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RADIOLOGICAL AND CLINICAL ANALYSIS OF BIPLANE OPENING WEDGE HIGH TIBIAL OSTEOTOMY FOR MEDIALLY ARTHRITIC VARUS KNEES FIXED BY LOCKING PLATE

By

Mahmoud Gamal Mahmoud, Mohammed Abd El-Monem Negm and Amr Abd El-Halim Amr

Department of Orthopedic Surgery and Traumatology, Faculty of Medicine, AL-Azhar University, Cairo, Egypt

Corresponding Author: Mahmoud Gamal Mahmoud, **E-mail:** hgazem79@gmail.com

ABSTRACT

Background: High tibial osteotomy is an established and helpful treatment for unicompartmental osteoarthritis associated with varus deformity. However, asupratubercle high tibial osteotomy leads to a decrease in patellar height making the technique not suitable in the case of concomitant patella Baja. Moreover, this kind of osteotomy can change in situ forces at the patellofemoral joint and the lateral patellar tilt. To widen the indication of high tibial osteotomy was proposed a biplane opening wedge high tibial osteotomy with a distal tuberosity osteotomy (B-OWHTO).

Objective: To assess the clinical and radiological outcome of biplane open wedge high tibial osteotomy in the treatment of medially arthritic varus knees.

Patient and Methods: Twenty varus knees (20) patients, with MCOA, were operated upon from 2019 to 2020 at Al-Azhar University Hospital (Assiut). They all had Medially Opening Wedge High Tibial (MOWHTO) using the biplanar technique and fixed by locking plates. We compared the data fetched preoperatively (at day 0 = D0) with data one year or more after surgery with a mean of 14.5 months (at year 1=Y1). The mean age was 49.39 ± 8.15 years old, 13 were females, while others were males. Eleven were right knees, and 7 were left. Types of occupation were; 9 employed, 7 unemployed. Sixteen were no sportive, and 2 were recreational athletes. Seven patients were normal weight, while 11 were overweight. Two patients were diabetic, and 2 were perceived as treated HCV infection. According to the MCOA K-L scale; 5 were grade 3, 9 were grade 2 and 4 were grade 1.

Results: The mean western Ontario and Macmaster universities osteoarthritis index (WOMAC), value was 51.44 ± 26.8 and then dropped to 24. 39 ± 17.41. The difference was statistically significant (p-value was <0.001). The mean Cincinnati score was 40.36 ± 19.28 at D0, then 81.88 ± 14.45 at Y1. The rising pattern from D0 to Y1 was significant statistically (p-value was <0.001). For radiological results, the mean amount of correction was 10.56º ± 2.97º. The mean TS for the18 patients was 10.78º ± 2.92º and changed to 10.49º ± 2.51º, and this was statistically insignificant. Regarding the patellar height (PH), there was a statistically significant decreasing tendency from a mean of 1.02 ± 0.16 to 0.97 ± 0.15. LPT showed a statistically significant decrease, although quite small, from 10.48 º ± 6.18 º to 9.43º ± 4.27º. MOWHTO using biplanar technique and fixed by the locking plate without BG filling was a very efficient modality of treatment for adult patients suffering from medially arthritic varus knees in terms of clinical and radiological aspects.

Conclusion: Medial Open Wedge High Tibial Osteotomy (MOWHTO) using biplanar technique and fixed by the locked plate without bone graft filling was a very efficient modality of treatment for adult patients suffering from medially arthritic varus knees in terms of clinical and radiological aspects.

Keywords: Open wedge osteotomy, Biplane high tibial osteotomy, Tibial slope.

INTRODUCTION

Osteoarthritis (OA) is the most common disease of joints in adults around the world. OA is characterized by a progressive loss of articular cartilage accompanied by the new bone formation and often synovial proliferation that may culminate in pain, loss of joint function, and disability *(Pereira et al., 2014).*

Symptomatic OA is characterized by radiographic evidence along with persistent joint pain or stiffness *(Henak et al., 2013).* The most common pattern of symptomatic OA within the knee is articular cartilage degeneration predominantly in the medial compartment, with joint degeneration further results in a varus deformity with increasing load transmission through the already degenerated compartment *(Morin et al., 2018).*

Many conservative treatments of knee OA have been reported, such as medical treatment, foot orthoses, knee braces, and muscle strengthening, those treatments may slow the progression of medial knee OA *(Reeves and Bowling, 2011).*

High tibial osteotomy (HTO) is an established treatment for patients with medial compartment knee osteoarthritis (OA) and varus malalignment *(Poignard et al., 2010),* open wedge high tibial osteotomy (OWHTO) has gained popularity over recent years as a viable alternative to the traditional lateral closed wedge osteotomy. Open wedge high tibial osteotomy has several advantages over the lateral closed wedge osteotomy, these include avoiding a fibular osteotomy and the risk of peroneal nerve complications, smaller surgical exposure without muscle detachment, an easier and more precise correction that can be changed even after the osteotomy cut *(Gaasbeek et al., 2010).* Furthermore, it can make an eventual future knee replacement easier not only due to the location of the skin approach but more because an OWHTO decreases the metaphyseal deformity caused by a closed wedge *(Hui et al., 2011).*

Open wedge high tibial osteotomy has some potential disadvantages for the patellofemoral joint. Firstly, because a supra-tubercle osteotomy can lower the height of the patella, which is particularly true when a large correction is required *(Amzallag et al., 2013).* As a consequence, the use of an OWHTO is not usually recommended in cases of patella infra *(Schallberger et al., 2011).* However, it should be kept in mind that the origin of patella infra is likely multifactorial and so even patients with a preoperative normal to-low patellar height could end up with this condition. Additionally, OWHTO can increase patellofemoral contact pressure and cause patellofemoral degeneration over time even when patellar height has not been modified *(Stoffel et al., 2010).*

A second possible drawback of supra-tubercle OWHTO is its tendency to increase the sagittal tibial slope *(Lee et al., 2016).* Increasing the tibial slope may affect anteroposterior translation of the tibia as well as the in-situ forces on the anterior cruciate ligament. To solve these potential problems and so broaden OWHTO indications, some authors still support the use of the standard infra-tubercle HTO in these cases *(Akizuki et al., 2010).* However, moving the tibial osteotomy distally reduces the total surface of cancellous bone at the osteotomy site and increases the risk of

non-union. Several authors have already reported superior clinical outcomes of traditional supra-tubercle OWHTO over infra -tubercle HTO due to lower non-union rates *(Shim et al., 2013)*. The further solution suggested by some authors in previous studies to deal with these issues is to perform a modification of the standard technique: a biplane OWHTO with a distal tuberosity osteotomy (OWHTO-B). This technique provides that the tibial tuberosity remains joined to the tibial metaphysis so as not to theoretically alter the patellar height without increasing the patellofemoral pressures *(Noyes et al., 2010)*.

The aim of the present work was to assess the clinical and radiological outcome of biplane open wedge high tibial osteotomy in the treatment of medially arthritic varus knees.

PATIENTS AND METHODS

Study Design: A prospective randomized controlled clinical trial was carried out in Orthopedics Department of Al-Azhar University Hospital, (Assiut branch) to assess the clinical and radiological outcome of biplane open wedge high tibial osteotomy in the treatment of medially arthritic varus knees. The study included 20 patients (7 males and 13 females). The age varied between 31 and 59 years with a mean age of (49.39). The research was reviewed by the Faculty Ethics Review Board, Al-Azhar University Cairo.

Inclusion criteria: Active patient less than 60 years in whom an arthroplasty would fail due to excessive wear, Genu varum, Symptomatic narrowing of medial compartment space, and Body mass index from 20 to 30Kg/m2.Exclusion criteria: Sever patellofemoral arthritis, severe bone loss in the femoral condyle or tibial plateau, Flexion contracture of more than 15 degrees, More than 20 degrees of correction needed, Inflammatory arthritis, and Significant peripheral vascular disease. All patients who agreed to participate in this study signed informed consents.

Preoperative radiological evaluation:

1. AP view in a standing position preoperative and after 1 year follow up.
2. Lateral view in 30 degrees flexion preoperative and after 1-year follow-up to assess the patellar height.
3. Skyline's view knee flexion 45 degrees (Merchant view) preoperative and after 1-year follow-up to assess lateral patellar displacement.
4. Skyline view knee flexed 20 degrees (Laurin view) preoperatively and after 1 year follow up to assess patellar tilt.
5. Weight-bearing long film from hip to ankle of both lower limbs in standing AP view to identify the site of deformity (whether femoral or tibial). The femoral mechanical axis is drawn from the center of the femoral head to the center of the knee. A tangent is then drawn along the distal femoral condyles. The mechanical lateral distal femoral angle (mLDFA) is then measured between those two lines. Normal values for this angle usually range from 85 to 90, with values greater than 90 degrees indicating varus of the distal femur. Thereafter, the axis of the tibia is drawn, and another line tangential to the tibial plateau. Between those two lines, the

medial proximal tibial angle (MPTA) is measured. Normal values for this angle are identical to those of the mLDFA (i.e 85-90), with values less than 85 indicating varus of the proximal tibia).

6. Standing plain X-ray in true lateral view preoperative and after 1 year follow up to assess tibial slope.

Surgical technique:

The patient was placed supine on the operating table. All 20 cases operated upon under spinal anesthesia after prophylactic parenteral antibiotic, bilateral knee examination under anesthesia was performed. Well-padded high thigh tourniquet applied and draping the patient limb and C-Arm to check correct visualization of knee joint in both planes done, then a 6–7 cm-longitudinal approach mid-way between the tibial tuberosity (TT) and the posteromedial border of the tibia was performed. The semitendinosus and gracilis tendons were released and the superficial medial collateral ligament was freed from its distal insertion. The patellar tendon was identified and protected with a retractor.

Osteotomy:

The Biplane OWHTO has two different osteotomy planes. While the horizontal cut was similar to the standard OWHTO, the vertical part of the osteotomy was performed posterior to the tibial tubercle. Under fluoroscopic control, one 2.4-mm guiding Kirschner wire was placed in the medial cortex of the tibia at the metaphyseal-diaphyseal transition zone to tip the fibular head in a proximal and posterolateral direction. The K-wire guided the sagittal cut performed in the posterior two-thirds of the tibia. It was crucial to maintain perfect perpendicularity to the main axis of the bone on the sagittal plane to avoid tibial slope modification. This section of the osteotomy ended 1 to 2 cm medial to the lateral border of the tibia. The second section of the osteotomy was vertical in the coronal plane and extended 3 to 4 cm distally. Thus, the tibial tuberosity together with the proximal segment of the osteotomized tibia was maintained. A thickness of 10 mm of the TT was maintained in the most proximal part to minimize the risk of fracture. The desired correction was achieved using a spreader introduced in the posterior-most part of the osteotomy site, thereby creating a trapezoidal gap to avoid an increase in the tibial slope. To prevent anterior tilting of the TT leading to an increase in the posterior tibial slope, one or two anteroposterior cortical screws fixing the TT were secured before plate fixation. The subcutaneous tissues and skin were then closed using interrupted sutures over a negative pressure suction drain.

Postoperative Regimen:

During the period of hospital stay (2 days in all patients), all patients were instructed for gentle active exercises and absolute non-weight bearing for at least 6 weeks, followed by partial weight bearing for another 4 weeks with the aid of a walker. Radiographic plain x-rays were obtained to assess correction and the position of plate and screws in both AP and lateral projections, followed by repeated visits at the outpatient clinic every one month for at least 6 months.

Clinical Evaluations:

Clinical and functional follow-up included the (WOMAC), and Modified Cincinnati Rating System Questionnaire (Cincinnati). The physical examination, as well as the functional evaluation of every patient, was performed preoperatively and at final follow-up by a single surgeon who was independent of the study.

Radiological evaluation:

In every case, a standard X-ray protocol was obtained preoperative and at 1–6–12 months postoperative. The protocol comprised a full-weight-bearing long-leg standing anteroposterior radiographs, lateral non-weight-bearing radiography of the knee at 30° of flexion, a Merchant view. Posterior tibial slope, CDI, LPT, and Congruence angle were collected. Immediately postoperative was not possible to obtain a full-weight-bearing long-leg standing X-ray as well as a Merchant view. Only standard anteroposterior and lateral non-weight-bearing radiography of the knee at 30° of flexion was obtained **(Fig. 1)**.

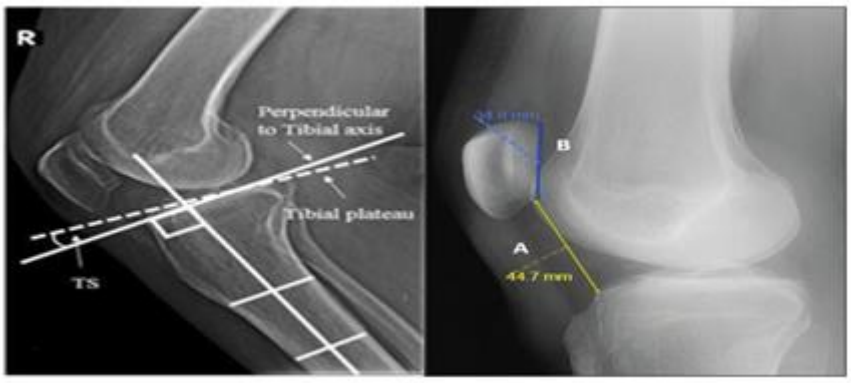

Figure (1): CDI for measuring patellar height and Tibial slope angle based on the tibial proximal anatomical axis

Statistical Analysis:

The mean and standard deviation, range, median values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests and showed non-parametric (not normal) distribution. Wilcoxon signed rank test was used to compare between two groups in related samples. Pearson was used for correlation coefficients between parameters. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

RESULTS

Our results had been perceived in two forms, i.e. the clinical and radiological results. For the clinical results, 2 questionnaires had been used namely; WOMAC and Cincinnati scores. From these scores, we managed to quantify the patients' satisfaction that was perceived as the final clinical outcome. Also, radiological results had been collected and analyzed, and we managed to study the influence of such results on the final clinical outcome.

Clinical results:

1. WOMAC score: Of note, as WOMAC scores decrease, it gets better, making zero the best value and 96 the worst.
2. Cincinnati score: Of note, as Cincinnati increases, it gets better, making zero the worst value while 100 is the best.

At D0, the mean value was 51.44 ± 26.8 which dropped to 24.39 ± 17.02 at Y1, also the lowest value was 15 and the highest one was 84 at D0, then the range was spreading from 60 down to 5 at Y1. Change was calculated as the difference between values of each patient at Y1 and D0 and it was statistically significant (p-value was <0.001). A mean change of 31.03 ± 11.23 was estimated, At D0, the mean value was 40.36 ± 19.28 and at Y1 was 81.88 ± 14.45 extending from 60 to 100. The range was from 6 as the lowest value to 66 as the highest. The rising pattern from D0 to Y1 was statistically significant (p-value was <0.001). The mean change between values at Y1 and D0 was estimated **(Table 1)**.

Table (1): WOMAC score and Cincinnati score at D0 and Y1

WOMAC	Day 0	Year 1	P. value
Min. - Max.	15 – 84	5 – 60	
Mean ± SD.	51.44±26.8	24.39±17.02	<0.001*
Median	58.50	20.00	
Change	↓27.06 ± 14.02		

Cincinnati (%)	Day 0	Year 1	P. value
Min. - Max.	6 - 66	60 – 100	
Mean ± SD.	40.36±19.28	81.88±14.45	<0.001*
Median	36.00	80.00	
Change	↑41.52 ± 10.21		

Radiological results:

1. **A-Amount of Correction:** The mean amount of correction was 10.56º ± 2.79º, with corrections ranging from 7º as the smallest to 15º as the highest. The amount of correction did not have any statistically significant effect on the WOMAC/Cincinnati scores at Y1.
2. **Tibial slope:** The mean TS for 18 patients was 10.78º ± 2.92º at D0 while at Y1 it was 10.94º ± 2.51º. No statistical significance could be proved to such change. Also, no statistically significant effect on the WOMAC/Cincinnati scores at Y1.
3. **Patellar height (PH):** All our patients had an almost normal range of PH at both D0 and Y1. However, there was an increasing tendency from a mean of 0.96± 0.16 to 0.97 ± 0.08. This proved to be statistically insignificant (p-value <0.05). The mean change was calculated as 0.05 ± 0.02. Despite this increasing tendency, the change of PH

did not seem to have a statistically significant effect on the final WOMAC/Cincinnati scores at Y1 **(Figure 2)**.

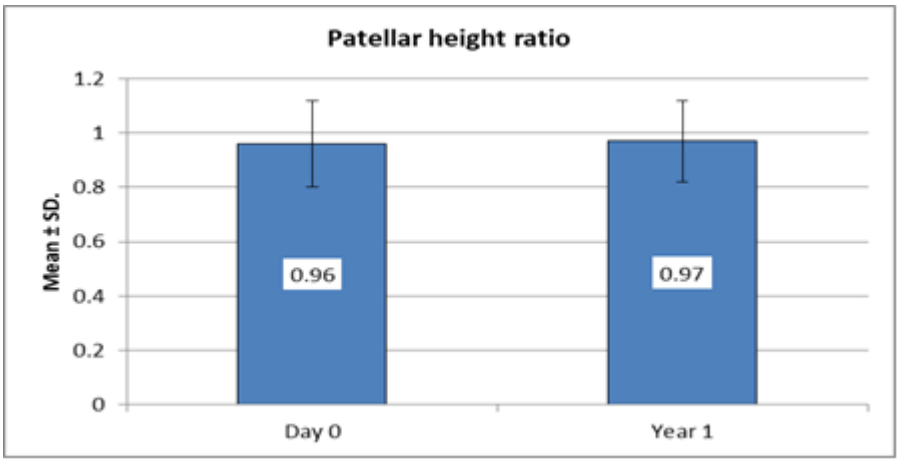

Figure (2): Clustered column chart showing (Mean±SD) of comparison between patellar height ratio at D0 and Y1

4. **Lateral Patellar tilt (LPT):** A decreasing tendency was noticed from 10.48º ± 6.18º at D0 to 10. 34º ± 4.27º at Y1. Although the change was quite small, yet a p-value of <0.001 proved this decrease to be statistically insignificant. Like PH, the change of LPT did not have a statistically significant effect on the final WOMAC/Cincinnati scores at Y1.
5. **Congruence angle (CA):** There was a decreasing pattern of CA from 17.76º ± 7.35º to 17.11º ± 7.37º but no statistically significant effect on the final WOMAC/Cincinnati scores at Y1.
6. **Healing of osteotomy:** All our patients achieved full union at a mean time of 15.69 ± 1.5 weeks, none of them showed delayed or non-unions. In general, consolidation started initially from the far lateral apex progressing medially. Nevertheless, the very medial couple of millimeters of the gap, in the anteroposterior view, were never filled up. It is of prime importance to note that all gaps showed full radiological union of the anterior oblique limb in the lateral view at as early as 5 weeks.

Complications: Were generally minor, where one patient had a superficial infection and he was treated by daily sterile dressings with empirical parenteral antibiotic administration for 5 days. Fortunately, the infection resolved and the wound healed uneventfully at the end. Also, 4 patients mentioned some tingling or numbness over the scar in early follow-up visits but that seemed to settle down with the time until it vanished by 1-year lapse. Fissuring of the articular surface during osteotomy was occurred in one patient and managed accordingly. No other significant complication appeared by the time of follow up.

DISCUSSION

In our study, 18 patients were selected according to our inclusion and exclusion criteria and were operated on at Al-Azhar university hospital (Assuit), the mean age of our patients was 49.93 ± 8.15 years old, 13 patients were females and 5 patients were males, this female predominance in our study is explained by in upper Egypt the economic burden of the family lies on males so they refuse the surgery plus most of the females in our study were frighten of the deformity and the abnormal gait of varus thrust.

All cases were operated on by the OWHTO-Biplanar technique as it accurately corrected varus axial malalignment in our patients with mid-to-low patellar height without causing any patellofemoral change or increasing the posterior tibial slope.

To avoid modifications in patellar height and the tibial slope, *Shim et al. (2013)* analyzed the results of an OWHTO distal to the TT. Despite achieving acceptable clinical and radiological results and because of the possibility of delayed union, they suggested the use of this technique only for those patients with open physis and/or require minor corrections, have a body mass index below 25, and that the osteotomy gap be filled with autogenous iliac crest bone graft.

Standard OWHTO is contraindicated in patients with patella infra. The Caton-Deschamps index defines patella Baja as those between 0.6 and 0.8. Those below 0.6 are considered a patella infra. However, there is no consensus on its threshold in terms of deciding whether to perform the OWHTO as the procedure it decreases patellar height *Erquicia et al. (2019).*

The Caton - Deschamps ratio has generally been used to evaluate patellar height and been measured both pre-and postoperatively to check for possible patella infra. However, *Buckland–Wright (2010)* has reported that in the supine position, the knee joint is under neither muscular nor mechanical load nor that when the muscles and ligaments are relaxed, the joint space opens up resulting in a false radiographic evaluation. Therefore, standing lateral views were used to evaluate the patella height.

Our clinical results were expressed in the form of WOMAC and Cincinnati scores. There was a decrease reflected quite an improvement for all patients. Pain intensity, stiffness, and physical function that comprise the main items in WOMAC improved, while the WOMAC score focused more on the symptoms of OA, Cincinnati provided more insight about symptoms of instability.

Han (2019) and associates presumed that osteotomy gap height seemed to be a very strong predictor of lateral hinge breakage. Their study although highlighted the importance of detecting the lateral hinge break in MOWHTOs in general, yet performing them with such technique showed no significant difference in terms of union or functional outcomes even in the presence of these breaks.

Lee et al. (2018) and associates reported a significant change of WOMAC and AKS (The American Knee Score). They pointed out a relation between the satisfaction of patients and less preoperative BMI and more preoperative

varus limb alignment, which was very sensible. However, more satisfaction was related to less postoperative valgus malalignment, which was sort of confusing. *Tsukada and Wakui (2015)* questioned the benefit for a degenerated cartilage from overcorrection and recommended further analysis of what was more favorable as an optimal correction.

Kamboj et al. (2017) and associates emphasized the lack of restrictions as compared to uni compartmental arthroplasty (UKA) on a background of certain cultural habits such as kneeling and squatting referring to the Indian culture which applies as well to our Egyptian/Middle eastern one.

As regards our radiological results, our main target of correction was restoring the mechanical axis to the center of the knee then adding 1-3º of overcorrection according to MCOA grade radiologically and arthroscopically. We achieved a mean amount of correction of 10.27 º ± 2.97 º, leading our FTA to be in a range of -2º to 3º without the use of perioperative computer navigation. *Van den Bempt et al. (2016)* demonstrated that the use of computer navigation, although not widespread among surgeons, might improve the accuracy of the correction better than conventional methods. On the other hand, *Schröter et al. (2017)* showed equivalent surgical accuracy between both techniques.

MOWHTO tends to increase tibial slope which led to more liability for ACL injuries and acted to shift the motion arc towards flexion with a potential extension lag. This is a major concern when using non-locking spacer plates. This problem was overcome in our study by using a T-locked plate where they can be easily seated anteromedially without the need to put them far posterior-medially like the case with non-locking ones to guard against tibial slope increase. Back to our study, apart from the patients we intentionally decreased their slopes to overcome their anterior laxity as a consequence of chronic ACL insufficiency. There was no statistically significant change of TS in all 18 MOWHTOs. Such findings were in accordance with *Goshima et al. (2017)* and *Krause et al. (2018).*

Different patellofemoral measurements were studied at D0 and Y1 to detect changes that occurred after MOWHTO and evaluate if these changes could have a clinical reflection on our patients. This was an important issue to be assessed especially in our eastern countries where several daily activities appear to be a patellofemoral function as ascending stairs, prolonged kneeling, and squatting.

Lee et al. (2016) and associates performing MOWHTO reported a statistically significant patellar descent in terms of radiology, yet did not affect the clinical outcomes. Therefore, they did not consider mild PF problems a contraindication for MOWHTO.

Otakara et al. (2019) found a significant decrease in PH. Second look arthroscopies detected deteriorations in 30 patients. The authors concluded that if deformity correction exceeded 10° of MPTA during MOWHTO, degeneration of PFJ should be considered.

Kim et al. (2017) found 21.9% of knees with patella OA progression and 41.2% with trochlea OA progression although

only 11.4% had anterior knee complaints. Also, there was no significant alteration of IS ratio after HTO. They concluded that PFJ might be adversely affected by MOWHTO although the incidence of postoperative anterior knee pain was low.

CONCLUSION

Medial Open Wedge High Tibial Osteotomy (MOWHTO) using biplanar technique and fixed by the locked plate without bone graft filling was a very efficient modality of treatment for adult patients suffering from medially arthritic varus knees in terms of clinical and radiological aspects, accurately corrected axial malalignment without changing patellar femoral height. Moreover, patellar axial changes (LPT, CA) did not affect the final clinical outcome. However, it should be considered with larger corrections. Also, tibial slope (TS) can be preserved in MOWHTO, using the biplanar technique and fixation by the locked plate.

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التقييم الأكلينيكيى والأشعاعى للشق العظمى المفتوح ذو المستويين بأعلى عظمة القصبة للركب الروحاء ذات الخشونة الأنسية بأستخدام شريحة معشوقة

محمود جمال محمود، محمد عبد المنعم نجم، عمرو عبد الحليم عمرو

قسم جراحة العظام والكسور، كلية الطب، جامعة الأزهر

E-mail: hgazem79@gmail.com

خلفيـــة البحـــث: الشــق العظمـــى المفتــوح هــو عــلاج راســخ ومفيــد فــي خشــونة العظــام أحاديـــة الجـــزء المرتبطـــة بتشـــوه التقـــوس. ومـــع ذلـــك، يـــؤدي قطـــع عظـــم الظنبـــوب المرتفــع إلــى إنخفــاض فــي ارتفــاع الرضــفة ممــا يجعــل التقنيــة غيــر مناســبة فــي حالــة الرضــفة المنخفضــة. عــلاوة علــى ذلــك، يمكــن أن يتغيــر هــذا النــوع مــن قطــع العظــم فــي القــوى الموضــعية عنــد المفصــل الرضــفي الفخــذي والميــل الرضــفي الجــانبي. ولتوســيع دلالـــة قطـــع عظـــم قصـــبة الســـاق المرتفعـــة ، تـــم اقتـــراح إجـــراء شـــق عظمـــي ذو ســـطحين وفتحة عالية مع قطع عظم الحدبة البعيدة.

الهـــدف مـــن البحـــث: تقيـــيم النتـــائج الســـريرية والإشـــعاعية للشـــق العظمـــى المفتـــوح ذو المستويين في علاج التقوس المفصلي الإنسي.

المرضـــي وطـــرق البحـــث: تـــم إجـــراء 20 عمليـــة جراحيـــة لعشـــرين مريضـــاً مصـــاباً بالـــخشونة الأنســـية فـــي الفتـــرة مـــن 2019 إلـــى 2020 فـــي مستشـــفى جامعـــة الأزهـــر (أســيوط)' وقــد تــم إجــراء الشــق العظمــى المفتــوح ذو المســتويين بإســتخدام تقنيــة ثنائيــة الســطح وتــم تثبيتهــا عــن طريــق شــريحة معشــوقة. وقــد قورنــت البيانــات (فــي اليــوم). مــع البيانــات بعــد عــام واحــد أو أكثــر بعــد الجراحــة بمتوســط 14.5 شــهرًا (فــي الســنة الأولـــى (وكـــان متوســـط العمـــر 8.15 ±49.39 ســـنة: 13 مـــنهم للإنـــاث والـــبعض الآخـــر مـــن الـــذكور: 11 ركـــبهم اليمنـــى و 7 تركـــوا. وكانـــت أنـــواع الأعمـــال 9 عـــاملين و 7 عـــاطلين عـــن العمـــل، 16 لـــم يكونـــوا رياضـــيين و 2 كـــانوا رياضـــيين تـــرفيهيين. وكـــان 7 مرضـــى بـــوزن طبيعـــي بينمـــا كـــان 11 يعـــانون مـــن زيـــادة الـــوزن، وكـــان اثنـــان مـــن المرضـــى مصـــابين بالســـكري واثنـــان كانـــا يعانيـــان مـــن عـــدوى فيـــروس التهـــاب

الكبد الوبائي. وفقًا لمقياس MCOA K-L ' 5 كانوا من الدرجة 3، 9 كانوا من الدرجة 2 و كانوا من الدرجة الأولى.

نتائج البحث: كان متوسط قيمة WOMAC51.44 ± 26.8 ثم انخفض إلى 17.41±39.24, وكان الاختلاف ذا دلالة إحصائية (كانت القيمة الاحتمالية <0.05). وكان متوسط درجة سينسيناتي 19.28 ±40.36. في اليوم صفر، ثم 14.45±81.88 في السنة الأولى. وكان النمط الصاعد من اليوم صفر إلى السنة الأولى معنوياً إحصائياً) كانت القيمة .(0.05> p بالنسبة للنتائج الإشعاعية ، وكان متوسط مقدار التصحيح 2.97 ± 10.56. كان متوسط TS لثمانية عشر مريضًا 2.29 10.78 ± °وتغير إلى 10.49± 2.51° وكان هذا غير مهم من الناحية الإحصائية. وفيما يتعلق بـ أرتفاع الرضفة ، كان هناك اتجاها تنازليا معتد به إحصائياً من متوسط 1.02 ± 0.16 إلى 0.97 ± 0.15. أظهر تزحزح الردفة انخفاضًا ذا دلالة إحصائية ، على الرغم من صغره ، من 10.48 6.18 ±° إلى 9.43 4.27 ±°باستخدام تقنية الشق العظمى المفتوح ذو المستويين والمثبتة بواسطة شريحة معشوقة دون حشو الرقعة العظمية هي طريقة فعالة للغاية في العلاج للمرضى البالغين الذين يعانون من تقوس الركبة الملتهب من الناحية السريرية والإشعاعية.

الاستنتاج: شق عظم الظنبوب المرتفع ذو الوتد المتوسط بإستخدام تقنية ثنائية السطح ومثبت بواسطة الصفيحة المقفلة دون حشو الكسب غير المشروع هو طريقة فعالة للغاية في العلاج للمرضى البالغين الذين يعانون من تقوس الركبة الملتهب الإنسي من حيث الجوانب السريرية والإشعاعية.

الكلمات الدالة: قطع العظم ذو الوتد المفتوح، قطع عظم الظنبوب ذو السطحين، منحدر الظنبوب.