



HIGH TIBIAL OSTEOTOMY FOR KNEE JOINT PRESERVATION: “OLD BUT GOLD”!

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INTRODUCTION

It is known that one of the most common chronic diseases affecting the elderly is knee osteoarthritis (OA). Knee OA significantly impairs the activity of daily living of the patients. In knee OA there is the destruction of the articular cartilage of the knee joint, leading to progressive impairment. The change in mechanical axis of the knee causes impairment on the three compartments of knee. In the knee joint, if the medial compartment of the knee is affected, it will cause a varus knee deformity, whereas lateral the knee (1,2). The techniques of surgery to address the mal-aligned axis of the joint is knee osteotomy.

This correcting the frontal and/or sagittal plane malalignment, including the instability of the knee with the healthy side of the compartment. In simpler terms, deformities of angular and/or rotational nature can be corrected using the knee osteotomy technique, consequently realigning the bone axis (3,4). Historically,

the osteotomy technique has been developed for centuries. The first modern osteotomy was performed by Williams Adams in 1879 and was reported in the British Medical Journal under the name 'On Subcutaneous Osteotomy.' Another historically significant osteotomy of the knee, which preserves joint function, was high tibial osteotomy (HTO) to treat varus deformity, performed by Wardle in 1941 (5). It was further popularized by Jackson and Waugh in 1961 (6) and Coventry MB in 1965 (7). Now, in 2023, this editorial article transformation most recent transformed the landscape of knee joint preservation.

There is a growing interest in developing minimally invasive techniques for HTO, such as using smaller incisions, arthroscopy-assisted osteotomy, Patient Specific Instrumentation (PSI) and computer-guided navigation systems. These techniques aim to reduce surgical trauma, minimize scarring, and facilitate faster recovery. One of the most significant recent advancements in knee osteotomy is

3D printing of the knee. Surgeons now can create patient-specific cutting guides and instruments, enabling precise and accurate bone resection. Reports have shown that HTO has lower accuracy post- operative compared to pre-operative planning.⁸ A systematic review conducted by Zaffagnini, et al. (9), stated that 3D printed patient-specific bone guides showed higher accuracy in HTO procedures, demonstrated by the pre-operative and post-operative correction of HKA (hip-knee-ankle angle) being less than or equal to 3 degrees and yielding better clinical outcomes.

The 3D printed cutting guide is based on the double limb weight bearing anteroposterior full leg radiograph (to assess HKA) and 3D CT (computed tomography) scan data of the tibia. These data are then used as guidance for designing the surgical plan and the PSI (patient-specific using medical grade materials, such as nylon, which can be sterilized using an autoclave (8). The use of navigation systems enables precise measurement of the alignment parameters, such as the mechanical axis, that need to be corrected during the procedure of HTO. During the surgery, navigation systems provide real-time guidance to ensure accurate bone cuts and alignment correction. The system provides visual feedback, such as virtual overlays on the surgical field or monitor screens, to guide the surgeon in achieving precise bone cuts and alignment. Navigation systems help improve the accuracy and precision of HTO. The surgeon can ensure that the planned correction is executed accurately, leading

to better alignment and overall outcomes (10,11).

REFERENCE

1. Peng H, Ou A, Huang X, Wang C, Wang L, Yu T, et al. Osteotomy Around the Knee: The Surgical Treatment of Osteoarthritis. *Orthop Surg*. 2021;13(5):1465–73.
2. Stoddart JC, Dandridge O, Garner A, Cobb J, van Arkel RJ. The compartmental distribution of knee osteoarthritis – a systematic review and meta-analysis. *Osteoarthr Cartil* [Internet]. 2021;29(4):445–55. Available from: <https://doi.org/10.1016/j.joca.2020.10.011>
3. Zampogna B, Vasta S, Papalia R. Patient Evaluation and Indications for Osteotomy Around the Knee. *Clin Sports Med* [Internet]. 2019;38(3):305–15. Available from: <https://doi.org/10.1016/j.csm.2019.02.011>
4. Jin C, Song EK, Santoso A, Ingale PS, Choi IS, Seon JK. Survival and Risk Factor Analysis of Medial Open Wedge High Tibial Osteotomy for Unicompartmen Knee Osteoarthritis. *Arthroscopy*. 2020 Feb;36(2):535-543.
5. Dabis J, Templeton-Ward O, Lacey AE, Narayan B, Trompeter A. The history, evolution and basic science of osteotomy techniques. *Strateg Trauma Limb Reconstr*. 2017;12(3):169–80.

6. Jackson JP, Waugh W. Tibial osteotomy for osteoarthritis of the knee. *J Bone Joint Surg Br.* 1961;43:746-51.
7. 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;47:984-90.
8. Jones GG, Jaere M, Clarke S, Cobb J. 3D printing and high tibial osteotomy. *EFORT Open Rev.* 2018;3(5):254–9.
9. Zaffagnini S, Dal Fabbro G, Belvedere C, Leardini A, Caravelli S, Lucidi GA, et al. Custom-Made Devices Represent a Promising Tool to Increase Correction Accuracy of High Tibial Osteotomy: A Systematic Review of the Literature and Presentation of Pilot Cases with a New 3D- Printed System. *J Clin Med.* 2022;11(19).
10. Wu ZP, Zhang P, Bai JZ, Liang Y, Chen PT, He JS, Wang JC. Comparison of navigated and conventional high tibial osteotomy for the treatment of osteoarthritic knees with varus deformity: A meta-analysis. *Int J Surg.* 2018 Jul;55:211-219.
11. Bae DK, Lee JW, Cho SJ, Song SJ. Comparison of Mechanical Axis and Dynamic Range Assessed with Weight Bearing Radiographs and Navigation System in Closed Wedge High Tibial Osteotomy. *Knee Surg Relat Res.* 2017 Sep 1;29(3):225-231. doi: 10.5792/ksrr.16.026. PMID: 28854769; PMCID: PMC5596404.