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Ilizarov's ring Fixator versus Internal Fixation for High Tibial Osteotomy in Medial Compartment OA Knee: A Comparative Study

Mohit Dua, Senior Resident, Department of orthopaedics, pt BD Sharma PGIMS, Rohtak
Monika, Junior Resident, Department of ophthalmology , pt BD Sharma PGIMS, Rohtak
Corresponding Author: Mohit Dua, Senior Resident, Department of orthopaedics, pt BD Sharma PGIMS, Rohtak, India
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Introduction

Osteoarthritis (OA) is one of the most common chronic degenerative condition of joints especially in aging population. The role of inflammation in osteoarthritis has been somewhat controversial. Osteoarthritis is known by various name as degenerative arthritis, gono-arthritis, osteoarthrosis, hypertrophic arthritis or age-related arthritis. The pathological features include loss and erosion of articular cartilage, subchondral sclerosis and bony overgrowth (osteophytes). It may involve soft tissue structure in and around the joints. There is modest inflammatory cell infiltration in the synovial tissue, ligaments get laxed and bridging muscle becomes weak. The patient has difficulty in walking and has heavy impact on daily activity and day to day life style and this disease represents an ever-increasing burden on health care. The most prominent symptom that bring the patient to doctor is pain. There might be a group of patients, who do not have any symptoms but might be showing pathological and radiological evidence of OA.[1]

The main aim of treatment for OA of the knee is to alleviate pain and improve function in order to mitigate reduction in activity. However, most treatments are not curative as they do not modify the natural history or progression of OA. Guidelines for the medical management of osteoarthritis, as per the American College of Rheumatology 2012, emphasize the role of both non-pharmacologic and pharmacologic therapies. Initial management involves non-pharmacologic therapies including education, physio-therapies, mild to moderate exercises, various appliances, braces and weight reduction.[2]

Pain is decreased with mild to moderate exercise and leads to improved functioning in people with OA of knee. Moderate exercise does not accelerate the patho-physiology of knee osteoarthritis, whether or not there is evidence of pre-existing disease. In either case there appears to be improved physical functioning and reduction of pain and disability in those who exercise. Adequate joint motion and elasticity of peri-articular tissues are necessary for cartilage nutrition and health, protection of joint structures from damaging impact loads, function and comfort in daily activities.[3]

Patients were benefitted with conservative measures such as weight control, appropriate rest, exercise and the use of mechanical support devices. Reduction in weight by 10% improves the function by 28%. Low energy diet is useful in rapid reduction of weight and more significantly loss of body fat.[4]

Pharmacologic modalities recommended for the initial management of patients with knee OA includes acetaminophen, oral and topical NSAIDs, tramadol, intra-articular corticosteroids injections and intra-articular hyaluronate injections. As first-line pharmacologic therapy acetaminophen is recommended. If pain does not relieved with acetaminophen, analgesic-dose nonsteroidal anti-inflammatory drugs (NSAIDs) may be used (e.g. ibuprofen, naproxen). If symptom response to a lower NSAID dosage is inadequate, higher, anti-inflammatory dose may be used. Analgesic drugs relieve pain and do nothing more. In contrast NSAIDs also suppress inflammation along with reducing pain but are preferred by physicians and patients for short periods of time. However, these drugs have to be used with great care especially in the patients with co-morbidites due to the well known side effects. In addition, NSAIDs have been shown to have a deleterious effect on cartilage metabolism. Topical agents can be used in view to avoid side effects associated with the systemic use of these NSAIDs; but these topical formulations also have only been proven useful for short-term use for mild to moderate pain in mild joint degeneration.[2,5]

Intra-articular injections of corticosteroids, as indicated by a few studies, are only of short-term benefit for pain and function. Furthermore, some evidence indicates that they are not able to change the natural history of the disease and may also have negative consequences on knee structures. Glucosamine and chondroitin sulfate have not been clearly shown to be effective either, and they cannot be considered ideal agents for the treatment of pain from chronic severe cartilage degeneration or osteoarthritis. Among the available pharmacologic solutions, despite contradictory findings and controversies regarding its effective usefulness, intra-articular hyaluronic acid (HA) is widely applied in clinical practice, with good results reported in many studies. Platelet-rich plasma (PRP) is a simple, low cost, and minimally invasive method that allows one to obtain from the blood a natural concentrate of autologous growth factors and it would improve symptoms and function, possibly through the release of growth factors and bioactive molecules, in patients affected by knee degeneration in early stages.[2,5-6,8]

High tibial osteotomy as surgical modality for OA knee attained popularity in the 1960‘s following work by Jackson and Waugh & Debeyre and Patte in 1961 and is now a well-established procedure. It is a widely performed surgery to treat OA of medial compartment of knee. High Tibial Osteotomy can be performed with various techniques i.e. closing wedge, opening wedge, dome and ―en chevron‖ osteotomies, but opening (medial) and closing (lateral) wedge osteotomies are the most commonly performed.[9,10]

The medial opening wedge osteotomy was described, in France, by Debeyre and Artigou in 1972. HTO has been documented in literature showing consistently significant pleasing result. The main concept of HTO, as weight bearing axis is shifted to relatively unaffected lateral compartment in varus knees, It reduces knee pain and delays or slows down the destruction of the medial joint compartment, hence delay the need for a knee replacement. HTO avoids the majority of the issues associated with lateral closing wedge osteotomy such as the need to perform a fibula osteotomy, risk of compartment syndrome and injury to common peroneal nerve and malunion of the proximal tibia resulting in more demanding subsequent total joint replacement and bone stock loss etc. For all these reasons, the opening wedge HTO gained popularity and became a widely used alternative option.[10-11]

Unicompartmental knee arthroplasty (UKA) when compared with high tibial osteotomy (HTO) in terms of functional results was found to be superior, however there was no difference in specific knee score; HTO got slightly

better results of the range of motion. Postoperative rate of revision and complications did not differ significantly between two groups. Unicompartmental/ Total knee replacement is the main stay of treatment in the western world. But the needs and habits of people in Indian sub-continent (squatting for toilet purposes and cross leg sitting/kneeling for prayer purposes) are little different. Hence, joint conserving surgeries suit such patients better than replacements. Moreover, most of these patients are manual laborers.[12,13]

Medial open wedge high tibial osteotomy could be fixed with: 1) Illizarov Fixator 2) Simple plate with bone grafting and 3) Locking plate without bone graft. Locking anatomical plate even without bone graft forms structurally stable construct and showed significant results in obese patients, osteotomies requiring large angle of correction and unstable osteotomies following lateral tibial cortex fractures.[7,14]

Keeping all these modalities of fixation of MOWHTO, the present study was planned for comparative evaluation of Open wedge high tibial osteotomy in medial unicompartmental osteoarthrosis of knee using locking plate osteosynthesis (without bone graft) versus Illizarov Ring Fixator .

Materials And Method

We report prospective longitudinal midterm results of high tibial osteotomy in medial compartment osteoarthritis knee . This study included 50 knees , between May 2013 to April 2015 , presented to OPD at Unique hospital , Indore , treated with high tibial osteotomy accompanied by either internal fixation with locking plate (group A, *n*=25) or Ilizarov's Ring fixator (group B, *n*=25).

Exclusion Criteria

1. Age >60 years
2. < 90 degree range of motion (ROM)
3. > 15 degree contracture (flexion)
4. Ligamentous instability
5. Rheumatoid arthritis
6. Traumatic deformity
7. Correction of > 20 degree
8. Ischaemic compromise of the limb
9. Severe synovitis with effusion
10. Hip ankylosis
11. Blood dyscrasia
12. Local/systemic infections

Preoperative planning

Age, weight, height, BMI, career, level of activity, detailed history, general physical examination, previous history of surgery, ROM, degree of deformity were noted and recorded on patient's proforma. Parameter as per Visual Analogue Scale (VAS)[18], Knee Injury Osteoarthritis Outcome Score (KOOS)[19] and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)[20] were noted.

Radiographic assessment

Bilateral weight bearing AP view

Lateral view

Scanogram to calculate the angle of correction

Pre-Operative Planning and Angle Calculation

Patients were evaluated with standard anteroposterior (AP) X-rays of both knee joints in weight-bearing stance and lateral X-rays of both knee joints. Full length X-rays from hip to ankle in weight-bearing position were taken to know anatomical axis, mechanical axis and weight-bearing line We adopted the technique to define the correction angle and height of osteotomy gap based on study by Fujisawa et al. and planning method described by Miniaci. The planning included five steps:

(1) Mechanical axis was drawn (line M),

(2) The corrected mechanical axis was planned on the basis of Fujisawa scale which usually comes to the Fujiwasa point (62.5 %) in the lateral compartment when scaling the entire width of tibial plateau from the medial border (0 %) to the lateral border (100 %),

(3) The corrected weight-bearing line was drawn from the centre of femoral head to the centre of tibial plafond passing through the point defined in step 2 (line CM),

(4) The hinge of osteotomy [H] is taken at lateral cortex of tibia at the level of proximal tibiofemoral joint. The angle formed between A and B was the correction angle of valgus osteotomy,

(5) The height of osteotomy gap was determined with the help of trigonometric chart developed by Hernigou which was based on medio-lateral diameter of osteotomy and desired correction angle. 12,15-17

Follow up

The results were assessed by visual analogue scale (VAS)[18] / Knee injury and osteoarthritis outcome score (KOOS)[19] and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)[20] score.

Visual Analogue Scale (VAS)[18]

It is a subjective scale. Before the surgical procedure, the pain was considered at 100 mm in all patients and at every follow up; patient was asked to mark a point on the line to explain how much of pain relief he or she had at that point of time.

Results evaluation as per VAS Scale improvement

Excellent >80% Improvement

Good 60- 80% Improvement

Fair 40- 60% Improvement

Poor <40% Improvement

Knee Injury and Osteoarthritis Outcome Score (KOOS)[19]

The KOOS's five patient-relevant dimensions were scored as: pain (nine items); symptoms (seven items); activity of daily living (ADL) function (17 items); sports and recreation functions (five items); quality of life (four items). A likert scale was used and all items had five possible answer options scored from 0 (no problem) to 4 (extreme problems) and each of five scores were calculated as the sum of the items included. Scores were transformed to a 0-100 scale, with zero representing extreme knee problems and 100 representing no knee problems as common in orthopaedic scales and generic measures. Scores between 0 and 100 represent the percentage of total possible scores achieved.

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)[20]

The WOMAC consisted of 24 items divided into 3 subscales:

Pain (5 items):

- During walking
- using stairs
- In bed
- sitting or lying
- standing

Stiffness (2 items):

- after first waking and later in the day

- Physical Function (17 items): stair use, rising from sitting, standing, bending, walking, getting in or out of a car, shopping, putting on or taking off socks, rising from bed, lying in bed, getting in or out of bath, sitting, getting on or off toilet, heavy household duties, light household duties

- Scoring and **Response** **Points** interpretation;

None	0
Slight	1
Moderate	2
Severe	3
Extreme	4

Score =SUM (points for relevant items)

Average score =(total score) / (number of items)

Interpretation:

• Minimum total score: 0

• Maximum total score: 96

Minimum pain subscore: 0

• Maximum pain subscore: 20
• Minimum stiffness subscore: 0
• Maximum stiffness subscore: 8
• Minimum physical function subscore: 0
• Maximum physical function subscore: 68

Statistical Analysis

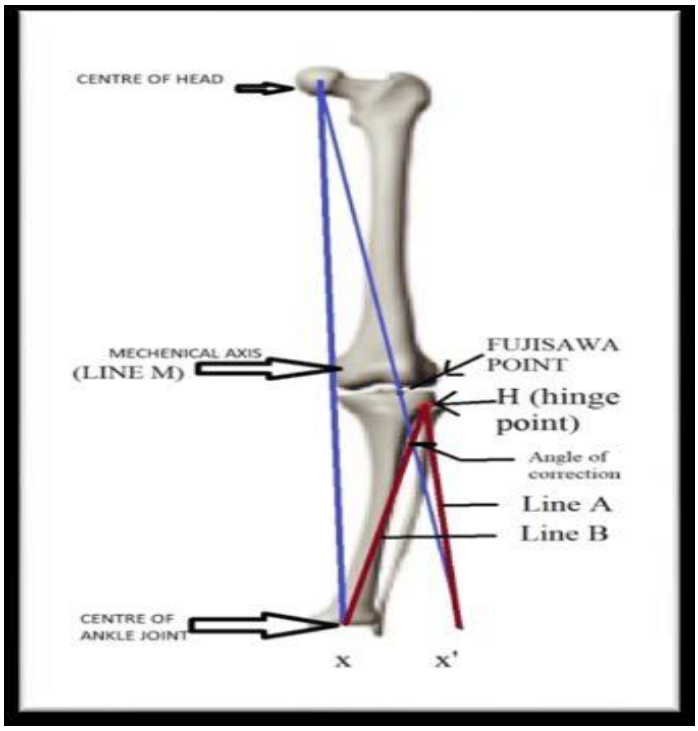
At the end of the study, the data was collected and analysed by using Student t-test. A p value of <0.05 was considered as significant.

Result and Discussion

1. Mean age of the patients in **Group 1** was 53.13±5.20 years and in **Group 2** it was 51.32±6.91 years.
2. With regard to gender distribution, out of 50 knees, 27 were males and 23 were females.
3. Mean body mass index (BMI) was 28.2±2.59 in **Group 1** and in **Group 2** it was 27.9±4.64.
4. As per Kellgren-Lawrence grading, **Group 1** had 9 knees with grade II knees and 16 knees were of grade III, while **Group 2** had 10 knees with grade II knees and 15 knees were of grade III.
5. Maximum number of patients i.e. 60% were with varus deviation of 10-15 degree in **Group 1** and 60% of the patients in **Group 2**, had varus deviation of more than 10 degree. Mean preoperative varus deviation was 11.97±3.34 degree in **Group 1** and was corrected to 3.27±1.75 degree valgus. In **Group 2** it was 11.78±3.05 degree varus preoperative which was corrected to 3.56±1.47 degree valgus.
6. All the patients achieved full weight bearing by 35th day postoperatively in **Group 1** with the mean value of 30.27±2.71 days and in **Group 2** all were allowed to bear full weight by 38th day with the mean value of 30.32±3.08 days.
7. The mean observed consolidation time was 16.47±1.68 weeks (range 14-20 weeks) in **Group 1** and in **Group 2** it was 15.2±1.44 weeks (range 14-18 weeks)
8. The average time of fixator removal was 13.4±3.29 weeks ranging from 6-16 weeks.
9. Mean VAS preoperatively found to decreased significantly in both the groups (p <0.001). In **Group 1** it was decreased from 6.74±0.79 (preoperatively) to 1.74±0.70 postoperatively (p <0.001) while in **Group 2** it dropped from 6.6±0.58 to 1.4±0.50 postoperatively (p <0.001).
10. Regarding their walking ability preoperatively and postoperatively. In **Group 1** mean walking distance preoperatively was 546.67±134.25 meters and postoperatively it increased significantly to 1143±192.60 meters (p <0.001) and in **Group 2** it increased from 564±131.90 meters to 1290±287.59 meters (p <0.001).
11. WOMAC score regarding pain and stiffness (preoperatively and postoperatively) found to be statistically significant (p <0.001).
12. WOMAC score regarding various global functions, total WOMAC score, average and index. WOMAC score improved significantly in both the groups. In **Group 1** it improved from 71.8±4.64 to 19±5.21 (p <0.001) and in **Group 2** it dropped from 69±8.44 to 17.1±3.47 (p <0.001)
13. KOOS index total improved significantly postoperatively from 143±11.7 & 156±24.03 to 366.2±14.57 & 375.38±29.69 (p <0.001) in **Group 1** and **Group 2** respectively.
14. All the patients were evaluated at the end of study regarding their experience and they were further graded according to their satisfaction. A total of 12(53.33%) reported the procedure as excellent; 8(33.33%) much better and 5(13.33%) little better in **Group 1** and in **Group 2** total of 16(64%) reported the procedure as excellent; 7(28%) much better and 2(8%) little better

15. With regard to complications in the present study, leg swelling was observed in 6 patients in **Group 2**; infection in 6 patients in **Group 1** and in 2 patients in **Group 2**. In **Group 1** all pin tract infections except 2 were treated with pin tract care (daily cleaning of pin sites with normal saline followed by cleansing with alcohol based sterilizing agents) or pin tract care with oral antibiotics and pin tract infection subsided. One patient in **Group 2** developed infection in muscular planes and was drained by incision and managed with antibiotics. Second patient developed superficial infection which healed spontaneously with antibiotics. The infection reappeared after 4 months and the implant was removed as the osteotomy got consolidated and the infection healed completely. Varus collapse was observed in 2 patients in **Group 1**. One patient in **Group 1** developed pin site infection at one and half month (after the deformity was corrected), so fixator was removed for that patient and above knee cast was given and patient was allowed to bear full weight. Similar episode happened with second patient at one and half months. After removal of fixator patient was given cast. Although valgus angle in both the patient could not be maintained and varus collapse occurred at final follow up, those patients had significant improvement in symptoms till the last follow-up

Finally in present study outcome was assessed by VAS score, KOOS score, WOMAC score, walking distance (post-operatively) and post-operative valgus angle. We found that in symptomatic patients with medial unicompartmental osteoarthrosis there were significant improvement in postoperative clinical and radiographic parameters. On comparing the postoperative clinical and radiographic parameters in both the procedures with unpaired t test (which was insignificant) we concluded that there was not much significant difference between the two methods tested as per above mentioned parameters. Both the procedures had its advantages and disadvantages. Pin site infection was one of the big problem with fixator and this procedure was cumbersome to patients and had less patient compliance and choice of the procedure depends on the patient‘s profile and surgeon‘s preference.



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