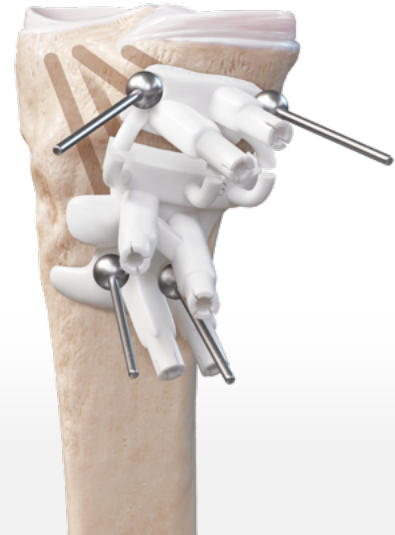


Patient-Specific Instrumentation (PSI) Guides for Osteotomy

Scientific Update

In recent years, scientific literature has supported the growing use of 3D-printed, patient-specific instrumentation (PSI) guides for osteotomy procedures to correct malalignment of the knee. Personalized PSI guides offer simplified preoperative planning and time savings,¹ minimized radiation exposure,^{1,2} and more precision than conventional techniques,^{2,3} resulting in optimized clinical outcomes.⁴ This document highlights key studies showcasing the benefits of PSI guides for correctional alignment and preservation of the knee joint.



A novel 3D-printed patient-specific instrument based on “H-point” for medial opening wedge high tibial osteotomy: a cadaver study.

Liu GB, Liu S, Zhu CH, Li J, Li J, Jia GX, Dong W, Zhao F, Huang Y

- 26 cadaveric lower limbs were collected and divided into 2 groups: PSI and conventional technique.
- The absolute correction error of mechanical femorotibial angle (mFTA) was significantly smaller in the PSI group. The accuracy for the conventional group within 1° was 63.8% and within 2° was 81.8%. For the PSI group, the accuracy within 1° was 86.7% and within 2° was 100%.
- The absolute correction error of tibial slope (TS) for the conventional group within 1° was 9.1% and within 2° was 45.5%. For the PSI group, the accuracy within 1° was 53.3% and within 2° was 93.3%.

Takeaway: The absolute correction errors for both mFTA and TS were significantly lower in the PSI group compared to the conventional technique.

J Orthop Surg Res. 2022;17(1):169. doi:10.1186/s13018-022-03057-w

Personalised 3D printed high tibial osteotomy achieves a high level of accuracy: ‘IDEAL’ preclinical stage evaluation of a novel patient specific system.

MacLeod AR, Mandalia VI, Mathews JA, Toms AD, Gill HS

- 8 cadaveric specimens received computerized tomography (CT) scans pre- and postoperatively to evaluate the planned vs executed correction.
- The average difference between preoperative planning and postoperative opening using PSI guides was 0.3° compared to the reported conventional osteotomy correction deviation of >1.5°.

Takeaway: PSI guides for high tibial osteotomy (HTO) lead to greater correction angle accuracy as compared to conventional techniques.

Med Eng Phys. 2022;108:103875. doi:10.1016/j.medengphy.2022.103875



A network meta-analysis evaluating valgization high tibial osteotomy cutting guides: improving surgical precision through navigation and PSI.

Delaigue F, Wardani H, Descamps J, Ollivier M, Nizard R, Bouché PA

- › Literature-based meta-analysis comparing conventional techniques, navigational systems, and PSI for HTO.
- › HTO evaluated radiological outcomes, surgical performance, and postoperative functional scores.
- › PSI had the highest likelihood of achieving the lowest rate of medial proximal tibial angle (MPTA) outliers and reduced the rate of hip-knee-ankle (HKA) angle outliers.
- › PSI guides improved 1- and 2-year postoperative Lysholm scores.

| **Takeaway:** Using PSI guides allows for more precise outcomes, including MPTA and HKA angles.

Knee Surg Relat Res. 2025;37(1):28. doi:10.1186/s43019-025-00278-1

Assessing the impact of patient-specific instrumentation and fixation on accuracy and radiation exposure in a cadaveric model of medial opening-wedge high tibial osteotomy.

Carey EG, Kamath AF, Vidal AF, Frush T, Alaia M, Baldwin RB, Ranawat A

- › Evaluated 16 cadaveric knees, comparing conventional osteotomies and osteotomies using PSI guides.
- › The mean deviation for the planned wedge size in the PSI group was 0.505 mm vs 3.016 mm in the conventional group.
- › Radiation exposure was lower for osteotomies performed with PSI guides: 0.85 mGy vs 2.04 mGy for the conventional group.

| **Takeaway:** Osteotomies performed using PSI guides demonstrated superior accuracy when compared with the conventional technique.

Orthop J Sports Med. 2025;13(1):23259671241285430. doi:10.1177/23259671241285430

Learning curves for high tibial osteotomy using patient-specific instrumentation: a case control study.

Stimolo D, Leggieri F, Matassi F, Barra A, Civinini R, Innocenti M

- › Compared accuracy and learning curves of 12 cases using PSI and 12 cases using the standard technique.
- › Mean surgical time (PSI 48.58 ± 7.87 vs standard 58.75 ± 6.86 min) and mean number of fluoroscopic shots (PSI 10.75 ± 3.93 vs standard 18.16 ± 4.93 shots) were lower in the PSI group.
- › The postoperative Δ HKA was $0.42 \pm 0.51^\circ$ in PSI vs $1.25 \pm 0.87^\circ$ in conventional; Δ MPTA was $0.50 \pm 0.67^\circ$ in PSI vs $3.75 \pm 1.48^\circ$ in conventional; Δ TS was $1.00 \pm 0.82^\circ$ in PSI vs $3.50 \pm 1.57^\circ$ in conventional; and Δ joint line convergence angle (JLCA) was $1.83 \pm 1.11^\circ$ in PSI vs $4 \pm 1.41^\circ$ in conventional.

| **Takeaway:** PSI guides for HTO are effective in reducing learning curves and producing more accurate procedural outcomes of HKA, MPTA, TS, and JLCA.

Innov Surg Sci. 2024;9(3):123-131. doi:10.1515/iss-2024-0007

Clinical experience using a 3D-printed patient-specific instrument for medial opening wedge high tibial osteotomy.

Yang JC, Chen CF, Luo CA, Chang MC, Lee O, Huang Y, Lin SC

- › Evaluated 10 patients with medial knee osteoarthritis who underwent HTO using PSI guides.
- › Radiographs to evaluate weight-bearing line (WBL) and TS were taken postoperatively and at 6-weeks postoperative.
- › The average pre- and postoperative errors for WBL and TS were 4.9% and 4.1%, respectively.

| **Takeaway:** There are numerous advantages to using PSI guides, including time savings, radiation reduction, ease of use, and precision.

Biomed Res Int. 2018;2018:9246529. doi:10.1155/2018/9246529

Patient-specific instrumentation for medial opening wedge high tibial osteotomies in the management of medial compartment osteoarthritis yields high accuracy and low complication rates: a systematic review.

Dasari SP, Hevesi M, Mameri E, Ferrer-Rivero R, Fortier LM, Jackson GR, Warriar AA, Maheshwer B, Jawanda H, Khan ZA, Kerzner B, Browning RB, Gursoy S, Chahla J

- › Systematic review summarized evidence surrounding the use of PSI guides.
- › The weighted mean error for mechanical medial proximal tibial angle (mMPT) was 0.5°, posterior tibial slope (PTS) was 0.6°, and HKA was 0.8°.
- › When comparing the correctional error for the mechanical axis, PSI guides were favored rather than conventional techniques ($P = .004$).

Takeaway: The use of PSI guides is highly accurate for planned corrections of the coronal plane, sagittal plane, and mechanical axis.

J ISAKOS. 2023;8(3):163-176. doi:10.1016/j.jisako.2023.02.001

3D-printed patient-specific instrumentation technique vs. conventional technique in medial open wedge high tibial osteotomy: a prospective comparative study.

Mao Y, Xiong Y, Li Q, Chen G, Fu W, Tang X, Yang L, Li J

- › 18 patients who underwent medial opening wedge high tibial osteotomies (MOWHTO) using PSI guides were compared to 19 patients who received MOWHTO using conventional techniques.
- › The correction errors were significantly lower in the PSI group: mFTA was $0.2^\circ \pm 0.6^\circ$ vs $1.2^\circ \pm 1.4^\circ$ and mMPTA was $0.1^\circ \pm 0.4^\circ$ vs $2.2^\circ \pm 1.8^\circ$.
- › The procedure duration and radiation exposure were also lower for the PSI group.

Takeaway: PSI-guided MOWHTO enhances safety and precision, delivering more accurate outcomes when compared to traditional methods.

Biomed Res Int. 2020;2020:1923172. doi:10.1155/2020/1923172

Patient-specific high tibial osteotomy for varus malalignment: 3D-printed plating technique and review of the literature.

Jeong SH, Samuel LT, Acuña AJ, Kamath AF

- › Reports the experience and outcomes in using a preoperative CT scan to create a PSI guide for HTO.
- › Differences in planned vs executed corrections were MPTA 1.9°, KHA 0.7°, and no change in the PTS. At 6-week follow-up, the patient had 125° of flexion and minimal pain.

Takeaway: Using PSI guides may lead to successful and accurate HTOs for correction of malalignment.

Eur J Orthop Surg Traumatol. 2022;32(5):845-855. doi:10.1007/s00590-021-03043-8

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