



Original article

Comparison of closing-wedge and opening-wedge high tibial osteotomies for medial compartment osteoarthritis of knee in Asian population: Mid-term follow-up



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ABSTRACT

Background: Valgus high tibial osteotomy (HTO) is a well-established treatment option for patients with early osteoarthritis of the medial compartment of the knee. It is achievable with either open-wedge or closed-wedge technique. The aim of the study was to compare the radiological and clinical outcomes following HTO done with open- and closed-wedge techniques.

Material and methods: Two groups of patients undergoing HTO and fixation with locking plates were compared. Twenty-five patients were operated using medial open-wedge technique and 23 using closed-wedge technique between January 2000 and June 2014. They were compared on the basis of Hospital for Special Surgery (HSS), knee score, preoperative and postoperative range of motion, femoro-tibial angle and duration required for full-weight bearing. Early and late postoperative complications were noted.

Results: Median HSS score at 6 months and 1 year post-surgery was better in the open-wedge technique group. The range of motion was also higher at early follow-up in the open-wedge technique group, with shorter duration for full-weight bearing. Delayed union was seen in two patients in the open-wedge technique group and four patients in closed-wedge group. Peroneal nerve palsy was noted in two patients in the closed-wedge group.

Conclusion: Both open-wedge and closed-wedge HTO lead to good and comparable results. However, the technique of open-wedge osteotomy provided better outcome in terms of functional scores in early as well as late follow-up with decreased duration required for full-weight bearing.

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1. Introduction

One of the most common joint disorders encountered today is osteoarthritis (OA) of the knee causing considerable pain immobility and deformity. The associated malalignment in the joint due to the deformity increases the progression of osteoarthritis of the knee.^{1,2} The gold standard treatment for advanced tri-compartmental osteoarthritis of the knee has been total knee arthroplasty. For patients with early osteoarthritis of the medial compartment of the knee, valgus high tibial osteotomy (HTO) is considered as a well-established treatment option.³ The aim of the osteotomy is to change the load distribution across the knee from

the involved medial compartment to the healthy lateral compartment in order to reduce pain, slow the degenerative process and ultimately delay the requirement of total knee replacement.^{4–7} Various techniques, including lateral closed-wedge, medial opening-wedge, dome osteotomy and hemicallotasis with external fixator, etc., are available. Each technique has its own advantages and disadvantages.^{8–11}

There is inadequate literature about the long-term results of open-wedge osteotomy as compared with closed-wedge osteotomy fixed with locking plates. Our aim in this study is to determine the radiographic and clinical mid-term results as well as the survival rate in our participants comparing open-wedge and closed-wedge osteotomies, which have been stabilized by locking plates.

2. Materials and methods

A total of 48 patients who underwent HTO at a tertiary hospital for medial compartment OA knee were considered for the study.

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The Institutional Review Board granted permission for the study. All patients were operated by a single, senior orthopaedic consultant at the same centre between January 2000 and June 2014. The patients were divided into two groups. The first group underwent medial open-wedge osteotomy and the second group underwent closed-wedge osteotomy. Both the osteotomies were secured with a locked plate and screws manufactured by Synthes. The indication for osteotomy was medial compartmental osteoarthritis of the knee. Patients with cardiac, respiratory, hepatic and renal disorders were excluded from the study.

In the first group, 13 men and 12 women (32 knees) aged 48–60 (mean, 55) years underwent opening-wedge technique; the extent of the wedge depended on the length of the osteotomy and diameter of the proximal part of the tibia and was calculated preoperatively. The AO manual¹¹ provides goniometric formula table, which gives the extent of the opening wedge for a specific correction. Also, during surgery, the degree of correction was corrected fluoroscopically.

The second group of 13 men and 10 women (30 knees) aged 48–60 (mean, 55) years underwent closed-wedge osteotomy with locking compression plate fixation (Table 1). Before surgery, similar to the opening-wedge group, the amount of bone to be resected was calculated as per the AO manual.¹¹ The incision was a midline vertical one, so as to accommodate the locking compression plate and when necessary enable switching to a total knee arthroplasty. The common peroneal nerve was exposed and retracted. The anterior aspect of the proximal part of the fibular head, which represents the anterior part of the proximal tibiofibular syndesmosis, was resected. Fragments were fixed with a locking compression plate and screws.

In both the cases, the knee was kept in a removable long knee brace. Early mobilization and exercises were possible due to enhanced rigidity of the plate. All other conditions remained the same for both groups. All the patients were clinically and radiologically examined before surgery and after surgery and in the subsequent follow-ups at every 6 weeks until 6 months, at 1 year, and yearly thereafter. Toe touch weight bearing was started at 6 weeks. Full-weight bearing was allowed after bone union. The Hospital for Special Surgery (HSS).¹² Knee Scores were determined based on pain, function, range of movement, muscle strength, flexion deformity and instability. Scores of 85–100 were considered excellent, 75–84 as good, 60–74 as fair and <60 as poor. Bone union was considered confirmatory when there was no tenderness along the osteotomy line and no pain during weight bearing, together with radiological evidence of callus formation in the form of crossover trabeculae. Delayed union was defined as non-union at 6 months, with distinct tenderness along the osteotomy line, pain during weight bearing and scarcity of crossover trabeculae. The femoro-tibial angle was measured. The stage of osteoarthritis was determined using antero-posterior radiographs of the legs in stance position, according to the Hokkaido University grading system¹³ (Table 2).

Table 1
Demographics of the study.

Parameters	Open-wedge osteotomy	Closed-wedge osteotomy
Men	13	13
Women	12	10
Mean age	56 years	55 years
Knees	32	30
No. of knees with stage II osteoarthritis	19	16
No. of knees with stage III osteoarthritis	13	14

Table 2
Stages of osteoarthritis according to The Hokkaido University Grading System.¹³

Stage	Radiological finding
I	Bony spur only
II	Narrowing of joint space (<half normal joint space)
III	Narrowing of joint space (>half normal joint space)
IV	Obliteration of joint space or minor bone erosion (<1 cm)
V	Major bone erosion (>1 cm) or subluxation

3. Results

No patients were lost to follow-up. As shown in Table 1, both the groups were comparable in terms of demographics and the number of knees operated. There were more cases of stage III arthritis than stage II in the open-wedge osteotomy (19 vs. 13) group as compared to the closed-wedge osteotomy group (16 vs. 14). There was no significant difference in terms of the duration required for surgery as well as the intra-operative blood loss. The preoperative median HSS score as well as the femoro-tibial angle was comparable in both the groups.

The median HSS scores at 6 months and 1 year post-surgery were better in the open-wedge group than the closed-wedge group. Six months after surgery, the number of patients with excellent and good HSS scores was higher in the open-wedge osteotomy group (25) as compared to the closed-wedge osteotomy (16) group ($P < 0.05$). The trend of more number of patients having excellent and good HSS scores in the open-wedge osteotomy group as opposed to closed-wedge osteotomy group continued at 1 year of follow-up. All these results were statistically significant. However, at 3 years follow-up, there was no change in these numbers (Table 3) and the results were not significant statistically.

As shown in Table 4, the femoro-tibial angles in both open-wedge and closed-wedge osteotomies remained similar at 6 months, 1 year and 3 years follow-up. There was minimal loss of correction in both the groups.

The range of motion of the knee joint was better in the open-wedge group as compared to the closed-wedge group at 6 weeks of follow-up, as illustrated by Table 5. However, at subsequent follow-ups, no difference was seen. The duration required for

Table 3
Hospital for special surgery scores for open- vs. closing-wedge high tibial osteotomies.

Parameters	Open-wedge osteotomy	Closed-wedge osteotomy	P value
Median (range) HSS score			
Preoperative	54 (40–64)	53 (45–61)	0.675 ^a
Postoperative – 6 months	77 (68–85)	76 (58–87)	0.012 ^a
Postoperative – 1 year	82 (69–87)	76 (59–87)	0.033 ^a
Postoperative – 3 years	82 (70–85)	75 (58–86)	0.657 ^a
Postoperative HSS score (no. [%] of patients)			
6 months			0.039 ^b
Excellent (85–100)	5 (16)	3 (9)	
Good (75–84)	20 (63)	13 (46)	
Fair (60–74)	4 (12)	9 (28)	
Poor (<60)	3 (9)	5 (17)	
1 year			0.856 ^b
Excellent (85–100)	10 (32)	7 (23)	
Good (75–84)	18 (56)	14 (47)	
Fair (60–74)	3 (9)	6 (20)	
Poor (<60)	1 (3)	3 (10)	
3 years			0.423 ^b
Excellent (85–100)	10 (32)	7 (23)	
Good (75–84)	18 (56)	14 (47)	
Fair (60–74)	3 (9)	6 (20)	
Poor (<60)	1 (3)	3 (10)	

^a Mann-Whitney *U* test.

^b Fisher's exact test.

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