KNEE3

BRAINLAB

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
PARTIAL

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A software guided surgery for partial knee replacement.

Contents

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

ASSISTENT

OPERATING SURGEON
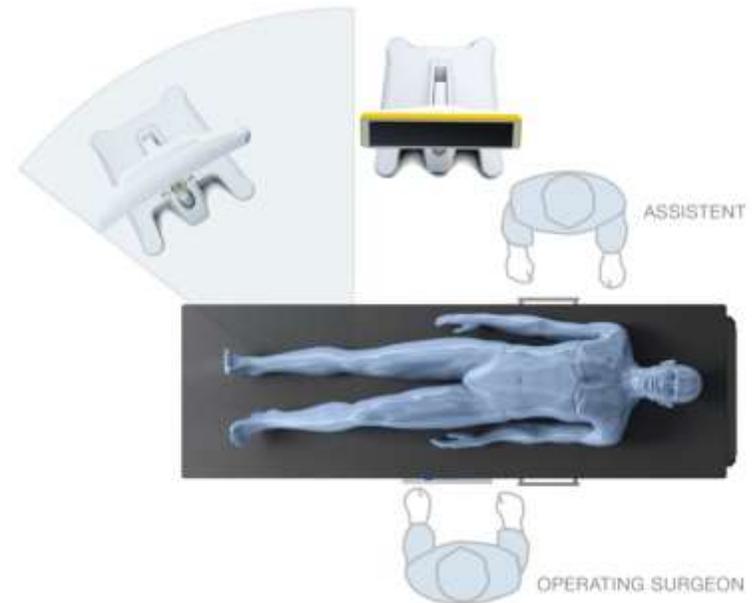
Software Start & Patient Selection

Start the KNEE3 Partial Workflow by pressing the corresponding icon on screen. Enter the patient name and ID or select a patient from the patient list. Press "Done" to proceed. To start the knee application, press the "KNEE3 Partial" icon. Select the treatment side and compartment.

To proceed, press "Navigate".
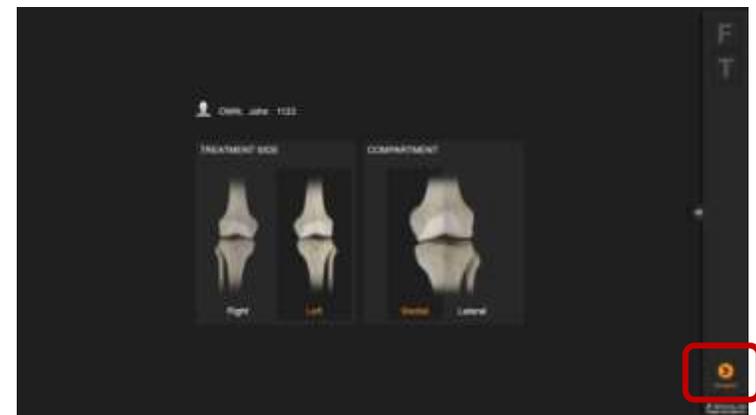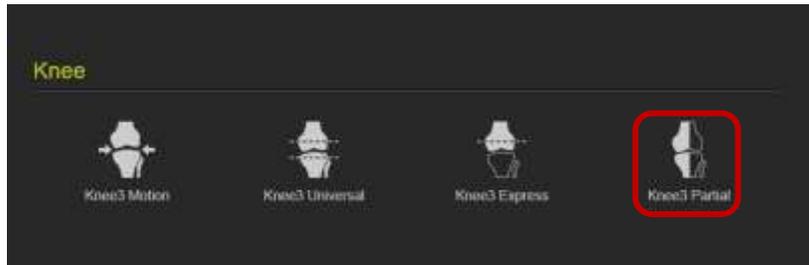
Instrument Preparation

At the scrub table, prepare instruments with marker spheres. 12 marker spheres are needed for a surgery. 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. If a marker is soiled the detected instrument position might be wrong. Remove reference arrays before resection to avoid soiling.

Art. no. 41774 Disposable Marker Spheres 270 pcs

Art. no. 41773 Disposable Marker Spheres 90 pcs

The Y-shaped array is placed on the femur, the T-shaped array on the tibia. During navigation they define the position of the bones.

Art. no. 52410 Reference Array T-Geometry, X-Press

Art. no. 52411 Reference Array Y-Geometry, X-Press

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 or Universal Cutting Block Adapter is used for navigating and verifying resections. The foot of the Plane Tool is inserted into the corresponding cutting block while fixing the block onto the bone.

Art. no. 53200 Plane Tool

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.

The incision must allow good exposure of the compartment to be resurfaced.

The reference arrays can be used through separate small (stab-) incisions outside the main incision.

After initial exposure, assess the extent of arthritic damage and the ligaments including the ACL and remove all prominent osteophytes from the medial (or lateral) edges of femur and tibia and in the intercondylar notch.

Reference Marker Placement

Brainlab Knee instruments are designed to be used with a variety of pins. It is recommended to use 3.2mm self-drilling, self-tapping pins as available from Brainlab. Alternatively, any pins between 3mm and 4mm can be used based on surgeon's preference. Please refer to the respective user guide for drilling, if using different pins.

Art. no. 54932 Adapter For AO Coupling (for 54922)
Art. no. 54922 Disposable Schanz Screw (AO) 3,2mm x 100mm (10 pcs)
Art. no. 54908 Disposable Schanz Screw (AO) 4mm x 125mm (10 pcs)

Tibia

The tibial array can be placed outside the incision. The pins need to be placed distant from the intended positions of tibial instruments to avoid any collision during bone resection and drilling.

The tibial pins can be placed through small stab incisions on the anterior cortex in the proximal third of the tibia. A position slightly medial of the anticipated position of the cutting block, angled slightly downwards is recommended.

If the pins are angled slightly to the medial side, extra medullary tibial alignment guides can be used for cutting block placement and adjustment as well as additional stability.

Please refer to standard instructions for the placement of pins and screws, such as the AO Guidelines, for exact safe zones for angulation and placement of the pins.

Place the first pin directly at the desired location, slide the Bone Fixator 2-Pin over the first pin (make sure the fixation screw is open) and place the second pin through the pinhole. Tighten the fixation screw securely to the bone in the correct orientation.

Art. no. 52429 Bone Fixator 2-Pin, Flip-Flop, X-Press

The T-reference array is connected to the fixation using the X-press mechanism. The T-reference has a joint with two degree of freedom, allowing adjustment of the orientation. Recommended orientation of the T-reference is rotated towards the camera, slightly tilted upwards parallel to the tibia.

Note the adjustment mechanism allows for discrete positions in both degree of freedom. Make sure the interface is in one of these positions before tightening the screw. If placed at in-between positions, the mechanism might snap into one of the predefined positions during the procedure, and thus losing the fixed reference.

Art. no. 52410 Reference Array T-Geometry, X-Press

Femur

The femoral array is placed outside the incision through two small stab incisions. Care must be taken to limit soft tissue damage. Excess stress on pin fixation must be avoided during range of motion intra-operatively.

Place the pins anteromedially in the supracondylar area while making sure to leave space for femoral instrumentation as well as for the resections during final preparation.

Again, place the first pin directly at the desired location, slide the Bone Fixator 2-Pin over the first pin (make sure the fixation screw is open) and place the second pin through the pinhole. Tighten the fixation screw securely to the bone in the correct orientation.

Art. no. 52429 Bone Fixator 2-Pin, Flip-Flop, X-Press

Recommended orientation of the Y-reference is rotated towards the camera, substantially tilted upwards from parallel to the femur. This will allow visibility of the femoral reference even in deep flexion. Again ensure the interface is not at in-between positions before tightening the fixation screw.

Art. no. 52411 Reference Array Y-Geometry, X-Press

Alternatives

Instead of the 2-pin fixation described above, 1-pin fixations can be used both on tibia and femur. 1-pin fixation requires 5mm screws to be used for fixation. Refer to the user manual for instructions. 1-pin fixation is not recommended in weak bone quality and in cancellous bone areas in particular when placed inside the incision.

Art. no. 54909 Disposable Schanz Screw (AO) 5mm X 175mm (10 psc)
Art. no. 5242x Bone Fixator 1-Pin Size S/M/L

Registration

After again checking visibility of the reference arrays over flexion and extension of the knee, start registering the anatomical landmarks.

Femur

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

- Femoral Head Center
- Distal Femoral Axis Point
- Femoral Anteroposterior Axis (AP)
- Femoral Condyle Surface (medial or lateral)

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 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.
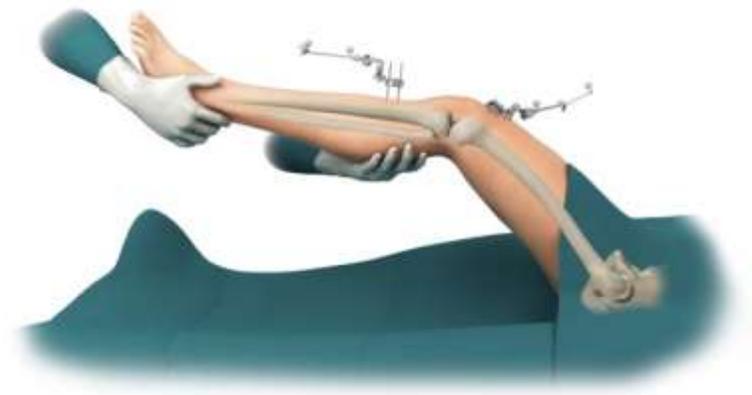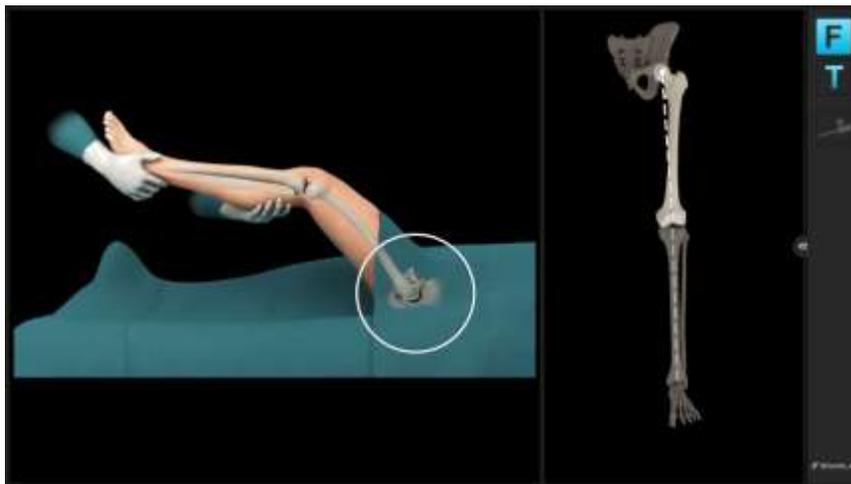
Distal Femoral Mechanical Axis Point

Defining the femoral mechanical axis is important for determining the varus/valgus overall leg alignment. Care should be taken to be as accurate as possible when collecting this point. 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.

Femoral Anteroposterior Axis

The femoral anteroposterior axis determines the femoral AP direction. It is used to define the femoral coordinate system as well as Varus/Valgus for the long leg alignment. The axis should be parallel to the Whiteside's Line and perpendicular to the transepicondylar axis.

The AP axis is acquired by holding the pointer along the patella's superiorinferior axis with the knee flexed at approximately 90 degrees.

Femoral Condyles (medial or lateral)

A number of points along the surface of the affected (medial or lateral) condyle 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 affected condyle. The system determines the most distal point 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.

The screen shows the current position of the pointer in a sector distally, in which a certain number of points need to be collected. The software will proceed until the sector is covered.
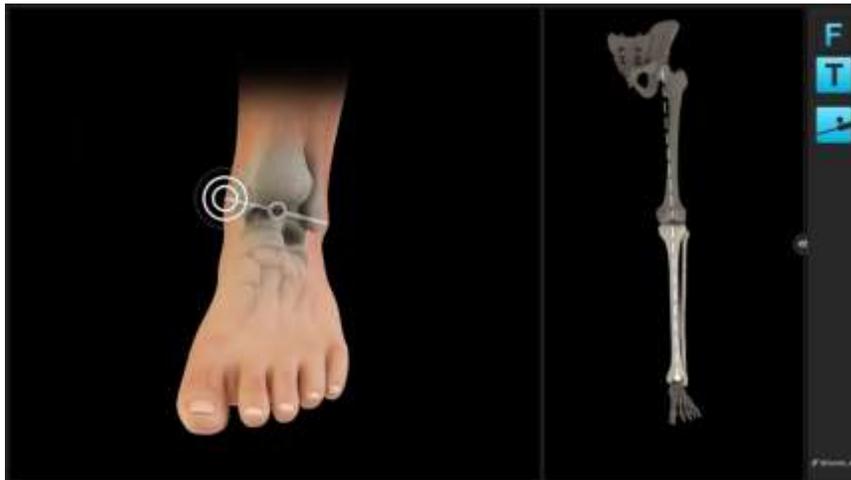
Tibia

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

- Medial and Lateral Malleolus
- Proximal Tibial Mechanical Axis Point
- Tibial AP Direction
- Medial or Lateral Tibial Plateau

Malleoli (medial and lateral)

The malleoli can usually be located by palpating the most prominent point of the malleoli before acquiring the points. It is important that draping or bandaging is reduced to a minimum to enable the malleoli to be located and registered accurately.

Place the tip of the pointer on the medial malleolus and pivot the pointer. Once the system has registered the medial malleolar point, the lateral malleolar point can be registered in the same way. Acquiring the malleoli defines the most distal point of the 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. Final implant position will be referenced to the mechanical axis.

Tibial AP Direction

The pointer is placed horizontally in the AP direction, so that it lies on center of the affected tibial plateau, parallel to the direction indicated on the screen. The pointer is held in place for a few seconds to allow the system to calculate the direction.

The system determines the direction of the 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.

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.
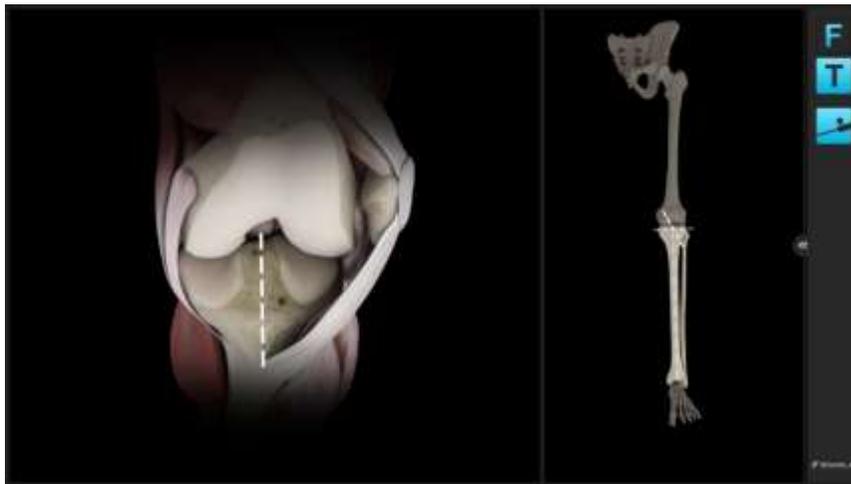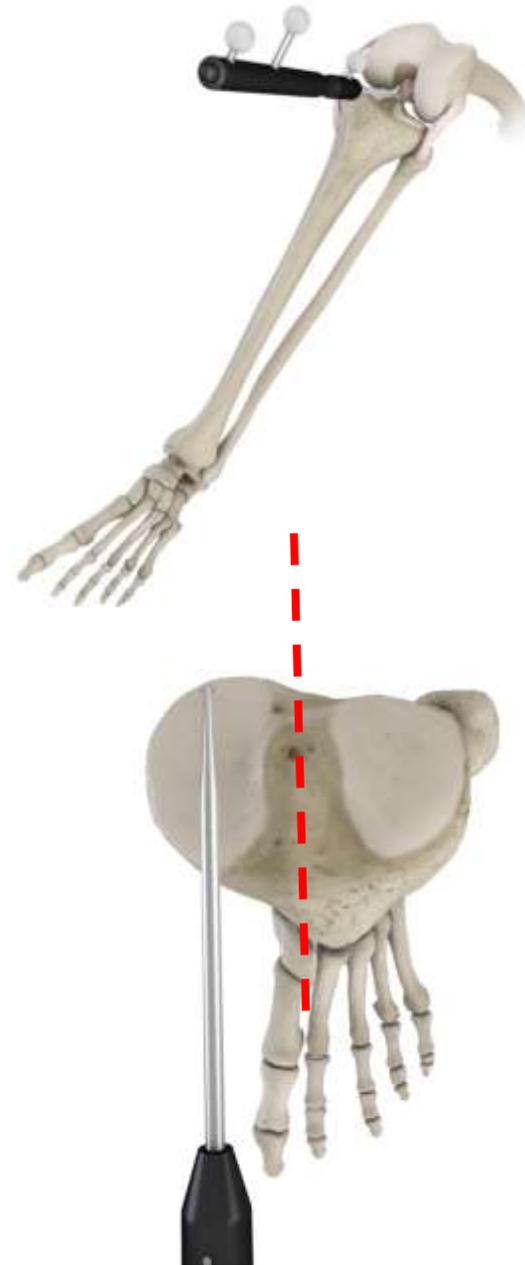
Tibial Plateau

A single point on the affected plateau is used as the reference to calculate the tibial resection level. Careful consideration should be given if there is bone defect present. The software will show resection height numbers from this reference point to the current cutting block position.
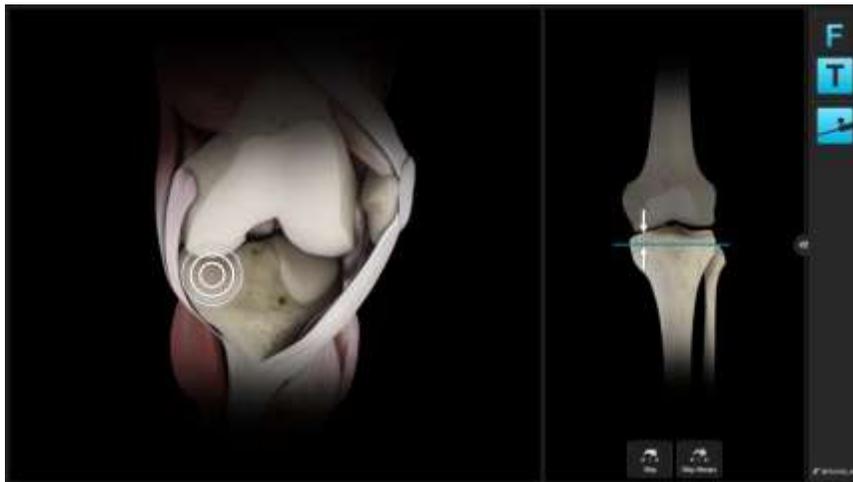
Adaptive Workflows

Brainlab KNEE3 follows the user. It automatically identifies the current treatment step and displays the matching content on the screen. If for example the tibia cutting block with the Plane Tool is positioned on the tibia cortex the software displays tibia cut navigation values.

The following navigation steps are advised:

- Tibia cut navigation
- Long leg alignment

Simply use the Plane Tool for navigation or the pointer for measurements and the software will automatically display the according information.

When no instrument (Plane Tool, Pointer) is used, the software displays the leg alignment screen. It allows evaluating leg axis and flexion range.

When the software detects that a cutting block – with the Plane Tool inserted into the cutting slot – is positioned on the bone, it displays all relevant information for the respective resection. All values are calculated relative to bone references.

Note: All values are referenced to bone landmarks.

Navigation

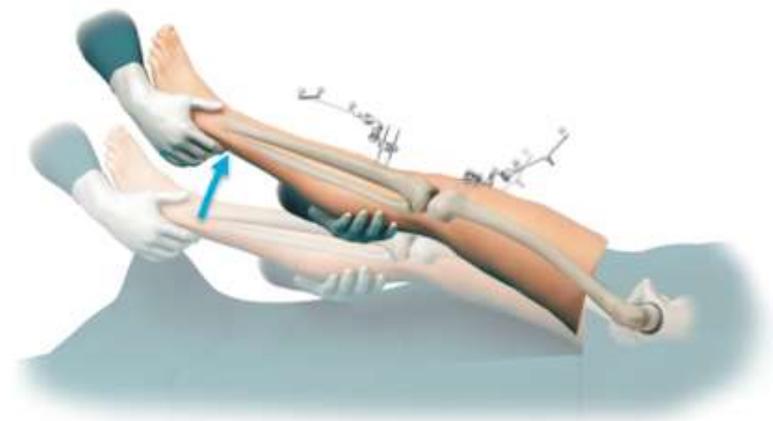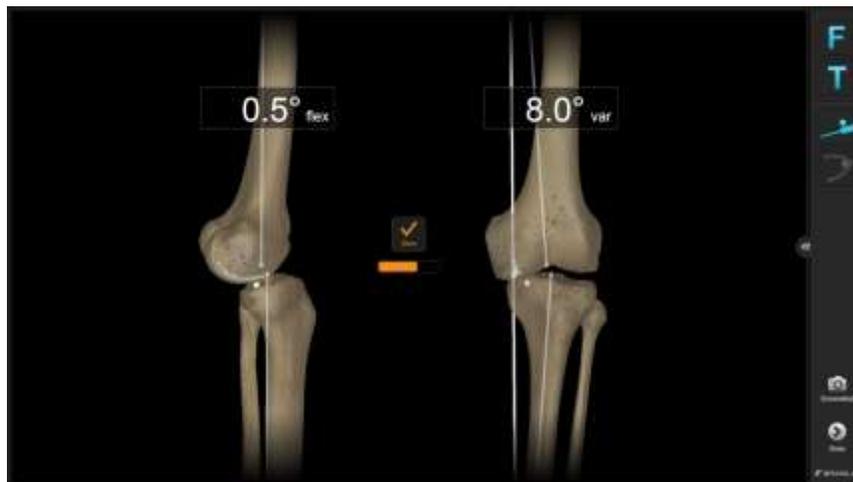## Initial Leg Alignment - Screen Layout

After the registration is finished, the screen shows the current anatomical situation. The range of motion can be assessed and the coronal extension alignment can be stored for comparison of the pre- and post-op alignment.

To store the pre-operative alignment, bring the leg in full extension without applying stress, then lift the fully extended leg approximately 10 degrees. The software will interpret the lifting gesture and store the alignment.

Alternatively, pressing the "Store" button on screen will also store the alignment.

When performing a medial partial knee replacement procedure you can check to what extend the leg can be corrected based on the given soft tissue situation by applying slight Valgus stress in full extension while assessing the extension alignment on screen.

When performing a lateral Partial Knee Replacement, apply slight varus stress to the fully extended knee while assessing the coronal alignment.

Placement of Cutting Block & Resection

The proximal tibia cut should be done perpendicular to the mechanical axis of the tibia with the minimum amount of resection to restore the pre-morbid joint line. The tibial slope should be matching the pre-operatively measured anatomical slope of the patient.

Place the knee in 90 degrees of flexion, place the ankle clamp and assemble the extramedullary alignment guide and cutting block. Assemble the plane tool adapter and place it in the transverse cutting slot of the tibial cutting block. Use the Adjustment mechanism of the alignment guide to navigate the resection plane to 0° Varus/Valgus, the desired slope and resection level. Use the conventional tibial stylus to cross-check the resection level.

Once the cutting block is placed matching the pre-operatively measured slope at the desired resection height, place the first pin stabilizing the cutting block while constantly checking for changes in alignment during drilling. After aligning the cut perpendicular to the tibial axis place the second pin, correcting for any alignment deviations from setting the first pin. Leave the ankle clamp in place during cutting to help stabilizing the cutting block.
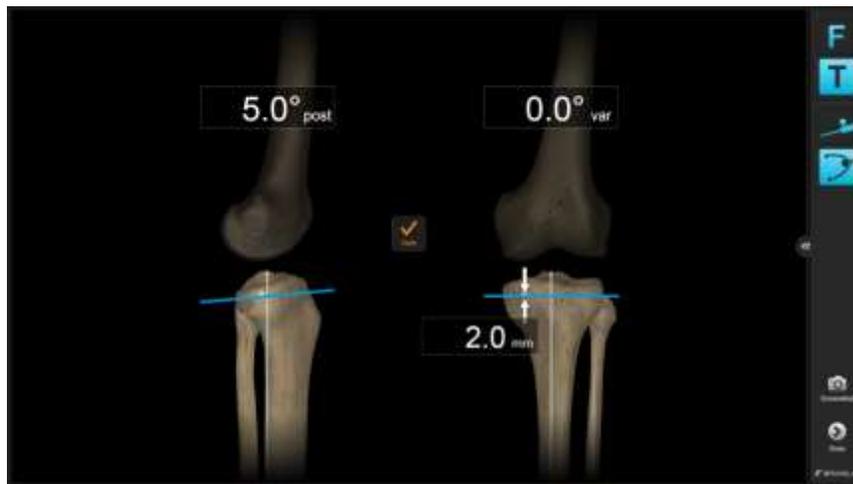
Tibial Resections

Use a reciprocating saw to make the vertical ("L"-) cut. Use anatomical landmarks such as the lateral margin of the medial femoral condyle and the medial margin of the ACL insertion as reference while aligning the cut parallel to the registered tibial AP direction. Avoid extending the cut past the transversal cut plane.

Use an oscillating saw in tibial cutting block slot to perform the proximal transverse cut while using retractors to protect the deep fibers of the medial collateral ligament.
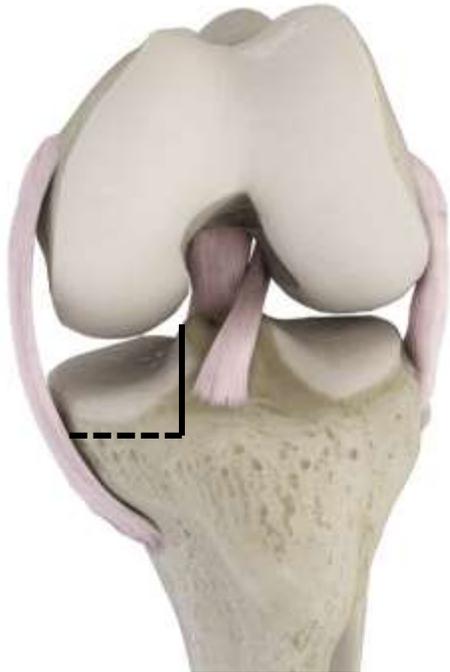
Tibial Resection Verification

After having resected the proximal tibia, verify the cut by placing the plane tool on the cut surface.
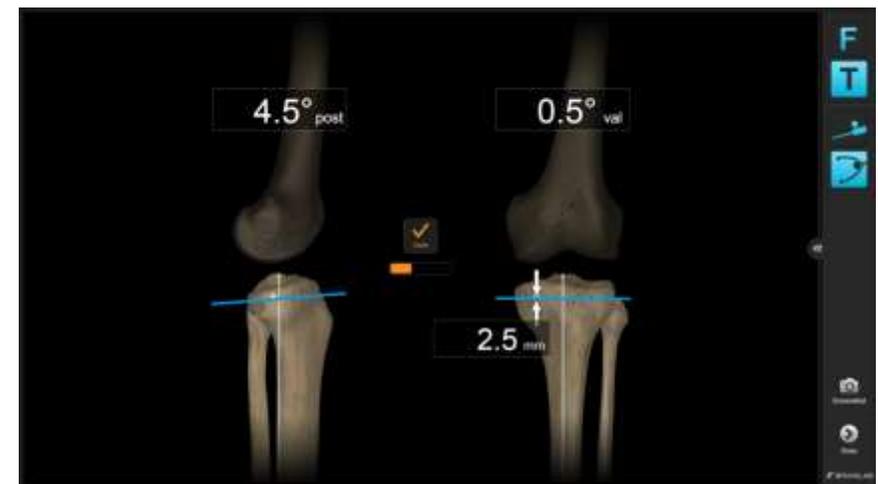
Balancing: Assessing Flexion and Extension Gap and Long Leg Alignment

Use the Alignment screen to check the coronal alignment in full extension during balancing to prevent overcorrecting. Check both, flexion and extension gaps using the trial of the desired thickness and size. Remove the retractors and flex the knee to 90 degrees. With the tibial spacer placed, assess ligament tension in flexion. If the flexion gap is tight, do not re-resect tibia until the extension gap has also been assessed. Also, assess the slope as it might be contributing to a tight flexion gap.

To evaluate the extension space, bring the leg into full extension and assess the long leg Varus/Valgus alignment on the navigation system screen using the same tibial spacer or trial. Use femoral defect shims to compensate for cartilage loss.

If both, flexion and extension gaps are loose, use a thicker tibial component and check the coronal alignment using the navigation system again.

Femoral preparation and sizing

Prepare the femoral resection(s) as per conventional surgical technique. If at any time in the procedure a long leg alignment assessment is needed, use the leg alignment screen to assess the varus/valgus alignment.

Trialing & Closure

Insert femoral and tibial trials of the selected sizes to assess soft tissue balance, range of motion and alignment. Move the leg through a full range of motion and bring it back into full extension.

In full extension you may apply slight Valgus stress to assess stability. Use the navigation to check and record the final coronal alignment.

To store the pre-operative alignment, bring the leg in full extension without applying stress, then lift the fully extended leg approximately 10 cm. The software will interpret the lifting gesture and store the alignment.

Alternatively, pressing the "Store" button on screen will also store the alignment.

After confirming sufficient range of motion, sizing, soft tissue balance and the desired alignment correction, proceed with the preparation of tibia and femur component implantation as per conventional surgical technique.

Close the knee in layers using the surgeon's preferred technique.
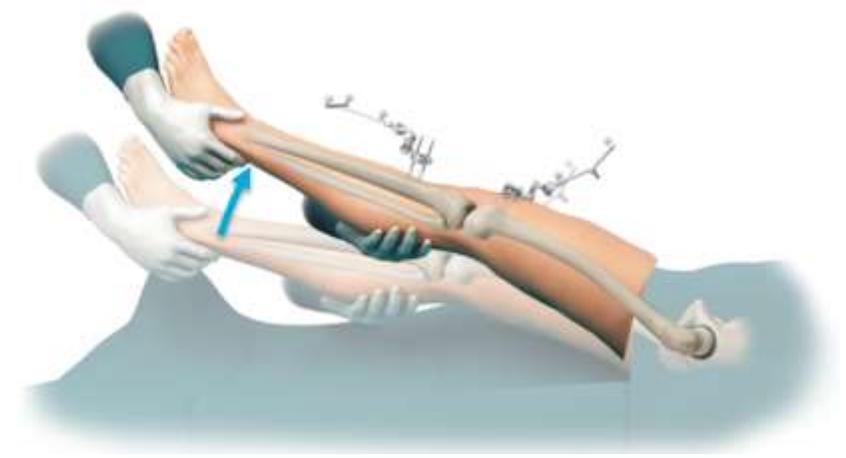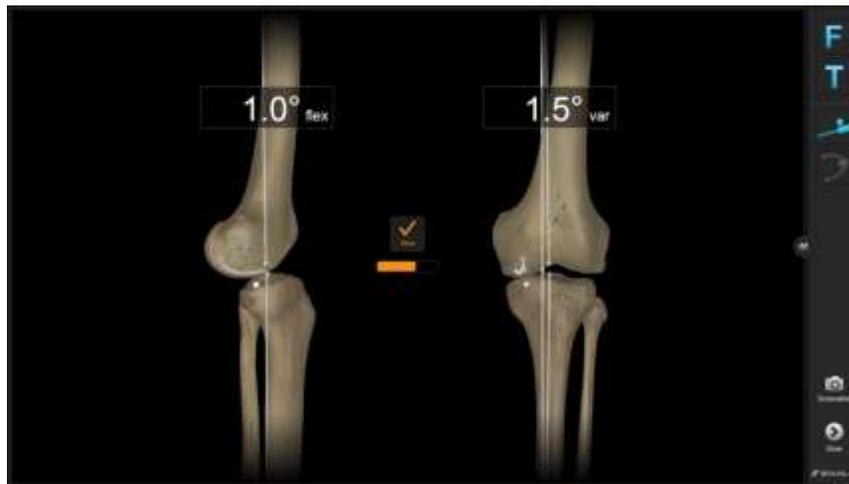
Patient Report

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.
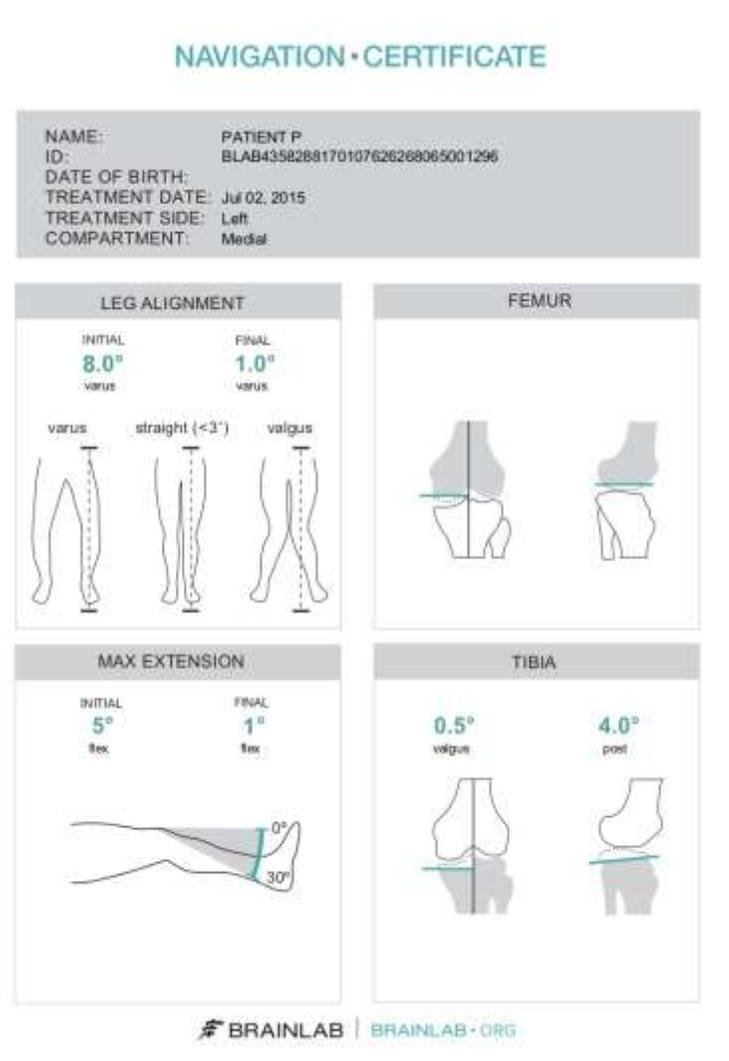
Appendix

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)
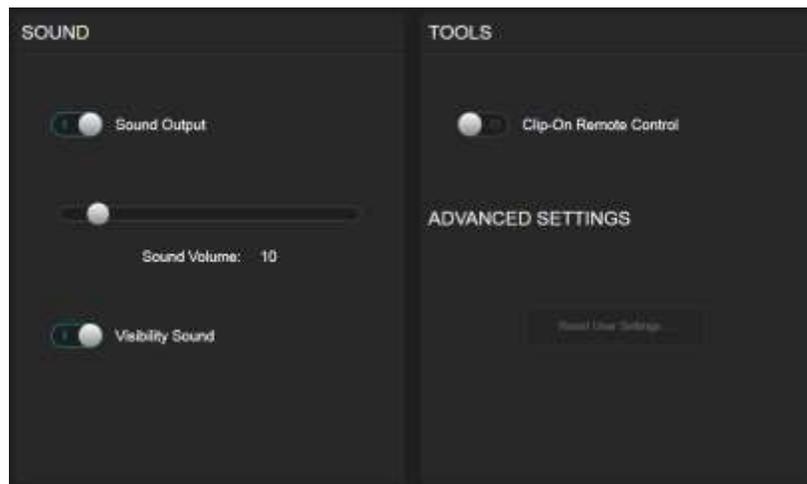
Article list

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	

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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