Functional Outcome of Rotatory Platform Hinged Total Knee Prosthesis in Revision Total Knee Arthroplasty Surgeries

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ABSTRACT: **Introduction**: Total knee arthroplasty (TKA) has evolved significantly over the decades, with advancements in prosthetic design and surgical techniques enhancing patient outcomes. Among the various prosthetic designs available, the rotatory platform hinged total knee prosthesis represents a sophisticated approach tailored to address specific challenges encountered in knee arthroplasty.
Aim and Objectives: To analyse the functional outcome of rotatory platform hinged total knee prosthesis in revision total knee arthroplasty surgeries.
Materials and Methods: A prospective study was done on 20 patients who under revision total knee arthroplasty surgeries in the department of orthopaedics, Vinayaka Mission kirupananda variyar medical college hospital, salem. Patient with Patient with infected primary Total knee arthroplasty with bone loss, Patient with primary failed total knee arthroplasty, patient with knee instability after primary TKA, Patient with periprosthetic fractures, Patient with primary loosened implants were included in this study.
Results: In this study, 20 patients underwent revision total knee arthroplasty (TKA), with 60% being male and 40% female. BMI distribution was: 2 patients had a BMI <18.5 kg/m², 11 had a BMI between 18.5-24.5 kg/m², and 7 had a BMI between 25-29.9 kg/m². ASA scores at presentation were: 2 patients had ASA 1, 9 had ASA 2, 6 had ASA 3, and 3 had ASA 4. Devane scores were: 2 patients had score 1, 8 had score 2, 6 had score 3, 3 had score 4, and 1 had score 5. The mean surgery duration was 152.5 minutes, with a mean hospital stay of 13.6 ± 3.6 days. Patients had an average of 5.06 ± 2.42 prior surgeries before hinged TKA.
Overall, knee scores improved across studies, although Springer et al. observed only modest functional improvements. Survivorship rates varied, with Hossain et al. reporting 92.5% at 10 years and Deehan et al. reporting 90% at 5 years. Smith et al. had a significantly lower survivorship rate of 52% at 5 years, and Farid et al. reported 51% at 10 years. These lower rates were attributed to higher rates of prior infections. Revision rates varied widely, from 8.9% to 47.5%. Cottino et al. had the lowest complication rate (12%), while Shen et al. and Baier et al. reported rates of 22% and 28%, respectively. In contrast, Smith et al. and Springer et al. reported high complication rates of 63% and 49%, respectively.
Conclusion: The results of our study suggest that individuals receiving complex revision total knee arthroplasty are capable of achieving commendable functional outcomes and enhanced quality of life.

Keywords: *Total knee arthroplasty (TKA), revision TKA, rotatory platform hinged prosthesis, functional outcomes, survivorship, complication rates, knee scores, ASA score, Devane score, periprosthetic fractures, knee instability, aseptic loosening.*

INTRODUCTION

Total knee arthroplasty (TKA) has evolved significantly over the decades, with advancements in prosthetic design and surgical techniques enhancing patient outcomes. Among the various prosthetic designs available, the rotatory platform hinged total knee prosthesis represents a sophisticated approach tailored to address specific challenges encountered in knee arthroplasty.

The rotatory platform hinged total knee prosthesis is distinguished by its unique design, which incorporates a rotating platform mechanism. This feature allows for enhanced adaptability and stability, particularly in complex cases where conventional designs may fall short. The prosthesis is characterized by its ability to accommodate rotational movements between the femoral and tibial components, aiming to provide improved functionality and durability.

Design and Mechanism of the Rotatory Platform Hinged Total Knee Prosthesis

The rotatory platform hinged total knee prosthesis is a sophisticated type of knee implant that incorporates a rotating platform mechanism. This design is characterized by a rotational component that allows the tibial and femoral components to rotate relative to each other. This feature is particularly beneficial for addressing complex knee conditions that may involve severe deformities or instability.

The key components of the rotatory platform hinged prosthesis include:

Rotatory Mechanism: The prosthesis includes a platform that allows for controlled rotational movement. This design aims to mimic the natural biomechanics of the knee more closely, providing improved adaptability and stability.

- **Hinged Joint**: The hinge mechanism provides a stable and fixed axis of rotation, which helps in maintaining proper alignment and function of the knee joint, especially in cases of ligamentous compromise.
- **Enhanced Bearing Surfaces**: The prosthesis is often designed with advanced bearing materials to reduce wear and tear, improve durability, and enhance patient outcomes.

Indications and Functional Outcomes

The indications for utilizing a rotatory platform hinged total knee prosthesis typically include severe knee deformities, instability, and complex joint conditions. These may encompass:

1) **Severe Ligamentous Instability**: Patients with significant ligament deficiencies or damage may benefit from the rotatory platform design, which offers enhanced stability and adaptability.
2) **Extensive Bone Loss or Deformity**: In cases where there is substantial bone loss or deformity that complicates traditional prosthesis fitting, the rotatory platform can provide a more secure and functional solution.
3) **Revision Surgery**: For patients undergoing revision TKA, particularly those with compromised bone stock or previous prosthesis failure, the rotatory platform's design can address the unique challenges of revision procedures.
4) **Post-Traumatic Arthrosis**: Patients with knee joint degeneration resulting from traumatic injuries may experience improved outcomes with the rotatory platform prosthesis, which can better accommodate irregular joint surfaces

Table 1

Anderson Orthopaedic Research Institute Classification of Bone Defects

Type	Severity of Bone Deficiency Encountered
1	Minor femoral or tibial defects with intact metaphyseal bone, not compromising the stability of a revision component
2	Damaged metaphyseal bone. Loss of cancellous metaphyseal femoral bone requiring reconstruction (cement fill, prosthetic augment, or bone graft) to provide stability of the revision component.
	A: Defects in one femoral or one tibial condyle
	B: Defects in both femoral or both tibial condyles
3	Deficient metaphyseal segment compromising a major portion of either femoral condyles or tibial plateau, occasionally associated with collateral or patellar ligament detachment.

AIM AND OBJECTIVES:

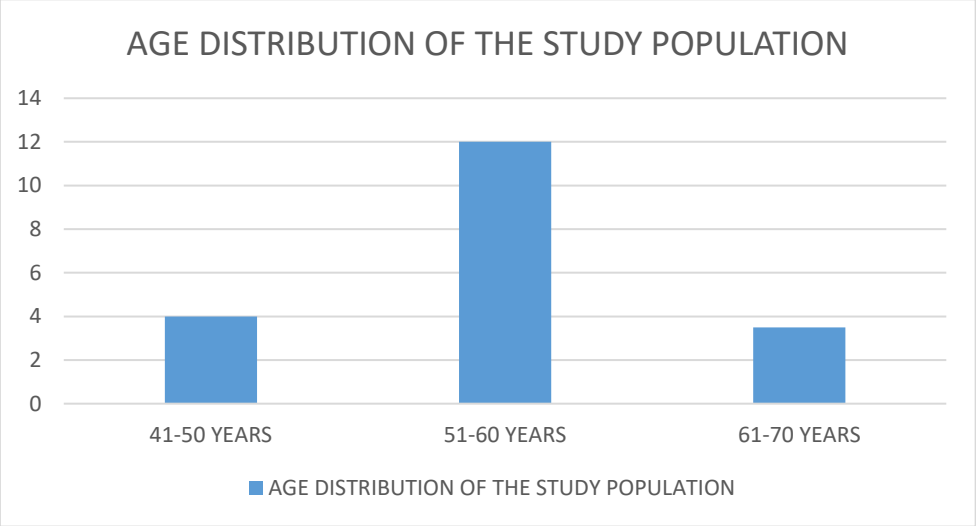
To evaluate clinically and radiologically functional outcome of rotatory platform hinged total knee prosthesis in revision total knee arthroplasty surgeries.

METHODOLOGY:

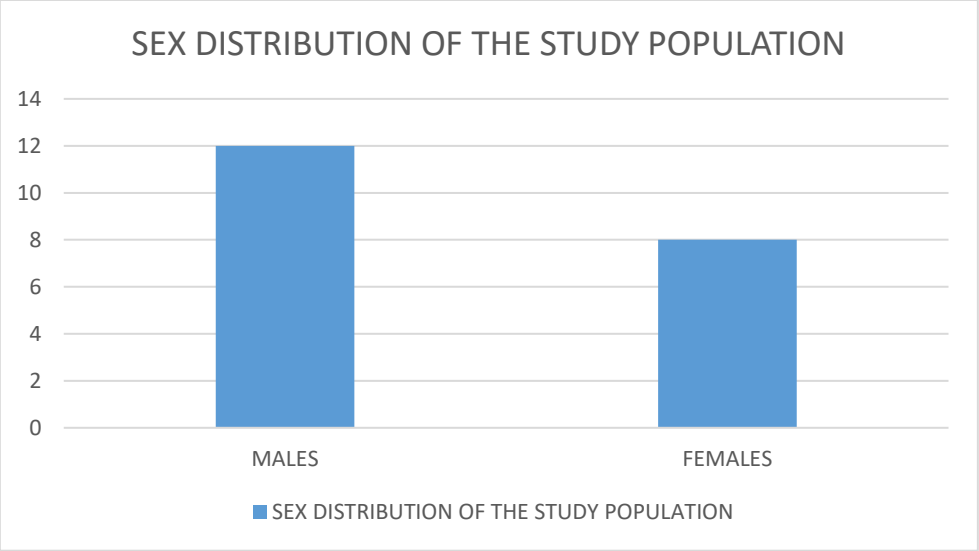
This study was done to evaluate the functional outcome of rotatory platform hinged total knee prosthesis in revision total knee arthroplasty surgeries. This is a prospective study of 20 patients treated at Vinayaka Mission Kirupananda Variyar medical college and hospital, Salem. It includes the patients presenting themselves in casualty and OPD of Department of orthopaedics. Maximum Follow up period will be 6 months after operative management. When the patients were seen for the first time, a through history will take concerning about the time of injury, mechanism of injury, any significant past or personal history. Patients will be examined giving special importance to post primary surgery trauma, infection, presence of other associated injuries, knee instability. Routine investigations will be done as necessary. The diagnosis will be confirmed by antero-posterior, lateral of flexion and extension radiographs. Anesthesia assessment will be obtained and will be planned for total knee hinged prosthesis revision surgery. Fixation will be confirmed by taking a post op xray on POD#1. On POD# 2 patient will be made standing and walking with support. On POD# 14 sutures will be removed and train the patient to flex the knee more than 90 degrees and patient will be discharged with physiotherapy advice. Follow up will be done 1month and 6-month post operatively to assess the pain by VAS score, Range of movements and wound healing.

RESULTS:

GRAPH 1: AGE DISTRIBUTION OF THE STUDY POPULATION



GRAPH 2: SEX DISTRIBUTION OF STUDY POPULATION



GRAPH 3: BMI DISTRIBUTION OF THE STUDY POPULATION

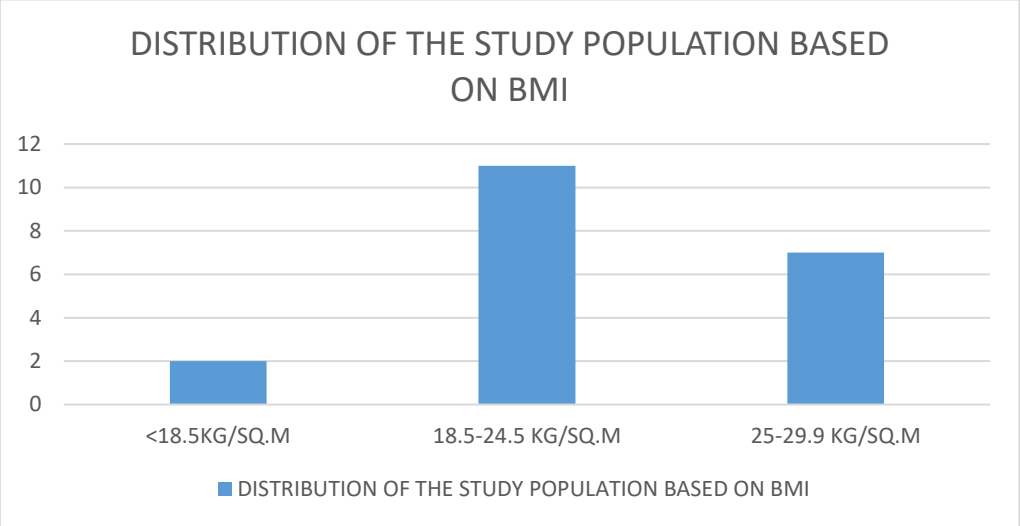


TABLE 1: ASA SCORE AT THE TIME OF PRESENTATION

ASA SCORE	NUMBER	PERCENTAGE
ASA1	2	10%
ASA2	9	45%
ASA3	6	30%
ASA 4	3	15%

TABLE 2: DEVANE SCORE AT THE TIME OF PRESENTATION

DEVANE SCORE	NUMBER	PERCENTAGE
DEVANE 1	2	10%
DEVANE 2	8	40%
DEVANE 3	6	30%
DEVANE 4	3	15%
DEVANE 5	1	5%

TABLE 3: MEAN DURATION OF SURGERY, MEAN HOSPITAL STAY, MEAN NUMBER OF SURGERIES BEFORE HINGED TKA

MEAN DURATION OF SURGERY	152.5 MINUTES
MEAN HOSPITAL STAY	13.6±3.6 DAYS
MEAN NUMBER OF SURGERIES BEFORE HINGED TKA	5.06±2.42

TABLE 4: REASON FOR REVISION TOTAL KNEE ARTHROPLASTY

INDICATION	NUMBER	PERCENTAGE
INSTABILITY	10	50%
ASEPTIC LOOSENING	4	20%
PERIPROSTHETIC FRACTURE	1	5%
ARTHROFIBROSIS	1	5%
OTHERS	4	20%

GRAPH 4: RISK FACTORES FOR INFECTION IN HOST

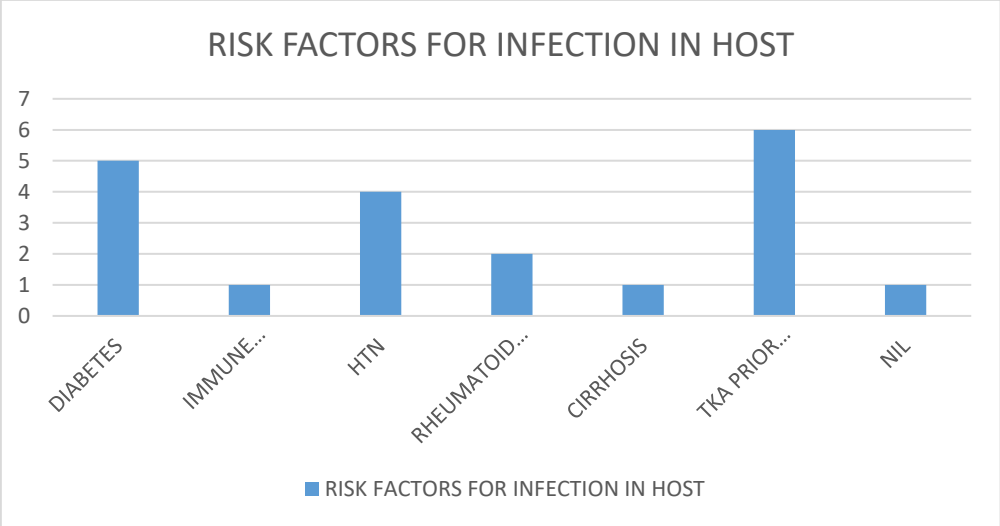


TABLE 5: KSS GRADING OF KNEE CLINICAL SCORE

KNEE CLINICAL SCORE	FREQUENCY	PERCENTAGE
GOOD	4	20%
EXCELLENT	16	80%
TOTAL	20	100%

TABLE 6: KSS GRADING OF KNEE FUNCTIONAL SCORE

KNEE CLINICAL SCORE	FREQUENCY	PERCENTAGE
GOOD	5	25%
EXCELLENT	15	75%
TOTAL	20	100%

TABLE 7: FUNCTIONAL OUT COME: PAIN -12 MONTH FOLLOW UP

PAIN	REVISION KNEE ARTHROPLASTY
ABSENT	8(40%)
SLIGHT	6(30%)

MILD	4(20%)
MODERATE	1(5%)
SEVERE	1(5%)
BEDRIDDEN	-
TOTAL	20(100%)

DISCUSSION

In our study 12 were males accounting for 60% of the study population and 8 were females accounting for 40% of the study population. Out of 20 patients BMI was <18.5kg/m² in 2 patients,11 patients BMI was in between 18.5-24.5kg/m² and BMI was in between 25-29.9kg/m² in 7 patients.ASA score at the presentation was 1 in 2 patients,9 patients had ASA 2 score,6 patients had ASA 3 score and 3 patients had ASA 4 score. Devane score at the time of presentation was 1 in 2 patients,8 patients had Devane 2,6 patients had Devane score 3,3 patients had Devane score 4 and Devane score was 5 in 1 patient. The mean duration of surgery in our study was 152.5 minutes, the mean hospital stay was 13.6±3.6 days and the mean number of surgeries before hinged TKA was 5.06±2.42.On the basis of indication for revision total knee arthroplasty-10 patients(50%) underwent total knee arthroplasty due to instability, aseptic loosening was the reason in 4 patients(20%),periprosthetic fractures in 1 patient(5%),arthro fibrosis in 1 patient(5%) and due to some other causes 4 patients (20%) underwent total knee arthroplasty. On the basis of risk factors resulting in infection 5 patients had diabetes,4 were hypertensive,2 patients had rheumatoid arthritis,1 patient had cirrhosis, TKA previous infection was seen in 6 patients and 1patient was immune suppressed. Out of 20 patients knee clinical score was good in 4 patients (20%) and excellent in 16 patients (80%), knee functional score was good in 5 patients (25%) and excellent in 15 patients (75%).

According to Farid et al., all cases presented with considerable periarticular bone loss and soft tissue deficiencies, averaging four prior arthroplasties. Nevertheless, Smith et al. did not specify the reasons for opting for a rotating hinge implant rather than a less constrained device (1). Regarding aseptic loosening, Joshi et al. reported that 60% of their revision cases involving rotating hinge implants were necessitated by polyethylene wear leading to aseptic loosening (2). Baier et al. indicated that 45% of their rotating hinge cases were attributed to aseptic loosening, particularly when patients reported weight-bearing pain or showed signs of osteolysis on serial radiographs (3). Again, neither study addressed the rationale for choosing a rotating hinge implant over a less constrained option. Deehan et al (4) noted that 24% of patients were indicated for ligamentous instability, while Smith et al. and Joshi et al. reported 34% and 30%, respectively. Lastly, Shen et al. indicated that 69%, Deehan 47%, and Springer 43% of their hinged revision total knee arthroplasty cases were linked to significant bone loss.In the analysis of the studies included in this review alongside the findings of Cottino et al., a consistent enhancement in knee scores was observed across all research papers. Notably, Springer et al. documented only a modest improvement in functional knee scores following the implementation of rotating hinge prostheses. The survivorship rates were comparable, with Hossain et al. reporting a 92.5% survivorship at the 10-year mark, while Deehan et al. indicated a 90% survivorship at 5 years. Conversely, Smith et al. noted a significantly lower survivorship rate of 52% at 5 years, and Farid et al. reported 51% at 10 years. Both research teams suggested that these diminished survivorship rates could be attributed to a higher prevalence of patients with previous infection diagnoses, which increased their risk of failure. The revision rates varied considerably among the studies, ranging from as low as 8.9% to as high as 47.5%. Cottino et al. exhibited one of the lowest complication rates at 12%(5), while Shen et al (6). and Baier et al (7). reported rates of 22% and 28%, respectively. In stark contrast, Smith et al. experienced a notably high complication rate of 63%, and Springer et al. also reported a significant complication rate of 49% by the conclusion of their study.

CONCLUSION

The results of our study suggest that individuals receiving complex revision total knee arthroplasty are capable of achieving commendable functional outcomes and enhanced quality of life.It may be necessary for these patients to receive optimal systemic antimicrobial prophylaxis along with novel strategies aimed at decreasing the incidence of superinfection.The use of rotating hinge knee prostheses is typically indicated in cases of infection, aseptic loosening, instability, and substantial bone loss. These prostheses yield positive outcome scores and survivorship rates; however, they are accompanied by a notable incidence of complications and the need for revisions. When applied correctly, this implant represents a suitable alternative for patients who cannot be treated with less constrained implants.

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