Correction of adolescent Genu varum using proximal tibial medial open wedge osteotomy by puddu plate

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Abstract

Purpose
Medial open wedge high tibial osteotomy (MOWHTO) can be considered a good surgical technique for the treatment of medial compartmental knee osteoarthritis associated with varus knee deformity. In genu varum, the extraordinary loads lie upon the medial compartment of the knee. After osteotomy, the loads are directed to the lateral compartment to be equalized on both compartments. The gap occurs after osteotomy has the advantage of less shortening but carries the risk of nonunion. To avoid this complication bone grafts or bone substitute was used by many authors to fill this gap and prevent collapse in osteotomy site. This study aims to evaluate the MOWHTOs results when performed without adding bone graft or bone substitutes.

Patients and Methods
Twenty patients with varus deformity were treated using (MOWHTO) technique performed in the period between 2014 and 2018. The age of the patients ranged from 18 to 40. Fifteen females and five males completed the follow-up period which was 12 months minimum.

Results
The union was complete without gap collapse in all osteotomies. The time of union ranged from 12-24 weeks with a mean of 12.8 weeks without major complication due to the procedure.

Conclusion
the MOWHTO technique can give good results without adding bone grafts or bone substitutes.

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

Introduction

One of the accepted procedures for the treatment of unicompartmental knee osteoarthritis in young patients with increased activity is the High tibial osteotomy (HTO) especially for those with varus deformity of the knee [1]. Using this technique we can transport the abnormal loads of weight-bearing from the medial compartment which has osteoarthritis to the healthy lateral compartment.

High tibial osteotomy may be carried on y medial opening-wedge or lateral closing wedge. [2]. Plates, wires, or fixators can be used fixation and adding bone grafts to fill the gap carried on by medial opening wedge osteotomy site [3-7]. Any fixation method should be stable to help in the union of the osteotomy to reduce the risk of loss of correction [8]. Locking titanium plates with locked screws is preferred by many authors [9-12]. One of the recorded disadvantages of (MOWHTO) is the loss of correction and collapse[13]. Autograft, allograft, xenograft, bone substitute, acrylic cement, and ceramic spacer were used to fill the defect [14,15]. Autogenous bone graft has wide acceptance as the union rate is high using it [16].

This work has the aim to evaluate the results of (MOWHTO) done without adding any bone graft or synthetic bone substitutes.

Patients and Methods

Twenty patients with varus knee deformity have been admitted to the hospital for (MOWHTO) in the period from June 2014 to February 2018. All osteotomies were done by the same surgeon. we have fifteen females and five males with ages ranged from 18 to 40 years. The patients selected for (MOWHTO) were those who have pain localized to the medial compartment of the knee with genu varum deformity.

The patients having symptomatic osteoarthritis of other rooms (the lateral or patellofemoral compartments) were excluded, also those with severe osteoarthritis. The patients with more than 15 degrees of varus deformity, less than 90 degrees range of motion of the knee, or fixed flexion deformity more than ten degrees. All patients were evaluated clinically and radiologically during the follow-up period. Regular visits at three weeks, six weeks, then three months, six months, and after one year.

Surgical Procedure

All operations were done in the supine position using a translucent operative table with an image intensifier for intraoperative judgment. An anteromedial approach with an 8 cm skin incision parallel to the tibial axis was used for performing all osteotomies (Fig. 1-A).

After skin incision, dissection beneath pes anserinus was done. The superficial medial collateral ligament (MCL) was then detached from the tibia. Then, exposure of the posterior surface of the tibia was done at the level of the osteotomy to insert a Hohmann retractor dorsally. Complete exposure of the tibia anteromedially was done. Then a retractor was placed under the patellar tendon after the release of its anterosuperior attachment.

Osteotomy

Parallel to the joint line under C-arm, the guide pin was drilled from the medial cortex to a point 1.5 cm below the joint line laterally but 1 cm before reaching the lateral cortex pointing the head of the fibula. The second guide pin was introduced parallel to the first.

The plate upper two holes were placed through the two guide pins, the osteotomy was done starting one mm above the patellar tendon attachment site with the protection of the patellar tendon with a retractor. The osteotomy was done using a power saw at first then osteotomes were utilized to complete the cut in tibia up to 1 cm medial to the lateral cortex (Figs. 1-B). Next, the opener was used gradually to reach the needed correction. A Puddu plate (Arthrex Inc., Naple, FL) was then placed in the osteotomy open wedge (Figs. 1-C). carful plate positioning to avoid placing it anteriorly which may increase tibial posterior slope.

Figure 1: Proximal Tibia Medial Open Wedge Osteotomy A) Intraoperative image after guidewire insertion, B) Intraoperative image showing osteotomy, C) after plate fixation.

Postoperative Period

Early postoperative AP and lateral X-rays were taken. Isometric quadriceps and active movements of the ankle and straight leg raising started one day after the operation. The allowed movements of the knee for 21 days postoperative was (0-30 degrees flexion) using a hinged knee brace but no weight-bearing.

The patients after the third week were allowed to flex the knee inside the brace up to 90 and partial weight-bearing using two crutches or three limb walkers. The hinged knee brace was removed and full flexion was stimulated after the second control that has been performed after six weeks, and also, the radiologic evaluation was performed. The patients were allowed to fully weight bear after signs of the union in the plain x-ray. By the sixth month, the plain x-ray was done to exclude any collapse at the osteotomy site.

Results

After six months of follow-up, the union of the osteotomy was completed without any collapse at the osteotomy site. The average time for the union was 14 to 24 weeks with a mean of 16.8 weeks. We have no major complication as regard osteotomy technique.

All patients were able to return to normal life with free walking on the operated legs after six months from the operation.

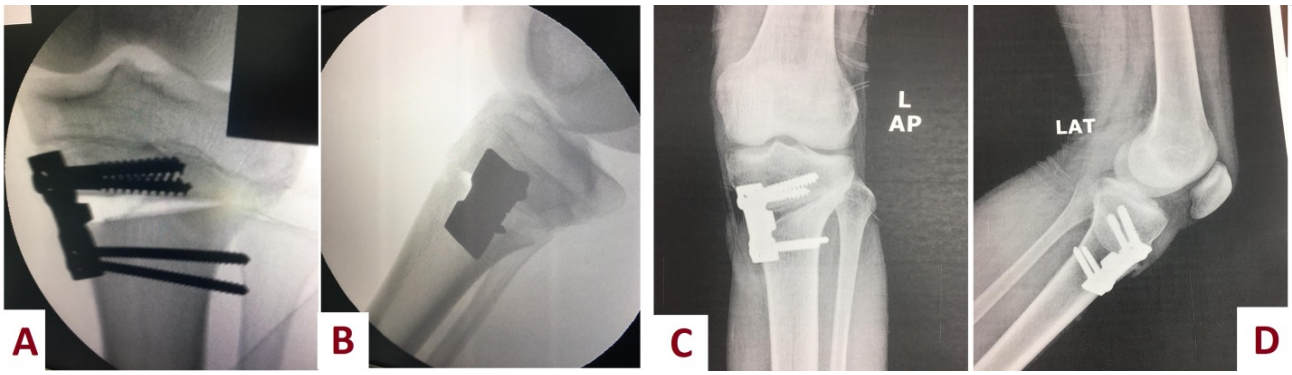

Figure 2: A case study of Male patient 25 years with g varum: A, B) Intraoperative after plate fixation. C,D) Preoperative plain x-ray AP & lateral view

Discussion

When compared to lateral closing-wedge osteotomy (LCWO) the (MOWHTO) has many benefits like easy technique without shortening, the correction is close to the center of the deformity without traction on the peroneal nerve. It also avoids injuries of the proximal tibiofibular joint and the anterior knee compartment [18, 19]. This technique also has the disadvantages of longer time for union and the need for bone grafts [20]. For some authors (MOWHTO) technique carries the risk of non-union in comparison with closed-wedge lateral osteotomy [21]. Gomoll [22] reported that the non-union in (MOWHTO) is related to the gap created in the site of the osteotomy.

Because of non-union and the early loss of correction, many surgeons added bone grafts and bone substitutes in their work. However, the disadvantages of bone grafts and bone substitutes are other problems. These two concerns decreased the preference for (MOWHTO) technique. This was why the (MOWHTO) technique was not popular as joint replacements. The (MOWHTO) when performed using puduu plate without adding any grafts or bone substitutes has low morbidity and safeguard against disadvantages of all bone grafts types. In our work, we have no cases of non-union or early loss of correction after twelve months of follow-up.

The (MOWHTO) osteotomy without adding bone graft is agreed by some authors [7] as Staubli et al. [8] who used a long plate and gave results of healing after (MOWHTO) without using any bone graft. However, the disadvantages of long plates as the need for a longer incision and more stripping to fix the plate and screws, and the need for removing the plates due to their large size. The puduu plate is short and easily applied and no need for its removal due to its small size.

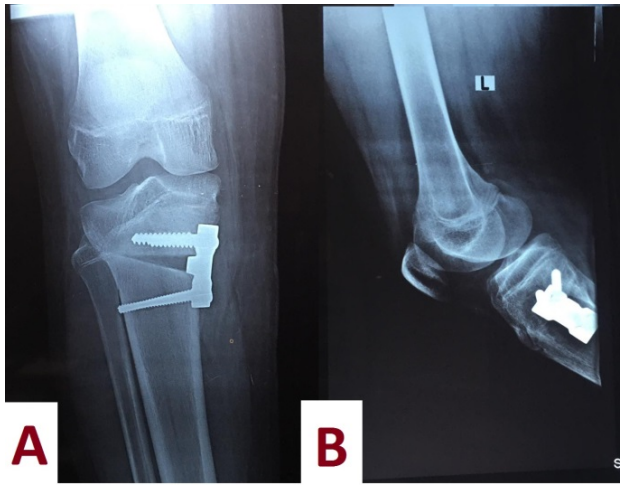

Figure 3: Preoperative plain x-ray of a male patient 27 years with g varum: A) AP view B) lateral view

In a randomized prospective clinical study, Zorzi et al. [2] compared the grafted and non-grafted types of the osteotomy. In the two groups, they reported no significant differences about the union, but they used spacers added to the plates in our, we used no spacers. Reduced handling and limited approach carry the advantage of healthy bone surface area which is very important for the bone union.

In this work, we used (MOWHTO) without any bone grafts or any other bone substitutes or any spacer. Clinically and radiologically there was an improvement in symptoms and complete union within 6 to 12 months postoperative. and also, there was no early recurrence of deformity or loss of correction.

Many types of grafts such as autografts, allografts, and many kinds of bone substitutes were used largely to avoid the collapse of the osteotomy site, non-union, and loss of correction while using (MOWHTO) technique in the literature [23, 24].

The bone grafts were used for filling the gaps in the osteotomy site to that increase the mechanical stability and the bone union. In our opinion, keeping the lateral cortex intact to provide an intact lateral hinge together with the application of locking plates and screws is sufficient to keep the mechanical stability and enhance union. The iliac bone autografts are considered a gold option [16], but carry the risk of donor-site morbidity such as chronic pain, paresthesia, and risk of infections also is possible. Pollock et al [25] represented donor-site morbidity following iliac bone graft 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 osteotomies (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 a bone graft. We think that some bleeding from the osteotomized bone is necessary for the formation of hematoma that is essential for the bone union. For this reason, we intentionally did not use a 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 an 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 [11, 23,30].

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 grafts, synthetic materials, or spacers for plates are not essential for bone healing but with locking plate fixationMOWHTO procedure. Considering mechanical and bio-logical reasons properly is the most important factor for bone healing and successful outcomes.

Conclusion

Satisfactory and good results can be achieved 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.

References

1. Franco V, Cerullo G, Cipolla M, Gianni E, Puddu G. Osteotomy for osteoarthritis of the knee.CurrOrthop2005;19:415–427
2. Zorzi AR, da Silva HG, Muszkat C, Marques LC, Cliquet A Jr, de Miranda JB.Opening-wedge high tibial osteotomy with and without bone graft.Artif Organs 2011;35(3):301–307
3. Klinger HM, Lorenz F, Ha¨rer T. Open wedge tibial osteotomy by hemicallotasis for medial compartment osteoarthritis. Arch Orthop Trauma Surg2001; 121(5):245–247
4. Koshino T, Murase T, Saito T () Medial opening-wedge high tibial osteotomy with use of porous hydroxyapatite to treat medial compartment osteoarthritis of the knee. J Bone Joint Surg Am 2003; 85-A (1):78–85
5. Kraal T, Mullender M, de BruineJH, Reinhard R, de Gast A, Kuik DJ, van Royen BJ. Resorbability of rigid beta-tricalcium phosphate wedges in open-wedge high tibial osteotomy: a retrospective radiological study. Knee 2007; 15(3):201–205
6. Sgaglione NA, Moynihan DP, Uggen C. The use of allografts in high tibial osteotomy: opening wedge technique. Oper Tech Sports Med 2007; 15:72–80
7. Stoffel K, Stachowiak G, Kuster M. Open wedge high tibial osteotomy: biomechanical investigation of the modified Arthrex Osteotomy Plate (Puddu Plate) and the TomoFix Plate. ClinBiomech2004; 19(9):944–950
8. Staubli AE, De Simoni C, Babst R, Lobenhoffer P. To- moFix: a new LCP-concept for open wedge osteotomy of the medial proximal tibia–early results in 92 cases. Injury 2003; 34(Suppl 2):B55–B62
9. Dorsey WO, Miller BS, Tadje JP, Bryant CR. The stability of three commercially available implants used in medial opening wedge high tibial osteotomy. J Knee Surg2006; 19(2):95–98
10. Niemeyer P, Koestler W, Kaehny C, Kreuz PC, Brooks CJ, Strohm PC, Helwig P, Suedkamp NP. Two-year results of open-wedge high tibial osteotomy with fixation by medial plate fixator for medial compartment arthritis with varus malalignment of the knee. Arthroscopy 2008; 24(7):796–804
11. Spahn G. Complications in high tibial (medial opening wedge) osteotomy. Arch Orthop Trauma Surg2004; 124(10):649–653.
12. Spahn G, Mu¨ckley T, Kahl E, Hofmann GO. Biomechanical investigation of different internal fixations in medial opening-wedge high tibial osteotomy. ClinBiomech2006; 21(3):272–278
13. Amendola A, Panarella L. High tibial osteotomy for the treatment of unicompartmental arthritis of the knee. Orthop Clin N Am 2005; 36(4):497–504
14. Brosset T, Pasquier G, Migaud H, Gougeon F. Opening wedge high tibial osteotomy performed without filling the defect(TomoFixTM) and early weight-bearing: prospective evaluation of bone union, precision and maintenance of correction in 51 cases. Orthtramatolsurg; Res 2011; 97(7):705–711
15. Levai JP, Bringer O, Descamps S, Boisgard S.Xenograft- related complications after filling valgus open wedge tibial osteotomy defects. Rev ChirOrthopReparatriceAppar Mot 2003; 89(8):707–711
16. Warden SJ, Morris HG, Crossley KM, BruknerPD, Bennell KL. Delayed- and non-union following opening wedge high tibial osteotomy: surgeons' results from 182 completed cases. Knee Surg Sports traumatolArthrosc2005; 13(1):34–37
17. Wade R, Richardson J. Outcome in fracture healing: a review. Injury 2001; 32:109–114
18. Rose T, Imhoff AB. Complications after transgenicular osteotomies.

Oper Tech Orthop2007; 17:80–86

19. Wright JM, Crockett HC, Slawski DP, Madsen MW, Windsor RE.High tibial osteotomy. J Am AcadOrthopSurg2005; 13(4):279–289
20. Ganji R, Omidvar M, Izadfar A, Alavinia SM. Opening wedge high tibial osteotomy using tibial wedge allograft: a case series study. Eur J OrthopSurgTraumatol2013; 23(1):111–114
21. Marti RK, Verhagen RA, Kerkhoffs GM, Moojen TM.Proximal tibial varus osteotomy.Indications, technique, and five to twenty-one-year results. J Bone Joint Surg Am 2001; 83-A (2): 164–170
22. Gomoll AH. High tibial osteotomy for the treatment of unicompartmental knee osteoarthritis: a review of the literature, indications, and technique. PhysSportsmed2011; 39(3):45–54
23. Aryee S, Imhoff AB, Rose T, Tischer T () Do we need synthetic osteotomy augmentation materials for opening-wedge high tibial osteotomy. Biomaterials 2008; 29(26):3497–3502
24. Kuremsky MA, Schaller TM, Hall CC, Roehr BA, Masonis JL. Comparison of autograft versus allograft in opening-wedge high tibial osteotomy. J Arthroplast2010; 25(6):951–957
25. Pollock R, Alcelik I, Bhatia C, Chuter G, Lingutla K, Budithi C, Krishna M. Donor site morbidity following iliac crest bone harvesting for cervical fusion: a comparison between minimally invasive and open techniques. Eur Spine J 2008; 17(6):845–852
26. Amendola A, Bonasia DE. Results of high tibial osteotomy: review of the literature. IntOrthop2010; 34(2):155–160
27. BrullSJ, Lieponis JV, Murphy MJ, Garcia R, Silverman DG. Acute and long-term benefits of iliac crest donor site perfusion with local anesthetics. AnesthAnalg1992; 74(1):145–147
28. Chae DJ, Shetty GM, Wang KH, Montalban AS Jr, Kim JI, Nha KW. Early complications of medial opening wedge high tibial osteotomy using autologous tricortical iliac bone graft and T-plate fixation. Knee 2011; 18(4):278–284
29. Ahlmann E, Patzakis M, Roidis N, Shepherd L, Holtom P. Comparison of anterior and posterior iliac crest bone grafts in terms of harvest-site morbidity and functional outcomes. J Bone Joint Surg Am 2002; 84-A (5):716–720
30. van Hemert WL, Willems K, Anderson PG, van Heerwaarden RJ, Wymenga AB.Tricalcium phosphate granules or rigid wedge preforms in open wedge high tibial osteotomy: a radiological study with a new evaluation system. Knee 2004; 11(6):451–456.