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Proximal Tibia Medial Open Wedge Osteotomy Using Puddu Plate for Treatment of Genu Varum in Adolescent and Young Patients

Waleed Faisal, Mohammed Elattar, Emad Abd-Elhadi

Orthopedic Surgery Dept. Zagazig University, Egypt
yousufmmkh@gmail.com

Abstract

Purpose: Medial open wedge high tibial osteotomy (MOWHTO) is an effective surgical procedure for patients who have medial compartmental osteoarthritis of the knee with varus deformity of the limb. The abnormal load on the medial compartment of the knee is directed to the lateral compartment with this procedure. A gap occurs on the proximal tibia while providing adequate correction. Filling this gap with bone grafts or synthetic materials has gained wide acceptance for preventing bone union problems or osteotomy site collapse. The aim of this study is to report our results of MOWHTOs performed without any bone graft or any other synthetic materials.

Patients and Methods: We evaluated 20patients MOWHTOs that have been performed between 2014 and 2018. Age of the patients ranged from 18 to 40. Fifteenpatients were females and five of them were males. The follow-up time was 12 months.

Results: All osteotomies united without loss of correction. The meanbone union time was 12.8 weeks. We did not have any major complication regarding the technique.

Conclusion: The results of our study have shown that we can achieve satisfactory and good results by performing MOWHTO procedure without using any bone grafts or synthetic materials.

Keywords: High tibial osteotomy, medial, open- wedge,puddu plate

Introduction

High tibial osteotomy is a procedure for young and active patients who have medial unicompartmental osteoarthritis of the knee and varus malalignment of the limb [1]. The aim of this procedure is to relocate the abnormal weight- bearing load from the medial arthritic compartment to the healthy lateral compartment. Medial opening-wedge technique is one of the high tibial osteotomy procedures [2]. There are numerous fixation techniques, bone grafts or augmentation materials for filling the gap on the osteotomy site [3–7]. Stable fixation is necessary for healing of the osteotomy and reducing the risk of non-union and loss of correction [8]. Stainless steel plates with conventional screws are first-generation plating systems. Current systems that provide more mechanical stability are locking titanium plates and locking screw designs [9– 12]. It has been theoretically thought that bone union problems or correction loss due to osteotomy defect are the disadvantages of medial opening-wedge high tibial osteotomy (MOWHTO) [13]. Filling the osteotomy defect with bone grafts or any other materials for preventing these theoretical disadvantages has gained wide acceptance. There are various materials for filling the osteotomy defect (autograft, allograft, xenograft, bone substitute, acrylic cement and ceramic spacer) [14, 15]. Autologous bone graft has been accepted as ‘gold standard’ for this purpose [16].

The aim of this study was to report our results of MOWHTO performed without any bone graft or any other synthetic materials.

Patients and Methods

Our study includes 20 MOWHTOs of 38 patients that have been performed between June 2014 and February 2018. The same surgeon performed all osteotomies. There were 15 females and five males aged ranging from 18 to 40. The inclusion criteria was patients to whom MOWHTO was performed for genu varum without any bone grafts and any synthetic materials. The indication for surgery was genu varum deformity and pain localized on medial knee compartment of the knee. The preoperative exclusion criteria were symptomatic osteoarthritis of the lateral or patellofemoral compartments, severe osteoarthritis, varus deformity of more than 15, range of motion less than 90 and flexion contracture of more than 10. We evaluated clinical and radiologic process of each patient. Follow-up clinical and radiologic examinations were performed at the third week, sixth week, third month, sixth month, and 1 year.

Surgical Procedure

The patient was placed in a supine position on the operative table. The C-arm of an image intensifier was set up on the same side of the knee and opposite to the surgeon.The osteotomy procedure is performed through a vertical anteromedial incision extending 7 to 8 cm distally and parallel to the tibial axis (Fig. 1B).

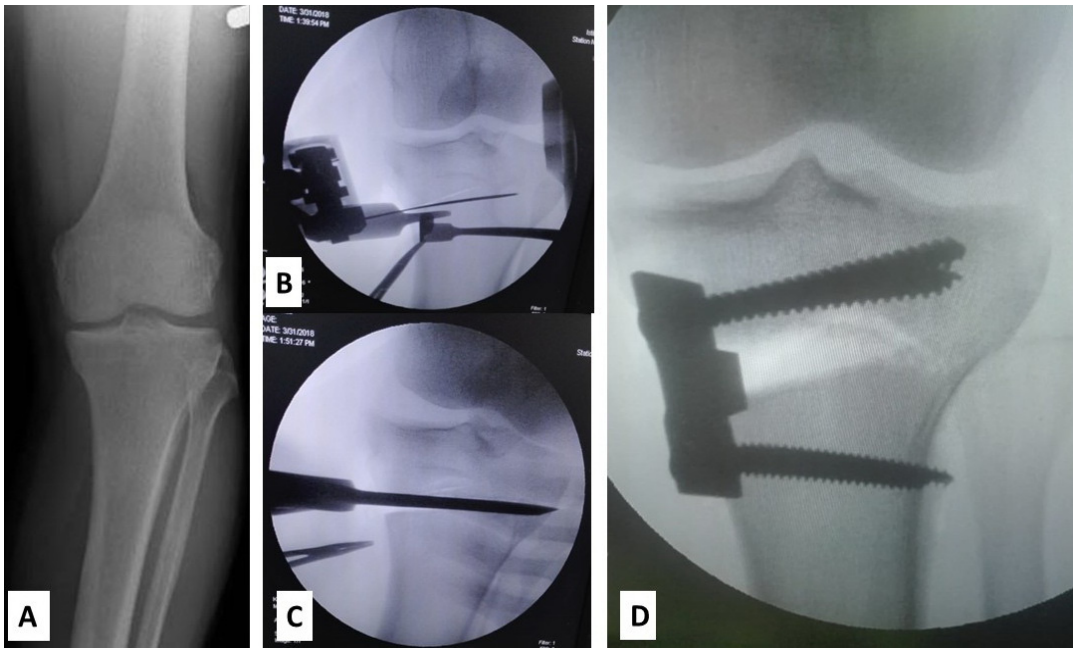

Figure1. *case no-5:Male patient with g varum:* ***A)*** *Preoperative x-ray,* ***B)*** *Intraoperative photo during guide wire insertion,* ***C)*** *Intraoperative photo during osteotomy,* ***D)*** *after plate fixation.*

Sharp dissection is carried out beneath the skin incision to the pes anserinus and superficial medial collateral ligament (MCL), and detached from the tibia using Cobb elevator. Then, both pes anserinus and superficial MCL are retracted posteriorly and the posterior surface of the tibia at the level of the osteotomy is exposed. A retractor is placed dorsally in the osteotomy line (Fig. 3). This procedure provides complete exposure of the anteromedial surface of the tibia. The anterosuperior attachment site of the patellar tendon is exposed and a radiolucent retractor is placed under the patellar tendon.

Osteotomy

Under fluoroscopic control, a guide pin is drilled from the medial attachment site of the patellar tendon to the point 1.5 cm below the lateral joint line, and 1 cm medial to the lateral cortex. This guide pin is roughly directed toward the fibular head. Another guide pin is drilled parallel to the first pin and tibial posterior slope.

A cutting plate is placed through 2 guide pins, and the osteotomy is started 1 mm above the attachment site of the patellar tendon. A radiolucent retractor is used to protect the patellar tendon. A bone saw is used to cut 2 to 3 cm of the medial site of the tibia. Then, osteotomes are used to cut the tibia 1 cm medial to the lateral cortex (Figs. 1C). If the osteotomy is completed, it will easily open the osteotomized site. If not, anterior and/or posterior cortex is not completely cut. Next, the opener is inserted and gradually opened until desired correction. A Puddu plate (Arthrex Inc., Naple, FL) is placed into the osteotomy site (Figs. 1D). Plate positioning is important; if a plate is placed anteriorly, the tibial posterior slope will be increased.5

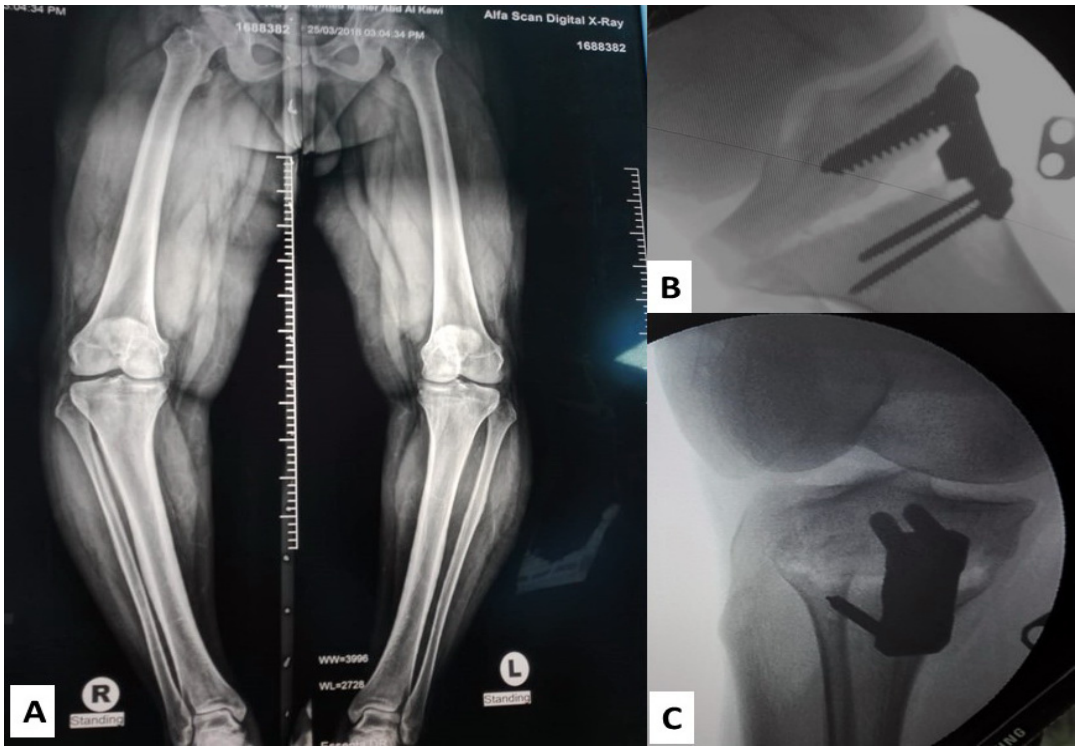

Figure2. *pre and intraoperative planning for osteotomy:* ***A)*** *preoperative scanogram,* ***B & C)*** *intraoperative radiology*

Postoperative Period

Early postoperative AP and lateral X-rays were taken (Fig. 3). Isometric quadriceps and active ankle exercises were started on the same day. Straight leg raising was started on the first day after surgery. For the next 3 weeks, patients were only allowed to move their knee from 0 to 30 of flexion in the hinge brace without *weight-bearing:* After the first control at the end of the third week, patients were allowed to flex their knees up to 90 in the brace and also partial weight-bearing with crutches or walker was allowed as tolerated. Brace was removed and full flexion was stimulated after the second control that has been per- formed at the end of the sixth week, and also, radiologic evaluation was performed. Full weight-bearing was allowed after radiographic evaluation at the second control. Another patient's radiographs demonstrating the full union of the bone without loss of correction at the sixth month (Figs. 3).

Results

All osteotomies united without early loss of correction at the end of the sixth month (Fig. 3). Mean time for bone union was 16.8 weeks (14-24). There was not any major complication. All of our patients were able to stand and walk on their operated legs 6 months after the procedure.

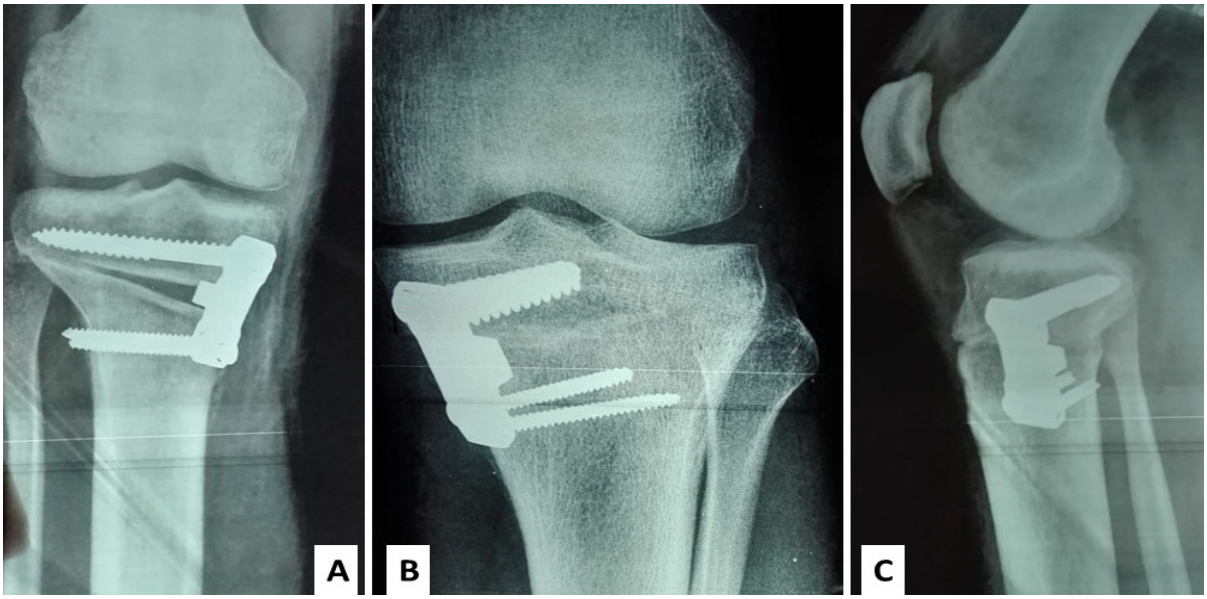

Figure3. *plain x-ray postoperative and 1 year follow up.*

Discussion

There are many benefits of MOWHTO procedure when compared with lateral closing-wedge osteotomy. These benefits include easier procedure, preventing bone structure at the proximal tibia, obtaining more predictable correction, correcting the deformity close to its center and avoiding peroneal nerve, proximal tibiofibular joint and the anterior compartment injuries [18, 19]. According to a report, despite its benefits, longer union time and requirement of bone grafts are handicaps of MOWHTO [20]. On the other hand, some authors reported that MOWHTO procedures had a higher risk of non-union when compared with closing-wedge osteotomies [21]. According to Gomoll [22] loss of correction and non-union are the two complications of the procedure, and according to him, non-union was related to the gap on the osteotomy site.

We think that the concerns about non-union and loss of correction forced the surgeons to use bone grafts and synthetic materials in many of the studies. However, the negative effects of grafts and synthetic materials are another cause of concern. Both of these concerns might decrease the surgeons' preference of MOWHTO procedure. Perhaps this is one of the reasons that MOWHTO procedure has not gain so much popularity as prosthetic replacements. We performed MOWHTOs without anygrafts or synthetic materials for protecting from the morbidity and negative effects of grafts and synthetic materials. Moreover, we did not encounter any non-union or any early loss of correction in our cases at 12-month follow-up.

Performing the osteotomy with no graft is supported by some authors [7]. Staubli et al. [8] reported their results of healing of MOWHTO without bone graft. They used a long plate for the procedure. However, there are some disadvantages of these long plates such as needing a longer or double incision for placing the plate and screws and needing a second surgery for removing them due to their large size. We used a short plate which can be applied easily. At the same time, removal of the plate is not essential due to its small size.

Zorzi et al. [2] have compared grafted and non-grafted osteotomies in their prospective randomized clinical trial. There were no significant differences about bone union between the two groups. However, they used spacers with plates. The difference of our study is that we did not use any spacers. The size of the healthy bone surface area is an important factor for bone healing. According to this classical knowledge, we support that any material like spacers that placed into the osteotomy site decreases the size of healthy bone surface area and so the union.

The finding of our study is that MOWHTO can be performed without any bone grafts or any other synthetic materials in fixation with locking titanium plates with locking screws without any spacer. Clinical and radiographic improvement occurred within 6 to 12 month after the surgery. There was not any non-union, and also, we did not see any early loss of correction.

A variety of grafts such as autografts or allografts and many kinds of synthetic materials have been largely used for avoiding non-union and loss of correction problems in MOWHTO procedure in the literature [23, 24].

The reason of using the bone grafts for filling the osteotomy gaps is to increase the mechanical stability and bone union. However, we think that keeping the lateral cortex intact and providing an intact lateral hinge together with applying locking plates and screws are sufficient for mechanical stability and bony union. Many authors considered that iliac bone autografts is the gold standard for this purpose [16]. However, donor-site morbidity is an important complication. Chronic pain, infections and paresthesia are possible donor-site morbidities of autologous iliac crest bone harvesting. Pollock et al [25] represented donor-site morbidity following iliac crest bone harvesting and its effect on walking. There are also other complications such as gluteal artery injury, deep wound infection, sciatic nerve injury related to this process [16, 26, and 27]. A review of 182 opening-wedge high tibial osteotomy (OWHTO) demonstrated that the most common problem of OWHTO was bone graft harvest morbidity [16]. Chae et al. [28] reported three patients who have a linear fracture in the iliac bone related to autograft harvesting from the iliac wing. Discomfort in wearing clothes is another disadvantage tag of this procedure [29]. Finally, other unfavorable effects of the procedure are prolonged operation time, increased blood loss and palpable defects on the iliac crest [6]. Some authors advocate that decreasing blood loss from the osteotomy site, increasing the mechanical stability and bone healing are the advantages of using bone graft. We think that some bleeding from the osteotomized bone is necessary for the formation of hematoma that is essential for bone union. For this reason, we intentionally did not used drain for any case. Furthermore, harvesting an auto- graft from the iliac wing is a cause of increased blood loss itself. Additionally, the absence of any non-union or early loss of correction in our study has shown that filling the osteotomy site for increasing mechanical stability and bone healing might be reviewed again. Another option is to use allografts for MOWHTO procedure. There are some disadvantages of using allografts for MOWHTO procedure. These disadvantages are disease transmission, immunologic reactions and slow remodeling [23]. An alternative option for filling the osteotomy gap is to use of synthetic bone substitutes. However, there are also several disadvantagesof the technique such as delayed incorporation into bone, infections and soft tissue irritation [11, 30]. Table 1 shows the complication rates of different techniques of MOWHTO [28]. Our reason for performing MOWHTO without bone grafts or any other synthetic materials depends on avoiding the complications of grafts and other synthetic materials. We believe that any of grafts, synthetic materials or spacers for plates are not essential for bone healing in but with locking plate fixationMOWHTO procedure. Considering mechanical and bio- logical reasons properly is the most important factor for bone healing and for successful outcomes.

Conclusion

Satisfactory and good results can beachieved by performing MOWHTO procedure without any kind of bone grafts or any synthetic augmentation materials so that we can avoid unnecessary morbidity and the risks of these materials.

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