PATELLOFEMORAL JOINT
REHABILITATION COMPONENTS

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Anatomy of the patella :

- Patella is triangular, apex directed downwards
- Anterior surface gently convex
- Deep surface partially articulating and changes throughout the ROM of the knee.
- Joint surfaces are not congruent. Upper 3/4th articulates

Functions :

- Patella functions to increase the level arm of the quadriceps mechanism 30%
- Mechanical advantage from the levering mechanism
- Effect is absent in full flexion as the patella sinks in the inter-condylar groove
- Beyond 10˚ of extension the lever arm is slightly reduced and necessitates increased quads force for the last few degrees of knee extension

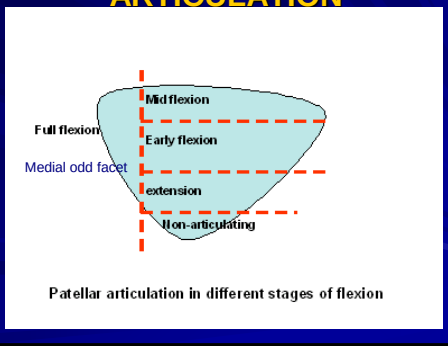
Functional anatomy:

- At full extension, the patella sits lateral to the trochlea.
- During flexion, the patella moves medial and comes to lie within the intercondylar notch until 130 when it starts to move laterally again.
- The patella's excursion is controlled by the quadriceps muscles, particularly the vastus medialis obliqus and vastus lateralis components.

Functional anatomy:

- With increasing knee flexion, a greater area of patellar articular surface comes into contact with the femur, thus, offsetting the increased load that occurs with flexion.
- Loaded knee flexion activities subject the patellofemoral joint to loads many times the body-weight
- Anatomically, the lateral structures of the patellofemoral joint are much stronger than the medial, imbalance in forces will cause the patella to drift laterally.

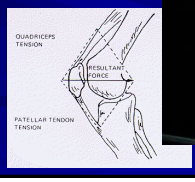
PATELLOFEMORAL ARTICULATION



Patellar articulation in different stages of flexion

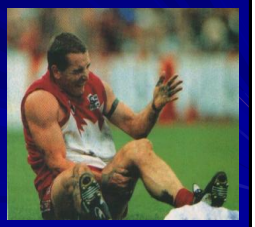
Patellofemoral Loading:

- Level walking: 0.5 x body-weight
- Going up stairs:3-4 x body-weight
- Squat:7-8 x body-weight



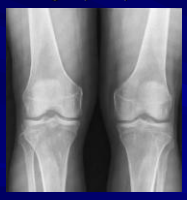
Anterior Knee Pain

- Most common knee complaint
- Need to discern between patellar
  - pain
  - instability
  - both pain and instability



Physical Exam and Radiographs

- Not all knee pain comes from knee pathology
  - Image hip or spine if history or exam suggests



  - ~5% of patients with hip arthritis present with isolated knee pain

Patellofemoral Categories of Disease:

- **Maltracking: Subluxation/ Dislocation**
- **Compression: Chondromalacia/OA**
- **Other: PFJS**

Ficat, P.R., D.S. Hungerford. Disorders of the Patellofemoral Joint. Baltimore: Williams & Wilkins 1977

Patellofemoral Categories of Disease:

- **Maltracking: Subluxation/DISLOCATION**

Dislocations are a separate management issue!

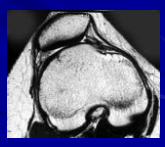
Patellar Instability

Lateral patellar subluxation or dislocation

knee flexion
tibial external rotation
valgus

Etiologies:

- an increased Q angle in early flexion
- incompetent MPFL
- shallow trochlea
- short trochlear groove (relative alta)

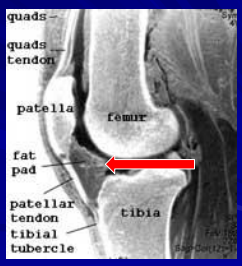


Problem

- Repeat patellar dislocators???

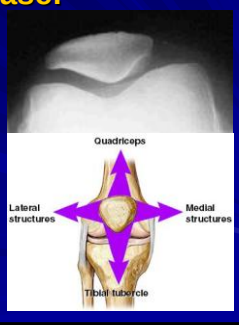
Patellofemoral Categories of Disease:

- **Compression:**
  - **Chondromalacia**
  - **OA**
  - **Impingement**



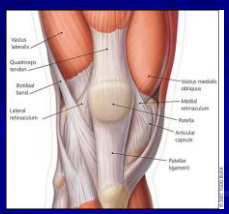
Patellofemoral Categories of Disease:

- **Other: PFJS**
- Muscle weakness or imbalance
- Previous knee injury
- Anatomy - wide hips, tibial torsion, flat feet
- Inflexible Achilles tendon, hamstrings (back of leg) or thigh muscles



What is PFPS/PFJS?

- Chondromalacia Patella?? (pathologic not general)
- Patellar Tendonitis
- Patellar Instability
  - Fat Pad Syndrome
  - Pre-patellar bursitis
  - Plica syndrome



Predisposing factors :

Abnormal biomechanics

- Excessive pronation
  Femoral anteversion
  (internal femoral torsion)
- High small patella
  (patella alta)
  Increased Q angle

Predisposing factors :

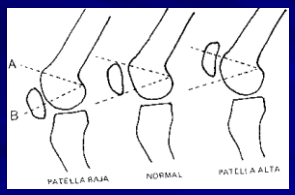
Soft tissue tightness

- Muscles
  Gastrocnemeus
  Hamstrings
  Rectus femoris
  Iliotibial band
- Lateral structures
  Lateral retinaculum
  Iliotibial band
  Vastus lateralis

Predisposing factors :

Muscle dysfunction

- Vastus medialis obliques
- Hip abductors/external rotators (gluteus medius and max)



Patellofemoral Malalignment Fulkerson Classification:

- type I, subluxation alone
- type II, subluxation and tilt
- type III, tilt alone
- type IV, no malalignment

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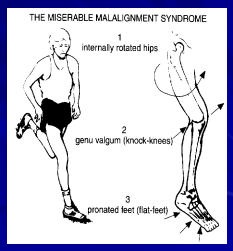
Exam findings most often associated with Patellofemoral Pain …..

- Quadriceps weakness
- VMO dysfunction
- Tight lateral structures
- Pes Planus
- Hip Abductor weakness
- Increased Q angle

Patello-Femoral Exam

- Lower Extremity Alignment
- Generalized Laxity
- Locations of Tenderness
- Patellar Alignment
- Passive Patellar Tilt
- Lateral and Medial Patellar Glide
- Patellar Apprehension
- Crepitation
- Q angle at 90 degrees



Radiographs

- Lateral Radiograph
  - Patellar Height
    - Blumenstaat's line
    - Physeal scar

Lateral Radiograph

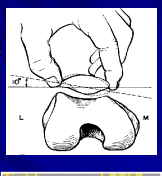
- *Insall-Salvati Ratio*
  - Defined as the length of the patella in relation to the length of the patellar tendon

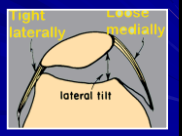
Assessment

- Survey
  - Knee Osteoarthritis Outcome Score
  - International Knee Documentation Committee Score
  - General Recovery Questions
- Physical Exam
  - J Sign
  - Apprehension
  - Subsequent Dislocations

Passive Patellar Tilt

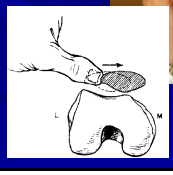
- Lifting the lateral border of the patella superiorly to assess the tightness of the lateral patellar-femoral retinaculum
- Inability to achieve horizontal is a positive test (excessively tight lateral structures)





Patellar Glides

- Lateral Patellar Glide
  - Manually sliding the patella laterally
  - Apprehension sign: when a lateral patellar glide produces fear of dislocation
- Medial Patellar Glide
  - Manually sliding the patella medially



McConnell Critical Test

- Multi angle isometric test
- Pain?
- Repeat with manual medial stabilization
- Pain?

PF Rehabilitation: Signs and Symptoms

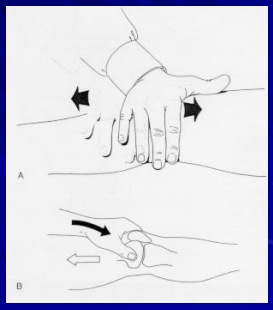
"Perkins" synovial pinch test

- Translate medial, pinch synovium against posterior surface
- Repeat laterally

PF Rehabilitation: Signs and Symptoms

Compression test:
"Grind Test"

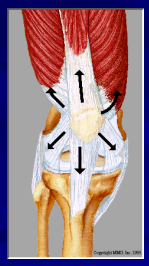
- Relax quads
- Compress proximal patella GENTLY
- Contract quads
- Many false positives (pain)

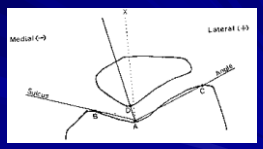


Q Angle

- Defined as the angle between
  - the axis of the femur to the center of the patella
  - the center of the patellar to the tibial tubercle
- **Assessment in flexion is more significant**
- Assessed in full knee extension and at 30 and 90º of knee flexion
- An increased Q angle increases the likelihood of lateral patellar subluxation

PF Rehabilitation: Conservative Management





PATELLOFEMORAL REHABILITATION

Numerous successful approaches exist for treating maladies of the patellofemoral joint. The focus of this presentation will be to present numerous components that may be included when treating the patellofemoral joint and the rationale for those components. This allows the clinician to develop an eclectic approach to patellofemoral rehabilitation by combining available equipment, knowledge of mechanics, and patient need.

PATELLOFEMORAL REHABILITATION

- Modalities

  Pain modulation - successful management of any musculoskeletal injury must include pain control. Common modalities include:

  1. Ice
  2. Electrical stimulation
  3. Ultrasound
  4. Laser; Iontophoresis; other

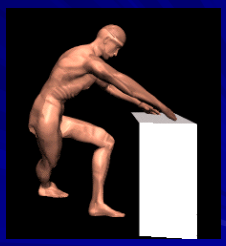
PATELLOFEMORAL REHABILITATION

- Neuro-Muscular Electrical Stimulation (NMES)

  A variety of devices and protocols exist to selectively activate the VMO and quadriceps musculature in cases of PFJS. The reader is referred to the literature for specific protocols.

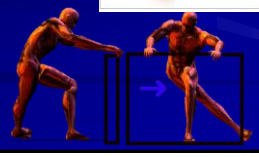
PATELLOFEMORAL REHABILITATION

- Stretching - numerous muscles other than the quadriceps have a dynamic impact on the patellofemoral joint. The following muscles in particular require attention and intervention.



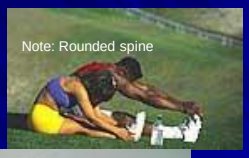
Ilio-Tibial Band (Tensor Fascia Lata)

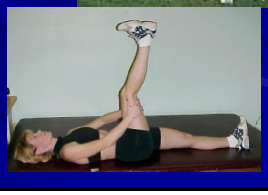
- A slip of the IT band inserts into the lateral patella. Tightness of this muscle increases lateral patellar tracking



Hamstrings

- Integral with the posterior capsule
- When tight increases patellofemoral compression





Gastrocnemeus

- Integral with the posterior capsule
- When tight increases patellofemoral compression

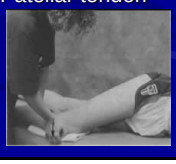
Quadriceps

- Often addressed only for strength.
- Tightness of the quadriceps can cause increased patellofemoral compression and/or patella alta which is associated with a less stable patella.

Mobilization

- Mobilization and passive or therapist induced movement patterns are an effective adjunct to patellar mobility. Special attention may be given to these structures, <u>especially their lateral components.</u>

- Capsule
- Capsular ligaments
- Patellar tendon



Orthotics/Taping

- Knee braces have proven an effective adjunct to patellofemoral rehabilitation, especially in case of patellar instability. Neoprene sleeves are commonly prescribed from the plethora of available braces. Features should include:

1. Open patella
2. Lateral bolster

Orthotics/Taping

- Foot orthotics are often prescribed in cases of PFJS. Stress at the patellofemoral joint can result from faulty mechanics of the foot which can sometimes be relieved with orthotics.

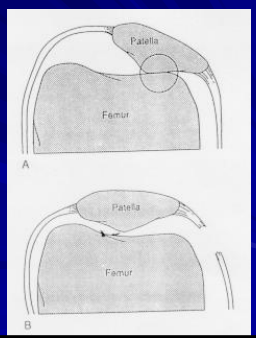
The Effect of Foot Orthoses on Patellofemoral Pain Syndrome
Saxena and Haddad *J Am Podiatr Med Assoc.*2003; 93: 264-271

Orthotics/Taping

- Patellar taping (McConnell) is effective in treating some patellofemoral maladies when combined with exercise. Analysis of patellar position is made and then appropriate correction is made with special tape.

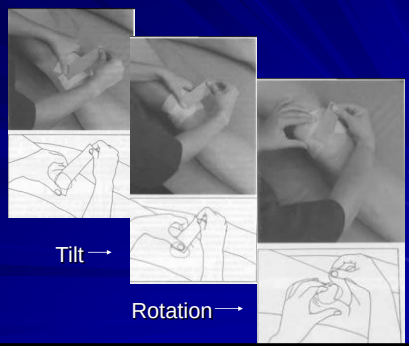
Orthotics/Taping

- Patellar taping (McConnell) components include:
  - Glide
  - Tilt
  - Rotation



Orthotics/Taping

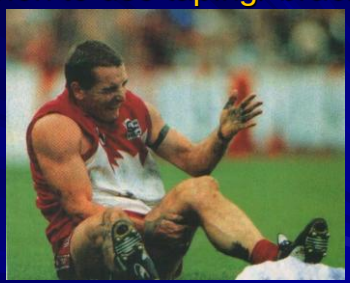
Glide →



Tilt →

Rotation →

When to use taping/ bracing



Is taping/ bracing effective?

- To decrease pain?
  - Yes
    - McConnel — Aust J Physiotherap 1986
    - Gerrard — Clin Orthop 1989
    - Finestone (RCT) — Clin Orthop 1993
    - Moller and Krebs — Arch Orthop Trauma Surg 1986
    - Palumbo — AJSM 1981
    - Bockrath et al — Med Sci Sports Exerc 1993
    - Grace — JOSPT 1997
    - Powers — JOSPT 1997
    - Crossley et al — Clin J Sport Med 2001
    - Greenwald et al — Clin Orthop 1996
    - Ng and Cheng — Clinical Rehabilitation 2002
    - Cochrane 2003 (Taping)
    - **Wilson et al. (!!) — JOSPT 2003**
  - No
    - Miller (RCT) — Am J Knee Surg 1997
    - Kowall (RCT) — AJSM 1996

Is taping/ bracing effective?

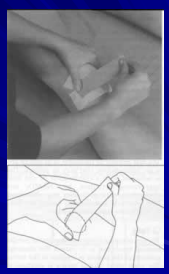
- For changing patellar position?
  - Yes
    - Shellock et al J Mag Res Imag 1994
  - Yes, but not maintained after ex
    - Larsen AJSM 1995
  - Yes, but only at rest (vs. AROM)
    - Muhle et al AJSM 2000
  - NO
    - Bockrath Med Sci Sports Ex 1993

Is taping/ bracing effective?

- On VM/ VL activation?
  - Yes
    - Gilleard Phys Ther 1998
  - No
    - Cerny Phys Ther 1995

When to use taping/ bracing

- Critical test
  - Manual medialization of patella
- Preferred method
  - Correct tilt
  - Correct glide (bunch skin)
  - Watch compression
    - Split tape prn



Taping….temporary
Bracing……long term

Exercise

- Exercise emphasizing the vastus medialis oblique muscle is by far the most frequently prescribed and effective treatment for PFJS. Numerous types of exercise may be employed of which the highlights are as follows:

Exercise: Endurance

- Endurance - although no adequate definition of endurance exists, endurance exercise is an important component of patellofemoral rehabilitation

Exercise: Endurance

- Frequency should be 3-5 times per week with duration building to 20-30 minutes.

Exercise: Endurance

Biking and swimming are frequently preferred due to limited skeletal shock.

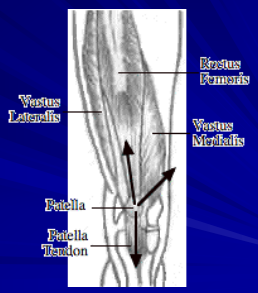
The bike seat should be high to limit knee flexion and flutter kicks avoided in swimming to prevent lateral stress.

Exercise: Endurance

- Stair climbers, rowing machines, etc. may be used, but often increase symptoms. Shorter arcs of motion are desirable.

Exercise: Strength

- VMO in particular
- Quadriceps in general
- Medialize and stabilize the patella
- EMG evidence suggest that hip adductors in particular, are important and facilatory to VMO activity



Exercise

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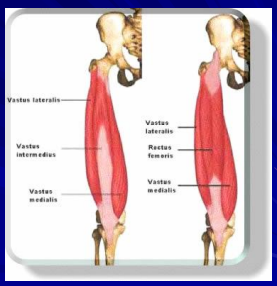


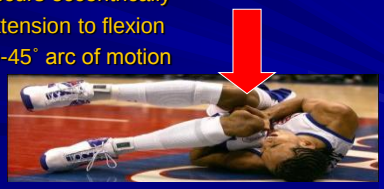
Exercise Parameters: ROM

- Range of Motion Progression Emphasis is placed on exercising in a pain free range of motion and progressing the arc of motion as pain resolves

Exercise Parameters: ROM CAUTION!

- Diagnosis dependant
- Dislocation and subluxation require special attention

1. Occurs eccentrically
2. Extension to flexion
3. 30-45˚ arc of motion



Exercise Parameters: ROM

- Frequently the arc is less than 0-45 degrees of knee flexion in acute cases.
- Terminal knee flexion (90-125 degrees) is also often pain free (patella positioned over femoral notch) and exercise can occur in that arc also.
  (1) Pain free arc (s)
  (2) Progressive arc 5-10 degrees per session or as tolerated

Exercise Parameters: Resistance

- Little evidence supports isotonic, isokinetic, or isometric exercise as most appropriate or desirable.
- Cost and availability may ultimately dictate selection.

Exercise Parameters: Resistance

- Isometric - range specific with carry-over of 15 degrees.
- Serial isometric (multi-angle) needed for global strengthening.

Exercise Parameters: Resistance

- Isotonic - universally available, may be desirable to start with proximal loading to reduce leverage on the patella.

  (a) Multi SLR

  (b) SAQ/LAQ

Exercise Parameters: Resistance

- Isokinetic - allows the patient to control resistance and gives objective quantification.

Exercise Parameters: Resistance

- The eccentric or decelerative is especially important in PFJS rehabilitation
- In cases of subluxation or dislocation the application of heavy load eccentric exercise may cause manifestation of the instability

Exercise Parameters: Open vs. Closed Chain

- Closed chain exercise are functionally integral to patellofemoral rehabilitation.
- Open chain exercise may allow better isolation of the quadriceps musculature.
- A combination of the two is recommended for comprehensive PFJS rehabilitation

Exercise Parameters: Open vs. Closed Chain

- Suggested closed chain exercises:
  (1) Quarter squats (1 or 2 leg)
  (2) Short step up
  (3) Short arc stair climber
  (4) Leg press

Patellar Surgery

Your surgeon is ready.

Junior mint?

Surgery

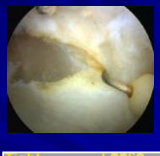
- **Lateral Release**

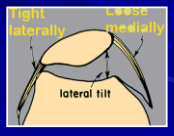
A lateral release is a surgical procedure where the retinaculum on the outer side of the patella (when the the patella tilts abnormally) are cut to allow the kneecap to assume a better position.

Arthroscopic electrothermal lateral release

Lateral Release

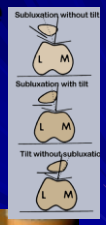
- Arthroscopic or open
- For LPCS
- NOT for general anterior knee pain
- Not for instability
- Isolated releases should be performed infrequently





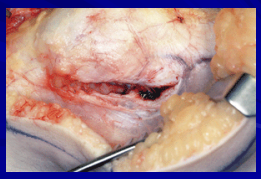
Patellar Instability *Proximal Soft Tissue Realignment*

- Medial Patellofemoral Ligament Reconstruction
- With vs. without lateral release
- No longer exclusive to open growth plate teens



Surgery

- **Lateral Release complications:**
- hemarthrosis - bleeding into the joint immediately after the procedure
- swelling & decreased range of motion
- marked quad inhibition
- Too aggressive

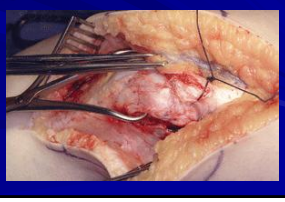


Surgery

- **Medial Reefing is a procedure to try and pull the kneecap towards the midline by tightening the structures on the inner side**

Surgery

- **Medial Plication**
- Similar to reefing, but involves taking 'tucks' through the inner structures.



MPFL Reconstruction

- BMC Musculoskelet Disord. 2007; 8: 22.
- 2007 February 28. doi: 10.1186/1471-2474-8-22
- **Medial patellofemoral ligament reconstruction: a new technique**
- Michael R Carmont and Nicola Maffulli

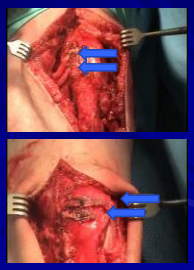
http://www.youtube.com/watch?v=mGvwk9opvyM

MPFL Reconstruction

- Examination under anaesthesia revealing marked patella instability.

MPFL Repair/Reconstruction

- Torn with dislocation
  - Repair (re-tighten)
  - Reconstruction



MPFL Reconstruction

- Following medial and lateral parapatellar incisions, the patella is stabilised using a large clamp on the right of the figure. Tunnels are produced by sequential drill holes in the superior half of the patella, 1 cm apart.

MPFL Reconstruction

- A Beath pin is used to pass a Vicryl loop through the patella tunnels.

MPFL Reconstruction

- The graft is passed through the tunnels, laterally then medially.

MPFL Reconstruction

- The medial epicondyle is exposed and the the transepicondylar axis and a tunnel is drilled to accommodate and secure both ends of the graft.

MPFL Reconstruction

- The graft is pulled into the tunnel using Vicryl through the eye of a Beath pin.

MPFL Reconstruction

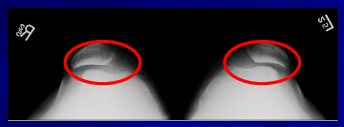
- After cycling the knee through a full range of movements to allow graft tension to settle, the graft is secured using an interference fit screw.

MPFL Reconstruction

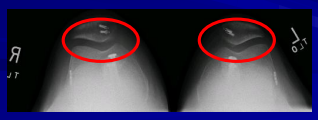
- The improved stability of the patella is confirmed.

Patellar tracking correction

Pre-Operative



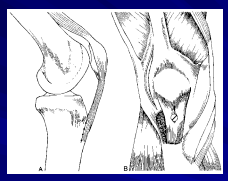
Post-Operative



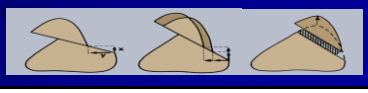
Adjunctive Surgery: Chondroplasty Via Microfracture

- **Numerous point fractures, resulting in fibrocartilaginous "repair"**
- **Fibrocartilage often appears to offer at least temporary pain relief.**

Patellar Instability *Distal Realignment*



Tibial tuberosity transfer (medially)



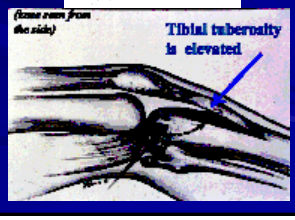
Distal Realignment Procedures

Results

- Good results regarding improved stability
- Fair results regarding decreasing patellofemoral pain
- Less favorable results if x-ray evidence of arthrosis

Surgery: Distal Realignment

- Fulkerson, Modified Maquet, and Elmslie-Trillat combines:
- Medialized tibial tubercle
- Distalized tibial tubercle
- Elevated tibial tubercle
- Screw fixation

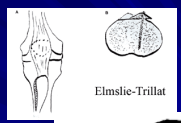


Surgery: Distal Realignment

- **Roux-Goldthwait Procedure**
- The patellar tendon is split vertically. The outer (lateral) half is pulled through under the inner (medial) half and attached to the tibia, pulling the patella over to the medial side.

Surgery

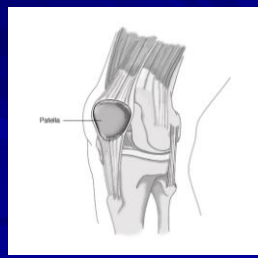
- **Fulkerson Osteotomy**
- Modification of the Elmslie-Trillat Procedure, but involves anterior displacement as well
- Indications are persistent pain and moderate articular degeneration
- Allows anteriorization of up to 15 mm, which should decrease lateral facet contact pressure
- Arthroscopy should precede the osteotomy to document patellar arthrosis



Fulkerson JP, Shea KP: Disorders of patellofemoral alignment. *J Bone Joint Surg* 1990; **72A:** 1424 -1429

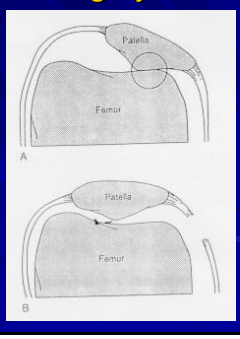
Post Operative Rehabilitation

General guidelines only will be presented for post-operative patellofemoral rehabilitation. Pain, inflammation control, and adequate tissue healing time follow the guidelines presented earlier. Tissue healing is variable for the type of surgery and exercises should be coordinated with and approved by the attending surgeon.



Post Operative Rehabilitation: "Conservative surgery"

- Lateral release - open or arthroscopic release of the lateral patellar retinaculum, sometimes combined with medial capsular reefing
- Rehabilitation - rehabilitation is similar to non-operative cases.
- Adequate incision healing must be allowed, usually 7-10 days before moderate to vigorous stress is allowed.



Post Operative Rehabilitation: Lateral Release

- Week 1 - AROM, PROM and MOB prn
  - (a) Isometrics
  - (b) Bike
  - (c) Sub-maximal quads/HS
- Weeks 2-4 - Progressive strength/endurance
- ROM to tolerance (FROM) PATELLA!
- Weeks 4-6 - Resume functional activities via functional progression.

Post Operative Rehabilitation: Lateral Release

- Complications - medial instability, no symptomatic relief, RSD, infection
- Discharge criteria - FROM, symmetrical strength, adequate stabilization, pain free

Post Operative Rehabilitation: "Conservative surgery "

- Chondroplasty- drilling holes through either the femoral or patellar articular surface or both, to promote bony perfusion.
- Weight bearing inhibits bone regeneration
- Patients may limit WB 2-4 weeks with progressive weight bearing up to 6-8 weeks post-op.

Post Operative Rehabilitation: Chondroplasty

- Weeks 1-3 - Post-op inflammatory control

(a) AROM to tolerance

(b) Patellar MOB prn

(c) Bike without tension.

(d) Open chain quads and HS, 25-50% effort.

Post Operative Rehabilitation: Chondroplasty

- Weeks 4-6 - Continue as above

(a) Promote full ROM.

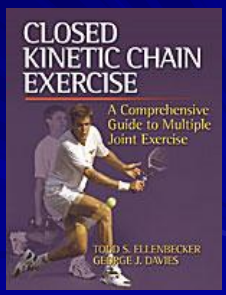
(b) Increase exercise intensity.

(c) Introduce weight bearing (physician discretion).

- Weeks 6 (+) - Progress to FWB

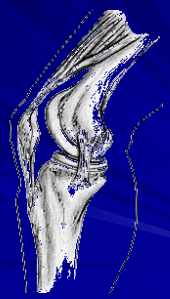
(a) Normalize strength, add closed chain.

(b) Functional integration.



Post Operative Rehabilitation: Distal Realignment

- Fulkerson, Modified Maquet, and Elmslie-Trillat combines:
- Medialized tibial tubercle
- Distalized tibial tubercle
- Elevated tibial tubercle
- Screw fixation

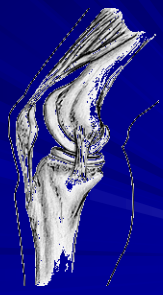


Post Operative Rehabilitation: Patellectomy

- Occasionally, in cases of severe degeneration or
- Ideally, the patella is "shelled" and continuity of the patellar tendon is not compromised.
- If continuity is lost, a more conservative approach is necessary

Rehabilitation Guidelines: Distal Realignment/Patellectomy

- Assumes screw fixation, non-compromised patellar tendon



Complete Patellectomy

- Greater ligament instability
- Quadriceps atrophy and loss of quadriceps strength compared with partial patellectomy.
- Reduction in the degree of stance-phase flexion during level walking and negotiating stairs.
- Salvage only

Rehabilitation Guidelines: Distal Realignment/Patellectomy

- Weeks 1-2

(a) Cast or immobilize ten (10) days, NWB or TWB 4-6 weeks.
(b) CPM
(c) ROM as established in OR.
(d) Hamstring isometrics and AROM to 100 degrees/or limit.
(e) Multi-SLR, no weight (in brace).
(f) NMES
(g) Co-contractions
(h) Inflammation control
(i) Distal patella MOB (re-alignment)

Rehabilitation Guidelines: Distal Realignment/Patellectomy

- Weeks 3-6

(a) Continue as above, TWB-PWB 4-6 weeks.
(b) Active quads, begin side lying.
(c) ROM to 100-120 degrees flexion.
(d) Emphasize ROM.
(e) HS strength to 100-120 degrees flexion.

Rehabilitation Guidelines: Distal Realignment/Patellectomy

- Post Week 6

(a) Continue as above.
(b) Establish full ROM as tolerated.
(c) Progressive strengthening, lower quarter.
(d) Functional progression.
(e) Normal (symmetrical) strength is not expected, particularly in the patellectomized knee. Deficits of 30-40% are common in the quadriceps muscles and allow most ADL.

- Range of motion is usually not a problem, but flexion to 125 degrees is usually acceptable.

Rehabilitation Guidelines: Distal Realignment/Patellectomy

- Go slow!
- Errors on the side of caution
- Slow strength gains
- New definition of normal

Thank You!

Pignon, Haiti