

# Comparison Of Results Of High Tibial Osteotomy Using Open Wedge Versus Close Wedge In Medial Uni-Compartmental Osteoarthritis Of Knee.

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## ABSTRACT

**Background:** Osteoarthritis is now considered to be primarily a disease of cartilage in which intrinsic biomechanical and mechanical alterations lead to its breakdown. Increasing failure of conservative treatment lead surgeons to explore the operative arena. High Tibial Osteotomy (HTO) is a satisfactory surgical method in knees with unicompartmental osteoarthritis and angular deformity. Objectives: To manage medial uni-compartment osteoarthritis of knee with medial open wedge or lateral closing wedge osteotomy and to compare between the two. **Methods:** HTO of 20 adult patients with medial compartment osteoarthritis or medial bicompart ment osteoarthritis with genu varum deformity and their followup with functional and radiological parameters. **Results:** Following operation 12 patients having excellent results & 8 patients (40%) having good results. 19(95%) patients were satisfied. **Conclusion:** There is no significant statistical difference between the patients undergoing medial open wedge and lateral close wedge high tibial osteotomy except for medial joint space. Medial Open Wedge is technically easy with fewer risks, hence preferred over lateral close wedge.

**Keywords:** High Tibial, Unicompartmental, Osteoarthritis, Osteotomy.

## INTRODUCTION

Osteoarthritis (OA) is one of the oldest afflictions of mankind. Now it is considered to be primarily a disease of cartilage in which intrinsic biomechanical and mechanical alterations lead to its breakdown. At present it is the most common disease affecting man. In 5 % cases it appears in young individuals.

Increasing failure of conservative treatment lead surgeons to explore the operative arena. A number of different operations from open joint debridement and drilling to total knee replacement and cartilage allografting have been tried and tested for the last 5-6 decades. It has been generally accepted that in certain specific indications High Tibial Osteotomy (HTO) is a satisfactory surgical method in knees with unicompartmental osteoarthritis and angular deformity.

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### High Tibial Osteotomy Relieves Pain By:

Redistribution of loading i.e. shifting of thrust of weight bearing and other stresses from degenerated condyle to better one (Conventry 1956, Jackson et al 1969)

- Reducing medial impingement of degenerated medial meniscus on capsule (Conventry)
- Reducing capsular stretching and tearing by correcting varus deformities.
- Excitation of normal biological changes of knee (Gupta AK et al 1978)

### Recently renewed interest in HTO because

- a) Growing number of chronologically and physiologically young patient with medial compartment disease.
- b) Arthroplasty is not the ideal option as running (impact not recommended in uni-condylar knee arthroplasty).
- c) New technique & instrumentation have improved fixation and post-operative mobilization, results and satisfaction.
- d) Useful for patient previously contraindicated for meniscal and /or chondral reconstructive procedure secondary to tibio-femoral malalignment.

- e) HTO is a joint preserving procedure that does not compromise future total knee arthroplasty (TKR).<sup>[1]</sup>

### Classification

Kellgren-Lawrence grading scheme was used to grade the severity of radiographic knee osteoarthritis.

**Table 1: Radiographic grading scheme for osteoarthritis**

Grade	Criteria
0	Normal
I	Doubtful joint space narrowing & possible osteophytes.
II	Definite osteophytes, absent or questionable narrowing of joint space
III	Moderate osteophytes, definite joint space narrowing, some sclerosis, possible deformity.
IV	Large osteophytes marked joint space narrowing, severe sclerosis, definite joint deformity.

### Aims & Objective

In this study we have planned to manage medial uni-compartment osteoarthritis of knee with medial open wedge or lateral closing wedge osteotomy. The aim of the study is to compare the results between the two groups patients treated by either medial open wedge or lateral closing wedge osteotomy. Improvement by clinical, radiological, functional aspects will be mentioned according to standard scoring system to assess any difference in the two groups of patients.

## **MATERIALS AND METHODS**

The present study comprise of 20 knees of 20 adult patients, age group between 40 to 60 years, with medial compartment osteoarthritis or medial bicompartement (i.e. medial unicompartmental and patella-femoral) osteoarthritis with genu varumdeformity. All of them attended orthopaedics outdoor of our hospital during the period 1st February2014 to 30th September2015i.e. through one and half year period.10 of them treated with medial wedge osteotomy with arthroscopic debridement and ten of them treated with lateral closing wedge osteotomy with arthroscopicdebridement. Patient with radiographic evidence of gross bicompartemental osteoarthritis were excluded from the study

### Study Area:

Study conducted in Orthopaedics, radiodiagnosis& physical medicine department of a peripheral tertiary care institute.

### Study Period:

Study was done from 1st February2014 to 30th September 2015i.e. one and half year period.

**Sample Size:** 20

### Sample Design:

Patients with medial unicompartmental osteoarthritis of knee joint are selected from out-patient department and emergency rooms of our hospital. Patients with other co-morbid condition affecting prognosis were excluded from the study.

### Study Design:

It was prospective without control study. Patients were examined thoroughly with particular emphasis on their functional, radiological and socio-economical status and patients were grouped accordingly. Operative intervention done in due course and patient were followed-up post operatively for at least 6 months. Pre and postoperative clinical, radiological and functional parameter were compared.

## **A. Pre Operative Assessment:**

### **a) Clinical assessment**

- I. History
  1. Past History
  2. Treatment history
- II. Generalexamination:
- III. Local examination:

### **b) Radiology**

Skiagram both knee antero posterior and lateral view in standing position to determine:

Anatomical axis of femur- it is the mid diaphyseal line connecting two midpoints of diaphyses.

Anatomical axis of tibia- by connecting two midpoints of tibialdiaphyses.

- i. Tibio-Femoral angle-
- ii. Medial and lateral joint space-
- iii. Joint Line Convergence angle (JLCA) -

Measurement of MAD (Mechanical Axis Deviation, ML DFA (Mechanical Lateral Distal Femoral Angle) –

MPTA (Medial Proximal Tibial Angle MJS (Medial Joint Space) Fujisawa et. Al (1979) recommended mechanical axis to pass 30-40% lateral to centre of knee joint called Fujisawa point.

We mainly consider, Fujisawa point, Femoro-tibial angle, MPTA for correction of deformity.

**Calculating Degree Of Correction:** For medial compartment arthrosis, overcorrection is usually needed so that mechanical axis should pass through 30-40% lateral tibial plateau. We prefer using exact measurements for the width of the base of osteotomy, with a right triangle constructed from preoperative drawing the formula  $W = \text{diameter} \times 0.02 \times \text{angle of correction}$ .

### **Lateral Closing Wedge Osteotomy**

Conventry recommended a lateral approach to correct a varus deformity. The advantages of this osteotomy are that—

- (1) It is made near the deformity, that is, the knee joint;
- (2) It is made through cancellous bone, which heal rapidly;

- (3) It permits the fragments to be held firmly in position by staples or a rigid fixation device, such as plate-and— screw construct;
- (4) It permits exploration of the through the same incision.

After this operation, the danger delayed or non-union is slight, and prolonged immobilization in a cast is unnecessary, especially with rigid internal fixation like plate and screw or staples.

**Calculation-** Normally there is valgus alignment of 5 degree to 8 degree in tibiofemoral angle measured on radiographs taken in weight bearing position. The amount of correction in arthritic knee needed to achieve a normal angle is calculated, and an additional 3 to 5 degrees of overcorrection is added to achieve approximately 10 degree of valgus.

#### B. After Care:

Drain was removed within 48hrs. Isometric quadriceps exercise started from 2nd post-operative day. Portable X-ray knee, antero- posterior & lateral View were taken in 15" X 12" film to determine:-

- Tibio-femoral Angle (Anatomical)
- MPTA
- Medial joint space
- JLCA
- mLDFA

#### C. Follow-Up

At the first follow-up 6-8 weeks after operation.

2nd follow-up at 12 weeks.

Subsequent follow-ups were done at 18 weeks, 6 months, 9months, 1 year and then at every 6 months interval to evaluate —

- Clinically about pain, stiffness, instability, other associated abnormality if any.
- Radiologically to determine if there was any loss of correction, to note any evidence of deterioration of arthritic changes e.g. joint space, osteophytes.

## RESULTS

#### Functional Results

Excellent: Knee score >85

Functional knee score >80

Patient joined earlier profession without any difficulty at all

Good: Knee score 71 to 84

Functional knee score >70,

Patient joined earlier profession with occasional difficulty

Fair Knee score 45-70

Functional knee score >60

Patient joined earlier profession but with constant difficulty; shifted to any less demanding profession

Poor: Knee score <45

Functional knee score <60

Patient not able to join earlier to any other profession

We also classified patients according to their satisfaction.

- Highly satisfied
- Satisfied
- Not satisfied

#### Results & Analysis

This study consist of 20 knees in 20 patients who attended our hospital from 1st February,2014 to 30th September,2015 i.e. one and half year period with a mean follow up of 2 years . 2 patients ceased to attend F/U clinic after 6 months of operation, all others remained in touch till the end of study.

Out of 20 patients 10 underwent medial open wedge HTO+AD & 10 underwent lateral closing wedge HTO+AD. We divide the 20 patients in two groups –Gr-I (n=10) consist of those underwent medial open wedge HTO+AD, and Gr- II (n=10) consist of those underwent lateral wedge HTO+AD.

**Table 2: Age Distribution of study population**

Age	No of patients	%	MOW-HTO	LCW-HTO
40-49	4	20	2	2
50-59	15	75	8	7
60-	1	5	0	1
Total	20	100	10	10

**Table 3: Sex Distribution of study population**

Sex	No of patients	No of knees	%	MOW-HTO	LCW-HTO
M	8	8	40	4	4
F	12	12	60	6	6

**Table 4: Distribution of study population according to Pre and Post operative pain score**

Pain Score	MOW-HTO		LCW-HTO	
	Pre op	Post op	Pre op	Post op
0				
10	6	0	10	0
20	3	0	0	0
30	1	1	0	3
40	0	7	0	5
45	0	3	0	1
Total	10	10	10	10

**Table 5: Distribution of study population according to Pre and Post operative Range of Motion**

Range of motion	MOW-HTO		LCW-HTO	
	Pre Op	Post Op	Pre Op	Post Op
Full (0-125o)	2	2	2	2
0-120o	4	4	3	3
0-110o	4	4	5	5

After operation pain score improved in all patients. Only patients had score 30 i.e. pain on walking and stairs. In this study, none had any significant antero-posterior instability (<5mm). Regarding mediolateral instability, on preoperative assessment 15 patients had <50 instability and rest 5 (6-9)0 of mediolateral instability. After operation scoring of stability was not changed in any group.

As we mobilized all of our patients immediately after stitch removal i.e. after 14th post operative day difference of ROM was not significant.

**Table 6: Distribution of study population according to Pre and Post operative Stability**

Stability	MOW-HTO		LCW-HTO	
	Pre op	Post op	Pre Op	Post Op
15(<5o)	9	9	6	6
10(6-9o)	1	1	4	4
5(10-14o)	0	0	0	0
0(>=15o)	0	0	0	0

**Table 7: Distribution of study population according to Pre and Post-operative walking score**

Walking Score	MOW-HTO		LCW-HTO	
	Pre Op	Post Op	Pre Op	Post Op
Unlimited (50)		3		0
More Than 10 Blocks(40)		7		10
5-10 Blocks(30)	1	0	4	0
Housebound	9	0	6	0
Unable	0	0	0	0

Most of the patients (15i.e.75%) preoperatively were able to walk less than 5 blocks i.e. scored 20 and 5 (25%) were able to walk (5-10) blocks scored 30. Postoperatively 17 patients (85%) could walk just short of unlimited walk.

Prior to operation 13 patients (65%) had to ascend or descend stairs with help of rail while 7 patients (35%) could descend stairs. After operation all of them improved & 25% patient ascends/descends with help of rail.

17 patients (i.e.85%) had functional knee score below 50.All of them improved with score >70. 3 patients (15%) have >90 & most patients 12 (60%) scored between (80-90) after surgery.

Except for 1 patient in Group II all have post-operative MAD value of (30-40) %, lateral to centre of knee joint.

Average preoperative JLCA was 3-5<sup>0</sup>. After HTO, it was decreased to some extent with the average of 2-3<sup>0</sup>.

**Table 8: Pre and post-operative measurements**

	PRE OPERATIVE		POST OPERATIVE	
	Group I	Group II	Group I	Group II
<b>FTA</b>	6.6±1.5	5.8±1.64	7.2±0.78	7.2±1.03
<b>MAD</b>	19.7±1.56	19.2±2.48	11±1.33	10.8±1.5
<b>JLCA</b>	3.6±0.69	3.6±0.48	2.2±0.42	2.0±0.47
<b>MJS</b>	1.1±0.316	1.1±0.316	2.2±0.42	2.1±0.316
<b>mLDFA</b>	86.7±1.88	86.0±1.49		
<b>MPA</b>	83.6±1.83	83.5±1.08	90.2±1.47	90.5±1.78

Complications:Superficial wound infection & delayed wound healing noticed in 3 cases (all were healed on regular dressing & antibiotics).Post spinal headache =2.After analysing the preoperative &post operative data and applying

criteria for qualitative assessment we found the outcome like-

Final Outcome:Following operation 12 patients having excellent results & 8 patients (40%) having good results.

19 (95%) patients were satisfied.

**Table 9: Distribution of study population according to knee scores**

Knee Score	Pre op mean	Post op mean
Group I	42±8.2	86±4.85
Group II	35.9±3.2	83.2±9.16



**Pre Operative**



**Post Operative (Immediate)**



**Post Operative (3 Months)**

## DISCUSSION

Proximal tibial osteotomy is well-documented procedure that produces satisfactory clinical results. Average age in this study was 53.6 years which is less than the average reported by Insall et al (1974-64.2 years).<sup>[2]</sup> Thomas R. Spenger (8AV2003, JBJS-69 years), Geoffe F Dervin (85A JBJS-61.7±8.6 years).But our study was close to that of G.Magyar (JBJS,81B1999-55 years) and Alan Nagel (JBJS 78A ,1996-49years).<sup>[3,4]</sup>

None of our patients had antero-posterior instability. 71 patients in Coventry's study (1973)had degenerative arthritis and based on the

findings he commented that instability due to laxity or disruption of cruciate ligaments or posterior part of capsule is rare in osteoarthritic knees.<sup>[5]</sup> Insall in 1974 described a symptom called thrust as sideways movement in coronal plane manifested on weight bearing or walking. He chose 'thrust' as an index of instability.<sup>[2]</sup> To correct instability Coventry, Mynerts etc. suggested tightening of lateral structures while doing a valgus closing wedge osteotomy.<sup>[5]</sup> In 1984 in JBJS he reported 69 knees postoperatively judged to be stable on passive varus – valgus testing in full extension, while 16 knees had mild instability (>50) and 10 had moderate instability (6-150).<sup>[6]</sup> The instability was related to erosion of bone in all cases but one.

In our study we did not perform osteotomy of fibula in lateral close wedge osteotomy but rather disrupted the superior tibio- fibular joint. We had 15 patients with <50 medio lateral instability and 4 patients with 6-90 of medio-lateral instability. There was no deterioration in any case.

J. P. Jackson and W. Waugh in their study of high tibial osteotomy published in JBJS (43B1961; page 784) reported improvement of ROM in 4 out of 5 knees. Insall (1984) found ROM about 1100 (80-1400) after operation which was approximately same as the preoperative value.<sup>[6]</sup> He needed manipulation under anaesthesia for recovery of earlier ROM in some patients. We had mean preoperative ROM of group I 116+6.15, and in group II 114 +8.43. As we have fixed the osteotomy by implants and mobilized all patients early we did not find any significant change after operation either by open wedge or close wedge method. This finding is consistent with that of Coventry (1973).<sup>[5]</sup>

Coventry corrected flexion deformity by removing more bone anteriorly during osteotomy, although the overall ROM remained same. However Coventry's osteotomy, although is contraindicated in cases >150 of FFD but this limitation is not applied to HTO in general. We have performed open wedge and close wedge HTO, and no patient had flexion contracture initially. But 4 patients developed flexion contracture which was mild in form (5-10) later.

Machner A. opined that HTO is an extra articular operation for treatment of OA knee that does not lead to improvement of quadriceps function, rather decreases its power in most the cases.<sup>[7]</sup> In our study 1 patient developed extensor lag of 50 after surgery.

In all the patients both type of osteotomy had improved the knee society score, mainly due to alleviation of pain which also leads to increased ROM. Walking ability improved substantially in all the patients. Overall functional knee score improved.

All earlier studies showed significant functional improvement after high tibial osteotomy.

Coventry in 1973 followed 86 cases where 76 had definitive functional improvement and were back to full working state.<sup>[5]</sup> TurgayEfe, GafarAhamed, Thomas J. Heyse et al in 2011 found no significant difference between medial open wedge and lateral close HTO regarding functional knee score.<sup>[8]</sup>

To achieve normal alignment Jackson et al (1961) used their estimation at operation table.<sup>[9]</sup> Insall (1974) commented that alignment alone can be the best guide for outcome of HTO.<sup>[2]</sup>

The common goal of HTO is to shift mechanical axis from medial compartmental to lateral one in order to decrease load on former. Fujisawa recommended corrections should be such that mechanical axis passes through a point 30-40% lateral to midpoint called, Fujisawa point.<sup>[10]</sup> Jacob and Murphy (1992) modified the overcorrection, recommended by Fujisawa et al based on amount remaining cartilaginous space on medial side as determined from stress radiographs: MAD=0 for varus with no loss of medial cartilage, MAD=1/3rd Fujisawa for 1/3rd medial cartilage loss, equal to 2/3rd Fujisawa for 2/3rd loss and MAD=Fujisawa for complete loss of medial cartilage space i.e. bone on bone (Dror Paley 2002).

Both the groups have similar kind of average MAD in pre-operative and post-operative period.

Going through the literature it is found that (Bhave et al, unpublished results) the anatomic tibio-femoral angle is 6.85+1.40 valgus. David E Scott had reported anatomical FTA in his patient population to be 3.9+2.060. That means we had to deal with slight more amount varus deformity. Mean post-operative anatomical FTA in our study was 7.2+0.780 valgus in group I, 7.2+1.030 valgus in group II.

In all patients JLCA was improved (mean 3.6+0.690 to 2.2+0.480 in group I, and from mean value of 3.3+0.480 to 2+0.470 in group II.) All the patients in both groups have post-operative JLCA around 20.

Medial joint space also increased in all cases from mean value of 1.1+0.316 mm to 2.2+0.42 mm in group I and from 1.1+0.316 mm to 2.1+0.316 mm in our study.

Considering the final results 60% patients have excellent & 40% have good improvement occurred in all cases. Patient's satisfaction grade is also high in (95%) cases.

In our study on high tibial osteotomy, pain relief was achieved in almost all cases. Range of movements also more or less correspondence with the preoperative value. Overall functional status like walking, ascending or descending stairs returning to work were definitely improved in all cases. MAD and Fujisawa point mattered significantly. We think that maintaining the Fujisawa point is the most desirable postoperative alignment. Medial Joint space was open in all cases in the both groups after operation.

The outcome of our study regarding mechanical alignment and functional improvement is comparable to published results in various journals.

### **Limitations Of This Study**

- Short sample size
- 3 patients do not attend follow up clinic after 2.5 months.

## **CONCLUSION**

As per our study we have seen there is no significant statistical difference regarding knee score, functional knee score and radiological assessment between the patient undergoing medial open wedge and lateral close wedge high tibial osteotomy except for medial joint space. Both methods of operation can be done. Medial open wedge osteotomy is technically easy, there is no chance of nerve palsy, the medial tibial slope can be restored anatomically by tricortical iliac bone graft and patient can be mobilised early, and ultimately bone healing can be guaranteed in absence of other medical co-morbidities. On the other hand, lateral close wedge high tibial osteotomy is technically demanding. So we recommend medial open wedge high tibial osteotomy in medial unicompartmental osteoarthritis of knee although results of both procedures are equal in our study which correlates with the previous international studies.

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