Preservation™ Knee System surgical technique


INTELLIGENT ORTHOPAEDICS

# Contents

# Ci™ System Connections


Ci™ Unit Connections

### Connecting the Ci™ System

All cables are connected to a panel at the rear of the Ci™ unit. All power cables and connectors are supplied with the system.

### 1. Power switch (on / off)

The power switch is positioned below the power socket. A green light indicates when the unit is switched on.

### 2. Power lead connection

The standard 3 pin power lead connects to the power socket.

### 3. Currency switch

The red ‘H-shape’ switch adjusts the power supply between 110 volts and 220 volts. Make sure that the correct voltage is selected before switching on the system.


4. Earth lead connection

The earth socket is identified by the standard yellow and green earth colours. The system must be earthed using the cable supplied before switching on the system.

5. Camera unit connection

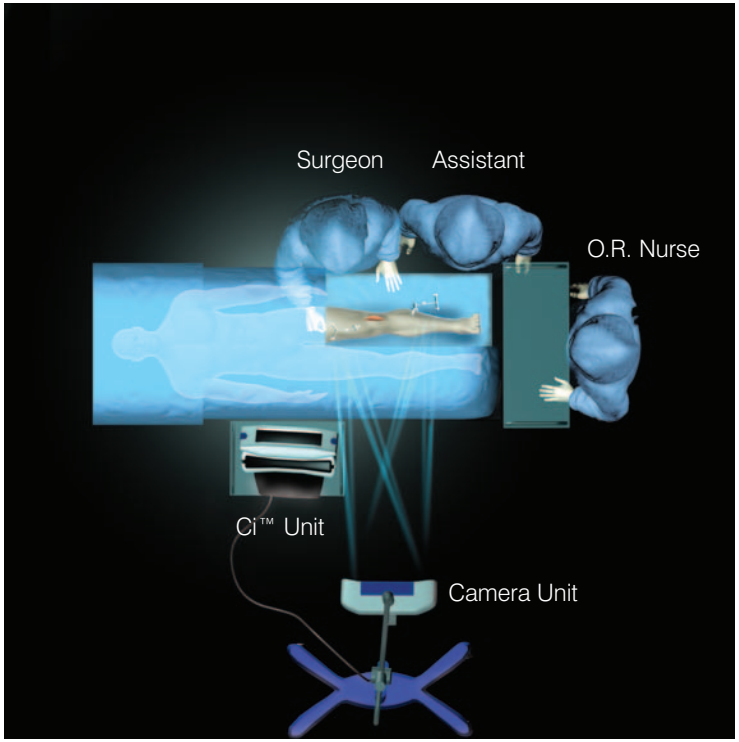
The orange coloured camera cable plugs into the camera unit socket (also marked in orange). The cable pins are aligned before inserting the cable. The cable is removed by pulling smoothly and slowly to avoid damaging the pins.

*Important: The camera must be switched on at least 20 minutes prior to the start of the procedure.*

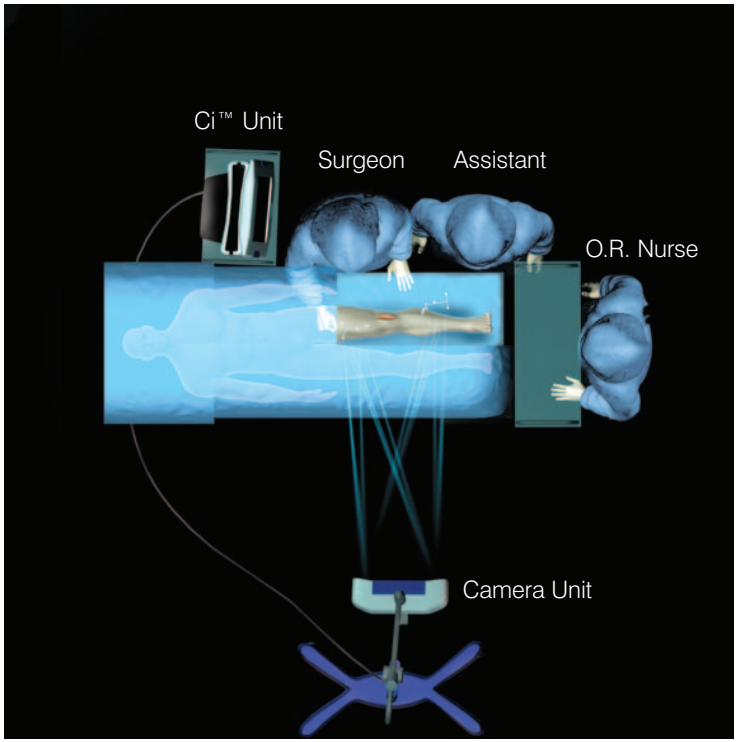
Connections on the camera unit should also be checked at this stage.

*Please refer to the System User Guide (Art-No: 52543-03EN) for detailed set-up instructions.*

# Ci™ System Set-up




Option 1: Ci™ System opposite surgeon




Option 2: Ci™ System next to surgeon

**Positioning the Ci™ System in the O.R.**
The Ci™ unit should be positioned so that the surgeon has a clear view of the screen. The touch-screen should be within easy reach of the surgeon or theatre assistant.

Ideally the infra-red camera unit has an uninterrupted view of the tibial and femoral marker arrays throughout a full range of motion (flexion, extension and pivoting of the hip joint). The camera unit should be positioned between 1.5 and 2 metres away from the surgical site.

If the Ci™ unit is positioned within the sterile field it must be covered using the drape supplied.

*Unstable stands or tables should not be used for placement of the Ci™ unit. (see ordering information for Ci™ unit trolley)*

*Please refer to the System User Guide (Art-No: 52543-03EN) for detailed set-up instructions.*

# Start-up Procedure

Figure 1

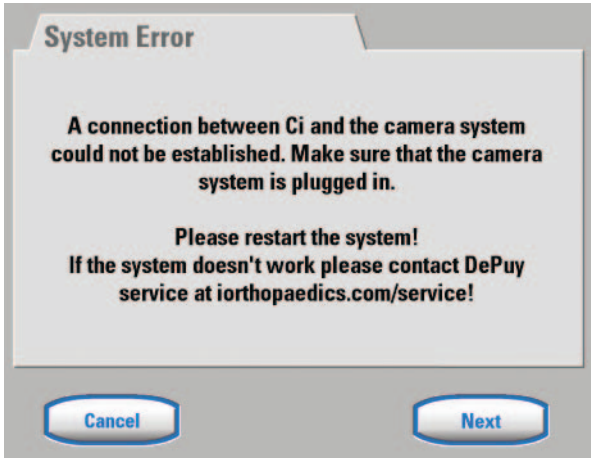



Figure 2

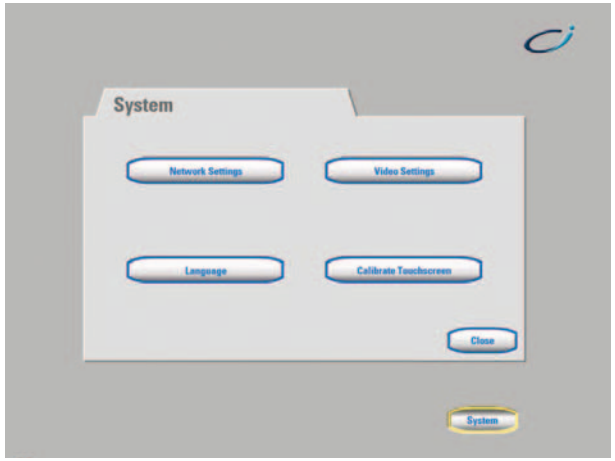



Figure 3

All cables must be fully connected before switching on the system.

Once the power supply has been switched on, the Ci™ software will automatically initialise (Figure 1).

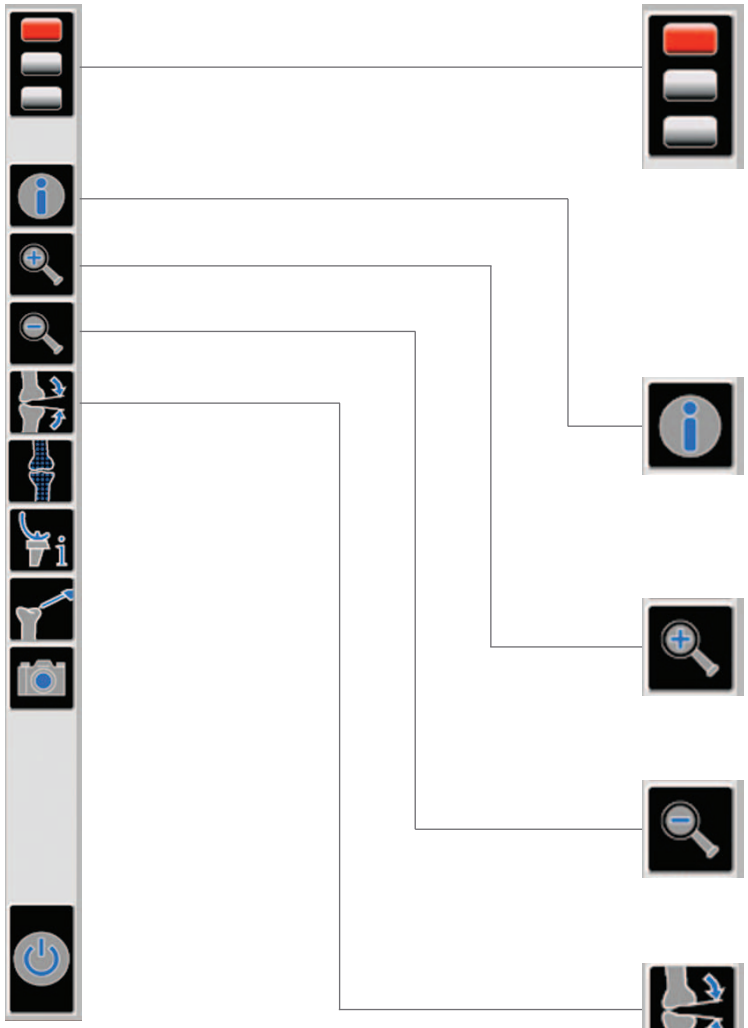
Two ‘beeps’ indicate that the camera unit is properly connected.

If the camera unit is not properly connected, no ‘beeps’ will be heard and an error message will appear asking you to restart the system (Figure 2).

The start-up screens allow the user to configure network and video settings if required (Figure 3).

A blank CD-R (not CD-RW) should be inserted into the Ci™ unit to allow any patient data to be stored.

# Ci™ Menu Buttons





1. Status Field – red / orange / green

Green: Normal tracking mode

Yellow: Ci™ instrument not visible to camera

Red: Ci™ instrument and / or navigation array not visible to camera for more than 3 seconds

Pressing on this button brings up the camera field of view screen. This will show the position of all visible navigated instruments in the field of view.



2. Information Button

Provides information on the application, version number, phone 'hotline' numbers and www.iorthopaedics.com website



3. Zoom In

Zooms in on the morphed bone model



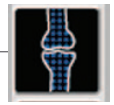
4. Zoom Out

Zooms out of the morphed bone model



5. Ligament Balancing

Can be used at any time after the registration procedure is complete



6. 3D Model

Allows the user to switch between hiding or displaying the 3D model, leaving only the ‘cloud’ of acquired points visible on screen.

7. Implant information

Provides details on the implants and sizes. This may be used to confirm the selected implants after the implant planning stage.

8. Verification Button

If, at any time the reference arrays are moved or knocked out of position, you can re-verify the accuracy of the bone model using the pointer. If the bone model is no longer accurate, the registration process will need to be repeated. (if only one array has been moved, the registration will only need to be repeated for that array). Use the next / back buttons to return to the appropriate point in the procedure.

9. Screenshot Button

This allows the user to take manual screenshots at any stage of the procedure. Screenshots are stored within the system and can be written to a CD. The system will also take automatic screenshots at key stages during the procedure.

10. Close Button

This closes the application. All information can then be stored on disk before continuing with a new procedure. The patient’s name and ID are stored as an HTML file with all information gathered during the procedure.

# Ci™ Procedure Set-up

On screen there are next and back buttons.
In this surgical technique we use arrows to indicate movement to the next step.

Arrow Key:
- Press 'next' to continue
- Press 'back' to return to the previous step

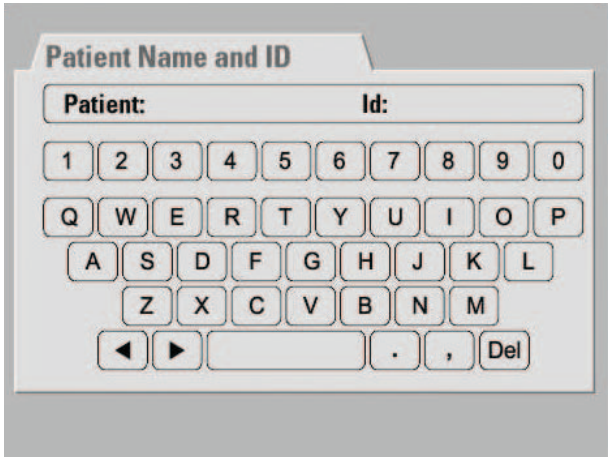



Figure 4

The procedure is started by entering the patient's name and ID, using the touch-screen keyboard (Figure 4).
This information will appear on the screen and on each screenshot taken during the operation.


Figure 5

The appropriate knee system software is selected from the choices displayed - LCS® / P.F.C.® Sigma™ / P.F.C.® Sigma™ RP / Preservation™ (Figure 5).

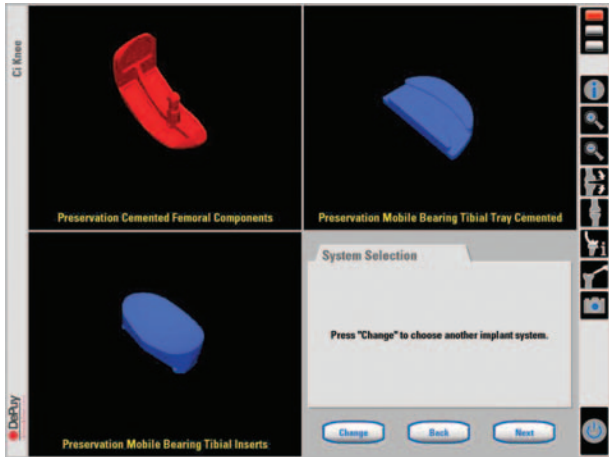



Figure 6

A choice of metal backed fixed bearing, all polyethylene fixed bearing or mobile bearing implants is displayed on screen (Figure 6). The desired implant is selected (as defined pre-operatively). Press ‘change’ to alter the selections on screen.


Figure 7

The appropriate leg and the affected condyle are selected for the operation (Figure 7).

# Tibial & Femoral Array Positioning

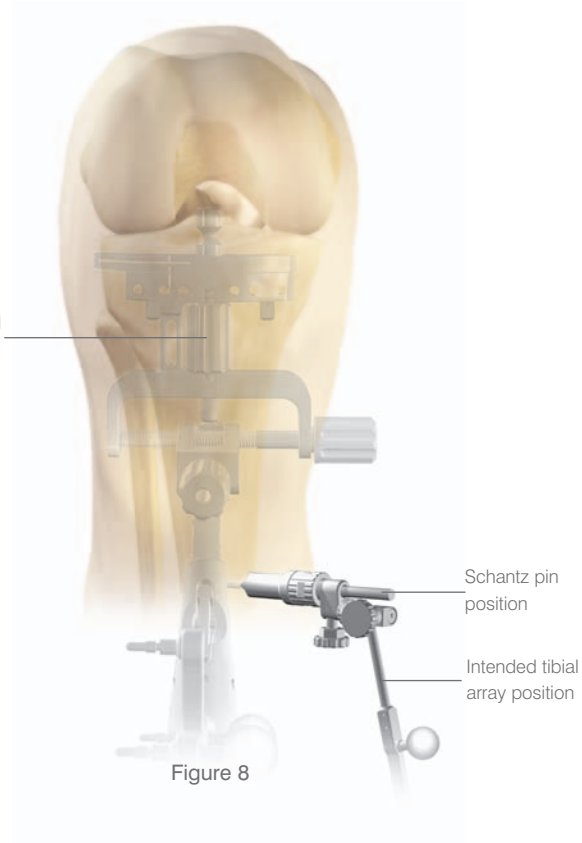



Figure 8

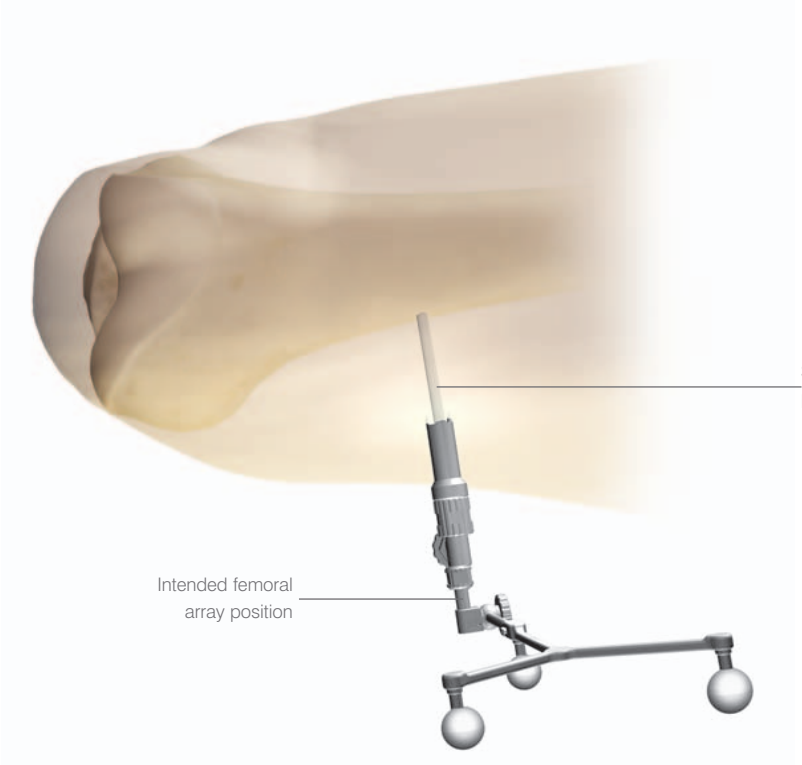



Figure 9

The arrays must be placed away from the intended positions of both the femoral and tibial instruments to avoid any contact during bone resection and drilling. It is important that the navigated system handle is attached to the tibial jig prior to array fixation and that its position is noted.

*Note: The position of the reference arrays must not be moved during the operation, as this will lead to inaccurate information being displayed, and possible cancellation of the procedure. Please refer to the Clinical User Guide (Art-No: 60901-11EN) for further information on positioning and fixation of the reference arrays.*

### Positioning of the tibial jig

The tibial jig / system handle assembly is held in an approximate position on the tibial while a a mark is made to identify the schantz pin position.Care should be taken to position the array clear of the tibial jig and any navigated instrument (Figure 8).

### Positioning of the femoral array

The femoral array should be positioned away from the intended incision and should not influence soft tissue and ligament movement in extension and flexion (Figure 9).

# Tibial & Femoral Array Fixation

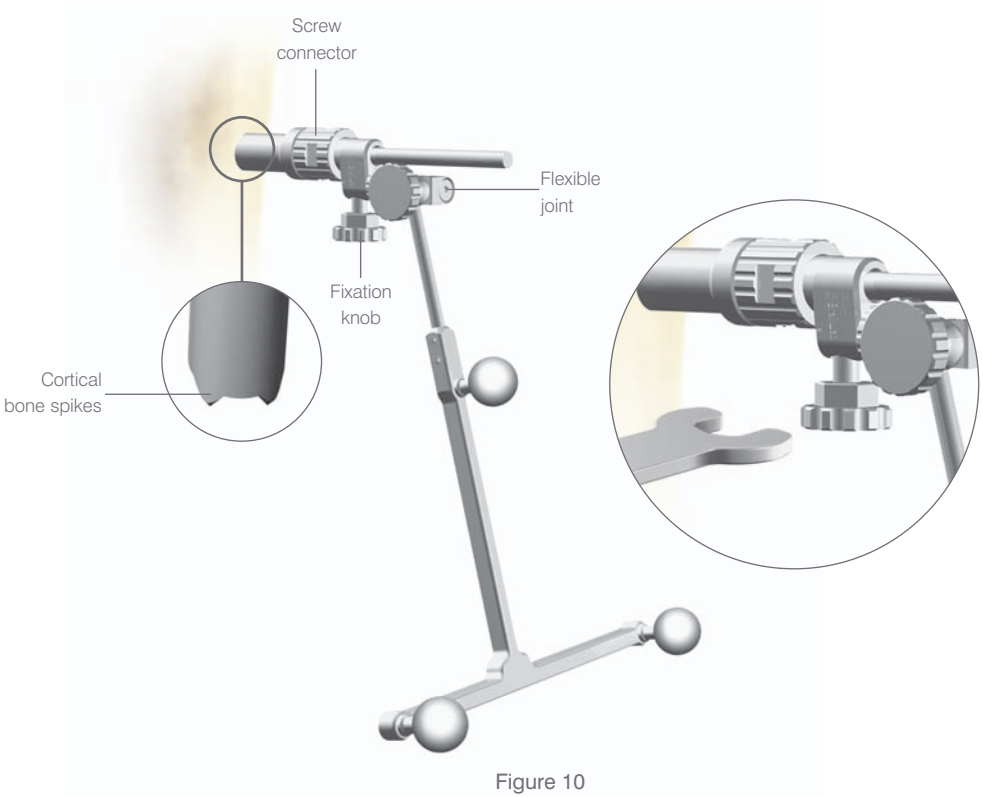



Figure 10

A schantz pin is inserted into the drill and introduced bicortically to the tibia. A soft tissue cover should be used on the schantz screw to avoid any tissue disruption. The reflective marker spheres should now be attached to the tibial (T-shape) array.

The tibial array is lowered onto the pin until it touches the surface of the leg and the spikes on the bottom of the array engage with cortical bone. The array is angled so that it does not interfere with the positioning of the tibial jig and the navigated system handle (Figure 10).

The screw connector is tightened by hand until the array is stable. A wrench is used to fully secure the final position and angle of the array.

*Care should be taken if the patient has osteoporotic bone, as over tightening of the array may loosen the schantz pin.*

# Camera Side

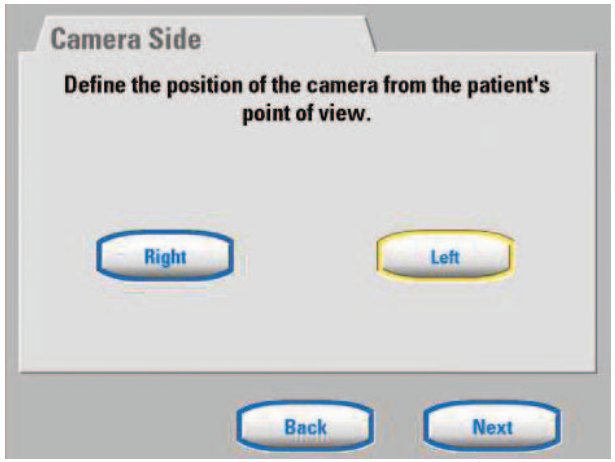



Figure 11

The position of the camera in relation to the patient is defined on the system (Figure 11).

# Camera Alignment

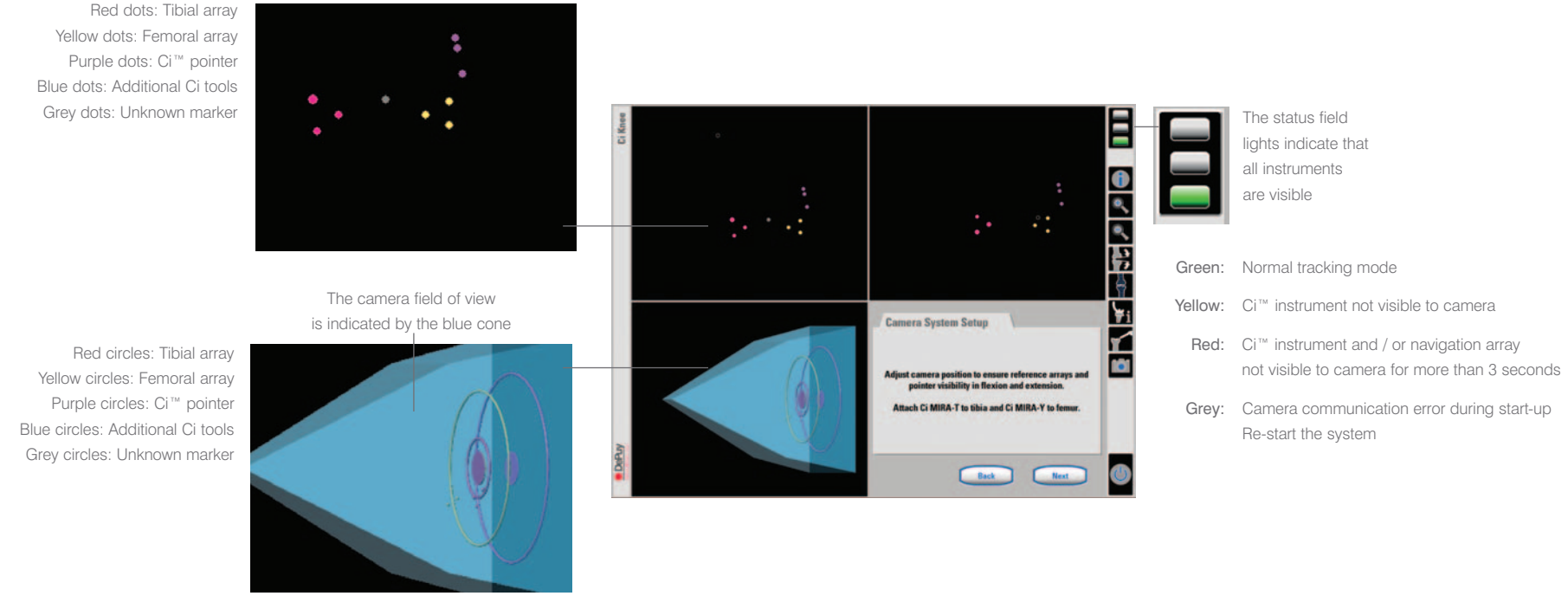



Figure 12

The camera alignment window highlights movement of the reference arrays and instruments. These are displayed as different coloured dots and circles on-screen (Figures 12).

Coloured dots represent the positions of the femoral and tibial reference arrays, and the Ci™ pointer.

The circles show the position of the instruments in relation to the camera unit's field of view.

The status field lights indicate the visibility of the arrays and instruments.

The camera displays can be accessed at any time during the procedure by touching the status field lights.

# Incision & Exposure

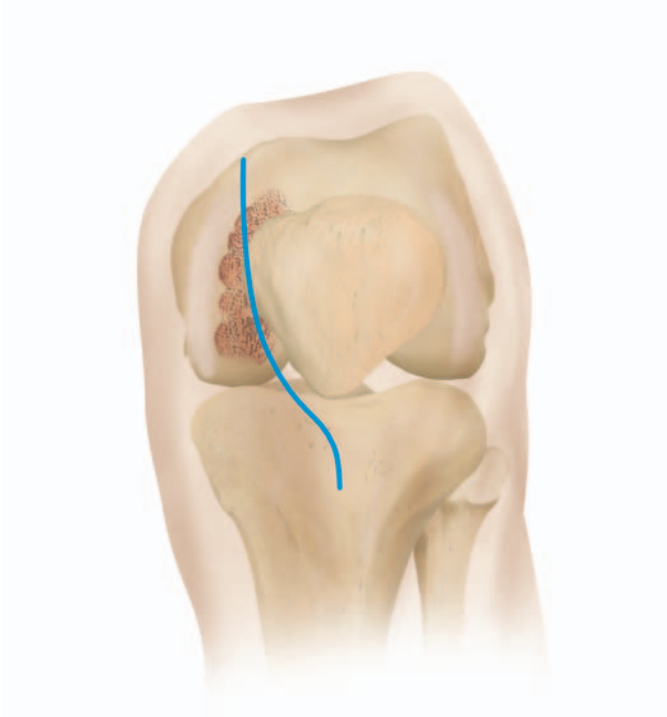


Figure 13

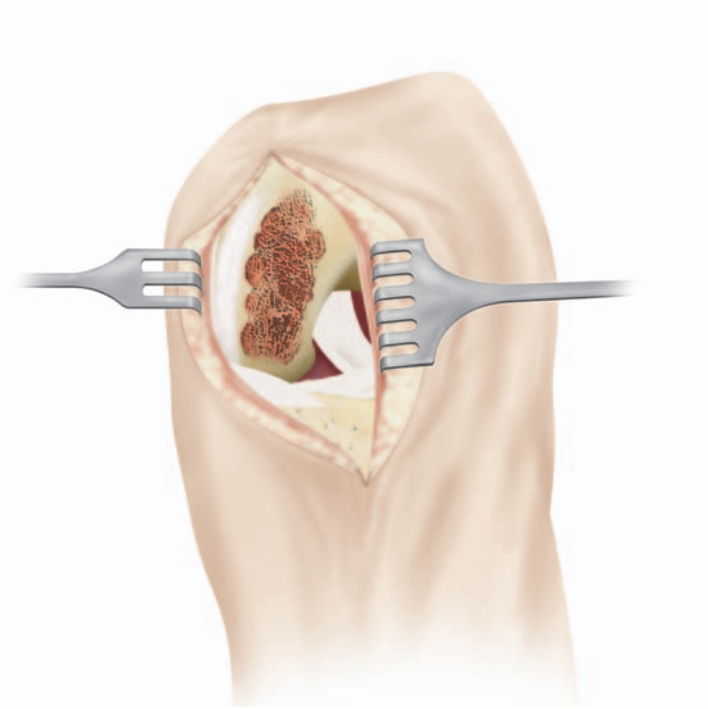


Figure 14

Depending on the location of the osteoarthrosis, an antero-medial or antero-lateral skin incision is performed. The incision should begin 1 cm proximal to the superior border of the patella. It should extend 6 - 10 cm distally along the edge of the patella and patella tendon, and end 2 cm distal to the joint line (Figure 13). The joint capsule is entered with a parapatellar incision (Figure 14). Once the joint is exposed a final assessment can be made of the extent of arthritic damage and the suitability of the joint for this procedure.

The deep menisco-tibial layer of the medial or lateral capsule should be carefully reflected to provide good access to any tibial osteophytes and allow accurate wound closure. Any excess deep synovium is excised to provide clear sight of the joint. If required, all or part of the fat pad may also be excised to improve vision and allow inspection of the opposite compartment. Two large rake retractors are then introduced to maintain access at all stages of the procedure.

*No ligament releases should be performed as part of this procedure.*

# Registration

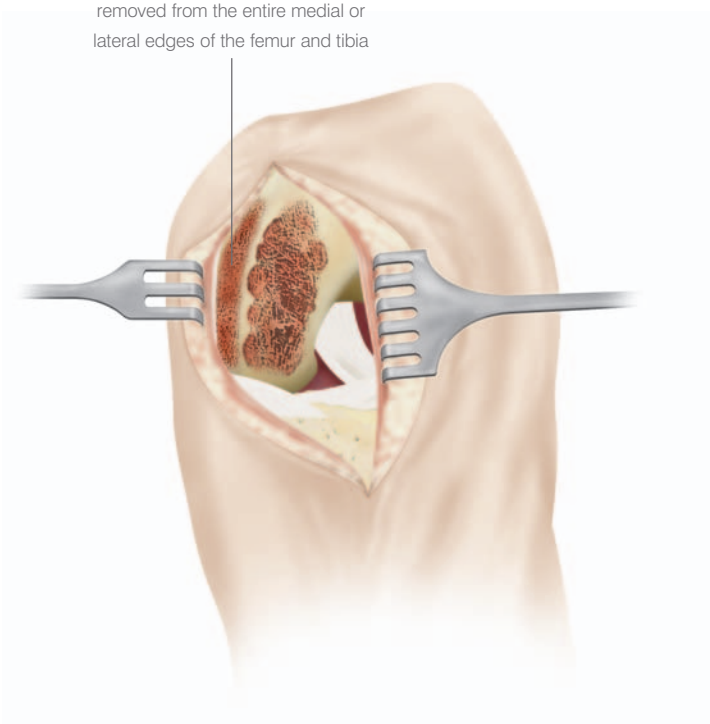



Figure 15

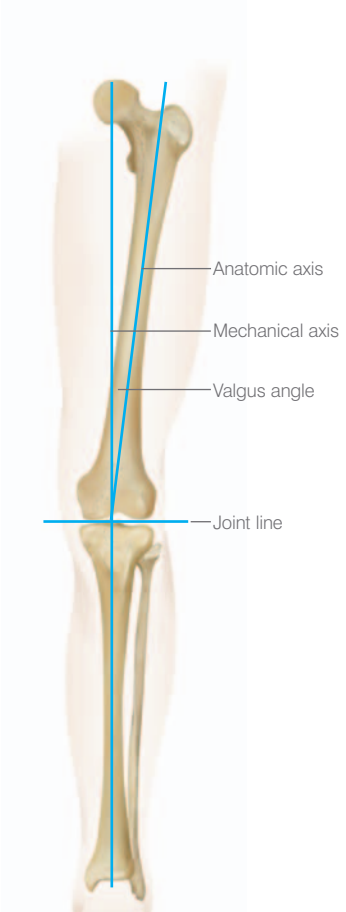


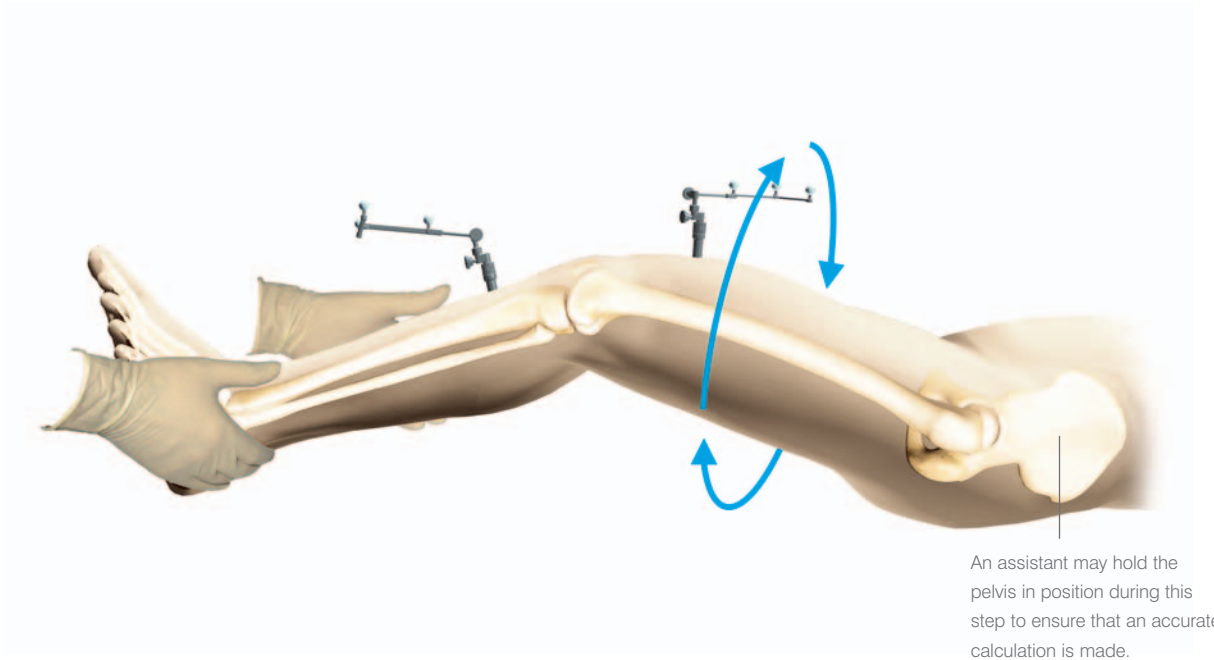

Figure 16

In order to achieve medial / lateral (M/L) alignment and joint stability, it is vital that all osteophytes are removed from the entire medial or lateral edges of the femur and tibia before registration takes place (Figure 15).

A retractor is used on the patella rim to draw the patella into a central position. Any significant osteophytes on the edge of the patella should also be excised.

Registration defines the mechanical axis and important anatomical landmarks (Figure 16). This allows accurate positioning and sizing of the intended implants. A 3D model of the patient's bone anatomy is created and mapped onto an existing 3D model created from an extensive database of healthy and arthritic knees. Tibial registration is performed first, followed by femoral registration. Each screen offers the option to re-perform the step if required.

# Calculating the Femoral Head Centre



An assistant may hold the pelvis in position during this step to ensure that an accurate calculation is made.

Figure 17

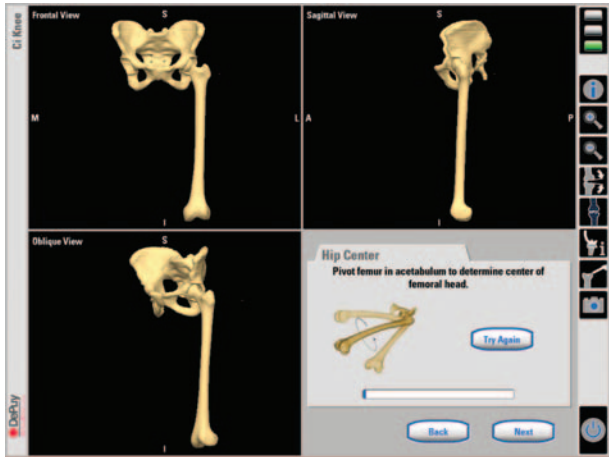



Figure 18

Registration defines the mechanical axis and important anatomical landmarks. This allows accurate positioning and sizing of the intended implants. A customised 3D model of the patient's bone anatomy is created. Each screen offers the option to re-perform the step if required.

Calculating the rotational centre of the femoral head defines the proximal point of the mechanical axis. It is important to make sure that the patient's pelvis is not moved excessively during registration as this will lead to miscalculation by the system.

The femur is pivoted using circular motions (Figure 17). The system calculates a series of points to determine the rotational centre and will automatically proceed when the rotational centre has been calculated (Figure 18).

*The system calculates the centre of the femoral head to within 3 mm. This relates to no more than a 0.5˚ deviation on the mechanical axis. If the centre of the femoral head is not calculated correctly, a warning box will appear and the step is re-performed.*

# Pointer Tips

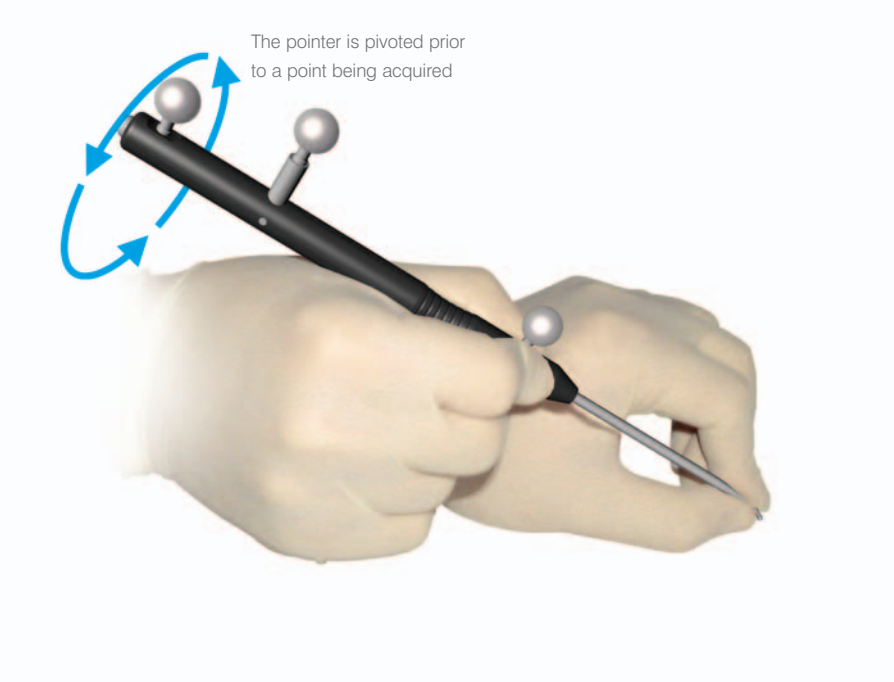



Figure 19

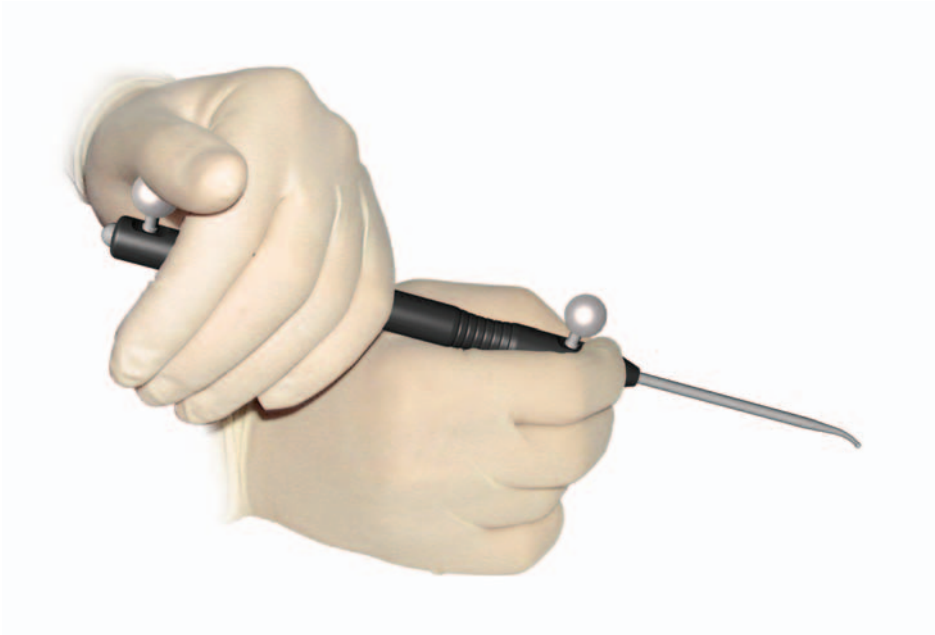


Figure 20

1. To acquire points accurately, it is helpful to hold the tip of the pointer with one hand while pivoting the pointer with the other. This will ensure that all of the points are registered on the bone, not away from the patient (Figure 19).
2. To avoid acquiring unnecessary points before the pointer is positioned, it may be helpful to cover one of the marker spheres with a hand. This will effectively 'eliminate' the pointer from the field of view (Figure 20).
3. Make sure all three marker spheres on the pointer are directed towards the camera unit when acquiring a point.
4. When a point has been successfully acquired, the system will emit an audible 'beep'. This removes the need to refer to the screen as each point is acquired. If the camera cannot see the pointer, a deep sounding 'beep' will be heard,
5. If at any stage during the procedure the marker spheres become contaminated with blood or tissue, they may be gently cleaned using lint-free cloth.

# Definition of the Malleoli

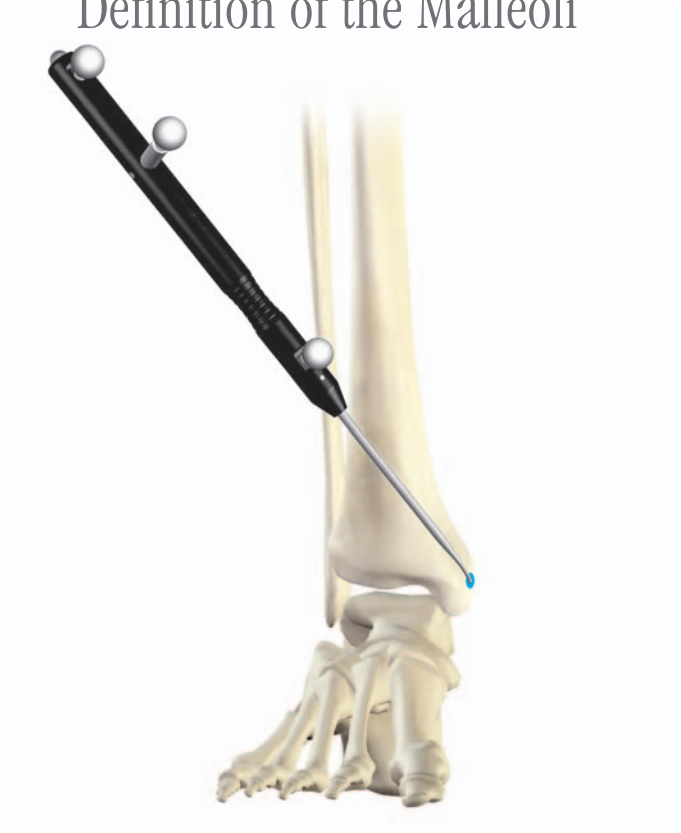
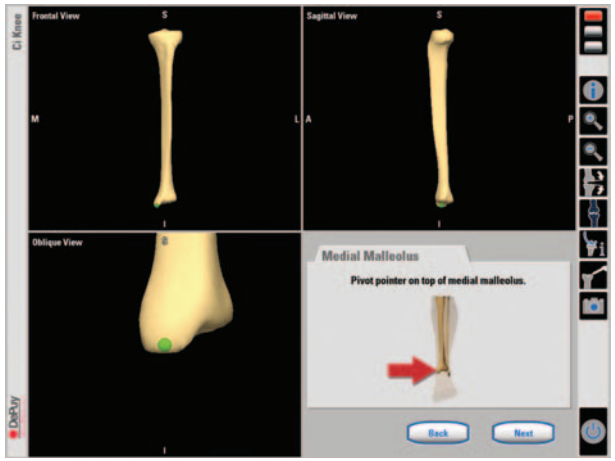


Figure 21



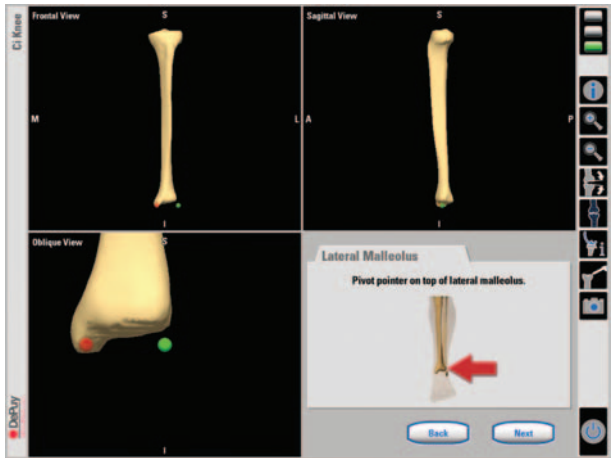




Figure 22

The medial and lateral malleolus are defined using the Ci™ pointer.

The malleoli can usually be located by hand before acquiring the points. It is important that draping or bandaging is reduced to a minimum to enable the malleoli to be located.

Place the tip of the pointer to the medial malleolus and pivot the pointer (Figure 21). It is important not to move the tip of the pointer from the bone. Once the system has registered the medial malleolus, the lateral malleolus can be registered in the same way (Figure 22).

Acquiring the malleoli defines the distal point of the mechanical axis.

All single registration points for anatomical landmarks are acquired in the same way.

*It is important that these points are acquired as accurately as possible as implant position and alignment are referenced to the hip / ankle axis and the mechanical axis.*

# Definition of the Tibial Mechanical Axis

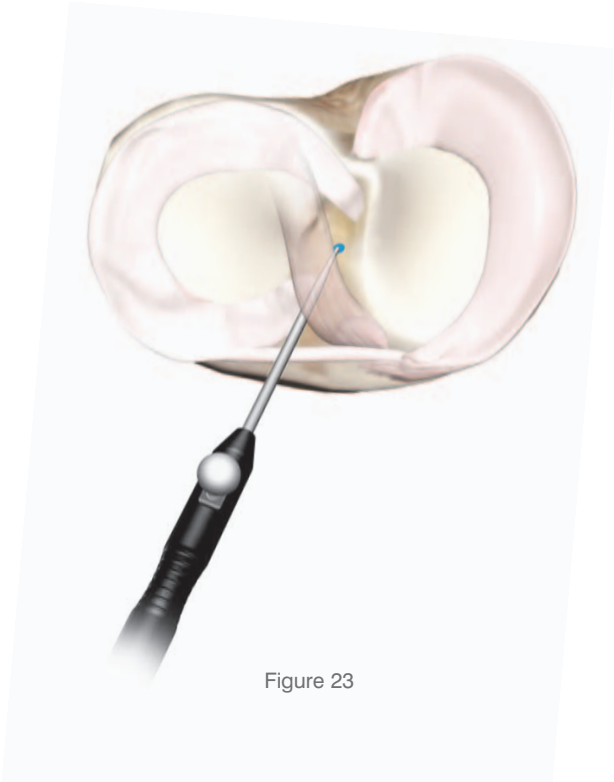


Figure 23

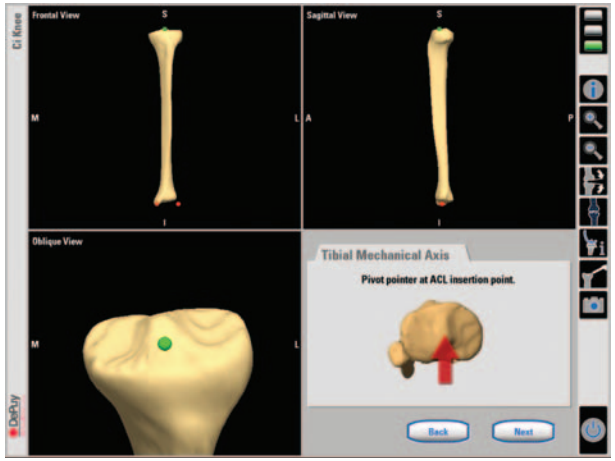



Figure 24

The mechanical axis is defined by acquiring the posterior aspect of the ACL tibial attachment point (Figure 23).

This is indicated by the arrow on screen (Figure 24).

It is important that the point acquired defines the mechanical axis, and not the tibial eminence.

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

# Tibial Sizing

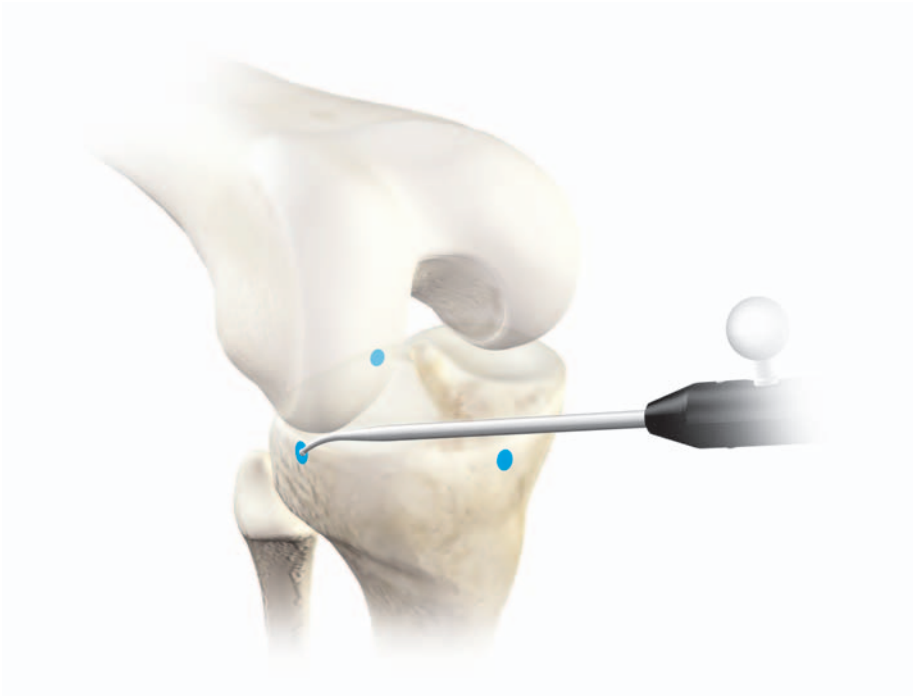


Figure 25

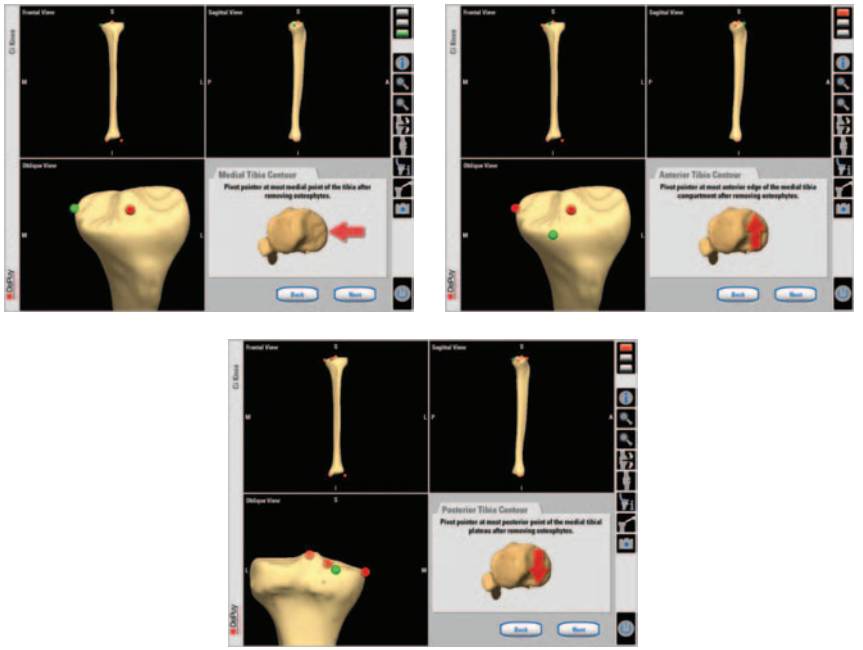


Figure 26

The most medial or lateral point of the proximal tibia is acquired using the pointer, followed by the most anterior and posterior point on the affected compartment (Figures 25 & 26).

The points should be acquired at the approximate level of resection.

The posterior point is required to assess tibial component sizing. This point should be acquired as accurately as possible.

A visual check should also be performed during the tray navigation step.

# Tibial A/P Direction

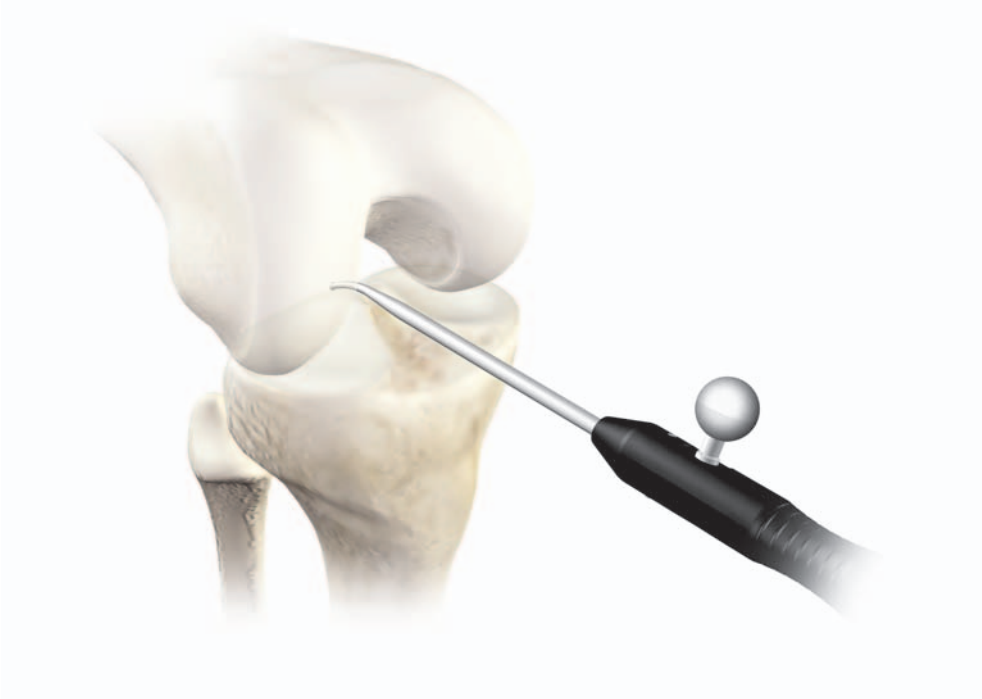


Figure 27

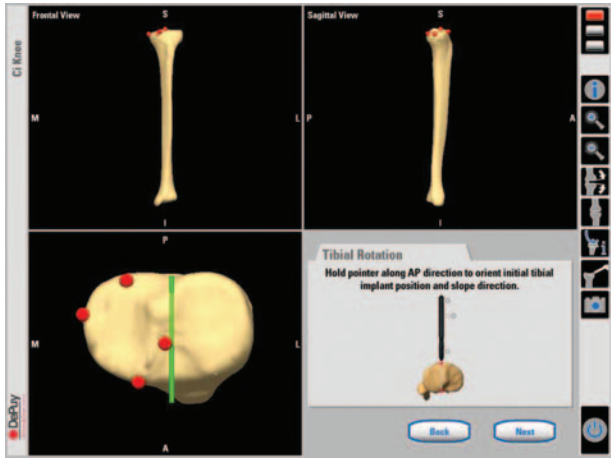



Figure 28

The pointer is placed on the tibia to determine the A/P direction of the tibial slope (Figure 27). If access to the centre of the tibia is limited, the pointer can be placed to one side.

The pointer is held in place for 2 seconds to allow the system to calculate the direction (Figure 28).

*Note: incorrect registration of the tibial A/P direction may lead to compound slope phenomenon.*

# Tibial Modelling

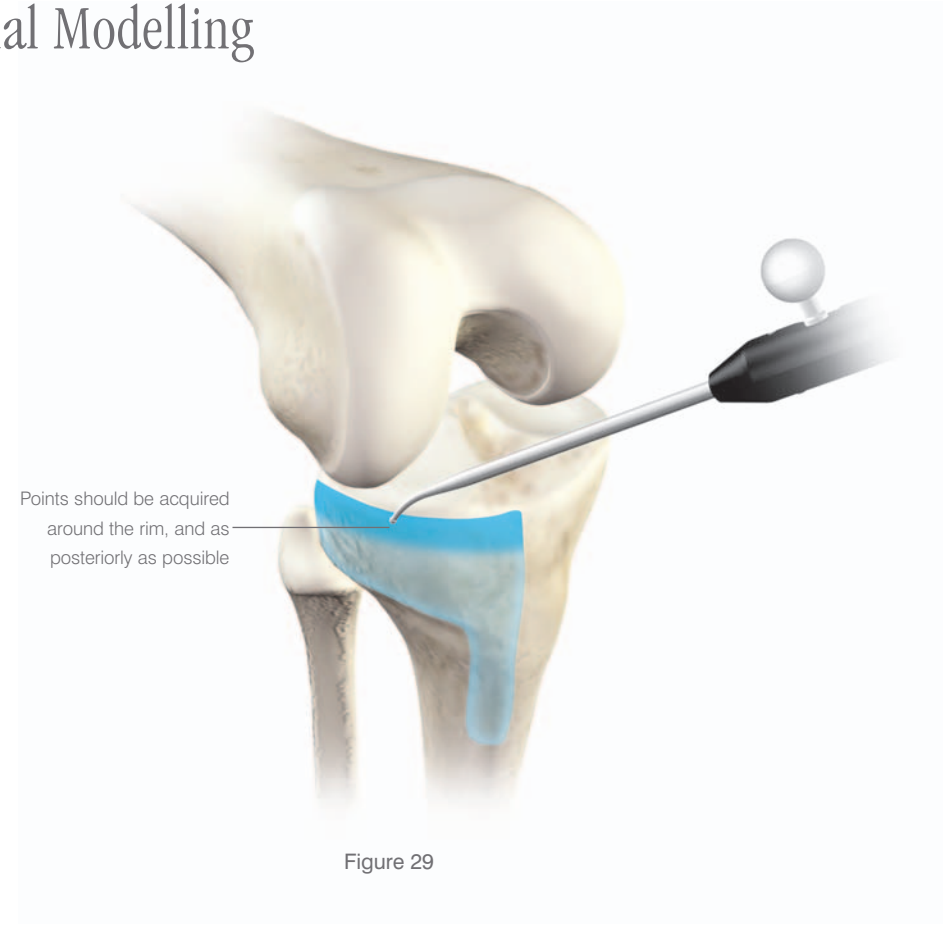



Figure 29

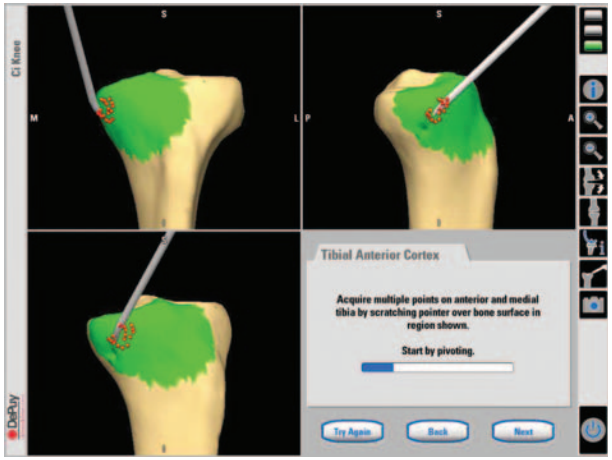



Figure 30

A fixed number of points along the anterior and medial or lateral tibia are acquired using the Ci pointer. These are used to define the bone model (Figure 29).

The pointer is placed on the tibia and pivoted to begin the procedure. A ‘beep’ will indicate when to begin moving the pointer (Figure 30).

The tip of the pointer should ‘paint’ the surface of the tibia. Points should be acquired mainly around the rim and extend as posteriorly as possible. Acquisitions further down the tibia are less important, but will add shape to the model.

The sequence ends when enough points have been acquired.

# Tibial Plateau Modelling

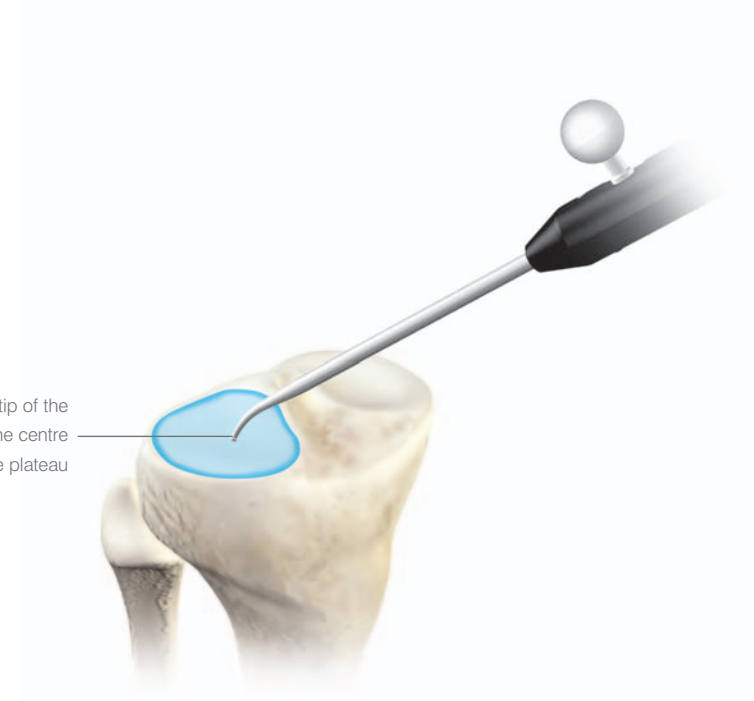



Figure 31

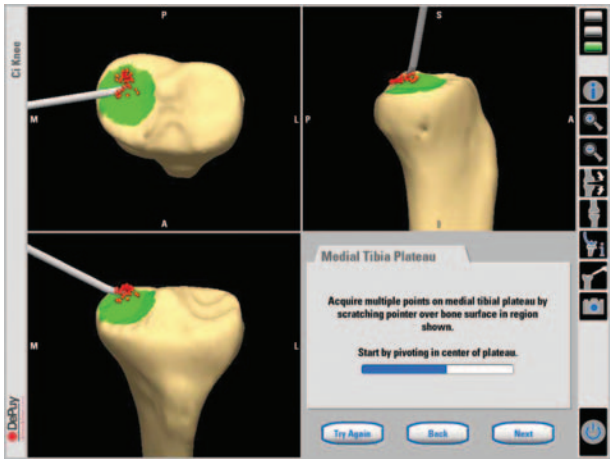



Figure 32

The Ci™ pointer should be placed in the centre of the medial or lateral tibial plateau (Figure 31).

The tip is moved in a circular motion across the surface of the plateau (Figure 32).

It may be helpful to apply varus or valgus stress to the knee joint to allow greater access to the tibial plateau.

The sequence ends when enough points have been acquired.

# Tibial Model Calculation and Verification

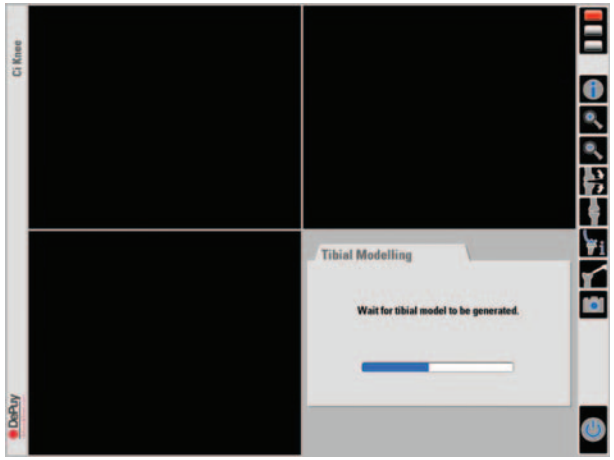
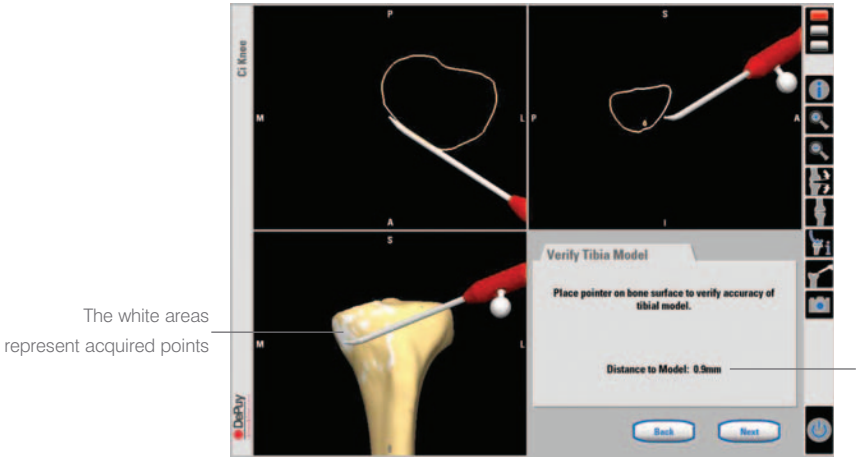



Figure 33




The white areas represent acquired points

The deviation from the tip of the pointer to the bone is represented in mm

Figure 34

Following registration, the system adapts the tibial model (Figure 33).

- White areas are parts of the model with deviations no greater than 2 mm from the actual bone structure.
- Brown areas are parts of the model where no points have been acquired.

The accuracy of the model is checked by holding the Ci™ pointer to the tibia. The exact deviation from the tip of the pointer to the model is displayed on the screen.

The maximum acceptable deviation is less than 2 mm. Acquired points will normally show a deviation of less than 1 mm Verification of the model will only be accurate in white areas where points have been acquired (Figure 34).

*Note: implant sizing is based on aquired points only. The accuracy of the model should be checked on the areas responsible for implant sizing and position (medial or lateral boundary, medial or lateral plateau).*

# Femoral Mechanical Axis

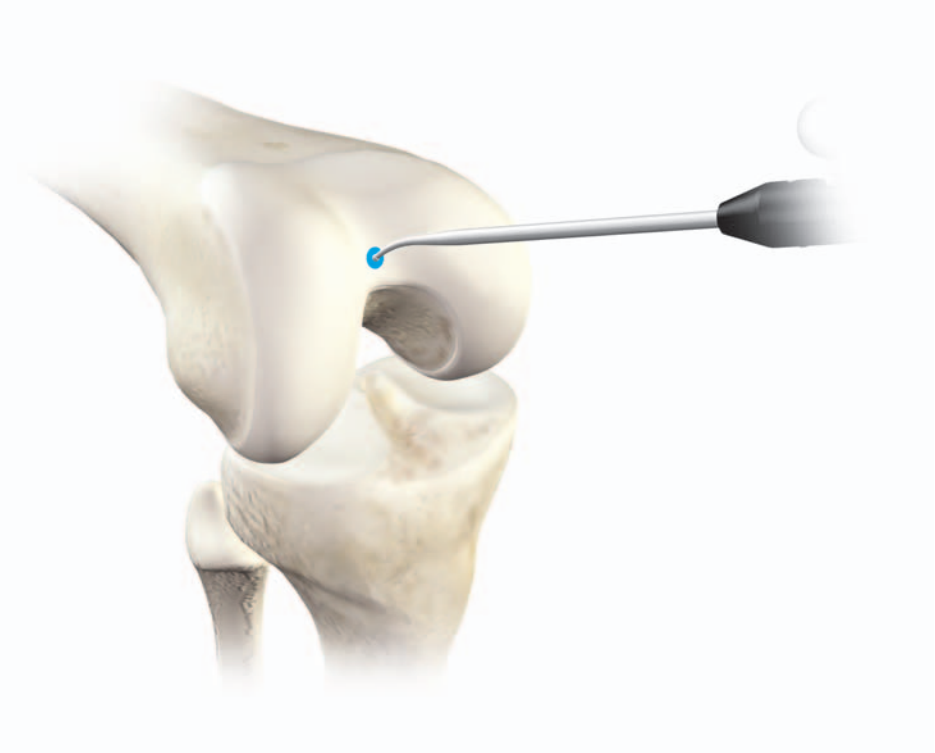


Figure 35

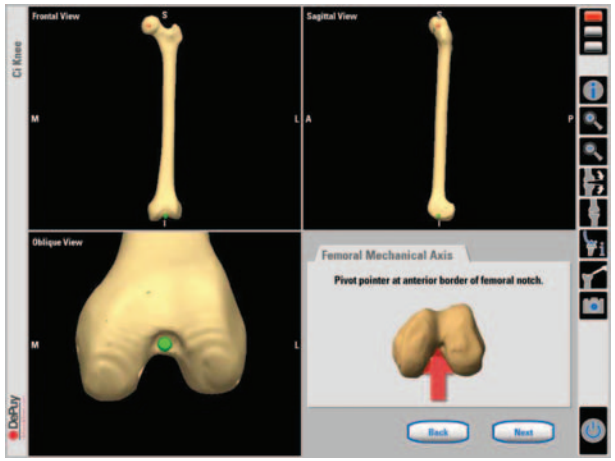



Figure 36

The registration of the femur is automatically activated once the tibial registration has been completed.

The pointer should be placed at the anterior aspect of the femoral notch point as indicated on screen (Figures 35 & 36).

*It is important that the mechanical axis point is acquired as accurately as possible.*

# Registration of Epicondyles

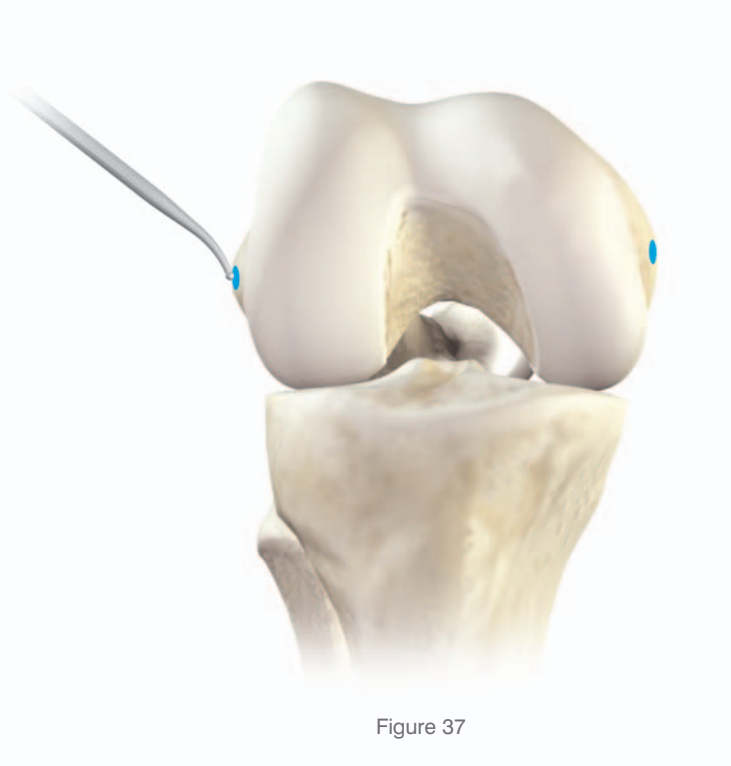
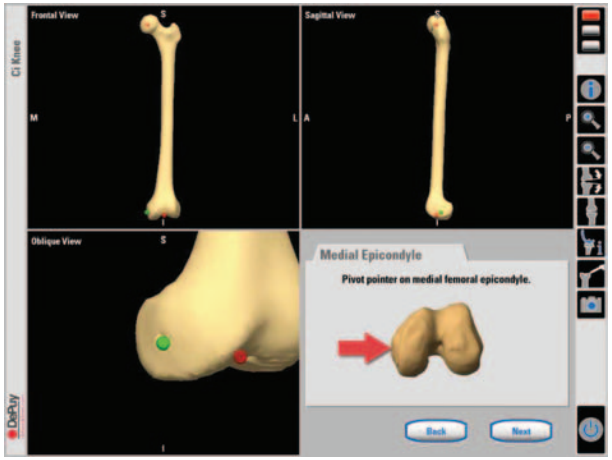


Figure 37



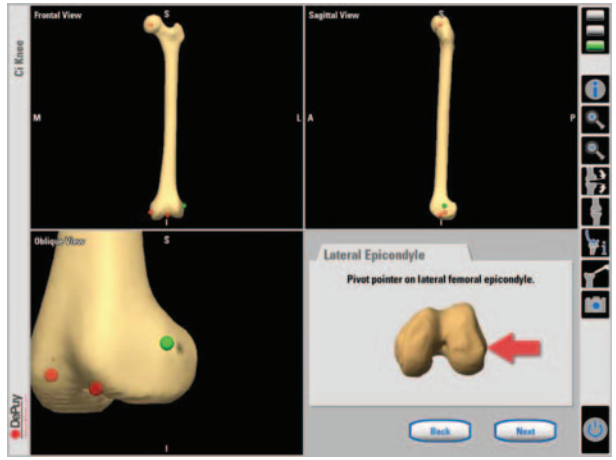




Figure 38

Acquisition of the most medial and lateral epicondylar points may be made either through the incision or on top of the skin (Figures 37 & 38).

These points are required for the model morphing process and are not used in implant alignment.

# Registration of the Anterior Cortex

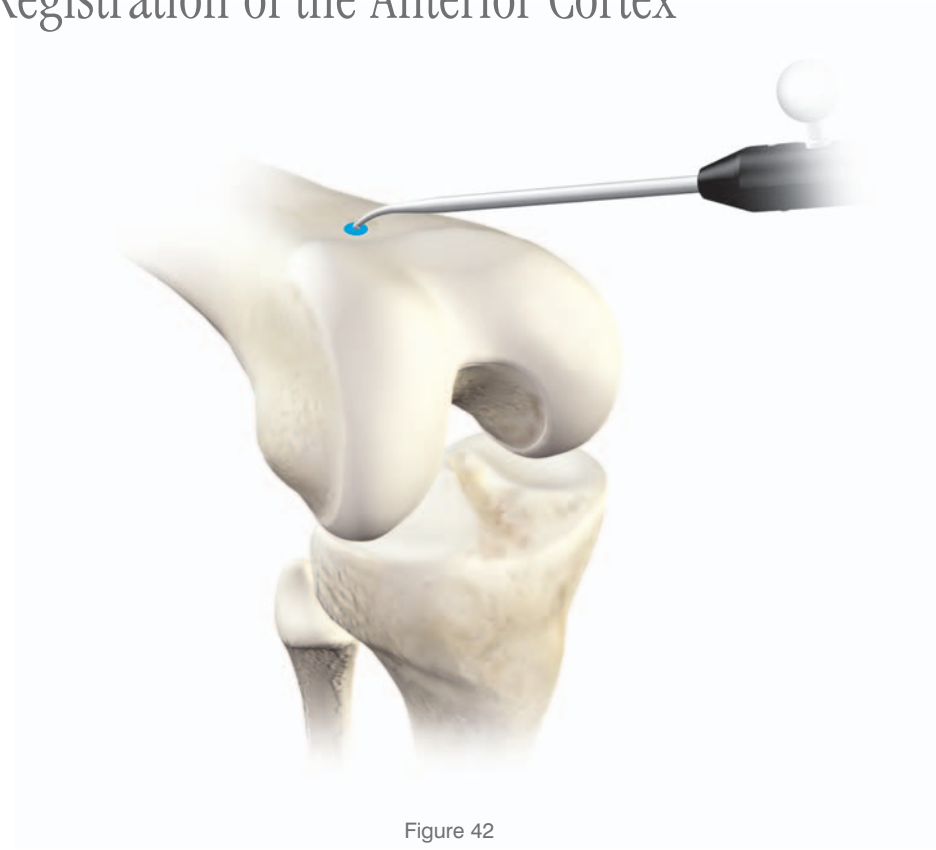


Figure 42

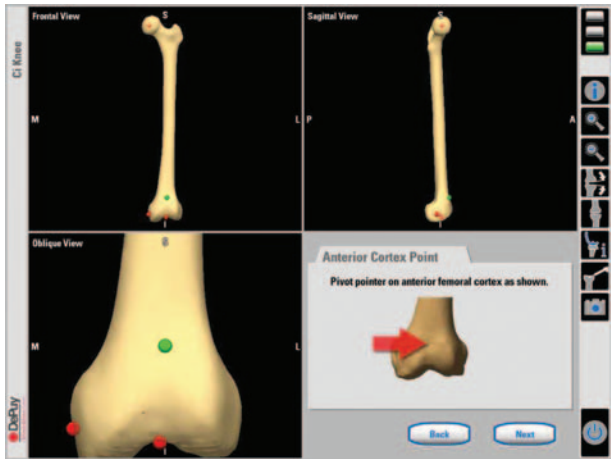



Figure 43

The anterior cortex is acquired using the pointer. Ideally, the pointer should be placed on the deepest point on the anterior femoral cortex just above the superior border of the femero-patella articular surface.

This point helps to shape the final bone model (Figures 39 & 40).

# Epicondylar Axis

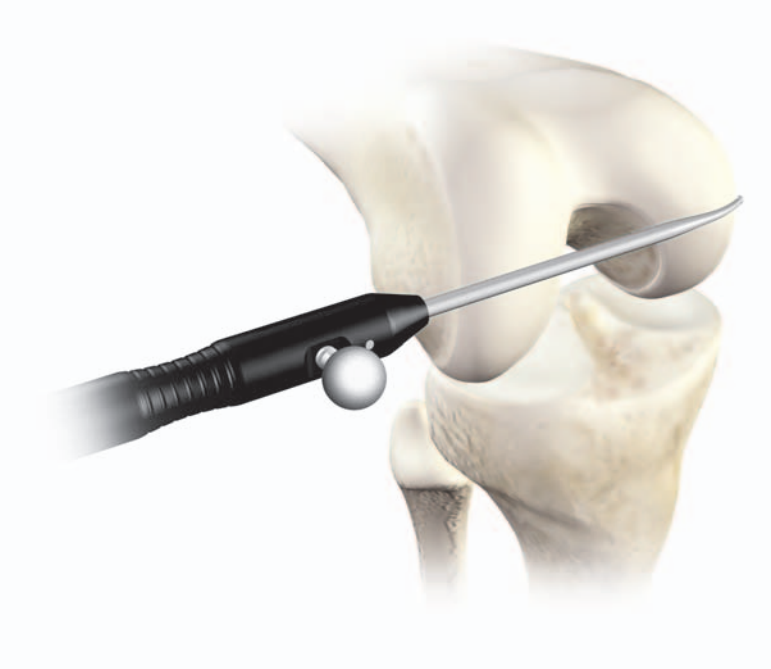


Figure 41

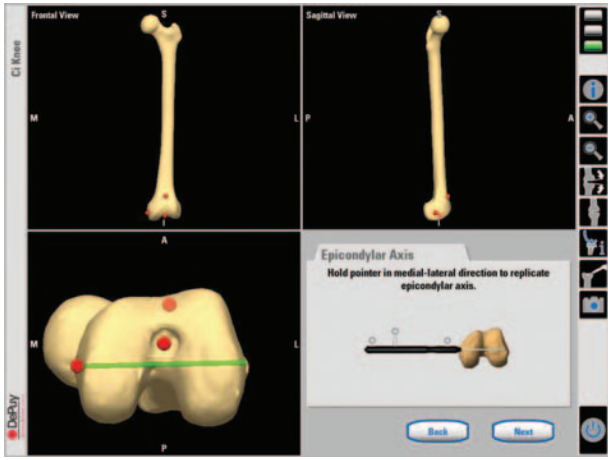



Figure 42

The pointer is placed on the distal condyles (below the patella) and held still to allow the system to calculate the epicondylar axis (Figures 41 & 42).

The pointer can be positioned through the incision and can be checked by feeling through the skin for contact.

Alternatively, it can be held on top of the incision and positioned against the condyles.

*Note: this line does not have an influence on the rotational alignment of the femoral component.*

# Femoral Condyle Modelling

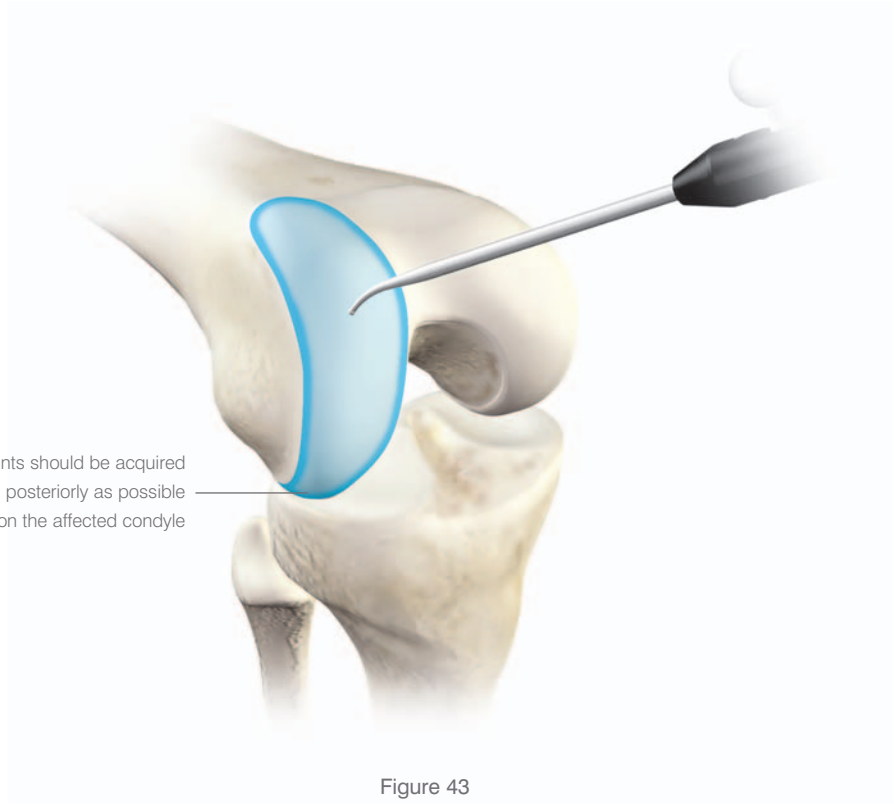



Figure 43

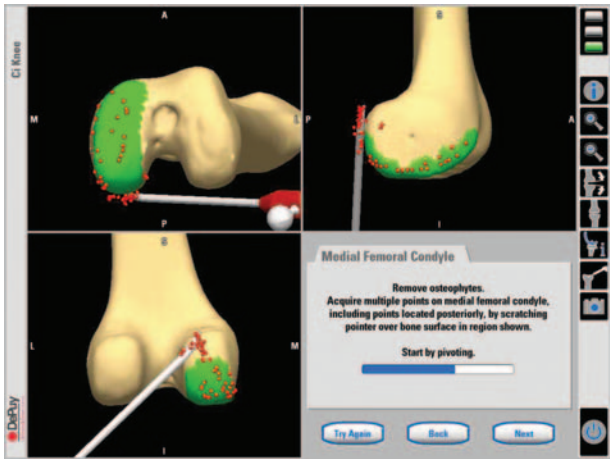



Figure 44

A fixed number of points along the surface of the medial or lateral condyle are acquired using the Ci™ pointer (Figures 43 & 44). Acquisition should begin at the most distal point.

The tip of the pointer should 'paint' the surface of the condyles. Points should be acquired as posteriorly as possible and along the distal part of the affected condyle. This allows the system to accurately calculate both the size and position of the intended implant.

If insufficient posterior points are acquired the system will ask for the step to be re-performed.

# Borders of the Condyles

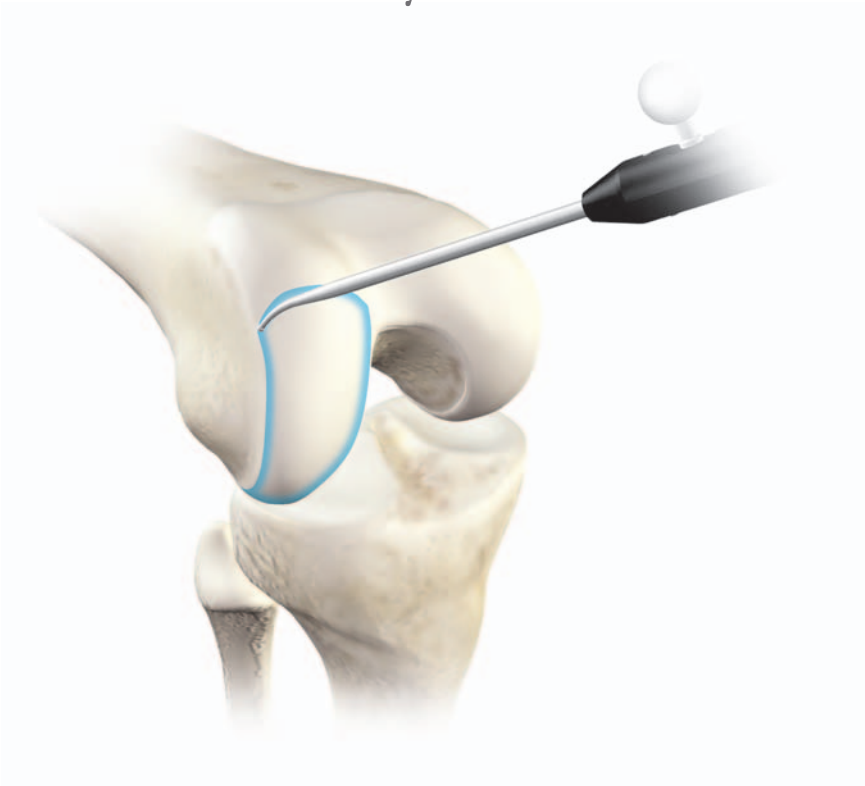


Figure 45

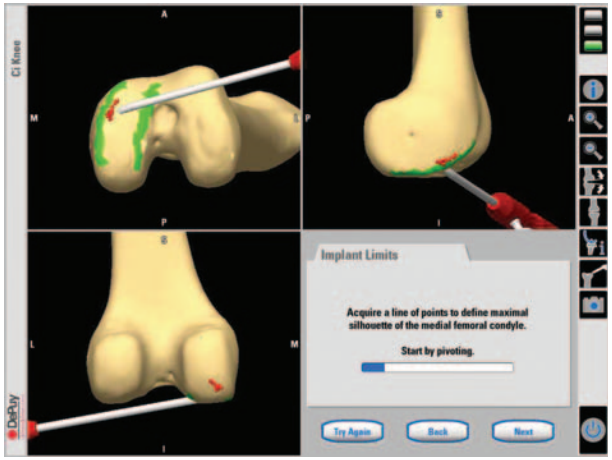



Figure 46

A fixed number of points along the border of the affected condyle are acquired using the Ci™ pointer. It should move along the outer and inner edge of the condyle in one movement (Figures 45 & 46).

These points will act as a guide to help define the M/L and rotational alignment of the implant.

# Femoral Cortex Modelling

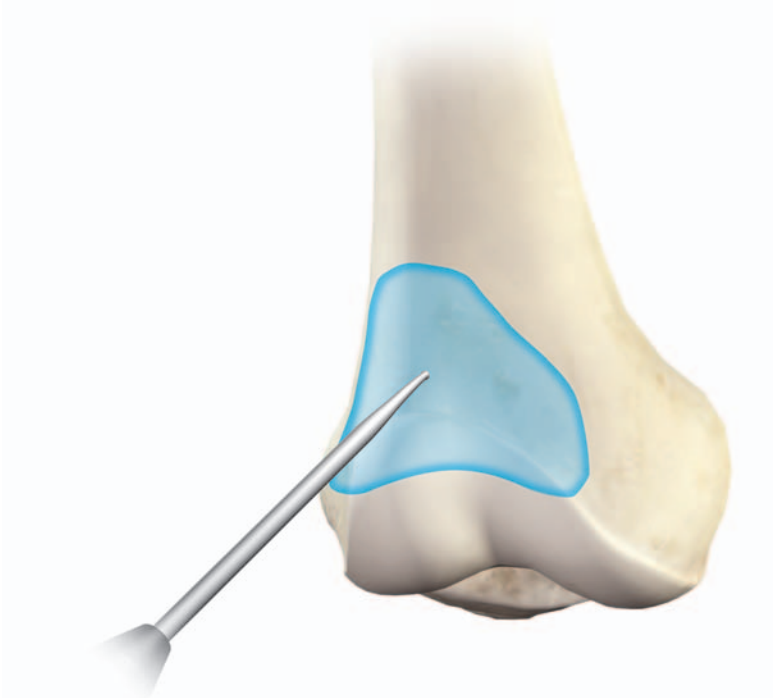


Figure 47

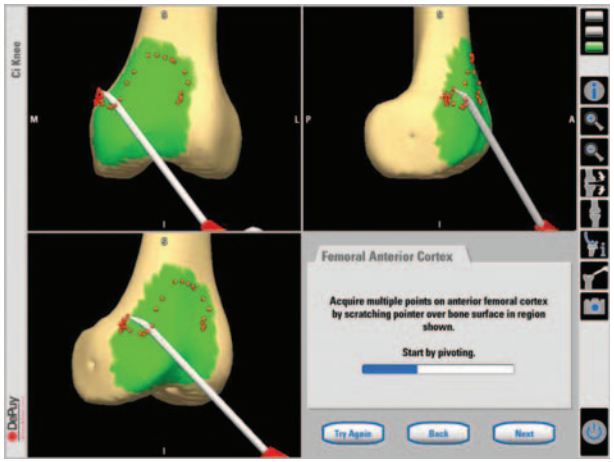



Figure 48

Multiple points on the affected side of the anterior femoral cortex are acquired using the Ci™ pointer (Figures 47 & 48).

# Femoral Model Calculation and Verification

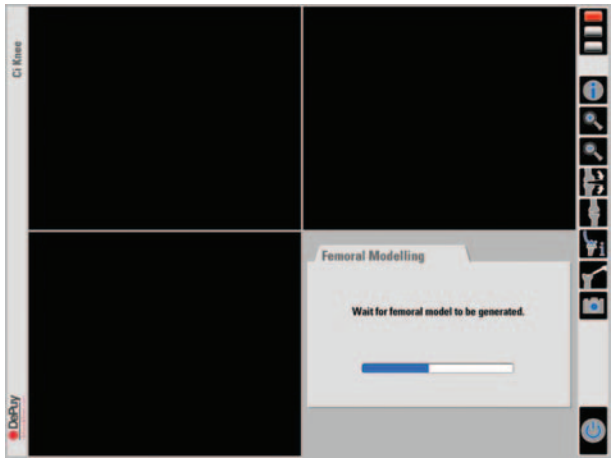
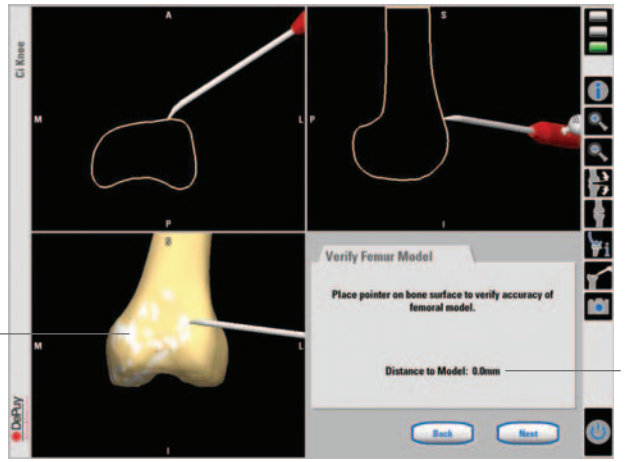



Figure 49




The white areas represent acquired points

The deviation from the tip of the pointer to the bone is represented in mm

Figure 50

Following registration, the system adapts the femoral model (Figure 49).

- White areas are parts of the model with deviations no greater than 2 mm from the actual bone structure.
- Brown areas are parts of the model where no points have been acquired.

The accuracy of the model is checked by holding the Ci™ pointer to the tibia. The exact deviation from the tip of the pointer to the model is displayed on the screen.

The maximum acceptable deviation is less than 2 mm. Acquired points will normally show a deviation of less than 1 mm Verification of the model will only be accurate in white areas where points have been acquired (Figure 50).

*Note: femoral implant sizing is based on aquired points only. The accuracy of the model should be checked on the areas responsible for implant sizing and position.*

# Tibial Slope

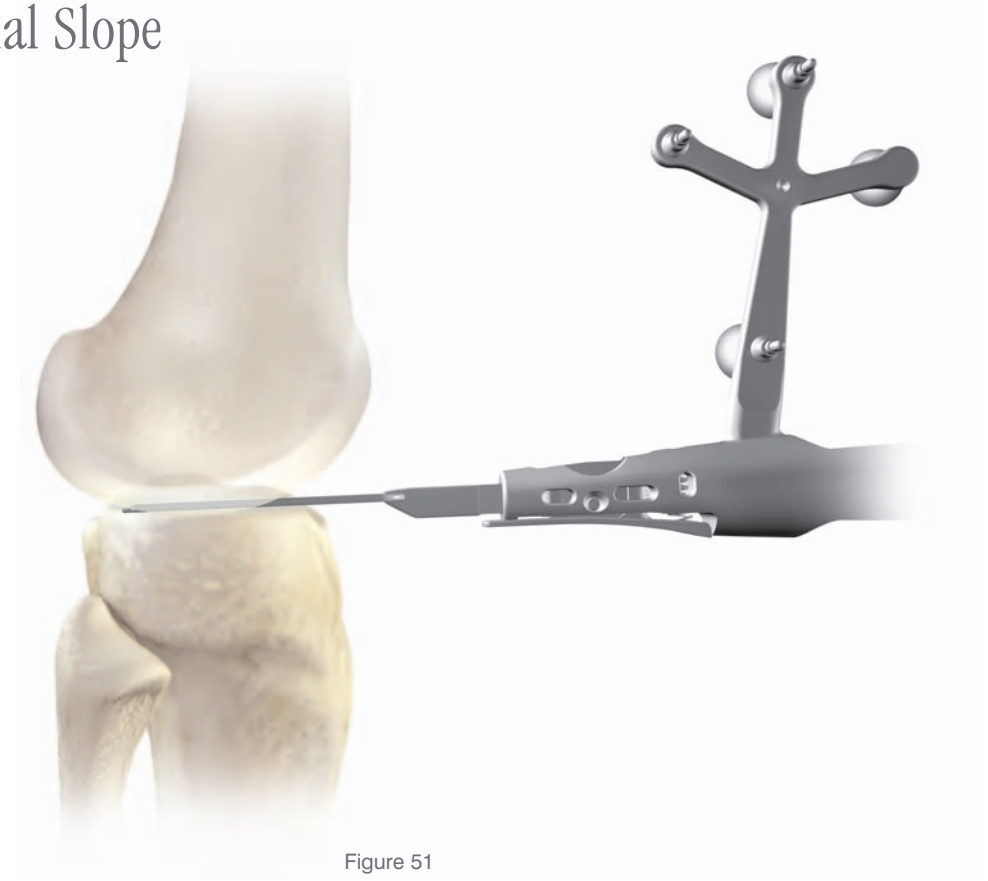


Figure 51

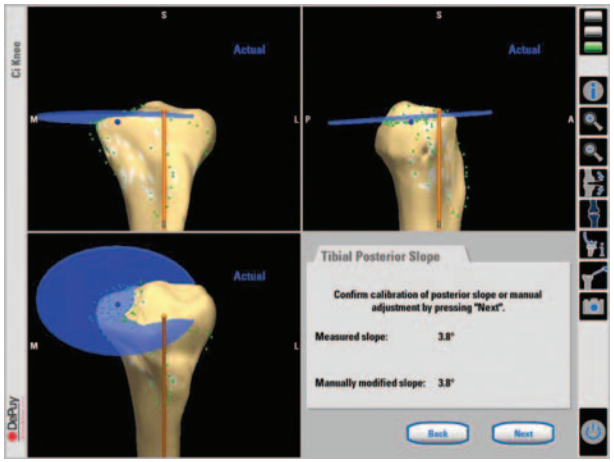



Figure 52

The navigated plane is attached to the navigated tibial handle with the flat side facing down toward the tibia.

After removal of the meniscus and with the leg in flexion, the instrument is placed on the tibial plateau as posteriorly as possible. The leg is placed in extension to enable the instrument to be secured between the tibia and femur (Figure 51).

After a couple of seconds or by pressing 'next' the system will measure the tibial slope angle and display this on screen (Figure 52). The tibial slope angle can be re-adjusted manually if required. Pressing 'next' will accept the tibial slope angle.

*It may be helpful to remove the 3D model and use the acquired points only as a reference to adjusting the slope manually.*

# Cartilage Defect Planning

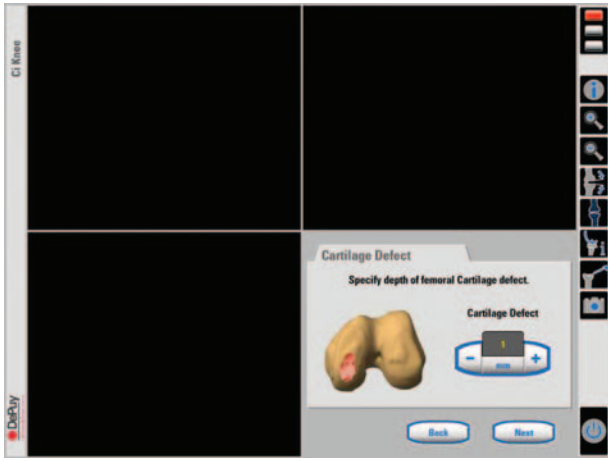



Figure 53

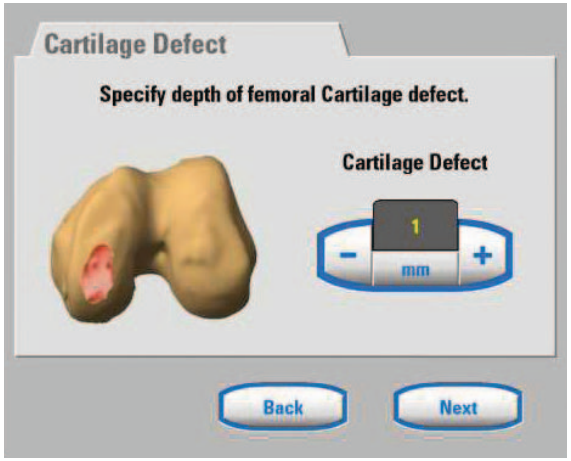



Figure 54

The next few steps allow the surgeon to assess the pre-disease leg alignment.

The amount of cartilage to be removed should be assessed visually. The defect amount (in mm) is entered into the system. Average defects range between 1 - 2 mm and in severe cases up to 3 mm (Figures 53 & 54).

*Important: Care should be taken when assessing the cartilage defect. The larger the cartilage defect, the thinner the distal bone resection. Choosing a 2 mm or 3 mm cartilage defect may cause problems in patient's with sclerotic bone.*

*Large cartilage defect assumptions may produce a small distal resection face. This may cause problems with fixation of the femoral cutting block later in the procedure.*

# Leg Extension

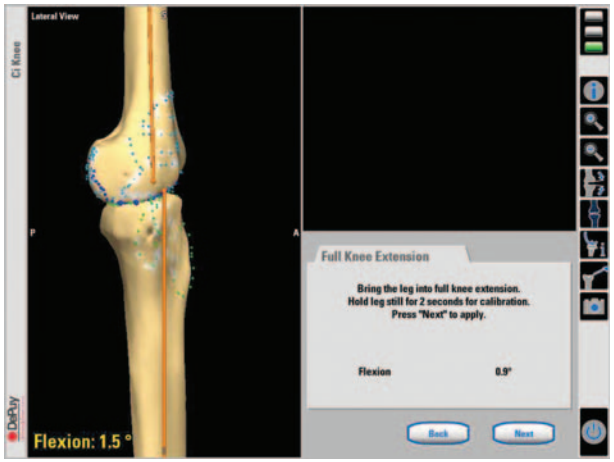



Figure 55

The leg is placed in full extension and held in position to allow the system to register the maximum extension angle (Figure 55).

This is used to gauge the patient's maximum extension range for the femoral planning steps.

# Desired Post-Operative Leg Alignment

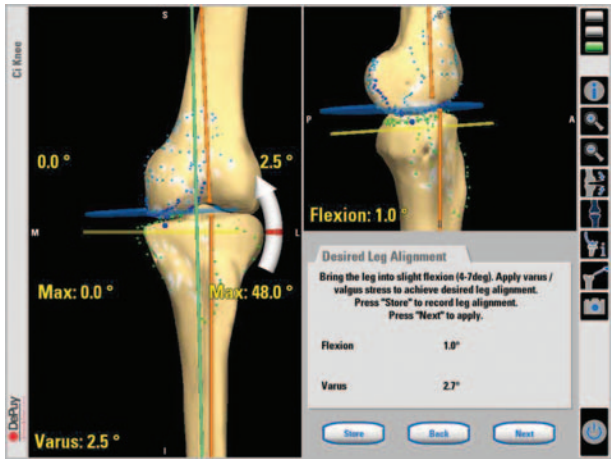



Figure 56

The leg is then placed in approximately 4 - 7 degrees of flexion. Varus / valgus movement is applied to the joint and ligament stress is assessed (Figure 56).

When natural alignment is achieved (balanced medial and lateral tension) the position is stored on the system.

# Leg Flexion

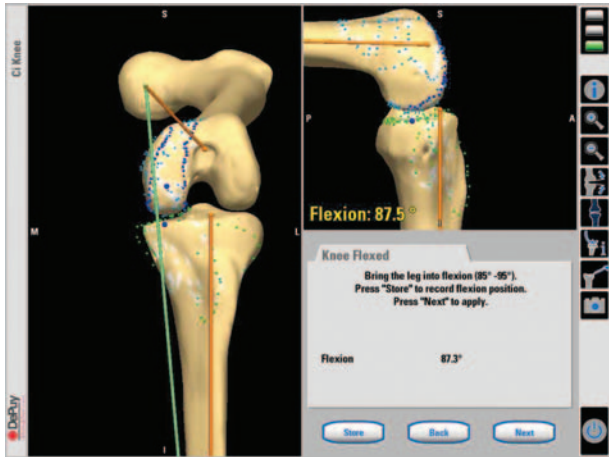



Figure 57

The leg is placed in approximately 85˚ to 95˚ of flexion. A neutral position of the tibia should be achieved. No external A/P or rotational force should be applied. The position is stored on the system (Figure 57).

# Femoral Implant Planning

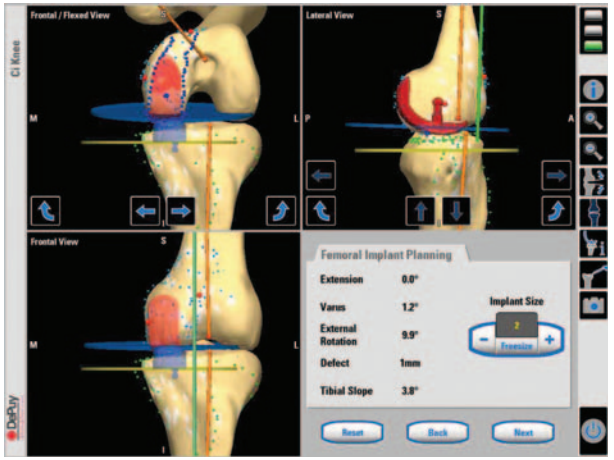



Figure 58

The femoral implant size and position is displayed on screen (Figures 58-61).

Button functions and screen information:

Blue arrows – allow repositioning of the femoral component

Dark blue lines – proposed cutting plane of the femur

Orange line - HKA line.

Yellow line – proposed cutting plane of the tibia

Green line - Most anterior point of the tibia, projected parallel to the mechanical axis of femur. The anterior point of the femoral component should always remain behind this line.

Frontal / flexed view (top left)

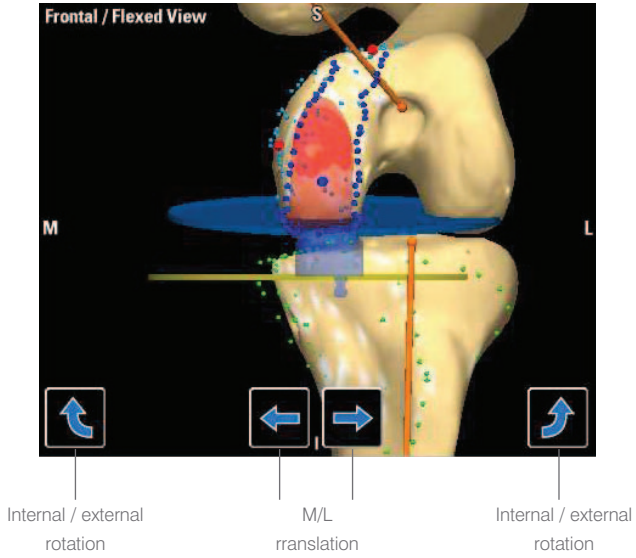



Figure 59

Lateral view (top right)

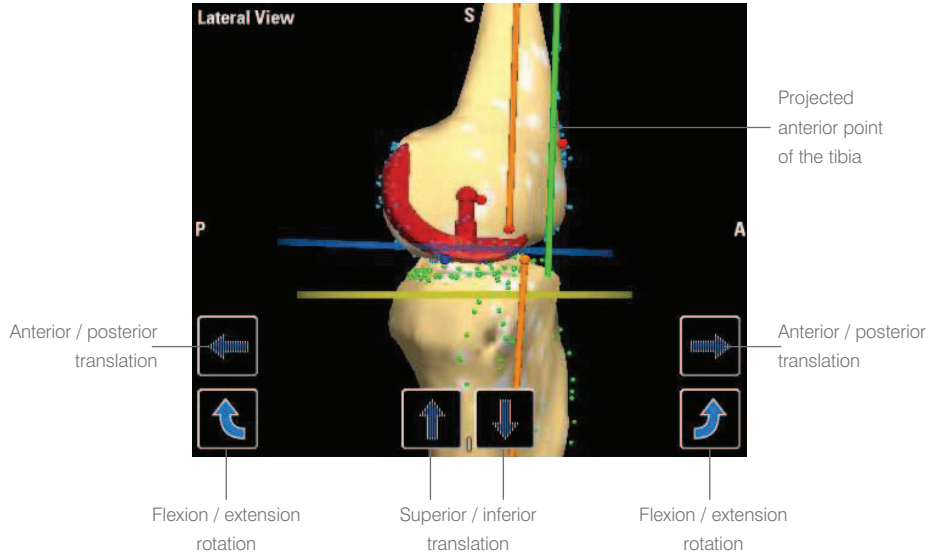


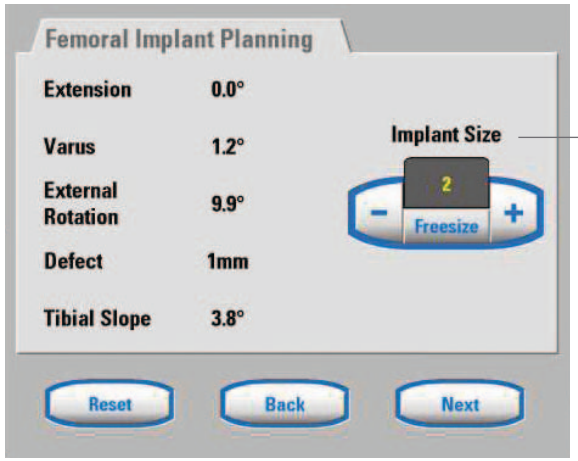

Figure 60

The image can be zoomed in or out for better viewing using the Zoom function on the menu bar.

Adjustment is limited to 10 degrees internal / external rotation, while changes to superior / inferior adjustment will automatically change the bone loss assumption.

# Tibial Implant Planning

Planning information (bottom right)




The implant size function is used to change the size of the femoral component. After changing the size, the distal cut will be re-calculated, and the flexion gap adjusted. The system will only allow compatible sized components to be selected.

The 'freesize' option can be used to manually change the implant size. However, if inappropriate implants are selected, the system will display a warning message relating to implant compatibility. The 'proceed' option will be removed at this stage to force the user to select compatible implants.

Figure 61

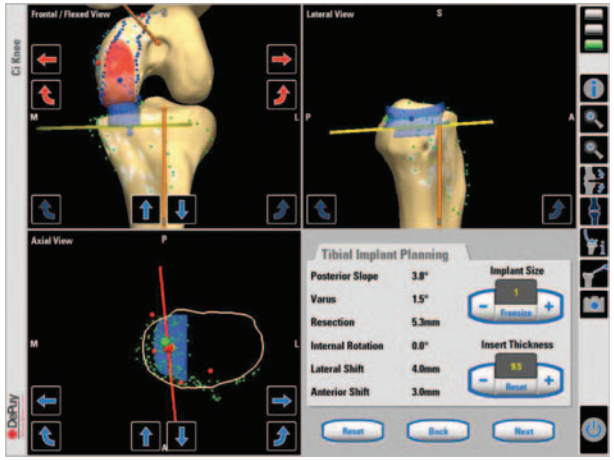



Figure 62

*When using the fine tune functions, the acquired points are the main reference for planning and implant placement. The 3D model only provides additional information and 3D orientation.*

Tibial implant planning is conducted in the same manner as the femoral implant planning. Adjustments can be made to both the proposed femoral and tibial implants at this stage (Figures 62 -66).

Frontal / flexed view (top left screen)

Superior / inferior and in varus / valgus adjustments can be made to the tibial implant. If the tibial insert thickness is increased, the resection level is automatically adjusted to ensure that leg alignment is not influenced.

Frontal / flexed view (top left)

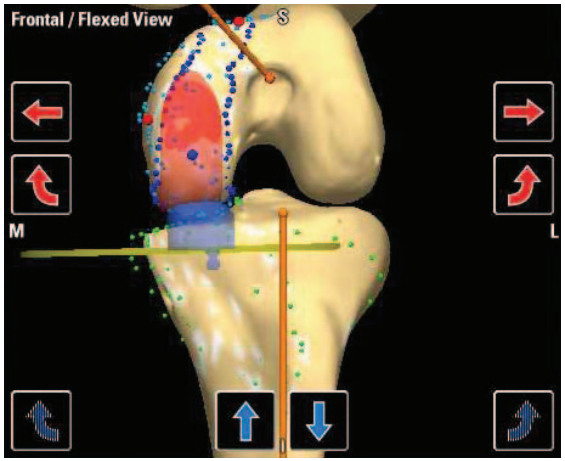



Figure 63

Medial / lateral and rotational adjustments may also be made to the femoral component at this stage.

Lateral view (top right screen)

The posterior slope can be adjusted using the blue arrows.

Lateral view (top right)

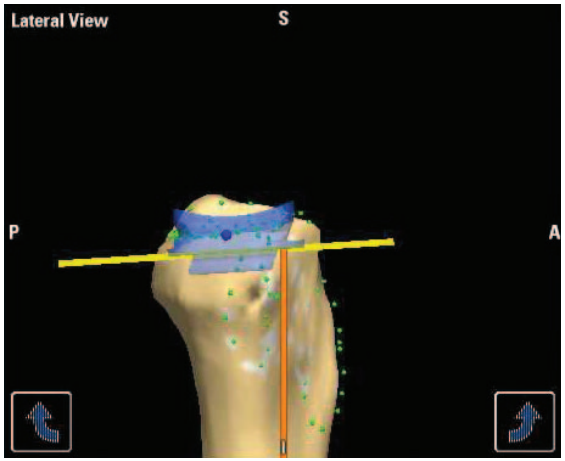



Figure 64

Axial view (bottom left screen)

The tibial implant position can be adjusted in A/P, M/L and internal / external rotation. The image shows the virtual tracking of the femoral component on the tibia in extension.

The yellow dot represents the centre of the tibial component

The red dot represents the contact point of the femoral component in extension

The red line represents the internal / external direction of the femoral implant in extension.

Axial view (bottom left)

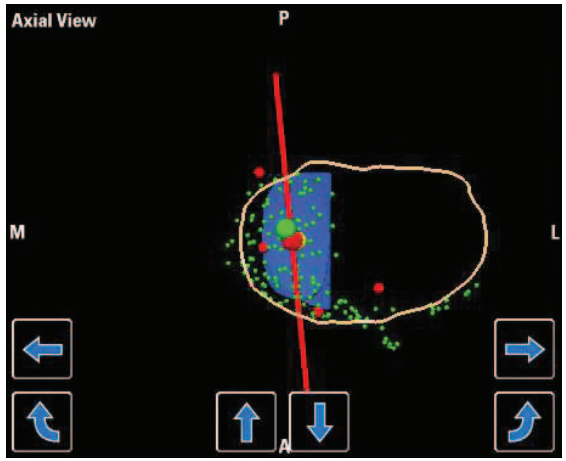
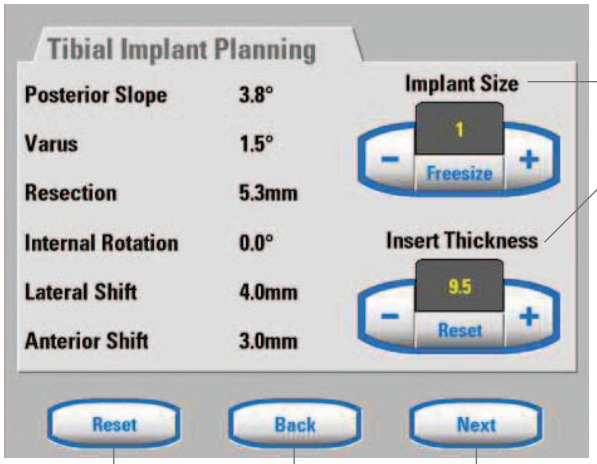



Figure 65

The tibial position and the femoral position (top left screen) are optimised to allow the contact point of the femoral component to lay central on the tibial component.
The orientation (red line) of the femur is approximately aligned to the direction of the tibial component.

# Motion Analysis

Planning Information (bottom right)




The 'implant size' and 'implant size' buttons change the size of the tibial component and / or the insert. The tibial cut is re-calculated and the gaps adjusted accordingly. The system only allows compatible sized implants to be selected.

The 'freesize' option can be used to change this manually. However, the system will only allow you to change the tibial component and insert size if a compatible femoral implant is also selected at the same time.

Resets all adjustments

Returns to the previous step

Accepts all adjustments

Figure 66

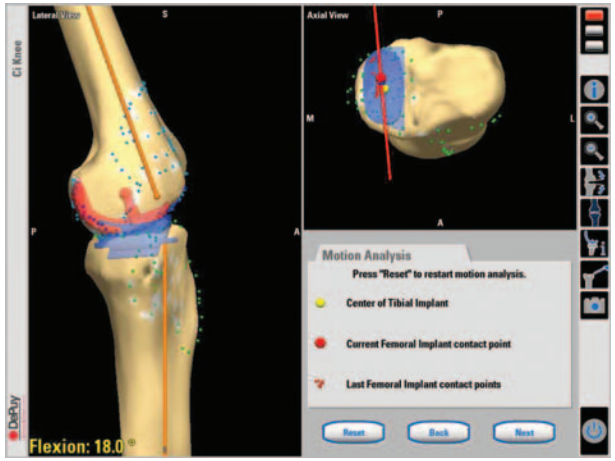



Figure 67

The planning screen displays the final tibial implant data.

The virtual contact points are shown on screen in real time through a full range of motions (Figure 67). If adjustments need to be made to the plan shown on screen, the previous implant planning steps can be repeated.

The yellow dot represents the centre of the tibial implant. The large red dot represents the current contact point of the femoral implant. The smaller red dots show the recorded contact points between the femoral and tibial components.

# Tibial Pin Insertion

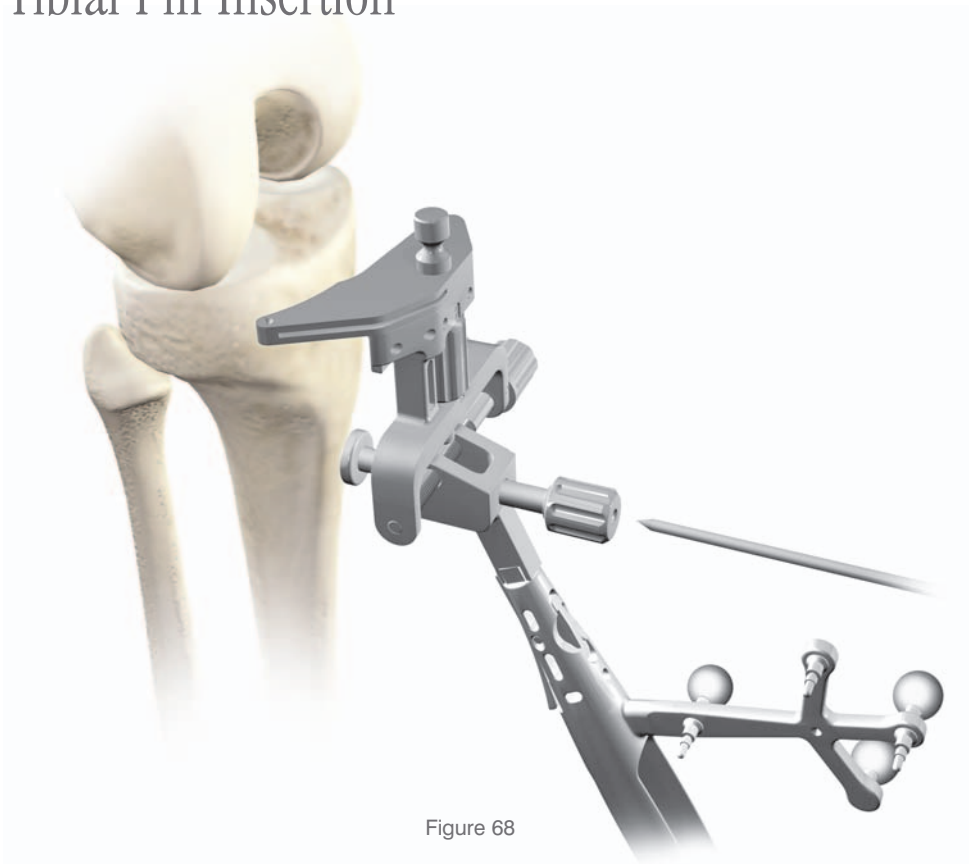


Figure 68

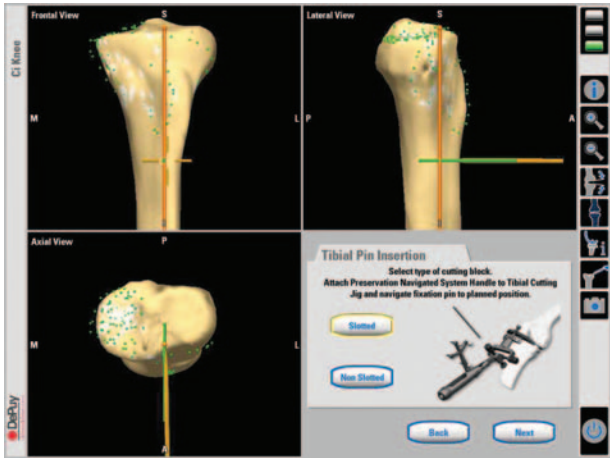



Figure 69

The navigated system handle is attached to the tibial jig (Figure 68). The suggested fixation position of the pin is shown on screen (Figure 69). The system handle allows the tibial jig and pre-fixation pin to be accurately positioned on screen.

If the shape of the tibia does not allow fixation in the M/L position shown on screen, the closest possible position should be used.

A slotted or non-slotted cutting option is selected on screen, depending on preference (Figure 69).

When navigation is complete, the tibial jig is pinned in place.

*Note: If the pin is moved too far from the suggested screen position, M/L adjustment may be difficult.*

# Tibial Resection Navigation

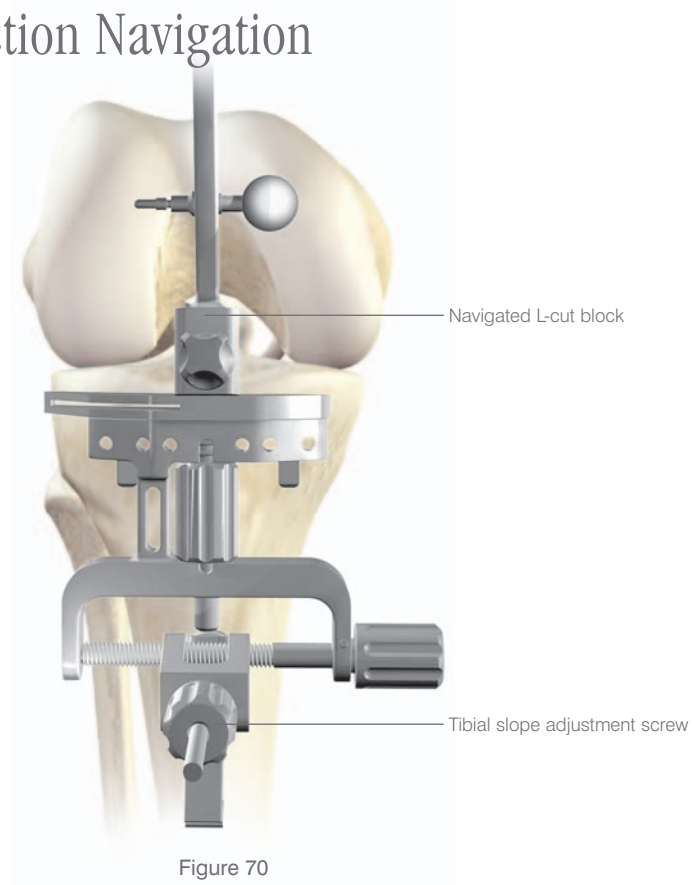



Figure 70

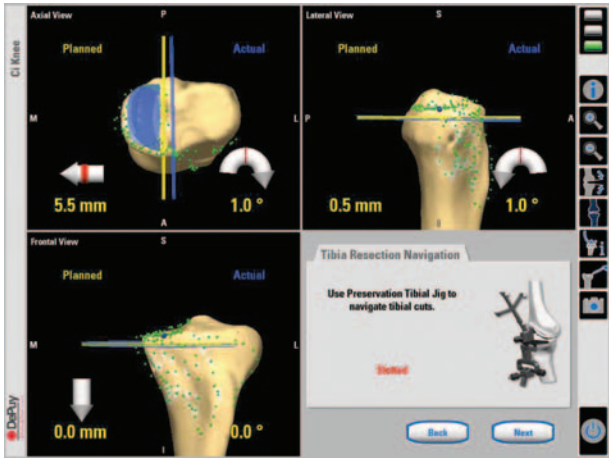



Figure 71

With the tibial jig pinned in place, the navigated handle is removed. The navigated tibial jig array / L-cut block is attached to the top of the tibial jig (Figure 70).

Make sure the tibial jig is placed against the tibia throughout the following steps to maintain a consistent reference for the fine adjustments on screen.

**Step 1:** The L-cut block is rotated until the navigated L-cut line (blue) is parallel to the planned L-cut line (yellow) (Figure 71). Once in position, the screw is tightened to ensure stable fixation.

**Step 2:** The tibial slope is adjusted by turning the slope screw until the planned and actual resection planes are parallel in the sagittal view. The slope may be increased by up to 2˚ after pinning the jig to the bone. The slope cannot be decreased at this stage.

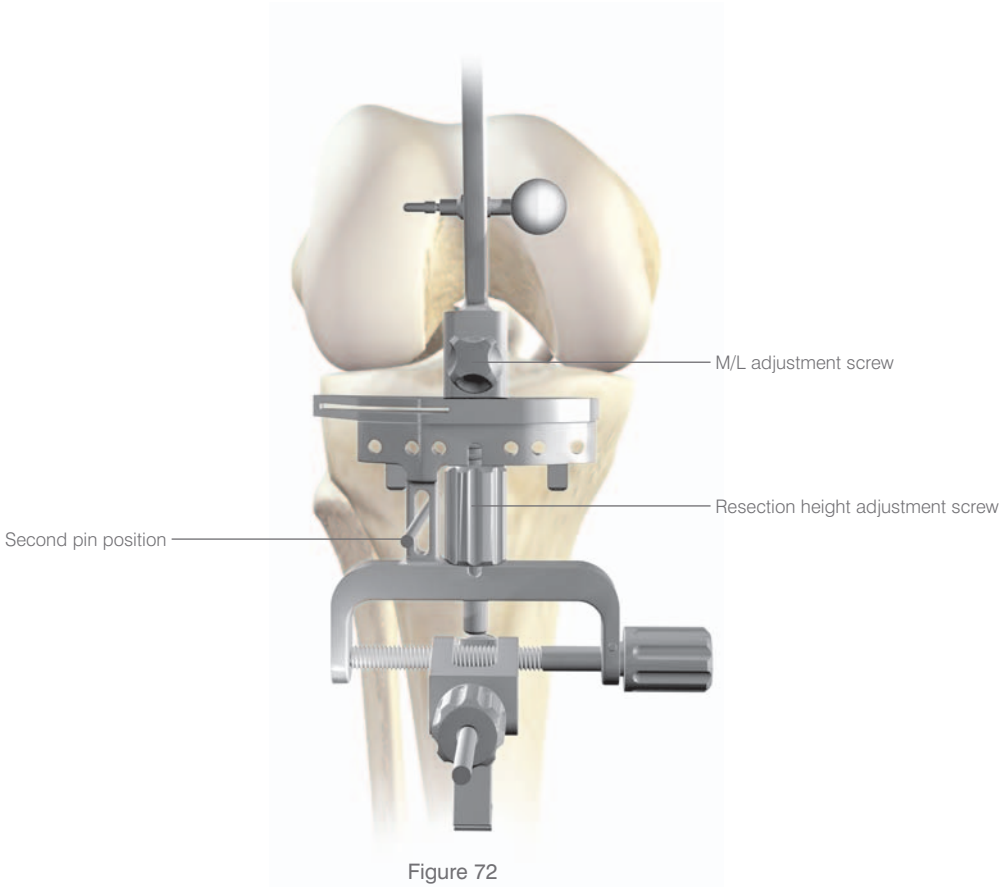



Figure 72

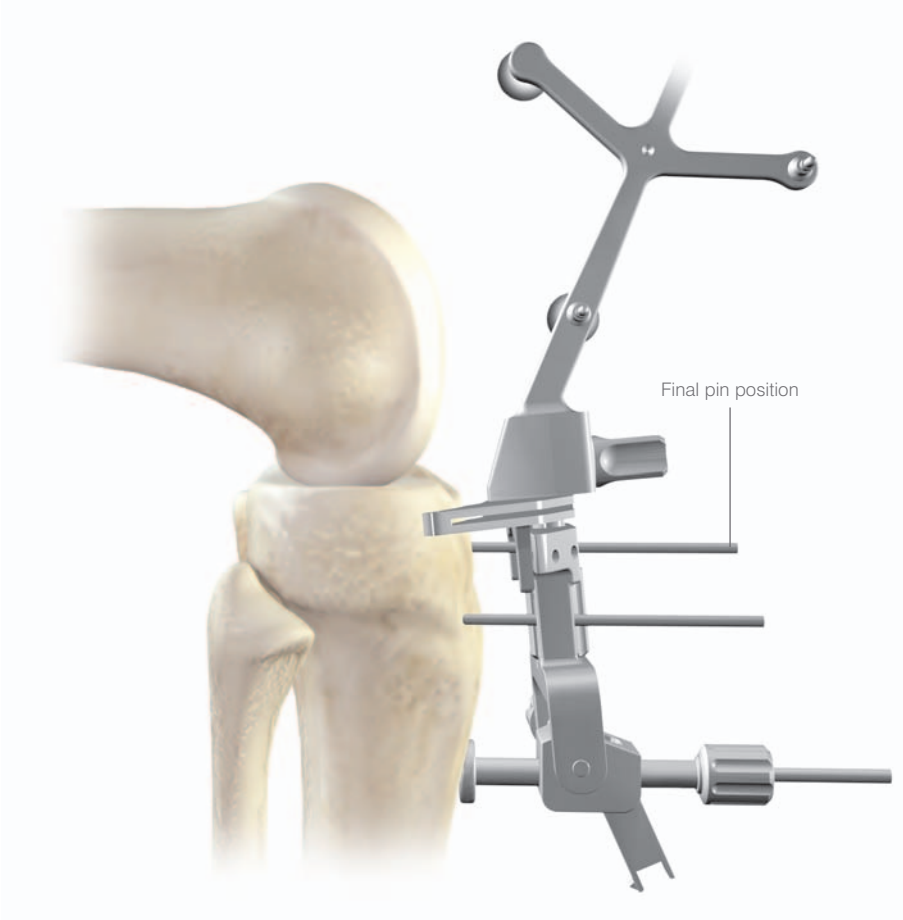



Figure 73

**Step 3:** The tibial jig is rotated around the initial pin to adjust the varus / valgus angle.

**Step 4:** The M/L-position of the L-cut is adjusted by turning the M/L adjustment screw. It is important that the varus / valgus angle remains unchanged during M/L adjustment.

**Step 5:** Once the M/L, varus / valgus and tibial slope are aligned, the tibial jig is secured in place below the cutting block using one or two pins (Figure 72).

**Step 6:** The height of the tibial cut is now adjusted by turning the vertical screw in the centre of the tibial jig. Adjustments to the varus / valgus angle and tibial slope can be made if required. The jig is secured in place with a final pin prior to resection (Figure 73).

# Tibial Resection

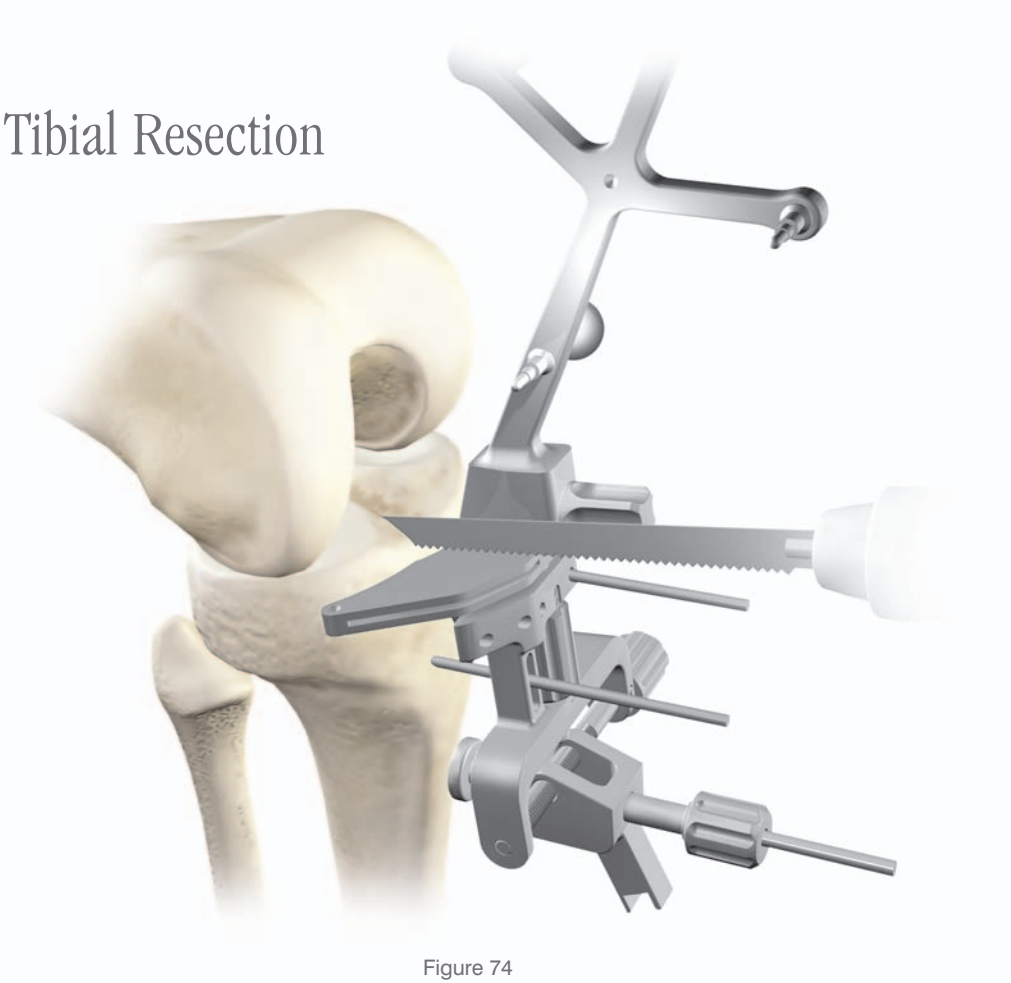


Figure 74

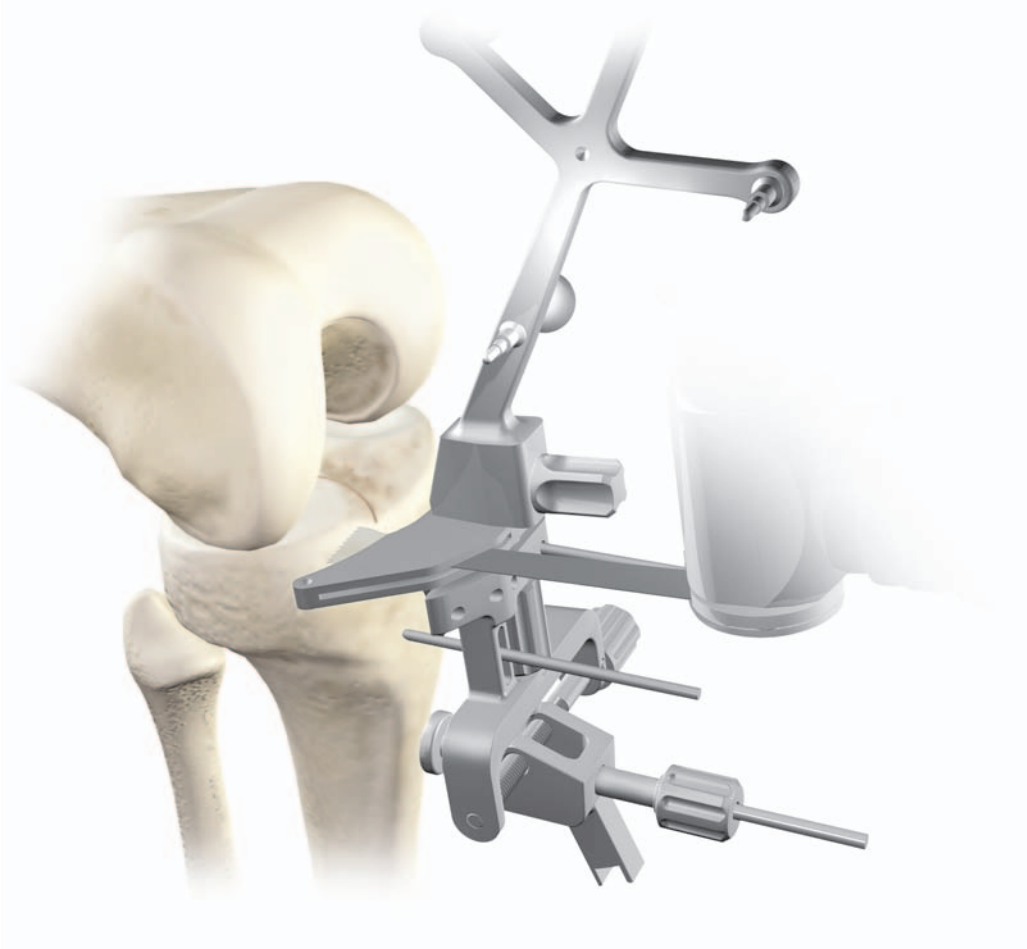


Figure 75

The L-cut is initiated along the L-cut guide. The L-cut can be completed after removing the L-cut block (Figure 74).

The transverse cut must be performed according to the cutting option selected earlier (either slotted or non-slotted) (Figure 75).

*Care must be taken to avoid over resecting the bone or weakening the ACL. During the transverse cut, the saw blade must be kept as level as possible, and the L-cut guide must be used to avoid cutting into the unaffected condyle. The L-cut must not proceed past the transverse cut as this may cause tibial fracture.*

# Tibial Resection Verification

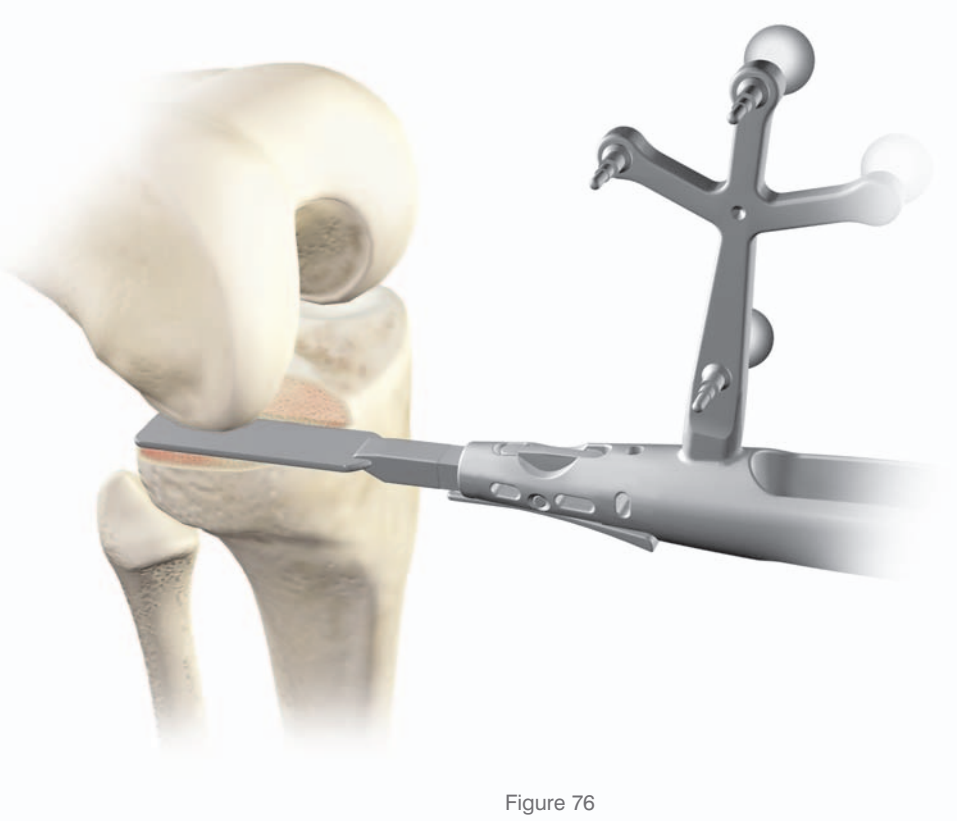
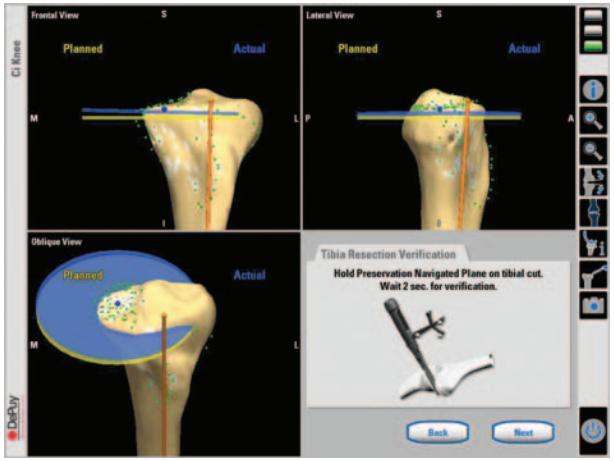


Figure 76



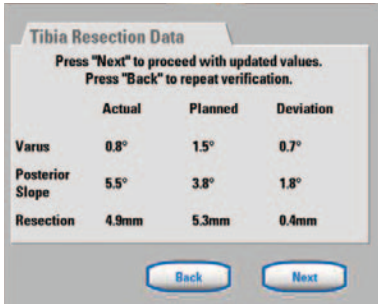




Figure 77

The tibial resection is verified using the navigated plane, attached to the navigated handle (Figures 76 & 77).

The resection may be repeated at this stage if required.

# Check Extension Gap

Figure 78

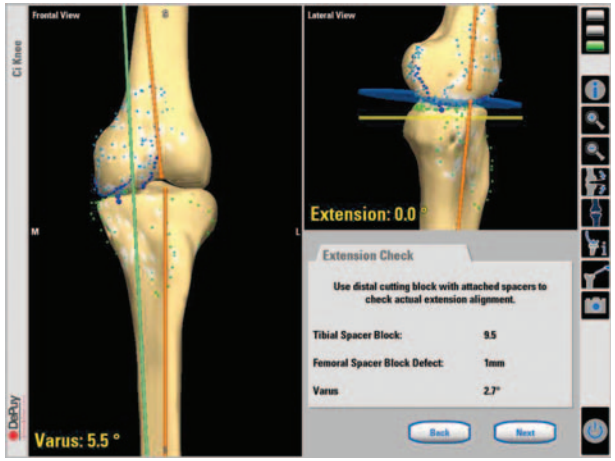



Figure 79

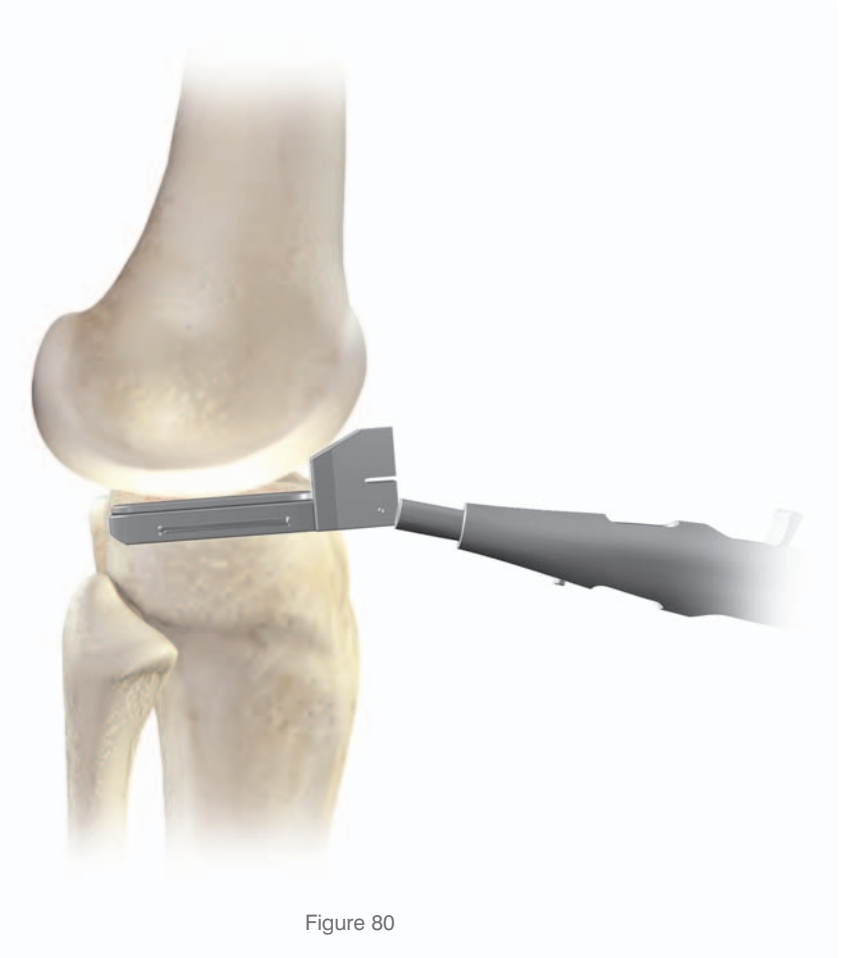


Figure 80

The distal femoral cutting block is attached to the non-navigated handle (Figure 78).

The system will indicate which tibial and femoral spacer blocks to attach to the cutting block (Figure 79).

The cutting block is inserted into the extension gap and the joint is assessed for stability and alignment is checked on screen (Figures 79 & 80).

# Check Flexion Gap

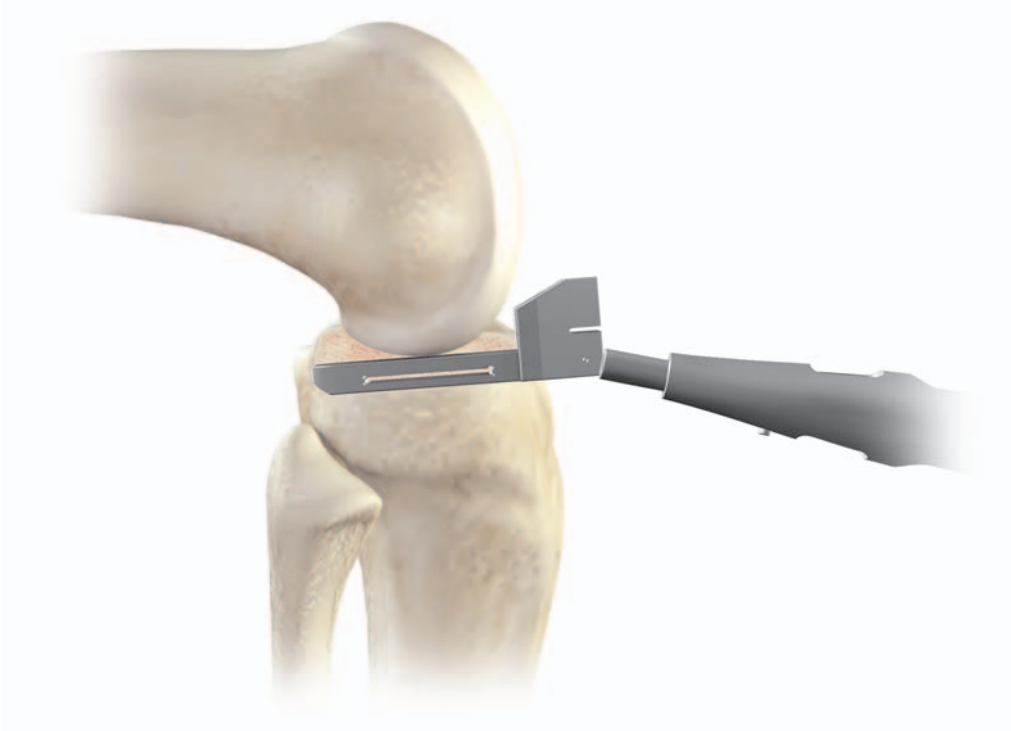


Figure 81

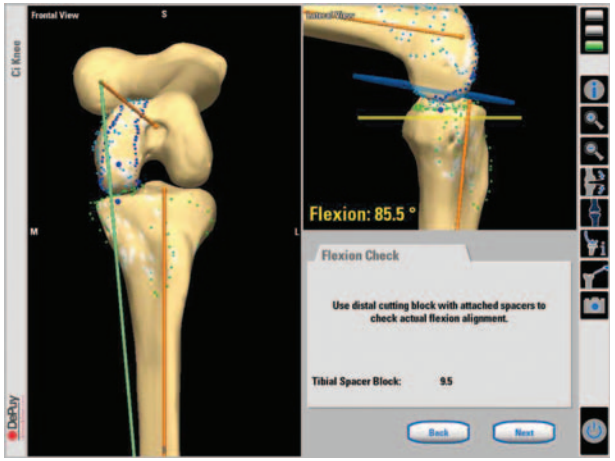



Figure 82

The cutting block is removed and the knee is placed in approximately 90˚ of flexion. The femoral spacer is removed, and the cutting block is inserted into the flexion gap. The joint is assessed for stability (Figures 81 & 82).

*Note: Make sure the knee is stable in extension. The flexion position allows for slightly more laxity, which may help in high flexion.*

# Extension / Flexion Gap Adjustments

### Tight in Extension / Flexion OK:

- Check the tibial slope and re-cut if necessary.
- Reduce the bone loss assumption (i.e. a thinner bone loss shim may be used to move the femoral component slightly proximal)

### Tight in Extension and Flexion:

- A thinner insert should be selected.
- If a thinner insert is not available, re-cut the tibia and update the tibial cut with the navigated plane

### Tight in Flexion / Extension OK:

- Check the tibial slope and re-cut if necessary.
- If the tibial slope is OK a small shave of bone may be taken from the posterior condyle.
- Alternatively, choose a thinner tibial insert or re-cut the tibia, and increase the bone loss assumption (i.e. a thicker bone loss shim may be used to move the femoral component slightly distal).

### Loose in Flexion / Extension OK:

- Check the tibial slope and re-cut if necessary.
- Choose a thicker tibial insert and reduce bone loss assumption. Reduce the bone loss assumption (i.e. a thinner bone loss shim may be used to move the femoral component slightly proximal. The knee should not be tight in flexion).

### Loose in Extension / Flexion OK:

- Check the tibial slope and re-cut if necessary.
- Choose a thicker tibial insert and shave a little off the posterior condyle to adjust the flexion gap.
- Alternatively, increase the bone loss assumption (i.e. a thicker bone loss shim may be used to move the femoral component slightly distal).

### Loose in Extension and Flexion:

- Use a thicker tibial insert.
- Note: Be careful with using larger bone loss shims to correct a loose extension position as this could lead to a very thin resection level on the distal femur. If this resection level is very thin, fixation of the femoral cutting block may be problematic later in the procedure.

# Distal Femoral Resection

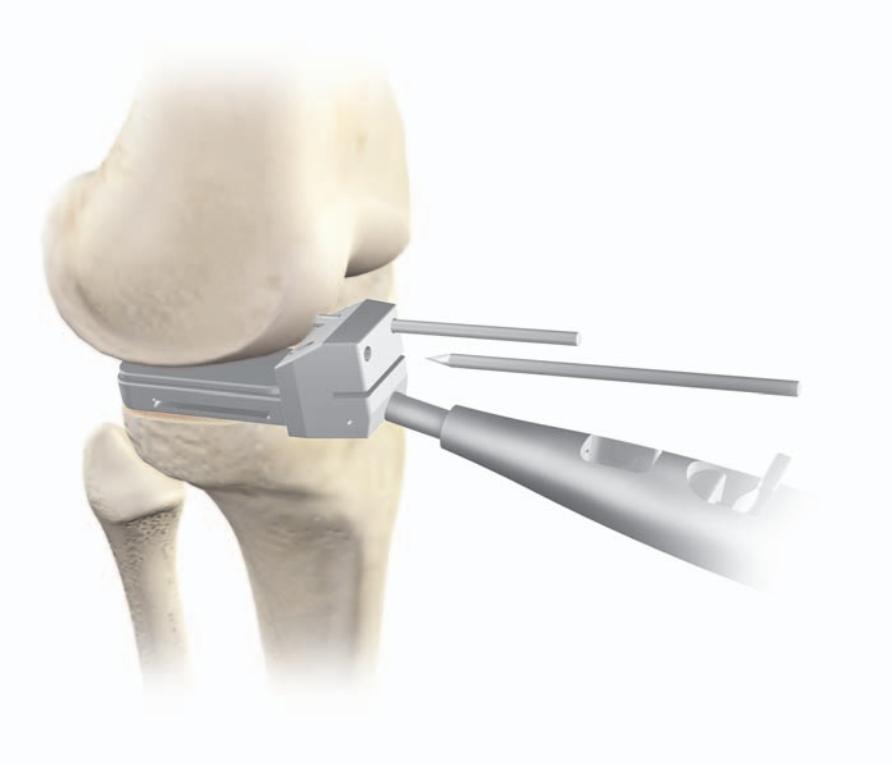


Figure 83

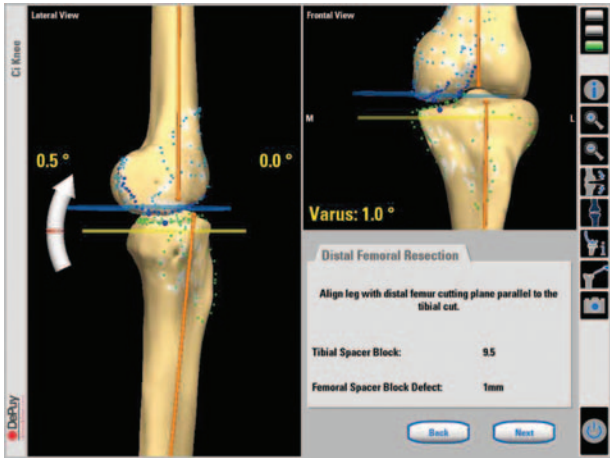



Figure 84

The non-navigated system handle is attached to the distal femoral cutting block. The appropriate tibial and femoral spacers are added to the cutting block as indicated on screen (Figure 84).

The block and spacers are introduced into the joint and the leg flexed to the angle as indicated on the screen (2 planes parallel). This ensures that the distal cut matches the planned flexion / extension angle of the femoral component (Figures 83 & 84).

Two pins are used to fix the cutting block in place.

*Important: There should be no gap between the distal cutting block and the surface of the femur. If a gap exists, the resection will not match the planned resection on the system.*

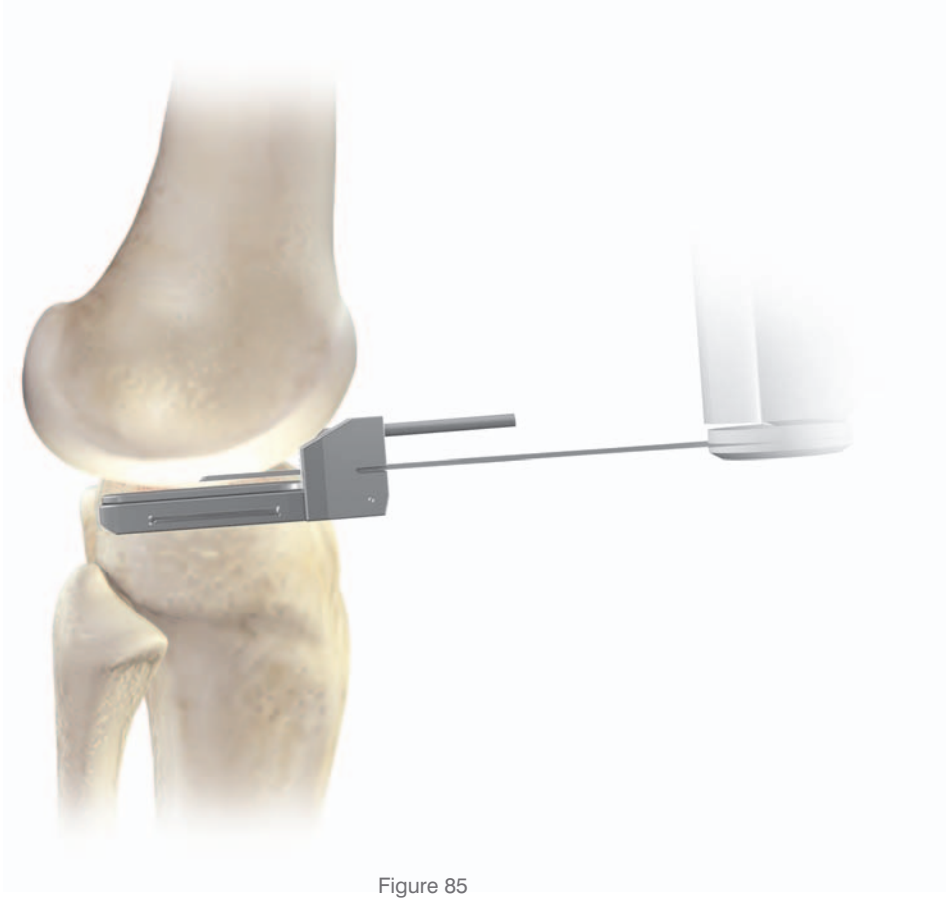


Figure 85

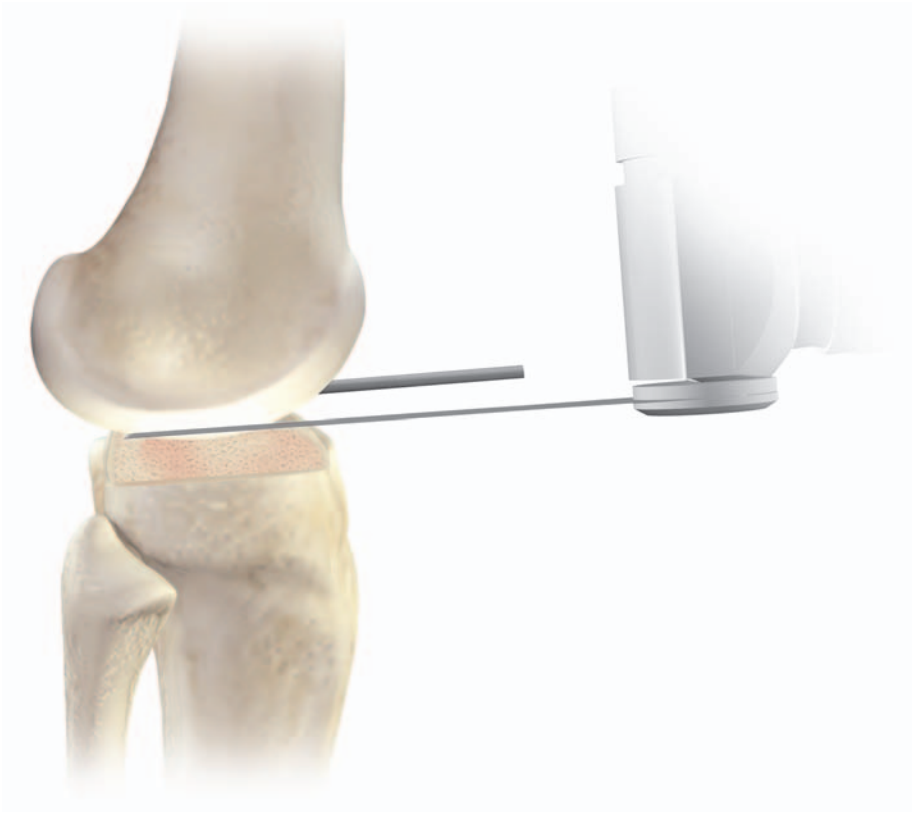


Figure 86

The system handle is removed and the distal resection performed (Figure 85).

To avoid capsular damage posteriorly, this cut should be completed with the distal femoral cutting block removed (Figure 86).

Once the resected distal bone is removed, any remaining soft tissue is cleared from the meniscal rim and posterior of the tibia.

# Distal Femoral Resection Verification

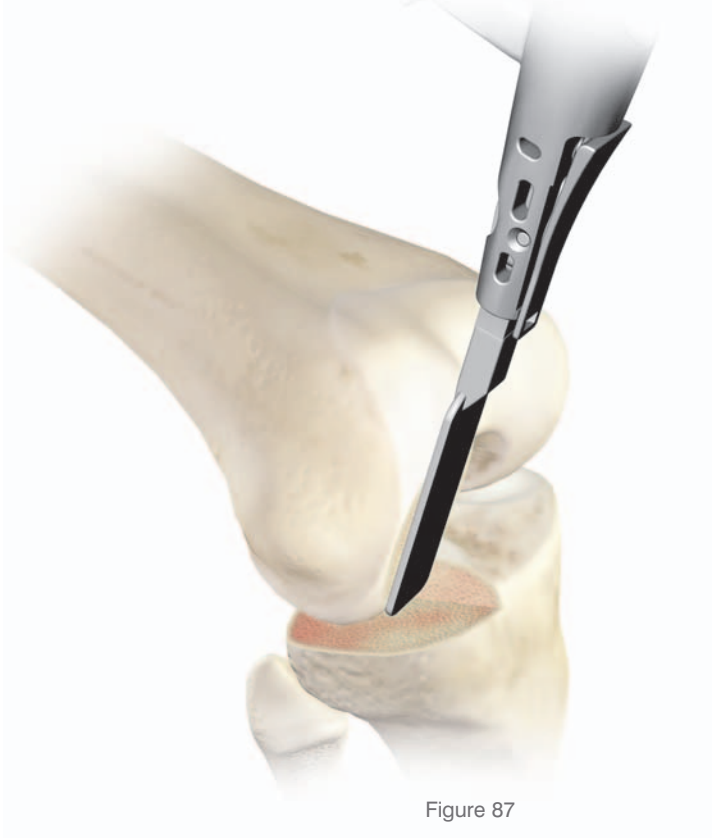
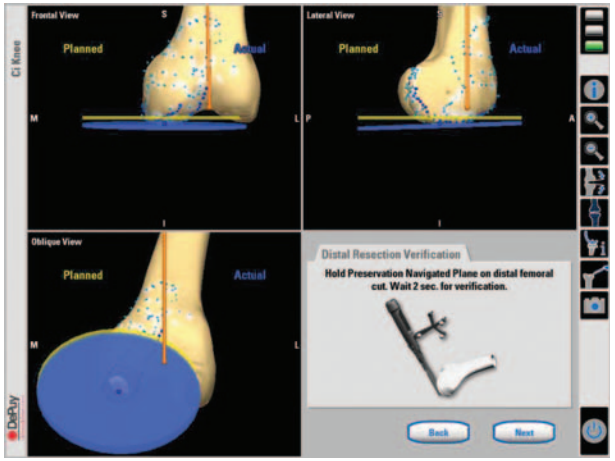


Figure 87



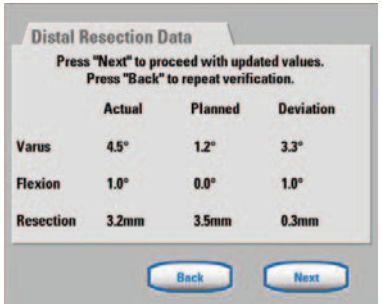




Figure 88

The femoral resection is verified using the navigated plane (Figure 87).

The resection may be re-performed if required. The verified position is used to update the plan on the system (Figure 88).

# Tibial Template Navigation

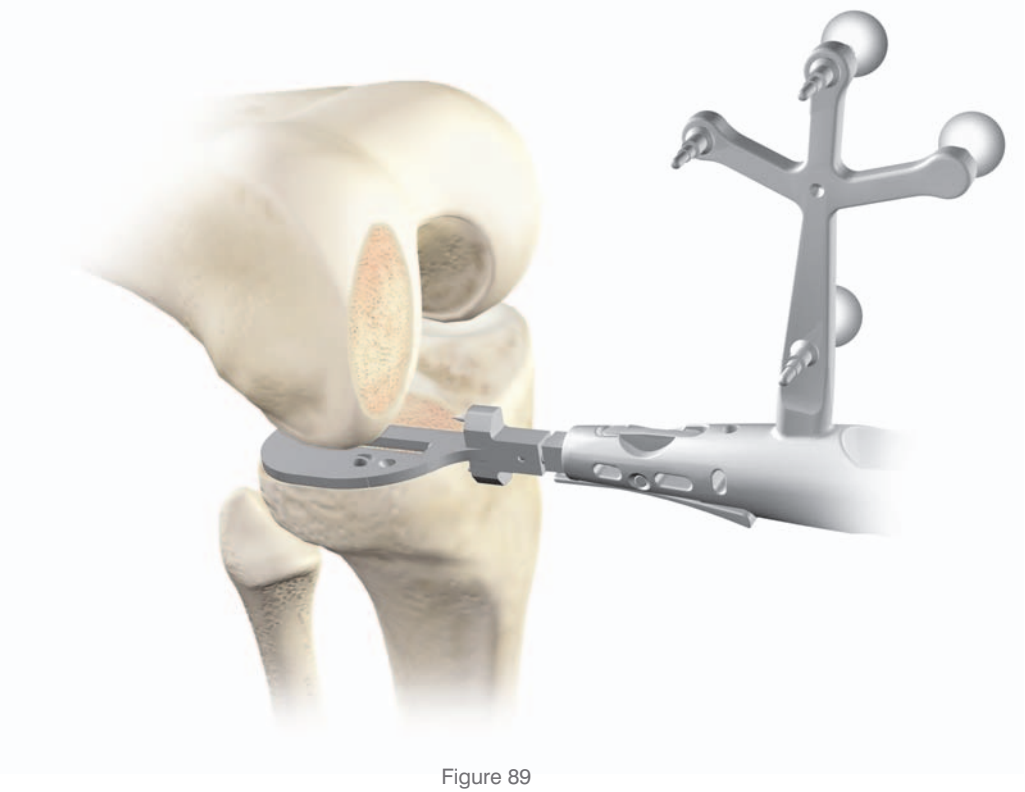


Figure 89

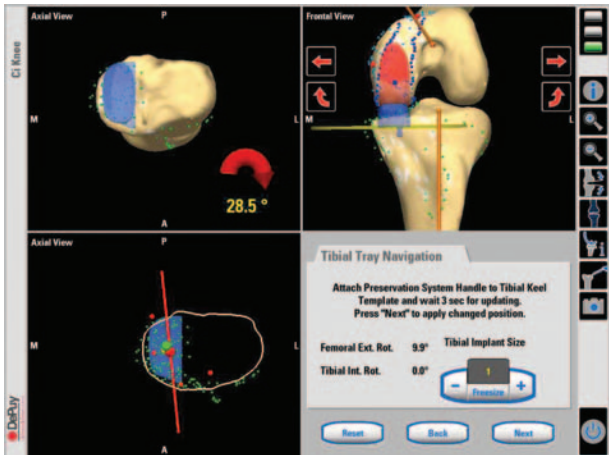



Figure 90

The tibial template (as indicated on screen) is attached to the navigated system handle and positioned on the resected tibia using on screen navigation (Figures 89 & 90).

If good bone coverage cannot be achieved, a new position can be chosen or the template size can be changed. The template is held in position for 3 seconds to update the system. The axial view is used to assess the component tracking on screen.

- The yellow dot represents the centre of the tibial component.
- The red dot represents the contact point of the femoral component in extension.
- The red line represents the internal / external rotation of the femoral component in extension.
- The M/L and rotational position of the femoral component can be adjusted at this stage to improve tracking alignment.

# Tibial Template Preparation

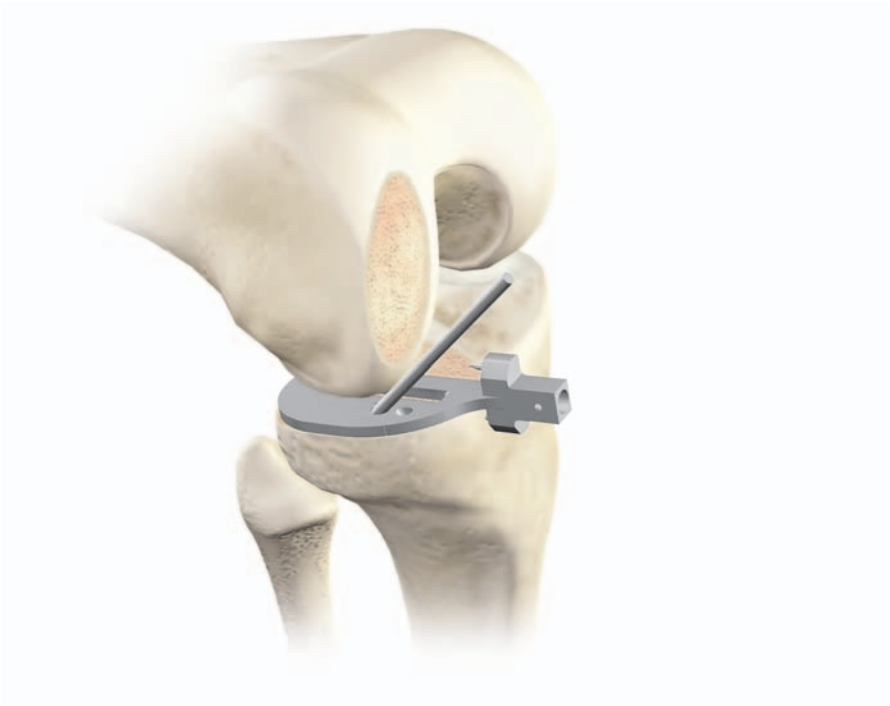


Figure 91

With all on screen adjustments made, the navigated handle is removed and the template is fixed in place with a Specialist® II pin and the navigated handle is removed (Figure 91).

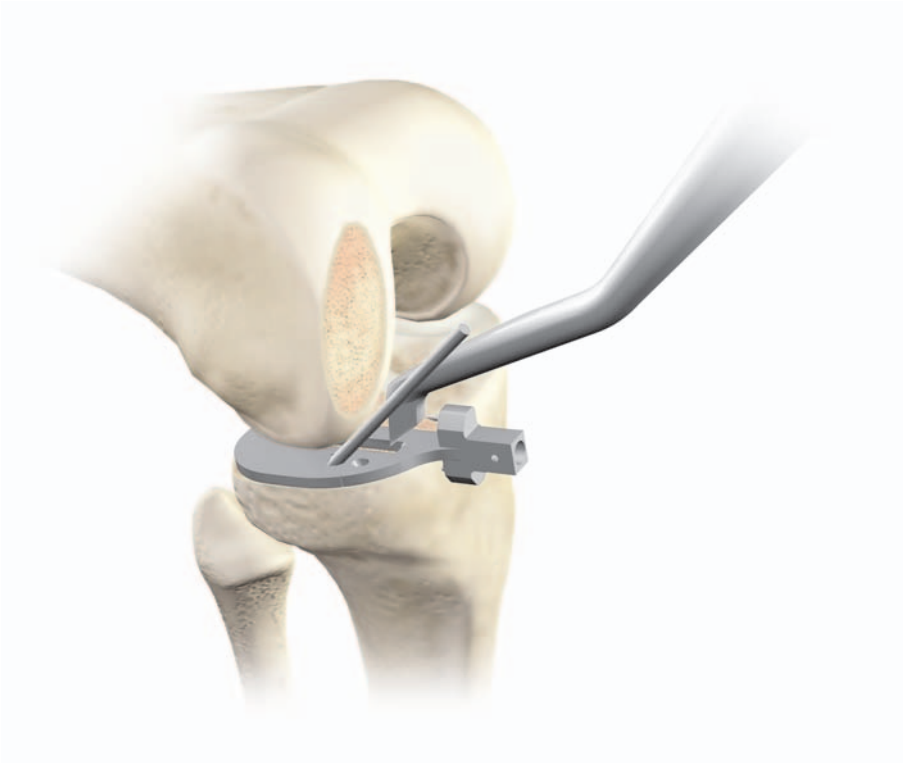


Figure 92

A sagittal saw is used to pre-cut the keel slot. The tibial osteotome completes the keel preparation (Figure 92).

# Femoral Preparation

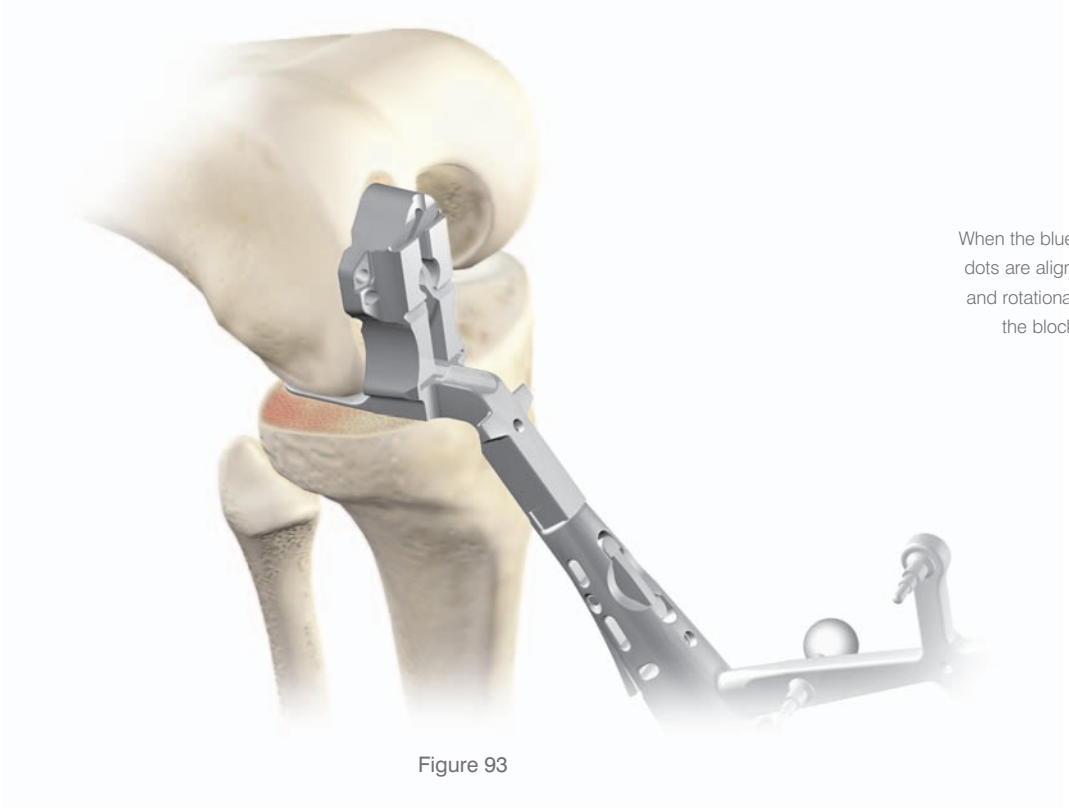


Figure 93

When the blue and yellow dots are aligned, the M/L and rotational position of the block is correct.

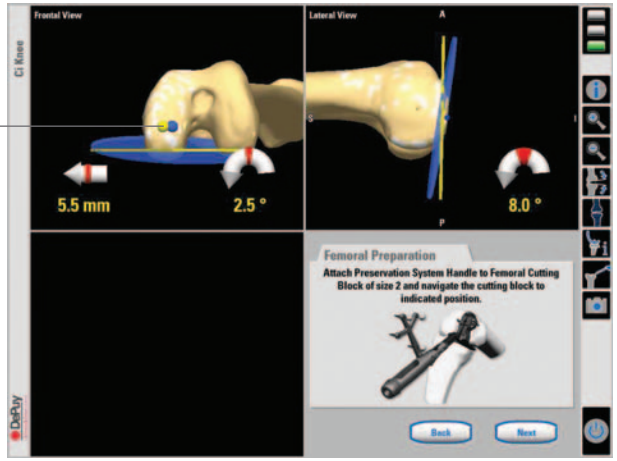



Figure 94

The femoral finishing block is attached to the navigated system handle.

The block is placed flush to the distal femoral resection, with the foot held against the posterior condyle. It may help to adjust the angle of the leg to reduce the tension in on the patella while positioning the block (Figure 93).

The screen indicates if the block is sitting flush on the distal cut (Figure 94).

Rotational alignment and M/L position are navigated on screen.

With correct alignment achieved, the block is pinned in place.

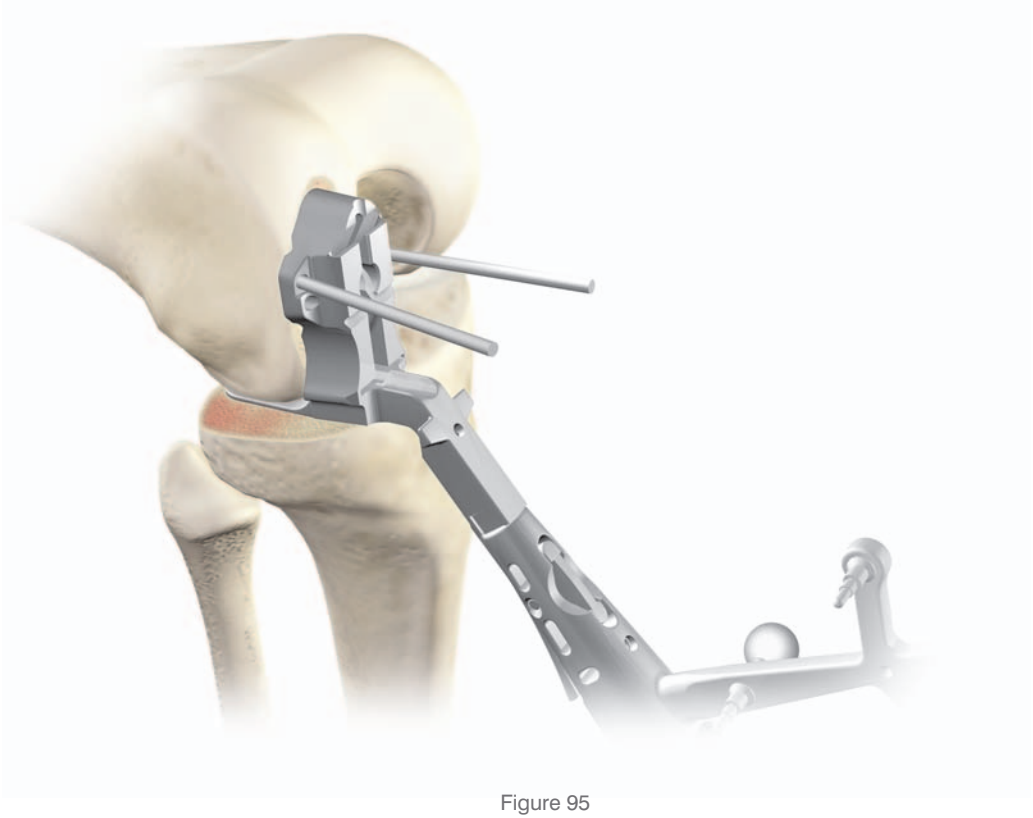


Figure 95

There are two pin holes on either side of the block. The upper pin hole is angled, and is used on the outer side of the condyle. The lower straight hole is used on the side closest to the patella (Figure 95).

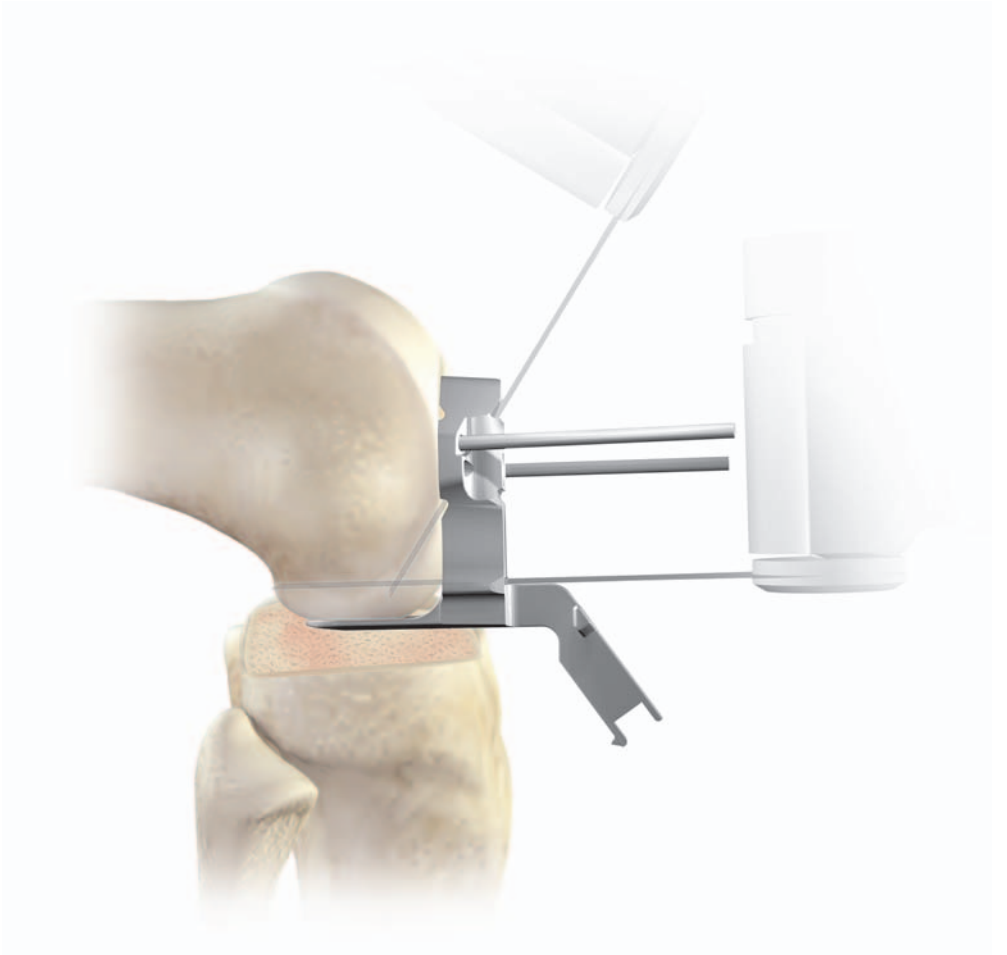


Figure 96

The system handle is removed and the posterior resection and posterior chamfer cut are made using a Preservation™ saw blade (Figure 96).

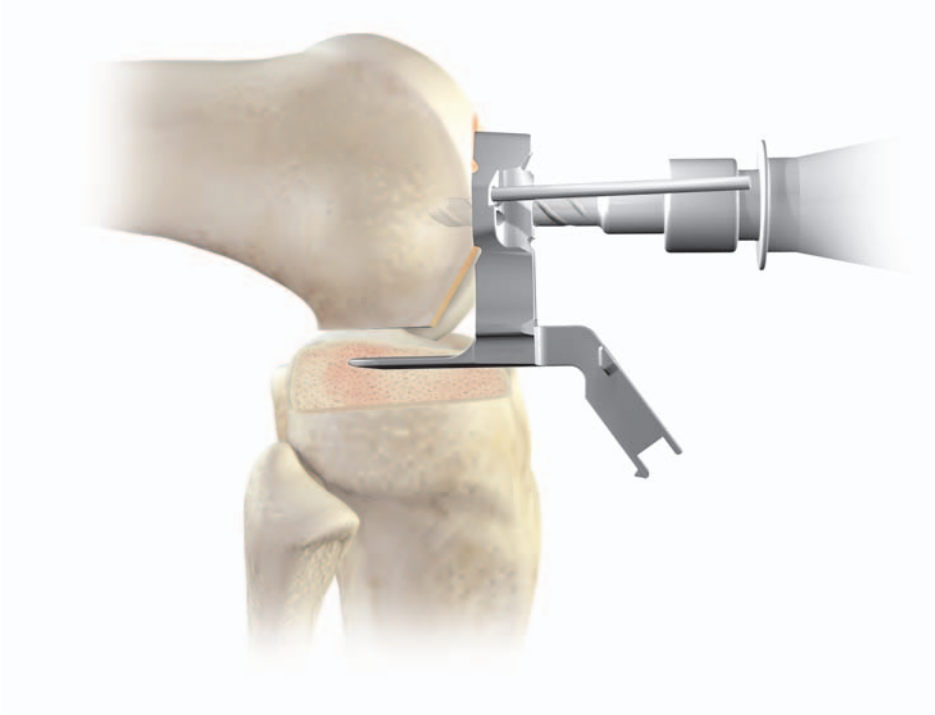


Figure 97

The femoral peg hole is made using the peg drill (Figure 97).

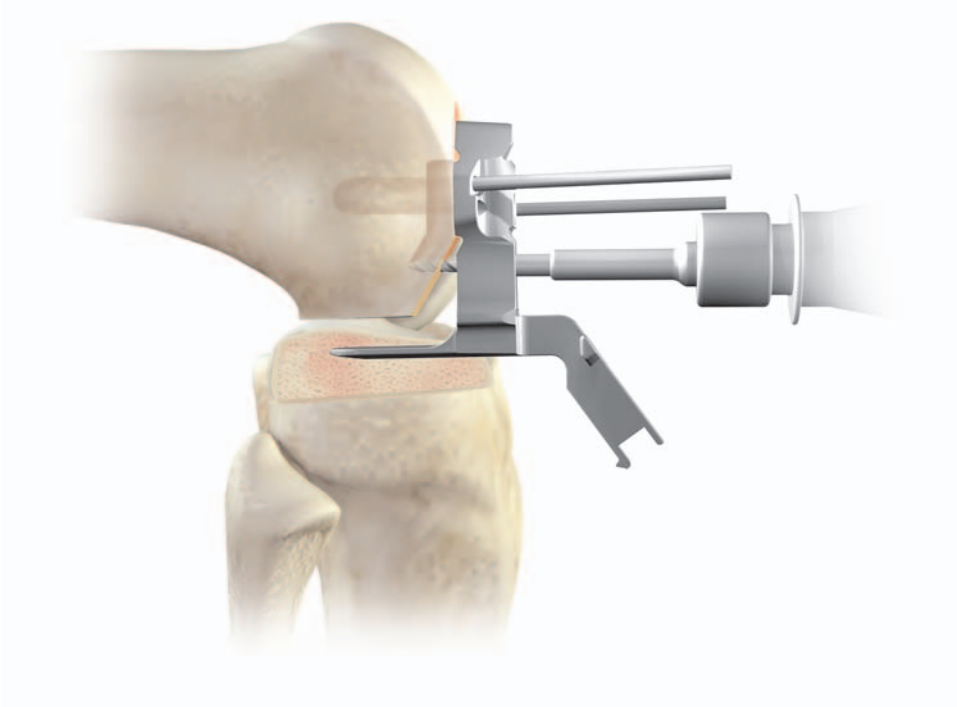


Figure 98

The femoral slot is completed with a burr. In cases where hard or sclerotic bone is present the slot should be pre-cut with a saw blade (Figure 98).

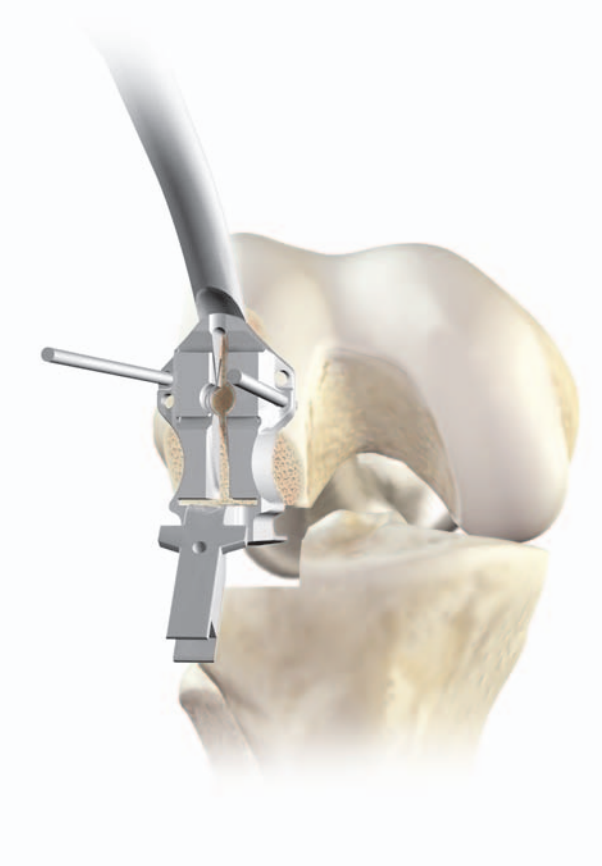


Figure 99

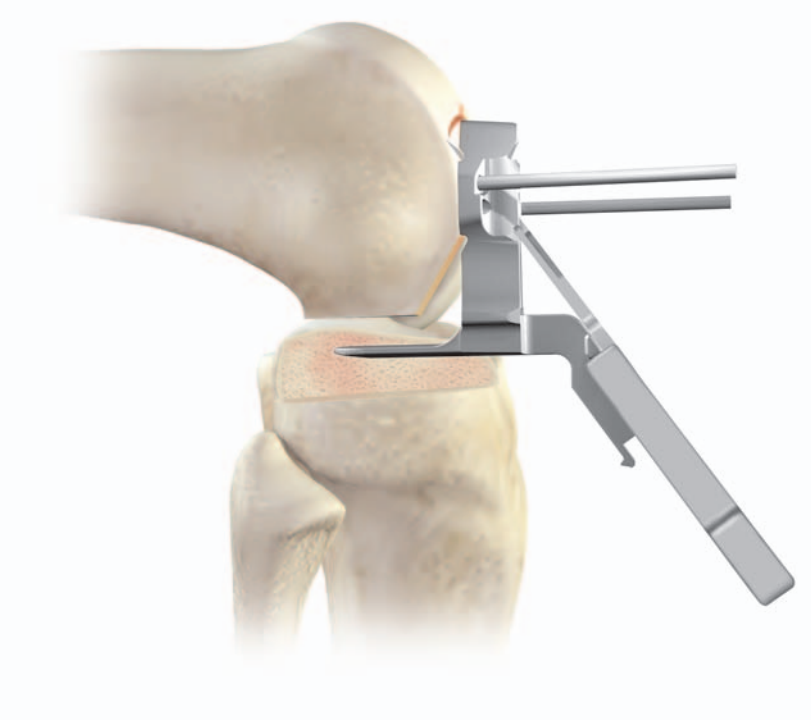


Figure 100

The $^{3}/_{8}$th hibs gouge is used to mark the anterior profile of the femoral component (Figure 99).

The Preservation™ chisel is used to make the anterior chamfer cut (Figure 100).

# Component Trial & Verification

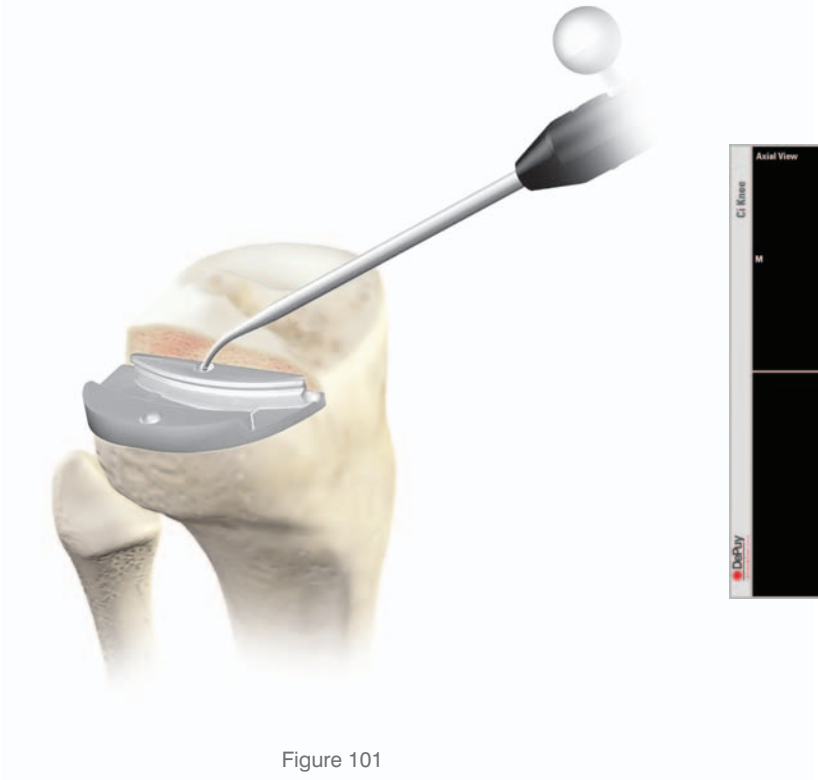


Figure 101


Figure 102

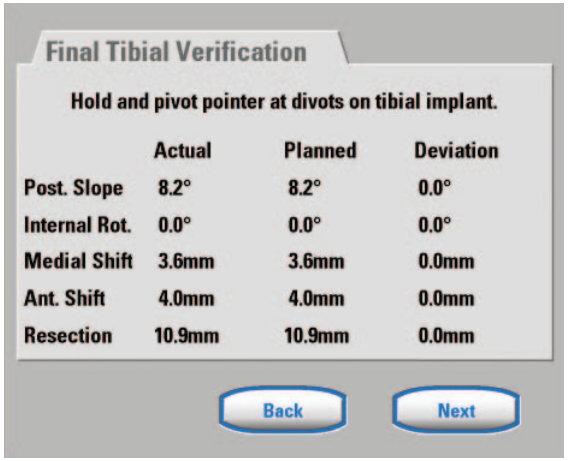



Figure 103

The trial components are used to ensure that the knee is placed in the appropriate position to facilitate implantation, prior to inserting the final components.

The tibial prosthesis is trialed first and gently impacted into place using the C-arm impactor. The tray and keel should be fully seated on the tibia. The position of the three dimples in the trial are recorded with the pointer in the order as indicated on screen (Figures 101 & 102).

The system will then display a report with planned and achieved measures. The appropriate tibial insert trial is inserted. For all poly and fixed bearing tibial implants the same modular trials are used (Figure 103).

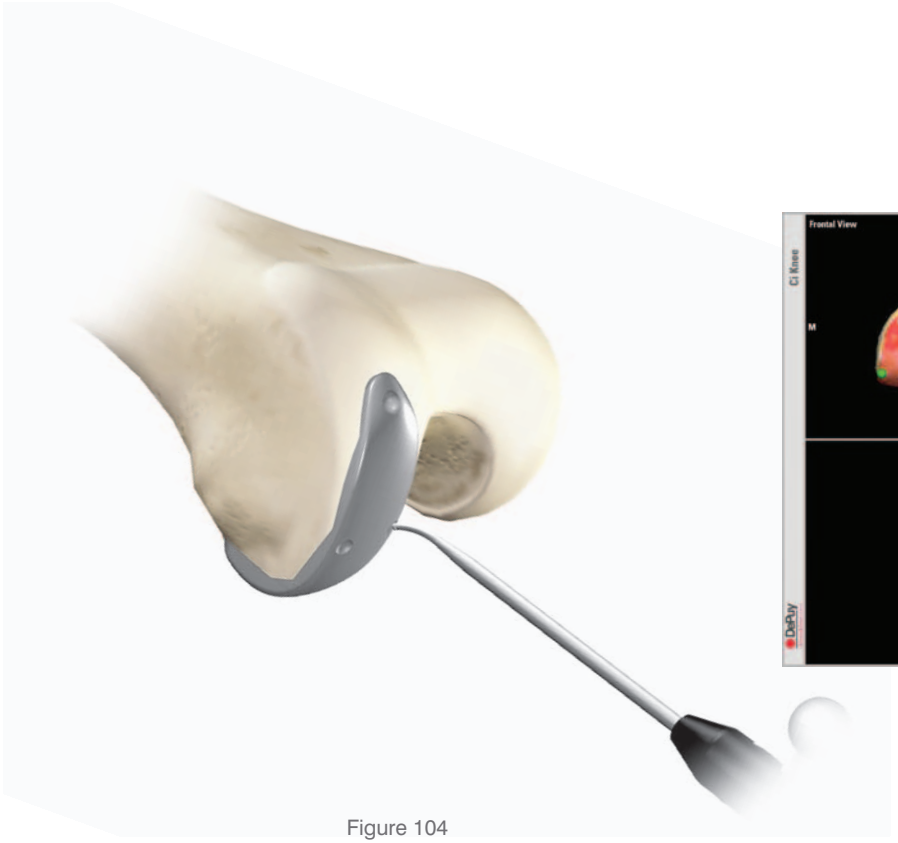
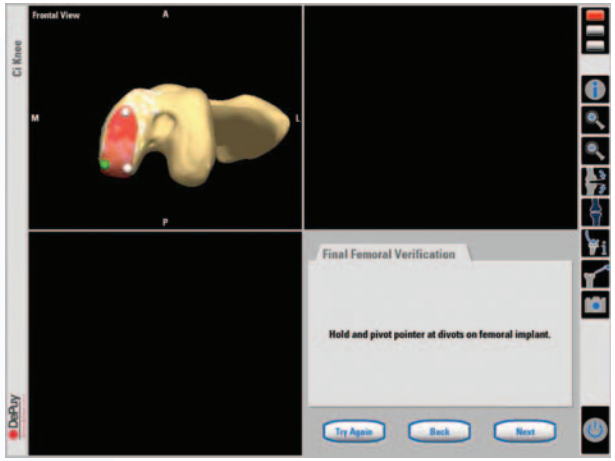


Figure 104



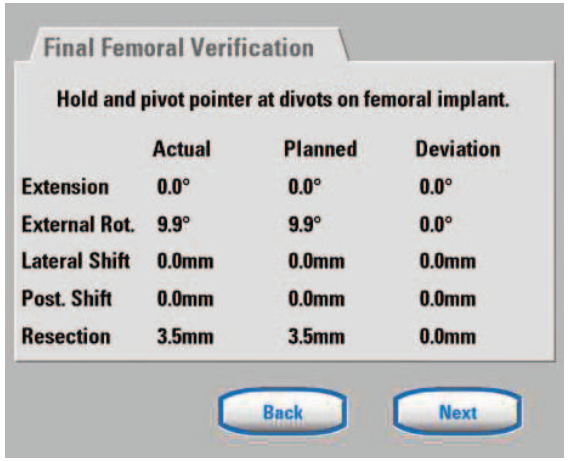




Figure 105

The femoral prosthesis is attached to the femoral introducer, introduced to the femur and gently pushed into place using the femoral impactor. The position of the three dimples in the trial are recorded with the pointer in the order indicated on screen (Figures 104 & 105).

The system will then display a report with planned and achieved measures (Figure 106).

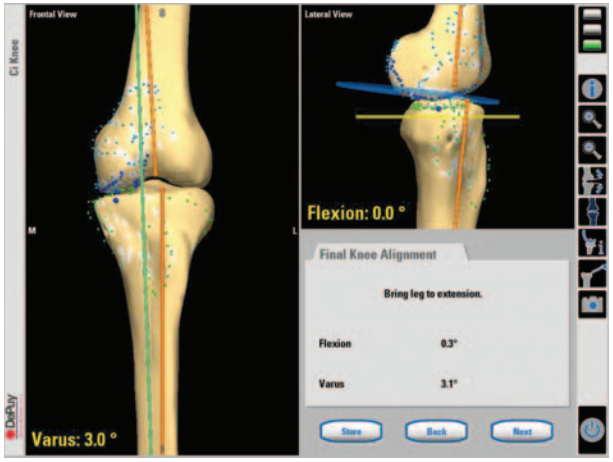



Figure 107

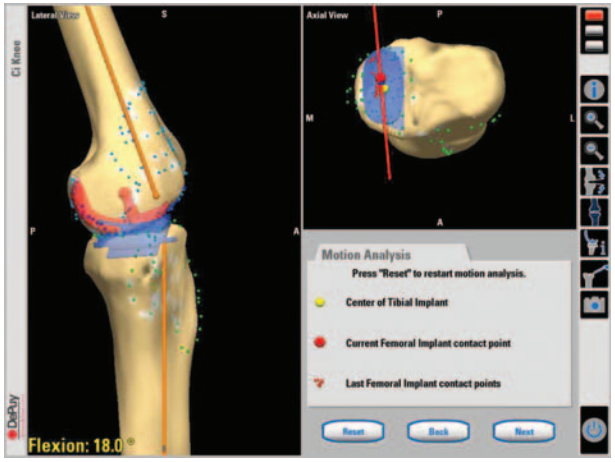



Figure 108

The joint is checked for alignment and stability in flexion and extension (Figure 107).

The tracking of the components can also be checked (Figure 108).

Final femoral preparation should be completed using current Preservation™ instruments.

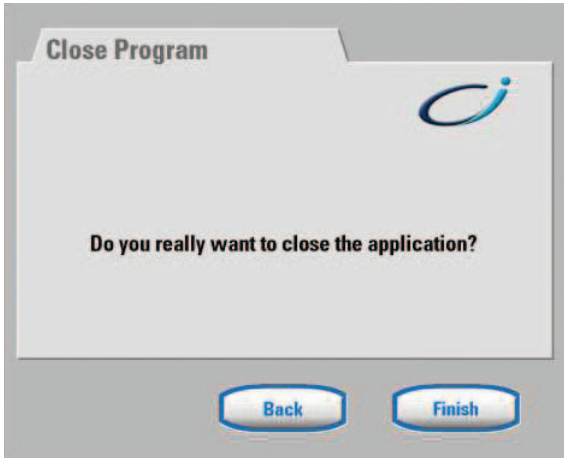



Figure 109

A CD-ROM is inserted to allow all planning information, screenshots and therapy reports to be recorded.

The system will automatically save this information on shut-down. The system shut-down begins after pressing the ‘close’ button on the final screen.

On the close application screen, press ‘finish’ to exit the Ci™ software (Figure 109).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powered by BrainLAB

**BrainLAB AG**
Ammerthalstraße 8
85551 Heimstetten
Germany
Tel: +49.89.991568-0
Fax: +49.89.991568-33

DePuy
a Johnson&Johnson company

**DePuy International Ltd**
St Anthony's Road
Leeds LS11 8DT
England
Tel: +44 (113) 270 0461
Fax: +44 (113) 272 4191