Articular Cartilage Management

Timothy J. Juelson, MD

The Bone & Joint Center

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Articular Cartilage Function

- 63% knee arthroscopies
- Provides a low friction, resilient, weight bearing surface.
- Absorbs mechanical shock.
- Coefficient of friction 15 times less than that of ice on ice. (Mankin, 1971)

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Collagen

- Major structural macromolecule.
- 50% of cartilage dry weight.
- Cartilage: Types II, V, VI, IX, X and XI.
- Type II : 95% of the total collagen in cartilage.
- Tensile and shear properties.
- Immobilize the proteoglycans.

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Cartilage Injury

- Cartilage has limited ability for repair or regeneration.
- Total joint replacement is unsuitable for younger, more active individuals. (Chandler, 1981; Dorr, 1983)
- A biologic solution to the repair of clinically significant articular cartilage defects is sought.

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Options

- **Debridement**
- Abrasion chondroplasty
- Microfracture
- **OATS-rare**

- Synthetic
- DeNovo
- ACI - MACI
- **Fresh Allograft**
- More…

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MACI/Autologus Chondrocyte Implantation

- Genzyme
- 3000/year
- 1200 cultured, rest stored (patients become asymptomatic)
- Can stay frozen up to 5 years (liquid phase nitrogen -140º C)

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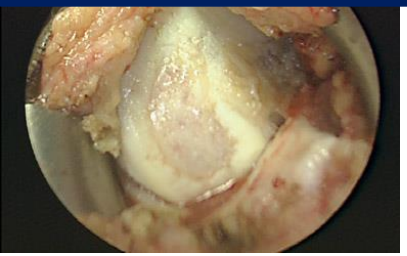
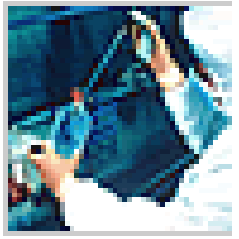


Autologus Chondrocyte Implantation

- First reported by Brittberg et al in 1994
  - 11/16 patients who returned for follow-up biopsy had hyaline cartilage
  - Patella defects faired worse
- Follow up studies
  - Good to excellent result in 79-86% of patients
  - 12% complication rate
  - 10% required a second operative procedure
  - 2% had treatment failure
- Grows a mixture of hyaline and fibrocartilage

1

2



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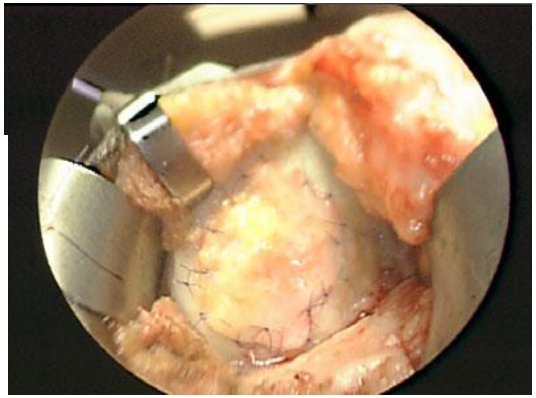

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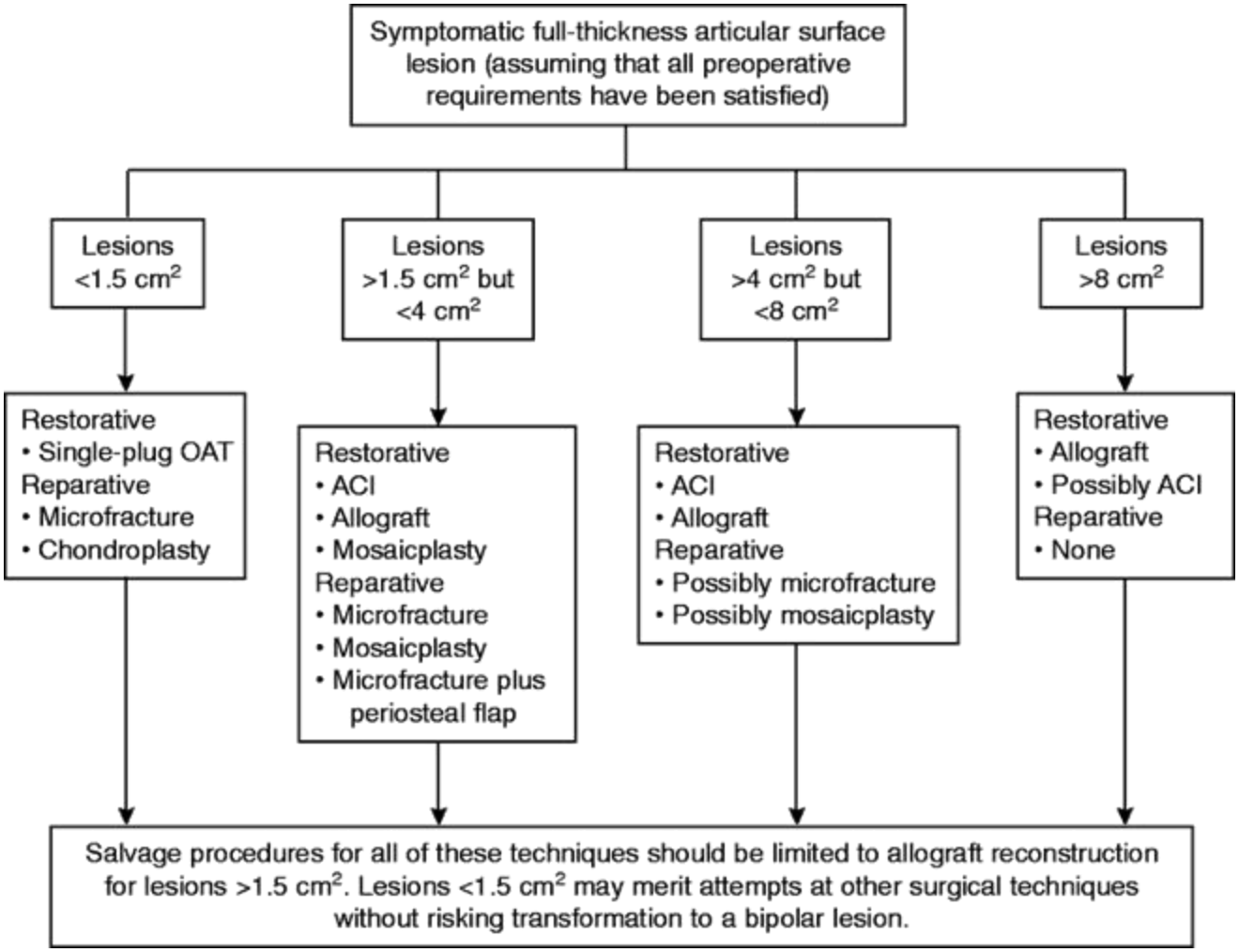
Rehabilitation

- Highly individualized
- All of these procedures, with the exception of debridement require some protected WB
- SURPRISE CARTILAGE RECOVERIES


Symptomatic full-thickness articular surface lesion (assuming that all preoperative requirements have been satisfied)
Lesions <1.5 cm²
Lesions >1.5 cm² but <4 cm²
Lesions >4 cm² but <8 cm²
Lesions >8 cm²
Restorative
• Single-plug OAT
Reparative
• Microfracture
• Chondroplasty
Restorative
• ACI
• Allograft
• Mosaicplasty
Reparative
• Microfracture
• Mosaicplasty
• Microfracture plus periosteal flap
Restorative
• ACI
• Allograft
Reparative
• Possibly microfracture
• Possibly mosaicplasty
Restorative
• Allograft
• Possibly ACI
Reparative
• None
Salvage procedures for all of these techniques should be limited to allograft reconstruction for lesions >1.5 cm². Lesions <1.5 cm² may merit attempts at other surgical techniques without risking transformation to a bipolar lesion.

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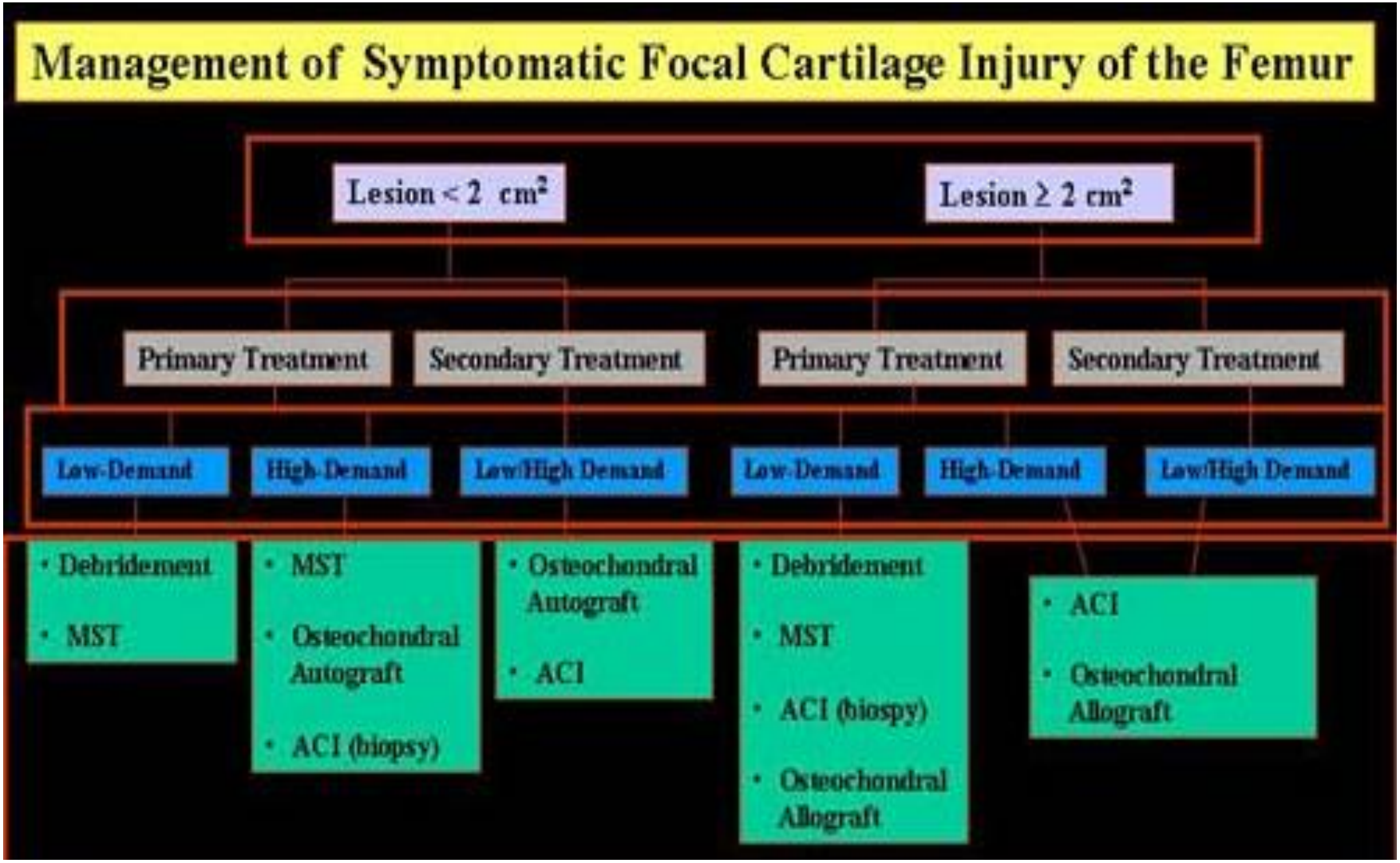

REAL WORLD

- Treat the patient
  - Symptomatic lesions
- NO SURPRISES
- STAGING ARTHROSCOPY – GOLD STANDARD
- BMI/NICOTINE/MOTIVATION/MEDICAL DISEASE

Other Options..

- Growth factors - future
- Adhesives
- Artificial bioabsorbable scaffold matrices
- Gene therapy manipulation
- **Fresh allograft (unfrozen, implanted 18-24 days post mortem)**

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Osteochondral Allograft

- Used for full thickness lesions
  - Fresh allograft provide the greatest potential for chondrocyte viability but also carry a higher risk of immunogenic and transmittable disease
  - With fresh frozen allograft, there is less immunogenic response, but a concern of chondrocyte viability and long term success of the graft
  - Creeping substitution occurs to remodel the bone

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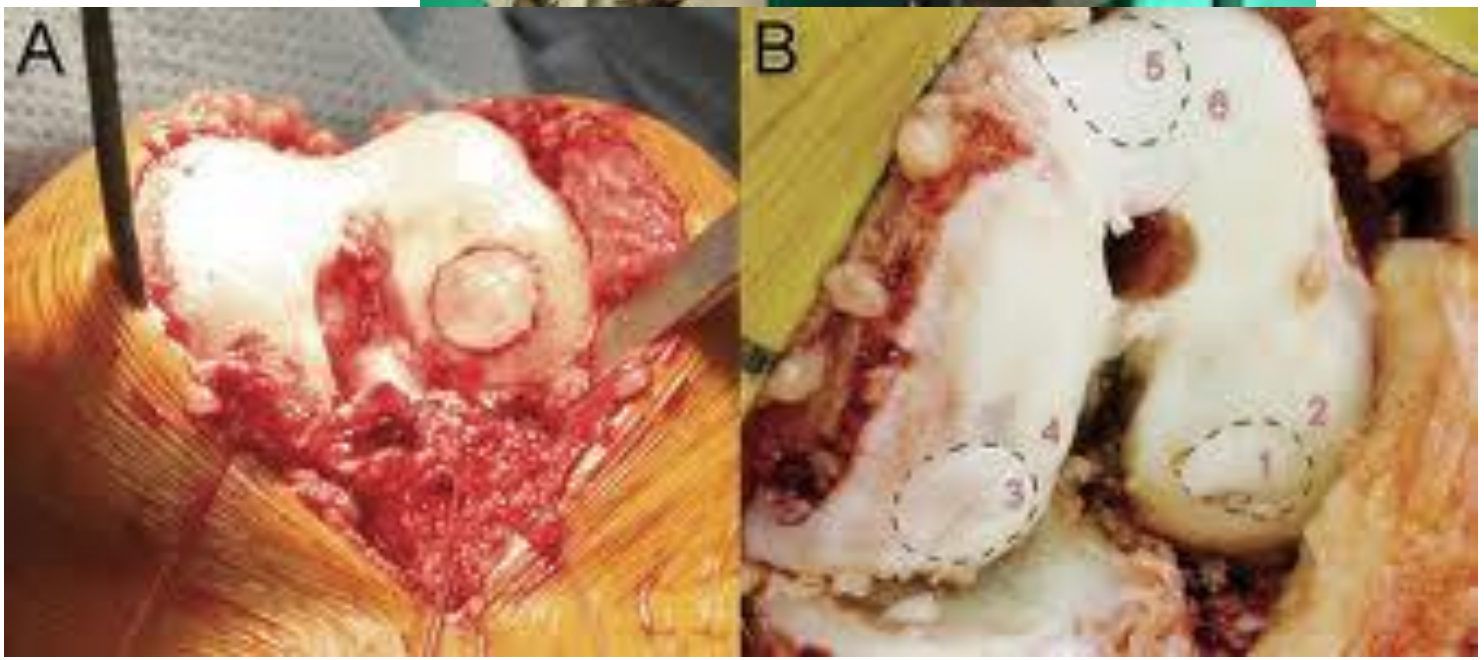
Osteochondral Allograft

- Gross et al 1997 reviewed 7.5 yr average follow-up on 123 knees and had:
  - Good or excellent result @ 5 yrs = 95%
    @ 10 yrs = 71 %
    @ 20 yrs = 66%
  - Best candidate was post traumatic or OCD
  - Worst was with **bipolar grafts or workers compensation**

- Goal is to relieve pain and avoid damage to the opposite side of the joint
- Most studies show an 85 % success rate with full incorporation (McCulloch et al 2006, Chu et al 1999)


A
B
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6
4
2
3
1

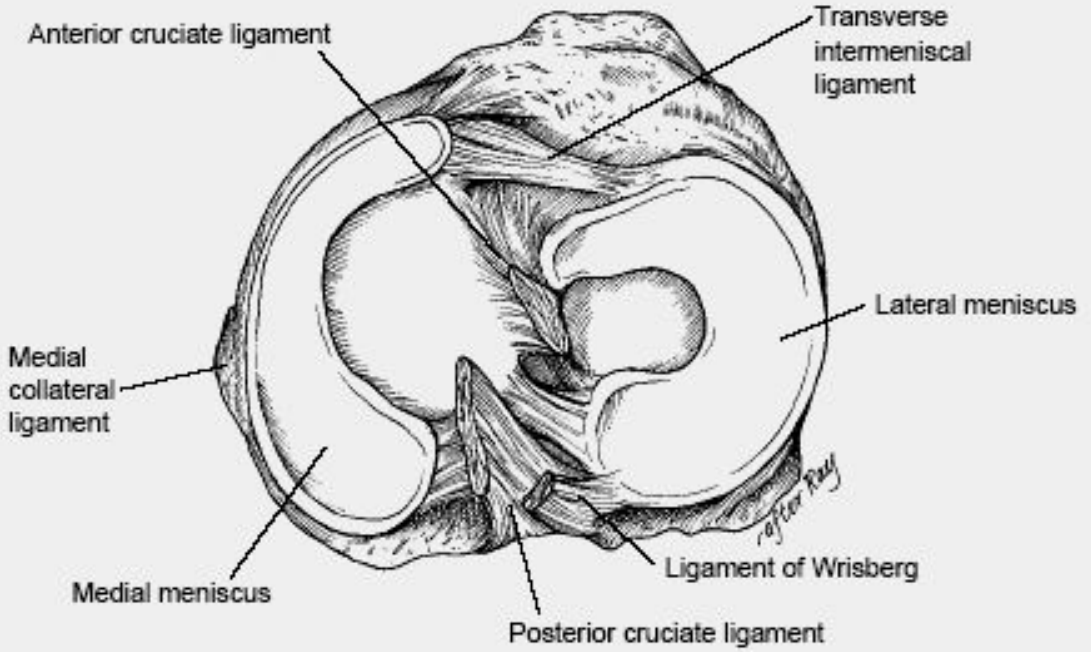

Figure 1 Anatomy of the menisci viewed from above. Note the differences in position and shape of the medial and lateral menisci. (Adapted with permission from Pagnani MJ, knee, in Nicholas JA, *ne*, ed 2. St Louis, MO:

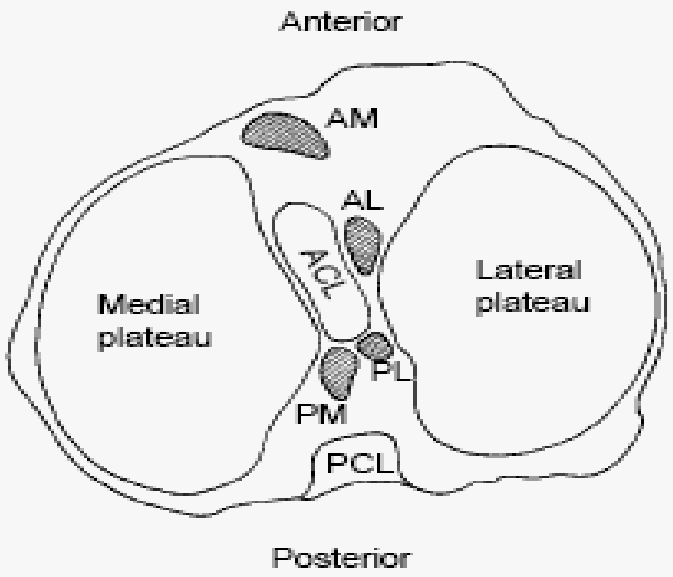

Figure 2 Meniscus horn insertion sites viewed from above. Note the proximity to the anterior cruciate ligament (ACL). AL = anterior horn lateral meniscus, AM = anterior horn medial meniscus, PCL = posterior cruciate ligament, PL = posterior horn lateral meniscus, PM = posterior horn medial meniscus. (Adapted with permission.[3])

REPAIR PLEASE!!!!

- 70-90% long term success rate
  - Dependent on location tear, pattern, tissue quality, repair fixation strength
- Risk for reoperation
- Roughly 33% tears repairable
- Recent studies showing consistently better outcomes with repair

Previous Meniscectomies..

- Meniscus deficient knee
- Pain
- Swelling
- Contributes to articular cartilage damage
- Options?
  - ALIGNMENT

Mensicus Transplants - Indications

- Ideal candidate is young, healthy, alignment of knee with mechanical axis through uninvolved compartment, no instability, with no chondral injury or damage
  - Unusual to find such a patient
- Noyes recommends age < 40
- Consensus age limit of 50-55 years
    - Physiologic age and demand are factors

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Indications

- Was an early interest in transplanting patients with severe OA
    - Early failure of grafts
- Currently those with grade IV chondromalacia considered poor candidates
- STABILITY/ALIGNMENT

Clinical Results - MAT

- Garrett et al, 1994
  - 43 patients, 16 fresh, 27 cryopreserved
  - 2-7 year follow-up
  - 24/43 also had ACL, 13/43 had osteotomy,
  - 11/43 had osteochondral allografts
  - 20/28 intact at 2nd look arthroscopy
  - Degree of arthritis main contributing factor to failure
    - 6/11 with grade IV changes failed
    - 2/32 with grade III or less failed

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Summary

- Repair meniscus tears
- Assess alignment
- Ensure stability
- Appropriate post-op rehab
  - OP-NOTE (all unique)

Other factors…

- ALIGNMENT
- BMI
- STABILITY
- Nicotine
- Inflammatory arthopathy

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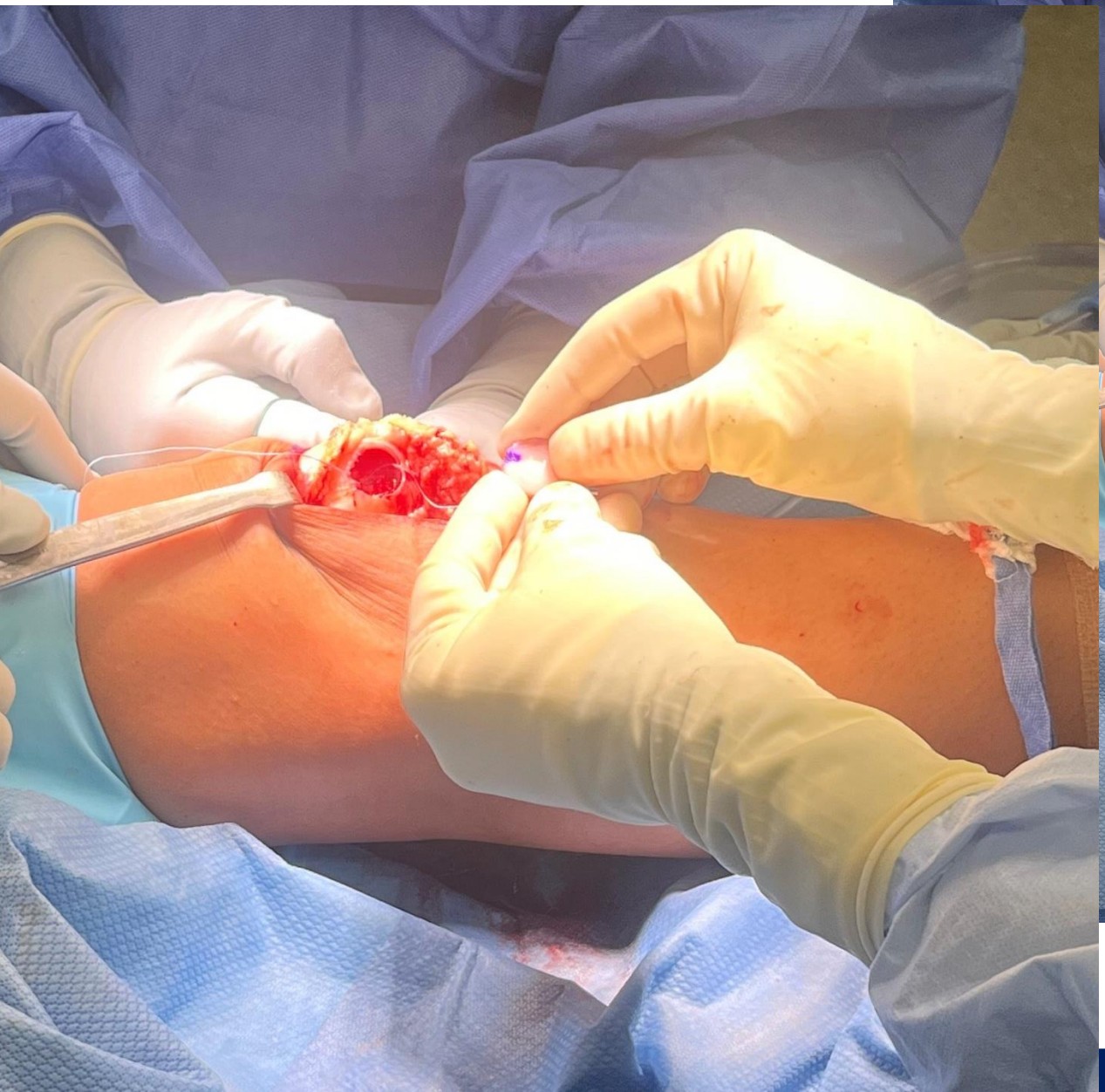
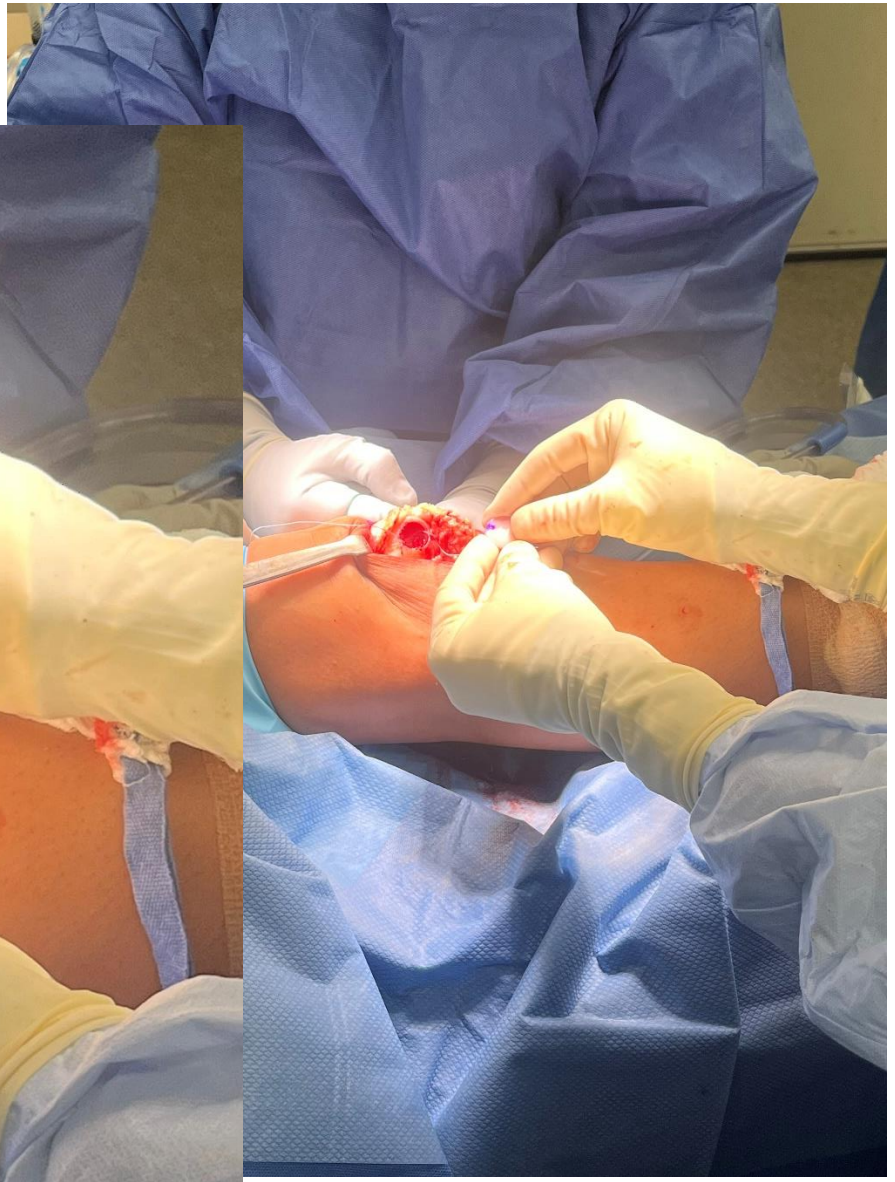
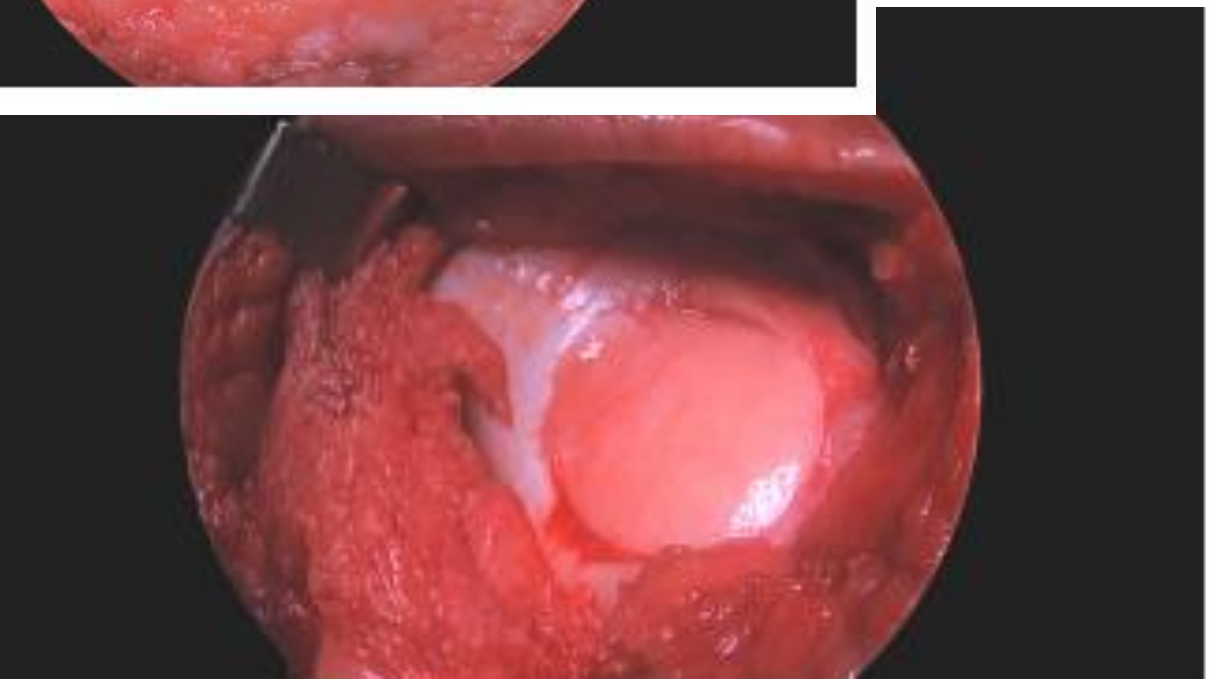
Cases

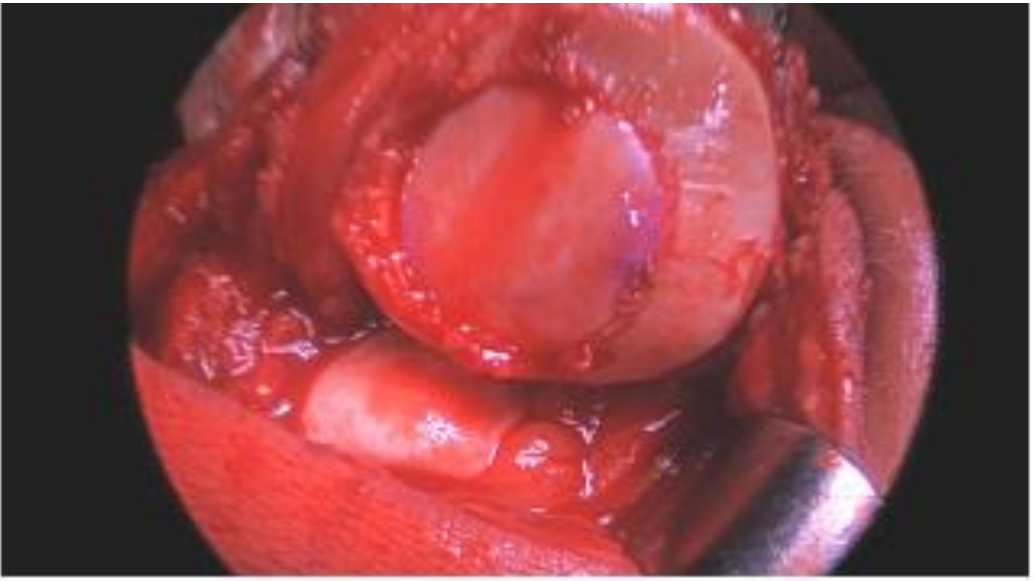


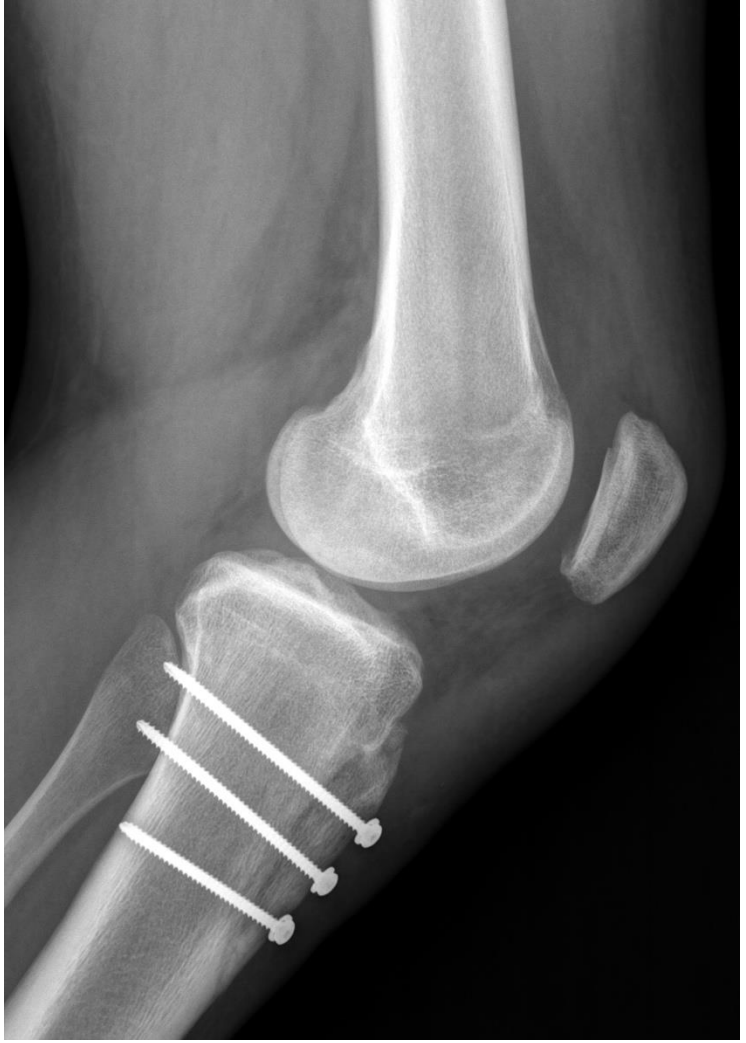


COLLEGIATE BASKETBALL 20 MALE

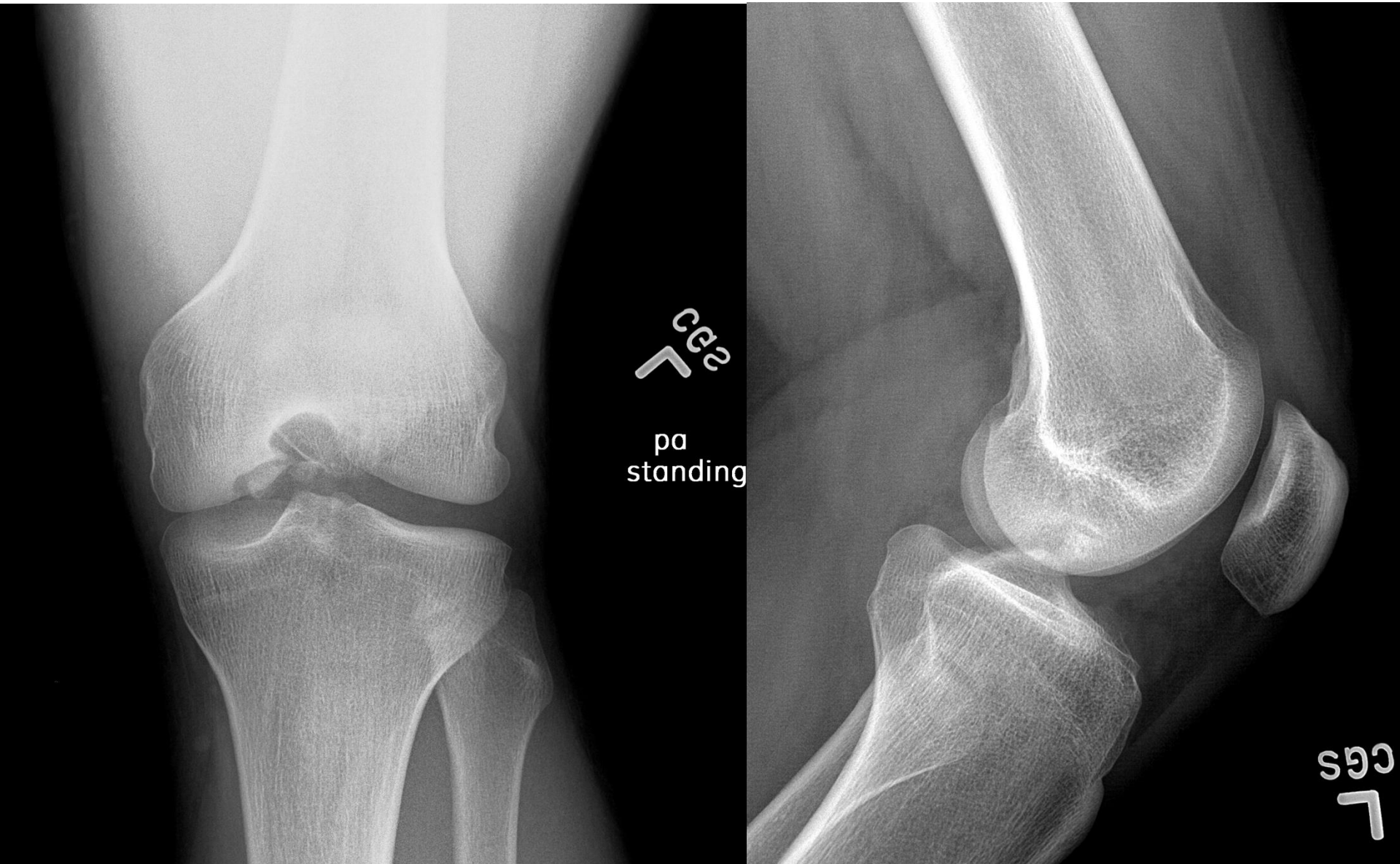


17 YO MALE
FRESH OC PATELLA/TTO
TT-TG 20.5

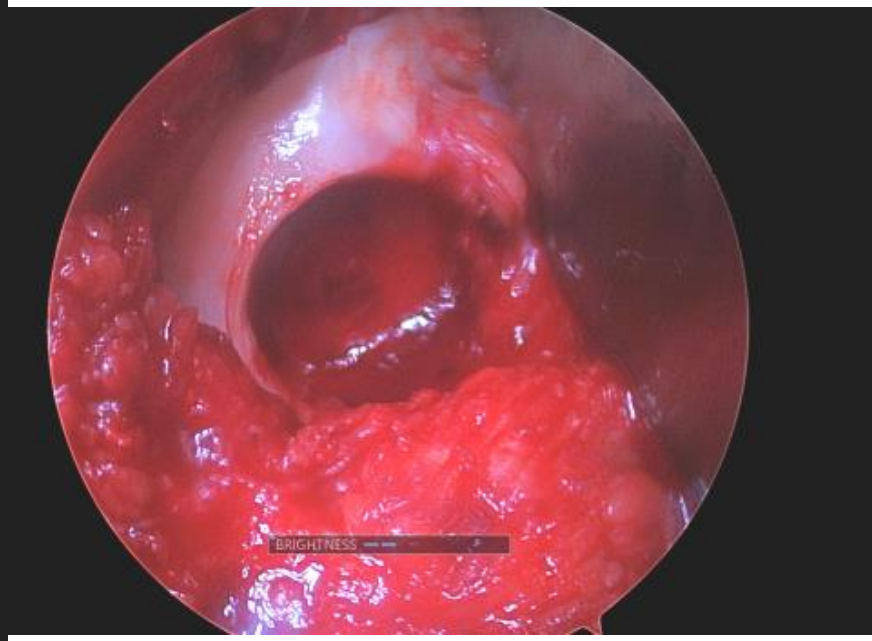




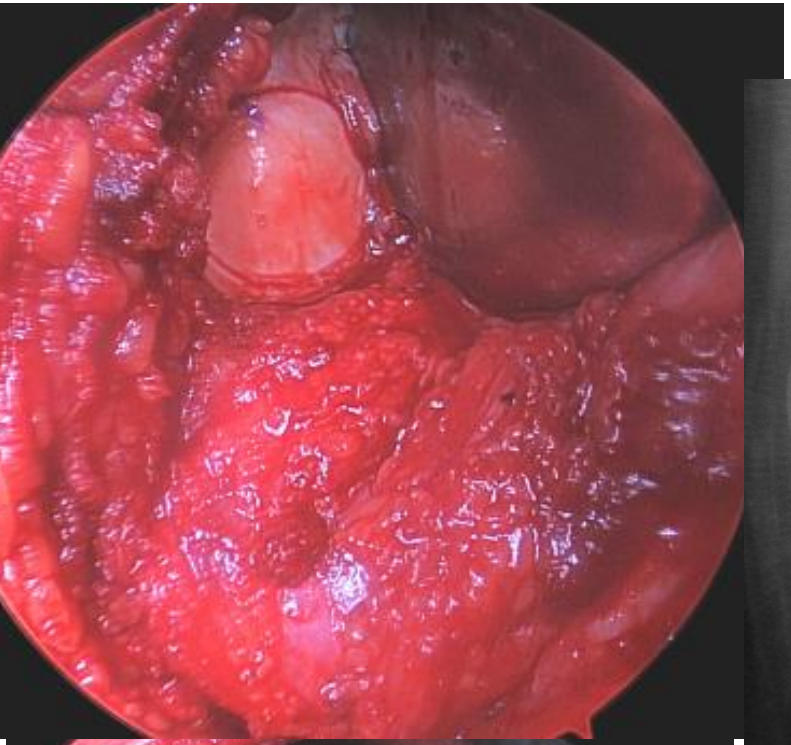
19 YO MALE (3.5 VARUS) OCD

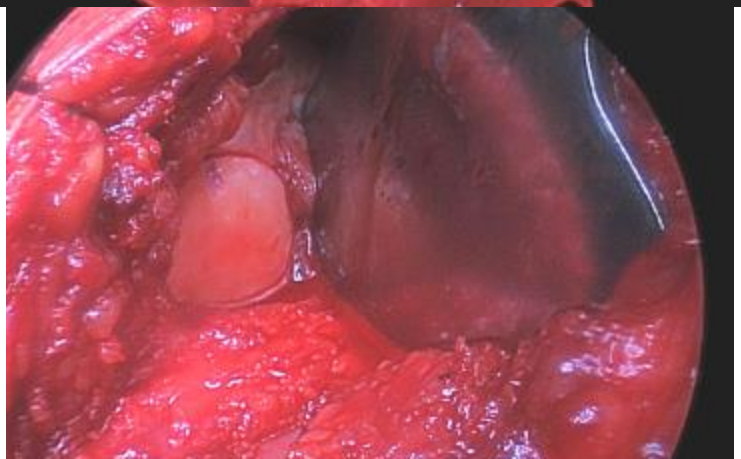


19 YO MALE – OCD MFC
3.5 DEGREES VARUS



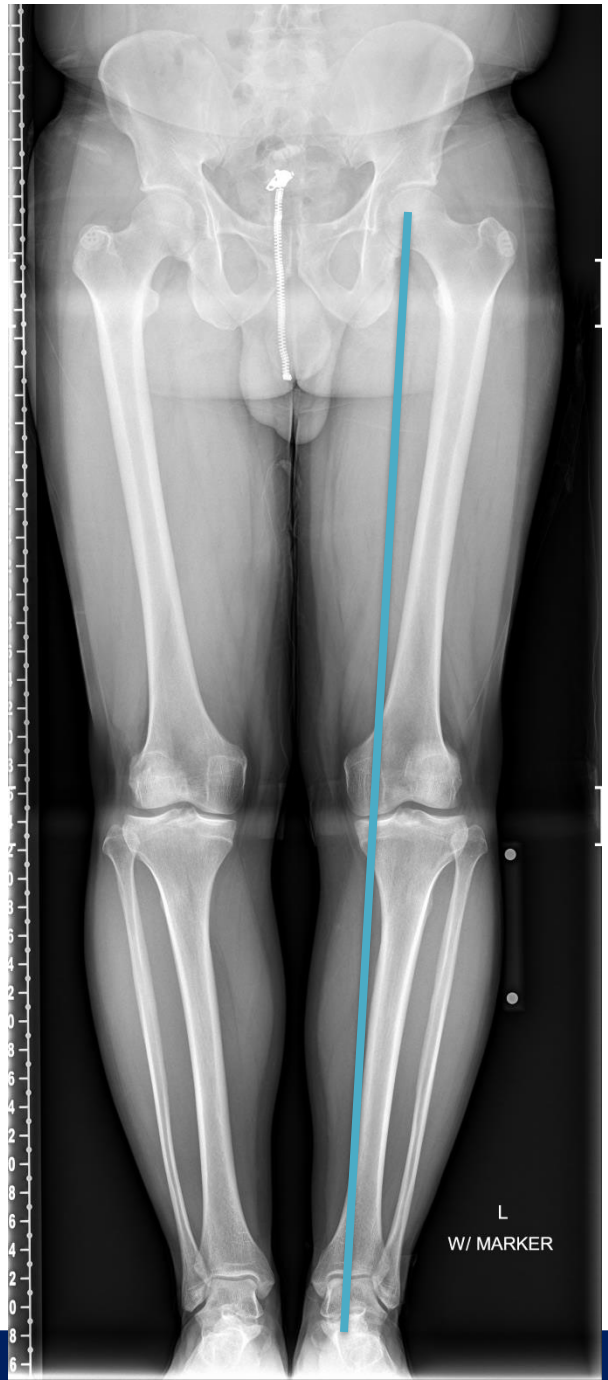
19 YO MALE (3.5 VARUS) OCD





ACL

- 40 year old active male
- ACL tear
- Medial Meniscus tear
- Chondromalacia MFC
- Careful Evaluation…
- Options



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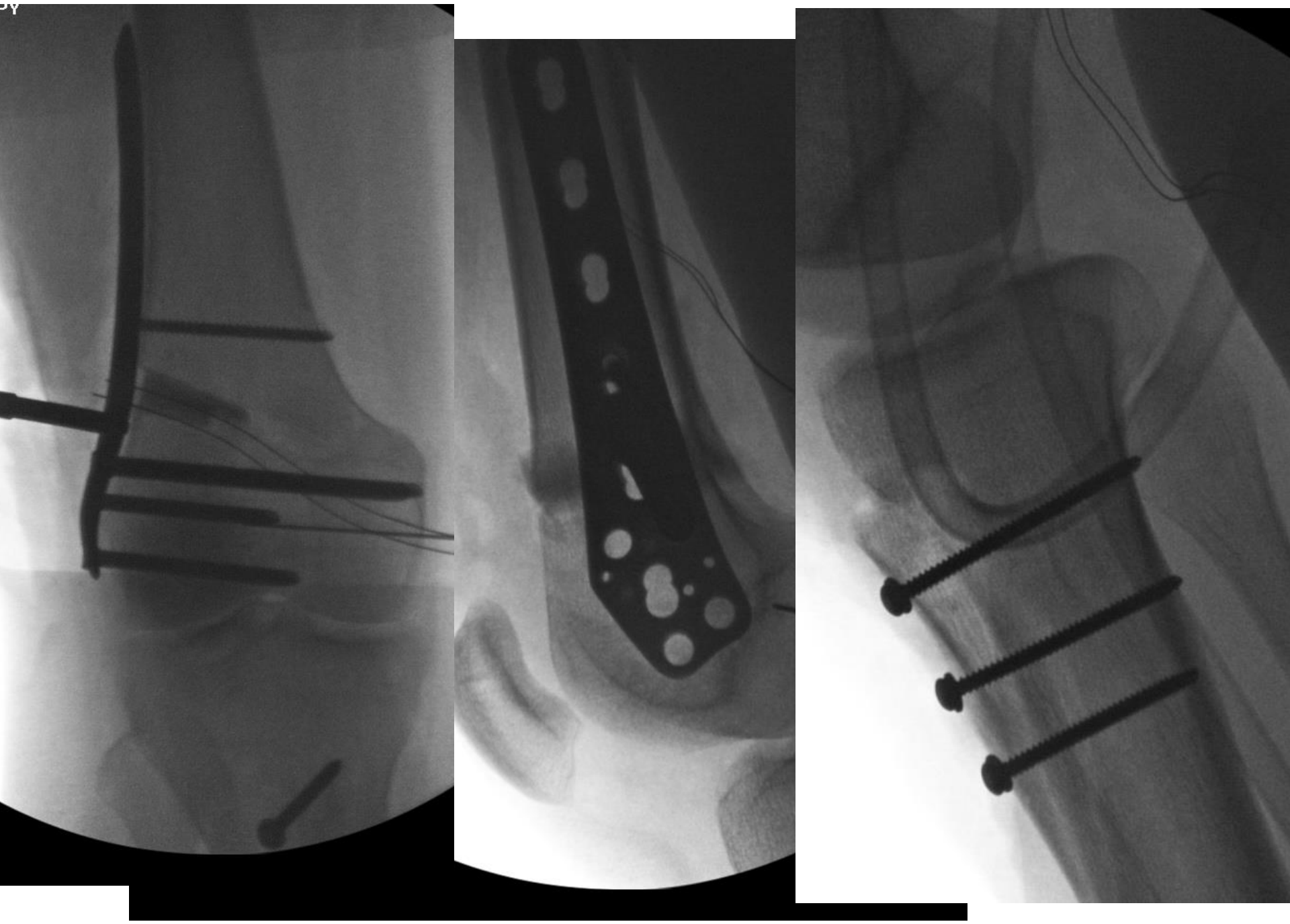
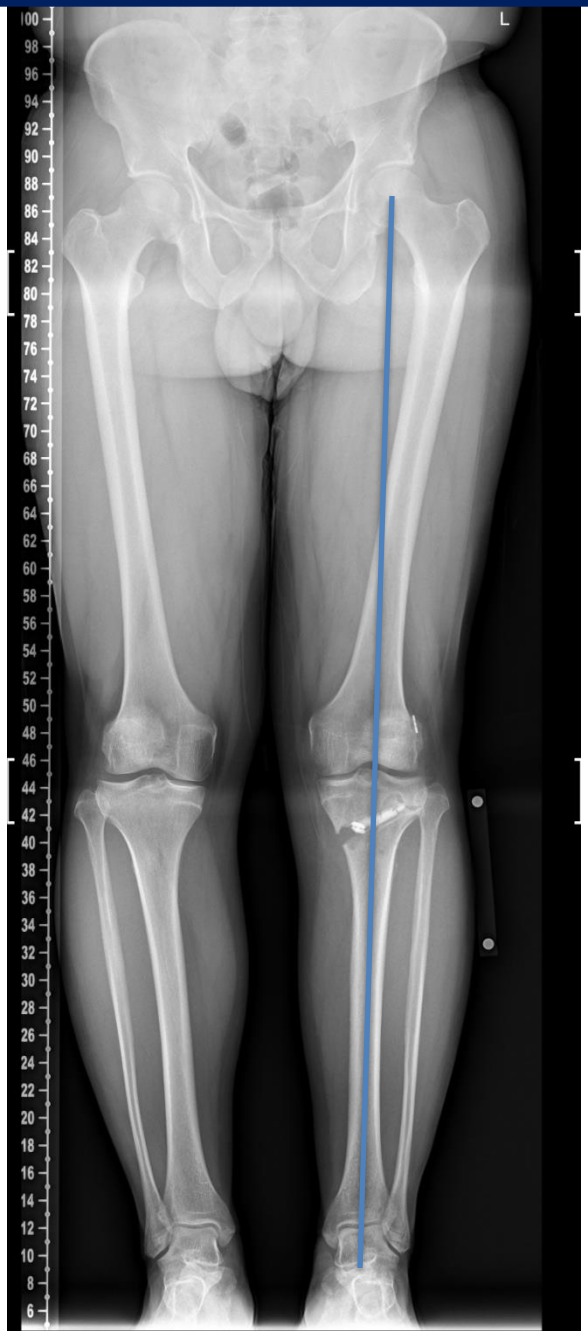


- 9 degree varus alignment
- Procedure
  - High Tibial Osteotomy
  - ACL Reconstruction
  - Role for Fresh allograft/MACI?



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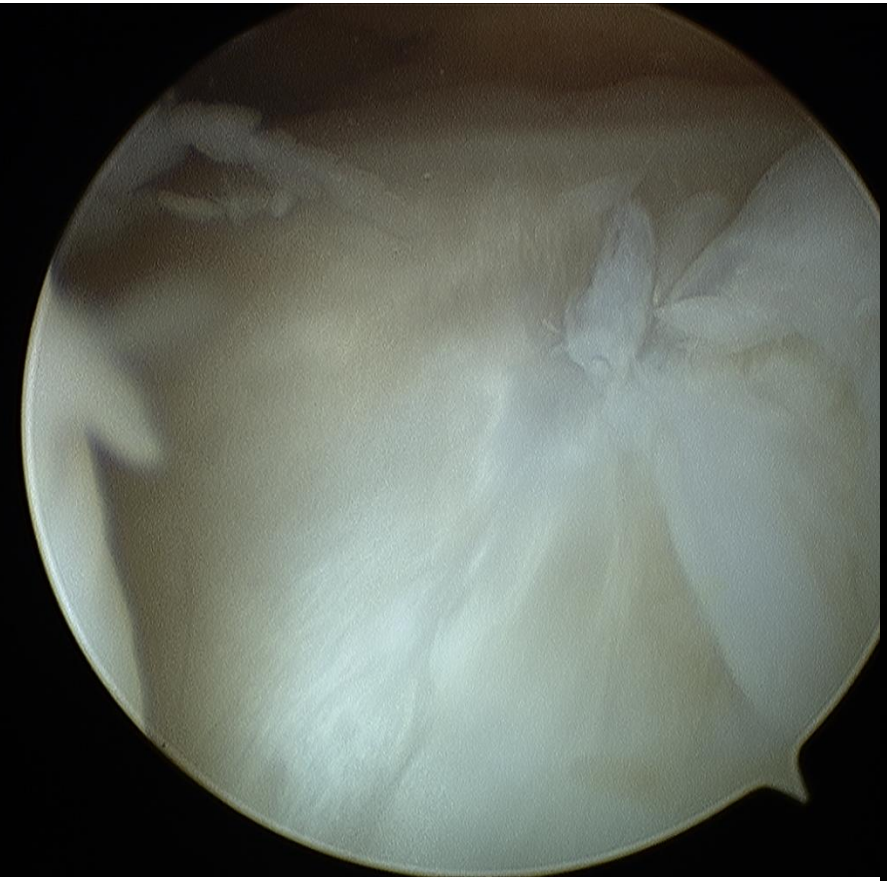
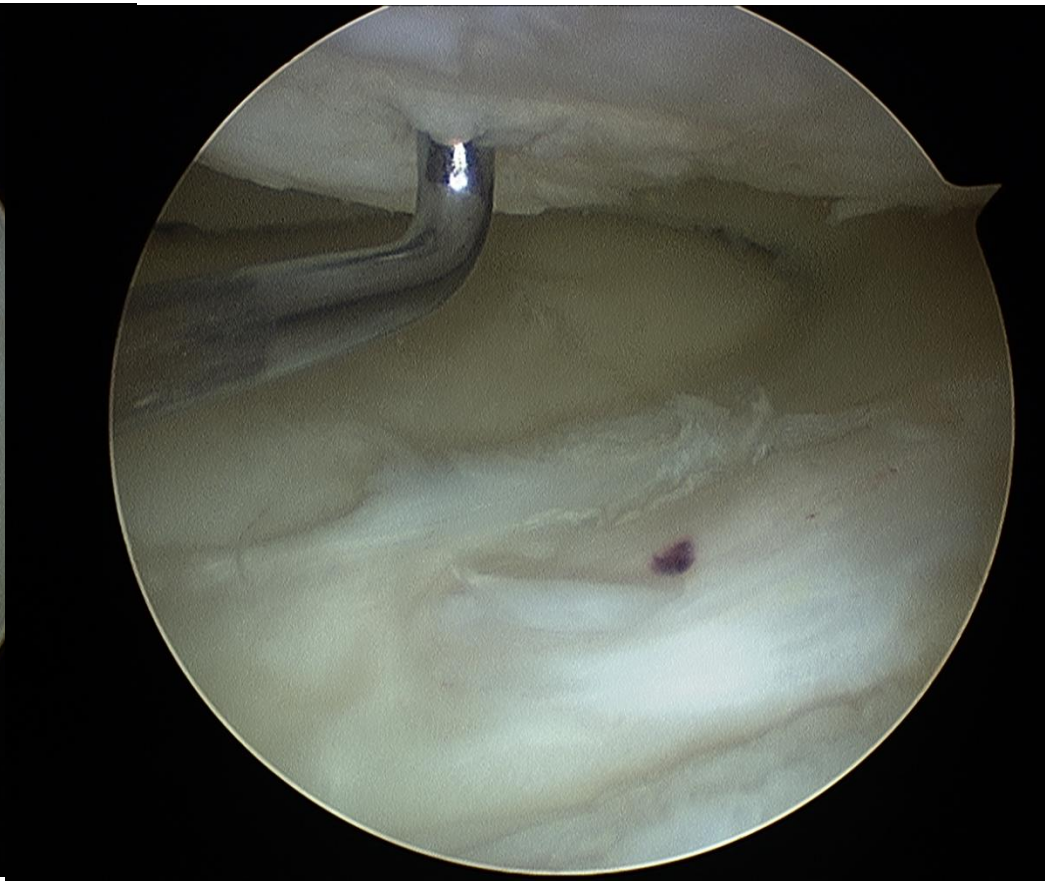
LFC/Valgus

- College athlete
- Lateral knee pain
- One failed surgery at other institution
- Desire to continue with athletics

LFC/Valgus





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LFC/VALGUS

- Staging Arthroscopy
- Full thickness lateral femoral condyle lesion
- Mild patellofemoral chondromalacia
- Options?

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LFC/VALGUS

- Fresh osteochondral allograft
  - Never frozen/processed
  - Sized to patient

- Distal Femoral Osteotomy


L
D
M
H
WEIGHT-BEARING

MFC/Varus

- 30 yo male stepped wrong onto a boat
- Persistent pain medial knee
- Mechanical symptoms present
- Healthy, active, non-smoker

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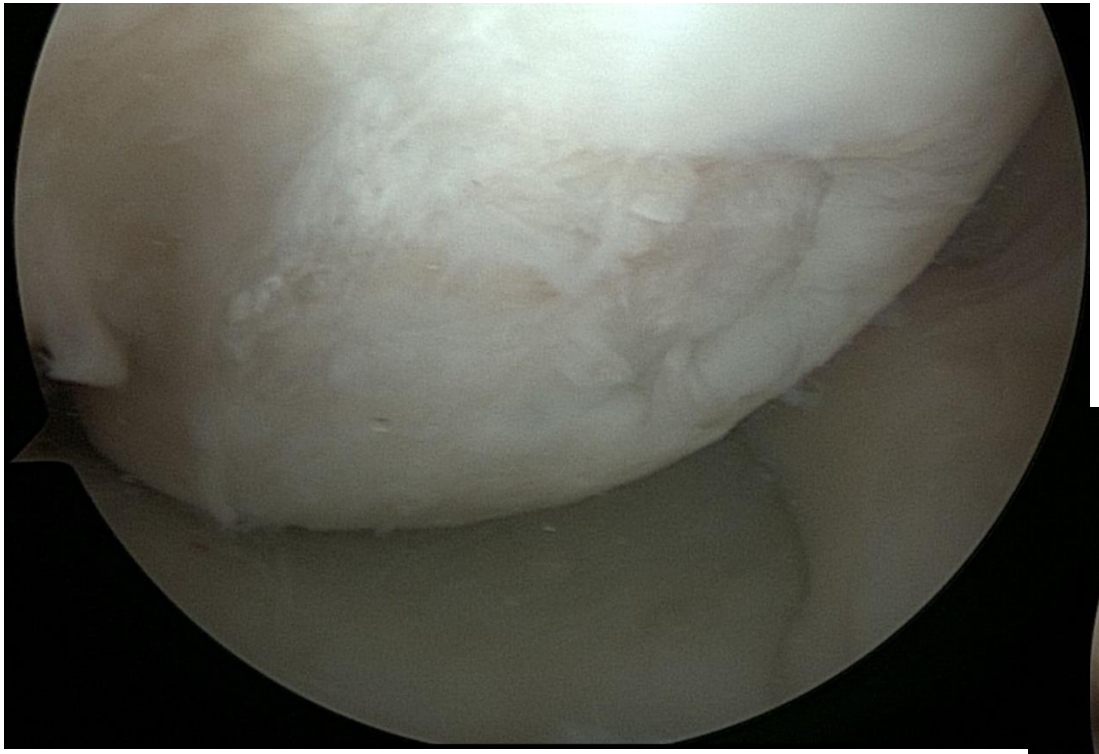
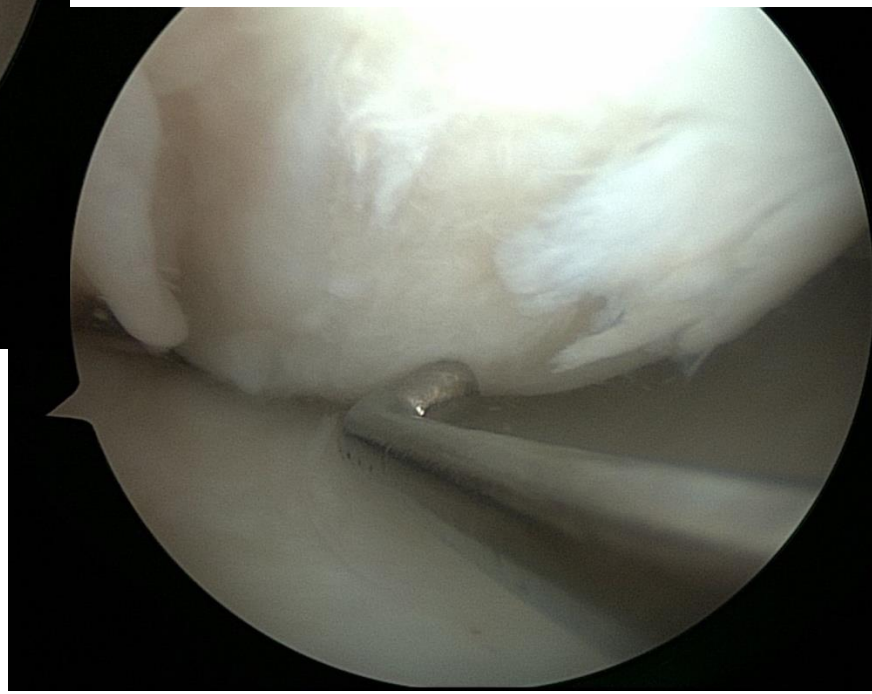
MFC/VARUS





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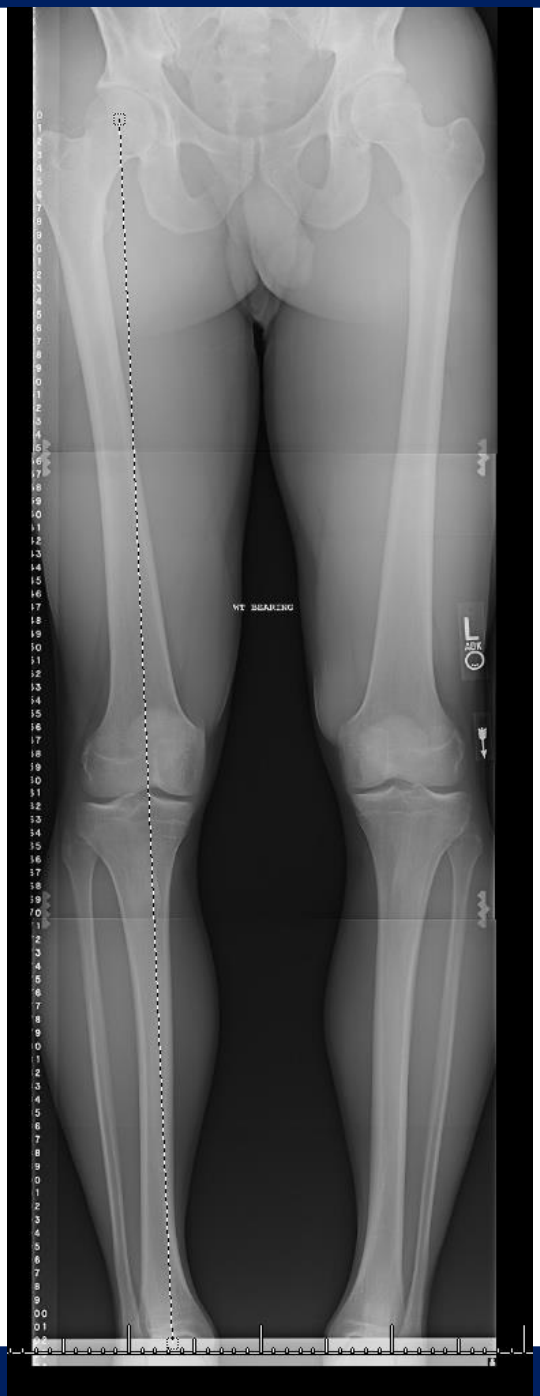
MFC/VARUS

- Debridement
- ACI Biopsy obtained
- Medial Unloader Brace
- Future Treatment?



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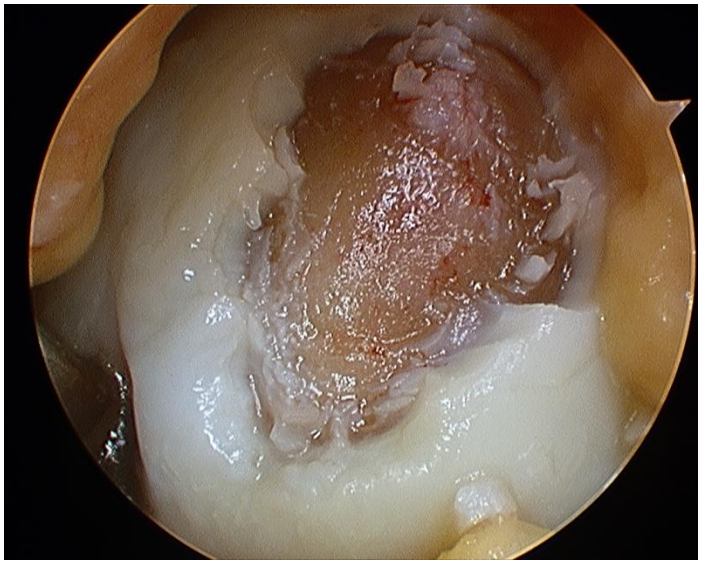
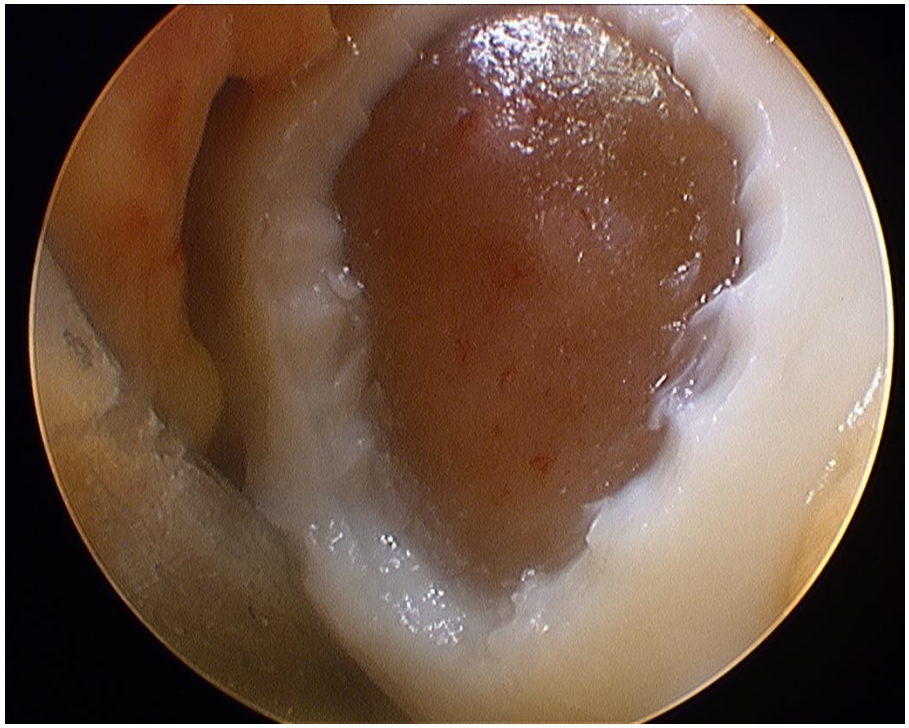
MFC/VARUS

- 6 months later
- Persistent Medial symptoms

ACI/HTO

- Realignment
- Autologous Chondrocyte Implantation
- Collagen scaffold





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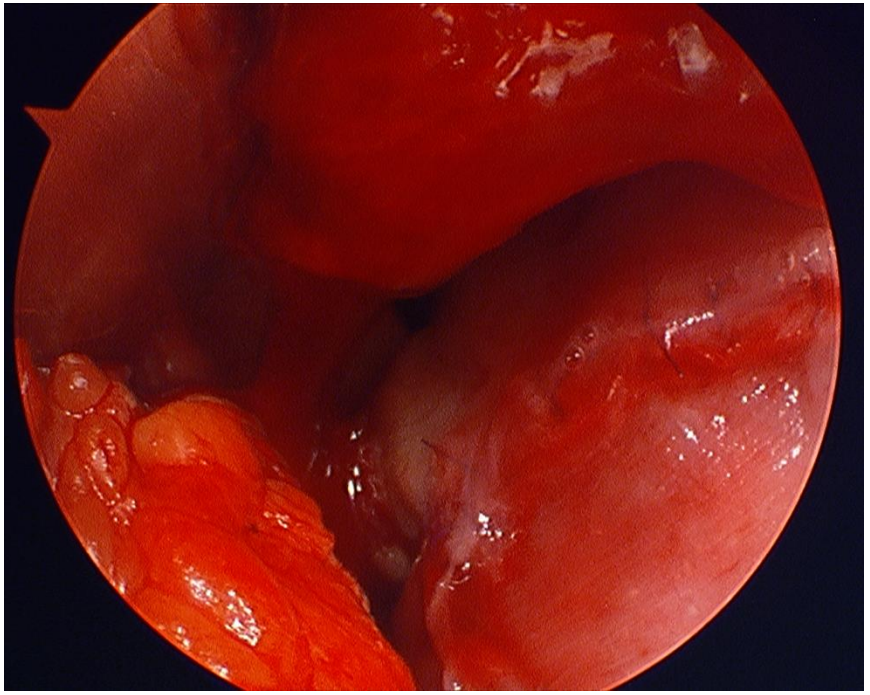
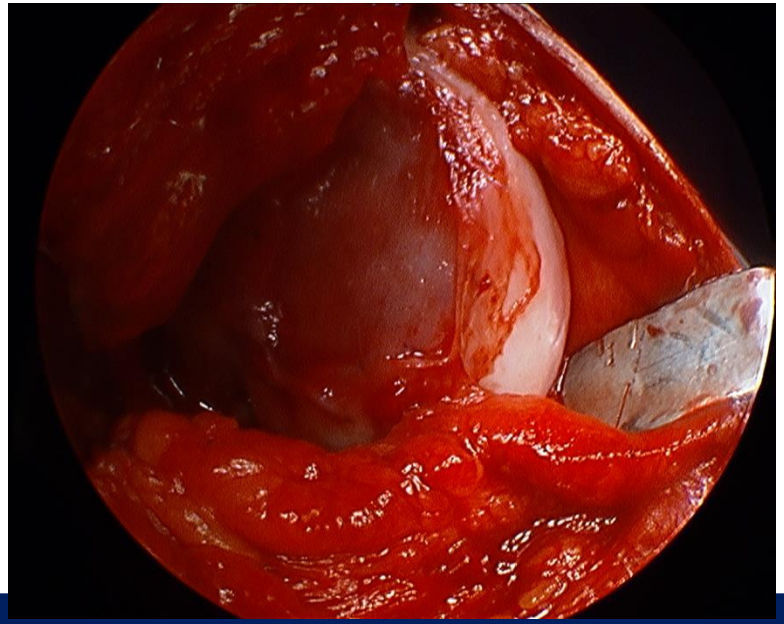
ACI/HTO

- 4.5 square centimeter lesion
- 7 degree varus correction





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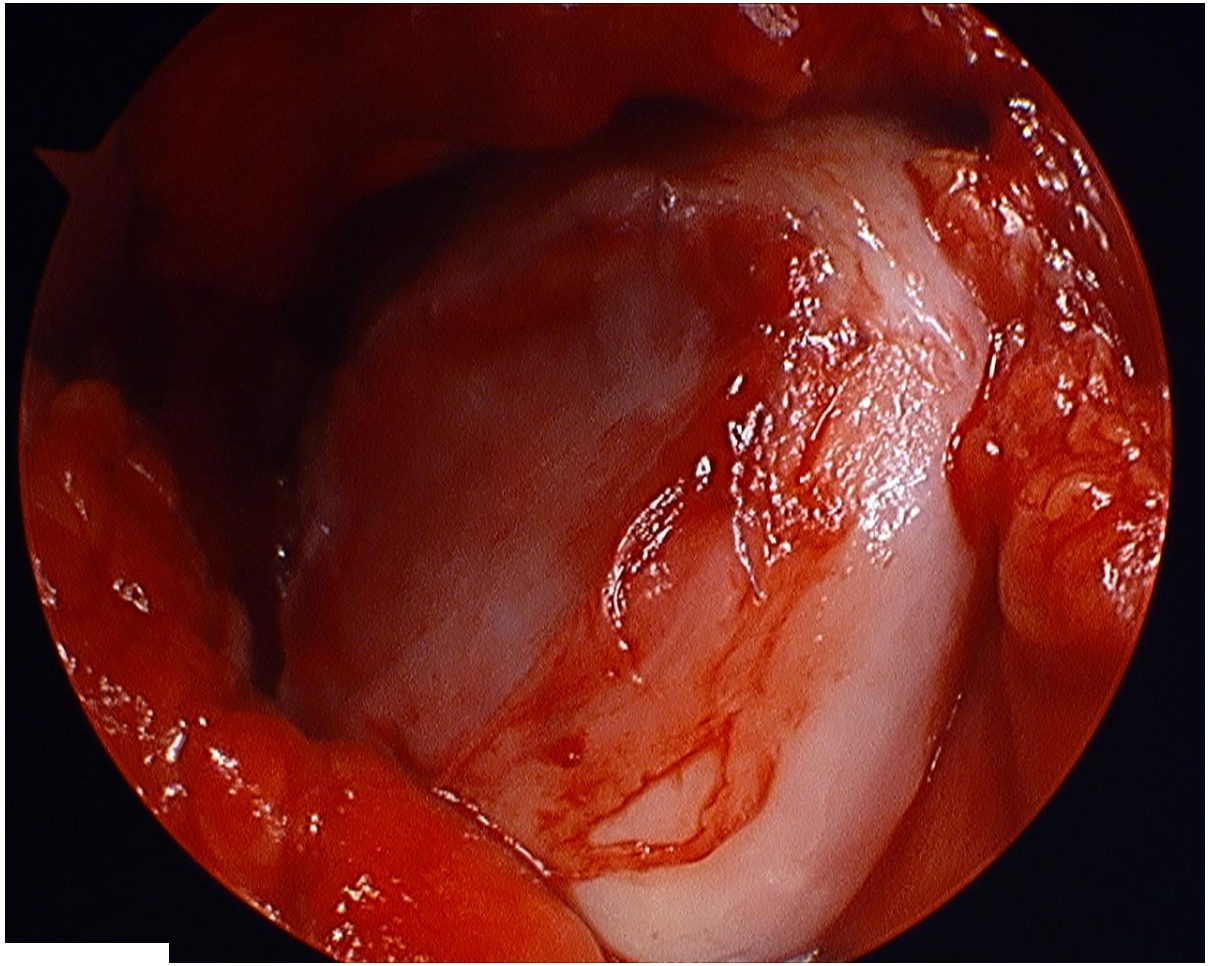

Center

ACI/HTO

- Medial sided discomfort eliminated
- Osteotomy healed
- Avoid impact loading minimum one year
- Chondrocyte maturation 18 months

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- Hip
  - Malalignment
    - Pincer
    - Cam
    - Mixed type
    - Labrum tear
    - Chondrolabral separation/ delamination
  - OA Progression

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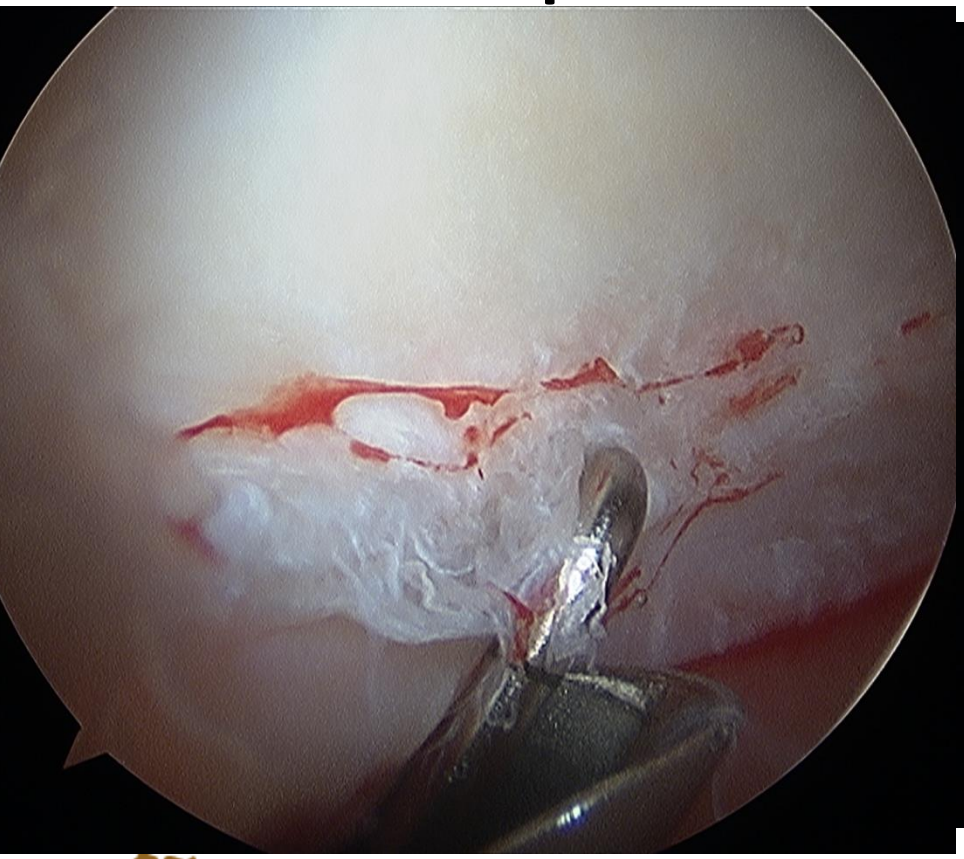
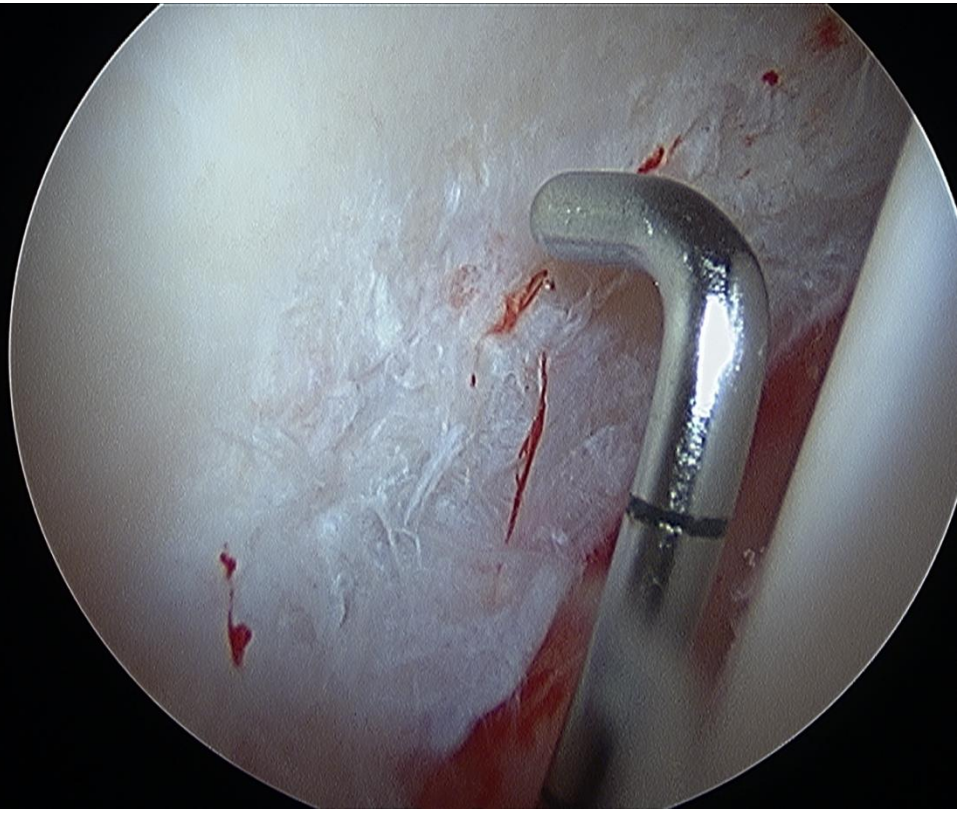
Hip Cartilage

- 38 yo male
- FAI (Cam, labrum tear)
- Excellent relief with diagnostic injection
  - Delayed surgery 6 months until symptoms fully returned

Hip Articular Cartilage





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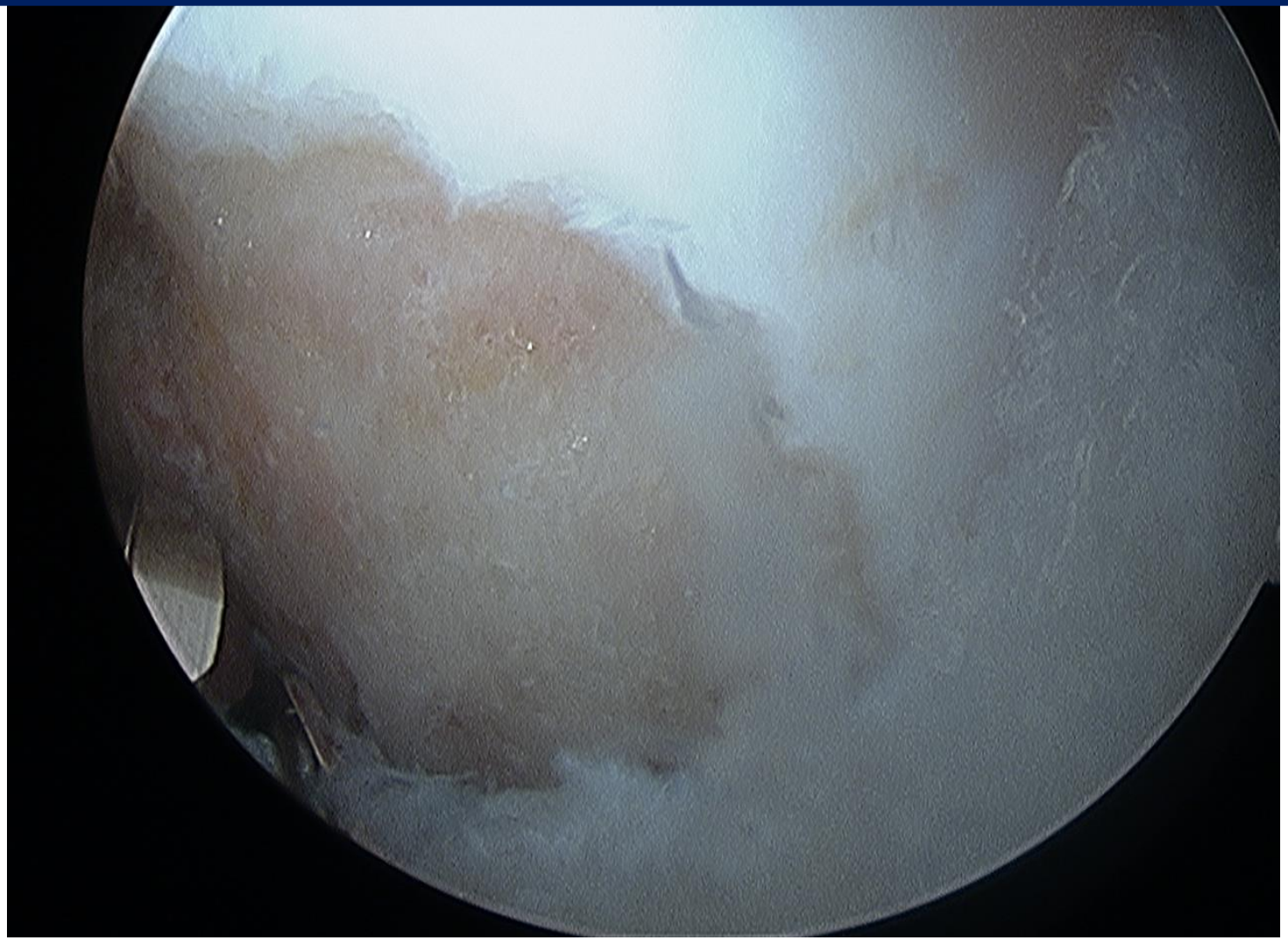

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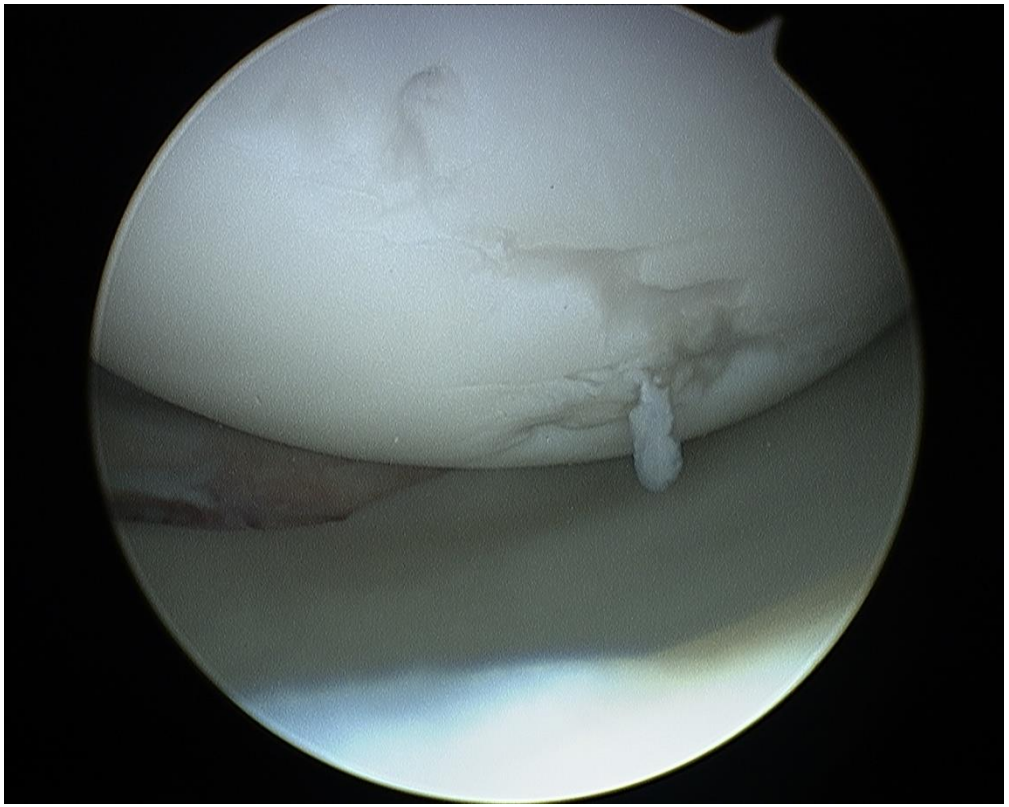
Shoulder Instability

- High level athlete
- Single dislocation



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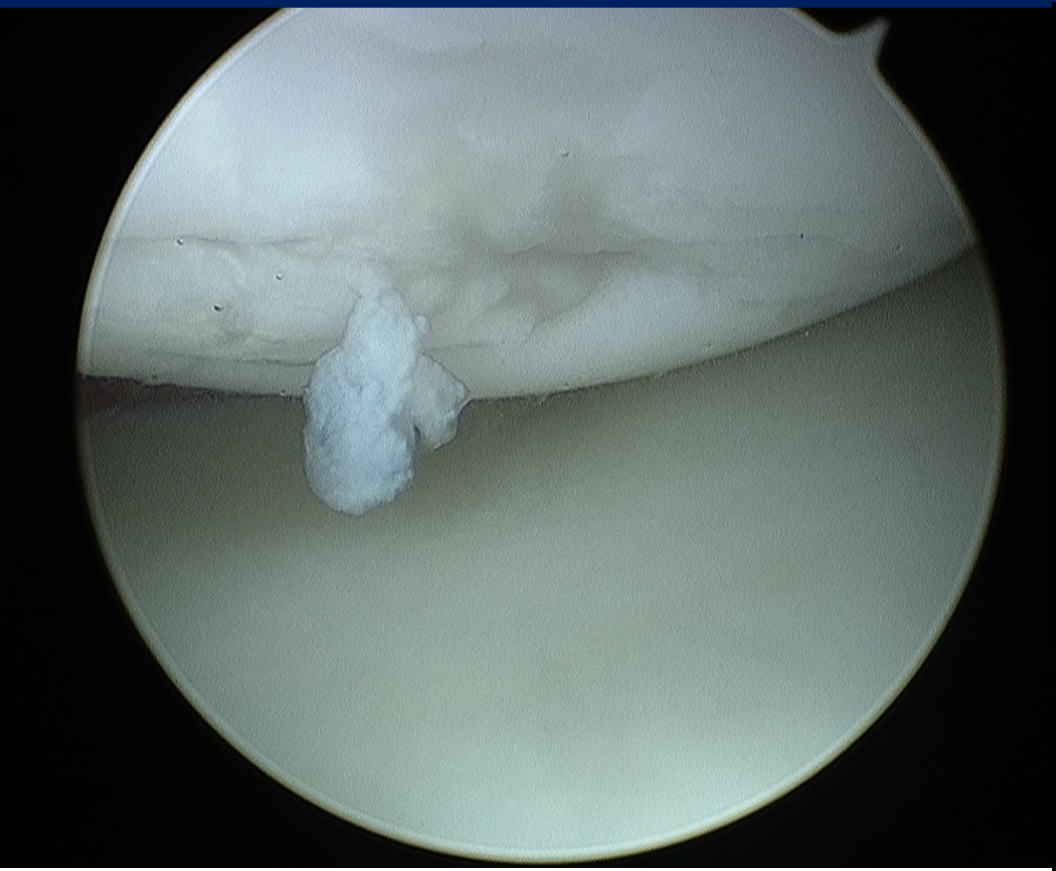

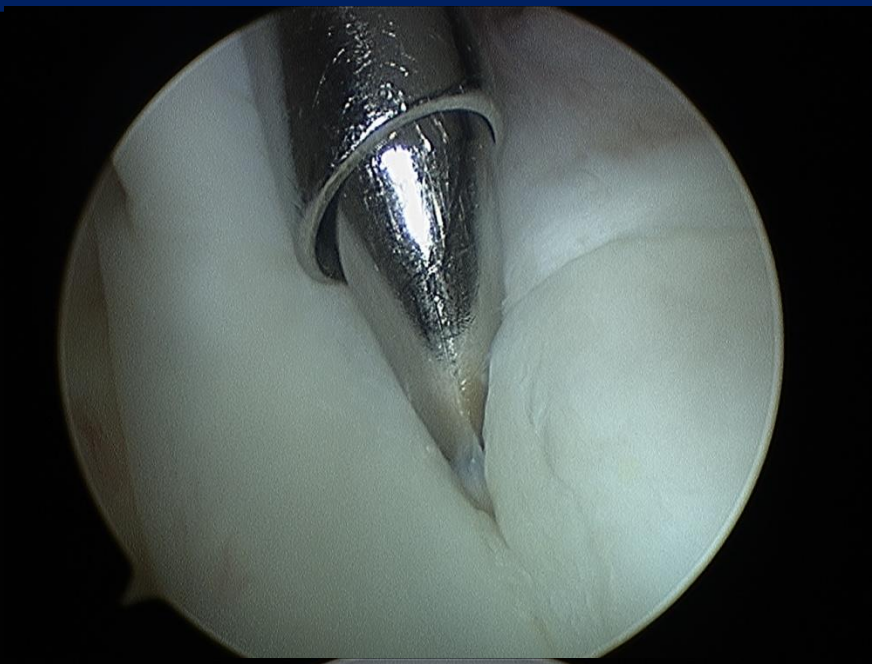

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Cartilage

- STABILITY
- ALIGNMENT
- THEN CARTILAGE TX
- Questions/Debate/Discussion

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Thank You for Attending!

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