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Results of High Tibial Osteotomy in Unicompartmental Osteoarthritis of Knee

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Abstract:
Background: *Osteoarthritis is the most frequent joint disease in the world and the commonest cause of disability in the older ages. Osteoarthritis is a chronic degenerative disorder of multifactorial aetiology characterized by cartilage destruction, subchondral bone thickening and new bone formation, resulting in pain, deformity and functional impairment, often requiring operative intervention.* ***Materials and Methods:*** *High tibial opening wedge osteotomy is done using Puddu plate (10 mm or 12 mm) according to the desired wedge to be created. Bone grafting was done in two patients and in all other twenty patients, bone grafting was not done.* ***Results:*** *A total of twenty-two patients were studied. The outcome was excellent in 15%, good in 62%, fair in 15%, poor in 8% by 'Knee society' knee score and excellent in 31%, good in 38%, fair in 31%, no poor results by 'Knee society' function score. The outcome was excellent in 31%, good in 38%, fair in 15% and poor in 15% by JOA knee rating scale.* ***Conclusion:*** *Medial open wedge osteotomy is a useful option in unicompartmental osteoarthritis and definitely relieves pain and improves functional outcome in patients.*

Key words:*Unicompartmental osteoarthritis, osteotomy, Puddu plate*

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I. Introduction

Worldwide one out of four human beings had already developed or will develop osteoarthritis in the future. About one third of the patients scheduled for total joint replacement of the knee are potential candidates for an osteotomy. The fundamental principles of osseous deformity correction were defined by Friedrich Pauwels in 1964[l] and Paul Maquet in 1976[2]. Since then, many techniques have been developed for osteotomies around the knee. Mark Coventry published his technique for closed wedge osteotomy in 1965[3], 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 the 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. The main problems were the intraoperative choice of the correction angle and the risk of a postoperative loss of correction. After many years of closed-wedge osteotomy, open wedge valgization osteotomy has become popular. The experience and the development of new techniques for axis correction around the knee have led to its revival. 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 the 1990s fixation plate by Puddu 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 inpatients having unicompartmental osteoarthritis with genu varum using the Puddu plate.

II. Materials and Methods

A Prospective observational study was conducted from May 2019 to December 2021 for a total of twenty-two cases of unicompartmental osteoarthritis of knee with pain not relieved by conservative management. Patients below the age of 30 years, Secondary osteoarthritis, with fixed flexion deformity, with vascular insufficiency and unfit for surgery due to associated medical problems, were not considered in our study. After detailed history and thorough clinical examinations, standard weight bearing radiographs in anteroposterior and lateral views of the knee were taken for confirmation of diagnosis.

III. Surgical technique

All cases were operated under spinal anaesthesia with the knee in 90˚ flexion. The skin incision is made in the medial aspect of the proximal tibia. The infrapatellar branch of the saphenous nerve is preserved. 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. The leg is then positioned in full extension and the knee joint adjusted in exact AP view under fluoroscopy. Two 2 mm k-wires are drilled into the tibial head under image intensification to mark the direction of the osteotomy. Both wires should run parallel and aim towards the upper third of the proximal tibiofibular joint. First, the posterior wire is inserted at the cranial border of the pes anserinus just in front of the posterior tibial ridge. The second wire is placed about 2 cm anterior and parallel to the first wire. 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. The knee is positioned in 90˚ flexion again. Electrocautery is used to mark the course which runs at an angle of 110˚ to the horizontal sawcut ending behind the patellar tendon insertion. These tuberosity segments should be at least 15-20 mm wide. The horizontal osteotomy is then performed with the oscillating saw below the two guide wires that act as guide rails. Attention must be paid to complete the osteotomy of the hard posteromedial tibial cortex. The osteotomy should be opened slowly over a period of several minutes in order to prevent fracturing of the lateral cortex. Leaving the two guide wires in place while opening the gap leads to stiffening of the proximal segment and prevents fracture of the articular surface of the tibia. When the planned width has been achieved, an arthrodesis spreader is placed in the posteromedial corner of the osteotomy. After spreading of the osteotomy gap to the desired width, the leg is again placed in extension. In this position, the leg axis can be evaluated clinically and radiologically. It is not necessary to fill the gap with bone substitute. Post-operative check X-rays were taken in both PA and lateral views. Wound was inspected on the 3rd postoperative day. Sutures were removed on the 10th to 12th postoperative day.

The patients were followed up for a minimum of 24 weeks. Clinical and radiological evaluations were performed at periodic intervals during follow-up. Functional evaluation of the patients was done at the last follow-up, according to the Knee society knee score, Knee society functional score and Japanese Orthopaedic Association (JOA) knee rating scale.

IV. Results

We have observed results in 22 knees with patients age ranging between 35 to 54 years. Female patients outnumber the male patients by a few percentages. Left side knee gets involved in 68 % of the patients and for unknown reasons is symptomatic earlier in most of the patients. On an average the Body mass index was 27.8 which is in the overweight category. Two of the three obese patients had fair and poor results. The relation of body weight to poor outcome could be attributed to the weight which the joint has to sustain and the poorer active rehabilitation by these patients.

Pain relief were found in 19 patients but for the 3 patients with complications of superficial infection in two and under correction in one. The outcome was excellent in 15%, good in 62%, fair in 15%, poor in 8% by Knee society knee score and excellent in 31%, good in 38%, fair in 31%, no poor results by Knee society function score. The outcome was excellent in 31%, good in 38%, fair in 15% and poor in 15% by JOA knee rating scale. On an average the walking distance increased by 500 metres in the patients, had significant relief of pain while walking, squatting and sitting cross-legged and good functional outcome. About 5 patients who were heavy manual labourers returned to their previous job in 8 months.

Bone grafting was not done in 20 knees and good bone consolidation started in 3 months laterally and progressed to the medial side in 1 year. There were no cases of implant failure. Two patients had superficial infection, one had implant prominence and one had under correction of varus resulting in implant exit in 3 patients (13%).

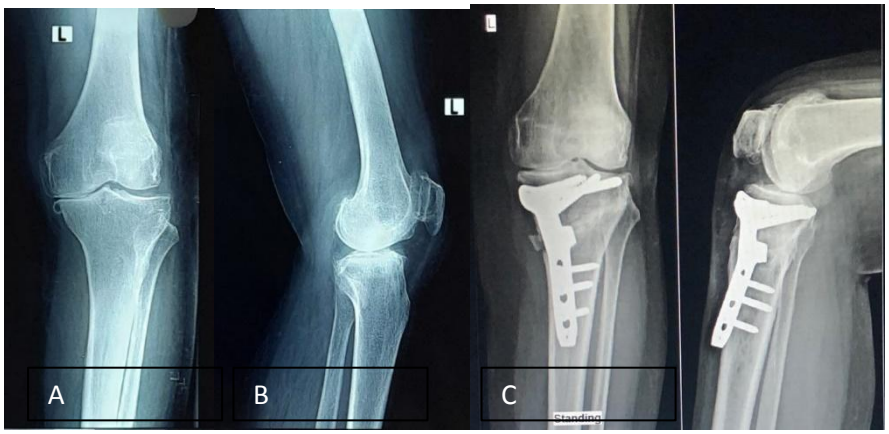

Figure 1: Pre-operative radiographs (anteroposterior and lateral views) of left knee joint in a 54-year-old female (A, B) for which HTO done with Pudduplate(C)

Figure 2: Clinical photographs of the same patient showing post-operative immobilization.

Table 1: General demographic data of patients	
Total No. of Knees	22
Women	56%
Left knee	68%
Mean Age in Years	43.7 Years
Mean Body Mass Index	27.8 (Overweight)

Table 2: Functional outcomes after High Tibial Osteotomy	
Total No of Cases Total No of Knees	22 22
Relief of Pain	19 patients- mild or no pain 3 patients- uncomfortable pain
Range of Movement	100-120 degrees
'Knee Society' Knee score Function Score	Excellent in 15% and Good in 62% Excellent in 31% and Good in 38%
Japanese Orthopaedic Association (JOA) Knee rating scale	Excellent in 31% and Good in 38%
Complications: ● Infection ● Under correction of varus	 2 1

V. Discussion

In medial compartment osteoarthritis due to shifting of the weight bearing on the medial side of the knee will result in more cartilage destruction and subsequently varus deformity. Therefore, unicompartmental knee replacement will not correct the alignment. Corrective osteotomy to alter the weight bearing axis will be ideal to slow down the degenerative process[4,5]. Many studies including one by Khan et.al have stressed the effect of local alignment on osteoarthritis occurring in respective compartments after analysing 306 patients and 608knees[6]. They have found that one degree increase in varus angle was associated with increased risk of having medial compartment disease[7].

RaymondH.Kim has stated osteotomy as a reasonable option to treat active, physiologically young patients[8].Although age is not a definitive criterion, the patients must be active enough to undergo rehabilitation and have good bone quality. Bodyweight is definitely an independent risk factor for complications. Song et al have analysed the complications of 104 lateral closing wedge and 90 medial opening wedge osteotomies and stated that the latter had slightly lesser complication[9]. Luites et al stated that both types of osteotomies had equal fixation stability, pain relief and certainly improved knee function, although the intended correction was achieved more likely with medial opening wedge technique[10].

Initially, a number of plates were used and later locked plates came into being. Kolb et al have analysed good results with locked low-profile plates. They have analysed 51 medial open wedge osteotomies and found that 50 osteotomies healed in an average period of 3 months without bone grafts and had excellent grading in 57%, good in 24% patients by one rating system and 18% excellent, 63% good by another rating system[11].

Brouwer et al have used the Puddu plate for opening wedge osteotomy and compared it with staples for closed- wedge osteotomy in overall 92 patients and have found that pain caused removal of Puddu plate in 60% patients and removal of staples in 23% patients which isa significant difference. They have stated that closed wedge osteotomy has more accurate correction but both types have equal functional outcome at the end of 1 year[l2]. Sen et al and Esenkaya et al have used Puddu plate and plates with edges respectively and showed that these plates provided better stabilization to maintain the wedge and early mobilisation. Sen et al assessed 65 knees with osteotomies and found that it resolves pain and improves knee function significantly. But he has stressed that long term studies are required in elderly patients to know whether the results are satisfactory[13].

Koshino et al have studied the effectiveness of high tibial osteotomy by the use of porous hydroxyapatite as a wedge and have stated to have good results and prevent collapse, but this study is not a comparative study. Bone grafts and substitutes are usually not necessary and we have observed that all the patients in our study without bone grafting had good consolidation[13].Theresults of total knee arthroplasty after osteotomy have variable results. Some studies state that there is no difference with primary arthroplasty whereas certain other studies like Haslam et al have shown slightly poorer results which are comparable to revision arthroplasty. The Opening wedge, however, has the advantage of preserving the bone stock for future arthroplasty. The excellent and good results seen in 15% and 62% by knee score, 31% and 38% by function score and JOA scores respectively seen in this study are comparable with results of Kolb et al and Sen et al.

The complications which are seen in this study could be prevented by proper preoperative planning and correct surgical technique. Infection control is also essential as the medial aspect of tibia is devoid of soft tissues and proper postoperative care and rehabilitation is essential. 13%of patients had implant removal which is better compared with results of Bower et al.Theconsolidation of the wedge occurred in all 22 of our patients in about 3 to 6 months. This is comparable to the results of Kolb et al.

This study has its limitations, as the sample size of the study is small. As stated by Sen et al, long term studies are lacking in high tibial osteotomies and are necessary for a clearer idea about the outcome. But this short-term study shows that osteotomy of the knee is definitely a viable option in unicompartmental osteoarthritis of the knee.

VI. Conclusion

From our prospective study with thirteen knees, we arrive at the following conclusions.

- Medial open wedge osteotomy is a useful option in unicompartmental osteoarthritis and definitelyrelieves pain and improves functional outcome in patients.
- The results are evident and maximal at 1 year.
- Bone grafting is not necessary for this procedure.
- No hazardous complications occur in these patients.
- Future Total knee replacement will not be a problem as the bone stock is preserved.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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None.

Conflict of interest

The authors declare no conflict of interest.

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