



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

International Journal of Current Research
Vol. 14, Issue, 02, pp.20745-20748, February, 2022

DOI: <https://doi.org/10.24941/ijcr.43134.02.2022>

RESEARCH ARTICLE

COMPARISON OF CLOSING WEDGE AND OPENING WEDGE HIGH TIBIAL OSTEOTOMY

Tuvshinjargal Boldbayar^{1,2,*}, Baatarjav Sosor³ and Sergelen Orgoi¹

¹Mongolian National University of Medical Sciences

²The First central hospital of Mongolia

³National Traumatology and Orthopaedics Research Center of Mongolia

ARTICLE INFO

Article History:

Received 17th November, 2021

Received in revised form

29th December, 2021

Accepted 24th January, 2022

Published online 28th February, 2022

Keywords:

Closing Wedge Osteotomy, High Tibial Osteotomy, Opening Wedge Osteotomy, Osteoarthritis.

ABSTRACT

Background and purpose: High tibial osteotomy (HTO) is a widely performed procedure to treat medial knee arthritis. Two basic HTO techniques are performed commonly, a lateral closing-wedge HTO and a medial opening-wedge HTO. Previous studies have not consistently demonstrated either technique to offer more clinical advantage than the other. **Material and methodology:** From 2019 to 2020, one hundred patients were randomized to receive either a closing-wedge or an opening-wedge high tibial osteotomy. The clinical outcome and radiographic results were examined preoperatively, at 2, 6 and 18 months postoperatively. Main demographic variables such as age, gender, body mass index (BMI) and previous non-surgical treatment data were collected and reviewed. The outcomes that we reviewed include maintenance of the achieved correction (pre- and postoperative weight bearing line, medial proximal tibial angle), progression of osteoarthritis (based on the Kellgren and Lawrence classification), severity of pain and quality of life (as assessed with an Oxford and a Lysholm knee score), knee function (pre- and postoperative knee range of motion), surgical duration and complications. Data analysis calculated by using Stata 13.0. **Results:** The mean age of study participants was 51±6 and 10 percent of those were men. The 51 percent of the total subjects underwent the lateral closing-wedge high tibial osteotomy and remained 49% received the medial opening-wedge technique. At 18 months, percent of weight bearing line increased to 57.1±4.2 in lateral closing-wedge osteotomy group and 58.8±4.0 in medial opening-wedge osteotomy group. The mean medial proximal tibial angle was 92.8±2.7 in lateral closing-wedge osteotomy group and 92.8±3.0 in medial opening-wedge osteotomy. The Oxford knee score and Lysholm knee score significantly increased at 6 months and 18 months follow-up in both study groups compared to pre-operation assessment ($p < 0.0001$). At 2 months follow-up period, participants in both groups obtained significantly lower score in the Oxford and Lysholm knee scale compared to both pre-operation and final assessment. **Conclusion:** Both method of tibial osteotomy, medial opening wedge and lateral closing wedge, depicted satisfactory result in our study. However, medial opening wedge technique may provide surgeons better possibility to correct weight bearing line more accurately than lateral closing wedge method.

*Corresponding author:
Tuvshinjargal Boldbayar

Copyright © 2022. Tuvshinjargal Boldbayar et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Tuvshinjargal Boldbayar, Baatarjav Sosor and Sergelen Orgoi. "Comparison of closing wedge and opening wedge high tibial osteotomy", 2022. International Journal of Current Research, 14, (02), 20745-20748.

INTRODUCTION

Two basic HTO techniques are commonly performed, a lateral closing-wedge HTO and a medial opening-wedge HTO. Traditionally, although closed-wedge HTOs were more common in the past, the open-wedge HTO has gradually taken the place of the closed-wedge HTO. Open-wedge HTOs have several advantages over closed-wedge HTOs, including easier control of the degree of correction, less extensive soft tissue dissection, sparing of the proximal tibiofibular joint, and the avoidance of serious complications such as peroneal palsy.

The number of HTO is increasing every year, however which technique is better than other is still remain unclear.

RESULTS

The mean age of study participants was 51±6. The 51 percent of the total subjects underwent the lateral closing-wedge high tibial osteotomy and remained 49% received the medial opening-wedge technique. There was not statistically significant difference on demographic variables such as age, gender, occupation, body mass index between intervention and control group ($p=0.007$). Total of 42 people with 3rd grade of osteoarthritis underwent high tibial osteotomy.

Table 1. The change in weight bearing line, medial proximal tibial angle, knee extension and flexion range, Oxford knee score and Lysholm knee score by study groups

		Study Group				P value
		LC		MO		
		Mean	sd	Mean	Sd	
WBL, %						
	Pre-operation	22.9	11.7	18.1	13.1	0.005
	At 2 months	56.8	3.6	57.7	3.8	
	At 6 months	56.6	3.7	58.4	3.5	
	At 18 months	57.1	4.2	58.8	4.0	
		p < 0.0001		p < 0.0001		
MPTA						
	Pre-operation	79.9	3.3	82.7	3.5	0.005
	At 2 months	92.6	2.3	92.9	3.1	
	At 6 months	92.8	2.3	92.4	3.1	
	At 18 months	92.8	2.7	92.8	3.0	
		p < 0.0001		p < 0.0001		
Ext						
	Pre-operation	3.0	2.4	2.8	2.3	0.005
	At 2 months	16.7	7.5	14.7	6.8	
	At 6 months	4.2	3.1	3.5	1.8	
	At 18 months	2.7	2.2	2.9	1.9	
		p < 0.0001		p < 0.0001		
Flex						
	Pre-operation	113.5	12.6	111.9	14.0	0.005
	At 2 months	73.6	9.6	74.4	11.6	
	At 6 months	105.1	12.9	107.4	12.6	
	At 18 months	111.3	12.6	111.9	13.6	
		p < 0.0001		p < 0.0001		
Oxford						
	Pre-operation	26.1	5.4	28.6	5.9	
	At 2 months	24.3	3.5	26.7	4.4	
	At 6 months	34.7	5.4	37.8	4.3	
	At 18 months	37.3	4.9	40.4	4.0	
		p < 0.0001		p < 0.0001		
Lysholm						
	Pre-operation	66.4	5.9	66.8	6.8	
	At 2 months	51.8	8.7	53.5	10.8	
	At 6 months	77.5	5.0	79.2	4.1	
	At 18 months	81.2	5.2	83.0	4.2	
		p < 0.0001		p < 0.0001		

LC- lateral closing-wedge osteotomy for medial compartment osteoarthritis of the knee MO- medial opening-wedge osteotomy for medial compartment osteoarthritis of the knee sd- standard deviation ** -P value<0.01 is regarded as statistically significance. Chi-square test conducted to assess difference between groups.



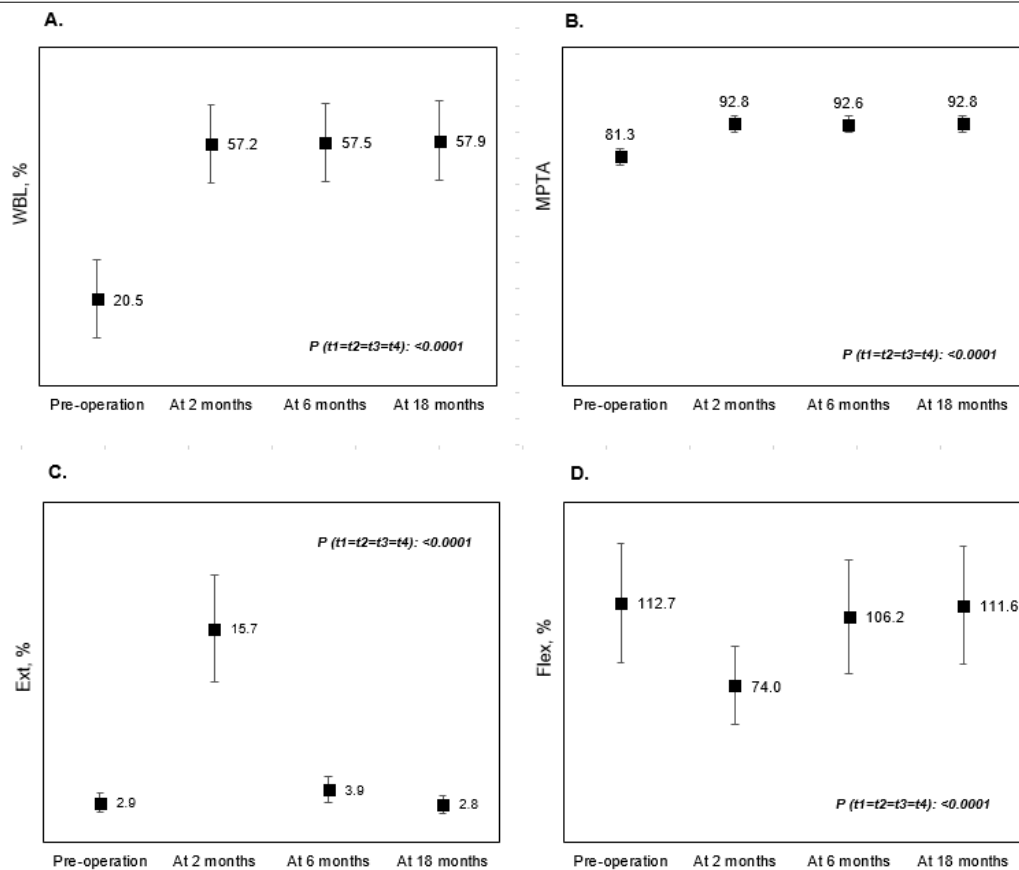
Picture 1. Weight bearing line before and after medial opening wedge high tibial osteotomy



Picture 2. X-ray images before and after lateral closing wedge high tibial osteotomy

Study participants' mean WBL % significantly increased from 20.5±4.1 at pre-operation assessment to 57.2±4.6 at 2 months follow-up. At 6 months and 18 months follow up period, mean WBL % remained as parameter at 2 months follow-up. In the figure B, mean MPTA was 81.3 at pre-operation and increased significantly to 92.8 at 2 months follow-up and remained at 6 months and 18 months (p< 0.0001). In the figure C, pre-operation mean knee extension range was 2.9 and sharply raised significantly to 15.7 at 2 months follow up.

The mean knee extension range significantly declined to 3.9 and 2.8, at 6 months and 18 months follow-up, respectively (p< 0.0001). In the figure D, mean knee flexion range was 112.7 at pre-operation assessment and significantly decreased to 74.0 at 2 months. During the 6 months and 18 months follow-up, the mean knee flexion range significantly increased to 106.2 and 111.6, respectively (p< 0.0001). There was significant difference between four times assessments on weight bearing line percentage in both intervention and control



Picture 3. The difference in some measurements of study participants A. WBL%, B. MPTA, C. Ext%, D. Flex%

group ($p < 0.0001$). At 18 months, percent of weight bearing line increased to 57.1 ± 4.2 in lateral closing-wedge osteotomy and 58.8 ± 4.0 in medial opening-wedge technique. At 18 months postoperatively, the mean medial proximal tibial angle was 92.8 ± 2.7 in lateral closing-wedge osteotomy and 92.8 ± 3.0 in medial opening-wedge osteotomy. The significant difference was found between the study time-points in both groups ($p < 0.0001$). In LC group, the mean knee extension range was 3.0 ± 2.4 in pre-operative stage and 2.7 in 18 months follow-up period. Moreover, in MO group, the mean knee extension range was 2.8 ± 2.3 in pre-operation and 2.9 ± 1.9 in 18 months assessment. There was significant difference between pre-operation, 2 months, 6 months and 18 months follow-up periods in both intervention and control group ($p < 0.0001$). In terms of the mean knee flexion range, significant difference also found between these follow-up periods in both groups ($p < 0.0001$). The Oxford knee score and Lisholm knee score significantly increased at 6 months and 18 months follow-up in both study groups compared to pre-operation assessment ($p < 0.0001$). At 2 months follow-up period, participants in both groups obtained significantly lower score in the Oxford and Lisholm knee scale compared to both pre-operation and final assessment (Table 3).

DISCUSSION AND CONCLUSION

It is possible to improve the symptoms and to prevent the progression of knee by initiating proper treatment such as HTO.⁷ In addition, clinical result of MOWHTO is superior even in KL-3 patients. Kim JH et al have performed a meta analysis study that depicted the survival rate with open- and closed-wedge HTO was 95.1% (95% CI: 93.1 to 97.1%) and 93.9% (95% CI: 93.1 to 94.6%) at 5 years, respectively, and

91.6% (95% CI: 88.5 to 94.8%) and 85.4% (95% CI: 84.0 to 86.7%) at 10 years, respectively. Sun et al noted in a study that CWO led to a higher incidence of opposite cortical fracture. Overall, we've concluded that surgeons may fix the axis of lower extremity more accurately by using medial opening wedge technique than lateral closing wedge method that leads to better outcome.

REFERENCES

1. Sun, H., Zhou, L., Li, F. & Duan, J. 2016. Comparison between Closing-Wedge and Opening-Wedge High Tibial Osteotomy in Patients with Medial Knee Osteoarthritis: A Systematic Review and Meta-analysis. *J. Knee Surg.*
2. Schallberger, A., Jacobi, M., Wahl, P., Maestretti, G. & Jakob, R. P. High tibial valgus osteotomy in unicompartmental medial osteoarthritis of the knee: a retrospective follow-up study over 13–21 years. *Knee Surg. Sports Traumatol. Arthrosc.* 19, 122–127 (2011)
3. Seo, S. S. et al. Complications and Short-Term Outcomes of Medial Opening Wedge High Tibial Osteotomy Using a Locking Plate for Medial Osteoarthritis of the Knee. *Knee Surg Relat Res* 28, 289–296 (2016)
4. Nha, K. W., Kim, H. J., Ahn, H. S. & Lee, D. H. Change in Posterior Tibial Slope After Open-Wedge and Closed-Wedge High Tibial Osteotomy: A Meta-analysis. *Am. J. Sports Med.* 44, 3006–3013 (2016)
5. Smith TO¹, Sexton D, Mitchell P, Hing CB. Opening- or closing-wedged high tibial osteotomy: a meta-analysis of clinical and radiological outcomes. *Knee.* 2011 Dec;18(6):361–8. doi: 10.1016/j.knee.2010.10.001. Epub 2010 Oct 29.
6. Michelle J Lespasio, Nicolas S Piuizzi, M Elaine Husni, George F Muschler, AJ Guarino, Michael A Mont. *Knee*

- osteoarthritis: A primer. *Perm J* 2017;21:16-183. E-pub: 09/13/2017.
7. Arden NK. Strategies for the prevention of knee osteoarthritis. *Nat Rev Rheumatol* 2016 Feb;12(2):92-101. DOI: <https://doi.org/10.1038/nrrheum.2015.135>.
 8. Kellgren JH, Lawrence JS. Radiological assessment of osteoarthritis. *Ann Rheum Dis* 1957 Dec;16(4):494- 502. DOI: <https://doi.org/10.1136/ard.16.4.494>.
 9. Loia MC, Vanni S, Rosso F, et al. High tibial osteotomy in varus knees: Indications and limits. *Joints* 2016 Aug 18;4(2):98-110. DOI: <https://doi.org/10.11138/jts/2016.4.2.098>
 10. Lingfeng Wu, Jun Lin, Zhicheng Jin, XiaobinCai, WeiyangGao. Comparison of clinical and radiological outcomes between opening wedge and closing wedge high tibial osteotomy: A comprehensive meta-analysis. *Plos One* 2017 12(2): e0171700. Doi:10.1371/journal.pone.0171700.
 11. Brosset, T., Pasquier, G., Migaud, H. &Gougeon, F. Opening wedge high tibial osteotomy performed without filling the defect but with locking plate fixation(Tomofix) and early weight-bearing: prospective evaluation of bone union, precision and maintenance of correction in 51 cases. *Orthop. Traumatol. Surg. Res.* 97, 705–711 (2011)
 12. Kim JH, Kim HJ, Lee DH. Survival of opening versus closing wedge high tibial osteotomy: A meta-analysis. *Sci Rep.* 2017 Aug 4;7(1):7296. doi: 10.1038/s41598-017-07856-8
 13. Van Raaij MT, Brouwer RW, de Vlieger R, Reijman M, Verhaar NAJ. Opposite cortical fracture in high tibial osteotomy: Lateral closing compared to the medial opening-wedge technique. *ActaOrthop* 2008;79:508-514.
 14. R Nakamura, N Komatsu, K Fujita, K Kuroda, M Takahashi, R Omi, Y Katsuki, H Tsuchiya. Appropriate hinge position for prevention of unstable lateral hinge fracture in open wedge high tibial osteotomy. Published Online: 1 Oct 2017. <https://doi.org/10.1302/0301-620X.99B10.BJJ-2017-0103.R1>
 15. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *ClinOrthopRelat Res* 1985;198:43e9.
 16. Satoshi Kamada, EtsujiShiota, Kazuhiko Saeki, Takahiko Kiyama, Akira Maeyama, Takuaku Yamamoto. Severe varus knees result in a high rate of under correction of lower limb alignment after opening wedge high tibial osteotomy. *Journal of Orthopaedic Surgery.* 2019 27(2) 1-6.
 17. Y.Akamatsu, H.Kobayashi, M.Tsuji, S.Nejima, K.Kumagai, T.Saito. Should sagittal osteotomy line be parallel to tibial posterior slope in high tibialosteotomy.BMC Musculoskeletal Disorders (2018) 19:338.
 18. Yasuhiro Takahara, Satoru Itani, Youichirou Uchida, Makoto Nakamura, Nobuaki Ochi, Hisayosi Kato, Yuichi Iwasaki, Masahiro Tsujimura. Mid term result of OWHTO regarding from KL stage. The 5th Korea – Japan knee osteotomy symposium. 2018, 25thAug(Sat); Abstract book: p165.
 19. Takenori Akiyama, Shunsuke Nakamura, Ken Okazaki. The timing of around the knee osteotomy for the early OA. The 5th Korea – Japan knee osteotomy symposium. 2018; p115.
 20. Soheil Sabzevari, Adel Ebrahimpour, Mostafa Khalilipour Roudi, Amir R. Kachooei. High tibial osteotomy: A systematic review and current concept. *Arch Bone Jt Surg.* 2016; 4(3): 204-212.
