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What is the Effect of Medial Open-Wedge Valgus Tibial Osteotomy on Patella?

Abstract

Background: Medial open wedge high tibial osteotomy (MOWHTO) is effective for the treatment of medial compartment osteoarthritis of the knee. Several studies report that it produces patella baja and increases patellofemoral contact pressure in the patellofemoral joint. Pressure distribution due to underlying varus deformity has a major influence on the onset and development of osteoarthritis in the knee joint. This study is reporting on the effect of MOWHTO on patello-femoral joint.

Methods: The present study was a retrospective case series study on the patients with symptomatic osteoarthritis of medial compartment of knee with varus deformity requiring correction, referring in a 2 year period to a teaching hospital. At the last follow-up, assessment of the patellar changes based on Insall and Blackburn indices, and mechanical axis deviation (MAD) measurements was done.

Results: A total of 49 knees were recruited. 52.6% of patients were male. The mean age of patients was 26.55±5.876 years and the mean body mass index was 25.05±2.903 kg/m2. No knee needed revision surgery, no intra-articular fracture occured in any patient after surgery.

The mean score of VAS[1] increased significantly after surgery (P <0.05). Patellar changes before and after surgery were not statistically significant based on radiographic indices. The mean pre-operative MAD of (−8.90° ± 3.07°) improved to (0.2° ± 2.780°) post-operative value.

Conclusion: Based on the above results, proper correction in MAD was obtained and no significant change in patellofemoral joint biomechanics was seen.

Keywords: Tibia, patellofemoral joint, Osteotomy, Biomechanics, mechanical axis

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Introduction

Osteoarthritis is the most common joint disease worldwide, and its prevalence has increased [(1)]. Unicompartmental knee osteoarthritis is often a medial joint problem and leads to pain and limits function. In the normal knee, about 60% of the weight is passed over the medial compartment of the knee and 40% through the lateral compartment[(2-3)].

Genu varum (GV) is a knee deformity in which the center of the knee joint is located lateral to the lower limb mechanical axis. Underlying causes for development of this deformity includes vitamin D deficiency during childhood, congenital factors, metabolic diseases of abnormal calcium and phosphorus, trauma and infection. If major changes occur in the alignment of the joint it will cause pain in the medial compartment of the knee [(2-3)]. Furthermore, it may lead to walking problems and inappropriate patellar movement in severe cases. The deformity may gradually destroy cartilage of the knee joint, resulting from unequal pressure imposed on the medial and distal compartments of the knee [(4)].

There are several treatment options for genu varum. 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 sagittal changes, including patellar height and tibial slope, have to be considered [5].

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 medial compartment and the preferred treatment of is proximal tibial osteotomy, in which the patient's weight is transferred to the lateral compartment that still has healthy cartilage. A medial opening wedge or lateral closing wedge osteotomy of knee, decrease the pressure in the involved compartment of the knee, reduce pain and slow the progression of arthritis [6]. Numerous studies have reported success rates of 80-90% in five-year follow-ups [7-8].

Pressure distribution due to underlying varus deformity has a major influence on the onset and development of osteoarthritis in the knee joint [9-13]. Medial open wedge high tibial osteotomy (MOWHTO) is effective in treatment of medial compartment osteoarthritis of the knee. This procedure is especially useful in younger patients to off-load the medial compartment of the knee by changing the mechanical axis. Some studies have reported adverse effects, like patella baja and increase in patellofemoral contact pressure in the patellofemoral joint [1,14]. There are various factors that could affect the progression of the patellofemoral osteoarthritis [15].

This study evaluates several factors in knees that underwent medial opening wedge high tibia osteotomy. The degree of mechanical axis correction and the relationship of patella height changes with pre- and post-operative mechanical axis deviation (MAD) were investigated.

Methods

This is a retrospective case series study on 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 from 2016 to 2018.

The inclusion criteria of the study included symptomatic medial unicompartment degenerative disease of the knee with an associated varus alignment of ≥ 2° and near normal lateral patellofemoral compartment with appropriate range of knee motion: Flexion more than 90 degrees and flexion contracture of less than 10 degrees. The exclusion criteria included traumatic genu varum, lateral compartment osteoarthritis and a history of fracture or previous open surgery on the ipsilateral lower limb.

The patients with over one-year follow-up were invited for clinical and radiographic examinations. After explaining the objectives and method of the study, informed consent was obtained from all the patients.

In all osteotomy patients, the opening-wedge valgus osteotomy was done for primary genuvarum and was done to transfer the weight bearing line to 50 or 62.5% of the medial cortex of the plateau width.

Radiological evaluation was: Standard radiography before surgery and at follow-up which included:1) Standing anterior/posterior radiography of the entire lower limb, including hip, knee, and ankle joints, and measurement of 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 knee in 30° flexion.

The patients' symptoms were checked with VAS. The MAD and patellar position using insall-black burn scores were compared with pre-operative values. The degree of knee degeneration was also assessed.

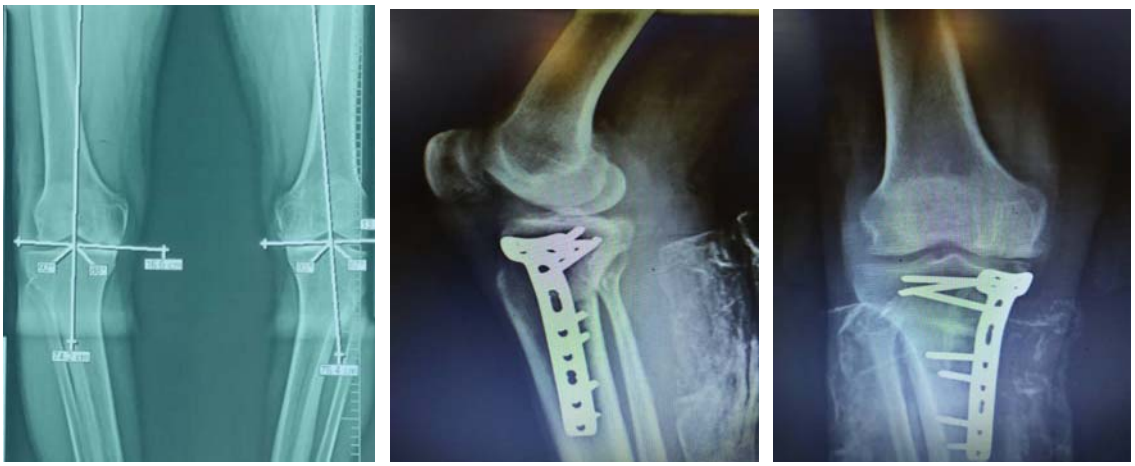

Figure 1. Preoperative evaluation graph, X-ray of the knee in one month after surgery

The Insall-Salvati ratio determining the length of patellar tendon (LT) and length of patella (LP) with normal LT-to-LP ratio of 1.0 were considered. Variation of more than 20% indicated abnormal position[16].

The Blackburne-Peel method measures length of articular surface of patella to length measured from articular surface of tibia to inferior pole of patella with normal ratio of 0.54-1.06[16].The degree of osteoarthritis (DJD Grade) of the knee was determined by the Kellegren-Lowrence scale. According to this classification, the grade of osteoarthritis is divided into 5 levels, grade 0 indicates the absence of osteoarthritis and grade 4 the highest osteoarthritis intensity[16].

Surgical technique: Surgery was performed in supine position and under general anesthesia with tourniquet. 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 image intensifier guide, two pins were inserted 3.5 cm distal to the articular surface from medial to lateral towards the fibular head tip. The osteotomy was done according to preoperative planning, fixation was performed with 4.5 T-Plate, and bone allograft was placed. Soft tissue repair was performed and after the operation, splinting of the lower limb was performed.

Statistical analysis was performed using Spss version23.A descriptive analysis of the sociodemographic characteristics of our cohort was initially done to evaluate the distribution, normality, and homogeneity of the data. Descriptive analysis included frequency and percentage distribution for categorical variables and mean and standard deviation for numerical variables.

The level of significance was set to be below 0.05.

Results

A total of 47 patients were included in the study, but only 38 patients (49 knees) agreed to participate in the study and attended the clinical follow-ups. 20 (52.6%) of patients were male and 18 female. The mean age of patients was 26.55±5.876 years and the mean body mass index of patients was 25.05±2.903 kg/m2. The mean BMI was 25.05±2.903. No patient required additional or revision surgery. Intra-articular fracture did not occur in any of the patients after surgery.

The mean score of VAS 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).

Table 1

Variables	Before surgery	After Surgery	P-value
Insall Score	0.992±0.357	0.994±0.381	0.229
Blackburn Score	0.798±0.0175	0.799±0.0179	0.322

Data are expressed as mean ± SD.
The statistical test used was t-test.
*P<0.05 is considered as significant level.

Table 2			
Variables	**Before surgery**	**After Surgery**	**P-value**
DJD Grade	1.07±0.721	1.12±0.714	0.16
Data are expressed as mean ± SD. The statistical test used was t-test. *P<0.05 is considered as significant level.			

The preoperative mean MAD of the knee was −8.90° ± 3.07° (minus meaning varus and plus meaning valgus), which improved to 0.2° ± 2.780°after surgery. (P-value<0.001)

The mean DJD Grade before and after surgery did not differ significantly (P >0.05)

Discussion

HTO is popular in the treatment of isolated osteoarthritis of knee medial compartment, especially in the younger age group [17-19]. By correcting the mechanical axis, it will allow redistribution of weight and, hence off-load the medial compartment and assist in cartilage regeneration.[20,21]

In the study of Ameli et al., patellar changes were not significant based on Blackburn and Insall indices [22].

Moghtadaei et al. in a quasi-experimental study, did open wedge high tibial osteotomy in 43 patients and saw no significant change in Insall-Salvati index[23]

These two studies had similar results to were our study ,showing no significant change in patellar biomechanic..Wright et al reported that patellar height decreased in entire patients treated with proximal tibial osteotomy [24] due to elevation of the articular surface in reference to the tibial tubercle in open wedge osteotomy. Noyes et al suggest that there is indeed a decrease in patellar height in 80% of open wedge osteotomy cases [25]. Tabrizi et al. saw no significant change in Insall -Salvati index in patient with close or open wedge proximal tibia osteotomy regarding changes in patellar height after treatment [26]. On the other hand, El-Azab et al. concluded that there was no correlation between the correction in the coronal plane and the changes in the sagittal plane with patella height changes [27]. Our findings were, similar to Tabrizi and El-Azab: The patellofemoral joint biomechanics did not show significant change post-surgery compared with pre-operative findings according to Insall and Blackburn indices.

Siew Ghim Gooi et al in a retrospective study in 106 patients who underwent HTO measured the mechanical axis deviation (MAD) and found no significant association with postoperative patellar height. [28]

In the present study, the mean pain intensity after surgery was significantly reduced after surgery. According to the patients' control x-ray, Kellegren-Lowrence scale 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 had stopped.

In a study y Ameli et al., the Kellegren-Lowrence scale increased by one degree during follow-up in 10% of patients with primary varus, while 50% of patients with secondary varus had 1 degree increase in DJD during follow-up [22].

The main limitation of our study , besides being a retrospective study, was the short follow-up and low number of cases .

Conclusion

Open-wedge medial tibial valgus osteotomy corrects MAD and shows no significant change in patellofemoral biomechanics in short follow-ups. ≥ 2°

References:

1. Avidan P, Adamson GJ, Miller JR, Durand P Jr, Dawson PA, Pink MM, Lee TQ. The effect of medial opening wedge proximal tibial osteotomy on patellofemoral contact. Am J Sports Med. 2013;41(1):80–6

2. Kawakami H, Sugano N, Yonenobu K, Yoshikawa H, Ochi T, Nakata K, et al. Change in the locus of dynamic loading axis on the knee joint after high tibial osteotomy. Gait & posture. 2005;21(3):271-8.
3. Ribeiro CH, Severino NR, Cury RdPL, de Oliveira VM, Avakian R, Ayhara T, et al. A new fixation material for open-wedge tibial osteotomy for genu varum. The Knee. 2009;16(5):366-70.
4. Lawrence RC, Felson DT, Helmick CG, Arnold LM, Choi H, Deyo RA, et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States: Part II. Arthritis & Rheumatism. 2008;58(1):26-35.
5. Heller M, Matziolis G, König C, Taylor W, Hinterwimmer S, Graichen H, et al. Muskuloskelettale Biomechanik des Kniegelenks. Der Orthopäde. 2007;36(7):628-34.
6. Agneskirchner JD, Hurschler C, Wrann CD, Lobenhoffer P. The effects of valgus medial opening wedge high tibial osteotomy on articular cartilage pressure of the knee: a biomechanical study. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2007;23(8):852-61.
7. Sprenger TR, Doerzbacher JF. Tibial osteotomy for the treatment of varus gonarthrosis: survival and failure analysis to twenty-two years. JBJS. 2003;85(3):469-74
8. Hernigou P, Medevielle D, Debeyre J, Goutallier D. Proximal tibial osteotomy for osteoarthritis with varus deformity. A ten to thirteen-year follow-up study. The Journal of bone and joint surgery American volume. 1987;69(3):332-54.
9. Block JA, Shakoor N. (2009) The biomechanics of osteoarthritis: implications for therapy. Curr Rheumatol Rep.;11(1):15-22.
10. Brandt KD, Dieppe P, Radin E. (2009) Etiopathogenesis of osteoarthritis. Med Clin North Am. ;93(1):1-24
11. Brandt KD, Dieppe P, Radin EL. (2009) Commentary: Is It Useful to Subset "Primary" Osteoarthritis? A Critique Based on Evidence Regarding the Etiopathogenesis of Osteoarthritis. Semin Arthritis Rheum. ;39(2):81-95
12. Messier SP, DeVita P, Cowan RE, Seay J, Young HC, Marsh AP. (2005) Do older adults with knee osteoarthritis place greater loads on the knee during gait? A preliminary study. Arch Phys Med Rehabil. ;86(4):703-709
13. Messier SP, Gutekunst DJ, Davis C, DeVita P. (2005) Weight loss reduces knee-joint loads in overweight and obese older adults with knee osteoarthritis. Arthritis Rheum. ;52(7):2026-2032
14. Bin SI, Kim HJ, Ahn HS, Rim DS, Lee DH. Changes in patellar height after opening wedge and closing wedge high Tibial osteotomy: a meta-analysis.Arthroscopy. 2016;32(11):2393–400
15. LaPrade RF. Editorial commentary: is it the osteotomy that is causing the development of Patellofemoral osteoarthritis or is it the Normal progression of preexisting osteoarthritis? Arthroscopy. 2017;33(4):817–8.
16. Frederick M. Azar, MD, James H. Beaty, MD, S. Terry Canale, MD. Knee injuries. Robert H. Miller III, Frederick M. Azar. Campbell's Operative Orthopedics, Philadelphia.elsevier.2017.p2123-2136
17. Pipino G, Indelli PF, Tigani D, Maffei G, Vaccarisi D. Opening-wedge high tibial osteotomy: A seven-to twelve-year study. Joints. 2016;4:6–11.
18. Floerkemeier S, Staubli AE, Schroeter S, Goldhahn S, Lobenhoffer P. Outcome after high tibial open-wedge osteotomy: A retrospective evaluation of 533 patients. Knee Surg Sports Traumatol Arthrosc. 2013;21:170–80
19. Smith TO, Sexton D, Mitchell P, Hing CB. Opening-or closing-wedged high tibial osteotomy: A meta-analysis of clinical and radiological outcomes. Knee. 2011;18:361–8.
20. Kanamiya T, Naito M, Hara M, Yoshimura I. The influences of biomechanical factors on cartilage regeneration after high tibial osteotomy for knees with medial compartment osteoarthritis: Clinical and arthroscopic observations. Arthroscopy. 2002;18:725–9.
21. Akizuki S, Yasukawa Y, Takizawa T. Does arthroscopic abrasion arthroplasty promote cartilage regeneration in osteoarthritic knees with eburnation? A prospective study of high tibial osteotomy with abrasion arthroplasty versus high tibial osteotomy alone. Arthroscopy. 1997;13:9–17
22. Jabalameli M, Rahbar M, Radi M, Hadi H. The results of high tibial open wedge osteotomy in patients with varus deformity . Tehran Univ Med J. 2013; 71 (4) :216-223.
23. Mehdi Moghtadaei, Babak Otoukesh, Bahram Bodduhi, Keyvan Ahmadi, Ali Yeganeh Med Arch. 2016 Jul 27; 70(4): 293–295. Published online 2016 Aug. doi: 10.5455/medarh.2016.70.293-295
24. Wright J M, Heavrin B, Begg M, Sakyrd G, Sterett W. Observations on patellar height following opening wedge proximal tibial osteotomy. Am J Knee Surg. 2001; 14: 163-73
25. Noyes FR, Mayfield W, Barber-Westin SD, Albright JC, Heckmann TP. Opening wedge high tibial osteotomy: an operative technique and rehabilitation program to decrease complications and promote early union and function. Am J Sports Med 2006 Aug; 34(8):1262-73.
26. Ali Tabrizi, Jafar soleimanpour, Ali Sadighi, Ali Jafari Zare .Malays Orthop J. 2013 Mar; 7(1): 7–12. doi: 10.5704/MOJ.1303.009
27. El-Azab H, Glabgly P, Paul J, Imhoff AB, Hinterwimmer S. Patellar height and posterior tibial slope after open- and closed-wedge high tibial osteotomy: A radiological study on 100 patients. Am J Sports Med. 2010;38:323–9.
28. Siew Ghim Gooi, Chloe Xiao Yun Chan, Melvin Kian Loong Tan, Andrew Kean Seng Lim, Kandiah Satkunanantham, James Hoi Po Hui Indian J Orthop. 2017 Sep-Oct; 51(5): 545–551. doi: 10.4103/ortho.IJOrtho_214_17