

Mid Term Outcome of Open Wedge High Tibial Osteotomy

Tarun Kumar Badam^{1*}, Muthukumar Balaji², Sathish Devadoss³, A. Devadoss⁴

¹Junior Resident, ²Junior Consultant, ³Senior Consultant, ⁴Chief, Department of Orthopaedics, IORAS Devadoss Multispeciality Hospital, Madurai

*Corresponding Author:

Email: btk_2075@yahoo.com

ABSTRACT

Introduction: High tibial osteotomy (HTO) is a common surgical technique for isolated medial compartment osteoarthritis of tibio-femoral component of knee, indicated in young and active patients with varus deformity. It can be performed by lateral closed wedge osteotomy, medial open wedge osteotomy and dome osteotomy. Purpose of this study was to evaluate the (1) Incidence and severity of complications after medial open wedge osteotomy, (2) functional outcome, (3) survival rate of HTO, (4) incidence of revision to TKR.

Materials And Methods: We have retrospectively evaluated 32 knees in 27 patients operated during last 10yrs (January 2005 to May 2015) who have undergone **Medial open wedge HTO** for Unicompartmental (medial) OA of knee. The indications for surgery were medial compartment osteoarthritis with varus deformity of knee, young and active patients with age < 55yrs, progressive symptoms unresponsive to conservative treatment for at least 6 months, >90° of flexion, flexion contracture <10°, intact cruciates and collaterals. Post-operatively, patients were followed up every month till bony union, thereafter every 3 months for 1yr post-surgery, at final follow-up and were evaluated for the complications and the functional outcome using HSS knee score.

Results: The mean duration of bony union was 12 weeks (10-16). All the pre-operative range of movements was retained post-operatively. HSS knee score has increased significantly following medial open wedge HTO. 5 year-survival rate was 100% and 10 year-survival rate was 87.5%. Four patients were revised to total knee replacement (12.5%). In our study, overall complication rate was 10.93%.

Conclusion: Success of arthroplasty in recent decades has degraded HTO lately, but HTO is still a viable option for young and active patients with medial compartment osteoarthritis of knee with varus deformity, with flexion >90°, with flexion contracture < 10°. It is less expensive and no changes in lifestyle are required which is very useful in Indian perspective. It retains all the pre-operative movements and helps in delaying total knee arthroplasty.

Keywords: High Tibial osteotomy, Medial open wedge HTO, Survival rate of HTO, Revision to TKR, Tibial slope in Open wedge HTO, Complications in open wedge HTO

INTRODUCTION

High tibial osteotomy (HTO) is most commonly used in the treatment of isolated osteoarthritis of the medial compartment of the knee¹. Treatment for osteochondritis dissecans and condylar osteonecrosis are less common indications²⁻⁹. It is mainly indicated in young and active patients with varus deformity of the knee¹⁰. HTO changes the load distribution across the knee from diseased medial compartment to healthy lateral compartment by which it reduces the pain, slows degenerative process and delays the requirement of Total knee replacement. It may be performed using lateral closed wedge osteotomy, medial open wedge osteotomy and dome osteotomy. Purpose of this study was to evaluate the (1) Incidence and severity of complications after medial open wedge osteotomy, (2) functional outcome, (3) survival rate of HTO, (4) incidence of revision to TKR.

MATERIALS AND METHODS

We have retrospectively evaluated 32 knees in 27 patients operated during last 10yrs (January 2005 to May 2015) who have undergone Medial open wedge HTO for Unicompartmental (medial) OA of knee. The indications for surgery were medial compartment osteoarthritis with varus deformity of knee, young and active patients with age <55yrs, progressive symptoms unresponsive to conservative treatment for at least 6 months, >90° of flexion, flexion contracture <10°, intact cruciates and collaterals. Patients with symptomatic osteoarthritis involving lateral compartment of knee and smokers were

excluded from the study. The study included 20 women and 7 men with a mean age of 47 years (39 to 52). The mean follow-up was 48 months (28 to 120).

Pre-operative templating was done according to the method described by Dugdale, to shift the weight bearing axis from medial to lateral compartment by doing overcorrection of 3-5°, above 7° of normal valgus. Standard surgical technique was followed with midline incision in view of future revision to TKR. Iliac crest bone graft was used in the open wedge and was fixed with T-butress plate on antero-medial surface of the tibia.

Post-operative rehabilitation: Static quadriceps and active ankle exercises were started immediately after surgery. Patellar mobilization, straight leg raises and active quadriceps exercises were started on second post-operative day. Partial weight bearing was allowed at 6 weeks and full weight bearing at 12 weeks post-operatively.

Follow-up visits: Patients were followed up every month till bony union, thereafter every 3 months for 1yr post-surgery, at final follow up and were evaluated for the complications and the functional outcome. At each visit, the range of movement was measured using a goniometer and functional assessment was performed using the Hospital for Special Surgery (HSS) knee score. Radiological evaluation was done on 1st and 12th post-operative day and then monthly till bony union and at final follow-up. Radiological evaluation was done for loss of

correction, failure of fixation, fracture of the tibial plateau and non-union at each visit.

RESULTS

From January 2005 to September 2015, 32 knees in 27 patients were treated with Medial open wedge HTO for Unicompartmental OA of knee. The study included 20 women and 7 men with a mean age of 47 years (39 to 52); with right sided predominance (right in 14, left in 8 and bilateral in 5 patients). The mean follow-up was 48 months (28 to 120). The mean duration of bony union was 12 weeks (10-16) and mechanical axis in valgus at final follow-up was 3° (1°-5°). Post-operatively tibial slope has increased which maintained till final follow-up. All the pre-operative range of movements was retained post-operatively. HSS knee score has increased significantly following medial open wedge HTO (Table I). 5 year-survival rate was 100 % (Fig. 2) and 10 year-survival rate was 87.5 % (Fig. 3). Four patients were revised to total knee replacement (12.5%) (Fig. 4). In our study, overall complication rate was 10.93% in which 1 had superficial and 1 had deep infection who were treated with intravenous antibiotics, 2 had intra-articular undisplaced tibial plateau fractures treated with cast immobilization for 4 weeks, and 2 had loss of correction for which re-plating was done (Table II). There were no cases of delayed union, nonunion or fixation failure. None of the patients had peroneal nerve injury.

DISCUSSION

Jackson and Waugh first introduced the concept of HTO for the treatment of osteoarthritis of the knee in 1961¹¹ and it was later popularized by Coventry in 1965¹². Maquet described dome osteotomy in 1976 and Turi described medial open wedge HTO in 1987. Medial open wedge osteotomy has become popular in recent years as it is simpler, more accurate, allows adjustment in both coronal and sagittal planes. It minimizes the disadvantages of

lateral closed wedge osteotomy like disruption of the proximal tibiofibular joint, injury to peroneal nerve, injury to lateral collateral ligament and compartment syndrome¹³. It maintains the proximal tibial bone stock that minimizes the risks of revision to TKR¹⁴. But, it has gradually fallen into disrepute because of failure of fixation, loss of correction, non-union and delayed union¹⁵⁻¹⁷. Several studies have reported a high rate of complication with medial open wedge HTO (Fig. 1). Coventry et al reported complication rate as high as 38.2%¹², Van den Bekerom et al 55%¹⁶, Brouwer et al 11%¹⁸, El Azab et al 16.4%¹⁹ and Ek Song et al 20%²⁰. However, in our study, the overall rate of complication was 10.93% that was low in comparison to other studies. There were no reported cases of nonunion, delayed union or fixation failure in our series, probably because of the auto graft and immobilization for 12 weeks. No evidence of peroneal nerve injury in any of the patients. 1 patient had undisplaced intra-articular tibial plateau fractures which were treated with cast immobilization for 10 weeks. We found increase in the posterior tibial slope after surgery which maintained till final follow-up. This was in agreement to El Azab et al study¹⁹. So, medial open wedge high tibial osteotomy can be used even in ACL laxity where increase in posterior tibial slope reduces anterior tibial translation (ATT) and prevents progression of degeneration of the articular surface.

In various studies, 5-year survival rate ranged from 75% to 95% (Fig. 2) and 10-year survival rate ranged from 51% to 98%²¹ (Fig. 3). In our study, 5-year survival rate was 100% and 10-year survival rate was 87.5%, which shows good outcome in comparison to other studies. A total of four knees were converted to total knee replacement (12.5%) (Fig. 4). The mean time from HTO to TKR was 8.5 years (7 to 9 years). Revision to TKR wasn't a problem as we followed midline incision while performing HTO, no loss of proximal tibial bone stock and no patella baja.

FIGURE 1:

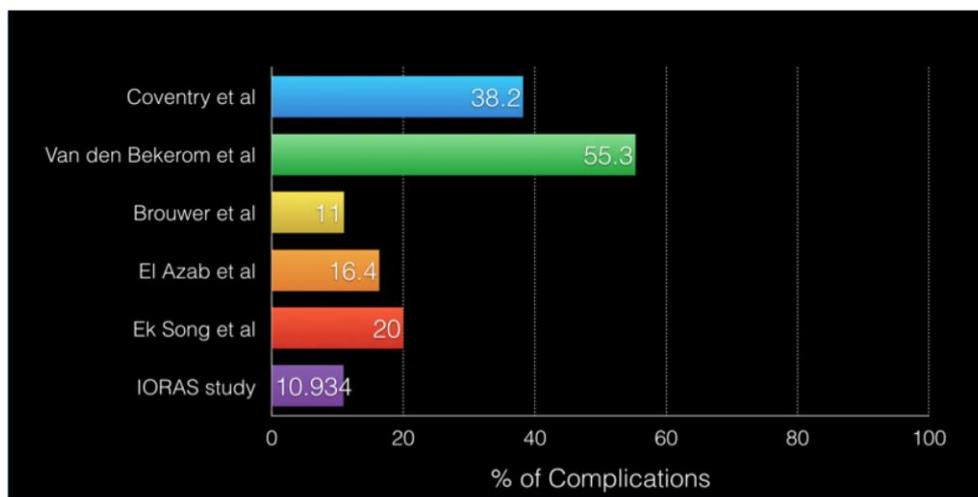


FIGURE 2:
5-YEAR SURVIVAL RATE

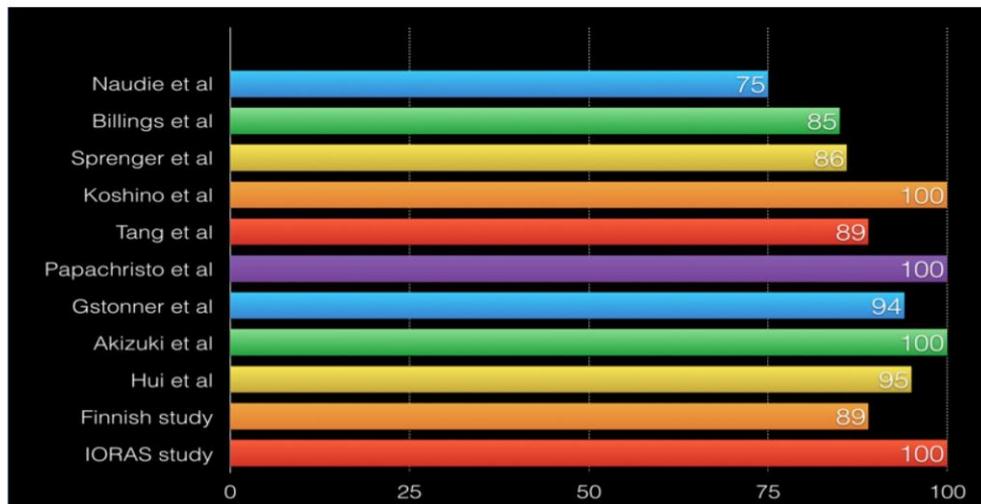


FIGURE 3:
10-YEAR SURVIVAL RATE

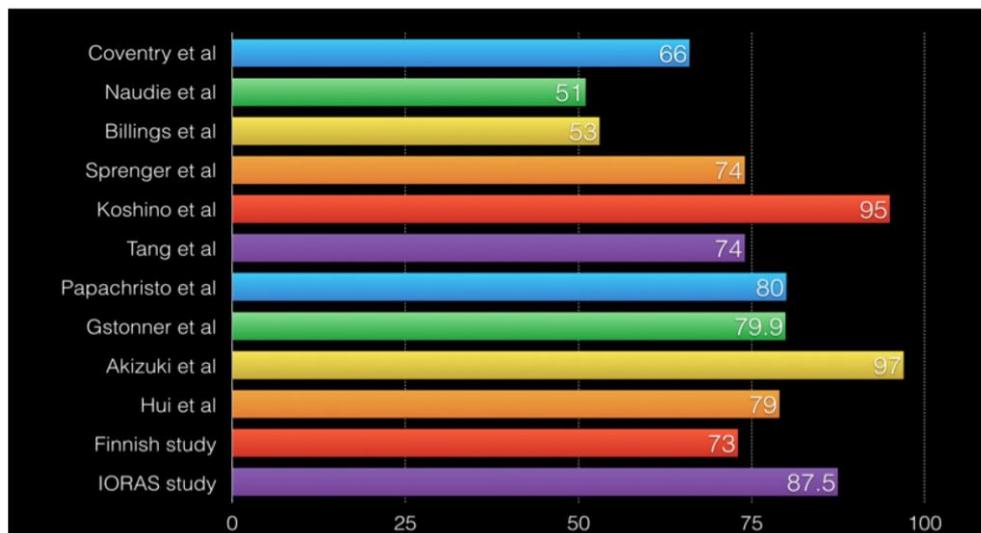


FIGURE 4:
REVISION TO TKR

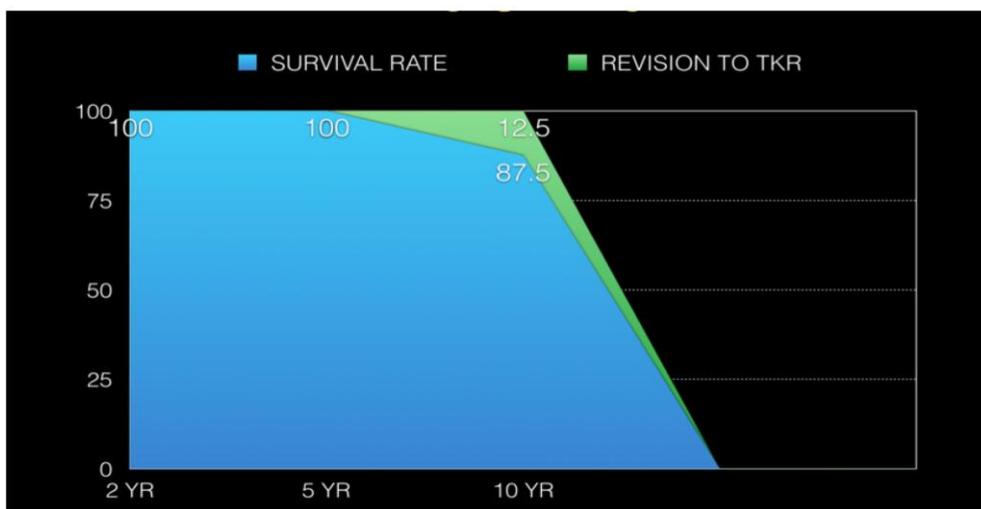


TABLE I:

1) Duration of Bony Union (weeks):	12 (10-16)
2) Range of movements (°):	
Pre-operative	140° (116-154°)
Post-operative	140° (115-154°)
3) Mechanical axis in valgus:	3°(1-5°)
4) HSS Knee Score:	
Pre-operative	75(55-90)
Post-operative	94(84-100)
Follow-up	87(76-94)
5) Tibial slope:	
Pre-operative	9(6-13)
Post-operative	10.5(7.5-14.5)
Final Follow-up	10.7(7.5-14.8)

**TABLE II:
COMPLICATIONS**

COMPLICATIONS	n	%
Superficial infection	1	1.562
Deep infection	1	1.562
Instability	1	1.562
Delayed Union	0	0
Non-union	0	0
Fixation failure	0	0
Loss of correction	2	3.124
Tibial Plateau #	2	3.124
Peroneal nerve injury	0	0
TOTAL	7	10.934

CASE 1:



CASE 2:



CONCLUSION

Success of arthroplasty in recent decades has degraded HTO lately, but HTO is still a viable option for young and active patients with medial compartment osteoarthritis of knee with varus deformity, with flexion $>90^\circ$, with flexion contracture $< 10^\circ$. It is less expensive and no changes in lifestyle are required which is very useful in Indian perspective. It retains all the pre-operative movements and helps in delaying total knee arthroplasty.

REFERENCES

1. Akizuki S, Shibakawa A, Takizawa T, Yamazaki I, Horiuchi H. The long-term outcome of high tibial osteotomy: a ten-to 20-year follow-up. *J Bone Joint Surg [Br]* 2008; 90-B:592-6.
2. Coventry MB. Upper tibial osteotomy. *Clin Orthop* 1984; 182:46-52.
3. Amendola A, Panarella L. High tibial osteotomy for the treatment of unicompartmental arthritis of the knee. *Orthop Clin North Am* 2005; 36:497-504.
4. Dowd GS, Somayaji HS, Uthukuri M. High tibial osteotomy for medial compartment osteoarthritis. *Knee* 2006; 13:87-92.
5. Hernigou P, Medevielle D, Debeyre J, Goutallier D. Proximal tibial osteotomy for osteoarthritis with varus deformity: a ten to thirteen-year follow-up study. *J Bone Joint Surg [Am]* 1987; 69-A:332-54.
6. Marti CB, Gautier E, Wachtl SW, Jakob RP. Accuracy of frontal and sagittal plane correction in open-wedge high tibial osteotomy. *Arthroscopy* 2004; 20:366-72.
7. Parker DA, Viskontas DG. Osteotomy for the early varus arthritic knee. *Sports Med Arthrosc* 2007; 15:3-14.
8. Noyes FR, Barber-Westin SD, Hewett TE. High tibial osteotomy and ligament reconstruction for varus angulated anterior cruciate ligament-deficient knees. *Am J Sports Med* 2000; 28:282-96.
9. Brinkman JM, Lobenhoffer P, Agneskirchner JD, et al. Osteotomies around the knee: patient selection, stability of fixation and bone healing in high tibial osteotomies. *J Bone Joint Surg [Br]* 2008; 90-B:1548-57.
10. Wright J, Heck D, Hawker G, et al. Rates of tibial osteotomies in Canada and the United States. *Clin Orthop* 1995; 319:266-75.
11. Jackson JP, Waugh W. Tibial osteotomy for osteoarthritis of the knee. *J Bone Joint Surg [Br]* 1961; 43-B:746-51.
12. Coventry MB. Osteotomy of the upper portion of the tibia for degenerative arthritis of the knee: a preliminary report. *J Bone Joint Surg [Am]* 1965; 47-A:984-90.
13. Spahn G, Wittig R. Primary stability of various implants in tibial opening wedge osteotomy: a biomechanical study. *J Orthop Sci* 2002; 7:683-7.
14. Meding JB, Keating EM, Ritter MA, Faris PM. Total knee arthroplasty after high tibial osteotomy: a comparison study in patients who had bilateral total knee replacement. *J Bone Joint Surg [Am]* 2000; 82-A:1252-9.
15. Stuart MJ, Beachy AM, Grabowski JJ, An KN, Kaufman KR. Biomechanical evaluation of a proximal tibial opening-wedge osteotomy plate. *Am J Knee Surg* 1999; 12:148-53.
16. van den Bekerom MP, Patt TW, Kleinhout MY, van der Vis HM, Albers GH. Early complications after high tibial osteotomy: a comparison of two techniques. *J Knee Surg* 2008; 21:68-74.
17. Spahn G. Complications in high tibial (medial opening wedge) osteotomy. *Arch Orthop Trauma Surg* 2004; 124:649-53.
18. Brouwer RW, Bierma-Zeinstra SM, van Raaij TM, Verhaar JA. Osteotomy for medial compartment arthritis of the knee using a closing wedge or an opening wedge controlled by a Puddu plate: a one-year randomised, controlled study. *J Bone Joint Surg [Br]* 2006; 88-B:1454-9.
19. El-Azab, Halawa, Anetzberger, Imhoff, Hinterwimmer. The effect of closed- and open-wedge high tibial osteotomy on tibial slope: A retrospective radiological review of 120 cases. *J Bone Joint Surg [Br]* 2008;90-B:1193-7.
20. E. K. Song, J. K. Seon, S. J. Park, M. S. Jeong. The complications of high tibial osteotomy closing- versus opening- wedge methods. *J Bone Joint Surg [Br]* 2010; 92-B:1245-52.
21. T. T. Niinimäki, A. Eskelinen, B. S. Mann, M. Junnila, P. Ohtonen, J. Leppilähti. Survivorship of high tibial osteotomy in the treatment of osteoarthritis of the knee. Finnish registry based study of 3195 knees. *J Bone Joint Surg Br* 2012;94-B:1517-21.