Original Research Article

Retrospective Study to Assess the Functional and Radiological Outcome of High Tibial Osteotomy in Medial Compartment Osteoarthritis in Younger Patients

Dr. Kausthubha K.P.[1], Dr. Shivakumar N.H.[2] , Dr. Amardeep G .[3], Dr. Arjun Gopal[4]

[1]Senior Resident, Department of Orthopaedics, Mandya Institute of Medical Sciences, Karnataka, India.
[2]Assistant Professor, Department of Orthopaedics, Mandya Institute of Medical Sciences, Karnataka, India.
[3]Associate Professor, Department of Orthopaedics, Mandya Institute of Medical Sciences, Karnataka, India.
[4]Postgraduate, Department of Orthopaedics, Mandya Institute of Medical Sciences, Karnataka, India

Corresponding Author
Dr. Arjun Gopal, Postgraduate, Department of Orthopaedics, Mandya Institute of Medical Sciences, Karnataka, India.

ABSTRACT

Background
Medial compartment osteoarthritis of the knee remains one of the most prevalent and disabling joint disorders, particularly in younger, active patients. High tibial osteotomy (HTO) is an established joint-preserving surgical procedure that redistributes the mechanical axis to unload the diseased medial compartment, thereby relieving pain and slowing arthritic progression. Despite its widespread use, data on functional and radiological outcomes in Indian patients under 60 years of age remain limited. This study aimed to evaluate the functional and radiological outcomes of medial open-wedge HTO in younger patients with medial compartment osteoarthritis at a tertiary care centre in Mandya, Karnataka.

Methods
A retrospective observational study was conducted on 30 patients with isolated medial compartment osteoarthritis treated with high tibial osteotomy at Mandya Institute of Medical Sciences. Inclusion criteria required patients to be under 60 years of age with isolated medial compartment osteoarthritis, adequate preoperative range of motion, and written informed consent. Functional outcomes were assessed using the Knee Society Score (KSS) and the Knee Injury and Osteoarthritis Outcome Score (KOOS) at 6 weeks, 3 months, and 6 months postoperatively. Radiological assessment included mechanical axis deviation, medial proximal tibial angle (MPTA), joint space width, and posterior tibial slope on weight-bearing long-cassette radiographs.

Results
The study included 23 males and 7 females with a mean age of 51.4 ± 5.6 years and a mean follow-up of 6 months. Postoperatively, 80% (n=24) of patients achieved excellent results and 13.3% (n=4) achieved good results by KSS. The mean preoperative KSS Knee Score improved from 51.8 ± 7.9 points to 79.4 ± 6.8 points, and the mean Functional Score improved from 54.2 ± 9.1 to 81.6 ± 8.0 points (both $p<0.001$). Pain relief was marked: 90% of patients had moderate

or severe preoperative pain, while 86.7% reported only mild pain or no pain at final follow-up. Knee flexion greater than 100 degrees was achieved in 73.3% of patients postoperatively compared to 40% preoperatively. Radiological correction to the planned mechanical axis target was satisfactory in 86.7% of cases. Five complications were recorded: three wound infections and two deep vein thromboses, all managed conservatively without the need for surgical revision.

Interpretation
HTO achieves reliable functional improvement and satisfactory radiological correction in carefully selected younger patients with medial compartment osteoarthritis. The joint-preserving nature of the procedure allows unrestricted physical activity without concerns regarding implant wear or revision surgery, making it particularly advantageous over arthroplasty in this age group.
Conclusion
High tibial osteotomy is an effective and durable joint-preserving surgical option for younger patients with isolated medial compartment osteoarthritis and varus malalignment. Careful patient selection, precise preoperative planning with the Fujisawa point as the target, and standardized postoperative rehabilitation are essential to achieving optimal functional and radiological outcomes.
Keywords: High Tibial Osteotomy, Medial Compartment Osteoarthritis, Knee, Varus Deformity, Functional Outcomes, KOOS, Knee Society Score, joint preservation, younger patients

INTRODUCTION

Osteoarthritis (OA) of the knee is one of the most common musculoskeletal disorders worldwide, responsible for significant pain, functional limitation, and reduced quality of life. Approximately one-third of patients with knee OA exhibit isolated unicompartmental disease, most commonly affecting the medial compartment in association with varus malalignment of the lower limb.[1,2] In younger and more active patients, this malalignment accelerates cartilage degeneration by concentrating excessive compressive forces on the already damaged medial articular surface, creating a self-perpetuating cycle of progressive arthritic damage.[3]

The management of medial compartment OA in younger patients presents a particular clinical challenge. Total knee arthroplasty (TKA), while highly effective in the elderly, carries significant limitations in patients under 60 years: higher long-term revision rates, activity restrictions, and the need for eventual re-revision with each successive surgery. Unicompartmental knee arthroplasty (UKA) offers a less invasive alternative but similarly commits the patient to prosthetic replacement with its associated durability concerns.[4,5] High tibial osteotomy (HTO), by contrast, is a joint-preserving procedure that addresses the underlying biomechanical cause of medial compartment overload by correcting the varus deformity and redistributing the mechanical axis laterally.[6]

The principle of HTO rests on shifting the weight-bearing line from the overloaded medial compartment toward the relatively spared lateral compartment, thereby unloading the diseased articular surface and allowing partial biological recovery. Numerous studies have documented satisfactory medium- and long-term outcomes following HTO, with preservation of bone stock, maintenance of native joint kinematics, and no compromise of future arthroplasty procedures should they become necessary.[7,8] When performed successfully, HTO provides substantial pain relief, improves functional scores, and may slow radiological progression of OA.[9]

Various HTO techniques have been described. The original Coventry closed-wedge method involved lateral resection of a bony wedge with fibular osteotomy, staple fixation, and a prolonged rehabilitation period. More recently, medial open-wedge osteotomy using locking

compression plate systems has emerged as the preferred technique at most centres, offering precise correction, stable fixation, avoidance of fibular osteotomy, maintenance of bone stock, and the possibility of early weight-bearing.[10,11]

The medial approach also permits simultaneous arthroscopic assessment and treatment of intra-articular pathology where indicated.[12] Despite an extensive international literature, data specifically addressing HTO outcomes in Indian patients, particularly in younger age groups under 60 years, remain limited. The demographic profile, activity requirements, cultural expectations (including floor-sitting and cross-legged postures), and resource constraints of Indian patients differ substantially from those of Western series. This study was therefore undertaken to evaluate the functional and radiological outcomes of HTO in younger patients with medial compartment osteoarthritis treated at a tertiary care centre in Mandya, Karnataka, and to identify the determinants of a satisfactory outcome in this population.

OBJECTIVES

1. To assess the functional outcomes of high tibial osteotomy in patients below 60 years of age with isolated medial compartment osteoarthritis using the Knee Society Score (KSS) and Knee Injury and Osteoarthritis Outcome Score (KOOS).
2. To evaluate the radiological outcomes including mechanical axis correction, medial proximal tibial angle, joint space width, and posterior tibial slope on serial postoperative radiographs.
3. To identify and quantify postoperative complications in patients treated with high tibial osteotomy.
4. To assess the correlation between the degree of radiological correction achieved and the functional outcome at follow-up.

MATERIALS AND METHODS

Study Design

Retrospective Observational Study

Study Setting and Period

The study was conducted in the Department of Orthopaedics, Mandya Institute of Medical Sciences (MIMS), Mandya, Karnataka, India, over a period of 18 months.

Inclusion Criteria

- Patients with isolated medial compartment osteoarthritis of the knee, confirmed clinically and radiologically
- Age less than 60 years at the time of surgery
- Varus malalignment of the lower limb (mechanical axis deviation medial to the knee centre)
- Kellgren and Lawrence Grade 2 or 3 osteoarthritis on weight-bearing radiographs
- Preoperative knee flexion of at least 90 degrees and flexion contracture of less than 15 degrees
- Written informed consent to participate in the study

Exclusion Criteria

- Patients not medically fit for surgery
- Inflammatory arthritis (rheumatoid, psoriatic, or crystal arthropathy)
- Post-traumatic arthritis
- Varus deformity exceeding 20 degrees on the mechanical axis

- Knee flexion less than 90 degrees or fixed flexion contracture greater than 15 degrees
- Significant lateral or patellofemoral compartment OA
- Cruciate or collateral ligament insufficiency
- Patients unwilling to give consent for participation in the study

Preoperative Assessment

All patients underwent a thorough clinical evaluation including assessment of pain using the Visual Analogue Scale (VAS), range of motion measurement with goniometry, assessment of ligamentous stability, and documentation of limb alignment. Functional assessment was performed using the Knee Society Score (KSS) and Knee Injury and Osteoarthritis Outcome Score (KOOS) prior to surgery.

Radiological evaluation was mandatory and systematic. Standard radiographs obtained in all patients included anteroposterior and lateral views of the knee, an axial (skyline) view of the patellofemoral joint, and weight-bearing long-cassette alignment radiographs of both lower extremities from the femoral head to the ankle.[13] Stress views were obtained where clinical examination revealed ligamentous laxity.

Mechanical axis, anatomical axis, and weight-bearing axis were measured on the alignment view. Normal reference values used were: mechanical axis 1–3 degrees varus, anatomical axis 5–7 degrees valgus, a 6-degree relationship between mechanical and anatomical axes, and the weight-bearing line passing through the lateral 30–40% of the tibial plateau on a single-leg weight-bearing radiograph.[14]

The degree of osteotomy correction was determined using the Fujisawa point method, targeting the weight-bearing line to pass through 62% of the tibial plateau width as measured from the medial edge of the medial tibial plateau. This point, which corresponds to a mechanical axis of 3–5 degrees valgus, lies slightly lateral to the lateral tibial spine and represents the optimal target for redistribution of weight-bearing forces.[15]

Surgical Technique

All operative procedures were performed under spinal or general anaesthesia with the patient supine and a thigh tourniquet applied. A medial open-wedge high tibial osteotomy was performed in all cases. The procedure commenced with a longitudinal skin incision along the medial border of the proximal tibia, followed by dissection through the pes anserinus tendons. The medial cortex of the proximal tibia was osteotomised obliquely from a starting point approximately 3–4 cm distal to the medial joint line, directed toward the proximal fibula, taking care to preserve the lateral cortical hinge and popliteal neurovascular structures.

The osteotomy was gradually opened using calibrated spreaders, with fluoroscopic guidance confirming the achievement of the planned correction as determined by the preoperative template. The correction was assessed intraoperatively using a long alignment rod or guide-wire from the femoral head to the ankle under fluoroscopy to confirm passage through the Fujisawa point. The osteotomy gap was stabilised with a locking compression plate (TomoFix or equivalent medial tibial plate) with bicortical locking screws. The gap was filled with autologous cancellous bone graft from the iliac crest or synthetic bone substitute as available. Wound closure was performed in layers.

Postoperative Management and Follow-up

Postoperatively, patients were commenced on passive and active range of motion exercises within 48 hours of surgery. Partial weight-bearing with walker support was commenced at one week and progression to full weight-bearing was permitted at 6–8 weeks following confirmation of early callus formation on radiographs. Deep vein thrombosis prophylaxis with low molecular

weight heparin was administered for a minimum of two weeks. All patients underwent physiotherapy-directed quadriceps strengthening and proprioception training.

Follow-up assessments were conducted at 6 weeks, 3 months, and 6 months postoperatively. At each visit, clinical assessment included KSS and KOOS scoring, pain assessment using VAS, and measurement of active range of motion. Radiological assessment was performed on weight-bearing anteroposterior and lateral knee radiographs at each visit. Parameters assessed radiologically included mechanical axis deviation (MAD), medial proximal tibial angle (MPTA), joint space width on the medial and lateral sides, and posterior tibial slope.

Outcome Measures and Scoring Systems

The Knee Society Score (KSS) is a validated instrument comprising two independent sub-scores: the Knee Score (0–100 points) assessing pain, stability, and range of motion; and the Functional Score (0–100 points) evaluating walking distance and stair climbing ability. Results are graded as excellent (85–100), good (70–84), fair (60–69), or poor (<60). This dual scoring system minimises the confounding effect of patient comorbidities on knee-specific outcomes.[16]

The Knee Injury and Osteoarthritis Outcome Score (KOOS) is a patient-reported outcome instrument with five subscales: Pain, Symptoms, Activities of Daily Living (ADL), Sport and Recreation Function, and Quality of Life (QoL). Each item is scored from 0 (no problem) to 4 (extreme problem) and subscale scores are transformed to a 0–100 scale, with 100 representing no problems.[17]

Radiological assessment included: mechanical axis deviation (MAD), measured as the perpendicular distance of the weight-bearing line from the centre of the knee in millimetres; medial proximal tibial angle (MPTA), which normally measures 87 ± 3 degrees; medial and lateral joint space width on weight-bearing anteroposterior radiographs; and posterior tibial slope on lateral radiographs. Representative preoperative and immediate postoperative radiographs are presented in the Figures section.[18]

Statistical Analysis

Data were entered and analysed using SPSS version 20.0 (IBM Corp., Armonk, NY). Continuous variables are expressed as mean ± standard deviation. Categorical variables are expressed as frequencies and percentages. Pre- and postoperative comparisons of functional scores and radiological parameters were performed using the paired t-test for parametric data and the Wilcoxon signed-rank test for non-parametric data. Correlation between degree of mechanical axis correction and functional improvement was assessed using Spearman's rank correlation coefficient. Statistical significance was set at $p<0.05$.

RESULTS

Patient Demographics

Thirty patients (30 knees) with medial compartment osteoarthritis who underwent high tibial osteotomy were included in the study. There were 23 males (76.7%) and 7 females (23.3%). The mean age at surgery was 51.4 ± 5.6 years (range 40–59 years). All patients were below 60 years of age at the time of surgery, confirming the younger patient cohort studied. The mean duration of follow-up was 6 months (range 3–9 months). The most common presenting complaint was medial knee pain with activity, followed by difficulty with squatting and floor-sitting activities.

Parameter	Value	Percentage / Range
Total patients	30	—
Male	23	76.7%
Female	7	23.3%

Mean age (years)	51.4 ± 5.6	40–59
Mean follow-up (months)	6	3–9
Dominant limb involved	18	60%

Table 1: Patient demographics

Preoperative Assessment

Preoperatively, 90% (n=27) of patients reported moderate or severe pain on the VAS (scores 4–8). The mean preoperative VAS pain score was 6.3 ± 1.4. The mean preoperative KSS Knee Score was 51.8 ± 7.9 (range 36–64), and the mean KSS Functional Score was 54.2 ± 9.1 (range 38–68). The majority of patients (60%) fell in the fair-to-poor KSS category preoperatively. Regarding range of motion, 40% of patients (n=12) achieved knee flexion greater than 100 degrees preoperatively. Radiologically, all 30 patients demonstrated varus malalignment with medial compartment joint space narrowing of Kellgren-Lawrence Grade 2 (n=13) or Grade 3 (n=17).

Functional Outcomes

At final follow-up, there was a statistically significant improvement in all functional parameters compared to baseline ($p<0.001$ for all). The mean postoperative KSS Knee Score was 79.4 ± 6.8 points, representing a mean improvement of 27.6 points over the preoperative score ($p<0.001$). The mean postoperative KSS Functional Score was 81.6 ± 8.0 points, an improvement of 27.4 points from the preoperative value ($p<0.001$). Overall KSS results at final follow-up: 80% (n=24) excellent, 13.3% (n=4) good, and 6.7% (n=2) fair. No patient recorded a poor result.

Pain relief was highly significant: 86.7% of patients reported only mild pain or no pain at final follow-up compared to 90% with moderate or severe pain preoperatively ($p<0.001$). The mean postoperative VAS pain score was 2.0 ± 1.1, representing a mean reduction of 4.3 points from the preoperative score.

Range of motion improved substantially. The proportion of patients achieving flexion greater than 100 degrees increased from 40% (n=12) preoperatively to 73.3% (n=22) at final follow-up. No patient developed a significant postoperative flexion contracture.

Parameter	Preoperative	Postoperative (Final)
KSS Knee Score (mean ± SD)	51.8 ± 7.9	79.4 ± 6.8*
KSS Functional Score (mean ± SD)	54.2 ± 9.1	81.6 ± 8.0*
VAS Pain Score (mean ± SD)	6.3 ± 1.4	2.0 ± 1.1*
Patients with flexion >100°	40.0% (n=12)	73.3% (n=22)*
Excellent results (KSS)	0%	80.0% (n=24)
Good results (KSS)	6.7%	13.3% (n=4)
Fair results (KSS)	40.0%	6.7% (n=2)
Poor results (KSS)	53.3%	0%

Table 2: Functional outcomes. *p<0.001 vs preoperative values (paired t-test)

Radiological Outcomes

Radiological correction was satisfactory in all 30 patients on immediate postoperative radiographs. The mechanical axis was corrected from a preoperative mean varus of 8.2 ± 2.4 degrees to a postoperative valgus of 3.7 ± 1.1 degrees, achieving the target Fujisawa point correction in 86.7% of cases. The mean medial proximal tibial angle (MPTA) improved from a preoperative mean of 82.4 ± 2.1 degrees to 90.1 ± 1.8 degrees postoperatively. Osteotomy healing with bridging callus was confirmed radiologically in all 30 patients by the 3-month review. Representative preoperative and immediate postoperative radiographs of two cases are shown in Figures 1 and 2.

Figure 1A: Preoperative AP and lateral views showing medial compartment osteoarthritis with varus deformity and medial joint space narrowing

Figure 1B: Preoperative bilateral AP views demonstrating varus malalignment and medial compartment osteoarthritis with joint space narrowing

Figure 1: Preoperative Radiographs

Figure 2A: Immediate postoperative AP and lateral views showing satisfactory open-wedge HTO with medial locking plate fixation and correction of the mechanical axis

Figure 2B: Immediate postoperative AP and lateral views showing open-wedge HTO with medial locking plate fixation and satisfactory mechanical axis correction

Figure 2: Postoperative Radiographs Following High Tibial Osteotomy

Complications

Five complications were recorded in this series (overall complication rate 16.7%). Three patients (10%) developed wound infections: two superficial infections presenting at two weeks postoperatively, managed successfully with oral antibiotics and wound care; and one deep wound infection presenting at three weeks, requiring intravenous antibiotics and regular wound dressing, with eventual complete resolution without the need for surgical debridement or hardware removal. Two patients (6.7%) developed symptomatic deep vein thrombosis, both diagnosed by Doppler ultrasound at three to four weeks postoperatively and managed conservatively with therapeutic anticoagulation, with full resolution confirmed at 8–10 weeks. There were no cases of intraoperative complications including lateral cortical hinge fracture, nerve injury, or vascular injury. No patient required revision surgery or hardware removal during the follow-up period.

DISCUSSION

This retrospective observational study evaluated the short-to-medium term functional outcomes of high tibial osteotomy in 30 younger patients (below 60 years) with isolated medial compartment osteoarthritis. The results demonstrate that HTO achieves significant functional

improvement with an acceptable complication profile in this patient group, supported by satisfactory radiological correction of the mechanical axis.

Our demographic findings are consistent with established literature. The male predominance (76.7%) likely reflects both occupational risk factors and referral patterns. The mean patient age of 51.4 years places our cohort squarely in the target group for joint-preserving surgery, where the goal is to delay or avoid arthroplasty. This aligns with the observations of Coventry, whose seminal series established that HTO yields best results in patients under 60 years with a physically demanding lifestyle.[19] Campbell's Operative Orthopaedics similarly identifies younger age, isolated medial compartment involvement, varus alignment, and adequate preoperative range of motion as the key determinants of patient selection for HTO.[20]

The functional improvement observed in our series is comparable to published international series. A mean KSS improvement from 51.8 to 79.4 points (Knee Score) and from 54.2 to 81.6 points (Functional Score) mirrors the results of Takeuchi et al., who reported mean postoperative KSS scores of 89 points in their OWHTO cohort with similar preoperative profiles, and of Coventry et al., who documented 80% satisfactory results at long-term follow-up following tibial osteotomy.[19,21] The 80% excellent and 13.3% good rate in our series, with no poor outcomes at 6 months, reflects satisfactory early results. It is acknowledged, however, that these functional scores may evolve over longer follow-up durations, and several published series document continued score improvement up to 2 years postoperatively.[7,9]

Pain relief was the most striking early benefit, with 86.7% of patients reporting only mild pain or none at final follow-up, compared with 90% who had moderate or severe pain preoperatively. This degree of pain relief is consistent with the biomechanical rationale of HTO: by redistributing the weight-bearing axis to the lateral compartment, compressive stress on the damaged medial cartilage is substantially reduced. The Fujisawa point, targeting the weight-bearing line at 62% of the tibial plateau width, was used as the correction target in our series and achieved in 86.7% of cases, consistent with published technical standards.[15]

Range of motion improvement, with the proportion of patients achieving flexion greater than 100 degrees increasing from 40% to 73.3%, is clinically important in the Indian context. Floor-sitting, cross-legged posture, and squatting are culturally and functionally essential activities in Indian daily life, and the maintenance and improvement of deep knee flexion following HTO represents a significant functional advantage over arthroplasty procedures. Takeuchi et al. specifically highlighted the ability of their OWHTO patients to achieve the Japanese-style floor-sitting posture postoperatively - a culturally analogous finding to our clinical context.[21]

The comparison between HTO and UKA in younger patients with medial OA remains the subject of ongoing debate. Several authors have reported comparable KSS scores between the two procedures at medium-term follow-up, while noting superior functional scores and activity levels in the HTO group.[21,22] Crucially, HTO preserves all native joint structures, avoids implant-related complications, and does not compromise future arthroplasty, unlike UKA which may complicate subsequent TKA by altering bone stock and ligament balance.[5,23] This advantage is particularly relevant in younger patients with a longer life expectancy and higher activity demands. Apley's System of Orthopaedics and Trauma notes that the ideal HTO candidate is an active patient under 65 years with unicompartmental OA, a varus deformity correctable to neutral, adequate range of motion, and no inflammatory arthritis - criteria met by all patients in our series.[24]

Radiological correction was achieved satisfactorily in all patients. Mechanical axis correction to the Fujisawa point is the most critical technical determinant of long-term HTO outcome.[15] Undercorrection (residual varus) leads to early recurrence of medial compartment overloading and failure, while overcorrection into excessive valgus causes lateral compartment overloading, patellofemoral dysfunction, and difficulty with future arthroplasty. Our correction

rate of 86.7% to the planned target reflects acceptable surgical precision for a retrospective institutional series. Intraoperative fluoroscopic alignment assessment using the alignment rod technique was employed routinely, as recommended in standard orthopaedic surgical protocols.[20]

The complication rate in our series (16.7%; three wound infections, two DVTs) is within the range reported in the literature. Wound complications occur in 1–10% of HTO series and are more common with medial open-wedge techniques, likely due to tension on the medial soft tissues and the proximity of the incision to the subcutaneous plane.[9,10] In our series, two infections were superficial and resolved with antibiotics alone, while one required a more prolonged course of intravenous antibiotics, though none required surgical debridement or hardware removal. DVT is a recognised complication of lower limb orthopaedic surgery, occurring in both cases despite routine pharmacological prophylaxis, underscoring the importance of vigilance, early mobilisation, and Doppler surveillance in high-risk patients. No cases of lateral cortical hinge fracture, popliteal vessel injury, peroneal nerve palsy, or non-union were recorded, which likely reflects adherence to careful intraoperative technique.

Study Limitations

This study has several limitations. The retrospective design at a single centre, combined with a sample of 30 patients, while larger than many single-institution HTO series, still limits the statistical power for detailed subgroup analyses and the generalisability of findings to broader patient populations. The follow-up period of up to 6 months is relatively short for the assessment of a joint-preserving procedure whose functional benefits and survival rates are best characterised over 5–10 years; long-term data on OA progression, osteotomy survival, and conversion to arthroplasty are not available from this series. The absence of a control group (UKA or TKA) precludes direct comparison of outcomes between treatment modalities. The lack of blinding in functional assessments introduces potential observer bias. Furthermore, the KOOS subscale data from this retrospective series were not uniformly captured at all timepoints, limiting complete longitudinal analysis. Future prospective studies with longer follow-up, standardised outcome recording at all timepoints, and comparative control groups would more comprehensively characterise HTO outcomes in younger Indian patients.

CONCLUSION

High tibial osteotomy is an effective and reliable joint-preserving surgical treatment for carefully selected younger patients with isolated medial compartment osteoarthritis and varus malalignment. In our series of 30 patients below 60 years of age, HTO achieved excellent or good functional outcomes in 93.3% of cases, substantial pain relief, and significant improvement in knee flexion and functional scores at a mean follow-up of 6 months. Radiological correction to the planned mechanical axis target was achieved in 86.7% of cases. The complication rate was acceptable and comparable to published literature.

The joint-preserving nature of HTO affords the younger, active patient unrestricted physical activity without concerns regarding polyethylene wear, aseptic loosening, or the limitations imposed by arthroplasty. Importantly, HTO does not compromise future arthroplasty surgery, offering a staged reconstructive pathway as the patient ages and arthritic disease progresses. Careful patient selection, meticulous preoperative planning using the Fujisawa point as the correction target, precise intraoperative execution with fluoroscopic guidance, and a structured postoperative rehabilitation programme are the cornerstones of a successful outcome.

Summary
This retrospective observational study evaluated 30 patients below 60 years of age with isolated medial compartment osteoarthritis treated with medial open-wedge high tibial osteotomy at Mandya Institute of Medical Sciences. The cohort comprised 23 males and 7 females with a mean age of 51.4 years and a mean follow-up of 6 months. Preoperatively, 90% of patients had moderate or severe knee pain and mean KSS scores were in the fair-to-poor range. At final follow-up, 80% achieved excellent and 13.3% achieved good results by KSS, with mean KSS Knee Score improving from 51.8 to 79.4 and Functional Score from 54.2 to 81.6 points (both $p<0.001$). Pain relief was marked, with 86.7% reporting mild or no pain postoperatively. Knee flexion greater than 100 degrees was achieved in 73.3% of patients postoperatively versus 40% preoperatively. Radiological correction to the Fujisawa point was satisfactory in 86.7% of cases. Five complications were recorded: three wound infections (two superficial, one deep) and two deep vein thromboses, all managed conservatively without surgical revision. These results confirm that HTO is a safe and effective joint-preserving procedure in younger patients with medial compartment OA, with outcomes comparable to international published series.

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