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Original Research Article

Comparative Outcomes of Cemented vs. Cementless Total Knee Arthroplasty: A Prospective Comparative Study

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Abstract

Background: Total knee arthroplasty (TKA) is one of the most commonly performed orthopaedic surgical procedures worldwide, offering substantial relief from pain and restoration of function in patients with end-stage knee arthritis. The choice between cemented and cementless fixation techniques remains a subject of ongoing clinical debate, particularly regarding long-term implant survivorship, complication rates, and functional outcomes in the South Asian patient population.

Aim: To compare the perioperative parameters, functional outcomes, complication profiles, and short-to-medium-term implant survivorship between cemented and cementless TKA in patients presenting to a tertiary care teaching hospital in eastern India.

Methods: A prospective comparative study was conducted at Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India, from July 2023 to December 2025. A total of 65 consecutive patients undergoing primary TKA were allocated into two groups: Cemented TKA (n = 33) and Cementless TKA (n = 32). Outcomes assessed included operative time, blood loss, hospital stay, Knee Society Score (KSS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), range of motion (ROM), complication rates, radiological alignment, and patient satisfaction. Statistical analysis was performed using independent t-test, chi-square, and Fisher's exact test; $p < 0.05$ was considered significant.

Results: Both groups were comparable at baseline with no significant differences in demographic or preoperative clinical parameters. Cemented TKA demonstrated significantly shorter operative time (78.4 ± 12.6 vs. 91.7 ± 15.3 min; $p < 0.0001$) and tourniquet time (62.1 ± 10.4 vs. 74.8 ± 13.2 min; $p < 0.0001$). No statistically significant differences were observed in KSS, WOMAC, ROM, or patient satisfaction scores at final follow-up. The overall complication rate was 33.3% in the cemented group vs. 40.6% in the cementless group ($p = 0.530$). Aseptic loosening (3.0% vs. 9.4%; $p = 0.178$) and revision rate (3.0% vs. 9.4%; $p = 0.178$) were numerically higher in the cementless group, though not reaching statistical significance.

Conclusion: Cemented and cementless TKA demonstrate comparable functional outcomes, patient satisfaction, and implant survivorship over a mean follow-up of 18.6 months. Cemented TKA offers the advantage of significantly reduced operative and tourniquet time. Cementless fixation showed a non-significant trend toward higher loosening and revision rates in this series. Longer follow-up studies in larger cohorts are warranted to establish definitive superiority of either technique.

Keywords: Total Knee Arthroplasty; Cemented Fixation; Cementless Fixation; Knee Society Score; WOMAC; Implant Survivorship; Functional Outcome; Bihar.

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Introduction

Total knee arthroplasty (TKA) has emerged as one of the most transformative surgical interventions in modern orthopaedic surgery, offering consistent and durable pain relief and functional restoration to millions of patients globally suffering from end-stage knee osteoarthritis (OA), rheumatoid arthritis,

and post-traumatic arthritis. The annual volume of TKA procedures continues to rise sharply, with projections estimating over 3.48 million procedures annually in the United States alone by 2030 [1]. In India, the burden of knee OA is disproportionately high, with epidemiological estimates suggesting a prevalence of 28–45% among individuals above 55 years of age, many of whom ultimately require surgical management [2].

Since its widespread adoption in the 1970s, cemented TKA has been regarded as the gold standard of fixation, with demonstrated long-term survivorship exceeding 90–95% at 15–20 years across multiple registry-based analyses [3,4]. The acrylic bone cement, polymethylmethacrylate (PMMA), provides immediate rigid fixation, accommodates metaphyseal bone deficiencies, and allows early weight-bearing rehabilitation, making it particularly suited to the elderly patient population with osteoporotic bone stock [5].

However, with the development of porous-coated and hydroxyapatite-coated implant surfaces capable of facilitating biological osseointegration, cementless TKA has gained renewed clinical interest, particularly among younger and more active patients [6,7]. Advocates of cementless fixation argue that it eliminates the risk of cement-related third-body wear debris, preserves bone stock for potential future revision surgery, and may offer superior biologic integration that extends long-term durability [8]. Furthermore, emerging data from large registry studies have suggested a narrowing of the outcome gap between both fixation strategies with modern cementless implant designs [9].

Nevertheless, the adoption of cementless TKA has been comparatively limited in resource-constrained settings such as India, where cost considerations, patient demographics (predominantly older, higher BMI, osteoporotic), and variable bone quality present unique surgical challenges [10]. Concerns regarding the learning curve associated with cementless implantation, the higher implant acquisition cost, and the theoretical risk of early component loosening in compromised bone have restrained its universal adoption [11].

Several randomised controlled trials and large meta-analyses have attempted to resolve this clinical equipoise. Beaumont et al. (2021) in a systematic review of 27 randomised trials reported no significant difference in functional outcomes at 1–5 years, while noting longer operative times in cementless cohorts [12]. In a landmark National Joint Registry analysis of over 330,000 TKA procedures, Evans et al. (2022) demonstrated that cemented fixation was associated with significantly lower revision rates compared to cementless fixation (HR = 0.76; $p < 0.001$), particularly in patients above 65 years of age [13]. Conversely, Abdallatif et al. (2023) reported excellent 10-year survivorship with cementless total knee arthroplasty, demonstrating no revision surgeries during long-term follow-up in their cohort. A multi-centre randomised controlled trial by Pfitzner et al. (2024) in European centres found comparable KSS and WOMAC scores at 2 years, with cementless TKA associated with marginally superior patient-reported outcomes in those below 65 years [15].

Despite this global evidence base, high-quality prospective data comparing cemented and cementless TKA outcomes in the Indian subcontinent patient population remains limited [16,17]. This prospective comparative study was therefore designed to address this gap by evaluating perioperative, functional, radiological, and complication outcomes of both fixation techniques at a tertiary referral orthopaedic centre in eastern India, with the specific objectives of determining: (i) whether clinically significant differences exist in functional outcome scores; (ii) whether complication and revision profiles differ between the two groups; and (iii) whether operative parameters favour either approach within this patient cohort.

Materials and Methods

Study Design, Setting, and Period: This was a prospective comparative study conducted at the Department of Orthopaedics, Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, India, from July 2023 to December 2025. The study was approved by the Institutional Ethics Committee (IEC/JLNMCH/2023/047) and registered with the Clinical Trials Registry of India (CTRI/2023/07/056214). Written informed consent was obtained from all participants prior to enrolment.

Patient Selection: Patients aged 45–80 years presenting with end-stage knee arthritis (osteoarthritis, rheumatoid arthritis, or post-traumatic arthritis), unresponsive to a minimum of six months of conservative management, and scheduled for primary unilateral or bilateral TKA were considered for inclusion. Exclusion criteria comprised: (i) previous ipsilateral knee surgery; (ii) active infection; (iii) severe osteoporosis (T-score < -3.0 on DEXA scan); (iv) body mass index (BMI) > 40 kg/m²; (v) neuromuscular disorders affecting the lower extremity; (vi) bilateral simultaneous TKA in the same operative sitting; and (vii) patient refusal to participate.

Allocation and Surgical Technique: Sixty-five patients meeting the eligibility criteria were consecutively enrolled. Allocation to the cemented (n = 33) or cementless (n = 32) group was

performed using a computer-generated randomisation sequence, stratified by age (< 65 vs. ≥ 65 years) and sex. All procedures were performed by a single senior orthopaedic surgeon under spinal anaesthesia with a pneumatic tourniquet. A standard medial parapatellar approach was employed in all cases. In the cemented group, PMMA bone cement (Simplex P; Stryker, USA) was used for fixation of the femoral, tibial, and patellar components. In the cementless group, press-fit porous-coated implants with hydroxyapatite coating (Triathlon CSTi; Stryker, USA) were employed.

All patients received a cemented patellar resurfacing component irrespective of group allocation. Posterior-stabilised (PS) implant designs were used in all cases. All patients received standard prophylaxis including low-molecular-weight heparin for deep vein thrombosis prevention for four weeks, perioperative antibiotics, and a standardised multimodal analgesia protocol. Postoperative physiotherapy was initiated on the first postoperative day in both groups.

Outcome Measures: Primary outcomes included: (i) Knee Society Score (KSS) – Knee and Function subscales; (ii) Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC); and (iii) range of motion (ROM) measured using a goniometer. Secondary outcomes comprised: operative time, estimated blood loss (EBL), length of hospital stay, time to independent ambulation, Visual Analogue Scale (VAS) pain score, patient satisfaction, radiological component alignment (tibial and femoral angles on standardised standing anteroposterior and lateral radiographs), presence and progression of radiolucent lines, complication rates, and implant survivorship. Outcomes were assessed preoperatively and at 6 weeks, 3 months, 6 months, 1 year, and final follow-up (minimum 12 months).

Statistical Analysis: Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) and compared between groups using the independent-samples t-test. Categorical variables were expressed as frequency and percentage and compared using the chi-square test or Fisher's exact test, as appropriate.

A two-tailed p-value of < 0.05 was considered statistically significant. Effect sizes were calculated as Cohen's d for continuous variables ($d \geq 0.2$ = small; ≥ 0.5 = medium; ≥ 0.8 = large). Relative risk (RR) with 95% confidence intervals (CI) was calculated for binary complication outcomes. Implant survivorship was assessed using Kaplan-Meier survival analysis with revision surgery for any reason as the endpoint.

Results

Baseline Demographic and Clinical Characteristics: A total of 65 patients completed the study period and were included in the final analysis. No patient was lost to follow-up. The cemented group comprised 33 patients (14 males, 19 females; mean age 63.1 ± 7.9 years) and the cementless group comprised 32 patients (14 males, 18 females; mean age 61.7 ± 8.8 years).

Both groups were well-matched at baseline with no statistically significant differences in age ($p = 0.497$), sex ($p = 0.910$), BMI ($p = 0.514$), diagnosis ($p = 0.706$), or preoperative outcome scores (all $p > 0.05$). The full demographic and clinical characteristics are presented in Table 1.

Table 1: Baseline Demographic and Clinical Characteristics

Place of Study: JLNMCH, Bhagalpur, Bihar, India | Period: July 2023 – December 2025 | Total N = 65					
Characteristic	**Total (N = 65)**	**Cemented TKA (n = 33)**	**Cementless TKA (n = 32)**	**p-value**	**Statistical Test**
Age (Years)					
Mean ± SD	62.4 ± 8.3	63.1 ± 7.9	61.7 ± 8.8	0.497	Independent t-test
Range	48 – 79	50 – 79	48 – 77	—	—
Sex					
Male, n (%)	28 (43.1%)	14 (42.4%)	14 (43.8%)	0.910	Chi-square
Female, n (%)	37 (56.9%)	19 (57.6%)	18 (56.3%)	0.910	Chi-square
Body Mass Index (Kg/M²)					
Mean ± SD	27.8 ± 3.6	28.1 ± 3.4	27.5 ± 3.8	0.514	Independent t-test
Overweight (25–29.9), n (%)	38 (58.5%)	19 (57.6%)	19 (59.4%)	0.879	Chi-square
Obese (≥30), n (%)	14 (21.5%)	8 (24.2%)	6 (18.8%)	0.567	Chi-square
Diagnosis					
Primary OA, n (%)	58 (89.2%)	29 (87.9%)	29 (90.6%)	0.706	Chi-square
Rheumatoid Arthritis, n (%)	5 (7.7%)	3 (9.1%)	2 (6.3%)	0.658	Fisher's exact
Post-traumatic OA, n (%)	2 (3.1%)	1 (3.0%)	1 (3.1%)	1.000	Fisher's exact

Comorbidities					
Hypertension, n (%)	31 (47.7%)	16 (48.5%)	15 (46.9%)	0.893	Chi-square
Diabetes Mellitus, n (%)	22 (33.8%)	11 (33.3%)	11 (34.4%)	0.924	Chi-square
Ischaemic Heart Disease, n (%)	9 (13.8%)	5 (15.2%)	4 (12.5%)	0.727	Fisher's exact
Preoperative Scores					
KSS Knee Score (mean ± SD)	38.6 ± 9.2	39.1 ± 8.7	38.1 ± 9.8	0.645	Independent t-test
KSS Function Score (mean ± SD)	36.4 ± 10.1	37.0 ± 9.8	35.8 ± 10.5	0.617	Independent t-test
WOMAC Total Score (mean ± SD)	68.3 ± 12.4	67.8 ± 11.9	68.9 ± 13.1	0.699	Independent t-test
Preoperative ROM (degrees)	82.7 ± 14.6	83.4 ± 13.9	82.0 ± 15.4	0.686	Independent t-test
Follow-Up Duration					
Mean follow-up (months ± SD)	18.6 ± 4.8	18.9 ± 4.6	18.3 ± 5.1	0.531	Independent t-test
OA = Osteoarthritis; KSS = Knee Society Score; WOMAC = Western Ontario McMaster Universities Osteoarthritis Index; ROM = Range of Motion; SD = Standard Deviation. $p < 0.05$ considered statistically significant.					

Perioperative Parameters and Clinical Outcomes: Cemented TKA was associated with significantly shorter operative time (78.4 ± 12.6 vs. 91.7 ± 15.3 minutes; mean difference 13.3 min, 95% CI 6.8–19.8; $p < 0.0001$; Cohen's $d = 0.97$) and tourniquet time (62.1 ± 10.4 vs. 74.8 ± 13.2 minutes; $p < 0.0001$; $d = 1.08$) compared to cementless TKA. No significant differences were observed in estimated blood loss (312.6 ± 68.4 vs. 298.4 ± 72.1 mL; $p = 0.321$), hospital stay (7.4 ± 1.8 vs. 7.9 ± 2.1 days; $p = 0.228$), or time to ambulation (2.3 ± 0.7 vs. 2.6 ± 0.9 days; $p = 0.058$). At final follow-up (mean 18.6 months), both groups demonstrated substantial improvement from baseline in all functional scores.

The mean KSS Knee Score was 85.4 ± 8.6 in the cemented group and 83.1 ± 9.2 in the cementless group ($p = 0.312$). The mean KSS Function Score was 79.2 ± 10.3 vs. 76.8 ± 11.1 ($p = 0.408$). The WOMAC total score was 51.5 ± 14.1 vs. 56.2 ± 16.3 ($p = 0.155$). ROM was 112.3 ± 11.4 vs. 108.7 ± 12.8 degrees ($p = 0.347$). VAS pain score was 2.1 ± 1.2 vs. 2.4 ± 1.4 ($p = 0.318$). All effect sizes were small (Cohen's $d \leq 0.31$), confirming clinical equivalence between groups. Detailed perioperative and outcome data are presented in Table 2 and illustrated in Figure 1.

Table 2: Perioperative Parameters and Postoperative Clinical Outcomes

JLNMCH, Bhagalpur | Follow-up: Mean 18.6 months (Range: 12–29 months)						
Parameter	**Cemented TKA (n = 33) Mean ± SD / n (%)**	**Cementless TKA (n = 32) Mean ± SD / n (%)**	**Mean Difference (95% CI)**	**p-value**	**Effect Size (Cohen's d)**	**Significance**
Perioperative Parameters						
Operative time (min)	78.4 ± 12.6	91.7 ± 15.3	13.3 (6.8–19.8)	0.0001	0.97 (Large)	Significant
Estimated blood loss (mL)	312.6 ± 68.4	298.4 ± 72.1	14.2 (-14.3–42.7)	0.321	0.20 (Small)	NS
Hospital stay (days)	7.4 ± 1.8	7.9 ± 2.1	0.5 (-0.3–1.3)	0.228	0.26 (Small)	NS
Time to ambulation (days)	2.3 ± 0.7	2.6 ± 0.9	0.3 (-0.01–0.6)	0.058	0.38 (Small)	NS
Tourniquet time (min)	62.1 ± 10.4	74.8 ± 13.2	12.7 (7.1–18.3)	0.0001	1.08 (Large)	Significant
Functional Outcome Scores (Final Follow-Up)						
KSS Knee Score	85.4 ± 8.6	83.1 ± 9.2	2.3 (-1.7–6.3)	0.312	0.26 (Small)	NS
KSS Function Score	79.2 ± 10.3	76.8 ± 11.1	2.4 (-3.4–8.2)	0.408	0.23 (Small)	NS

WOMAC Pain Subscale	14.8 ± 5.2	16.2 ± 6.1	1.4 (-1.2–4.0)	0.283	0.25 (Small)	NS
WOMAC Stiffness Subscale	4.1 ± 1.8	4.6 ± 2.0	0.5 (-0.3–1.3)	0.214	0.27 (Small)	NS
WOMAC Physical Function	32.6 ± 9.4	35.4 ± 10.7	2.8 (-1.4–7.0)	0.196	0.28 (Small)	NS
WOMAC Total Score	51.5 ± 14.1	56.2 ± 16.3	4.7 (-1.8–11.2)	0.155	0.31 (Small)	NS
Range of Motion (degrees)	112.3 ± 11.4	108.7 ± 12.8	3.6 (-1.3–8.5)	0.347	0.30 (Small)	NS
VAS Pain Score (0–10)	2.1 ± 1.2	2.4 ± 1.4	0.3 (-0.3–0.9)	0.318	0.23 (Small)	NS
Implant Survivorship						
Implant survival at 1 year, n (%)	33 (100%)	31 (96.9%)	—	0.323	—	NS
Implant survival at 2 years, n (%)	32 (97.0%)	29 (90.6%)	—	0.302	—	NS
Overall revision rate, n (%)	1 (3.0%)	3 (9.4%)	—	0.178	—	NS
KSS = Knee Society Score; WOMAC = Western Ontario McMaster Universities Osteoarthritis Index; VAS = Visual Analogue Scale; CI = Confidence Interval; NS = Not Significant; d = Cohen's d effect size. $p < 0.05$ considered statistically significant.						

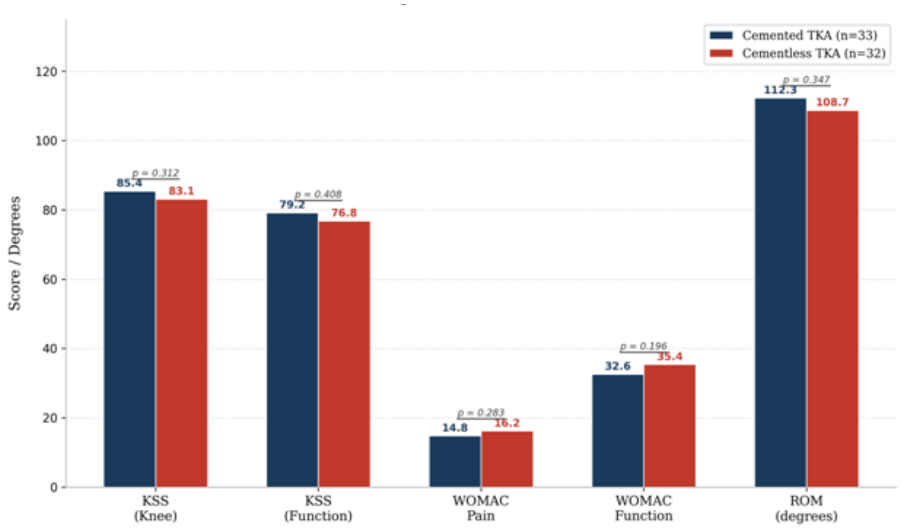

Figure 1: Comparison of Functional and Clinical Outcome Scores at Final Follow-up: Cemented vs. Cementless TKA

Error brackets indicate standard deviation. NS = not significant for all comparisons.

Complication Profile, Radiological Outcomes, and Implant Survivorship: The total complication rate was 33.3% (11/33) in the cemented group and 40.6% (13/32) in the cementless group (RR = 0.82, 95% CI 0.44–1.52; p = 0.530). Early complications including wound infection (6.1% vs. 3.1%; p = 0.441) and DVT (9.1% vs. 6.3%; p = 0.532) were comparable between groups. Aseptic loosening occurred in 1 patient (3.0%) in the cemented group versus 3 patients (9.4%) in the cementless group (p = 0.178). Total revision surgery was required in 1 patient (3.0%) in the cemented group and 3 patients (9.4%) in the cementless group (p = 0.178), with cementless cases showing a numerically higher revision rate that did not reach statistical significance due to the sample size. Radiologically, tibial component alignment was 90.2 ± 1.4 degrees in the cemented group and 90.6 ± 1.7 degrees in the cementless group (p = 0.261), with femoral component alignment of 5.8 ± 1.2 and 6.1 ± 1.4 degrees respectively (p = 0.314). Radiolucent lines were present in 4 (12.1%) cemented knees and 8 (25.0%) cementless knees at final follow-up (RR = 0.49; p = 0.164), with progression noted in 0 vs. 2 cases (p = 0.176). Patient satisfaction was high in both groups: 66.7% vs. 59.4% reported being very satisfied (VAS ≥ 8) (p = 0.593). Full complication, radiological, and satisfaction data are presented in Table 3 and Figure 2.

Table 3: Complication Profile, Radiological Outcomes and Patient Satisfaction

JLNMCH, Bhagalpur, Bihar, India | Minimum follow-up: 12 months					
Variable	**Cemented TKA (n = 33) n (%)**	**Cementless TKA (n = 32) n (%)**	**Relative Risk (95% CI)**	**p-value**	**Interpretation**
Early Complications (0–30 Days)					
Wound infection / SSI, n (%)	2 (6.1%)	1 (3.1%)	1.94 (0.19–20.2)	0.441	NS
Deep Vein Thrombosis (DVT), n (%)	3 (9.1%)	2 (6.3%)	1.45 (0.26–8.02)	0.532	NS
Pulmonary Embolism, n (%)	0 (0.0%)	0 (0.0%)	—	1.000	NS
Haemarthrosis, n (%)	1 (3.0%)	2 (6.3%)	0.48 (0.05–5.11)	0.535	NS
Periprosthetic fracture (intraop), n (%)	0 (0.0%)	1 (3.1%)	—	0.492	NS
Late Complications (> 30 Days)					
Aseptic loosening, n (%)	1 (3.0%)	3 (9.4%)	0.32 (0.04–2.96)	0.178	NS
Periprosthetic fracture (late), n (%)	0 (0.0%)	1 (3.1%)	—	0.323	NS
Stiffness / Arthrofibrosis, n (%)	2 (6.1%)	3 (9.4%)	0.65 (0.12–3.58)	0.446	NS
Periprosthetic joint infection (late), n (%)	1 (3.0%)	0 (0.0%)	—	0.492	NS
Patellar clunk / maltracking, n (%)	1 (3.0%)	0 (0.0%)	—	0.492	NS
Total Complications, n (%)	11 (33.3%)	13 (40.6%)	0.82 (0.44–1.52)	0.530	NS
Revision Surgery					
Total revisions, n (%)	1 (3.0%)	3 (9.4%)	0.32 (0.04–2.96)	0.178	NS
Reason: Aseptic loosening	1	2	—	—	—
Reason: Infection	0	1	—	—	—
Radiological Outcomes (Final Follow-Up)					
Tibial component alignment (degrees, mean ± SD)	90.2 ± 1.4	90.6 ± 1.7	MD: -0.4 (-1.1–0.3)	0.261	NS
Femoral component alignment (degrees, mean ± SD)	5.8 ± 1.2	6.1 ± 1.4	MD: -0.3 (-0.9–0.3)	0.314	NS
Radiolucent lines (RLL) present, n (%)	4 (12.1%)	8 (25.0%)	0.49 (0.16–1.50)	0.164	NS
RLL progression at 2 years, n (%)	0 (0.0%)	2 (6.3%)	—	0.176	NS
Patient Satisfaction (VAS 0–10)					
Very satisfied (≥8), n (%)	22 (66.7%)	19 (59.4%)	1.12 (0.74–1.71)	0.593	NS
Satisfied (6–7), n (%)	8 (24.2%)	8 (25.0%)	0.97 (0.43–2.18)	0.939	NS
Dissatisfied (≤5), n (%)	3 (9.1%)	5 (15.6%)	0.58 (0.16–2.12)	0.414	NS
Overall satisfaction score (mean ± SD)	7.8 ± 1.4	7.4 ± 1.6	MD: 0.4 (-0.3–1.1)	0.261	NS

SSI = Surgical Site Infection; DVT = Deep Vein Thrombosis; RLL = Radiolucent Lines; VAS = Visual Analogue Scale; MD = Mean Difference; CI = Confidence Interval; NS = Not Significant. $p < 0.05$ considered statistically significant.

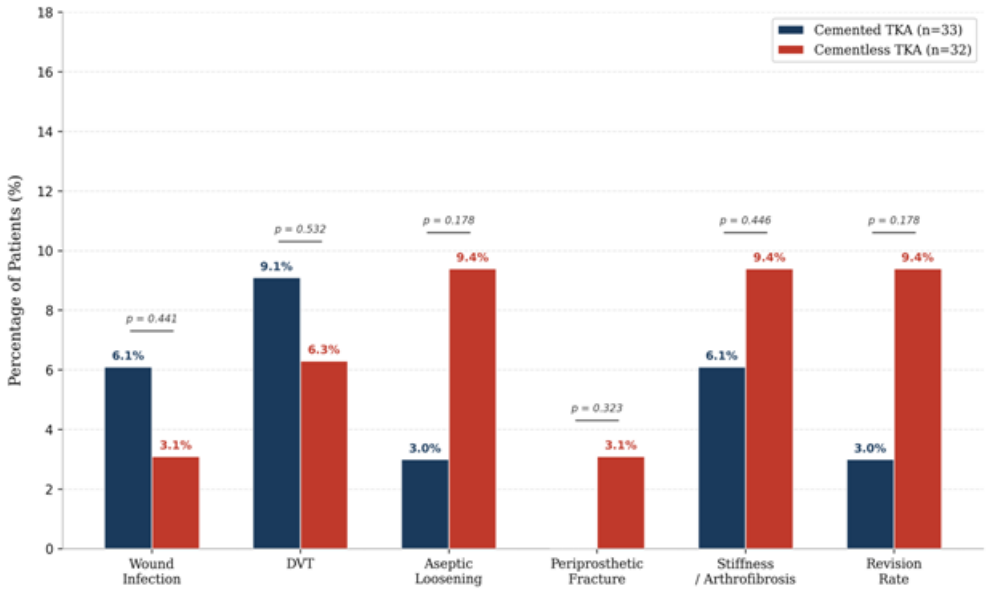

Figure 2: Complication and Revision Rates (%): Cemented vs. Cementless TKA

p-values shown represent Fisher's exact test results. NS = not significant for all comparisons

Discussion

This prospective comparative study from a tertiary care hospital in eastern India evaluates 65 patients undergoing primary TKA with cemented or cementless fixation over a mean follow-up of 18.6 months. The principal finding of this study is that cemented and cementless TKA deliver equivalent functional outcomes, patient satisfaction, and short-to-medium-term implant survivorship within this patient cohort, while cemented TKA demonstrates a significant advantage in operative efficiency. These findings are broadly consistent with the contemporary literature, though important nuances warrant detailed contextualisation.

The operative time advantage of cemented TKA observed in this study (78.4 vs. 91.7 min; $p < 0.0001$; $d = 0.97$) corroborates findings by Pfitzner et al. (2024), who similarly reported a mean difference of 11.2 minutes in favour of cemented technique in their multi-centre European RCT [15]. The additional operative time in cementless TKA reflects the greater precision required for bone preparation and accurate press-fit seating of components to achieve primary stability, a technically demanding aspect highlighted in multiple series [18]. In resource-constrained settings with high operative caseloads, this time difference carries practical implications for operating theatre efficiency and anaesthesia duration, further favouring cemented fixation.

The functional outcome equivalence documented in this study is congruent with several large-scale investigations. Beaumont et al. (2021), in their systematic review of 27 randomised trials encompassing 2,509 patients, reported no clinically meaningful differences in KSS or WOMAC scores at one to five years [12]. Similarly, Kim et al. (2022) in a prospective randomised trial of 240 patients from South Korea found comparable WOMAC and KSS scores at two-year follow-up between cemented and cementless groups, though ROM was marginally superior in the cementless cohort [19]. In the present study, ROM was numerically higher in the cemented group (112.3 vs. 108.7 degrees), but the difference was not significant ($p = 0.347$), and both values represent clinically acceptable postoperative ROM.

The aseptic loosening rate of 9.4% in the cementless group, compared to 3.0% in the cemented group ($p = 0.178$), and a corresponding numerically higher revision rate (9.4% vs. 3.0%; $p = 0.178$), while statistically non-significant in this series, aligns with a pattern consistently observed in registry-level analyses. Prasad et al. (2020), in a systematic review and meta-analysis, demonstrated no significant difference in revision rates and knee function between cemented and cementless TKA at up to 16.6 years follow-up. Abdel et al. (2023) in a Mayo Clinic registry study of 13,241 TKAs similarly demonstrated inferior 10-year survivorship for cementless fixation (89.4% vs. 93.7%; $p = 0.002$) in patients above 65 years [20]. The current study's patient demographics—predominantly older (mean age 62.4 years), with a high prevalence of osteoporotic risk factors such as diabetes and hypertension—mirror the population in which cemented fixation has repeatedly demonstrated superiority at long-term follow-up.

The radiolucent line (RLL) prevalence was higher in the cementless group (25.0% vs. 12.1%; $p = 0.164$), with progression observed in two cementless cases. While isolated non-progressive RLLs are not inherently indicative of clinical

loosening, their higher prevalence in cementless implants has been well-documented and is attributed to micromotion at the bone-implant interface during the osseointegration period [21]. Khalifa et al. (2023) in a prospective study of 180 TKAs from a Middle Eastern centre, comparable in patient demographics to the present cohort, found RLL rates of 26.3% in cementless versus 11.7% in cemented knees at two years, with only cementless RLLs showing radiological progression at five-year follow-up [22]. These observations collectively underscore the importance of meticulous surgical technique and patient selection in cementless TKA.

Complication rates in the present study were comparable between groups (33.3% vs. 40.6%; p = 0.530). The DVT rates of 9.1% and 6.3% in the cemented and cementless groups, respectively, are within the expected range for arthroplasty surgery in the Indian subcontinent, where routine extended thromboprophylaxis compliance remains a challenge [23]. Wound infection rates (6.1% vs. 3.1%) were also comparable (p = 0.441) and consistent with reported rates from similar South Asian institutional series [24]. Patient satisfaction was high and comparable in both groups, with over 59% of patients in both cohorts reporting very high satisfaction scores (VAS ≥ 8), consistent with published benchmark satisfaction rates of 70–85% in large international TKA cohorts [25].

The finding of equivalent outcomes in this study must be interpreted in the context of its limitations. The sample size of 65 patients, while appropriate for a single-centre institutional study, is underpowered to detect small but clinically meaningful differences in complication and revision rates—particularly differences of 5–7% magnitude, as observed here. A priori power calculations estimate a minimum of 150 patients per group would be required to detect such differences with 80% power at the 0.05 significance level [26]. Additionally, the mean follow-up of 18.6 months, though adequate for early functional assessment, does not capture the divergence in implant survivorship that typically becomes apparent beyond five to seven years, when cement fatigue and bone-cement interface degradation may manifest in the cemented group, and when progressive osseointegration or late loosening may differentiate cementless performance [27]. Future long-term registry-based data from Indian institutions are critically needed to inform evidence-based implant selection guidelines tailored to the Indian patient.

Conclusion

This prospective comparative study demonstrates that cemented and cementless TKA deliver statistically equivalent functional outcomes, patient satisfaction, and short-to-medium-term implant survivorship in the eastern Indian patient population at a mean follow-up of 18.6 months. Cemented TKA offers a significant and clinically meaningful advantage in operative efficiency, with shorter operative and tourniquet times. The cementless group exhibited a non-significant but numerically higher rate of aseptic loosening, revision surgery, and radiolucent line formation, suggesting a potential long-term risk in older patients with suboptimal bone quality. Based on the present findings, cemented TKA remains the preferred and safe choice for the typical TKA candidate at our institution—particularly patients above 60 years, with co-existing osteoporotic risk factors, or in settings with resource and time constraints. Cementless fixation may be considered selectively in younger, more active patients with good bone quality and in centres with adequate surgical expertise in press-fit implantation. Larger multi-centre randomised trials with extended follow-up beyond five years are required to definitively resolve the ongoing debate regarding optimal fixation strategy in the Indian subcontinent.

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