



EARLY OUTCOME COMPARISON BETWEEN NATURAL (KINEMATIC) AND TRADITIONAL (MECHANICAL) KNEE REPLACEMENT TECHNIQUES MAX SUPERSPECIALITY HOSPITAL, GREATER NOIDA SECTOR-128

Orthopaedics

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ABSTRACT

Background: Mechanical alignment in total knee arthroplasty (TKA) has traditionally been the standard surgical approach for patients with advanced osteoarthritis. However, kinematic alignment TKA has recently emerged as an alternative technique aimed at restoring the knee's natural, pre-arthritis anatomy. As current evidence does not clearly establish the superiority of either method, this study was undertaken to compare the immediate and short-term postoperative outcomes of kinematic and mechanical alignment TKA. **Methods:** This prospective cohort study, conducted at Max superspeciality hospital (noida), included all patients who underwent TKA using either MA or KA techniques between August 2025 and March 2026. Inclusion criteria consisted of patients with gr3/4 OA, who had failed non-operative management, including structured physiotherapy and intra-articular corticosteroid injections. Exclusion criteria were revision surgeries, concomitant ipsilateral symptomatic hip osteoarthritis, TKA due to fracture, infection, rheumatoid arthritis, and malignancy. Baseline demographics and perioperative data were collected from medical records. Outcomes assessed included patient-reported outcome measures (PROMs), functional performance (Timed Up and Go and stairs test), pain scores (VAS), analgesic use, length of stay, and discharge disposition. Assessments were conducted preoperatively, during hospitalization, and at postoperative day 14 by a blinded evaluator. Data integration and statistical analysis adhered to ethical standards, with a p-value of ≤ 0.05 considered significant, and ongoing collaboration among the research team was maintained. **Results:** Patients undergoing KA TKA demonstrated significantly shorter hospitalization duration and were more frequently discharged directly home compared to MA TKA patients. The KA group also showed significantly improved POD1 functional mobility, with faster TUG test performance. At POD14, patients in the KA TKA group achieved significantly better OKS, KOOS-Symptoms, and SF-12 mental component scores. No significant differences were observed between groups regarding postoperative pain scores, opioid consumption, or emergency room visits due to pain. No revision surgeries, re-hospitalizations, or major surgery-related complications occurred during the early postoperative period. **Conclusion:** Kinematic alignment (KA) total knee arthroplasty demonstrates better short-term outcomes than mechanical alignment (MA), with improved functional recovery, patient-reported outcomes, and earlier discharge.

KEYWORDS

Background

Total knee arthroplasty (TKA) is a commonly performed surgical procedure intended to relieve pain and enhance quality of life in patients with advanced osteoarthritis unresponsive to conservative management(1)(2). The demand for TKA continues to rise significantly, with projections estimating that by 2030, nearly 3.5 million procedures will be performed annually in the United States, representing a substantial increase compared to earlier decades(3).

With this growing demand, optimizing surgical techniques has become increasingly important. Mechanical alignment (MA) TKA, the traditional approach, aims to achieve a neutrally aligned limb through standardized bone resections and soft tissue balancing(1). It is widely regarded as a safe and effective treatment for end-stage osteoarthritis(4). However, despite its success, approximately 15–20% of patients remain dissatisfied with postoperative outcomes, leading to interest in alternative techniques(5).

Kinematic alignment (KA) TKA has emerged as a notable alternative, focusing on restoring the patient's native, pre-arthritis knee anatomy with minimal soft tissue disruption(6). Although multiple randomized controlled trials and meta-analyses have demonstrated the safety and effectiveness of both MA and KA techniques, there is no clear consensus regarding the superiority of one over the other(7).

Furthermore, most existing literature has primarily focused on mid- and long-term outcomes, with limited data addressing early postoperative recovery and rehabilitation. Therefore, the present study aims to compare both objective measures and patient-reported immediate and short-term outcomes between patients undergoing KA and MATKA.

Methods

This prospective observational study was conducted at Max superspeciality hospital, noida, spanning from September 2025 to March 2026. A total of 120 cases were included in the analysis.

Inclusion Criteria: Patients with advanced osteoarthritis (Kellgren-Lawrence grade 3–4) unresponsive to conservative treatment.

Exclusion criteria: comprised revision TKA, inflammatory or infective arthritis, fractures, malignancy, and associated ipsilateral hip pathology

Procedure: Following the selection criteria, all eligible patients received counselling about the study, provided informed written consent, and underwent documentation of relevant demographics and clinical parameters. Necessary investigations were conducted.

All surgeries were performed via a standardized medial parapatellar approach. KA and MA techniques followed established protocols, with cemented implants (CR or CS) selected based on posterior cruciate ligament status. Postoperative care, including analgesia and physiotherapy, was uniform across groups.

Follow-up: Patients were followed during hospitalization and up to postoperative day 14 for assessment of patient-reported outcomes (PROMs), functional performance, pain and analgesic use, length of stay, and discharge disposition.

Statistical analysis: Data integration, statistical analysis, and comprehensive interpretation of the integrated data were conducted, adhering to ethical standards throughout the study. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

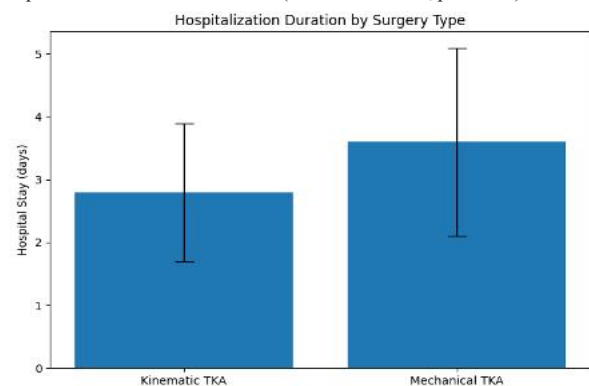
The study cohort included 124 patients who underwent total knee arthroplasty (TKA), with 92 patients in the kinematic alignment (KA) TKA group and 32 patients in the mechanical alignment (MA) TKA group, reflecting the relative proportion of surgeons utilizing each technique. The mean age of the cohort was 68.9 ± 7.9 years, with a female predominance (64.5%), which was comparable between the study groups. Mean body mass index (BMI) was also similar between groups, averaging 31.6 ± 6.2 kg/m². The majority of implants utilized were cruciate-retaining designs, with no statistically significant difference between groups.

Preoperative functional and patient-reported outcome measures, including pain visual analogue scale (VAS), Oxford Knee Score

(OKS), Knee Injury and Osteoarthritis Outcome Score (KOOS), and SF-12 scores, were largely comparable between groups. However, the preoperative stair-climb test demonstrated significantly better performance in the KA TKA group compared to the MA TKA group (31.2 ± 20.1 s vs. 45.7 ± 24.5 s, $p = 0.004$).

Hospitalization and POD 1 Outcomes

Patients in the KA TKA group demonstrated a significantly shorter hospitalization duration compared to the MA TKA group (2.8 ± 1.1 days vs. 3.7 ± 1.5 days, $p = 0.011$). Furthermore, patients undergoing KA TKA were more frequently discharged directly home rather than to inpatient rehabilitation facilities (76.1% vs. 40.6%, $p = 0.002$).



No statistically significant differences were observed between groups regarding opioid consumption during hospitalization or postoperative day 1 (POD1) VAS pain scores.

Functional recovery on POD1 favored the KA TKA cohort. The timed up and go (TUG) test was significantly faster in the KA group compared with the MA group (27.6 ± 24.8 s vs. 46.8 ± 39.7 s, $p = 0.021$), indicating earlier postoperative mobilization and improved immediate functional recovery.

Multivariable regression analysis demonstrated that KA TKA remained independently associated with superior POD1 functional performance and shorter hospitalization duration after adjustment for baseline covariates. Patients in the KA TKA group were approximately 3.4 times more likely to be discharged home compared to patients undergoing MA TKA (OR = 3.4, 95% CI 1.2–10.8).

POD 14 Outcomes

At postoperative day 14, patient-reported outcome measures demonstrated significantly superior early recovery in the KA TKA group. Patients undergoing KA TKA achieved higher OKS values compared to the MA TKA cohort (15.1 ± 5.8 vs. 10.2 ± 5.1 , $p = 0.028$). Similarly, KOOS-Symptoms scores were significantly improved in the KA group (44.3 ± 17.2 vs. 30.4 ± 15.1 , $p = 0.031$).

Mental health recovery also favored KA TKA, with significantly higher SF-12 Mental Component Scores observed at POD14 (41.8 ± 10.3 vs. 24.6 ± 11.4 , $p < 0.001$).

There were no statistically significant differences between groups regarding return visits to the emergency department due to pain, KOOS activities of daily living scores, or postoperative VAS pain scores at POD14.

Adjusted multivariable analyses confirmed superior outcomes associated with KA TKA, particularly regarding KOOS-Symptoms, OKS, and SF-12 mental component scores.

Importantly, none of the patients in either group required revision surgery or re-hospitalization during the initial postoperative follow-up period, and no major surgery-related adverse events were documented.

Table 1: Hospitalization and Postoperative Outcomes by Study Group

Variable	KA TKA (n = 92)	MA TKA (n = 32)	p-value
Hospital stay (days)	2.8 ± 1.1	3.6 ± 1.5	0.011
Home discharge, n (%)	70 (76.1%)	13 (40.6%)	0.002

POD1 VAS pain score	4.8 ± 1.6	5.1 ± 1.8	0.372
POD1 opioid consumption (mg morphine equivalent)	28.5 ± 9.2	30.7 ± 10.4	0.284
POD1 TUG (s)	27.6 ± 24.8	46.8 ± 39.7	0.021
POD14 OKS	15.1 ± 5.8	10.2 ± 5.1	0.028
POD14 KOOS-Symptoms	44.3 ± 17.2	30.4 ± 15.1	0.031
POD14 SF-12 MCS	41.8 ± 10.3	24.6 ± 11.4	<0.001
POD14 VAS pain score	3.1 ± 1.4	3.5 ± 1.6	0.194
ER return due to pain, n (%)	5 (5.4%)	3 (9.3%)	0.441
Revision surgery	0	0	â€”
Re-hospitalization	0	0	â€”

Sensitivity Analysis of Loss to Follow-Up

The loss-to-follow-up rate at POD14 was approximately 18% in the MA TKA group and 27% in the KA TKA group. Sensitivity analyses demonstrated no major baseline demographic differences between patients who completed follow-up and those lost to follow-up. However, patients in the KA group who did not attend POD14 evaluation demonstrated relatively faster preoperative stair-climb performance compared to those who completed follow-up assessments.

DISCUSSION

The present study demonstrated that patients undergoing kinematic alignment total knee arthroplasty (KA TKA) experienced superior early postoperative recovery compared to mechanically aligned total knee arthroplasty (MA TKA)(8)(9). Patients in the KA group showed shorter hospitalization duration, improved POD1 mobility, higher rates of direct home discharge, and superior early patient-reported outcome measures at POD14. These findings suggest that restoration of native knee kinematics through KA TKA may facilitate enhanced functional recovery during the immediate postoperative periods as in study recent study Of pintore et al(10)(11)

A key finding of this study was the significantly shorter hospital stay in the KA group. Early discharge is an important indicator of successful perioperative recovery and may reduce healthcare costs and hospital-related complications. The higher proportion of patients discharged directly home in the KA cohort further supports the potential functional benefits of kinematic alignment.

The significantly faster TUG performance on POD1 among KA TKA patients indicates improved early mobilization. Kinematic alignment aims to restore the patient's native joint line and soft tissue balance, potentially resulting in more physiologic knee mechanics and less soft tissue disruption. These factors may contribute to earlier ambulation and improved functional confidence following surgery.

At POD14, patients undergoing KA TKA demonstrated significantly better OKS, KOOS-Symptoms, and SF-12 mental component scores. These findings are consistent with previous studies suggesting that KA TKA may provide a more natural-feeling knee and improved patient satisfaction compared to conventional mechanical alignment techniques.

No significant differences were observed in postoperative pain scores or opioid consumption between groups. This suggests that although pain control was comparable, functional recovery and perceived knee function may still be enhanced with kinematic alignment.

No cases of revision surgery, re-hospitalization, or major surgery-related complications occurred during the early follow-up period, supporting the short-term safety of KA TKA.

The present study has several limitations, including its retrospective design, unequal group sizes, and relatively short follow-up duration. Additionally, loss to follow-up at POD14 may have introduced attrition bias. Long-term studies are needed to evaluate implant survivorship and durability of functional outcomes.

CONCLUSION

This study suggests that kinematic alignment (KA) total knee arthroplasty (TKA) provides superior short-term outcomes compared

to mechanical alignment (MA) TKA, as demonstrated by improved objective parameters and patient-reported outcome measures. KA TKA facilitates faster postoperative recovery, better functional and psychological outcomes, and a higher likelihood of early discharge to home. These findings support the potential for broader adoption of the kinematic alignment technique in clinical practice. However, further studies with larger sample sizes and well-designed prospective randomized trials are required to validate these results and establish definitive comparisons with mechanical alignment.

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