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Original Research Article

RESULTS OF MEDIAL OPEN WEDGE HIGH TIBIAL OSTEOTOMY FOR THE TREATMENT OF GRADE 2 OSTEOARTHRITIS OF KNEE JOINT

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ABSTRACT

Background: Osteoarthritis knee with degeneration of only medial compartment needs joint preservation surgeries. Both lateral closing wedge HTO and medial opening wedge HTO are in vogue to offload the diseased compartment. Medial opening wedge HTO avoids the complications of lateral closing wedge HTO like Peroneal Nerve injury, patella baja, need for fibular osteotomy or proximal tibiofibular joint disruption. Also it has some advantages like precise correction, no limb length discrepancy and relatively easier conversion to total knee replacement. **Materials and Methods:** This prospective study was conducted in Gauhati Medical College and Hospital, Guwahati, Assam, India, from May 2021 to April 2022. A total of 25 patients with Ahlback Grade 2 medial compartment osteoarthritis knee, of age group 40 to 60 years were included in the study. The patients with valgus knee, lateral compartment osteoarthritis, unstable knee, Rheumatoid arthritis, flexion contracture of more than 15 degrees, knee flexion less than 90 degrees were excluded. The patients suitable for the surgery were preoperatively evaluated by Visual analogue pain scale, Knee Society Scoring System and Japanese Orthopaedic Association Knee rating scale. The deformity was surgically corrected by medial open wedge HTO and fixed by Tomofix plate. Follow up evaluations were done at 3,6,12,18 and 24 weeks by Standing Radiographs, Knee Society Scoring and Visual Analogue Scale. **Result:** We used Knee Society Score and Japanese Orthopaedic Association Knee rating scale for functional improvement. Postoperatively, the Pain score assessed by Visual Analogue Score, decreased to 2.7 from mean pre-operative score of 6.7. The mean Knee Society Score increased from 98.3 to 178.6 post-operatively. Similarly, the Japanese Orthopaedic Association Knee Rating Scale also improved significantly from mean pre-operative score of 50.8 to mean post-operative score of 71.2. The varus deformity was also got corrected from mean pre-operative 9.1 degrees to mean post–operative value of 1.6 degrees valgus. Four patients had under correction of varus, but they also had pain relief and improved knee function. Regarding complications, we did encounter three cases of superficial infection, resolved with antibiotics and two cases of hardware prominence. **Conclusion:** Medial open wedge HTO is a viable option in the treatment of medial compartment osteoarthritis of the knee with varus deformity. It relieves pain and improves functional outcome in carefully selected patients. Surgical procedure is relatively easy and reproducible. Relatively short follow up and less number of cases in the study are major limitations.

INTRODUCTION

Ortheoarthritis is the most common form of knee arthritis, which is a degenerative condition affecting the cartilages characterized by progressive wear and tear. It predominantly affects the middle-aged individuals above 40 years and more common in females.[1,2,3] There is loss of articular cartilages predominantly in the areas of excessive load, subchondral sclerosis, cyst formation, formation of marginal osteophytes and synovial imflammation. Biomechanically there is alteration of tensile, compressive and shear properties and also permeability of the cartilage.[4] Clinically, the disease is characterized by knee pain, decreased range of motion, knee swelling, and marginal bony enlargement. The symptomatology is due to cartilage damage, subchondral bony changes and synovitis.[5] At the initial phase, Osteoarthritis knee is managed conservatively by Analgesics, lifestyle modification, physiotherapy aimed at strengthening the muscle around knee, unloading Braces and Orthoses, intra-articular injection of Synovial fluid analogues like Hyaluronic acid and Steroids.[6]

When the conservative management is not successful, there are few surgical options. Joint preservation procedures like Corrective Osteotomies are done where medial joint is off loaded to lateral compartment, which has relatively intact cartilage layer. Replacement arthroplasties like unicondylar knee replacement are done when only the medial compartment is damaged while the intra-articular ligaments as well as the lateral compartment cartilages are intact. In advanced stages of Knee Osteoarthritis, Total knee replacement is the gold standard surgical procedure.[7,8] High tibial corrective osteotomies realign the mechanical axis from varus or valgus mal-alignment of the knee. It also decompresses the subchondral area relieving pain. In cases of knee osteoarthritis with varus deformity, high tibial osteotomy can be either medially open or lateral closed wedged. In the earlier period, lateral closed wedge high tibial osteotomy was more preferred. It was inherently stable but has complications like common peroneal nerve injury, limb shortening, patellar tendon contracture resulting patella baja, need for fibular osteotomy or separation of proximal tibio-fibular joint.[9]

Medial open wedge HTO avoids the limitations of lateral closed wedge HTO. It also has some added advantages like precise correction, no instability of lateral knee ligaments, no disruption of proximal tibio-fibular joint, no limb length discrepancy and also relative ease of converting to total knee replacement.[10]

We are presenting here a study conducted in a tertiary care centre on Medial Open Wedge HTO performed on grade 2 osteoarthritis knee with medial compartment involvement and varus deformity. The objectives of the study were to assess the outcome of Medial open wedge HTO using TomoFix plate in relieving knee pain in unicompartmental medial osteoarthritis knee joint, to study the functional outcome in these patients and also to show that bone graft is not always necessary.

MATERIALS AND METHODS

This was a prospective study conducted in Gauhati Medical College and Hospital, Guwahati, Assam, India, which is a tertiary care centre from May 2021 to April 2022. Before conducting the study, prior permission from the Institutional Ethics Committee was obtained. A total of 25 patients with medial compartment osteoarthritis knee were included in the study. The age group included was from 40 to 60 years, who were diagnosed to have Ahlback Grade 2 Medial osteoarthritis knee with varus deformity. The patients who had valgus knee, lateral compartment osteoarthritis, unstable knee, Rheumatoid arthritis, flexion contracture of more than 15 degrees, knee flexion less than 90 degrees were excluded from the study. The patients suitable for the surgery were preoperatively evaluated by Visual analogue pain scale, Knee Society Scoring System and Japanese Orthopaedic Association Knee rating scale (Picture 1).

Picture 1: Pre-operative Evaluation

Post-operatively the Patients were asked to start static quadriceps and ankle pumping exercises from the day of surgery. Non weight bearing walking for initial 6 weeks, followed by partial weight bearing from 6 to 12 weeks and then after 12 weeks full weight bearing were allowed. Follow up evaluations were done at 3,6,12,18 and 24 weeks by Standing Radiographs, Knee Society Scoring and Visual Analogue Scale.

Surgical Techniques

The surgery was performed under spinal anaesthesia with the patient in supine position. After preparation and drapping of the limb, a longitudinal incision of about 6 to 8 cm was made on the medial aspect of proximal tibia starting from just below the joint line. Subcutaneous tissues dissected and the pes anserinus was identified. The pes tendons retracted and the Medial collateral ligament was exposed and the superficial fibres were detached. Then a K wire was passed from the upper margin of pes attachment

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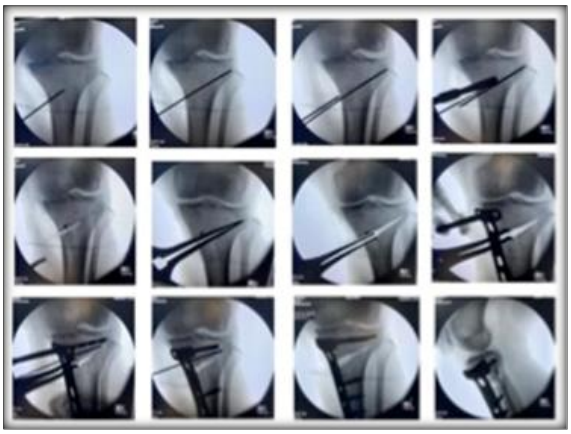
towards the lateral cortex of tibia and aiming to the fibular tip. A second K wire was passed parallel to the first one and posterior to it. After satisfactory placement of the K wires, osteotomy of the medial cortex was made along the K wires using a saw leaving one centimeter of lateral cortex intact. The posteromedial cortex was also osteotomised. Another vertical osteotomy was made joining the primary one posterior to the Tibial tuberosity and exits proximally and anteriorly. Osteotomes were used to gradually open the wedge, taking care not to violate the lateral cortex. Alternatively, Tomofix bone spreader was inserted in the osteotomy site and gradually opened the osteotomy up to the pre requisite angle of correction. During the whole procedure c arm images guide the steps.

Then the Tomofix plate was placed over the medial aspect, aligning the distal part with the tibial shaft. In the first distal hole below the osteotomy, a lag screw was inserted in order to compress the lateral hinged cortex of the osteotomy. Usually eight locked holes (Four proximal and four distal) were utilized to fix the Tomofix plate (Picture 2 and Picture 3).



Picture 2: Per-Operative C Arm Images

Picture 3: Follow Up X-rays and Photoes

RESULTS

Medial opening wedge HTO using Tomofix plate was performed in 25 patients in an age group of 40 to 60 years. They were followed up regularly and observed for any surgical site infection and other complications. Weight bearing full length x-rays were taken to evaluate objectively the correction achieved and also the progress of union. Subjective evaluation was done by Visual analogue scale, Knee Society Score and Japanese Orthopaedic Association rating scale.

Out of total 25 patients, 16 were female and most of them were engaged in household activities. Mean age of the females was 53.5 years and that of the males was 49.3 years. Mean BMI of the patients was 25.0, while the mean for male was 23.8 (22 to 28) and that for females was 25.7 (23 to 28). The patients were followed up to a minimum duration of 6 months to a maximum of 14 months, mean follow up period being 8.8 months.

The pain improved significantly after the Osteotomy. The Visual analogue score decreased from pre-operative score of 6.7 to post-operative score of 2.7. It was observed that the patients had maximum pain relief only after one year, which could be correlated to the time for cartilage regeneration. On the average, patients walking distance had been increased by one kilometer. They had significant relief of pain while walking, squatting and sitting cross-legged. Patients returned to their respective job after an average post-operative period of 8 weeks (Picture 4).

Picture 4: Right Knee Medial Opening HTO.

The Knee Society Score is also increased from mean pre-operative score of 98.3 to a mean post-operative score of 178.6, which was found statistically significant. We found one Excellent, 13 Good, and 11 Fair results based on this score, and none with poor outcome. Similarly, the Japanese Orthopaedic Association Knee Rating Scale also improved from a mean pre-operative score of 50.8 to mean post-operative score of 71.2, which was significant. In this scale we found 3 Excellent, 14 Good and 8 Fair outcomes. Excellent results were associated with

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more valgus correction. The score was found improving up to one year and thereafter it remained a plateau.

The mean pre-operative varus deformity of the knee of 9.1 degrees had been corrected to mean post - operative valgus of 1.6 degrees. Out of all 25 patients with varus deformity, we achieved 4 degrees valgus in 2 patients, 3 degree valgus in 5 patients, 2 degree valgus in 4 patients and neutral in 7 patients. Rest 4 patients had undercorrection with slight varus.

Picture 5: Complications.

Regarding complications, three patients had superficial infection, two patients had hardware prominence (Picture 5) causing pain and 4 patients had under correction of varus. The infections resolved with antibiotics and regular dressings. The patients with hardware prominence had anterior leg pain and difficulty in squatting, while no pain during walking. The patients with under correction also relieved of pain and functions improved compared to pre-operative period.

DISCUSSION

High tibial osteotomy was introduced by Jackson in 1961 and later popularized by Coventry. Mark Coventry published his technique of lateral closed wedge HTO for the management of unicondylar osteoarthritis of the knee.[11] Hernigou et al in 1987 described the technique of medial opening wedge HTO as a joint preservation method in young patients with medial compartment osteoarthritis.[12] The debate that which osteotomy is better is still going on. In the lateral closed osteotomy a wedge of bone is removed and the gap is closed with the intact medial cortex as a hinge and fixed with staples or plate and screw. However, it often requires either fibular osteotomy or disruption of the proximal tibiofibular joint. Also, there is a risk of peroneal nerve injury ranging from 3.3% to 11.9%.[13] Again it poses some technical difficulty and longer operating time if needed to convert to Total Knee Replacement.[13]

Medial opening wedge HTO forms an empty wedge without removing bone while correcting the deformity,[14,15] and the correction is secured with a plate and screw. The superficial medial collateral ligament can be released partially or completely depending on the correction needed.[16] Larger correction may need bone grafting for healing of the osteotomy site.[17] Again if the osteotomy is made proximal to the tibial tuberosity, the opening wedge lowers the patella and causes Patella baja.[18] Both lateral closing and medial opening HTO are effective treatment options and have similar clinical as well as radiological outcomes. The preference of medial opening wedge osteotomy in recent years is largely due to bone preservation, technically easier procedure, availability of good implants and easier convertibility to Total Knee Replacement. It offloads the diseased medial compartment to relatively healthier lateral compartment. However, severe medial compartment osteoarthritis is a contraindication to this. It is found that, patients with a preoperative Ahlback grade 2 or more in the medial compartment had 28% more chance of failure at 10 years following high tibial osteotomy compared to patients with an Ahlback grade 1 or less.[19]

The lower and upper limit of frontal plane malalignment correction is ambiguous. Varus alignment means that Hip Knee Ankle axis has an angulation of 1.5 degrees or more medially or the Mikuliz line crosses more than 4 milimetre +/- medial to the centre of the knee joint. In case of small varus malalignment it is difficult to effectively offload the medial compartment. Similarly in severe varus deformity correction by medial open wedge may result in delayed union or even non-union at the osteotomy site.[20,21] Large correction may alter the joint line obliquity, change the loading profile due to over tensioning of the medial collateral ligament and also may cause lateral cortex hinge fracture.[22]

Regarding amount of correction, both under correction and over correction may have unfavorable outcomes. Under correction fails to effectively offload the diseased medial compartment, while over correction into valgus may progress to patellofemoral degeneration and excessive loading of lateral compartment.[22] In earlier studies the target of correction was 5 to 10 degrees valgus.[11]

"Fujisawa point" may be a guide in this aspect. It is the point in tibial plateau situated at 62% from medial point through which the weight bearing line should pass after correction by osteotomy.[23] Recent studies however show that correction up to 50% to 55% had similar functional and pain scores to patients corrected to more conventional 62% to 66%.[24] Therefore, corrections to Fujisawa point may not be necessary in all cases. In the present study also, we had 7 patients whom the varus correction was done to neutral and in 4 patients residual slight varus remained. However they also showed good clinical and functional outcome. The knee joint ideally should have full range of movement for high tibial osteotomy. Knee flexion contracture of more than 25 degrees is a contraindication for the procedure. Similarly

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patients with high BMI have poorer outcomes following high tibial osteotomy. Patients having BMI more than 30 Kg/m2 is associated with more likelihood of lateral cortex fracture and delayed or non-union of the osteotomy gap.[24]

Medial open wedge osteotomy can be uniplanar or biplanar depending on the technique used. The uniplanar has only one osteotomy from the medial cortex and are relatively unstable and depends on the lateral 5 to 10 milimetre intact lateral cortex. In the biplanar technique a second osteotomy joins the first posterior to the tibial tuberosity. This technique is more stable and the extensor mechanism integrity is maintained.[14] The medial opening gap, in some instance fail to unite or there is delayed union. To address this complication, bone grafts are used to fill the defect. Autograft taken from iliac crest are mostly used.[25] Other options are plates with inserts and synthetic bone inserts, both reduce the incidence of lateral cortex fracture and form a stable construct.

Proper patient selection, accurate surgical technique and fixation and appropriate post-operative management are necessary for favorable outcome. Recent systematic review shows that HTO is effective in reducing the pain and improving knee function in medial compartment osteoarthritis of the knee. However, no osteotomy technique seemed superior to the others and also no sufficient evidence that osteotomy is better than unicondylar knee replacement or non-operative treatment.[26] Soleiman pours et al found slightly more favourable outcome in medial open wedge osteotomy group than the closed one as regards duration of operation, weight bearing duration and return to normal daily function.[27] Harris et al, in their systematic review of 4,557 patients in 69 studies, found that after two year post operative follow up, the prognostic survival was statistically inclined towards open wedge high tibial osteotomy.[28] Similarly, Deie et al found that open wedge osteotomy reduced the varus movement and lateral thrust compared to the lateral closed osteotomy.[29]

The ideal age limit for the high tibial osteotomy is also not clear. Many studies found excellent long-term survival rates and post operative results in relatively younger age group patients. Brinkman et al however, suggested the ideal as for osteotomy as 40 to 60 years.[30] Some reported more failure rates after the age of 65; again some studies found that age does not greatly influence clinical outcome or survival after high tibial osteotomy.[31] BMI has direct influence on the prognosis of high tibial osteotomy. Herbst M et al. in their study found that patients having BMI more than 30Kg/m2 have inferior clinical and functional outcome compared to the normal counterparts.[32] We also found similar correlation; low BMI patients had better outcome scores.

Post operatively in our patients pain was significantly reduced; from mean pre-operative Visual Analogue Score of 6.7 to post-operative score of 2.7. This finding showed the effectiveness of high tibial osteotomy in relieving pain, similar to earlier studies.[33] We used both the Knee Society Score and Japanese Orthopaedic Association Knee Rating as a tool to assess the functional outcomes. The Knee Society Score in our patients improved significantly from a mean pre-operative score of 98 to mean post-operative score of 178.6, which are comparable to previous studies.[20,21,33] The Japanese Orthopaedic Association Knee Rating Score also improved from a pre-operative mean score of 50.8 to mean post-operative score of 71.2. These are also found similar to previous studies.[34,35]

The complications seen in this study was preventable by proper preoperative planning and correct surgical technique. Infection control is also essential as the medial aspect of tibia is devoid of soft tissue and proper plate positioning will avoid implant prominence.

Limitations

Number of patients included in this study is relatively less to make the observations and outcomes statistically stronger. Again due to shorter follow up period, delayed complications could not be assessed. Most of the patients were from lower socioeconomic group with lesser understanding of the post-operative physiotherapy protocols negatively affected the outcome. The Tomofix implant we used, was primarily designed for the western population bone anatomy. Therefore, in shorter Indian population we found the unique complication of implant prominence.

CONCLUSION

Medial open wedge high tibial osteotomy is a good option in medial compartmental osteoarthritis and definitely relieves pain and improves functional outcome in selected group of patients. The results are evident and maximal after at least 1-year post-operative period. Bone grafting is not always necessary for this procedure as none of our patient had non-union at osteotomy site. There is gradual consolidation of the gap over time. No hazardous complications occur in these patients. Future Total knee replacement should not be a problem as the bone stock is preserved.

Declaration

All Authors contributed equally to the study. No funding was received from any source. Written consent was taken from the patients for the study.

Conflict of Interest: None.

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