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Functional Outcome of High Tibial Osteotomy for Medial Compartment Osteoarthritis Knee

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Abstract: ***Background**: Osteoarthritis of knee is chronic debilitating disease-causing considerable disability which is increasing in incidence even in younger population. Global statistics reveal that osteoarthritis accounts for 3% of total global 'years lived with disability' and is associated with significant health and welfare costs. It influences day to day activities of person. Osteoarthritis commonly affects the medial compartment of knee giving rise to varus deformity in majority of cases. Significant varus deformity further aggravates the pathology due to medialisation of the weight bearing axis. HTO is a valuable treatment modality in correcting malalignment and thereby relieving the symptoms associated with medial unicompartmental osteoarthritis. **Materials and Method**: This was a prospective, observational cohort study conducted at the Orthopaedics Department of Navodaya Medical College Hospital and Research Centre, Raichur, between April 2023 and April 2024. A total of 20 patients aged 30– 65 years with symptomatic medial compartment osteoarthritis and varus deformity were enrolled through consecutive sampling. Patients underwent preoperative clinical and radiological assessments, followed by HTO surgery. Functional outcomes were evaluated using IKDC, KOOS, and Knee Society Scores at multiple follow-ups. Data collection was performed using structured case record forms, and statistical analysis included descriptive statistics and association testing with a significance threshold of P < 0.05. **Results**: Of the 20 patients included in the study, 55% were male and 45% were female. The majority (55%) were between 51–60 years of age. Preoperatively, 75% of patients had Grade 2 osteoarthritis (OA), while 25% had Grade 3 OA. Based on the XV Visual Analogue Scale (VAS), 65% of patients reported severe pain and 35% reported moderate pain before surgery. Postoperatively only 20% experienced with mild pain. All patients were evaluated using the IKDC (International Knee Documentation Committee), KOOS (Knee Injury and Osteoarthritis Outcome Score), and KSS (Knee Society Score). IKDC Score: Preoperatively, 15 patients were classified as 'Poor' and 5 as 'Fair'. Postoperatively, outcomes improved to 'Excellent' in 7 patients, 'Good' in 9, and 'Fair' in 4. KOOS Score: Preoperatively, 12 patients had 'Poor' and 8 had 'Fair' scores. Postoperative assessment showed improvement to 'Excellent' in 14 patients and 'Good' in 6.KSS-Knee Score: Initially, 13 patients were 'Poor' and 7 were 'Fair'. Following surgery, 14 achieved 'Excellent', 5 'Good', and 1 'Fair'. KSS-Functional Score: Preoperatively, 16 patients were rated 'Poor' and 4 'Fair'. Postoperatively, 16 patients reached 'Excellent' and 4 achieved 'Good' scores. Postoperative deformity correction was successfully achieved in the majority of cases. No major complications or surgical failures were observed. **Conclusion**: As per the latest trends of knee preservation Medial opening wedge high tibial osteotomy is an effective surgical treatment for medial compartment osteoarthritis of the knee, providing significant improvements in knee alignment, pain relief, and functional outcomes. The procedure shows high patient satisfaction with low complication rates in appropriately selected patients. Early intervention in carefully selected patients can yield excellent functional results and delay the need for total knee arthroplasty.*

Keywords: medial compartment osteoarthritis of knee, high tibial osteotomy, total knee arthroplasty

1. Introduction

Osteoarthritis of knee is chronic debilitating disease causing disability which is increasing in incidence even in younger population. HTO is a valuable treatment modality in correcting malalignment and thereby relieving the symptoms. The aim of this study is to analyse the effectiveness of medial opening wedge osteotomy using high tibial osteotomy plate in patients with early medial compartment osteoarthritis knee.

2. Materials and Method

This was a prospective, observational cohort study conducted at the Orthopaedics Department of Navodaya Medical College Hospital and Research Centre, Raichur, between April 2023 and April 2024. A total of 20 patients aged 30– 65 years with symptomatic medial compartment osteoarthritis and varus deformity were enrolled through consecutive sampling. Patients underwent preoperative clinical and radiological assessments, followed by HTO surgery. Functional outcomes were evaluated using IKDC, KOOS, and Knee Society Scores at multiple follow-ups. Data collection was performed using structured case record forms, and statistical analysis included descriptive statistics and association testing with a significance threshold of P < 0.05

Inclusion Criteria

1) Patients with pain and disability resulting from osteoarthritis that interferes with high-demand employment or recreational activities.
2) Medial compartment osteoarthritis (MCOA) of the knee joint with varus deformity.

3) Age between 30 to 65 years.
4) Patients who are able to use crutches or walkers post-surgery.
5) Patients with grade 2 or 3 osteoarthritis of knee joint (Kellgren and Lawrence).

Exclusion Criteria

1) Patients with knee flexion of less than 90 degrees.
2) Patients with flexion contracture of more than 15 degrees.
3) Patients diagnosed with rheumatoid arthritis or other inflammatory joint diseases.
4) Patients with uncontrolled systemic diseases or infections that may complicate surgery or rehabilitation.

3. Operative Treatment

a) Skin incision: made on the medial aspect of proximal tibia. longitudinal incision starting just below the joint line between the medial border of patellar ligament and posterior margin of tibia.
b) Soft tissue dissection: subcutaneous tissue dissected and pes anserinus retracted posteriorly. this exposes medial collateral ligament. The long fibres of superficial medial collateral ligament are then detached until posteromedial cortex of proximal tibia is exposed.
c) K-wire placement: Leg is placed in full extension and knee joint is placed in exact AP view under fluoroscopy. 2 mm K- wire is passed starting from medial cortex about 4 cms below joint line to proximally towards lateral cortex about 1 cm below joint line and Second k-wire is passed parallel and anterior to first one.
d) Osteotomy cut using saw: Using saw osteotomy cut is made along the k wires leaving 1 cm of lateral cortex intact. Attention must be given to complete the osteotomy of posteromedial tibial cortex
e) Plate fixation: Osteotomy site is opened with valgus stress.it should be opened slowly in order to prevent fracturing of the lateral cortex. Due to medial collateral ligament complex the osteotomy tends to open more anteriorly which increases posteriorinclination of tibial plateau. Therefore, it is important to release the long superficial fibres of ligament for symmetrical opening of osteotomy. After opening the osteotomy site. HTO plate along with attached metal block is inserted and locked with locking screws

Case :40Yrs/F Labourer by occupation
c/o Pain over left knee since 4 years

Pre-Operative X-Ray

Pre OP Alignment X-Ray

Approach to Entry Site

Intra Operative Image

Post Operative X-Ray

Radiography after 3months post-surgery, it is showing complete bony union

6 Months Post OP

12 Months Post OP

Function Outcome at End of Study Period

Post Surgery

Postoperative protocol:

1) Static quadriceps and ankle pumping exercises on the day of surgery.
2) Non-weight bearing walking for 6weeks.
3) Partial weight bearing 6 to 12weeks.
4) Complete weight bearing after 12 weeks.
5) Follow-up evaluation at 3, 6, 12, 18, 24 months.

4. Results

Table 1: Age Distribution

Age category	Frequency	Percent
31-40	5	25
41-50	3	15
51-60	11	55
61-65	1	5

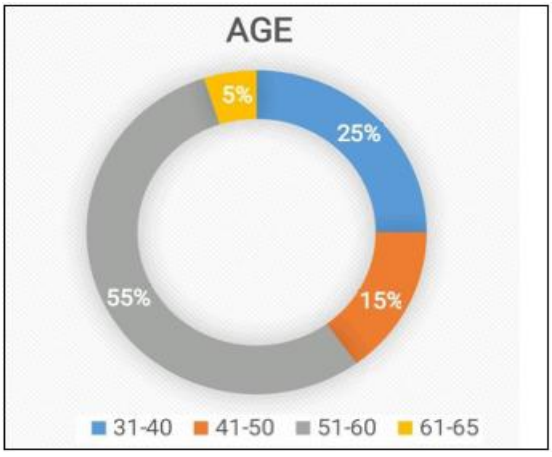


Table 2: Grade of Osteoarthritis

Grade of OA	Frequency	Percent
1	0	0
2	15	75
3	5	25
4	0	0

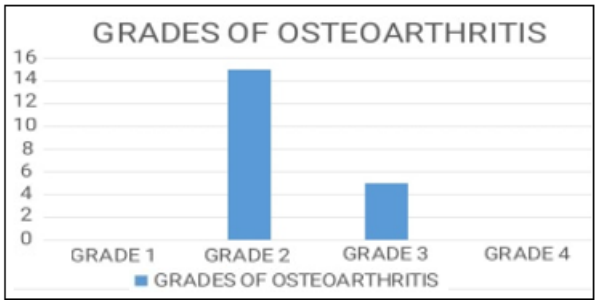


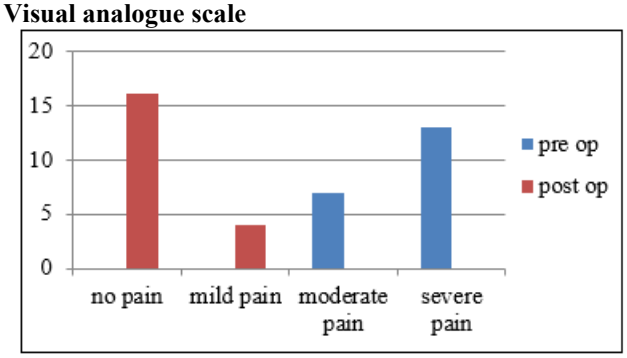
Table 3: Preoperative Deformity (Varus Alignment)

Deformity_Pre_OP_Varus	Frequency
100	4
110	1
80	9
90	6

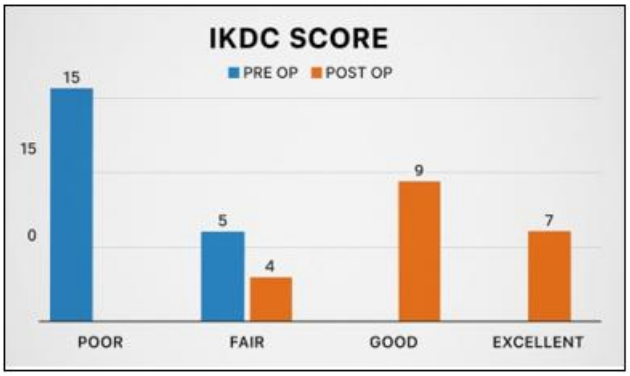
Table 4: Postoperative Deformity (Alignment Correction)

Deformity Post OP	Frequency
Valgus 3^0	4
Valgus 2^0	8
Valgus 1^0	3
NEUTRAL	3
Varus 1^0	1
Varus 4^0	1

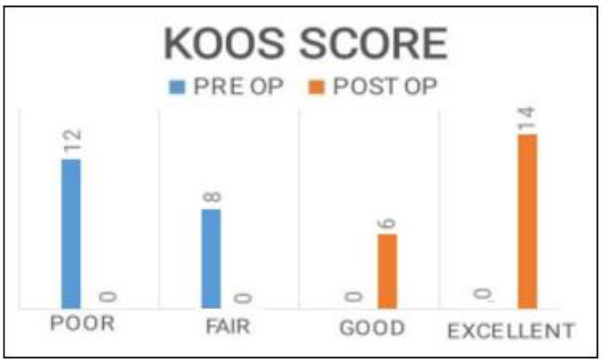
Visual analogue scale



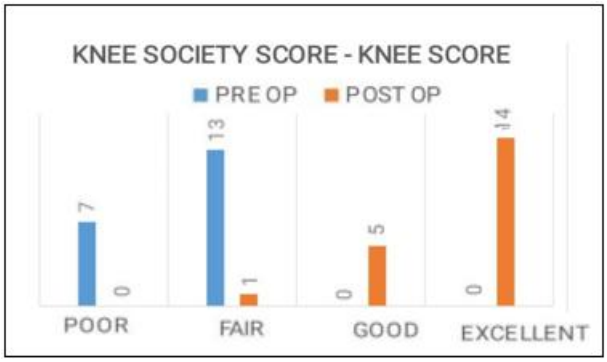
IKDC Score



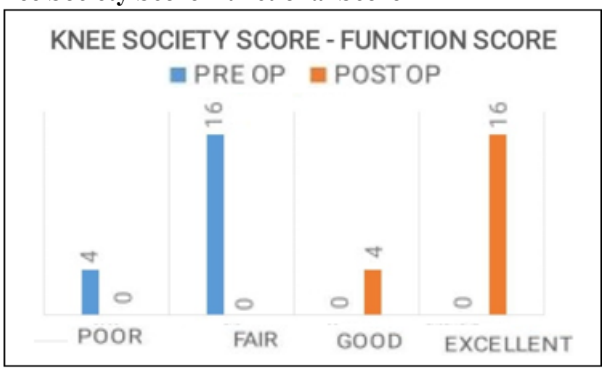
KOOS Score



Knee Society Score-Knee Score



Knee Society Score-Functional Score



5. Discussion

The aim of this study was to evaluate comprehensively the clinical, functional, and radiological outcomes of high tibial osteotomy (HTO) in patients with medial compartment osteoarthritis of the knee. Specifically, the study sought to assess the extent to which HTO can restore knee function, alleviate pain, and correct malalignment in a cohort of patients whose preoperative status was poor. By examining a range of outcome measures—including the International Knee Documentation Committee (IKDC) score, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Society Score, and detailed angular measurements of knee deformity.

The study was designed to quantify both subjective improvements and objective biomechanical corrections following surgery. The significance of this study lies in its potential to validate HTO as a reliable joint-preserving surgical option, particularly for middle-aged patients who are keen to delay or avoid total knee arthroplasty. The investigation not only highlights the dramatic postoperative improvements in clinical scores and alignment correction but also underscores the importance of precise patient selection and meticulous surgical planning.

These factors are critical for optimizing outcomes and ensuring that patients regain a high level of function and quality of life. Furthermore, the study contributes to the broader body of orthopedic research by providing a detailed analysis of both the immediate and sustained benefits of HTO, thereby informing clinical decision-making and shaping future therapeutic strategies. In essence, the study aims to demonstrate that HTO is not only effective in correcting varus deformities but also transformative in enhancing overall knee function, which has important implications for patient care, healthcare resource allocation, and the development of tailored rehabilitation protocols.

1) In 2019 a prospective study titled "Proximal tibial inverted 'V' osteotomy and cast application for medial compartment knee osteoarthritis" by Dr. Farid Mohammed, Dr. Anuj Rastogi and Dr. Afzaal Rafeeq Ansari concluded that PTO followed by above knee POP cast application is a satisfactory and cost- effective alternative to knee replacement surgery for isolated medial compartment knee OA in developing countries like India[2].
2) In 2019 a prospective study titled "Functional and radiological outcome of high tibial osteotomy in osteoarthritis patients with varus knee" by Dr. Satyendra Ravidas, Dr. Jay Palak and Dr. LB Manjhi concluded that HTO is a good option in isolated medial compartment OA of knee. It works by unloading the medial compartment and shifting the weight bearing axis to lateral compartment[3].
3) In 2019 a prospective study titled "Functional outcome of high tibial osteotomy among patients with osteoarthritis" by Dr. Kandaswamy Ganeshsankar, Dr. Manoharan Praneshkumar concluded that : The main improvements seen in this study was the increase in the knee score and functional score after high tibial osteotomy for the patients of osteoarthritis with varus deformity. Appropriate patient selection, proper osteotomy types and precise surgical techniques are essential for the success of high tibial osteotomy[4].

1) Age Distribution

The age distribution table categorizes patients into four age groups, giving insight into the typical age range for high tibial osteotomy. The majority of patients (55%) were between 51 and 60 years old, indicating that middle-aged individuals are most affected by medial compartment osteoarthritis. Younger patients (31–40 years, 25%) and those in the 41–50 years range (15%) form a smaller proportion, while the 60–65 group accounts for only 5% of the sample. This spread reflects that while the condition predominantly affects middle-aged individuals, it is not exclusive to them. It helps in planning treatment modalities suited for different age groups.

2) Grade of Osteoarthritis

The Grade of Osteoarthritis (kellgren lawrence) table shows the severity of joint degeneration in the study population. Seventy-five percent of patients had Grade 2 osteoarthritis, suggesting mild osteoarthritic changes, while 25% had Grade 3, indicating moderate osteoarthritic changes. This distribution implies that most patients presented with mild disease severity, making them ideal candidates for joint-preserving procedures like high tibial osteotomy. Recognizing the grade is crucial as it guides surgical decision-making and helps predict outcomes. Overall, the predominance of Grade 2 OA reflects a patient cohort that may benefit greatly from mechanical realignment and symptom relief.

3) Alignment-Preoperative Deformity (Varus Alignment)

The preoperative deformity table gives details about the degree of varus alignment present in patients before surgery. The data shows that 45% of patients had an 8° varus alignment, 30% had 9° varus, 20% had 10° varus, and 5% had 10° varus alignment. These measurements reflect a range of deformity severity contributing to the medial compartment overload in osteoarthritis. The predominance of the 8° reading suggests that many patients exhibited moderate varus deformity. This preoperative assessment is critical for surgical planning, as the degree of varus alignment helps determine the extent of correction needed during high tibial osteotomy. A clear understanding of preoperative deformity is essential to achieve optimal postoperative alignment.

Postoperative Deformity (Alignment Correction)

The postoperative deformity table shows the alignment achieved after high tibial osteotomy. Post-surgery, 15% of patients achieved a neutral alignment, 15% were corrected to a 10° valgus, 50% to a 20° valgus, and 20% to a 30° valgus alignment. This correction from varus to valgus is pivotal for offloading the medial compartment and improving knee mechanics. The majority of patients obtaining a 20° valgus alignment suggests that surgeons aimed for an optimal balance between load redistribution and joint stability. These results demonstrate the success of the procedure in achieving the desired correction, which is critical for pain reduction and functional improvement in patients.

Visual analogue scale

Pain was analysed by using visual analogue scale both preoperatively and postoperatively. Most of the patients had preoperative score of 7(40%) followed by 6(35%), and 8 (25%). Postoperatively majority of patients had score of 0(80%), rest by 1(20%).

IKDC Score

The preoperative IKDC score table provides an overview of knee function before surgery. 15 patients (75%) were rated as "Poor" on the IKDC scale and 5 patients (25%) were rated as "fair", reflecting severe dysfunction and significant limitations in knee stability and performance. This uniform finding indicates that before high tibial osteotomy, the entire cohort experienced considerable impairment, likely resulting from advanced medial compartment osteoarthritis. A "Poor" and "fair" IKDC score underscores the clinical need for intervention to restore knee mechanics and improve patient quality of life. The preoperative assessment sets a clear benchmark against which postoperative improvements can be measured.

Postoperative IKDC Score

The postoperative IKDC score table reflects significant improvements following surgery. After high tibial osteotomy, 35% of patients achieved an "Excellent" rating, 45% were rated "Good," and 20% were "Fair". This represents a remarkable shift from a poor preoperative condition. The improvements in IKDC scores indicate enhanced knee stability, function, and reduced symptoms post-surgery. The variation in outcomes may be influenced by individual patient characteristics and the degree of correction achieved during surgery. Overall, these results confirm that high tibial osteotomy is effective in improving knee function in patients with medial compartment osteoarthritis.

KOOS Score

Preoperative

The preoperative KOOS score table assesses the knee condition from the patient's perspective before surgery. In this cohort, 40% of patients were classified as "Fair" and 60% as "Poor" on the KOOS scale. These ratings indicate a significant level of pain, limited function, and overall compromised knee health prior to high tibial osteotomy. The higher proportion of "Poor" ratings underscores the severity of symptoms experienced by most patients. This preoperative status justifies the need for surgical intervention to improve knee mechanics and relieve symptoms. The KOOS score serves as an important patient-reported outcome measure to evaluate the impact of osteoarthritis and the benefits of surgical treatment.

Postoperative KOOS Score

The postoperative KOOS score table demonstrates a complete improvement in patient-reported outcomes after surgery. Following high tibial osteotomy, 14 patients (70%) attained a "Excellent " rating and 6 patients (30%) attained "Good" rating on the KOOS scale. This outcome represents a dramatic shift from the mixed "Fair" and "Poor" preoperative ratings. Such consistent improvement indicates that the surgical procedure was highly effective in alleviating pain and restoring knee function. The favorable postoperative KOOS scores underscore the benefits of realignment surgery and the potential for enhanced quality of life and mobility in patients suffering from medial compartment osteoarthritis.

Knee Society Score-Knee Score

Preoperative

The preoperative table evaluates overall knee function and stability before surgery. In this assessment, 35% of patients were rated as "Fair" and 65% as "Poor," indicating that a majority experienced considerable functional impairment and discomfort. These scores reflect the severity of knee dysfunction due to medial compartment osteoarthritis, underscoring the clinical need for intervention. The disparity between "Fair" and "Poor" ratings provides a baseline for comparing postoperative improvements. The results highlight that before high tibial osteotomy, most patients had significant limitations in knee performance, justifying the need for corrective realignment to restore function and improve patient outcomes.

Postoperative Knee Society Score-Knee Score

The postoperative knee score table reveals a transformation in knee function after high tibial osteotomy. 14 patients (70%) achieved an "Excellent" rating postoperatively, 5(25%) patients achieved "Good" rating and 1(5%) patient achieved "Fair" rating postoperatively, marking a significant improvement from the preoperative state. This outcome demonstrates that the surgical intervention was

highly successful in restoring knee stability, reducing pain, and enhancing overall function. The dramatic change indicates that the realignment and offloading of the medial compartment had a profound positive impact on knee mechanics. Such improvements in knee scores are indicative of the procedure's effectiveness and support its continued use as a joint-preserving option for patients with medial compartment osteoarthritis

Knee Society Score-Functional Score

Preoperative

The preoperative functional score table highlights that 16 patients had a "Poor" functional score and remaining 4 patients had "Fair" functional score before surgery. This result indicates that the patients experienced severe limitations in daily activities and mobility due to medial compartment osteoarthritis. This functional rating underscores the impact of pain, reduced joint mobility, and instability on overall quality of life. These scores across the cohort emphasizes the need for intervention to restore function and improve patient outcomes. This baseline measurement sets the stage for evaluating the dramatic improvements expected after the corrective surgery provided by high tibial osteotomy.

Postoperative Knee Society Score-Functional Score

The postoperative functional score table demonstrates remarkable improvement following high tibial osteotomy. After surgery, 80% of patients achieved an "Excellent" functional score, with the remaining 20% classified as "Good." This nearly universal improvement in functional status reflects the success of the procedure in restoring knee performance, alleviating pain, and enhancing mobility. The transformation from a nearly poor preoperative functional rating to predominantly excellent postoperative outcomes underscores the efficacy of the surgical intervention. Improved functional scores are directly associated with better quality of life and increased ability to perform daily activities, confirming high tibial osteotomy as an effective treatment for medial compartment osteoarthritis.

6. Conclusion

As per the latest trends of knee preservation Medial opening wedge high tibial osteotomy is an effective surgical treatment for medial compartment osteoarthritis of the knee, providing significant improvements in knee alignment, pain relief, and functional outcomes. The procedure shows high patient satisfaction with low complication rates in appropriately selected patients. Early intervention in carefully selected patients can yield excellent functional results and delay the need for total knee arthroplasty.

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