

Original Research Article

EVALUATING FUNCTIONAL AND RADIOLOGICAL OUTCOMES OF TOMOFIX ASSISTED MEDIAL OPEN WEDGE HIGH TIBIAL OSTEOTOMY IN MEDIAL UNICOMPARTMENTAL KNEE OSTEOARTHRITIS

Hari Kishore Potupureddy¹, G. Parameswara Rao², Padala Ashok³, D. Tejnarayana⁴

¹Assistant Professor, Department of Orthopaedics, NRI Institute of Medical sciences, Sangivalasa, Visakhapatnam, Andhra Pradesh, India.

²Professor, Department of Orthopaedics, NRI Institute of Medical sciences, Sangivalasa, Visakhapatnam, Andhra Pradesh, India.

³Associate Professor, Department of Orthopaedics, NRI Institute of Medical sciences, Sangivalasa, Visakhapatnam, Andhra Pradesh, India.

⁴Post graduate, Department of Orthopaedics, NRI Institute of Medical sciences, Sangivalasa, Visakhapatnam, Andhra Pradesh, India.

Received : 04/04/2025
Received in revised form : 18/05/2025
Accepted : 10/06/2025

Corresponding Author:

Dr. Padala Ashok,

Associate Professor, Department of Orthopaedics, NRI Institute of Medical sciences, Sangivalasa, Visakhapatnam, Andhra Pradesh, India.
Email: ashokpamc@gmail.com

DOI: 10.70034/ijmedph.2025.3.12

Source of Support: Nil,

Conflict of Interest: None declared

Int J Med Pub Health

2025; 15 (3); 66-70

ABSTRACT

Background: There is an increase in incidence of knee osteoarthritis among middle-aged individuals, leading to pain and functional limitation. Medial Open Wedge High Tibial Osteotomy (MOWHTO) is a joint-preserving surgical procedure designed to realign the mechanical axis and offload the diseased compartment. The usage Tomofix plate offers better biomechanical stability and prevents the loss of correction thus allowing early mobilization and reliable healing. This study aims to evaluate the functional and radiological outcomes of MOWHTO using the Tomofix plate.

Materials and Methods: This prospective interventional study was conducted at NRI Institute of Medical Sciences, Visakhapatnam, over a period of 24 months. 20 patients with symptomatic medial compartmental OA were selected based on strict inclusion criteria. Functional outcomes were assessed using the Knee Society Score, Visual Analogue Scale and Range of Motion. Radiological outcomes were evaluated via Hip-Knee-Ankle (HKA) angle measurements pre- and post-operatively.

Results: The mean age of population in this study is 54.45 with 60% females and 40% males. The mean BMI is 25.17. The mean HKA angle improved significantly from 170.5° preoperatively to 184.2° postoperatively indicating successful correction of varus deformity. VAS scores decreased from a mean of 6.8 to 2.6. The KSS score improved from 54.1 to 90.6 and Functional KSS scores also showed significant improvement from 50.2 to 85.5. The overall complication rate is 10%.

Conclusion: MOWHTO using the Tomofix plate is a safe and effective procedure for selected patients with medial compartmental OA. It significantly improves pain, alignment, and functional outcomes with minimal complications, reinforcing its role as a viable alternative to knee arthroplasty in active, physiologically young individuals.

Keywords: High Tibial Osteotomy, Tomofix Plate, Osteoarthritis, KSS score, VAS score.

INTRODUCTION

Osteoarthritis of the knee is a chronic debilitating disease in old age causing considerable disability. It impairs day-to-day activity of a person, leading to an increase in health and welfare costs. Global statistics reveal that osteoarthritis accounts for 3%

of the years lived with disability. The prevalence of osteoarthritis in the Indian population is 22–39%, with an increasing trend of incidence even in the younger population.^[1]

Varus deformity is more common in primary osteoarthritis due to predominant involvement of the medial compartment of the knee joint. The

significant varus further aggravates the disease progression due to medialization of the weight-bearing axis of the knee joint. High tibial osteotomy (HTO) is a valuable treatment modality to correct the malalignment, hence relieving the symptoms. Various types of osteotomies are described, such as Open wedge HTO, Closed wedge HTO, and Dome osteotomy, to shift the mechanical axis. Medial open wedge HTO (MOWHTO) has the advantage of adjusting the correction intraoperatively, decreased risk of common peroneal nerve injury, and preservation of bone stock in case of further knee replacement.

Medial open-wedge HTO (MOWHTO) is an unstable condition; hence a stable fixation device is required to stabilize and improve bone union. Though there are various types of implants available, the most popular implant is a long spacer plate with angle-stable locking screws like the Tomofix plate, which has higher biomechanical stability.

In recent times, the need for joint-preserving surgeries is increasing in active high-demand individuals. With advancement in newer techniques and implants, there is an increase in the success rate and longevity in preservation of the native knee joint, which needs to be studied. This study aims to assess the effectiveness of MOWHTO fixed with the Tomofix plate and to identify its potential complications.

MATERIALS AND METHODS

This prospective interventional study was conducted at the Department of Orthopaedics, NRI Institute of Medical Sciences, Visakhapatnam, India, over a 24-month period from April 2023 to March 2025. The study was approved by the Institutional Ethics Committee, and informed consent was obtained from all participants. 20 patients who satisfied inclusion and exclusion criteria were selected and followed for period of 1 year. None were lost to follow up.

Inclusion Criteria

- Patients with symptomatic primary osteoarthritis hampering high demand employment or recreation.
- Evidence on weight bearing radiograph showing degenerative arthritis predominantly affecting medial compartment with corresponding varus deformity
- Physiologically active subjects who can use walker or clutches during post-operative rehabilitation.
- Patients without neuro-vascular deficits

Exclusion Criteria

- Medically unfit and not willing for surgery
- Osteoarthritis involving lateral or patellofemoral compartments
- Knee flexion contracture $>15^\circ$ or ROM $<90^\circ$

- Patients with more than 20 degrees of correction needed
- Patient who require correction of varus in distal femur
- Patients with cruciate and collateral ligaments insufficiency
- Genu valgum

Each patient underwent a comprehensive history assessment and clinical examination. Radiological and haematological tests were performed. Radiographs include Scanogram (Standing), Stress views and skyline views. The knee society score (KSS) and VAS score were assessed pre operatively and also postoperatively 6 weeks, 3 months, 6 months and 1 year. The pre and post-operative scores were analysed statistically.

Pre op planning

A full weight bearing long leg radiograph is mandatory for planning. A standing True AP view of knee is obtained in knee forward position and patella centred over femoral condyles irrespective of foot position. The radiographic tube is positioned 10 feet away from cassette. 3 cassettes are placed one above the other to include hip, knee and ankle joints. 3 spherical balls of same size are placed at level of bone on each cassette. In case of limb length discrepancy, a block is placed below foot to bring the both iliac crests at same level. The target is to shift mechanical axis towards lateral aspect of knee joint, mainly through Fujisawa point and the angle of correction is calculated using Miniaci method.

Surgical technique

All patients underwent MOWHTO under spinal anaesthesia using a medial approach. Bi-planar osteotomy was performed with a wedge size determined by preoperative planning using the Miniaci method and full-length weight-bearing scanograms. A Tomofix plate with locking screws was used for fixation, and tricortical iliac crest bone grafts were inserted into the osteotomy gap. Postoperative care included early mobilization, with non-weight-bearing for 3 weeks and progressive weight-bearing from 6 weeks.

RESULTS

The study included 20 patients (12 females, 8 males), aged 48–60 years (mean 54.45 ± 3.6). Right knee was operated in 60% and left in 40% of cases. Most patients had KL grade III OA (70%), and mean BMI was 25.17 ± 3.1 .

HKA Angle improved significantly from $170.5^\circ \pm 1.85$ (pre-op) to $184.2^\circ \pm 1.06$ (post-op) ($p < 0.0001$). FFD showed a reduction from $11.25^\circ \pm 2.5$ to $6.25^\circ \pm 7.5$, but this change was not statistically significant ($p = 0.18$). ROM improved from $104^\circ \pm 6.8$ to $119^\circ \pm 9.1$ ($p < 0.0001$). VAS Score improved from 6.8 ± 0.95 to 2.6 ± 1.23 ($p < 0.0001$), indicating significant pain relief.

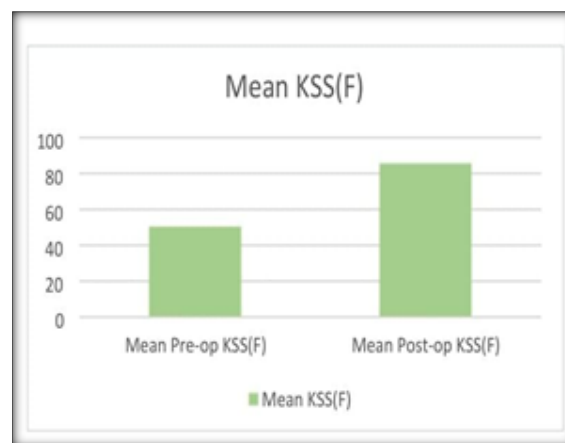


Chart 2: Showing improvement in KSS functional score



Knee Society Score (KSS) increased from 54.1 ± 5.5 to 90.6 ± 3.2 ($p < 0.0001$). KSS Functional Score improved from 50.3 ± 5.0 to 85.5 ± 5.1 ($p < 0.0001$). Two patients (10%) experienced complications: one superficial surgical site infection managed with antibiotics and one Type-I hinge fracture managed conservatively. No cases of non-union, hardware failure, or loss of correction were reported.

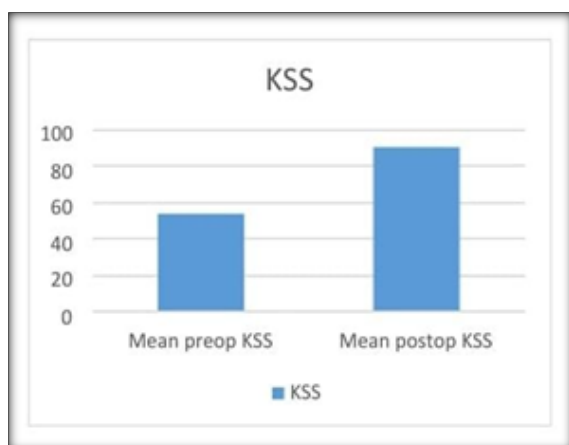


Chart 1: Showing improvement in KSS scores

DISCUSSION

This present study demonstrates that Medial Open Wedge High Tibial Osteotomy (MOWHTO) using the Tomofix plate provides significant improvement in both radiological alignment and functional outcomes in patients with medial compartmental osteoarthritis (OA) of the knee.

Postoperative restoration of the mechanical axis was achieved with a mean correction of Hip-Knee-Ankle (HKA) angle from 170.5° to 184.2° ($p < 0.0001$), aligning well with the optimal correction range reported in literature ($183-186^\circ$) for favourable load redistribution across the knee joint. This result is consistent with the findings of Fujisawa et al,^[2] who emphasized the biomechanical importance of realigning the mechanical axis through the Fujisawa point to delay OA progression and improve knee mechanics. Similar results were seen in studies of Gupta et al,^[3] who had correction of HKA angle from pre-op mean of 172 to post-op mean of 184 degrees and his target HKA correction was 183-186 degrees. Pipino G et al,^[4] in his study had correction of HKA from preop mean of 171 degrees to postop mean of 184 degrees and his target correction is 183-186.

The mean preop ROM is 104 ± 6.81 degrees and mean post-op ROM is 119 ± 9.12 degrees. There is significant increase in ROM with $p < 0.0001$ after MOWHTO. None of the patients with loss of ROM in their final follow up. This increase in rom is due to decrease in pain, early mobilisation and good rehabilitation protocol. Similar findings were observed in studies of Weidenhielm et al,^[5] and Lawrence et al.^[6]

Although fixed flexion deformity (FFD) did not show statistically significant change, the overall improvement from a mean of 11.25° to 6.25° , may be due to relief of pain and adherence to rehabilitation protocol.

Functional improvement was equally robust. The Knee Society Score (KSS) rose from 54.1 to 90.6, and KSS(F) from 50.3 to 85.5 ($p < 0.0001$), indicating substantial recovery in pain, stability, and

activity. These findings are comparable to Staubli et al,^[7] who reported successful outcomes using the Tomofix plate with rigid angular stability that enabled early mobilization without compromising osteotomy healing. This study also correlates with studies of Saito et al,^[8] Niemeyer,^[9] et al. and Bonasia et al.^[10]

The significant reduction in Visual Analogue Scale (VAS) scores (mean drop from 6.8 to 2.6) shows effective pain relief post-realignment. This mirrors studies of Bajoria et al,^[11] and Kim et al.^[12] Arnoldi et al,^[13] felt the pain relief was due to lowering of intra osseous venous pressure. Helal B et al,^[14] explained reduction of pain is due to decongestion.

In this study tricortical iliac crest bone graft was used in all cases. Staubli et al,^[7] demonstrated that leaving a gap in MOWHTO was safe and effective with 75% of the gap filled at 6-18 months using Tomofix plate. Sharma et al,^[15] used autologous tricortical iliac crest bone graft if gap width is more than 13mm. Nikose et al,^[16] used iliac crest graft in all his cases. The use of bone graft decreases the chance of non-union in patients with risk factors like smoking and obesity. It also provides additional support and prevent collapse of osteotomy site. As a result none of the patients had loss of reduction by end of 1 year in this study.

Importantly, the complication rate was low (10%), with only minor cases of superficial infection and hinge fracture which is managed conservatively, affirming the safety profile of this technique. This aligns with the reported complication ranges in the literature, such as Takeuchi et al.'s,^[17] classification of hinge fractures and the protective effect of using Tomofix in controlling fracture propagation. Similarly Niemeyer et al,^[9] had 8.6% complications rate. Yabuuchi K et al,^[18] observed 41.2% complication rate. Jung WH et al,^[19] had 8.6% overall complication rate in his study.

Overall, this study affirms that MOWHTO with Tomofix fixation is a biomechanically sound, clinically effective, and reproducible procedure for managing medial compartment OA in appropriately selected patients. Key predictors of favorable outcomes include lower Kellgren–Lawrence grades and BMI <25 kg/m², reinforcing the need for stringent patient selection.

CONCLUSION

Medial Open Wedge High Tibial Osteotomy (MOWHTO) using the Tomofix plate is an effective joint-preserving surgical option for patients with symptomatic medial compartmental osteoarthritis and varus malalignment. This study demonstrates that with meticulous patient selection, accurate preoperative planning, and stable fixation, MOWHTO significantly improves radiological alignment, functional mobility, and pain scores with a low complication rate. The procedure provides a valuable alternative to early joint replacement,

especially in physiologically active middle-aged patients.

Research Recommendation

- To Improve long term outcomes of HTO. Combination procedures like Arthroscopic microfractures, Chondroplasty etc must be improved and studied extensively.
- Development of software for accurate wedge calculation.
- Development of patient specific zig for precise osteotomy cuts.
- Development of biomechanically stable implants which are bioabsorbable, which minimizes need for hardware removal.

Limitations

- This study was conducted on relatively small sample size of 20 patients which limits generalizability. Larger and multicentre studies are needed to validate the results.
- The average follow up of this study is 1 year. Studies with large follow ups are needed to know the long term effects of HTO
- This study only evaluated Pain and functional score of MOWHTO. No effect is made to study the thickness and regenerated cartilage using MRI and Arthroscope.

Conflicts of interest: There are no conflicts of interest.

REFERENCES

1. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee osteoarthritis in India and related factors. *Indian J Orthop* 2016;50:518-22.
2. Fujisawa Y, Masuhara K, Shiomi S. The effect of high tibial osteotomy on osteoarthritis of the knee. An arthroscopic study of 54 knee joints. *Orthop Clin North Am*. 1979;10:585–608.
3. Gupta AK, Mukherjee D, Kumar S. Clinical outcome of high tibial osteotomy by hemicallosis using a dynamic axial fixator on 52 knees. *J Orthop Traumatol Rehabil*. 2024 Jul–Dec;16(2):113–119. doi:10.4103/jotr.jotr_67_23.
4. Pipino G, Indelli PF, Tigani D, Maffei G, Vaccarisi D. Openingwedge high tibial osteotomy: a seven-to twelve-year study. *Joints*. 2016;4:6–11.
5. Weidenhielm L, Olsson E, Broström LA, Börjesson-Hederström M, Mattsson E. Improvement in gait one year after surgery for knee osteoarthritis: a comparison between high tibial osteotomy and prosthetic replacement in a prospective randomized study. *Scand J Rehabil Med*. 1993;25:25–31.
6. Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. *Arthritis Rheum*. 2008;58(1):26–35.
7. Staubli AE, De Simoni C, Babst R, Lobenhoffer P. TomoFix: A new LCP-concept for open wedge osteotomy of the medial proximal tibia—early results in 92 cases. *Injury*. 2003;34(Suppl S2):B55–B62.
8. Saito T, Kumagai K, Akamatsu Y, Kobayashi H, Kusayama Y. Five- to ten-year outcome following medial opening-wedge high tibial osteotomy with rigid plate fixation in combination with an artificial bone substitute. *Bone Joint J*. 2014;96(3):339–344.
9. Niemeyer P, Koestler W, Kaehny C, Kreuz PC, Brooks CJ, Strohm PC. Two-year results of open-wedge high tibial osteotomy with fixation by medial plate fixator for medial

- compartment arthritis with varus malalignment of the knee. *Arthroscopy*. 2008;24(7):796–804.
10. Bonasia DE, Dettoni F, Sito G, Blonna D, Marmotti A, Bruzzone M, et al. Medial opening wedge high tibial osteotomy for medial compartment overload/arthritis in the varus knee: Prognostic factors. *Am J Sports Med*. 2014;42:690–698.
 11. Bajoria RS, Parihar YS, Priyadarshi S. A prospective study for initial assessment of functional outcome of high tibial osteotomy in active young adults in early osteoarthritis of knee. *Ortho J MPC*. 2023;29(1):12–17.
 12. Kim JH, Kim HJ, Lee DH. Survival of opening versus closing wedge high tibial osteotomy: a meta-analysis. *Sci Rep*. 2017;7:7296.
 13. Arnoldi CC, Djurhuus JC, Heerfordt J, Karle A. Intraosseous phlebography, intraosseous pressure measurements and ^{99m}Tcpolyphosphate scintigraphy in patients with various painful conditions in the hip and knee. *Acta Orthop Scand*. 1980;51:19–28.
 14. Helal B. The pain in primary osteoarthritis of the knee. Its causes and treatment by osteotomy. *Postgrad Med J*. 1965;41:172–181.
 15. Sharma G, Sagar V, Kumar R, Sharma AK, Kumar M, Sinha SK. Functional outcome of open-wedge high tibial osteotomy in medial compartmental osteoarthritis of knee joint. *J Orthop Dis Traumatol*. 2023;6:190–3.
 16. Nikose SS, Nikose D, Kekatpure AL, Jain S, Saoji K, Reddy SM. Impact of medial open-wedge high tibial osteotomy for medial compartment osteoarthritis of the knee. *World J Orthop*. 2020;11(12):606–614.
 17. Takeuchi R, Ishikawa H, Kumagai K, Yamaguchi Y, Chiba N, Akamatsu Y, et al. Fractures around the lateral cortical hinge after a medial opening-wedge high tibial osteotomy: a new classification of lateral hinge fracture. *Arthroscopy*. 2012 Jan;28(1):85–94.
 18. Yabuuchi K, Kondo E, Onodera J, et al. Clinical outcomes and complications during and after medial open-wedge high tibial osteotomy using a locking plate: a 3- to 7-year follow-up study. *Orthop J Sports Med*. 2020 Jun 8;8(6):2325967120922535.
 19. Jung WH, Takeuchi R, Chun CW, Lee JS, Jeong JH. Comparison of results of medial opening-wedge high tibial osteotomy with and without subchondral drilling. *Arthrosc J Arthrosc Relat Surg*. 2015;31(4):673–679.