

A Prospective Comparative Study on Knee Preservation Surgeries in Patients with Osteoarthritis Based on Detailed Evaluation of Radiological Parameters Pre- and Post-Intervention

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Abstract:

Background: Knee osteoarthritis (OA) is a prevalent condition causing significant impairment in patients' lives. Knee preservation surgeries have become essential interventions for OA management, especially in cases not suitable for total knee replacement. The study aims to comprehensively evaluate radiological parameters before and after knee preservation surgeries to assess their efficacy in OA management.

Methods: A prospective comparative study involved 80 adult patients diagnosed with knee osteoarthritis. Patients underwent various knee preservation surgeries, and radiological assessments, including joint space width, cartilage thickness, alignment, and disease progression, were conducted before and after surgery. Data analysis involved descriptive statistics, paired t-tests, and chi-square tests, with significance set at $p < 0.05$.

Results: The study found considerable radiological improvements after knee preservation procedures. Joint gap width expanded from 2.4 to 4.9 mm, whereas cartilage thickness improved from 1.8 to 3.2 mm. The mean variation in knee alignment decreased from 5.7 degrees to 2.1 degrees. Disease progression severity decreased from 70% to 20%. Clinical outcomes were promising, with 85% of patients reporting pain reduction and 90% improved joint function. Minor wound infections (5%), temporary joint stiffness (4%), and mild effusion (6%), were the main complications in 15% of cases.

Conclusion: Knee preservation surgeries demonstrated significant improvements in radiological parameters and clinical outcomes, making them valuable interventions for knee osteoarthritis management. The study emphasizes the effectiveness of these surgeries in ameliorating radiological and clinical aspects of OA.

Recommendations: This study's findings warrant specific recommendations for further research and clinical practice. There is a vital need for continued long-term research on knee preservation surgeries to ascertain their durability and sustained benefits. Further investigations should explore the potential of knee preservation surgeries to delay long-term disease progression.

Keywords: Knee Osteoarthritis, Knee Preservation Surgery, Radiological Assessment, Clinical Outcomes.

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Introduction

Osteoarthritis (OA) of the knee is a prevalent degenerative joint disease that significantly impairs mobility and quality of life. In the realm of orthopaedic surgery, knee preservation surgeries have emerged as pivotal interventions for managing OA, particularly in patients who are not yet candidates for total knee replacement. These surgeries aim to alleviate pain, restore function, and delay the progression of OA. A critical aspect of evaluating the efficacy of knee preservation surgeries is through radiological assessments, both pre- and post-intervention. Radiological imaging plays a crucial role in diagnosing the extent of OA, planning surgical interventions, and monitoring postoperative outcomes.

Recent studies have delved into the analysis of knee preservation surgeries in OA patients, focusing on

radiological outcomes to assess the changes in knee alignment, joint space, and overall structural integrity of the knee joint. These studies provide valuable insights into the effectiveness of various surgical techniques, such as osteotomies, cartilage repair procedures, and minimally invasive joint preservation techniques. Radiological assessments pre- and post-intervention are instrumental in quantifying the changes in the knee joint, thereby offering an objective measure to evaluate the success of these surgeries [1,2].

The introduction of advanced imaging techniques has further enhanced the ability to assess subtle changes in the knee joint, enabling surgeons to tailor interventions more precisely and predict long-term outcomes. This evolving field continues to explore the potential of knee preservation surgeries in

altering the natural course of OA, with a focus on improving patient-specific outcomes and prolonging the life of the native knee joint. As such, the analysis of knee preservation surgeries through radiological assessment is not only pivotal in current clinical practice but also in guiding future advancements in the treatment of knee OA [3, 4].

The aim of this prospective comparative study is to assess and compare the efficacy of various knee preservation surgeries in patients with osteoarthritis by conducting a comprehensive evaluation of radiological parameters before and after intervention.

Methodology

Study Design: A prospective comparative study.

Study Setting: The study was conducted at Government Medical College, Purnea, Bihar, between 2022-2023.

Participants: The study included 80 participants. Patients aged 18 years and above, diagnosed with knee osteoarthritis and scheduled for knee preservation surgeries, were enrolled in the study.

Inclusion Criteria

1. Adult patients aged 18 years and older.
2. Clinical diagnosis of knee osteoarthritis.
3. Scheduled for knee preservation surgery (e.g., osteotomy, arthroscopy, cartilage restoration).
4. Willingness to participate and provide informed consent.

Exclusion Criteria

1. Patients with contraindications to knee preservation surgery.
2. Inability or unwillingness to provide informed consent.
3. Patients with comorbidities that may affect the study outcomes.

Bias: To minimize bias, eligible patients were enrolled consecutively, and the surgical procedures were performed by experienced orthopaedic surgeons. Radiological assessments were conducted by trained radiologists who were blinded to the patients' clinical details.

Variables: Variables included type of knee preservation surgery (e.g., osteotomy, arthroscopy, cartilage restoration), radiological parameters including joint space width, cartilage thickness, alignment, and any signs of disease progression.

Data Collection:

1. Pre-Intervention Assessment: Pre-operative radiological assessments were conducted using X-rays, magnetic resonance imaging (MRI), and computed tomography (CT) scans to measure joint space width, cartilage thickness, and

assess alignment. Clinical data, including patient demographics and disease severity, were also recorded.

2. Intervention: Patients underwent knee preservation surgeries based on their clinical condition and surgeon's recommendations. Surgical details, including the type of procedure and any intraoperative findings, were documented.
3. Post-Intervention Assessment: Radiological assessments were repeated at scheduled follow-up visits after the surgery to evaluate changes in joint space width, cartilage thickness, alignment, and to assess the effectiveness of the knee preservation surgery. Clinical outcomes, including pain relief and functional improvement, were also recorded.

Statistical Analysis: Data analysis was performed using statistical software SPSS. Descriptive statistics were used to summarize patient demographics and baseline characteristics. Comparative analysis will be conducted using appropriate statistical tests (e.g., paired t-tests, chi-square tests) to assess changes in radiological parameters before and after knee preservation surgery. Statistical significance will be set at $p < 0.05$.

Ethical Considerations: The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

The study included a total of 80 patients diagnosed with knee osteoarthritis who underwent various knee preservation surgeries. The participants had a mean age of 58.4 years, with a range from 42 to 74 years. Among the participants, 47 were male (58.8%) and 33 were female (41.2%).

The evaluation of joint space width pre and post-intervention revealed significant improvements following knee preservation surgeries. The mean pre-operative joint space width was 2.4 mm, which increased to a mean post-operative width of 4.9 mm, indicating a statistically significant increase ($p < 0.001$).

Pre-operative assessment of cartilage thickness showed a mean thickness of 1.8 mm. Following knee preservation surgeries, there was a significant increase in cartilage thickness, with a mean post-operative thickness of 3.2 mm ($p < 0.001$).

Radiological assessment of knee alignment demonstrated improved alignment post-intervention. The pre-operative alignment measurements showed a mean deviation of 5.7 degrees from the neutral axis, which improved to a mean deviation of 2.1 degrees post-operatively ($p < 0.001$).

Evaluation of radiological signs of disease progression revealed a reduction in the severity of osteoarthritic changes post-intervention. Pre-operatively, 70% of patients exhibited moderate to severe disease progression, while post-operatively, only 20% demonstrated similar severity, indicating a significant reduction in disease progression ($p < 0.001$).

Patients reported significant improvements in clinical outcomes following knee preservation surgeries. Pain relief was reported by 85% of patients, with a notable reduction in pain intensity. Functional improvement was observed in 90% of patients, with increased range of motion and enhanced joint stability.

Table 1: Radiological and Clinical Results (Mean \pm SD)

Parameters	Pre-operative	Post-operative Mean
Synovial Fluid Analysis (mm^3)	3.8 (± 1.2)	1.2 (± 0.6)
Knee Flexion Range (degrees)	95.2 (± 8.7)	118.6 (± 10.3)
WOMAC Score (0-100)	62.7 (± 12.4)	28.5 (± 9.6)
Radiographic Joint Space (mm)	2.4 (± 0.8)	4.9 (± 1.2)
MRI Cartilage Volume (mm^3)	9856 (± 1245)	12785 (± 1678)

Complications were observed in 15% of the patients post-operatively. The most common complications included minor wound infections (5%), transient joint stiffness (4%), and mild effusion (6%). These complications were managed conservatively, and no major complications were reported.

Subgroup analyses based on the type of knee preservation surgery (e.g., osteotomy, arthroscopy, cartilage restoration) did not reveal significant differences in radiological improvements or clinical outcomes. All surgical approaches showed statistically significant improvements in joint space width, cartilage thickness, alignment, and disease progression, with comparable results.

Discussion

The results of the study involving 80 patients with knee osteoarthritis who underwent various knee preservation surgeries are highly encouraging. Radiological parameters, including joint space width, cartilage thickness, alignment, and disease progression, showed substantial and statistically significant improvements post-intervention. These positive radiological changes were complemented by significant pain relief and enhanced joint function, with 85% of patients experiencing pain reduction and 90% reporting improved functional outcomes. While minor complications were observed in 15% of cases, they were manageable and did not diminish the overall benefits of the surgeries. The study suggests that knee preservation surgeries are effective in improving both radiological and clinical outcomes for patients with knee osteoarthritis, highlighting their potential as a valuable treatment option in managing this challenging condition.

Recent studies in the field of orthopaedics have provided valuable insights into the clinical and radiological outcomes of knee preservation surgeries in patients with osteoarthritis. A study on young patients under 45 years undergoing medial

opening wedge high tibial osteotomy (MWOHTO) demonstrated a high survival rate and effective joint preservation, highlighting its viability as a treatment option for active patients with medial compartment osteoarthritis [5]. Another research compared the outcomes of the Internal Brace primary repair technique to hamstring autografts in ACL tears, finding comparable results in the short term, thus offering an alternative to traditional reconstruction methods [6]. Meniscal allograft transplantation was also shown to provide good clinical results at short-term and midterm follow-up, improving knee function and maintaining acceptable complication rates [7]. The role of intra-articular mesenchymal stem cell (MSC) injections post-high tibial osteotomy (HTO) was explored, suggesting potential benefits in cartilage repair, although conclusive evidence on knee function improvement remains limited [8]. Additionally, the effectiveness and safety of long tibial stemmed total knee arthroplasty in knee osteoarthritis complicated by tibial stress fracture were confirmed, providing a reliable surgical option for advanced cases [9]. These studies collectively contribute to the understanding of various knee preservation techniques, their impact on joint health, and their potential in altering the course of osteoarthritis.

Conclusion

Knee preservation surgeries in patients with osteoarthritis resulted in significant improvements in radiological parameters, including joint space width, cartilage thickness, alignment, and disease progression. These improvements were associated with substantial pain relief and functional enhancement, leading to enhanced patient quality of life. Although minor complications were observed in a subset of patients, the overall benefits of knee preservation surgeries outweighed the risks.

Limitations: The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be

generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendations: Based on the positive outcomes of the study, knee preservation surgeries should be considered as a viable option for patients with knee osteoarthritis, especially those seeking pain relief and functional improvement. Surgeons should tailor the choice of surgical approach to the individual patient's condition and characteristics. Further long-term studies are warranted to assess the durability of these improvements and the potential for disease recurrence.

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List of abbreviations:

1. OA - Osteoarthritis
2. MRI - Magnetic Resonance Imaging
3. CT - Computed Tomography
4. SPSS - Statistical Package for the Social Sciences
5. SD - Standard Deviation
6. WOMAC - Western Ontario and McMaster Universities Osteoarthritis Index
7. ACL - Anterior Cruciate Ligament
8. MSC - Mesenchymal Stem Cell
9. HTO - High Tibial Osteotomy
10. MWOHTO - Medial Opening Wedge High Tibial Osteotomy

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