Patella Instability in Adolescents

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Objectives

- Understand the anatomy of the patellofemoral joint
- Name anatomical risk factors that place one at risk for patella instability
- Implement reduction technique for a patella dislocation
- Discuss a conservative treatment plan for a young athlete with patella instability
- Remember surgical indications for patella instability

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Introduction

- Patellofemoral Instability
  - ✓ Spectrum of diseases
  - ✓ Common and complex problem
  - ✓ Significant morbidity
- A nuanced and individualized approach is necessary
- Management continues to evolve

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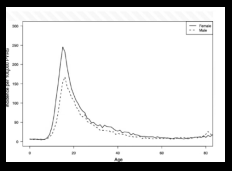
Epidemiology



Incidence of primary patella dislocation

- 29-50/100,000 per year (peds)
- 3% of knee injuries
- 70% occur during sport
- Peak age 15
- Lateral most common
- 15-40% will have recurrence
- > 2 episodes, 50% recurrence
- 5-8% contralateral dislocation
- Most common cause of knee hemarthrosis in adolescents

Patellar Instability in Young Athletes
Parikh, Shital N. et al.
Clinics in Sports Medicine, Volume 41, Issue 4, 627 - 651

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Risk Factors

- Female
- Obesity
- Ligamentous laxity
- Bony malalignment
- Connective tissue disorder
- Family History
- Sport participation
- Previous patella instability on either side

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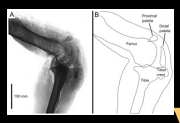
Patella

- "Kneecap"
- "Shallow dish"
- Sesamoid bone
- Fundamental for extensor mechanism
- Found in many mammalian tetrapods, birds, and lizards but absent in reptiles, most mammalian marsupials, or whales
- Discovered in frogs in 2017
- Likely evolved 350 million years ago



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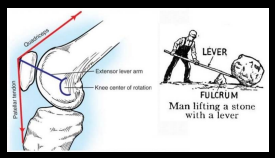
Function of The Patella



- Enhances mechanical advantage of quadriceps muscle /extensor function
- Less force is required from the quad to extend
- Protects the knee joint
- Starts to engage with the trochlea at about 20 degrees of flexion, max contact 90 degrees

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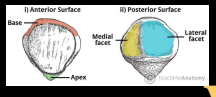
Anatomy

- Ossifies age 3-6 yrs – two centers that fuse
- 2-3% bipartite- failure of fusion
- Flat triangular bone that articulates with the femur
- Stability relies on bony morphology and soft tissue restrains



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Patella Stabilizers

- Passive:
  - ✓ Medial patellofemoral ligament (MPFL) Primary stabilizer against lateral displacement
    - Primary restraint in the first 20-30 deg of flexion
    - + tensor fascia lata, knee capsule, retinaculum
  - ✓ Bony stabilizers of patellar-femoral joint
    - Stability in deeper knee flexion
- Dynamic:
  - ✓ Vastus medialis- controls patella movement in trochlear groove

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Dislocation Vs Subluxation

- Dislocation- complete displacement of patella
- Subluxation- partial displacement of patella
- Maltracking- dynamic malalignment during motion

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Patella Instability

- Categories:
- Congenital
- Obligatory
- Acute traumatic- equally by gender
- Recurrent/ Chronic instability
- Habitual- usually painless, occurs during each flexion
- Syndromic: Associated with neuromuscular, connective tissue d/o or syndrome

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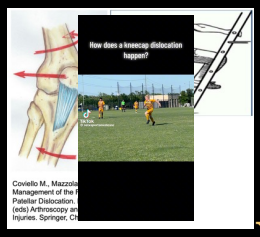
Injury Mechanism

- Contact (7%) or non-contact (93%). Some recent studies show higher contact.
- Sudden giving way or locking under load in stance phase and a combination of valgus-flexion-external rotation
- Quad commonly contracted
- Rapid deceleration & twisting
- Direct contact to partially flexed knee
- Many will describe the patella as displacing medially



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Chronic Instability Presentation

- Anterior knee pain
- Subjective feeling of unstable patella
- Decreased level of functioning
- Decreased confidence in physical activity
- Locking/ catching = mechanical symptoms
- Findings of maltracking or subluxation on exam
- +/- effusion

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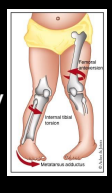
Physical Exam

- Common findings:
  - ✓Knee effusion
  - ✓Tenderness medial patella, lateral femoral condyle
  - ✓Absent Lachman
- Contralateral knee exam--> may demonstrate anatomical risk factors
- Limb alignment
- Rotational alignment



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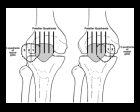
Physical Exam

- Patella translation
- Patella apprehension test
- J-sign
- Q- Angle

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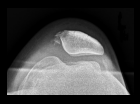
Imaging: X-Ray


Lateral dislocation



Medial patella avulsion fracture

- X-ray: Knee
  - ✓Anatomy
  - ✓Osteochondral loose bodies (medial patella facet/ lateral femoral condyle)
  - ✓Medial patella avulsion fractures
  - ✓Lateral: Patella height
  - ✓Trochlea dysplasia – limited utility
- X-ray: Lower extremity alignment

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Imaging: MRI

- MRI
  - ✓Contusion pattern
  - ✓Loose bodies - also CT
  - ✓Ligamentous injury- MPFL tear
  - ✓Osteochondral lesions – also CT
  - ✓Anatomy – also CT(TT-TG distance)

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Anatomical Risk Factors

- Anatomy greatly impacts recurrence/ chronic instability and dictates management
- Trochlea dysplasia
- Patella alta
- Excessive TT- TG distance
- Q angle- increase lateral force on patella
  - ✓Miserable malalignment: femoral anteversion, genu valgum, external tibial torsion/pronated feet
- Patella tilt angle
- Increased J angle
- Muscular abnormalities: dysplastic vastus medialis oblique and overpull of lateral structures such as IT band

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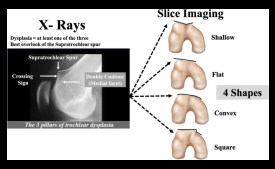
Trochlear Dysplasia

- Pathologic alteration of the femoral trochlea
  - ✓Decreased depth, convex, or flat
- 3x risk of recurrent instability
- Can decrease lateral stability by 70%
- X-ray:
  - ✓Crossing sign
  - ✓Supratrochlear spur
  - ✓Double contour sign



Dejour, D.H., Mesnard, G. & Giovannetti de Sanctis, E. Updated treatment guidelines for patellar instability: "un menu à la carte". *J Exp Ortop* **8**, 109 (2021).

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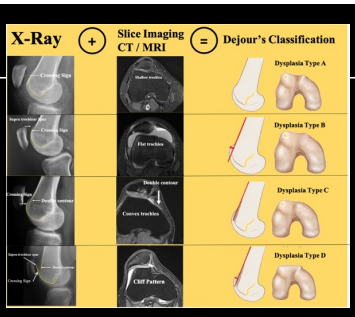

Classification based on lateral radiograph and axial imaging on CT or MRI

A. Shallow trochlea
B. Flat trochlea
C. Convex trochlea
D. Cliff pattern w/ convex lateral and hypoplastic medial femoral condyles

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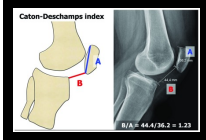
Patella Alta



- More proximal position of the patella
- Present in 50-60% patella dislocations
- Delay in patella engagement within the groove during early flexion
- Increased free motion-without bony constraints in range
- Caton –Deschamps Index: patella inferior pole to antero-superior tibial plateau: length of the patella articular surface
  - ✓ Alta:> 1.2
- There are many additional ways to measure

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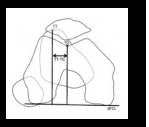
TT- TG Distance

- Measures lateralization of the tibial tubercle
- Measure of the lateral quadriceps vector acting on the patella
- Tibial tuberosity to trochlear groove distance
- CT and MRI
- Low reproducibility
  - ✓ Normal: <15 mm
  - ✓ Borderline: 15-20 mm
  - ✓ Abnormal: >20 mm
- TT – PCL maybe alternative



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Q -Angle

- Measured by extending a line through the center of the patella to the anterior superior iliac spine and another line from the tibial tubercle through the center of the patella. The intersection of these two lines is the Q-angle.
- Measure of lateral force on patella
- Normal 13-18 degree in female; 12-15 degrees in males
- Common causes: femoral anteversion, external tibial torsion, lateralized tibial tubercle, genu valgum

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Associated Injuries

- MPFL injury – up to 90% acute dislocations, increased risk of recurrence
- Up to 1/6 traumatic patella dislocations have osteochondral fragments. (most common spontaneous reduction)
  - ✓Medial patella facet, lateral femoral condyle
  - ✓Typically occurs during relocation
- Up to 90% have chondral injury
- Extra-articular bony avulsion
  - ✓Most common off the MPFL

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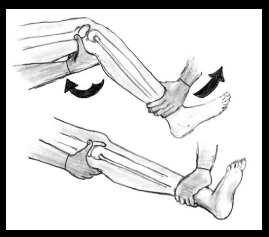
On-Field Management



- Knee may be locked in flexion
- Spontaneous reduction is common
- Reduce with gentle knee extension

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Initial Management

- Effusion management:
  - ✓Protection: may include short-term immobilization < 21 days
  - ✓+/- Arthrocentesis
  - ✓Rest from activity
  - ✓Ice
  - ✓Compression
  - ✓NSAIDS
  - ✓Elevation
  - ✓Gentle range of motion
  - ✓Crutches as needed
  - ✓Can consider aspiration
- Patella stabilizing brace
- Rehabilitation
- Short-term immobilization is controversial

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Immobilization Controversy

- Early mobilization: Improved ROM, strength, proprioception, with a downside of slightly increased dislocation risk in short-term
- Prolonged immobilization: Stiffness, cartilage degeneration, muscle wasting.
- Small randomized study: tape vs cylindrical cast – improved function w/tape. No re-dislocations either group

Vermeulen D, van der Valk MR, Kaas L. Plaster, splint, brace, tape or functional mobilization after first-time patellar dislocation: what's the evidence? EFORT Open Rev. 2019 Mar 27;4(3):110-114. doi: 10.1302/2058-5241.4.180016. PMID: 30993012; PMCID: PMC6440297.
. Rood A, Boons H, Ploegmakers J, van der Stappen W, Koëter S. Tape versus cast for non-operative treatment of primary patellar dislocation: a randomized controlled trial. Arch Orthop Trauma Surg 2012;132:1199–1203. [PubMed]

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Rehabilitation

- After pain control/ improvement of swelling
- Protected restoration of motion
- Normalize gait
- Restoration of strength
  - ✓Focus on quadricep (VMO specific exercises have not been shown to be superior)
  - ✓Short arc/ closed chain quad
  - ✓Quad strength
  - ✓Core/ hip- hip abductors, glutes, and abs
- Promote proprioception

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Conservative Management

- Mainstay for 1st time dislocations without significant osteochondral injuries or loose bodies
- Few randomized trials : 1st time
  - ✓Possibly reduced early re-dislocation in surgical
  - ✓Post op complications
  - ✓Higher rates of arthritis surgical
  - ✓Functional and subjective ratings similar in pediatric and adult trials

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Surgical Indications

- Major injury to medial stability structures: findings of subluxation
- Anatomical predisposing factors
  - ✓Malrotation
  - ✓Malalignment
- Recurrent- 2+
- Osteochondral fractures- 10% of patella or weight bearing surface of the femoral condyle
- Failed conservative therapy

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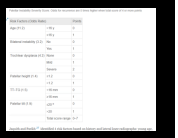
Complications

- Recurrence – 15-54% adolescent/ peds
  - ✓Majority in first five years after injury
- Persistent instability
- Pain
- Functional limitations
- Arthritis (adjusted odds ratio 3.2)
  - ✓20% by 20 years
- Medial instability (overcorrected surgical treatment)



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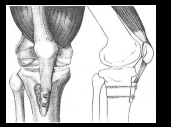
Surgical Options

- Arthroscopic debridement
- MPFL repair
- MPFL reconstruction- recurrent w/ no significant malalignment
  - ✓Graft: gracilis or semitendinosus
- Fulkerson Osteotomy +/- MPFL recon
  - ✓Tibial tubercle transfer, correct TT-TG
- Tibial tubercle osteotomy
- Lateral release/ lateral lengthening: not common
- Trochleaplasty: rare in US even in severe dysplasia, may consider in severe or revision
- Hemi epiphysiodesis- genu valgum, 6 months of growth remaining



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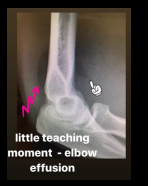
Return to Play

- 2/3 return to pre-injury level of participation in operative and non-operative groups
- Sport specific rehab (can use ACL recommendations for guidelines)
- No pain
- No effusion
- No subjective or dynamic instability
- Normal ROM
- Near equal strength to contralateral
- Sport-specific skills performance
- Timeframe: 9-12 weeks s/p injury
- Patella stabilizing brace up to 12 months s/p dislocation than as needed



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Patella Instability Summary

- Patella instability is a complex problem
- Patella instability has a high rate of morbidity with a high rate of recurrent injury, long-term pain and instability.
- High risk of patellofemoral arthritis in young adults.
- A nuanced approach to individual patients is important

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Resources

- Hasler CC, Studer D. Patella instability in children and adolescents. EFORT Open Rev. 2017 Mar 13;1(5):160-166. doi: 10.1302/2058-5241.1.000018. PMID: 28461943; PMCID: PMC5367529.
- Vermeulen D, van der Valk MR, Kaas L. Plaster, splint, brace, tape or functional mobilization after first-time patellar dislocation: what's the evidence? EFORT Open Rev. 2019 Mar 27;4(3):110-114. doi: 10.1302/2058-5241.4.180016. PMID: 30993012; PMCID: PMC6440297. Patellar Instability in Young Athletes
- Parikh, Shital N. et al.Clinics in Sports Medicine, Volume 41, Issue 4, 627 - 651
- **Gao, Chan and Aaron J. Yang. "Patellar Dislocations: Review of Current Literature and Return to Play Potential." Current Physical Medicine and Rehabilitation Reports 6 (2018): 161-170.**

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