



## A Prospective Study of the Outcome of High Tibial Osteotomy in Osteoarthritis of Knee with varus Deformity

Authors

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### Introduction

Medial opening wedge high tibial osteotomy (HTO) is surgical treatment option for the management of medial compartment knee osteoarthritis.<sup>1</sup> High tibial osteotomy (HTO) is a widely performed procedure to treat medial knee arthrosis. Many techniques have been developed (i.e. closing wedge, opening wedge, dome and “en chevron” osteotomies), but opening (medial) and closing (lateral) wedge osteotomies are the most commonly used. The goal of the treatment is to relieve medial compartment knee pain and slow down the arthritic progression. The surgery is described as a biomechanical intervention designed to alter dynamic knee joint loading, with the aim of improving patient function and decreasing pain. This is achieved by a partial unloading of the medial compartment with a slight overcorrection 3-5 degree of the mechanical axis. Some studies showed that regenerative process began after realignment. HTO was considered as an option to treat an isolated medial compartment Osteoarthritis (OA) in Varus knees, which was reported by Jackson in 1958. This surgery was not popular until Coventry reported good results in 1973, HTO became more popular in young active patients after improvement in surgical

technique, fixation devices, and patient selection with fewer complications. Although overall HTO results show the effectiveness of the procedure there are still some debated issues about osteotomies. These include the choice between opening or closing wedge tibial osteotomy, the graft selection in opening wedge osteotomies, the type of fixation, the comparison with uni-compartmental knee arthroplasty (UKA) and whether HTO affects a subsequent total joint replacement (TKR).

### Aims and Objectives

#### Aim

To evaluate the clinical, functional and radiological outcome achieved by high tibial osteotomy performed in osteoarthritis of knee patient with varus deformity.

#### Objectives

To assess clinical, functional and radiological outcome from the high tibial osteotomy done in osteoarthritis patients with varus deformity

### Review of Literature

#### Anatomy

Functionally, the knee comprises 2 articulations—the patellofemoral and tibiofemoral. Stability of

the joint is governed by a combination of static ligaments, dynamic muscular forces, meniscocapsular aponeurosis, bony topography, and joint load.

### **Osteoarthritis of Knee**

OA involves the whole joint (Hunter and Felson, 2006). There are concomitant changes in the bone underneath the cartilage (Felson et al., 2000); including sclerosis (remodeling and thickening) of the subchondral bone, and formation of osteophytes (Felson et al., 2000; Dieppe and Lohmander, 2005).

Within the tibiofemoral joint, articular cartilage degradation is most prevalent in the medial compartment (Cooke et al., 1997; McAlindon, 1992)

### **Biomechanics**

The goal of valgus HTO is to reach a slight valgus axis to prevent recurring of varus. Nearly 8-10° of valgus in the anatomical axis or 3- 5° of valgus in the mechanical axis are considered optimal correction after surgery.

Fujisawa et al gave a guideline to determine pre and postoperative amount of varus correction (8). The weight bearing line (WBL) should pass from 62% of the tibial plateau width when measured from the edge of the medial tibial plateau. This point – called Fujisawa point – matches over the mechanical axis with 3-5° valgus and locates slightly lateral to the lateral tibial spine.

### **Different Methods of Fixations**

Matthews et al. (9) treated 40 patients with Coventry or Coventry- Bowman techniques followed by cast immobilization. Internal fixation with staples was used in 25 cases and external fixation in three cases. They reported 86% of satisfactory results at one year from surgery, 64% at three years, 50% at five years and 28% at nine years. They also concluded that obesity, advanced age, overcorrection or under correction had the worst outcomes

Rudan and Simurda<sup>10</sup> treated 79 knees with valgus closing wedge HTO. They evaluated the patients at an average follow-up of 5.8 years and reported 80% of good or excellent results at the last follow up. They noticed that under correction and patellofemoral arthrosis were associated with poorer prognosis.

Ivarsson et al<sup>11</sup> performed 99 lateral closing wedge HTO, fixed with staples and immobilized in a cast. They reported 75% of good and acceptable outcomes at 5.7 years and 60% at 11.9 years. They obtained better results in patients with Ahlbäck grade I or II osteoarthritis and when a slight overcorrection was achieved (from 3° to 7° of valgus)

Naudie et al.<sup>12</sup> performed 94 closing wedge osteotomies and 12 dome osteotomies, fixed with staples and followed by cast immobilization in 75 cases.

Gstottner et al.<sup>13</sup> treated 134 arthritic knees with lateral closing HTO, fixed with staples. The survival rates were 94% at five years, 79.9% at ten years, 65.5% at 15 years and 54.1% at 18 years.

Akizuki et al.<sup>14</sup> followed up 118 closing wedge HTO, fixed with a plate. Survivorship was 97.6% at ten years and 90.4% at 15 years from surgery

McNamara et al.<sup>15</sup> suggested a concomitant tibial tuberosity osteotomy if more than 12.5 mm correction is required to avoid adverse effects of patella infra and increased patellofemoral compartment pressure

Han et al.<sup>16</sup> studied on 18 fresh frozen human cadaver knees and found a safe zone to avoid breaking the lateral cortex. This safe zone is an area between the tip of the fibular head and the remnant of fibular head epiphysis line.

To keep posterior tibial slope and patellar height within the normal range, the authors follow the recommendations of Hernigou et al and Noyes et al.<sup>17</sup>. A study by Asada et al showed that excess increase in the posterior tibial slope resulted in loss of correction in the coronal plane and failure of surgery. Increase in the posterior tibial slope occurs after MOWHTO whereas lateral closing

wedge osteotomy decreases the posterior tibial slope.

Agneskirchner et al<sup>18</sup> studied the biomechanics of 3 spacer plates with different length, two with locking bolts and one was the TomoFix fixator. The TomoFix plates were superior at single load to failure

and cyclical load to failure tests and had the maximum residual stability after failure of the lateral cortex.

Kachooei et al<sup>19</sup> reported good short term outcome for MOWHTO with Orthopedic Dual Sliding Compression Plate (ODSCP) using 2 to 3 non locking screws on each side. The plate is inserted before correcting the alignment to hold the bone fragments in place.

Staubli et al<sup>20</sup> studied the bone healing using radiography after HTO without filling the osteotomy gap. They showed that healing starts from the lateral hinge and gradually progresses toward medial. Callus formation and ossification is visible three months after surgery. The new bone fills 75% of the gap 6 months after surgery.

## Materials and Methods

**Study Area:** Department of Orthopedics, Katihar medical college and hospital, Katihar

**Study Population:** Younger and active patients.

### Inclusion Criteria

1. Medial compartment arthrosis only
2. Kellgren-Lawrence of grade 1–4
3. Varus limb alignment
4. Knee flexion more than 90 degree
5. Good muscle strength to carry out rehabilitation
6. Good vascular status without arterial insufficiency

### Exclusion Criteria

1. Patient who lost follow up
2. Ligamentous instability
3. Lateral tibial subluxation more than 1cm
4. Medial compartment tibial bone loss of > 2 or 3mm

5. Flexion contraction of >15 degree
6. Knee flexion < 90 degree
7. > 20 degree of correction needed
8. Rheumatoid arthritis

**Study Period:** January 2021 to September 2022

**Sample Size:** 30

**Study Design:** Prospective interventional study.

## Methodology

It is a prospective interventional single centre study that will be conducted in Katihar Medical College, Katihar during period between January 2021 to September 2022 after permission from Institutional Ethical committee. About 30 patient will be selected and assessed preoperatively and postoperatively with knee society score and knee society functional score. Assessment and evaluation will be done using a regularized custom made protocol which included the symptom of patients, associated medical condition, knee society score and knee society functional score. The Knee society score is a special score which has been widely accepted as an objective measure of knee status in patient undergoing high tibial osteotomy. All the data will be entered into the protocol proforma. The postoperative X-ray will be done immediate postoperative and after 1 month, 6 month and yearly thereafter.

## Data Collection Methods

1. By interview
2. By follow up at intervals 1st, 3rd, 6th, months respectively and 1 year postoperatively.

The data collection methods had subjective and objective variables

- Sex of the patient- male/female.
- Age of patient
- BMI of the patient
- History of the injury-.
- History of comorbidity- yes/no.

Data will be collected and statistically formulated, tabulated and analysed.

### Statistical Analysis

The analysis will be carried out using SPSS software v.24 with appropriate statistical tests to determine significance level. All the results will be considered statistically significant at  $p < 0.05$ .

Baseline variables will be compared between groups to determine baseline equivalence using independent t tests for continuous data and chi-square tests for nominal variables. Differences on KSS and Lysholm scores will be examined using repeated-measure analysis of variance (ANOVA) with time (6 months) as the within-subject factors and groups as the between-subjects factor. Pair wise comparisons using only 2 time points will be conducted to assess differences between the groups at each time period.

### Observation and Discussion

The results will be compiled, tabulated and compared with previous studies.

### Summary and Conclusion

On the basis of outcomes of all observations and results, data will be analysed to reach a definite summary and conclusion of present study under the direct guidance of Dr. Masoor Alam, Department of Orthopaedics, Katihar Medical College and Hospital, Katihar

### Bibliography

1. Khan A, Ifthekar S. Evaluation of functional outcome of high tibial osteotomy in medial compartment osteoarthritis of knee fixed with orthofix and puddu plate: A comparative study. ~ 408 ~ Int J Orthop Sci [Internet]. 2018;4(3):408–13.
2. Hoell S, Suttmoeller J, Stoll V, Fuchs S, Gosheger G. The high tibial osteotomy, open versus closed wedge, a comparison of methods in 108 patients. Arch Orthop Trauma Surg. 2005;125(9):638–43.
3. Flandry F, Hommel G. Normal Anatomy and Biomechanics of the Knee. 2011;19(2):82–92.
4. Leitch KM. Biomechanical Investigations of Medial Opening Wedge High Tibial Osteotomy: Gait Analysis, Materials Testing and Dynamic Radiography. 2014;(April).
5. Kohn MD, Sassoon AA, Fernando ND. Classifications in Brief: Kellgren-Lawrence Classification of Osteoarthritis. Clin Orthop Relat Res [Internet]. 2016 Aug;474(8):1886–93.
6. Hunter DJ, Felson DT. Osteoarthritis. BMJ. 2006;
7. McAlindon T, Dieppe P. Osteoarthritis: Definitions and criteria. Ann Rheum Dis. 1989;
8. 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 [Internet]. 1979 Jul;10(3):585–608.
9. Matthews LS, Goldstein SA, Malvitz TA, Katz BP, Kaufer H. Proximal tibial osteotomy. Factors that influence the duration of satisfactory function. Clin Orthop Relat Res [Internet]. 1988 Apr;(229):193–200.
10. Rudan JF, Simurda MA. High tibial osteotomy. A prospective clinical and roentgenographic review. Clin Orthop Relat Res [Internet]. 1990 Jun;(255):251–6.
11. Ivarsson I, Myrnerets R, Gillquist J. High tibial osteotomy for medial osteoarthritis of the knee. A 5 to 7 and 11 year follow-up. J Bone Joint Surg Br [Internet]. 1990 Mar;72(2):238–44.
12. Naudie D, Bourne RB, Rorabeck CH, Bourne TJ. The Install Award. Survivorship of the high tibial valgus osteotomy. A 10- to -22-year followup study. Clin Orthop Relat Res [Internet]. 1999 Oct;(367):18–27.
13. Michaela G, Florian P, Michael L, Christian B, Liebensteiner M, Michael L, et al. Long-term outcome after high tibial osteotomy. Arch Orthop Trauma Surg [Internet]. 2007 Oct 30;128(1):111–5.

14. Akizuki S, Shibakawa A, Takizawa T, Yamazaki I, Horiuchi H. The long-term outcome of high tibial osteotomy: A TEN-TO 20-YEAR FOLLOW-UP. *J Bone Jt Surg - Br Vol* [Internet]. 2008;90–B(5):592–6.
15. McNamara I, Birmingham TB, Fowler PJ, Giffin JR. High tibial osteotomy: evolution of research and clinical applications—a Canadian experience. *Knee Surgery, Sport Traumatol Arthrosc* [Internet]. 2013 Jan 28;21(1):23–31.
16. Han SB, Lee DH, Shetty GM, Chae DJ, Song JG, Nha KW. A “safe zone” in medial open-wedge high tibia osteotomy to prevent lateral cortex fracture. *Knee Surgery, Sport Traumatol Arthrosc* [Internet]. 2013 Jan 19;21(1):90–5.
17. Hernigou P. Open wedge tibial osteotomy: combined coronal and sagittal correction. *Knee* [Internet]. 2002 Feb;9(1):15–20.
18. Lobenhoffer P, Agneskirchner JD. Improvements in surgical technique of valgus high tibial osteotomy. *Knee Surgery, Sport Traumatol Arthrosc* [Internet]. 2003 May 11;11(3):132–8.
19. Samani SS, Kachooei AR, Ebrahimzadeh MH, Omidi Kashani F, Mahdavian Naghashzargar R, Razi S. Application of Orthopedic Dual Sliding Compression Plate (ODSCP) in High Medial Tibial Open Wedge Osteotomies. *Iran Red Crescent Med J* [Internet]. 2013 May 5;15(4):335–9.
20. 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* [Internet]. 2003 Nov;34 Suppl 2:B55–62.

#### ANNEXURE – A

##### PATIENT’S INFORMED CONSENT FORM

Patient identification number for this trial:

Title: A PROSPECTIVE AND OF THE OUTCOME OF HIGH TIBIAL OSTEOTOMY IN OSTEOARTHRITIS OF KNEE WITH VARUS DEFORMITY.

Name of the Principal Investigator: DR. MANISH J CHOUDHARY

The contents of the information sheet dated (version)

that was provided have been read carefully by me/explained in detail to me, in a language that I comprehend. I have fully understood the content of the information sheet and I confirm that I have opportunity to ask questions.

The nature and purpose of the study and its potential risks/benefits and extended duration of the study and other relevant details of the study have been explained to me in detail. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal right be affected. I understand that the information collected about me from my participation in this research and sections of any medical notes may be looked at by responsible individuals. I gave permission for these individuals to have access to my records. I agree to take part in above study.

Date: Place:

Name of participants: impression)

(Signature of patient / Left thumb

Son/Daughter/ Spouse of :

**ANNEXURE –B****UNDERTAKING**

I/We agree to abide by the ethical guidelines for biomedical research on human subjects ( As per the ICMR guidelines )while the research project being submitted for Ethical Committee consideration.

1. Project is considered to be absolutely essential for the advancement of knowledge and for the benefit of all.
2. Only subjects who volunteer for the project will be included .Their informed consent will be obtained to commencement of the research project and subjects will be kept fully apprised of all the consequences.
3. Privacy and confidentiality of the subjects shall be maintained and without the consent of the subject no disclosure will be made.
4. Proper precautions shall be taken so as to minimize risk and prevent irreversible adverse effects.
5. Research will be conducted by the professionally competent person.
6. Research will be conducted in a fair , honest ,impartial and transparent manner.Research will be accountable for maintaining proper records.
7. Research will be conducted keeping in view the public interest at large.
8. Research reports, material and data will be preserved (as per institutional guidelines)
9. Results of research will be made known through scientific publication.
10. Professional and moral responsibilities will be of the researchers ,directly or indirectly connected with the research.
11. Only those drugs which are approved by the Drug Controller of India for a specific purpose will be used in the research project.