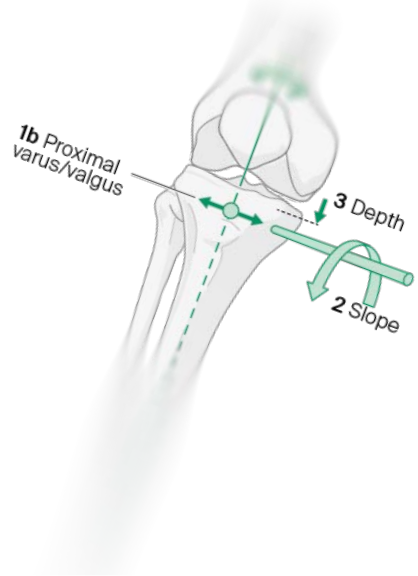
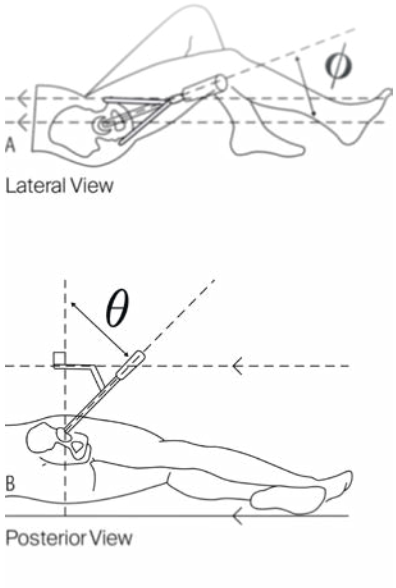
AO RECON

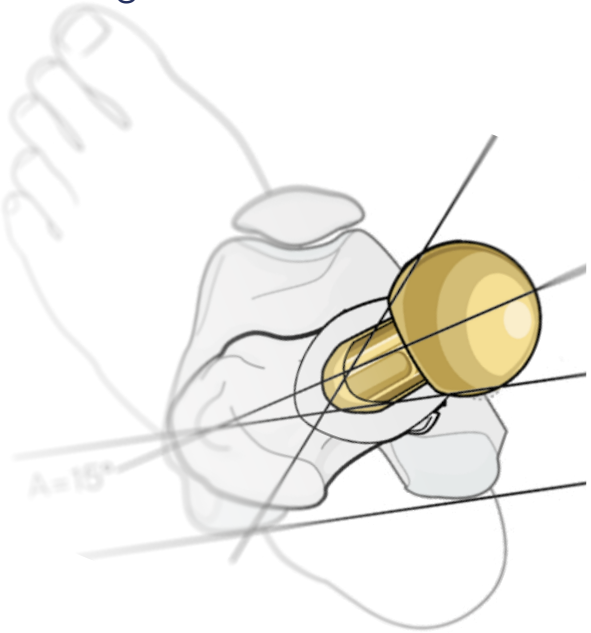
Participant Booklet

AO Recon Skills Lab

Learnings, take-home messages and further tools







Version 2.2

AO Recon Skills Lab—Introduction

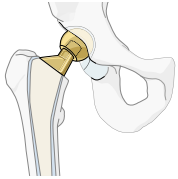
Dear participant,

Welcome to the AO Recon Skills Lab. As part of this Principles course, you will be able to practice and learn key basic skills for performing hip and knee arthroplasty, and recognize the importance of each of them. You will spend 30 minutes at each station, where two Faculty will moderate and assist you.

Sincerely,

AO Recon Curriculum Development Group

Templating a THA



This exercise is about:
– explaining the importance of planning
– performing all relevant steps, including identification of landmarks, and proper sizing

Steps

The artificial x-ray shows the pelvic model used in the stations for acetabular and femoral preparation. Template this case first to be prepared for the stations.

1. Check the quality of the x-ray
2. Identify the reference line by combining the tips of the os ischiaticum or by drawing the inter-teardrop line
3. Assess the leg length discrepancy by measuring the distance between a femoral landmark and the reference line on both sides
4. Define the basis for cup orientation (ilioischial line, 45° inclination)
5. Draw the anatomical outline of the pelvis onto the transparent paper
6. Define the correct cup size using the template, overlay the transparent paper and draw the cup
7. Define the correct stem size and position to match the center of rotation using the template
8. Place the transparent paper over the correct stem to match the cup's center of rotation, draw the stem
9. Overlay the transparent paper onto the x-ray and outline the femur with stem in place
10. Define and draw the anticipated femoral neck cut

Learning objectives

- Recognize anatomical landmarks
- Explain how to reconstruct the center of rotation

Take-home messages

- Reconstructing the center of rotation and leg length is crucial to achieve optimal joint kinematics
- Planning helps being ready in the OR

Which pitfalls can I identify when planning?
Examples include osteolysis, excess osteophytes, anomalies of anatomy, deformities, residual implants

How can I translate the plan into the operation?
Take the planning into the OR and cross-check regularly, use the planning as a basis for in situ decision making

The center of rotation

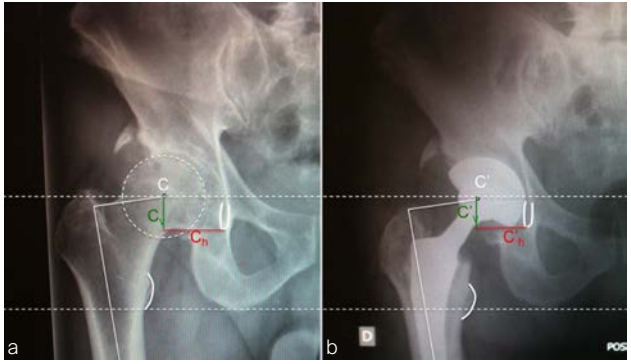


Fig 1 Example of acetabular offset modification due to excessive cup medialization. This patient had moderate hip dysplasia (a), and it was therefore reasonable to medialize the center of rotation to improve bony coverage of the cup (C'h < Ch) (b). There is little change to the height of the center of rotation. A cementless fixed-angle stem was chosen. To obtain good joint stability, the surgeon chose an extra long neck (note the skirt on the head), despite the resulting limb lengthening, which was expected to be less than 1 cm and therefore without clinical significance.

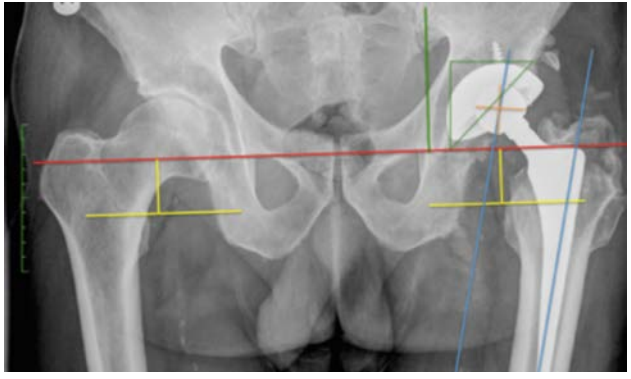
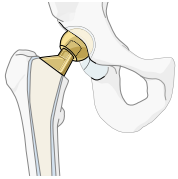


Fig 2
Red: Horizontal reference line (trans-teardrop line)
Green vertical: Ilioischial line
Blue: Determination of femoral offset
Yellow: Determination of leg length
Green triangle: Ranawat approach to reconstruct the native center of rotation

Only detailed planning allows me to identify potential pitfalls through simulating the operation.

Reaming the acetabulum and inserting a cup



This simulation is about:
– preparing the acetabular component, starting with the positioning of the cup based on landmarks
– then moving to several key steps in the techniques of reaming and cup insertion

Steps

1. Identify the landmarks to define positioning and mark these on the model
2. Draw lines on the model for access/ direction of reaming (inclination, anteversion)
3. Review all preparations and equipment to be used
4. Remove the soft-tissue cover and identify the depth of the acetabular fossa
5. Use a small reamer down to the bottom of the acetabular fossa: proceed to the medium and final reamers (aim for 45° inclination and 25° anteversion)
6. Insert the cup (aim for 45° inclination and 25° anteversion)
7. Check the positioning by inserting the laser pointer into the center of the cup
8. Place the target plate to show where the cup should be placed
9. Interpret and discuss the results

Learning objectives

- Plan the positioning of the cup based on landmarks for defining inclination and anteversion (supine or lateral positioning)
- Perform the key steps in acetabular reaming
- Identify where to place the cup

Take-home messages

- Use the appropriate landmarks to plan orientation for positioning the cup (for inclination and anteversion)
- Reflect on the consequences of the positioning and check for appropriate placement before implantation (and don't forget that the cup depth impacts the offset)

Which inclination and anteversion angles should I aim for?
Corridor of I=40 plus minus 10, anteversion of 15 plus minus 10 degrees

Which landmarks help me define an appropriate implant position?
Ligamentum transversum, pubic symphysis, ASIS (anterior superior iliac spine)

Recommended acetabular cup orientations

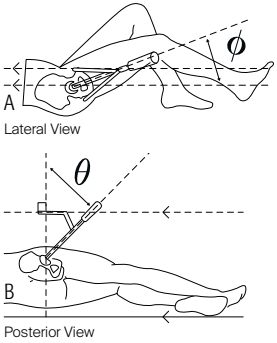


Fig 3 Surgical definition of anteversion (A) and inclination (B) angles

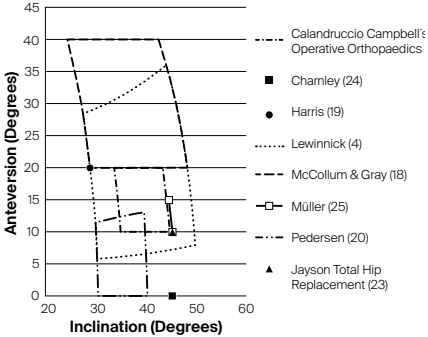


Fig 4 Recommended safe zones of the acetabular cup in the operative reference system.

"Recommended" does not necessarily mean "safe"

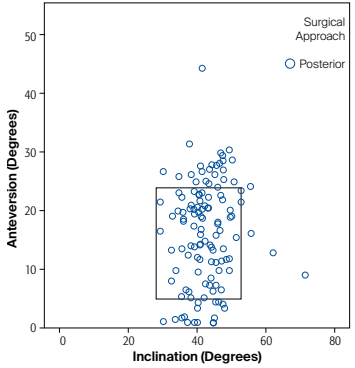
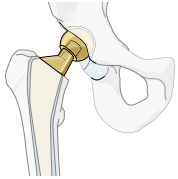


Fig 5 THA can dislocate even if the safe zones have been reached.
Each circle indicates a dislocated hip. The square indicates the Lewinnek Safe Zone for inclination and anteversion.

Even if I recognize all landmarks and define the implant position according to gold standards, there is still room for error.

Preparing the femur and inserting a stem



This simulation is about:
– preparing the femoral component, starting with the appropriate positioning
– then moving to several key steps in the techniques of broaching and stem insertion

Steps

1. Define the height and mark the intended cut
2. Cut the neck
3. Open the femoral canal and define the anteversion
4. Start the broaching process
5. Define the intended depth of the stem
6. Insert the trial stem with proper press-fit
7. To assess the stem position in this educational environment:
   - Remove the trial component
   - Open the femur with the saw, and insert a press fit stem
   - Check its positioning, check for cortical contact/press-fit

Learning objectives

- Decide the correct height of the femoral neck cut
- Prepare the femur
- Set the correct version and depth of the stem
- Achieve neutral stem insertion position (version, height, etc)

Take-home messages

- Check the version via the plane of the femur and tibia with the knee flexed at 90° (figure 4 position)
- The depth of the stem is crucial for the center of rotation and leg length reconstruction
  (and don't forget the femoral offset mentioned in the templating station)

With which factors can I influence the center of rotation?
Femoral offset, depth and rotation of the stem

How can I influence the femoral offset?
Choose a stem with an appropriate offset, and be aware of the consequences when positioning the stem in varus/valgus

The correct version

Finding ways to notice that I have created appropriate press-fit is important in the OR. Once the press-fit is achieved, I should have reconstructed the center of rotation.

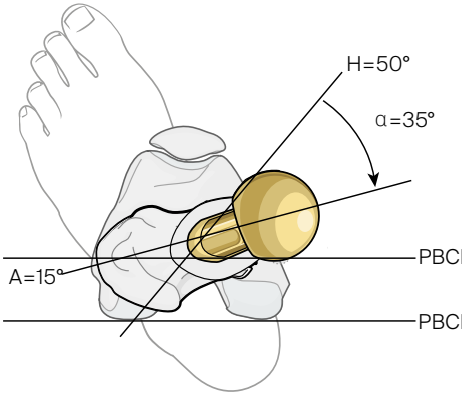


Fig 6 Measurement of femoral anteversion, and the alpha angle.
The posterior bicondylar line (PBCL) is translated to the level of the neck (PBCL') to allow the measurements. The desired prosthetic anteversion angle is about 15° (A).

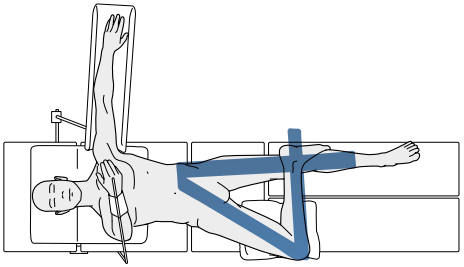
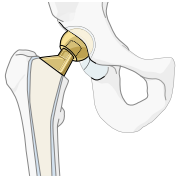


Fig 7 In case of decubitus position the figure "4" helps to determine the correct version.

Safe screw insertion



This simulation is about:
– identifying the safe and dangerous zones when inserting screws for cup fixation
– it can be conducted by individual participants and as a group exercise for comparison

Steps

1. Use the anatomical model to identify the interdependencies of the anatomical structures
2. Pick up the hemi-pelvis and consider the available bone stock and anatomical structures
3. With a green pen, mark the areas of the acetabulum where it is safe to insert screws
4. With a red pen, mark the areas of the acetabulum where it is NOT safe to insert screws
5. Discuss your marked areas with your group and the Faculty
6. Open the box and insert the screws into the holes of the multi-hole cup
7. Discuss which screw would have resulted in a soft-tissue injury

Learning objectives

- Understand the anatomical structures of the pelvis
- Describe the safe and unsafe places to put the screws based on good and poor bone stock and with respect to anatomical structures

Take-home messages

When positioning screws, the location:

- Should have good bone stock
- Should avoid injuring important anatomical structures

Additionally, use common sense in the OR to further reduce the risk of persistent soft-tissue injuries

Which structures are at risk during acetabular preparation?
Sciatic nerve, internal iliac artery, venus plexus

What do I have to do when I injure vessels and nerves anyway?
Ask for expert help rather too often than too few times

Anatomy of the hip

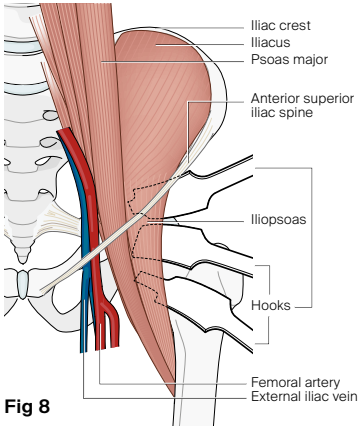


Fig 8

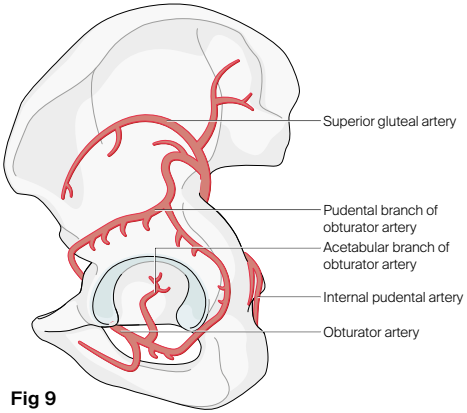


Fig 9

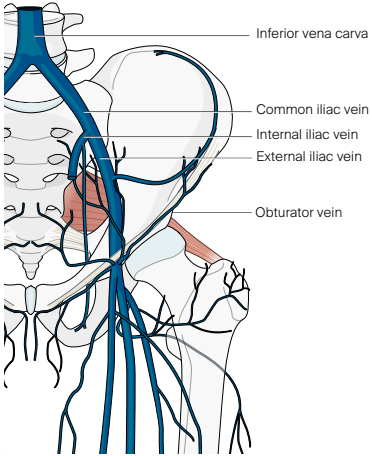


Fig 10

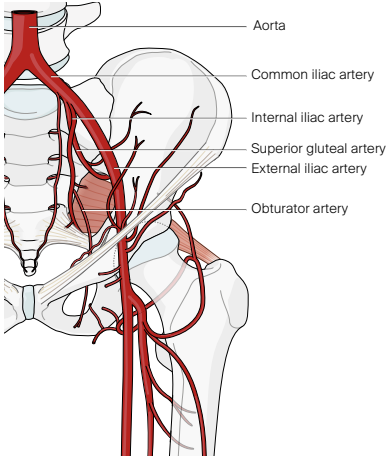
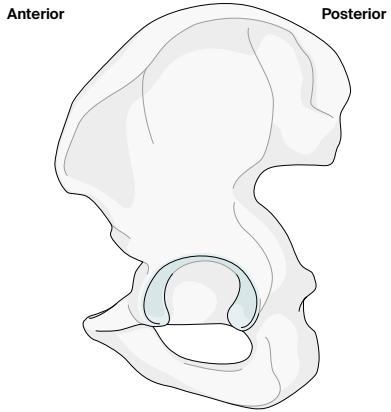


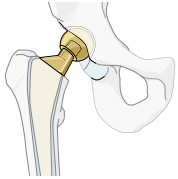
Fig 11

Even though assessing the landmarks and safe zones helps me to avoid persistent nervous and vascular injuries, I will never be able to reduce the risk to zero.

Use this illustration to color the safe and danger zones for screw insertion



Meet the experts



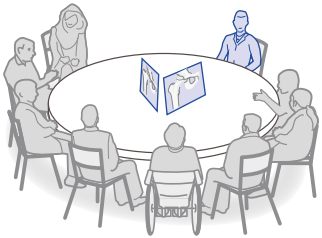
This session is about:
– your individual questions to faculty
– receiving direct feedback to cases, uncertainties, open points, or experiences in the OR

Steps

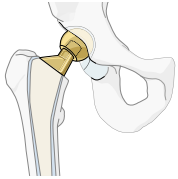
1. Collect questions to be asked to the experts throughout the course
2. Present your questions to the Faculty
3. Discuss the options, answers, or recommendations in the group

Learning objectives

- Relate learnings from the presentations to your personal experience
- Clarify eventual questions on important concepts and models
- Collect feedback and advice from the experts in the field



Take-home messages



Case discussions

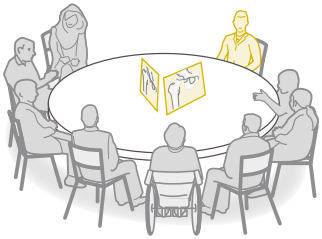
This session is about:
– case-based group discussion using standard AO Recon THA cases
– topics: intraoperative challenges and complications

Steps

1. The faculty introduces each case and moderates the discussion
2. The participants and faculty discuss the parts of each case
3. Review the take-home messages for each case

Learning objectives

- Each case has specific learning objectives integrated



Take-home messages

Skills lab hip stations

Reflection Checklist THA

This checklist allows you to take a structured approach at reflecting on your performance after having conducted a primary THA. Feel free to copy and use this page in daily practice: Ask your mentor to fill one page per case with his ratings, and record your reflections.

Reflecting on my performance after each procedure step by step helps me identify areas for improvement efficiently.

Patient name: _____

Date of operation: _____

No	Step	Learnings / Areas for improvement	Rating from mentor
1	Patient positioning		
2	Approach		
3	Exposure of the acetabulum (soft tissue)		
4	Acetabular reaming		

5	Insertion of the cup and liner
6	Preparation of the femur (soft tissue)
7	Broaching of the femoral canal
8	Insertion of the stem
9	Trial reduction (trial head)
10	Checking for stability and leg length
11	Choosing the head size and final reduction
12	X-ray (if available)
13	Closure

Planning a TKA

This exercise is about:
– understanding the importance of planning
– performing all relevant steps including the identification of landmarks, and proper sizing

Steps

AP full leg x-ray

1. Check the quality of the x-ray
2. Mark the center of the femoral head, the center of the knee joint, and the center of the upper ankle. Connect them with lines and measure the varus/valgus angle
3. Draw a line along the center of the femoral canal and measure the femoral valgus angle
4. Define the femoral resection plane by drawing a perpendicular line to the mechanical femoral axis
5. Define the tibial resection place by repeating step 4 on the tibia

Lateral view

6. Draw a line along the center of the femoral canal in order to identify the level of the entry of femoral intramedullary rod
7. Draw a line along the center of the tibial canal
8. Draw a tangent at the level of the joint line and follow the tibial slope
9. Measure the tibial slope (using the lines from steps 7 and 8)

Learning objectives

- Recognize anatomical landmarks
- Describe how to achieve desired alignment in coronal and sagittal planes

Take-home messages

- Proper alignment is crucial to achieve optimal joint kinematics
- Planning the planes helps avoid surprises in the OR

Which pitfalls can I identify when planning?
Examples include osteolysis, excess osteophytes, anomalies of anatomy, deformities, previous operations

What about kinematic alignment?
Kinematic alignment is based on the patient-specific anatomy and considers pre-existing ligamentous tensions. Thus, the aim is to reconstruct the patient's inherent kinematics before OA as accurately as possible. As kinematic alignment has only been applied to varus patients so far, anatomic alignment is still most widely used.

Fig 12 **Fig 13**
Standing LL x-rays are crucial for planning.

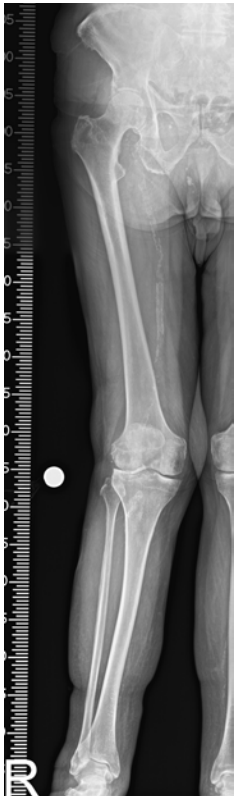


Fig 14 **Fig 15**
Reconstruct the planning process to obtain the same result as in the two pictures to the left.

Only detailed planning allows me to identify potential pitfalls through simulating the operation.

Alignment for a tibial cut

This simulation is about:
– highlighting the importance of alignment for a tibial cut
– helping to visualize all the important components

Steps

1. Assemble the guide on the tibia using appropriate landmarks
2. Perform the desired alignment with regards to:
   - Setting the depth to 8 mm
   - Aiming for a 5° slope
   - Varus/valgus
3. Turn on the laser, remove the cover and assess result regarding the above factors
4. Describe how to correct any problems and adjust accordingly

Learning objectives

- Carry out alignment planning based on the correct landmarks
- Describe the causes for error and perform the according corrections

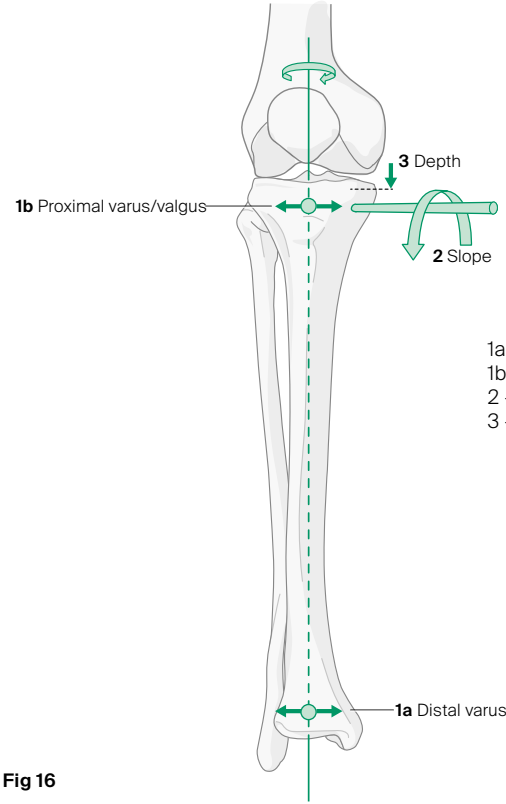
Take-home messages

- Alignment must be planned based on the correct landmarks
- All three dimensions must be considered for correct alignment and kinematics

Which factors help me define an appropriate implant position?
Four dimensions:
1. tibial tuberosity
2. ankle/second toe
3. tibia slope
4. thickness of resection

What are indications for intramedullary alignment?
Severe obesity, revision surgery with stem extensions

The three dimensions of alignment



1a – distal varus/valgus
1b – proximal varus/valgus
2 – slope
3 – depth

Fig 16

Even if I recognize all landmarks and define the implant position in all planes, there is still room for error.

Performing a tibial cut

This simulation is about:
– outlining how to make an accurate cut as planned
– how to avoid damaging any vessels, veins, and other soft tissues such as the collateral ligaments while sawing

Steps

1. Insert the posterior capsule (block 1 with plasticine) behind the bone
2. Select a blade and perform the tibial cut through the cutting guide
3. Remove the block and check for soft-tissue penetration
4. Insert block 2, check the accuracy of the cut, and reflect on the result
5. Smoothen the plasticine in block 1, insert it, move the bone up, and repeat the cut with a different saw blade
6. Reflect on the differences between the two cuts

Learning objectives

- Perform an accurate plain tibial cut
- Avoid any soft-tissue damage during the performance of a tibial cut

Take-home messages

- Check that you have the correct blade thickness before sawing
- Avoid soft-tissue damage
- Be aware of possible errors that cause poor bone cuts

What happens if I penetrate the posterior soft tissue too much?
Loss of stabilizing function of posterior capsule, damage of neurovascular structures such as the popliteal artery

Which structures do I put at risk if I penetrate medially or laterally too much?
The medial collateral ligaments, popliteal tendon, iliotibial tract, peroneal nerve

What do I have to do to protect the patellar ligament?
Dissect the Hoffa's fat pad to clearly visualize the patellar ligament, use medialized cutting guides, and use additional retractors guarding the tendon.

Proper bone cuts

Fig 17 Correct

Fig 18 Wrong

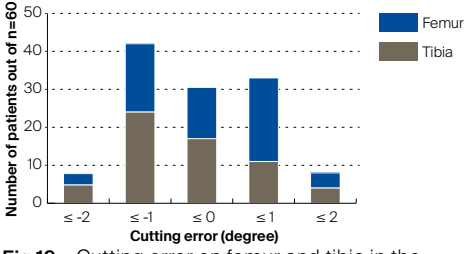


Fig 19 Cutting error on femur and tibia in the coronal plane.

Vicinity of vessels in posterior capsule

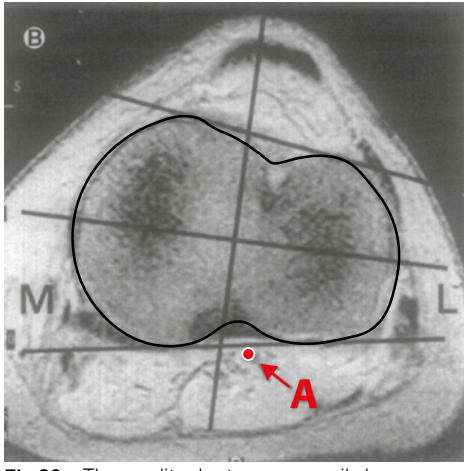


Fig 20 The popliteal artery can easily be damaged when the tibial cut is not done carefully

When my bone cuts are not perfect, I may need to consider counterintuitive factors to find the cause.

Cementing

This simulation is about:
– demonstrating the result of using cement with various types of surfaces
– demonstrating that cement is not glue, it is grout

Steps

1. Mix the cement according to instructions
2. Examine the available numbered plates: 1 is plain (represents the cortical bone), 2 has a green inlet (represents spongeous bone with debris), 3 has a dove tail (represents clean, spongeous bone). The counterparts without numbers represent the rough implant surface.
3. When the cement is no longer sticky, apply 3 equally sized chunks to the three samples
4. Use the drying phase to understand the surgical relevance by watching the featured video
5. After the hardening phase, test the strength of bonding between the samples and compare the three test sets

Learning objectives

- Describe the function of cement
- Recognize the various phases with cement (preparation phase, sticky phase, and working phase)

Take-home message

- Cement is not glue, it is grout

What is grout?
Principle of how cement fills voids in the bone structure and thus anchors to it

What is fourth generation cementing and what are its elements?
Fourth generation cementing ensures proper fixation based on the grout principle and includes: Vacuum mixing, pulsatile lavage, drying of bone, pressurization of cement into the bone, use centralizers to ensure an even cement mantle around the stem.

The form closure principle

Cement creates fixation by “hooking” into empty spaces of spongeous bone.

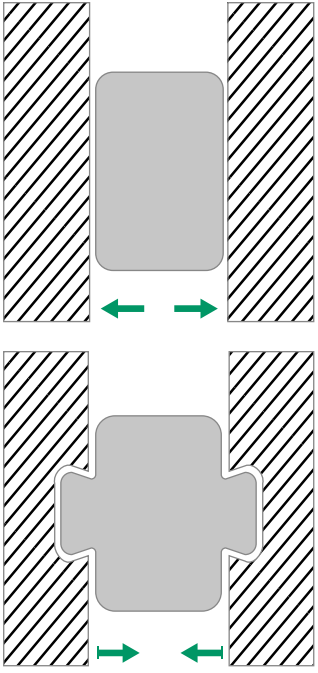


Fig 21

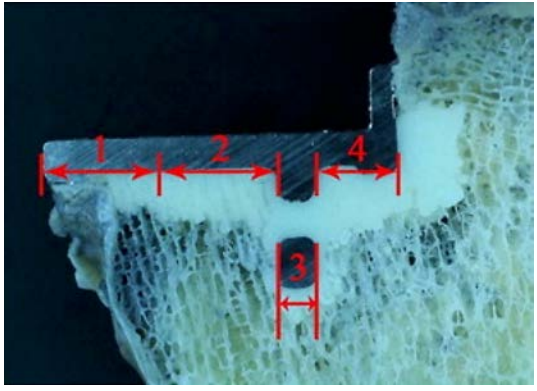


Fig 22 Cross-section of a stable bone-implant cement interface

I cannot use cement as if it was glue, because it is not sticky by itself.

Meet the experts

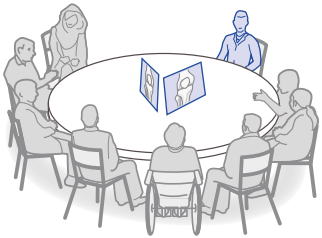
This session is about:
– your individual questions to faculty
– receiving direct feedback to cases, uncertainties, open points, or experiences in the OR

Steps

1. Collect questions to be asked to the experts throughout the course
2. Present your questions to the Faculty
3. Discuss the options, answers, or recommendations in the group

Learning objectives

- Relate learnings from the presentations to your personal experience
- Clarify eventual questions on important concepts and models
- Collect feedback and advice from the experts in the field



Take-home messages

Case discussions

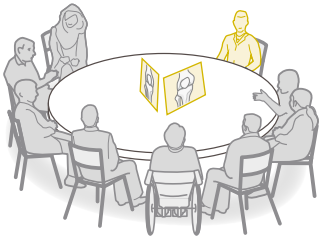
This session is about:
– case-based group discussion using standard AO Recon TKA cases
– topics: intraoperative challenges and complications

Steps

1. The faculty introduces each case and moderates the discussion
2. The participants and faculty discuss the parts of each case
3. Review the take-home messages for each case

Learning objectives

- Each case has specific learning objectives integrated



Take-home messages

Skills lab knee stations

Reflection Checklist TKA

This checklist allows you to take a structured approach at reflecting on your performance after having conducted a primary TKA. Feel free to copy and use this page in daily practice: Ask your mentor to fill one page per case with his ratings, and record your reflections.

Reflecting on my performance after each procedure step by step helps me identify areas for improvement efficiently.

Patient name: _____

Date of operation: _____

No	Step	Learnings / Areas for improvement	Rating from mentor
1	Patient positioning		
2	Approach		
3	Distal femoral cut		
4	Proximal tibial cut		
5	Checking the extension gap with spacerblocks and release		

6	Sizing of the femur
7	Setting the rotation of the femur
8	Checking the flexion gap with spacerblocks while the 4-in-1 cutting block is in place
9	Anterior/posterior/oblique cuts of the femur
10	Final check/fine tuning of the balancing/range of motion/patella tracking
11	Implantation of the trial components
12	Final balancing with release of the dorsal capsule and collateral structures
13	Cementing/Impaction of the implant
14	X-ray in two planes (if available)
15	Closure

Notes

Notes

References

Fig 22 **Sebastian Jaeger, Joern B. Seeger, Christian Schuld, Rudi G. Bitsch, et al.** Tibial Cementing in UKA: A Three-Dimensional Analysis of the Bone Cement Implant Interface and the Effect of Bone Lavage. *The Journal of Arthroplasty.* 2013;28 Suppl. 2;191–194

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