

+ Kinematic Alignment with JOURNEY II TKA and CORI Surgical System

Smith+Nephew

JOURNEY[◇] II
Total Knee Arthroplasty

CORI[◇]
Surgical System



Amplified by

CORI[◇] XT
Handheld Robotics Platform

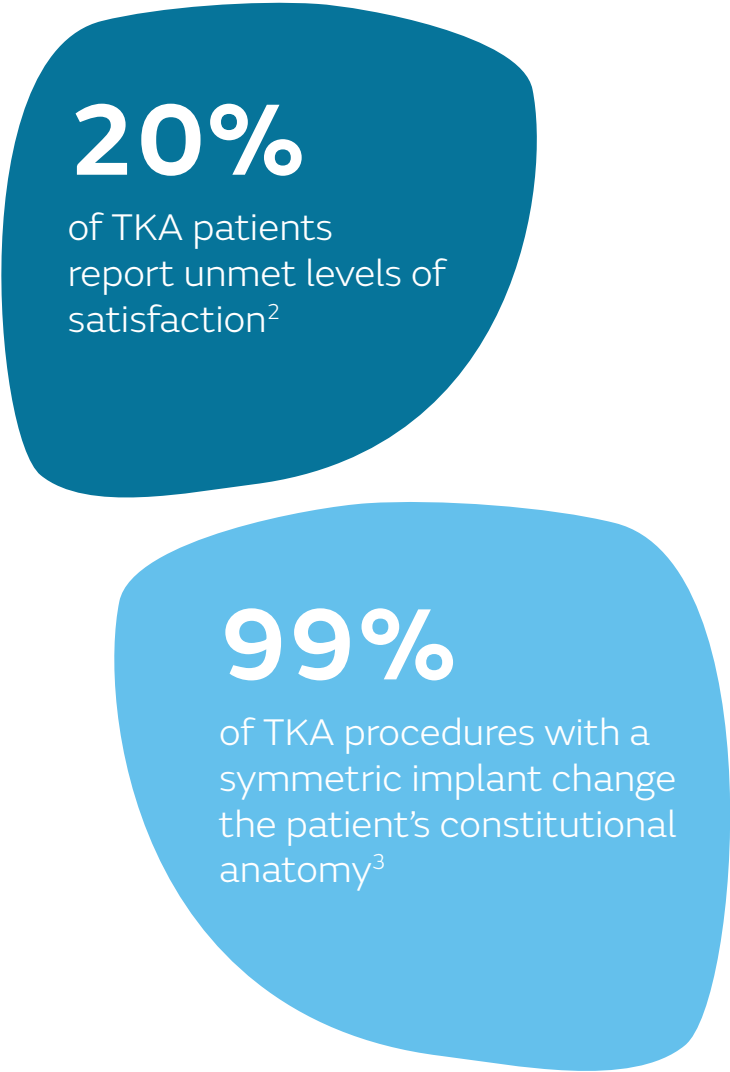


Kinematic Alignment 101

The rise of personalized alignment

Since anatomic alignment was first described in 1985¹, several personalized alignment philosophies have been introduced to challenge traditional mechanical alignment, including Kinematic Alignment (KA) and Functional Alignment (FA).

While Functional Alignment seeks to reconstruct native alignment while achieving balanced flexion-extension gaps and soft tissues, Kinematic Alignment seeks to restore a patient's pre-arthritic alignment and joint line through anatomic resurfacing. This avoids ligament releases and supports more natural knee kinematics.



20%

of TKA patients
report unmet levels of
satisfaction²

99%

of TKA procedures with a
symmetric implant change
the patient's constitutional
anatomy³



Goals of Kinematic Alignment

The goal of Kinematic Alignment (KA) is to restore a patient's native, prearthritic alignment and joint line through anatomic resurfacing, avoiding ligament releases and supporting more natural knee kinematics.¹

KA does this by matching the implant to the knee's pre-arthritic anatomy using a measured resection approach, where the distal and posterior bone cuts match the femoral implant thickness while adjusting for wear specific to each compartment. By replicating the knee's original anatomy, this approach helps deliver a more natural feel, improved stability, and greater confidence in everyday movement.⁴⁻⁶

3 goals of KA:

1. Restore the pre-arthritic tibial-femoral articular surfaces
2. Restore the pre-arthritic knee and limb alignments
3. Restore the pre-arthritic laxities of the knee

Determining resection values for KA:

Desired resection = Implant thickness -
Cartilage wear (-2mm)

Healthy Condyle = Implant thickness

Worn Condyle = Implant thickness - 2mm

In most cases surgeons assume
no wear in the posterior femoral condyles



What does the normal knee look like?

The normal knee has asymmetric shapes and thicknesses on both the femur and tibia and, when combined, form a 3° joint line in the average person.^{1,7}

In 2021, Dr. Samuel MacDessi et al. introduced the Coronal Plane Alignment of the Knee (CPAK), a classification system that defines nine knee phenotypes based on overall limb alignment and joint-line orientation (Figure 1).⁸ Their analysis showed that more than 65% of patients fall into CPAK Type I or Type II, characterized by a varus tibial joint line combined with neutral or slightly varus full leg alignment when standing.

CPAK (Coronal Plan Alignment of the Knee) Arithmetic Hip-Knee-Ankle (aHKA = MPTA - LDFA)

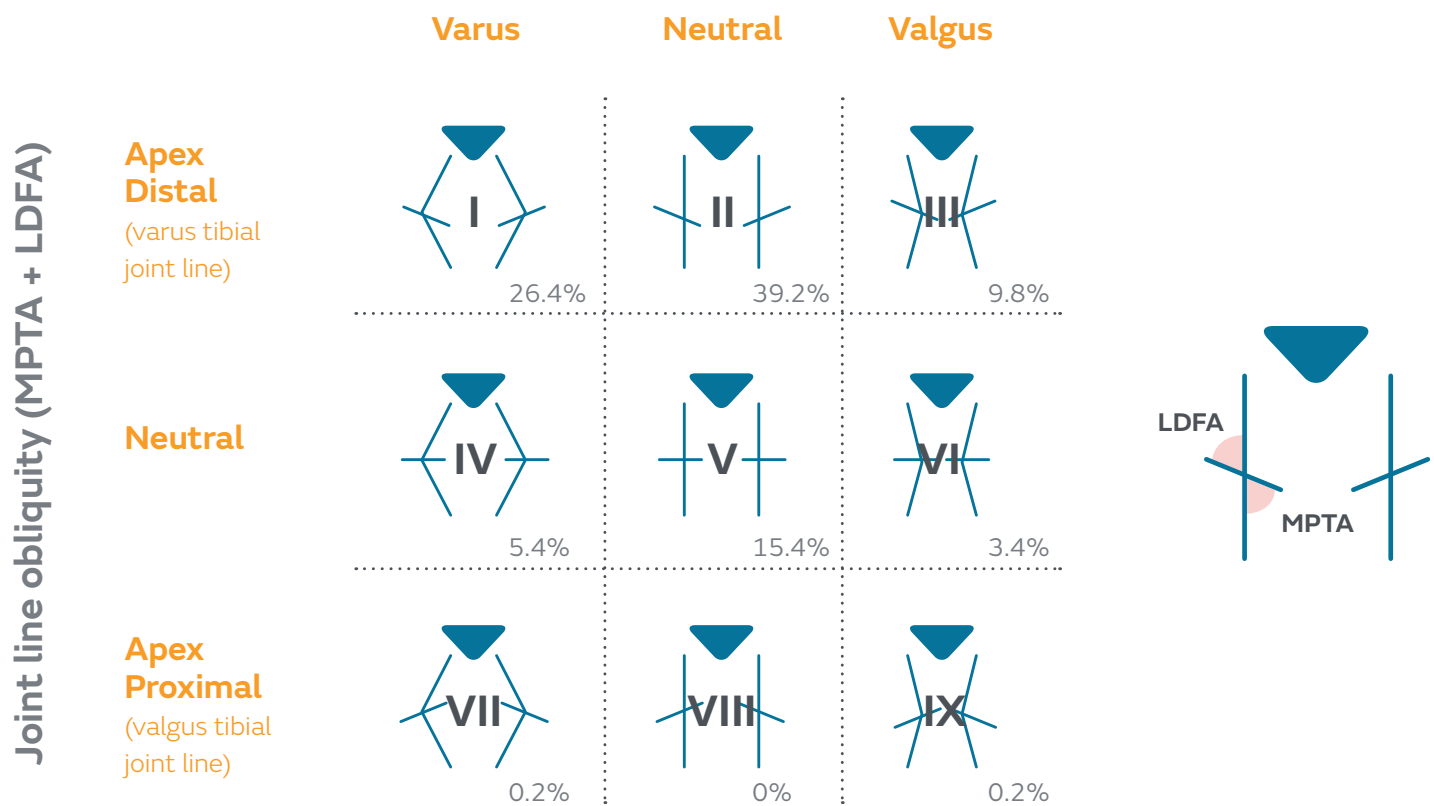


Figure 1: Coronal Plane Alignment of the Knee (CPAK) classifies patients into nine different phenotypes based on joint line obliquity (JLO) and the arithmetic HKA (aHKA)⁸

MPTA = Medial Proximal Tibial Angle

LDFA = Lateral Distal Femoral Angle

Implant design and alignment execution

Accurate joint line restoration is achieved when the thickness of each bone resection closely matches the corresponding implant thickness.

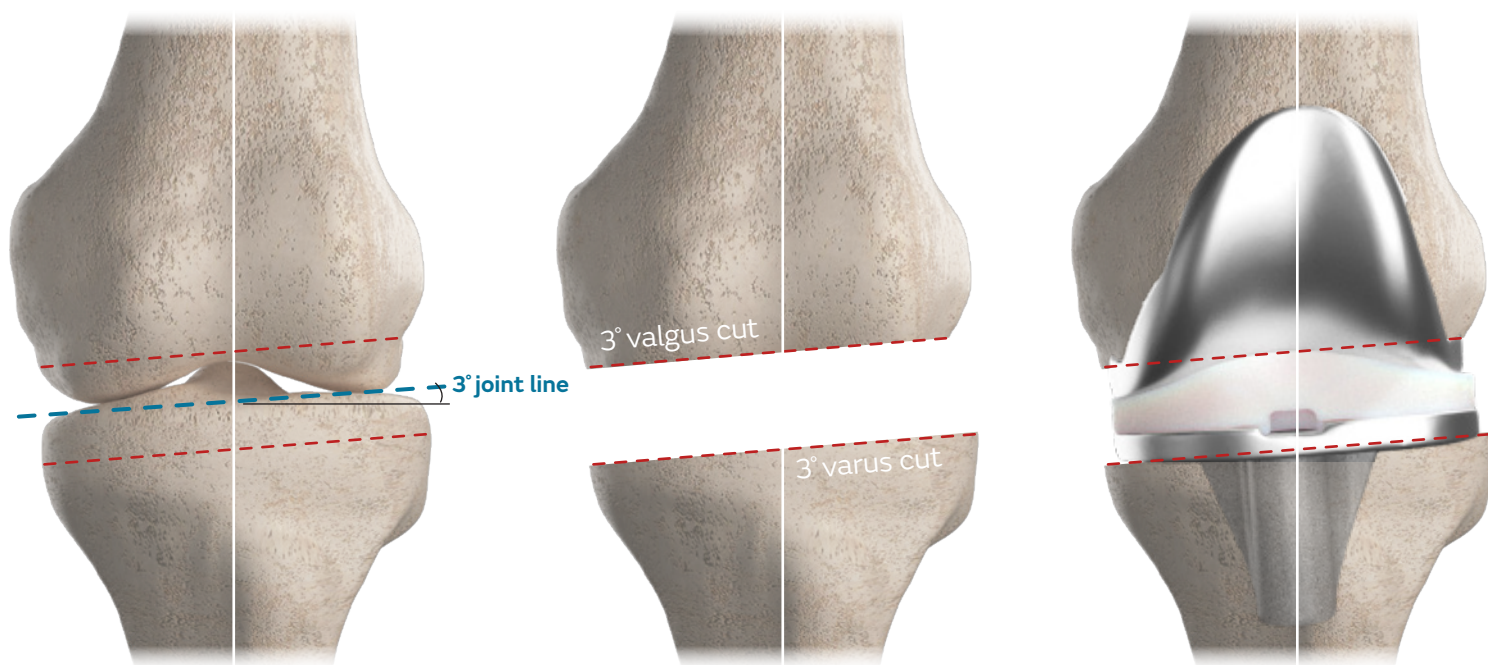


Figure 2

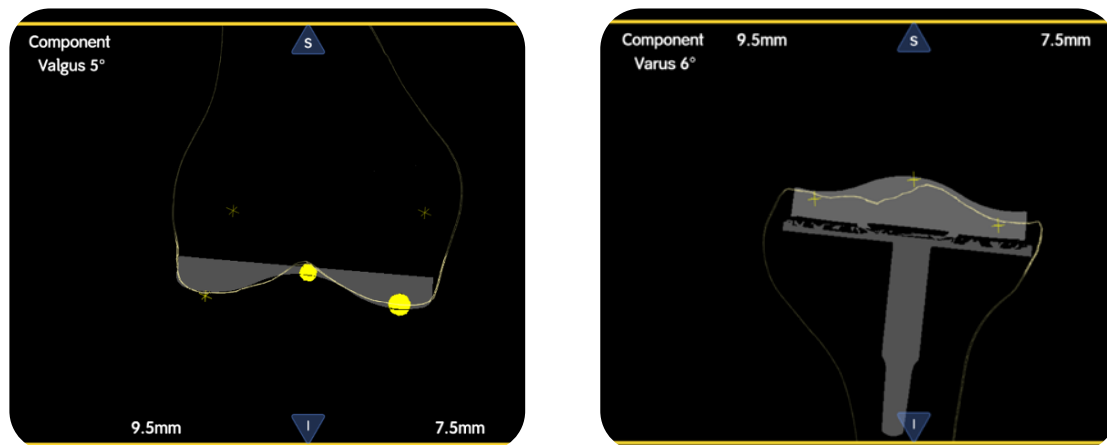
Despite the normal knee being asymmetric in nature, conventional knee designs have symmetric, non-anatomic femoral and tibial components that create a 0° joint line. In practice, this often requires positioning the femoral component in approximately 3° of valgus and the tibial component in approximately 3° of varus to replicate the patient's native joint line (Figure 2).

The symmetric design of conventional knee implants often doesn't match the patient's native anatomy.⁴

Going beyond 3°

Malalignment in the coronal plane (>3° from mechanical axis)

Aligning the knee more than 3° from the mechanical axis has been associated with increased risk of collapse, wear, loosening, instability and pain.^{5,6,10-12}



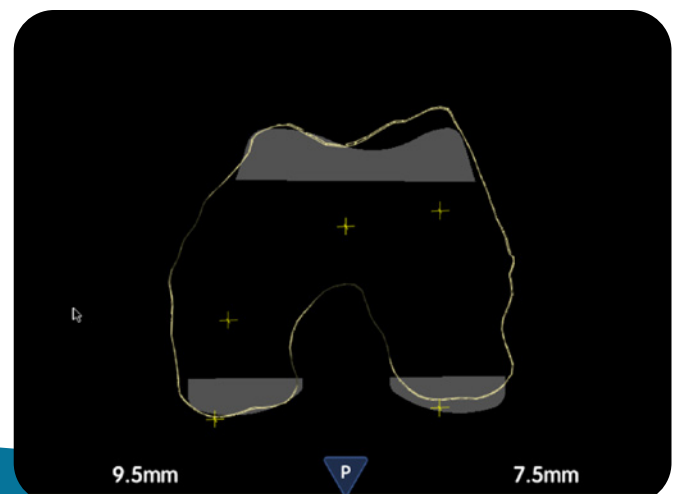
The figure above shows how a symmetric implant must be positioned to match the patient's native joint line to achieve Kinematic Alignment with a robotic system. In this example, the femur needs to be aligned in 5° valgus and the tibia in 6° of varus in order to match the patient's native joint line.

Malalignment in the transverse plane (>3° from epicondylar axis)

Internally rotating the femur greater than 3° from the epicondylar axis medializes the trochlear groove and places the patella in a non-anatomic position. This has been shown to result in increased risks of:¹³⁻¹⁷

- Patella tracking issues
- Patella contact forces
- Pain
- Failure

The figure on the right shows how a symmetric implant must be rotated to match the patient's native posterior joint line to achieve Kinematic Alignment with a robotic system. This posterior joint line replication is at the cost of moving the trochlear groove away from its natural position.



Kinematic Alignment with JOURNEY[◇] II TKA

The goal of Kinematic Alignment is to restore the patient's normal, pre-arthritis anatomy. That thought has been at the forefront of the JOURNEY II TKA design since the beginning.

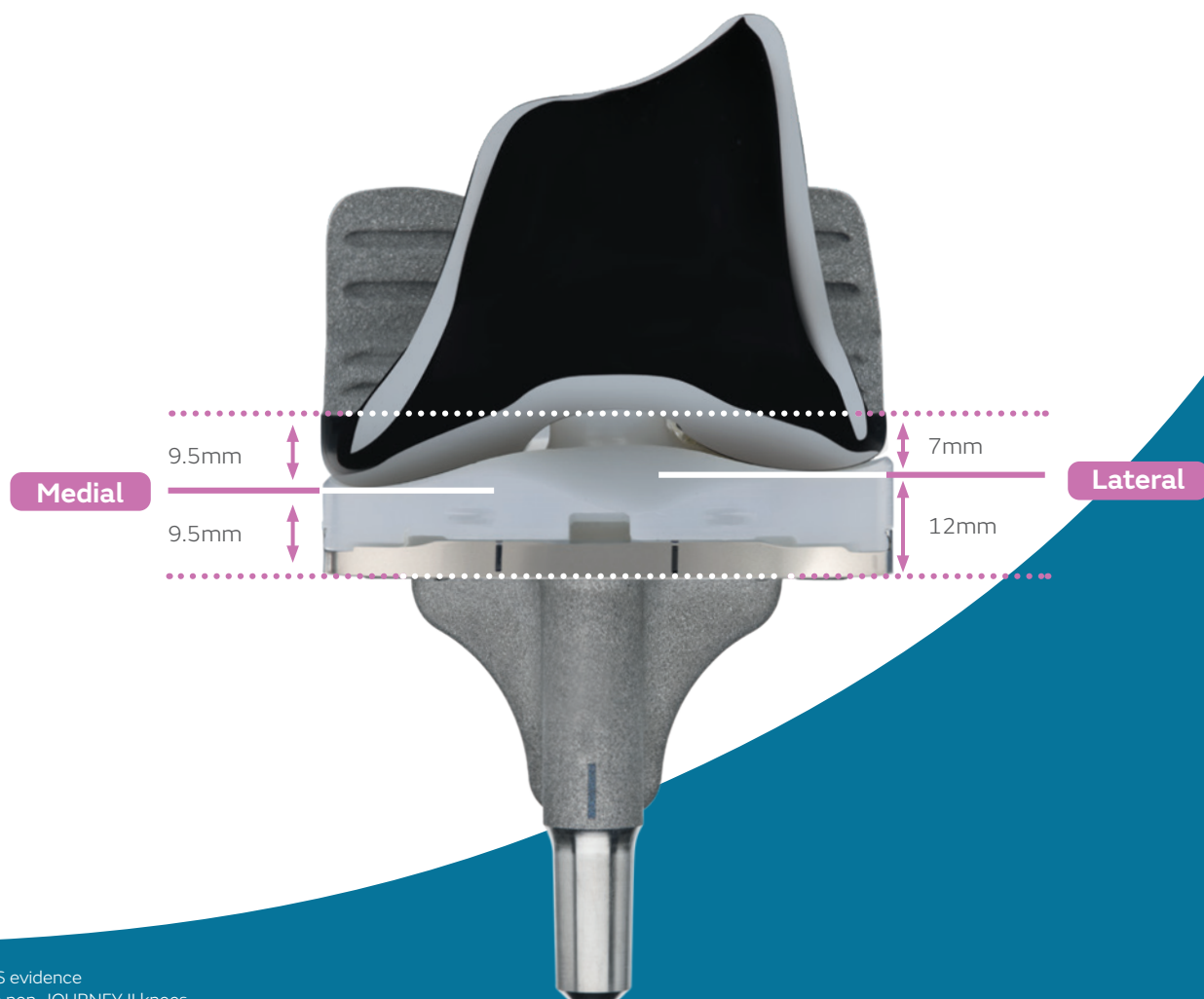
JOURNEY II TKA is designed and clinically shown to restore the anatomic shape, position, and motion of the natural knee.^{18-22*} This anatomic restoration has been associated with improved clinical outcomes and higher patient satisfaction.^{23-28*†}

Normal shapes^{20-22, 29}

Like the normal knee, JOURNEY II TKA has been designed with an asymmetric femur and tibia.

Femur: the medial condyle is thicker than the lateral condyle

Tibia: the lateral plateau is thicker than the medial plateau

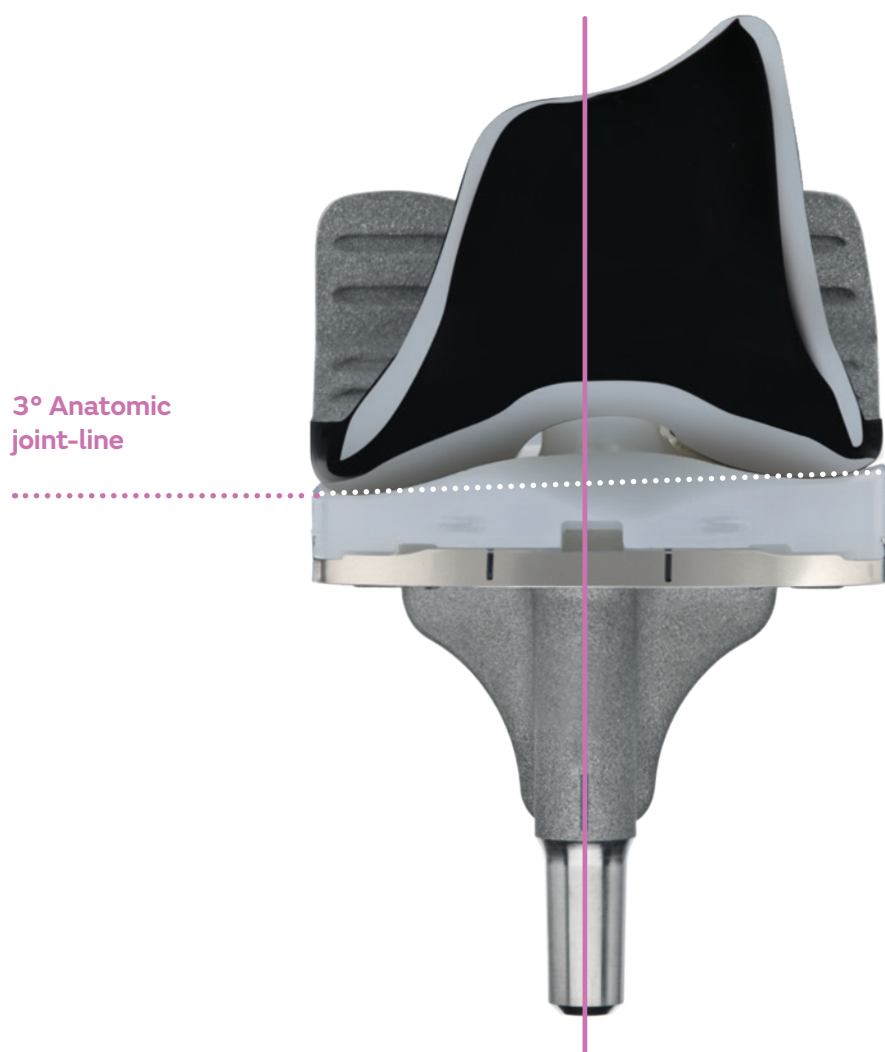


*Based on BCS evidence

†Compared to non-JOURNEY II knees

Normal position^{20,24,25,29-32}

When the asymmetric femur and tibia of JOURNEY[®] II TKA are combined, they create the 3° joint line found in the normal, healthy knee. This replication of the normal joint line leads to more normal ligament tension and more natural patella tracking throughout the range of motion.^{20,24,29,32*}



Executing Kinematic Alignment with JOURNEY[®] II TKA

Because JOURNEY II TKA already has a 3° joint line built into the implant, **executing KA to shape-match the patient's pre-arthritic anatomy requires less deviation from the mechanical axis** compared to symmetrical knee designs that have a 0° joint line.

Figure 3 adds in an additional orange diamond that represents JOURNEY[®] II TKA's ability to restore the native joint line in the patient population within MacDessi's study.⁸ As the graph shows, the orange diamond captures a larger portion of the the patient population while still staying within the +/- 3° window from the mechanical axis. This is a huge advantage for JOURNEY II TKA compared to a symmetric implant when executing an alignment technique that is trying to better restore the patient's original anatomy.

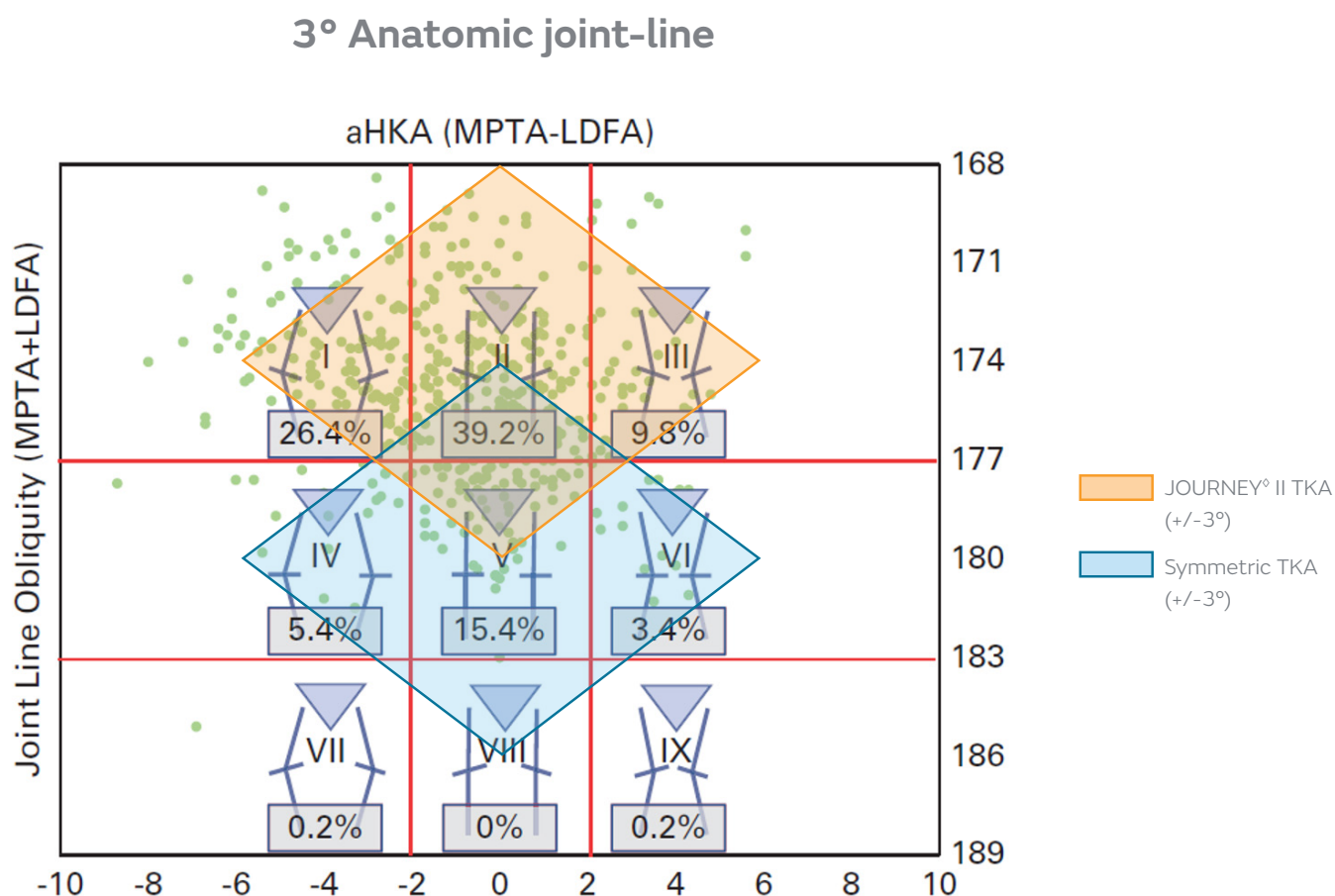
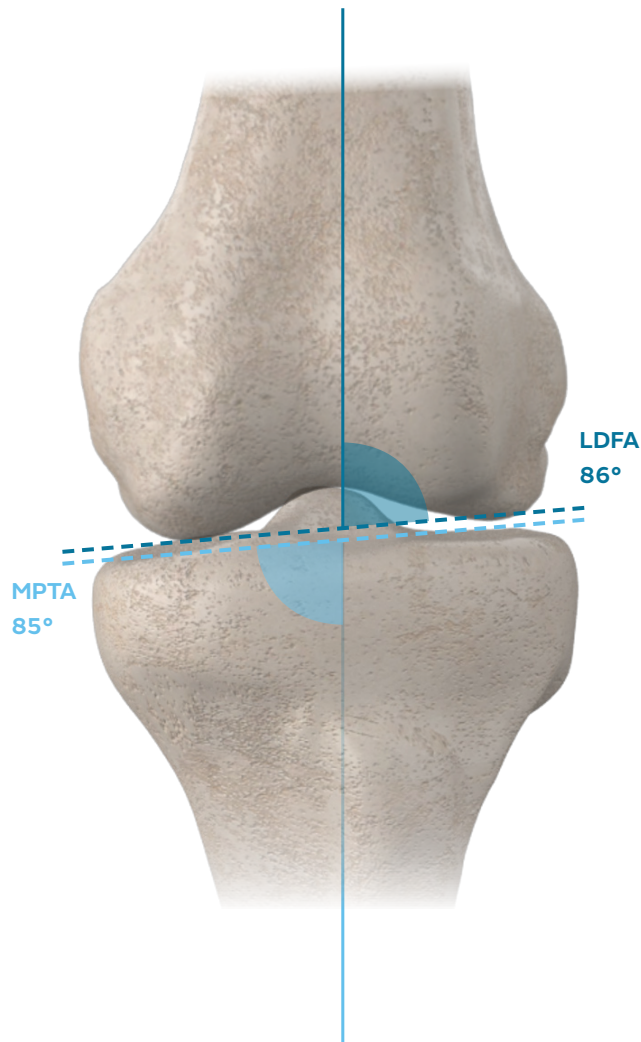


Figure 3: Plot of aHKA against joint line obliquity for a healthy population showing distribution by percentage in the nine CPK types. Blue region indicates portion of population where joint line can be restored by a symmetric TKA implanted within +/- 3° from the mechanical axis. Orange region indicates portion of population where joint line can be restored by JOURNEY II TKA within +/- 3° from the mechanical axis. The orange JOURNEY II TKA region covers a noticeably larger portion of the normal and arthritic populations compared to the blue symmetric TKA region.⁸

Slight Varus Deformity (CPAK Type II) with JOURNEY[®] II TKA:

An example below shows the advantage JOURNEY II TKA has for a patient within the Type II phenotype (neutral or slightly varus full leg deformity and a varus tibial joint line). According to MacDessi, Type II patients make up 39.2% of the population.⁸



CPAK Type II Knee example

Patient Measurements:

MPTA = 85°

LDFA = 86°

aHKA (MPTA-LDFA) = -1° (neutral/slightly varus knee)

JLO (MPTA+LDFA) = 171° (varus tibial joint line)

Kinematic Alignment with Symmetric Implant:

Align femur in 4° valgus



Align tibia in 5° varus

Kinematics Alignment with JOURNEY II TKA:

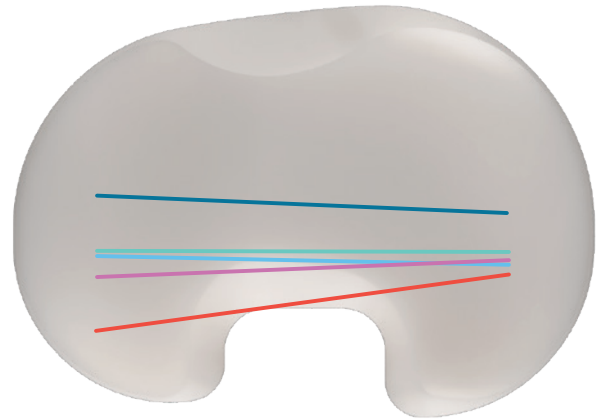
Align femur in 1° valgus



Align tibia in 2° varus

JOURNEY^{II} Medial Dished Insert

A Medial Dished insert option is available for KA users who prefer additional medial stability when using a CR construct.



Medial



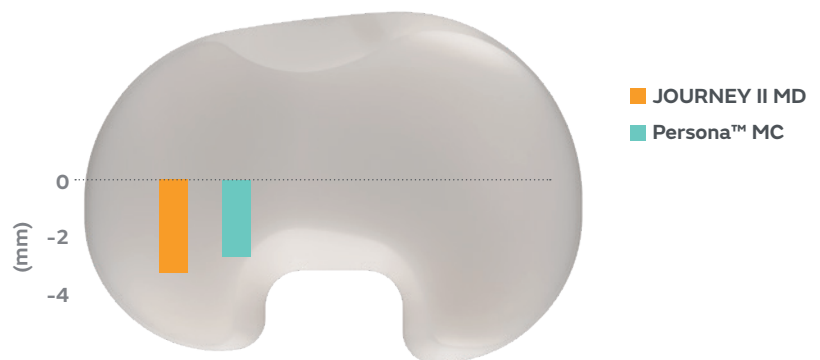
Lateral

JOURNEY II Medial Dished is designed with a flatter lateral geometry to promote rollback and external rotation to provide more normal kinematics.^{18-21,29,33,34}

JOURNEY II Medial Dished insert improves upon the lateral posterior translation (or “rollback”) over a competitor’s offering leading to more normal kinematics.^{7,35,36}

Lateral Femur A/P Translation 60-120°^{35,36}

PCL-Retaining

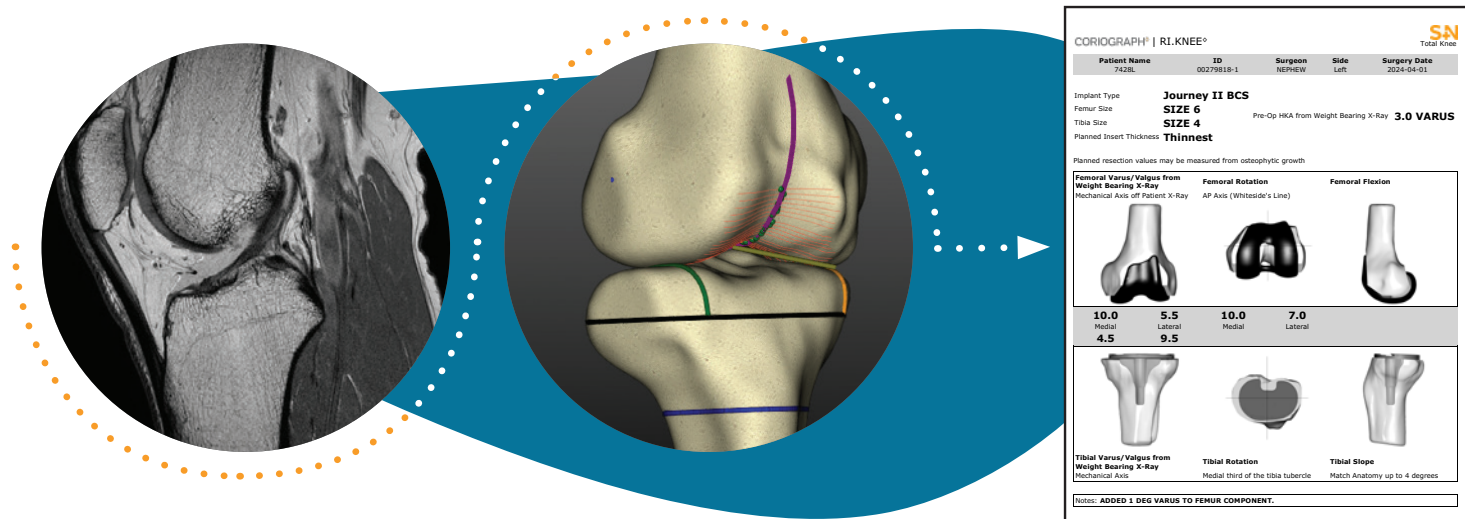


Evolution of KA with CORI[®] Surgical System

CORI Surgical System offers users several tools to accurately and efficiently achieve their desired alignment target.

Pre-operative planning using CORIOGRAPH[®] Pre-Op Planning and Modeling Services

- Patient specific pre-operative plan based on the selected alignment philosophy, including Kinematic Alignment
- Designed to enhance intra-operative efficiency in TKA
- Built on 15+ years of clinical expertise and over 350,000 image-based surgery plans³⁷



Accurately shape-match native bone with intraoperative adjustments in real time^{38‡}

- Intra-operative mapping, visualization and planning of tibia, femur, and patello-femoral position
- Multiple visualization options available across all three anatomical planes
- Special points for visualization of anatomic landmarks and intra-articular pathology (e.g., cartilage loss, wear patterns)

‡With the use of the handpiece; As demonstrated in cadaveric and sawbone studies



CORI[®] Surgical System measured resection

- Accurate execution with a handheld burr³⁹⁻⁴³
- The Visualize Cut screen displays a real-time bone model, enabling surgeons to:
 - Compare planned versus actual resections (if using hybrid technique with cut block)
 - Verify cut depth and angular alignment relative to plan



Objectively assess joint laxity with CORI Digital Tensioner

- Measure joint laxity without making a femoral or tibial cut^{44,45}
- Automatic data capture when a predefined force is reached and maintained throughout range of motion (ROM)
- Allows surgeons to define the target force setting (50±10N, 100±10N, or 150±10N) shown to support consistent alignment tension⁴⁶⁻⁴⁸



Notes

Notes

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