

Evaluation of the Early Functional Outcomes Following Cruciate-Retaining Total Knee Arthroplasty: A Prospective Study

Authors:

Ritesh Dhara¹, Nishan Yadav², Dr. Shubham Verma³, Kumar Amitoj Singh⁴, Rohil Jain⁵, Raunak Ranjan⁶, Ankur Garg⁷, Sumit Tibrewal⁸

^{1,2,3}Senior Resident, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India.

^{4,5,6,7,8}Junior Resident, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India.

Corresponding Author:

Nishan yadav, Senior Resident, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India.

DOI: <https://doi.org/10.5281/zenodo.23003907>

Received: 29 August 2026, Revised: 11 September, Accepted: 21 September 2026, Online First: 03 October 2026

ABSTRACT

Background: Cruciate-retaining total knee arthroplasty (CR-TKA) preserves the posterior cruciate ligament (PCL) and may provide physiological knee kinematics and satisfactory functional recovery. However, the early functional outcomes and postoperative recovery following CR-TKA remain important areas of clinical evaluation. This study was conducted to assess the early functional outcomes, pain relief, range of motion (ROM), functional recovery, and complications following CR-TKA. **Methods:** This prospective study was conducted in the Department of Orthopaedics at a tertiary care hospital in Rohtak, Haryana, after obtaining ethical approval and clinical trial registration. Fifteen patients undergoing primary total knee arthroplasty with an intact PCL were included. Patients with infection, bleeding disorders, neurological or vascular disorders of the lower limb, significant deformities, previous posterior cruciate ligament injury, post-traumatic or post-infectious osteoarthritis, and those requiring revision or hinged prostheses were excluded. Patients were followed clinically and radiographically at 1, 3, and 6 months postoperatively. Outcomes were assessed using range of motion (ROM), Visual Analogue Scale (VAS), Knee Society Score (KSS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Knee Injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS-JR). Postoperative complications were also documented. **Results:** The mean age of the patients was 58.40 ± 13.02 years, with 53.3% females and 46.7% males. There was significant improvement in knee ROM from $103.67 \pm 13.02^\circ$ preoperatively to $117.67 \pm 9.98^\circ$ at 6 months ($p < 0.0001$). Mean VAS pain scores decreased significantly from 9.87 ± 0.35 preoperatively to 0.40 ± 0.51 at 6 months ($p < 0.0001$). The mean KSS improved from 36.60 ± 10.46 preoperatively to 75.40 ± 6.82 at 6 months ($p < 0.0001$). WOMAC total scores decreased from 63.20 ± 11.12 to 3.07 ± 1.53 , while KOOS-JR-related scores also demonstrated significant improvement at 6 months ($p < 0.0001$). At 1 month, stiffness and superficial skin infection were reported in 13.3% of patients each. By 3 and 6 months, 86.7% of patients had no reported complications. No cases of deep vein thrombosis, pulmonary embolism, compartment syndrome, deep wound infection, or mortality were observed. **Conclusion:** Cruciate-retaining total knee arthroplasty was associated with significant improvements in knee range of motion, pain, functional status, and patient-reported outcomes during the first 6 months following surgery. The observed complication profile was generally favorable. Larger prospective studies with longer follow-up are required to confirm these findings and evaluate the long-term functional outcomes of CR-TKA.

Keywords: Cruciate-retaining total knee arthroplasty; Total knee arthroplasty; Posterior cruciate ligament; Knee osteoarthritis; Functional outcome; Knee Society Score; WOMAC; KOOS-JR; Pain; Range of motion.

INTRODUCTION

Total Knee arthroplasty (TKR), a surgical procedure to replace weight-bearing surfaces of knee joint to relieve pain and disability; is an end-of-line treatment for patients with severe pain and functional limitations. The controversy over retention or substitution of the posterior cruciate ligament (PCL) continues. The excellent long-term results of TKR done with cemented condylar components of cruciate sacrificing, cruciate substituting and cruciate retaining designs ensures that this debate will continue. The central concept is focused on whether PCL retention can reliably and reproducibly promote femoral roll back as the knee flexes. An assessment of the theoretical issues and clinical results of knee arthroplasty assists in the analysis of this controversy. Important new data from the field of bio-mechanics, histology gait analysis, and radiology as well as from the operating room have sharpened the PCL debate. The aim of this study was to evaluate the early functional outcome of PCL retaining total knee arthroplasty (TKA). Objectives were to evaluate the rehabilitation protocol in cruciate retaining TKA and complications if any.

MATERIALS AND METHODS

This prospective study was conducted at Department of Orthopaedics of a tertiary care hospital, Rohtak after ethical approval (BREC/23/TH-Ortho 09) with clinical trial registration no- CTRI/2024/01/061715. Patients undergoing primary TKR with structurally intact PCL were included in the study. Patient with Local/systemic infection, bleeding disorders, neurological disorder of lower limb, ischemic disease of the limb, difficulty in mobility, foot, ankle and hip disorders, flexion deformity >10°, varus and valgus deformity >10°, leg length discrepancy, patients requiring hinged prosthesis, prior PCL injury, post-traumatic osteoarthritis and post-infectious osteoarthritis and undergoing revision TKR were excluded.

Sample size formula:

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2 \sigma^2}{(d)^2}$$
$$n = \frac{(1.96 + 0.84)^2 * (7.5)^2}{(6)^2}$$
$$n = 12.25 \cong 15$$

$Z_{1-\frac{\alpha}{2}}$ = Confidence interval at 95% (standard value 1.96)

$Z_{1-\beta}$ = Power of the study 80% = 0.84

(σ) = standard deviation = 7.5

d = margin of error = 6

Sample size $n=15$

SURGICAL PROCEDURE

Preoperative Planning

Detailed clinical history, hematological/biochemical investigations and radiological assessments were done for all the patients. Written valid consent was obtained for all patients. Preoperatively all the patients were explained about the lifestyle modifications that they have to make, like avoiding squatting and sitting cross legs after TKR. Pre-operative anesthetic assessment was done for all patients. On the eve of surgery, part preparation of the patient's limb was done by removing all hair, scrubbing the limb with povidone iodine scrub solution (5%) and draping with sterile cotton sheet in ward. Adequate pre-operative fasting was advised for all patients and preoperative antibiotic prophylaxis with Injection cefuroxime 500mg intravenously, after antibiotic susceptibility test, was given 1 hour before surgery.

In Operation Theatre

Patient positioned in supine followed by sand bags/bolsters were placed on the operating table to support the foot to keep the knee in 30° and 90° flexion. Side posts were attached to support the thigh laterally. Surgeries were done under spinal-epidural anesthesia. Automated high pneumatic pressure tourniquet was applied over the proximal part of thigh. The overnight drape was removed and thorough scrubbing of the limb was done again with povidone iodine scrub solution followed by two cycles of alternate painting of skin in surgical field with povidone iodine solution (5%) and spirit solution. The limb was then draped for surgery.

Skin incision³⁸

Skin marker was used to mark the incision site. The most commonly used skin incision for total knee arthroplasty was an anterior midline incision. The skin incision extended from 4 cm above the patella to 4 cm below the patella. Immediate post-operatively, the patient's knee was immobilized in a compressive bandage with a crepe bandage and a knee immobilizer. The patients were given IV antibiotics and subcutaneous low molecular weight heparin (LMWH) for DVT prevention. Patients were required to exercise for the first seven days following surgery under the supervision of experienced doctors and rehabilitation experts.

POST-OPERATIVE ANTIBIOTICS

Analgesics and Antibiotics (Cefuroxime and Amikacin) as per coverage were administered intravenously for 5 days post-surgery. Following which switched to oral antibiotics Cefuroxime 500 mg every 12 hours until sutures were removed. Early ambulation and limb

mobilization exercises (ankle pump, quadriceps statics) were started. DVT prophylaxis was followed as per institutional protocols (LMWH and tab aspirin 150 mg every 24 hours for 4 weeks).

POST OPERATIVE PROTOCOL

Until the fifth post-operative day, a strict nursing barrier was maintained.

- Static quadriceps exercises were started as soon as the effect of anesthesia wore off.
- On the second post-operative day, drain was removed, the wound was evaluated, and fresh dressing was done. Passive knee bending exercises were begun up to patients' tolerance. The patients were encouraged to sit at the bedside. Walker-assisted ambulation was first permitted within the confines of the nursing barrier.
- On the fourth post-operative day, active and active-assisted knee flexion, as well as dynamic quadriceps workouts, were begun. Patients were permitted and encouraged to sit in a chair.
- Patients were discharged when patients achieved a flexion range of motion of up to 90 degrees and no/some extension gap.
- Sutures were removed on the 14th post-operative day, and the patient was recommended to continue with regular physiotherapy.
- Weight-bearing mobilization using a walker was continued for another two weeks, following which the form of support to be used was left to the patient's discretion, preferably a walking stick, depending on their level of comfort.
- Patients were not permitted to use stairs for four weeks following surgery.

- Any post-operative complications were documented.

Follow up visits

Patients were called at 1month, 3month and 6 months for clinical and radiographic evaluation (AP and lateral view). A clinical examination was done and functional assessment were made using Knee society score⁴⁰, WOMAC Score⁴¹ and KOOS JR score⁴² at each follow up and data will be recorded. Thromboembolic manifestations, wound healing, and ROM are more important in postoperative treatment.

RESULTS

Out of the 15 cases, there was a slight female predominance, with 53.3% of female patients, aligning with the general trend in osteoarthritis (OA) where women have a higher prevalence of the disease. Males constituted 46.7% of the study participants. The mean age of the subjects was 58.4 years. It was observed that the majority of study subjects (40%) were in the age group of 51-60 years, followed by 33.3% of subjects aged above 60 years. The age ranged from a minimum of 34 years to a maximum of 75 years. The weight distribution data shows that most patients (53.3%) weighed between 50-60 kg, with a mean weight of 59.80 kg. Another 33.3% weighed between 60-70 kg, while only 13.3% had a weight of 70-80. A higher proportion of participants (60%) had the left side affected, whereas 40% had the right side affected. In our study, 13.3% of patients had valgus deformity, while 86.7% had varus deformity. These findings indicate that varus deformity is more prevalent in osteoarthritis patients undergoing total knee arthroplasty.

Table 1: Demographic profile

Variables	Range	Percentage (%)
Age (years)	58.40 ± 13.02	
Weight (kg)	59.80 ± 6.84	
Gender (male/female)	7/8	46.7/ 53.3%
Affected side (L/R)	9/6	60/40%
Valgus	02	13.3%
Varus	13	86.7%

Our study demonstrated a significant improvement in ROM from preoperative ($103.67^{\circ} \pm 13.02^{\circ}$) to 6 months postoperative ($117.67^{\circ} \pm 9.98^{\circ}$) measurements, with a P-value of <0.0001 indicating statistical significance.

Table 2: Comparison of range of motion from baseline to 6 months

Range of Motion	Mean ± SD	Min-Max	Friedman test value	P – value
Pre	103.67 ± 13.02	75-125	35.417	<0.0001 (sig)
1months	98.27 ± 11.76	80-130		
3months	108.67 ± 10.66	90-130		
6months	117.67 ± 9.98	100-135		

One month postoperatively, ROM slightly decreased to $98.27^{\circ} \pm 11.76^{\circ}$, improved to $108.67^{\circ} \pm 10.66^{\circ}$ at 3 months, and further increased to $117.67^{\circ} \pm 9.98^{\circ}$ at 6 months. We observed a substantial reduction in VAS pain scores from preoperative (9.87 ± 0.35) to 6 months postoperative (0.40 ± 0.51), highlighting the effectiveness of our intervention in providing pain relief. Pain levels dropped significantly at 1 month (5.00 ± 1.07), further decreased to 2.20 ± 1.21 at 3 months, and reached minimal levels (0.40 ± 0.51) at 6 months.

Table-3 Comparison of Pain score from baseline to 6 months

PAIN AS PER VAS SCALE	Mean $\pm$ SD	Min-Max	Friedman value	test	P – value
Pre	9.87 ± 0.35	9-10	44.265		<0.0001 (sig)
1months	5.00 ± 1.07	3-7			
3months	2.20 ± 1.21	0-4			
6months	0.40 ± 0.51	0-1			

Knee Society Score (KSS): The Objective Knee Society Score (KSS) showed a substantial increase, with the mean score rising from 36.60 ± 10.46 preoperatively to 52.00 ± 10.15 at 1 month, further improving to 65.80 ± 7.07 at 3 months, and reaching 75.40 ± 6.82 at 6 months ($p < 0.0001$). Similarly, the Patient Satisfaction Score (PSS) improved significantly, starting from 6.93 ± 1.94 preoperatively and increasing to 20.73 ± 4.33 at 1 month, 28.00 ± 2.67 at 3 months, and 32.73 ± 2.69 at 6 months ($p < 0.0001$). Furthermore, the Patient Expectation Score (PES) increased from 8.47 ± 1.25 preoperatively to 9.80 ± 1.08 at 1 month, 11.20 ± 1.27 at 3 months and 12.00 ± 1.41 at 6 months ($p < 0.0001$). Additionally, the Functional Knee Score (FKS) showed a notable improvement, rising from 39.73 ± 7.81 preoperatively to 52.60 ± 6.03 at 1 month, 67.00 ± 5.92 at 3 months and 74.33 ± 6.13 at 6 months ($p < 0.0001$). WOMAC Score: Figure 1 illustrates a significant improvement in functional and symptomatic outcomes as measured by the WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) score over six months postoperatively. Pain scores demonstrated a substantial reduction, decreasing from 14.53 ± 2.50 preoperatively to 0.73 ± 0.59 at 6 months ($p < 0.0001$). Similarly, stiffness scores dropped markedly from 3.47 ± 1.36 pre-operatively to 0.13 ± 0.35 at 6 months ($p < 0.0001$). Physical function also improved notably, as reflected by a decrease in scores from 43.73 ± 8.14 preoperatively to 2.20 ± 1.01 at 6 months ($p < 0.0001$). The total WOMAC score exhibited a dramatic decline from 63.20 ± 11.12 preoperatively to 3.07 ± 1.53 at 6 months ($p < 0.0001$).

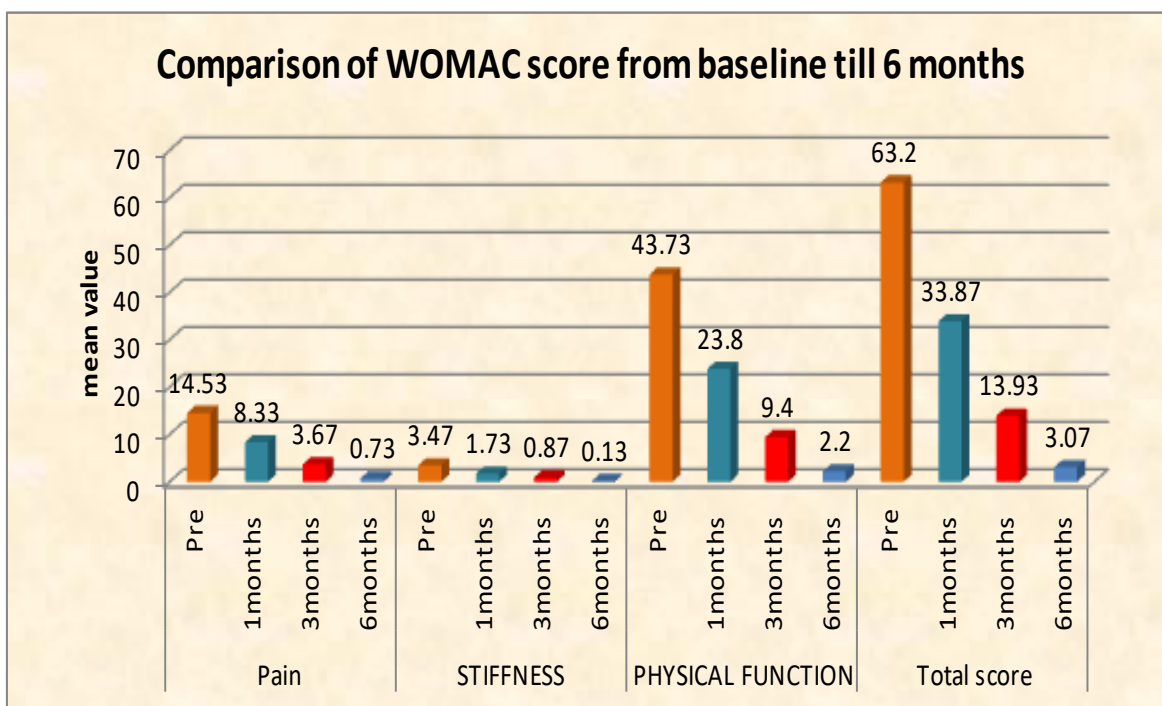


Figure 1: Comparison of WOMAC score from baseline till 6 months

KOOS JR Score: Figure 2 highlights a significant improvement in patient-reported outcomes as measured by the KOOS JR (Knee Injury and Osteoarthritis Outcome Score for Joint Replacement) over a six-month period. Stiffness showed a remarkable reduction, decreasing from 3.33 ± 3.48 preoperatively to 0.20 ± 0.41 at 6 months ($p < 0.0001$). Pain levels reduced markedly, from 11.20 ± 3.28 preoperatively to 0.73 ± 0.70 at 6 months ($p < 0.0001$). Function in daily living improved significantly, with scores declining from 5.47 ± 2.26 to 0.33 ± 0.49 at 6 months ($p < 0.0001$). The raw response total score exhibited a substantial decline, from 18.40 ± 5.46 preoperatively to 1.27 ± 0.88 at 6 months, with a statistically significant repeated measures ANOVA p-value of <0.0001 . The most common complications post-TKA included stiffness in 2 subjects and superficial skin infections in 2 subjects at 1-month post-op. By 3- and 6- months post-op, 13 number of subjects reported no complications, with 2 subject's still experiencing stiffness. No cases of deep vein thrombosis, pulmonary embolism, compartment syndrome, superficial wound infection, deep wound infection, or mortality were observed at any time point.

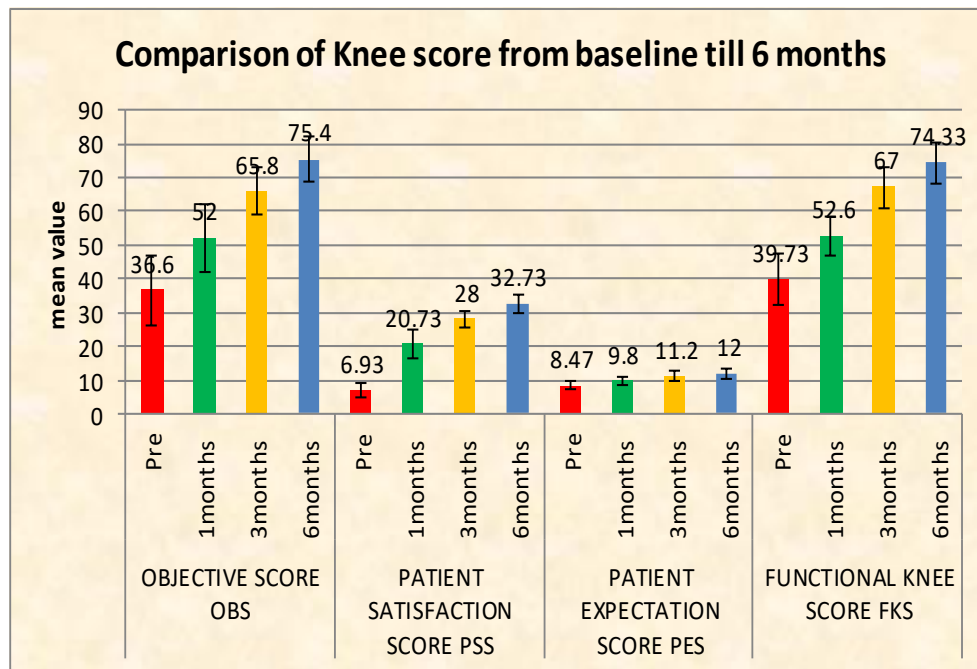


Figure 2: Comparison of Knee score from baseline till 6 months

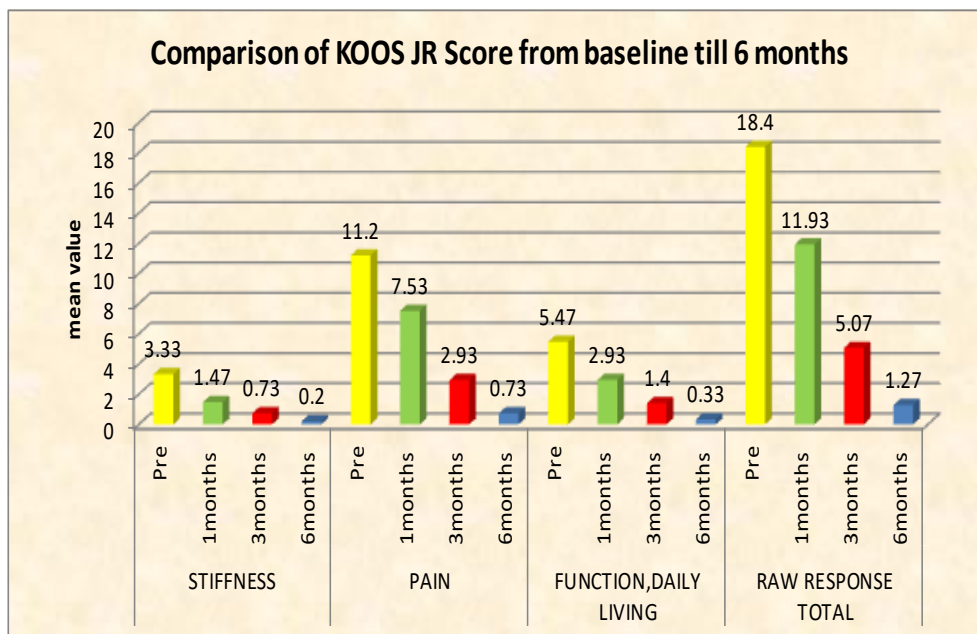


Figure 3: Showing KOOS JR Score in Cases

Table 4: Complications

Complication	1 Month	3 Months	6 Months
None	11 (73.3%)	13 (86.7%)	13 (86.7%)
Stiffness	2 (13.3%)	2 (13.3%)	2 (13.3%)
Superficial Skin Infection	2 (13.3%)	0 (0%)	0 (0%)
DVT	0 (0%)	0 (0%)	0 (0%)
Pulmonary Embolism	0 (0%)	0 (0%)	0 (0%)
Compartment Syndrome	0 (0%)	0 (0%)	0 (0%)
Superficial Wound Infection	0 (0%)	0 (0%)	0 (0%)
Deep Wound Infection	0 (0%)	0 (0%)	0 (0%)

DISCUSSION

This prospective study evaluated 15 patients who underwent Cruciate retaining TKR demonstrated a slight female predominance. Overall, the study observed significant improvements in various aspects of patient outcomes following knee arthroplasty. Factors such as gender distribution, age, deformity type, and weight distribution were found to influence outcomes and should be considered when analysing clinical results. Significant improvements in ROM, pain relief, and patient-reported outcomes (KOOS-JR, KSS, and WOMAC scores) indicate the effectiveness of the posterior cruciate retaining primary total knee arthroplasty. At 6 months Post-operatively, ROM increased significantly from baseline. However, a transient drop to $98.27 \pm 11.76^\circ$ was noted at 1 month, followed by progressive increase at 3 months and 6 months consecutively. Robust and continuous pain relief as assessed by VAS scores declined from preoperatively to reaching at minimal levels by 6 months. KSS improved significantly from preoperative values ($36.60 \pm 10.46^\circ$) to $75.40 \pm 6.82^\circ$ at 6 months ($p < 0.0001$). WOMAC index scores exhibited a significant decrease from preoperative values to at 6 months with notable improvements in pain, stiffness and physical function ($p < 0.0001$). Koos JR outcomes dropped from preoperatively to at 6 months driven by key reduction in stiffness, pain and daily living limitations ($p < 0.0001$). At 1 month, mild knee stiffness ($n=2$) and superficial skin infections ($n=2$) were seen postoperatively.

The present study demonstrated a significant improvement in range of motion (ROM) from preoperative ($103.67^\circ \pm 13.02^\circ$) to 6 months postoperative ($117.67^\circ \pm 9.98^\circ$) measurements, with a P-value of < 0.0001 indicating statistical significance. Similarly, the study by Dash et al. (2018)⁴³ showed a significant improvement in ROM from preoperative (87.5°) to postoperative (104.2°) measurements, with a P-value of .010. In contrast, the study by French et al.

(2019)⁴⁷ observed improvements in ROM for the cruciate-retaining (CR) group from preoperative ($104.9^\circ \pm 11.9^\circ$) to 6 months postoperative ($114.3^\circ \pm 8.4^\circ$) measurements, but these differences were not statistically significant (P-values of .33 and .55, respectively). The study by D'Ambrosi et al. (2022)³² showed a significant improvement in ROM from preoperative ($90.35^\circ \pm 8.20^\circ$) to 1-year follow-up ($116.14^\circ \pm 5.57^\circ$) in octogenarians, with a P-value of 0.048. Both the present study and Dash et al.'s⁴³ study indicate that posterior cruciate retaining primary total knee arthroplasty is effective in significantly improving ROM. However, the French et al.(2019)⁴⁷ and D'Ambrosi et al. (2022)³² studies showed varying degrees of significance in their findings, highlighting the importance of surgical technique, patient selection, and postoperative care in achieving optimal outcomes in total knee arthroplasty. This emphasizes the need for further research and individualized approaches to improve patient outcomes.

The analysis of the VAS pain scores from the present study, the study by D'Ambrosi et al. (2022)³², and the study by Budhiparama et al. (2023)³⁷ highlights significant findings. In the present study, we observed a substantial reduction in VAS pain scores from preoperative (9.87 ± 0.35) to 6 months postoperative (0.40 ± 0.51). This remarkable improvement underscores the effectiveness of our intervention in providing pain relief. Comparatively, the study by D'Ambrosi et al. (2022)³² reported VAS scores of 7.46 ± 1.39 preoperatively and 1.56 ± 1.33 at 3 months postoperative, indicating significant pain reduction but not as profound as our study's results. The study by Budhiparama et al. (2023)³⁷ also showed preoperative VAS scores of 7.91 ± 0.80 for the PCL-retained group, further supporting the importance of evaluating pain management strategies. Overall, the data from our study demonstrates superior pain alleviation over time compared to other studies, highlighting the effectiveness

of our approach and its potential impact on improving patient outcomes.

In our study, the most common complications post-TKA included stiffness (13.3%) and superficial skin infections (13.3%) at 1-month post-op. By 3- and 6-months post-op, 86.7% of subjects reported no complications, with 13.3% still experiencing stiffness. The Dash et al. (2018)⁴³ study reported 8% of subject's experienced DVT and compartment syndrome, which were not observed in our study. 5% of subjects had superficial wound infections, a higher rate compared to our study (13.3%). Both studies reported no cases of deep wound infection, pulmonary embolism, or death. These comparisons highlight differences in complication rates between the studies, particularly regarding DVT, compartment syndrome, and superficial wound infections. Our study shows a lower rate of certain complications and emphasizes the importance of postoperative care and monitoring.

The study's findings underscore the necessity of documenting affected side data and the importance of minimizing complications through vigilant postoperative care. The lower rate of complications in this study compared to others highlights the benefits of careful monitoring and tailored care strategies.

CONCLUSION

Cruciate-Retaining Total Knee Arthroplasty has demonstrated significant improvements in functional outcomes, pain relief, and patient satisfaction for osteoarthritis patients. Our study emphasizes the importance of tailored postoperative care and vigilant monitoring to minimize complications and optimize recovery. The findings highlight the need for further research with larger sample sizes and extended follow-up periods to validate and expand upon these results, enhancing treatment strategies and improving the overall quality of life for osteoarthritis patients.

DECLARATIONS

Ethics Approval and Consent to Participate

The study was conducted in accordance with the ethical standards of the responsible institutional research committee and the principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India (Approval No. BREC/23/TH-Ortho 09). The study was also registered with the Clinical Trials Registry-India (CTRI/2024/01/061715). Written informed consent was obtained from all participants prior to their enrolment in the study.

Consent for Publication

Written informed consent was obtained from the participants for publication of the study findings. No individually identifiable information is presented in the manuscript.

Competing Interests

The authors declare that they have no competing interests related to this study.

Funding

The authors received no specific grant, financial support, or funding from any governmental, commercial, or non-profit organization for this study.

Authors' Contributions

All authors contributed to the conception and design of the study, data collection, analysis and interpretation of the results, and preparation of the manuscript. All authors critically reviewed the manuscript and approved the final version for publication.

Data Availability

The data generated and/or analyzed during the current study are available from the corresponding author on reasonable request, subject to institutional and ethical considerations.

Acknowledgements

The authors would like to acknowledge the Department of Orthopaedics, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India, for providing the necessary clinical and institutional support for conducting this study.

AI Use Disclosure

The authors declare that no generative artificial intelligence tools were used to generate or substantially modify the scientific content of this manuscript.

REFERENCES

1. Mihalko MW. Arthroplasty of the knee. In: Azar FM, et al., editors. Campbell's operative orthopaedics. 13;Philadelphia. Elsevier. 2017;p. 397.
2. Maloney JW, Schurman JD. The effects of implant design on range of motion after total knee arthroplasty. Clinical Orthopaedics and Related Research. 1992;278:147–152.
3. Insall JN, Lachiewicz PF, Burstein AN. The Posterior stabilized condylar prosthesis: a modification of the total condylar design. Two to four-year clinical experience. J Bone Joint Surg Am 1982;64:1317-23.

4. Castellarin G, Bori E, Rapallo L, Pianigiani S, Innocenti B. Biomechanical analysis of different levels of constraint in TKA during daily activities. *Arthroplasty*. 2023;5:3.
5. MANUAL LU. The 2011 Knee Society Knee Scoring System
6. Walker LC, Clement ND, Bardgett M, Weir D, Holland J, Gerrand C, Deehan DJ. The WOMAC score can be reliably used to classify patient satisfaction after total knee arthroplasty. *Knee Surgery, Sports Traumatology, Arthroscopy*. 2018;26:3333-41.
7. Lyman S, Lee YY, Franklin PD, Li W, Cross MB, Padgett DE. Validation of the KOOS, JR: a short-form knee arthroplasty outcomes survey. *Clinical Orthopaedics and Related Research* 2016;474:1461-71.
8. Sharath KR, Dinakar Reddy D, Mahesh M. Comparing cruciate-retaining total knee arthroplasty and cruciate-substituting total knee arthroplasty: A prospective clinical study. *Int Orthop* 2021;7(3):225-8.
9. Sarad R, Aggarwal R, Singh B, Singh D (2020) Comparative study of cruciate retaining vs posterior stabilized prosthesis in total knee replacement. *International Journal of Orthopaedics Traumatology & Surgical Sciences* 6(1): 75-80.
10. Adawy AH, Tabl EA, El-Saify IM. Posterior Cruciate Ligament Retaining Versus Sacrificing in Total Knee Replacement. *Benha Journal of Applied Sciences*. 2021 1;6(1):173-9.
11. D'Ambrosi R, Menon PH, Salunke A, Mariani I, Palminteri G, Basile G, et al. Octogenarians Are the New Sexagenarians: Cruciate-Retaining Total Knee Arthroplasty Is Not Inferior to Posterior-Stabilized Arthroplasty in Octogenarian Patients. *Journal of Clinical Medicine*. 2022 Jun 30;11(13):3795.
12. Budhiparama NC, Lumban-Gaol I, Novito K, Hidayat H, De Meo F, Cacciola G, et al. PCL retained is safe in medial pivot TKA—a prospective randomized trial. *Knee Surg Sports Traumatol Arthrosc*. 2023;31(12):5856-63.
13. Dash SK, Mishra S, Tripathy S, Sharma M, Das A. Early outcomes of posterior cruciate retaining primary total knee arthroplasty in patients of osteoarthritis in Indian population. *Int J Res Orthop*. 2018 May;4(3):463-470.
14. French SR, Munir S, Brighton R. A Single Surgeon Series Comparing the Outcomes of a Cruciate Retaining and Medially Stabilized Total Knee

Arthroplasty Using Kinematic Alignment Principles. *J Arthroplasty*. 2019;xxx:1-7.