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## The Knee



## Can osteoarthritic patients with mild varus deformity be indicated for high tibial osteotomy?

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## ABSTRACT

**Background:** Whether osteoarthritic patients with mild varus deformity can be indicated for high tibial osteotomy (HTO) is not established. We examined the preoperative characteristics and postoperative outcomes of HTO in patients with mild genu varum compared to patients with greater varus deformity.

**Methods:** Seventy-one patients who underwent HTO were included in this retrospective study. Patients were divided into either mild varus (MV, mechanical femorotibial angle (mFTA)  $\leq 4^\circ$ ,  $n = 31$  (44%)) and greater varus (GV, mFTA  $> 4^\circ$ ,  $n = 40$  (56%)) groups. Preoperative characteristics on single photon emission computed tomography-computed tomography (SPECT-CT), magnetic resonance image and radiograph were evaluated. Alignment parameters and functional outcomes were compared pre- and postoperatively between the groups.

**Results:** Preoperative characteristics were similar between the two groups, except the severity of arthritis and coronal alignment. There was no difference in the proportion of hot uptake in the medial compartment; medial meniscus posterior horn root tear, complex or radial tear; bone marrow edema. Full-thickness cartilage defect of medial compartment was more frequent and arthritis grade was also more severe in GV group. Coronal alignment of the MV group was corrected into more valgus than the GV group ( $4.5^\circ$  vs.  $2.8^\circ$  in mFTA,  $P = 0.012$ ). Pre- and postoperative Knee Society knee and function scores were also comparable in the two groups.

**Conclusions:** Mild varus patients are similar to greater varus patients regarding preoperative features and achieve the comparable functional outcome. A selected subset of osteoarthritic patients with mild varus deformity might be indicated for HTO.

**Level of evidence:** III (Retrospective comparative study).

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### 1. Introduction

High tibial osteotomy (HTO) is a load-shifting procedure in patients with medial compartment osteoarthritis (OA) with genu varum deformity [1,2]. Long-term survivorship of HTO is inferior to those of arthroplasty, but it is a good surgical option, especially for younger patients who are typically more active than elderly people [3,4]. Even aggressive labor or sports activity is allowed after surgery because HTO is a native joint-preserving procedure [5–8].

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To achieve optimal surgical outcomes, the appropriate patient selection is mandatory [1]. The severity of varus deformity should be considered when selecting patients with indications for HTO. A certain degree of varus deformity is requisite, but there is no consensus about a cut-off value of varus malalignment for HTO indication. Five degrees of mechanical femorotibial angle (mFTA) is frequently used but is arbitrary [9]. Considering that varus malalignment is an important risk factor for OA progression, patients who have varus deformity, although initially not severe, may develop worsening symptoms [10–12]. Furthermore, the presence of medial meniscus (MM) posterior horn root tear or complete radial tear may indicate arthritic progression, as normal hoop tension cannot be restored [13]. The severity of the symptoms does not always correlate with varus deformity. Therefore, determining whether to perform HTO based merely on an arbitrary cut-off of varus deformity may not be appropriate. However, whether HTO indications can be extended to the patients with mild varus deformity is unclear. We assessed whether medial OA patients with mild varus deformity can be indicated for HTO by comparing the preoperative characteristics and postoperative outcomes of patients with mild genu varum ( $\leq 4^\circ$ ) with those of patients with greater varus

**Table 1**  
Comparison of group characteristics.

	Greater varus ( $>4^\circ$ ) (n = 40)	Mild varus ( $\leq 4^\circ$ ) (n = 31)	P
<b>Demographics</b>			
Age (years)	56.9° ± 6.6° (range, 40–74°)	57.9° ± 7.9° (range, 31–80°)	0.555
Sex: female	33° (83%)	27° (87%)	0.595
Height (cm)	157.5° ± 7.7°	157.9° ± 8.7°	0.817
Weight (kg)	65.3° ± 10.4°	68.1° ± 14.7°	0.350
BMI (kg/m <sup>2</sup> )	26.3° ± 3.7°	27.1° ± 4.2°	0.393
Side: right	24° (60%)	9° (29%)	<b>0.009</b>
<b>Preoperative characteristics</b>			
Hot uptake on SPECT	28/28° (100%)	17/18° (94%)	0.391
MMPH root tear	20° (50%)	21° (68%)	0.133
MM tear (other than root tear)			
Complex or radial MM tear	12° (32%)	10° (33%)	1.000
Horizontal tear	2° (5%)	1° (3%)	
MM extrusion (mm)	3.5° ± 1.7	3.2° ± 1.4	0.660
MM extrusion $\geq 3$ mm	27° (68%)	17° (55%)	0.276
BM edema	23° (58%)	20° (65%)	0.549
Full-thickness cartilage defect (MFC)	28° (70%)	12° (39%)	<b>0.008</b>
Full-thickness cartilage defect (MTP)	26° (65%)	13° (42%)	0.053
K–L grade (medial compartment)			
Grade 2	1° (2%)	3° (10%)	<b>0.007</b>
Grade 3	31° (79%)	28° (90%)	
Grade 4	8° (20%)	0°	
<b>Concurrent arthroscopic procedures</b>			
MMPH root repair	10° (25%)	19° (61%)	<b>0.002</b>
Meniscectomy (MM and/or LM)	11° (28%)	6° (19%)	0.425
Microfracture	12° (30%)	6° (19%)	0.306
<b>Radiographic parameters</b>			
mFTA (preoperative)	−7.7° ± 2.6° (range, −4.2°–−12.2°)	−2.8° ± 0.9° (range, −0.9°–−3.9°)	<b>&lt;0.001</b>
mFTA (postoperative)	2.6° ± 2.8°	4.2° ± 2.4°	<b>0.012</b>
WBL (preoperative)	13% ± 12%	36% ± 5%	<b>&lt;0.001</b>
WBL (postoperative)	62% ± 12%	68% ± 11%	<b>0.038</b>
mMPTA (preoperative)	84.5° ± 1.8°	86.8° ± 1.3°	<b>&lt;0.001</b>
mMPTA (postoperative)	93.7° ± 2.9°	93.2° ± 2.9°	0.545
mLDFA (preoperative)	89.1° ± 1.9°	87.4° ± 1.4°	<b>&lt;0.001</b>
mLDFA (postoperative)	89.0° ± 2.1°	87.4° ± 1.4°	<b>&lt;0.001</b>
Tibial posterior slope (preoperative)	10.6° ± 3.4°	10.0° ± 2.9°	0.417
Tibial posterior slope (postoperative)	10.9° ± 3.6°	10.7° ± 2.6°	0.824
<b>Functional outcome (univariate analyses)</b>			
AKS knee (preoperative)	61.7° ± 16.3°	66.8° ± 15.2°	0.255
AKS knee (postoperative)	89.2° ± 12.8°	88.6° ± 13.4°	0.854
AKS function (preoperative)	71.4° ± 12.3°	71.0° ± 19.9°	0.925
AKS function (postoperative)	84.9° ± 14.9°	80.4° ± 18.4°	0.305
<b>Functional outcome (multivariate analyses)<sup>a</sup></b>			
AKS knee (postoperative)	92.2° (SE, 2.3°)	89.3° (SE, 3.2°)	0.507
AKS function (postoperative)	83.6° (SE, 3.5°)	82.9° (SE, 4.8°)	0.906

P values less than 0.05 were shown in bold.

<sup>a</sup> Analysis of Covariance (ANCOVA), adjusted for age, sex, body mass index (BMI), concurrent arthroscopic procedures (medial meniscus posterior horn (MMPH) root repair, meniscectomy, microfracture), Kellgren–Lawrence (K–L) grade (medial compartment), preoperative American Knee Society (AKS) knee/function score, BM, bone marrow; MFC, medial femoral condyle; mLDFA, mechanical lateral distal femoral angle; MM, medial meniscus; mMPTA, mechanical medial proximal tibial angle; mFTA, mechanical tibiofemoral angle; MTP, medial tibial plateau; SE, standard error; WBL, weight bearing line coordinate.

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