

A Prospective Study of Functional and Radiological Outcome of High Tibial Osteotomy in Active Indian Population

Jayanta Mukherjee¹, Mujtaba Ahmad², Rabiul Haque³, SK Sariful Rahaman⁴, Bhuban Kumar Pramanik⁵, Vibhash Chandra⁶

¹Associate Professor, Department of Orthopaedics, KPC Medical College, Jadavpur Kolkata, West Bengal, India

²Junior Resident, Department of Orthopaedics, KPC Medical College, Jadavpur Kolkata, West Bengal, India

³Junior Resident, Department of Orthopaedics, KPC Medical College, Jadavpur Kolkata, West Bengal, India

⁴Junior Resident, Department of Orthopaedics, KPC Medical College, Jadavpur Kolkata, West Bengal, India

⁵Junior Resident, Department of Orthopaedics, KPC Medical College, Jadavpur Kolkata, West Bengal, India

⁶Assistant Professor, Department of Orthopaedics, MGM Medical College, Jamshedpur, Jharkhand, India

Received: 04-01-2022 / Revised: 15-02-2022 / Accepted: 08-03-2022

Corresponding author: Dr. Vibhash Chandra

Conflict of interest: Nil

Abstract

Aim: High tibial osteotomy is an accepted surgical technique for treatment of primary or secondary medial compartment degenerative arthritis of knee in younger and active patients. Hence this study was done to assess the functional & radiological outcome in patients undergoing High Tibial Osteotomy using knee society score (pain score, Functional score and total knee score) & femorotibial angle respectively.

Methods: This is a prospective, single centre interventional study done on 26 patients who were clinically and radiologically diagnosed as medial compartment knee osteoarthritis with varus deformity. After proper preoperative assessment, patient underwent high tibial osteotomy. The clinical outcome was evaluated with knee society knee scoring system. The patients were followed up at regular intervals during 6th week 3rd, 6th and at 12th month.

Results: The preoperative mean pain score and the mean total knee society score of the patients before surgery were 17.31 and 94.88 respectively. The postoperative mean knee score and functional score at 12 months was 40.75 and 177 respectively. So the preoperative and postoperative comparison score showed statistically significant improvement in both the pain score and total knee score. Mean preoperative FT angle (varus) was 6.23 ± 1.5 and post operative FT angle (valgus) was 6.1 ± 1.7 at 1 yr.

Conclusion: In this study, there was significant increase in the knee society knee score, pain score and FT angle after high tibial osteotomy for the patients of medial compartment knee osteoarthritis with Varus deformity. Therefore, High tibial osteotomy should be recommended for the treatment of degenerative arthritis of the knee in young, active patient and even in elderly physiologically young patients in India for symptomatic improvement and maintenance of activity level.

Keywords: Hightail osteotomy, femoro-tibial angle (FT) angle, knee society knee score.

This is an Open Access article that uses a fund-ing model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative

(<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

High tibial osteotomy was first described in 1958 as a successful treatment for moderate to severe unicompartmental, degenerative arthritis of the knee associated with angular deformity [1]. In osteoarthritis Varus and valgus deformities are fairly common & cause an abnormal distribution of the weight bearing stress within the joint. The biomechanical rationale for proximal tibial osteotomy in patients with unicompartmental osteoarthritis of knee is unloading of the involved joint compartment by correcting the malalignment and redistributing the stresses on the knee joint. High tibial osteotomy alters the mechanical axis of a limb so that the weight bearing load is transferred to healthy cartilage during the treatment of osteoarthritis with varus deformity (2). Properly done High tibial osteotomy with full corrected deformity in properly selected patient gives pain relief for 10-15 years and delays the need of arthroplasty if required later [3]. The purpose of this study is to evaluate the functional and radiological outcome of high tibial osteotomy in medial compartment knee osteoarthritis in active Indians.

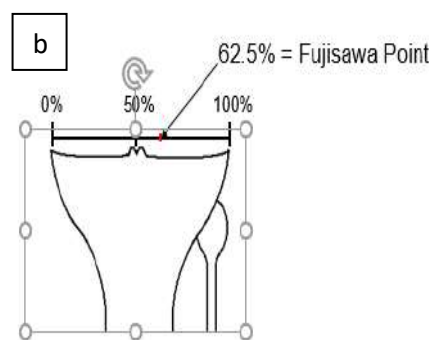
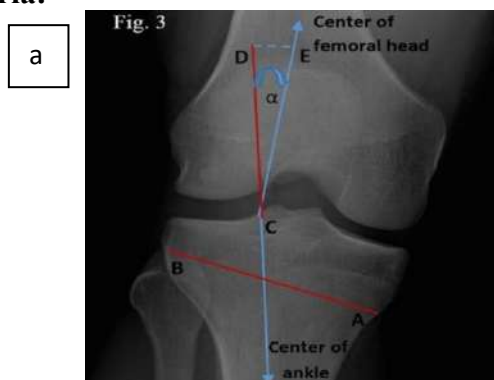
Material and methods:

Study sample of 26 patients were selected prospective among the patients coming to outpatient department in the department of Orthopedics, during a period 2 years based on the following inclusion.

Criteria:

1. Unicompartmental (medial) osteoarthritis of knee with varus deformity
2. No relief of knee pain after 3 weeks of conservative treatment, and if the patient is motivated for surgery after proper examination.
3. Age <60 years
4. Physiologically young and active patients having unicompartmental involvement even in chronological age >60 years.
5. Pain restricting the daily activity.
6. Stage 1, 2 & 3 osteoarthritis according to Kellgren and Lawrence classification.

Based on the above criteria patients were selected and their history, general examination were noted. Therefore, 26 patients were eligible for this study, and were consecutively evaluated radiologically by x-ray B/L knee AP view (standing)/lat view and scanogram B/L lower limb AP films for measurement of femoro-tibial angles and size of wedge. To determine the amount of required correction, a line was drawn from Fujisawa point to the center of the femoral head and another to the center of the ankle joint. The angle created by these two lines indicates the amount of correction. The weight bearing line should pass through the Fujisawa point. Fujisawa point represents 62.5% across tibial plateau from medial side [4].

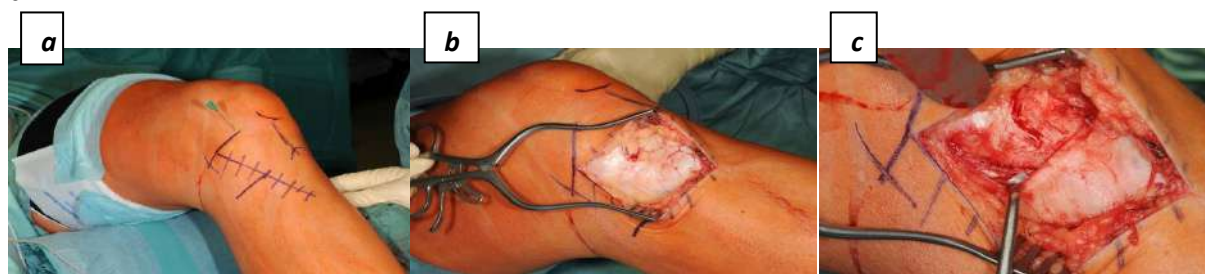


a) Anteroposterior weight-bearing alignment view is used for pre-operative planning. To determine the weight-bearing line, two separate lines are drawn from the center of the femoral head and the center of ankle toward the Fujisawa point. The angle (α) is made by intersection of these two lines indicating the amount of correction needed. DE distance is measured in millimeters, which represents the amount of opening wedge required after osteotomy b) figure showing Fujisawa point.

Preoperatively knee score of the patients were assessed by knee society knee score.[5] All patients after pre anaesthetic checkup and proper consent was taken for surgery. Medial opening wedge high tibial osteotomy secured with internal fixation (plating-tomofix/ LCP) was done in all patients.

Surgical Technique:

- Patients were positioned supine on OT table
- Pneumatic tourniquet was used in all of our cases but is not mandatory.
- Knee was flexed in 90-degree position and anatomic landmarks were marked (a) medial joint line (b) cranial border of pes anserinus (c) course of medial collateral ligament (d) tibial tuberosity.
- 6 – 8 cm long skin incision running from a point anterior to the insertion of the pes anserinus in a posterocranial direction was made.
- Anterior border of the superficial layer of the medial collateral ligament comes into view.
- A k-wire or, a Steinmann or guide pin was drilled through the proximal tibia from medial to lateral in extension. This was obliquely oriented, starting approximately 4cm distal to the joint line and directed across the superior edge of the tibial tubercle to a point 1cm below the joint line laterally. Then a high tibial osteotomy was performed, preserving a lateral hinge of approximately 1.5cm of intact bone.
- Then an osteotomy chisel was inserted into the osteotomy up to the lateral bony hinge using light hammer blows.
- The insertion depth corresponds with the cutting depth which was marked on the chisel then slowly second osteotomy chisel was inserted between the first one and the guide wires.
- Then third, fourth and fifth chisel was inserted one, until the desired opening angle and wedge was reached.
- Correction was checked under radiographic control. (our preferred method was cauterly lead method)
- Then plate was positioned so that the solid plate segment was bridging the osteotomy and the plate was fixed using locking screws and the wedge was filled with bone graft cortico-cancellous bone graft.



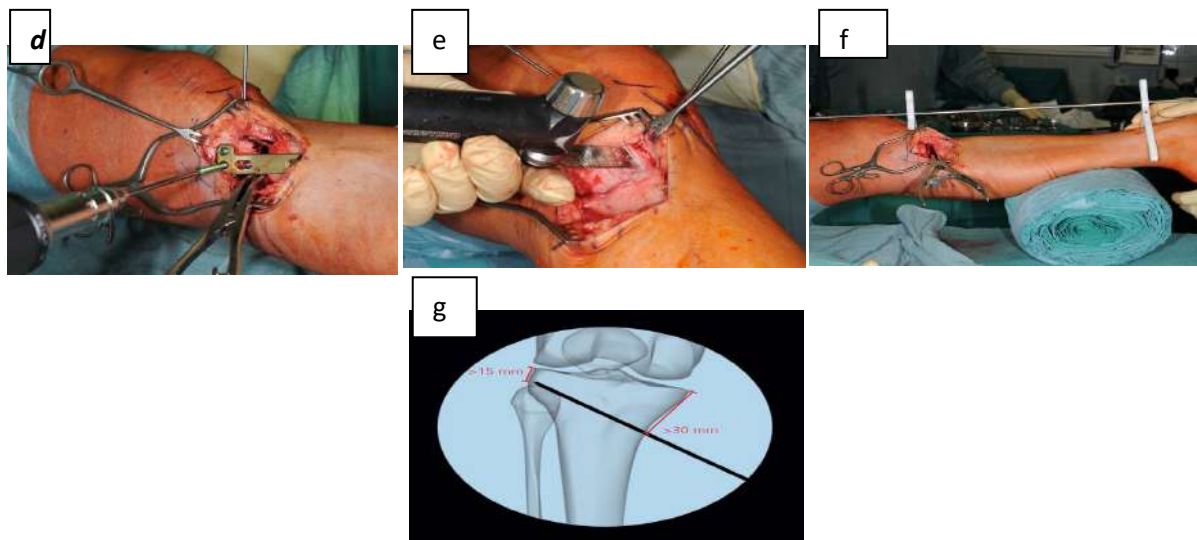


Figure 1: (a) Surface marking, (b) Incision of 6-8 cm, (c) Medial collateral ligament comes to view, (d) Guide wire from medial to lateral, (e) Osteotomy done, (f) Alignment checked, (g) Osteotomy fixed with tomofix

Rehabilitation was started from Day 1 post surgery (knee bending) and non-weight bearing ambulation was allowed from 3rd day with crutches or walker and after 3-5 weeks according to the radiological bony union full weight bearing was allowed. Patients were reviewed in the OPD at 6th week, 3rd month and at 6th month after the operation thereafter every 6 monthly. The data was analyzed by using spss version 2.0.

Results

In our study 26 patients were included which consisted of 16 males (61.53%) and 10 females (38.46%). The average age of the patients was 58.88yrs and most patients belonged to age group 50-59 (n=13, 50%) who under high tibial osteotomy for medial compartment knee osteoarthritis. Among the patients HTO in right knee was done in 61.53 % (n=16) cases and left knee was operated in 38.47 % (n=10) of cases.

According to radiological classification based on Kellgren & Lawrence classification 22 knees (84.61%) had grade II changes and 04 knees (15.38%) had

grade III. The femoro-tibial angle was in varus alignment in all the cases. 09 cases (34.61%) had femoro-tibial angle between 0-5 degrees varus and 17 cases (65.38%) between 6-10 degrees varus. Based on knee society pain score (maximum score {no pain}=50) preoperative score ranged from 10-20 in 22 cases(84.21%) and from 21-30 in 4 cases (15.38%). Hence mean pre op knee society pain score was 17.31 ± 7.1 . Postoperative knee society pain score improved in most patients with 8 patients (40%) achieving the range of 40-50 and 9 patients (45%) achieving the range of 30-40 and 3 patients (15%) in range of 21-30. Mean post op knee society pain score was 40.75 ± 5.76 . On comparing the data between pre & post-operative scores at 1 year the difference of values was found to be statistically highly significant ($p < 0.0001$). Mean preoperative total knee society score was 94.88 ± 9.96 and mean post operative total score was 177 ± 12.69 . Hence average gain in knee society score was 83.07. There was a significant increase in total score in knee society score ($p < 0.001$). Post-operative complications like superficial wound infection was seen in

1 patient which was managed by antibiotics, delayed union was seen in 1 patients and was managed by

immobilization for 3 weeks and pain due to plate impingement was seen in 2 patients which was managed by analgesics.

Table 1: Average gain in pain score

Knee Society Knee Score (pain)	
Mean pre-op total score	Mean post-op total score at 1 Year
17.31±7.1	40.75±5.76

Average gain in knee society score = 23.44

There is a significant increase in pain score in knee society score (p<0.001)

Table 2: Average gain in total score

Knee Society Knee Score	
Mean pre-op total score	Mean post-op total score at 1 Year
94.88±9.96	177±12.69

Average gain in knee society score = 83.07

There is a significant increase in total score in knee society score (p<0.001)

Table 3: Grading for the knee society score:

Excellent Score-80 to 100	Good Score -70 to 79	Fair Score -60 to 69	Poor Score below 60
24 (93.30%)	2(7.7%)	0	0

Table 3: Femoro-Tibial angle

MEAN Pre OP FT (varus)ANGLE IN DEGREES	MEAN POST OP FT (valgus)ANGLE (AT 1 YEAR)
6.23 SD 1.5	6.1 SD 1.79

Discussion:

The present study was conducted on 26 patients. There were 61.53% male and 38.46% female cases. Mean age of Patients in our study was 55.88 years with maximum age of 65 years and minimum 45 years the maximum patients (50%) were in the 50-59 years age followed by 34.61% cases in age group of more than 60 yrs. In this study the mean age of patients at the time of operation was 55.88 years (52.4yrs for female and 58.06 yrs for male pts) which was similar to studies done by Choi HR. (2001), Koshino T (2004), Dehoux. E (2005), Takeuchi R(2008) and Zaki SH(2009) studies were 59.0 years, 59.6 years, 45.2 years, 69 yrs and 39.5yrs

respectively was the mean age.[6][7][8][9][10].

All patients in this study had a genu varum deformity secondary to Osteoarthritis. In this study the mean pre-operative pain score was 17.31± 7.1 (Knee Society Pain Score).

The roentgenograms were graded from 0-4 using Lawerence classification according to the severity of radiological changes. 22 patients (84.61%) had grade II changes and 04 patients (15.38%) grade III changes. No patient gave history of any trauma. The femorotibial angle was in varus alignment in all the cases. 09 cases (34.61%) had femoro-tibial angle between 0-5 degrees varus and 17 cases (65.38%) between 6-10 degrees varus.

Study by Takeuchi R, 2009 partial weight bearing was started from first week using Tomofix with artificial bone graft to fill osteotomy gap, which is similar in our case were partial weight bearing was allowed after 7-10 days. Full weight bearing in our case was started after 4-6 weeks in locking plate with autologous bone graft taken from iliac crest in medial open wedge osteotomy which is delayed when compared to study by Takeuchi R, 2009 in which full weight bearing was allowed after 2 weeks in unilateral cases using Tomofix.[9]

All cases experienced definite improvement in the pain. It is amply clear from the percentage increase in average pain score of 23.44 (Knee Society Pain Score) P value <0.001. 19 cases (73.07%) cases had pain score >40 in follow-up visits (the maximum pain score for pain is 50). It was noted that the patients kept on improving for 1 year after osteotomy. The follow up in this study is relatively short and many patients complained of weakness or some swelling around the knee joint up to 3 months which finally improved with quadriceps strengthening exercise. The average pain score pre-operatively was 17.31 ± 7.1 and post-operatively was 40.75 ± 5.76 the percentage increase in pain score post-operatively was 24. By comparing the pre-operative with post operative knee score (pain, range of motion and stability) of all patients, the maximum affected was the pain score $P < 0.001$ and pain was the primary cause of morbidity and that was the main reason for which high tibial osteotomy was done.

In our study the mean tibio-femoral angle in standing was 6.23 ± 1.5 degrees varus pre-operatively and 6.1 ± 1.79 degrees valgus post-operatively. Similar correlation of deformities were reported in the studies of Koshino T (2004) and Spahn G (2005) in which the tibio-femoral angle in standing was 6 degrees and 7 degrees varus pre-operatively and 9 degrees and 3.7 degrees post-operatively respectively[11][12].

In this study the results were rated as excellent in 24 cases (92.30%) good in 2(7.7%) and poor in 0 cases (0%). This compares well with the study of Pfahler M (2003) with 90% excellent and 10% poor result [13]. In the study of U. Munzinger (2004) results were good to excellent in 71.50% cases, fair in 10.70% and poor in 17.80% cases [14]. In Wu LD (2004), Zhou YX (2003) and Miklos Papp (2004) studies results were excellent in 97.30%, 88.00%, and 91.30% cases at two years[15][16][17]. The results deteriorated thereafter as the time passes. To comment on deterioration, this study needs further follow-up.

All the cases regained their pre-operative range of movement. As such high tibial osteotomy does not increase the range of movement on contrary it may lead to stiffness of knee joint if proper physiotherapy is not instituted. But with the use of locking plates for the fixation and avoidance plaster has led to early mobilization resulting in improved range of movement after 1 year which was seen in our study with the use of tomofix for fixation.

Correlation between valgus attained and reduction of Pain:

In the study of Hernigou-P (1987), best result was obtained when the femoro-tibial angle attained was 3 to 60 postsoperatively [18]. Under correction and over correction were related to poor results. In our study, the patients who attained valgus post-operatively definitely showed the better results. The cases in which post-operative femorotibial angle was between 0-4-degree 1 case (3.8%) the mean increment in pain score was 16.67 ± 7.63 . In 24 cases (92.3 %) in which the post-operative femorotibial angle was between 5-7 degrees valgus, the mean increment in pain score was 24.41 ± 6.7 . and more than 7-degree valgus 1 case had an improvement in pain score of 13.20. This showed that post-operative increment in pain score was

better if the post operative femorotibial angle was between 5-7 degrees.

There were negligible complications only two patients complaints plate impingement & one patient suffered with superficial infection.

Conclusion:

From our study we can conclude that in patients with medial compartment osteoarthritis of knee (even grade 3), medial open wedge high tibial osteotomy had provided significant relief in pain and improvement in function of the knee. High tibial osteotomy also resulted in correction of varus knee to appropriate valgus knee which had direct effect on reduction of pain. This procedure had very minimal or no complications postoperatively. Hence this study gives a very clear view that high tibial osteotomy can be preferred procedure in unicompartmental knee arthritis in active adults specially in Indian population where patients after the procedure can return to active lifestyle (heavy work for daily wages, squatting etc)

References:

1. Jackson JP, Waugh W, Green JP. High tibial osteotomy for osteoarthritis of the knee. *J Bone Joint Surg.* 1969;51B:88–94
2. Agreskirchner JD, Christof H, Christiane DW, Philipp L, quantify the effects of medial opening wedge high tibial osteotomy on articular cartilage pressure of the knee. *Journal of arthroscopic and related surgery*, vol 23, No-8 pp (852-861) Aug 2007.
3. Brouwer RW, Bierma Z, Vanraaij TM, Verhaar JAN, Effectiveness of high tibial osteotomy for treating the unicompartmental osteoarthritis of the knee joint. *Journal of bone and joint surgery*, 19(2) : 15-4, Nov 2006.
4. Sabzevari S, Ebrahimpour A, Roudi MK, Kachooei AR. High tibial osteotomy: a systematic review and current concept. *Archives of Bone and Joint Surgery.* 2016 Jun;4(3):204.
5. Insall JN, Dorr LD, Scott RD, Scott WN (1989) Rationale of the knee society clinical rating system. *Clin Orthop* 248:13–14.
6. HR Choi, Hasegawa Y, Kondo S, Shimizu T, Imda K, Iwata H. High tibial osteotomy for varus Borjesson M, Weidenhielm L, Mattsson E, Olsson E. Gait and clinical measurements in patients with knee osteoarthritis after surgery: a prospective 5-year follow-up study. *Knee.* 2005 Apr;12(2):121-7.
7. Koshino T, Yoshida T, Ara Y, Saito I, Saito T. Fifteen to twenty-eight years follow-up results of high tibial valgus for osteoarthritic knee. *Knee.* 2004 Dec; 11(6): 439-44.
8. Dehoux E, Madi K, Fourati E, Mensa C, Segal P: High tibial open-wedge osteotomy using a tricalcium phosphate substitute: 70 cases with 18 months mean follow-up. *Rev Chir Orthop Reparatrice Appar Mot.* 2005 Apr;91(2):143-8.
9. Takeuchi R, Ishikawa H, Aratake M, Bito H, Saito I, Kumagai K, Akamastuy, Saito T: Medial opening wedge high tibial osteotomy with early full weight bearing. *Arthroscopy* 2009 Jan; 25(1): 46-53.
10. Saeed H. Zaki, Paul J. Rae High tibial valgus osteotomy using the Tomofix plate – Medium-term results in young patients. *Acta Orthopaedica Belgica* 2009;3 (Vol. 75/3) :360-357.
11. Spahn G, Kirtschbaum S, Kahl E. Factors that influence high tibial osteotomy results in patients with medial gonarthrosis : a score to predict the results. *Osteoathitis Cartilage.* 2005 Nov 2.
12. Koshino T, Yoshida T, Ara Y, Saito I, Saito T. Fifteen to twenty-eight years follow-up results of high tibial valgus for osteoarthritic knee. *Knee.* 2004 Dec; 11(6): 439-44.

13. Pfahler M, Lutz C, Anetzberger H, Majer M, Hausdorf J, Pellengahr C, Refior HJ: Long-term results of high tibial osteotomy for medial osteoarthritis of the knee. *Acta Chir Belg.* 2003 Nov-Dec; 103(6): 603-6.
14. U. Munzinger, P. Frey, M. Huber, W. Miehke. Schulthess Clinic, Zurich, Switzerland. Long term results after high tibial osteotomy for the treatment of varus gonarthrosis. *Journal of Bone and Joint Surgery*, 2004.
15. Zhou YX, Yao L, Kang Q, Xu H, Dou BX, Huang DY. Long term follow up of patients with knee osteoarthritis after high tibial osteotomy. *Zhonghua Yi Zue Za Zhi.* 2003 Nov. 25; 83(22): 1949-51.
16. Wu LD, Hahne HJ, Hassenpflug J: A long term follow up study of high tibial osteotomy in medial compartment osteoarthritis. *Clin J. Traumatol* 2004 Dec; 7 (6): 384-53.
17. Miklos Papp, L. Rode, S. kazai: long term results of proximal tibial osteotomy. *Journal of Bone and Joint Surgery*, 2004.
18. Hernigou P, Medevielle D, Debeyre J, Goutallier D. Proximal tibial osteotomy for osteoarthritis with varus deformity. A ten to thirteen-year follow-up study. *J Bone Joint Surg Am.* 1987 Mar;69(3):332-54.