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Medial unicondylar resurfacing

Surgical reference guide

Mako MCK Implant System



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This publication sets forth detailed recommended procedures for using Stryker's devices and instruments. It offers guidance that you should heed, but as with any such technical guide, each surgeon must consider the particular needs of each patient and make appropriate adjustments when and as required.

Note: the information provided in this document is not to be used as the surgical technique when completing a Mako Partial Knee procedure. Please refer to the Mako PKA Surgical Guide (PN 210713) for detailed intended use, contraindications, and other essential product information.

Implant compatibility



Medial

Patellofemoral

Lateral

Medial bicompartmental

Note: this surgical reference guide only covers a medial Mako Partial Knee replacement.

Mako MCK Implant System					
	Options	Sizes	Part number		
	Left medial/Right lateral	1-8	18050X		
Femoral implant	Right medial/Left lateral	1-8	18051X		
Tibial baseplate	Left medial/Right lateral	1-8	18060X		
	Right medial/Left lateral	1-8	18061X		
Poly insert	8,9,10,12mm	1-8	18070X-X		
X3 insert 8,9,10,11,12mm		1-8	18073X-X		
Patella implant 3mm increments		26-41mm	180320-X		
	Left	2-8	18040X		
Patemoral implant	Right	2-8	18041X		

Pre-operative implant planning



In order to best size and fit the tibial implant, start by setting the desired proudness value (typically 3mm) and the sagittal tibial slope to match the native anatomical slope of the patient denoted by the magenta line (Figure 1).

For a very steep native slope, stay at the maximum recommended 7° slope positioning limit (Table 1).

Figure 1

Recommended tibial c	Preferred	
Rotation	5º internal – 5º external	0° (match rotation to tibial spine)
Varus/valgus	0° – 1.5° varus	0º – 1º varus
Posterior slope	3° – 7° slope	< 7º

Table 1



Scroll through the transverse slices where the baseplate will rest on the cortical rim. The ideal size is the largest size that provides the most coverage anterior/posterior (A/P) without overhanging the cortex (Figure 2).

Figure 2

Tibial implant planning



Tibial components should not rise beyond half-way up the tibial eminence in the coronal view so as not to undermine the ACL and cut into the ACL fibers (Figure 3). The implant should blend with the eminence ridge.

Figure 3



After the size of the implant has been established use the transverse view again to confirm that the implant is matched to the cortex (Figure 4).

Figure 4



Figure 5

The tibial component should not interfere with the PCL insertion, which is recognizable by the white outline of denser bone (Figure 5). It may be necessary to adjust the I/E rotation of the tibial implant to accomplish this.

Note: If the tibial rotation appears high, confirm that the rotational landmarks are set correctly in the CT landmarks page.

Occasionally, increased A/P coverage may result in medial overhang or intrusion into the tibial eminence. In these cases, it is preferable to use a smaller component to prevent intrusion into the eminence or overhang.

Femoral implant planning



Figure 6

SAGITTAL (++) Imm P O Flexion 0.0°

In the sagittal view, find a CT slice that passes through the center of the component at the anterior tip of the implant. This slice is typically the one that shows no posts in the image. Use this view to select the size that best matches the native femoral curve of the patient and adjust the component's flexion/extension (F/E) if necessary. Also, position the posterior and distal aspects of the component lmm proud of bone by adjusting the A/P and superior/inferior (S/I) positions (Figure 7).

Use the 3-D bone model in the transverse view to select the femoral component that covers 75% of the distal femoral condyle from posterior to anterior (Figure 6). Final femoral size is determined during intra-op planning using pose

capture data (see page 8).

Figure 7

Femoral implant planning



Set the component rotation to 0° or match the native condylar curvature of the patient's femur, as shown in the 3-D bone model (Figure 8).

Figure 8



Lateralize the femoral component without overhang by adjusting the medial/lateral position of the implant in the transverse view. Place the component as close to the intercondylar notch as possible on the posterior aspect of the condyle (Figure 9).

Table 2 shows the recommended positioning limits for the femoral component.



Recommended femore	Preferred	
Rotation	5º internal – 5º external	0°
Varus/valgus	3º varus – 3º valgus	0° – 1° valgus
Flexion/extension	5° flexion – 5° extension	0° – 5° flexion

Table 2

Intra-operative planning



Figure 10

Osteophyte removal

Remove all visible and overhanging osteophytes. Be sure that this step is done before capturing any poses, but after bone registration.

Pose capture

In order to balance the F/E gaps throughout the knee's entire range of motion and obtain femorotibial tracking data, it is necessary to position the knee at multiple flexion angles and "capture" poses. To do this, take the limb to the desired flexion angle and while supporting the thigh, apply a valgus stress to the knee joint while controlling and keeping the foot pointing straight ahead. Avoid externally rotating the foot during flexion. Apply just enough force to passively correct the varus deformity and tension the MCL to proper tightness (Figure 10). It is often necessary to have an assistant provide counter-pressure to the inner thigh during pose captures throughout flexion to counteract the internal rotational force of the hip while the knee is flexed.

Avoid overcorrecting the deformity. Also, in cases of "tight" knees, do not force the joint beyond passive correction. Stop at the point where the MCL has reached its natural end-stop. Ideal limb alignment is between 1° and 3° of varus, but knees with more pre-op varus may be left in slightly more varus. Over-correction occurs when the knee is forced into valgus alignment.

Continue to apply the valgus stress and slowly take the limb through range of motion, capturing at least 4 poses, preferably at the flexion angles listed below.

- 5-10° (extension)
- 45° (mid-flexion)
- 90° (flexion)
- 100-120° (deep-flexion)

Pre-resection gap balancing and tracking



Figure 11

When all poses have been captured, the gap balancing graph will show the planned joint gaps for each of the captured flexion poses (Figure 11).

There is no maximum number of poses that can be collected. Moreover, the more poses that are captured, the easier it is to spot and discard incorrect readings or outliers.

It is important that the foot is neutrally rotated (not stressed internally or externally) as the limb is flexed. This can lead to inaccurate readings.

It is preferable to capture the extension pose in the $5-10^{\circ}$ range when the screwhome mechanism is no longer engaged and the posterior capsule is not tensed. Poses at less than 5° flexion can give the appearance of a tight gap.

Note: For your first cases you might find it beneficial to capture the poses, look at the resultant gap graph, ask your MPS to clear the graph data, and repeat. This process provides an opportunity to learn how to consistently reproduce the desired valgus/varus stress and pose capture.

Gap balancing and tracking

After poses have been captured, the sagittal position of the planned femoral and tibal components is fine-tuned to achieve gaps of 0-1.5mm of looseness throughout the range of motion and to obtain smooth transition of the patella onto the anterior aspect of the femoral condyle.

To help balance flexion and extension gaps, refer to Table 3.

	Tight flexion	Optimal flexion	Loose flexion
Tight extension	• Decrease tibial proudness (move tibial component distally).	 Move femoral component proximally. Extend the femoral component around a fixed posterior point on femoral condyle (tuck femoral component distally). Decrease tibial slope by rotating the anterior tibial component counterclockwise around its posterior tip. 	 Move femoral component proximally and posteriorly. Extend the femoral component around the tip of the posterior post (tuck femoral component in distally). Decrease tibial slope by rotating the tibial component counterclockwise around its center.
Optimal extension	 Move the femoral component anteriorly. Flex the femoral component around a fixed distal point on the femoral condyle (tuck the femoral component posteriorly). Increase tibial slope by rotating the tibial component around its anterior tip. 	• No action necessary.	 Move the femoral component posteriorly. Extend the femoral component around a fixed distal point on the femoral condyle. Decrease tibial slope by rotating the tibial component around its anterior tip.
Loose extension	 Move femoral component distally and anteriorly. Flex the femoral component around the tip of the posterior post (tuck femoral component posteriorly). Increase tibial slope by rotating the tibial component around its center. 	 Move femoral component distally. Flex the femoral component around a fixed posterior point on femoral condyle. Increase tibial slope by rotating the tibial component around its posterior tip. 	• Increase tibial proudness (move tibial component proximally).

Addressing mid-flexion

Increasing or decreasing femoral component proudness can be used to fine-tune midflexion gaps. Femoral proudness moves the virtual femoral component in line with the femoral posts, which are at a 30° flexion angle. As a result, increasing femoral component proudness tightens mid-flexion, while decreasing proudness loosens mid-flexion. Please keep in mind that changing the femoral component proudness will also affect flexion and extension gaps. Flexing/extending the femoral component will also affect the mid-flexion gap. Flexing the component loosens mid-flexion, and extending the component tightens mid-flexion.

Cartilage mapping







Figure 13

A proud anterior tip of the femoral component can impinge with the patella during flexion. This can eventually lead to disease progression and pain. Cartilage mapping helps create a smooth transition from the femoral component to the anterior surface of the femoral condyle.

By mapping the cartilage surface with the green blunt probe in the area surrounding the anterior tip of the planned femoral component, you can assess the cartilage thickness in the transition zone of the femoral condyle. When the green probe is positioned and the capture button is pressed, the application generates a small yellow patch at the exact location of the probe tip representing the cartilage surface (Figure 12).

By slightly flexing or extending the virtual femoral component around the sagittal condyle center, you can finetune the position of the anterior tip so that it is flush with the mapped cartilage (Figure 13).

Implant tracking



Figure 14



Figure 15

Once the joint is balanced, you may fine-tune the M/L position and I/E rotation of the femoral component to ensure that the femoral component tracks centrally over the tibial component throughout the patient's range of motion.

The application displays a red dot on the surface of the femoral component for each pose captured. This red dot represents the center location of the tibial component at that particular pose. The proudest region of the virtual femoral component (low point pathway) is represented by a dark line running along its articular surface (Figure 14). When the femoral component is properly aligned, optimal M/L loading between the femoral and tibial components is achieved when the tracking path of the red dots coincides with the proudest region of the planned femoral component.

When fine-tuning related to the low-point pathway is completed, optimal tracking can be verified and optimized by observing the relative position of both implants to each other throughout range of motion (Figure 15).

This view can also be used to confirm proper femoral component sizing when the limb is in full extension. The femoral component is sized appropriately when the tibial component maintains contact with the femoral component in full extension and does not impinge on opposing femoral cartilage.

Alternatively, proper femur sizing can also be confirmed by looking at the limb in full extension on a sagittal view. The anterior tip of the femoral component should be anterior to the anterior tip of the tibial bearing. If this is not the case, choose the next size up femoral component.

Review of virtual component placement

After all adjustments are completed it is important to review the final position of the virtual femoral and tibial implants. This is accomplished by scrolling through the appropriate slices of the bone model in all three planes and confirming proper fit, no impingement, and no overhang.

It is also important to verify that the gap balancing graph still yields the desired gaps throughout range of motion. If any of the gaps are now outside the desired range, these must be adjusted before proceeding to bone resection.

Bone registration and gap balancing



Figure 16



Perform a medial incision and parapatellar arthrotomy to expose the joint. Place the femoral and tibial arrays, and the femoral and tibial checkpoints.

Collect patient landmarks. Register and verify the femoral and tibial checkpoints.







Perform bone registration and verification of both the femoral and tibial surfaces.

Note: Do not remove osteophytes before bone registration is completed.



Remove overhanging medial osteophytes and then capture a minimum of 4 poses while applying a valgus stress to passively correct the coronal deformity. The magnitude of the valgus stress must be such that it opens up the collapsed medial compartment and tensions the medial collateral ligament (MCL) to achieve the desired degree of correction and joint stability.

Note: Caution must be exercised to not overcorrect the deformity.

In the case of a lateral partial knee procedure, capture poses while applying a varus stress.

The poses captured are in extension, mid-flexion, flexion, and full-flexion (or approximately $5-10^{\circ}$, 45° , 90° , and $100-120^{\circ}$).

Bone resection, trialing and implant insertion



Figure 20

Fine-tune the femoral and tibial implant placement to ensure:

- \bullet Joint gaps are 0–1.5mm of looseness throughout range of motion
- Good central loading between the femoral and tibial components

Position the Mako in the operative field and perform registration and verification of the robotic arm.

Figure 21



Resect the femoral and tibial surfaces, then prepare the peg holes and keel.

Figure 22



Remove any meniscus and other soft tissues. Clean up the joint and install trial components. Take the limb through range of motion to assess joint stability.





Wash the joint with pulse lavage and dry before cementing the final implants. Ensure that there is good pressurization of the cement to achieve good inter-digitation. Remove all extraneous cement and then keep the joint stable until cement cures.

Once cement cures, reassess joint stability, femorotibial central tracking, and range of motion. Remove checkpoints, bone pins, and arrays. Close the surgical wound in the normal fashion.

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