

# Robotic PKR



**Sam Oussedik**

Consultant Orthopaedic Surgeon & Dept Head, UCLH

Director of Surgical Education, UCLH

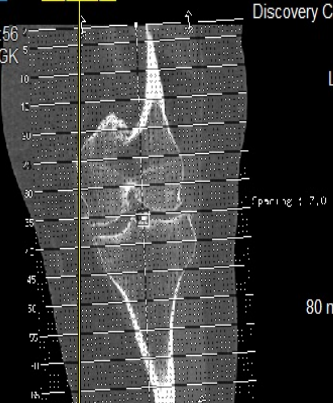
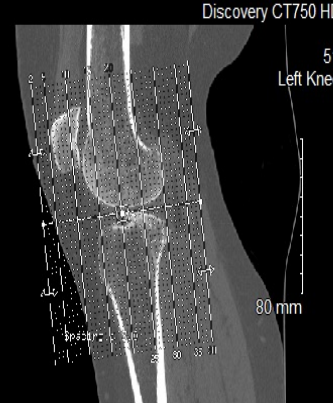

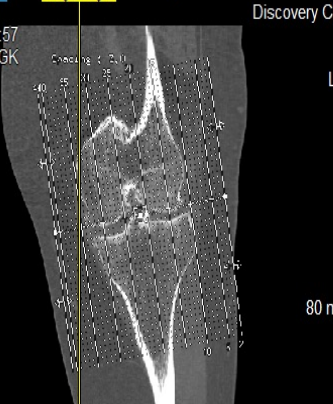


Honorary Associate Professor, UCL

# Patient selection

- Suitable for all PKA
- Indications are the same as any other PKR
  - Single compartment disease
  - competent ACL
  - correctable deformities



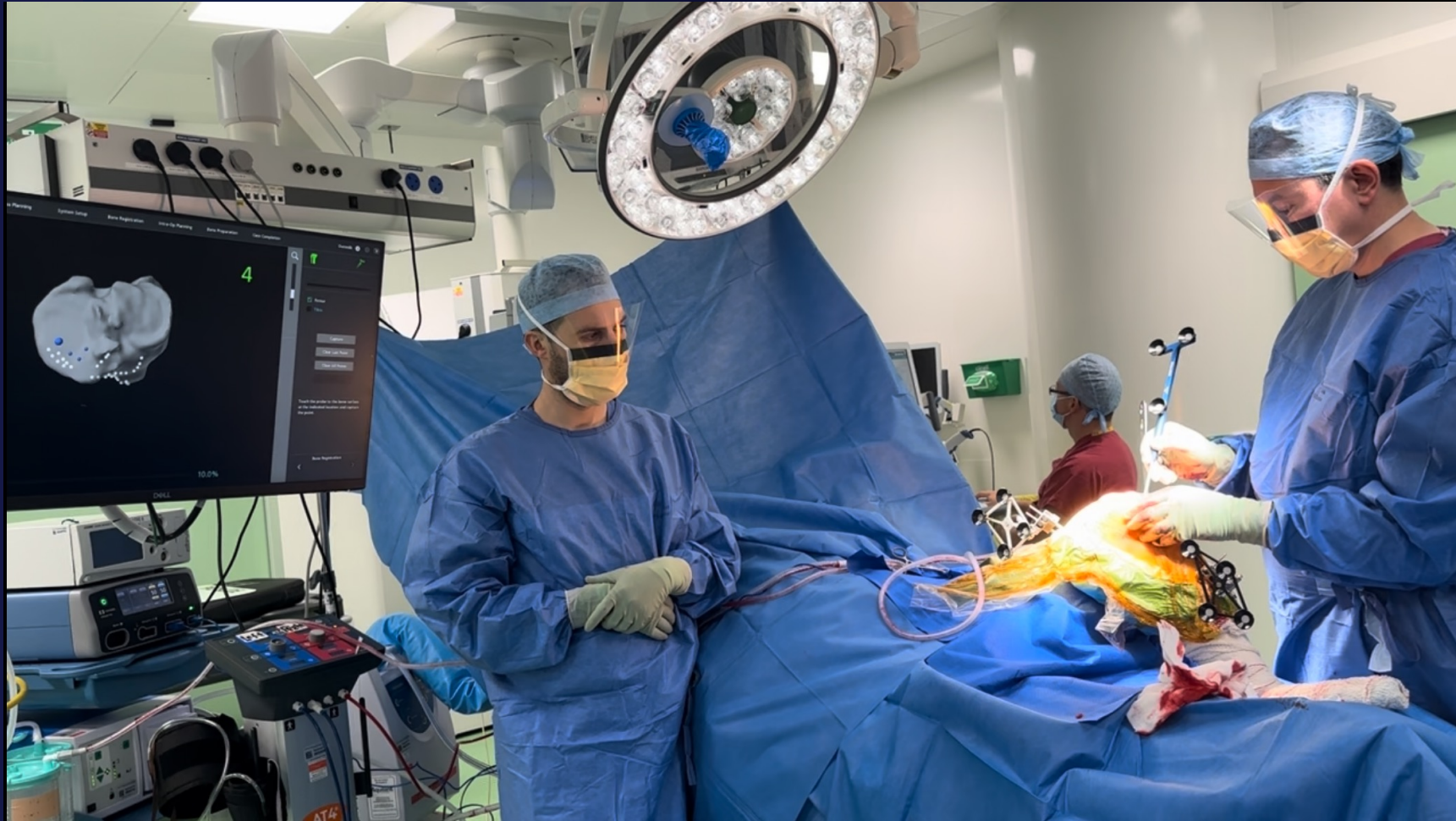
# Process

<p><b>POST ANCHOR</b> <b>R1(CT1):6</b> S Princess Grace Coote, Bettina Discovery CT750 HD pghgect01cts #1 26-Apr-2018 12:56 FFS Ac: 000699238COCGK 3MM AXIAL Series: 200 L</p>  <p>80 mm</p> <p>BONE KV: 120.00 mA: 200 Slice: 0.49 Loc: 10.81</p> <p>W:2000 L:250 Filter:None Fact:0</p>	<p><b>POST ANCHOR</b> S Princess Grace Coote, Bettina Discovery CT750 HD pghgect01cts #1 26-Apr-2018 12:58 FFS Ac: 000699238COCGK 3MM COR Series: 202 L</p>  <p>80 mm</p> <p>BONE KV: 120.00 mA: 200 Slice: 0.49 Loc: 46.24</p> <p>W:2000 L:250 Filter:None Fact:0</p>	<p><b>POST ANCHOR</b> <b>R1(CT1):6</b> Princess Grace Coote, Bettina Discovery CT750 HD pghgect01cts #1 26-Apr-2018 12:45 FFS Ac: 000699238COCGK Scout Series: 1 L</p>  <p>400 mm</p> <p>STANDARD KV: 80.00 mA: 35 Tilt: 0.00 Slice: 1,220.55 Loc: 20.00</p> <p>W:1000 L:100 Filter:None Fact:0</p>
<p><b>POST ANCHOR</b> <b>R1(CT1):6</b> S Princess Grace Coote, Bettina Discovery CT750 HD pghgect01cts #1 26-Apr-2018 12:57 FFS Ac: 000699238COCGK 3MM SAG Series: 201 L</p>  <p>80 mm</p> <p>BONE KV: 120.00 mA: 200 Slice: 0.49 Loc: 10.81</p> <p>W:2000 L:250 Filter:None Fact:0</p>	<p><b>POST ANCHOR</b> <b>R1(CT1):6</b> A Princess Grace Coote, Bettina Discovery CT750 HD pghgect01cts #1 26-Apr-2018 12:48 FFS Ac: 000699238COCGK MAKO KNEE Series: 2 L</p>  <p>80 mm</p> <p>BONE KV: 120.00 mA: 200 Tilt: 0.00 Slice: 5.00 Loc: -122.50</p> <p>W:2000 L:250 Filter:None Fact:0</p>	<p><b>POST ANCHOR</b> <b>R1(CT1):6</b> Scout Princess Grace Coote, Bettina Discovery CT750 HD pghgect01cts #2 26-Apr-2018 12:45 FFS Ac: 000699238COCGK Scout Series: 1 L</p>  <p>400 mm</p> <p>STANDARD KV: 80.00 mA: 35 Tilt: 0.00 Slice: 1,220.55 Loc: 20.00</p> <p>W:1000 L:100 Filter:None Fact:0</p>

# Patient positioning



# MAKO position



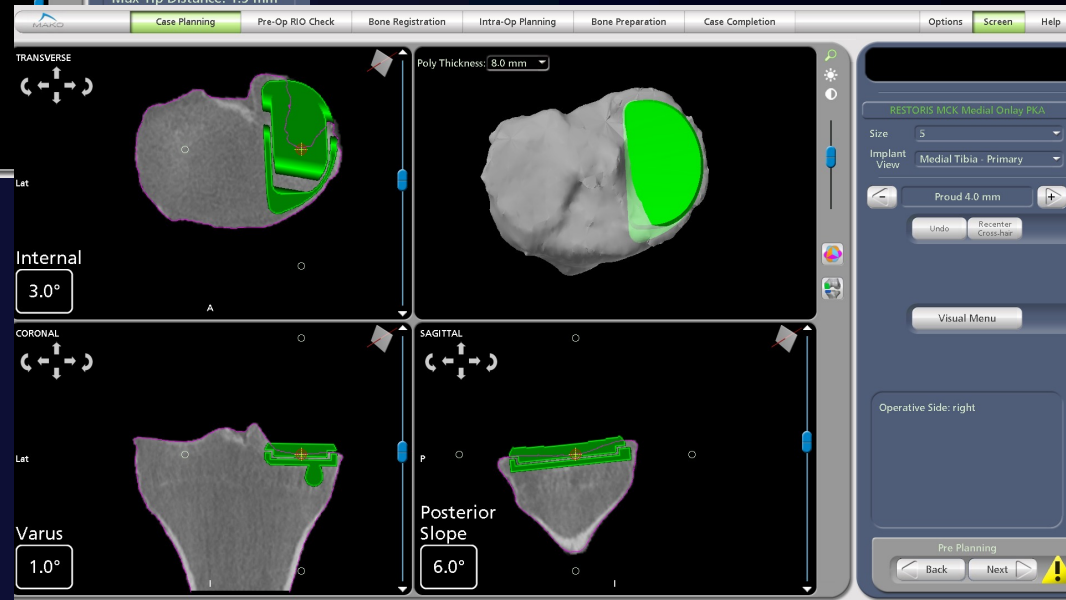
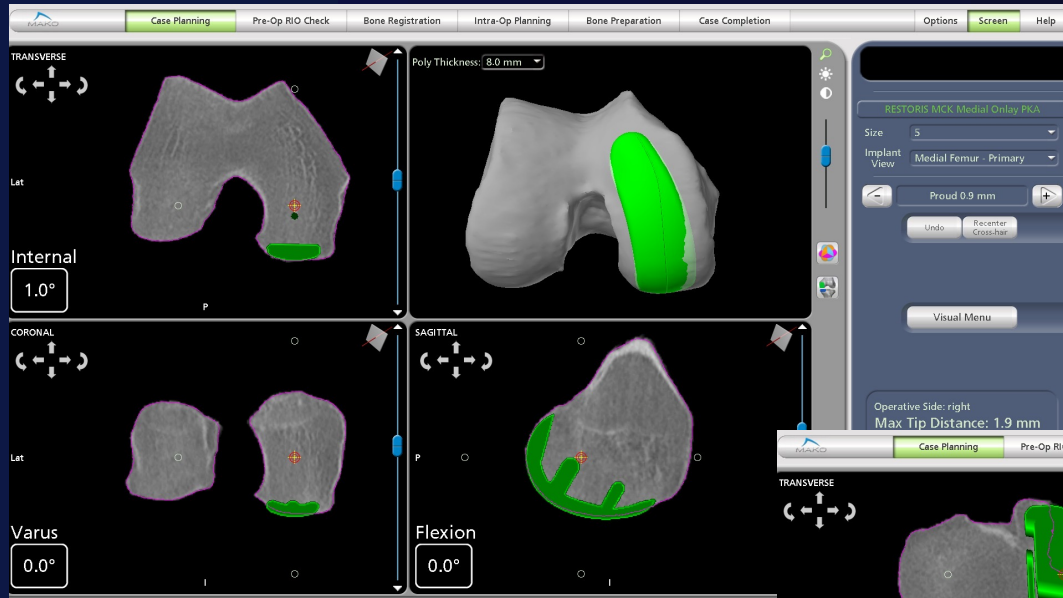
# MAKO position



# The Procedure

- Sizing & initial position  
– pre-op plan
- Registration
- Balancing
- Bone resection

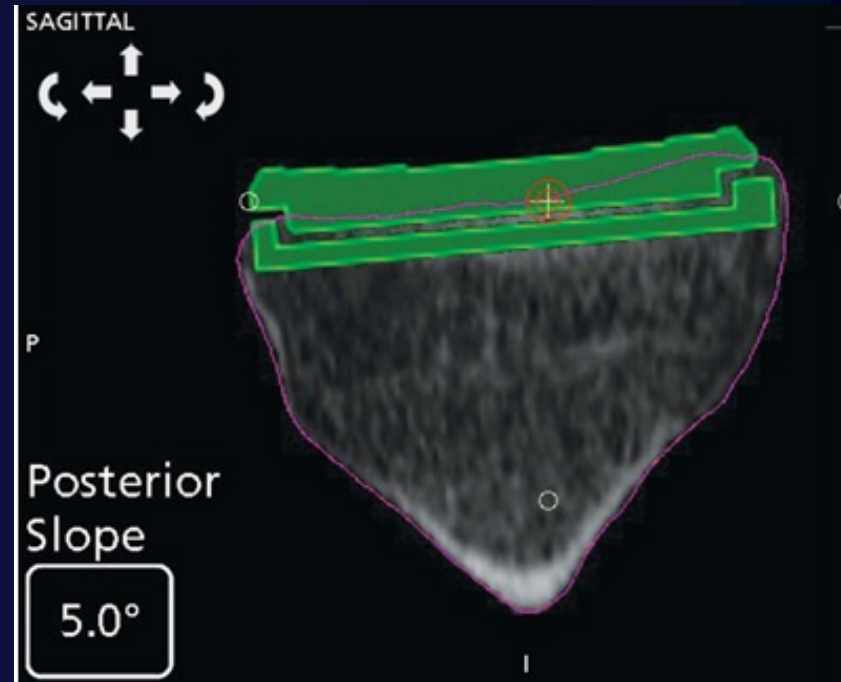
# Sizing & Positioning





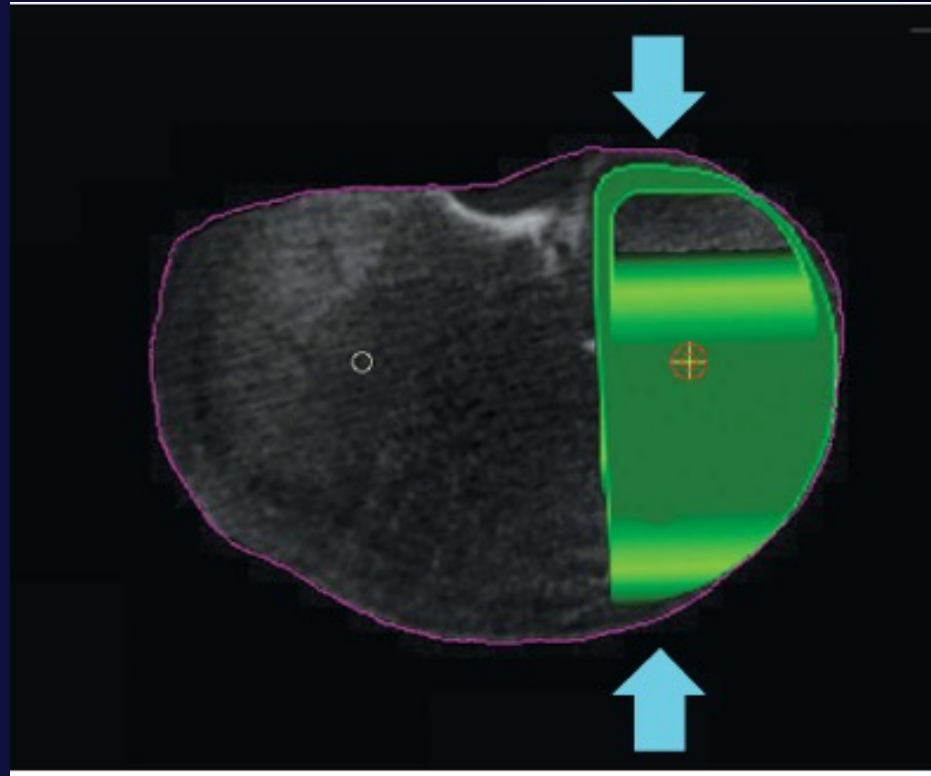
# Sizing & Positioning

- Tibial slope
- AP sizing



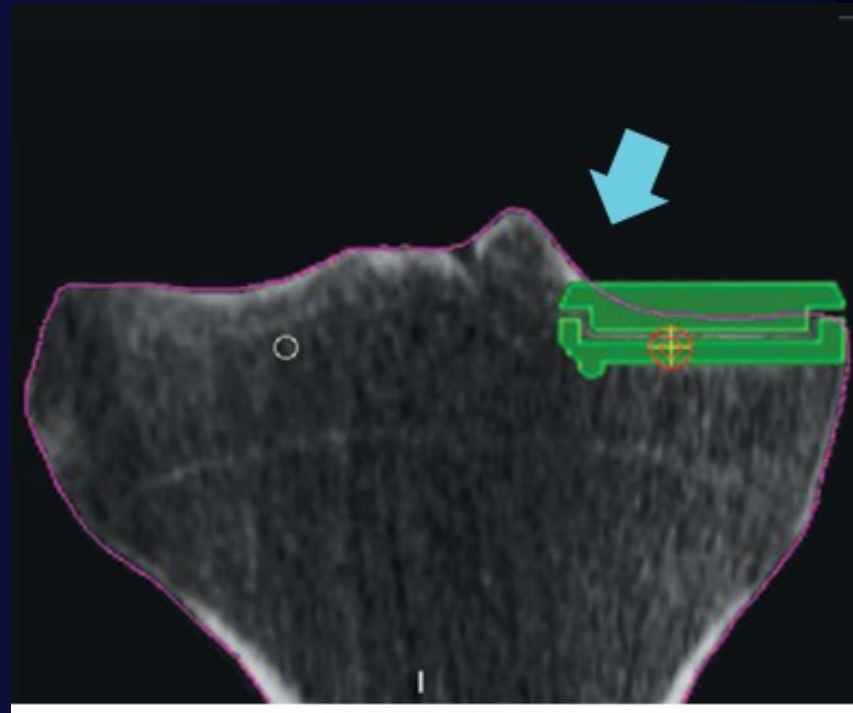
# Sizing & Positioning

- Tibial slope
- AP sizing
- Coverage
- Rotation



# Sizing & Positioning

- Tibial slope
- AP sizing
- Coverage
- Rotation



- M/L sizing
- Eminence resection
- Medial overhang

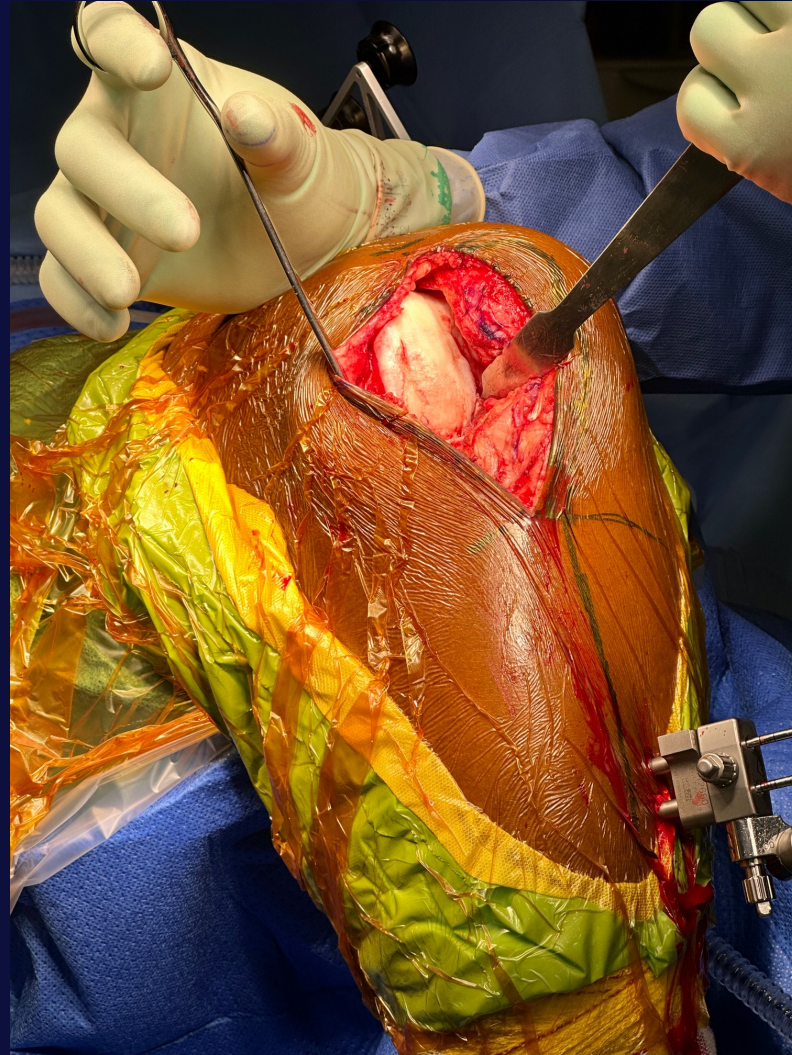
# Sizing & Positioning

- Femoral curvature
- Posterior overhang

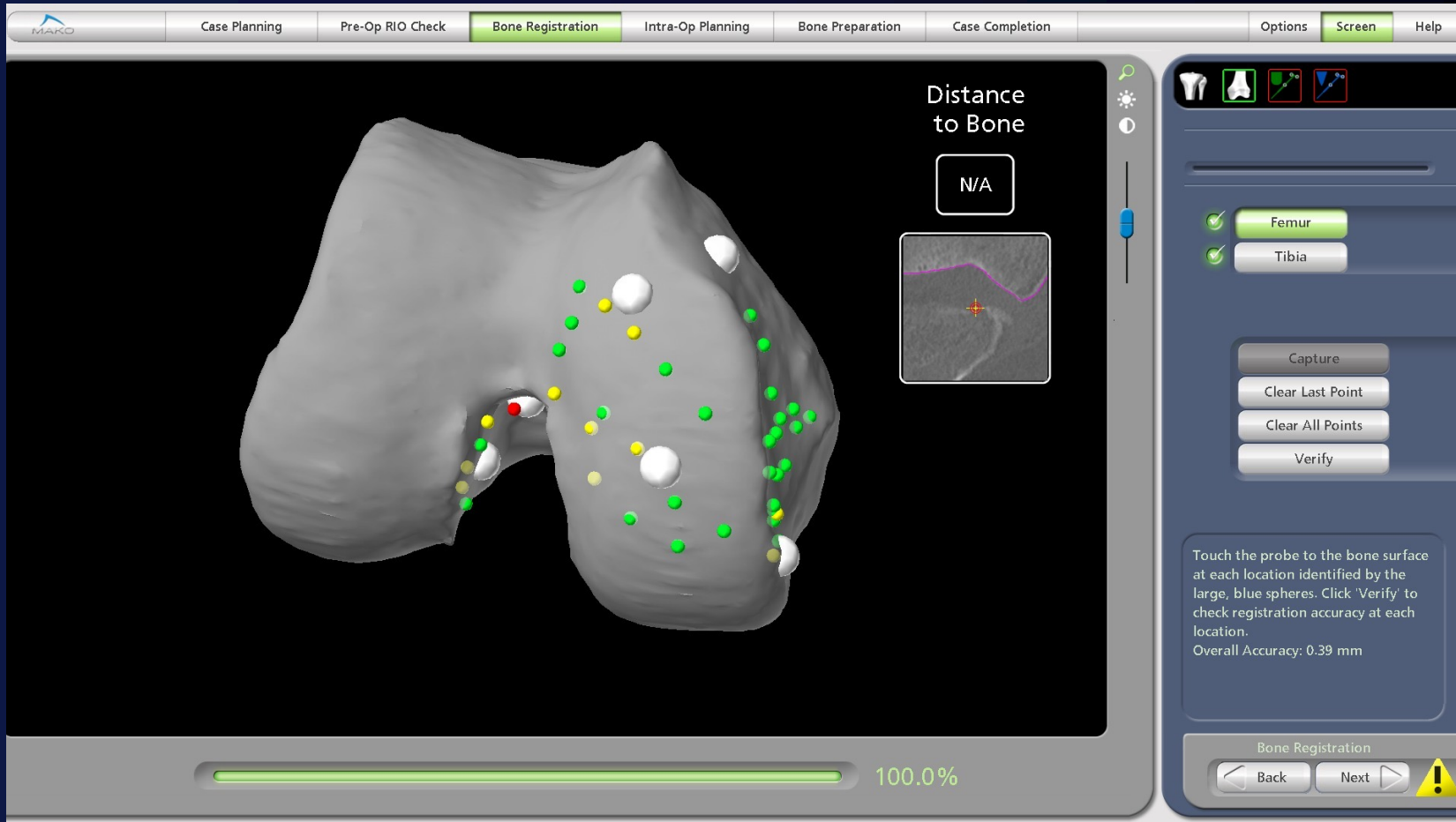


- Anterior proudness

# Surgical approach

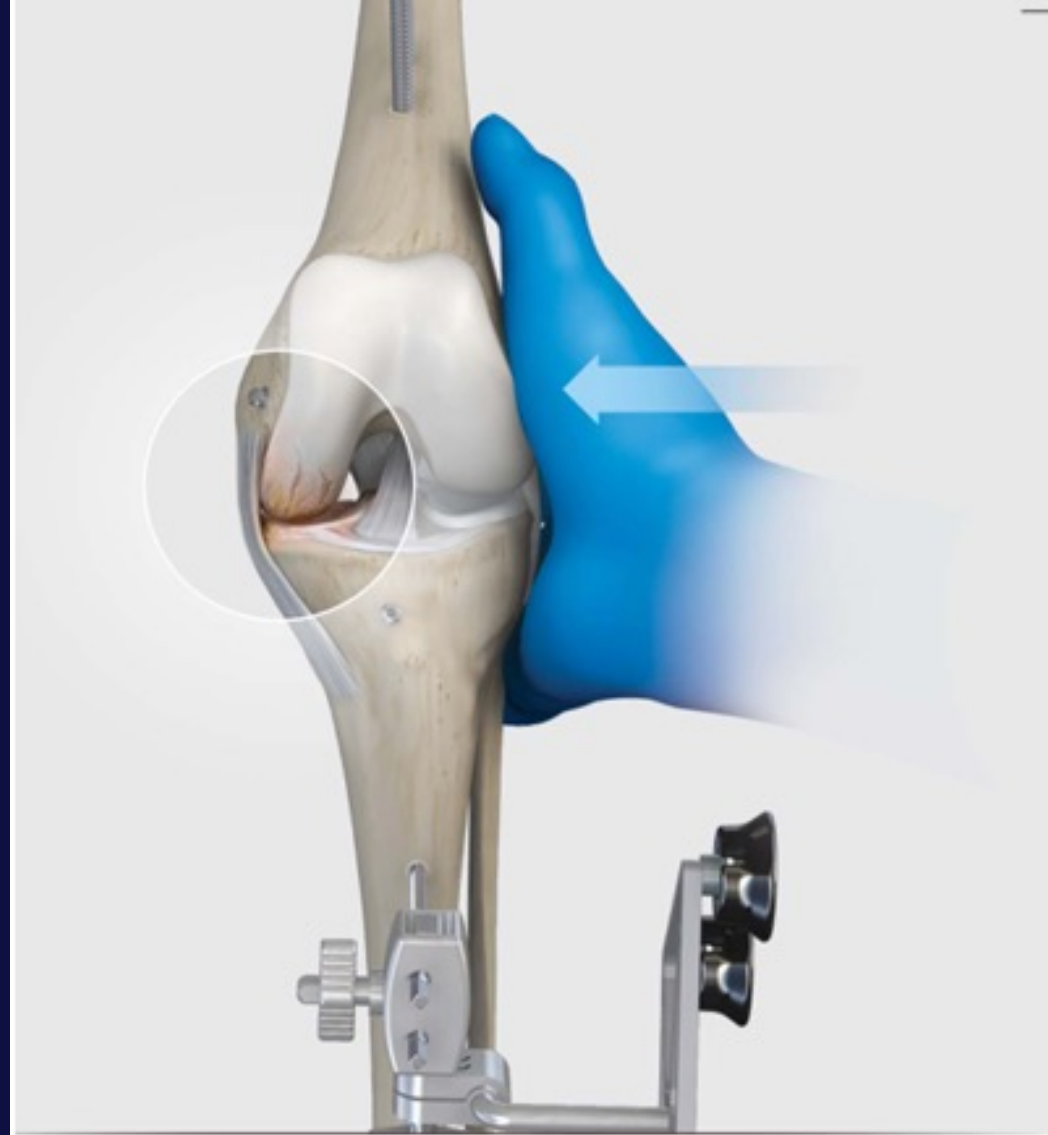


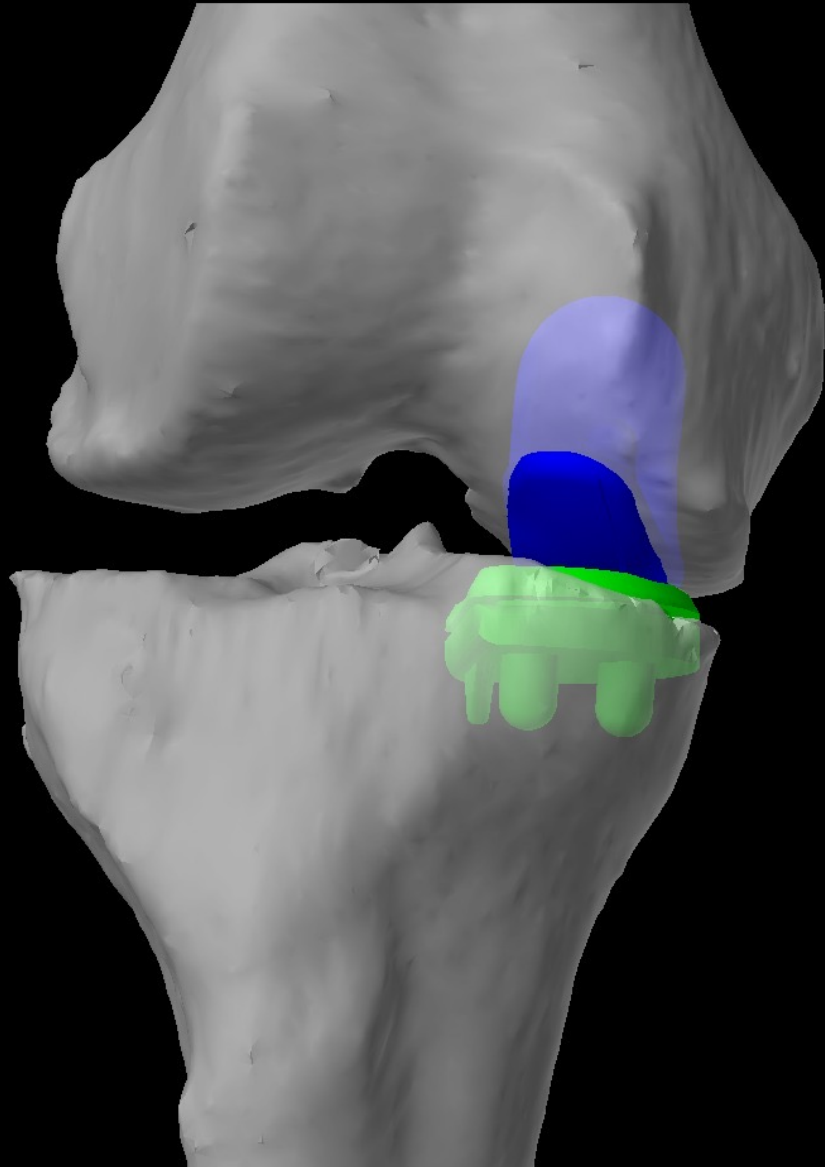
# Registration



The screenshot displays the MAKO Bone Registration software interface. The top navigation bar includes tabs for Case Planning, Pre-Op RIO Check, Bone Registration (highlighted), Intra-Op Planning, Bone Preparation, Case Completion, Options, Screen, and Help. The main display area shows a 3D model of a knee joint with numerous registration points (small green and yellow spheres) and larger blue spheres. A 'Distance to Bone' box shows 'N/A' and a small inset image shows a probe tip on a bone surface. The right-hand control panel features icons for femur and tibia, checkboxes for 'Femur' and 'Tibia', and buttons for 'Capture', 'Clear Last Point', 'Clear All Points', and 'Verify'. A text box at the bottom right of the control panel reads: 'Touch the probe to the bone surface at each location identified by the large, blue spheres. Click 'Verify' to check registration accuracy at each location. Overall Accuracy: 0.39 mm'. At the bottom of the interface, a progress bar shows 100.0% completion, and navigation buttons for 'Back' and 'Next' are visible, along with a warning icon.

# Remove osteophytes & evaluate laxity





Flexion

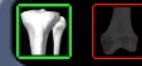
11.0°

Varus

5.5°

External  
Rotation

4.0°



Capture

Delete

0  
Poses

Live

Review

MAKO Surgical recommends that you follow standard surgical practice and take at least 4 poses - full extension, full flexion, and two angles in between.

Joint Balancing

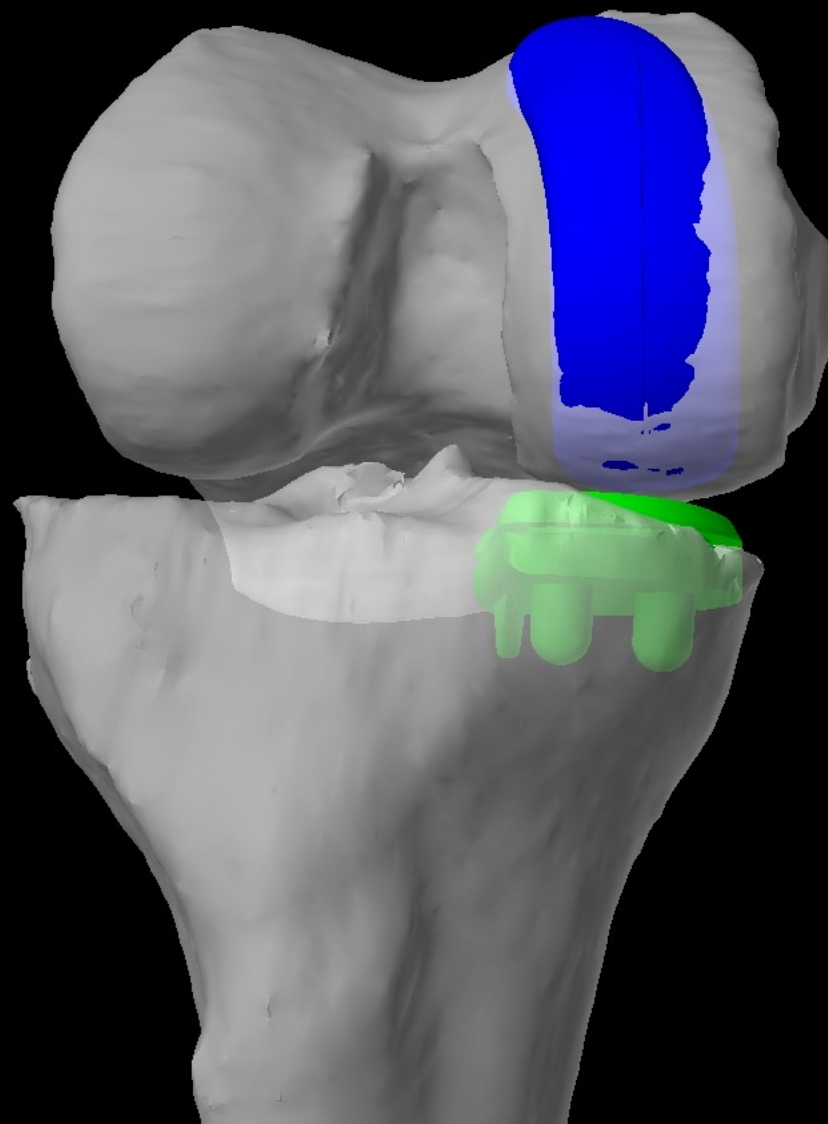


Back

Next







Flexion

139.0°

Valgus

1.0°

Internal Rotation

2.0°



Capture

Delete

0  
Poses

Live

Review

MAKO Surgical recommends that you follow standard surgical practice and take at least 4 poses - full extension, full flexion, and two angles in between.

Joint Balancing



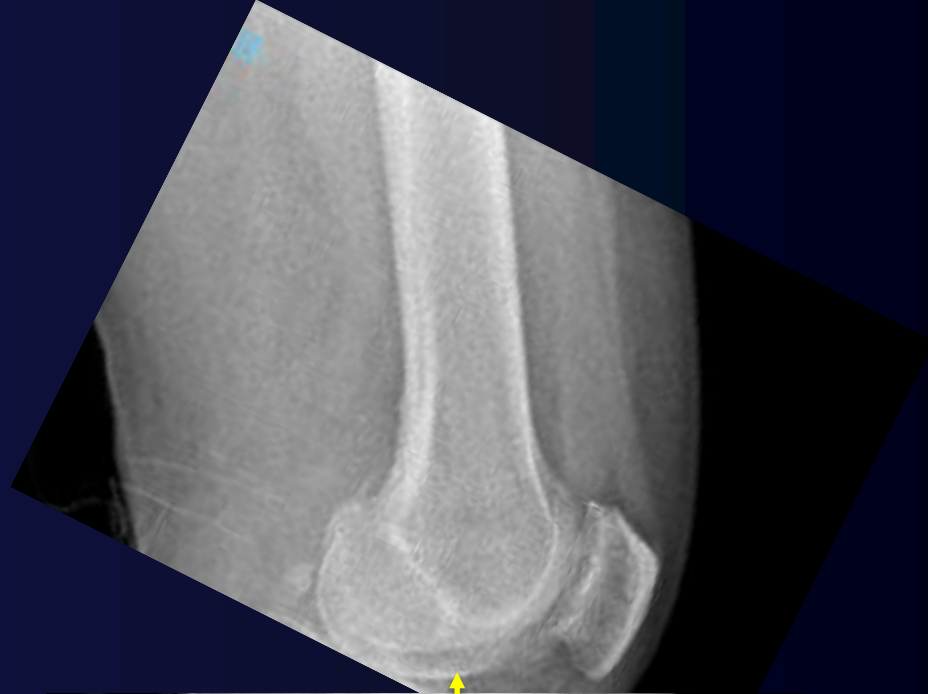
Back



Next



# Remove osteophytes & evaluate laxity



# Remove osteophytes & evaluate laxity



# Remove osteophytes & evaluate laxity



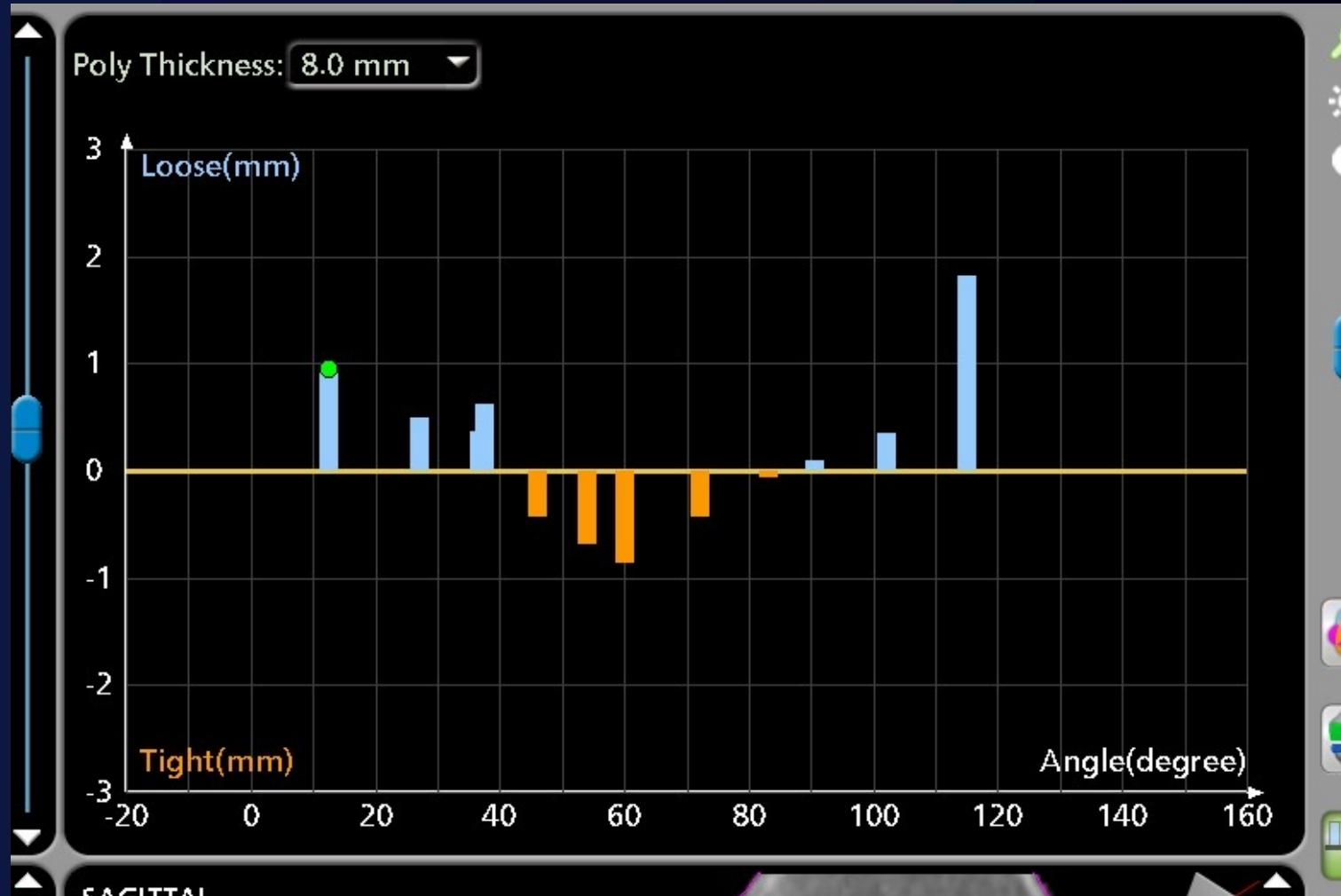
# Remove osteophytes & evaluate laxity

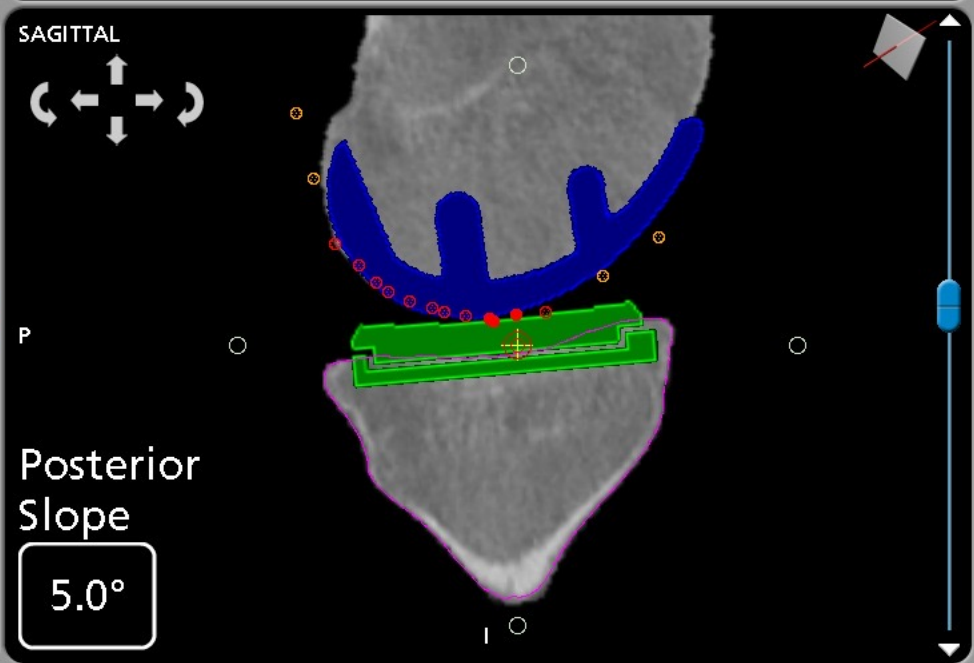
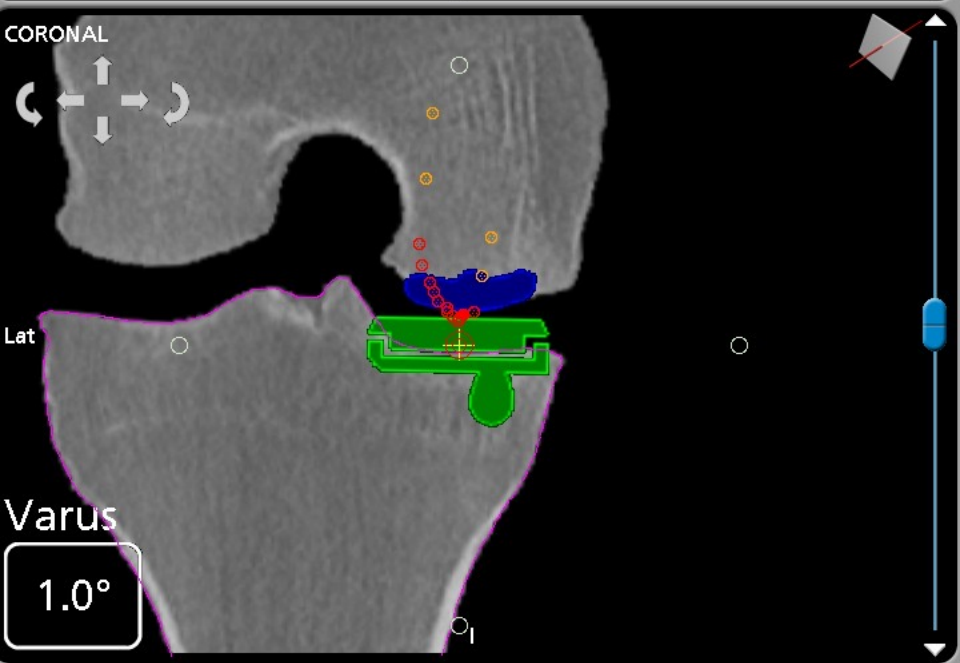
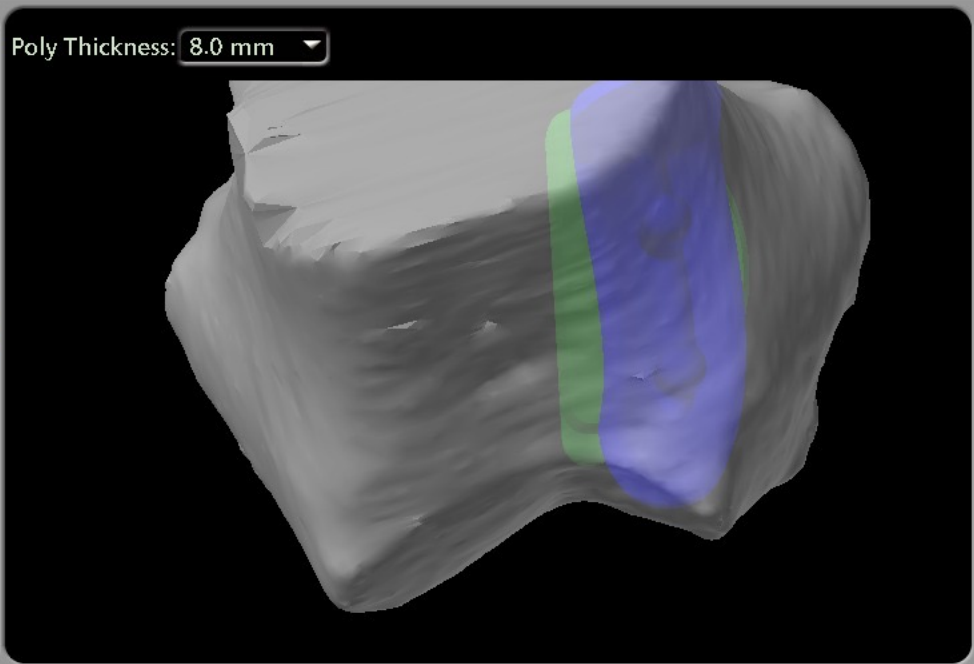
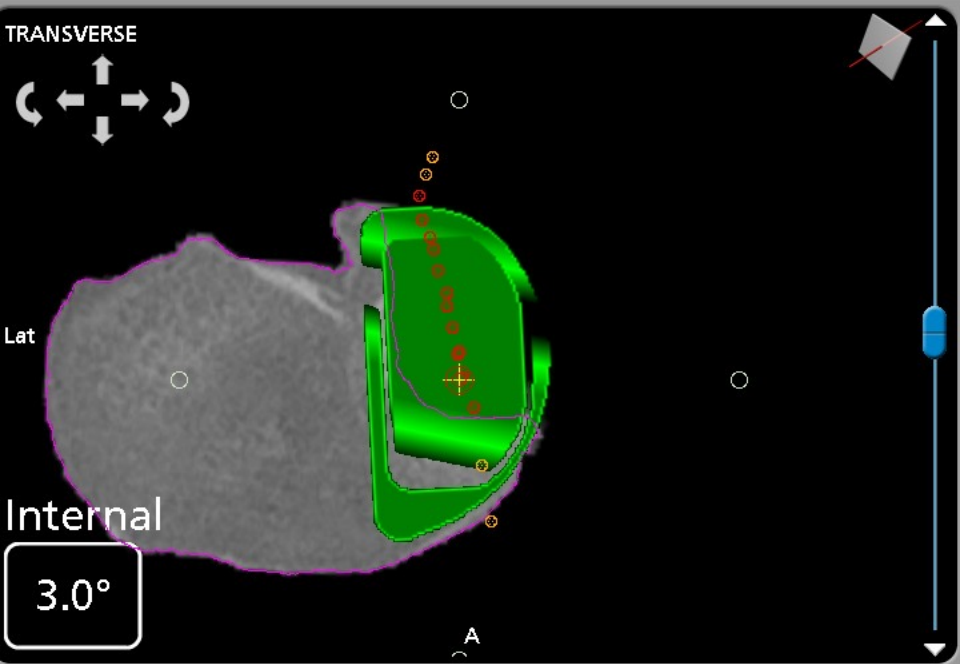


# Remove osteophytes & evaluate laxity



# Soft tissue balancing





RESTORIS MCK Medial Onlay PKA

Size 5

Implant View Medial Tibia - Primary

Proud 5.5 mm

Flexion 37.5°

Undo Recenter Cross-hair

Gap Settings Quick Fit

Map Point/Surface Clear Point/Surface

Map Cartilage Visual Menu

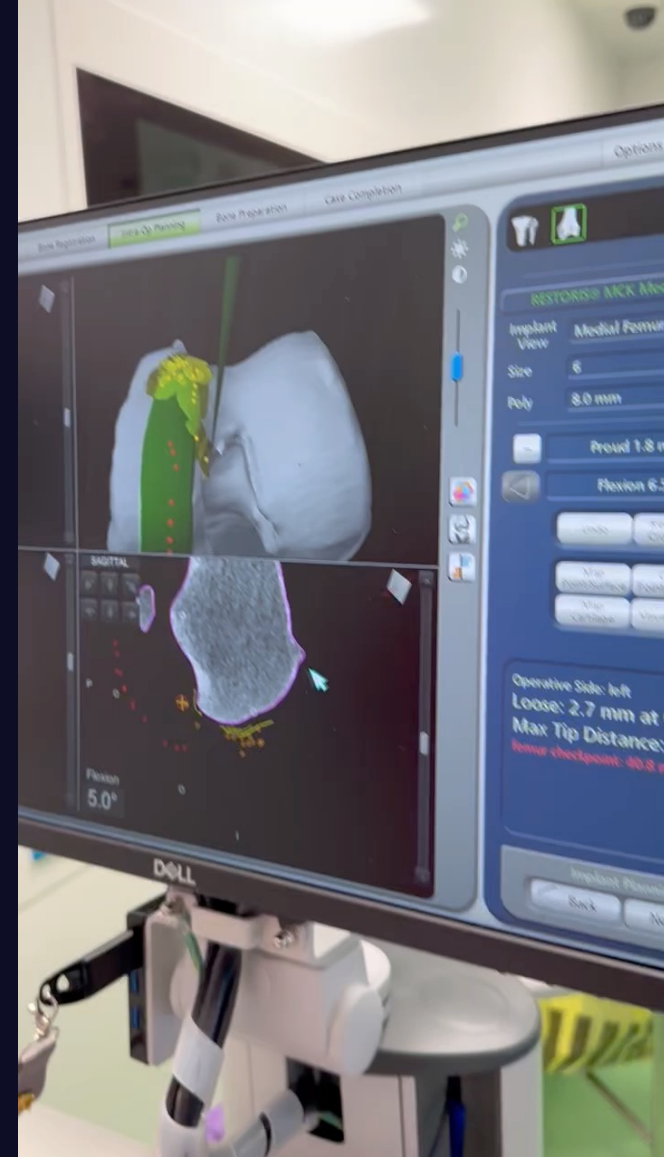
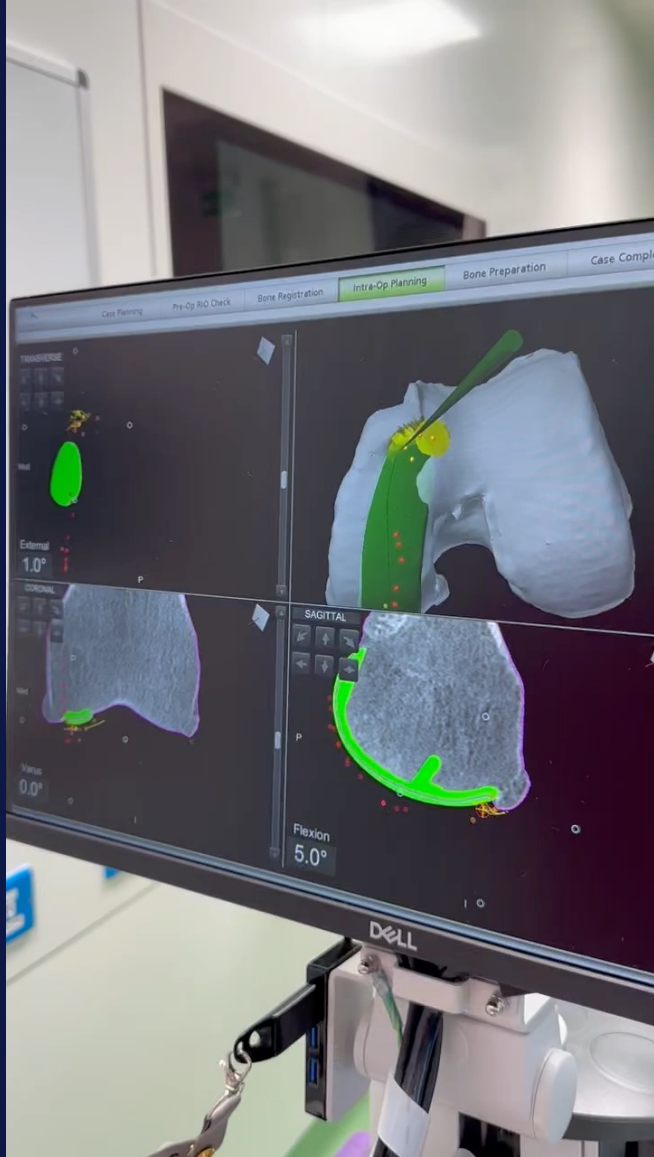
Operative Side: right  
Loose: 0.6 mm at 37.5°

Implant Planning

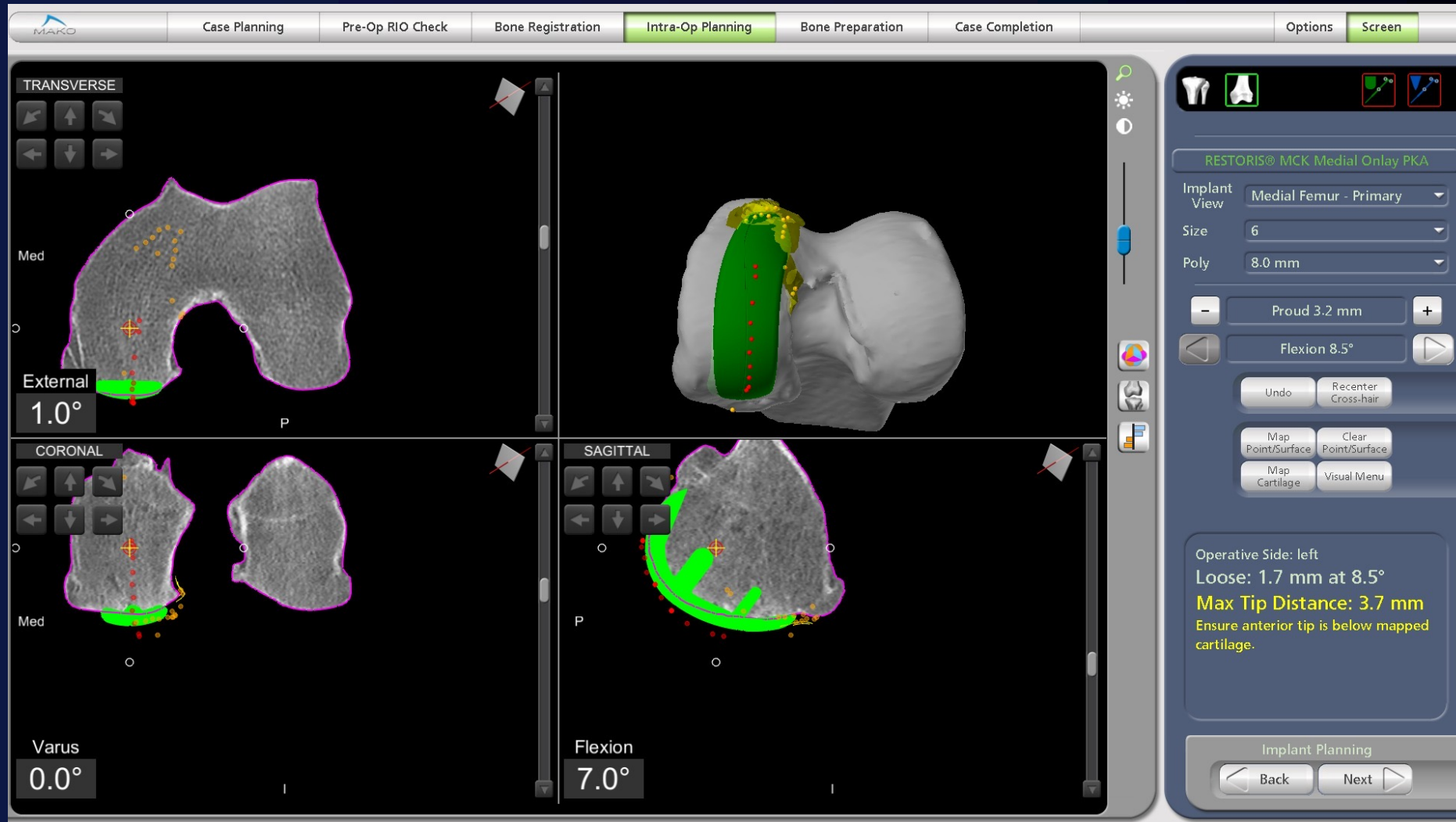
Back Next



# Cartilage mapping



# Implant tracking



The screenshot displays the MAKO navigation software interface during the 'Intra-Op Planning' phase. The main workspace is divided into three views: TRANSVERSE, CORONAL, and SAGITTAL. The TRANSVERSE view shows a femoral cross-section with a green implant overlay and a 1.0° External rotation. The CORONAL view shows a frontal view of the femur with a 0.0° Varus angle. The SAGITTAL view shows a side view of the femur with a 7.0° Flexion angle. A 3D model of the femur and implant is shown in the top right. The right-hand panel contains controls for the 'RESTORIS® MCK Medial Onlay PKA' implant, including 'Medial Femur - Primary' view, size '6', and poly '8.0 mm'. It also features 'Proud 3.2 mm' and 'Flexion 8.5°' settings, along with 'Undo', 'Recenter Cross-hair', 'Map Point/Surface', 'Clear Point/Surface', 'Map Cartilage', and 'Visual Menu' buttons. A summary box at the bottom right indicates 'Operative Side: left', 'Loose: 1.7 mm at 8.5°', and 'Max Tip Distance: 3.7 mm', with a note to 'Ensure anterior tip is below mapped cartilage.' The bottom navigation bar includes 'Back' and 'Next' buttons.

MAKO

Case Planning Pre-Op RIO Check Bone Registration **Intra-Op Planning** Bone Preparation Case Completion Options Screen

TRANSVERSE

Med

External 1.0°

P

CORONAL

Med

Varus 0.0°

SAGITTAL

P

Flexion 7.0°

RESTORIS® MCK Medial Onlay PKA

Implant View: Medial Femur - Primary

Size: 6

Poly: 8.0 mm

- Proud 3.2 mm +

Flexion 8.5°

Undo Recenter Cross-hair

Map Point/Surface Clear Point/Surface

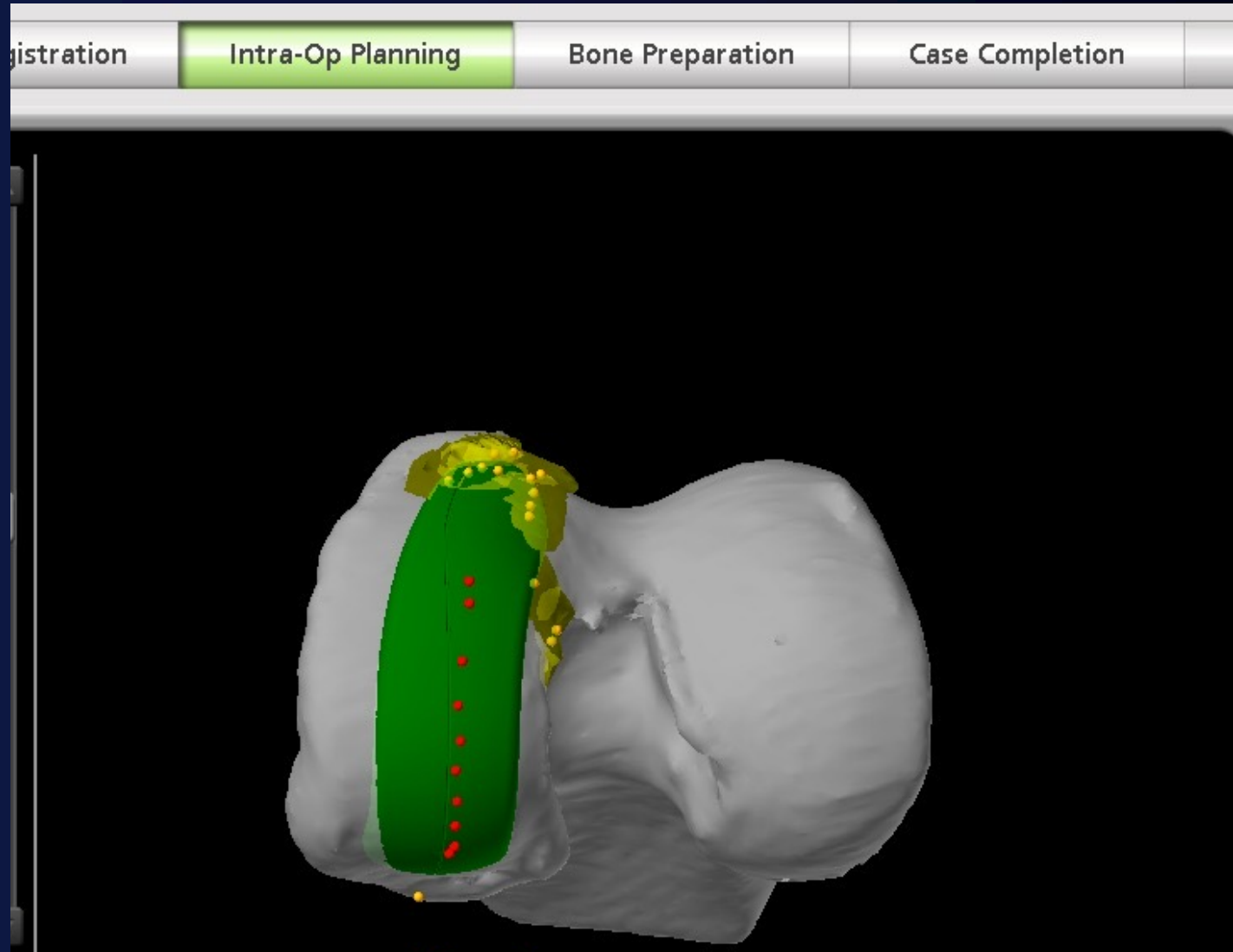
Map Cartilage Visual Menu

Operative Side: left  
Loose: 1.7 mm at 8.5°  
**Max Tip Distance: 3.7 mm**  
Ensure anterior tip is below mapped cartilage.

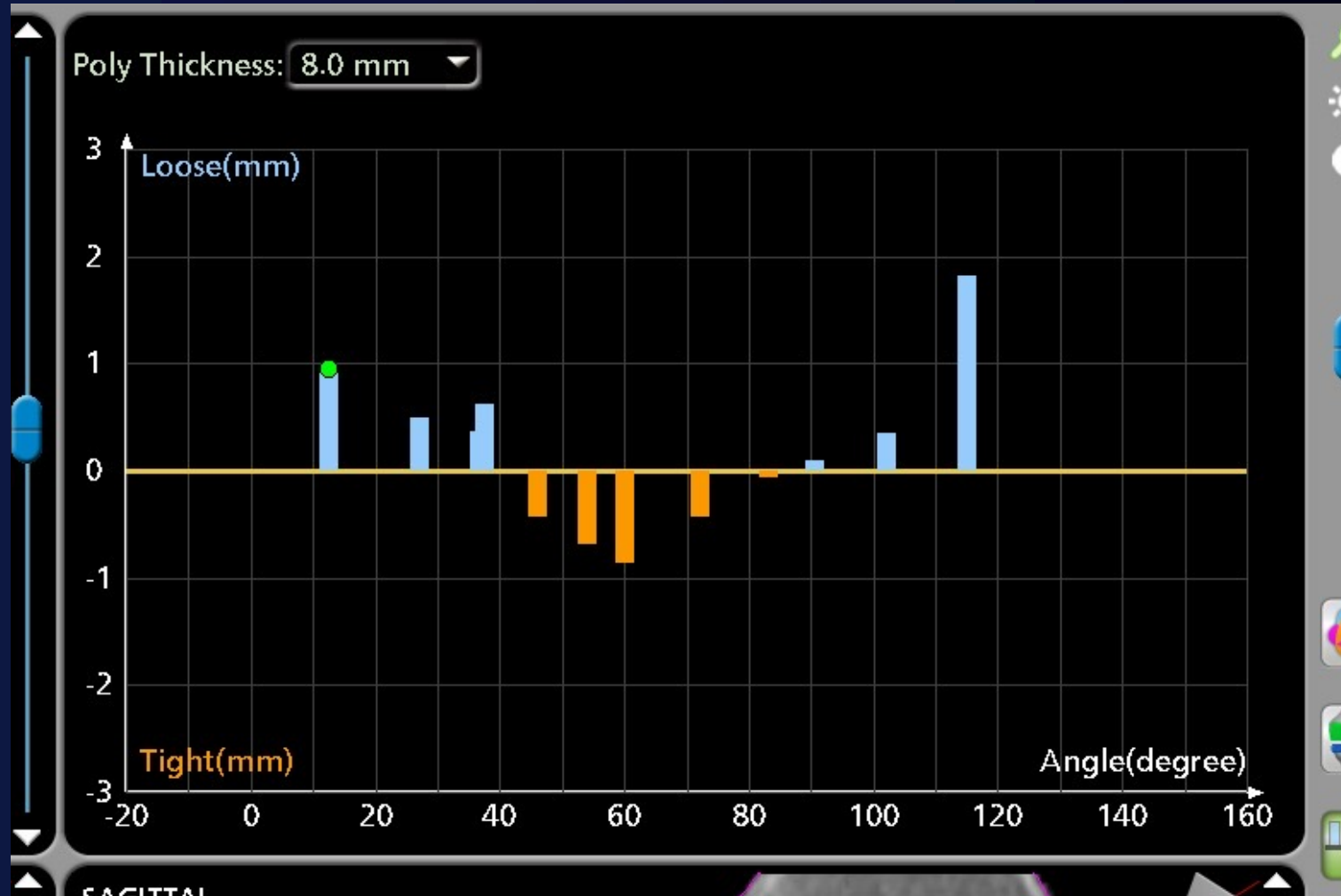
Implant Planning

Back Next

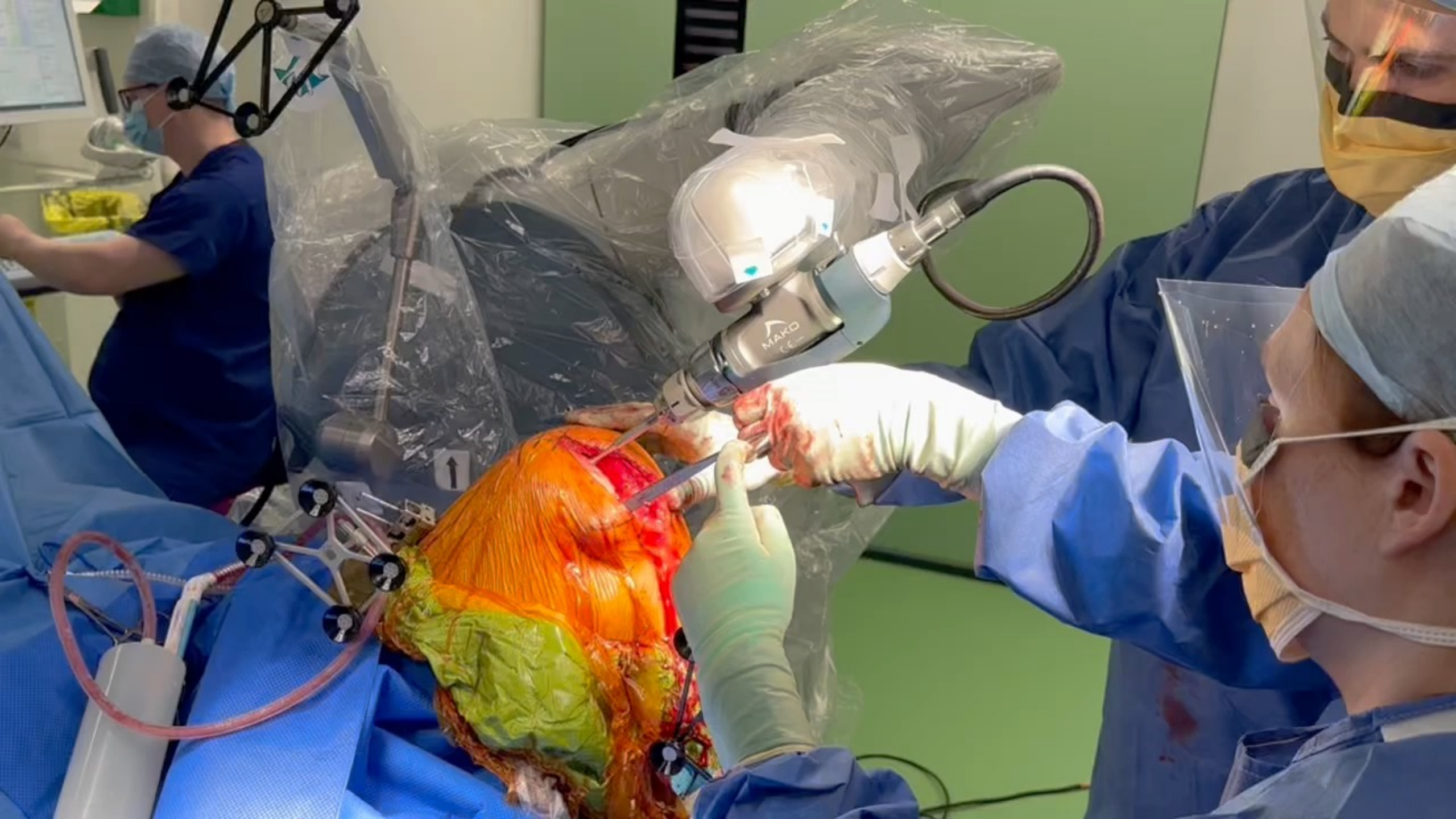
# Implant tracking

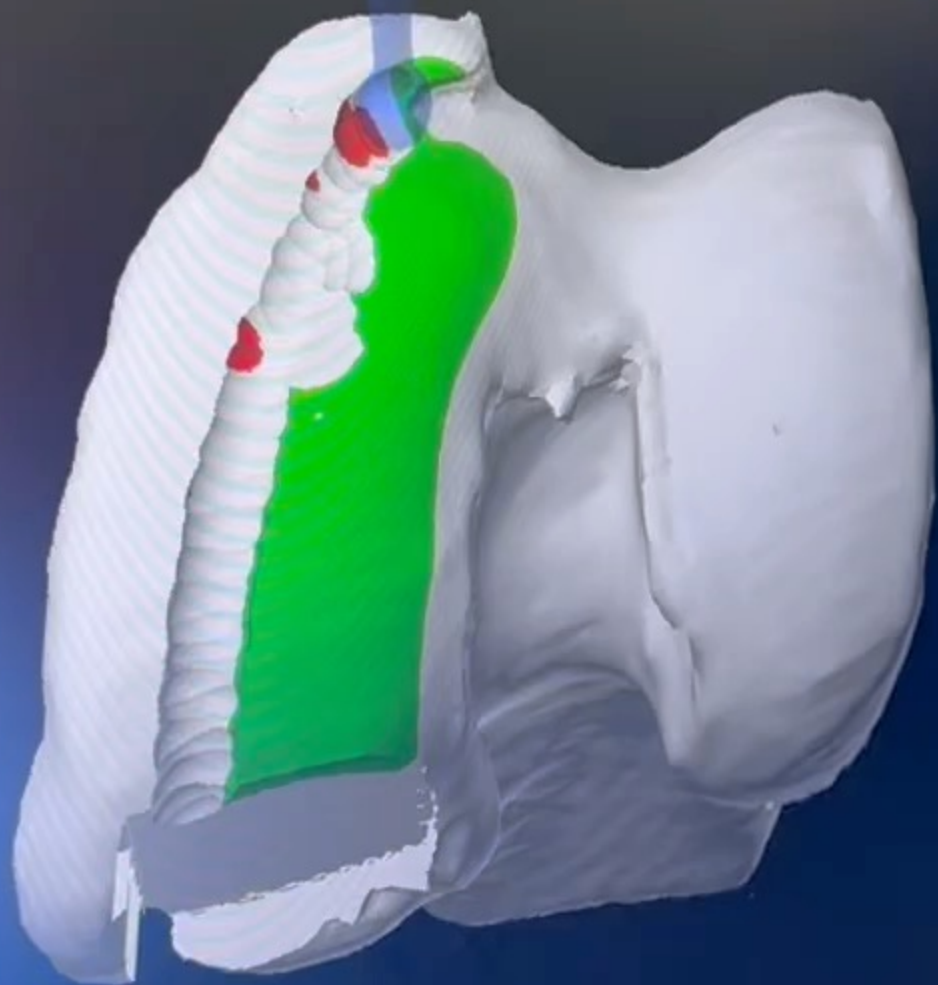


# Soft tissue balancing









File Operations  
Data Comparison



FILE  
EDIT  
VIEW  
HELP



# Trialling

MAKO Case Planning Pre-Op RIO Check Bone Registration Intra-Op Planning **Bone Preparation** Case Completion Options Screen Help

Pre-Resection **Trialling** Implantation

Options: **Trialling**  
Poly: 8.0 mm

Pose 1

Live Review

Delete Pose

Review each pose and assess the overall alignment and gap values

Kinematic Analysis

Back Next !

Flexion

**9.5°**

Planned Gap

**0.8 mm**

Gap

**0.6 mm**

Contact Varus

**2.0°**

Planned Varus

**2.0°**

Varus

**2.0°**



# Results



## ■ KNEE

### **Robotic arm-assisted versus conventional medial unicompartmental knee arthroplasty: five-year clinical outcomes of a randomized controlled trial**

**M. Banger,  
J. Doonan,  
P. Rowe,  
B. Jones,  
A. MacLean,  
M. J. B. Blyth**

*From Glasgow Royal  
Infirmary, Glasgow, UK*

#### **Aims**

Unicompartmental knee arthroplasty (UKA) is a bone-preserving treatment option for osteoarthritis localized to a single compartment in the knee. The success of the procedure is sensitive to patient selection and alignment errors. Robotic arm-assisted UKA provides technological assistance to intraoperative bony resection accuracy, which is thought to improve ligament balancing. This paper presents the five-year outcomes of a comparison between manual and robotically assisted UKAs.

# Results

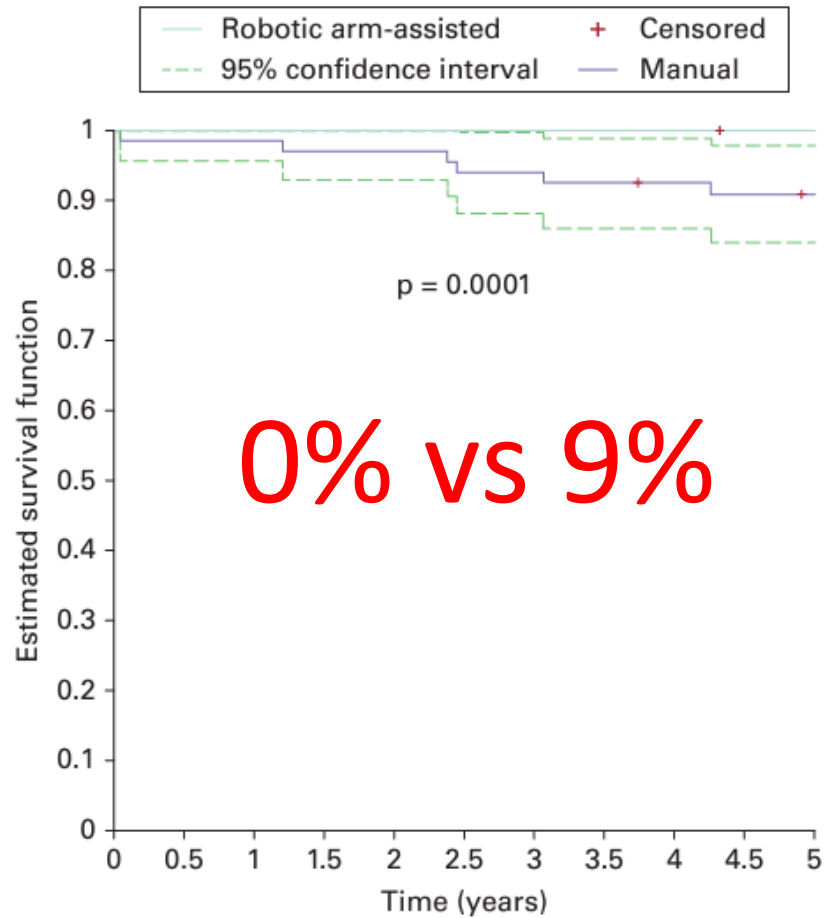
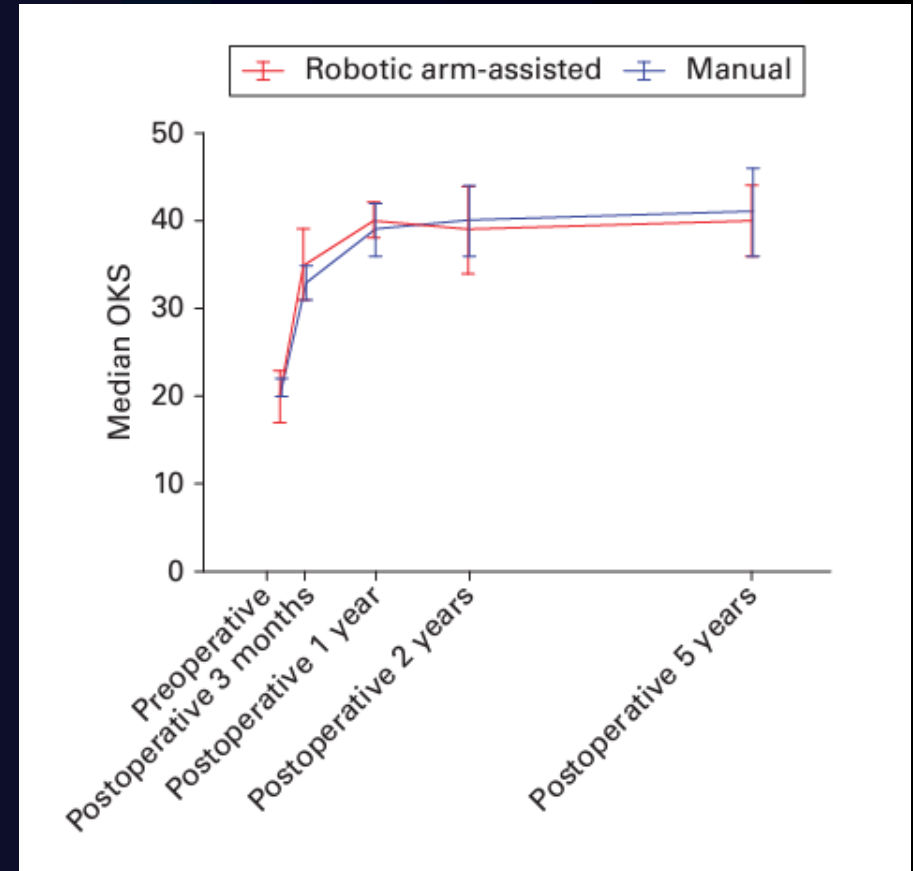


Fig. 2



# Results

Brand <sup>1</sup>	N	Age at primary Median (IQR)	Male (%)	Time since primary					
				1 year	3 years	5 years	10 years	15 years	19 years
All unicompartmental knee replacements	168,069	64 (56 to 71)	51	0.98 (0.94-1.03)	3.49 (3.40-3.59)	5.33 (5.21-5.45)	10.19 (10.00-10.39)	15.48 (15.16-15.81)	20.16 (19.26-21.10)
<b>Unicondylar</b>									
AMC/Uniglide[Fem:Tib]	3,025	64 (57 to 71)	51	2.35 (1.87-2.96)	6.02 (5.23-6.94)	7.71 (6.81-8.73)	12.56 (11.37-13.87)	18.29 (16.51-20.23)	
Journey Uni Oxinium[Fem] Journey Uni[Tib]	1,890	63 (56 to 70)	54	1.29 (0.86-1.93)	2.98 (2.25-3.94)	4.43 (3.45-5.68)	7.44 (4.73-11.60)		
MG Uni[Fem:Tib]	2,283	63 (57 to 70)	55	0.88 (0.57-1.36)	4.02 (3.29-4.91)	6.06 (5.15-7.13)	10.29 (9.08-11.65)	13.46 (12.03-15.03)	16.24 (13.56-19.37)
Oxford Cementless Partial Knee[Fem:Tib]	33,730	65 (58 to 72)	56	1.14 (1.03-1.27)	2.26 (2.09-2.44)	3.17 (2.95-3.40)	5.91 (5.40-6.46)		
Oxford Cementless Partial Knee[Fem] Knee[Tib]	2,310	66 (58 to 74)	45	1.17 (0.80-1.72)	3.38 (2.67-4.27)	5.19 (4.25-6.32)	9.31 (7.77-11.14)	14.35 (11.16-18.36)	
Oxford Single Peg Cemented Partial Knee[Fem] Oxford Partial Knee[Tib]	43,442	64 (58 to 71)	52	1.22 (1.12-1.32)	4.35 (4.16-4.54)	6.45 (6.22-6.68)	11.46 (11.14-11.78)	16.63 (16.18-17.09)	21.22 (20.05-22.44)
Oxford Twin Peg Cemented Partial Knee[Fem] Oxford Partial Knee[Tib]	6,411	65 (57 to 72)	48	0.79 (0.60-1.04)	2.46 (2.09-2.90)	3.78 (3.29-4.34)	7.09 (6.21-8.08)	11.54 (9.60-13.83)	
Persona Partial Knee[Fem:Tib]	5,615	65 (58 to 72)	58	0.28 (0.16-0.49)	1.36 (0.99-1.87)	1.67 (1.22-2.29)			
*Physica ZUK[Fem:Tib]	25,354	64 (56 to 71)	55	0.33 (0.26-0.41)	1.66 (1.49-1.84)	2.61 (2.38-2.86)	5.44 (4.98-5.95)	8.13 (6.90-9.56)	
Preservation[Fem:Tib]	1,515	62 (56 to 69)	55	2.52 (1.84-3.44)	8.15 (6.87-9.65)	11.63 (10.10-13.37)	17.69 (15.81-19.75)	23.31 (21.15-25.65)	27.73 (24.36-31.47)
Restoris[Fem:Tib]	2,187	65 (59 to 73)	59	0.50 (0.26-0.96)	1.74 (1.11-2.73)	1.74 (1.11-2.73)			
Sigma HP (Uni)[Fem] Sigma HP[Tib]	15,483	63 (56 to 71)	58	0.67 (0.55-0.82)	2.67 (2.41-2.96)	3.73 (3.41-4.08)	6.42 (5.86-7.02)		
Triathlon Uni[Fem] Triathlon[Tib]	1,908	62 (56 to 70)	56	1.02 (0.64-1.62)	3.82 (2.98-4.88)	6.06 (4.92-7.46)	8.26 (6.74-10.10)		

# Results

Oxford Single Peg Cemented Partial Knee[Fem] Oxford Partial Knee[Tib]	43,442	64 (58 to 71)	52	1.22 (1.12-1.32)	4.35 (4.16-4.54)	6.45 (6.22-6.68)	11.46 (11.14-11.78)	16.63 (16.18-17.09)	21.22 (20.05-22.44)
Oxford Twin Peg Cemented Partial Knee[Fem] Oxford Partial Knee[Tib]	6,411	65 (57 to 72)	48	0.79 (0.60-1.04)	2.46 (2.09-2.90)	3.78 (3.29-4.34)	7.09 (6.21-8.08)	11.54 (9.60-13.83)	
Persona Partial Knee[Fem:Tib]	5,615	65 (58 to 72)	58	0.28 (0.16-0.49)	1.36 (0.99-1.87)	1.67 (1.22-2.29)			
*Physica ZUK[Fem:Tib]	25,354	64 (56 to 71)	55	0.33 (0.26-0.41)	1.66 (1.49-1.84)	2.61 (2.38-2.86)	5.44 (4.98-5.95)	8.13 (6.90-9.56)	
Preservation[Fem:Tib]	1,515	62 (56 to 69)	55	2.52 (1.84-3.44)	8.15 (6.87-9.65)	11.63 (10.10-13.37)	17.69 (15.81-19.75)	23.31 (21.15-25.65)	27.73 (24.36-31.47)
Restoris[Fem:Tib]	2,187	65 (59 to 73)	59	0.50 (0.26-0.96)	1.74 (1.11-2.73)	1.74 (1.11-2.73)			

# Summary

- Reproducible technique
- Good performance so far in the “real world”
- Makes it easier to do a good job



# Thank you



Elective Orthopaedic Centre @ Grafton Way Building, UCLH