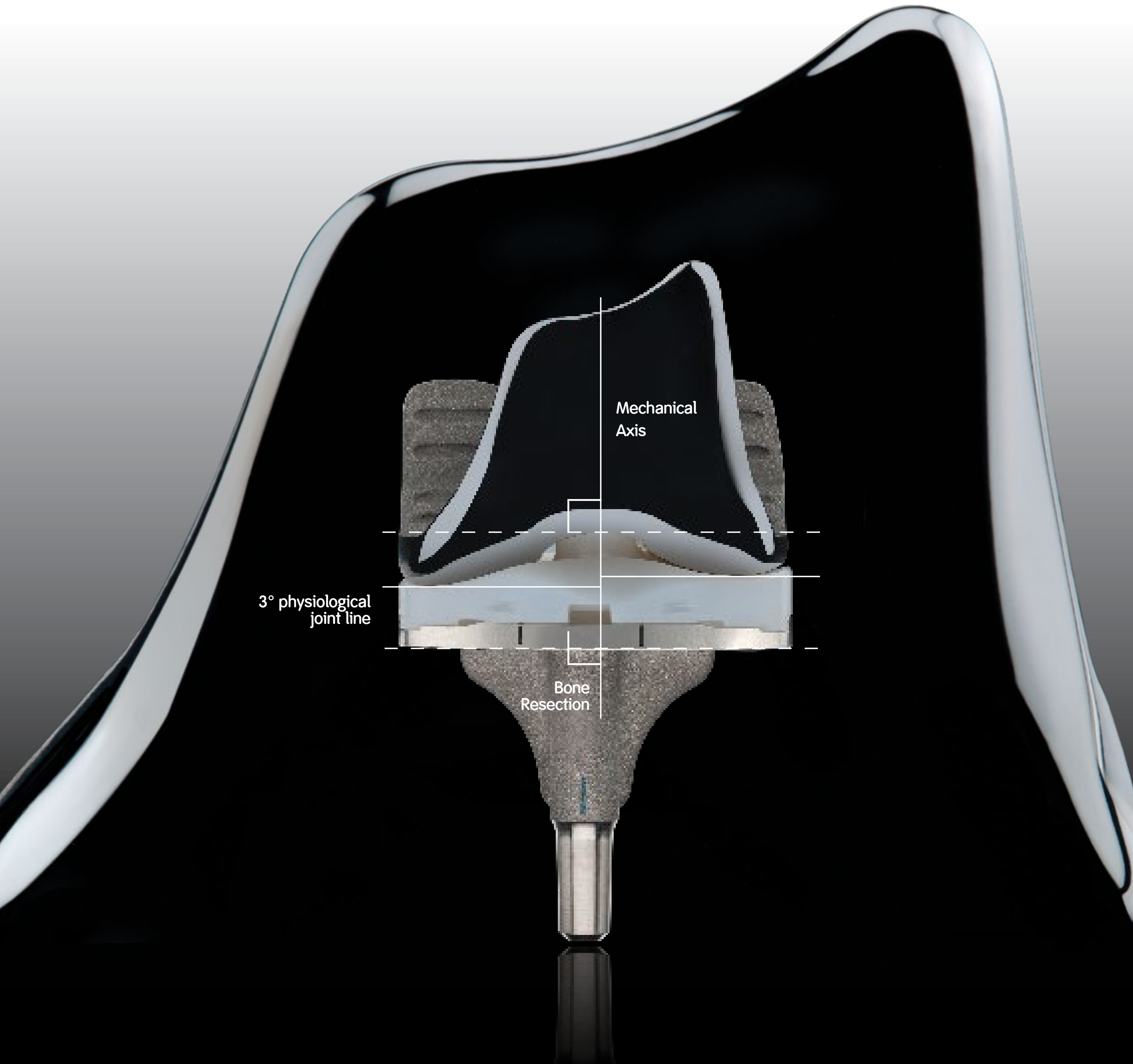


Design Rationale

smith&nephew

JOURNEY◊ II CR◊

Cruciate Retaining Knee System

JOURNEY◊ II BCS

Bi-Cruciate Stabilized Knee System

Supporting healthcare professionals

Table of contents

Rediscover normal

Introduction

While literature reports good outcomes for many current knee systems,[1] clinical scores do not necessarily reflect patient satisfaction.[2, 3] While this dissatisfaction could be attributed to abnormal motion, such as paradoxical motion and AP instability,[4] today's active patients simply expect more out of their knee replacements than ever before. These expectations are not being met by the current generation of knee replacement designs.

In an effort to replicate normal knee function, Smith & Nephew conducted in-depth analyses of the geometry, kinetics, kinematics and ligament behavior of the normal knee and conventional TKA systems. These analyses created a better understanding of how the normal knee works and the limitations inherent in current knee designs. The knowledge gained through this research fueled the creation of a knee system to address those limitations.

The JOURNEY◊ Bi-Cruciate Stabilized Knee System was shown to replicate both the PCL and ACL function, promote recovery of normal muscle activity, accommodate deep flexion, induce normal tibiofemoral axial rotation and provide proper patellar tracking throughout the entire range of flexion.[5–19] Building upon that history, the JOURNEY II Total Knee System has refined the design and expanded the system to include cruciate retaining, deep dished, and constrained posterior stabilized options.

JOURNEY II knees were designed to achieve normal shapes, position and motion. Smith & Nephew created this platform to empower patients to rediscover normal post total knee arthroplasty.

Indications

Indications for use include rheumatoid arthritis; post-traumatic arthritis, osteoarthritis or degenerative arthritis; failed osteotomies or unicompartmental replacement.* This system is designed for use in patients in primary total knee replacement surgery. Posterior stabilized knee systems are designed for use in patients where the anterior and posterior cruciate ligaments are incompetent and the collateral ligaments remain intact. Constrained knee systems are designed for use in patients where the posterior cruciate ligament and one or both of the collateral ligaments (i.e. medial collateral and/or lateral collateral ligament) are incompetent.

Achieving normal kinematics

The guiding principle behind the design of the JOURNEY◊ II Total Knee System was to achieve near normal function and motion while maintaining excellent durability and having the robustness to accommodate surgical and patient variability.

How to achieve normal

Shapes. Position. Motion.

To restore the native 3° Varus joint-line, the medial condyle on the JOURNEY II Femoral component was designed to be thicker both distally and posteriorly than the lateral condyle. This unique design was created to restore the knee's native morphological surfaces while allowing the surgeon to make cuts perpendicular to the mechanical axis. Like the human knee, the posterior condyles in the JOURNEY II femoral component have been designed to be circular in shape; allowing for soft tissue influence in axial rotation and overall physiological performance.

The medial and lateral articular surfaces designed into the polyethylene insert allow the surgeon to restore proper knee kinematics:

Medial – Concave shape promotes pivot

Lateral – Convex shape promotes rollback

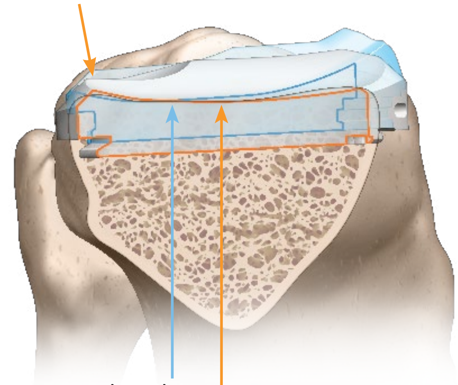
The insert sulcus design replicates the AP midline found in the human knee, allowing restoration of tibio-femoral articulations without paradoxical motion. To accommodate deep flexion, the convex lateral surface in the sagittal plane creates a slight posterior slope.[8, 9, 12, 35, 41]

Durability/Robustness

- Wear – VERILAST◊ Technology combines OXINIUM◊ and XLPE to form a highly durable and long-lasting bearing combination.[25-33]
- OXINIUM Oxidized Zirconium, exclusively from Smith & Nephew, contains <0.0035% nickel content compared to 0.5% in cobalt chrome.
- Surgical robustness – All the benefits of improved function and motion with similar sensitivity to surgical and patient variability as conventional knee systems.[34]

Medial

Prominent posterior medial lip provides stability and promotes normal kinematics[5, 9, 13, 35, 41]

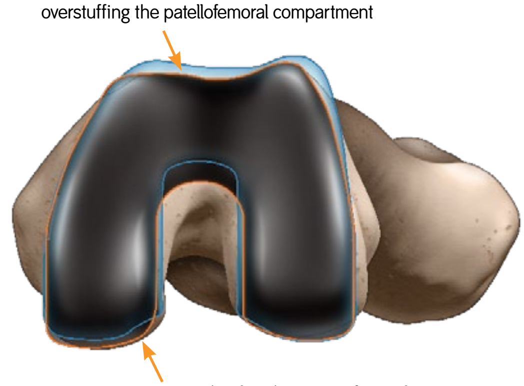


Conventional AP sulcus

Normal AP sulcus position prevents paradoxical motion[9, 12, 35, 41]

Femur

Anatomic, asymmetric flange is designed to prevent overstuffing the patellofemoral compartment



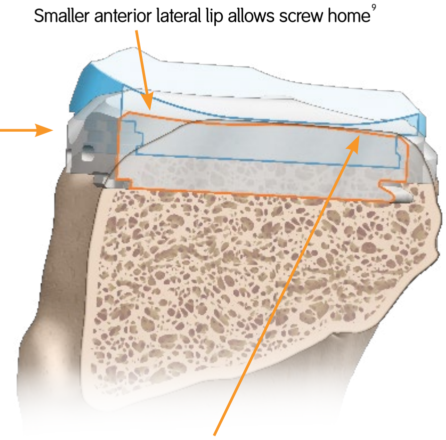
Restores anatomic 3° distal and posterior femoral joint line providing more normal ligament strain and patello-femoral tracking[22, 24, 35, 41]

Lateral

Smaller anterior lateral lip allows screw home[9]

JOURNEY II TKA

Conventional TKA



Normal convexity provides increased posterior lateral slope to facilitate anatomic lateral femoral rollback and external rotation[5, 9, 35, 41]

Advanced design tools and methods

Sizing and fit

To design the JOURNEY◊ II Total Knee System, statistical data from over 250 femurs and tibias was used to characterize articular shapes and resected profiles in an effort to optimize four types of fit:

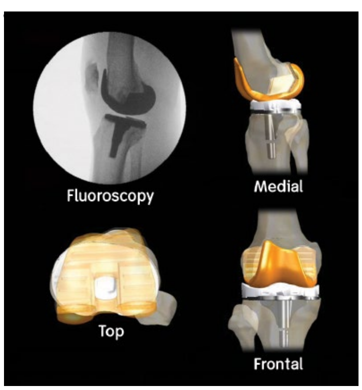
- **Coverage fit** – coverage of resected bone
- **Resection fit** – resection required to attach implants to bone
- **Interface fit** – implant/bone interface stability
- **Biomechanic fit** – restoration of functional surfaces
- This wealth of data showed clear dimensional and size differences across a variety of unique patient anatomy that required a non-linear progression of more anatomic and personalized implant dimensions throughout the size range as seen below:
- Bone coverage was optimized by providing asymmetric baseplates and 10 (non-scaled) femoral sizes[42]
- Bone resections were minimized by angling the PS box and posterior resection for all sizes[43]
- Through a unique femoral 'hooking' implantation method that helps pressurize the cement and lock the implant to the femur[45]
- Biomechanic fit was improved by restoring the sagittal profiles, trochlear depth and jointline[22, 24, 35, 41]

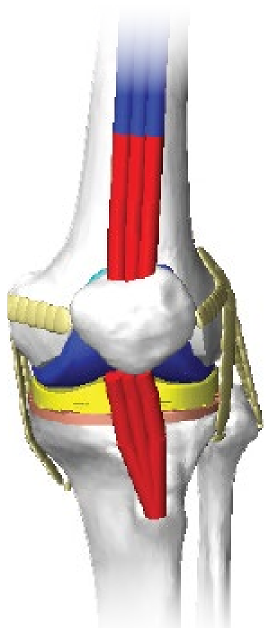
The result is a system that is anthropometrically optimized.[44]

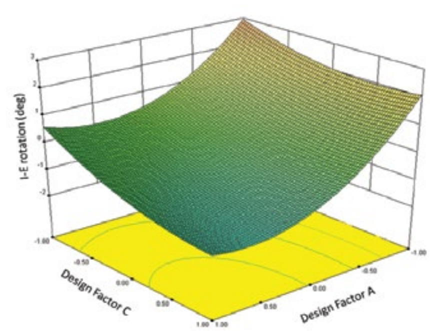
The JOURNEY II Total Knee System was designed using state-of-the-art computer simulation and optimization techniques. Parametrically controlled CAD models were virtually implanted in an advanced computer knee simulator (proprietary, enhanced version of LifeMOD™/KneeSIM™) and analyzed during multiple activities including deep knee bend and gait.

Key measures including kinematics and ligament strain, which have been correlated to in vivo[5] and in vitro data[20] respectively, were collected throughout flexion to characterize the biomechanic performance of the design. This allowed targeted advancements over previous total knee designs including JOURNEY BCS to further close the gap between total knee arthroplasty and normal healthy knees.[41] Output from LifeMOD/KneeSIM was processed using the following:

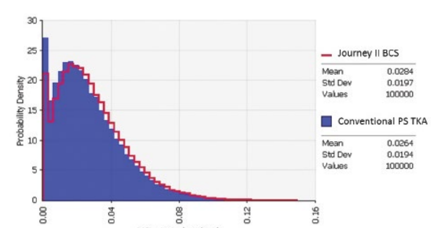
- Characterize: Design of Experiments to characterize implant behavior and identify the most influential design parameters
- Optimize: Response Surface Methodology to optimize the implant shapes
- Analyze: Monte Carlo Simulations to evaluate surgical sensitivity on multiple patients compared to conventional knee designs
- During development of the JOURNEY II Total Knee System, hundreds of thousands of combinations[34] of implant designs, patient anatomy, and surgical positioning were simulated, which is impossible to accomplish using conventional implant design methods. The resulting optimized design maintains the anatomic shapes of the original JOURNEY BCS design and uses subtle enhancements to expand the benefits of normal shapes, position and kinematic motion.[46]







Response surface



MCL strain 60° flexion[34]

Characterize → Optimize → Analyze

Normal knee function

Shape

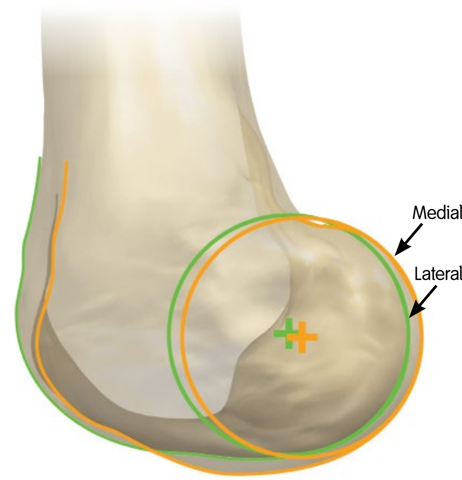
Joint line
- Medial condyle more distal than lateral condyle
- 3° physiological joint line

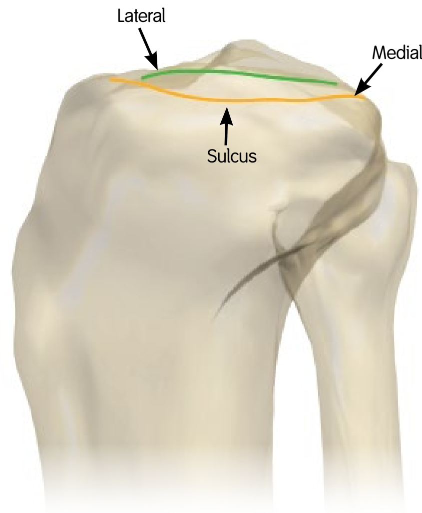
Femur
- Distal lateral condyle less round than the medial condyle
- Lateral posterior offset less than medial
- Posterior condyles circular in shape

Tibia
- Medial concave surface
- Medial sulcus near AP midline
- Lateral convex surface

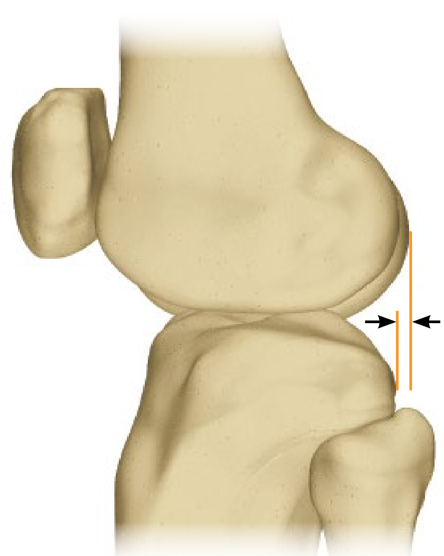
AP stability

- ACL provides anterior stability and limits anterior translation of the tibia (femoral posterior translation)
- PCL provides posterior stability and limits posterior translation of the tibia (femoral anterior translation)
- Medial sulcus causes the medial posterior femoral condyle to sit nearly flush with the posterior tibia
- In this anterior position, the force environment causes femoral rollback during flexion





Concave medial, convex lateral surface



Anterior AP position

Kinematics and ligament behavior[21, 22]

Extension

0° – Screw-home, anterior AP position

- Tibial tubercle approximately 10mm lateral to the ML midline
- Femur internally rotated 5° "screw-home" creating a Q-angle of 14-17°
- Sulcus of medial side and ACL cause the femur to sit nearly flush with the posterior tibia

Mid-flexion

0 – 90° – Rollback medial pivot

- Because of the anterior position of the femur, forces during flexion direct the femur to roll back
- During flexion, the quadriceps mechanism attempts to straighten and applies external rotation torque to the femur through the patella
- Femur external axial rotation is aided by the downhill force of the convex lateral compartment
- Axial rotation occurs due to greater lateral than medial rollback until the quadriceps mechanism is straight and the Q-angle is minimized
- Rollback combined with femoral external axial rotation yields a medial pivot
- MCL strain is near constant 0-60° before starting to slacken
- LCL strain gradually decreases with flexion
- PCL strain increases with flexion aiding femoral rollback

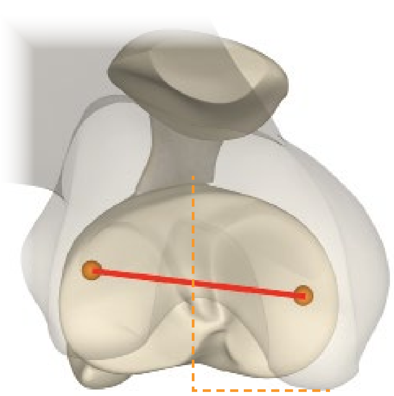
Deep-flexion

90 – 155° – Posterior translation

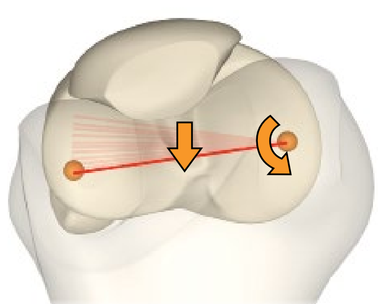
- Femur translates further posteriorly
- Femoral axial rotation continues due to lateral rollback while medial rollback has small changes and may decrease
- MCL continues to become looser with flexion
- PCL strain reaches its peak without becoming overly tight and limiting flexion

Functional flexion

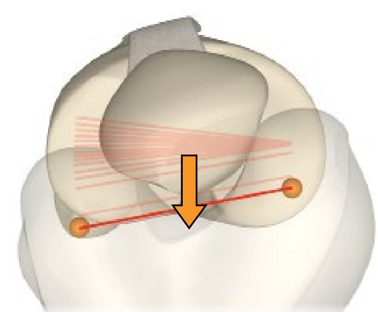
- Lateral posterior offset is less, so femoral external axial rotation and convex lateral compartment are necessary for lateral condyle to clear tibia
- Medial condyle is more anterior than the lateral condyle, therefore, large posterior offset is needed to clear tibia
- Femoral external axial rotation and lateralized patella groove minimizes patellofemoral ML shear force, which optimizes quadriceps mechanism function



0° – Screw-home, anterior AP position



0-90° – Rollback medial pivot



90-155° – Posterior translation

Conventional TKA function

Shape

Joint line

- Medial and lateral condyles equal thickness
- Non-physiological 0° joint line

Femur

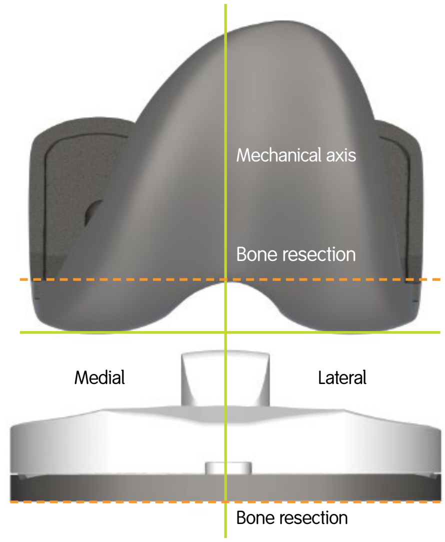
- Symmetric distal condyles identical in thickness and shape
- Symmetric posterior condyles identical in thickness and shape

Tibia

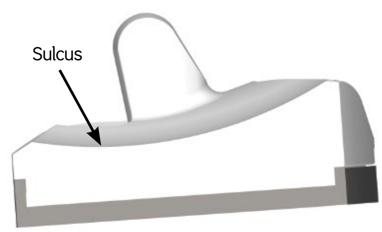
- Symmetric insert identical in thickness and shape, creating a bi-concave design
- Sulcus located in posterior 1/3 of insert
- Symmetric baseplate does not provide anatomic coverage

AP stability

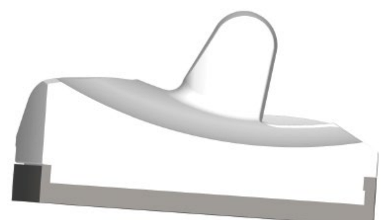
- Lack of ACL replicating feature causes anterior instability, especially in early gait while small tibial insert posterior lips further limits anterior stability
- Posterior cam or PCL provides posterior stability and limits anterior translation of the femoral component
- Insert sulcus causes the posterior femoral condyles to overhang the tibia posteriorly
- In this posterior position, the force environment causes femoral paradoxical anterior translation during flexion

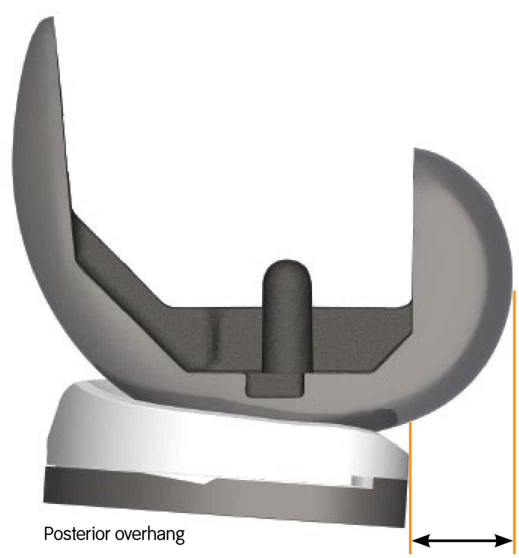


0° non-physiological joint line



Concave medial


Concave lateral


Posterior overhang

Kinematics and ligament behavior

Extension

0° – No screw-home, posterior overhang

- Symmetric insert causes femoral component/femur to be directed anteriorly
- This results in no screw-home, reducing Q-angle
- Posterior sulcus and lack of an ACL cause the femur to overhang the tibia posteriorly
- This may require continuous use of the quadriceps muscle to stand, causing fatigue

Mid-flexion

0° – 90° – Paradoxical motion, lateral pivot

- Because of the posterior position of the femoral component, forces during flexion direct the femur to paradoxically translate anteriorly
- During flexion, the quadriceps mechanism attempts to straighten and applies external rotation torque to the femur through the patella
- Femoral external axial rotation resisted by insert bi-concave conformity
- Q-angle is not minimized, causing patellofemoral ML shear force
- Paradoxical anterior translation combined with limited femoral external axial rotation yields a lateral pivot
- MCL strain remains near constant 0-90° which could result in more tension than normal in some conventional designs. In others the MCL becomes slack in mid-flexion before regaining tension by 90°, which could contribute to mid-flexion instability.
- LCL strain is likely looser than normal in extension because femur sits more posterior.
- When the PCL is retained, its strain increases with flexion aiding femoral rollback, but it is likely looser than normal in extension because the femur sits more posterior, which could reduce early flexion stability

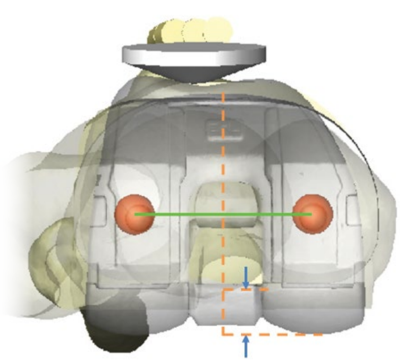
Deep-flexion

90° – Max flexion – Posterior translation, abnormal rotation

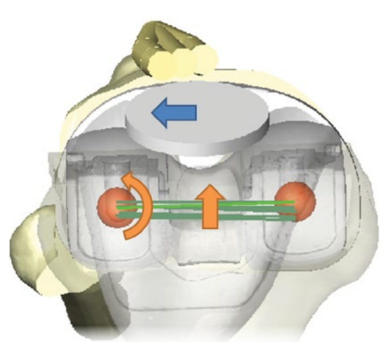
- Posterior cam causes femoral posterior translation
- Insert bi-concave conformity exceeds external torque applied by the quadriceps mechanism
- Femoral component abnormally rotates internally and aligns with symmetric insert
- Posterior translation combined with femoral abnormal internal rotation yields a lateral pivot
- Q-angle is increased, causing significant patellofemoral ML shear force
- MCL strain continues to remain constant which could restrict flexion
- When the PCL is retained, its strain reaches its peak but is often tighter than the normal knee[23] which could inhibit high flexion

Functional flexion

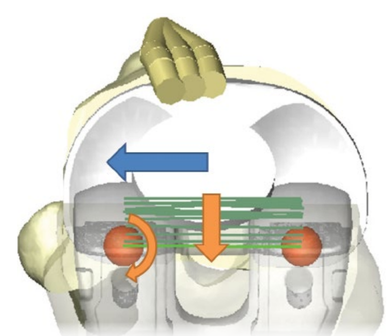
- Lateral posterior offset is less, so femoral internal axial rotation and concave lip of lateral insert may cause early bone impingement, limiting flexion
- Large patellofemoral ML shear force may cause anterior knee pain, which can limit functional flexion



0° – No screw-home, posterior overhang



0-90° – Paradoxical motion, lateral pivot



>90° – Posterior translation, abnormal axial rotation

JOURNEY◊ II Total Knee System function

Shape

Joint line

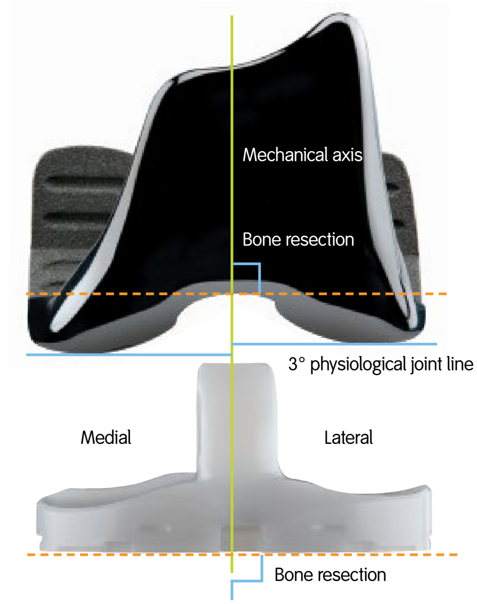
- Medial condyle more distal than lateral condyle
- 3° physiological joint line created

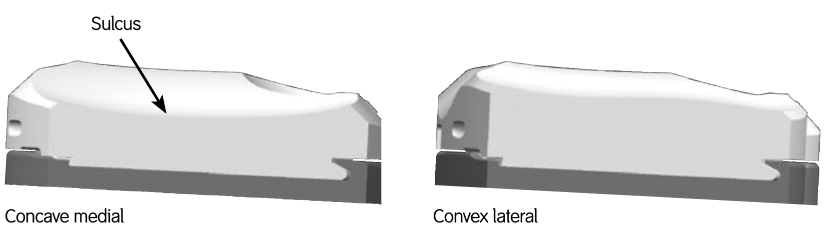
Femur

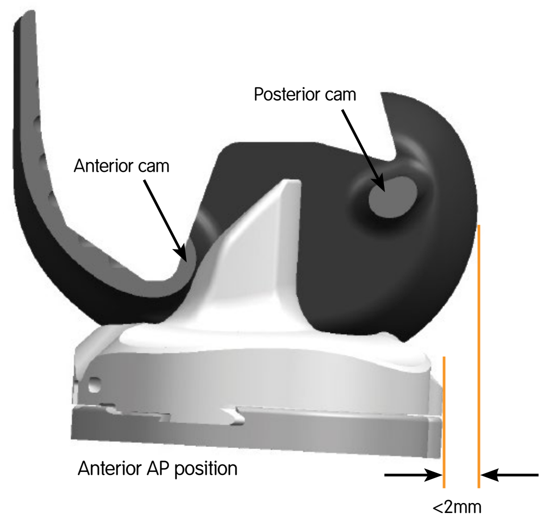
- Lateral distal condyle less thick than medial femoral condyle
- Asymmetric posterior offset of medial and lateral condyles maintained
- Posterior condyles circular in shape

Tibia

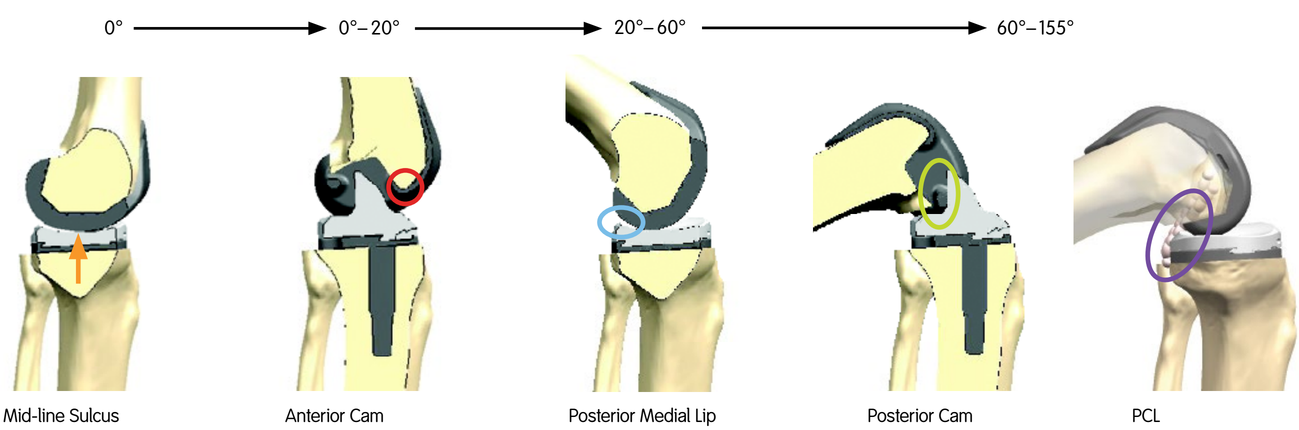
- Concave medial surface
- Medial sulcus near AP midline
- Lateral compartment thicker than the medial compartment
- Convex lateral surface in sagittal plane creates a slight posterior slope







Stability throughout a range of motion



Kinematics and ligament behavior

Extension

0° – Screw-home, anterior AP position

- Insert arcuate path allows for 5° of screw-home
- Sulcus of medial side causes the femur to sit nearly flush with the posterior tibia
- Normal Q-angle and AP position created in extension

Mid-flexion

0° – 90° – Rollback medial pivot

- Because of the anterior position of the femur, forces during flexion direct the femur to roll back
- During flexion, the quadriceps mechanism attempts to straighten and applies external rotation torque to the femur through the patella
- Femur external axial rotation is aided by the downhill force of the convex lateral compartment
- Rotation continues until the quadriceps mechanism is straight and the Q-angle is minimized
- Rollback combined with femoral external axial rotation yields a medial pivot
- MCL strain is near constant 0-60° before starting to slacken
- LCL strain gradually decreases with flexion
- When the PCL is retained, its strain increases with flexion aiding femoral rollback plus the PCL is under some tension in extension due to the anatomic anterior position of the femur, which provides early flexion stability

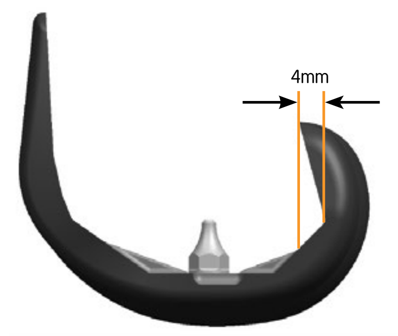
Deep-flexion

90° – 155° – Posterior translation

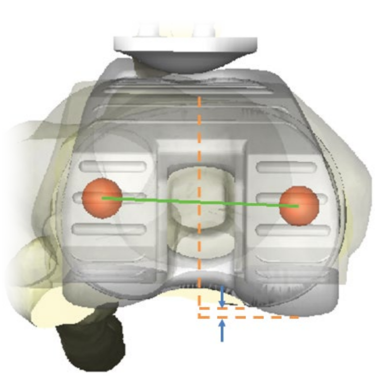
- Femur translates posteriorly
- MCL continues to become looser with flexion which allows for high flexion
- When the PCL is retained, its strain reaches its peak but less tight than conventional knees, which allows for high flexion

Functional flexion

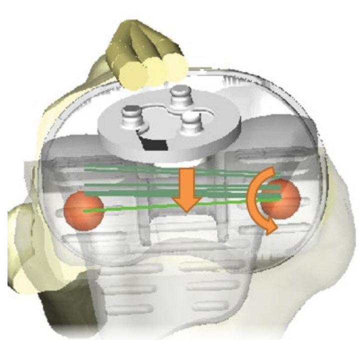
- 15° flexed cut extends articular surfaces by 4mm while minimizing bone resection
- Lateral posterior offset is less, so femoral external axial rotation and convex lateral compartment are necessary for lateral condyle to clear tibia
- Medial condyle is more anterior than the lateral condyle, therefore, large posterior offset is needed to clear tibia
- Femoral external axial rotation and lateralized patella groove from anatomic asymmetric femoral condyles designed to minimize patellofemoral ML shear force and maintain normal quadriceps mechanism function[14]



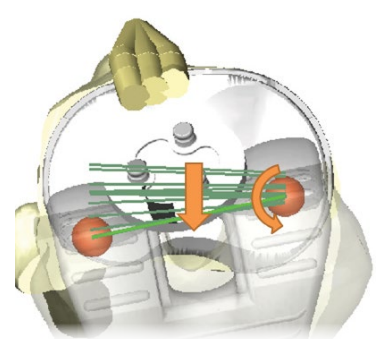
15° flexed cut extends the articular surfaces



0° – Screw-home, anterior AP position

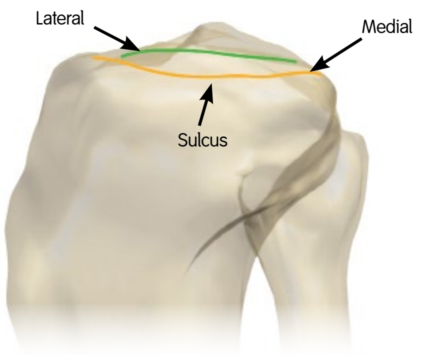


0° – 90° – Rollback medial pivot

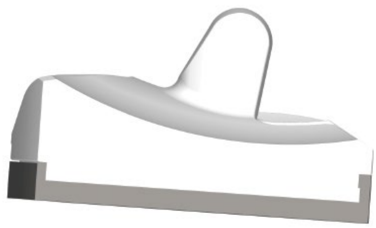


90° – 155° – Posterior translation

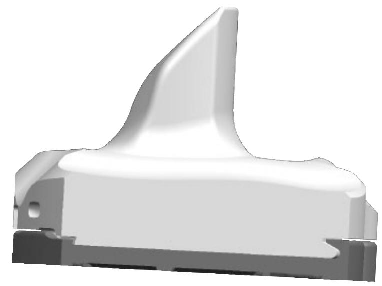
Function summary



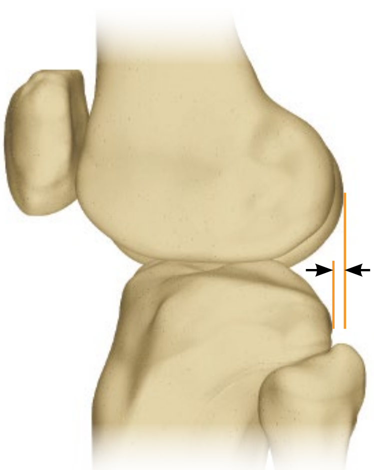
Shape – Normal knee
- Concave medial surface
- Sulcus near AP midline
- Convex lateral surface
- 3° physiological joint line



Shape – Conventional TKA
- Symmetric concave medial and lateral surfaces
- Sulcus located in posterior 1/3
- 0° unnatural joint line

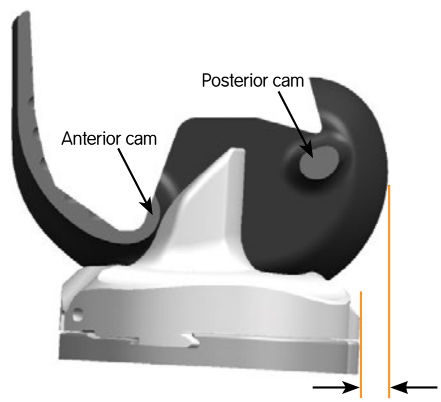


Shape – JOURNEY° II Total Knee System
- Concave medial surface
- Sulcus near AP midline
- Convex lateral surface
- 3° physiological joint line



AP stability – Normal knee
- ACL provides anterior stability
- PCL provides posterior stability
- Anterior AP position causes femoral rollback

AP stability – Conventional TKA
- Lack of anterior stability (ACL function)
- Posterior overhang causes femoral paradoxical anterior translation
- Anterior and mid-flexion instability



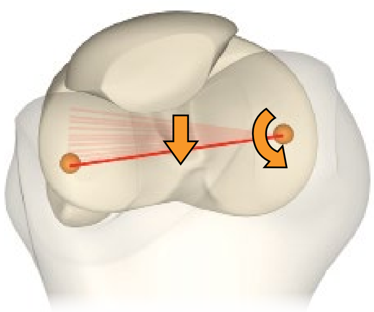
AP stability – JOURNEY II Total Knee System
- Anterior cam and posterior medial lip provide anterior stability
- Anterior AP position causes femoral rollback
- ACL function and femoral rollback provide anterior and mid-flexion stability

Conventional TKA function

AP stability	Ant. instability (No ACL function)	Mid-flexion instability (Paradoxical motion)	Posterior stability/ Over tension or reduced stability (Posterior cam/PCL or PCL release)
Kinematics	No screw-home	Lateral pivot (Paradoxical motion and limited axial rotation)	Posterior translation (Posterior cam/PCL)
Flexion	Adequate quadriceps efficiency	Patellofemoral ML shear stresses increase	

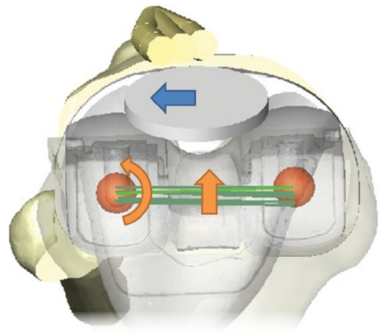
-5 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

Flexion



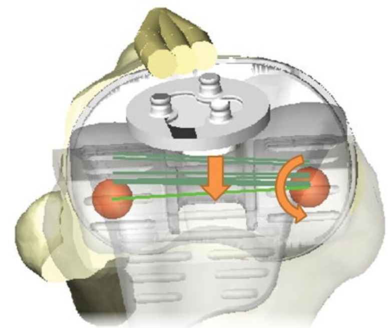
Kinematics – Normal knee

- 0° – Screw-home, anterior AP position
- 0° – 90° – Rollback plus femoral external axial rotation yields medial pivot
- 90° – 155° – Posterior femoral translation



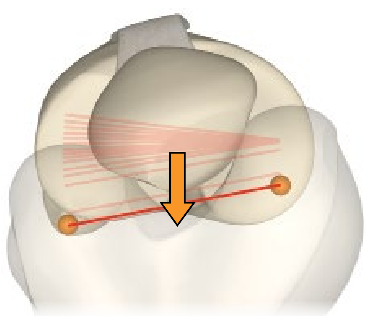
Kinematics – Conventional TKA

- 0° – No screw-home, posterior overhang
- 0° – 90° – Paradoxical motion plus limited axial rotation yields lateral pivot
- 90° – 155° – Abnormal femoral internal axial rotation



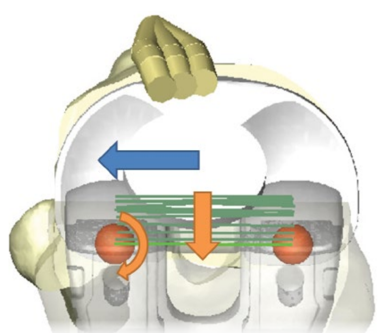
Kinematics – JOURNEY° II Total Knee System

- 0° – Screw-home, anterior AP position
- 0° – 90° – Rollback plus femoral external axial rotation yields medial pivot
- 90° – 155° – Posterior femoral translation



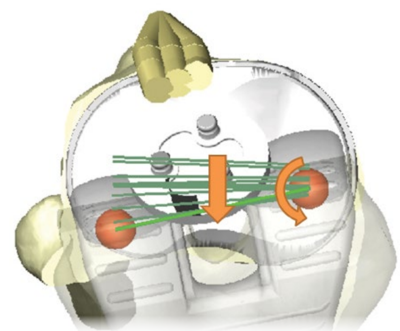
Flexion – Normal knee

- External axial rotation of femur allows lateral condyle to clear posterior tibia
- Large posterior offset allows medial condyle to clear posterior tibia
- Patellofemoral ML shear force minimized



Flexion – Conventional TKA

- Abnormal internal axial rotation causes early bone impingement, limiting flexion
- Internal axial rotation and centralized distal patella track causes significant patellofemoral ML shear force



Flexion – JOURNEY II Total Knee System

- External axial rotation of femur allows lateral condyle to clear posterior tibia
- Large posterior offset allows medial condyle to clear posterior tibia
- Patella is designed to minimize shear force by tracking laterally similar to the normal knee[35]

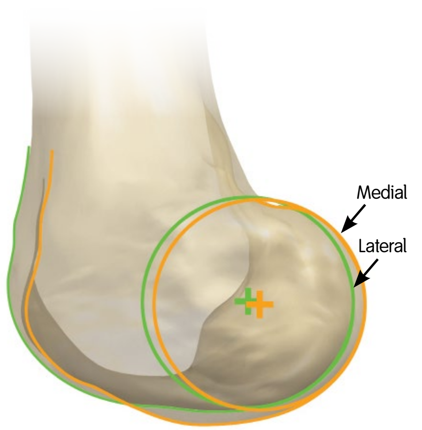
JOURNEY II Total Knee System function

AP stability	Ant. stability (Anterior cam)	Mid-flexion stability (Concave medial surface)	Posterior stability (Asymmetric posterior cam/PCL)
Kinematics	Screw-home	Medial pivot (Convex lateral and concave medial)	Posterior translation (Asymmetric posterior cam/PCL)
Flexion	Enhanced quadriceps efficiency		Minimized patellofemoral ML shear stress Extended articular surfaces

-5 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 155

Flexion

Ligament behavior



Ligament behavior – Normal knee

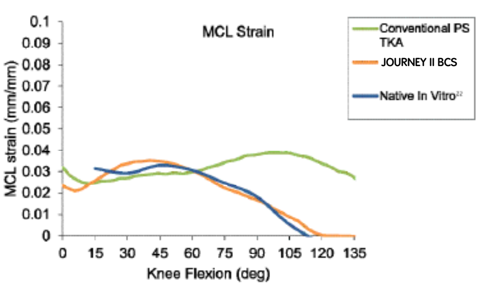
- Asymmetric femoral condyles affect tension profile of medial and lateral soft tissues differently
- MCL strain is near constant 0-60° before starting to slacken[22]
- LCL strain gradually decreases with flexion[22]
- PCL strain increases with flexion up to its peak in deep flexion without being overly tight

Ligament behavior – Conventional TKA

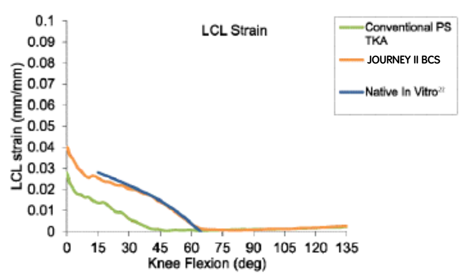
- Symmetric femoral condyles can not replicate normal tension profile of medial and lateral soft tissues without femoral malalignment
- MCL strain is typically near constant throughout flexion which could restrict deep flexion or loose in mid-flexion which could cause instability
- LCL strain is likely looser than normal in extension because femoral sits posterior
- PCL strain is looser in extension which could affect knee stability and tighter in deep flexion which could restrict deep flexion

Ligament behavior – JOURNEY° II Total Knee System

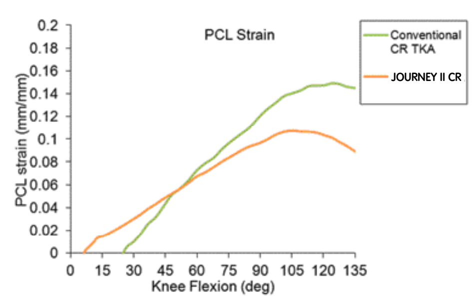
- Asymmetric femoral condyles allow replication of normal tension profiles of both medial and lateral soft tissues[22, 41]
- MCL strain is near constant 0-60° before starting to slacken
- LCL strain gradually decreases with flexion
- PCL strain increases with flexion up to its peak in deep flexion without being overly tight



Ligament behavior comparison - MCL strain[41]



Ligament behavior comparison - LCL strain[41]



Ligament behavior comparison - PCL strain[35]

Durability

Conventional TKA wear

- Paradoxical motion during flexion may increase sliding distance/wear[40]
- Concave lateral insert conformity increases the wear footprint (the total amount of area that the femoral traverses during the entire ROM), which may increase wear

Conventional TKA post contact

- Unintended femoral contact with the post causes severe post stresses
- Surpassing fatigue stress can cause post breakage
- Non-rounded posts and cams can cause edge loading during femoral external axial rotation, increasing stresses on the post

Conventional TKA patellofemoral shear forces

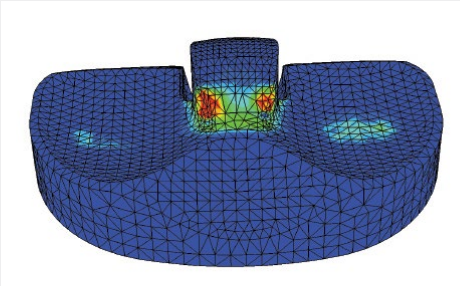
- Limited and abnormal femoral axial rotation increases patellofemoral ML shear forces
- Excessive shear force may cause anterior knee pain, premature articular wear and/or peg breakage

Conventional TKA materials

- CoCr is less abrasion resistant and is less lubricious than OXINIUM◊ Oxidized Zirconium, increasing both adhesive and abrasive wear[36, 37, 38]
- Non-polished baseplates produce more backside wear than polished baseplates

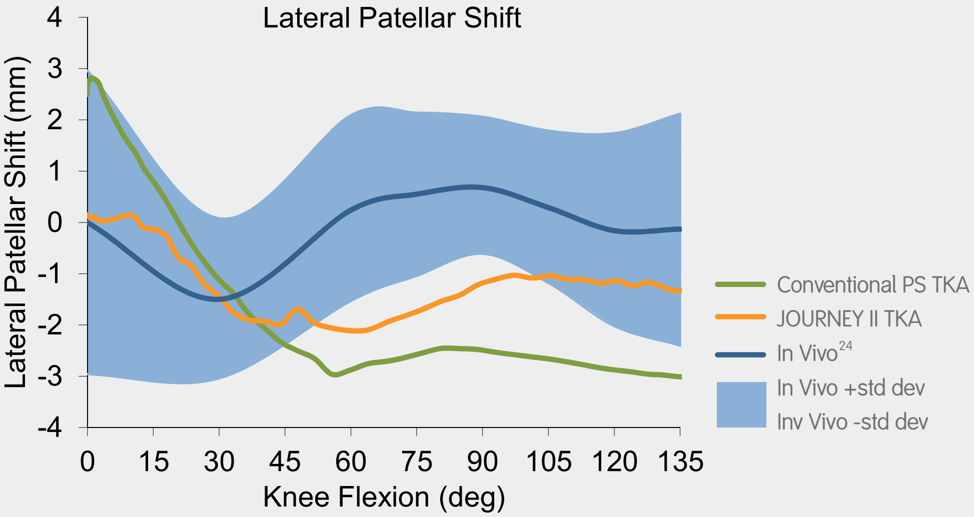
Conventional TKA locking mechanism

- Competitive insert/baseplate locking mechanisms require a screw or bolt augment through the insert to prevent insert disassociation

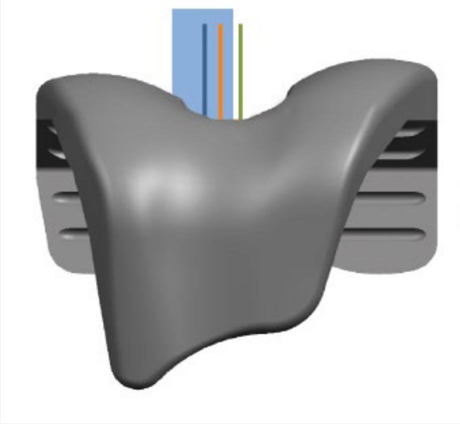


Conventional PS post edge impingement

Wear simulator



Patella tracking comparison[35]



JOURNEY◊ II TKA

Durability *(continued)*

JOURNEY◊ II TKA wear

- Wear tested to five million cycles[32]
- Predominant wear feature on the insert articular surface was burnishing[32]
- There were no signs of fatigue wear or delamination[32]
- Volumetric wear was less than previously published wear for conventional TKA[25-33]
- Medial pivot and rollback cause the lateral side to roll more and slide less and virtual elimination of paradoxical sliding as the knee flexes should maintain the normal cycles of the femur across the polyethylene leading to reduced wear compared to conventional designs[44]
- Convex lateral insert compartment reduces wear footprint[44]

JOURNEY II BCS Knee System post contact

- Large, rounded anterior cam reduces contact stresses and eliminates edge loading[48, 49]
- Asymmetric, rounded posterior cam maintains congruent contact during femoral axial rotation, eliminating edge loading and minimizing stress[50]

JOURNEY II TKA patellofemoral ML shear forces

- Femoral external axial rotation and patella groove lateralized by asymmetric femoral condyles are designed to reduce patellofemoral ML shear forces, risk of premature wear, peg breakage and anterior knee pain

JOURNEY II TKA materials

- OXINIUM◊ Oxidized Zirconium reduces abrasive and adhesive wear[26]
- Highly cross-linked polyethylene (XLPE) combines with OXINIUM to form VERILAST Technology a highly durable bearing combination shown have low wear rates during simulator testing[26]
- ETO sterilization does not produce free radicals, which reduces the risk of oxidation and subsequent delamination[39]
- Polished tibial baseplate reduces backside wear[47]

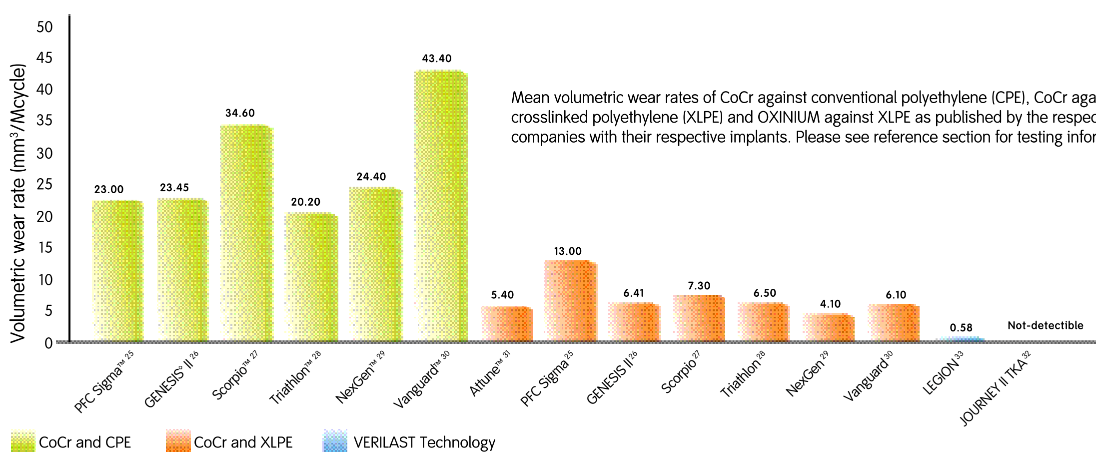
JOURNEY II TKA locking mechanism

- Strategic interference designed to reduce micromotion
- Insertion tool provides confidence of proper assembly
- Large dovetail interface area eliminates the need for additional locking mechanisms (i.e. screws, clips)
- Deep flexion possible

JOURNEY II TKA insert

JOURNEY II TKA baseplate

The implants identified to the right were tested by their manufacturers using different testing protocols and, therefore, the results are not directly comparable.

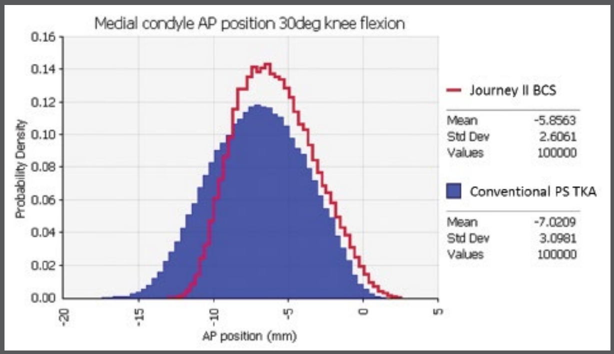


Mean volumetric wear rates of CoCr against conventional polyethylene (CPE), CoCr against crosslinked polyethylene (XLPE) and OXINIUM against XLPE as published by the respective companies with their respective implants. Please see reference section for testing information.

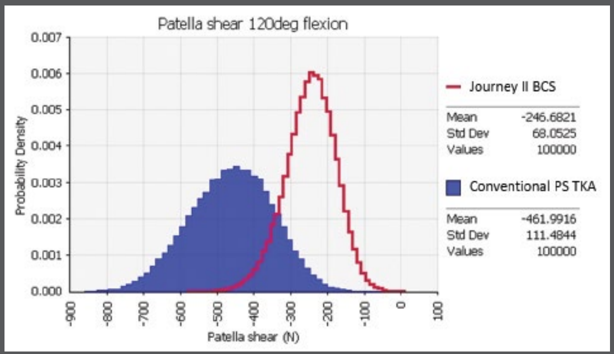
Robustness

Surgical sensitivity analysis

- Used to determine how sensitive JOURNEY◊ II Total Knee System is when not implanted in optimal alignment
- Response Surface Methodology was used to create a model of the effects of deviations from ideal surgical alignment
- Distributions, based on literature, were assigned to the surgical deviations. Then, Monte Carlo Analysis simulated a patient performing a deep knee bend after 100,000 random surgeries to identify the effects on knee joint loads, ligament strain, and kinematics for JOURNEY II and compared them to conventional TKA
- The distribution of outcomes from the surgical sensitivity analysis[34] showed JOURNEY II system has:
- Lower worst case patella shear
- Similar or lower likelihood of overly tight ligaments
- More normal kinematics even when malaligned than a conventional TKA design



Variation in kinematics due to surgical variation[34]



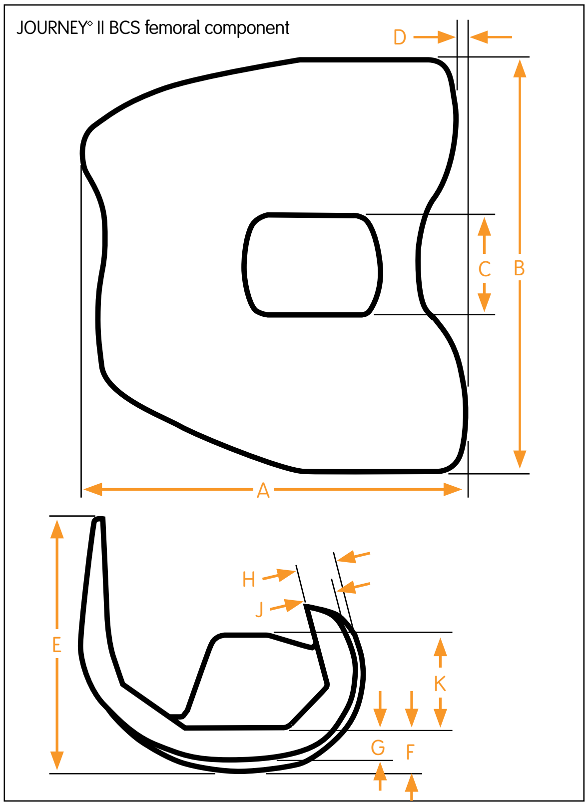
Variation in patella shear due to surgical variation. Left, more negative number, is higher shear force[34]

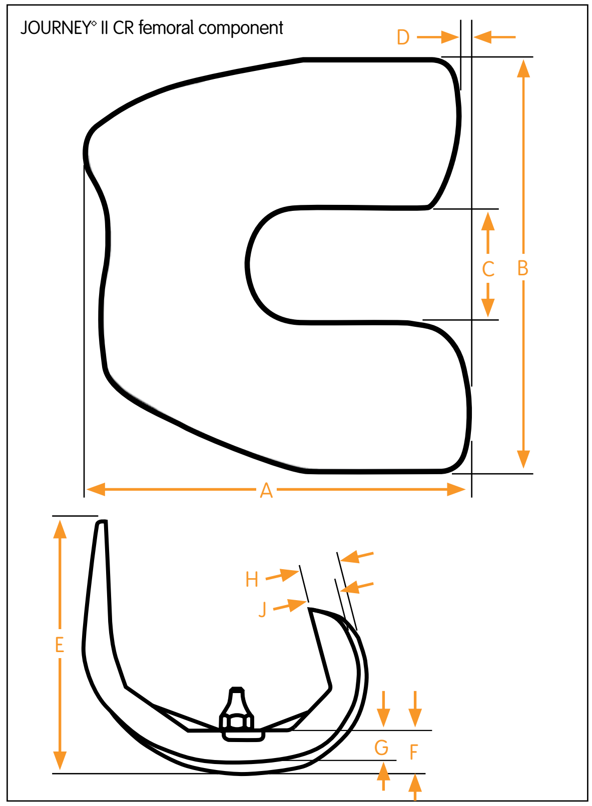
Surgical Variable	Max. Value	Min. Value
Femoral Joint Line	Superior 4mm	Inferior 2mm
Femoral Anterior-Posterior	Anterior 2mm	Posterior 2mm
Femoral Varus-Valgus	Valgus 4°	Varus 4°
Femoral Internal-External	External 6°	Internal 6°
Tibial Posterior Slope	Posterior 9°	Anterior 3°
Tibia Internal-External	External 6°	Internal 6°
Tibia Varus-Valgus	Varus 6°	Valgus 6°
Extension Gap	4mm gap	2mm interference

Surgical sensitivity

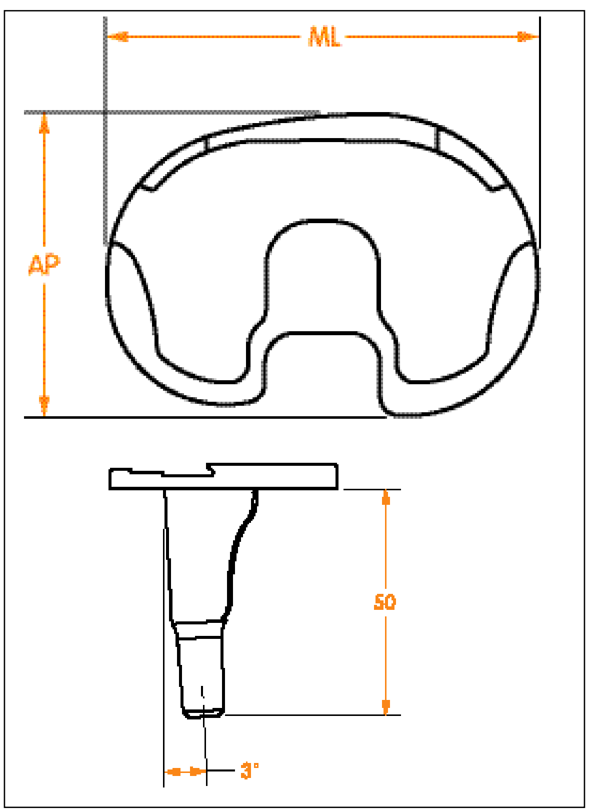
System overview

Femoral component dimensions (mm)





Tibial baseplate dimensions (mm)



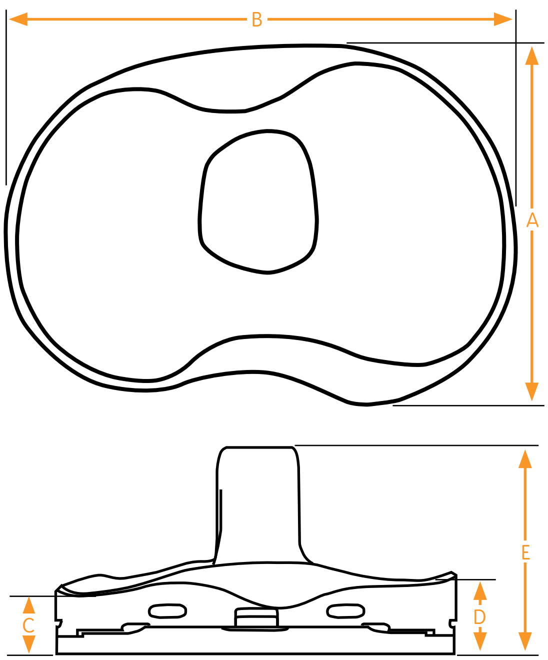
Size	A Anterior Posterior	B Medial Lateral	C PS Box / CR IC Notch Width	D Posterior Condylar Offset	E Flange Height	F Distal Medial Thickness	G Distal Lateral Thickness	H Posterior Medial Thickness	J Posterior Lateral Thickness	K Box Height
1	51.7	59.0	16.5 / 19	1.7	49.5	9.5	7	9	7.4	16.0
2	53.7	60.0	16.5 / 19	1.7	50.7	9.5	7	9	7.4	17.0
3	56.7	61.5	16.5 / 19	1.7	52.5	9.5	7	9	7.4	17.0
4	59.7	64.5	16.5 / 19	1.7	54.3	9.5	7	9	7.4	20.5
5	62.7	67.5	16.5 / 19	1.7	56.0	9.5	7	9	7.4	20.5
6	65.7	70.5	16.5 / 19	1.8	57.7	9.5	7	9	7.4	22.0
7	68.8	73.5	16.5 / 19	1.8	59.5	9.5	7	9	7.4	22.0
8	71.8	76.0	16.5 / 19	1.8	61.2	9.5	7	9	7.4	22.0
9	75.8	80.0	16.5 / 19	1.8	63.5	11.5	9	11	9.4	22.8
10	79.8	82.0	16.5 / 19	1.8	65.7	11.5	9	11	9.4	22.8

Size	AP Anterior Posterior	ML Medial Lateral
1	42	60
2	45	64
3	48	68
4	50	71
5	52	74
6	54	77
7	56	81
8	59	85
9	61	89

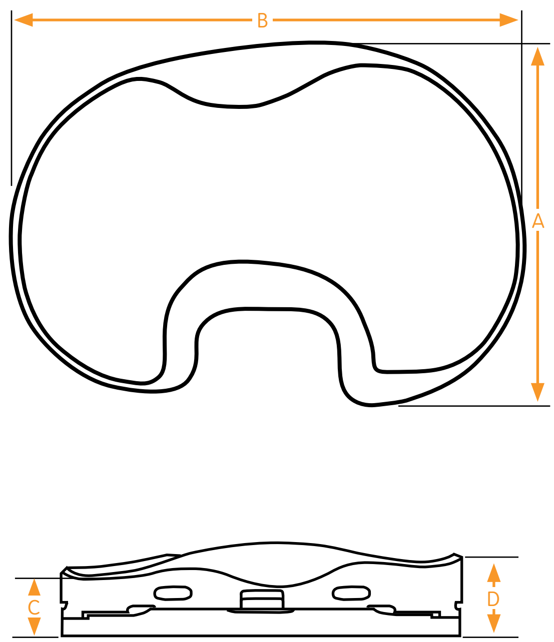
Note: Stem sloped 3° posteriorly. Stem length is 50mm on all nonporous sizes.

Articular insert dimensions (mm)

JOURNEY° II BCS articular insert



JOURNEY II CR articular insert



9mm BCS Insert	A (Anterior Posterior)	B (Medial Lateral)	C (Medial* Thickness)	D (Lateral* Thickness)	E (Post* Height)
Size 1-2	42	60	9.6	11.9	34.1
Size 3-4	48	68	9.6	11.6	35.1
Size 5-6	52	74	9.6	11.9	38.6
Size 7-8	56	81	9.6	11.9	40.1

Minimum polyethylene thickness for a 9mm metal-backed component is 6.7mm on the medial side.
*Baseplate thickness included.

9mm CR Insert	A (Anterior Posterior)	B (Medial Lateral)	C (Medial* Thickness)	D (Lateral* Thickness)
Size 1-2	42	60	9.6	11.6
Size 3-4	48	68	9.6	11.6
Size 5-6	52	74	9.6	11.6
Size 7-8	56	81	9.6	11.6

Minimum polyethylene thickness for a 9mm metal-backed component is 6.7mm on the medial side.
*Baseplate thickness included.

JOURNEY II CR insert compatibility

Completely interchangeable with all size femoral components

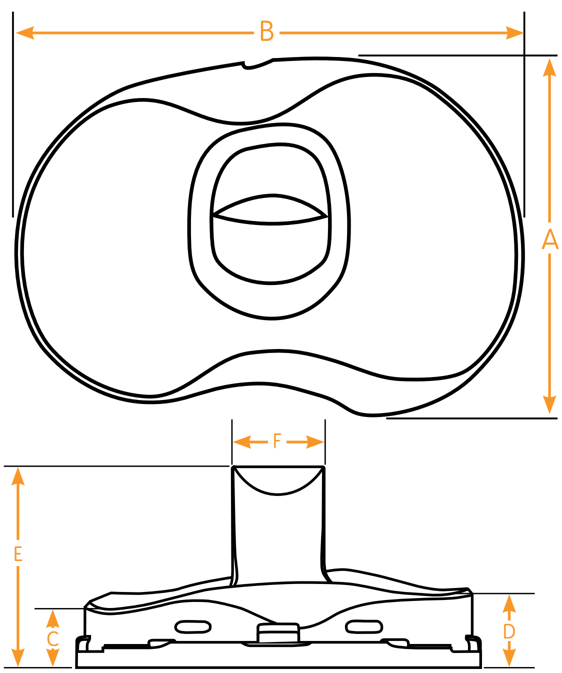
Insert offering / compatibility (BCS, Constrained, Deep Dished)

	Femoral Size									
Insert Size	1	2	3	4	5	6	7	8	9	10
1-2	●	●	●	●						
3-4		●	●	●	●	●				
5-6				●	●	●	●	●	●	
7-8						●	●	●	●	●

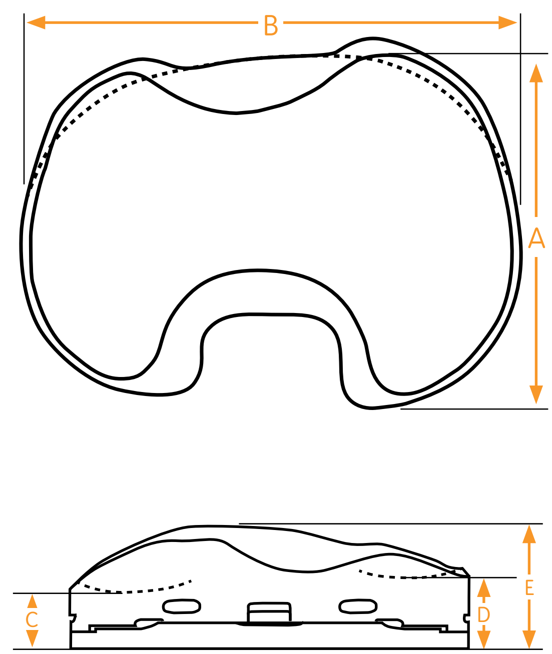
System overview *(continued)*

Tibial insert dimensions (mm)

JOURNEY® II BCS constrained insert



JOURNEY II CR deep dished insert



9mm Constrained Insert	A (Anterior Posterior)	B (Medial Lateral)	C (Medial Thickness*)	D (Lateral Thickness*)	E (Post Height*)	F (Post Width)
Size 1-2	42	60	9.6	12.1	34.1	16.1
Size 3-4	48	68	9.6	12.1	35.3	16.1
Size 5-6	52	74	9.6	12.1	38.6	16.1
Size 7-8	56	81	9.6	12.1	40.1	16.1

Minimum polyethylene thickness for a 9mm metal-backed component is 6.7mm on the medial side.

*Baseplate thickness included.

9mm Deep Dished Insert	A (Anterior Posterior)	B (Medial Lateral)	C (Medial Thickness*)	D (Lateral Thickness*)	E (Anterior Thickness*)
Size 1-2	42	60	9.6	12.1	16.9
Size 3-4	48	68	9.6	12.1	18.1
Size 5-6	52	74	9.6	12.1	19.3
Size 7-8	56	81	9.6	12.1	19.9

Minimum polyethylene thickness for a 9mm metal-backed component is 6.7mm on the medial side.

*Baseplate thickness included.

Insert offering / compatibility (BCS, Constrained, Deep Dished)

	Femoral Size									
Insert Size	1	2	3	4	5	6	7	8	9	10
1-2	●	●	●	●						
3-4		●	●	●	●	●				
5-6				●	●	●	●	●	●	
7-8						●	●	●	●	●

Summary

The JOURNEY◊ II Total Knee System is the next step for a knee system designed to restore normal function in that it maintains the tenets of restoring normal knee AP stability, kinematics and deep flexion while adding a Cruciate Retaining version, more stable Constrained PS and Deep Dished options, and enhancing the Bi-Cruciate Stabilized design. Smith & Nephew has continually improved the technologies used to better understand the behavior of the knee from the kinematics to the soft tissue function to further advance the science behind knee arthroplasty design. With a design based on natural anatomy, the JOURNEY II Total Knee System addresses many of the problems associated with conventional systems, while maximizing durability and minimizing sensitivity to malpositioning.

The JOURNEY II Total Knee System achieves function, motion and durability without sacrificing robustness required to work in the real world.

Notes

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00225 V3 01/18

References

1. Robertsson O, et al. The Swedish Arthroplasty Register 1975-1997. An update with special emphasis on 41,223 knees operated on in 1988-1997. Acta Orthopaedica Scandinavica. 72(5): 503-513. 2001. **2.** Weiss JM, et al. "What Functional Activities Are Important to Patients With Knee Replacements?" Clinical Orthopaedics & Related Research. 404: 172-188. 2002. **3.** Noble PC, et al. "Does total knee replacement restore normal knee function?" Clinical Orthopaedics & Related Research. 431: 157-165. 2005. **4.** Dennis DA, et al. A multicenter analysis of axial femorotibial rotation after total knee arthroplasty. Clinical Orthopaedics & Related Research. 428: 180-9. 2004. **5.** Victor J, et al. In vivo kinematics after a cruciate-substituting TKA. Clin Orthop Relat Res. 2010 Mar; 468(3):807-14. **6.** Zingde SM, et al. In vivo comparison of kinematics for 1891 non-implanted and implanted knees. AAOS. 2009; Scientific Exhibit No. 22. **7.** Zingde SM, et al. In vivo comparison of tka kinematics for subjects having a PS, PCR, or Bi-Cruciate Stabilizing design. Orthop Res Soc, Las Vegas, NV, Feb 22-25. 2009, Paper No. 2067. **8.** Ward TR, et al. Bicruciate-stabilised total knee replacements produce more normal sagittal plane kinematics than posterior-stabilised designs. J Bone Joint Surg Br. 2011 Jul;93(7):907-13. **9.**Catani F, et al. In vivo kinematics and kinetics of a bi-cruciate substituting total knee arthroplasty: a combined fluoroscopic and gait analysis study. J Orthop Res. 2009 Dec;27(12):1569-75. **10.** Morra EA, et al. The influence of contemporary knee design on high flexion: a kinematic comparison with the normal knee. JBJS Am. 2008; 90: 195-201. **11.** Catani F, et al. The Mark Coventry Award: Articular contact estimation in TKA using in vivo kinematics and finite element analysis. Clin Orthop Relat Res. 2010 Jan; 468(1):19-28. **12.** Van Duren BH, et al. Bicruciate substituting total knee replacement: how effective are the added kinematic constraints in vivo? Knee Surg Sports Traumatol Arthrosc. 2012 Oct; 20 (10):2002-10. **13.** Arbuthnot JE and Brink RB. Assessment of the antero-posterior and rotational stability of the anterior cruciate ligament analogue in a guided motion bi-cruciate stabilized total knee arthroplasty. J Med Eng Technol. 2009;33(8):610-5. **14.** Lester DK and Shantharam R. Objective Sagittal Instability of CR-TKA by Functional EMG During Normal Walking. AAOS. 2012; Presentation No. 810. **15.** Mahfouz MR, et al. In vivo assessment of the kinematics in normal and anterior cruciate ligament-deficient knees. J Bone Joint Surg Am. 2004;86-A Suppl 2:56-61. **16.** Carpenter RD, et al, Magnetic resonance imaging of in vivo patellofemoral kinematics after total knee arthroplasty. Knee. 2009 Oct;16(5):332-6. **17.** Brilhault J and Ries MD. Measuring patellar height using the lateral active flexion radiograph: Effect of total knee implant design. Knee. 2010 Mar;17(2):148-51. **18.** Victor J, et al. High-flexion, motion-guided total knee arthroplasty: who benefits the most? Orthopedics. 2007 Aug; 30 (8 Suppl): 77–9. **19.** Kuroyanagi Y, et al. In vivo knee kinematics during stair and deep flexion activities in patients with bicruciate substituting total knee arthroplasty. J Arthroplasty. 2012 Jan; 27(1):122-8. **20.** Ref: Smith & Nephew OR-11-172. **21.** Johal P, et al. "Tibio-femoral movement in the living knee." Journal of Biomechanics. 38(2): 269-76. 2005. **22.** Harfe DT, at al. Elongation patterns of the collateral ligaments of the human knee. Clin Biomech. 1998 Apr;13(3):163-175. **23.** Yue B, et al. In vivo function of posterior cruciate ligament before and after posterior cruciate ligament-retaining total knee arthroplasty. Int Orthop. 2012 Jul;36(7):1387-92. **24.** Nha KW, et al. In vivo patellar tracking: clinical motions and patellofemoral indices. J Orthop Res. 2008 Aug;26(8):1067-74. **25.** McEwen HMJ, et al. The influence of design, materials and kinematics on the in vitro wear of total knee replacements, J Biomech, 2005;38(2):357-365. **26.** Parikh A, et al. Wear testing of crosslinked and conventional UHMWPE against smooth and roughened femoral components, Orthop Res Soc, San Diego, CA, Feb 11-14, 2007, Paper No. 0021. **27.** Essner AA, et al. Sequentially crosslinked and annealed UHMWPE knee wear debris. Orthop Res Soc, Washington D.C., 2005, Paper No. 71. **28.** Herrera L, et al. Evaluation of sequentially crosslinked and annealed wear debris. World Biomater Cong, Amsterdam, May 28-Jun 1, 2008, Paper No. 583. **29.** Schaerer C, et al. Wear of UHMWPE tibial inserts under simulated obese patient conditions. Orthop Res Soc, New Orleans, LA, Feb 6-10, 2010, Paper No. 2329. **30.** Biomet publication, FDA Cleared Claims for E1 Antioxidant Infused Technology" **31.** Ref: DePuy Attune 510 K Document K101433 Dec 10, 2010 **32.** Ref: Smith & Nephew OR-12-129 **33.** Papannagari R, et al. Long-term wear performance of an advanced bearing knee technology. ISTA, Dubai, UAE, Oct 6-9, 2010. **34.** Data on File; K09-JRN2 Surgical Positioning Sensitivity. **35.** Data on file; K06-JNCR KneeSim Analysis RevA. **36.** Hunter G, et al, 6th World Biomaterials Cong. Trans., Society For Biomaterials, Minneapolis, MN, 2000, p. 835. **37.** Salehi A, et al, Dynamic Contact Angle Measurements on Orthopaedic Ceramics and Metals, Medical Device Materials, S. Shrivatstava (ed.), ASM International, Materials Park,OH, 2004, pp. 98-102 **38.** Salehi A. et al, Wettability Analysis of Orthopaedic Materials Using Optical Contact Angle Methods, Bioceramics, Vol. 18, T. Nakamura, K. Yamashita, and M. Neo (eds.), Trans Tech Pub., Uetikon-Zuerich, Switz., 2006, pp. 1199-1202. **39.** J.P. Collier, L.C. Sutula, B.H. Currier, J.H. Currier, R.E. Wooding, I.R. Williams, K.B. Farber and M.B. Mayor, "Overview of polyethylene as a bearing material: comparison of sterilization methods," Clin Orthop Relat Res, 1996;333:76-86. **40.** Dennis DA, Komistek RD, Stiehl JB,Walker SA, Dennis KN. Range of motion after total knee arthroplasty: the effect of implant design and weight-bearing conditions. J Arthroplasty 1998;13(7):748–52. **41.** Data on File; K09-JRN2 KneeSim Analysis RevA **42.** Westrich GH, et al. Current analysis of tibial coverage in total knee arthroplasty. Knee 1997; 4(2): 87-91. **43.** Data on File; K09-JRN2 Journey II BCS box prep bone removal **44.** Data on file with Smith & Nephew **45.** Bollars et al. Femoral component loosening in high-flexion total knee replacement. J Bone Joint Surg Br 2011; 93(10): 1355-61. **46.** Moore C and Lenz N The evolution of guided motion total knee arthroplasty: The JOURNEY II Bi-Cruciate Stabilized knee system. Bone & Joint Science 2012; 3(3): 1-8. **47.** Abdel et al. Polished trays reduce backside wear independent of post location in posterior-stabilized TKAs. Clin Orthop Relat Res. 2014;472(8):2477-82. **48.** Hada et al. Bi-cruciate stabilized total knee arthroplasty can reduce the risk of knee instability associated with posterior tibial slope. Knee Surg Sports Traumatol Arthrosc. 2017 Sep 22.[Epub ahead of print] **49.** Kuwashima et al. Contact stress analysis of the anterior tibial post in bi-cruciate stabilized and mobile-bearing posterior stabilized total knee arthroplasty designs. J Mech Behav Biomed Mater. 2016; 60:460-467. **50.** Arnout et al. Post-cam mechanics and tibiofemoral kinematics: a dynamic in vitro analysis of eight posterior-stabilized total knee designs. Knee Surg Sports Traumatol Arthrosc. 2015; 23(11):3343–3353.

*For detailed product information, including indications for use, contraindications, effects, precautions and warnings, please consult the product's Instructions for Use (IFU) prior to use.