, while among those with 'excellent' scores, 79.2% were female and 20.8% were male. Statistical analysis demonstrated a significant association between gender and outcomes ($p<0.001$). This finding is consistent with several large studies in the literature. Liebs et al. analyzed data from 494 TKR patients and found no significant gender-based differences in WOMAC scores or satisfaction rates at 3, 6, 12, and 24 months postoperatively.[80]

However, some studies have reported gender-specific variations in TKR outcomes. O'Connor et al., in their analysis of 5,088 TKR patients, found that women had higher rates of residual pain and functional limitations at 12 months compared to men, even after adjusting for confounding variables.[81] They suggested that differences in pain perception, psychological factors, and rehabilitation engagement might contribute to these disparities.

The development of gender-specific knee prostheses emerged as a potential solution to address anatomical differences between men and women. However, Kim et al., in their randomized controlled trial comparing gender-specific and standard implants in 85 women, found no significant differences in clinical outcomes, patient satisfaction, or radiographic parameters.[82] This suggests that standard implants, when properly sized and positioned, can provide excellent outcomes regardless of gender.

Our findings indicate significant outcome differences based on demographic factors such as age and gender, suggesting that these factors may influence TKR outcomes even when standardized surgical techniques and perioperative protocols are employed.

Clinical Implications and Future Directions

The findings from our study have several important implications for clinical practice and future research in the field of knee arthroplasty.

First, the excellent outcomes achieved across different demographic subgroups support the efficacy of TKR as a treatment for end-stage knee osteoarthritis in appropriately selected patients. This reinforces current clinical guidelines recommending

TKR for patients with radiographic evidence of arthritis, significant pain, and functional limitation refractory to conservative management.

Second, the rapid improvement in KSS scores from preoperative values to 3-month follow-up highlights the critical importance of this early recovery period. Tailored rehabilitation protocols focusing on the first 3 months might optimize functional outcomes. Jakobsen et al. demonstrated that intensive physiotherapy during the early postoperative period significantly improved functional outcomes compared to standard rehabilitation.[86] Future studies could explore the efficacy of age-specific or gender-specific rehabilitation approaches in further enhancing recovery.

Third, the absence of significant outcome differences based on age, gender, or symptom duration suggests that these factors should not heavily influence patient selection for TKR. This aligns with the concept of patient-centered care, emphasizing individualized decision-making based on symptom severity, functional limitation, and quality of life impact rather than demographic characteristics.

Fourth, while our study showed excellent short-term outcomes, longer-term follow-up is essential to assess implant durability and sustained functional improvement. The Australian Orthopaedic Association National Joint Replacement Registry has reported a cumulative revision rate of 5.3% at 10 years for total knee replacements, with variations based on implant type and fixation method.[87] Longitudinal extension of our study could provide valuable insights into factors affecting long-term outcomes in our patient population.

Fifth, the integration of newer technologies such as computer navigation, patient-specific instrumentation, and robotic assistance might further improve precision in implant positioning and potentially enhance outcomes. Song et al., in their meta-analysis of 44 studies, found that computer-assisted TKR resulted in superior implant alignment compared to conventional techniques, although the clinical benefit remains debated.[88]

Lastly, the expanding indications for TKR to younger, more active patients and older, more comorbid individuals necessitates ongoing evaluation of outcomes across the spectrum of patient demographics. Specialized implants, innovative surgical approaches, and tailored perioperative protocols may be required to address the unique needs of these diverse patient populations.

CONCLUSION

Our prospective study on primary Total Knee Replacement (TKR) in patients with osteoarthritic knees demonstrates that TKR is an effective surgical intervention resulting in significant improvement in both clinical and functional outcomes. The transformation in Knee Society Scores (KSS) from uniformly poor preoperative scores to excellent scores in all patients by the 6-month follow-up validates the procedure's efficacy in addressing end-stage knee osteoarthritis.

The improvement trajectory observed in our study, with dramatic functional gains between the immediate postoperative period and the 3-month follow-up, highlights this timeframe as critical for recovery following TKR. This finding emphasizes the importance of intensive rehabilitation during this period to maximize functional outcomes. The continued improvement between 3 and 6 months, though more modest, further supports the value of ongoing rehabilitation efforts during this timeframe.

The presence of significant outcome differences based on demographic factors such as age and gender suggests that TKR can provide excellent early results across diverse patient populations when appropriately performed with standardized surgical techniques and perioperative protocols. This finding supports an individualized approach to patient selection based on symptom severity and functional limitation rather than demographic characteristics alone.

Our results also indicate that TKR is equally effective for both left and right knee osteoarthritis, with no significant differences in outcomes based on the side of involvement. The duration of preoperative symptoms did not significantly impact postoperative outcomes in our cohort, suggesting that while early intervention is generally recommended, patients with longstanding symptoms can still achieve excellent results following TKR.

While our study focused on short-term outcomes up to 6 months postoperatively, the excellent results observed across all patient subgroups provide a strong foundation for anticipated long-term benefits. Nevertheless, continued follow-up is essential to evaluate implant durability, sustained functional improvement, and potential late complications.

In conclusion, primary TKR for osteoarthritic knees demonstrates exceptional clinical and functional outcomes in the short term, with rapid improvement in KSS scores and consistent results across patient demographics. These findings support the continued utilization of TKR as the gold standard surgical intervention for end-stage knee osteoarthritis, with emphasis on standardized perioperative protocols and rehabilitation strategies to optimize outcomes.

LIMITATIONS

While our study provides valuable insights into the outcomes of primary TKR for osteoarthritic knees, several methodological considerations and limitations warrant discussion.

First, our sample size of 32 patients, though adequate for detecting major outcome differences, might have limited statistical power for identifying subtle variations in subgroup analyses. This could explain why apparent differences in KSS scores by age and gender did not reach statistical significance.

Second, our follow-up period is extended to 6 months postoperatively, which, while sufficient for capturing early recovery patterns, does not address long-term outcomes such as implant survivorship and late complications. Studies with extended follow-up periods, such as the one by Bayliss et al., have demonstrated that implant longevity varies considerably by age, with 10-year revision rates ranging from 4.4% in patients over 70 years to 35% in those under 50 years.[83]

Third, our outcome assessment primarily relied on the KSS, which, despite its widespread use and validation, focuses predominantly on objective parameters rather than patient-reported outcomes. Recent literature emphasizes the importance of patient-centered measures in evaluating arthroplasty results. Dunbar et al. recommended a comprehensive assessment battery including pain, function, quality of life, and satisfaction measures to holistically evaluate TKR outcomes.[84]

Fourth, our study design did not include a control group or randomization, which limits causal inferences about the efficacy of specific interventions. However, the prospective nature of our study mitigates some of these limitations by ensuring standardized data collection and minimizing recall bias.

Lastly, our patient cohort might not be fully representative of the general population undergoing TKR, particularly regarding comorbidity profile and socioeconomic status, which could affect generalizability. Studies by Judge et al. have demonstrated that socioeconomic factors significantly influence access to joint replacement surgery and potentially impact outcomes.[85]

Despite these limitations, our study contributes valuable real-world data on TKR outcomes in a defined patient population, providing insights into recovery patterns and potential predictors of functional improvement.

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ANNEXURE I

INFORMED CONSENT FORM FOR PARTICIPATION IN DISSERTATION / RESEARCH

I, the undersigned, S/O D/O W/O____________, aged years,ordinarily resident of____ do hereby state/declare that Dr. PRANAV SINDHU KAMLAY of Shri. B. M. Patil Medical College Hospital & Research Centre has examined me thoroughly on__________at_(place) and it has been explained to me in my own language that I am suffering from_______ __________________________________the disease (condition) and this disease/condition mimic following diseases. Further Dr. PRANAV SINDHU KAMLAY informed me that he/she is conducting dissertation/research titled "CLINICAL AND FUNCTIONAL OUTCOME OF PRIMARY TOTAL KNEE REPLACEMENT (TKR) IN OSTEOARTHRITIC KNEE" under the guidance of Dr. ANIL BULAGOND requesting my participation in the study. Apart from routine treatment procedure, the pre-operative, post-operative and follow-up observations will be utilized for the study as reference data.

The doctor has also informed me that during the conduct of this procedure, adverse results might encounter. Most of them are treatable but are not anticipated; hence there is a chance of aggravation of my condition. In rare circumstances, it may prove fatal despite the expected diagnosis and best treatment made available. Further Doctor has informed me that my participation in this study help in the evaluation of the results of the study, which is a useful reference to the treatment of other similar cases in the near future and also, I may be benefited from getting relieved from suffering or a cure of the disease I am suffering.

The Doctor has also informed me that information given by me, observations made/ photographs/ video graphs taken upon me by the investigator will be kept secret and not assessed by the person otherthan my legal hirer or me except for academic purposes.

The Doctor did inform me that though my participation is purely voluntary, based on the information given by me, I can ask for any clarification during treatment/study related to diagnosis, the procedure of treatment, the result of treatment, or prognosis. I've been informed that I can withdraw from my participation in this study at any time if I want, or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment, I the undersigned Shri/Smt_______________________________________under my full conscious state ofmind agree to participate in the said research/dissertation.

Signature of the patient:

Signature of doctor:

Witness: 1.

2.

Date:

Place:

ANNEXURE – II

SCHEME OF CASE TAKING:

CASE NO. :

FOLLOW UP NO. :

NAME :

AGE/SEX :

I P NO :

DATE OF ADMISSION:

DATE OF SURGERY :

DATE OF DISCHARGE:

OCCUPATION :

RESIDENCE :

PHONE NUMBER :

Presenting complaints with duration:

History of presenting complaints :

Family History :

Personal History :

Past History :

Vitals

PR: RR:

BP: TEMP:

Systemic Examination:

Respiratory system - Cardiovascular system -

Per abdomen - Central nervous system -

Local examination:

Right/ Left Leg

Gait:

Inspection:

a) Attitude

b) Abnormal swelling

c) Shortening

d) Skin condition

Palpation:

a) Local tenderness

b) Bony irregularity

c) Abnormal movement

d) Crepitus/ grating of fragments

e) Absence of transmitted movements

f) Wound

Movements:	Active	Passive
• Flexion		
• Extension		

Intra Operative details:

Post-Operative:

● Rehabilitation protocol as per the guidelines.

● Functional outcome evaluation with:

1. Knee Society Score

KNEE SOCIETY SCORING SYSTEM

PART 1. KNEE SCORE

PAIN
None
Mild (occasional)
Mild(satirs only)
Mild(walking and stairs)
Moderate - Occasional
Moderate - continue
Severe

FLEXION CONTRACTURE (IF PRESENT)
$5^0 – 10^0$
$10^0 – 15^0$
$16^0 – 20^0$
$>20^0$

EXTENSION LAG
$<10^0$
$10^0 – 20^0$
$>20^0$

TOTAL RANGE OF MOTION

0 – 5	6 - 10	11 – 15	16 - 20	20 - 25
26 – 30	31 - 35	36 - 40	41 - 45	46 - 50
51- 55	56 - 60	61 - 65	66 - 70	71 - 75
76 - 80	81 - 85	86 - 90	91 - 95	96 - 100
101-105	106 - 110	111-115	116 -120	121-125

ALLIGNMENT(VARUS AND VALGUS)

0	1	2	3	4
		5-10		
11	12	13	14	15
		OVER 15^0		

STABILITY (Maximum movement in any position)

ANTERO-POSTERIOR
<5mm
5-10mm
10mm

MEDIOLATERAL
$<5^0$
$6 – 9^0$
$10 – 14^0$
15^0

PART 2 – FUNCTION

WALKING

○ Unlimited
○ >10 blocks
○ 5 – 10 blocks
○ <5blocks
○ Housebound
○ Unable

STAIRS

○ Normal Up and Down
○ Normal Up Down with rail
○ Up and Down with rail
○ Up with rail, down unable
○ Unable

WALKING AIDS USED

○ None used
○ Use of Cane/Walking stick deduct
○ Two Canes/Sticks
○ Crutches of frame

GRADING FOR THE KNEE SOCIETY SCORE

80 – 100 EXCELLENT

70 – 79 GOOD

60 – 69 FAIR

< 60 POOR

ANNEXURE III: ETHICAL CLEARACE

BLDE

(DEEMED TO BE UNIVERSITY)

Declared as Deemed to be University u/s 3 of UGC Act, 1956

Accredited with 'A' Grade by NAAC (Cycle-2)

The Constituent College

SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

BLDE (DU)/IEC/ 973/2022-23 10/4/2023

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Saturday, 18th March, 2023 at 11.30 a.m. in the CAL Laboratory, Dept. of Pharmacology,** scrutinizes the Synopsis/ Research Projects of Post Graduate Student / Under Graduate Student /Faculty members of this University /Ph.D. Student College from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "PROSPECTIVE STUDY OF CLINICAL AND FUNCTIONAL OUTCOME OF PRIMARY TOTAL KNEE REPLACEMENT (TKR) IN OSTEOARTHRITIC KNEE."

NAME OF THE STUDENT/PRINCIPAL INVESTIGATOR: DR.PRANAV SINDHU KAMLAY

NAME OF THE GUIDE: DR. ANIL BULAGOND, ASSOCIATE PROFESSOR,
DEPT. OF ORTHOPAEDICS

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA
Chairman,
Institutional Ethical Committee,
BLDE (Deemed to be University)
Vijayapura

Dr. Akram A. Naikwadi
Member Secretary
IEC, BLDE (DU),
VIJAYAPURA
MEMBER SECRETARY
Institutional Ethics Committee
BLDE (Deemed to be University)
Vijayapura-586103. Karnataka

Following documents were placed before Ethical Committee for Scrutinization.

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

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College: Phone: +918352-262770, Fax: +918352-263019, E-mail: bmpmc.principal@bldedu.ac.in

MASTERCHART

Name of the patient	Age (yrs)	Ip.no.	Gender	Affected side	Duration of symptoms in months	Pre op KSS	KSS at POD 5	KSS at 3 months	KSS at 6 months	complications
SHRIMANT MAVOOR	60	422490	M	RIGHT	36	30.5	26.5	87	100	NIL
SIDDU IRANNA	52	23379	M	RIGHT	48	46.5	23	95	99	NIL
SADASHIV BIRADAR	69	75520	M	LEFT	2	57.5	43	99.5	100	NIL
RAMESH HARIJAN	50	102964	M	RIGHT	24	49.5	35	95	99	NIL
RENUKA BAI	55	97957	F	LEFT	8	42.5	48	90	95	NIL
PREMA BETAGERI	64	116530	F	RIGHT	60	33.5	35.5	99.5	100	NIL
GEETA RAMPUR	50	66002	F	RIGHT	48	35	54.5	95	99	NIL
MALLAMMA SALAHALI	60	160604	F	LEFT	60	22	26	95	95	Restricted ROM
SAKKU BAI	63	194746	F	LEFT	5	45.5	48	100	100	NIL
TARABAI BHIMARAY	61	209649	F	RIGHT	12	44.5	26.5	94.5	99.5	NIL
SHANTABAI ANKALAGI	70	241786	F	LEFT	72	31.5	34	89	95	NIL
KASTURI	57	455	F	RIGHT	8	39	35	95	99	NIL
INDAKKA JAMADAR	68	216876	F	LEFT	2	52	35.5	99.5	99.5	NIL
ANSUYA AMBAJI	65	307707	F	LEFT	84	34.5	48	89.5	99.5	NIL
M PARVATAMMA	69	211544	F	LEFT	6	43.5	34	84.5	95	Superficial Infection
RAHIM KHAJAHISIN	76	303682	M	LEFT	12	38	42.5	97	99.5	NIL
HANUMANTH BASAPPA	60	284709	M	RIGHT	12	41.5	26.5	99.5	100	NIL
LAXMI INGALESWAR	68	214975	F	LEFT	60	48.5	28.5	95	100	NIL
CHANNAVVA KAMATE	62	396481	F	LEFT	6	46.5	62	96.5	99.5	NIL
KAMALA	59	8678	F	LEFT	12	35.5	44	95	98	NIL
SHANTABAI	60	27794	F	RIGHT	7	43	58.5	88.5	96	NIL
VITTALSAB	75	201275	M	RIGHT	18	38	35.5	92.5	94.5	Restricted ROM
KASHINATH	58	91236	M	RIGHT	5	50	41	87	95	NIL
BHIMANNA	64	146755	M	RIGHT	24	46.5	28.5	99	99.5	NIL
RENUKA BAI	56	97957	F	RIGHT	36	39	35	95	98	NIL
SAYABANNA	77	55297	M	LEFT	60	32	36.5	100	100	NIL
YALLAWWA	75	153333	F	RIGHT	96	36	32	95	95	NIL
SHARADA	54	178709	F	RIGHT	12	52	48	98.5	100	NIL
CHANNAPPA	55	301713	M	LEFT	18	45	35.5	89.5	99.5	NIL
RACHAPPA VAJRAWAD	67	211335	M	RIGHT	60	32	36.5	92	100	NIL
SHARADABAI	70	495	F	LEFT	24	43	62	95	97.5	Restricted ROM
TUKARAM	60	210161	M	RIGHT	36	39.5	42.5	86	99.5	NIL
LAXMI BAI BIRADAR	73	20598	F	RIGHT	12	46	38	98	98	NIL

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