



Original Article

## Short-term outcome of high tibia osteotomy in unicompartmental medial osteoarthritis of the knee: a single center report

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### Abstract

**Background:** As an established method of treatment for medial unicompartmental knee osteoarthritis, we aimed to evaluate results of short-term follow up of closed and open wedge high tibial osteotomy.

**Methods:** In teaching hospital of Rasoul-e-Akram and during 2001-2009, we retrospectively surveyed documents of 41 cases with osteoarthritis of the knee and genu varum deformity that underwent high tibial osteotomy. Radiographic evaluation of knee alignment was performed using lower extremity scanogram in three measurements of preoperation, postoperation and last follow up visit (average of 2 years). Improvement of pain was assessed via visual scales.

**Results:** From a total of 13 closed and 28 open wedge high tibial osteotomies, the femorotibial angles were calculated varus of  $7.7 \pm 2.5^\circ$  preoperatively, valgus of  $7 \pm 2.3^\circ$  postoperatively and reached valgus of  $6.1 \pm 3^\circ$  at the final follow-up. In open-wedge osteotomies, loss of correction was meaningful during follow-up, mainly in patients without fixation. Higher amount of preoperative knee varus ( $>10^\circ$ ) was accompanied with more loss of correction postoperatively. About 80% of patients were satisfied of pain relief with average knee flexion of 125 degrees. Our major complications were two cases of intra-articular fracture. Open wedge cases without plate fixation experienced more failure of correction.

**Conclusion:** With proper patient selection and applying appropriate technique plus sufficient correction, high tibial osteotomy can be an effective treatment for medial knee osteoarthritis with genu varum. It may diminish the need for knee arthroplasty or at least delay the surgery.

**Keywords:** Knee, Osteoarthritis, Genu varum, Osteotomy, High tibial.

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### Introduction

In the treatment of medial unicompartmental osteoarthritis of knee with varus alignment, high tibial osteotomy (HTO) is safe and regarded as an effective surgical technique (1). Initially the HTO was performed and published in the literature for about half a century ago by several surgeons including Jackson, Gariépy, and Coventry (2-4).

Different surgical techniques for osteotomies have been described comprising closed and opening wedge osteotomies with many variations in the fixation technique and augmentation. The aim of these procedures is to transfer the mechanical load axis from the damaged knee compartment to the intact one, thereby leading to reduction of subchondral sclerosis and spontaneous regeneration of cartilage (1-3). With proper

patient selection, HTO can be an easier and less expensive counterpart of arthroplasties (5-7).

In order to compare the results of this technique and its variation with others, different centers worldwide have released their short-, intermediate- and long-term follow-up findings. In this study, we aimed to report the radiologic and clinical findings in short term follow up after HTO indicating our teaching hospital performance.

### Methods

The present retrospective study was conducted to evaluate clinical and radiographic outcome of HTO in a consecutive series of patients with knee varus deformity. The studied cases underwent surgery at the teaching hospital of Rasoul-e-Akram (affiliated to Iran University of Medical Sciences, Tehran, Iran) during 2001-2009. The study was approved by our institutional board review.

Indications for osteotomy were symptomatic medial unicompartamental degenerative diseases of the knee with an associated varus alignment. Exclusion criteria were: severe medial compartment osteoarthritis, age > 65 years, poor bone quality, obesity (BMI > 30), flexion contracture > 15 degrees, ROM < 90 degrees, osteoarthritis of in lateral or patellofemoral compartment, rheumatoid arthritis, a history of fractures or previous open surgery of the lower limb. Therefore, 41 cases were qualified from a total of 48 patients with average follow up period of 2 years.

Radiological investigations were comprised of standard weight-bearing anteroposterior and lateral radiographs, intercondylar notch view, skyline view and weight-bearing full-leg alignment view. These images were prepared for comparison of alignment and bone union in three phase of preoperative, postoperative and the final visit assessment. Mechanical femoral-tibial angle was used for alignment assessment. Also, visual scales were applied to assess pain improvement.

Open and closed wedge technique

osteotomies were performed proximal to the tibial tuberosity. Closed wedge osteotomy was performed by a modified Weber technique with a step cut osteotomy to the proximal fibula. Open wedge osteotomy was performed by a release of the medial collateral ligament. The osteotomy opening sizes were measured aiming to shift the mechanical axis to the Fujisawa point (62% of the tibial plateau on the lateral side). In non-arthritic patients, the correction was performed so to shift the mechanical axis to 50% of the tibial plateau. The osteotomy gap was stabilized via a block of allograft, some of them further augmented with a plate. An additional knee arthroscopy was not systematically carried out. Postoperatively, the patients were allowed full range of motion with partial weight bearing in a removable splint for six to eight weeks until radiographic evidence of osteotomy consolidation.

### Results

A total of 41 cases of HTO were studied including 37 women and 4 men with a mean age of 51 years (ranging 35-60 years). Thirteen (31%) of patients underwent closed wedge and 28 (69%) had open wedge osteotomy. Eighteen knees were left-sided and 23 right-sided. The mean follow-up duration was 2.2 years ( $\pm 1.2$ ). Average body mass index was  $26.3 \pm 3$ .

Totally, the femorotibial angle, which was measured using Bauer's method, was calculated with mean varus of  $7.7 \pm 2.5^\circ$  preoperatively. This was corrected to a mean valgus of  $7 \pm 2.3^\circ$  postoperatively and reached valgus of  $6.1 \pm 3^\circ$  at the final follow-up. In open wedge group, these values were varus of  $8 \pm 3.1$  preoperatively and valgus of  $7.5 \pm 1.9$  and  $5.8 \pm 2.4$  postoperatively. Results of closed wedge group showed that a mean varus of  $6.2 \pm 2.7$  before surgery was shifted to  $6.8 \pm 1$  and  $6 \pm 2.2$ .

Table 1 shows detailed information about correction condition in two stages of postoperation and in last follow up. Overcorrection, normal and under correction in alignment were defined as valgus of more

Table 1. Correction condition of patients in two measurements of alignment at postoperation and last follow up visit.

	postoperation			Last follow-up			p-value
	O	N	U	O	N	U	
Overall (41)	11	18	12	7	18	16	N/S
Closed-wedge (13)	5	5	3	4	6	3	N/S
Open-wedge (28)	5	13	10	3	12	13	0.034

Over correction (O), normal (N) and under correction (U) were defined as valgus of more than 7, between 0 to 6, and less than zero degrees, respectively.

than 7, between 0 to 6, and less than zero degrees. To consider the patients as a whole, there was no statistical difference between knee alignments in two postoperation measurements. Further subgroup analysis showed similar result in patients underwent closed-wedge osteotomy. However, in open-wedge HTO cases, loss of correction was meaningful during follow-up, mainly pertained to failure in patients without fixation (18 out of 28 cases).

Moreover, analysis showed that the more knee varus observed preoperatively (>10 degrees), the more loss of correction experienced postoperatively. Patients' score for their pain revealed improvement and satisfaction in 32(78%), no change in 7(17%), and aggravation in 2(5%). The average flexion was 125° based on final follow up measurement.

Our major complications were 2 cases of intra-articular fracture while performing osteotomy. Five patients also complained of prolonged pain at fibula osteotomy site. No delayed union, nonunion, superficial infection, deep infection, skin necrosis or peroneal nerve and vascular injury were observed.

### Discussion

High tibial osteotomy is considered as an accepted treatment for osteoarthritis of the knee with defined indication, aiming to correct deformity, and improves pain and function.

The open wedge osteotomy has become more appealing in recent years because of some clinical advantages over closed wedge osteotomy including avoiding neurological complications such as common peroneal nerve, the ability to achieve a predictable

biplanar correction (coronal and sagittal), the ability to adjust the correction intraoperatively, applying only a single bone cut and the relative ease of combining it with other procedures (9-11). Moreover, it allows easier change to an eventual total knee arthroplasty. A closed wedge osteotomy is favored, however, for minimal chance of delayed union or nonunion and more accurate correction of deformity especially in moderate varus angles and in younger patients enjoying good bone stock (12).

There has been remarkable controversy considering the ideal valgus correction angle (13-16). It is implied, from the literature, that valgus side of this spectrum is more favored, even though a noticeable valgus position might be cosmetically unacceptable, particularly with varus angulation of the contralateral knee which can result in wind-blown appearance. Coventry (7,16) verified that knees with less valgus correction had a higher risk of failure, and recommended that an over correction of a normal 5° of anatomical valgus improves the long-term results. However, it should be considered that excessive valgus angulation may not only overload the lateral compartment, but it might also raise cosmetic problem. A valgus angulation of 7 to 10° is seemed to be agreed as a desirable correction threshold among surgeons.

Progression of radiological and clinical results of HTO during time has been evaluated in various follow-up studies. Some stated that even though the radiological degenerative changes may aggravate eventually, but the clinical symptoms generally improve after

intervention (10,11).

In our practice, we tried to correct the knee alignment to accepted range of valgus. It was observed that higher varus deformity was accompanied with higher rate of over or under correction. Also, open wedge osteotomy without plate stabilization was observed to result in increased rate of correction failure despite appearing stable configuration while operation. This poses the need for meticulous preoperative planning regarding amount of correction, type of osteotomy and necessity of extra augmentation. As short-term follow up, our patients were generally satisfied regarding pain relief and improved range of motion. Also as a retrospective study, we had limitation about controlling confounding factors and evaluating patients' preoperative clinical and functional status. Long-term observation is needed to evaluate the outcome of operations performed in our series of cases.

### Conclusion

High tibial osteotomy can be considered as an effective procedure for prevention and the treatment of early knee arthritis. Compared with total knee arthroplasty (TKA), the HTO has advantages of less complicated surgical technique and a lower surgical cost. With proper patient selection and applying appropriate technique plus sufficient correction, it may diminish the need for knee arthroplasty or at least delay the surgery.

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