# *Editorial Commentary:* Avoid Creating an Oblique Joint Line After an Opening Medial Wedge High Tibial Osteotomy

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**Abstract:** A medial opening wedge high tibial osteotomy is a cost-effective procedure for younger patients with symptomatic medial compartment knee arthritis. A high rate of success can be expected, but excessive postoperative joint line obliquity is associated with inferior clinical outcomes. If preoperative planning predicts that the postoperative medial proximal tibial angle, the medial angle between the tibial anatomical axis and the joint line of the proximal tibia, will exceed 95°, a surgeon should consider performing a double-level osteotomy (combined proximal tibial and distal femoral osteotomies).

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High tibial osteotomy (HTO) has regained popularity as a surgical technique to correct a varus deformity and unload the medial compartment. It has been shown to be a cost-effective, joint-preserving treatment for younger patients with symptomatic medial compartment osteoarthritis.[1,2]

The traditional technique is a lateral closing wedge HTO, but I, like many surgeons, prefer a medial opening wedge HTO (MOWHTO), partly because of improvements in implant design, but also because it minimizes the risk of a postoperative peroneal nerve palsy, avoids a fibular osteotomy or resection of the proximal tibiofibular joint, and allows the desired angle of correction to be fine-tuned during surgery.[3] Also, should conversion to a total knee arthroplasty be required subsequently, there is a lower risk of running into technical issues when converting a MOWHTO.[4]

Osteotomy survival after a OMWHTO is reported as 91% to 99% at 5 years and 84% to 92% at 10 years.[5] Despite this high chance of success, it is important to identify factors associated with a poor outcome, and one such factor is joint line obliquity.

In their retrospective study titled "Excessively Increased Joint-line Obliquity After Medial Opening Wedge High Tibial Osteotomy Is Associated With Inferior Radiologic and Clinical Outcomes: What Is Permissible Joint Line Obliquity," Kim, Lim, Choi, Jeong, Park, Shim, and Lee[6] assessed the radiological and clinical outcomes of 135 Asian patients who had undergone a MOWHTO. Joint line obliquity was expressed as the medial proximal tibial angle (MPTA), the medial angle between the tibial anatomical axis and the joint line of the proximal tibia. The knees were grouped into quartiles based on the 3-month postoperative MPTA, with group IV containing knees with an MPTA $\geq$95.23°. The weightbearing line ratio (WBLR; the denominator being the width of the tibia and the numerator being the distance of the weightbearing line from the medial edge of the tibial plateau) was greatest in group IV, with a mean of 63.85%. There was also a significantly lower percentage of patients in group IV who attained the minimal clinically important difference for the Knee Society functional score and the SF-36 physical component summary at final follow-up (56-79 months after surgery).

Thus, a postoperative MPTA $\geq$95.23° was associated with valgus over-correction and worse clinical outcomes than a MPTA <95.23°. Accordingly, the authors suggest performing a double-level osteotomy

*The author reports the following potential conflict of interest or source of funding: C.S. reports personal fees from AANA (*Arthroscopy Journal*). Full ICMJE author disclosure forms are available for this article online, as supplementary material.*



*0749-8063/211769/$36.00*

*https://doi.org/10.1016/j.arthro.2021.12.025*

(combined distal femoral and proximal tibial osteotomies) if the predicted postoperative MPTA ≥95.23°.

The authors are honest in admitting the limitations of their study, although one limitation that I feel they have underplayed is that the surgical technique was altered depending on the extent of the degenerative changes within the knee. The target WBLR was increased from 62% (the Fujisawa point) to 65% if there was severe degeneration in the medial compartment or if a medial meniscus repair was required, and the target WBLR was decreased to 55% to 60% if there was pathology in the lateral compartment. Although this aligns with contemporary osteotomy practice, the variability in the target WBLR may have influenced the differences in clinical outcome between the groups. Because the authors showed that there was a positive correlation between the postoperative MPTA and the postoperative WBLR and, and because patients with severe medial degeneration had a greater target WBLR, it then follows that patients with a postoperative MPTA ≥95.23° would be more likely to have severe medial degeneration and possibly inferior clinical outcomes.

Having said that, the findings reported by Kim et al.[6] correspond with what has already been published on joint line obliquity. Other retrospective cohort studies have shown that a postoperative MPTA greater than 95° is associated with worse clinical outcomes[7-9] or more frequent lateral compartment pain.[10] Goshima et al.[11] reported that a postoperative MPTA of 95° or more did not affect the clinical outcomes, although it may be pertinent to note that their cohort was relatively old (the mean age was 63 years).

The theory is that joint line obliquity leads to inferior clinical outcomes due to increased shear forces. Indeed, Nakayama et al.[12] used a 3-dimensional finite element model to show that joint line obliquity (in this case, the angle between a line tangent to the tibial plateau and a line parallel to the ground) of more than 5° induced excessive shear stress in the tibial articular cartilage.

So, it seems prudent to avoid creating a postoperative MPTA of greater than 95°, which may mean that an isolated OMWHTO is not always the best option. Feucht et al.[13] simulated an osteotomy on the radiographs of 303 patients with a mechanical axis of ≥3° varus, correcting the mechanical axis to 2° valgus. To avoid a postoperative MPTA greater than 95°, they found that a OMWHTO was feasible in only 57% of patients, and 33% would require a double-level osteotomy. This is echoed by the retrospective study of Akamatsu et al.,[14] who analyzed a cohort of knees with a predicted postoperative MPTA of greater than 95° and found that joint line obliquity was increased significantly from 1.4° to 6.3° in knees treated with an isolated OMWHTO but maintained in knees treated with a double-level osteotomy. What is uncertain is whether the maintenance of joint line obliquity justifies the increased complexity and morbidity of a double-level osteotomy. Well-designed, prospective studies are needed.

In summary, the article by Kim et al.[6] adds to the evidence that a predicted postoperative MPTA of greater than 95° should compel a surgeon to consider a double-level osteotomy. Where I work (in Suffolk, England) a phrase beloved of local tradesmen is "on the huh," meaning not level, lopsided, or askew. In our trade of orthopaedic surgery, we should try not to leave our patients "on the huh."

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