

## Studying the effect of medial open wedge high tibial osteotomy on the posterior slope of tibia among patients with Genu varum

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### RESEARCH

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### ABSTRACT

#### Background

A slight change in the posterior slope of tibia results in complications such as limited movement of knee joint and higher risks of Osteoarthritis.

#### Aims

The present research seeks to study levels of tibia's posterior slope change and limited movement of knee joint and knee stability following medial open wedge osteotomy used to treat patients with genu varum.

#### Methods

The present research is a clinical trial conducted in the form of a before and after study on patients with genu varum resorting to Imam Reza (PBUH), Khanevade, and Fajr hospitals from 2009 to 2012. As many as 40 knees (32 patients) were studied and the posterior slope of tibia

before and after medial open wedge high tibial osteotomy was measured by someone totally unaware of the research using true lateral radiography. Movement limitation and stability of the knee was measured before and after the operation using scope of motion and Lachman and Drawer test. Paired sample test was used in this research and SPSS was used to analyse the data.

#### Results

The average posterior slope of tibia before the operation was 9.912, while this value changed to 11.625 after the operation signifying a significant increase. In terms of limited knee joint movement, 7 patients were diagnosed with grade 5 Extension LAG after operation, while the remaining 33 patients had a normal motion range (Extension LAG=0).

#### Conclusion

Medial open wedge osteotomy above tibia can help increase the posterior slope of tibia.

#### Key Words

Genu varum, posterior slope of tibia, open wedge osteotomy

#### What this study adds:

##### 1. What is known about this subject?

This research showed that medial open wedge high tibial osteotomy can increase posterior tibial slope.

##### 2. What new information is offered in this study?

This research provides information on levels of tibia's posterior slope change and limited movement of knee joint and knee stability following medial open wedge osteotomy used to treat patients with genu varum.

### 3. What are the implications for research, policy, or practice?

We need to pay greater attention to the techniques that reduce this complication. Keeping in mind the importance of this matter and the small number of researches conducted in this field, further studies are recommended.

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### Background

Knee joint is the largest Synovial joint in the body. This joint is considered to be one of the most complicated of all joints. Contrary to hip joint, knee is a relatively superficial joint and relatively strong ligaments connect bones to each other for their stability and strength. As a matter of fact, the stability of this joint is greatly dependent upon soft tissue.<sup>1</sup> The anatomical axis line or mechanical axis naturally runs in the center of knee. If the knee has an outward position relative to the mechanical axis, we will have genu varum. An inward position of knee center will result in genu valgum. In a standing position and when ankles are put together, it will be natural if the distance between the two knees is less than 2.5cm.

The following grades are defined based on the distance between knees: grade 1 for a distance of 2.5cm, grade 2 for a distance of 2.5 to 5cm, grade 3 for a distance of 5 to 7.5, and grade 4 for a distance of 7.5 and more.<sup>2,3</sup> Genu varum is a relatively common orthopaedic disorder with a frequency rate of 1 per cent in general population which engages lower limbs. If no proper attention is paid to it and no suitable therapeutic measures are taken, disabilities in the old age will be inevitable. It is necessary to correct knee deflection among those patients with painful genu varum who have no history of other diseases. Further to paying attention to background diseases, treating this disorder requires corrective consideration, nonoperational treatments, correction of Varus deformity using surgical methods based upon osteotomy and creation of correct anatomy in the suffering knee in order to reduce the pressure on knee compartments.<sup>4,5</sup>

Structural genu varum is usually possible through timely application of brace in suitable periods. Placing an external wedge in sole or heel is not recommended because as the legs grow curved, the feet will also move toward pronation. Correcting this disorder requires correction of skeletal structure and operation is used only in severe cases.<sup>6,7</sup> HTO is a proven cure for knee unilateral osteoarthritis. 80 per cent of all cases exhibited satisfactory results 5 years following the HTO.<sup>8</sup> The satisfaction level of these results will reduce as time passes by. The rate of Proximal Tibial Osteotomies in North America has decreased greatly over

last few years; however, the rate of unilateral and full arthroplasties of knee has increased. HTO is still considered to be a useful method for some patients.<sup>9</sup> Correcting knee deflection using bone open wedge high tibial osteotomy (medial opening wedge high tibial osteotomy) is a common operation with long-term satisfactory results. This operation is conducted in cases of early arthrosis in the internal area of the knee and when there is extra pressure on this area among patients suffering from Symptomatic genu varum.<sup>10,11</sup> Osteotomy was conducted through the upper pin of tibia and a calibrated wedge was placed in the site of osteotomy in order to open the site of osteotomy after removing the pin. Then, various types of plaques are used to stabilize the bone on the medial side and iliac crest can be used for bone graft. One of the complications reported in this type of operation is the change observed in the posterior slope of tibia. The normal slope of tibia is 10 degrees.<sup>9,12,13</sup> The present research seeks to measure the change caused in the posterior slope of tibia following medial open wedge osteotomy used to treat patients with genu varum. We also seek to study the motion limits of knee joint and knee instability among patients.

### Method

This is a clinical trial conducted in accordance with the principles of before & after study. Each patient also acts as his own control with open wedge high tibial osteotomy being the selected intervention. As many as 40 knees (32 patients) with genu varum resorting to Imam Reza (PBUH), Khanevade, and Fajr hospitals from 2009 to 2012 who had undergone medial open wedge high tibial osteotomy were randomly studied. This study was conducted with due observation of all ethical principles and the informed consent of the participants was obtained before entering the research. In order to study the posterior slope of tibia, a simple radiograph in true lateral dimension was made of the knee of the patient suffering from genu varum before and after open wedge high tibial osteotomy. The radiograph of patient's knee needs to be adjusted in such a way that femoral condills could be perfectly matched. Then a line was drawn tangent to the joint level of the upper tibia. Another line was drawn along the posterior axis of tibia with a line drawn perpendicular to it. The angle between the perpendicular line and the tangent line to the joint level of upper tibia was set as the posterior slope of tibial plateau. All measurements were made by an agent totally unaware of the owner of radiography. Lachman test, anterior drawer test, and range of motion test were used examine and study the test before and after the operation. Statistical analysis benefited from paired sample test and data was analyzed using SPSS.

## Results

First the variables were introduced then the raw data was studied using proper statistical tests. The present research was conducted on 32 patients (40 knees) resorting to Imam Reza (PBUH), Khanevade, and Fajr hospitals. Many parameters were studied and the following results were achieved. Of the whole 40 knees studied, 21 of them were on the left leg (52.5 per cent) and 19 were in the right leg (47.5 per cent). The patients' age ranged from 19-26 with the average of  $21 \pm 1.588$  years. The pre-osteotomy tibial slope was between 7–12 with an average of  $9.912 \pm 1.270$  degrees. The post-osteotomy tibial slope was between 8.5 to 16 degrees with an average of  $11.625 \pm 1.518$  degrees.

Prior to osteotomy, all patients were examined for limited motion range and stability and the whole population turned to be in a normal state. A review of motion limit following the operation showed that only 17.5 per cent of the knees (7 knees) had limited knee extension problem and others were in a normal state in terms of this movement. Lachman and drawer tests were used to study and examine patients in terms of knee stability following open wedge high tibial osteotomy and all of them were found to be in a normal state (Figures 1 and 2).

The various studies failed to find a significant correlation between the side with complication (left or right knee) and posterior tibial slope before and after operation ( $p=0.276$ ). The present research also studied the correlation between age and posterior tibial slope using proper statistical tests before and after operation. Numerical analysis failed to find a significant difference between these two variables ( $p=0.207$ ). Analysis also showed that post-operation posterior tibial slope ( $1.518 \pm 11.625$ ) was significantly more than average pre-operation posterior tibial slope ( $1.270 \pm 9.912$ ) ( $p < 0.05$ ). The statistical data of this research are presented in Table 1.

## Discussion

The present research was conducted on 40 knees for 32 patients suffering from genu varum disease with the age range of 19–26 years who had undergone medial open wedge high tibial osteotomy. 21 knees were in the left leg and the remaining 19 were in the right leg. We measured posterior tibial slope before and after operation using simple radiography in true lateral view. The average posterior tibial slope before and after operation was 9.912 and 11.625. As it was expected and with regard to results, a significant rise was observed in post-operation posterior tibial slope which may be attributed to various factors such as tibial cortex incomplete osteotomy, and insufficient

posterior release for the fear of neuro-vascular damages. Authors recommend the following methods to prevent the increase of posterior tibial slope: sufficient release of posterior tibial Periosteum, complete osteotomy of posterior cortex, placing the wedge in the posterior part, and fixation in full knee extension.<sup>14</sup> Cameron et al had previously shown that open wedge osteotomy could reduce post-operation pain.<sup>15</sup> The patients were also examined in terms of knee joint extension lag. Seven cases of extension LAG grade 5 were observed, while the other 33 patients were normal (Extension Lag=0).

Considering the fact that only a minor rise in the posterior tibial slope was made, it had no great clinical influence on knee joint motion restriction. As a result, the major cause in occurrence of Extension LAG was faulty rehabilitation and physiotherapy of patients besides the rise of posterior tibial slope. Concerning knee stability, all patients had stable knees after operation. A minor rise in posterior tibial slope had no influence on knee's clinical stability. El-Azab et al.<sup>16</sup> measured posterior tibial slope of knee in 100 patients in Rechts de isar Hospital of Munich, Germany. This measurement was conducted following open wedge high tibial osteotomy (OWHTO) on 50 patients and closed wedge high tibial osteotomy (CWHTO) on 50 other patients. The results of this research showed a rise in posterior tibial slope after OW and CWHTO (16). A study by Kendoff et al.<sup>17</sup> in the computer surgery center of New York that investigated the effects of OWHTO on posterior tibial slope and another research by BS Sterett WI Miller et al. in Colorado which studied post-open wedge high tibial osteotomy posterior tibial slope of 82 knees using radiography before and after operation found results similar to those of our research.<sup>18</sup> Several researches by Shao et al.,<sup>19</sup> Todd,<sup>20</sup> and Brandon<sup>21</sup> found that a rise in posterior tibial slope could result in forward movement and greater load on anterior cruciate ligament (ACL) and cause rupture in this ligament and instability in the knee. Despite a rise in posterior tibial rise in our research, normal knee stability was observed among all patients. This fact may be attributed to the minor rise in posterior tibial slope which has no influence on clinical stability. Yanasse et al.<sup>22</sup> studied the posterior tibial slope by investigating lateral tibial roentnogram before and after operation in 28 patients resorting to a hospital in Sao Paulo, Brazil. The clinical results achieved in this research were based upon Lysholm knee score. Based on the results achieved in this research, posterior tibial slope experienced an average rise of 2.38 degrees after operation.<sup>22</sup>

## Conclusion

This research showed that medial open wedge high tibial osteotomy can increase posterior tibial slope. Considering the fact that a rise in posterior tibial slope can cause complications such as knee joint motion restriction and greater possibility of Osteoarthritis, etc., we need to pay greater attention to the techniques that reduce this complication. Keeping in mind the importance of this matter and the small number of researches conducted in this field, further studies are recommended.

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## PEER REVIEW

Not commissioned. Externally peer reviewed.

## CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

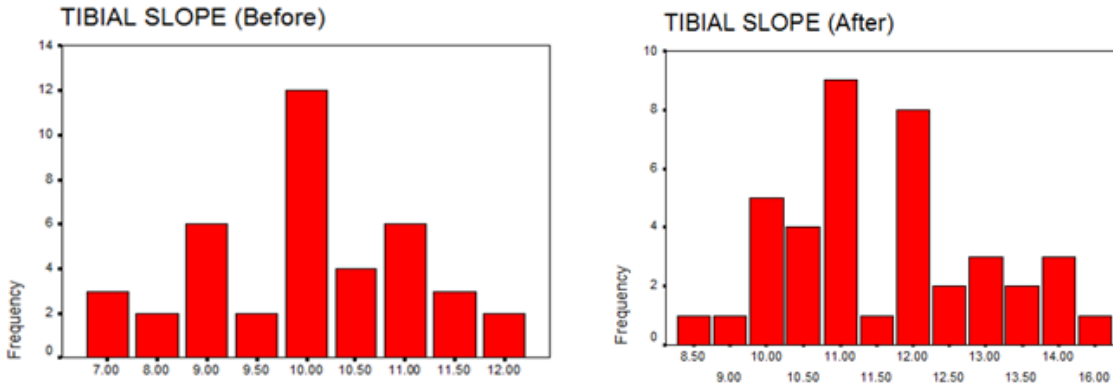
## FUNDING

None

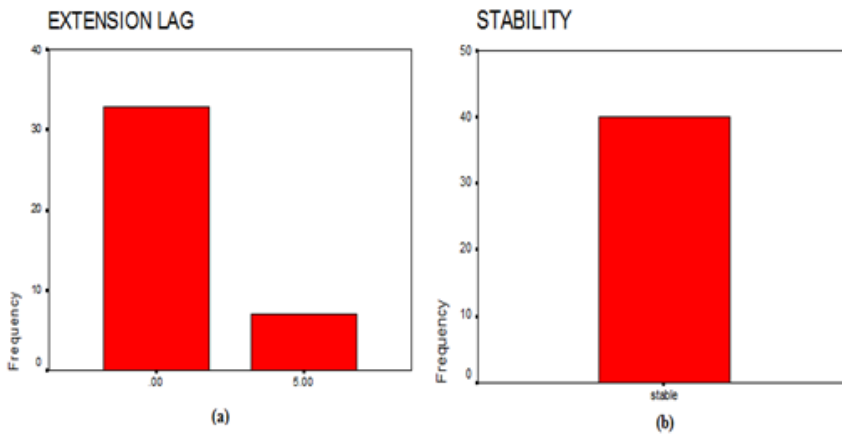
**ETHICS COMMITTEE APPROVAL**

This study obtained ethical approval from AJA University of Medical Sciences Ethics Committee.

**Figure 1: Frequency of posterior tibial slope before and after operation in the population studied**



**Figure 2: Knee extension lag (a) and stability (b) after operation**



**Table 1: The frequency and analysis of posterior tibial slope before and after operation**

		Mean±S.D	Mean Differences ± S.D	t	Df	p Value
Tibial Slope	Before	9.912±1.270	-1.7125±1.467	-7.382	39	0.001
	After	11.625±1.518				