Journal of Orthopaedic Experience & Innovation
Clinical, Economic, and Innovative Orthopaedic Experience

Howell, Stephen. 2026. "From My Perspective... The Post-Osteotomy Knee: Why the Evidence Favors Mechanical Alignment but the Mechanics Favor Kinematic." *Journal of Orthopaedic Experience & Innovation*, November 20.
https://doi.org/10.60118/001c.164670.

Editorial

From My Perspective... The Post-Osteotomy Knee: Why the Evidence Favors Mechanical Alignment but the Mechanics Favor Kinematic

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Keywords: kinematic alignment, high tibial osteotomy, conversion, total knee arthroplasty, deformity, ligament release, mechanical alignment
https://doi.org/10.60118/001c.164670

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The author shares his perspective on knee alignment in the post-osteotomy knee.

Converting a high tibial osteotomy (HTO) to total knee arthroplasty (TKA) is common: roughly one in five to one in three osteotomies are converted within ten years, and the strongest predictor of early conversion is the radiographic severity of disease at the time of the osteotomy (Primeau et al. 2021; Bax et al. 2025). The literature is broadly reassuring — outcomes are reported as comparable to primary TKA — yet it concedes a consistent pair of penalties: reduced motion and lower long-term survivorship, often with more tibial component loosening. What matters first is the variable hidden inside all of them.

My perspective begins with an easy-to-miss point: every one of those conversions was mechanically aligned. When the literature says a post-HTO knee can match a primary knee, it describes a proximal tibia resected perpendicular to a mechanical axis the osteotomy has already disturbed, with the components forced onto axes mismatched to the native knee. The reduced motion and risk of tibial component loosening are the fingerprints of an axis-mismatched, soft-tissue-released, often mal-sloped reconstruction. Kinematic alignment (KA) does the opposite: it restores the pre-arthritic joint lines and slope and aligns the components to the three kinematic axes, with little or no ligament release. The evidence favors mechanical alignment (MA) only because it is the only one that has been studied. The mechanics favor KA and its influence on the post-osteotomy knee.

THE CONVERSION LITERATURE IS A MECHANICAL-ALIGNMENT STORY

In matched cohorts, revision rates for converted and primary knees were statistically indistinguishable — 5.2% versus 4.5% ($p = 0.69$) (Bax et al. 2026) — a result echoed in a separate matched series (Fernandez and Coolican 2025). A large single-institution series reported ten-year survivorship free of aseptic loosening of 97%, with Knee Society Scores rising from 59 to 93 (Chalmers et al. 2019); in a paired bilateral study, most patients could not tell their converted knee from their primary one at 25 years (Hevesi et al. 2022). An osteotomized knee is not doomed. But the same literature concedes the cost: pooled, flexion is lower after conversion (Seo et al. 2019; Sun et al. 2020), long-term survivorship is lower (93.6% versus 95.5%; OR 0.71), and radiographic tibial loosening is more frequent (Seo et al. 2019; Chen et al. 2020); conversion after HTO even carries a worse risk profile than conversion after unicompartmental replacement (Smitterberg et al. 2026). Two alignment-dependent mechanisms explain the pattern: the osteotomy has already moved the joint line and often the slope, and an MA re-cut compounds that distortion; and

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balancing an axis-mismatched knee requires release, the trauma from which stiffness grows. The literature is recording what mechanical alignment costs in a knee already realigned once.

WHY THE CLOSING-WEDGE KNEE IS THE HARD CASE — AND WHY KA RESURFACING ANSWERS IT

The lateral closing-wedge osteotomy is more demanding than the medial opening-wedge: it leaves a shortened, sclerotic, widened metaphysis, tends to lower the posterior slope, is associated with patella baja, and may leave a lateral plate whose screws sit in the path of the tibial component. Comparative data are reassuring — clinical and radiographic outcomes and revision rates do not differ between closing- and opening-wedge conversions, yet the closing-wedge knee demands more quadriceps snips, tubercle osteotomies, and lateral releases, and raises the specific hazard of stem impingement on the lateral cortex (Han et al. 2016). The mechanically aligned answer is more surgery: a stem to bypass the metaphysis, augments or constraint for the residual imbalance, and added exposure for a baja patella. Kinematic alignment treats the same knee differently. By referencing the pre-arthritic joint surfaces rather than the mechanical axis, KA restores pre-arthritic knee alignment by matching the femoral resection thickness to the femoral component condylar thickness, leaving the osteotomy-related deformity the patient has grown accustomed to.

THE HONEST TRADEOFF: A BETTER-FEELING KNEE OR A STRAIGHTER LIMB

KA in the post-osteotomy knee forces a tradeoff that the surgeon must explain. The surgeon should share that restoring high knee function and neutral or pre-arthritic limb alignment are competing goals that cannot both be achieved. There are three paths. The first is KA on the limb as it stands — the better-feeling knee, with superior balance and, in my view, no separate long-term-survival concern as it is balanced without ligament release. The honest cost is arithmetic. Restoring a medial joint space collapsed by 5 mm corrects about 4° of the arthritic deformity and moves the ankle center about 30 mm. It reduces the deformity at the knee and leaves the osteotomy-induced limb deformity untouched. If the patient accepts a slight residual limb deformity in exchange for a better-functioning knee, I proceed. Templating the tibia is essential: the baseplate position must be checked in AP and lateral projections to ensure the stem clears the tibial cortex. Otherwise, cortex impingement blocks the seating of the baseplate or fractures the tibia.

Slope deserves scrutiny because an osteotomy can change it. I measure the osteotomy-side slope, compare it to the contralateral knee or a pre-osteotomy film, and answer one binary question: did the osteotomy change it, yes or no? One to two degrees is measurement error; if it changed, I would restore the contralateral pre-arthritic slope. Restoring the pre-arthritic slope maximizes internal tibial rotation in a PCL-retaining KA knee (Nedopil et al. 2021), whereas a tibial slope set 5° or more posterior to the pre-arthritic value invites posterior tibial component failure from subsidence and wear (Nedopil et al. 2017).

The second path undoes the osteotomy and performs the KA TKA conversion about three months later. In this scenario, pre-arthritic alignment is restored with the caveat that it requires a second operation and a higher infection risk. I reserve this two-stage approach for rare cases, such as a young patient with a combined ligament reconstruction. The third path, MA with extensive releases, is less likely to achieve either goal — high knee function or pre-arthritic alignment.

THE CASE IN BRIEF

A 75-year-old man presented with end-stage medial osteoarthritis, a 10° varus deformity, and 18°–114° of motion eighteen years after a lateral closing-wedge HTO fixed with a lateral plate and five screws — three of which sat where the tibial component would go — with adequately controlled diabetes (A1c 7.4%). Because diabetes increased the risk of infection from the simultaneous lateral skin incision to remove the plate and the medial arthrotomy incision, the conversion was staged: hardware removal first, then a caliper-verified kinematically aligned TKA about 12 weeks later. The femoral resection thicknesses were matched to the condyles of the femoral component within half a millimeter after compensating for cartilage wear and saw blade kerf, the slope was set to the pre-arthritic value, and the anatomically shaped tibial baseplate was best-fit within the cortex so the stem cleared the metaphysis. The knee balanced through the arc with no collateral release, the posterior cruciate ligament was retained, and uncemented femoral and tibial components were press-fit on viable bone. It is one knee — an illustration of method, not an outcome series.

FOUR THINGS A KNEE SURGEON SHOULD TAKE FROM THIS

First, the evidence that conversion TKA matches primary arthroplasty is built entirely on mechanically aligned knees, and even there it concedes reduced motion, lower long-term survival, and more tibial loosening (Seo et al. 2019; Sun et al. 2020; Chen et al. 2020). Second, the closing-wedge knee is the hard case, and KA potentially sidesteps its problems by resurfacing the knee to its pre-arthritic state with negligible soft-tissue release. Third, the tradeoff. KA on the standing limb buys the better-feeling knee at the cost of a few degrees of osteotomy-induced deformity the patient has grown accustomed to. Restore the pre-arthritic slope, because a tibial slope set 5° or more posterior to it invites posterior tibial component failure (Nedopil et al. 2017). Fourth, stage the reconstruction when

host and hardware factors demand it, as the diabetes did here.

THE BOTTOM LINE

The post-osteotomy knee has already altered the pre-arthritic limb alignment once, usually toward neutral, and often changes in tibial slope and joint-line obliquity. Mechanical alignment changes the pre-arthritic alignment of the knee and the limb in 85% of knees when analyzed by coronal plane alignment of the knee (CPAK), and the literature reports costs in terms of lost motion, ligament release, and tibial component loosening. Kinematic alignment resurfaces instead — restoring the pre-arthritic joint line, slope, and three axes, balancing with a fraction of the release, and asking the patient to accept a few degrees of the old deformity for a knee that feels like their own. No series has yet tested KA conversion directly, so this remains a mechanistic hypothesis awaiting data; but the mechanics, the slope evidence, and the release burden all point the same way — restoring the knee and leaving the osteotomy alone might be the more rational conversion.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the author used Claude (Anthropic, San Francisco, CA, USA) to improve the language, readability, and clarity of the manuscript. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the publication's content.

CONFLICTS OF INTEREST

The author is the developer of the kinematic alignment technique for total knee arthroplasty and runs the educational platform www.kaoptimizedtka.com. He receives consulting fees and royalties from Medacta International, which manufactures implants used in the author's kinematically aligned practice. He receives no financial support from any other implant or robotic surgical platform manufacturer.

FUNDING

None.

Submitted: June 17, 2026 EST. Accepted: July 05, 2026 EST.
Published: November 19, 2026 EST.

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