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Varus Deformity and Medial Opening Wedge High Tibial Osteotomy: Assessment on Short-Time Outcomes

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Abstract

The present study aimed to provide short-term therapeutic outcomes in patients with varus deformity treated with the opening-wedge proximal tibial osteotomy method. A retrospective case series study on the patients with symptomatic osteoarthritis of the knee medial compartment with a deformed varus field requiring correction of deformities. At the last follow-up session, parameters such as mean bone union time, surgical site infection rate, intra-articular fracture rate, need for reoperation, mean partial and full weight-bearing time, International Knee Documentation Committee (IKDC) index, changes in pain intensity before and after surgery based on Visual Analogue Score (VAS), patella changes based on Insall and Blackburn indices, and Grad DJD changes in patients were examined. None of the knees experienced union and showed signs of revision surgery. Superficial surgical site infection was observed in 4.9%. Intra-articular fracture did not occur in any of the patients after surgery. The mean score of IKDC and VAS increased significantly after surgery. In 2 knees Grade DJD increased up to 1 degree. Based on the results we concluded that the opening-wedge proximal tibial osteotomy method could provide satisfactory results in the clinical outcomes in patients with symptomatic osteoarthritis of the medial compartment of the knee with a varus deformity requiring correction of deformity

Introduction:

Osteoarthritis is the most common joint disease worldwide, and its prevalence has increased in recent years (Lawrence *et al.*, 2008). Unilateral knee osteoarthritis is associated with severe pain and limited function. In the normal knee, about 60% of the force is passed over the medial compartment of the knee and 40% through the lateral compartment. If major changes occur in the direction of the joint, applying too much force through the medial compartment will cause pain in the inner edge of the knee (Kawakami *et al.*, 2005; Esenkaya & Elmali, 2006; Ribeiro *et al.*, 2009).

Osteotomy is a classic procedure for the treatment of patients with primary degenerative osteoarthritis and its deformity correction. The most common site of involvement in osteoarthritis of the knee is the medial compartment of the knee (Heller *et al.*, 2007). The selected treatment of these patients is proximal tibial osteotomy, in

which the patient's weight is transferred to the outer side where the cartilage is still intact by opening the wedge inside the knee. In this method, removing the pressure from the compartment involved in the knee joint reduces pain and slows the progression of arthritis (Agneskirchner *et al.*, 2007). Numerous studies have reported a success rate of 80-90% in five-year follow-ups (Agneskirchner *et al.*, 2007; Sprenger & Doerzbacher, 2003; Azhar, 2015; Noyes *et al.*, 2000).

In dual varus, in addition to varus changes in the tibiofemoral joint, there is also a separation of the tibiofemoral lateral compartment due to lateral soft tissue damage. Triple varus, caused by angular posterolateral ligament damage, leads to varus and Recurvatum. The triple varus is, in fact, a combination of a simple and a double varus that, in addition to the varus changes along with the limbs and separation of the tibiofemoral compartment, posterolateral instability also increases

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external rotation and hyperextension (Noyes *et al.*, 2000).

Considering there are several treatments for genu varum modification, accurate preoperative evaluations play an important role in selecting the appropriate treatment and treatment success. Examination of limb extension indicators in the standing position, which is performed using standard radiography before and after surgery, is used to select the appropriate patients, determine the amount of correction required, and examine the results of treatment. In addition to standard radiography, the importance of sagittal changes today, including patella height and tibial slope, has been considered. Besides, the clinical results of these patients are of particular importance. Following the above, the aim of this study was to evaluate the clinical and radiological results of patients with osteoarthritis and genu varum after proximal tibial osteotomy.

Methodology:

It is a retrospective case series study, carried on the patients with symptomatic osteoarthritis of the knee medial compartment with a knee varus deformity requiring correction of deformities who referred to Imam Khomeini Hospital in Ahvaz in 2017-2018. Based on this, the sampling method in the present study was done as available and non-random sampling. A total of 37 patients were examined, and eventually, 31 patients (41 knees) agreed to participate in the study and collaborated to attend the clinic.

The inclusion criteria of the study were included symptomatic medial unicompartamental degenerative diseases of the knee with an associated 2° = varus alignment and near-normal lateral an patellofemoral compartment with appropriate range of motion flexion $>90^\circ$ and flexion contracture $<10^\circ$. The exclusion criteria of the study were traumatic genu varum, lateral compartment osteoarthritis, and a history of fractures or previous open surgery on the ipsilateral lower limb.

Patients who had undergone surgery for at least one year were contacted for treatment at the clinic and clinical and radiological examinations. After explaining the objectives and method of the study, informed consent was received from all patients. In all osteotomy patients, the opening-wedge valgusosteotomy was associated with primary genu varum was done to transfer the weight-bearing line based on preoperative evaluation to 50 or 62.5% from the medial cortex of the plateau width.

Radiological evaluation: standard radiography was performed for all patients before and during the follow-up period after surgery, and patients were asked to go to the clinic with the obtained graphics. Standard radiographs included the following:

- 1) Posterior anterior radiograph of the entire lower limb while standing, including the hip, knee, and ankle joints, which was used to calculate the mechanical axis of the lower limb.

- 2) Anterior-posterior view of both knees in a standing position and 45° of flexion.
- 3) Posterior anterior radiography of both knees and lateral radiography with 30° flexion.

Surgical technique: surgery was performed in the supine position and under general anesthesia with a tourniquet. Prior to surgery, relevant examinations were performed based on patients' injuries such as meniscus tears, cartilage damage, and instability symptoms. After skin incision the fascia was opened with an anteromedial approach in the proximal tibia, and the pes anserinus was explored and the insertion of the pes anserinus was released and superficial MCL also released from tibia Then, under C.Arm's guide, two pins 3.5 cm distal to the articular surface from medial to lateral towards the fibular head tip was placed. The osteotomy was done according to preoperative planning, fixation was performed with T-Plate 4.5 plate, and bone graft was placed. Soft tissue repair was performed and after the operation, splinting of the lower limb was performed.

Rehabilitation Technique: all patients started waking with crutch immediately after surgery and physiotherapy was started for all patients. Also, all patients started isometric exercises of the quadriceps muscle from the day after the operation. After a week, the initial visit was performed and the patients' wounds were seen. The splint was removed in the third week after surgery when the new x-ray had not shown any issue in the fixation. In the sixth week, after re-examination and checking the fixation with new x-rays, the partial weight-bearing started, and then they were followed up monthly. Full weighting-bearing was permitted for patients after seen callus in the x-rays and obtain painless surgical site At the last follow-up session, parameters such as mean bone union time, surgical site infection rate, intra-articular fracture rate, need for reoperation, mean partial and full weight-bearing time, International Knee Documentation Committee (IKDC) index, changes in pain intensity before and after surgery based on Visual Analogue Score (VAS), patella changes based on Insall and Blackburn indices, and Grad DJD changes in patients were examined.

VAS Score is a subjective criterion for assessing the severity of pain, which is determined by asking the patient and the severity of the pain that he or she will determine it from 0 to 10. The degree of osteoarthritis (Grade DJD) of the knee was determined by the Kellegren Lowrance standard before and after surgery. According to this classification, the grade of osteoarthritis (OA) is divided into 5 levels, grade 0 indicates the absence of OA and grade 4 the highest OA intensity.

The International Knee Documentation Committee (IKDC) questionnaire evaluates treatment outcomes in three fields, including symptom assessment, ability to perform daily activities, and knee function, and finally evaluates the functional quality of the knee based on a 100-0

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score. In this questionnaire, the higher score shown the better performance level.

Results were reported based on frequency and percentage of frequency or mean and standard deviation. A paired t-test was used to compare radiographic findings. SPSS software version 23 was used to analyze the data and a significant level was considered as <0.05 .

Result:

A total of 31 patients (41 knees) were evaluated, out of which 51.6% of the patients were male and 48.4% were female. The mean follow-up time was 17.34 ± 4.08 months (12-4 months). The mean age of the patients was 27.03 ± 6.145 (19-42 years of age). The mean body mass index of patients was 25.1 ± 3.102 kg/m². Union time based on callus formation, and painless weight-bearing was recorded with the control x-ray for each patient were obtained, the union time-mean was 11.98 ± 1.369 weeks (10-17 weeks) in the patients of the present study. None of the operated knees experienced non-union. Only one knee had a delay in the union (delay-union), but after 17 weeks complete union had been confirmed in the obtained x-ray.

The mean time interval between surgery and partial weight-bearing by using a crutch was 5.97 ± 0.72 , and the full weight-bearing without using the crutch was 12.24 ± 0.89 weeks. Superficial surgical site infection was seen in 2 knees (4.9%), which healed with irrigation and antibiotic therapy. None of the patients had deep surgical site infection. Intra-articular fractures did not occur in any of the patients. None of the patients had complications that led to revision surgery.

The mean pain intensity decreased significantly after surgery ($P < 0.05$). IKDC score increased significantly after surgery ($P < 0.05$).

Patellar changes before and after surgery were not statistically significant based on Insall and Blackburn indices ($p > 0.05$). The mean DJD Grade before and after surgery did not differ significantly ($p > 0.05$) (Table-1). None of the patients reported peroneal nerve damage, over-correction, plate fracture, and deep vein thrombosis.

Table-1: Comparison of the mean parameters studied in the study before and after surgery

Variables	Before Surgery	After Surgery	p value
VAS Score	5.41 ± 1.16	2.61 ± 1.09	0.001*
IKDC Score	51.32 ± 6.567	69.66 ± 9.43	0.001*
Insall Score	0.98 ± 0.037	0.99 ± 0.40	0.311
Blackburn Score	0.799 ± 0.018	0.8 ± 0.019	0.323
DJD Grade	1.07 ± 0.721	1.12 ± 0.714	0.16

Data are expressed as mean $\pm$ SD. The statistical test used was t-test. * $p < 0.05$ is considered as significant level.

Discussion:

In the present study, the mean bone union time was 11.97 ± 1.36 weeks (10-17 weeks). Non-union was not reported; only one knee had a delay in the union.

In a retrospective study by Seo *et al.* (2016), the results of short-term treatment and the side effects of medial-open-wedge proximal tibia osteotomy were examined in 167 patients with osteoarthritis of the knee. A total of 2.4% patients had a delay in union and 0.6% had non-union, which led to surgical revision. Further, Woodacre *et al.* (2016) studied the long-term treatment outcomes and side effects of the medial-open-wedge proximal tibia osteotomy method, where the rate of non-union requiring revision was reported to be 4.3%. In the study of Pornrattanamaneewong *et al.* (2012) union occurred 12 weeks after surgery in all patients.

Superficial surgical site infection was observed in 2 knees (4.88%), which healed with irrigation and antibiotic therapy. None of the patients had deep surgical site infection. Seo *et al.* (2016) reported the deep surgical site infection was reported in 0.6% of patients. In a study by Woodacre *et al.* (2016) the rate of partial wound infections was reported to be 9.6% and major wound infections were reported to be 3.5%. In a study by Mobarakeh *et al.* (2011) 2.99% of patients had surgical site infections.

In the present study, the intra-articular fracture did not occur in any of the patients. Kessler *et al.* (2002) reported the rate of intra-articular fracture was to be 11%. In a study by Jabalameli *et al.* (2013) 0.88% of patients had a lateral tibial plateau fracture due to technical problems during surgery, which improved with conservative treatment. Similarly, Seo *et al.* (2016) reported the lateral cortical fracture was reported in 15.6% of patients. Mobarakeh *et al.* (2011) found that the 7.46% of intra-articular fractures, 4.48% of screw entry to the knee, 1.49% of screw entry to the tibiofibular joint, and 1.49% of insufficient correction were reported. In the present study, there were no patients with symptoms that led to surgical revision. In a study by Pornrattanamaneewong *et al.*, a screw penetrated the joint of one knee and two knees suffered local pain and burning, which led to the removal of the device (Pornrattanamaneewong *et al.*, 2012).

In the present study, the mean pain intensity after surgery was significantly reduced after surgery. According to the patients' control x-ray, Grade DJD had increased by only 1 degree in 2 knees during the follow-up period, and in other cases, the progression of osteoarthritis of the medial compartment of the knee was inhibited. In a study by Jabalameli *et al.* (2013), the Grad DJD increased by one degree during follow-up in 10% of patients with primary varus, while 50% of patients with secondary varus had a 1 degree increase in DJD during follow-up.

In the present study, the mean score of the IKDC questionnaire increased significantly after surgery. Accordingly, the functional level of the knee was significantly improved after surgery. As per the present study, Mobarakeh *et al.* (2011), reported the mean of the knee scoring index was significantly enhanced from 75.5 to 98.73. In Jabalameli *et al.* (2013) IKDC and Modified Larson indices in both primary and secondary varus groups increased after surgery.

In the present study, the patellar biomechanics changes before and after surgery were not statistically significant before and after surgery based on the mean Insall and Blackburn indices. In the study of Jabalameli *et al.* (2013) patellar changes were not significant based on Blackburn and Insall indices. In the present study, none of the patients reported peroneal nerve damage, over-correction, plate fracture, and deep vein thrombosis.

In the study of Mobarakeh *et al.* (2011) none of the above complications were observed, similar to the present study. In the study by Seo *et al.* (2016) neuropathy (3.6%), lack of appropriate correction (2.4%), wound healing delay (2.4%), and device failure without associated symptoms (0.6%) were reported. Major complications included device failure with associated symptoms (0.6%) and deep surgical site infection (0.6%). Woodacre *et al.* (2015) reported the need to remove plate (7%), vascular damage (1.7%), compartment syndrome (0.9%), and other minor complications (4%). No thromboembolic complication was reported.

Conclusively, due to the significant increase of IKDC index, VAS Score, satisfactory union rate, the acceptable rate of complications, and no significant changes in patella-femoral compartment and biomechanics of patella the medial-open-wedge proximal tibia osteotomy method can be led to satisfactory results in patients with symptomatic osteoarthritis of the medial compartment of the knee with a background of knee varus deformity requiring correction of the deformity. It is also recommended that studies with larger sample sizes, longer follow-up duration, and comparison of different types of proximal tibial osteotomy be performed.

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