Arthritis in Athletes

PAOS Winter CME Conference
February 18th, 2023

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Banner Health Medical Center

Banner
Sports Medicine

Disclosures

- None

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Case 1- HPI

- 18 yo female volleyball player who sustained a left knee injury during a game. The patient landed wrong and felt a “pop” in her knee. Since then, she has been having difficulty weight bearing.

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Case 1-PE

- Physical exam:
  - ROM 5-120
  - 1+ effusion
  - Lachman 2B
  - Positive anterior drawer
  - Negative posterior drawer
  - Pain in lateral joint line
  - TTP lateral femoral condyle
  - + McMurray's

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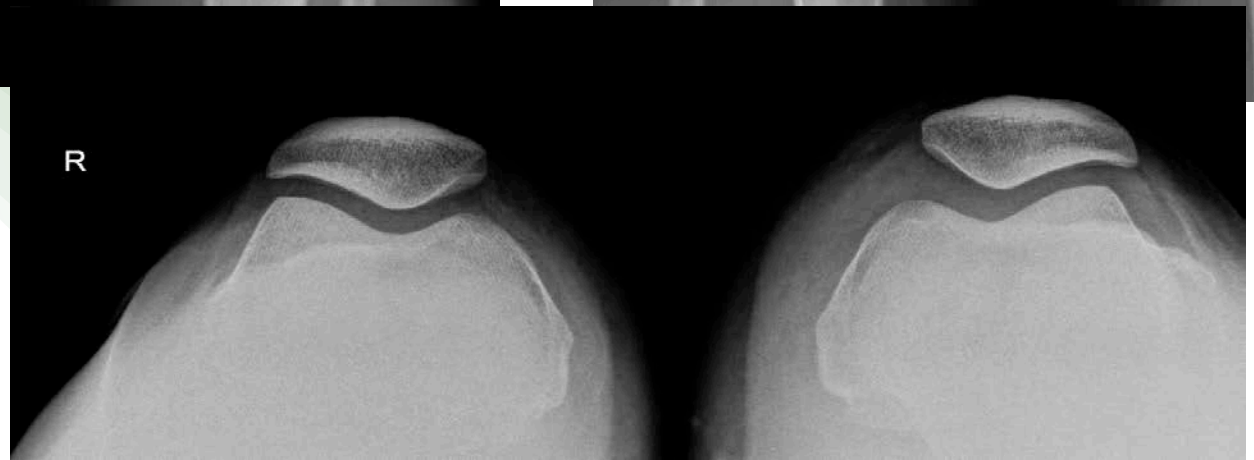
Case 1- Radiographs



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Case 1- Differential Diagnosis?

- ACL tear
- Likely meniscus tear
- +/- cartilage injury

NEXT STEP?

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CASE 1-MRI

Complete ACL tear

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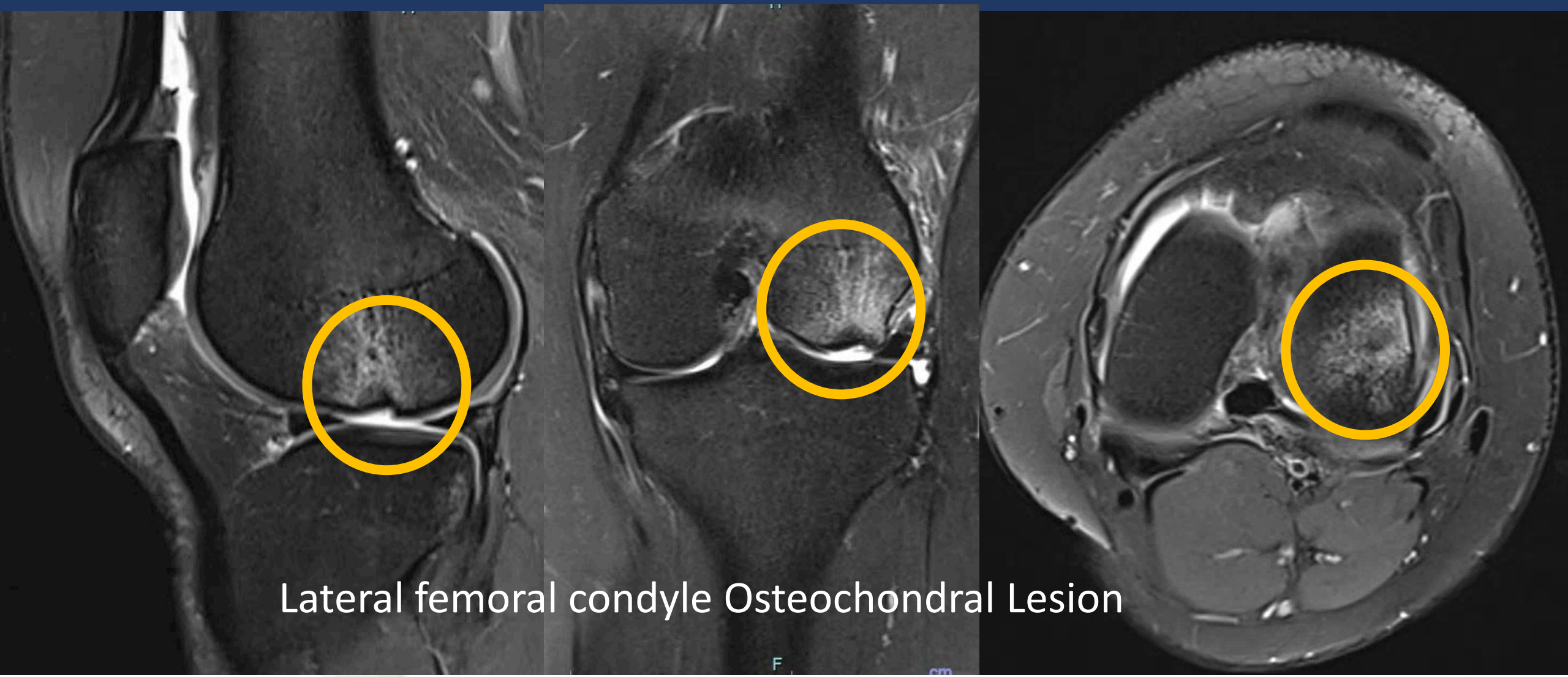
CASE 1-MRI



Lateral femoral condyle Osteochondral Lesion

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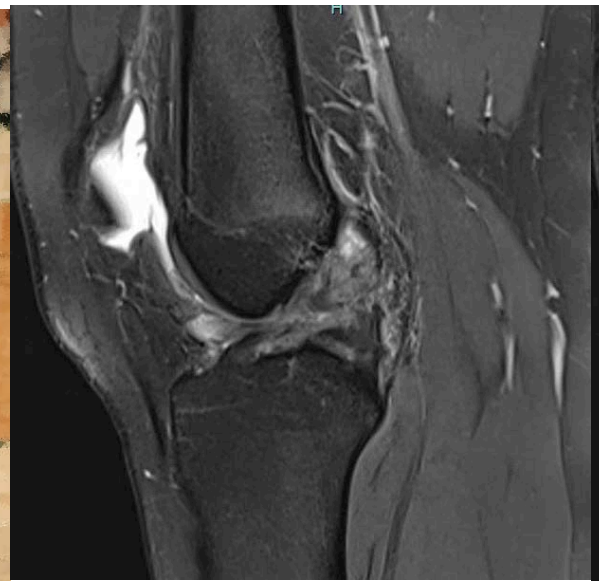
Case 1-Summary

- 18 F, volleyball athlete with a left knee:
  - ACL tear
  - Lateral meniscus tear
  - Lateral femoral condyle cartilage defect



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Case 2

- 21 M, runner who was in a car accident 2 years ago and had a patella dislocation. The patient had recurrent patellar instability and underwent an MPFL reconstruction by an outside surgeon.
- No recurrent dislocations since index procedure
- The patient complains of anterior knee pain, crepitus, swelling

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Case 2-Physical Exam

- No effusion
- Stable to valgus/stresses
- Negative anterior/posterior drawer tests
- Lachman 1A
- 1+ medial and lateral patellar glide
- 3 out of 4 crepitus on flexion and extension
- TTP at the lateral patellar facet
- Radiographs are unremarkable with neutral alignment

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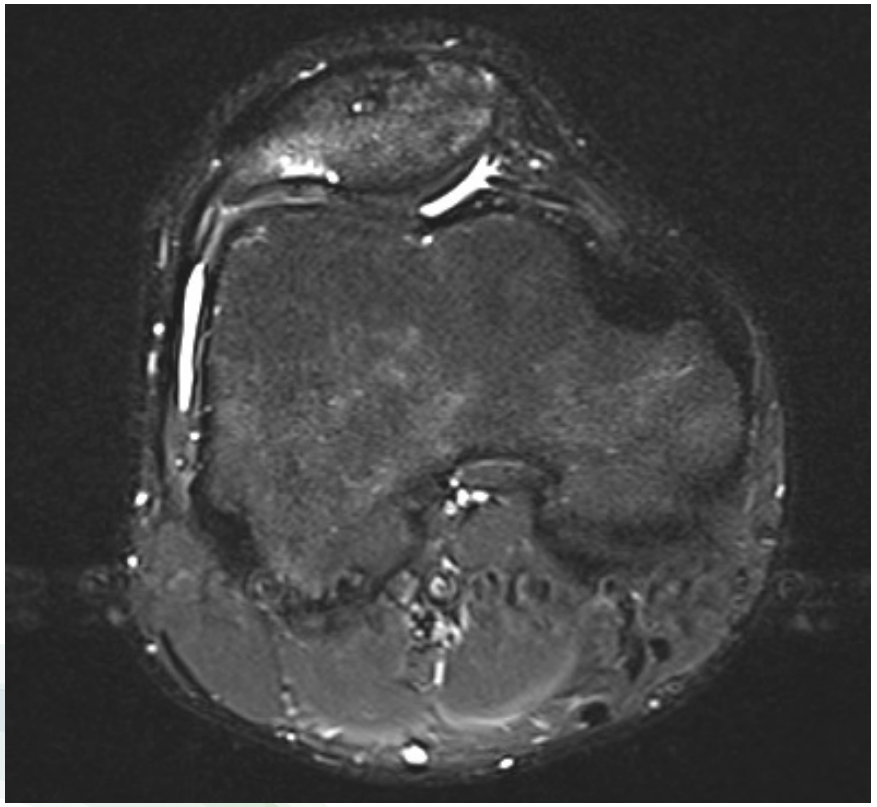
Case 2- MRI



- TT-TG normal
- No loose bodies
- MPFL restored

Lateral patellar Osteochondral defect on MRI

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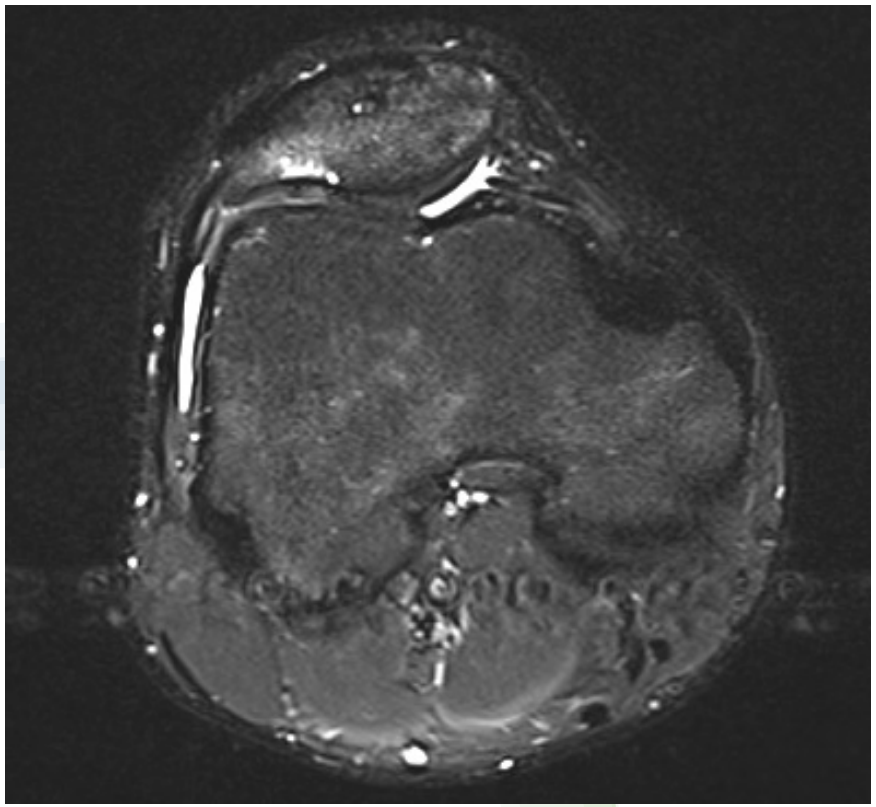
Case 2-Summary

- 21 M runner with osteochondral defect in lateral patellar facet after recurrent traumatic patella dislocations s/p MPFL recon by outside surgeon.



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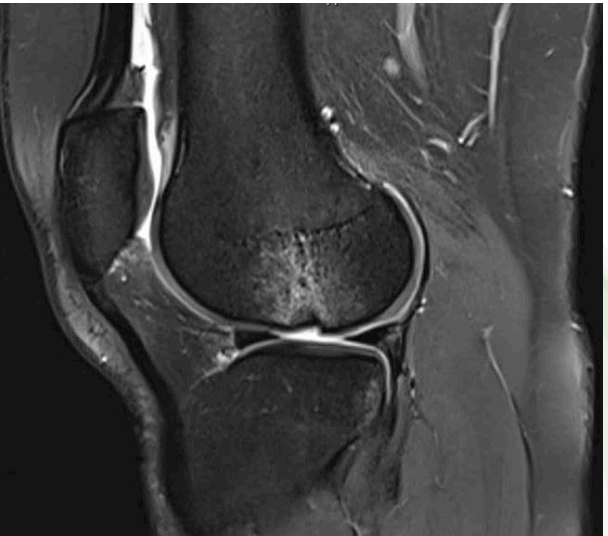
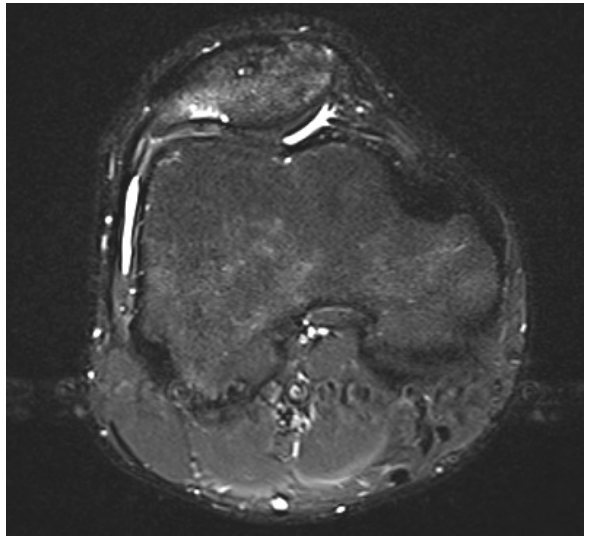
Arthritis in Athletes

- Articular cartilage injuries of the knee are being observed with increasing frequency.
  - 36% of athletes
  - ~ 50% of athletes undergoing ACL recon





Review > Med Sci Sports Exerc. 2010 Oct;42(10):1795-801.
doi: 10.1249/MSS.0b013e3181d9eea0.

Prevalence of chondral defects in athletes' knees: a systematic review

David C Flanigan [1], Joshua D Harris, Thai Q Trinh, Robert A Siston, Robert H Brophy

Affiliations + expand

PMID: 20216470 DOI: 10.1249/MSS.0b013e3181d9eea0

> Am J Sports Med. 2003 Jul-Aug;31(4):601-5. doi: 10.1177/03635465030310042101.

Intraarticular injuries associated with anterior cruciate ligament tear: findings at ligament reconstruction in high school and recreational athletes. An analysis of sex-based differences

Dana P Piasecki [1], Kurt P Spindler, Todd A Warren, Jack T Andrish, Richard D Parker

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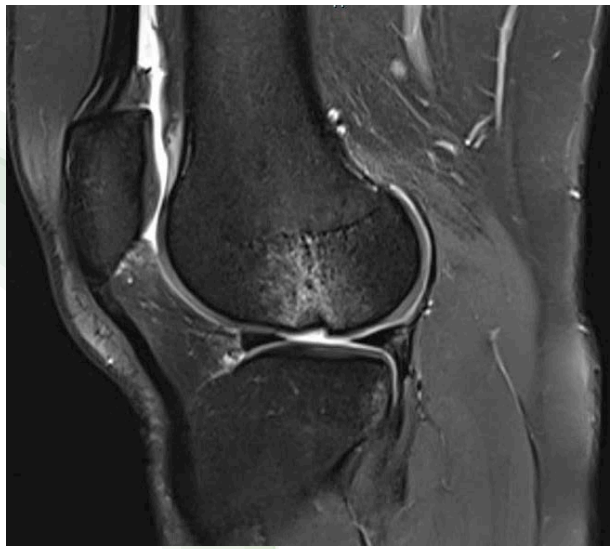
Arthritis in Athletes

- Natural history of cartilage lesions not fully understood
- Poor capacity to heal is well known
- Potential for progressive joint degeneration if left untreated.

Acta Orthop Scand. 1996 Apr;67(2):165-8. doi: 10.3109/17453679608994664.

The long-term prognosis for severe damage to weight-bearing cartilage in the knee: a 14-year clinical and radiographic follow-up in 28 young athletes

K Messner [1], W Maletius



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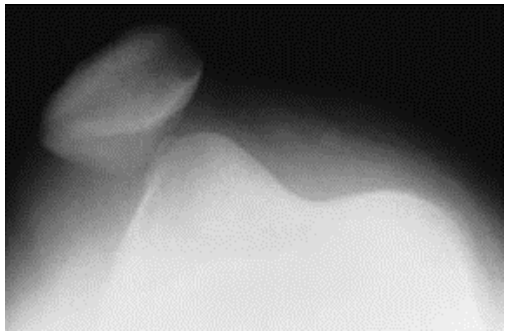
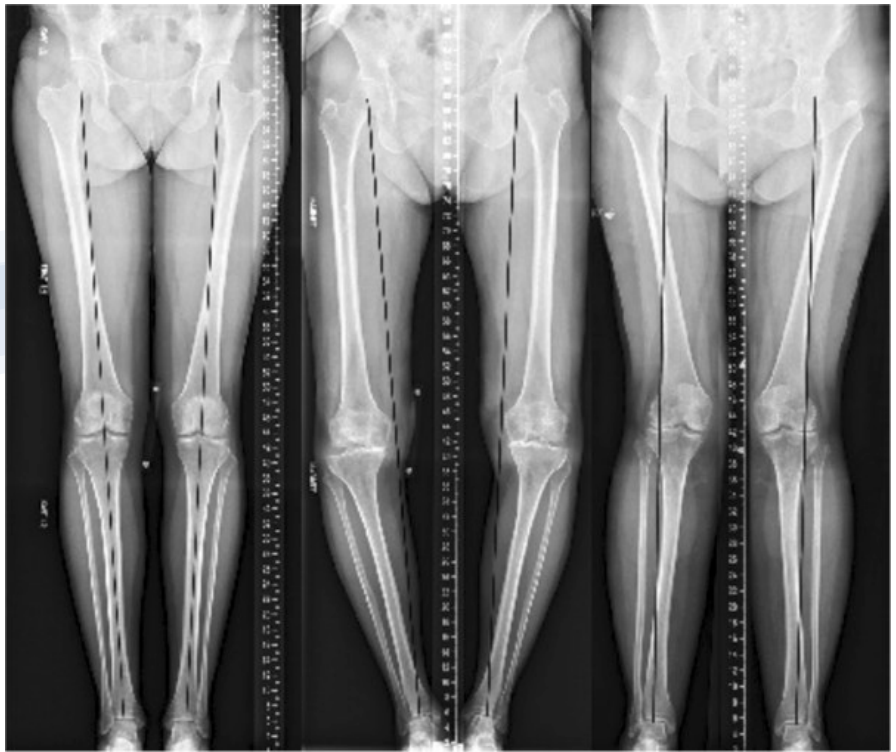
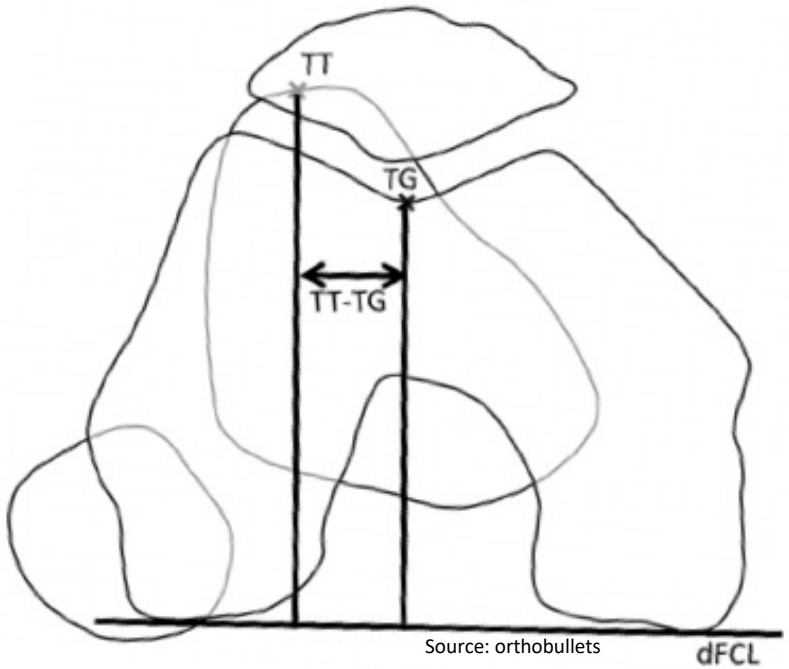
Arthritis in Athletes

- Key to understand underlying cause and/or contributing factors
  - Traumatic injury?
  - Mal-alignment?







Source: orthobullets

Image source: Biol Sex Differ . 2012 Dec 23;3(1):28. doi: 10.1186/2042-6410-3-28.

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Arthritis in Athletes

- Presentation will focus on skeletally mature athletes

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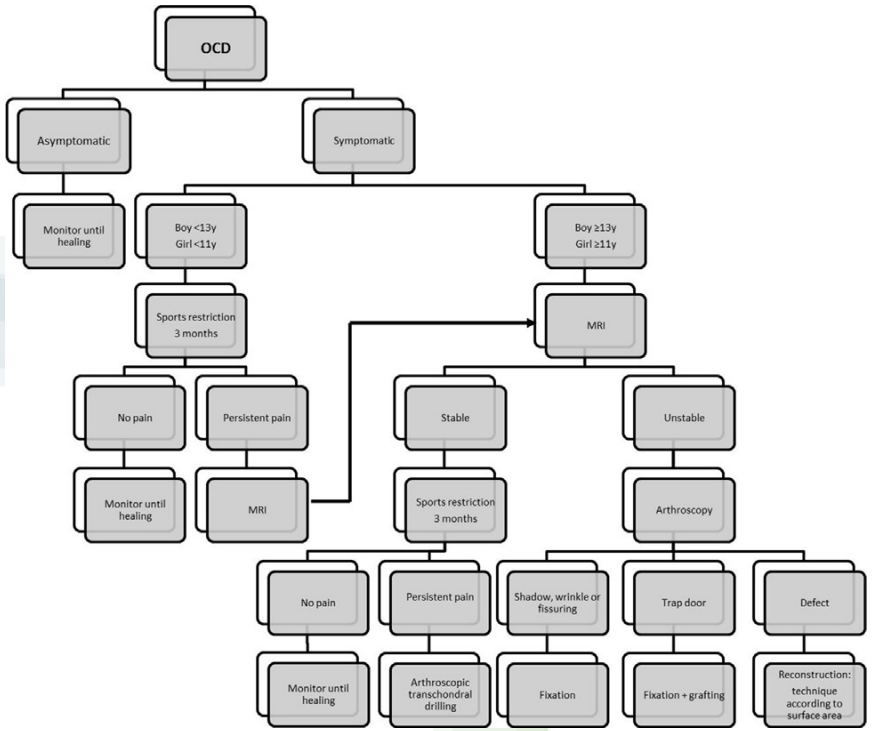
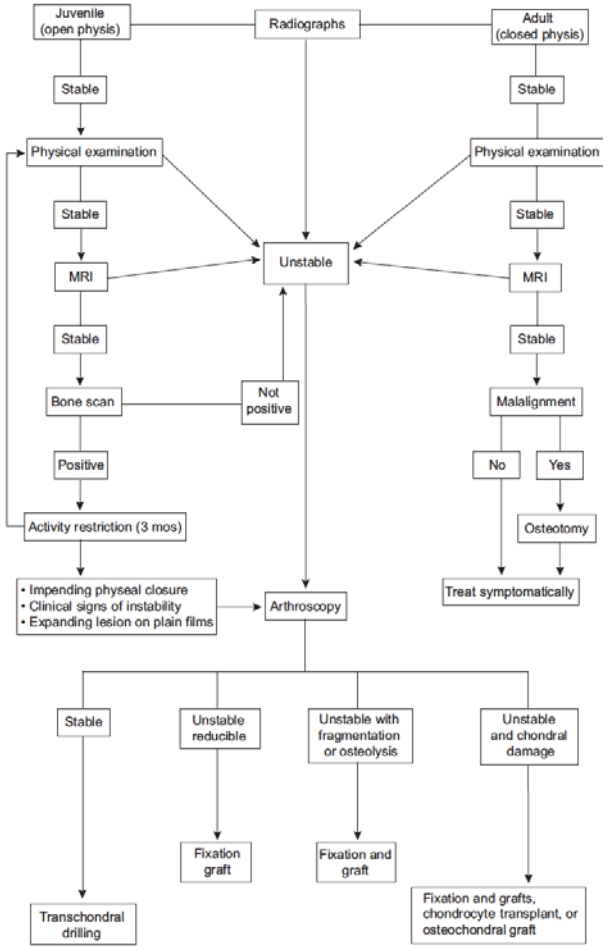
Arthritis in Athletes

- Presentation will focus on skeletally mature athletes
- Will not discuss pediatric osteochondritis dissecans (OCD) lesions
  - Complicated subject
  - Must consider growth plates





ARTICLES

Osteochondritis Dissecans of the Knee

Crawford, Dennis C. MD, PhD; Safran, Marc R. MD

Author Information

Journal of the American Academy of Orthopaedic Surgeons 14(2):p 90-100, February 2006.

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Treatment options

- Operative
  - Chondroplasty
  - Microfracture
  - OAT (osteochondral autograft transplantation)
  - OCA (osteochondral allograft transplantation)
  - ACI (autologous chondrocyte implantation)
  - Osteotomies
- Non-operative
  - PT
  - Injections

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So many options! Which one do I choose?

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- Pros and Cons to all
- Systematic approach

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- **Treatment must**
  - Fit lesion needs
  - Fit athlete's needs

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So many options! Which one do I choose?

- Pros and Cons to all
- Systematic approach
- **Treatment must**
  - Fit lesion needs
  - Fit athlete's needs
- **Factors to consider**
  - Patient's age
  - Activity level
  - Lesion size
  - Concomitant pathology
  - Malalignment
  - Cost

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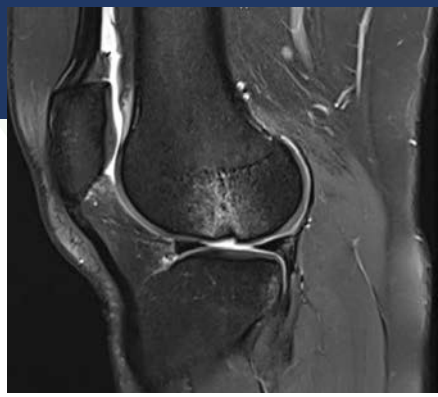

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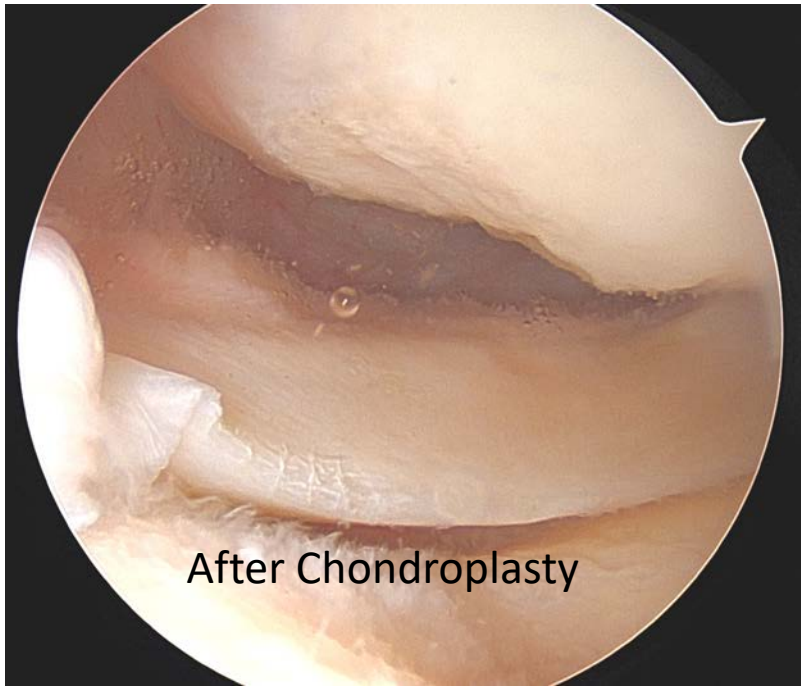
Chondroplasty

- Smoothing of the defect with no violation of the subchondral bone
- Pros:
  - Technically simple
  - Inexpensive
  - Easy post-op rehab
- Cons:
  - Cannot be used for osteochondral lesions
  - May not be used for larger defect (>2 cm^2)


Before Chondroplasty


After Chondroplasty

Chondroplasty

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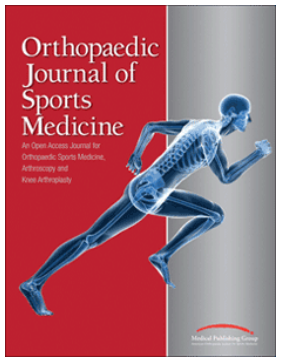
Before Chondroplasty

- Outcomes
  - Improvement in all patient-reported outcomes (PROs) at 31.5 months
  - However, grade 3 & 4 lesions showed less improvement



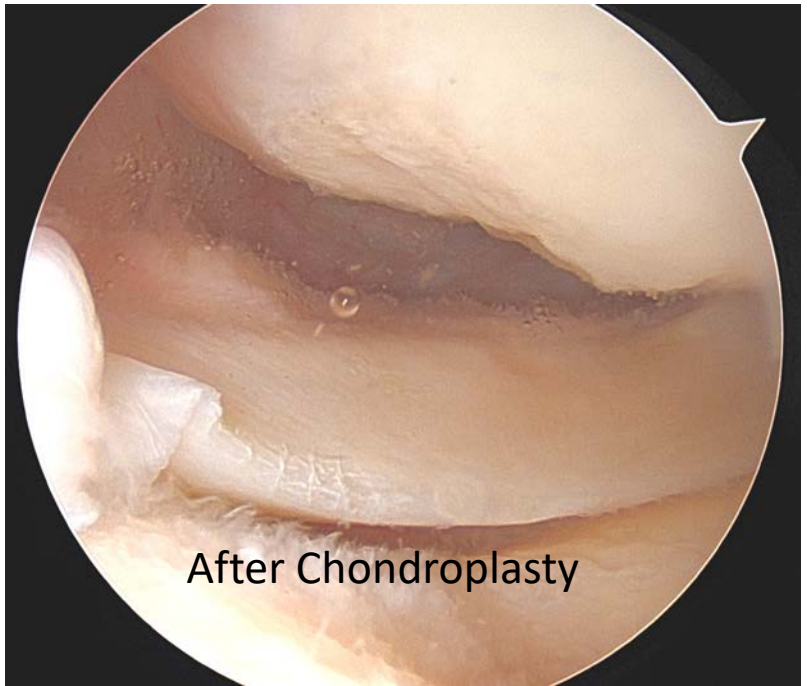
Orthopaedic Journal of Sports Medicine
Volume 5, Issue 5, May 2017

https://doi.org/10.1177/2325967117707213

SAGE journals

Arthroscopic Mechanical Chondroplasty of the Knee Is Beneficial for Treatment of Focal Cartilage Lesions in the Absence of Concurrent Pathology

Devon E. Anderson, PhD*, Michael B. Rose, MD*, Aaron J. Wille, BS*, Jack Wiedrick, MS†, and Dennis C. Crawford, MD, PhD*,‡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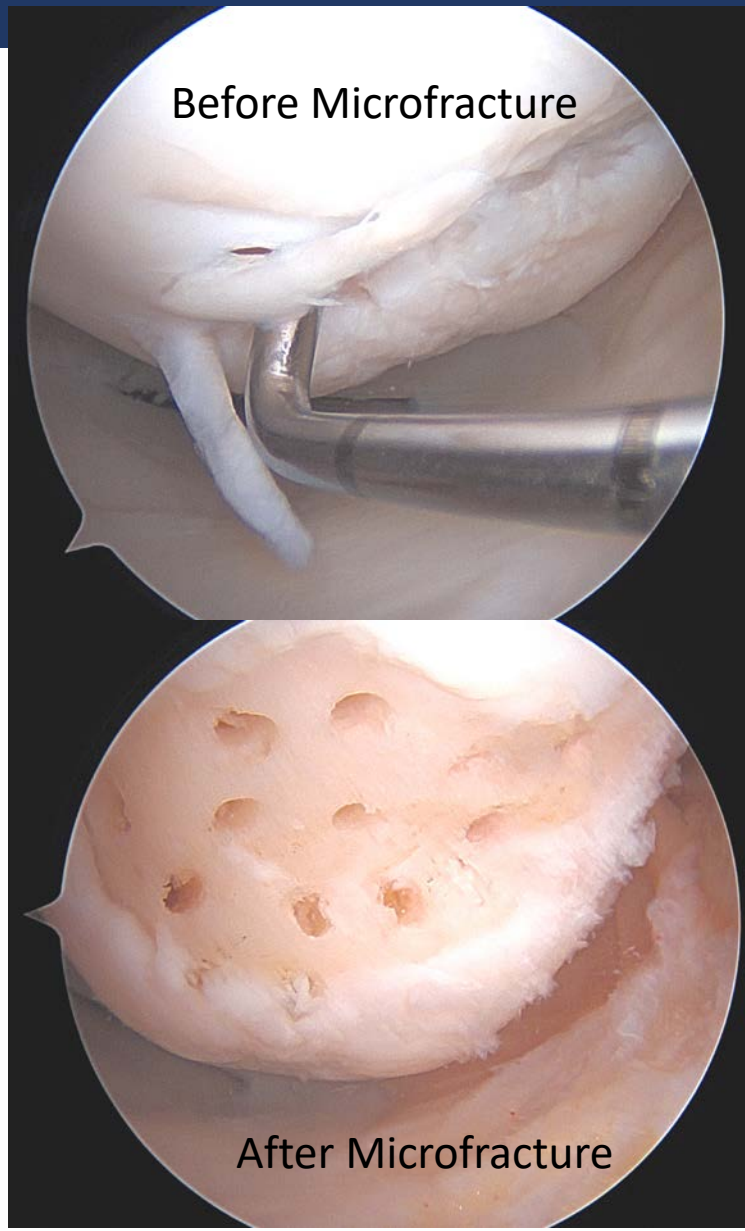
Microfracture

- Puncturing holes in the subchondral layer to allow for release of precursor cells that can reorganize to form fibrocartilage
- Pros:
  - Technically simple
  - Inexpensive
  - Minimal post-op rehab
- Cons:
  - Cannot be used for osteochondral lesions
  - May not be used for larger defect (>2 cm^2)
  - Deterioration in outcomes after short-term follow-up



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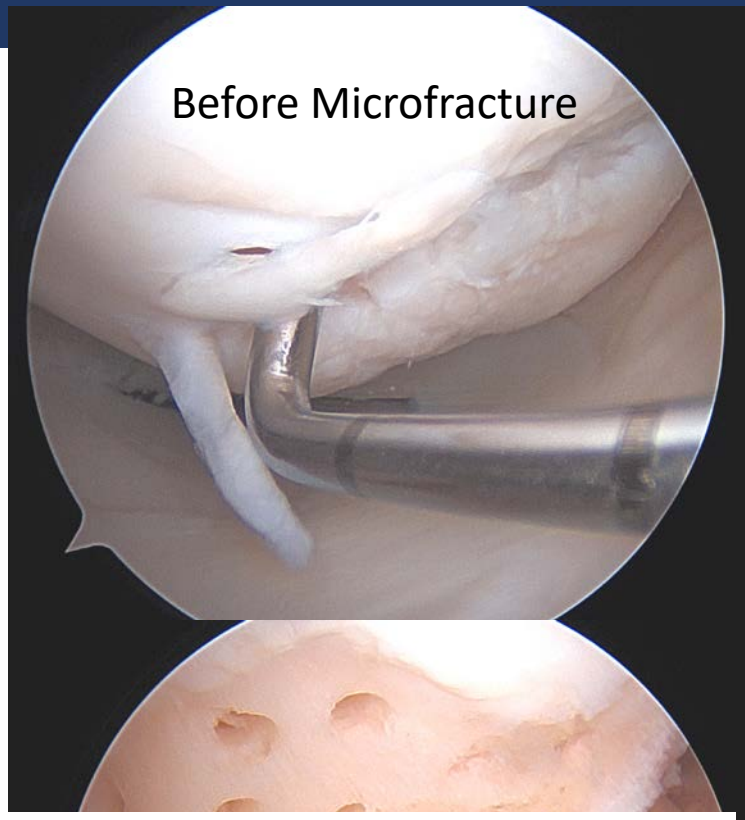

- Outcomes
  - Good & excellent results in 67%
  - Significant improvements in multiple PROs.
  - Outcomes deteriorate at 5 years
  - However, these decreased scores still higher than preop scores.

Cartilage
SAGE

Cartilage. 2010 Apr; 1(2): 113–120.
doi: 10.1177/1947603510366576
PMCID: PMC4297048
PMID: 26069542

Clinical Outcome and Return to Competition after Microfracture in the Athlete's Knee

An Evidence-Based Systematic Review

Monitoring Editor: Brian J. Cole and James S. Kercher

Kai Mithoefer,[1] Thomas J. Gill,[2] Brian J. Cole,[3] Riley J. Williams,[4] and Bert R. Mandelbaum[5]

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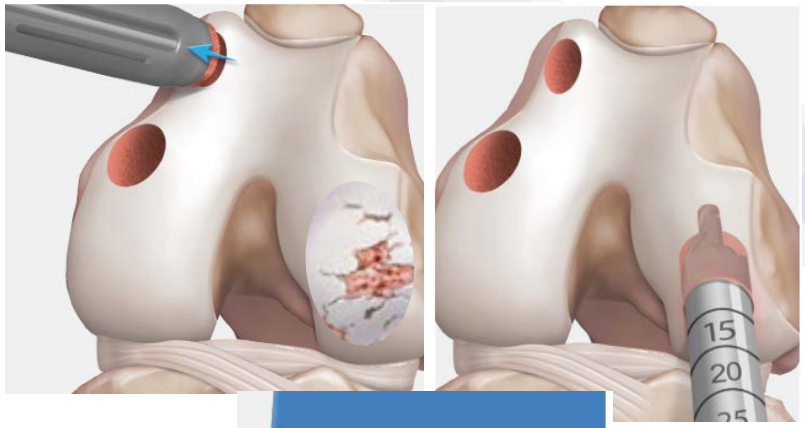
OAT (Osteochondral Autograft Transplantation)

- Osteochondral plug are harvested from limited wb portion of knee and are transplanted onto defect. (Mosaicplasty=multiple plugs)



- Pros:
  - Immediate bony and cartilaginous integrity
  - Better healing potential with autograft tissue
  - Inexpensive
- Cons:
  - Donor site morbidity
  - May not be used for larger defect (>2 cm^2)
  - Extensive post-op rehab

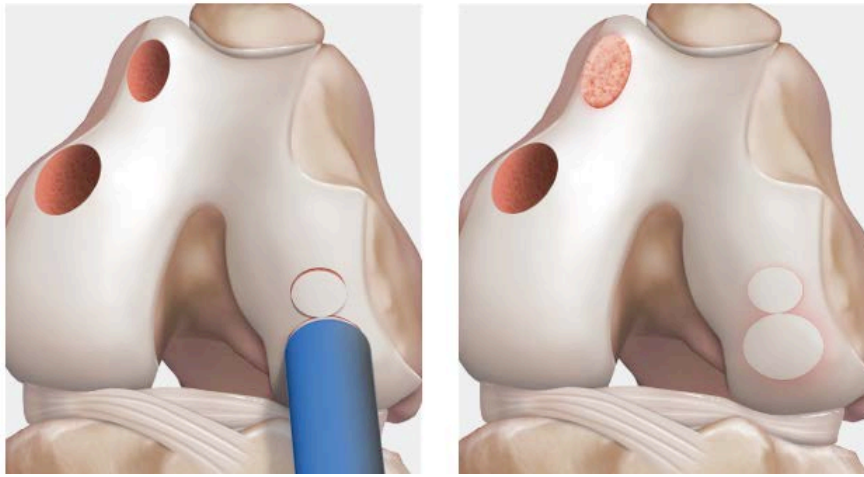


Image source: arthrex

OAT (Osteochondral Autograft Transplantation)

- Outcomes
  - Better than microfracture at 3 years
    - Improved HSS scores
    - Better radiographic healing on MRI
  - Successful in 72%
  - Mean failure rate of 28%
  - Revision rate 19%
  - Risk factors for failure:
    - Increased age
    - Previous surgery
    - Large defect size

Arthroscopy
The Journal of Arthroscopic and Related Surgery
AANA ADVANCING THE SCOPE

ORIGINAL ARTICLE | VOLUME 21, ISSUE 9, P1066-1075, SEPTEMBER 2005

A Prospective Randomized Clinical Study of Mosaic Osteochondral Autologous Transplantation Versus Microfracture for the Treatment of Osteochondral Defects in the Knee Joint in Young Athletes

Rimtautas Gudas, M.D., Ph.D. • Romas J. Kalesinskas, M.D. • Vytautas Kimtys, M.D. • ...
Vytautas Toliušis, M.D. • Giedrius Bernotavičius, M.D. • Alfredas Smailys, M.D., Ph.D. • Show all authors

DOI: https://doi.org/10.1016/j.arthro.2005.06.018

Randomized Controlled Trial > Am J Sports Med. 2012 Nov;40(11):2499-508.
doi: 10.1177/0363546512458763. Epub 2012 Sep 28.

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

Rimtautas Gudas [1], Agne Gudaite, Arnoldas Pocius, Asta Gudiene, Emilis Cekanauskas, Egle Monastyreckiene, Algidas Basevicius

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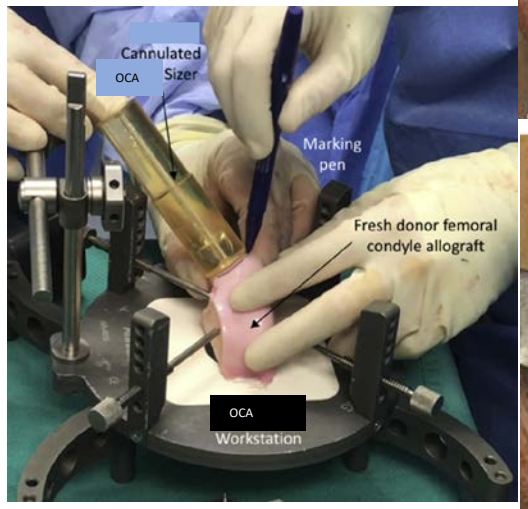
OCA (Osteochondral ALLOgraft Transplantation)

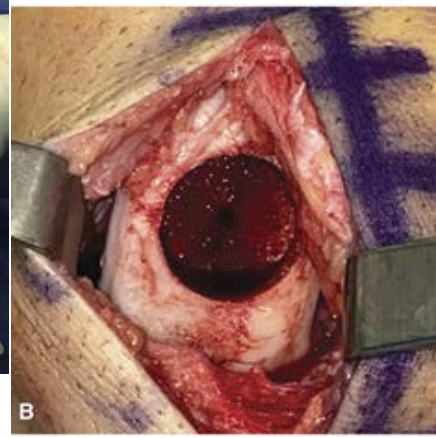
- Large osteochondral plug is harvested from a "size-and-radius of curvature matched donor" (i.e. recently deceased cadaver)

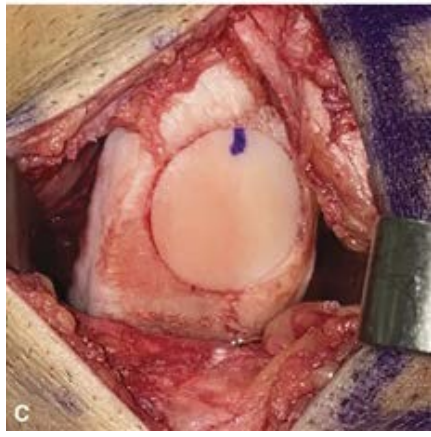


> Arthrosc Tech. 2019 Feb 25;8(3):e321-e329. doi: 10.1016/j.eats.2018.11.008. eCollection 2019 Mar.

Osteochondral Allograft Transplantation of the Medial Femoral Condyle With Orthobiologic Augmentation and Graft-Recipient Microfracture Preparation

James Gwosdz [1], Alexander Rosinski [1], Moyukh Chakrabarti [1], Brittany M Woodall [1], Nicholas Elena [1], Patrick J McGahan [1], James L Chen [1]



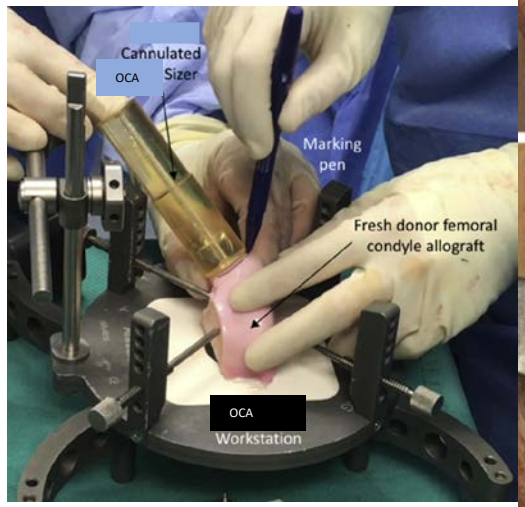


OCA (Osteochondral ALLOgraft Transplantation)

- Large osteochondral plug is harvested from a "size-and-radius of curvature matched donor" (i.e. recently deceased cadaver)

- Pros:
  - No donor site morbidity
  - For larger defects (>2 cm^2)
  - Immediate bony and cartilaginous integrity
  - Good salvage option

- Cons:
  - Expensive
  - Decreased healing potential with allograft tissue
  - Extensive post-op rehab
  - Finding match is challenging
  - Surgery must occur within certain time-frame after match is found (~ <14 days)



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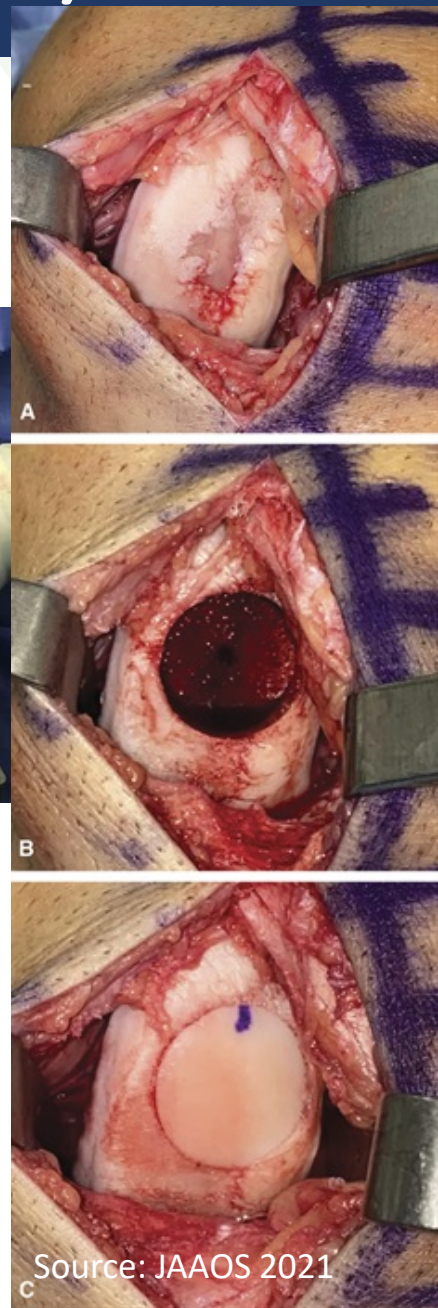


Source: JAAOS 2021

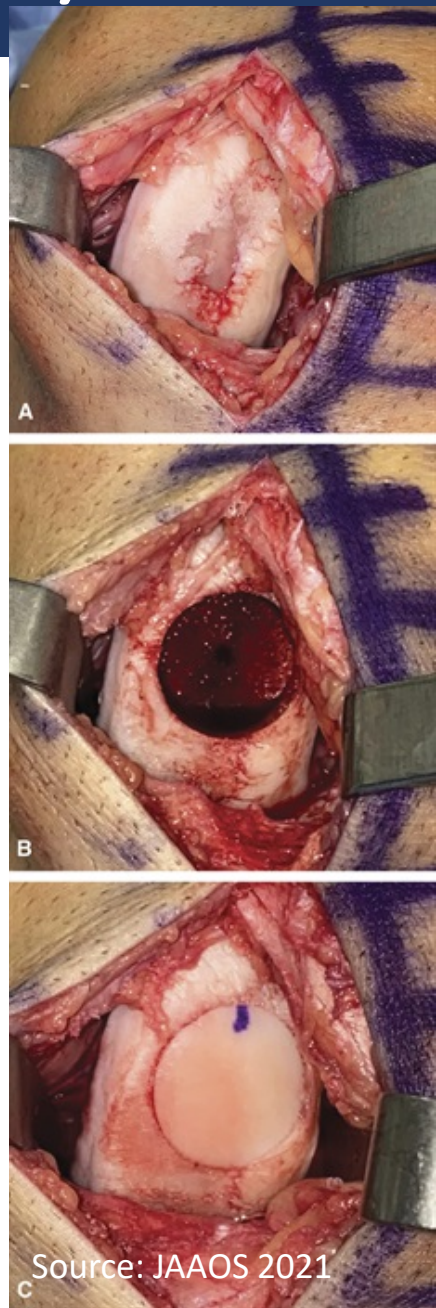
OCA (Osteochondral ALLOgraft Transplantation)

- Outcomes
  - Significant improvement in patient reported outcomes (PROs)
  - Survival analysis:
    - 5-years: 86.7%
    - 10-years: 78.7%
    - 20-years: 67.5%
    - 83.1% of graft incorporation on MRI

› Am J Sports Med. 2018 Dec;46(14):3541-3549. doi: 10.1177/0363546517732531. Epub 2017 Oct 17.

Clinical Outcomes and Failure Rates of Osteochondral Allograft Transplantation in the Knee: A Systematic Review

Filippo Familiari [1], Mark E Cinque [2], Jorge Chahla [2], Jonathan A Godin [2], Morten Lykke Olesen [3], Gilbert Moatshe [2 4 5], Robert F LaPrade [2 6]



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› Am J Sports Med. 2018 Dec;46(14):3541-3549. doi: 10.1177/0363546517732531. Epub 2017 Oct 17.

Clinical Outcomes and Failure Rates of Osteochondral Allograft Transplantation in the Knee: A Systematic Review

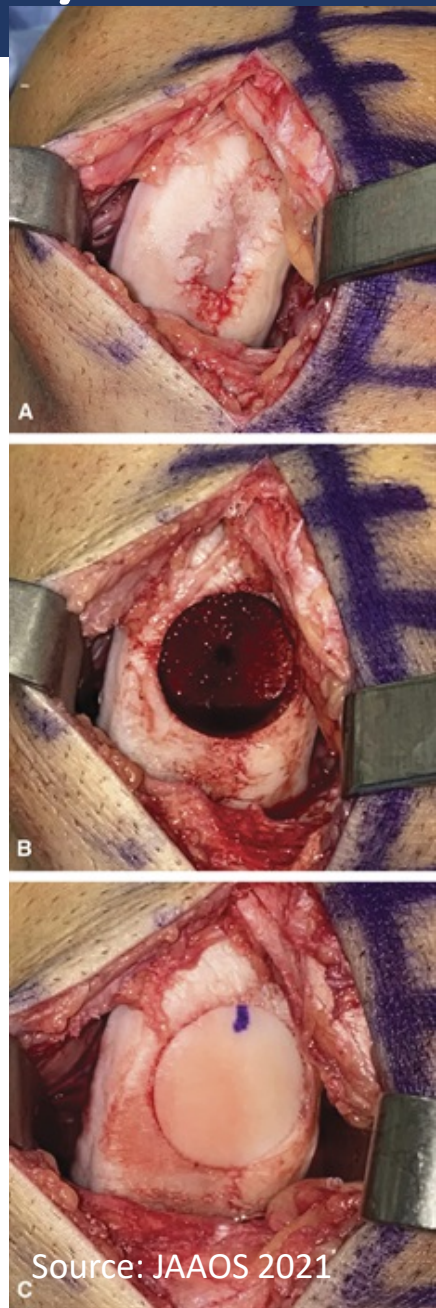
Filippo Familiari [1], Mark E Cinque [2], Jorge Chahla [2], Jonathan A Godin [2], Morten Lykke Olesen [3], Gilbert Moatshe [2 4 5], Robert F LaPrade [2 6]

- Nielsen et al. OCA in in 142 high-level athletes @6yrs:
  - 71% excellent to good knee function
  - 79% able to return to high level activity
  - 91% satisfied with surgery
  - 25.5% revision surgery
  - 9.4% failed

› Am J Sports Med. 2017 Jun;45(7):1608-1614. doi: 10.1177/0363546517694857. Epub 2017 Apr 4.

Return to Sport and Recreational Activity After Osteochondral Allograft Transplantation in the Knee

E Scott Nielsen [1], Julie C McCauley [2], Pamela A Pulido [2], William D Bugbee [1]



Source: JAAOS 2021

Treatment options

- Operative
  - Chondroplasty
  - Microfracture
  - OAT (osteochondral autograft transplantation)
  - OCA (osteochondral allograft transplantation)
  - ACI (autologous chondrocyte implantation)
  - Osteotomies
- Non-operative
  - PT
  - Injections

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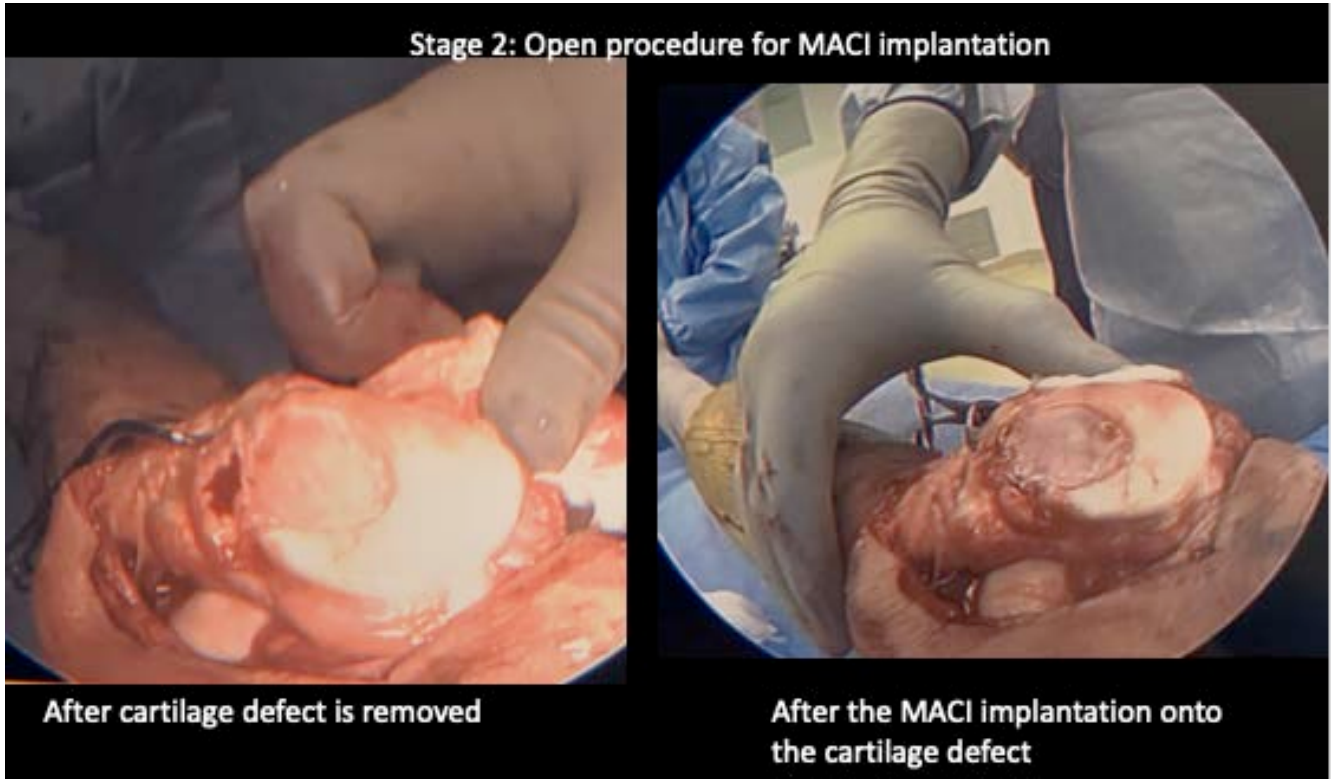
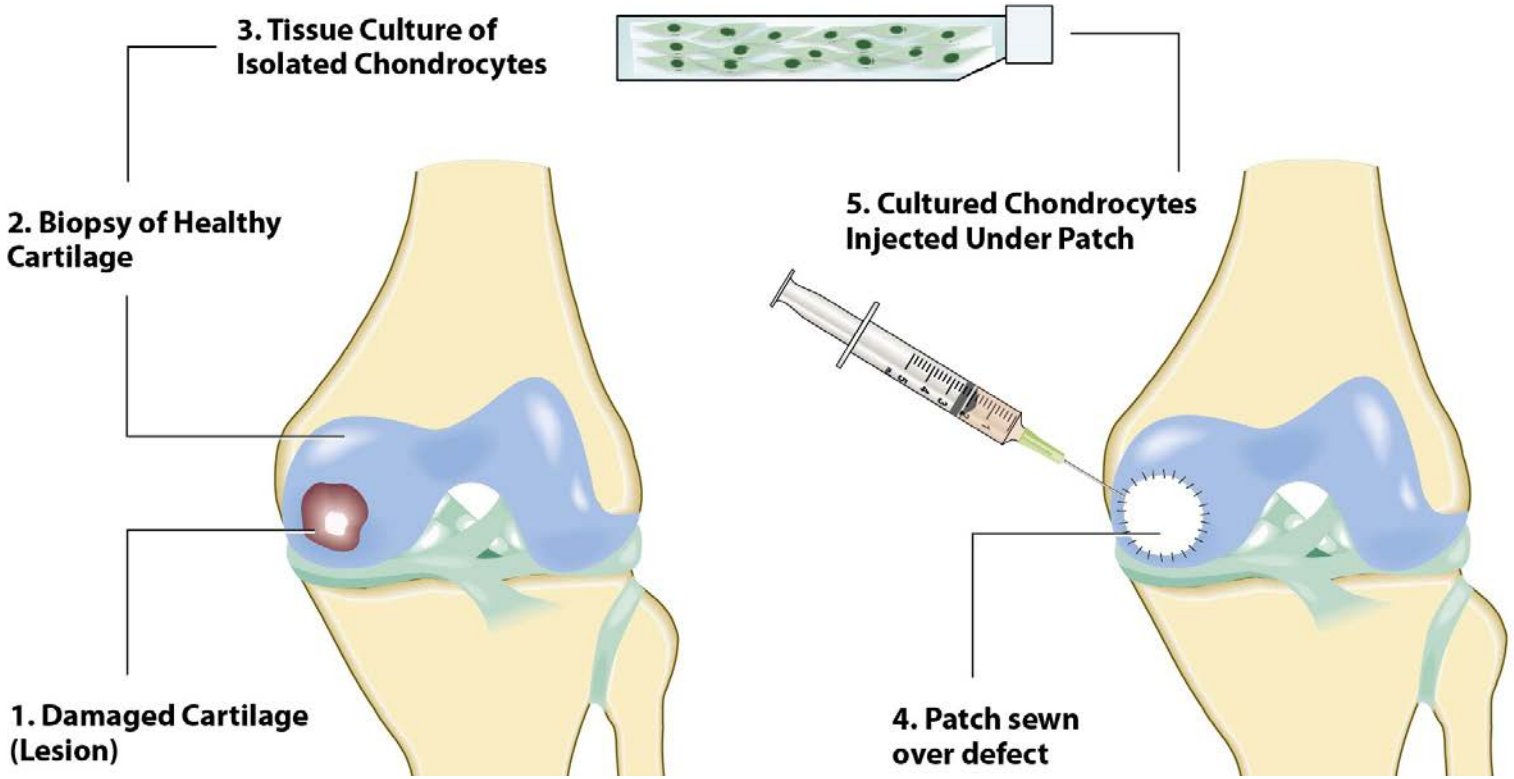
ACI (Autologous Chondrocyte Transplantation)

- **Two-stage procedure**
  - **Stage 1:** Cartilage harvest followed by 6-week period where chondrocytes are cultured with growth factors in a lab
  - **Stage 2:** Lab-expanded chondrocytes are re-implanted into defect



ACI (Autologous Chondrocyte Transplantation)

- **Multiple generations of ACI**
  - Early: injection of chondrocytes under periosteal patch or allograft collagen membrane
  - 3rd gen: matrix-induced ACI **(MACI)**
    - direct implantation of cells onto a biomatrix
    - Matrix then placed into the defect

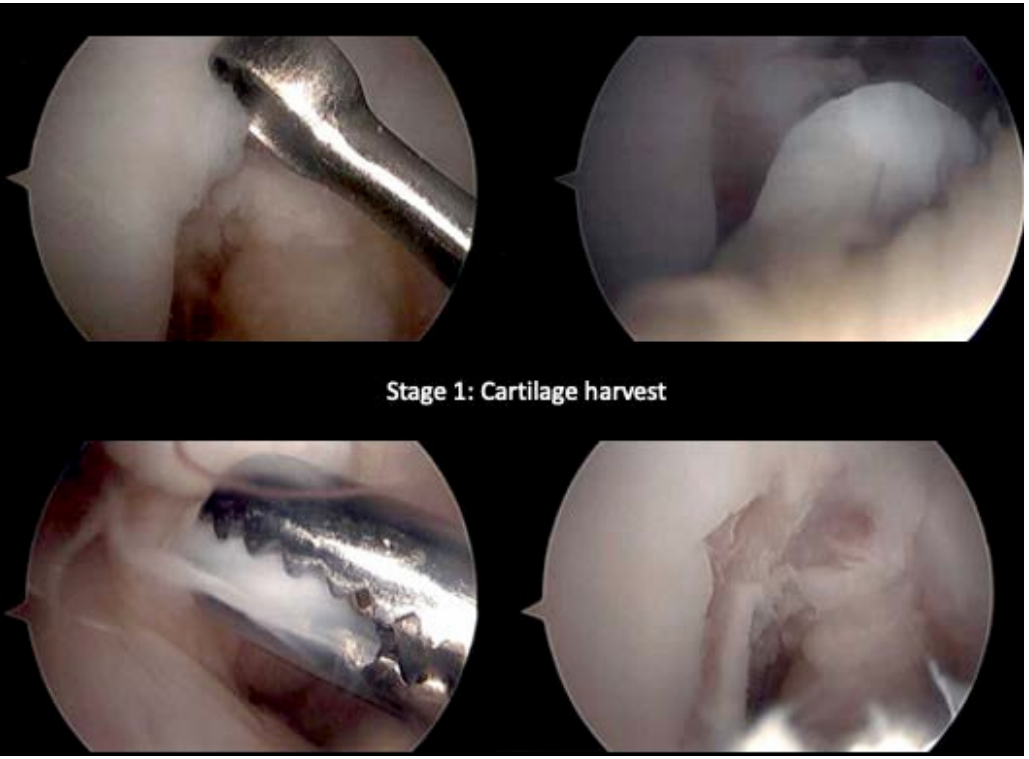


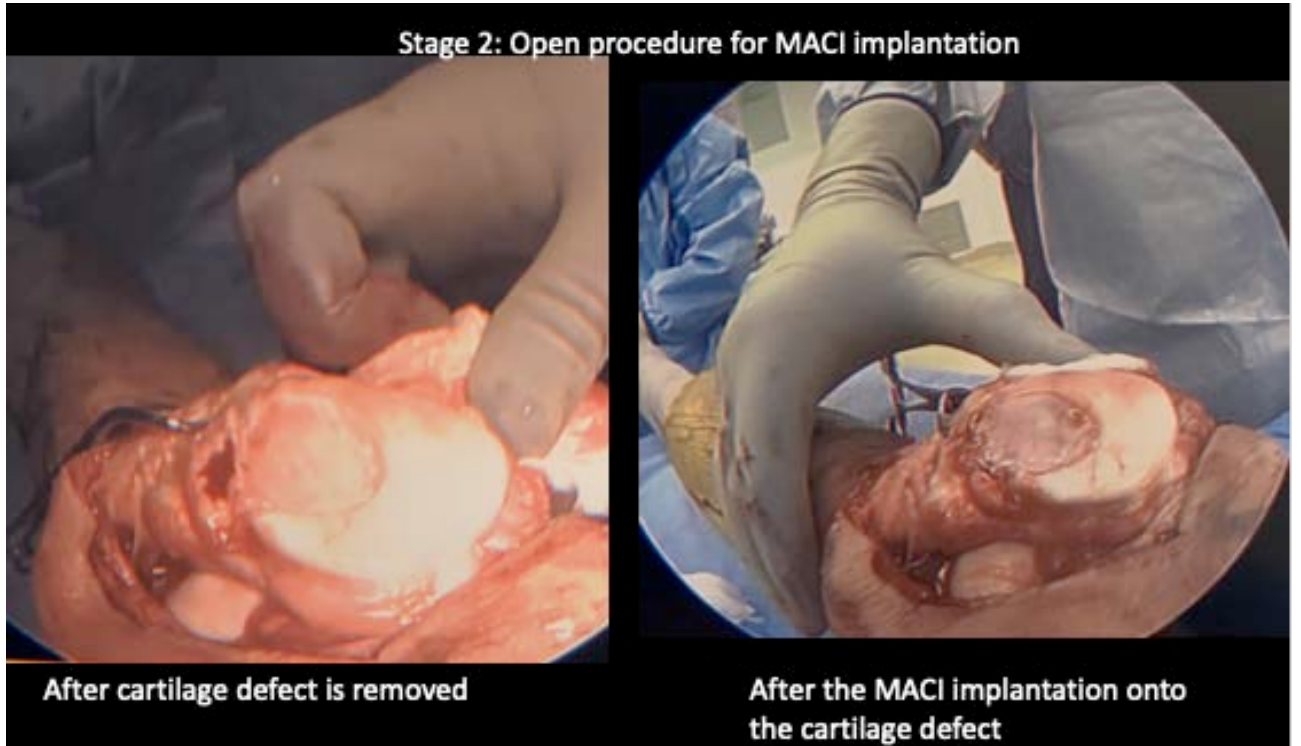
Source: RJAH hospital

Source: Vericel

ACI (Autologous Chondrocyte Transplantation)

- Pros:
  - For larger defects (>2 cm^2)
  - Good salvage option
- Cons:
  - Expensive
  - Requires 2 stages
  - Extensive post-op rehab





ACI (Autologous Chondrocyte Transplantation)

- Outcomes
  - **Ebert et al.: 63 patients s/p MACI @ 2 and 5 yrs**
    - Improvements in all: Osteoarthritis Outcome Score (KOOS), Short Form-36, and Visual Analog Scale.
    - KOOS Sport/recreation subscale improved from years 2-->5
    - 94% knee pain relief
    - 95% improvement in ADLs
    - 58% showed MRI graft healing over time
    - MRI healing and outcome scores did not correlate

Randomized Controlled Trial > Am J Sports Med. 2012 Jul;40(7):1527-37.
doi: 10.1177/0363546512445167. Epub 2012 Apr 26.

A randomized trial comparing accelerated and traditional approaches to postoperative weightbearing rehabilitation after matrix-induced autologous chondrocyte implantation: findings at 5 years

Jay R Ebert [1], Michael Fallon, M H Zheng, David J Wood, Timothy R Ackland

ACI (Autologous Chondrocyte Transplantation)

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A randomized trial comparing accelerated and traditional approaches to postoperative weightbearing rehabilitation after matrix-induced autologous chondrocyte implantation: findings at 5 years

Jay R Ebert [1], Michael Fallon, M H Zheng, David J Wood, Timothy R Ackland

  - **Brittberg et al: MACI vs. Microfracture in 128 pts**
    - KOOS at 2-years: MACI > Microfx
    - Pain and function at 5-years: MACI > Microfx
    - MRI healing: MACI = Microfx
    - MRI thus not good surrogate for clinical effect

Randomized Controlled Trial > Am J Sports Med. 2018 May;46(6):1343-1351.
doi: 10.1177/0363546518756976. Epub 2018 Mar 22.

Matrix-Applied Characterized Autologous Cultured Chondrocytes Versus Microfracture: Five-Year Follow-up of a Prospective Randomized Trial

Mats Brittberg [1], David Recker [2], John Ilgenfritz [3], Daniel B F Saris [4 5 6];
SUMMIT Extension Study Group [7]

Treatment options

- Operative
  - Chondroplasty
  - Microfracture
  - OAT (osteochondral autograft transplantation)
  - OCA (osteochondral allograft transplantation)
  - ACI (autologous chondrocyte implantation)
  - Osteotomies
- Non-operative
  - PT
  - Injections

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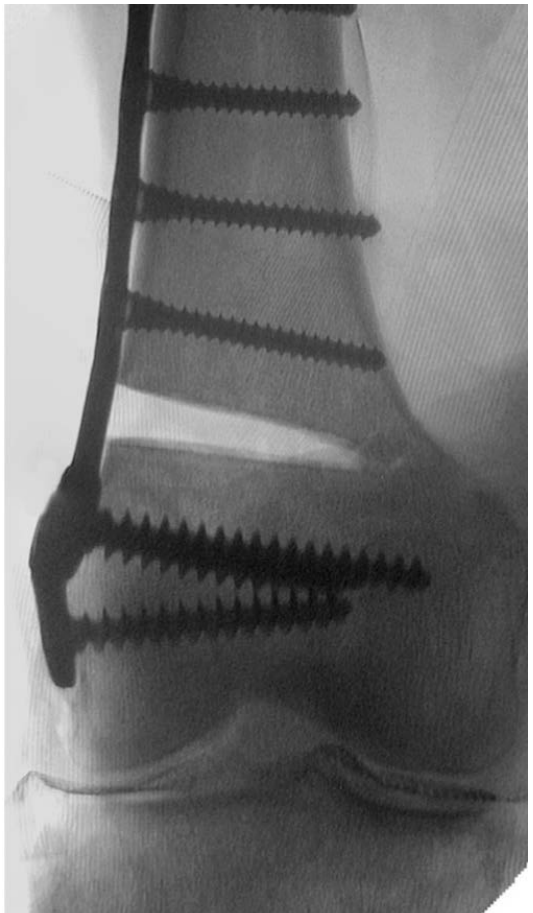
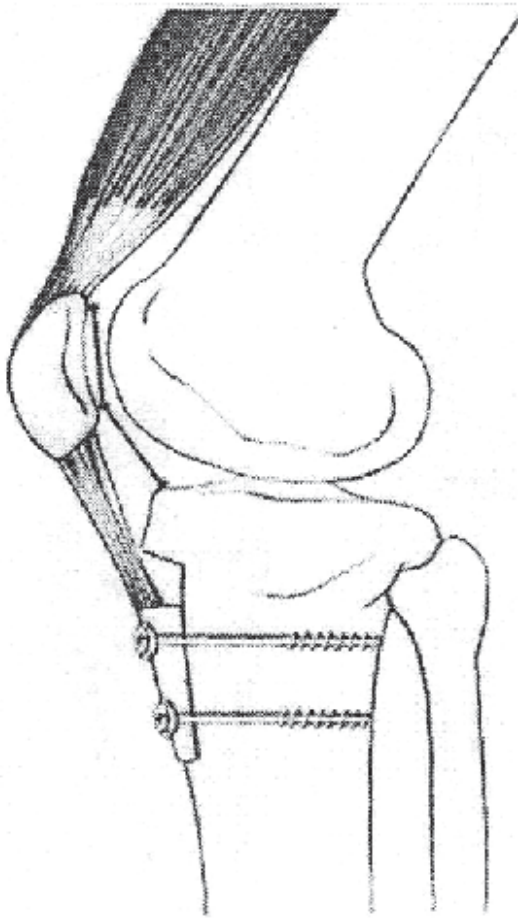
Osteotomies

- Procedures in which the bone is cut and stabilized to correct angular deformities of the knee to prevent progression or development of unicompartmental osteoarthritis





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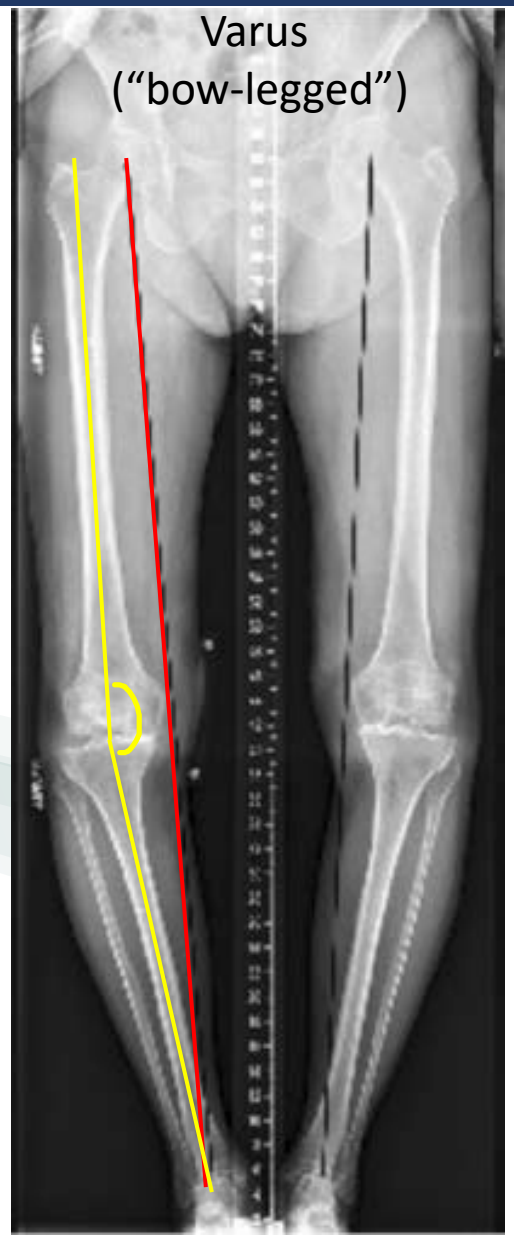
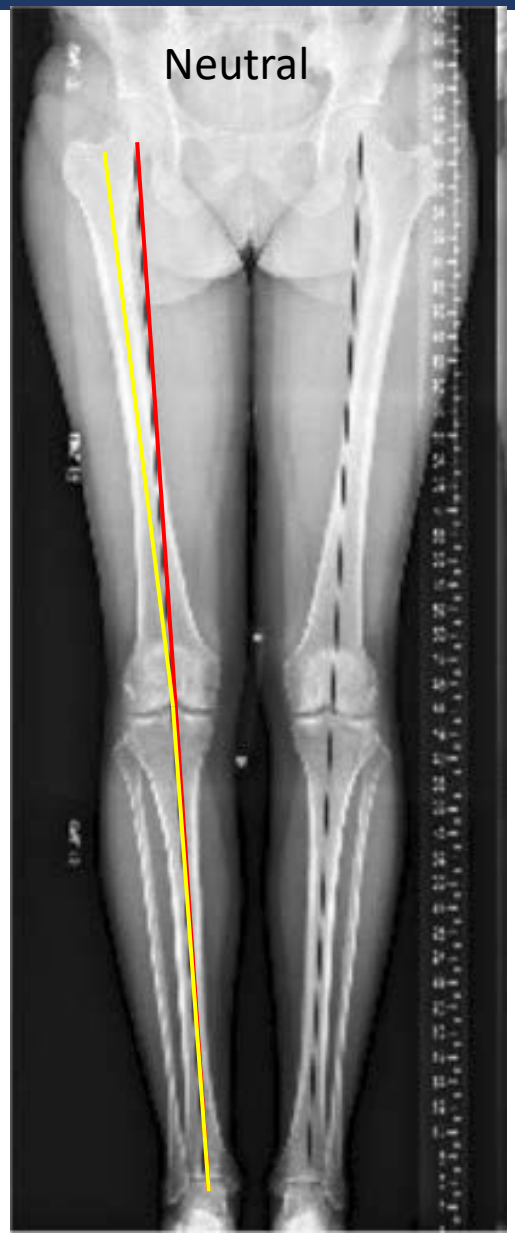
Osteotomies





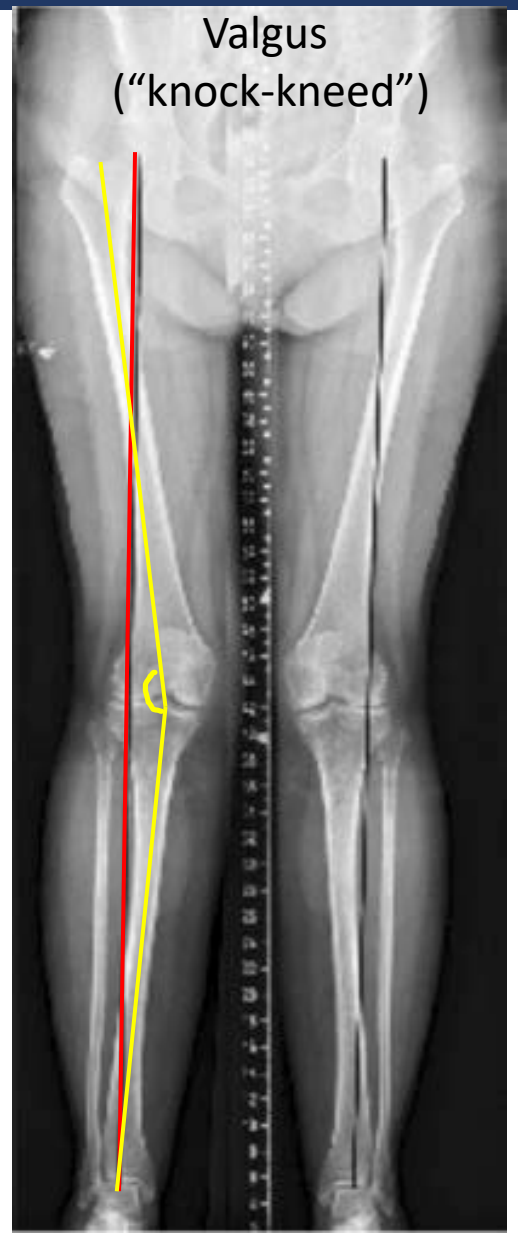


Image source: Biol Sex Differ . 2012 Dec 23;3(1):28. doi: 10.1186/2042-6410-3-28.

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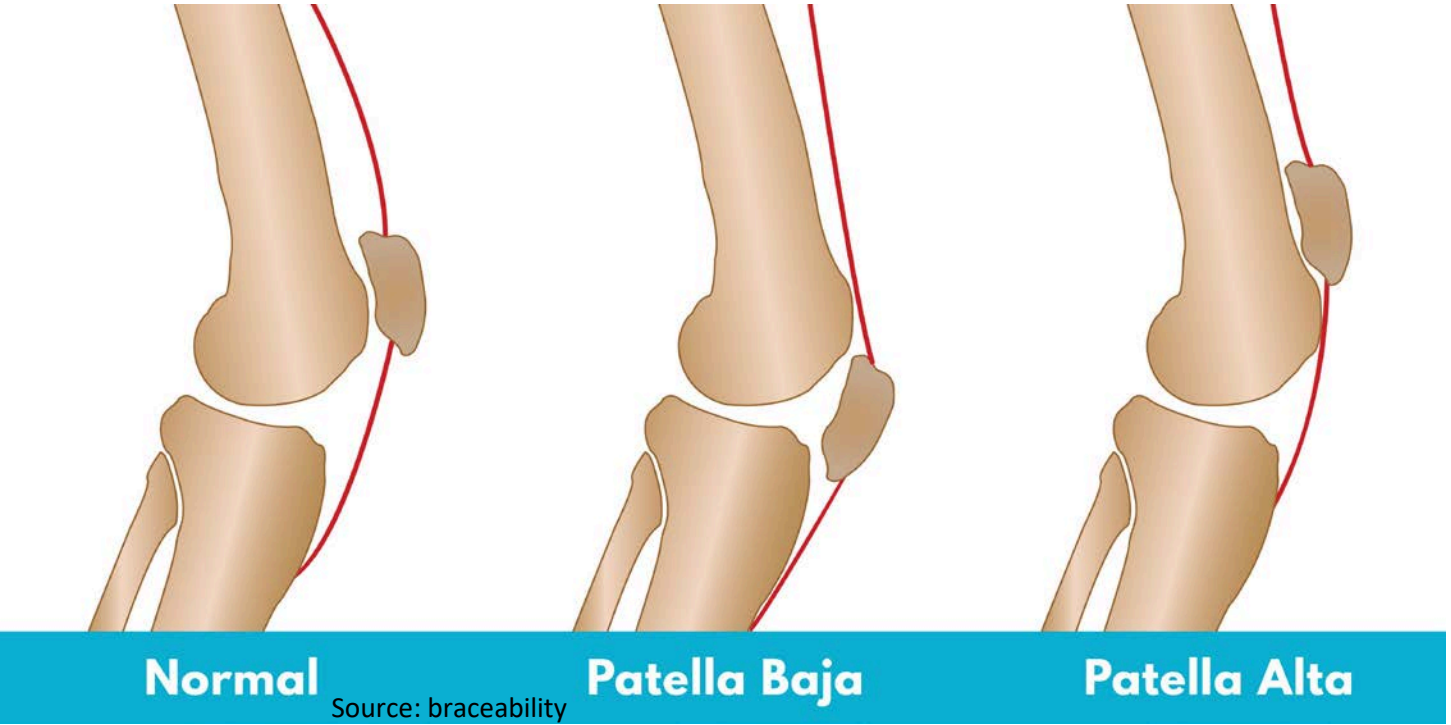
Osteotomies

- Patellofemoral mal-alignment
  - Patella Alta
  - Patella Baja
  - Lateral patellar tilt
  - Trochlear dysplasia



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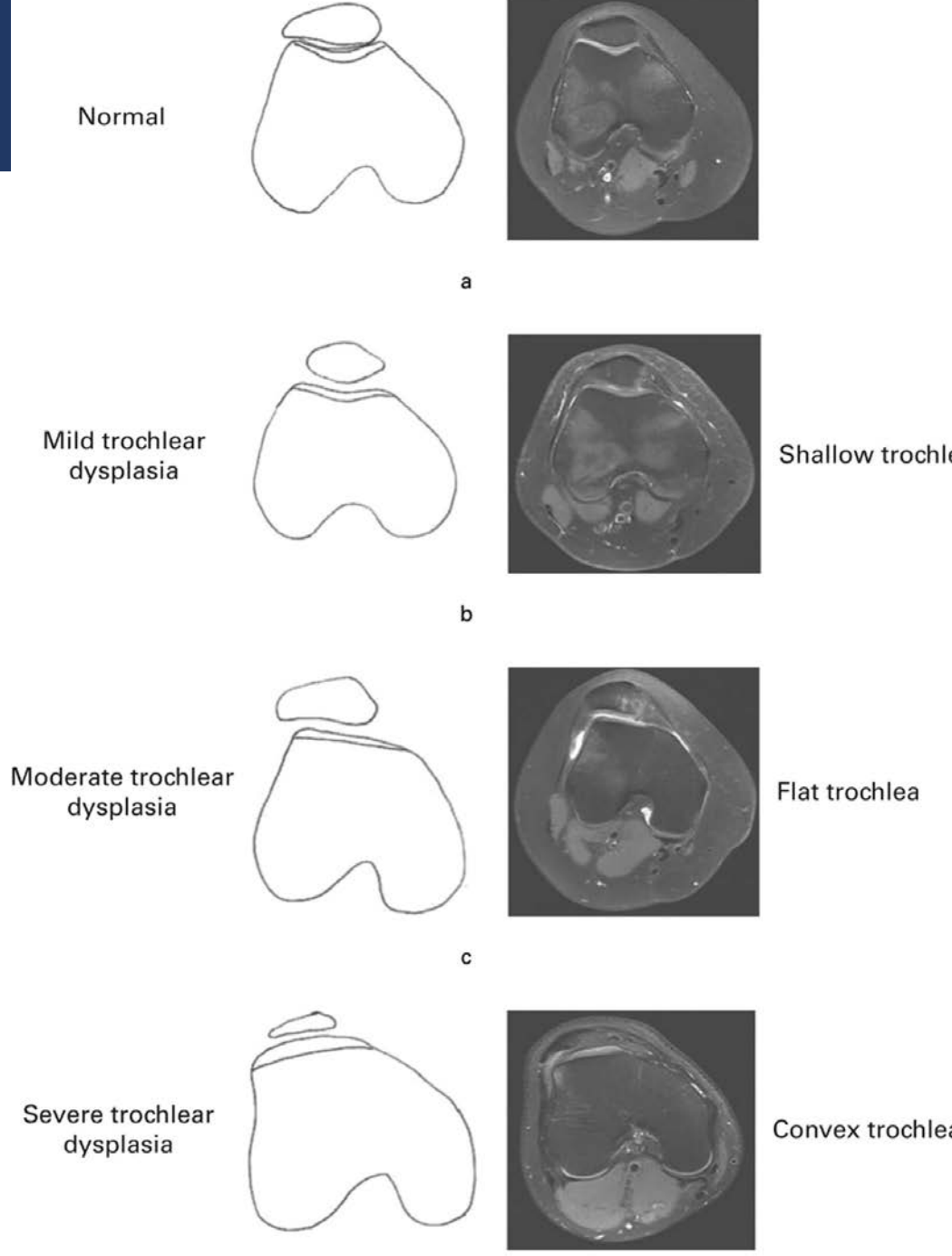

Source: Bone& Joint open journal 2020

Osteotomies

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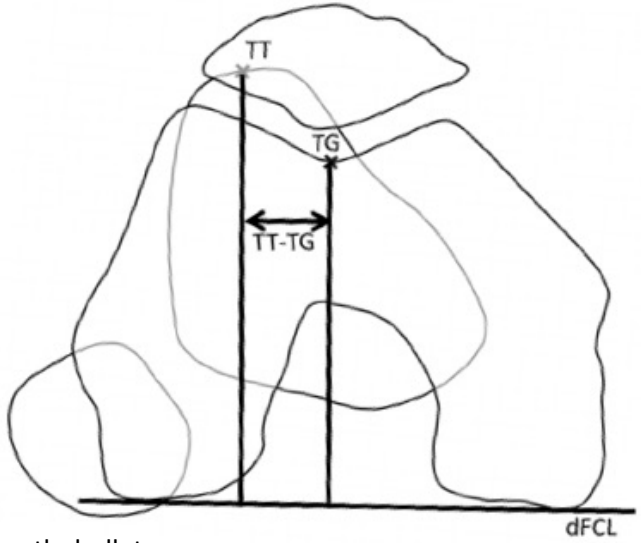
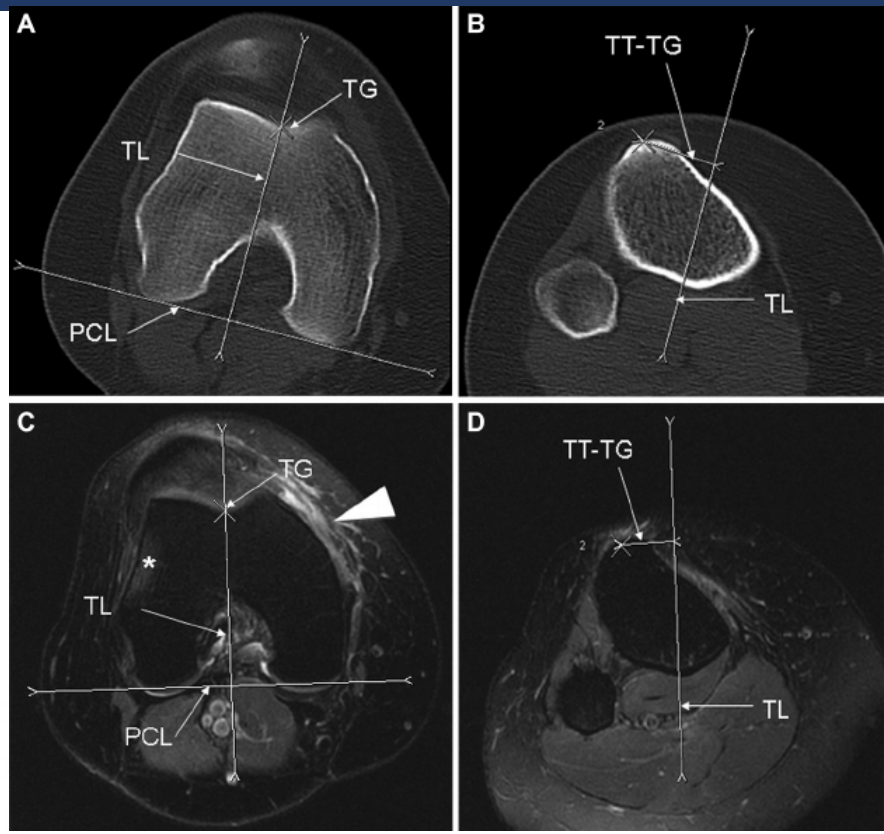


Source: orthobullets



Source: AJSM 2020

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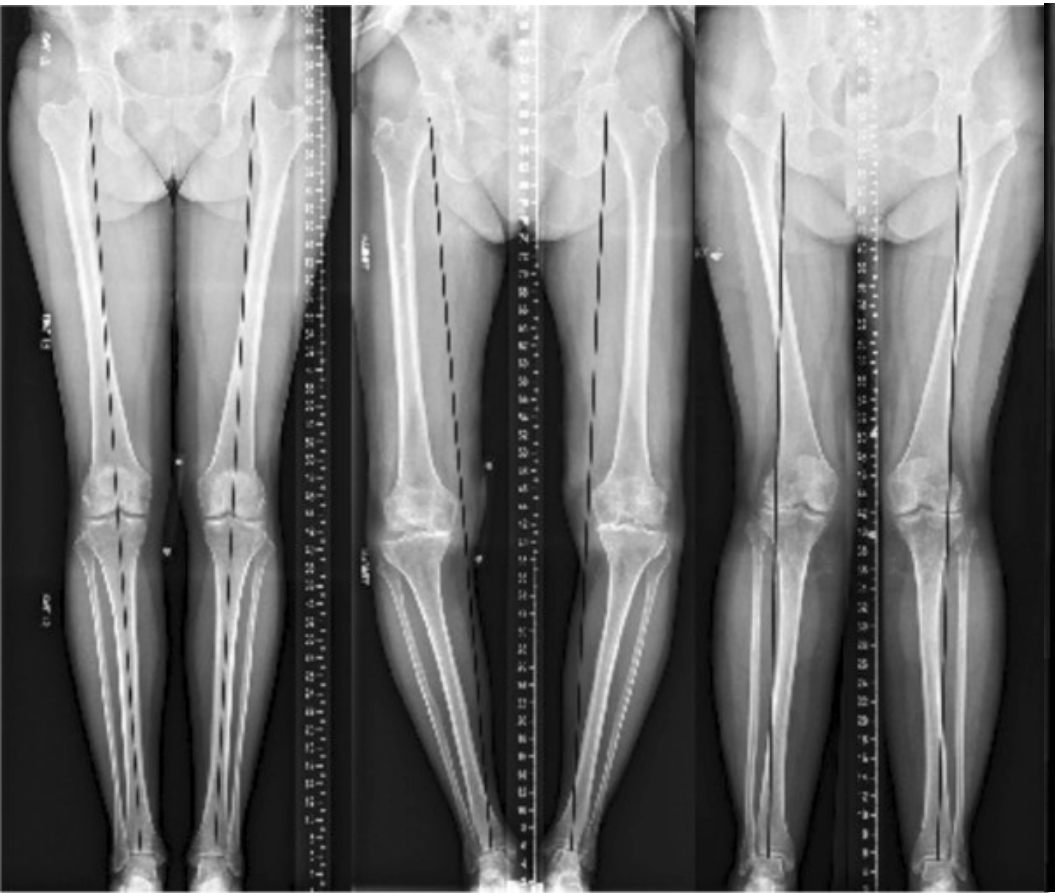
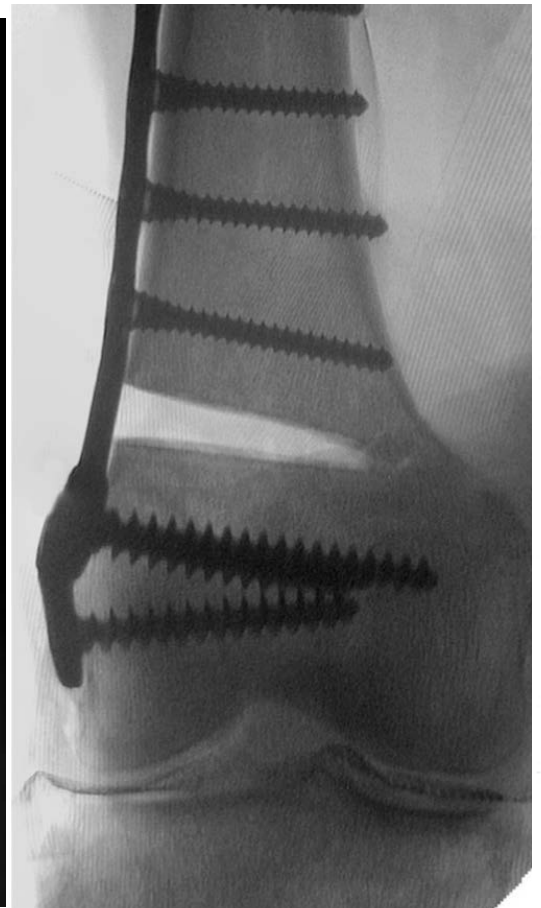
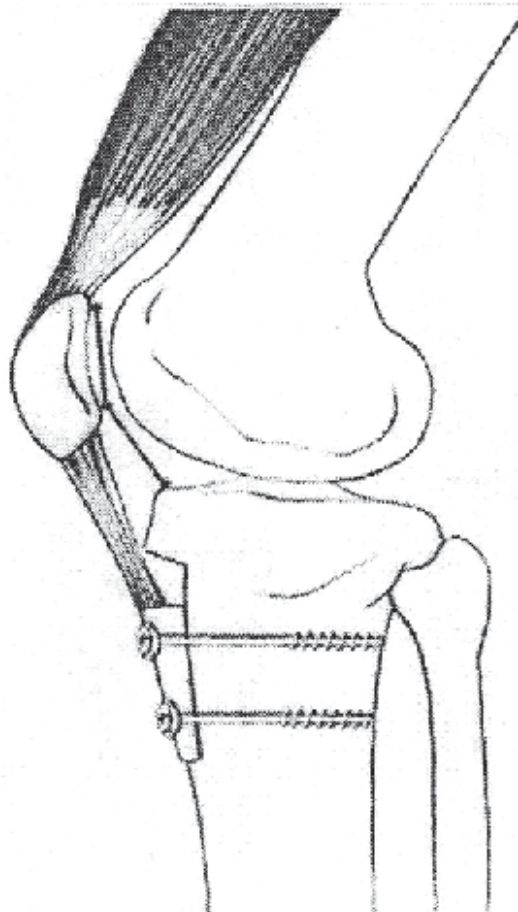
Osteotomies

- Procedures in which the bone is cut and stabilized to correct angular deformities of the knee to prevent progression or development of unicompartmental osteoarthritis



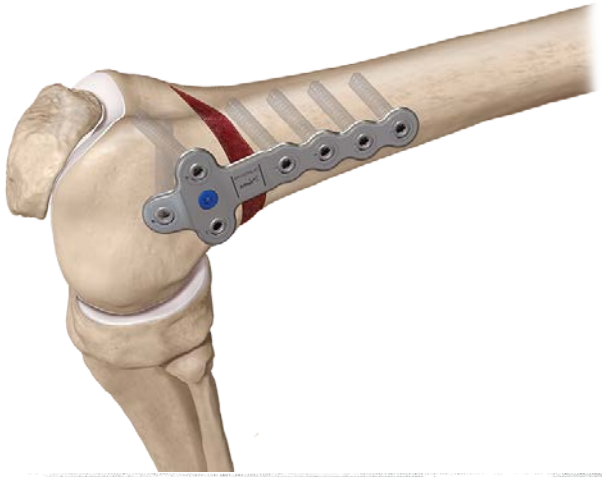



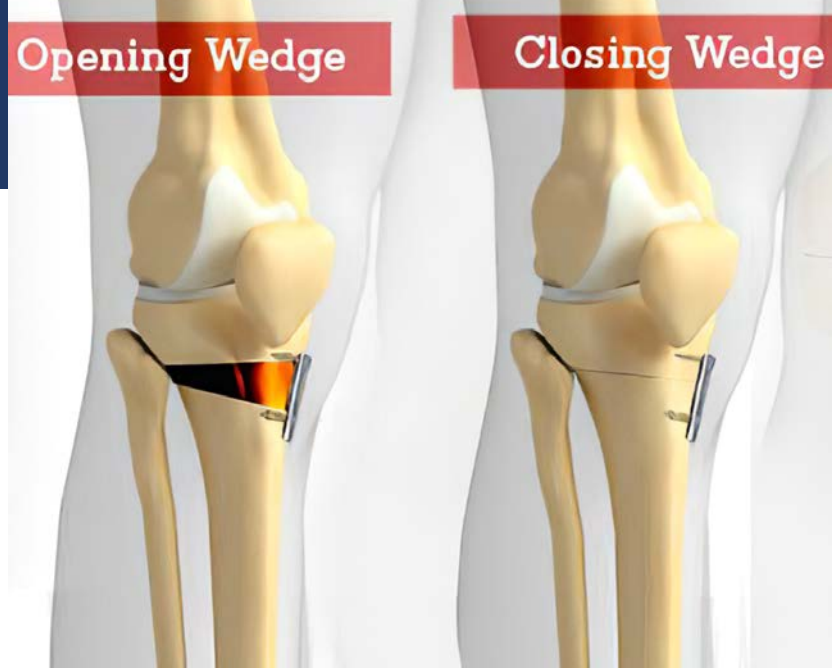
Osteotomies

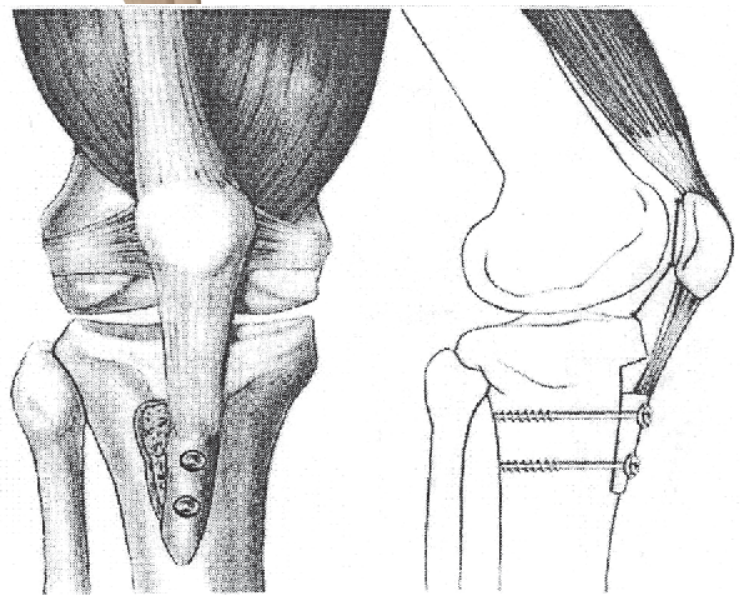
- Correct varus, valgus, or patellofemoral alignment
- Sometimes need to be performed in conjunction with ACI, OCA, OATs procedures
- Key to look at alignment before proceeding with any of the above
- How to order images:
  - Full length alignment films (not available everywhere)
  - CT scanogram
    - Eval alignment

Osteotomies

- Complex subject (need separate presentation)
  - High Tibial osteotomy
    - Opening
    - Closing
  - Distal femoral osteotomy
    - Opening
    - Closing
  - Tibial tubercle Osteotomies
    - Distalization
    - Medialization
    - Antero-medialization







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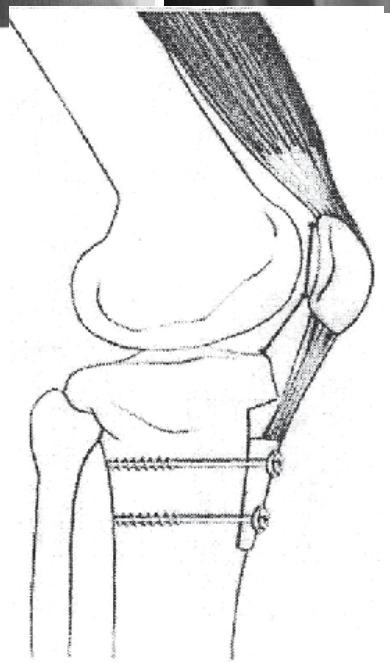
Osteotomies

- Big time surgery gets big time complications
  - Non-union
  - Mal-union
  - Recurrence
  - Compartment Syndrome
  - Nerve Palsies
  - Ligamentous incompetency

- Outcomes
  - Varus-producing high tibial osteotomy
    - 87% successful in 10 years
  - Valgus-producing high tibial osteotomy
    - 50-85% in 10 years



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Return to sport?

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Return to sport?

- Pre-op Factors
- Intra-op Factors
- Post-op Factors

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Return to Sport (RTS)

- Pre-op factors
  - Age
    - < 25 have higher return to sport
    - Many confounding factors
      - More failed surgeries
      - Natural decrease in activity
  - Level of sports participation
    - Higher level of RTS in elite athletes
      - Access to elite rehab
      - Timely recognition and surgery
      - Motivation
  - Pre-op duration of symptoms
    - Shorter duration of symptoms→ higher RTS
  - Previous surgeries
    - More surgeries→ lower RTS

Functional Outcomes and Return to Sport After Cartilage Restoration of the Knee in High-level Athletes

Mehran, Nima MD; Singla, Varun MD; Okoroha, Kelechi R. MD; Mitchell, Justin J. MD

Author Information

Journal of the American Academy of Orthopaedic Surgeons 29(21):p 910-919, November 1, 2021. | *DOI:* 10.5435/JAAOS-D-21-00242

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Return to Sport (RTS)

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- Intra-op factors
  - Defect Size
    - Higher RTS with smaller lesions for microfx and OAT
    - Similar RTS for OCA or ACI regardless of lesion size
  - Defect location
    - OAT
      - Higher RTS with femoral condyle lesions
      - Lower RTS with trochlea, patella, tibial lesions
    - Microfracture
      - Similar RTS for femoral condyle and trochlear lesions
    - ACI
      - Similar RTS for all lesion locations

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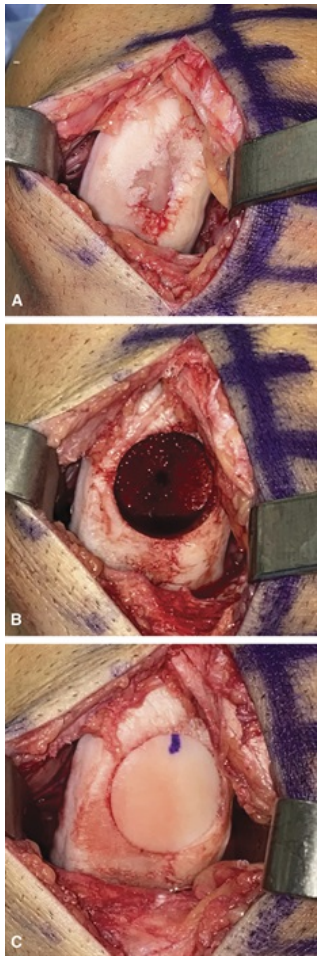
Return to Sport (RTS)

> Am J Sports Med. 2017 Jun;45(7):1608-1614. doi: 10.1177/0363546517694857. Epub 2017 Apr 4.

Return to Sport and Recreational Activity After Osteochondral Allograft Transplantation in the Knee

E Scott Nielsen [1], Julie C McCauley [2], Pamela A Pulido [2], William D Bugbee [1]

- Post-op factors
  - Limited data
  - 142 OCA patients
    - 75.2% returned to sport
    - 24.8% did not
      - 72% confident knee could tolerate sports
      - 41% reported concerns over reinjury
      - 24% health concerns unrelated to knee
      - 12% less interest in their sport
      - 12% cited family or career considerations



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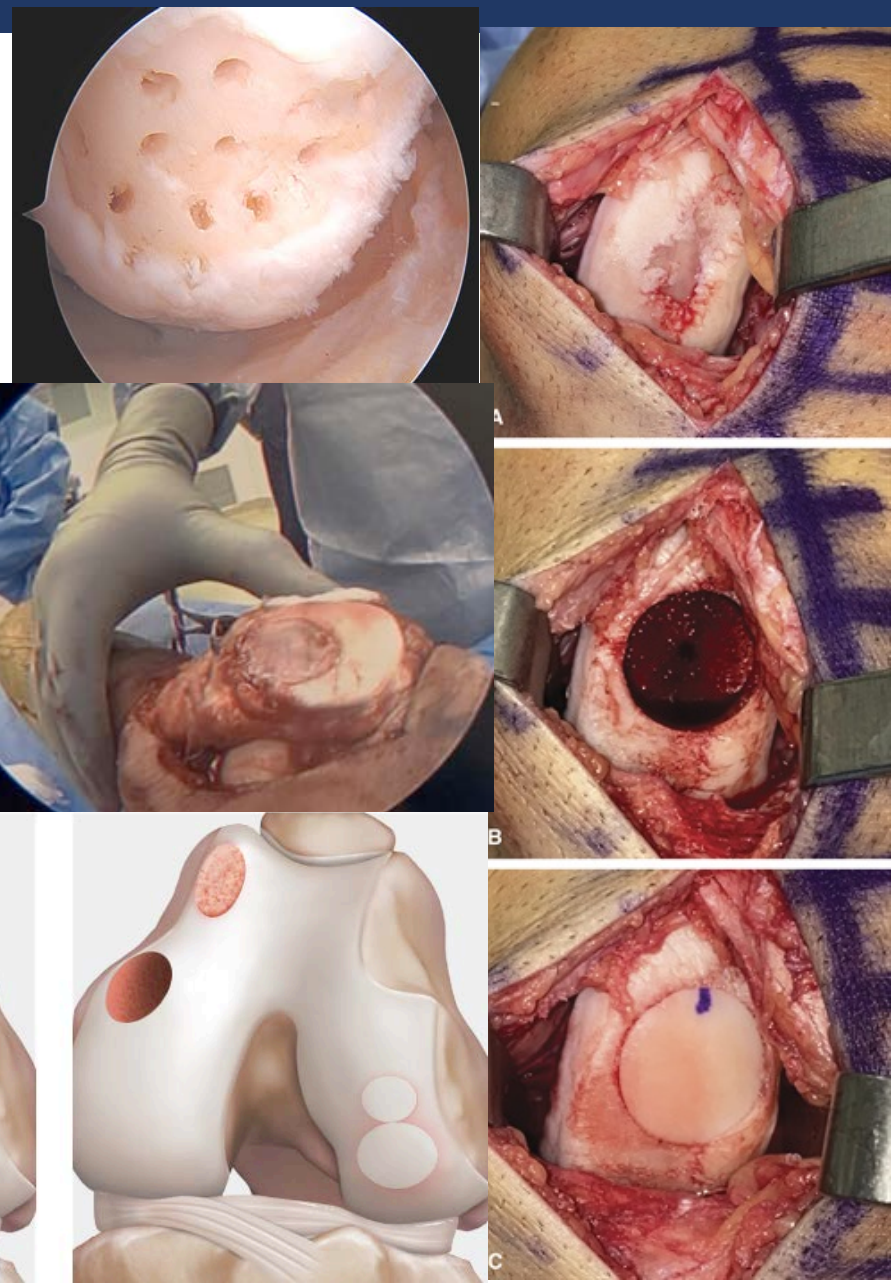
Return to Sport (RTS) comparison by procedure

- Overall satisfactory return to sport rates after all cartilage repair methods (~76%)
  - OAT: 93%
  - OCA: 88%
  - ACI: 82%
  - Microfx: 58%
- Time to RTS
  - OAT: 5.2 months
  - Microfx: 9.1 months
  - OCA: 9.6 months
  - ACI: 11.8 months
- Rate of return to pre-injury level play
  - Highest: OAT 79.3%
  - Lowest ACI 57.3%



Back to the cases: Which one do I choose?

- Operative
  - Chondroplasty
  - Microfracture
  - OAT (osteochondral autograft transplantation)
  - OCA (osteochondral allograft transplantation)
  - ACI (autologous chondrocyte implantation)
  - Osteotomies
- Non-operative
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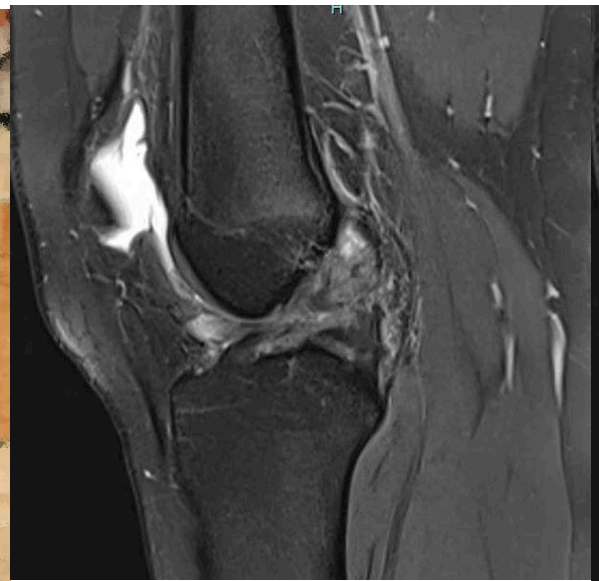
Case 1-Summary and resolution

- 18 F, volleyball athlete with a left knee:
  - ACL tear
  - Lateral meniscus tear
  - Lateral femoral condyle cartilage defect



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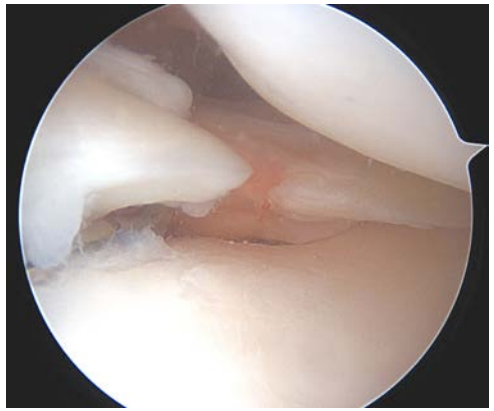
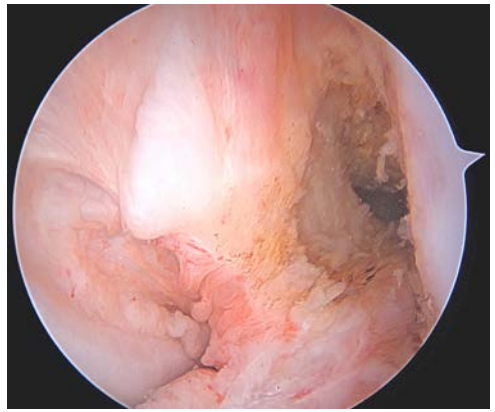
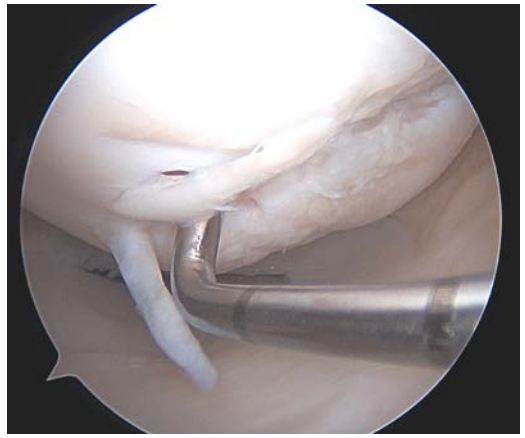
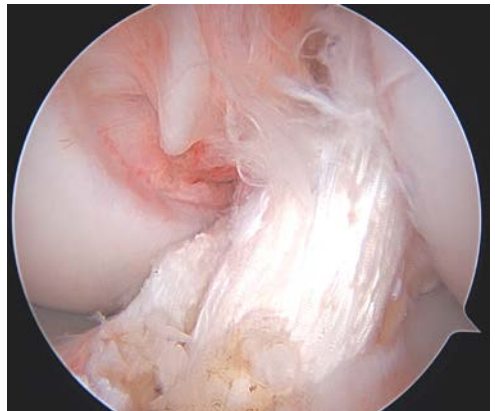
Case 1-Summary and resolution

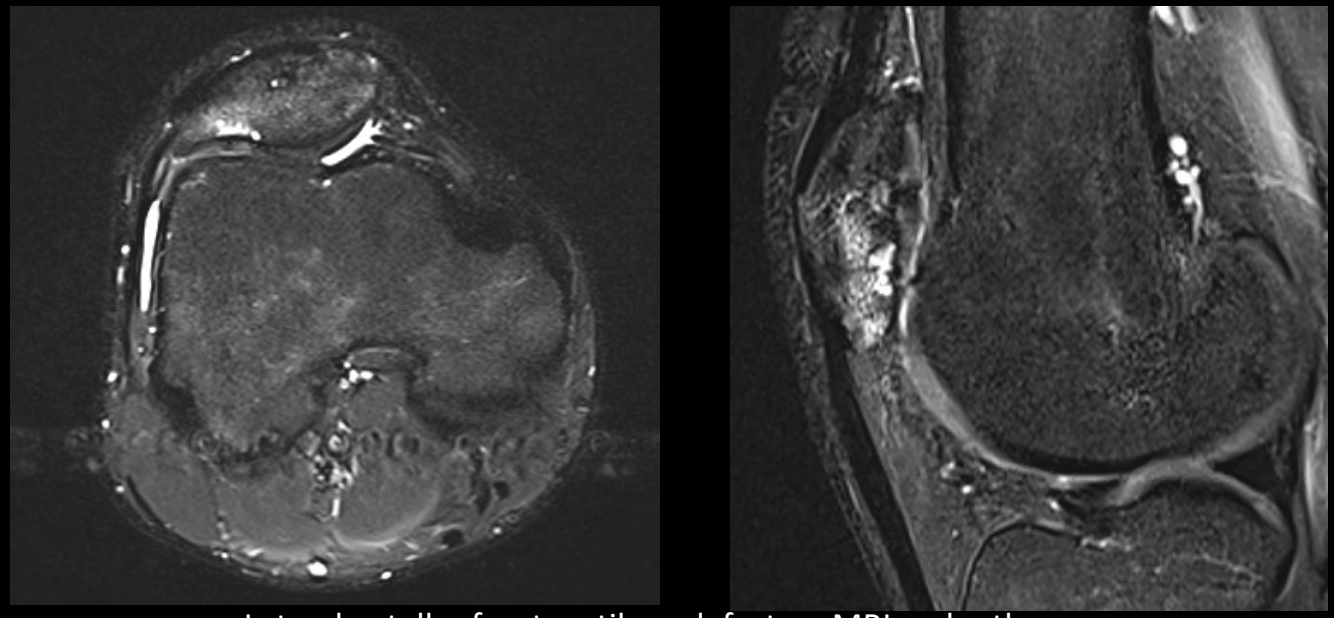
- 18 F, volleyball athlete with a left knee:
  - Lateral meniscus tear→ Lateral meniscus repair
  - ACL tear→ ACL recon with Quad tendon autograft
  - Lateral femoral condyle cartilage defect→ microfracture

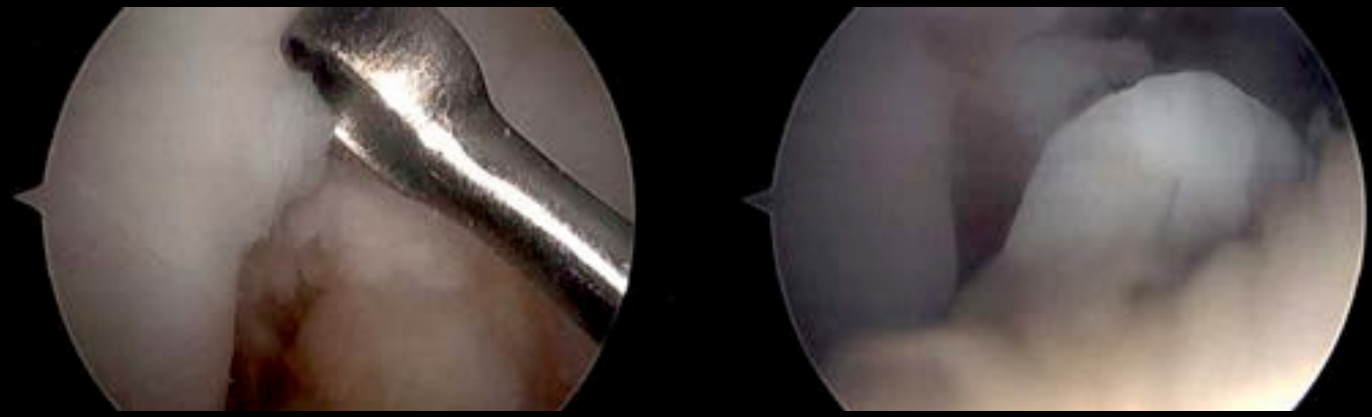



Case 2-Summary and resolution

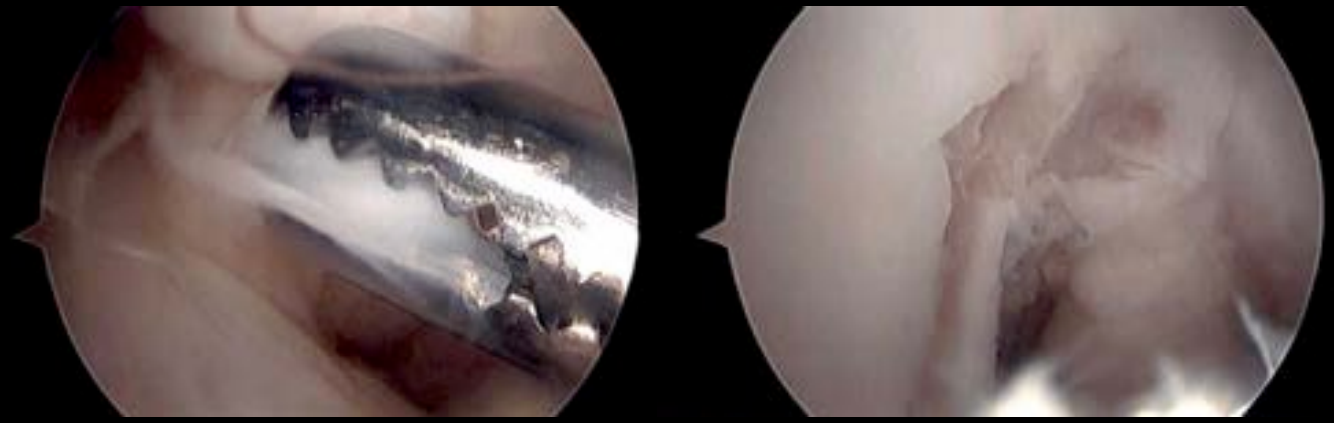
- 21 M runner with osteochondral defect in lateral patellar facet after recurrent traumatic patella dislocations s/p MPFL recon by outside surgeon→ 2 stage MACI procedure



Lateral patellar facet cartilage defect on MRI and arthroscopy



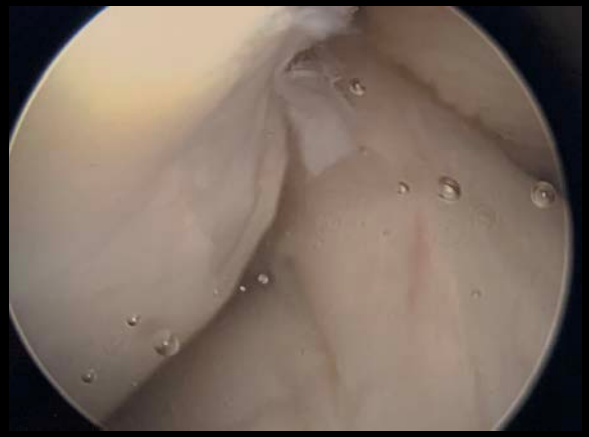
Stage 1: Cartilage harvest



Stage 2: Diagnostic arthroscopy part

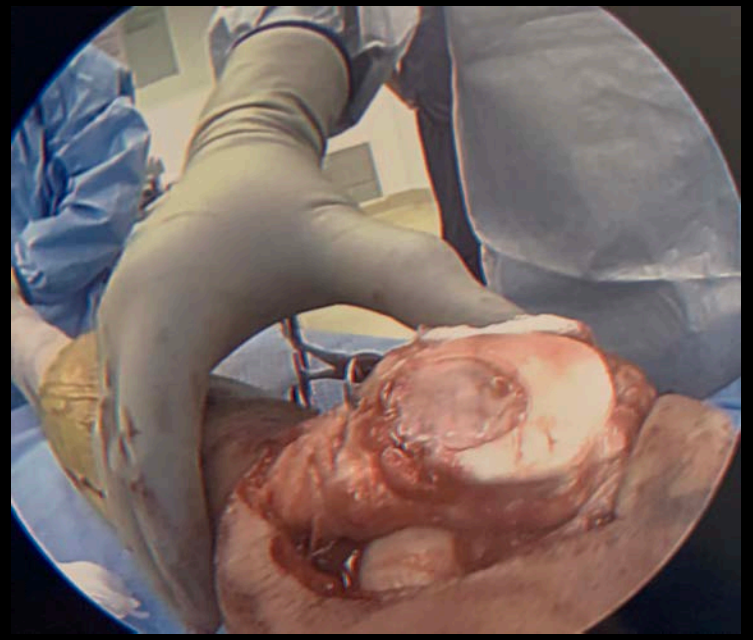
Patellar defect

Patellar defect: note soft cartilage



Fibrocartilage formed in previous
Cartilage harvest site

Stage 2: Open procedure for MACI implantation



After cartilage defect is removed

After the MACI implantation onto the cartilage defect

Summary

- Articular cartilage lesions are on the rise in athletes
- PROs are satisfactory across all techniques
- Alignment needs to be evaluated and corrected
- Most athletes return to sport regardless of technique
  - OAT may provide highest RTS and shortest RTS
    - Limited to smaller defects
- Multiple factors affect RTS
- **Choose the procedure that best fits your patient and the lesion!**

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Thank you

Banner Sports Medicine Center
Scottsdale, AZ
Opening May 2023!

- Questions?

- Email: rafael.buerbasiller@bannerhealth.com

- Socials: @drbuerba

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