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Assessment of Medial Open Wedge High Tibial Osteotomy in Management of Medial Compartment Osteoarthritis of The Knee

Adel Abd-Elazeem Ahmed, Khaled Edris Abdel-Rahman,
Mohamed Reda Khairy*, Ahmed Mohammed Abd-Elwahab
Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University, Egypt
***Corresponding author:** Mohamed Reda Khairy, **E-Mail:** reda199020.aa@gmail.com

ABSTRACT

Background: Osteoarthritis of the medial compartment of the knee in young, active individuals with intact range of motion is commonly treated with medial open wedge high tibia osteotomy (MOWHTO).

Objective: The aim of the work was to use medial open wedge high tibial osteotomy to treat patients with medial compartment osteoarthritis and varus deformity improves their surgical outcomes.

Patients and Methods: Twelve patients with varus deformity were treated by using MOWHTO performed in the period between 2020 and 2021 at Zagazig University Hospitals and El-Sahel Teaching Hospital. The age of the patients was ranged from 17 to 42 years. Eight males and four females completed the follow up period. Eight osteotomies were fixed using Puddu plate while the other four were fixed using Tomofix plate. Three osteotomies were performed with using bone graft while the others without using bone graft.

Results: The time of union ranged from 9 to 24 weeks with a mean of 12.3 weeks. The mean period of pain relief among study subjects was eight months. All patients had full range of motion postoperatively except two who developed limited ROM due to pain after surgery and they restore full range of motion four months after surgery with physiotherapy.

Conclusion: It could be concluded that for patients with medial compartment osteoarthritis 2ry to genu varus, MOWHTO is a good treatment as it restores the mechanical axis, relieves pain, improves motion and about 5 degrees valgus position is reached and thus redistribution of the load from medial compartment of the knee to lateral compartment.

Keywords: High tibial osteotomy, Genu varus deformity, Medial compartment knee osteoarthritis

INTRODUCTION

Regarding the treatment of medial compartment knee OA with varus deformity in young, active individuals, high tibial osteotomy (HTO) has been commonly used [(1)]**.** By shifting the center of gravity slightly to the outside of the knee joint, the weight-bearing axis shifts away from the medial compartment [(2)].

Medial compartment knee OA symptoms can be alleviated with HTO because it realigns the lower leg so that weight is distributed more evenly between the medial and lateral joints [(3)]. Using an HTO with a medial opening wedge preserves bone mass, ensures a consistent correction, and protects the lateral knee components including the proximal tibiofibular joint and the common peroneal nerve [(4)]**.**

The hinge must be preserved and maintained if the osteotomy is to heal properly and remain stable. It is possible that secondary correction may be lost if the hinge is weakened [(5, 6, 7)]**.**

For medial open wedge HTO, a wide range of fixation techniques have been designed and tested. Because of the plate's instant post-operative stability, patients were able to be mobilised right away, and the technique's initial success helped to popularize it among active, youthful patients hoping to delay or avoid arthroscopic resurfacing or replacement surgery [(8, 9)].

For those with medial compartment osteoarthritis and varus deformity, this study was aimed to use medial open wedge high tibial osteotomy as a surgical therapy option.

PATIENTS AND METHODS

This study was conducted at Department of Orthopedic Surgery, Zagazig University Hospitals and El-Sahel Teaching Hospital, in the period between 2020 and 2021. Twelve medial opening wedge high tibial osteotomies were performed on twelve patients. Seven of them were left while the other five were right patients with medial compartment osteoarthritis of the knee with Varus malalignment less than 20°.

***Ethical Consideration*:**

An approval of the study was obtained from Zagazig University Academic and Ethical Committee (ZU-IRB#6056). Every patient signed an informed written consent for acceptance of the operation. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: Medial Compartment arthritis, varus alignment across the knee. (Less than 20°), and young, active patients (<55 years old).

Exclusion criteria: Combined medial and lateral osteoarthritis, patients older than 55 years,

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patients with severe Varus deformity (greater than 20°), and patients with patellofemoral osteoarthritis.

Prior to and following surgery, all patients underwent comprehensive clinical and x-ray evaluations.

All patients had pre-operative routine lab investigations.

Surgical Procedure For all surgeries, the patient was placed face down on the operating table with an image intensifier placed in front of him. The air in the tourniquet above the knee had been pumped up to maximum pressure. In an antero-medial approach, incisions are performed 6–8 cm distally to the joint line between the medial patellar and the medial tibial tubercle under spinal anesthesia. Dissection of the pes anserinus was performed following skin incision. When the tibia was cut open, the superficial collateral ligament was dissected.

The posterior arteries were protected, and the postero-medial corner of the tibia was exposed by placing a blunt retractor dorsally, deep to the collateral ligament. A second retractor was positioned under the patellar tendon anteriorly. When the knee is flexed, the operation becomes easier.

K-wires (three millimeters in diameter) were advanced medially up to the lateral cortex and parallel to the joint line to maintain the original tibial slope as well as to prevent the fracture from progressing further into the tibial condyles. After that, a second K-wire (2.4 mm in diameter) was inserted into the lateral cortex at an acceptable angle.

Fig. (1): Showing skin incision and exposure for HTO.

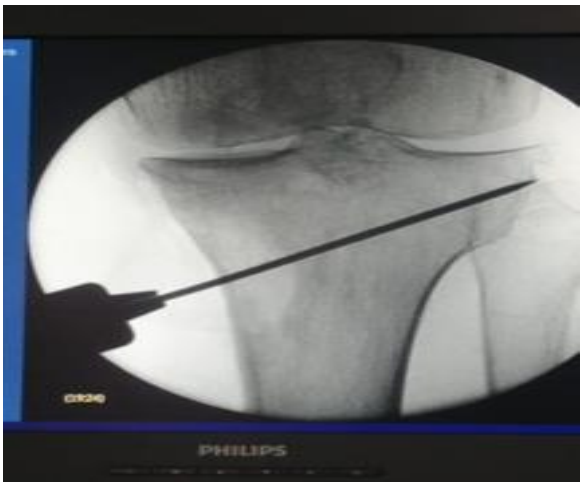

Fig. (2): Using the osteotomy saw in osteotomy

An osteotomy of the lower part of the tibial tuberosity was performed to prevent its fracture during the tibial osteotomy. Osteotomy was performed with oscillating saw blade parallel to guiding pin to avoid intra-articular fracture. Specifically, the saw was used to sever the medial cortex of the patient in this case.

This procedure was then completed with the use of a sharp osteotome to preserve around 0.5% of the bone. Medial and posterior incisions are preferred. To allow for a gradual opening of the osteotomy, the opening should be advanced slowly. Osteotomy guide was removed, and an appropriate plate (Puddu or Tomofix plate) was inserted into the osteotomy site following acceptable exposure of the osteotomy line. A diathermy cable reaching from the center of the femoral head through the knee to the center of the talus should be used to check for mechanical axis before attaching the plate.

Two 6.5mm cancellous screws were used to secure the plate proximally and two 4.5-mm cortical screws or two 6.5mm cancellous screws were used to secure the plate distally. To provide additional stability, bone graft was mostly used in wedges larger than 12 mm in diameter.

Fig. (3): Fixation by Puddu plate.

Postoperative rehabilitation:

Postoperative AP and lateral were taken. Strengthening activities for the quadriceps and hamstrings were used to help the patients recover. Patients were allowed to walk with knee-hinge immobilizers six weeks after surgery.

Statistical Analysis:

Microsoft Excel software was used to code, enter, and analyze data obtained during the history, basic clinical examination, laboratory investigations, and outcome measures. A Statistical Package for the Social Sciences (SPSS) import was then performed (SPSS version 20.0). Use the following to determine whether there is any correlation between two variables. The Chi square test can be used to compare two qualitative variables and see if there is any relationship between them (X^2). Analysis of statistical differences across quantitatively paired groups. P value was chosen at 0.05 for significant results, while the higher the P value, the greater the statistical significance.

RESULTS

This study was conducted on twelve patients, age was distributed as **32.25±7.28** with minimum 17 years and maximum 42 years, BMI was distributed as **29.30±2.88** (kg/m^2) and regarding sex distribution male were majority with 66.7% and 66.7% were working **(Table 1)**

The mean time for the union was distributed as 12.33±4.53 with minimum 9 and maximum 24 weeks. The mean period of pain relief among study subjects was eight months. Among the study patients three osteotomies were performed with using bone graft while the others without using bone graft. We use Puddu plate in eight osteotomies while the other four osteotomies were fixed by Tomofix plate. Tibial plateau fracture was found in one case and it was fixed using partially threaded cancellous screws. Infection was found in one case and was treated with the use of broad spectrum antibiotics. Two cases developed delayed union that healed completely within 24 weeks **(Table 2, 3).**

Table (1): Demographic characters distribution among studied group

		N = 12	
Age (years)	**Mean± SD**	32.25±7.28	
	Median (Range)	32 (17-42)	
BMI (kg/m^2)	**Mean± SD**	29.30±2.88	
		N	**%**
Sex	**Male**	**8**	66.7
	Female	**4**	33.3
Working	**No**	**4**	33.3
	Working	**8**	66.7
	Total	**12**	100.0

Table (2): Type of plate of fixation distribution among studied group

		N	%
Type of plate of fixation	**Puddu**	**8**	**66.7**
	Tomofix	**4**	**33.3**
	Total	**12**	**100.0**

Table (3): Duration of pain relief distribution among studied group

	Duration of pain relief /month
Mean± SD	**8.41±1.50**
Median (Range)	**8.0 (7-12)**

DISCUSSION

Medial compartment osteoarthritis secondary to genu Varus is a common problem [(10)]. Treatment of medial compartment OA in young, active patients with varus deformity who are willing to accept some reduction in physical activity is appropriate for HTO [(11)]. HTO has good biomechanical benefit that it corrects the Varus deformity, shifts the excess weight load, and decreases the load from upon medial compartment of the knee to the relatively unloaded lateral compartment thus redistribution the uneven load, widens the joint space, and delays the joint wear out [(12)]. HTO procedures often used can result in a shift in weight-bearing to a different compartment, such as from the medial to the lateral compartment, lateral

closed wedge & medial open wedge HTO [13]. However, Because of this, the medial open wedge HTO has steadily replaced lateral closed wedge HTOs in terms of popularity [14].

In comparison to lateral closed wedge HTOs, open wedge HTOs are easier to use, more precise, and less invasive Decreased extensive soft tissue dissection allows for less risk of peroneal palsy and other catastrophic consequences. It also allows for early postoperative exercise applications to open knee movements and a higher survival rate [15, 16].

This study included 12 knees of 12 consecutive patients complying with the inclusion criteria, they had performed open-wedge HTO for varus malalignment and medial compartment OA. There were eight males (66.7%) and four females (33.3%), their ages range from 17 to 42 years (with a mean age of 32.25 at time of surgery) with BMI mean 29.3. Six of them had grade I OA, five had grade II, one had grade III OA. They all had full or reasonable range of motion, impaired everyday life activities. **El Assal *et al.*** [15] fifty-two individuals who had medial OWHTO between 2004 and 2008 were included in the study. There were 31 females and 21 males in attendance. The patients ranged in age from 24 to 65 years. The average BMI for the group was 28.5 (kg/m^2). Patients with grade I medial compartment osteoarthritis (40%) and grade II medial compartment osteoarthritis (23%), respectively, were found in this study. According to several studies, younger patients are more likely to benefit from realignment osteotomies, while others found no apparent correlation. Bone texture, patient activity level, and biological age have a stronger impact on selection criteria than other factors [16].

In this study, HTO was performed and fixed with Puddu plate or Tomofix plate. Puddu plate was used in eight patients while Tomofix plate was used in four patients. While the TomoFix plate uses a locking compression mechanism, the Puddu plate relies on dynamic compression. Both types of plates are able to withstand axial loads [17].

In this study, HTO with use of bone graft was performed in three patients while for the other nine; HTO was done without using of bone graft. Study proved that there is no difference in the duration of healing between grafted and non-grafted osteotomies, inferring the lack of need to grafting, and also MOWHTO can be performed successfully with no graft [18]. However, determining the need for grafting depends on the osteotomy gap size neglects other factors that influence the healing process. These factors include age, gender, body mass index, smoking -among other clinically interfering habits- and physical activity. These factors -combined- determine the biological activity of bone healing and the physiological capability of osteogenesis [19].

In this study, preoperative tibiofemoral angles were measured, the mean was 4.8° (0°– 11°) Varus, while it became 5.2 ° (2°–11°) valgus postoperatively. For hip–knee–ankle surgery, recent investigations have found that a postoperative valgus angle of 2°–8° is necessary (mechanical axis). If you want to see results, you'll need to have an anatomical and mechanical correction of 9–10 degrees, as well as an overcorrection of 5 degrees, to achieve this [20].

Knee flexion, proper cruciate ligament function, and appropriate knee kinematics all depend on the posterior tibial slope. 6°-10° is the range of the tibial plateau's physiologic slope [21]. In this study, the mean posterior TS of the patients preoperatively was 7.19° (± 2.23°), increased to 7.94° (± 3.08°) postoperatively. This result was found to be accordant with previous studies. **Ducat *et al.*** [22] concluded from their study that, it has been shown that MOWHTO has little side effects on tibial slope modification, provided that the surgical method is adhered to.

Complications occurred among study subjects; delayed union in two cases, infection in one case, lateral tibial plateau fracture in one case. Delayed union occurred in an obese smoker patient and middle-aged patient with sedentary lifestyle. They healed completely after 24 weeks without any other surgical intervention. The infection occurs in one patient not regularly clean the wound after operation and it was treated by broad spectrum antibiotics. another case while performing the osteotomy the lateral tibial plateau was fractured and this fracture was fixed with two partially threaded cancellous screws.

There have been reports of partial vascular injury, intraarticular lateral tibial plateau fracture, lateral cortex fracture, subluxation, delayed healing, deep and superficial infections, deep vein thrombosis, tibial slope changes, patellar height changes, excessive correction, loss of correction degrees and graft collapse during medial opening wedge osteotomy [23].

It was suggested by **Paccola and Fogagnolo** [24] that a percutaneously applied lag screw be used to prevent corrective loss following a lateral cortical fracture during medial opening wedge osteotomy.

In this study the mean healing time was 12.33 weeks, the mean of the time to return to previous activities was 4.5 months with full range of motion except two patients that have limited ROM due to pain after surgery and they restore full active ROM after four months of surgery with the aid of physiotherapy.

Jung *et al.* [25] after three months, the first signs of improvement were seen in the patients who had undergone HTO. Knees with varus deformity and medial compartment osteoarthritis have been treated successfully in the short term by many writers. However, these outcomes decrease over time. According to several studies, the first five-year success percentages were about 80%–90%, but after ten years, that number had dropped to 60%–65%.

CONCLUSION

It could be concluded that for patients with medial compartment osteoarthritis 2ry to genu Varus,

MOWHTO is a good treatment as it restores mechanical axis, relieves pain, improves motion and about 5 degrees valgus position is reached and thus redistribution of the load from medial compartment of the knee to lateral compartment.

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