EMORY HEALTHCARE

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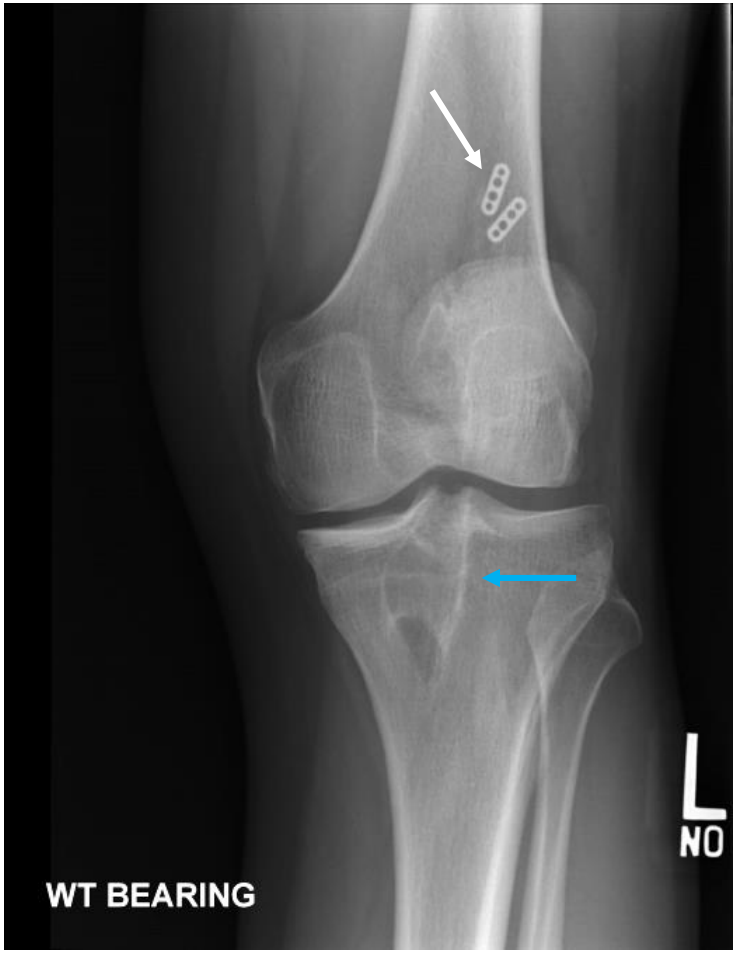
Arthroscopy / MRI Correlation Conference

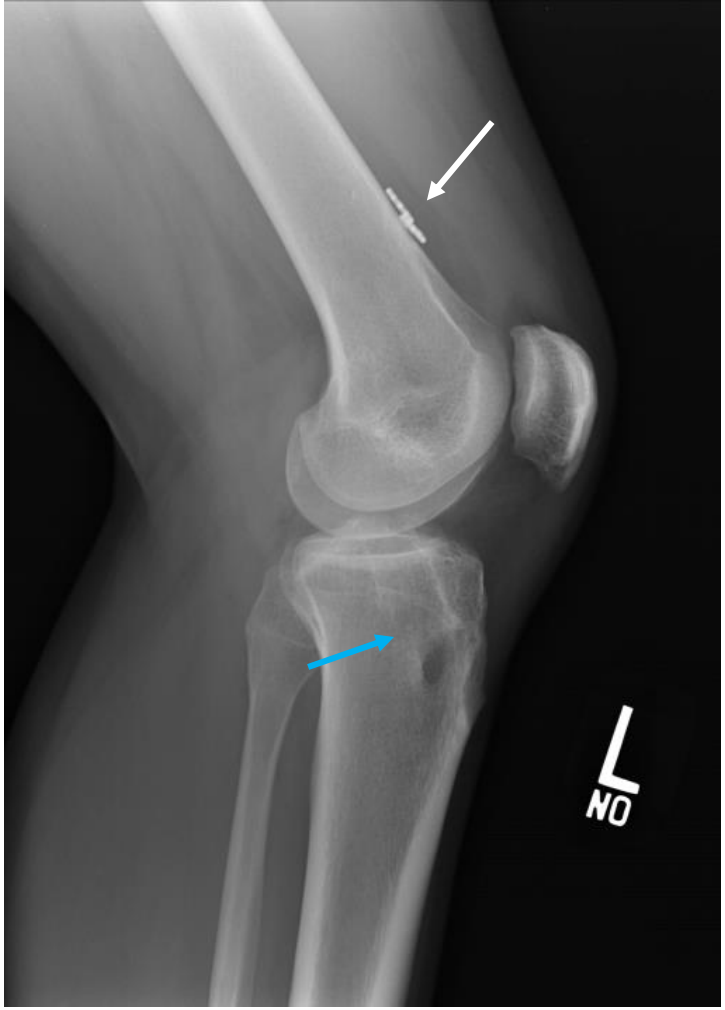
Department of Radiology, Section of MSK Imaging
Department of Orthopedic Surgery

Conference #2

Case 1: Knee

- 33 YOM with left knee instability
  - ACL tear 8 years ago
  - s/p ACL recon x2
    - BTB Autograft (2008)
    - Allograft (~2011)
  - Did well for ~1 year after most recent surgery
- Recurrent instability and pain
- Works as a stuntman
- Physical Exam
  - Grade 2 Lachmans
  - Grade 2 Pivot Shift



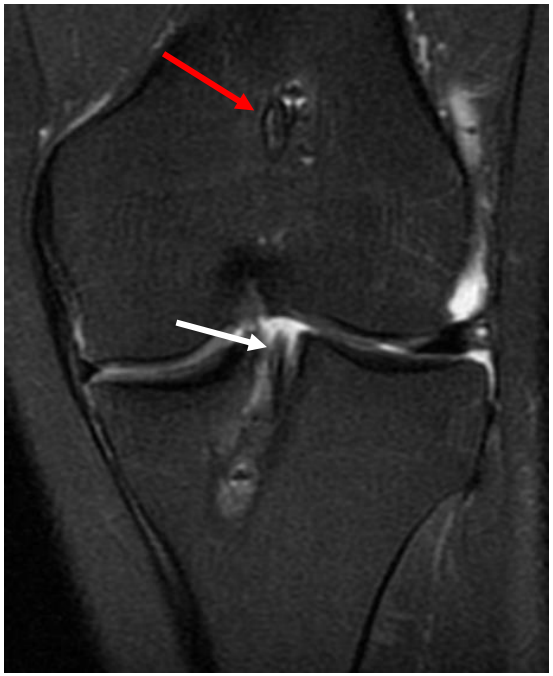


AP (left) and lateral (right) preoperative radiographs demonstrate a vertical positioning of the tunnels with anterior femoral cortical endobuttons (white arrows) suggesting that the suspected failed ACL graft was reconstructed by a transtibial approach. The tibial tunnel is markedly widened due to osteolysis (blue arrows).

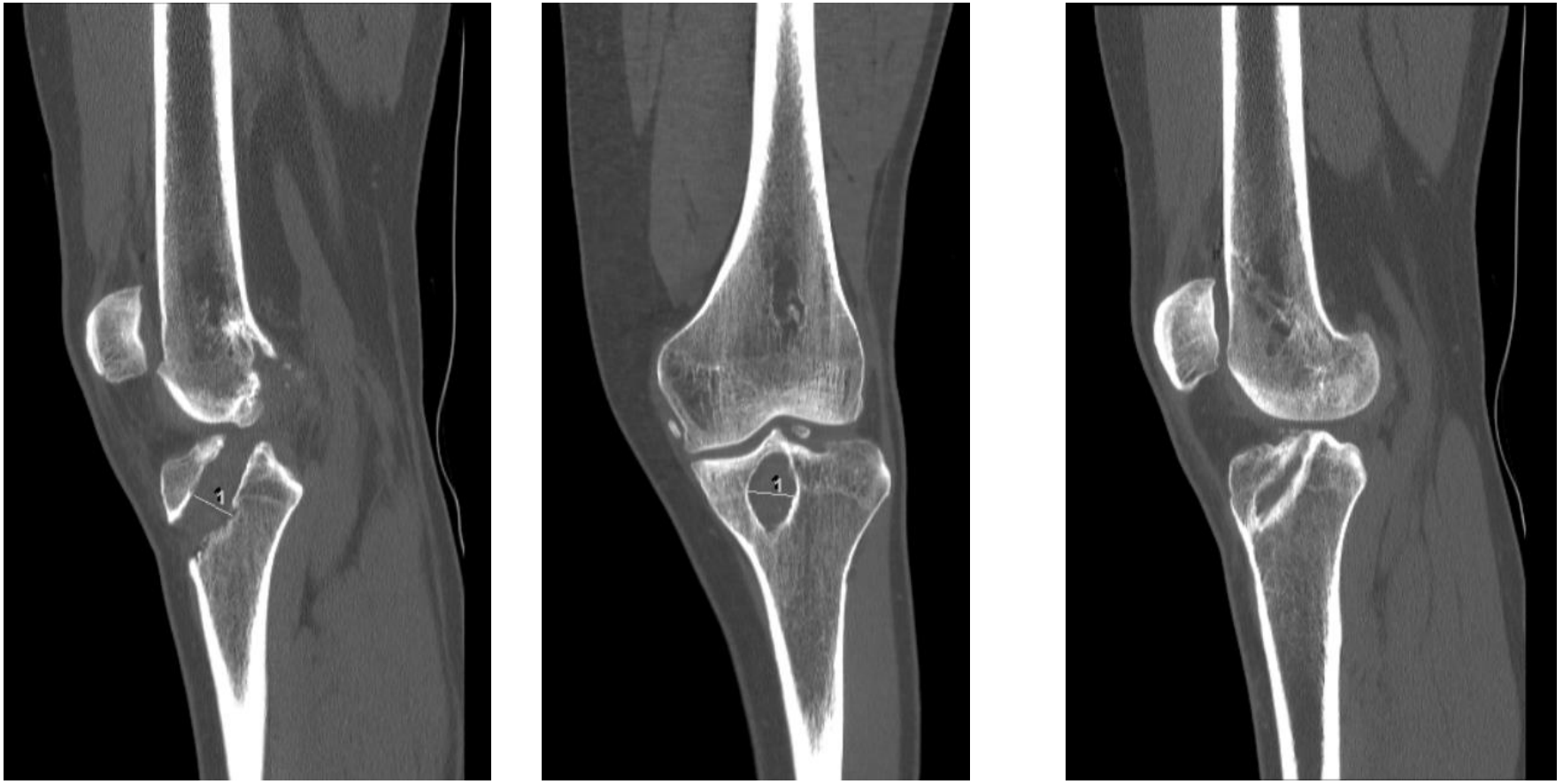


Sagittal PDFS MRI shows attenuation of the graft (white arrow)without a full thickness tear. There is granulation tissue in the tibial tunnel with tunnel widening (blue arrow). The ACL graft is taut and parallels the intercondylar roof as expected.

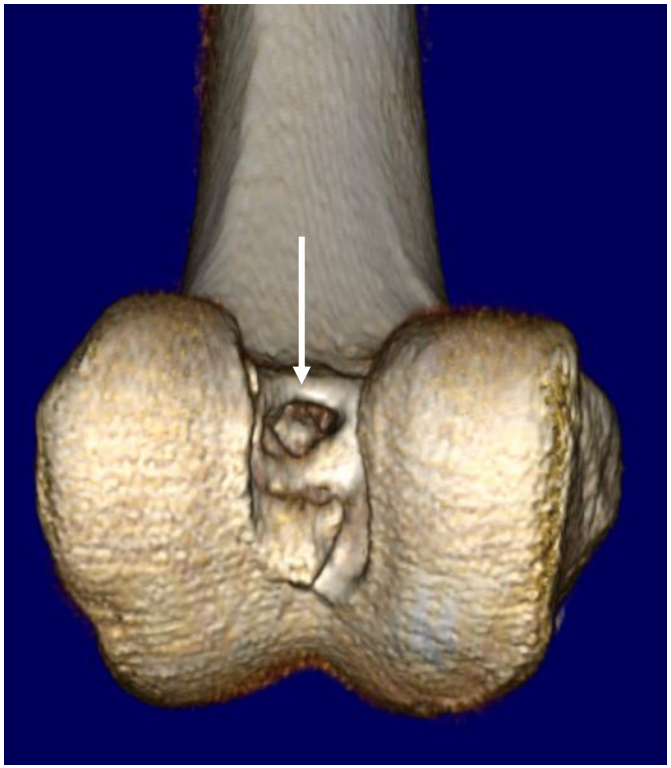
The tibial aperture is posterior the intercondylar roof line as expected, but the femoral tunnel is slightly anterior.

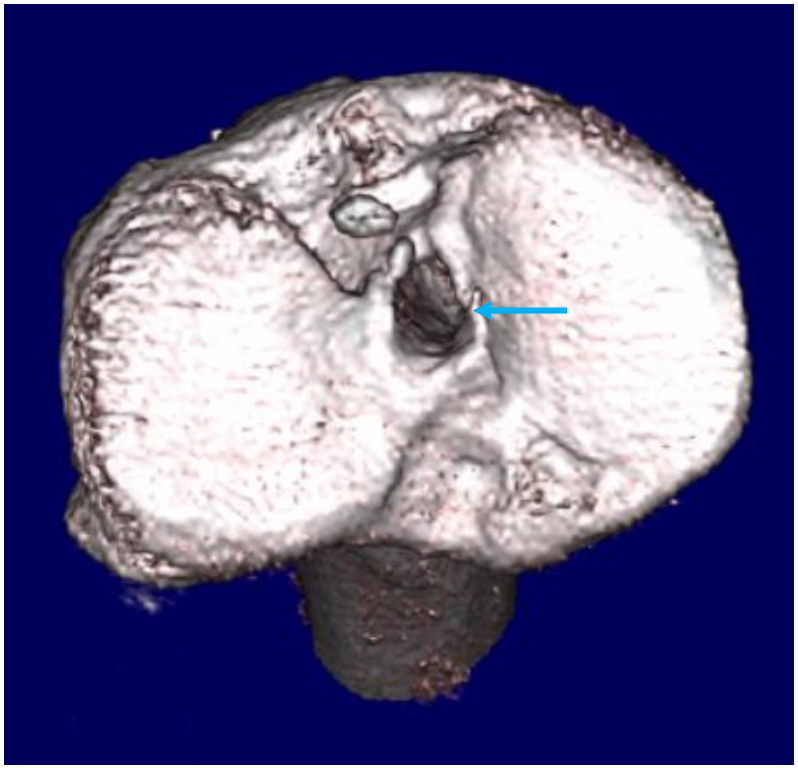




Coronal PDFS MRI shows attenuation of the graft (white arrow)without a full thickness tear. There is granulation tissue in the tibial tunnel with tunnel widening (blue arrow). The femoral tunnel is near the 12 position (vertical, red arrow).



Sagittal (left and right) and coronal (middle) CT images show widening of the tibial tunnel especially centrally where there is cavitary dilation. On the coronal series, maximal mediolateral diameter was 17 mm while on the sagittal maximal AP diameter was 15 mm.





Surface rendering from the CT shows a vertical position of the femoral aperture (white arrow, left). The dilated tibial aperture and tunnel is seen looking down on the tibial plateau (blue arrow, right).

Tunnel Size

Although no significant correlation between tunnel enlargement and clinical outcomes has currently been reported, tunnel widening may have serious implications for patients requiring ACL revision surgery.

Crespo B, et al. Measurements of bone tunnel size in anterior cruciate ligament reconstruction: 2D versus 3D computed tomography model. J Exp Orthop. 2014 Dec; 1: 2.

Skeletal Radiol (2017) 46:161–169
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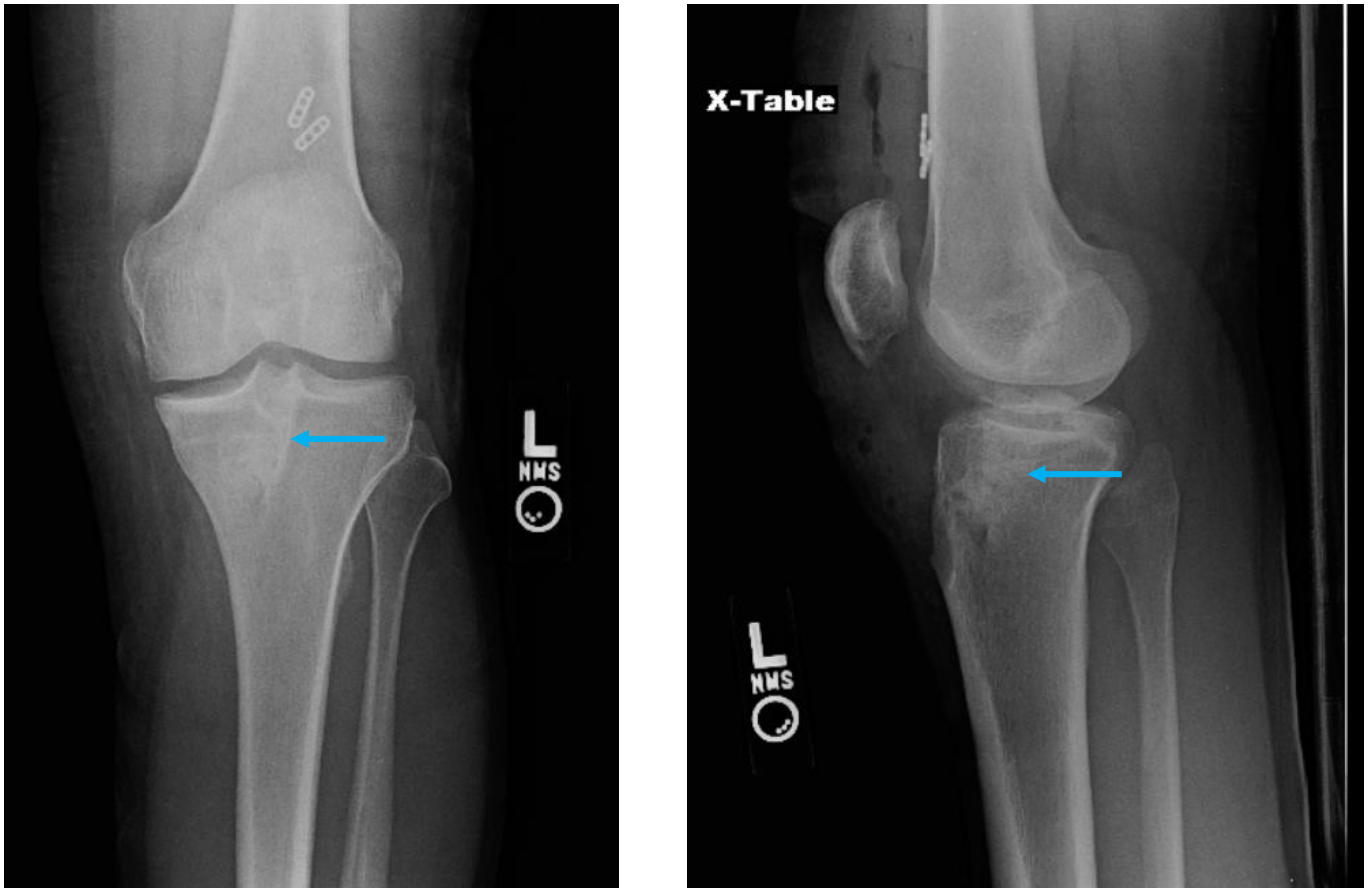
REVIEW ARTICLE

Anterior cruciate ligament reconstruction tunnel size: causes of tunnel enlargement and implications for single versus two-stage revision reconstruction

Magda Rizer[1] · Gregory Brian Foremny[2] · Augustus Rush III[3] · Adam D. Singer[4] · Michael Baraga[5] · Lee D. Kaplan[6] · Jean Jose[7]

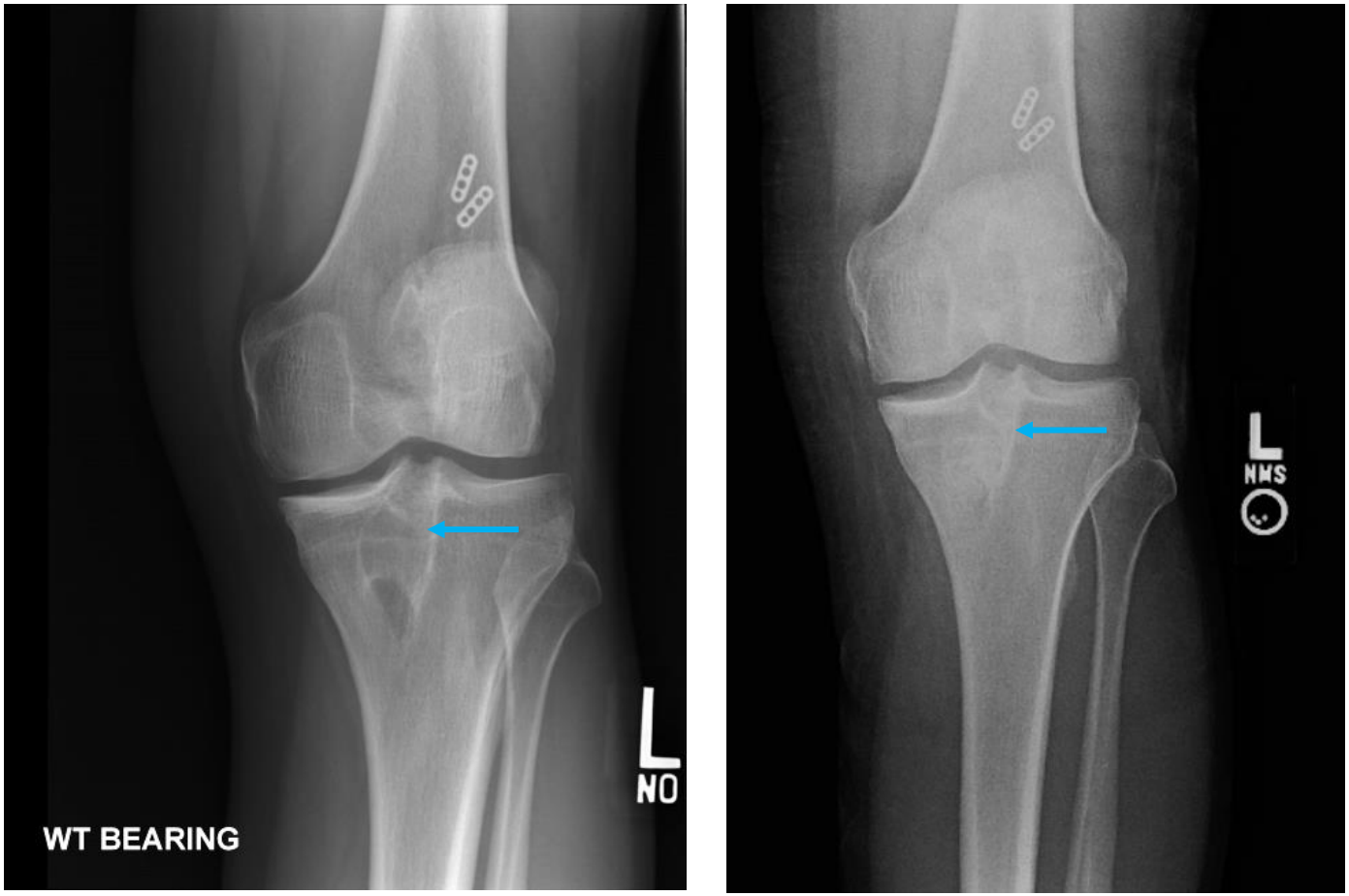
1. Expected immediate post-operative ACL tunnel diameter should be around 10 mm regardless of graft selection.
2. Tunnel widening is generally cavitary, frequently maximal in the mid-zone of the tibial tunnel.
3. One of the main factors associated with tunnel enlargement is malposition of the tibial tunnel, which likely leads to graft micromotion.
4. A two-stage revision involves an initial bone grafting procedure to fill the tunnels, followed at least 3 months later with revision surgery.
5. A tunnel diameter greater than 15 mm will require two-stage surgery when the original tunnels are in anatomic position, while revision with a tunnel diameter of less than 10 mm can be accomplished in a single surgery. Revision of tunnels 10–15 mm differs depending upon tunnel shape, position and the treating surgeon's preference.

Stage 1: Tibial tunnel bone grafting



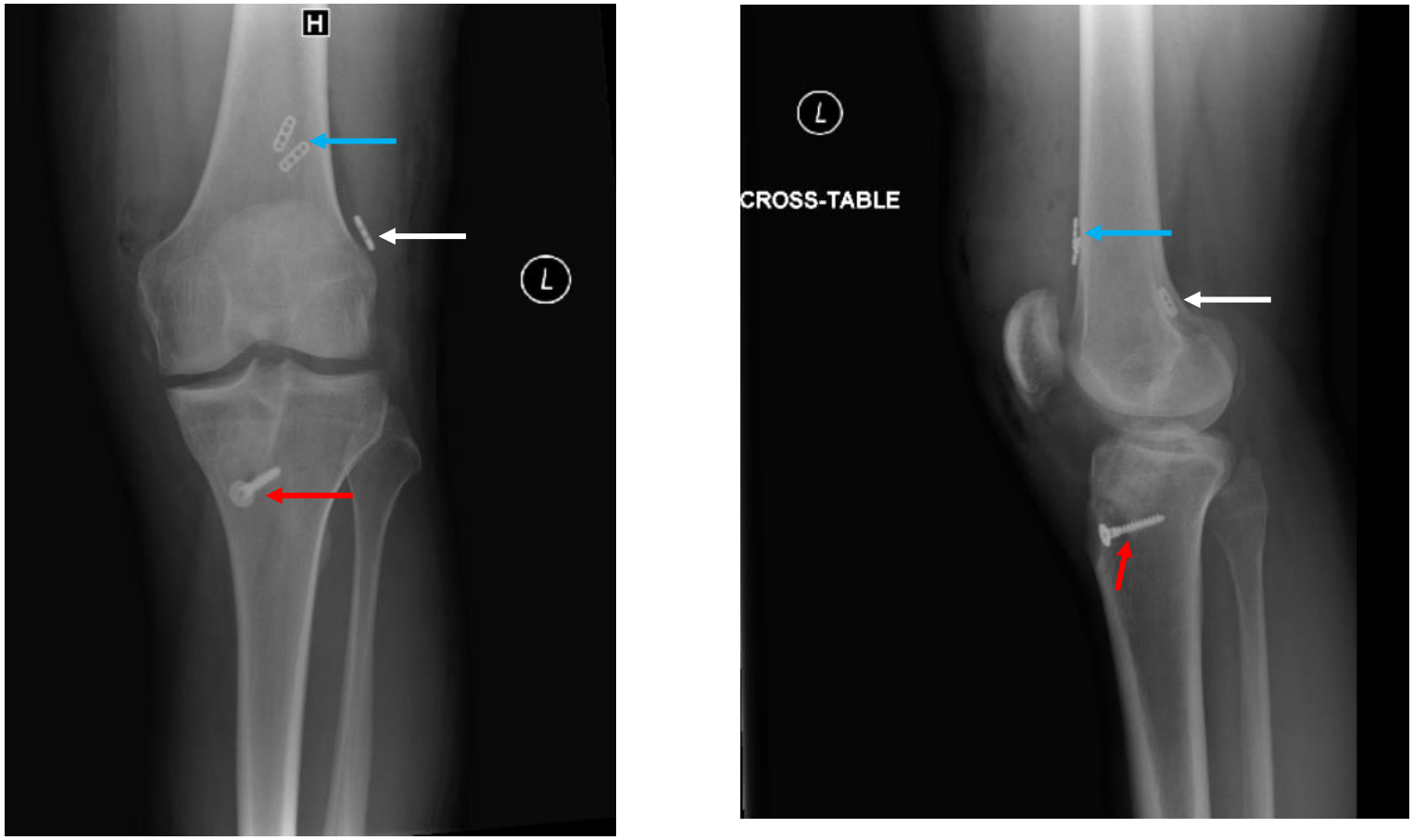
AP (left) and lateral (right) show the tibial tunnel has been filled with bone graft (blue arrows). The femoral tunnel was not because the tunnel is not drilled in an anatomic position and the revision ACL femoral tunnel will be drilled in an anatomic position.

Stage 1: Tibial tunnel bone grafting



AP before bone graft (left) and after (right) show the tibial tunnel has been filled with bone graft (blue arrows).

Stage 2: Revision ACL reconstruction

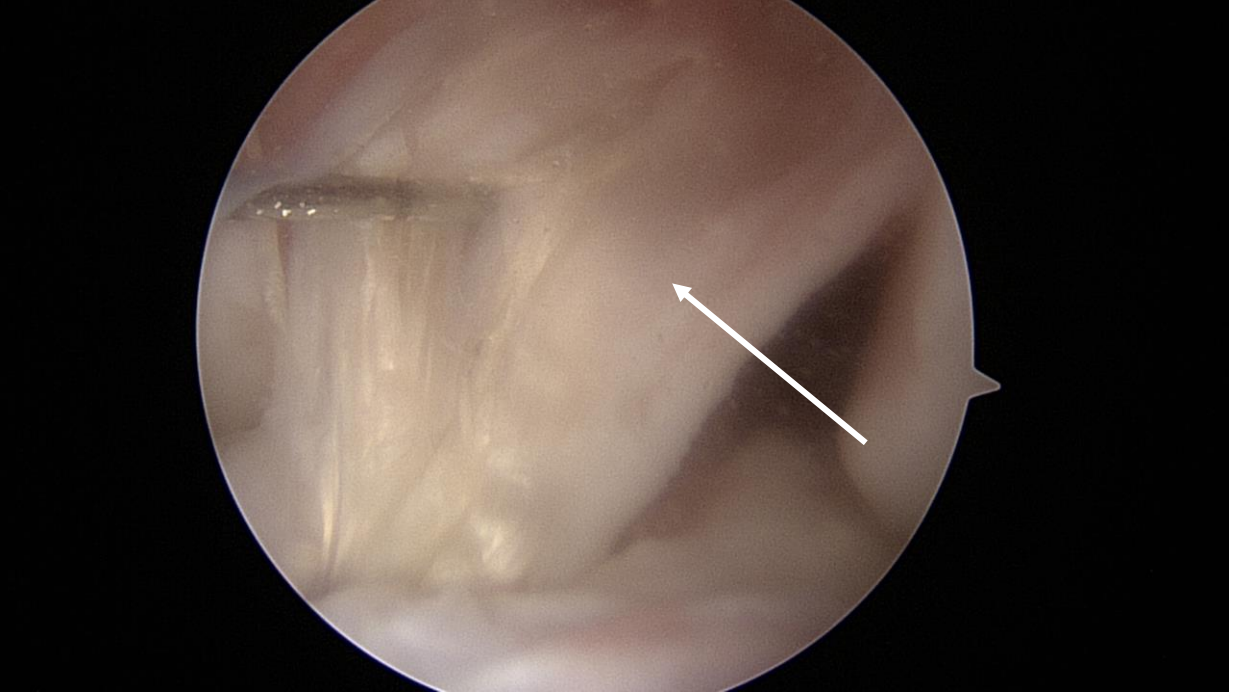


AP (left) and lateral(right) show the revision ACL reconstruction. The old cortical endobuttons are left behind (blue arrows) while a new cortical endobutton is placed on the lateral femoral condyle in this anatomic ACL revision (white arrow). A tibial post screw is used to secure the tibial side of the graft (red arrows). The tunnel is drilled to 10.5-11 mm.

Stage 1: Bone graft tibial tunnel

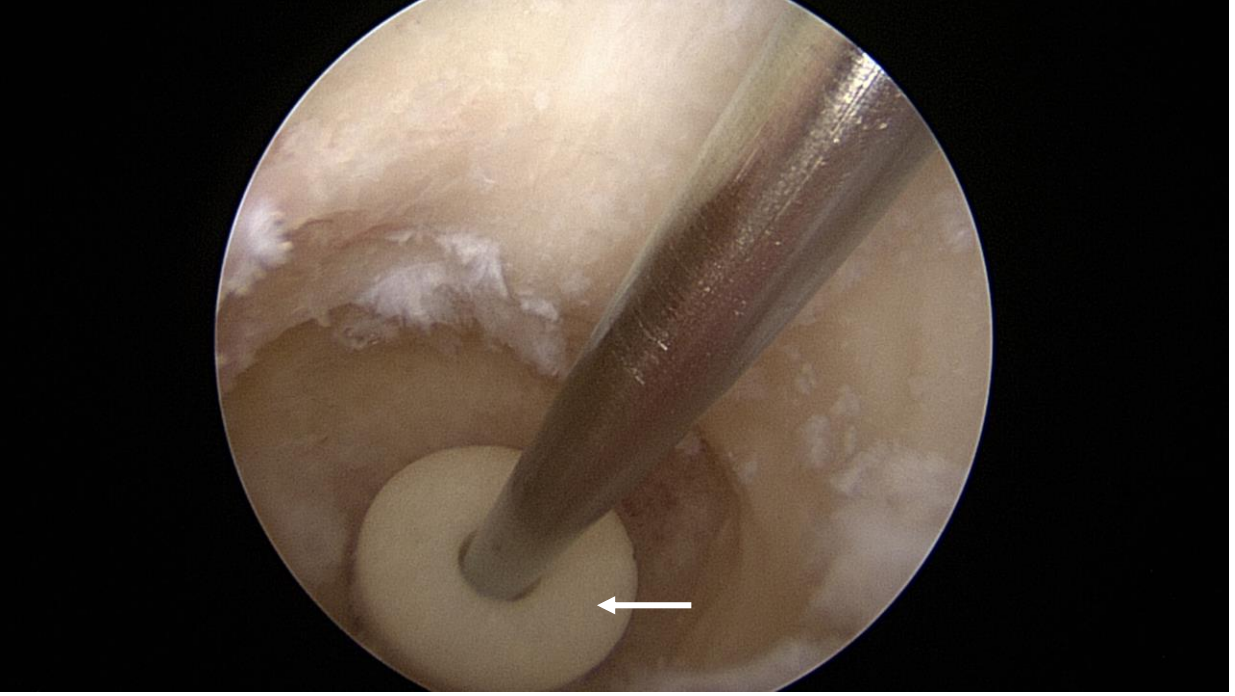
- Procedure
  - 1. Diagnostic Left Knee Scope
  - 2. Arthroscopic assisted bone grafting, tibial tunnel

- Findings:
  - “Thin attenuated ACL graft in vertical position”
  - “ Distally, larger cavitary lesion, >15mm”



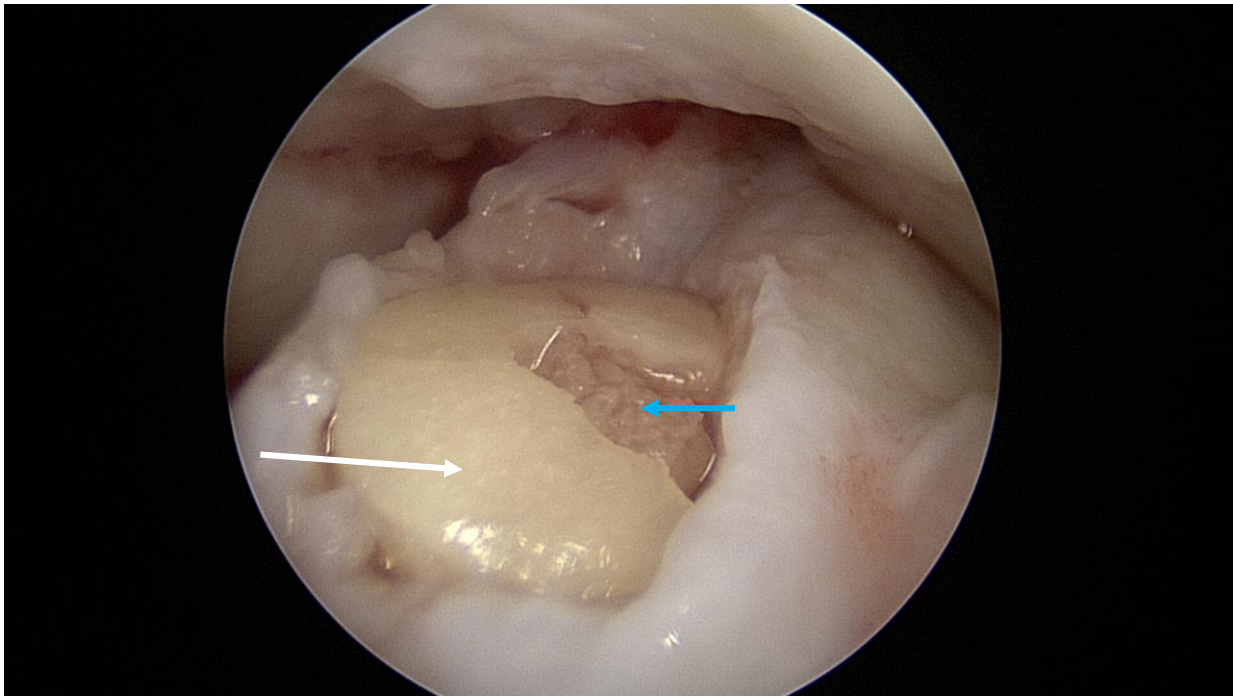
Vertical ACL graft, attenuated, some fibers intact as seen on MRI (white arrow)

Tibial tunnel, debrided, appears dilated



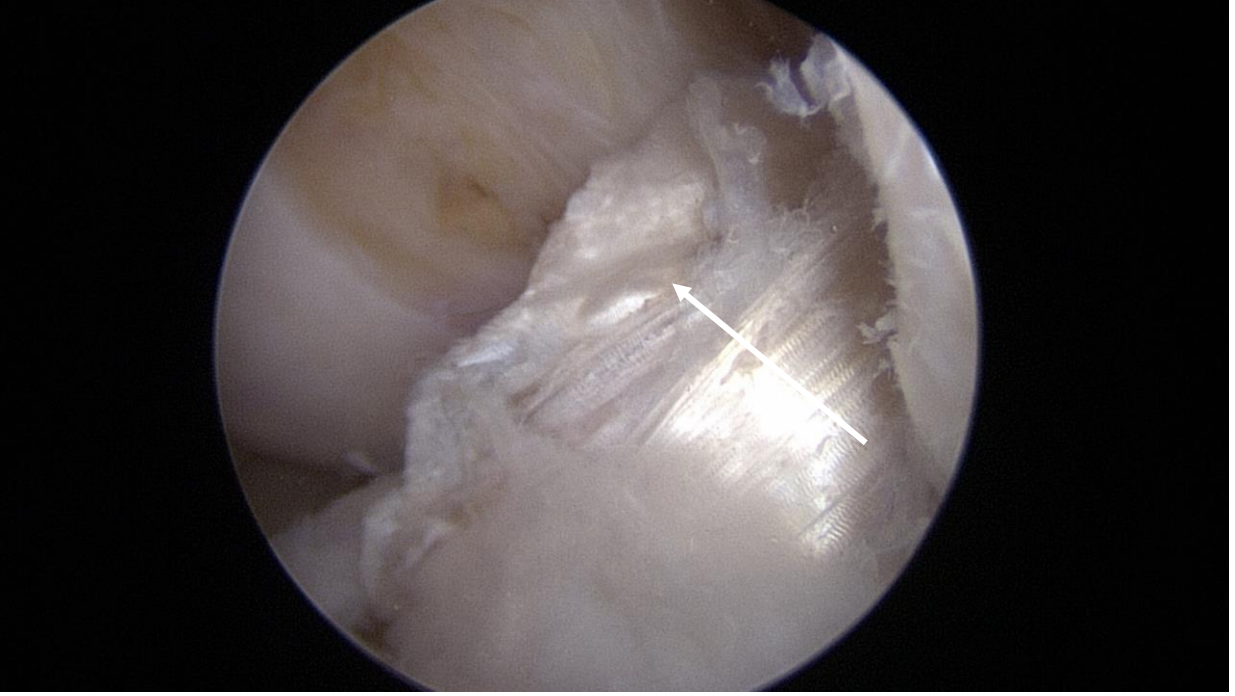
Tibial tunnel, allograft dowel (white arrows) being delivered to aperture

Tibial tunnel, allograft at aperture with packed cancellous (blue arrow) allograft



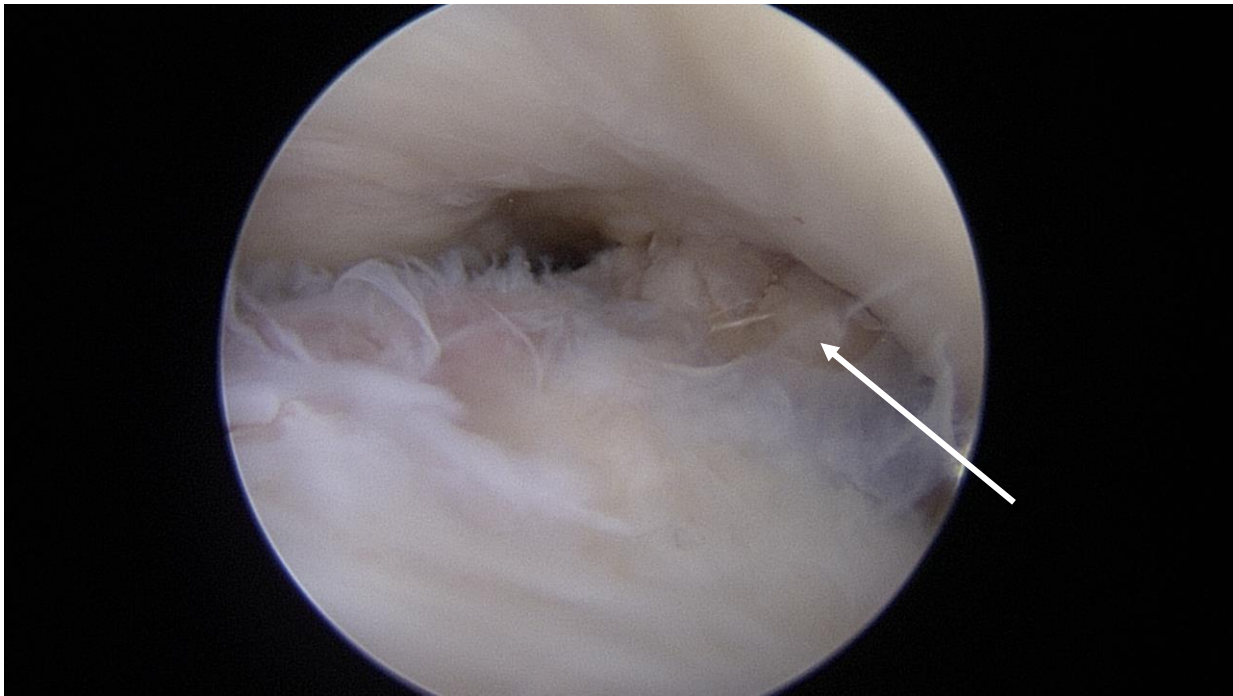
Stage 2: Reconstruct ACL

- Procedure
  - 1. Diagnostic arthroscopy, left knee
  - 2. Arthroscopic assisted ACL reconstruction with 10.5mm quadriceps tendon autograft
- Findings
  - Well healed tibial tunnel from previous surgery



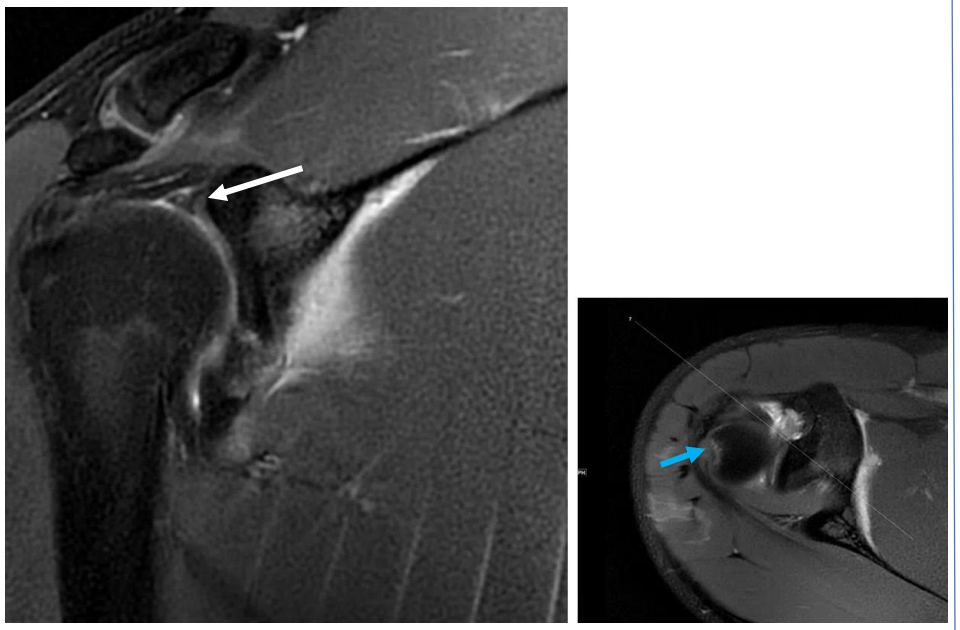
Successful ACL
Quadriceps Autograft
(white arrows)

Successful ACL Quadriceps
Autograft, no impingement
in full extension

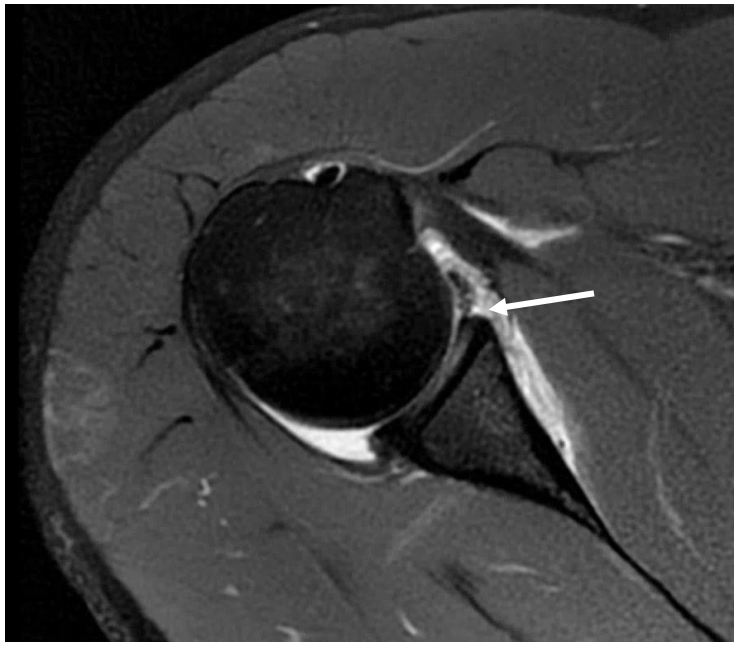


Case 2: Shoulder

- 22 YOM, elite athlete
- Left shoulder injury in preseason game
- Felt shifting in shoulder, no deformity noted
- Xrays negative
- PE:
  - Positive apprehension, relocation tests
- MRI obtained



Coronal PDFS (with axial PDFS and localizer line in bottom right of each image).
From anterior to posterior (top left to bottom right), there is linear increased signal in the superior labrum from anterosuperior to posterosuperior undercutting the anchor (white arrows). The signal turns away from the glenoid in a lateral direction indicating a SLAP lesion. There is also a Hill-Sachs impaction fracture of the posterosuperior humeral head with underlying bone marrow edema (blue arrows).

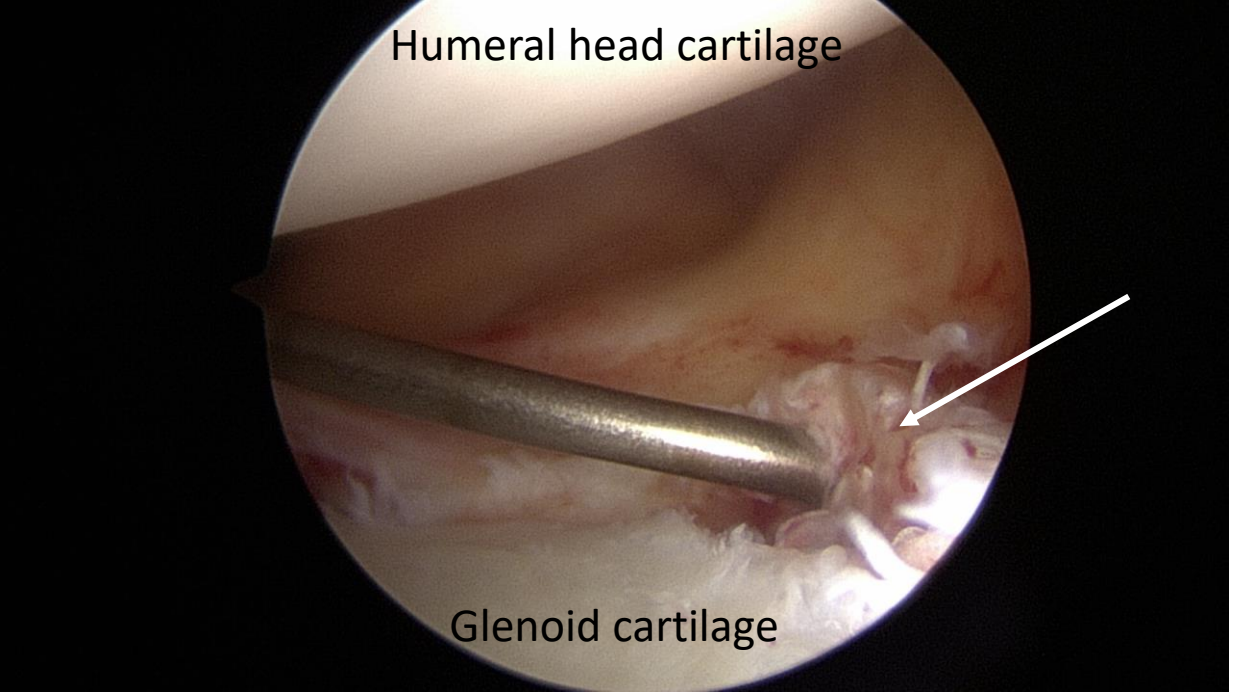


Axial PDFS shows a tear of the anteroinferior labrum without glenoid rim fracture (white arrows). The labrum and periosteum are torn, but they are non-displaced, consistent with a Bankart lesion. In conjunction with the SLAP, this would be a type 5 SLAP by Snyder classification.

- Exam Under Anesthesia
  - Grade 2+ anterior translation, Grade 1 posterior translation, Grade 1+ sulcus (improved with ER)

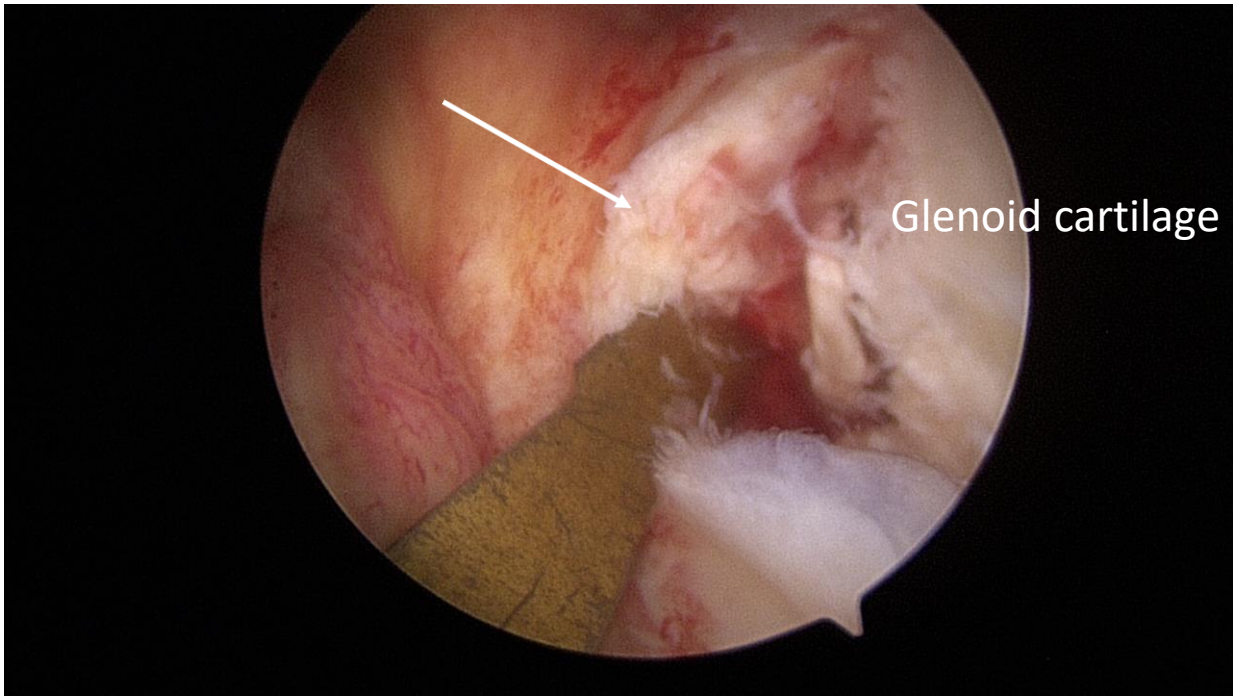
- Procedures
  - 1. Diagnostic arthroscopy, left shoulder
  - 2. Arthroscopic Bankart reconstruction (3 anchors)
  - 3. Arthroscopic SLAP repair (2 anchors)

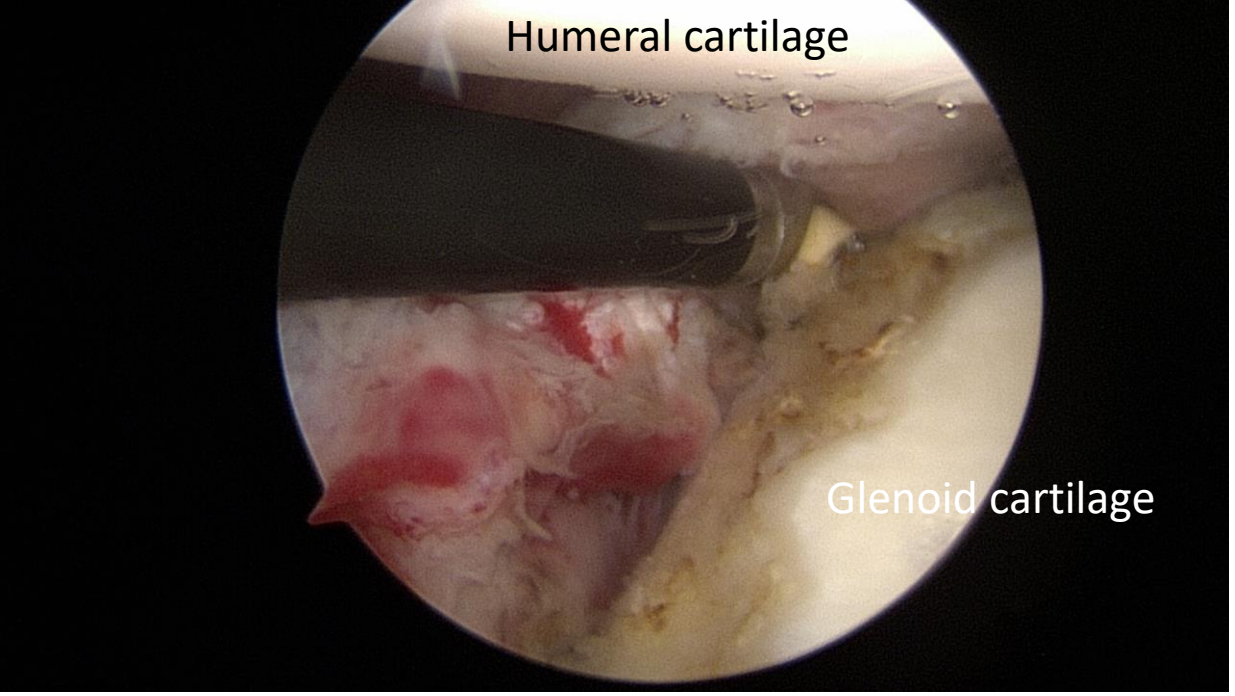
- Findings:
  - “An anterior labral tear that extended past 6 o'clock up superiorly posterior to the biceps tendon in a classic type V SLAP lesion.”



Posterior Portal: Anterior Labral tear (white arrow) Bankart injury extending inferiorly to the "6 o'clock Position," with probe in the tear

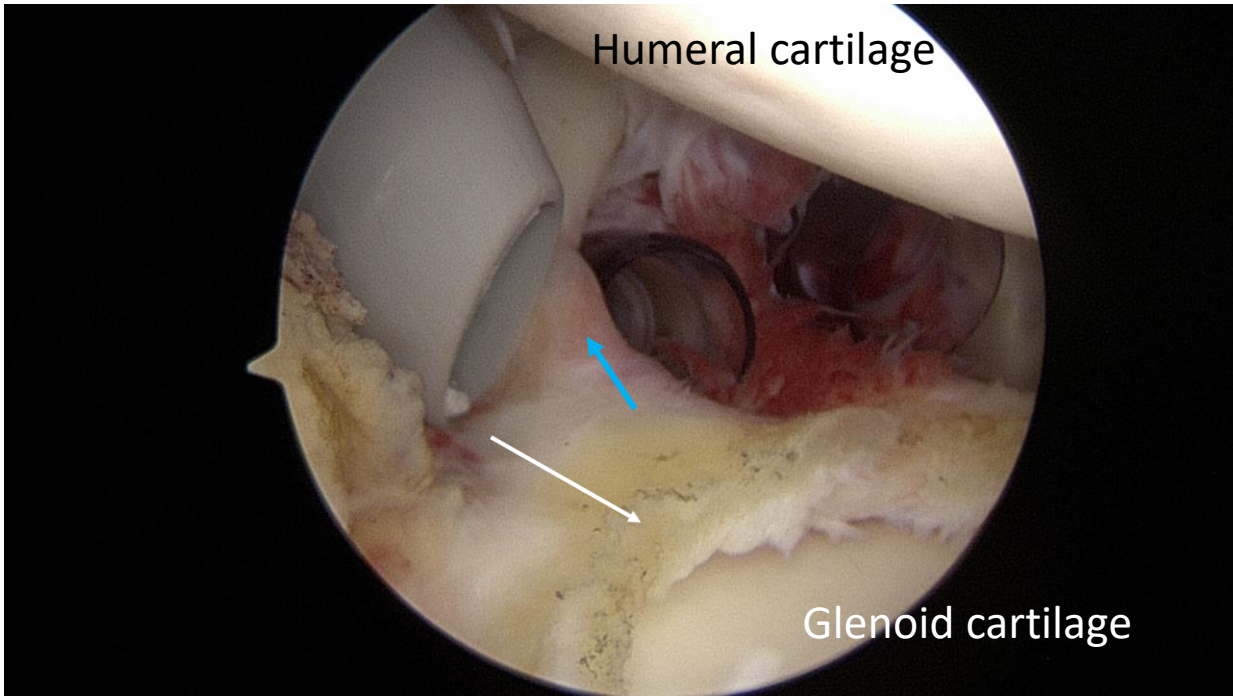
Anterior Superior Portal: Anterior Labral injury, freeing up labrum (white arrow) and underlying soft tissue

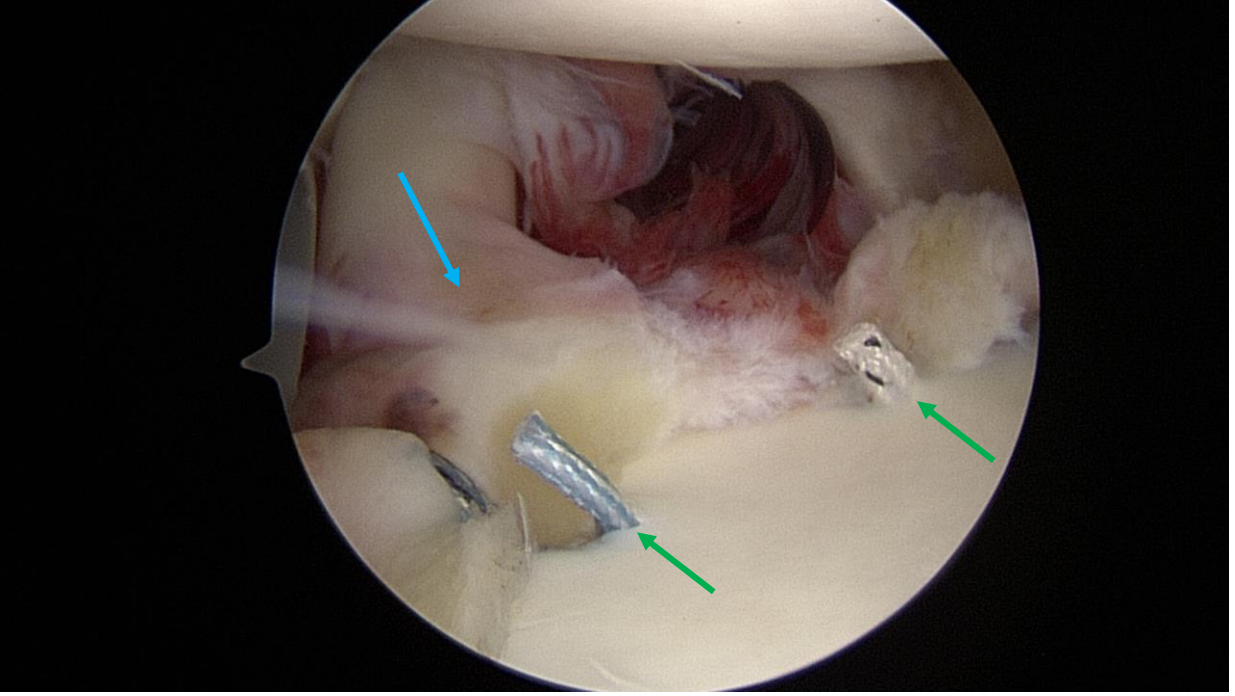




Anterior Portal: Using cautery to create nice plane of tissue

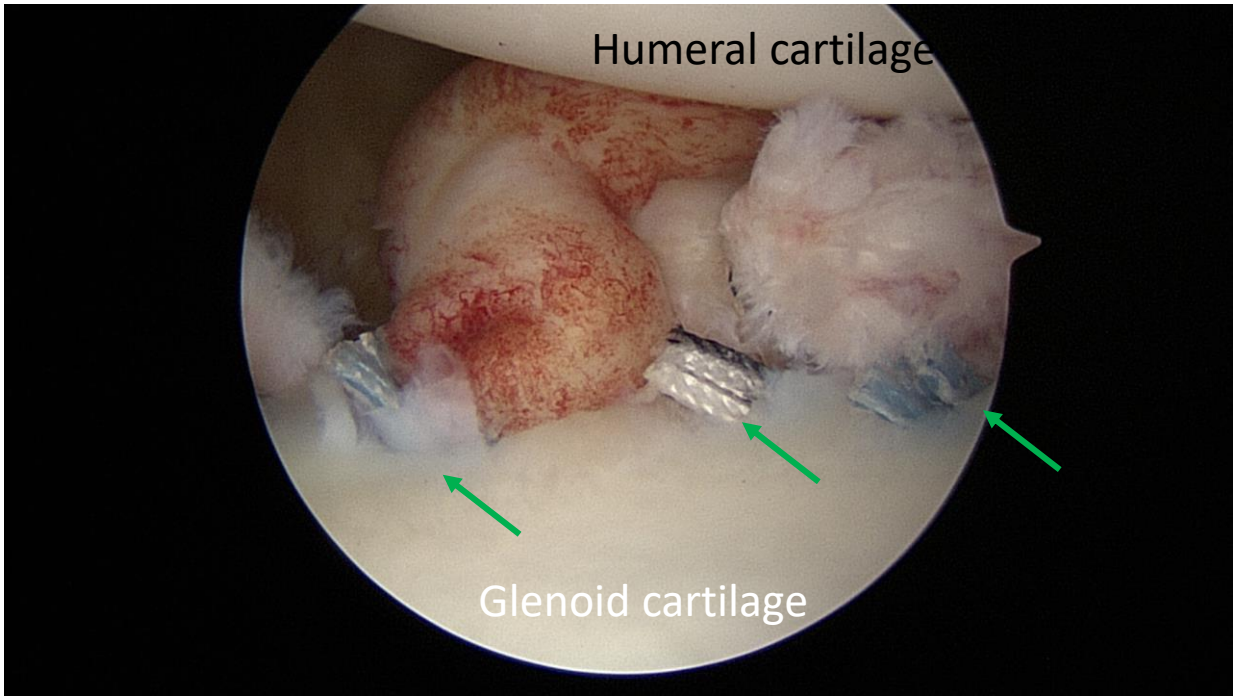
Posterior Portal:
3 Cannulas established for repair. Blue cannula placed for SLAP repair. SLAP seen (white arrow) with biceps/labral anchor frayed and undercut at the cartilage interface. The long head of the biceps is seen (blue arrow).





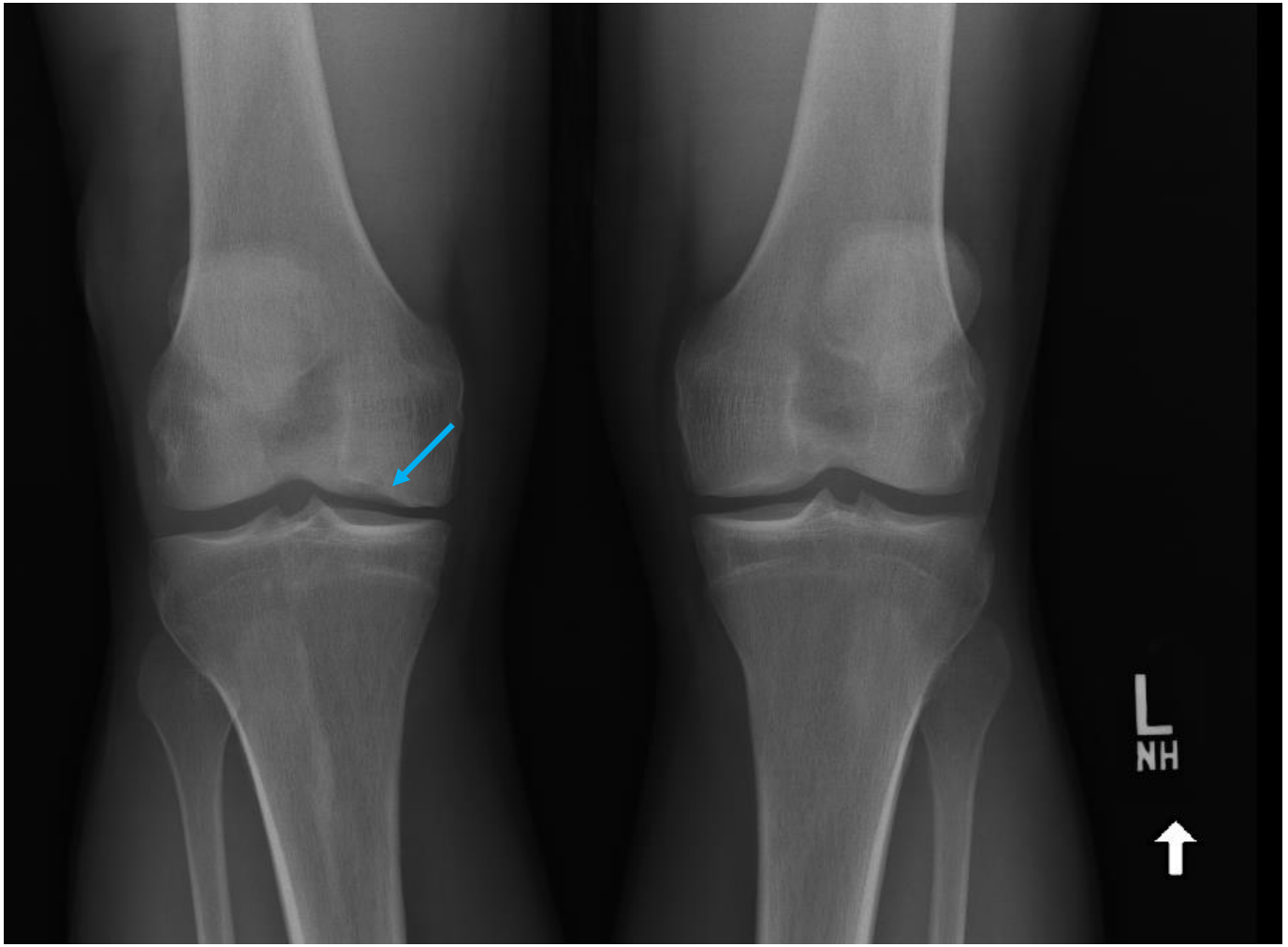
Posterior Portal:
Successful repair of Type V SLAP (2 anchors, green arrows). The long head of the biceps is seen (blue arrow).

Posterior Portal:
Successful repair of Anterior Labral Injury (3 anchors, green arrows)

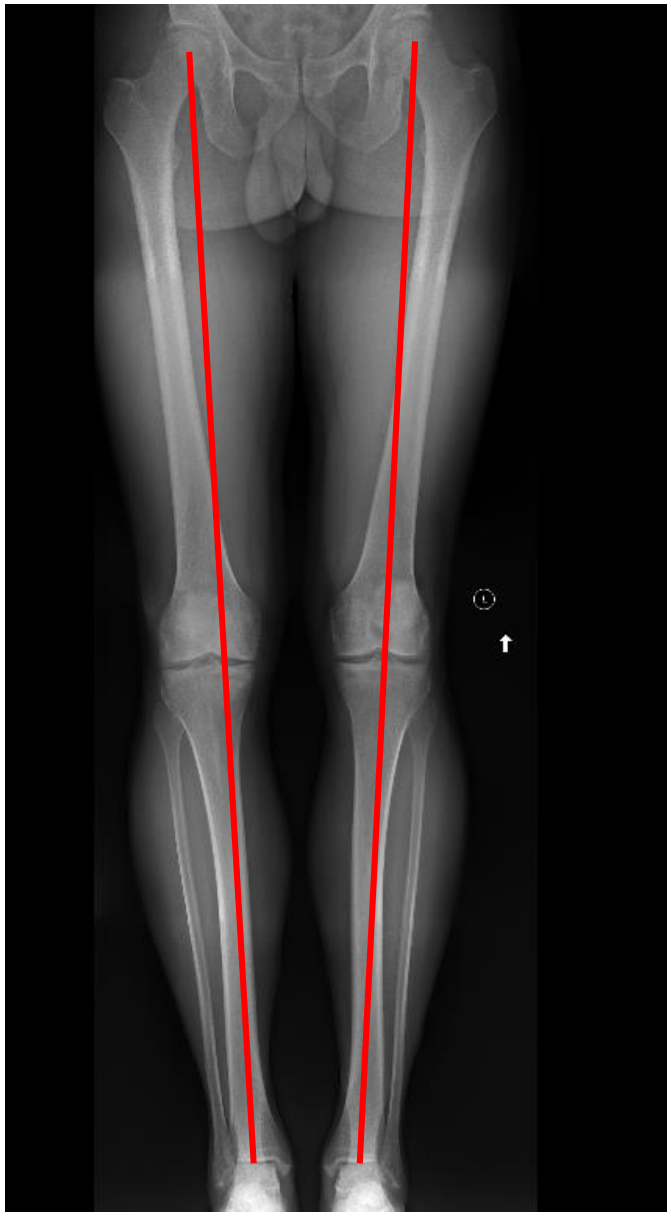


Case 3: Knee

- 41 YOM with right knee pain
- Injured running a few months prior
- Felt pop in knee, noticed swelling
- Underwent knee scope 7/14/16 at OSH
  - “MFC chondroplasty and loose body removal”
  - “Would need a secondary procedure”
- Presented to us 8/16/16
- Avid runner, job in Army Reserves

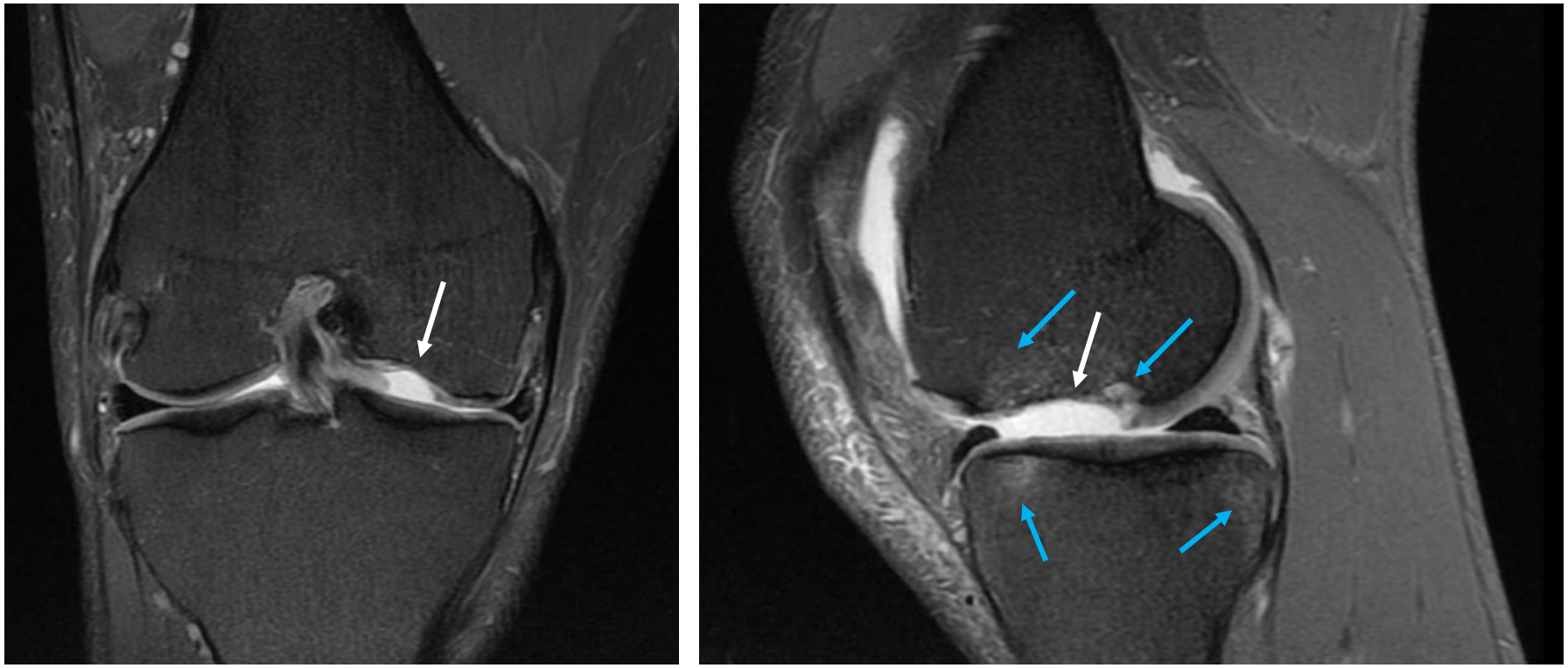


AP view of the bilateral knees shows an osteochondral lesion on the inner margin of the right medial femoral condyle (blue arrow) and a slight varus angulation (5 degrees) of the right tibia.



AP standing length radiographs demonstrate the mechanical axes (red lines) of the bilateral limbs. In the right limb, the mechanical, weight bearing axis is over the lateral margin of the medial tibial plateau.

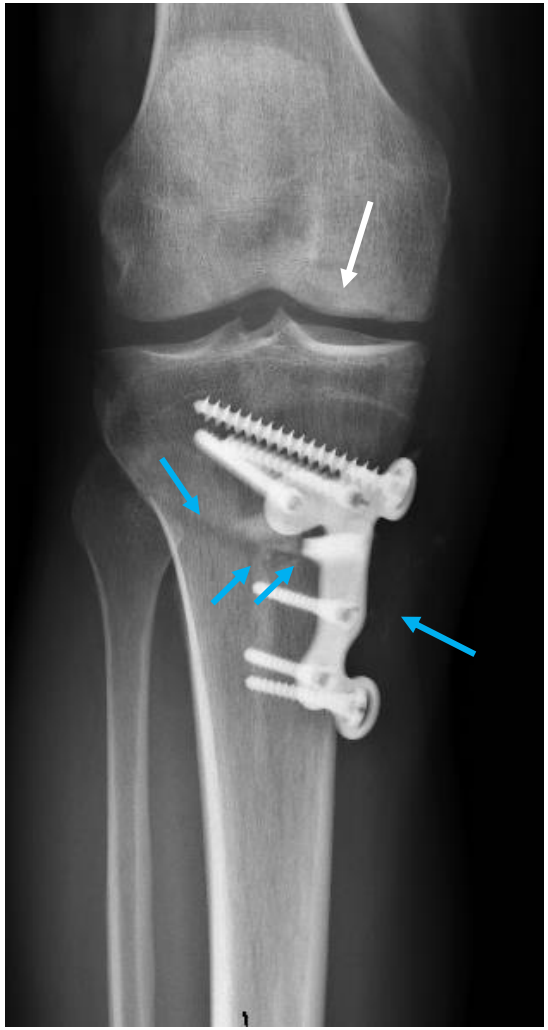
The mechanical axis of the limb should pass through the center of the knee. In this case, the right limb mechanical axis line passes through the medial plateau which may accelerate wear on the medial tibiofemoral compartmental cartilage.



Coronal (left) and sagittal (right) PDFS images show a large grade 4 (Modified Outerbridge) chondral defect corresponding to the one seen on the radiographs in the inner margin of the medial femoral condyle (white arrows). There is underlying subchondral cystic change and edema (blue arrow).

Intraoperative image showing the end of the opening wedge high tibial osteotomy.

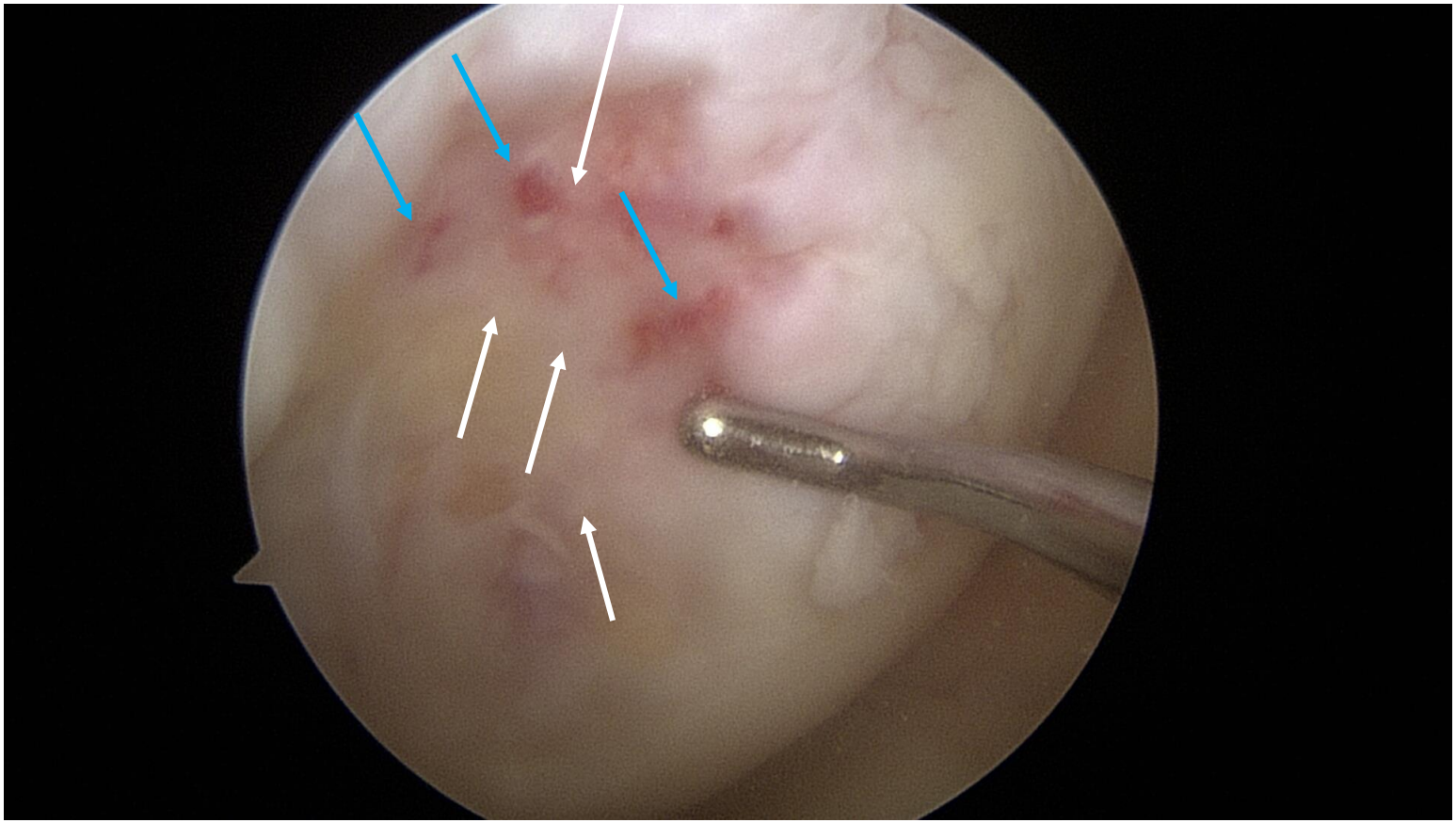
Preop **Postop**



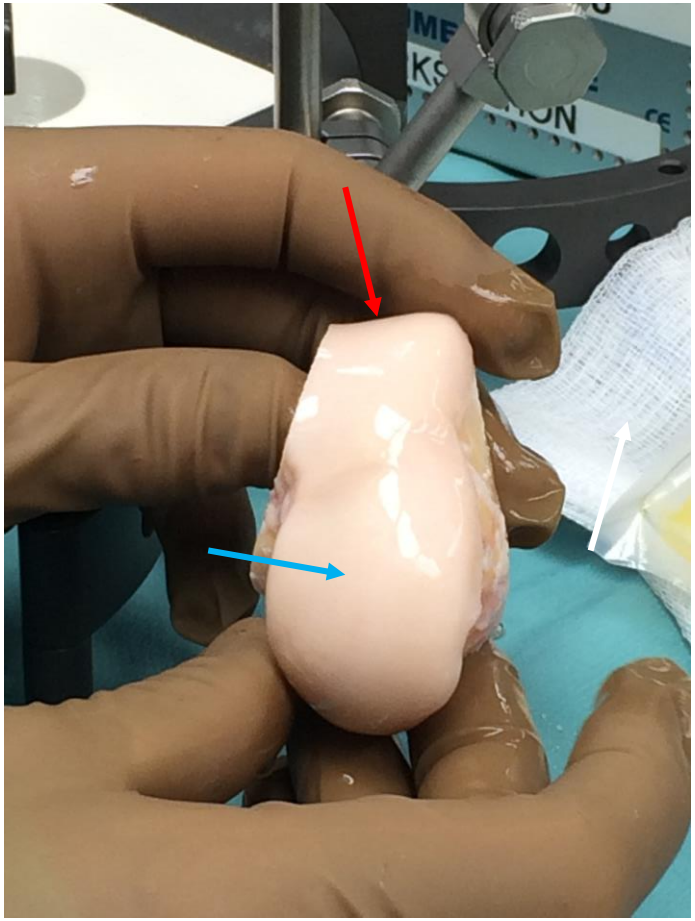
The bone defect in the osteochondral defect has been filled with an allograft (white arrow). There has also been an opening wedge high tibial osteotomy (blue arrow) to correct the mild varus angulation as failure to fix this could result in accelerated allograft failure and worsening medial compartment arthritis.

- Procedures:
  - 1. DIAGNOSTIC ARTHROSCOPY OF THE RIGHT KNEE.
  - 2. OPEN ALLOGRAFT OF RIGHT MEDIAL FEMORAL CONDYLE CHONDRAL DEFECT WITH 22.5 MM FRESH OSTEOCHONDRAL ALLOGRAFT
  - 3. MEDIAL OPENING WEDGE HIGH TIBIAL OSTEOTOMY.

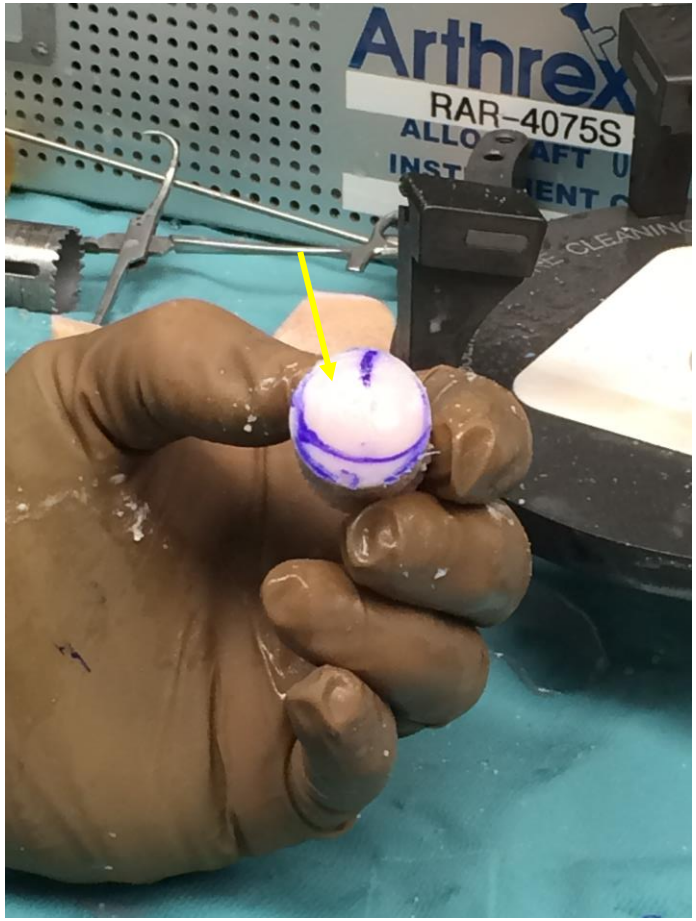
- Findings:
  - “Large 22 mm full thickness grade 4 chondral defect with some surrounding superficial grade 3 changes were noted on the lateral aspect of the medial femoral condyle.”



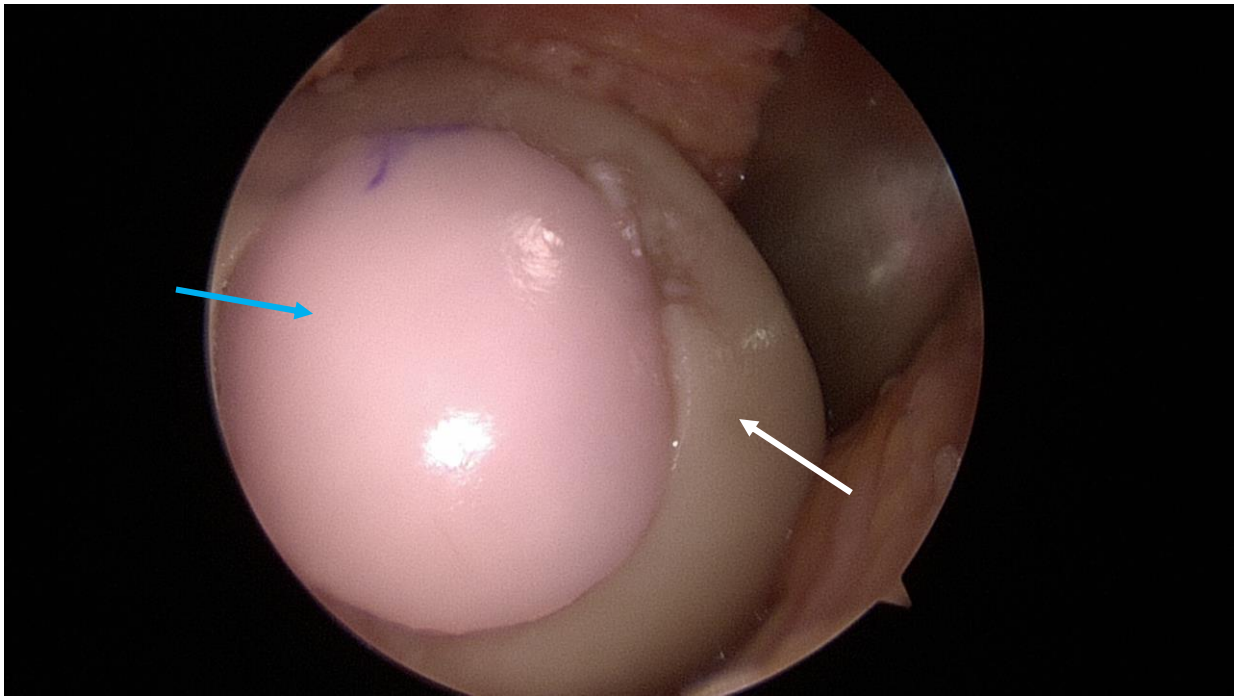
Subchondral bone exposure (grade 4 defect, white arrow) with cystic change and edema (blue arrow).



Allograft donor medial femoral condyle (blue arrow) and medial trochlear facet (red arrow).



The donor allograft has been carved down to fit the defect in the patient (yellow arrow).

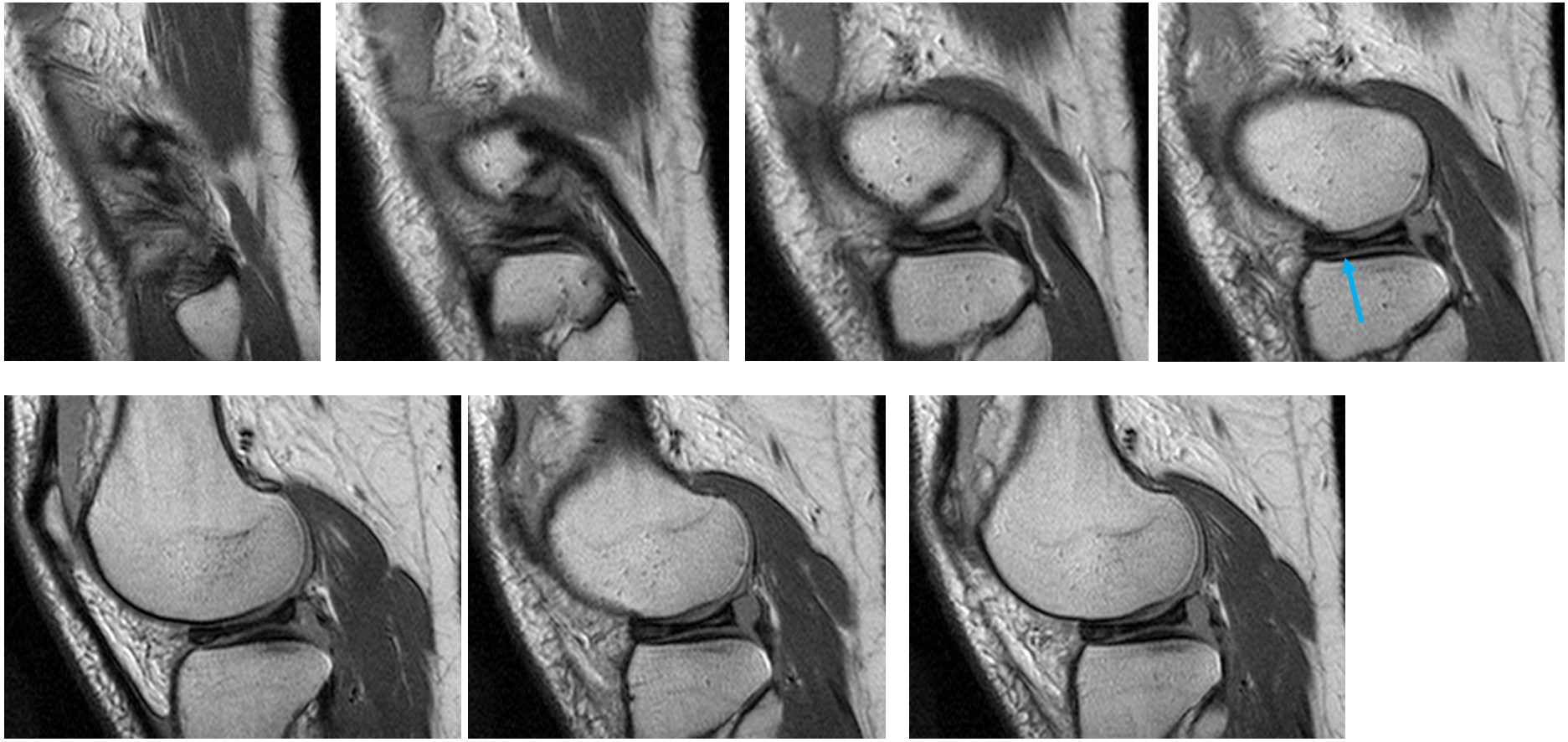


Allograft donor plugging the osteochondral lesion (blue arrow). The remaining surrounding normal native medial femoral condylar cartilage is seen for comparison.

Case 4: Knee

- 23 YOF with right knee pain
  - Injured knee while running, felt it “give out”
  - Pain along lateral aspect of knee
  - Outside MRI obtained

- PE:
  - Stable Lachmans, lateral joint line tenderness
  - Positive McMurrays, Thessalys

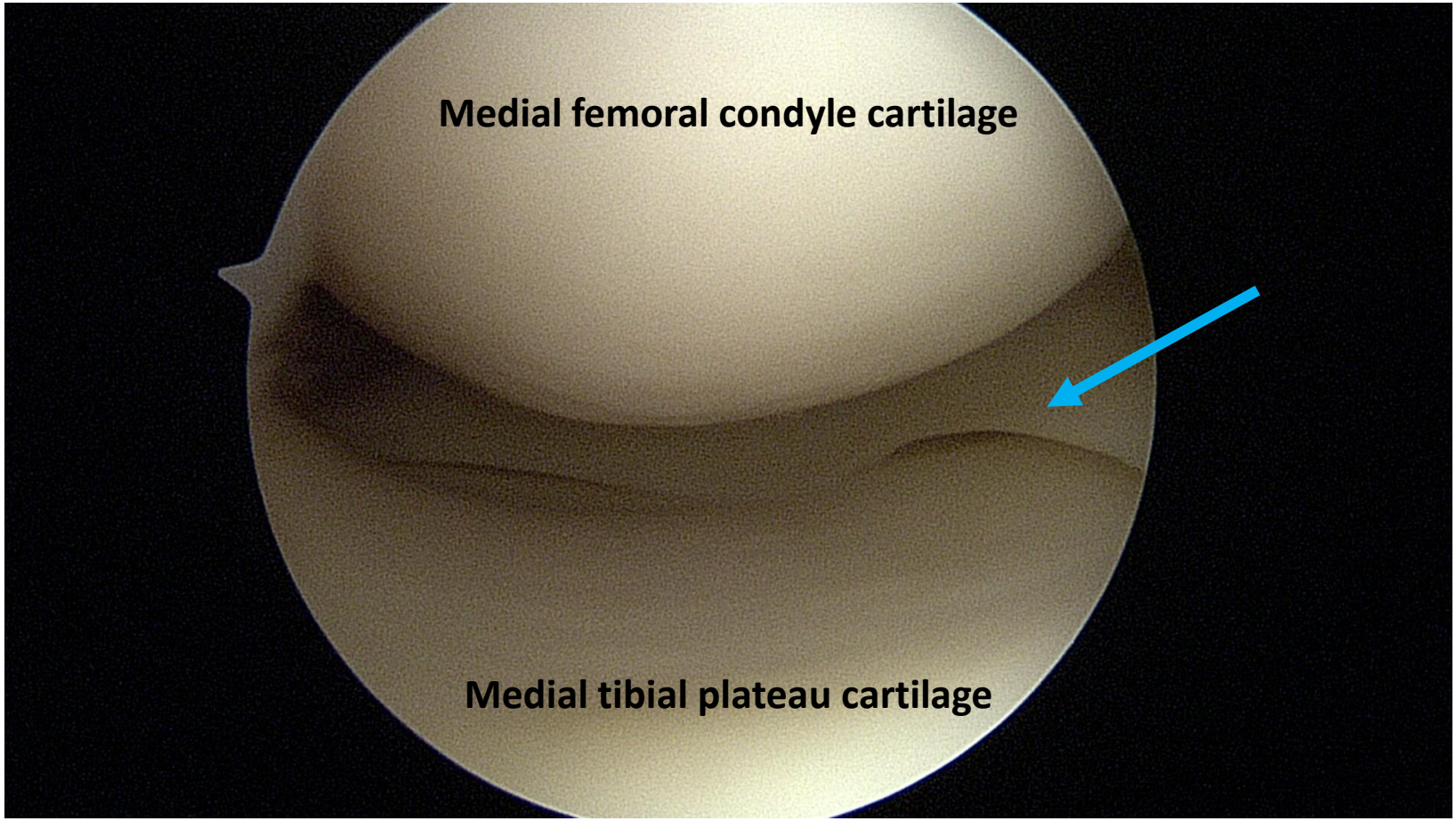


Sagittal PD images (from lateral on the top left to medial on bottom) of the lateral meniscus show the “too many bow ties sign” where the meniscus had too many images showing the anterior horn, body and posterior horn on 3+ consecutive slides. There is also linear increased signal hitting the tibial/undersurface consistent with a horizontal cleavage tear (blue arrow).

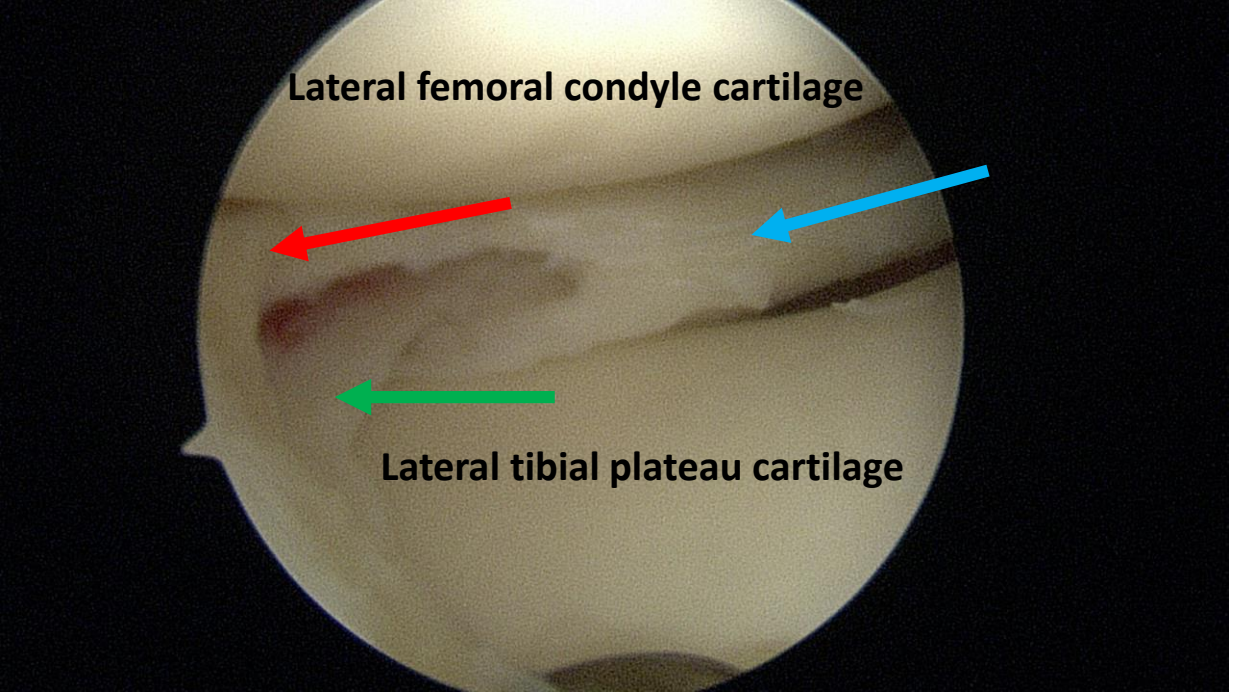
Coronal PDFS image shows a lateral meniscus with the body extending medially toward the notch. The meniscus measured 16 mm in transverse diameter. There is linear increased signal splitting the meniscus into upper and lower leaflets consistent with a horizontal cleavage tear (blue arrow).

- Procedure:
  - 1. Diagnostic arthroscopy, right knee
  - 2. Saucerization lateral meniscus with meniscectomy

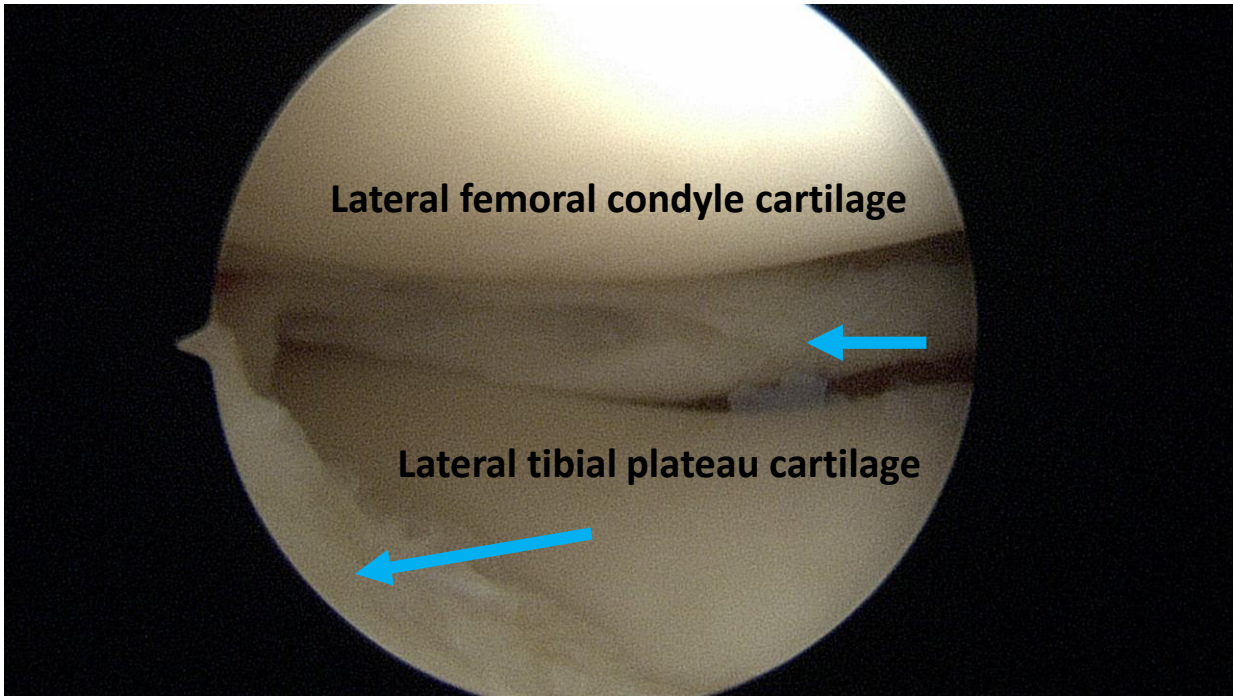
- Findings:
  - “The lateral compartment revealed a discoid meniscus with the complex tear of the middle one-third, but otherwise an intact peripheral meniscus. ”

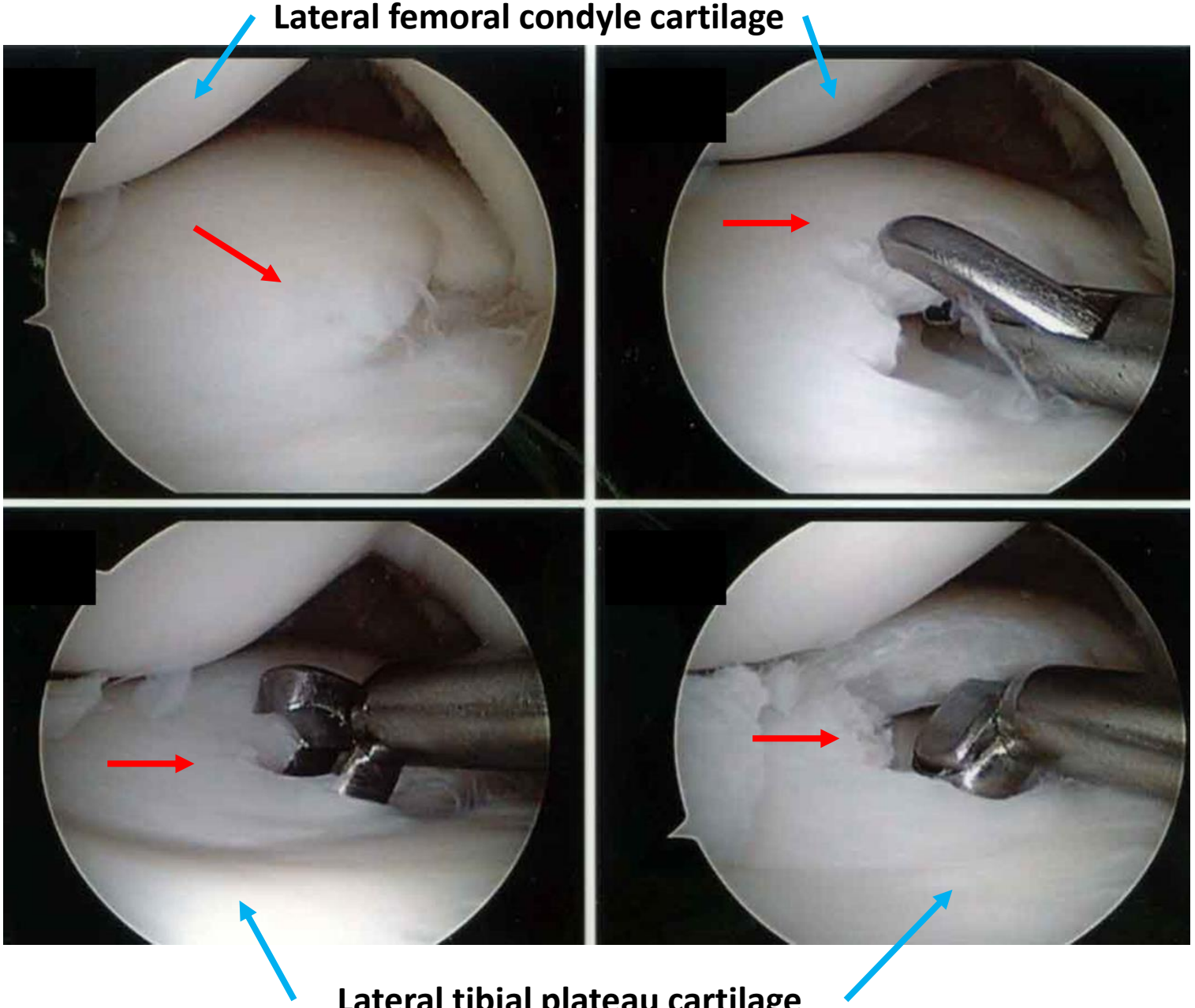


Normal appearance, medial meniscus (blue arrow) looking from the inner free edge out toward the periphery



Both images show end product after the partial meniscectomy performed to create a more normal appearing and sized lateral meniscus. The horizontal cleavage tear can still be seen with upper (red arrow) and lower (green arrow) leaflets delineated.





Pathologic very thickened discoid lateral meniscus, progressively debrided down to create a more normally sized and appearing meniscus (red arrows).