

Comparative Analysis of Tibial Extender Usage in Total Knee Replacement for Mild Varus Deformities

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Abstract

Background: This study evaluates the effectiveness of using tibial extenders in total knee replacement (TKR) for patients with mild varus deformities.

Methods: A retrospective analysis of 48 TKR cases performed between January 2015 and December 2021 was conducted. Patients were divided into two groups: 24 received tibial extenders (Group A) and 24 did not (Group B). Data included demographic information, clinical assessments, and radiographic evaluations. Primary outcomes measured were knee alignment, range of motion, pain relief, and functional improvement. Secondary outcomes included complication rates and the need for revision surgery.

Results: Group A showed better postoperative knee alignment (mean deviation of 2.5 degrees vs. 4.1 degrees in Group B, $p < 0.05$), greater range of motion (120 degrees vs. 115 degrees, $p < 0.05$), and more pain relief (VAS scores decreased from 8.2 to 2.1 vs. 8.0 to 2.5, $p < 0.05$). Functional improvement was higher in Group A (KSS improvement from 45 to 85 vs. 43 to 80, $p < 0.05$). Complication rates and revision surgery needs were comparable between groups.

Conclusion: Tibial extenders in TKR for mild varus deformities result in better postoperative outcomes without increasing complication rates. Further research is needed to validate these findings and explore long-term benefits.

Keywords: Total Knee Replacement (TKR), Tibial Extenders, Varus Deformities, Postoperative Outcomes

Introduction

Total knee replacement (TKR) is a widely performed orthopedic procedure aimed at alleviating pain and restoring function in patients with severe knee arthritis. One of the critical aspects of TKR is achieving proper alignment of the knee joint, which can be particularly challenging in patients with mild varus deformities. Varus deformities, characterized by an inward angulation of the lower leg, can lead to uneven wear of the knee joint, exacerbating arthritic symptoms and complicating surgical intervention [1].

The use of tibial extenders has been proposed as a solution to address alignment issues during TKR in patients with mild varus deformities [2]. Tibial extenders are prosthetic components designed to provide additional support and stability to the tibial side of the knee joint. By extending the tibial component, surgeons can correct the varus alignment and achieve more balanced load distribution across the knee.

Mild varus deformity is defined as an inward angulation of the lower leg, where the mechanical axis of the knee deviates medially by 5 to 10 degrees from the normal alignment [3].

Material and Methods

This retrospective study analyzed the outcomes of total knee replacement (TKR) surgeries performed between January 2015 and December 2021. A total of 48 cases were included, with 24 cases in each arm. The study aimed to compare the effectiveness of using tibial extenders versus not using them in patients with mild varus deformities.

Study Population

The study included patients who underwent TKR for mild varus deformities. Patients were divided into two groups: one group received tibial extenders during the surgery, while the other group did not. Each group consisted of 24 patients.

Surgical Procedure

All surgeries were performed by experienced orthopedic surgeons. The decision to use tibial extenders was based on the surgeon's assessment of the patient's knee alignment and stability. Tibial extenders were used to provide additional support and stability to the tibial side of the knee joint, aiming to correct varus alignment and achieve balanced load distribution across the knee.

Data Collection

Patient data were collected from medical records, including demographic information, preoperative and postoperative clinical assessments, and radiographic evaluations. The primary outcomes measured were knee alignment, range of motion, pain relief, and functional improvement. Secondary outcomes included



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complication rates and the need for revision surgery.

Statistical Analysis

Statistical analysis was performed to compare the outcomes between the two groups. Continuous variables were analyzed using t-tests, while categorical variables were analyzed using chi-square tests. A p-value of less than 0.05 was considered statistically significant.

Results

The study included a total of 48 patients who underwent total knee replacement (TKR) for mild varus deformities between January 2015 and December 2021. The patients were divided into two groups: 24 patients received tibial extenders during the surgery (Group A), and 24 patients did not receive tibial extenders (Group B).

Demographic Data

The demographic characteristics of the patients in both groups were comparable. The mean age of the patients in Group A was 67.5 years (range: 55-80 years), while the mean age in Group B was 68.2 years (range: 56-82 years). There were no significant differences in gender distribution, body mass index (BMI), or preoperative knee alignment between the two groups.

Primary Outcomes

- 1. Knee Alignment:** Postoperative knee alignment was significantly improved in both groups. However, Group A showed a greater correction of varus deformity, with a mean postoperative mechanical axis deviation of 2.5 degrees compared to 4.1 degrees in Group B ($p < 0.05$).
- 2. Range of Motion:** Both groups demonstrated significant improvements in knee range of motion postoperatively. The mean range of motion in Group A increased from 95 degrees preoperatively to 120 degrees postoperatively, while Group B showed an increase from 93 degrees to 115 degrees ($p < 0.05$).
- 3. Pain Relief:** Patients in both groups reported significant pain relief postoperatively. The mean Visual Analog Scale (VAS) pain score decreased from 8.2 to 2.1 in Group A and from 8.0 to 2.5 in Group B ($p < 0.05$).
- 4. Functional Improvement:** Functional improvement, as measured by the Knee Society Score (KSS), was observed in both groups. Group A had a mean KSS improvement from 45 to 85, while Group B improved from 43 to 80 ($p < 0.05$).

Secondary Outcomes

- 1. Complication Rates:** The overall complication rates were low in both groups. Group A had two cases of superficial wound infection, while Group B had one case of deep vein thrombosis. There were no significant differences in complication rates between the two groups.
- 2. Revision Surgery:** One patient in Group B required revision surgery due to aseptic loosening of the tibial component. No patients in Group A required revision surgery during the follow-up period.

Discussion

The findings of this study demonstrate that the use of tibial extenders in total knee replacement (TKR) for patients with mild varus

deformities results in better postoperative knee alignment, greater range of motion, and improved functional outcomes compared to patients who did not receive tibial extenders. These results are consistent with previous studies that have highlighted the importance of achieving proper knee alignment and stability in TKR. Kutzner et al. (2010) conducted an in vivo study measuring the loading of the knee joint during daily activities in five subjects [4]. Their findings emphasized the significant impact of knee alignment on joint loading and stress distribution. Our study supports these findings by demonstrating that the use of tibial extenders, which improve knee alignment, leads to better postoperative outcomes.

Kim et al. (2012) compared the long-term outcomes of fixed-bearing and mobile-bearing TKR in patients younger than fifty-one years of age with osteoarthritis [5]. They found that proper alignment and stability are crucial for the longevity and success of TKR. Our study aligns with these results, showing that tibial extenders, which enhance knee stability, contribute to improved functional outcomes and reduced complication rates.

Callaghan et al. (2010) reported on the long-term follow-up of cemented rotating platform TKR, highlighting the importance of proper alignment and load distribution for the success of the procedure [6]. Our study's findings are in agreement, as the use of tibial extenders resulted in better load distribution and knee alignment, leading to improved postoperative outcomes.

Kim et al. (2007) investigated the long-term results of simultaneous fixed-bearing and mobile-bearing TKR performed in the same patient [7]. They concluded that achieving proper alignment and stability is essential for the success of TKR. Our study supports this conclusion, demonstrating that tibial extenders, which improve knee alignment and stability, lead to better functional outcomes and reduced need for revision surgery.

Tang et al. (2018) explored the role of LncRNA DANCR in osteolysis after total hip arthroplasty [8]. While their study focused on hip arthroplasty, the importance of proper alignment and stability in joint replacement procedures is a common theme. Our study's findings align with this theme, showing that tibial extenders, which enhance knee stability, contribute to improved postoperative outcomes.

Anthony et al. (2007) examined the contribution of loading conditions and material properties to stress shielding near the tibial component of TKR [9]. Their findings highlighted the importance of proper load distribution for the success of TKR. Our study supports these findings, demonstrating that tibial extenders, which improve load distribution, lead to better postoperative outcomes.

Limitations of our study included the following. (1) This study is retrospective, which inherently limits the ability to establish causality. The reliance on historical data may introduce biases related to data collection and accuracy. (2) The study included a relatively small sample size of 48 patients, with 24 patients in each group. A larger sample size would provide more robust and generalizable results. (3) The study was conducted at a single center, which may limit the generalizability of the findings to other settings or populations. Multi-center studies would be beneficial to validate the results. (4) The follow-up period for this study was limited to a few years. Longer follow-up periods are necessary to assess the long-term outcomes and potential complications associated with the use of tibial extenders in TKR. (5) The surgeries were performed by different orthopedic

surgeons, which may introduce variability in surgical techniques and decision-making. Standardizing surgical procedures and techniques would help minimize this variability. (6) The study included patients with mild varus deformities, and the results may not be applicable to patients with more severe deformities or other types of knee conditions. Further research is needed to explore the effectiveness of tibial extenders in a broader range of patients. (7) The study was not randomized, which may introduce selection bias. Randomized controlled trials are needed to provide higher levels of evidence regarding the effectiveness of tibial extenders in TKR.

Conclusion

This study demonstrates that the use of tibial extenders in total knee replacement (TKR) for patients with mild varus deformities results in significantly better postoperative outcomes compared to patients who did not receive tibial extenders. Specifically, patients who received tibial extenders showed improved knee alignment, greater range of motion, and enhanced functional outcomes. Additionally, the complication rates and need for revision surgery were comparable

between the two groups, indicating that the use of tibial extenders does not introduce additional risks.

These findings align with previous research emphasizing the importance of achieving proper knee alignment and stability in TKR to ensure successful outcomes. However, the study's limitations, including its retrospective nature, small sample size, and lack of randomization, suggest that further research, particularly randomized controlled trials with larger sample sizes and longer follow-up periods, is needed to validate these results and explore the long-term benefits and potential complications associated with the use of tibial extenders in TKR.

In conclusion, tibial extenders appear to be a valuable tool in improving the outcomes of TKR for patients with mild varus deformities, contributing to better knee alignment, increased range of motion, and overall functional improvement. Future studies should aim to build on these findings to provide more robust evidence and guide clinical practice.

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Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

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