

# KNEE3

SURGICAL TECHNIQUE - EXPRESS

## Purpose

This Surgical Technique is based on the Brainlab KNEE3 software. It documents how KNEE3 may be used in a clinical setting, but it is not meant as a replacement to the KNEE3 Software User Guide. For questions regarding recommended use of Brainlab equipment and/or software, always refer to the KNEE3 Software User Guide as your first level of product support. The training provided to the customer is based on the product-specific training requirements. Users must be trained and qualified to operate the KNEE3 navigation system. Contact Brainlab Customer Support if new users require training.

# KNEE3 EXPRESS

Femur First Technique

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A Femur Distal Cut First technique, using the Brainlab Adjustable Cutting Block for distal femoral Live Navigation and the tibia cutting block Position Verification.



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# OR Setup

## Camera Placement

The ideal position for the camera is at a distance of about 1m to 1.5m on the opposite side of the surgeon's position on the table, approximately between 90° and 45° towards the foot of the patient. The camera is equipped with a laser pointer. Point the laser at the center of the knee joint when the knee is in flexion.

The camera should be switched on for several minutes prior to use, as the infrared source needs some time to reach maximum efficiency. Any light sources or highly reflective objects should not be within the camera's field of view, as reflections can interfere with the procedure.

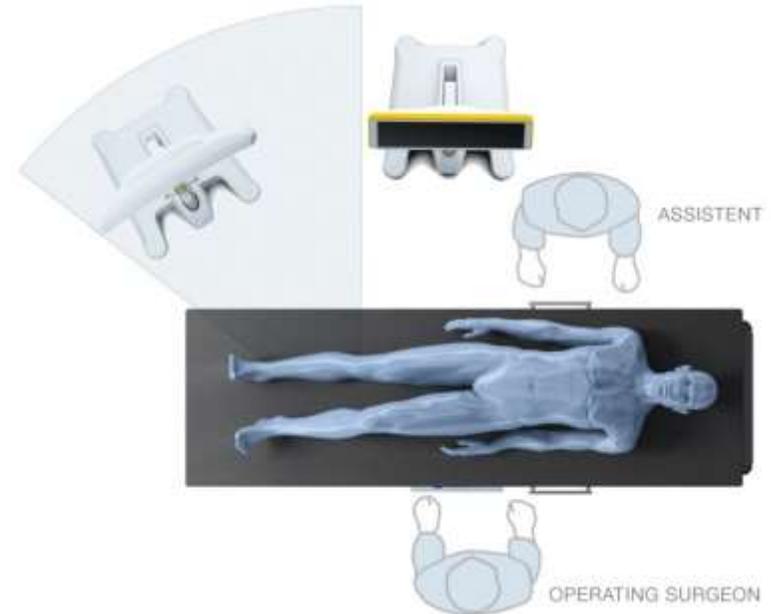
## Screen Placement

A good position for the display is on the opposite side of the surgeon's position next to the camera.

User interaction with the touchscreen is reduced to a minimum through an adaptive workflow. Nevertheless, sometimes it may be necessary to make inputs on the screen (e.g. to adjust implant size). In these cases, the optional footswitch or sterile monitor drape can optimize operating the navigation system.

Art. no. 18460 Footswitch

Art. no. 18071-50 Disposable Sterile Monitor Drapes 40 pcs



## Software Start & Patient Selection

Start KNEE3 Express, enter the patient name or select a patient from the list (PACS). Select the treatment side and press “Navigate” to start. For more details see the Patient Data Manager user manual.

At the scrub table, prepare the instruments with marker spheres. Nine marker spheres are needed for the Femur Distal Cut First technique described in this technique.

Tightly screw the spheres onto the socket. If the markers are not tightly screwed on the socket the instruments might not be detected at the correct position.

Art. no. 41774 Disposable Marker Spheres 270 pcs

Art. no. 41773 Disposable Marker Spheres 90 pcs

The pointer is used for registration of anatomical landmarks and measurements throughout the case. To ensure that the pointer is not bent, place it into the corresponding gauge.

Art. no. 53109 Pointer Straight

Art. no. 53101 Pointer Angled

The Plane Tool is used for verifying the cutting block position and the proximal tibial resections. The foot of the Plane Tool is inserted into the tibial and/or femoral cutting block after fixing the tibial block onto the bone using conventional alignment guides. The Bone Verification Plate is placed on the bone cuts to verify the resection plane's alignment.

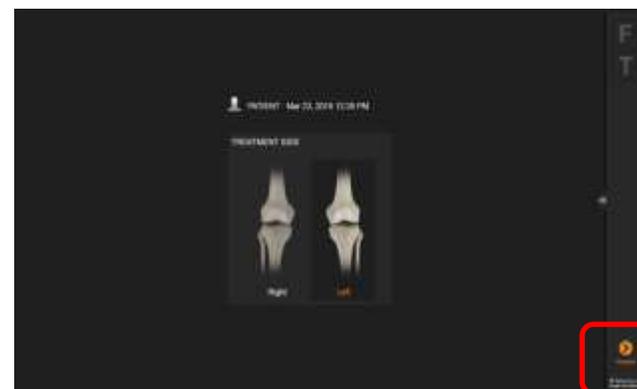
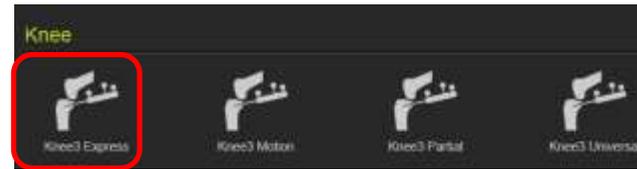
Art. no. 53200 Plane Tool

53201 KNEE PLANE TOOL - TRACKING ARRAY

53202 KNEE PLANE TOOL - CUTTING BLOCK ADAPTER

53203 KNEE PLANE TOOL - BONE VERIFICATION PLATE

Art. no.532xx Adjustable Cutting Block – Femur Kit



# Femur First Workflow

KNEE3 offers different workflows for cutting block position verification and/or position verification in combination with live cutting block navigation.

This document describes a Femur Distal Cut First technique, using the Brainlab Adjustable Cutting Block for Distal Femoral Live Navigation and the Tibia Cutting Block Position Verification.

For the femoral distal cutting block live navigation, a femoral reference array that attaches to the Brainlab Adjustable Cutting Block's base is available. Hence no additional pins are required in the femur, still allowing live distal cutting block navigation.

In the Tibial Block Position Verification, KNEE3 Express uses the Plane Tool as bone reference array. It is placed in the cutting block's sawing slot, after the block is placed using a conventional extramedullary alignment guide.

Thus, this workflow does not require extra incisions or placement of additional pins.

Any other combinations of the options below are also possible.



# Incision & Exposure

Incision and exposure to the knee joints should be performed based on the surgeons' choice of technique. Brainlab knee navigation instruments support all standard approaches. After initial exposure, remove prominent osteophytes.

## Femoral Cutting Block Base And Array Placement

The Adjustable Cutting Block - Femur Kit is used for navigating the distal femoral resection when the distal cut is performed first.

The cutting block is pinned close to its desired position with the help of an alignment guide. Fine-adjustments of varus/valgus, flexion/ extension and resection height can then be made using values displayed by the navigation system.

For detailed handling information and assembly/disassembly Instructions of the Adjustable Cutting Block see Brainlab's Hip and Knee Instrument User Guide.

The Fine-Adjustable Cutting Block - Femur Kit consists of

1. Femur Alignment Guide
2. Cutting Slot Femur
3. Adjustment Unit
4. Femur Base
5. Femur Reference Array



The Adjustable Cutting Block's adjustment ranges are:

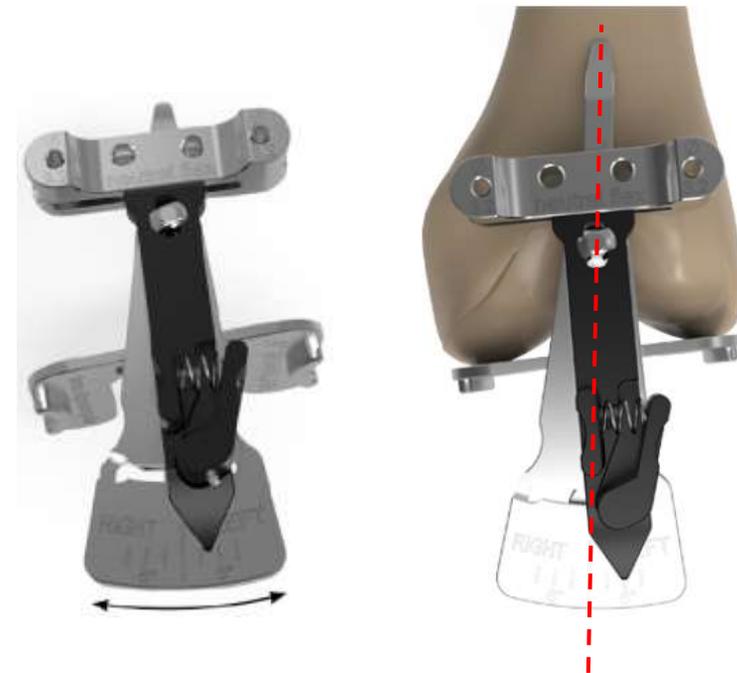
- Varus/valgus:  $\pm 8^\circ$
- Flexion/extension:  $\pm 8^\circ$
- Resection height:  $\pm 6$  mm

When working with the Femur Reference Array on the Femur Base of the Fine-Adjustable Cutting Block, the base has to be attached to the bone before registration can start.

For fixation of the cutting block, use threaded Schanz screws with a diameter of 3.2 mm only.

Art. no.53230 Adjustable Cutting Block – Femur Kit 1.19mm

Use the angular adjustment unit on the Femur Alignment Guide to adjust the femur anatomical angle according to the X-ray measurement or use average anatomical values, e.g. left,  $6^\circ$ .



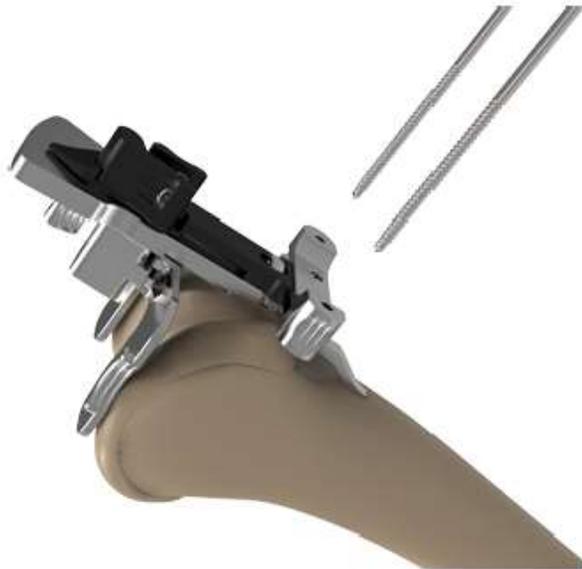
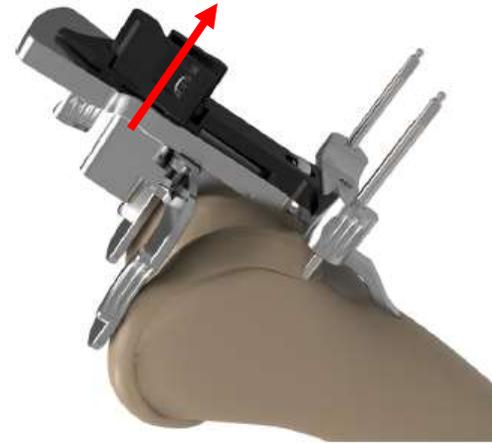
Place the Femur Alignment Guide on the distal femur, such that the distal condyle alignment paddles rest centered on the distal femoral condyles.

Center the Anterior Femoral Alignment Stylus on the anterior femoral cortex. Align the stylus with the femoral shaft axis.

Make sure the Femur Alignment Guide is in contact with the anterior cortex to adjust flexion.

Center the drill template on the anterior cortex and drill two threaded 3.2 mm Schanz screws through the holes of the drill template.

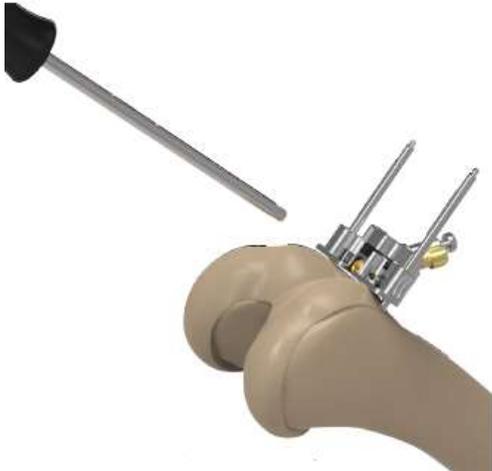
After having placed the pins, remove the Femur Alignment Guide by pulling it over the Schanz screws.



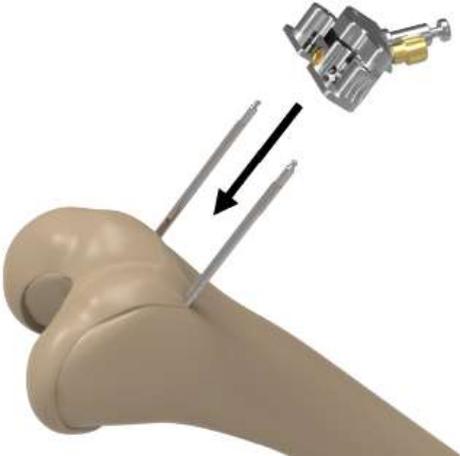
Make sure the Femur Base's fixation screw is unlocked.



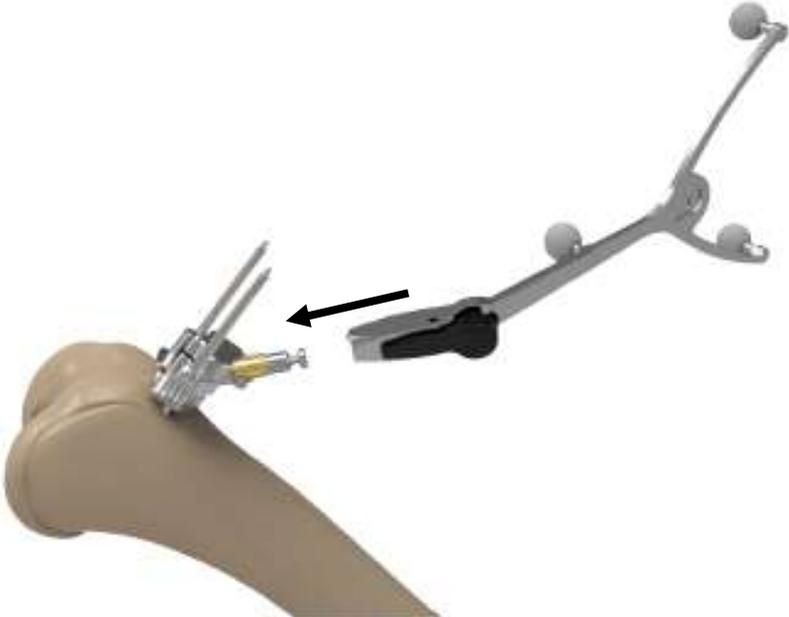
Fix the Femur Base onto the Schanz screws by tightening the base fixation screw using a 3.5 mm hex driver



Slide it over the pins.



Attach the Femur Reference Array to the Femur Base.



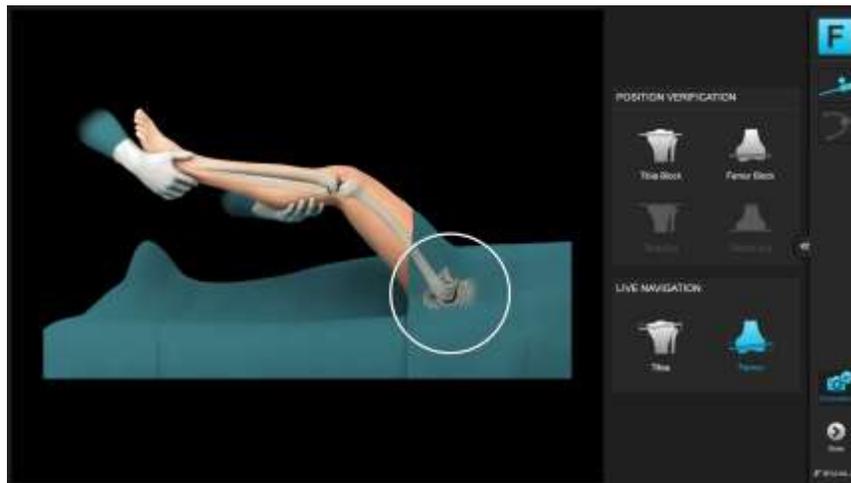
## Femur Resection

After having placed the Femur Base and Array, start the femoral registration by clicking on the Live Navigation Femur icon.



On the femoral anatomy, the following bone landmarks are registered:

- Femoral Head Center
- Distal Femoral Mechanical Axis Point
- Medial and Lateral Femoral Condyles



## Femoral Head Center

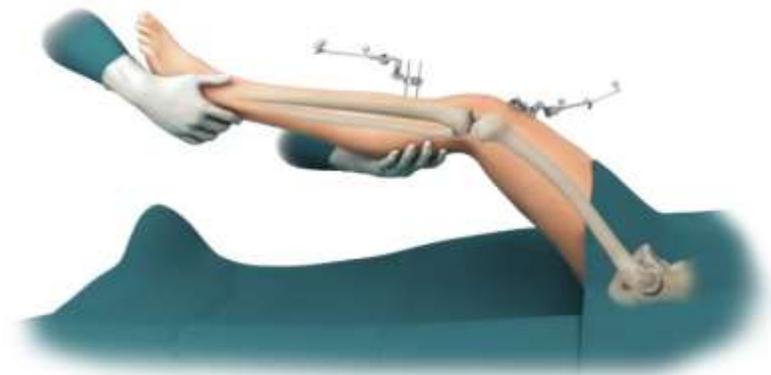
The femoral head center point defines the proximal part of the Mikulicz Line and femoral mechanical axis.

Make sure the femoral reference array is visible to the camera. The system will produce a humming visibility sound (if turned on in Settings, see Appendix) while the femur reference is visible.

Bring the leg from flexion to extension and back, then slightly rotate the leg externally and repeat the flexion-extension movement. Alternatively, apply circular motions of the femur around the hip center.

The system calculates a series of points to determine the rotational center and will automatically proceed when the rotational center has been accurately calculated.

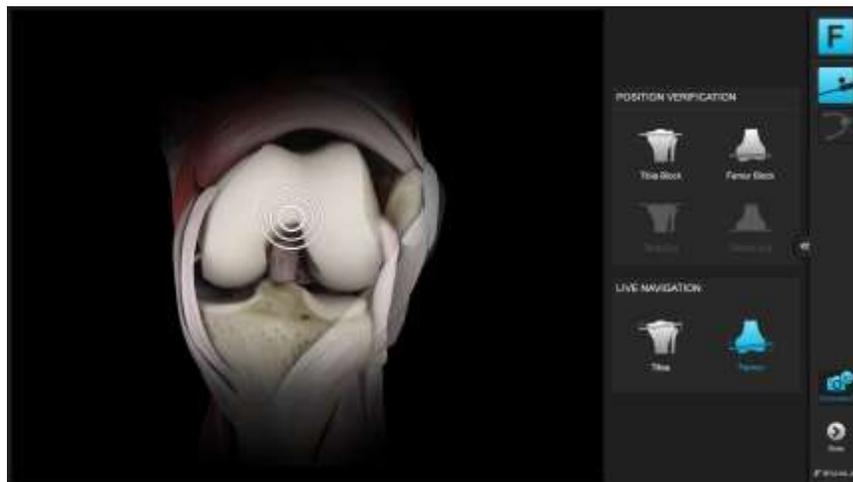
Make sure that the patient's pelvis is not moved during registration, as this may lead to miscalculation of the femoral head center. If the surgeon is having difficulty acquiring the femoral head center, it is helpful to have an assistant hold the pelvis firmly. Furthermore do not move the Camera while moving the leg.



### Distal Femoral Mechanical Axis Point

Defining the femoral mechanical axis is important for determining the varus/valgus and flexion/extension alignment of the femoral component. The pointer should be placed slightly in medial at the posterior aspect of the femoral notch point (as indicated on screen) and pivot the pointer.

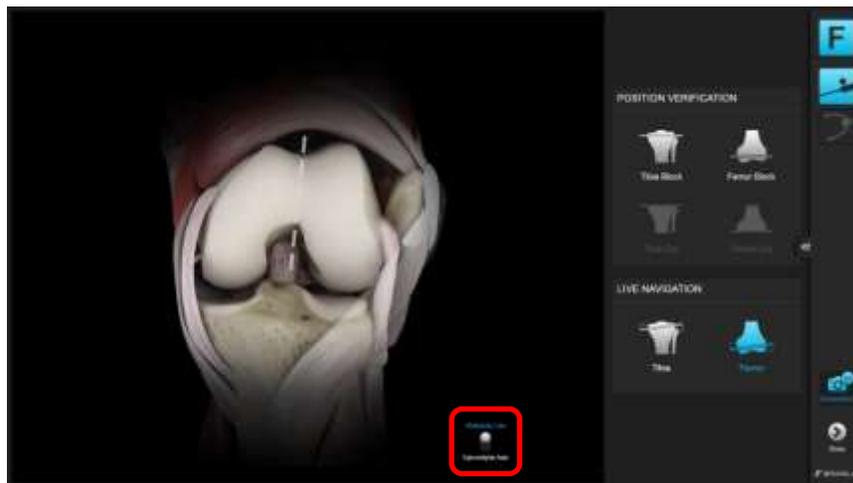
The acquisition of this point along with the femoral head center completes the femoral mechanical axis.



### Whiteside's Line (Anteroposterior Axis)

Whiteside's Line or alternatively the Epicondylar Axis is used to define the femoral AP direction. Furthermore it can be used as an optional reference for femoral component rotational alignment. It may be marked initially using electrocautery or a sterile pen. It is easiest to draw by looking along the horizon of the trochlear groove. Align the pointer along the line marked and hold the pointer still for two seconds to register.

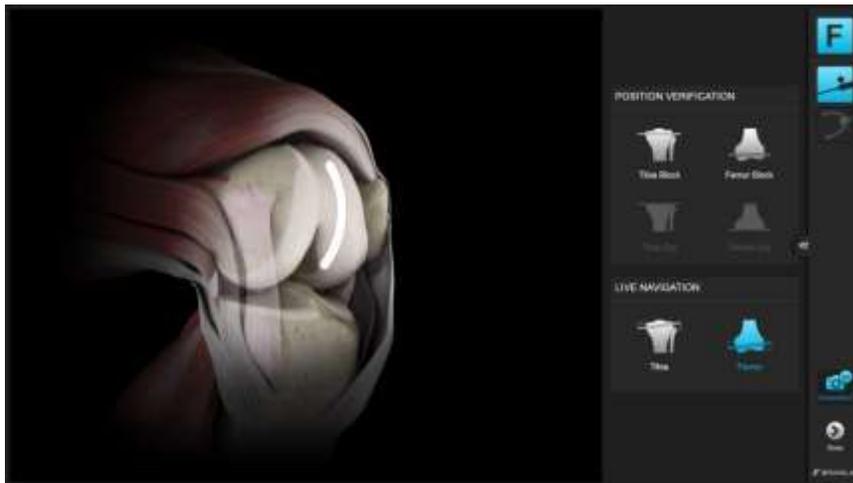
To toggle from the default Whiteside Line to Epicondylar Axis, press the button on the bottom of the screen.



### Medial and Lateral Femoral Condyles

A number of points along the surface of the medial and lateral distal condyles are acquired using the pointer. The tip of the pointer should “paint” the surface of the condylar surface. Points should be acquired along the distal part of the condyle. The system determines the most distal point and therefore the resection height from all the data collected.

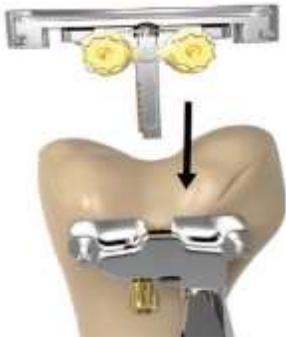
Start with pivoting on the distal aspect of the condyle, then move to posterior in a zig-zag motion to make sure to cover the most prominent points of the condyles.



## Femoral Distal Cut Navigation

Once the registration sequence is completed, the distal cutting block can be navigated.

Insert the Adjustment Unit with the Cutting Slot into the Femur Base. Then insert the Cutting Block Adapter into the cutting slot.



As soon as the Femoral Reference Array and the Cutting Block Adapter are visible to the tracking camera, the current resection plane will be displayed by the navigation system.

Turn the adjustment knobs of the Adjustment Unit and Femur base to adjust the cutting slot towards the desired alignment:

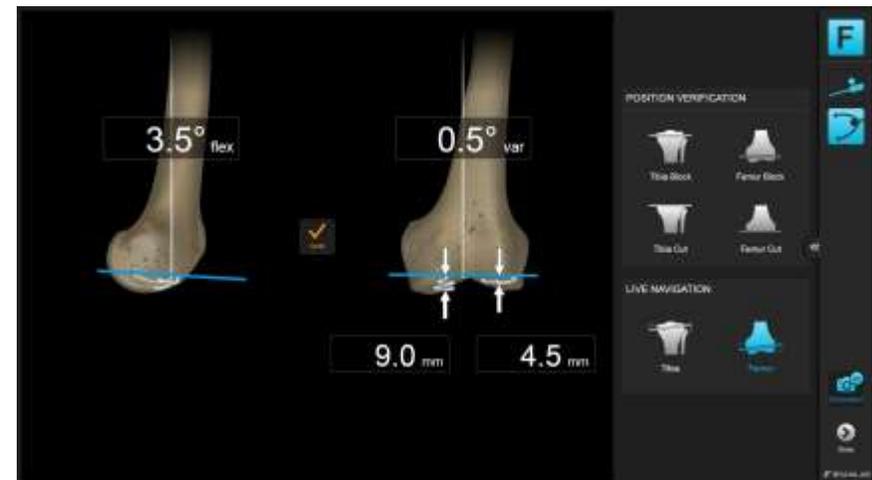
1. Varus/Valgus
2. Flexion/Extension
3. Resection height



Once the desired alignment of the cutting block is established, fixate the cutting slot by inserting a third Schanz pin through one of the oblique screw holes.

Note: It is recommended to insert the oblique pin under navigation as well, carefully monitoring the alignment values on screen.

Check the cutting block stability and use an oscillating saw to perform the distal femoral resection.



## Femoral Distal Cut Verification

After performing the cut, verify the resected surface by placing the cutting block adapter on the resection plane. Hold the plane tool still and the software records the resections plane position and orientation. Alternatively press the “Verify” button on screen to verify the cut.

Once the desired distal femoral resection has been established and verified, you can proceed with finishing the femur conventionally.

Alternatively you can proceed to tibial cutting block position verification directly before finishing the femur.

Note: Depending on the conventional instrumentation, the 4-in-1 cutting block’s pins, pegs and/or the saw blade could collide with the Adjustable Cutting Block’s fixation pins. To remove the pins, first unmount the Cutting Slot and Adjustment Unit. Make sure the Femur Base is unlocked before removing the Schanz pins!

To proceed to the Tibia Block Position Verification, press the “Tibia Block” button on the right hand side of the screen.



## Tibia Registration



On the tibial anatomy, the following bone landmarks are registered:

- Medial and Lateral Malleoli
- Proximal Tibial Mechanical Axis Point
- Tibial AP Direction

Before starting the tibial registration, use the conventional extramedullary alignment guide to position the tibial cutting block. Adjust resection height, varus/valgus and posterior slope on the alignment guide as per the conventional surgical technique. Preliminarily fix the block using a single pin.

Insert the plane tool into the cutting slot, start the registration sequence to measure the cutting block alignment before performing the resections.

Note: The plane tool must not be moved inside the cutting slot during the four point registration sequence. If the array moves or rotates after registration of the first landmark, the registration sequence is automatically restarted to ensure accurate and valid registration and measurement of the cutting block position.

## Medial and Lateral Malleolus

The medial and lateral malleoli are located by palpating through the drape. Draping and/or bandaging should be reduced to a minimum to ensure accurate landmark location.



Place the tip of the pointer on the medial malleolus and pivot the pointer to acquire the landmark. Once the system has registered the medial malleolar points, the lateral malleolar point is registered in the same way. The malleoli points define the most distal point of the tibial axis.

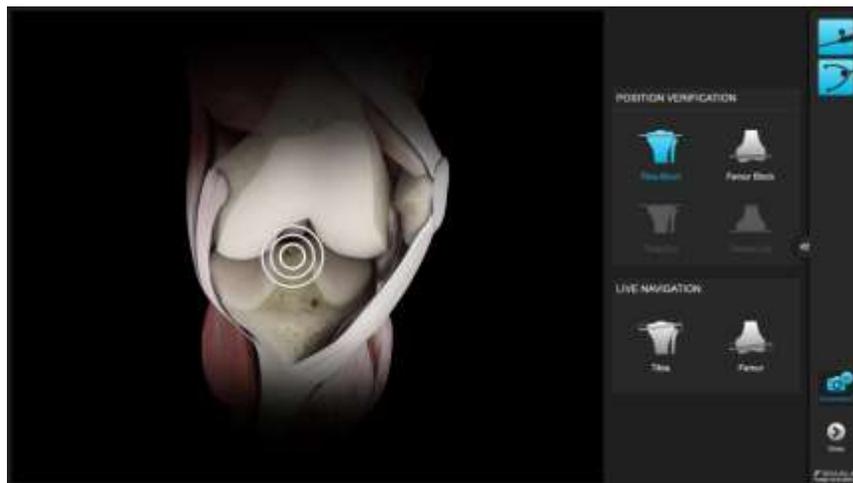


### Proximal Tibial Mechanical Axis Point

The proximal point on the tibial mechanical axis is defined by acquiring the posterior aspect of the ACL tibial insertion point.

This is indicated by the circle on the screen. Additionally the intersection of the mid-coronal and mid-sagittal planes can be used for the identification of this point.

The definition of the mechanical axis is the basis for all further calculations and should be acquired as accurate as possible.

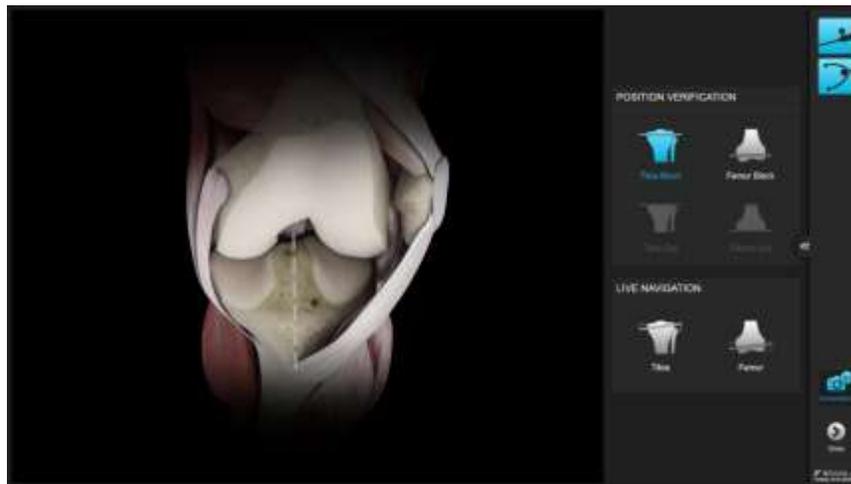


### Tibial AP Direction

The pointer is placed horizontally in the AP direction, so that it lies on the tibial eminence. The handle should be in line with the medial third of the tibial tubercle. The pointer is held in place for a few seconds to allow the system to calculate the direction.

The system determines the direction the tibia is facing and the direction of any intended slope which may need to be cut. The rationale behind this is to avoid a compound tibial slope (oblique tibial slope). Accurate acquisition of the AP direction will help to avoid an oblique tibial slope in the anteromedial to posterolateral direction or anterolateral to posteromedial direction.

Compound slope can put the tibial component into varus or valgus and lead to poor tibial/femoral contact. This can in turn lead to malalignment.



## Tibia Cutting Block Alignment Verification

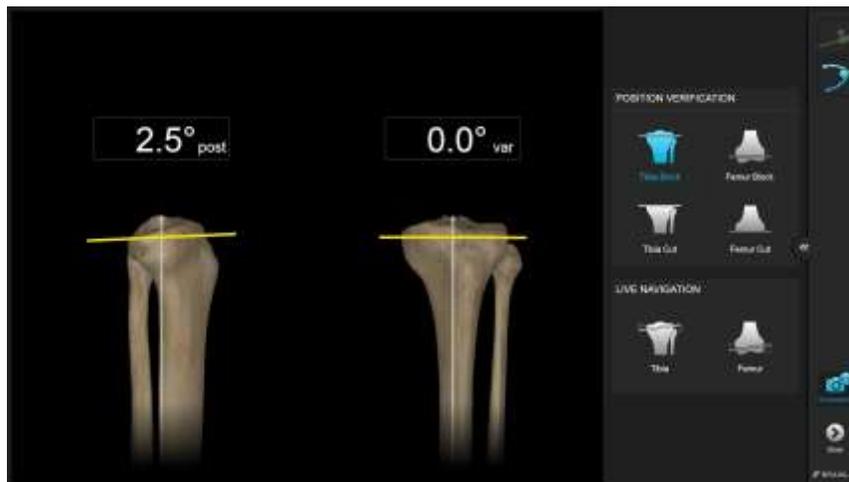
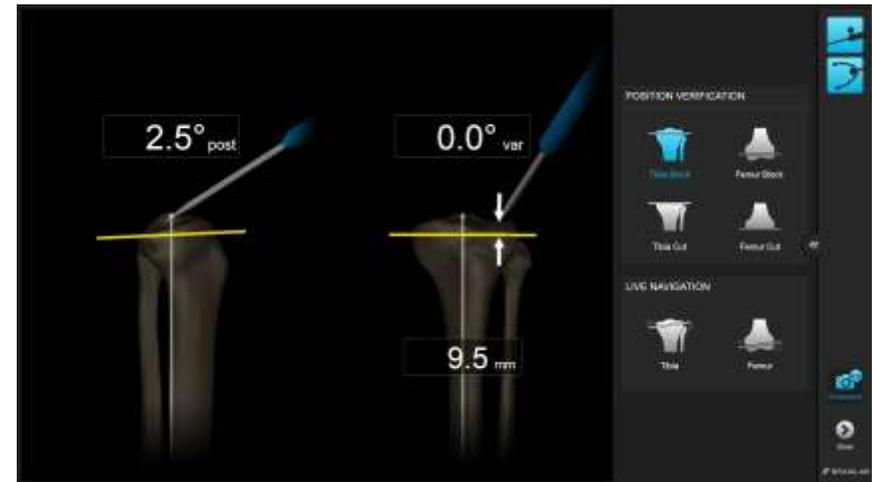
After registration of the tibial mechanical axis the software immediately displays the varus/valgus alignment and posterior slope values of the cutting block.

To verify the resection height, position the pointer tip on both tibial plateaus and read the resection height on screen

If the desired alignment was achieved using the conventional alignment, fix the cutting block in the current position using additional pins and proceed with the resection.

If the verified cutting block position is outside the desired alignment, modify the position based on the alignment information given by the navigation system.

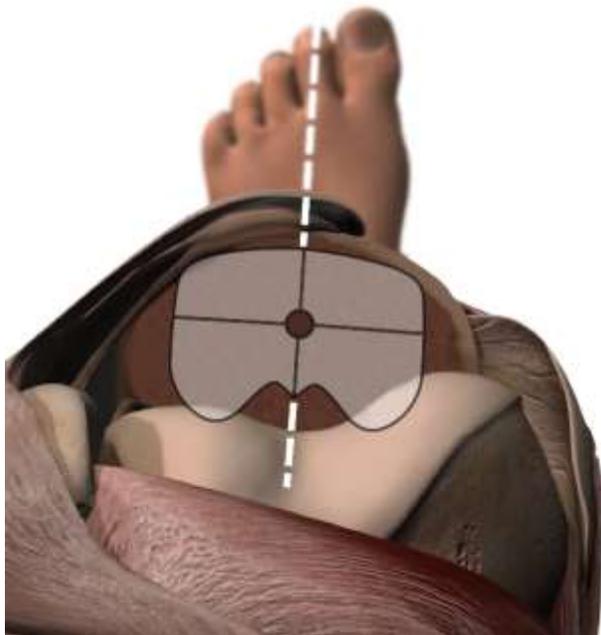
Repeat the registration after adjusting the alignment guide to verify the corrected cutting block position. To re-register, press the “Tibia Block” button on the right hand side of the screen.



## Tibial Resection Verification

Once the resection has been performed, the cut is verified to ensure correct alignment. Place the plane tool with the verification plate attached on the tibial cut. Align the Bone Verification Plate's Anterior/Posterior mark along the tibial AP direction and place the hole over the exit point of the tibial mechanical axis as indicated by the image on screen.

For the cut verification, only the ankle needs to be registered. While holding the Verification Bone Plate in place, register both, the medial and lateral malleolus.



## Malleoli

Place the tip of the pointer on the medial malleolus and pivot the pointer.

Art. no.53201 Knee Plane Tool – Tracking Array

Art. no.53203 Knee Plane Tool – Bone Verification Plate



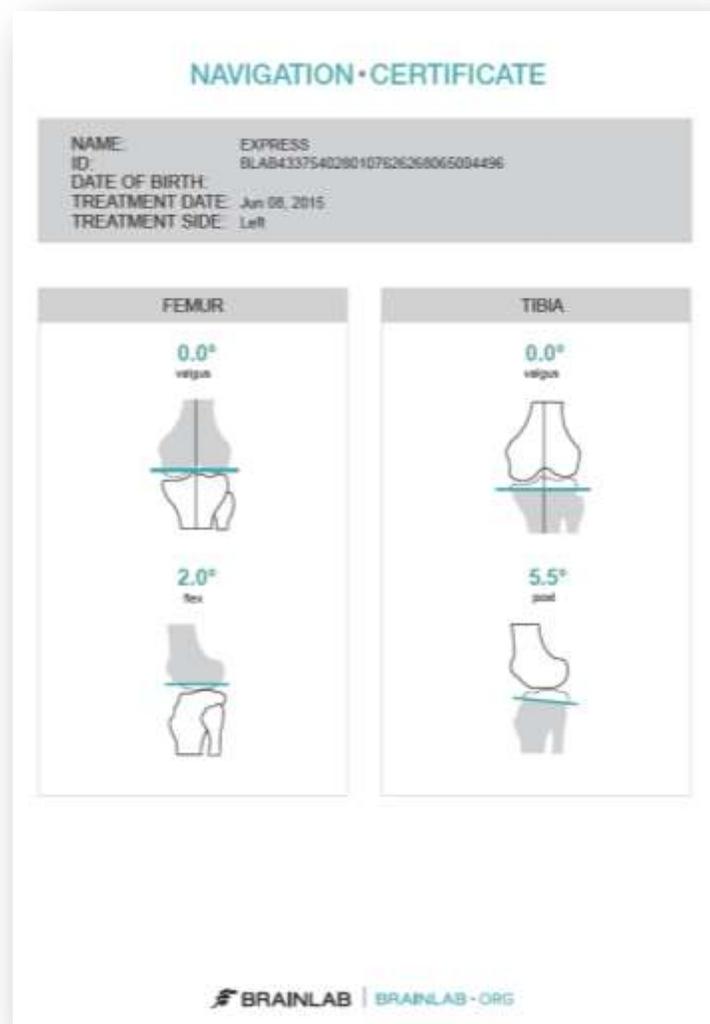
As soon as both malleoli landmarks have been registered, the orientation of the resection plane will be displayed on screen immediately. Rework the cut if needed, using a rasp or by free handing the saw.



Once the desired tibial resection alignment is achieved, continue with either conventionally finishing the femoral resections or with preparation for implant trialing.

# Patient Report

After finishing the procedure, press the “Done” button to access the patient report. This report contains information in a simplified language for printing it for the patient.



# Appendix

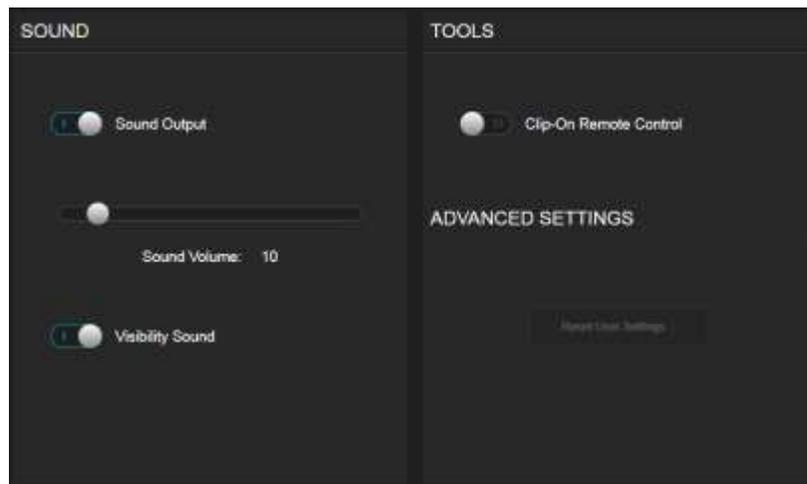
## Settings

Some application settings, including sound volume controls, can be accessed from the menu drawer on the right part of the screen.

## Clip-On Remote

The use of the optional disposable clip-on remote control can be enabled for registration of the anatomic landmarks in Settings. When turned on, hold the tip to the indicated landmark and press the 'Control' button. The remote control reacts upon pressing the button, not upon releasing. If the tip moves during registration, the point is not acquired.

Art. no. 53153 Disposable Clip-On Remote Control (20 pcs)



## Article list

### Pointer

Number	Name	Image
53101	Pointer Angled For Hip/Knee	
53109	Pointer Straight For Knee	

### Arrays and fixation

Number	Name	Image
52410	Reference Array T-Geometry X-Press	
52411	Reference Array Y-Geometry X-Press	

41866-77	Universal Cutting Block Adapter	
52429	Bone Fixator 2-Pin, Flip Flop, X-Press (for two pin fixation)	
54932	Pindriver Adapter For AO Coupling (for 3,2mm pins)	
52421/ 52422/ 52423	Bone Fixator 1-Pin Size S/M/L (for one pin fixation)	

### Plane Tool

Number	Name	Image
53201	Knee Plane Tool – Tracking Array	
53202	Knee Plane Tool – Cutting Block Adapter	

53203	Knee Plane Tool – Bone Verification Plate	
53204	Knee Plane Tool – Bone Verification Plate Small	

### Clip-On Remote Control & Footswitch

Alternatively to pointer tip pivoting the Clip On Remote Control or the Footswitch can be used to trigger landmark acquisition.

Number	Name	Image
18460	Footswitch	
53153	Disposable Clip-On Remote Control (20 pcs)	

### Disposables

Number	Name
54922	Disposable Schanz Screw 3.2 mm x 100mm (10pcs)
54922	Disposable Schanz Screw 4.0 mm x 125mm (10pcs)
54909	Disposable Schanz Screw (AO) 5mm X 175mm (10 pcs)
18071-50	Disposable Sterile Monitor Drapes 40 pcs
41774/ 41773	Disposable Marker Spheres 270 pcs or 90 pcs

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