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Study of evaluation of functional outcome of medial opening wedge high tibial osteotomy in unicompartmental osteoarthritis knee

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Abstract
Introduction: Osteoarthritis is a multifactorial disease but abnormal stress produced by biomechanical alteration is one of the major accelerating factors. Medial compartment osteoarthritis refers to the excessive loading of weight onto the medial femoral condyle and medial tibial plateau. If mechanical axis is realigned in correcting varus in open wedge high tibial osteotomy to unload the medial compartment, patient gets significant pain relief and surgery adds life to the knees.
Material and Methods: This is a prospective study of patients who attended the Orthopaedics outpatient clinic in tertiary care hospital. The patients were evaluated by clinical examination and weight bearing radiographs. The patients who were found to have unicompartmental osteoarthritis with knee pain not relieved by conservative management and who satisfy the inclusion criteria were selected. During this period 21 patients were selected and were included in study.
Results: Major group of patients in our study belong to age group 46-50 years (62%). The mean age of patients in our study is 48.38 years, the mean time of union is 4.04 months. As far as complications are concerned there were 3 complications we encountered 1 among them was superficial infection 1 had lateral tibial condyle involvement due to higher correction angle 1 patient had under correction noted on post operative HKA axis scanogram. The average JOA Knee score preoperatively was 52.6 which improved postoperatively with average score of 82.9.average. Functional knee society score was 70.80 preoperatively which improved postoperatively to 90.57. VAS score preoperatively was 6.95 which reduced considerably to an average score of 2.09 postoperatively. We got excellent results in 18 patients (86%), good results in 2 patients (9.5%) and fair results in 1 patient (4.5%).
Conclusion: In our study medial opening wedge high tibial osteotomy with osteosynthesis is a physiologically better surgery in medial compartmental primary osteoarthritis knee in early stages. Early results are gratifying for Indian patients, who cannot afford the costlier surgery and implant and also are reluctant to change squatting habits & job profile. Though complications are there but they are avoidable & treatable.

Keywords: Evaluation, outcome, medial, osteotomy, unicompartmental, osteoarthritis

Introduction
Osteoarthritis is a multifactorial disease but abnormal stress produced by biomechanical alteration is one of the major accelerating factors. Minor degree of varus or valgus deformity of knee alters the load on tibial and femoral condyles. Main symptoms of osteoarthritis are disabling pain, restriction of movements and deformity. Initial symptomatic treatment constitutes analgesics, rest, Exercise. Various surgical procedures have been described in literature from time to time like synovectomy, joint debridement, arthrodesis, patellectomy, patelloplasty and menisectomy. Tibial osteotomies were introduced in 1950's and have been variedly used and modified since then. These osteotomies change the weight-bearing axis of the knee. Venous decongestion has also been cited to be one factor responsible for pain relief apart from axial realignment [1]. Medial compartment osteoarthritis refers to the excessive loading of weight onto the medial femoral condyle and medial tibial plateau. This imbalance of load creates stress risers along the medial compartment of knee. This leads to catalytic cascade of events culminating with erosions of the articular surfaces, extrusion of articular cartilage with subsequent enchondral ossification leading to formation of osteophytes,

those events ultimately culminates in medialization of weight bearing axis of lower limb. In patients with medial compartment osteoarthritis, if mechanical axis is realigned in correcting varus in open wedge high tibial osteotomy to unload the medial compartment, patient gets significant pain relief and surgery adds life to the knees [2]. Friedrich Pauwels in 1964 and [3] Paul Maquet in 1976 described deformity correction principles of bone. Since then, many techniques have been developed for osteotomies around the knee. Mark Coventry [4] published his technique for closed wedge osteotomy in 1965, which became the gold standard for many years. The success of an osteotomy around the knee depends on the biomechanics of the lower extremity, Wolff's law of continuous transformation of bone under stress, load distribution in knee and also on the mechanical property of the implants used for osteotomy fixation. Osteotomies around the knee have had a significant complication rate in the past and many surgeons abandoned these procedures although the favourable long term results were well known. After many years of closed-wedge osteotomy, open wedge valgus osteotomy has become popular. Medial opening wedge osteotomy has advantage over lateral close wedge osteotomy in maintaining bone stock and correcting the deformity close to its origin, which may facilitate subsequent arthroplasty. Fibular osteotomy is not required and osteosynthesis of osteotomy is technically easier. New techniques for knee axis correction has lead to evolution of knee osteotomies.90% of all osteotomies around the knee are for valgization of tibia (high-tibial osteotomy = HTO). Whereas in the past closed-wedge osteotomy from the lateral side with fibula osteotomy was the gold standard in many countries; and in 1990s fixation plate came to vogue. This procedure looked very attractive to many surgeons because of the small incision and the simple surgical steps. Open- wedge osteotomy of the tibia can be performed without bone grafting or bone substitution in most cases. In this study we analyse the outcome of open wedge osteotomy in patients having unicompartmental osteoarthritis with genu varum using the tomofix plate.

Materials and Methods

Study design, sample size and period

This is a prospective study of patients who attended the orthopaedic outpatient clinic in tertiary care hospital. The patients were evaluated by clinical examination and weight bearing radiographs. The patients who were found to have unicompartmental osteoarthritis with knee pain not relieved by conservative management and who satisfy the inclusion criteria were selected. During this period 21 patients were selected and were included in study.

Inclusion criteria

- Patient willing to participate in study and giving written consent for the same.
- Pain and disability resulting from osteoarthritis that interfere with high-demand employment or recreation.
- Evidence on weight bearing radiographs of degenerative arthritis that is confined to medial compartment with a corresponding varus deformity. Age < 60 years.

Exclusion criteria

- Patients not willing to participate in the study.
- Narrowing of lateral compartment cartilage space.
- Lateral tibial subluxation of more than 1 cm.
- Flexion contracture of more than 15 degrees.
- Knee flexion of less than 90 degrees.
- More than 20 degrees of correction needed.
- 7. Rheumatoid arthritis.

The patients were explained about osteotomy and its advantages and disadvantages were discussed. Those patients who were willing for the procedure were selected and their consent obtained. Pre-operative planning is done by Miniaci method and pre-operative evaluation by Visual Analogue pain scale, Knee society knee scale. High tibial opening wedge osteotomy was done using Tomofix plate.

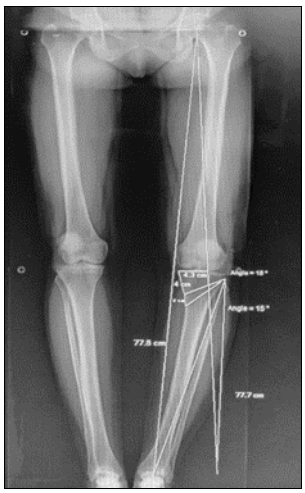


Fig 1: Determination of correction angle pre operative drawing at digital work station using weight bearing x-ray. (Miniaci method)

Surgical Technique

After appropriate anaesthesia (preferably spinal), torniquet was applied and painting draping was done to start with-

- **Incision** Between tibial tuberosity & pace anserinus, incision is taken just above the pes anserinus, subcutaneous tissue is cut but periosteum is not raised. The infrapatellar branch of the saphenous nerve is preserved. The subcutaneous tissue dissected and the pes tendons retracted. This exposes the medial collateral ligament, which is elevated from the tibia with a raspatorium. The long fibres of the superficial medial collateral ligament are then carefully detached until the posteromedial cortex of the proximal tibia is exposed. A Hohmann retractor is inserted behind the tibial ridge.
  At the anterior edge of the incision, the insertion of the patellar tendon at the tibial tuberosity and the medial border of the patellar ligament are exposed. The cranial border of the patellar tendon insertion must be clearly visualised so that the destination of the ascending osteotomy can be defined later in the procedure.
- **Insertion of k-wires:** 1st k wire passed 4cm below the articular margin just above the pes insertion in oblique manner towards the fibular head, this represents the osteotomy plane.

2nd k wire is inserted under fluoroscopic guidance parallel to tibial slope in anteroposterior direction.
Since both wires end at the lateral tibial cortex, the width of the tibial head can now be measured with reference to the two inserted wires. This is done by holding a third wire of the same length onto the cortex and measuring the excess length compared to the inserted wires. The tibial diameter is generally 5-10 mm smaller anteriorly than posteriorly. The measured values should be noted. The depth of the saw cut is 10 mm less

than the value measured against the wires in order to leave a lateral bone hinge. Than osteotomy is performed using osclillating saw, using k wire as a guide.

Care is taken, wire should be posterior to tibial tuberosity and not to breach the lateral cortex. For quick and safe bone healing of the osteotomy as much biological potency as possible must be preserved in the area of the bone separation. We use an oscillating saw at an extremely low pace and continuous irrigation with cold Ringer's lactate solution.

The posterior osteotomy is stopped 10 mm before the lateral cortex. This intact lateral bone stock serves as a fulcrum when the osteotomy is opened. The osteotomy is opened gradually using flat chisels.

A first broad chisel is inserted in the transverse part of the osteotomy. This chisel glides into the saw slot under the K-wires and is inserted as deep as the saw has protruded. A second broad chisel is now inserted between the first chisel and the K-wires. This chisel is now tapped into the osteotomy with light blows of a hammer slightly less deep than the first chisel. The surgeon should take some time for this step to allow the bone to adapt to the gradual opening of the osteotomy.

The opening of the transverse and anterior oblique osteotomy plane should be monitored carefully. There should be a continuous and smooth separation of the two planes. A third chisel can now be inserted between the first two chisels, and, again, this chisel is tapped into the osteotomy with light blows of a hammer over 1–2 min. If necessary, this elastic deformation manoever can be repeated until the desired opening is achieved. Alternatively a special tool combining two chisels and a distraction mechanism called bone spreader can be inserted. Gradual opening of this tool has the same effect. Corticocancellous bone graft of adequate size as per size of opening was harvested from ipsilateral iliac crest and was placed in osteotomy site before removing bone spreader and plate fixation. Center the plate, with the 4.3 mm threaded LCP Drill Guide(s) installed, over the osteotomy and place onto the bone. The three holes in the head and the most proximal Combi hole on the shaft should be positioned proximal to the correction gap. The solid midsection of the plate should be placed over the osteotomy site Osteosynthesis is completed, wash is taken and sterile dressing is kept.

Fig 2: Osteotomy by power saw

Fig 3: Incision

Fig 4: k wire insertion

Fig 5: Osteosynthesis

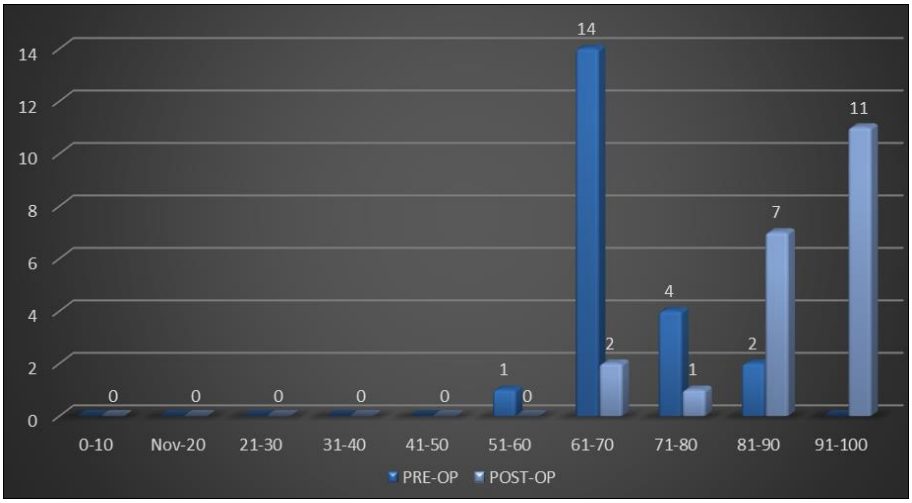
Follow up

After 6 weeks, depending upon the progression of union of osteotomy, Long knee brace was continued or discontinued and allow weight bearing with: support or without support and mobilization according to physiotherapy. Repeat x-ray was taken and union was measured. Post op HKA axis x-ray was taken and alignment was evaluated. Assessment is done according to knee society score. Further assessment was done on follow up at 6, 8, 12, 24 weeks.

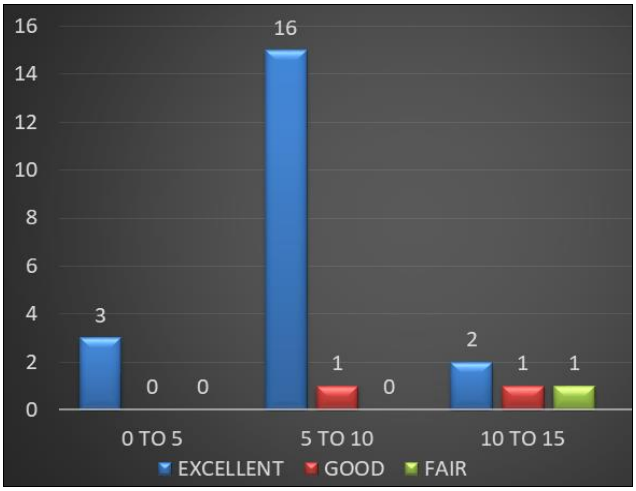
Results

Major group of patients in our study belong to age group 46-50 years (62%). The mean age of patients in our study is 48.38 years, 14 females (67%) and 7 males (33%). 13 were operated for right OA knee and 8 for left OA knee. we got union by 3-5 months of time. The mean time of union is 4.04 months. 16 knees were having 6 to 10 degrees of varus deformity, 3 knees had 0 to 5 degree of varus deformity and 2 had 11 to 16 degree varus deformity. as far as complications are concerned there were 3 complications we encountered 1 among them was superficial infection which resolved by dressing at 2 weeks without any residual infection, 1 had lateral tibial condyle involvement due to higher correction angle due to which weight bearing was delayed, 1 patient had under correction noted on post operative HKA axis scanogram. The average JOA Knee score preoperatively was 52.6 which improved postoperatively with average score of 82.9.average functional knee society score was 70.80 preoperatively which improved postoperatively to 90.57. Average VAS score preoperatively was 6.95 which reduced considerably to an average score of 2.09 postoperatively. We got excellent results in 18 patients (86%), good results in 2 patients (9.5%) and fair results in 1 patient (4.5%).

As per ANOVA test applied to our data p value turns out to be 0.12(>0.05) for age, 0.64 for sex, 0.0001 for preoperative varus angle and 0.266 for union time with respect to functional outcome determined by KSS score which interprets that there seems to be significant difference in functional outcome of patient with regards to preoperative varus angle and no significant difference in functional outcome with respect to age, sex and union time.



Graph 1: Knee society score (functional)



Graph 2: Preoperative varus angle (degree)

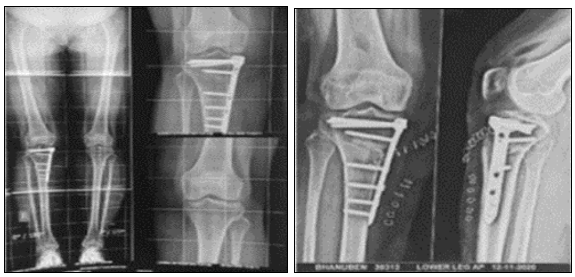
Case 1

Pre-op

Post-op

Case 2

Pre op HKA axis **Post op x-ray**



Post op HKA axis at 1 month **Post op 1 month**

Post op 3 months **Post op 6 months**

Discussion

Osteoarthrosis of knee is the commonest of all symptomatic joint arthroses in Indian subcontinent. Patients who have osteoarthritis of the knee experience a successive wearing on the menisci and articular cartilage, which may develop tears. The degeneration of these tissues limits the knee's ability to glide smoothly and can result in popping, catching, locking, clicking and pain.

In a condition called malalignment, unbalanced forces cause excessive pressure on either in the inner (medial) or outer (lateral) portion of the knee. Degenerative arthritis and malalignment can cause the knee's protective tissues to wear on one side more than the other in a repetitive cycle of damage.

When the joint damage is beyond repair, knee replacement surgery can correct this condition. But in certain patients, a high tibial osteotomy can realign the knee to take pressure off the damaged side by wedging open the upper portion of the tibia to reconfigure the knee joint. Weight bearing is then shifted away from the damaged or worn tissue and onto the healthier tissue.

The aim of the study was to evaluate the results of medial opened wedge High tibial osteotomy with osteosynthesis in medial compartment osteoarthritis of the knee.

Table 1: Knee society score among different study groups

Study	Mean KSS
Howells *et al.* [6]	84
Aydogdu S *et al.* [7]	93
Saito T *et al.* [8]	89.4
Present study	92.66

Table 2: Comparison of complication rate

Study	Complication
Staubi *et al.* [9]	1(1%)
Lobenhoffer *et al.* [10]	1 deep infection 4 months postop
Valkering *et al.* [11]	4 (10%)superficial infection and under correction
Zaki *et al.* [12]	2 superficial infection
Kolb *et al.* [13]	0
Niemeyer *et al.* [14]	1 superficial infection
Gebhard *et al.* [15]	2 (4%) superficial infection
Present study	1 superficial infection 1 under correction 1 lateral compartment involvement

Table 3: Comparison of mean age group in years

Study group	Mean age group (years)
M. Pfahler *et al.* [16]	52.8
Goran Magyer *et al.* [17]	54
G F McCoy *et al.* [18]	59.8
Anis Shiha *et al.* [19]	38.5
Present Study	48.38

Conclusion

In our study medial opening wedge high tibial osteotomy with osteosynthesis is a physiologically better surgery in medial compartmental primary osteoarthritis knee in early stages. Early results are gratifying for Indian patients, who cannot afford the costlier surgery and implant and also are reluctant to change squatting habits & job profile. Though complications are there but they are avoidable & treatable.

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