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Original article

Evaluation of Medial Open Wedge High Tibial Osteotomy in Osteoarthritis of Knee

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Abstract

Study Design: Prospective and Interventional Randomized Comparative Study. ***Duration of study***: 18 months. ***Objective:*** 1. To estimate pain relief in a patient with primary degenerative osteoarthritis of knee after medial open wedge high tibial osteotomy (HTO) using visual analog scale(VAS). 2. To assess the change in femorotibial angle, weight bearing line deviation and tibial slope pre and post operatively. 3. To compare pre- and post-operative WOMAC (The Western Ontario and McMaster Universities Osteoarthritis Index) index. ***Methodology:*** This study is a prospective analysis of patients with the requisite inclusion criteria, done over 18 months in the Central Institute of Orthopaedics, VMMC & SJH, and New Delhi. It includes a total of 20 patients who were followed up for 6 months. After initial preoperative evaluation, they underwent medial open wedge HTO for primary degenerative osteoarthritis of knee. Post operatively, patients were assessed clinically, functionally and radiologically for the benefits & drawbacks of this technique. This study is used to compare the clinical, radiological and functional improvement using this technique in patients pre-operatively and post-operatively. ***Observation and Result:*** Based on our observation we conclude that the study suggest that medial open wedge HTO using TomoFix™ should be recommended for treatment of primary degenerative osteoarthritis of knee primarily involving the medial compartment of knee.

Keywords: ***High tibial osteotomy, osteoarthritis, knee, TomoFix™, WOMAC score***

Introduction

Osteoarthritis is a chronic disorder of synovial joints with progressive disintegration and softening of articular cartilage along with growth of new cartilage and bone at joint margins (osteophytes), cyst formation and sclerosis in subchondral bone [1].

Osteoarthritis is a dynamic phenomenon with features of simultaneous destruction and repair. It is not a disease but a process, occurring in conditions when articular cartilage is unable to withstand the increase in mechanical stress [1].

Osteoarthritis (OA) affects over 250 million people or 4% of the world's population. Knee OA includes 83% out of total cases of OA.

OA generally can be subcategorized into primary (idiopathic) and secondary OA. Common causes of secondary OA include post-traumatic, dysplastic, infectious, inflammatory, or biochemical etiologies that are relatively well understood. Although the etiology of primary OA remains largely undefined, genetic factors, age-related physiological changes, ethnicity, and biomechanical factors likely play an important role [2]. Diagnostic criteria for osteoarthritis of the knee include patient history, physical examination and radiologic and laboratory findings. However, the standard radiograph alone allows definitive diagnosis of knee osteoarthritis in most of the patients. Other radiological modalities such as computed tomography, ultrasound imaging, Magnetic Resonance Imaging (MRI) and bone scan can provide alternative or supplementary information [5].

Several treatment options are available for OA knee like non-surgical treatments including weight loss, quadriceps strengthening exercises and Non-Steroidal Anti-Inflammatory Drugs (NSAID's) for early osteoarthritis. If these measures fail then intraarticular local anesthetic and corticosteroid injections are other available options. In case of severe osteoarthritis surgical options like osteotomies around the knee and joint replacements can be considered [6].

Surgeries like total knee arthroplasty, unicondylar arthroplasty have their disadvantages like being expensive and hence being out of reach for the rural population suffering from osteoarthritis. In patients with late-stage knee osteoarthritis Total Knee Arthroplasty relieves pain very effectively and improves knee function. However, total knee arthroplasty is complex and expensive, and some patients need a revision surgery [7]. Other disadvantages of knee replacement surgeries include aseptic loosening, instability and malalignment [8].

Osteotomies around the knee alter the weight bearing axis of the lower extremity [9]. The aim is to slightly overcorrect into a

valgus or varus axis to unload the damaged compartment and to transfer the weight load from the affected areas to reduce pain, slow the degenerative process and delay joint replacement [10].

However in lateral closed wedge HTO several problems have been reported, like the procedure requires a fibular osteotomy or a release of the proximal tibiofibular joint, which can result in neurovascular complications. Lateral bone resection can result in shortening of the lower limb. In addition, stem impingement or metal augmentation is unavoidable in a subsequent total knee replacement due to the proximal tibial deformity and bone loss of the lateral condyle [11].

But medial open wedge HTO shows no. of advantages like is a relatively simple procedure that involves a single osteotomy and a few dissections. Accordingly, the normal anatomical tibial bone shape is maintained after the procedure, which allows for conversion to knee replacement. In the coronal and sagittal planes, the level of correction can be identified and adjusted intraoperatively and shortening of the lower limbs can be prevented or treated [11].

Different kinds of internal fixation devices have been developed to achieve more rigid fixation and to prevent any possible loss of correction and for early weight bearing for medial open wedge high tibial osteotomy like TomoFix™, Puddu plate, Aesculap (dual) plate, plate with or without a spacer (rectangular or tapered) [11].

As compared to Puddu plate, the TomoFix™ plate is reported to provide superior stability in both compression and torsion and is an effective option in elderly and young individuals [12].

Method

This study was conducted in Central Institute of Orthopaedics, VMMC & Safdarjung Hospital, New Delhi after approval from Ethical Committee.

Patients meeting the inclusion criteria were subjected to clinical examination, weight bearing radiograph of a single leg with knee joint in extension (anteroposterior and lateral view), standing long cassette radiographs of lower extremities. Patients diagnosed with primary degenerative osteoarthritis of the knee were taken up for surgery after written informed consent and they were followed up for 6 months. Pre operative evaluation was done in respect to WOMAC index, VAS score & radiological assessment. These patients were then operated by high tibial osteotomy and were followed up with the similar parameters to see about improvement in knee functions in respect to the pre operative findings.

Observations And Results

The analysis was performed on observations recorded from 20 patients. There were no missing values considered in the study. The description of the patients is given in Table 1. The mean age of the patients was 51.4 (±6.6) years, ranged between 40 to 62 years. Out of 20 patients, 6 (30%) patients were male while 14 (70%) were female.

Table 1: Age and gender distribution of patients

Characteristics	Values
Age in years (Mean± SD)	51.4 ± 6.6
Age in years Median (Interquartile Range)	50 (40-62)
Gender distribution • Male • Female	 6 (30%) 14(70%)

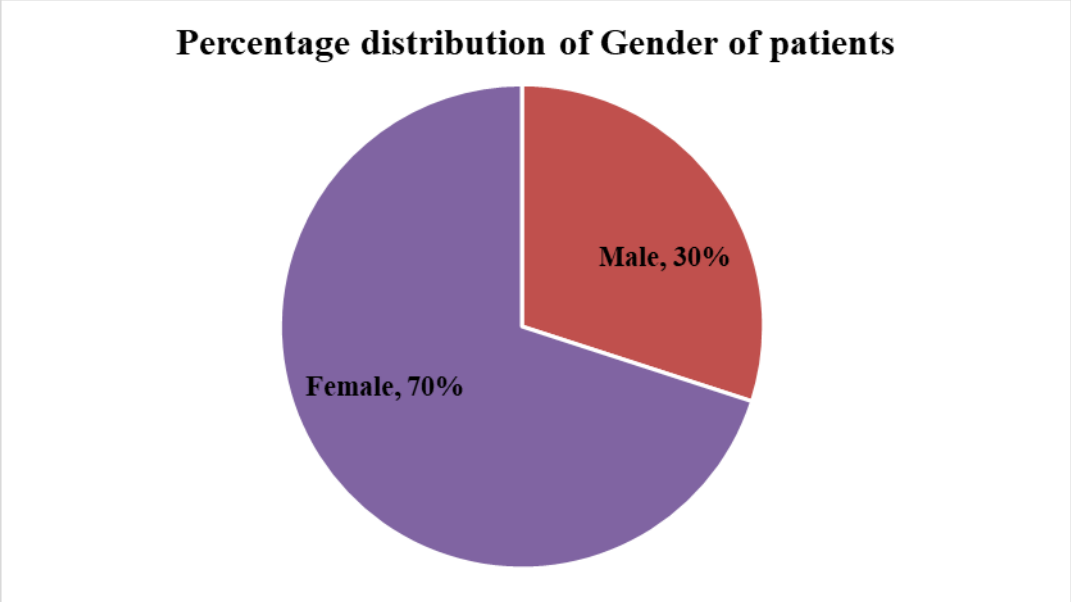

Figure 1: Percentage distribution of Gender of patients

Table 2: Distribution of side

Side	Frequency (Percentage)
• Right side	11 (55%)
• Left side	9 (45%)

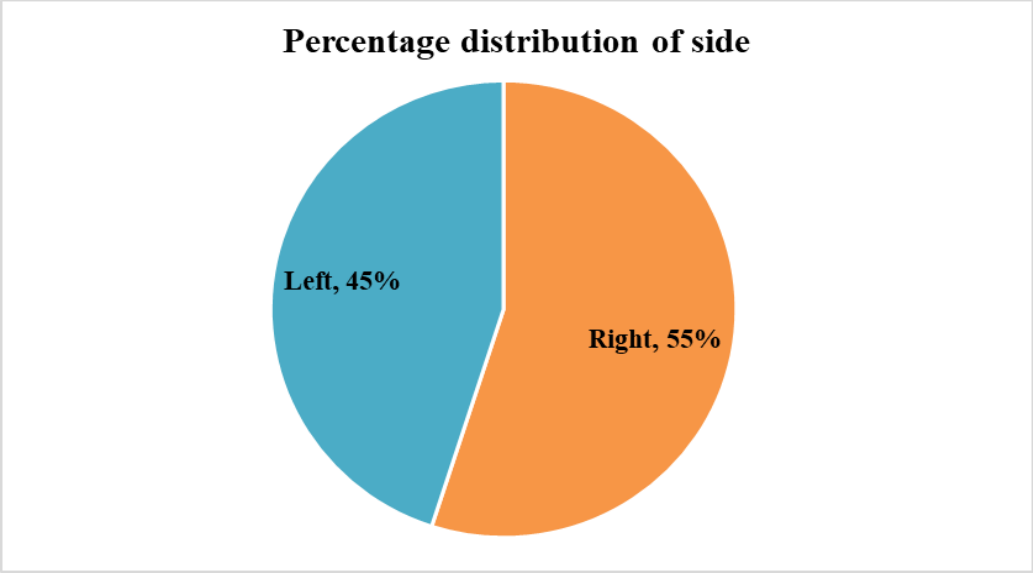

Figure 2: Percentage distribution of side in patients

As shown in Table 2 and Figure 2, the percentage distribution of the side was same, 11 (55%) cases were on the right side and 9 (45%) cases were on the left side.

Table 3: Comparison of the Visual Analog Scale (VAS) Score

Visual Analogous Scale(VAS)	Mean ± SD	Median	Range	p-value comparing with Pre-op (Wilcoxon's signed rank test)
Pre-operation	7.7 ±0.8	8	6-9	-
Follow-up at 1st month	7±0.8	7	6-9	<0.001
Follow-up at 2nd month	4.7 ±0.9	5	3-6	<0.001
Follow-up at 4th month	2.5± 1.2	2	1-5	<0.001
Follow-up at 6th month	1.4±1.1	1.5	0-3	<0.001

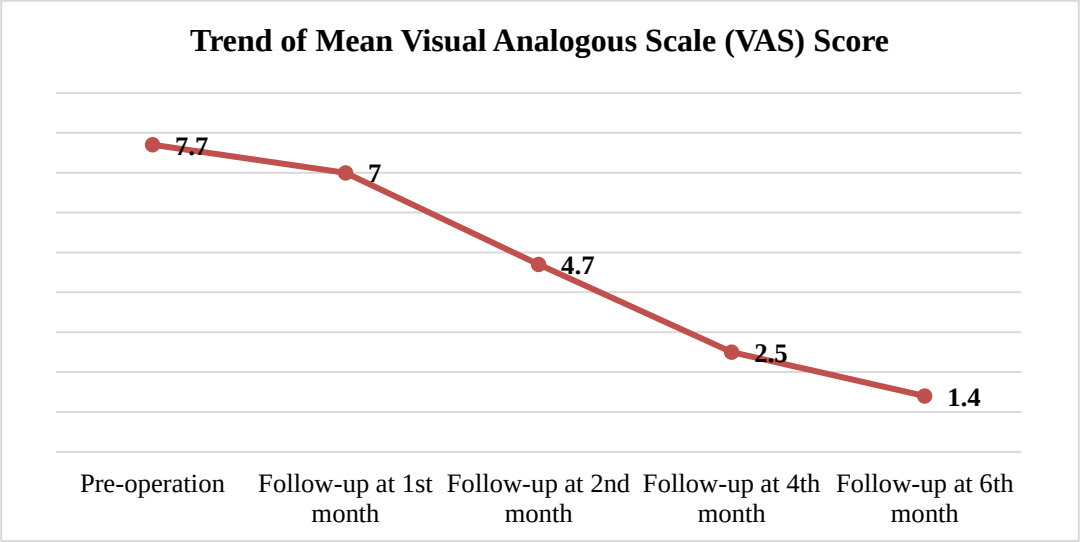

Figure 3: Trend of Mean Visual Analog Scale (VAS) Score

The given Table 3 and Figure 3 describes the Visual Analog Scale (VAS) score during pre-operative phase and follow-up intervals at 1st month, 2nd month, 4th month and 6th month. The mean VAS score during pre-operative phase was 7.7±0.8 with range 6-9. After the surgical procedure, one month later, the mean score was 7±0.8 with range of 6-9. During the second month follow-up, the mean score was 4.7±0.9 with range 3-6 and follow up at fourth and sixth month it was 2.5±1.2 with range 1-5 and 1.4±1.1 with range 0-3, respectively. When the mean score was compared to all the follow-up scores, a statistical difference was observed (p<0.001). Figure 3 showcases the downward trend of the mean VAS score on the operated side.

Table 4: Comparison of the functional outcome using WOMAC score

WOMAC Score	Mean ± SD	Median	Range	p-value comparing with Pre-op (Wilcoxon's signed rank test)
Pre-operation	53.4±7.3	53.5	40-65	-
Follow-up at 1st month	44.8±6.7	45	33-63	<0.001
Follow-up at 2nd month	34.9± 6.9	34.5	21-55	<0.001
Follow-up at 4th month	26.4±6.7	25	15-45	<0.001
Follow-up at 6th month	15.3±5.5	14.5	8-25	<0.001

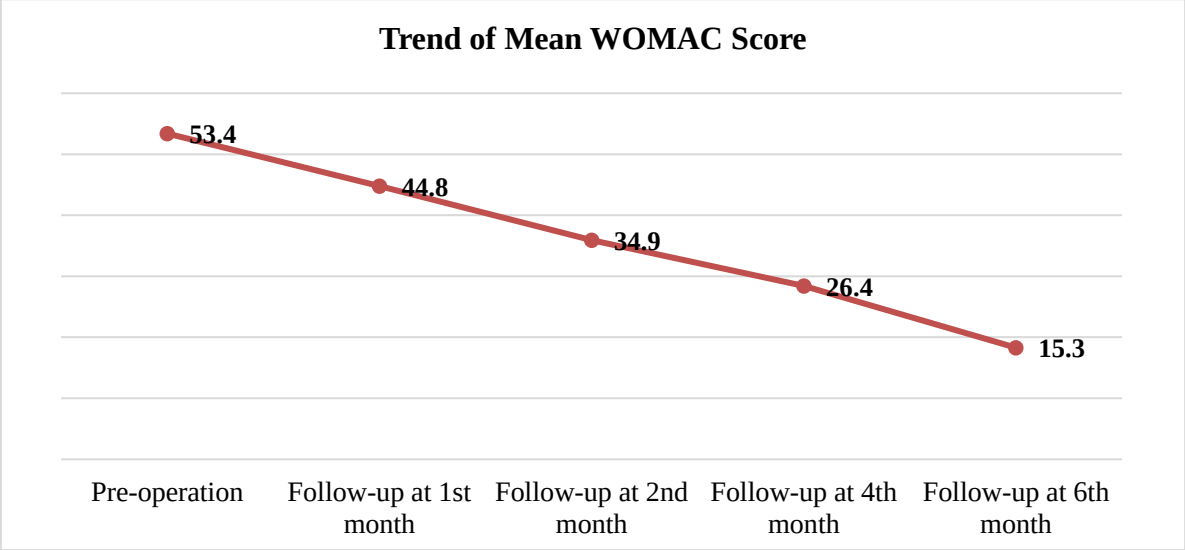

Figure 4: Trend of Mean WOMAC Score

The given Table 4 and Figure 4 describes the mean WOMAC scoreduring pre-operative phase and follow-up intervals at 1st month, 2nd month, 4th month and 6th month. The mean WOMAC score during pre-operative phase was 53.4±7.3 with range 40-65. After the surgical procedure, one month later, the mean score was 44.8±6.7 with range of 33-63. During the second month follow-up, the score was 34.9±6.9 with range 21-55. During further follow up at fourth and sixth month mean WOMAC score was 26.4±6.7 with range 15-45 and 15.3±5.5 with range 8-25, respectively. When the mean preoperative WOMAC was compared to all the follow-up scores, a statistical difference was observed (p<0.001). Figure 4 showcases the downward trend of the mean WOMAC score on the operated side.

Table 5: Comparison of the radiological outcome using Femorotibial Angle (Degrees)

Femorotibial Angle (Degrees)	Mean ± SD	Median	Range	p-value comparing with Pre-op (Wilcoxon's signed rank test)
Pre-operation	185.2±2.5	185.3	181.4-189.6	-
Follow-up at 1st month	172.8±3.1	172	169.2-176.6	<0.001
Follow-up at 2nd month	172.8±3.1	172	169.2-176.6	<0.001
Follow-up at 4th month	172.8±3.1	172	169.2-176.6	<0.001
Follow-up at 6th month	172.8±3.1	172	169.2-176.6	<0.001

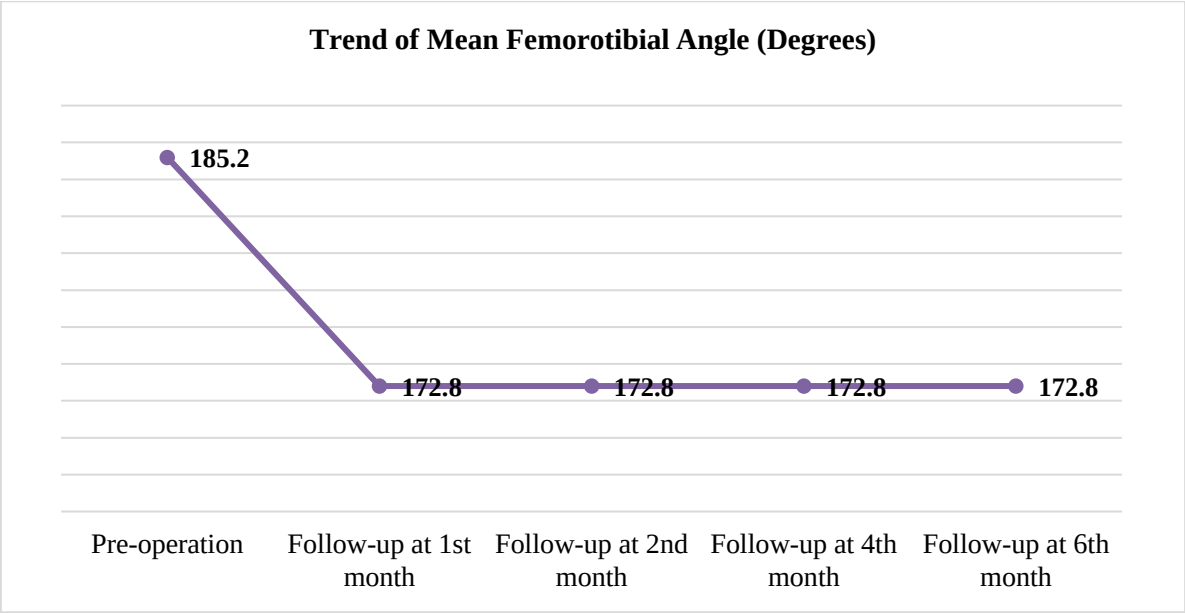

Figure 5: Trend of Mean Femorotibial Angle (Degrees)

The given Table 5 and Figure 5 describes the Femorotibial Angle (FTA) during pre-operative phase and follow-up intervals at 1st month, 2nd month, 4th month and 6th month. The FTA angle during pre-operative phase was 185.2±2.5 degrees with range 181.4-189.6. After the surgical procedure, one month later, the angle was at 172.8±3 degrees with range of 169.2-176.6. During the second, fourth- and sixth-month follow-up, the mean FTA remained same at 172.8±3.1 degrees with range of 169.2-176.6. When the mean preoperative FTA angle during was compared to all the follow-up scores, a statistical difference was observed (p<0.001). Figure 5 showcases the trend of the mean FTA on the operated side.

The medial open wedge HTO is a relatively predictable procedure that involves a biplaner osteotomy and a few dissections. In this the normal anatomical tibial bone shape is also maintained

after the procedure, which allows for conversion to knee replacement [11]. Appropriate patient selection, good pre operative planning and precise surgical techniques are essential for success of HTO. Therefore, the study suggests that medial open wedge HTO using TomoFix™ should be recommended for treatment of primary degenerative osteoarthritis of knee primarily involving the medial compartment of knee. There are several limitations to this study including the lack of control group for comparison, a relatively short period of follow up of only 6 months and a small sample size. Future studies on the topic could involve a larger sample size so as to study the possible complications of the procedure. Even the long-term effects of medial open wedge HTO on hip and ankle are not known. The future studies could also benefit with a longer period of follow up along with classification of the patients according to the grade and severity of osteoarthritis for better understanding effects of medial open wedge HTO in patients with osteoarthritis of the knee.

Ethics approval and consent to participate

Not required

List of abbreviations

OA: Osteoarthritis
VAS: Visual Analog Scale
HTO: High Tibial Osteotomy
FTA: Femoro Tibial Angle
WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index
NSAID's: Non-Steroidal Anti-Inflammatory Drugs
MRI: Magnetic Resonance Imaging

Conflicts of Interest

None declared

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