Cartilage Challenges From Repair to Transplantation Practical Treatments In The New Millennium

Encore Sports Symposium

July 15,2017

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AOSM

- A drunk man who smelled like beer sat down on a subway seat next to a priest. The man's tie was stained, his face was plastered with red lipstick, and a half empty bottle of gin was sticking out of his torn coat pocket. He opened his newspaper and began reading.
- After a few minutes the man turned to the priest and asked, "Say, Father, what causes arthritis?"

•“My son, it’s caused by loose living, being with
•cheap, wicked women, too much alcohol and a
• contempt for your fellow man.”
•“Well, I’ll be darn,” the drunk muttered, returning
• to his paper.
•The priest, thinking about what he had said,
•nudged the man and apologized.
•“I’m very sorry. I didn’t mean to come on so strong.
• How long have you had arthritis?”
•“I don’t have it, Father. I was just reading here that
•the Pope does”.

Arthritis
"a disease of cartilage"

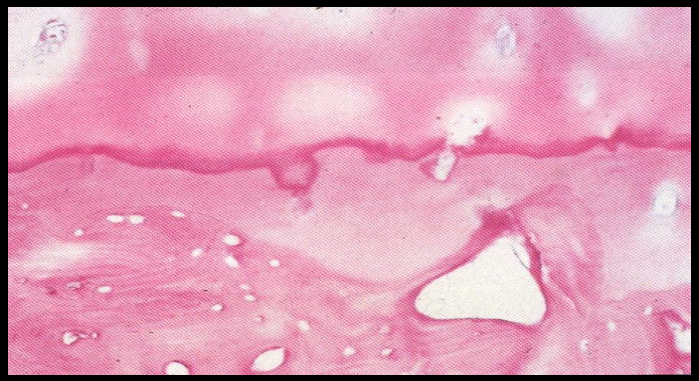
- A diffuse Disease of Cartilage and presents challenges in its own right.
- This morning I am going to concentrate more on focal cartilage injury and disease and share with you my experience with treatment options currently available

Disclosures

- I have no disclosures related to this talk

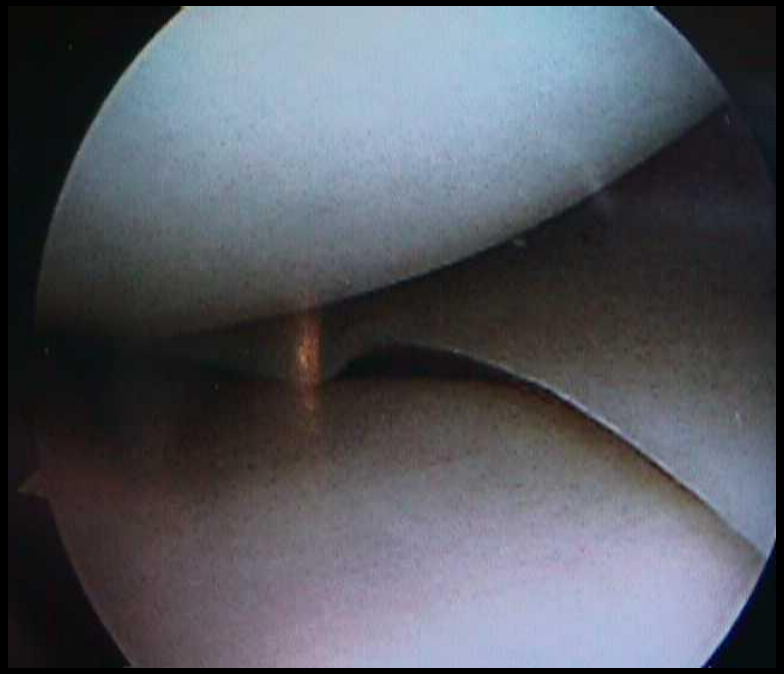
Our Objectives

- Briefly Review the basic science of cartilage
- Understand options available in 2017 to treat focal cartilage lesions



Arthroscopic View of Knee Cartilage

- Normal Cartilage



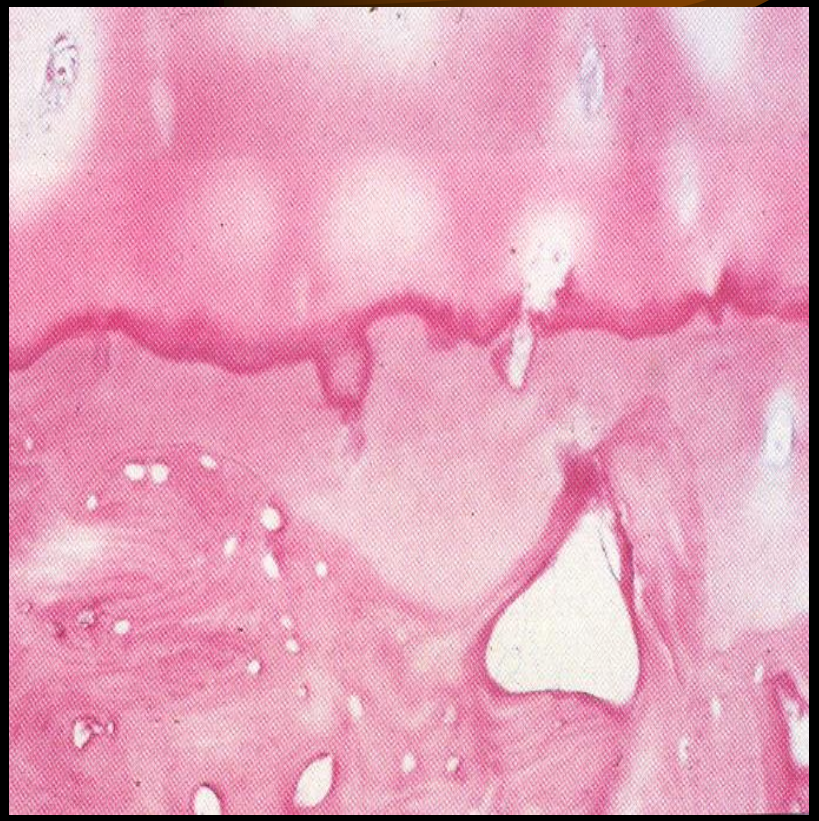
- Lets look at what makes up this cartilage

Cartilage

• Articular(Hyaline)	Type II collagen
• Fibrocartilage	Type I collagen
• Elastic cartilage	Type II collagen
• Epiphyseal cartilage	

Hyaline Cartilage

- Collagen
  - Type II
- Water
  - 65%-85%
- Extracellular Matrix
  - Chondrocytes
  - Proteoglycans
  - Glycosaminoglycans



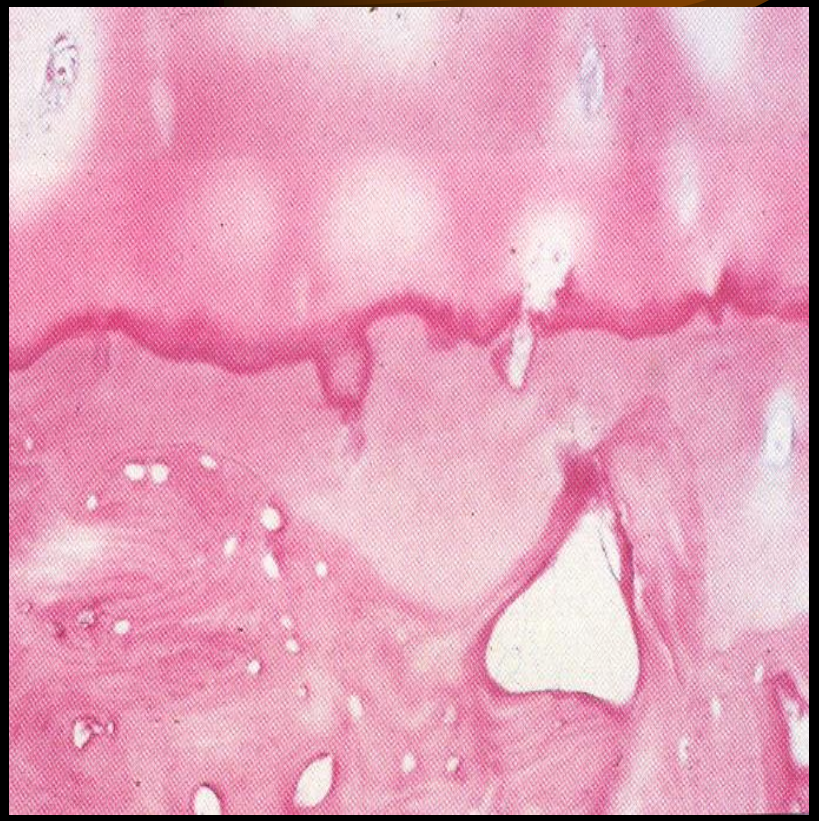
Extracellular Matrix

Chondrocytes

- Synthesize and maintain matrix
- Anaerobic metabolism
- Metabolism slows with age
- Mitotic activity ceases with development of tidemark(calcified zone)
- Cells rarely divide after skeletal maturity

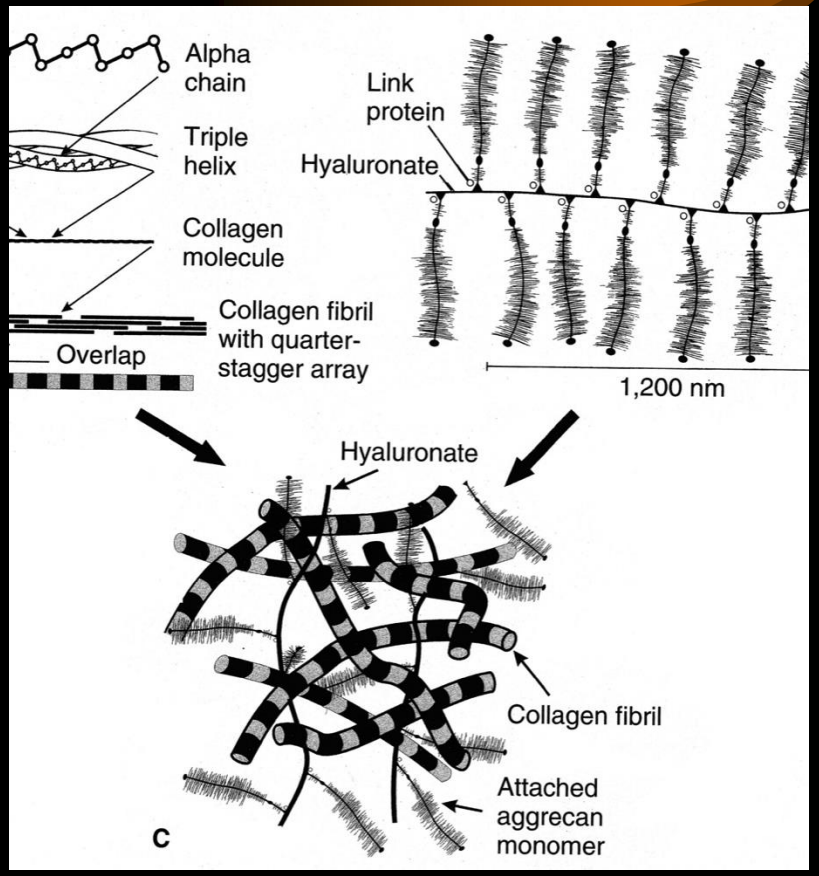
Adult Chondrocytes

- Healing potential is minimized
- No pluripotent cells in mature cartilage,
- Limited ability to heal /repair defects after maturity

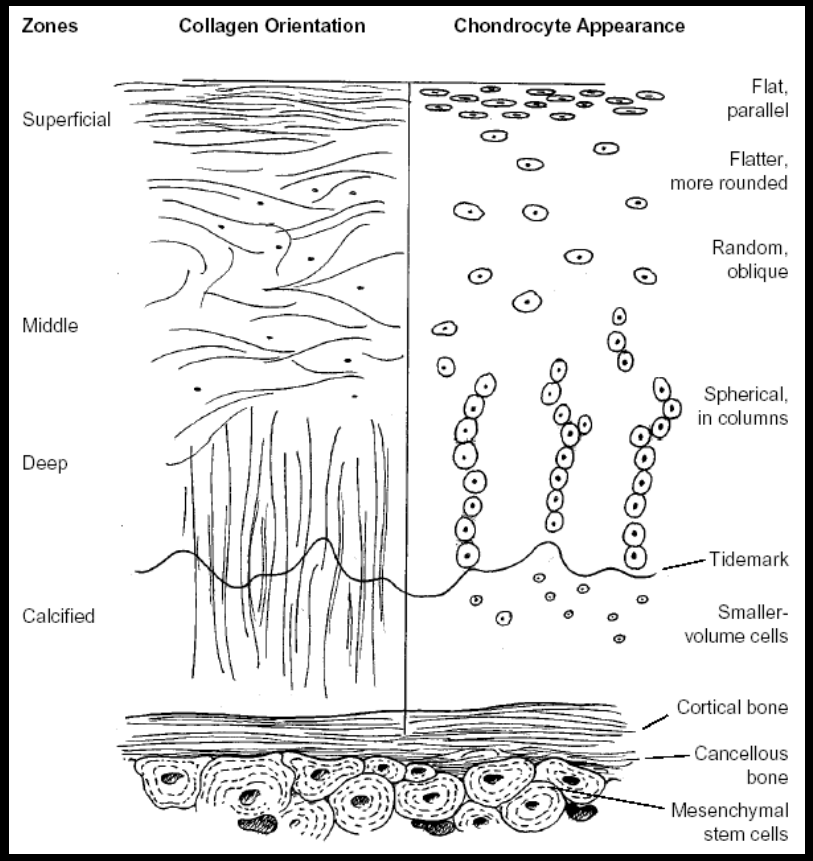


Proteoglycans

- 10-20% of cartilage
- High affinity for water
- Provides compression strength and stiffness
- Joined to hyaluronic acid by linked protein
- Composed of Glycosamioglycans (keratin sulfate and chondrointin sulfate)

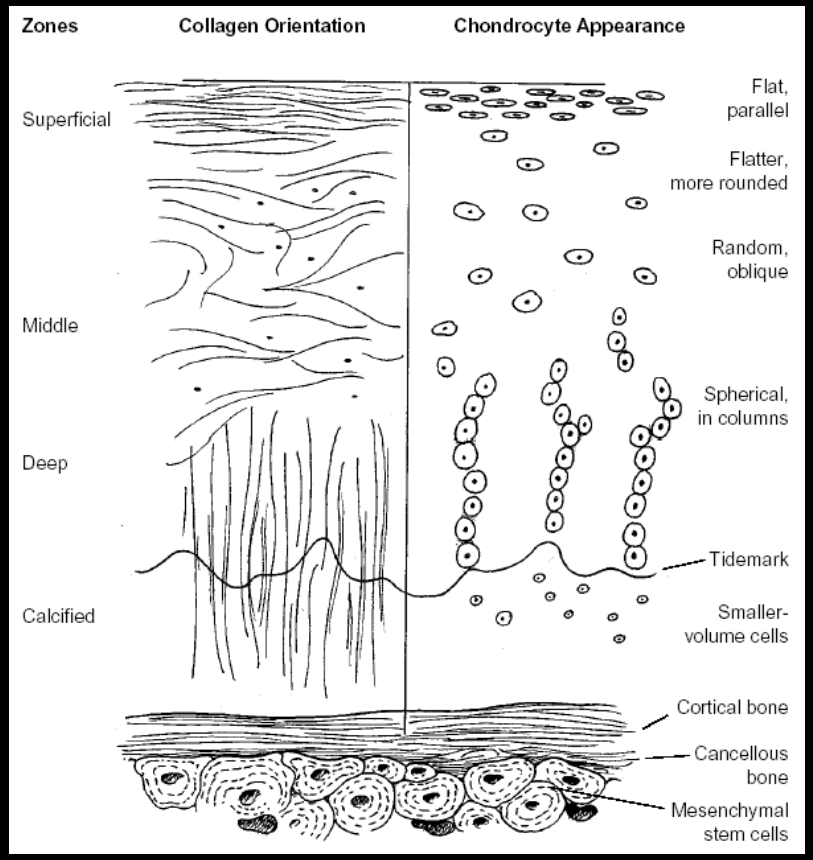


Cartilage Anatomy



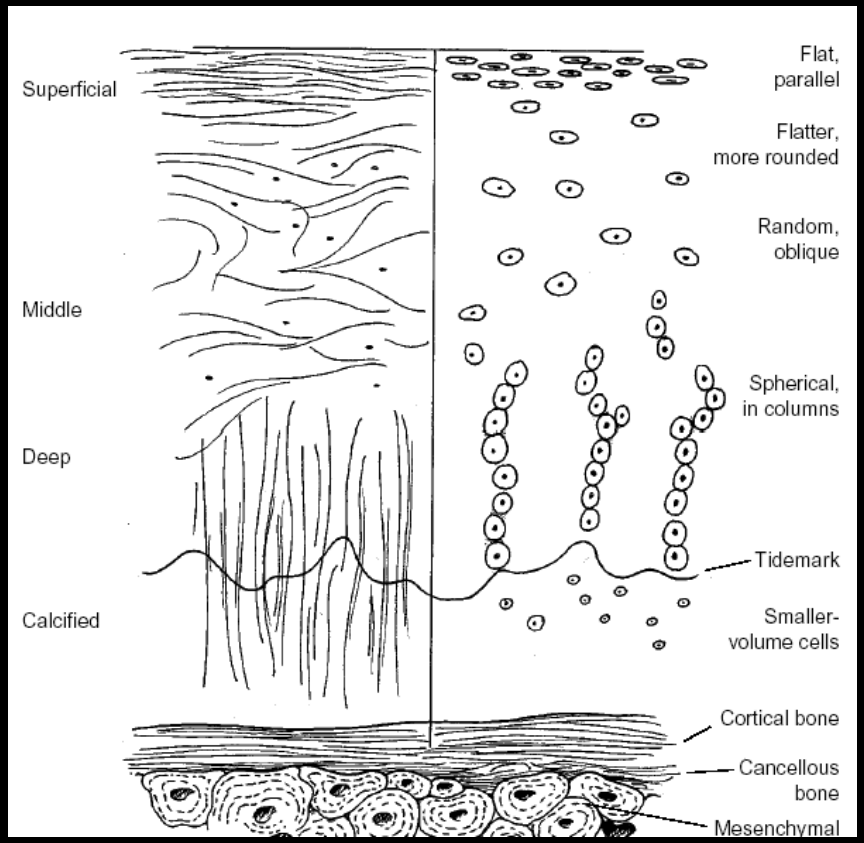
- Four Zones
  - Superficial
  - Middle/Transitional
  - Deep
  - Calcified Cartilage

Superficial Zone



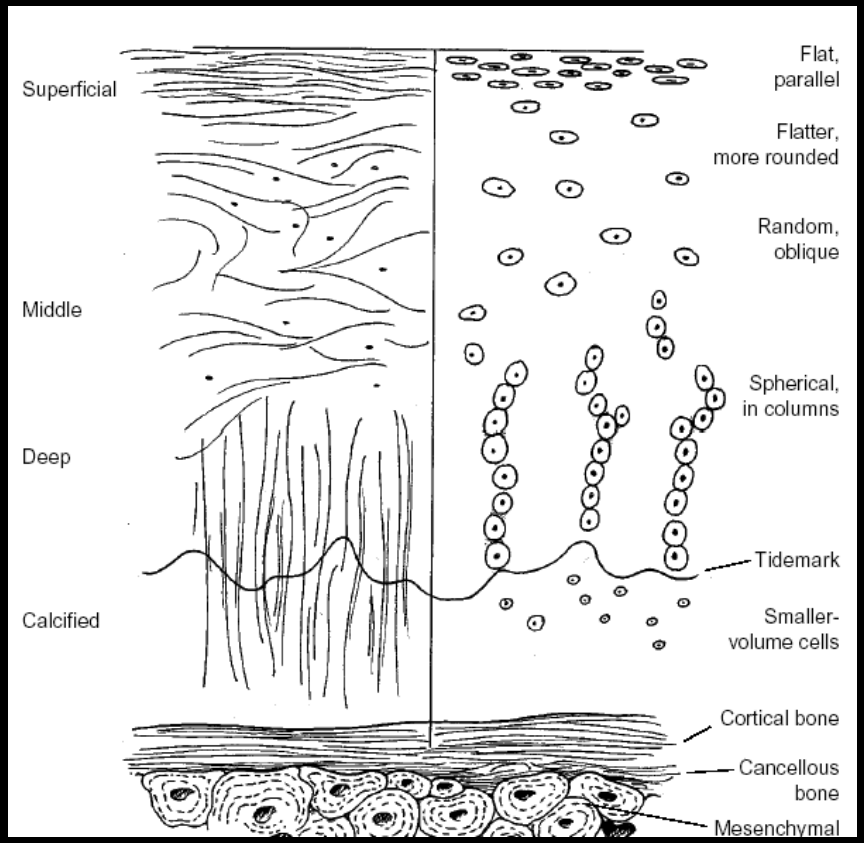
- Thin collagen fibrils parallel to surface
- Elongated chondrocytes parallel to surface
- Lubricin coats the surface forms gliding surface, resists tensile stress
- Water content highest(80%)
- Proteoglycan content lowest

Middle/Transitional Zone



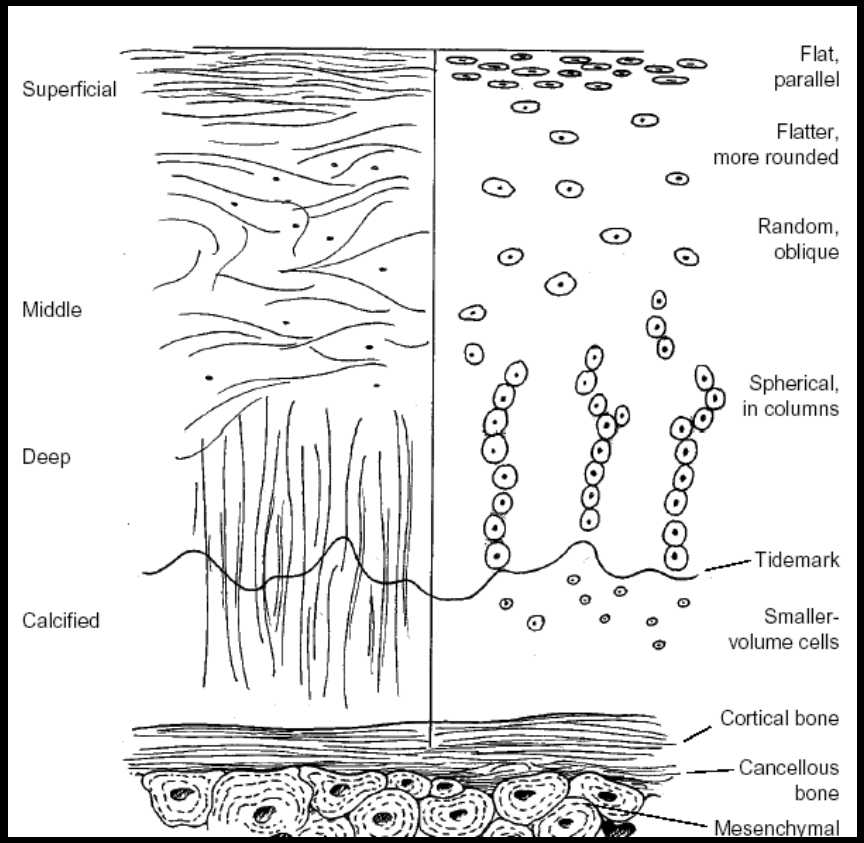
- Collagen fibrils are larger diameter
- Less organized
- Chondrocytes rounded in appearance

Deep Zone

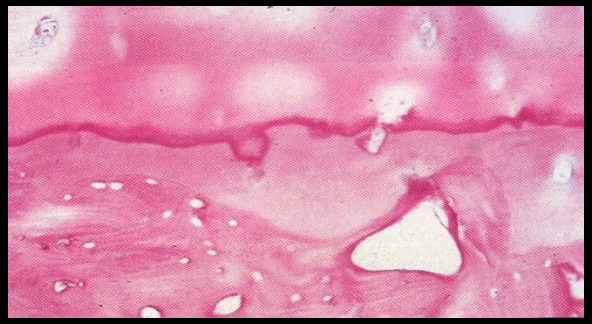


- Larger diameter collagen fibers are organized in columns perpendicular to surface
- Chondrocytes are arranged in columns
- Water content lowest (65%)
- Proteoglycan content Highest

Zone of Calcified Cartilage



- Separates Hyaline cartilage from sub-chondrol bone
- Separated from deep zone by Tide mark
- Cartilage is avascular and aneural above this zone



Cartilage Nutrition

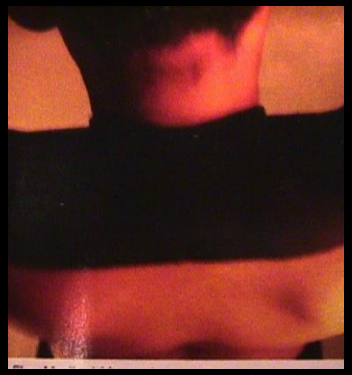
- **Immature cartilage**
- Mainly from Diffusion from bone, but limited once tide mark has formed because of disposition of apatite in the calcific zone

- **Adult cartilage**
  - **Avascular**
- Main nutrition and Oxygen is from diffusion from synovial fluid
- Immobilization may contribute to
  - chondrocyte hypoxia,
  - cartilage thinning
  - decreased PG metabolism

Focal Cartilage Defect

Treatment Options

- Non-operative
- Best response in patients without mechanical symptoms
  - Activity Modification
  - NSAIDS (Cox1,Cox2)
  - Glucosamine/CS
  - Viscosupplementation
  - PRP/Stem cells
  - Alternative Medicine
    - Accupuncture
    - Magnets
    - Prolo therapy



Surgical Treatment Options

- Most patients experiencing mechanical symptoms don’t respond to non-operative treatment options

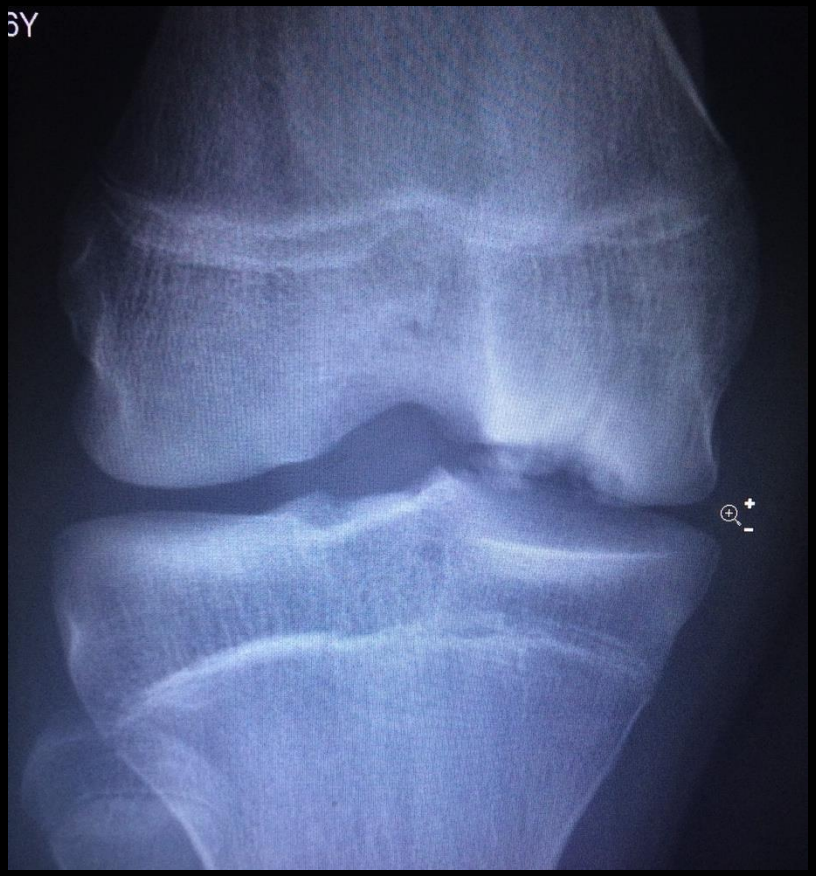
Surgical Treatment Options

- Operative
  - Repair/fixation
  - Non-restorative
  - Mesenchymal stem cells
  - Chondrocytes
  - Structural

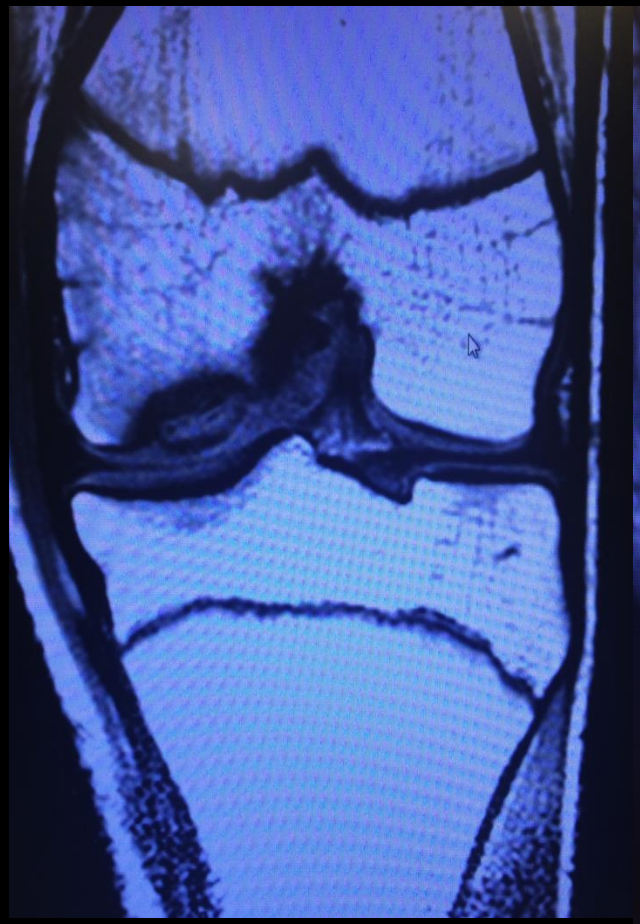
Patient 1
16 y/o High School Football Player with recurrent knee swelling pain and popping

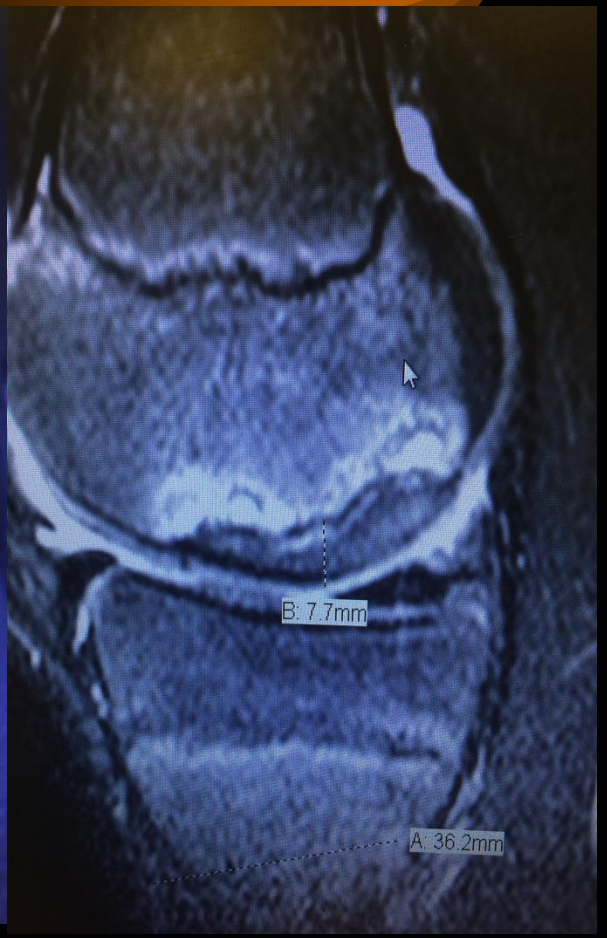
- questions
- Examination
- Tests?

Patient 1
16 y/o High School Football Player with recurrent knee swelling pain and popping



16 y/o High School Football Player with recurrent knee swelling pain and popping





OCD

- A pathologic lesion affecting both cartilage and bone
- Juvenile and Adult form
- Most common found knee MFC (70%)
- Factors for poor prognosis
  - Lateral Femoral Condyle
  - Synovial Fluid behind lesion on MRI
  - Closed physis

Classification of osteochondritis dissecans

Stage	Plain radiograph findings	Magnetic resonance imaging findings	Arthroscopic findings
I	Depressed osteochondral fragment	Articular cartilage thickening and low signal changes	Irregular and softened articular cartilage with no fragment
II	Osteochondral fragment attached by an osseous bridge	Articular cartilage breached, low signal rim behind fragment representing fibrous attachment	Articular cartilage breached with definable fragment that is not displaceable
III	Detached, nondisplaced fragment	Articular cartilage breached, high signal changes behind fragment indicating synovial fluid between fragment and subchondral bone	Articular cartilage breached with definable fragment that is displaceable but attached by overlying articular cartilage
IV	Displaced fragment	Loose foreign body	Loose foreign body

Data from:

1. *DeLee JC, Drez Jr D, Miller MD. DeLee & Drez's Orthopaedic Sports Medicine Principles and Practice, 2nd ed, Elsevier Science, Philadelphia 2003.*
2. *Dipaola JD, Nelson DW, Colville MR. Characterizing osteochondral lesions by magnetic resonance imaging. Arthroscopy 1991; 7:101.*
3. *Guhl JF. Arthroscopic treatment of osteochondritis dissecans. Clin Orthop Relat Res 1982; :65.*

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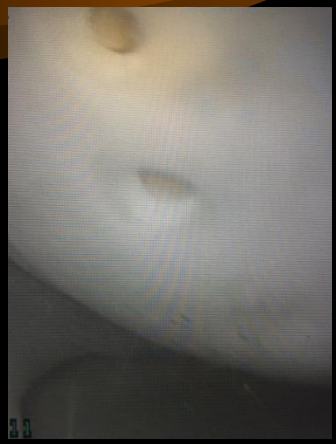
Non –Operative treatment

- Rest, NWBing,
  - Immobilization? Injections?
- Best chance of success with non-op and op treatment :
  - Open physis (younger better)
  - Contained Lesion
  - Less sub-chondral edema

Operative Treatment Options

- Arthroscopic
  - Fixation in situ (repair/fixation)
    - Debridement with grafting/fixation
  - Debridement (non-restorative)
    - Decision depends on :



Patient: age, skeletal maturity,low/high demand

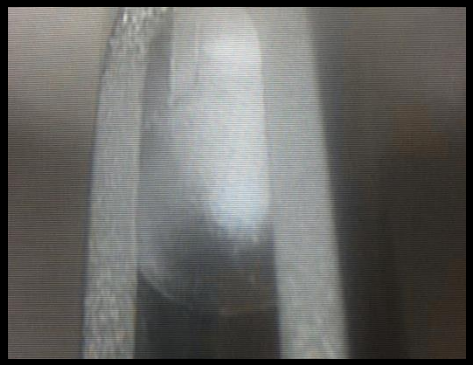
Defect details: size,location,contained or uncontained, subchondral involvement (MRI)

16 y/o High School Football Player
Failed 10 weeks of Non-op Rx

Pinning of Contained Lesion

Smart Nails$_{tm}$

Absorbable: Poly-L-lactic acid, Poly-glycolic acid



Smart Nails

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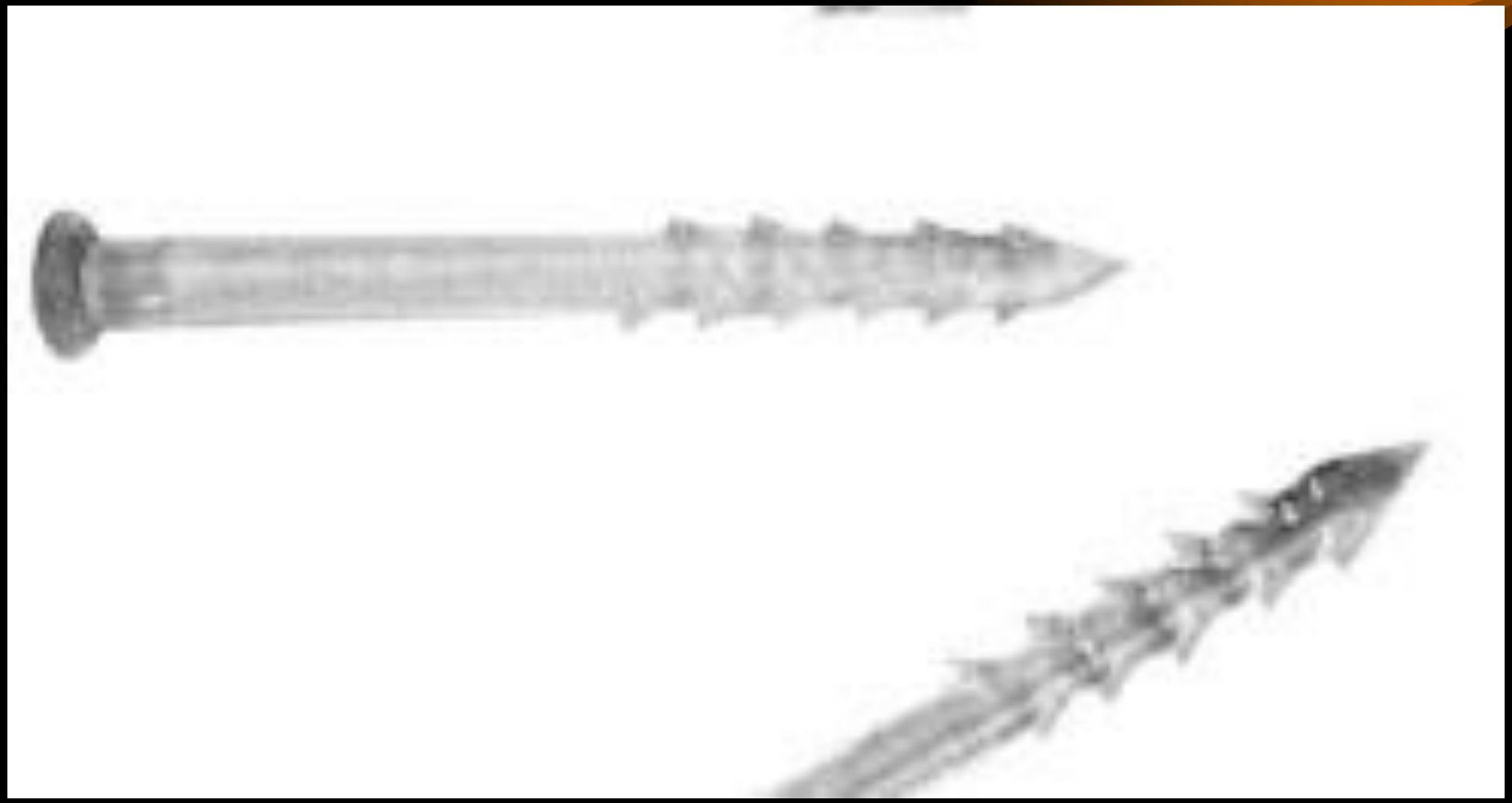
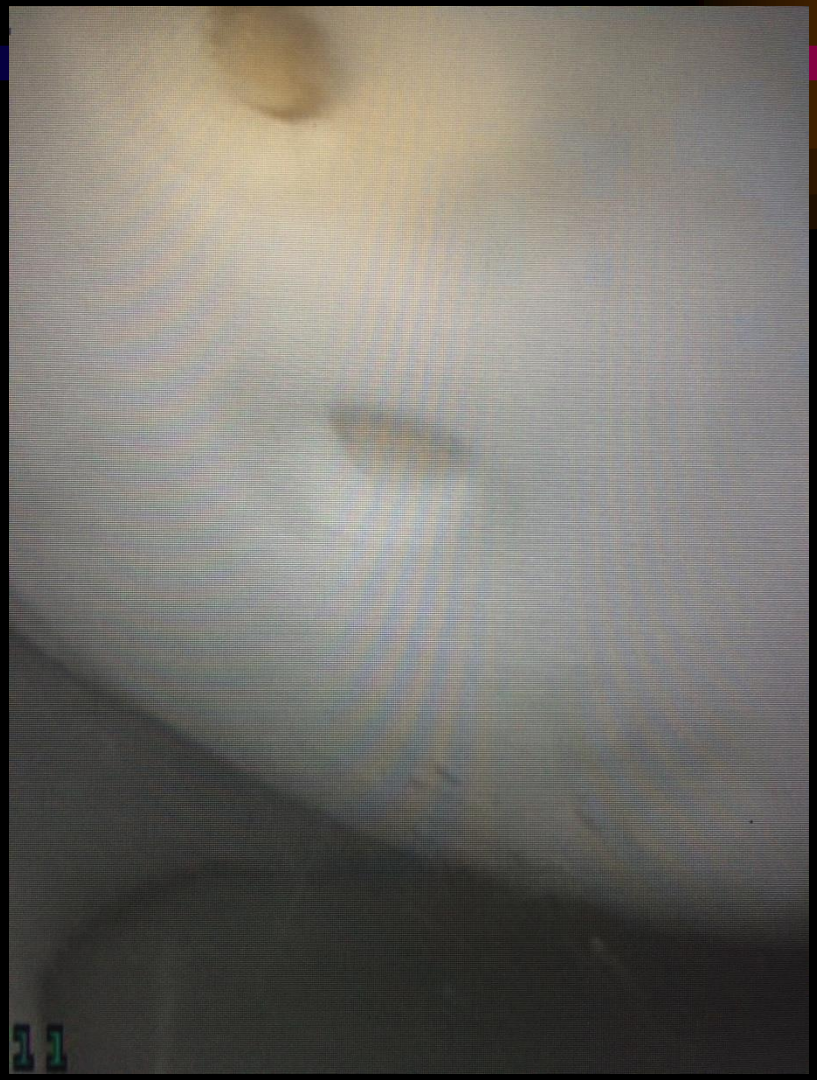
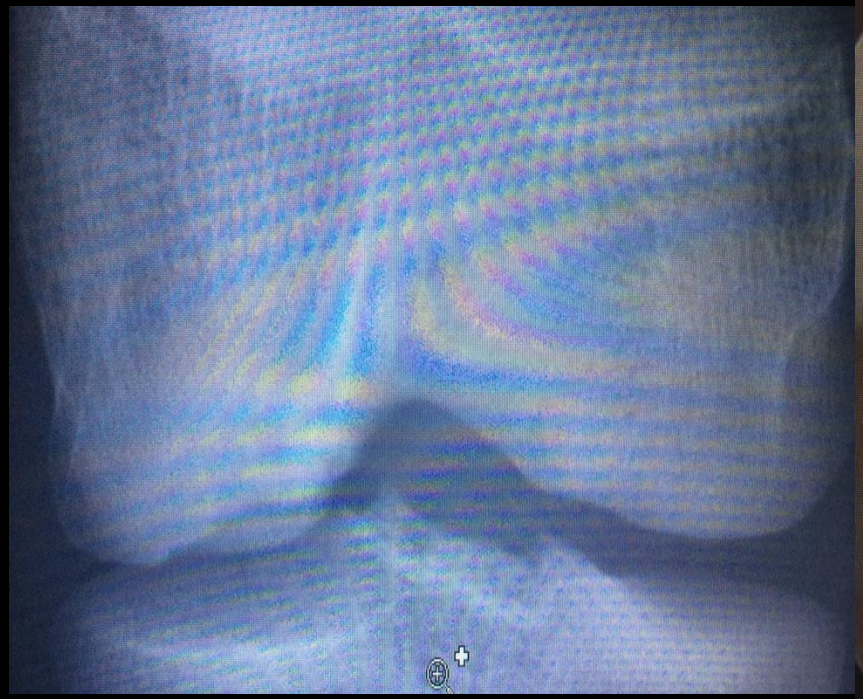


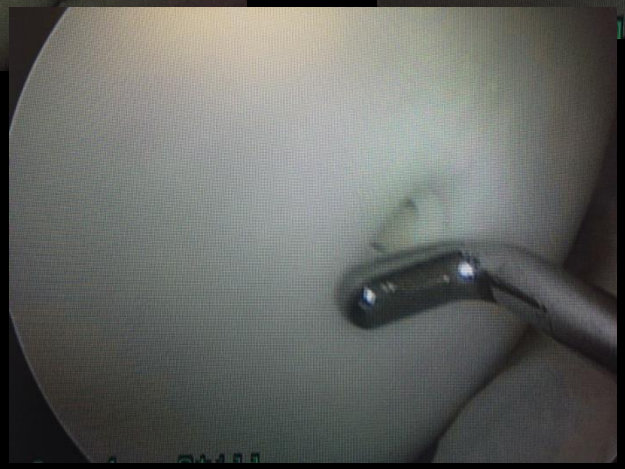
Smart Nails



Bilateral OCD
Opposite knee



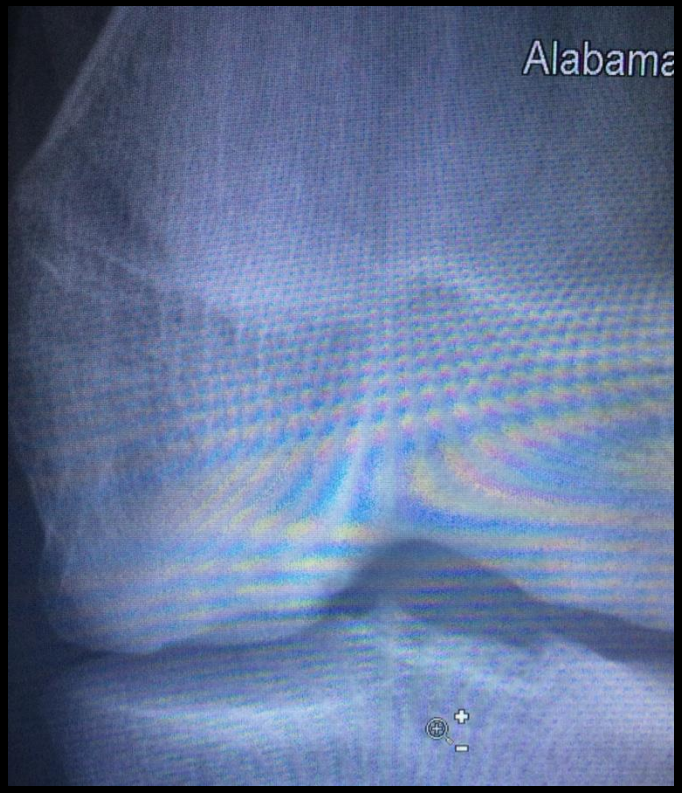
Opposite knee Smart Nails



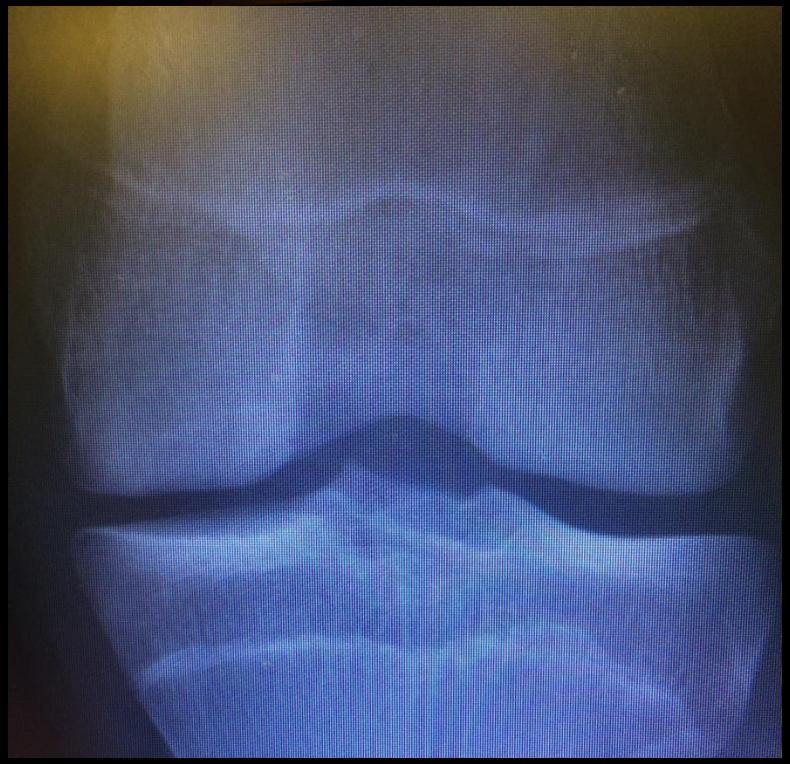
Healed OCD

Left knee
Healed OCD

- Before



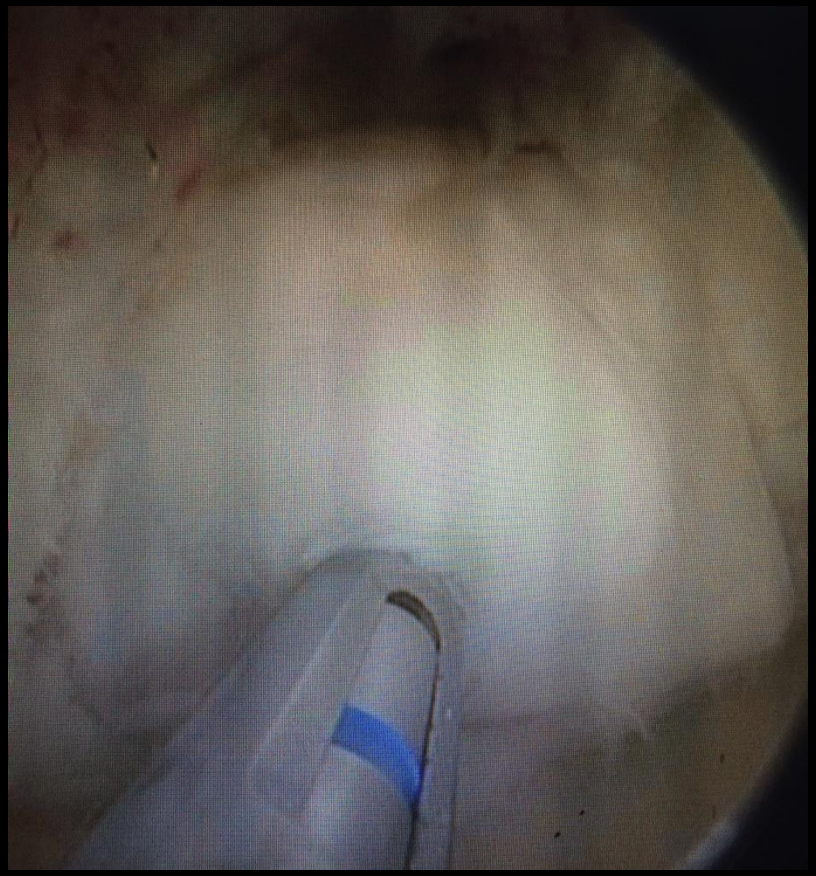
- After



Adult OCD

32 y/o High school coach


Acc 1 - Still



Adult OCD

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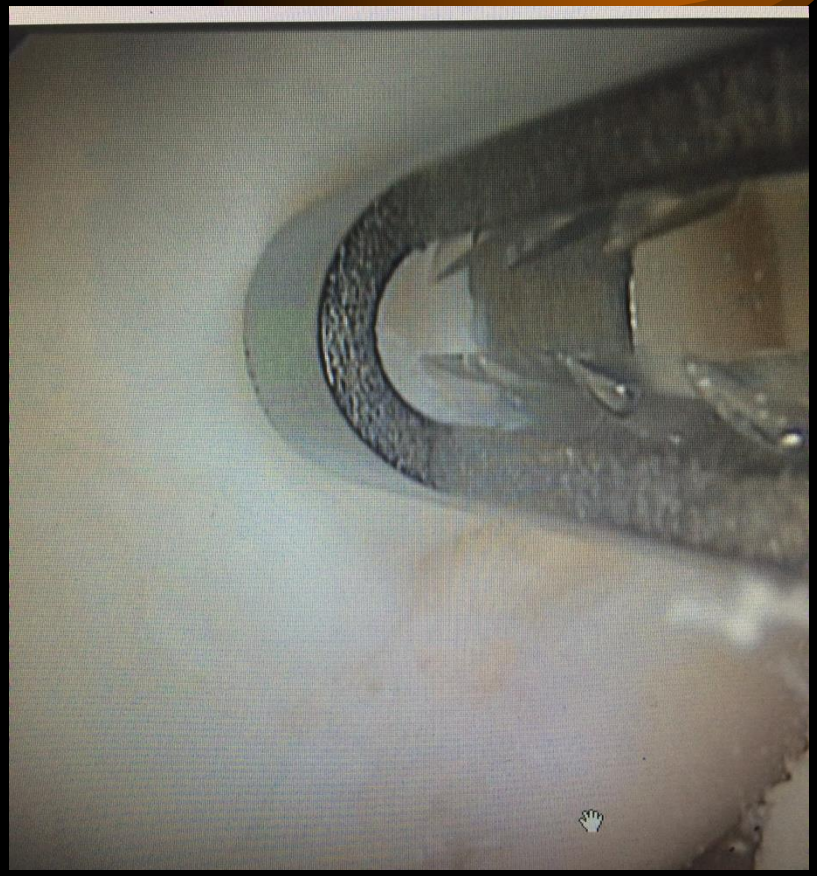
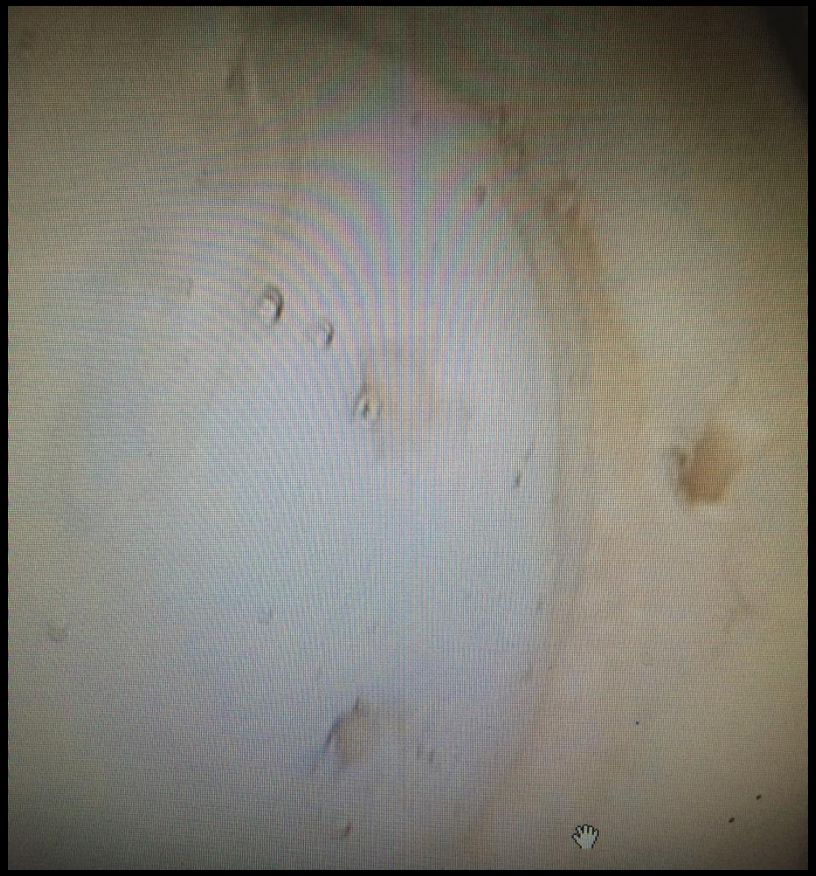


Pinning /Drilling

Pinning with Microfracture



OCD (fixation/repair)

- Advantages
  - Arthroscopic
  - Restorative/Repair
  - Cost effective
  - Single Operation
  - Exellent short-term & long-term results
    - (MFC,contained,MRI open physis)
- Disadvantages
  - Implant removal
    - Implant choice
  - Lower Success Rates
    - Uncontained lesions
    - Age limitations
    - Need for bone grafting and fixation

Literature

- Anderson AF, Lipscomb AB, Coulam C. Antegrade curettement, bone grafting and pinning of osteochondritis dissecans in the skeletally mature knee. *Am J Sports Med.* 1990;18(3):254-261.
- Anderson AF, Richards DB, Pagnani MJ, Hovis WD. Antegrade drilling for osteochondritis dissecans of the knee. *Arthroscopy.* 1997;13(3):319-324.
- Andrew TA, Spivey J, Lindebaum RH. Familial osteochondritis dissecans and dwarfism. *Acta Orthop Scand.* 1981;52(5):519-523.
- Cahill BR. Osteochondritis Dissecans of the Knee: Treatment of Juvenile and Adult Forms. *J Am Acad Orthop Surg.* 1995;3(4):237-247.
- Chambers HG, Shea KG, Anderson AF, et al. Diagnosis and treatment of osteochondritis dissecans. *J Am Acad Orthop Surg.* 2011;19(5):297-306.
- Chambers HG, Shea KG, Anderson AF, et al. American Academy of Orthopaedic Surgeons Clinical Practice Guideline on: The Diagnosis and Treatment of Osteochondritis Dissecans. *J Bone Joint Surg Am.* 2012;94(14):1322-1324.
- De Smet AA, Ilahi OA, Graf BK. Untreated osteochondritis dissecans of the femoral condyles: prediction of patient outcome using radiographic and MR findings. *Skeletal Radiol.* 1997;26(8):463-467.
- Edmonds EW, Albright J, Bastrom T, Chambers HG. Outcomes of extra-articular, intra-epiphyseal drilling for osteochondritis dissecans of the knee. *J Pediatr Orthop.* 2010;30(8):870-878.

In the Literature

- Plenty of support for both operative and non-operative treatment options
- Good results reported for fixation of stable and some unstable lesions especially when physis open
- Need more Level 1 Prospective studies
  - Osteochondritis Dissecans of the Knee, Kevin Shea MD, et.al.,Sports Medicine Update March/April 2013
  - Osteochondritis Dissecans of the elbow, Fine Kenneth MD Sports Medicine Update November/December 2012

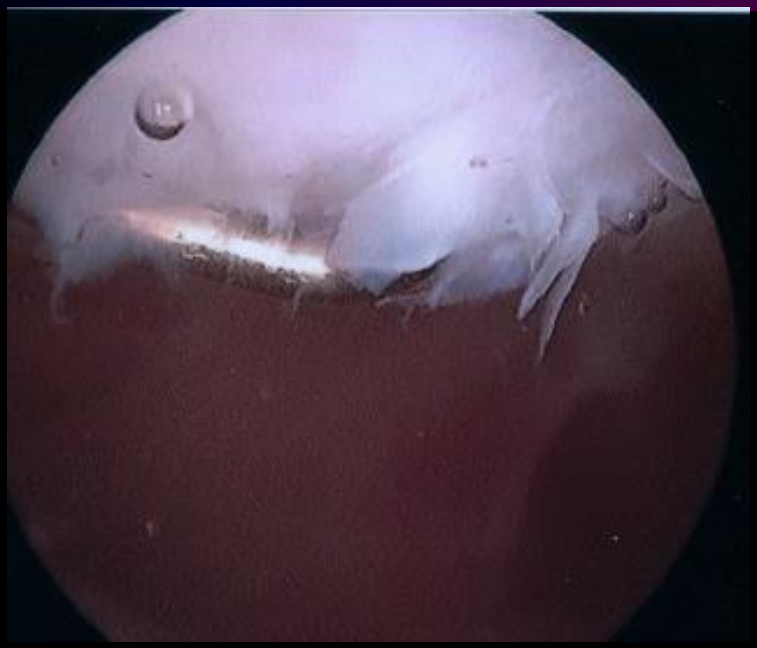
Physical Therapy Pinning OCD

- Standard post op modalities, Quad sets unloaded, gentle AROM NWB.
- Limit sheer forces across OCD, OK for FROM non-weight bearing.
- May begin weight bearing in locked knee brace to limit sheering forces, allow compression force.

Patient #2
34 y/o avid weekend athlete/weight lifter with persistent popping/catching/pain/swelling knee

- Examination
  - FROM
  - Ligaments stable
  - 2+ effusion
  - MJLT
  - Neg. Mcmurray's
  - X-ray normal

Patient #2

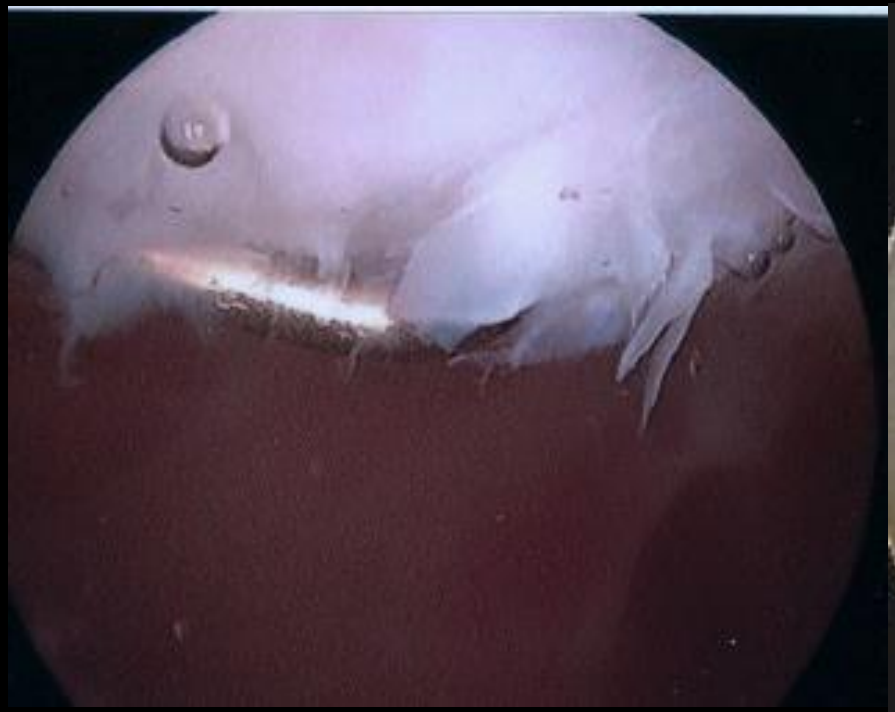


Arthroscopic Grading of Chondromalacia

- **Outerbridge Arthroscopic Grading System**

- Grade 0 Normal cartilage
- Grade I Softening and swelling
- Grade II Superficial fissures
- Grade III Deep fissures, without exposed bone
- Grade IV Exposed subchondral bone

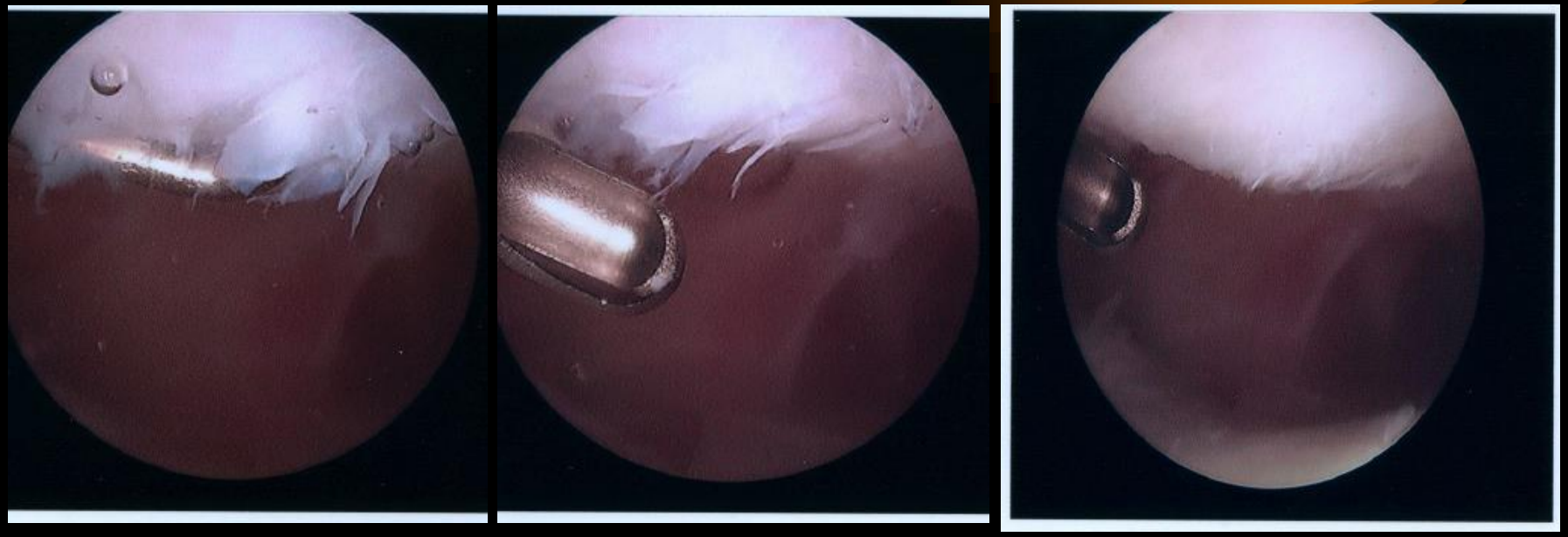
Partial Thickness vs Full thickness Lesions



Surgical Options

- Arthroscopic Chondroplasty
  - Debridement (non-restorative)
  - Microfracture (mesenchymal stem cells)
- Cartilage Transplantation (restorative structural)
  - OATS (Osteo Articular Transplant system)
    - Osteo-chondral plugs
  - ACI Carticel (Chondrocytes)
    - Cartilage Harvest/Growing/Re-implantation
- Fresh Osteochondral Allograft OCA
- Joint Resurfacing

Non-Restorative Treatment
Chondroplasty debridement



Chondroplasty
(Debridement)

- Advantages
  - Arthroscopic
  - Single Operation
  - Cost Effective
  - Low Complexity
  - Safety
    - With Mechanical shaver

- Disadvantages
  - Non-restorative
  - Minimal Healing potential
  - Good Short-term

    success (grade 1-2)

    Questionable

    long-term success

    Less successful results with Grade 3-4
    - OA, Mosely et al

A Controlled Trial of Arthroscopic Surgery for Osteoarthritis of the Knee

J. Bruce Moseley, M.D., Kimberly O'Malley, Ph.D., Nancy J. Petersen, Ph.D., Terri J. Menke, Ph.D., Baruch A. Brody, Ph.D., David H. Kuykendall, Ph.D., John C. Hollingsworth, Dr.P.H., Carol M. Ashton, M.D., M.P.H., and Nelda P. Wray, M.D., M.P.H.

N **Engl J Med 2002**; 347:81-88July 11, 2002

This study concluded that arthroscopic lavage with or without débridement is not better than and appears to be equivalent to a placebo procedure in improving knee pain and self-reported function

Widely criticized for its conclusions and for not recognizing significance of defining mechanical symptoms and focal articular cartilage lesions

Chondroplasty Literature

- Anthony J. Scillia, Kyle T. Aune, John S. Andrachuk, E. Lyle Cain, Jeffrey R. Dugas, Glenn S. Fleisig, and James R. Andrews
- Return to Play After Chondroplasty of the Knee in National Football League Athletes
- Am J Sports Med March 2015 43 663-668

  - A majority (67%) of NFL players are able to RTP after arthroscopic knee surgery including chondroplasty of articular cartilage lesions. Athletes are more likely to RTP after chondroplasty of articular cartilage lesions of the knee, but those undergoing concomitant microfracture are less likely to return. No statistical significance was determined when comparing the athletes who returned to play with respect to age at surgery, lesion location, lesion size, lesion grade, position that the athlete played, or draft round.

Chondroplasty Literature

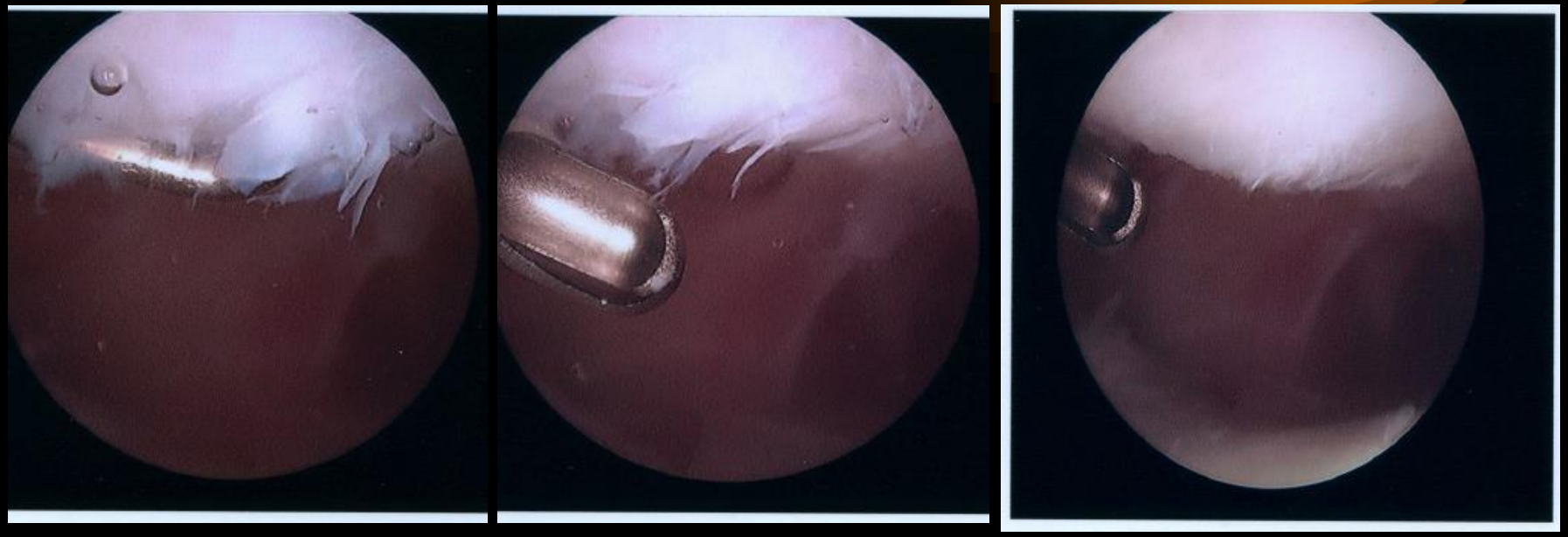
- Ryland B. Edwards III, Yan Lu, Shane Nho, Brian J. Cole, and Mark D. Markel
- Thermal Chondroplasty of Chondromalacic Human Cartilage: An Ex Vivo Comparison of Bipolar and Monopolar Radiofrequency Devices
- Am J Sports Med January 2002 30 90-97
  - Significant chondrocyte death, as determined by cell viability staining with confocal laser microscopy, was observed with each group.
  - The bipolar radiofrequency systems penetrated 78% to 92% deeper than the mono-polar system. The bipolar systems penetrated to the level of the subchondral bone in all osteochondral sections during
  - **Radiofrequency energy should not be used for thermal chondroplasty until further work can establish consistent methods for limiting the depth of chondrocyte death while still achieving a smooth articular surface.**

Chondroplasty Literature

- Aaron Potts, John J. Harrast, Christopher D. Harner, Anthony Miniaci, and Morgan H. Jones
  - Practice Patterns for Arthroscopy of Osteoarthritis of the Knee in the United States
  - Am J Sports Med June 2012 40 1247-1251

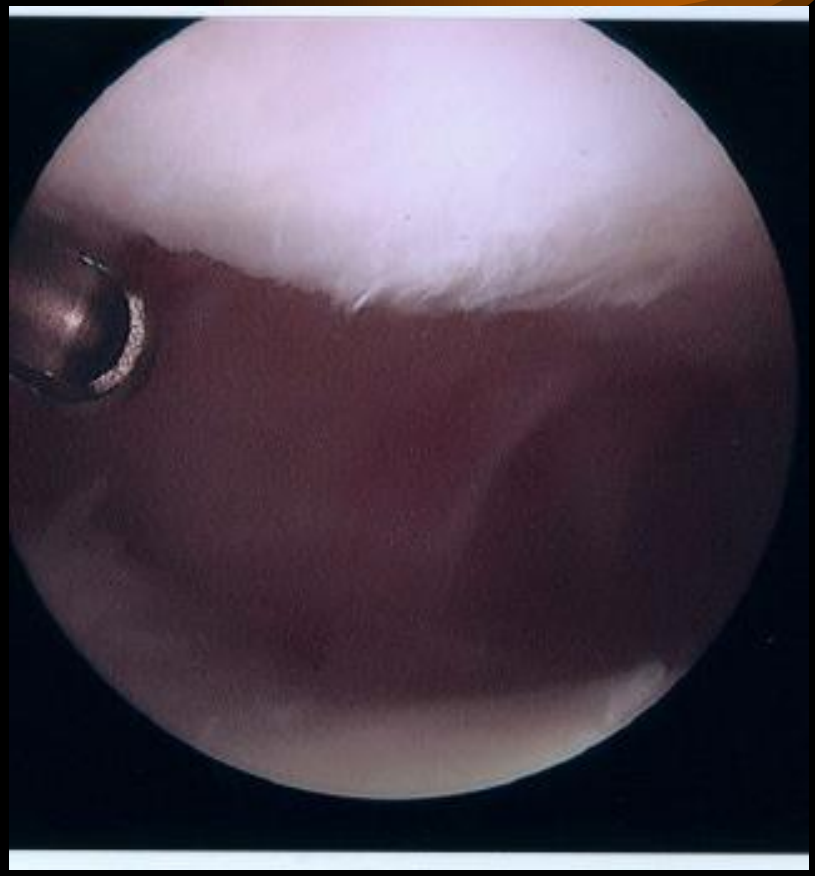
  - The authors examined the American Board of Orthopaedic Surgery (ABOS) database that includes 6-month case logs for each examinee sitting for the Part II board examination for 1999 to 2009.
  - Hypothesis: Knee arthroscopy for osteoarthritis has decreased after the publication of the study by Moseley et al,
  - Knee arthroscopy for patients with osteoarthritis among orthopaedic surgeons during their ABOS examination case collection period has decreased after the publication of a highly publicized article demonstrating a lack of efficacy of this procedure (Moseley et al)

Chondroplasty debridement

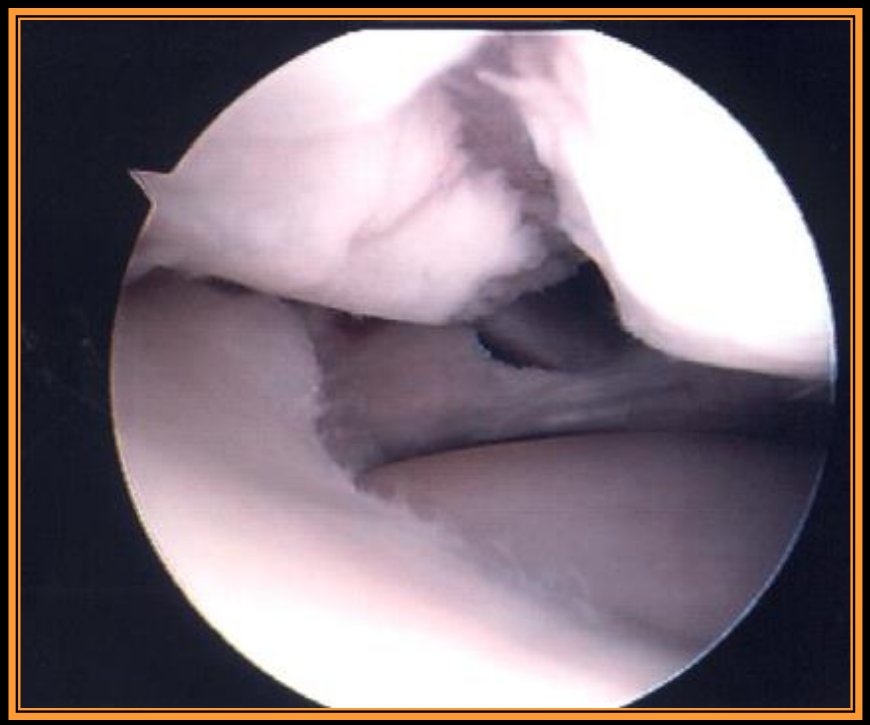


Physical Therapy Arthroscopic Chondroplasty

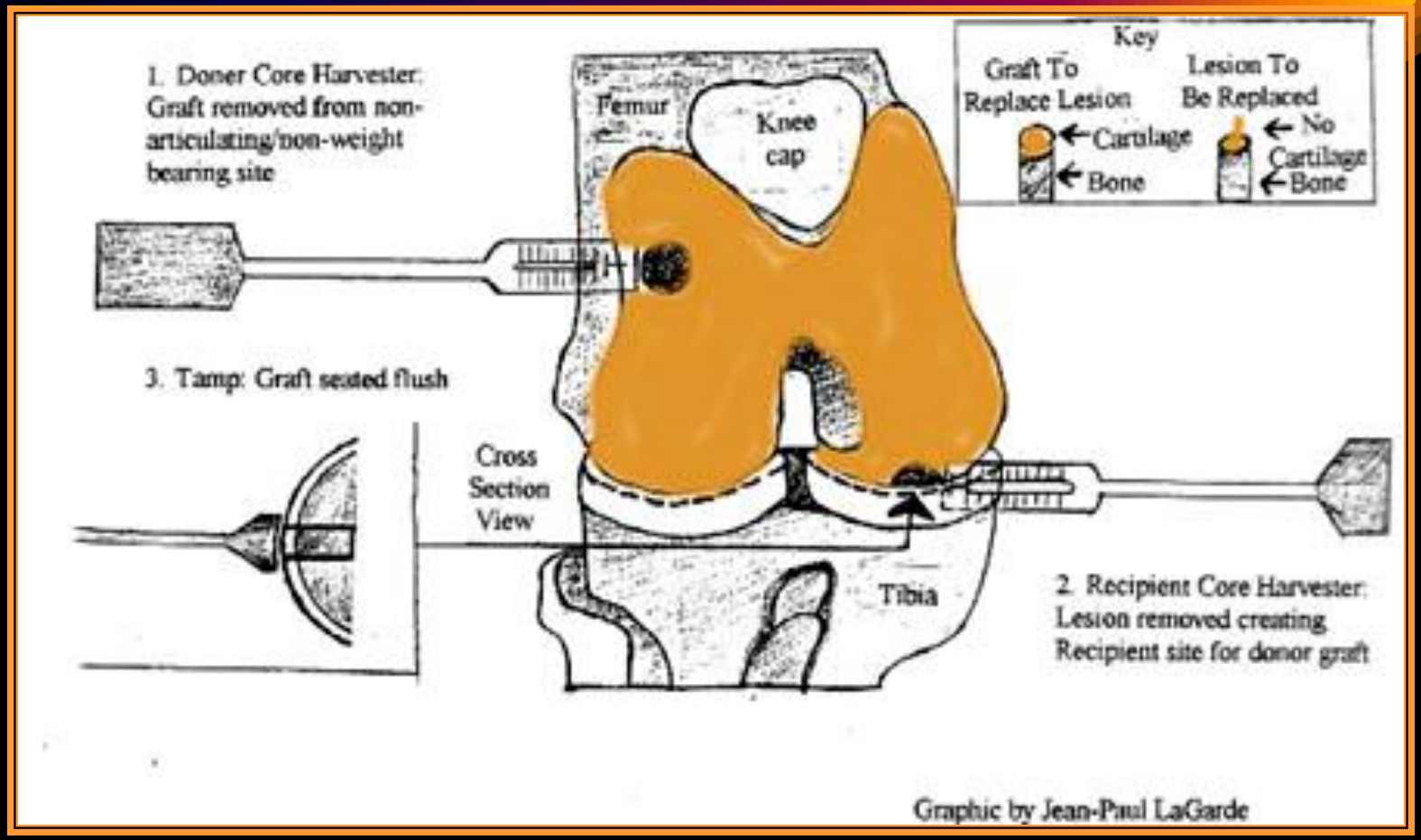
- Standard Post op modalities
- OK to begin Weight bearing as tolerated
- FROM without restrictions



Full Thickness Cartilage Defects



Cartilage Transplantation
OATS

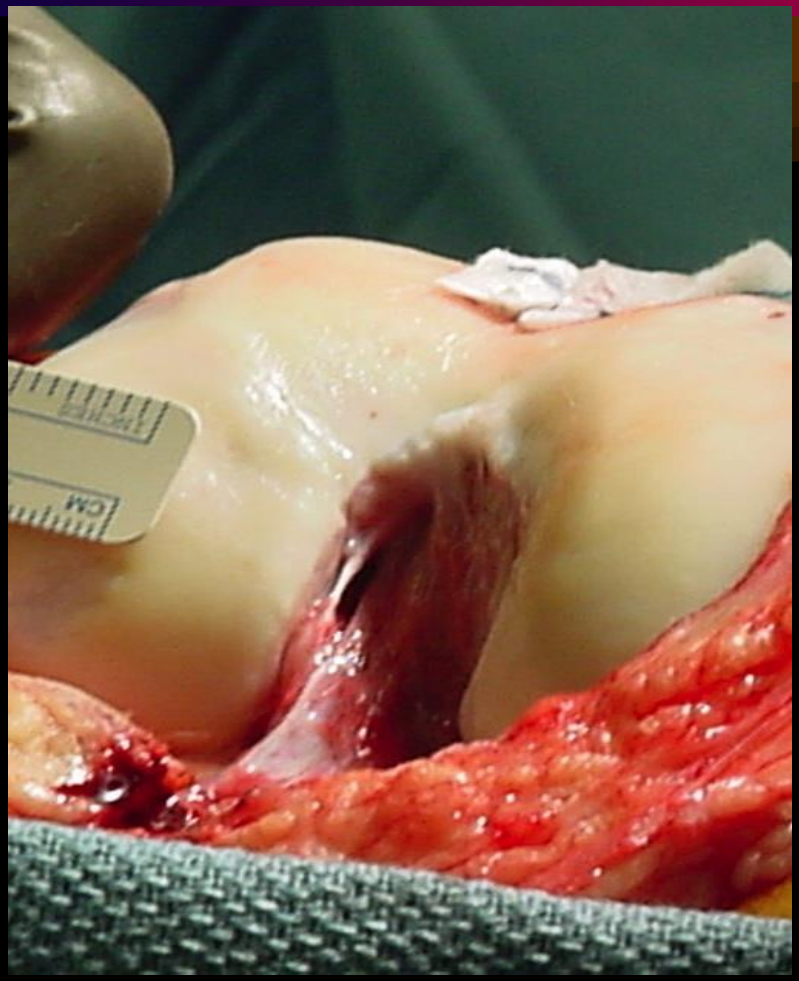


Must have been a golfer?

- Add video of changing hole harvest
- Replace old hole

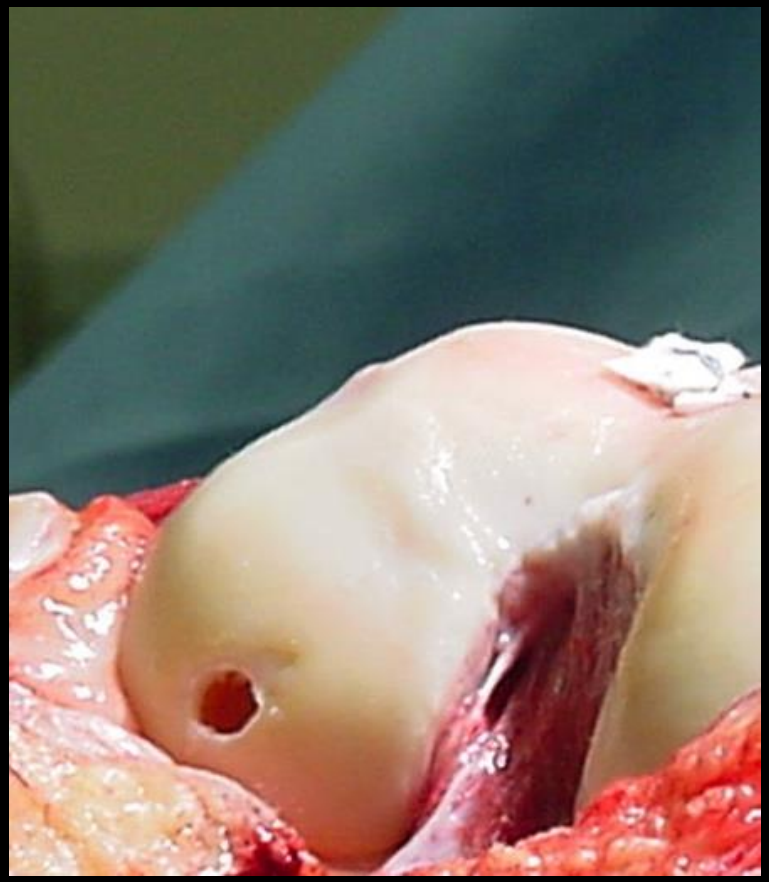
Must have been a golfer?

MFC lesion with Trochlear lesion undergoing open proceedure

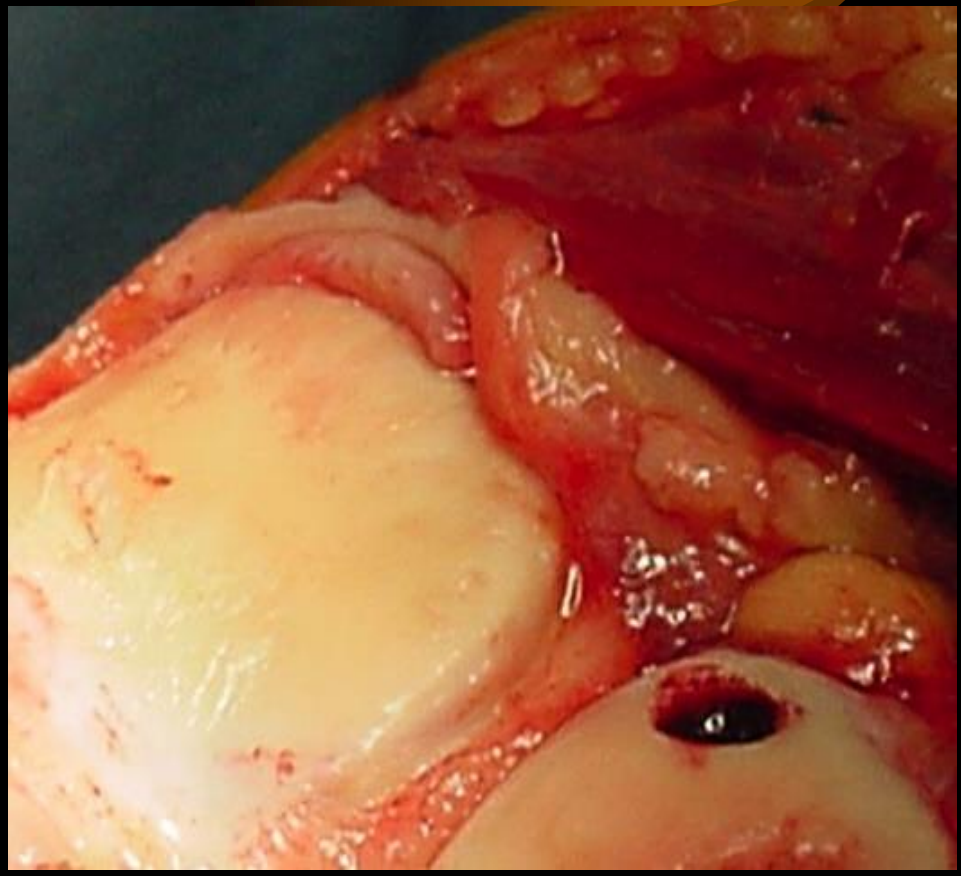


Open OATS

Receiving site

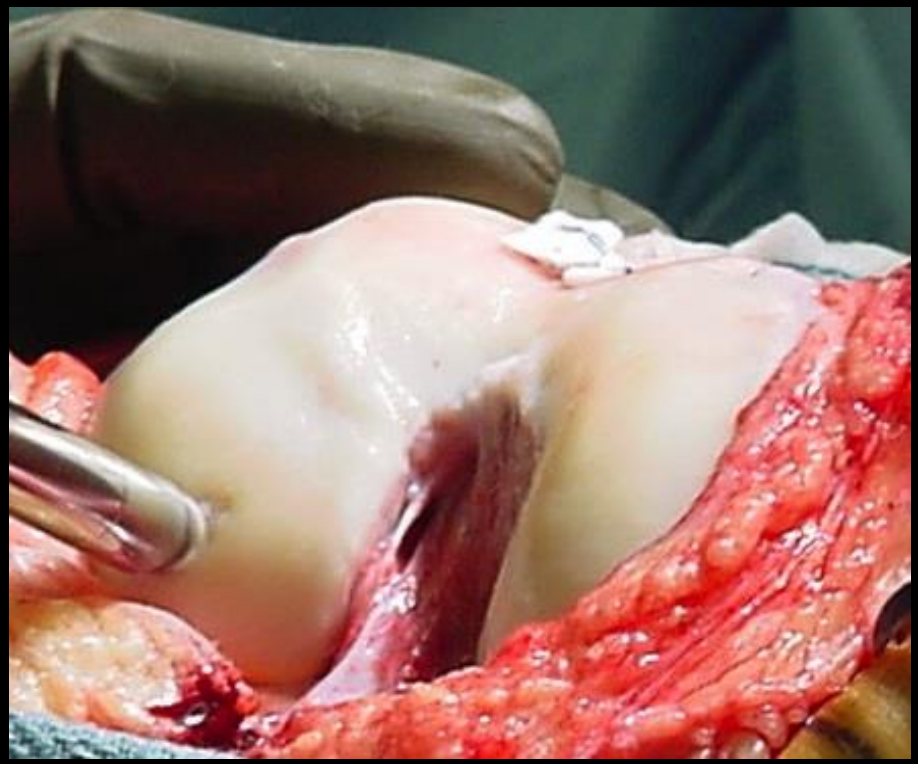


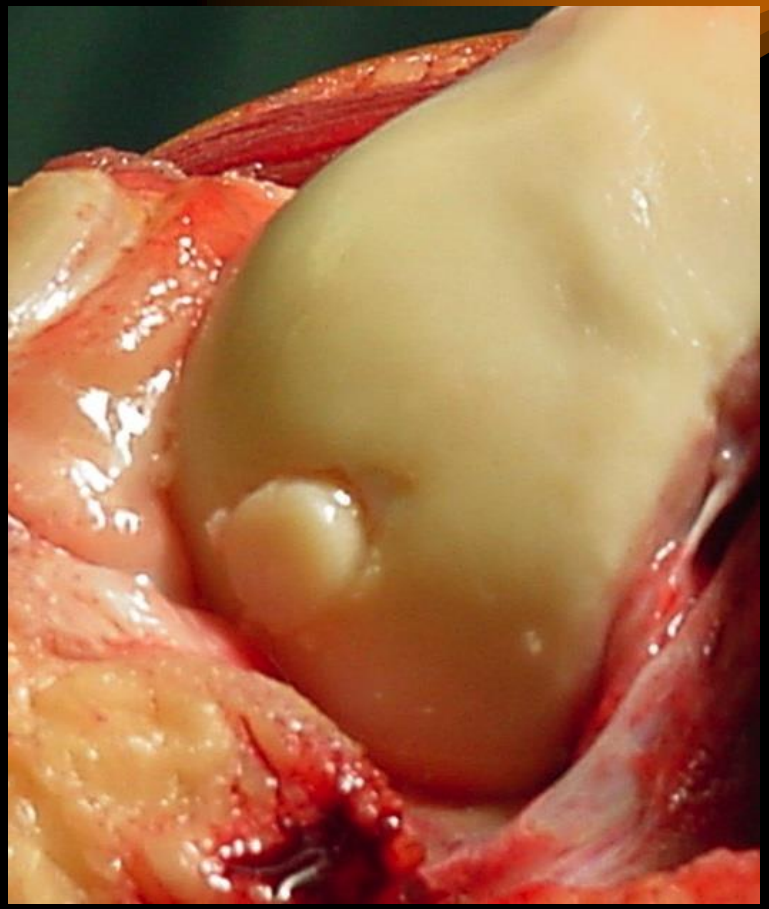
Donor/ Harvest site



Open OATS

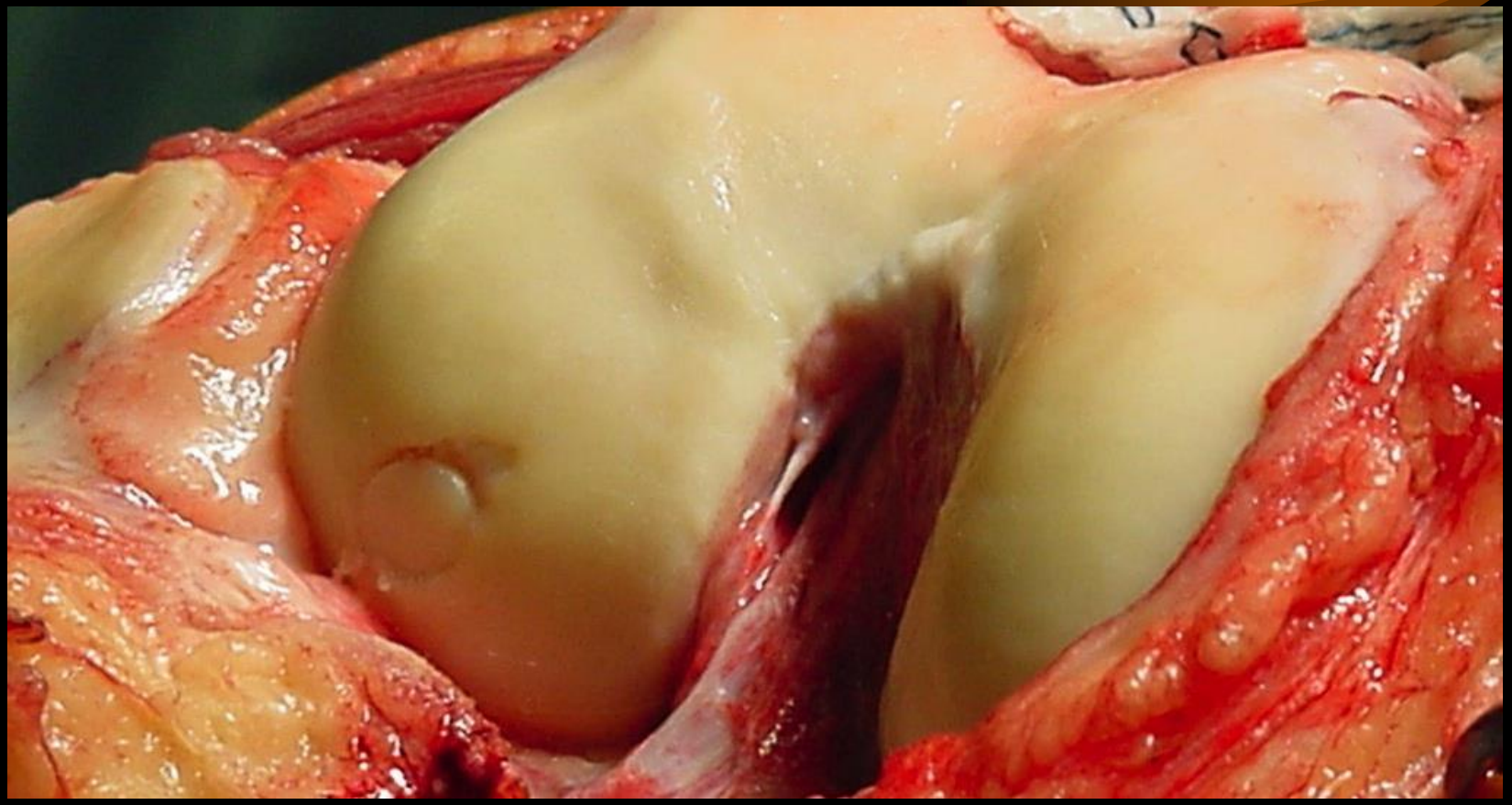
Placement of graft



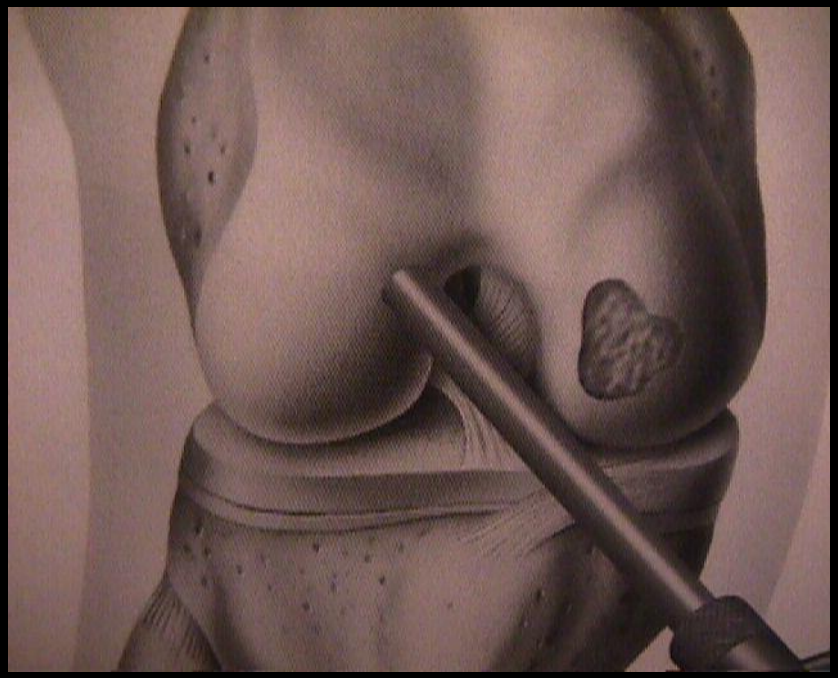


Open OATS

Tapping graft flush



Cartilage Transplantation
Osteo-Articular Transplant



Prepare Recipient site

Seating Cartilage Transplant

Tapping It Flush!!

Transplant complete

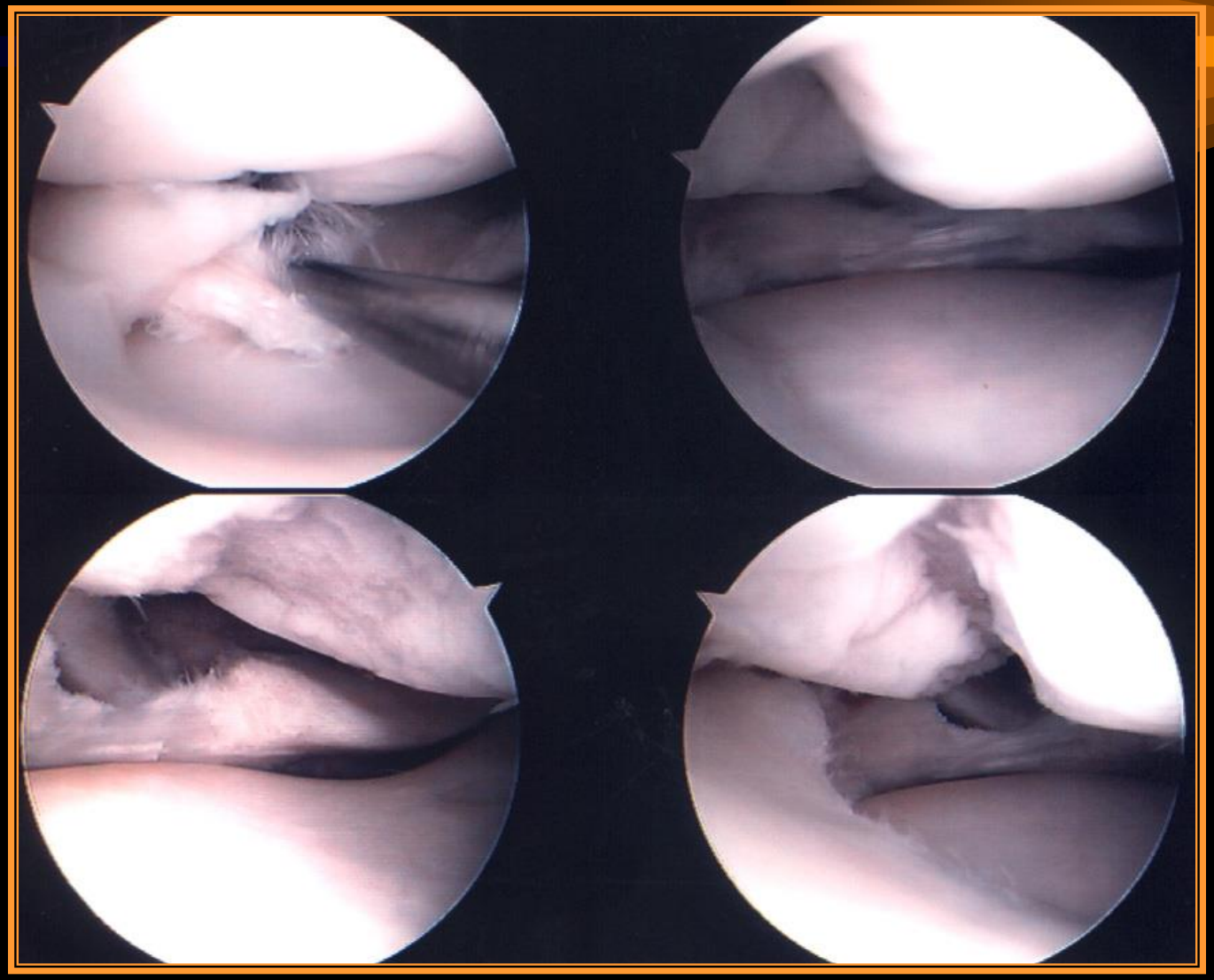
Donor Site Revisited

- Fills in with Fibrocartilage
  - Much like micro-fracture technique

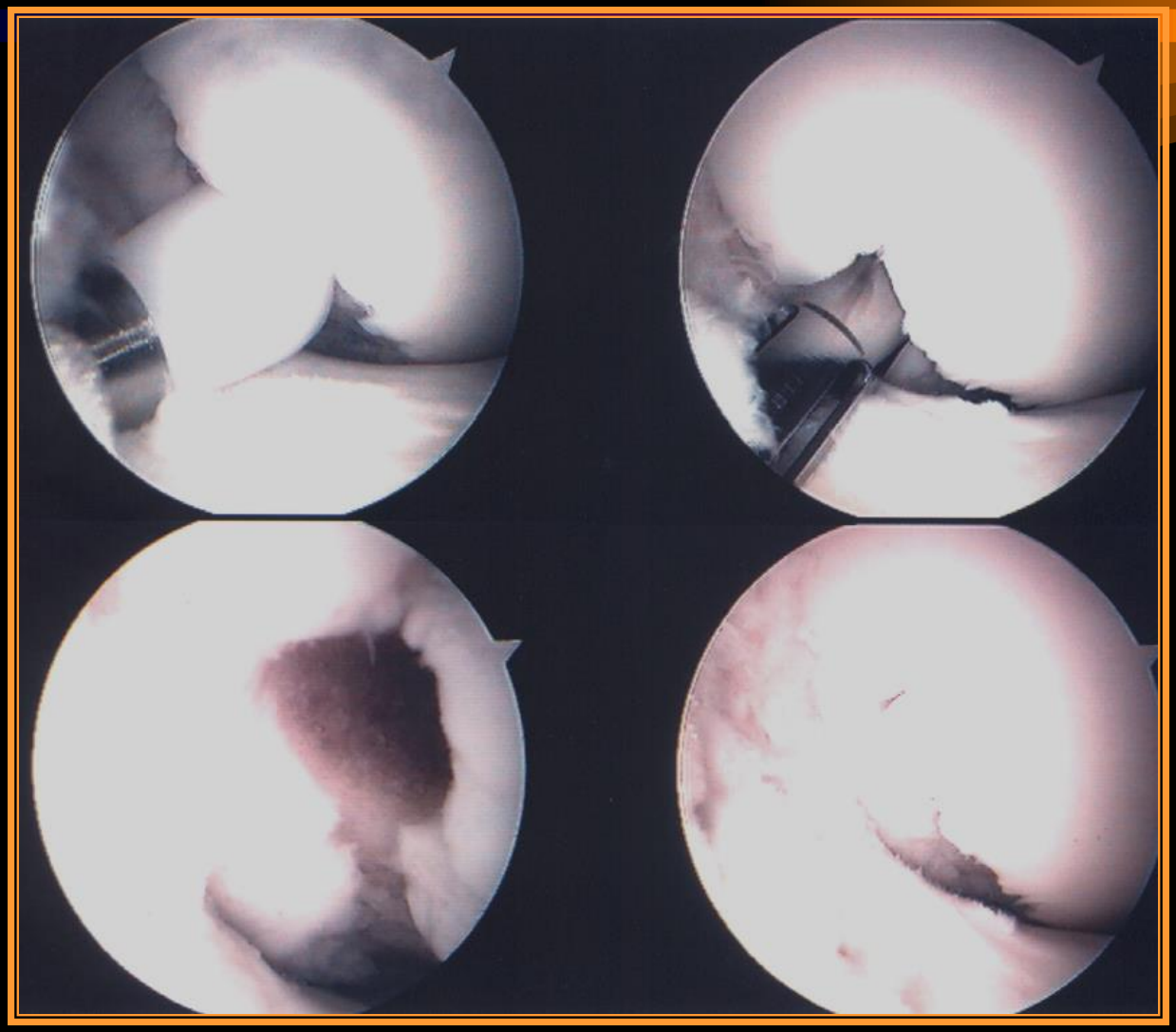
Seating of graft

Success

26 y/o with cartilage damage caused by meniscus tear

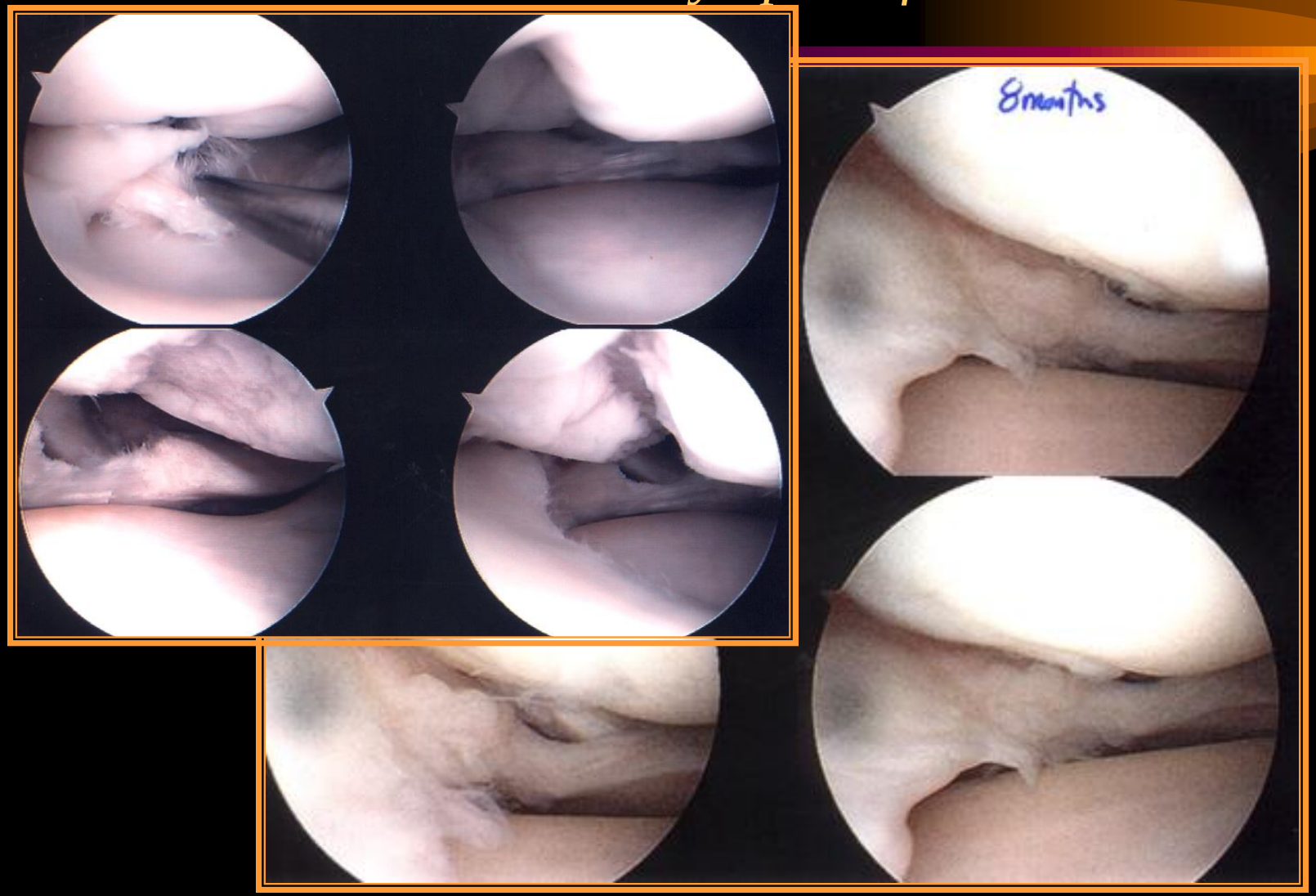


Transplant



Second Look at 8 Months

Patient symptom free

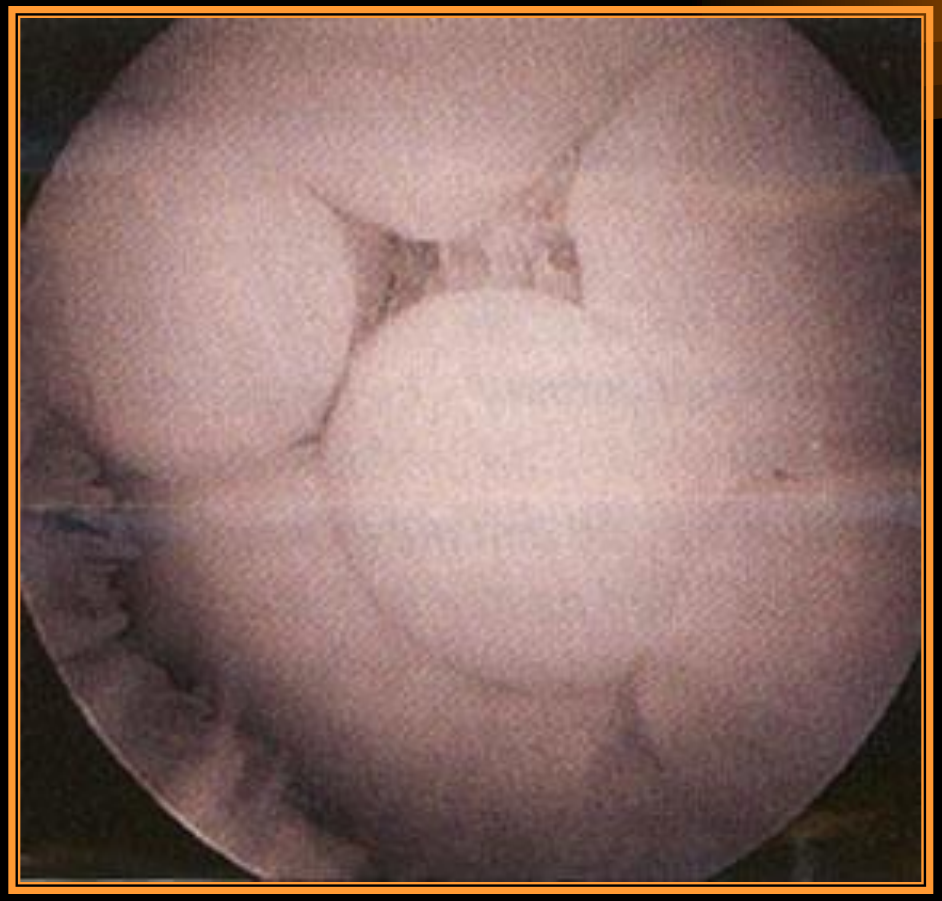


OATS

Osteo-Articular Transplant System
(Auto-graft)

- Advantages
  - Arthroscopic
  - Restorative
    - Hyaline Cartilage
    - Subchondral bone
  - Cost effective
  - Single Operation
  - Excellent short-term & long-term results
- Disadvantages
  - Technically demanding
  - Matching contours
  - Limited cartilage autograft available
  - Size of defect limitations $<2cm^2$
    - (Mosaicplasty)

Large Defects can be filled in with Multiple plugs



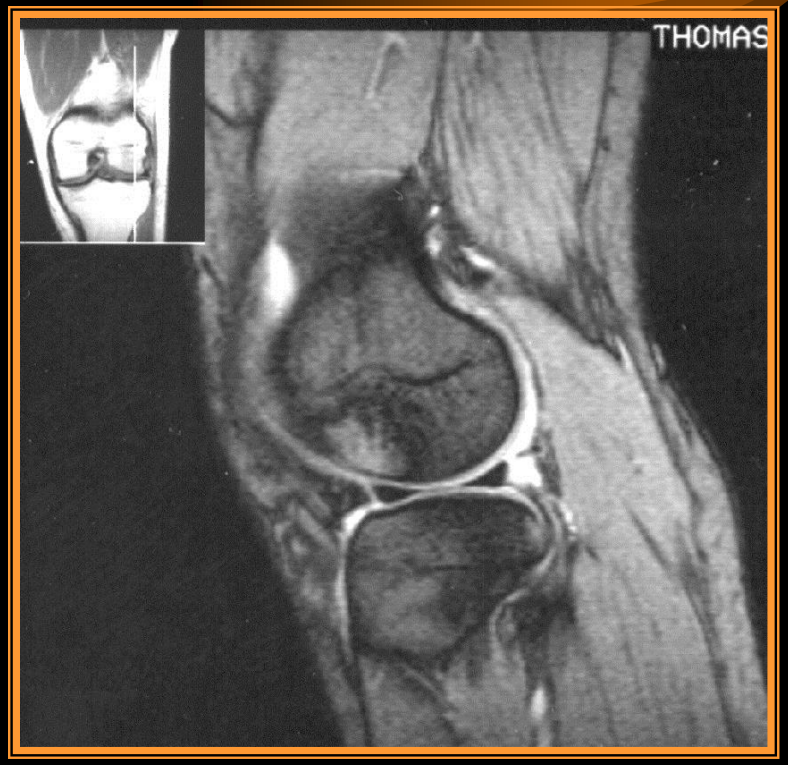
PT for OATS

- Standard post op modalities
- After 2 weeks progress to allow weight bearing as tolerated in compression only.. limiting sheer forces
- Straight leg wbing in drop lock brace
- Progress to normal gait 4 weeks
- No running or jumping 8-10 weeks

Patient #3

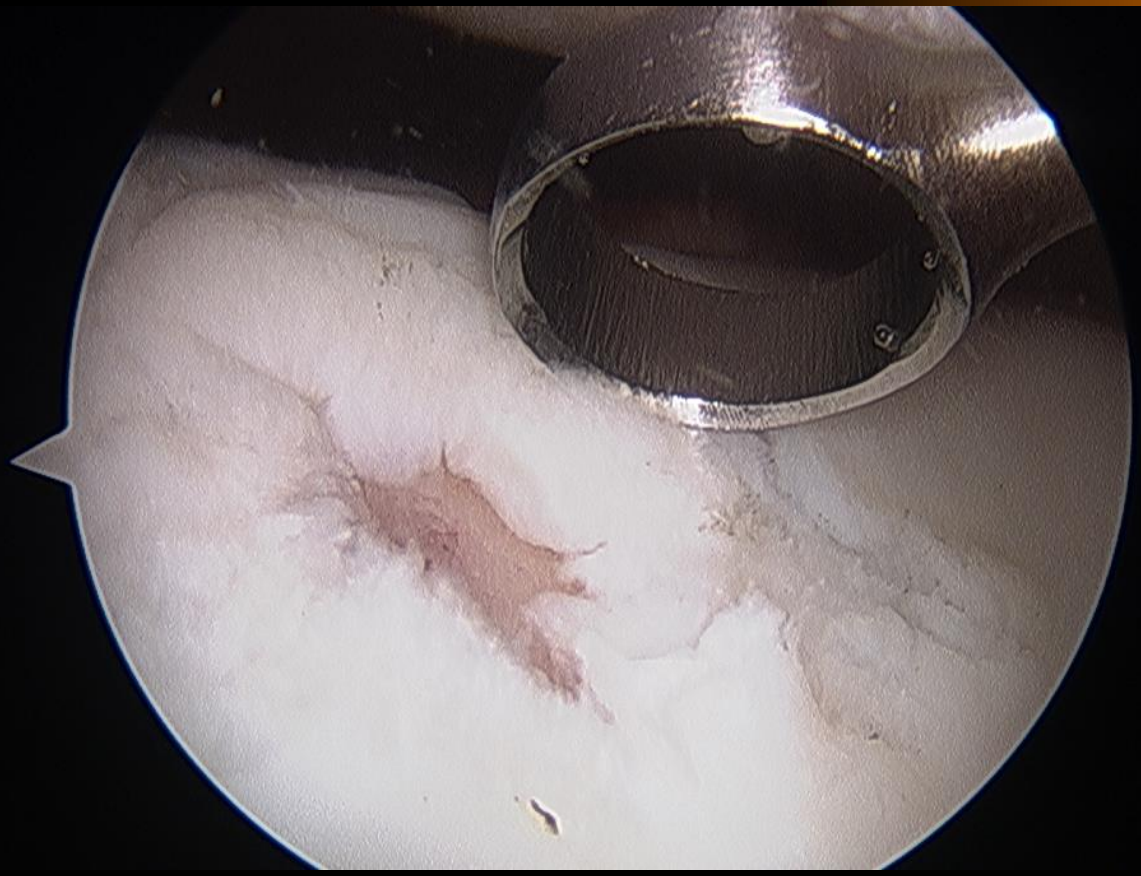
32 y/o avid weekend athlete with inability to run, secondary to popping ,pain, intermittent locking , swelling, No history of injury

- Examination
  - Pain, popping with PROM
  - JLT
  - 1+ effusion
  - Negative McMurray's
  - X-rays normal



Arthroscopic Evaluation

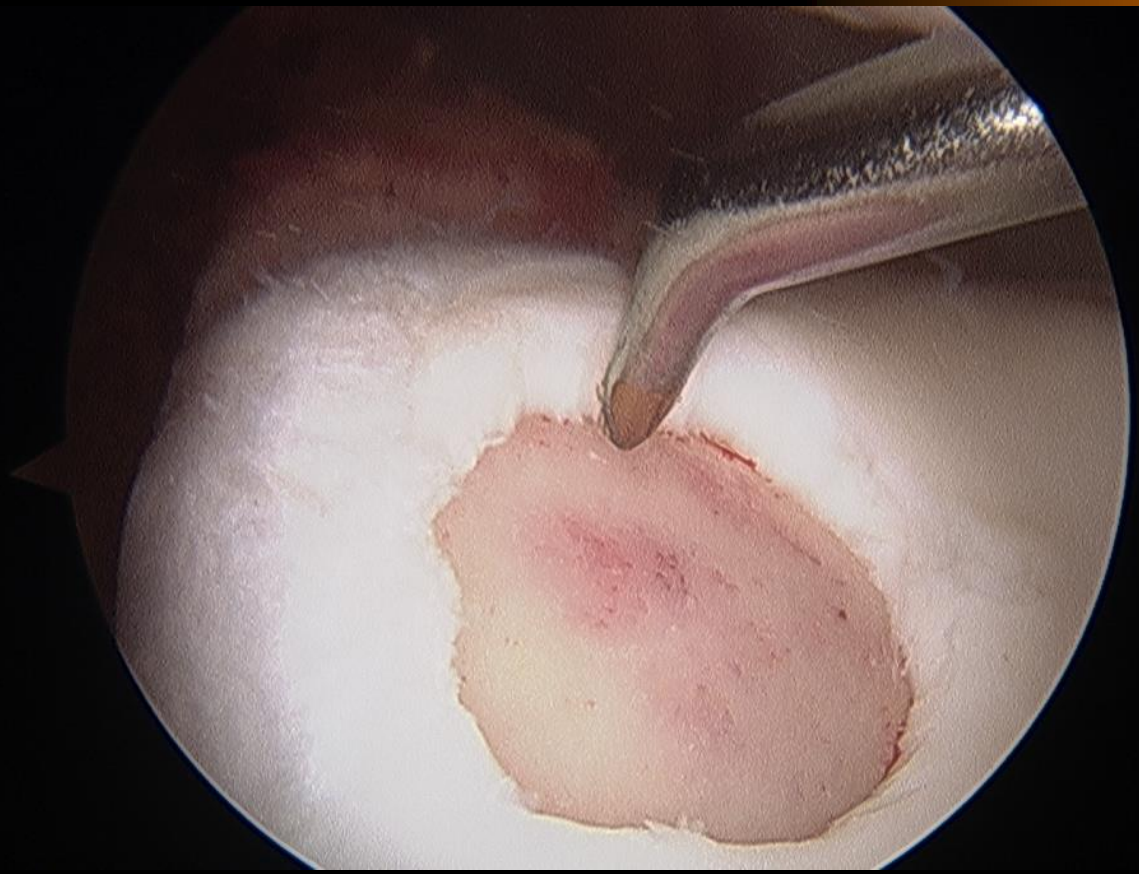
Treatment?



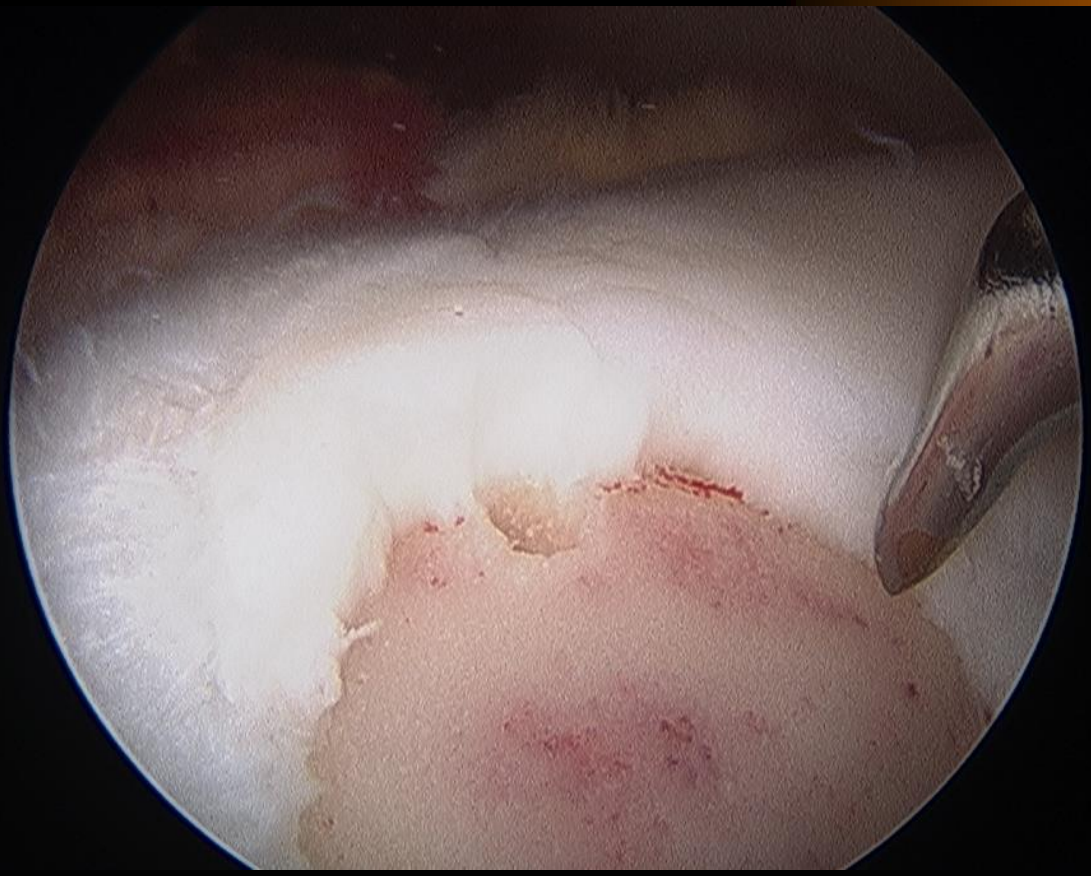
Reassessment after debridement Vertical/stable Walls?

Reassessment after debridement Vertical/stable Walls?

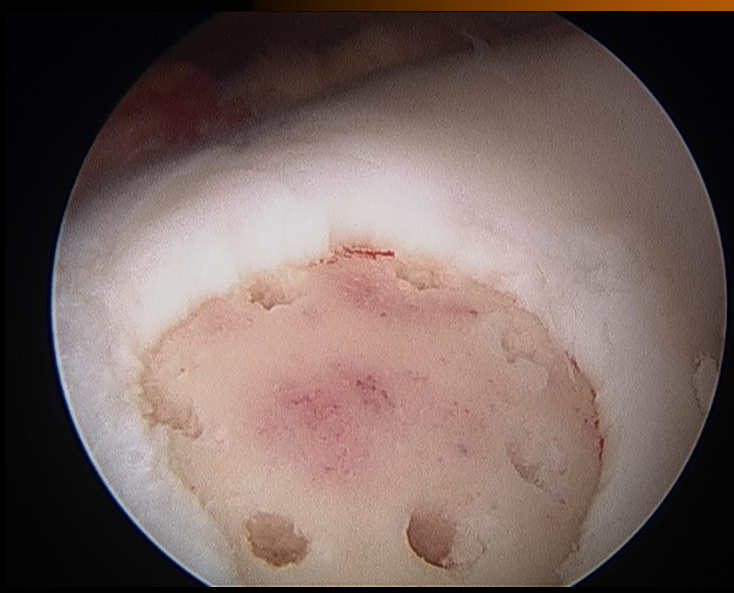
Microfracture
Awl or Drilling



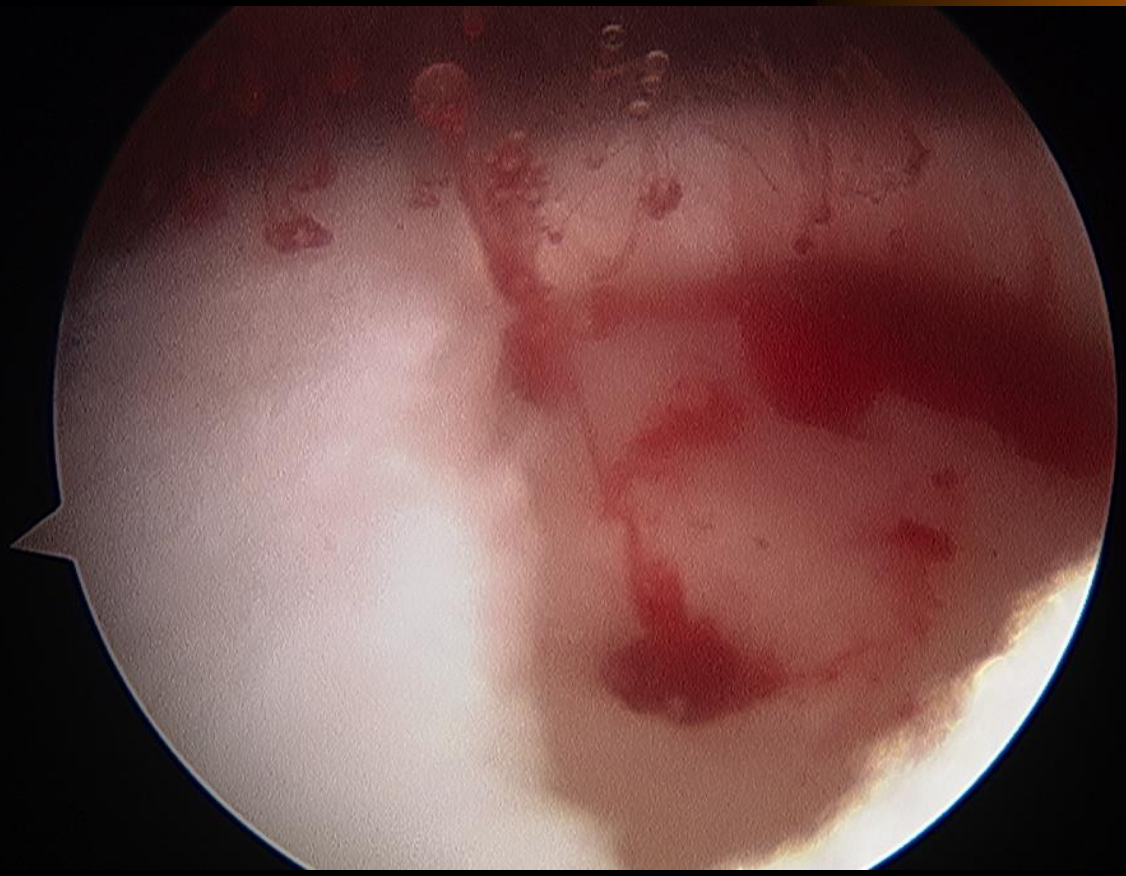
Hole Spacing
2-3mm



Mesenchymal Cell stimulation Microfracture/Drillng



Marrow Elements Released



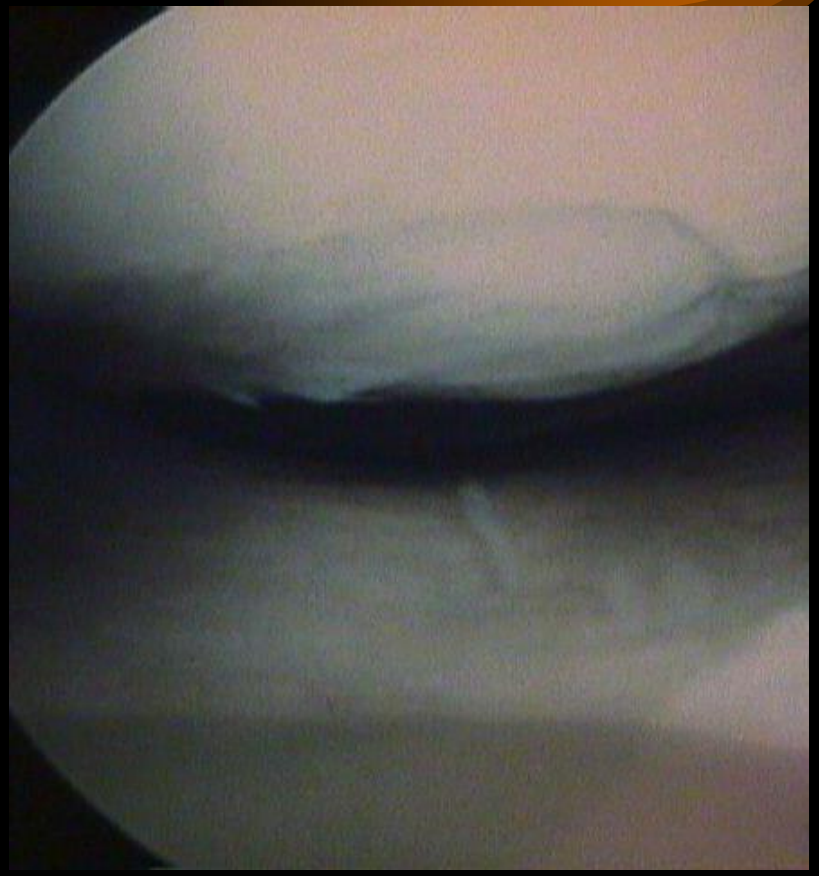
Healed Arthroscopic Chondroplasty Fibrocartilage

Micro-Fracture

- Advantages
  - Arthroscopic
  - Technically less demanding
  - Cost effective
  - Single Operation
  - Good short-term results
- Disadvantages
  - Non-restorative
  - Long recovery
    - Non weight bearing
    - 2 months
  - Fibrocartilage/Not Hyaline cartilage
    - Long-term durability
  - Limitations
    - Lesion type, walls

Therapy for Microfracture

- Strict NWBing x 8 weeks
- Begin ROM non weight-bearing unloaded week one
- Unloaded ROM very important for cartilage nutrition/healing



Other treatment Options?

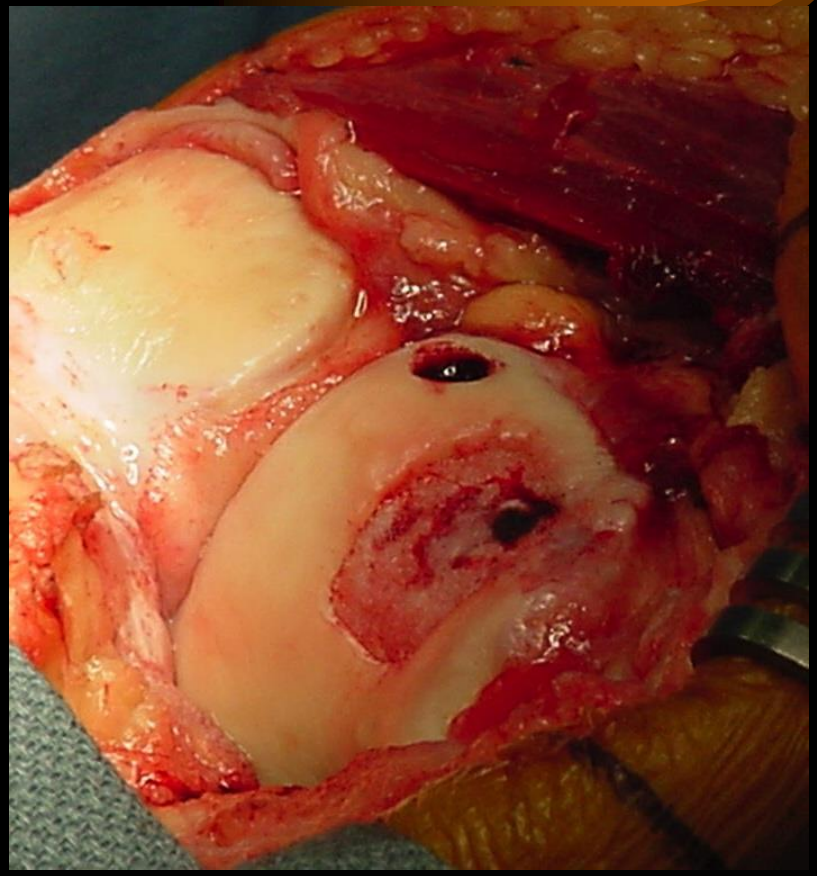
Carticel™

Autologous Chondrocyte Implantation

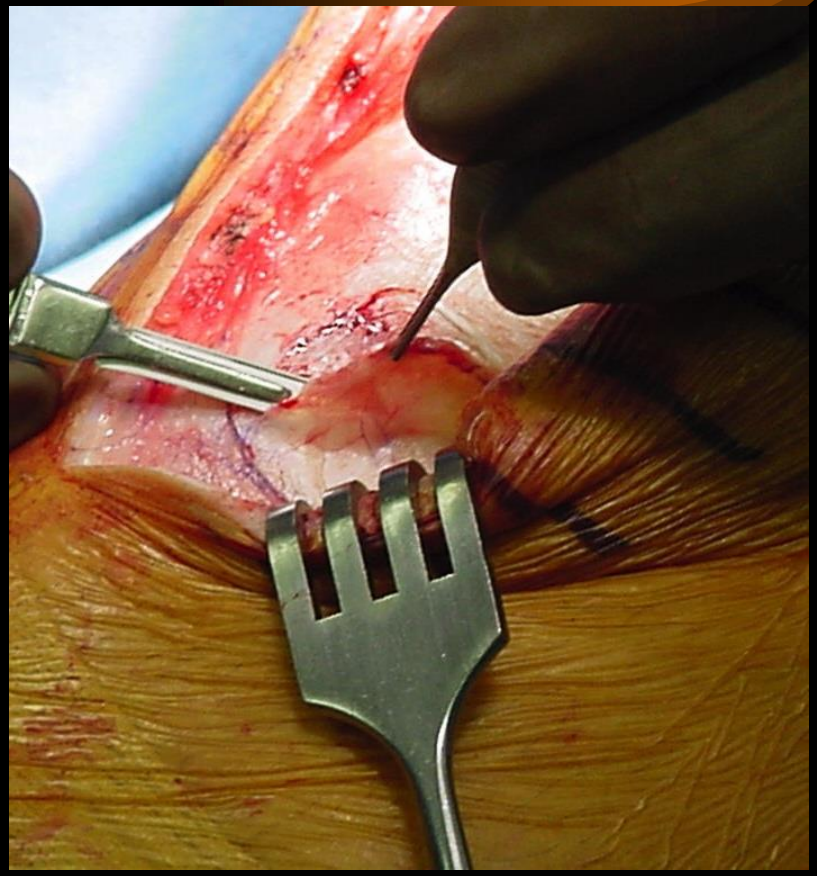
- Requires Harvesting of Chondrocytes(ATS)

- Growing Chondrocytes in medium(Boston$$)
  Second Operation Open procedure

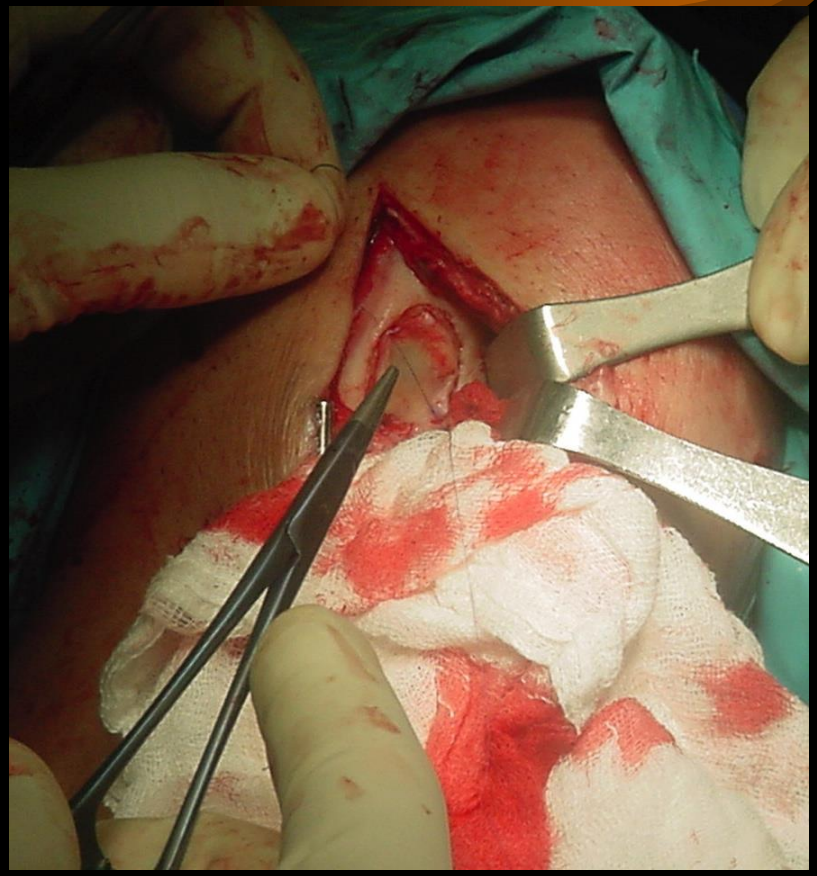
MFC Defect/Trochlear Defect



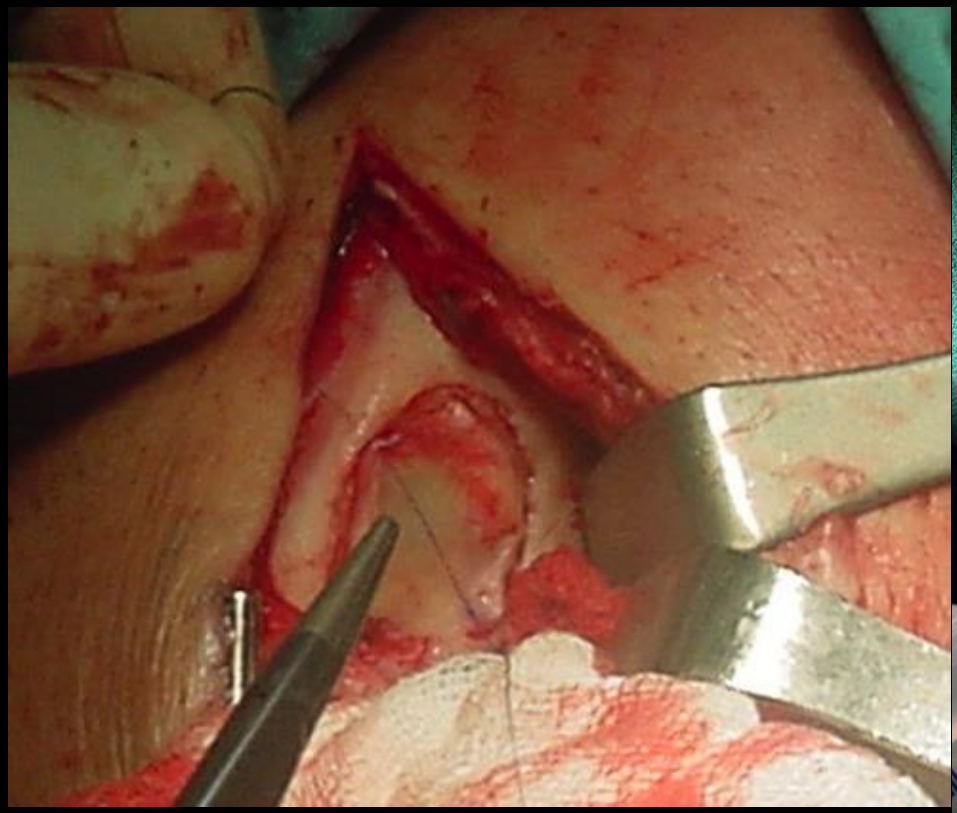
Defect Preparation/Harvesting Periosteal patch

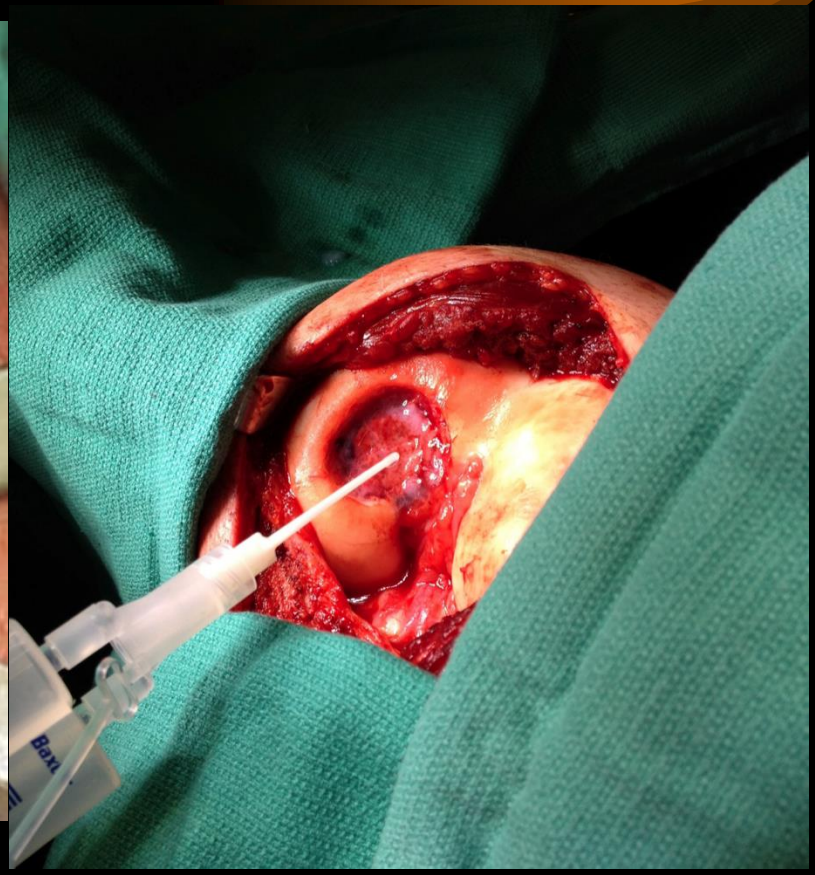


Periosteal Patch/Sewing patch



Injecting cells after sewing flap





Carticel™ *(Chondrocyte Restoration)*

- Advantages
- Chondrocyte restoration
- Over Microfrature
- "Hyaline Type Cartilage"
- Outcome studies:
- Good to excellent results with condyle lesions and PFJ lesions(I have not) often require unloading procedure
-

- Disadvantages
- Poor results (my hands)with PFJ lesions
- Unorganized Hyaline Cartilage
  - (OATS procedure)
- Required two operations
- Open Operation
- $$$$ ($30,000+)
- Less success with disease involving significant amount of subchondral bone

Literature
MS

Microfracture of Articular Cartilage

- Mark F. Sommerfeldt , MD; Robert A. Magnussen , MD, MPH; Timothy E. Hewett , PhD; Christopher C. Kaeding , MD; David C. Flanigan , MD
- *JBJS Reviews*, 2016 Jun; 4 (6): e6. http://dx.doi.org/10.2106/JBJS.RVW.15.00005

Microfracture is a treatment option for symptomatic, full-thickness cartilage defects.

- Microfracture is most likely to be successful when performed in non-obese patients under the age of thirty years for small (<2 to 4-cm2) femoral condylar defects that have been symptomatic for a short time (less than twelve to twenty-four months).
- ➢ Microfracture has acceptable short-term clinical results, but results can be expected to decline over time.

Microfracture Literature

- Current Concepts
- Kai Mithoefer, Timothy McAdams, Riley J. Williams, Peter C. Kreuz, and Bert R. Mandelbaum
- Clinical Efficacy of the Microfracture Technique for Articular Cartilage Repair in the Knee: An Evidence-Based Systematic Analysis
- Am J Sports Med October 2009 37 2053-2063;

  - **Conclusion** This systematic analysis shows that microfracture provides effective short-term functional improvement of knee function but insufficient data are available on its long-term results.
  - Further well-designed studies are needed to determine the long-term efficacy of microfracture and to define its specific clinical indications compared to other cartilage repair techniques.

Literature
OATS / MS

- D. Josh Miller, et.al
- Microfracture and Osteochondral Autograft Transplantation Are Cost-effective Treatments for Articular Cartilage Lesions of the Distal Femur Am J Sports Med September 2015

- **Conclusion:** Published level 1 and 2 clinical studies with a 10-year follow-up demonstrated that the net cost and cost-effectiveness of OAT and microfracture are comparable for the treatment of isolated articular cartilage lesions of the distal femur.
- **Clinical Relevance:** Given similar clinical outcomes, microfracture and OAT are both viable, cost-effective first-line treatment options for these injuries.

Literature MS/OATS

- Rimtautas Gudas, et.al.
- Ten-Year Follow-up of a Prospective, Randomized Clinical Study of Mosaic Osteochondral Autologous Transplantation Versus Microfracture for the Treatment of Osteochondral Defects in the Knee Joint of Athletes Am J Sports Med November 2012 40 2499-2508

- Level 1 Evidence

- **"Conclusion:** The OAT technique for ACD or OCD repair in the athletic population allows for a higher rate of return to and maintenance of sports at the preinjury level compared with MF."

ACI Literature

- Brian J. Cole, Thomas DeBerardino, Robert Brewster, Jack Farr, David W. Levine, Carl Nissen, Prudence Roaf, and Kenneth Zaslav
- Outcomes of Autologous Chondrocyte Implantation in Study of the Treatment of Articular Repair (STAR) Patients With Osteochondritis Dissecans Am J Sports Med September 2012 40 2015-2022

- **Conclusion:** Patients with OCD of the knee had statistically significant pain reduction and functional improvement for up to 48 months after ACI, despite the complexity and severity of the osteochondral lesions

ACI Literature

- Leela C. Biant, George Bentley, Sridhar Vijayan, John A. Skinner, and Richard W.J. Carrington
- Long-term Results of Autologous Chondrocyte Implantation in the Knee for Chronic Chondral and Osteochondral Defects
- Am J Sports Med September 2014 42 2178-2183

  - **Purpose:** To examine the long-term clinical results of ACI for large chronic articular cartilage defects, many treated as salvage.

  - **Conclusion:** Autologous chondrocyte implantation can provide a long-term solution in more than 70% of young patients of a difficult-to-treat group with large chronic articular cartilage lesions, even in the salvage situation.

Literature MS/OATS/ACI

- Raman Mundi, et.al
- Cartilage Restoration of the Knee: A Systematic Review and Meta-analysis of Level 1 Studies Am J Sports Med July 2016 44 1888-1895

- **Conclusion:** There is no significant difference between MS, ACI, and OAT in improving function and pain at intermediate-term follow-up. Further randomized trials with long-term outcomes are warranted.

Therapy after ACI

- Strict NWBing x 8 weeks
- Begin ROM non weight-bearing unloaded week one
- Unloaded ROM very important for cartilage nutrition/healing
- Consider CPM

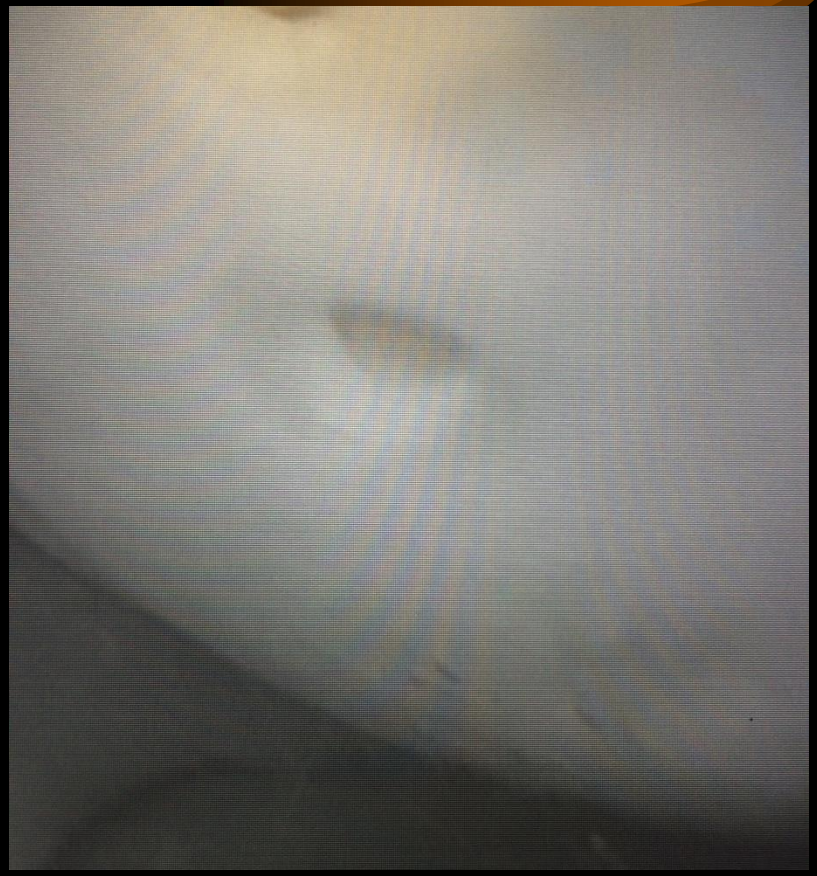
Patient #4

19 year old college freshman with pain, recurrent right knee swelling inability to play football

- History of previous fixation of OCD femoral condyle right knee doing very well

Remember His Left knee

- Also had pinning of left knee OCD

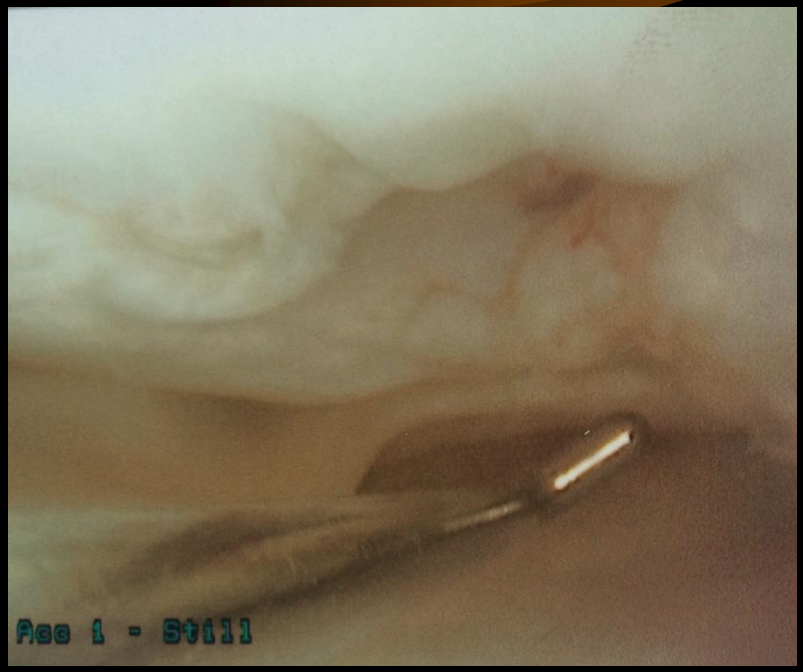


3 years later

- Left knee doing Great
- Right knee Great for 36 months but last 6 months:

  severe pain, popping, locking , catching, swelling

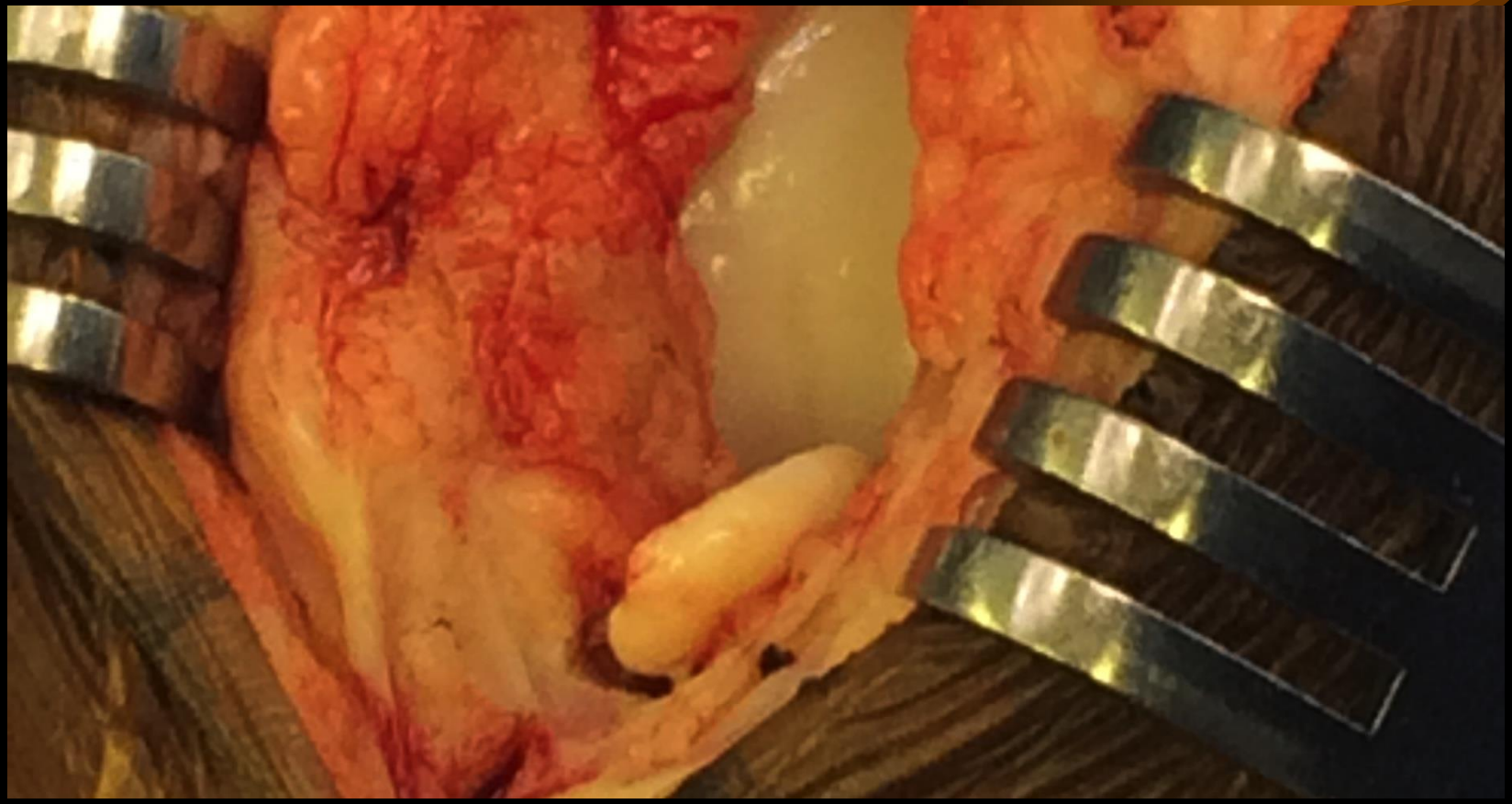
MRI reveals defect in MFC, ATS evaluation…

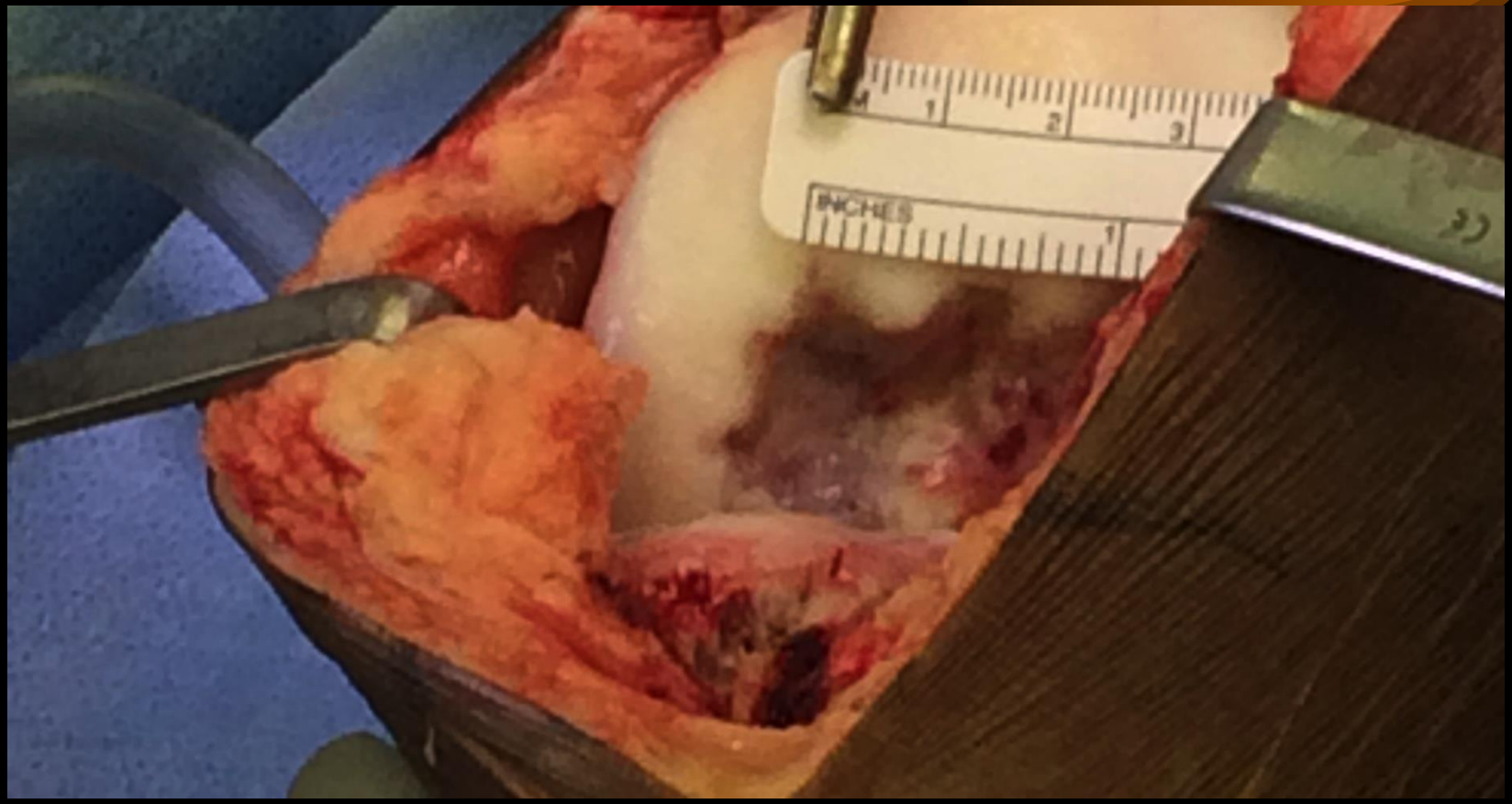


IMG013

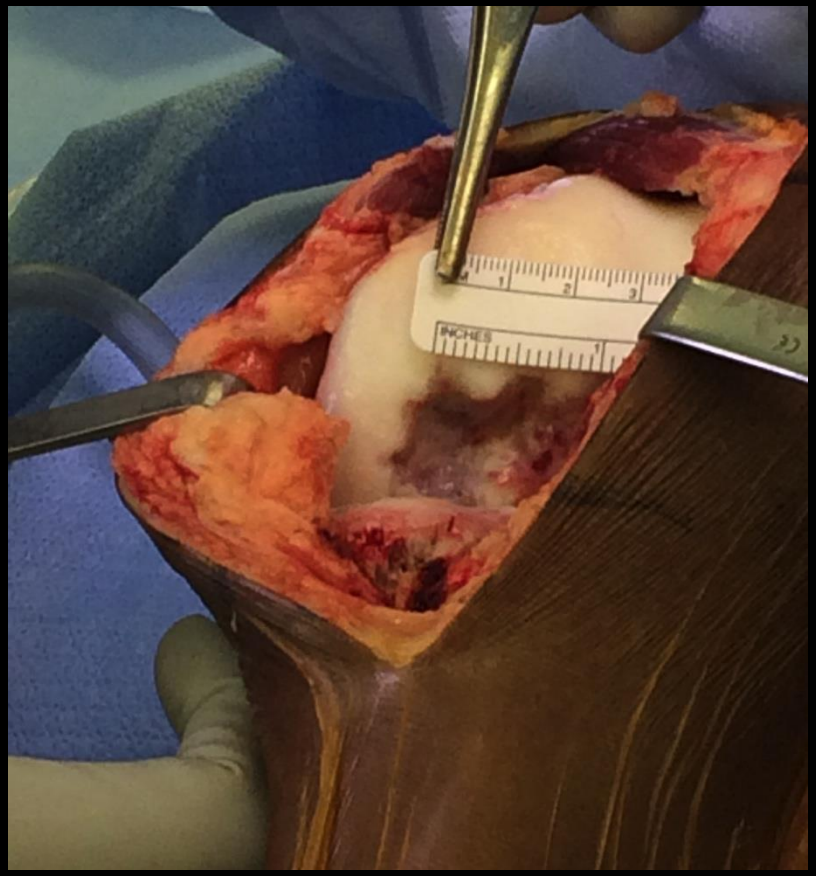
Treatment Options?

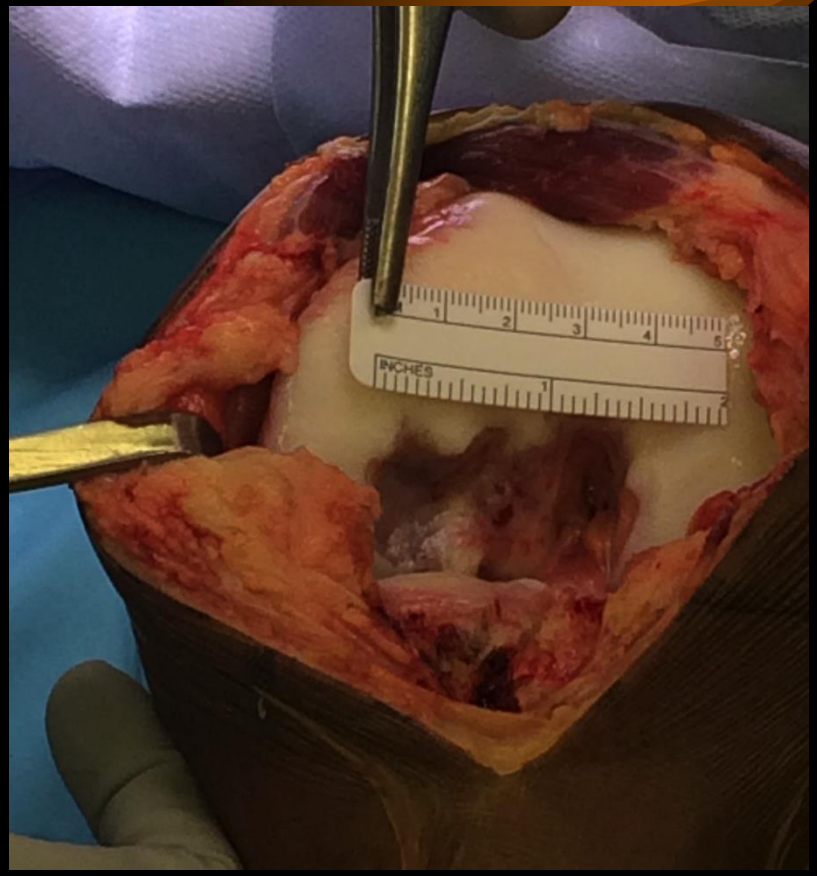
- Large Defect MFC >4cm
- Uncontained
- Cartilage and Bone involvement
  - Debridement?
  - Microfracture?
  - ACI?
  - ? Fresh OCA ?



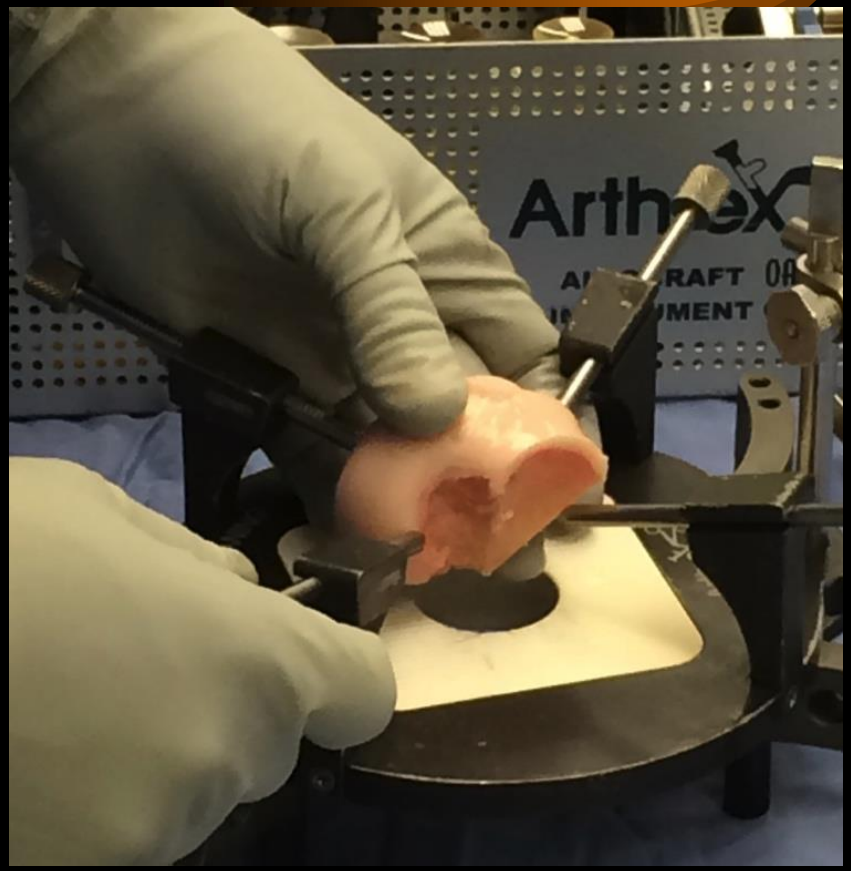

INCHES

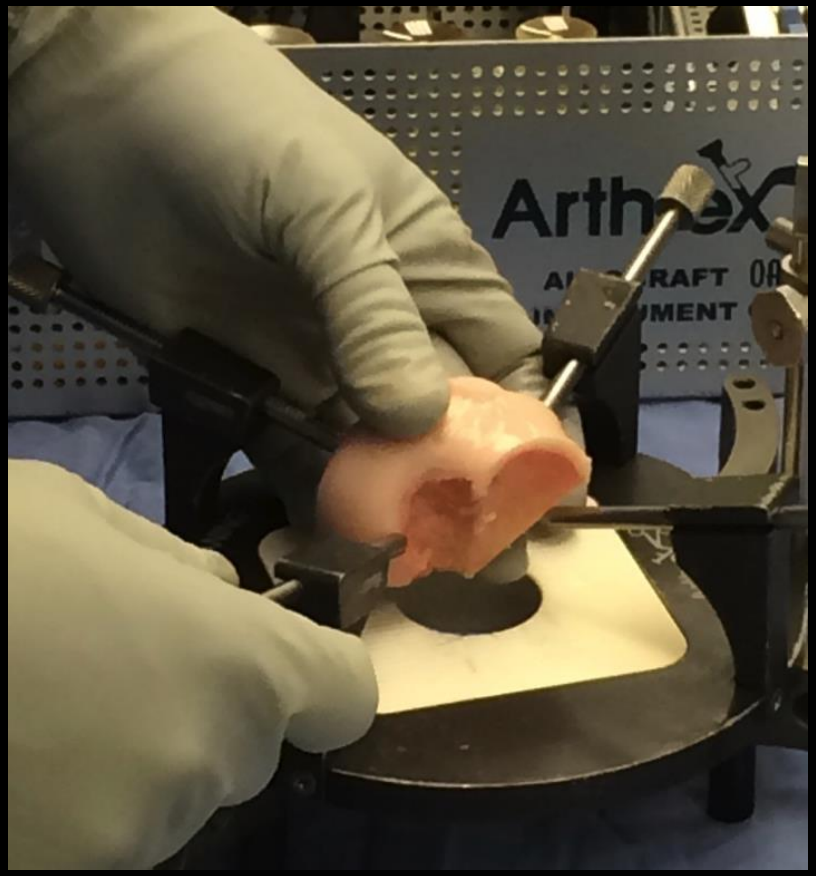
Fresh OsteoChondral Allograft OCA

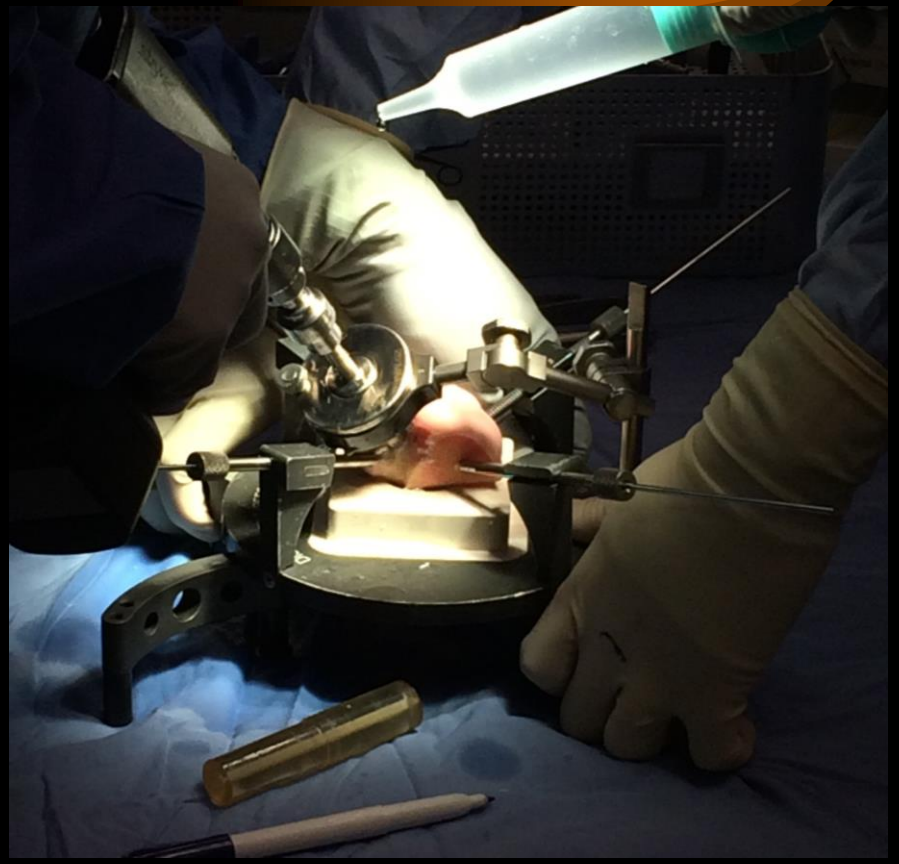


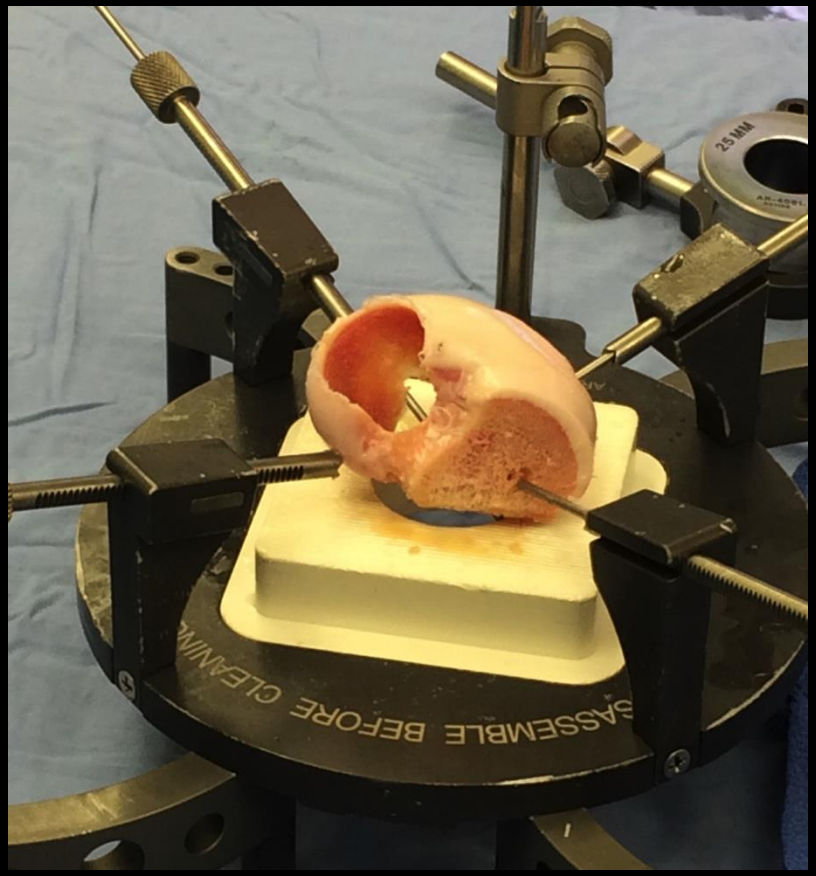


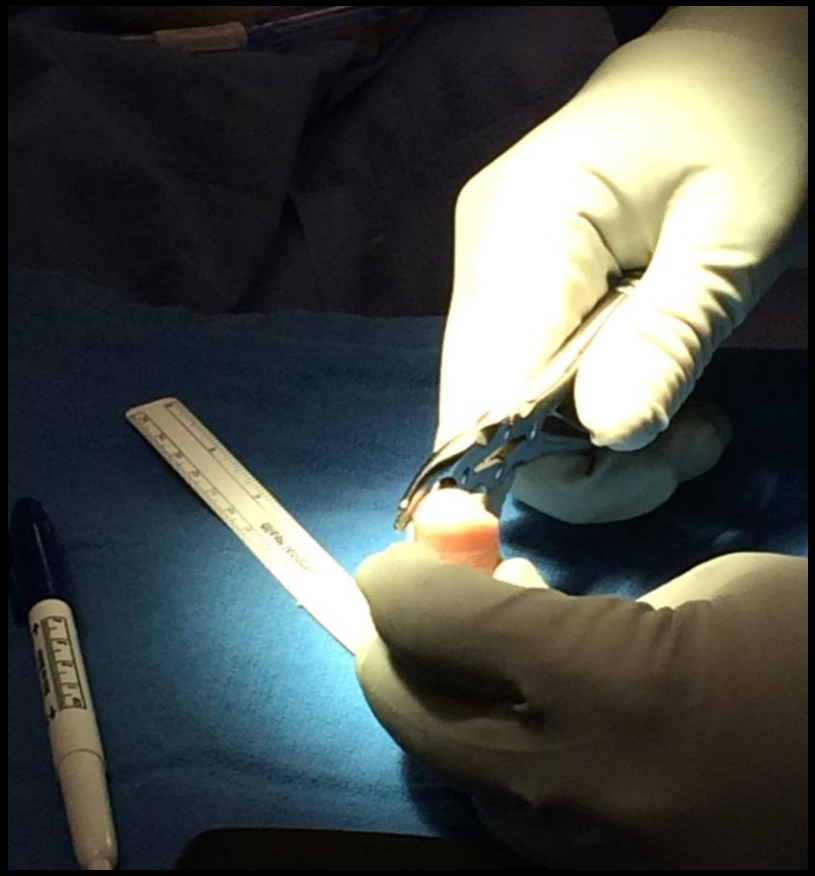
Preparing graft

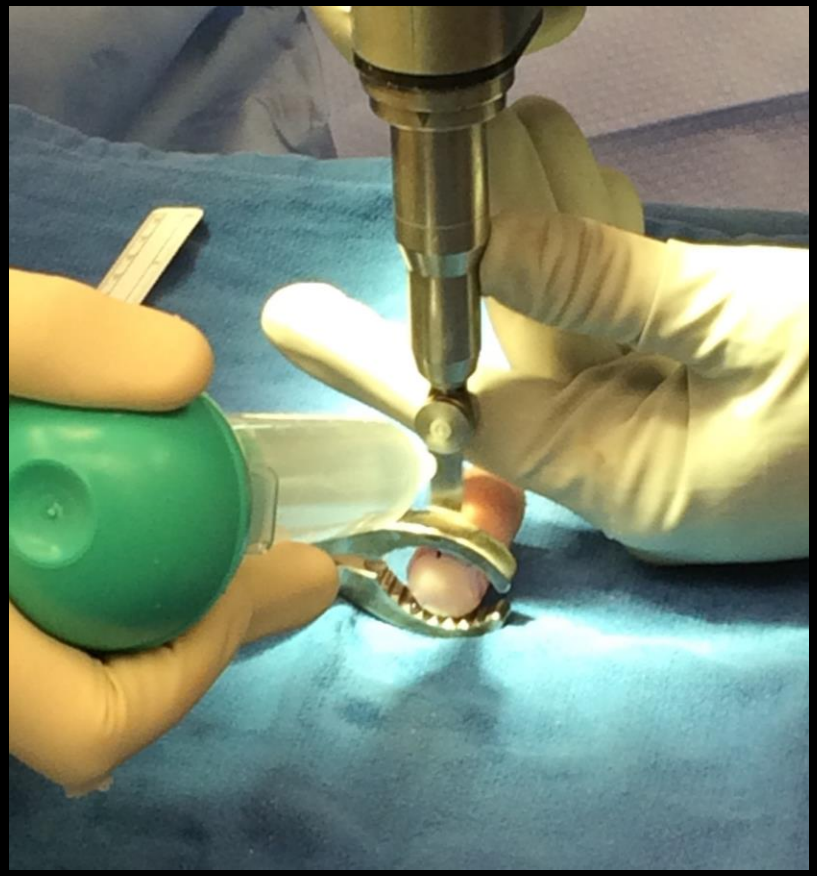


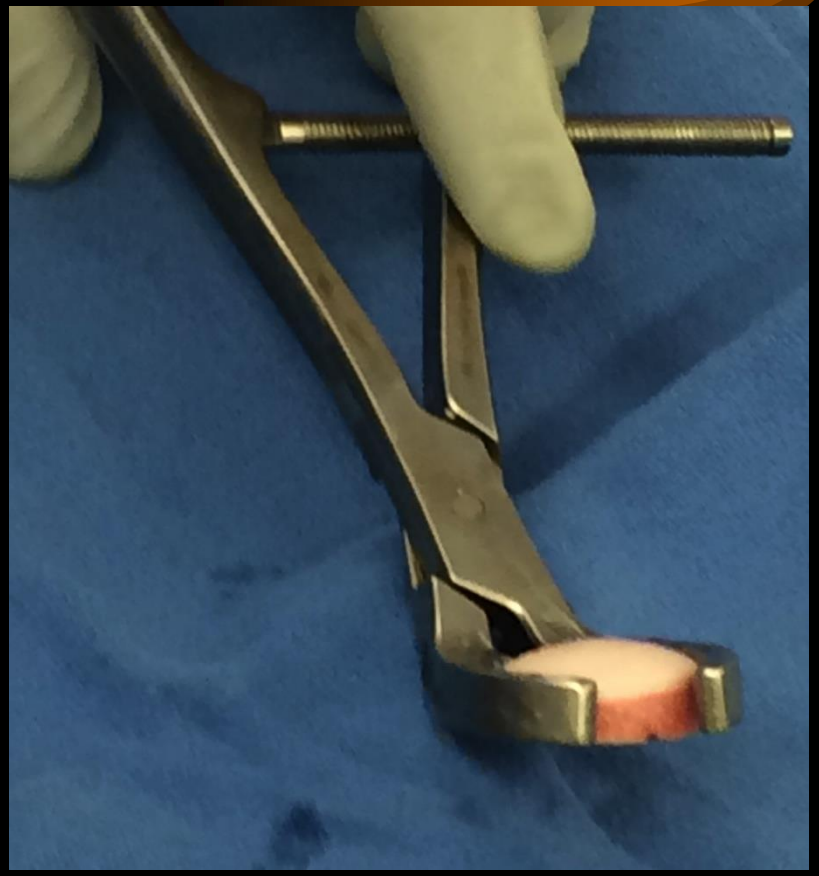

Arthrex

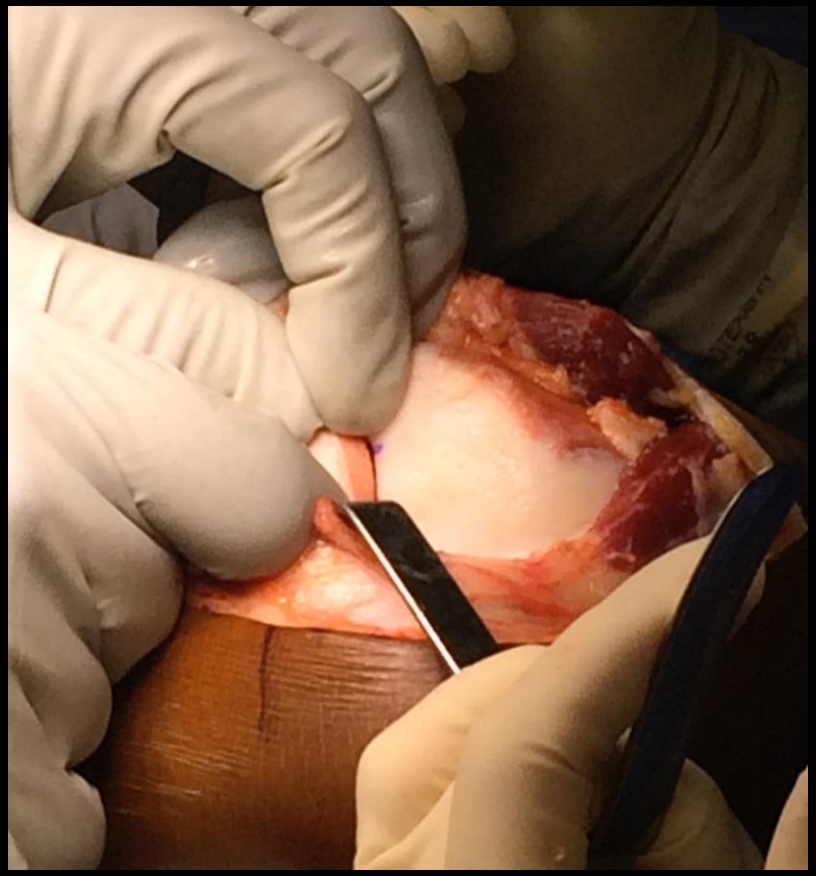


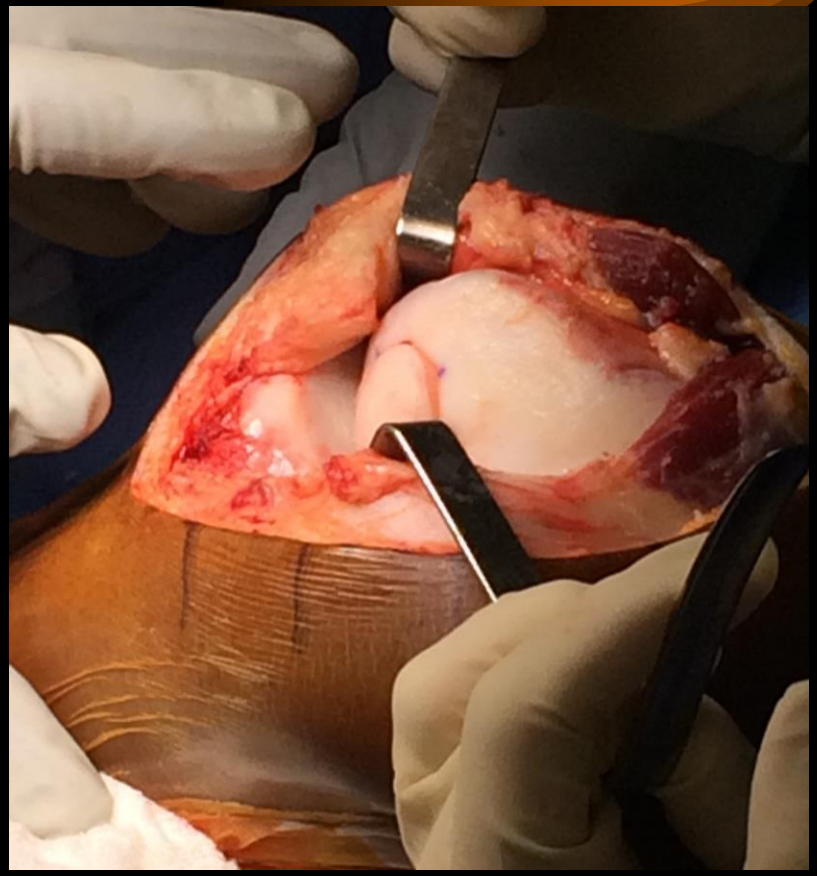

25 MM
ASSEMBLE BEFORE

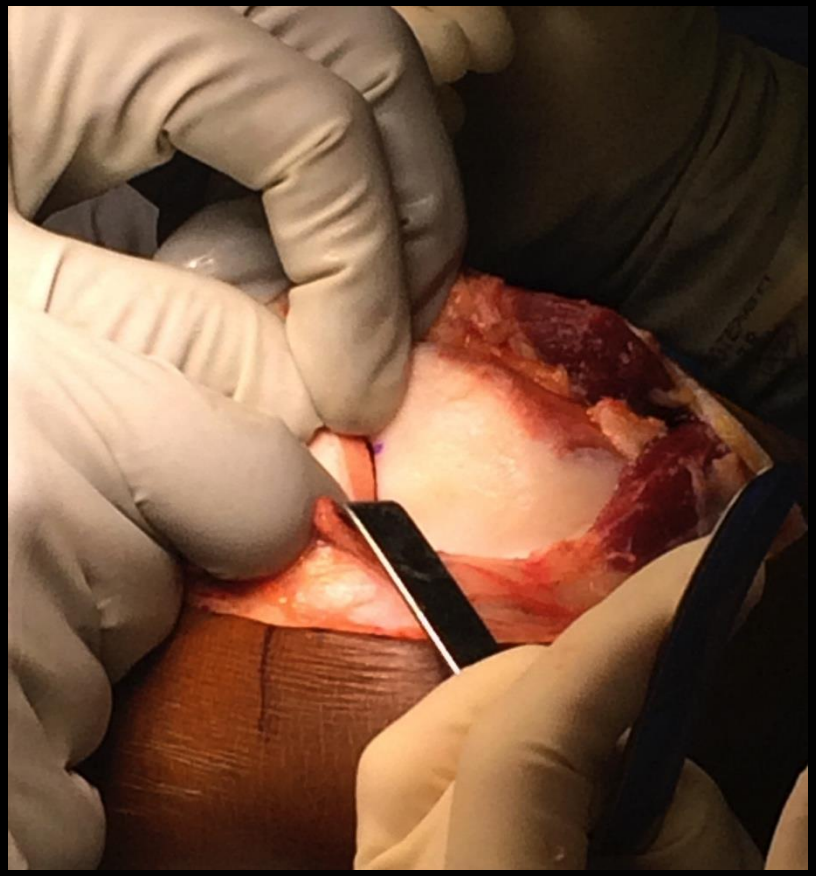


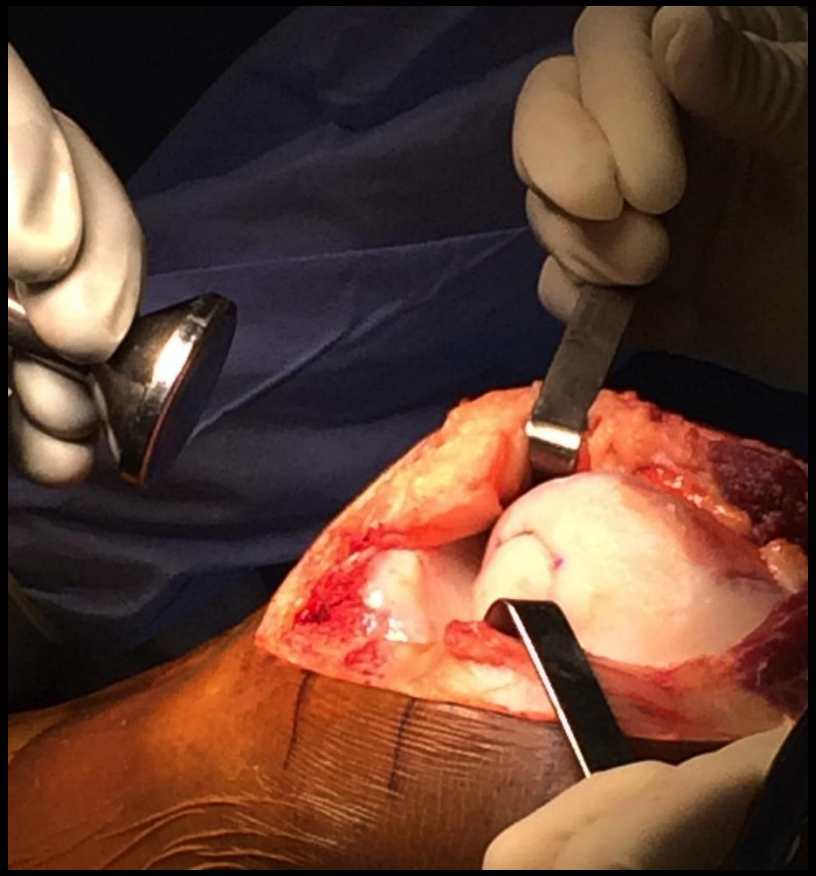


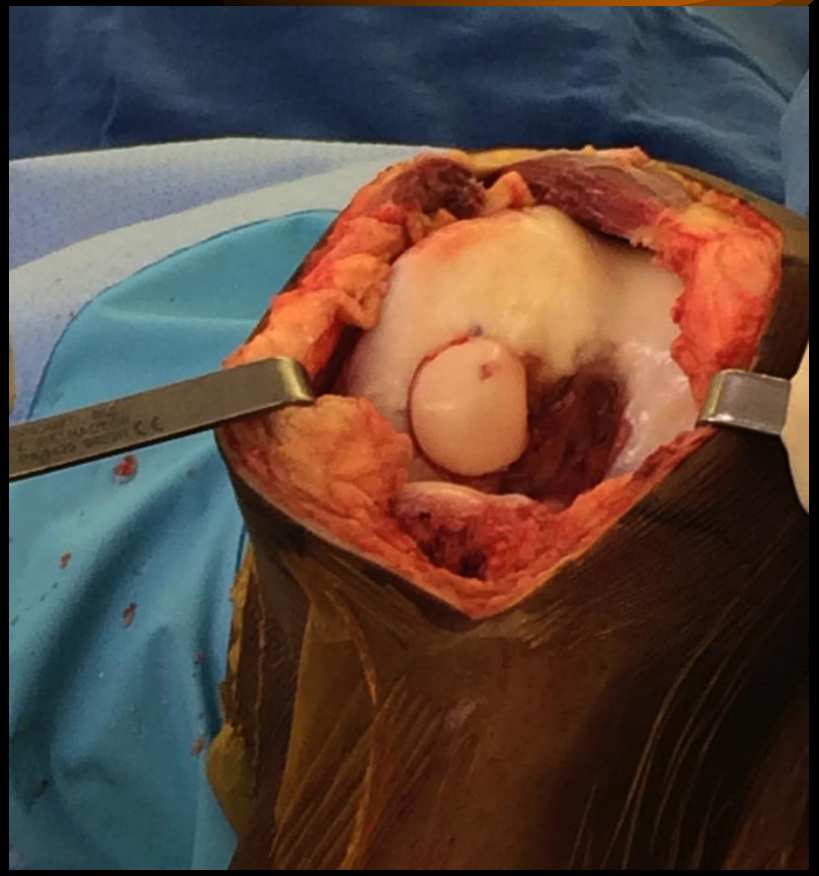




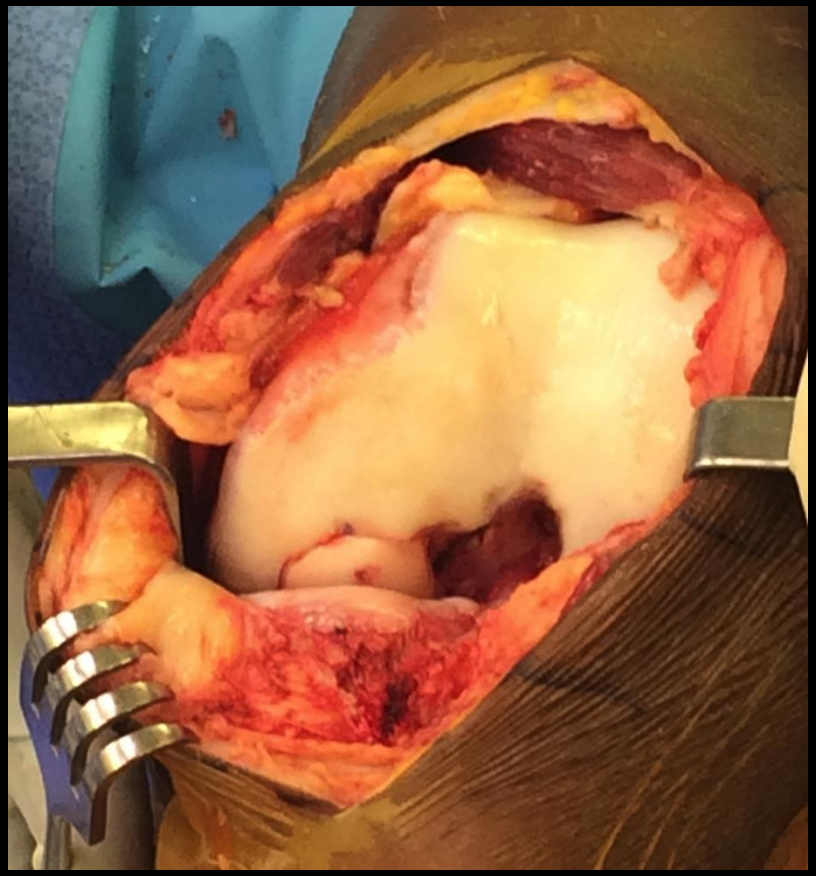






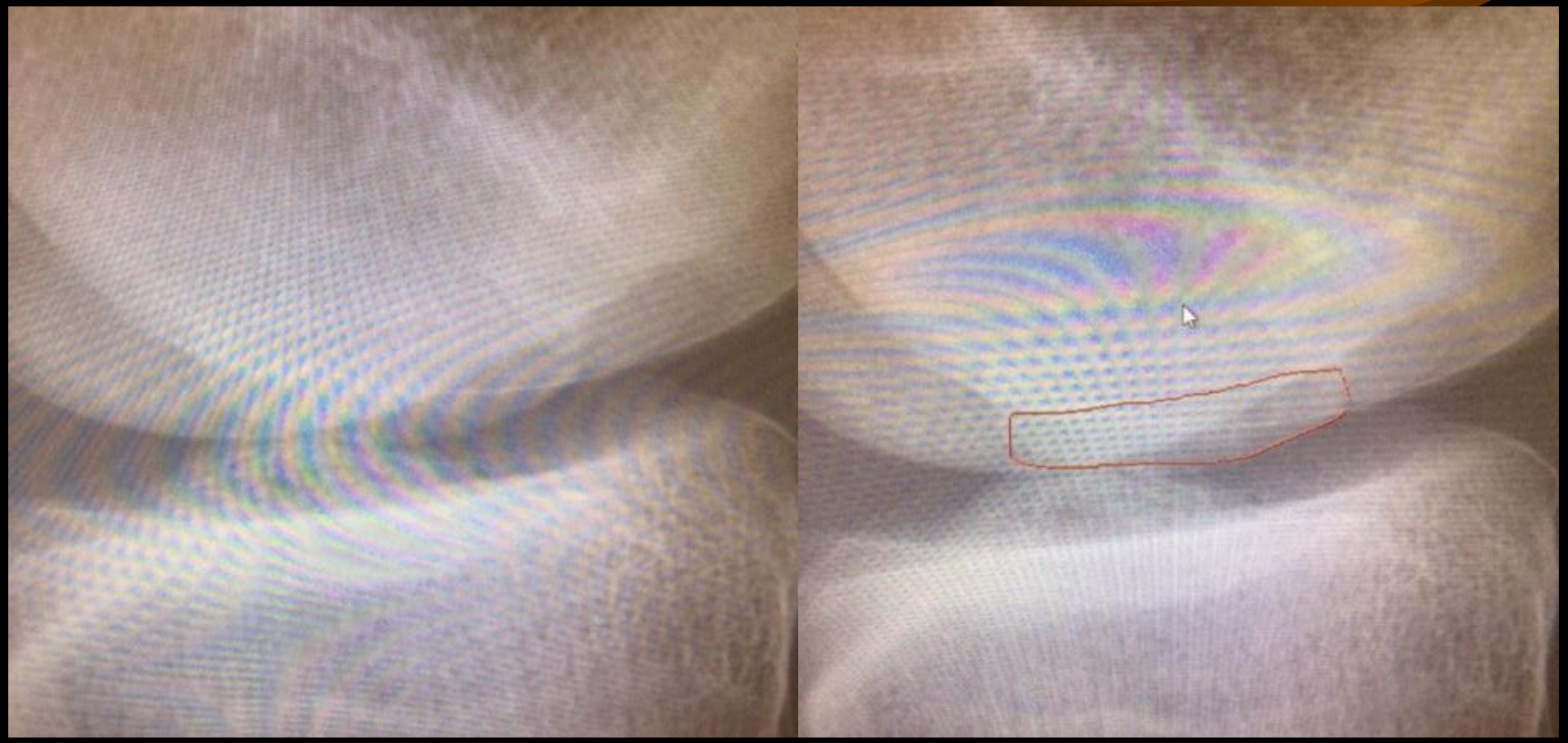


Final Seating



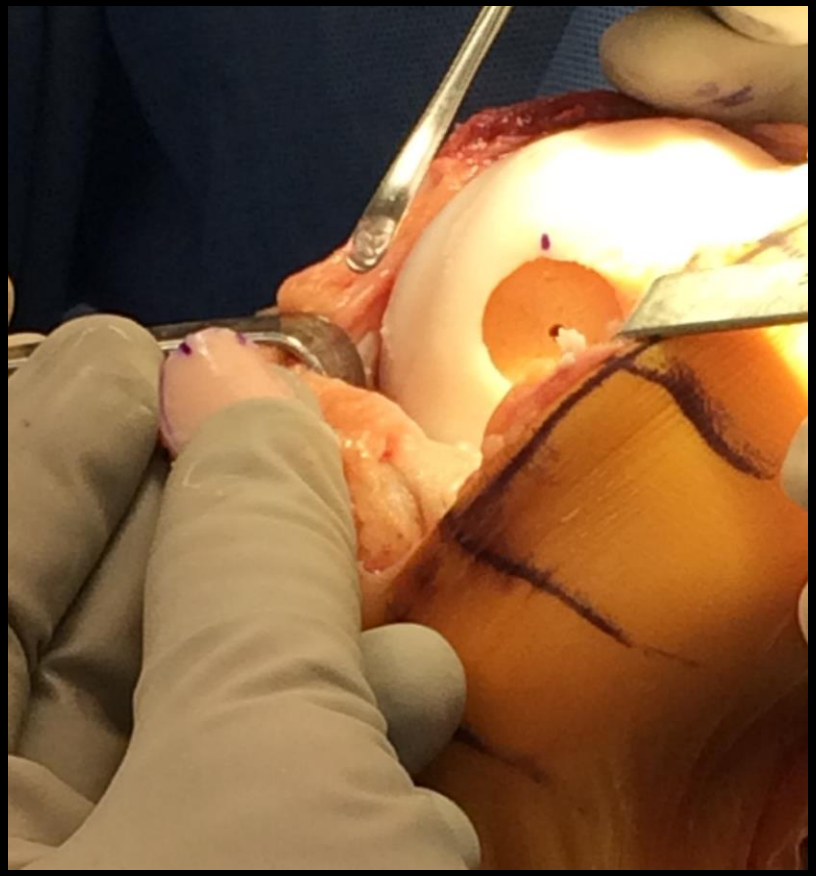
X-ray 3 months out

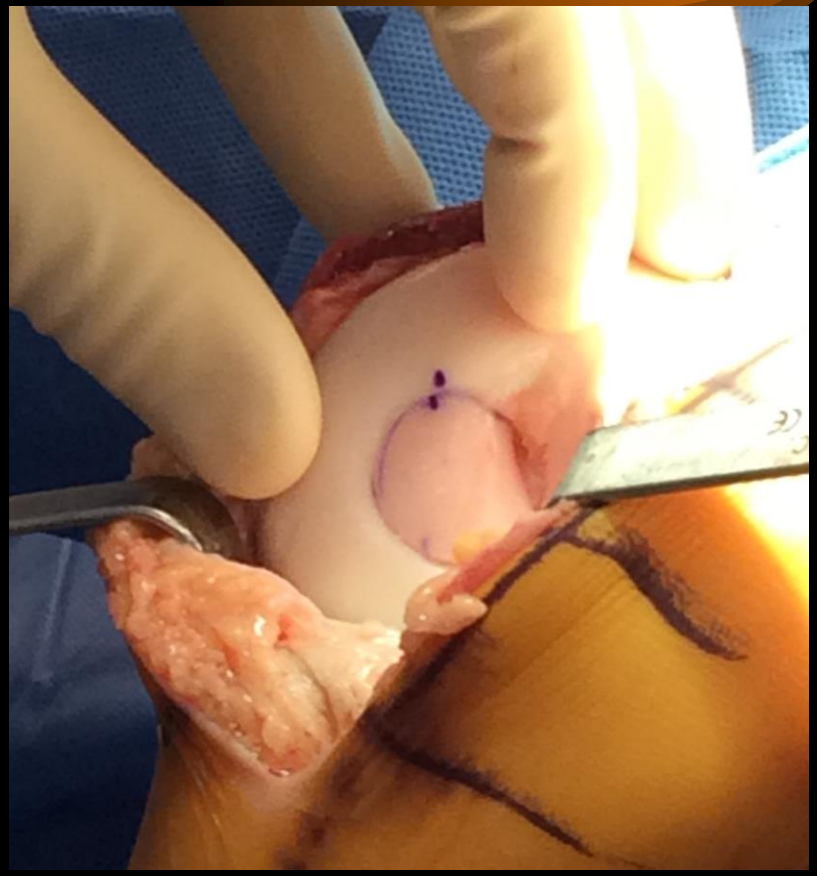
X-rays



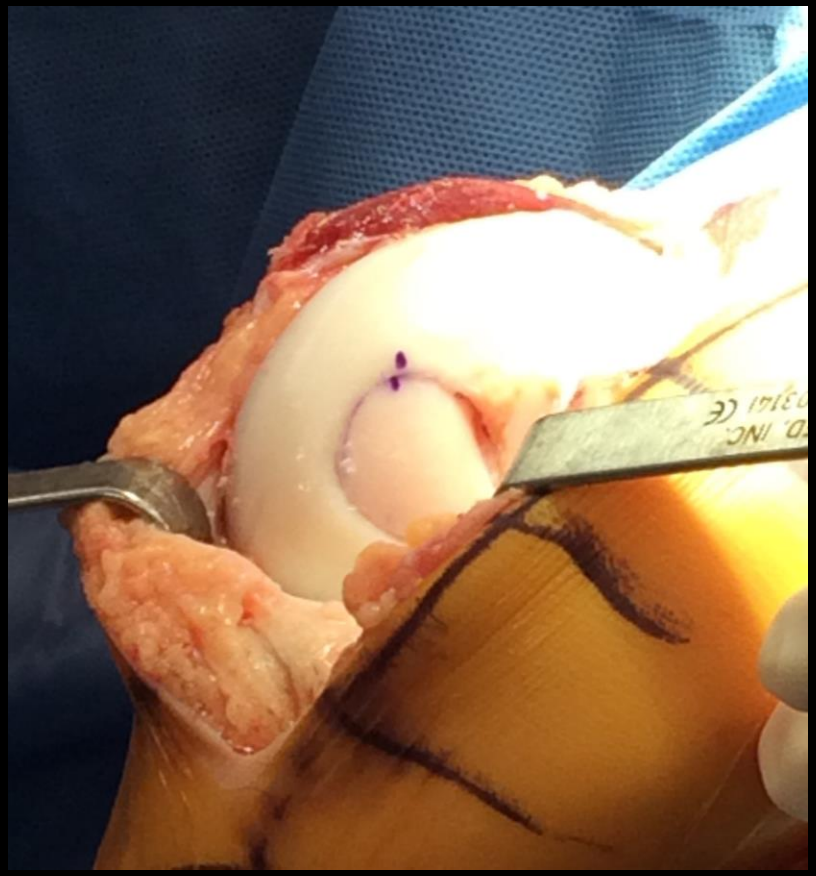
6 Months *12 months*

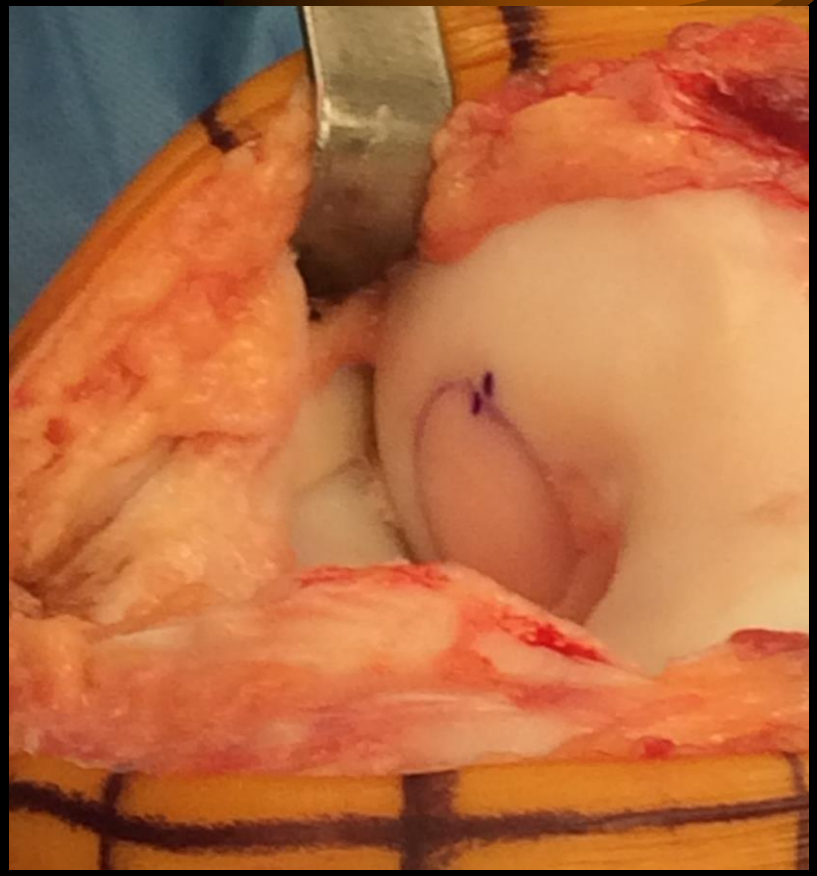
patient #2





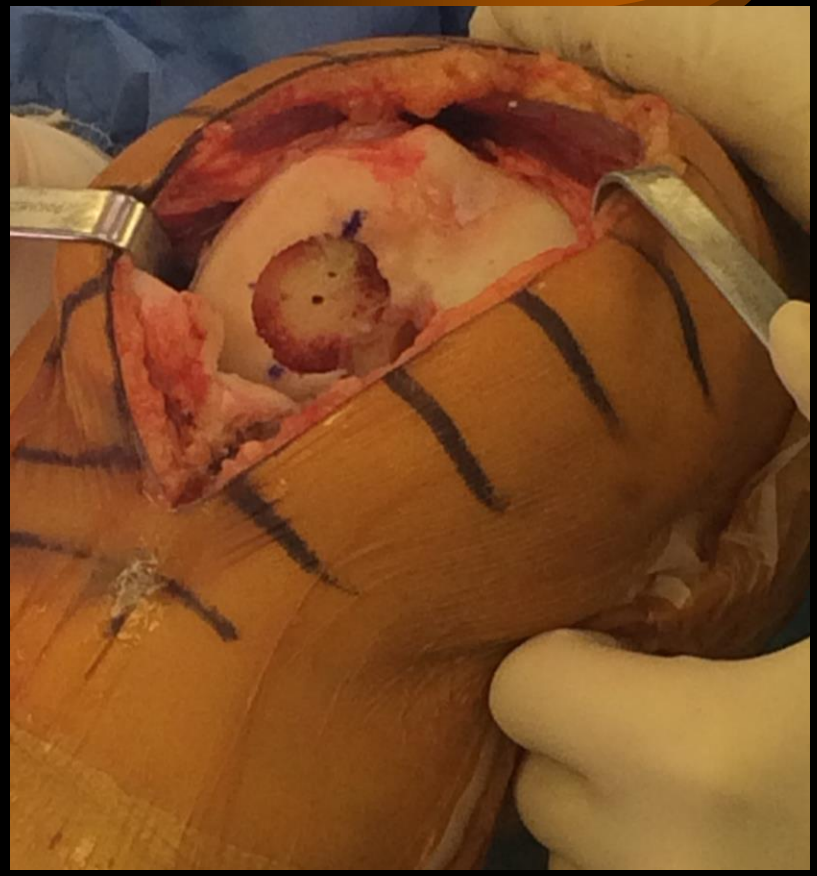
#2



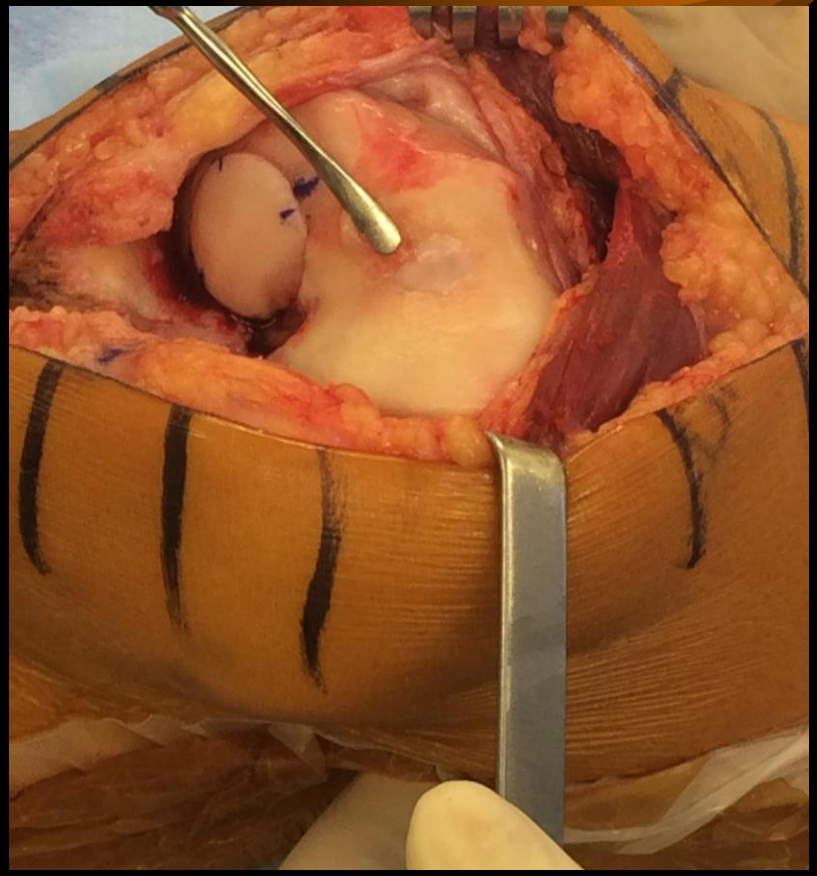


Patient #3
You may remember this case

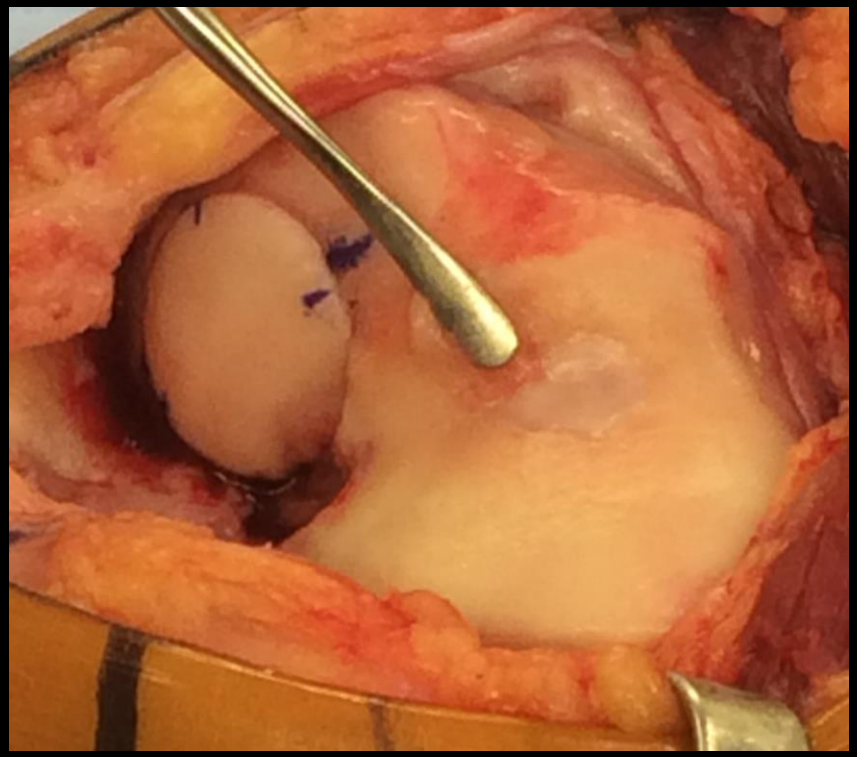
Patient #3

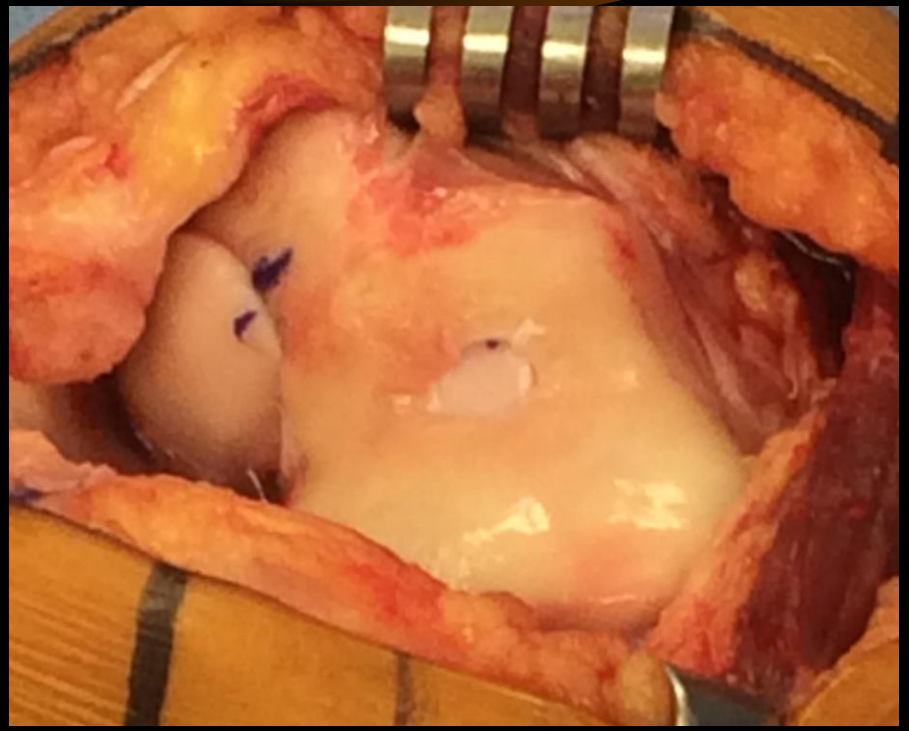


Lesion of Trochlea



Fibrocatilage……..OATS





Fresh Osteochondral Allograft OCA

- Advantages
  - Restorative
  - Unlimited graft source
  - Viable Mature Hyaline cartilage
  - Address both Cartilage and Bone defects
  - No real size limitations
  - Well established Good to Excellent Long-term results with allografts
  - Only biologic option for failed cell-based repair
- Disadvantages
  - Open procedure
  - Allograft tissue
  - Timing >14days<21 days to implant

Literature

- Gross AE, Kim W, Las Heras F Backstein D, Safir O, Pritzker KP: Freshosteochondral allografts for posttraumatic knee defects: Long-term followup. *Clin Orthop Relat Res* 2008; 466(8):1863-1870.

- ”Demonstrated that long-term survival of OCAs depended on the presence of viable chondrocytes, intact extracellular matrix and incorporation of host bone”
- “Chondrocyte viability at the articular surface (superficial zone) is also important for long-term graft survival.”
- “OCAs retrieved after revision procedures have shown that donor chondrocytes remain viable for many years after transplantation.”

Literature
What about rejection?

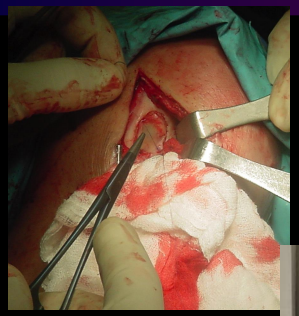
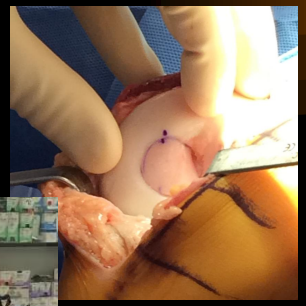
- Langer F, Gross AE: Immunogenicity of allograft articular cartilage. *J Bone Joint Surg Am* 1974;56(2):297-304.
- Oakeshott RD, Farine I, Pritzker KP, Langer F, Gross AE: A clinical and histologic analysis of failed fresh osteochondral allografts. *Clin Orthop Relat Res* 1988;233:283-294.

- "intact articular cartilage elicits no immune response"
- "retrieved allografts consistently have shown that patients tolerate the OCA immunologically, with no histologic evidence of rejection despite the lack of human leukocyte antigen or blood-type matching."
- subchondral bone and marrow components of the graft DO elicit a strong
- immune response

Therapy for Fresh Osteochondral Allograft

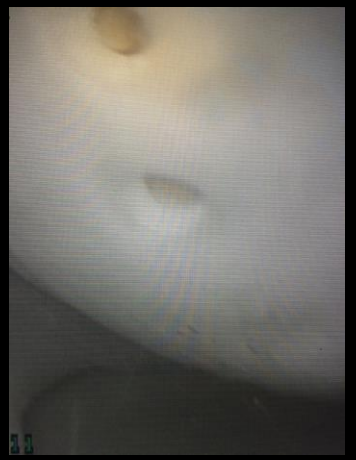
- Really just a LARGE OATS
- Standard post op modalities
- After 4 weeks progress to allow weight bearing as tolerated in compression only.. limiting sheer forces
- Straight leg wbing in drop lock brace
- Progress to normal gait at 4 weeks, OOB
- No running or jumping 16 weeks
- Return to Sport 6 months

Fearfully and Wonderfully made……..






Thank You