

MAD ID # 18228

The Sports Physical Therapy Section:

The Enigmatic Patella

Thursday, February 12, 2009

1:00-4:00 PM

The Enigmatic Patella: Patellar Tendinopathy

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APTA Combined Sections Meeting 2009
Sports Physical Therapy Section: Knee SIG

- I. Epidemiology of Patellar Tendinopathy
 - A. Reported as “common” in
 - 1. Basketball and volleyball athletes
 - 2. High- and long-jumpers
 - 3. Military recruits
 - B. 23% incidence in elite volleyball players¹
 - C. 4.8% injured runners²
 - D. 1/3 of athletes with patellar tendinopathy were unable to participate in sport for > 3 months³
 - E. Of 17 athletes followed over 15 years, 9 (53%) quit their sport because of patellar tendon pain⁴
- II. Patellar Tendon Anatomy
 - A. Attachment of knee extensor mechanism to tibia
 - B. Quadriceps tendon/patellar tendon continuous on anterior patella
 - C. Tendon size⁵
 - 1. 25-40 mm wide at infrapatellar pole, narrows 15% from infrapatellar pole to tibial tubercle
 - 2. Length 4-6 cm long
 - 3. Mean thickness should not exceed 7mm
 - D. Intimacy with fat pad. Pain generation?^{6,7}
- III. Patellar Tendon Pathology
 - A. Typically occurs at posterior region of enthesis site
 - B. Histology^{8,9}
 - 1. Loss of longitudinal arrangement of collagen fibers
 - 2. Increased cellularity
 - 3. Neovascularization
 - 4. Lack of inflammatory cells
 - 5. Mucoid ground substance
 - C. Pain generation
 - 1. Neovascularization is observed in painful tendons (tendinosis)¹⁰
 - 2. Association of free nerve endings with neovessels

3. Vascular growth factor (VEGF)
 - a) Stimulates angiogenesis
 - b) Downregulated in healthy tendon
 - c) Upregulated in diseased tendon
4. Association between pain and angiogenesis¹¹⁻¹³
5. Presence of VEGF adversely affects material properties of tendons
 - a) How? (Pufe 2005)¹⁴
 - (1) Stimulates production of proteolytic enzyme (MMP)
 - (2) Downregulates inhibitors of proteolytic enzymes
 - b) Consequence?
 - (1) Decreased tendon strength
 - (2) Predisposes tendon to microtears

IV. Evidence-Based Risk Factors for Patellar Tendinopathy

- A. Witvrouw et al. 2001¹⁵
 1. Examined anthropometric variables, leg alignment, flexibility and muscle strength in a group of college students
 2. Using stepwise logistic regression, found the only variables that were associated with the development of patellar tendon pain was decreased quadriceps and hamstring flexibility
- B. Gaida et al. 2004¹⁶
 1. Studied whether anthropometry, body composition, or muscle strength were predictors for unilat or bilat patellar tendon pain
 2. Found
 - a) No identifiable risk factors for bilat patellar tendon pain
 - b) Risk factors in unilat patellar tendon pain
 - (1) Higher waist to hip ratio
 - (2) Decreased eccentric muscle strength
- C. Allen et al. 1999¹⁷
 1. Examined the relationship between patellar tracking (evaluated with MRI) and patellar tendon pain
 2. Greater percentage of patients with abnormal patellar tracking in the patellar tendon pain group
- D. Tyler et al. 2002¹⁸
 1. Measured anteroposterior patellar tilt angle at 30° knee flexion and neutral femoral rotation
 2. Anteroposterior tilt
 - a) Normals:
30.8° ± 6.7°

- b) Patellofemoral pain group
29.1° ± 8.5°
- c) Patellar tendinitis group
25.6° ± 7.0°

3. No difference b/w angles of involved and uninvolved knees

E. Lorbach 2008¹⁹

Increased length of lower patellar pole in persons with patellar tendinopathy

F. Ferretti 1986¹

- 1. Training amount: 40% of vb players who trained more than 4x/week reported patellar tendon pain
- 2. Surface
 - a) Concrete: 37% incidence
 - b) Wood parquet: 5% incidence
 - c) Linoleum: 23% incidence

G. Richards et al^{20, 21}

- 1. Studied lower extremity dynamics in elite volleyball players.
- 2. Found following factors related to patellar tendinopathy
 - a) Increased vertical ground reaction in jumping
 - b) Increased knee flexion during landing from jump
 - c) High ankle inversion-eversion moments
 - d) High external tibial rotation and plantarflexion moments

H. Bisselling 2008²²

Decreased knee flexion and ankle dorsiflexion during jump landing

I. Grau 2008²³

- 1. 42 female runners: 21 healthy and 21 with patellar tendinopathy
- 2. Risk factors for patellar tendon pain included: faster knee flexion, increased pronation velocity, and greater hip adduction

J. Cook et al²⁴

- 1. Examined relationship of anthropometry and physical performance test results in elite basketball players to patellar tendon US results
- 2. Found
 - a) No relationship between anthropometry and US findings
 - b) Better vertical jump and decreased hamstring flexibility in athletes with abnormal tendons

V. Clinical Examination

A. History

- 1. Leadbetter's "Principle of Transitions" (1992²⁵)

2. Overuse staging
 - a) Blazina
 - b) Modified Blazina
 - c) VISA score
 - (1) Visentini et al. 1998²⁶
 - (2) 0-100 point scale
 - (a) Asymptomatic fully performing = 100 points
 - (b) Theoretical minimum 0 points if maximal symptoms and interference with activity
 - (3) Reliable tool
 - (a) Test-retest ($r=0.99$)
 - (b) Inter-tester ($r=0.99$)
 - (c) Stability ($r=0.87$)

B. Tests and Measures

1. Observation
 - a) Muscle bulk, effusion
 - b) Lower extremity kinematics
2. Postural assessment
3. Mobility assessment
 - a) ROM
 - b) Muscle length
4. Muscle performance assessment

Palpation

 - a) Tenderness at infrapatellar pole
 - b) Palpation study²⁷
 - (1) Intratester reliability (Pearson $r = .82$) for categorization as mild, moderate, or severe
 - (2) Moderate and severe tenderness was associated with abnormal tendon morphology per ultrasonography
 - (3) Comparing palpation and US imaging
 - (a) NPV: 80% (No tenderness, no US abn)
 - (b) PPV: 12% with mild tenderness
 - (c) PPV= 37% with mod-severe tenderness
 - (d) Sensitivity= 68%, specificity= 9%
 - (4) Mild tenderness is a normal finding in athletes

5. Decline squat test
 - a) Described by Cook et al²⁸
 - b) Single leg squat with foot on decline surface
 - c) Tendon pain is a positive test

6. Imaging studies
 - a) Ultrasound (Grey-scale sonography)
 - (1) Hypoechoic region in tendon: abnormal
 - (2) Moderate to severe tenderness with palpation associated with hypoechoic regions
 - (3) Study on 14-18 year old basketball players^{29, 30}
 - (a) 26% with US abnormalities; more prevalent in oldest tertile
 - (b) Some US abnormalities in athletes without pain
 - (c) Some painful tendons without US abnormalities
 - (d) Risk of developing patellar tendinopathy 4.2 x greater in asymptomatic tendons with US abnormalities

 - b) Color Doppler sonography
 - (1) Neovascularity present in abnormal tendons³¹
 - (a) Neovascularity located in region of tendon abnormality
 - (b) Pain is more related to presence of neovessels than blood flow through vessels
 - (2) Neovascularity more evident after exercise³²

 - c) MRI³³
 - (1) MR imaging of 10 patients with patellar tendinopathy and 15 control subjects
 - (2) Lack of MRI changes in Blazina Stage 1 & 2
 - (3) Only Blazina Stage 3 were associated with abnormal MRI findings
 - (4) Sn 0.75, Sp 0.29, LR+=1.06, LR-=0.85

VI. Intervention for Patellar Tendinopathy

A. Relative rest/load reduction^{25, 28, 34, 35}

1. Immobilization is contraindicated as tendon needs load to stimulate repair

2. Decrease in combination of intensity, duration, frequency of offending activity and implementation of cross training

3. Biomechanical correction of jumping^{20, 21}
- B. Modalities
1. Cryotherapy: minimizes movement of protein from capillaries³⁶
 2. Iontophoresis
 - a) More effective than modalities and cross friction massage in decreasing pain and increasing function³⁷
 - b) Effective in driving dexamethasone into patellar tendon tissue³⁸
 3. Phonophoresis: evidence does not support³⁹
 4. Ultrasound
 - a) Evidence to support its positive effects on collagen production by fibroblasts in vitro⁴⁰
 - b) Increased tensile strength of tendons⁴¹
 - c) No evidence in vivo
- C. Manual therapy: Cross friction massage
1. Advocated by Cyriax for tendon pain
 2. Purported to reduce adhesions within the tendon and promote normal collagen alignment
 3. Animal studies have shown increased fibroblastic activity with tissue mobilization^{42, 43}
 4. Brosseau et al., 2002: systematic review of TFM. Concluded no evidence to support or refute use of TFM⁴⁴
- D. Exercise
1. Muscle stretching: focus on hamstrings and quadriceps
 - a) No evidence to support or refute
 - b) Recommended based on
 - (1) Witvrouw et al. (2001): poor quadriceps & hamstring flexibility in athletes with patellar tendinitis¹⁵
 - (2) Cook et al. (2004): poor hamstring flexibility in elite basketball players with patellar tendon pain
Muscle strengthening: eccentric focus²⁴
 2. Eccentric exercise
 - a) Accumulating evidence to support for patellar tendon pain

- b) Curwin and Stannish, 1984⁴⁵
 - (1) 6 week drop squat training program (3 x 10 reps daily)
 - (2) Progressed slow to fast
 - (3) Progressed no resistance to resistance
 - (4) Retrospective review of 66 pts⁴⁶
 - (a) 20 complete relief
 - (b) 42 marked decrease in sx
 - (c) 4 worsened

- c) Alfredson Eccentric Protocol⁴⁷
 - (1) Painful training of Achilles tendinopathy
 - (2) Dosage: 3 x 15 repetitions, 2x/day, 7 days/wk, 12 weeks

- d) Cannell et al. 2001⁴⁸
 - (1) Pilot study (n=19) comparing drop squats & OKC exercise
 - (2) More athletes in drop squat group returned to sport

- e) Stasinopoulos & Stasinopoulos 2004⁴⁹
 - (1) Compared exercise program (Eccentric quad exercise, quad/hamstring stretching), US, TFM
 - (2) Eccentric group had better outcome at 4 weeks, 8 weeks, and 16 weeks

- f) Purdham et al. 2004⁵⁰
 - (1) Squat (n=9) vs. decline squat training (n=8)
 - (2) Higher % in decline squat group returned to sport

- g) Young et al. 2005⁵¹
 - (1) Decline squat training (25°) and 10" step down
 - (2) Both groups improved; decline squat group showed significantly better VISA scores at 12 months

- h) Jonsson & Alfredson 2005⁵²
 - (1) RCT with 2 groups: single leg eccentric or concentric decline squat training
 - (2) Eccentric group had decreased pain and increased function

- i) Bahr 2006⁵³
 - (1) RCT with 2 groups: open tenotomy & single leg decline squat eccentric exercise
 - (2) No difference in VISA score at 12 month follow up

- j) Frohm et al. 2007⁵⁴
 - (1) RCT with 2 groups: single leg decline & eccentric training device
 - (2) Both groups showed signif improvement in pain and function
 - 3. Evolution of eccentric exercise for patellar tendinopathy⁵⁵
 - a) What component of protocol is responsible for effect?
 - b) Common features of successful training
 - (1) Decline squat
 - (2) Painful training
 - (3) Athletes should take time away from sport
 - 4. Why eccentric exercise?⁵⁶
 - a) Increased Type I collagen content
 - b) Increased tendon stiffness
 - c) Decreased neovascularity
 - 5. Why decline squat?
 - a) Increase in patellar tendon force⁵⁷
 - b) Increase in patellar tendon strain, increase in quadriceps recruitment (per EMG)^{58, 59}
- E. Orthotic devices
- 1. Patellar tendon counterforce brace
 - a) Commonly used for patellar tendon pain⁶⁰
 - b) Miller et al⁶¹ tested strap in military recruits
 - (1) No specific diagnoses - “anterior knee pain”
 - (2) Cho-Pat was not effective in controlling pain
 - c) Systematic review of knee orthotics for patellofemoral pain: cannot support or refute use of knee braces⁶²
 - 2. Foot orthotics: no evidence to support or refute

VII. Conclusions

- A. Patellar tendinopathy is a common condition seen by physical therapists and is challenging to treat
- B. Risk factor evidence suggests there are modifiable factors associated with patellar tendinopathy
 - 1. Extrinsic factors: sport, training amount, surface
 - 2. Intrinsic factors
 - a) Muscle length
 - b) Patellar position and tracking
 - c) Jump mechanics

- C. Evidence for intervention is lacking
- D. Only intervention with some supporting evidence is eccentric exercise
- E. Further studies are needed!

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PATELLAR RE-ALIGNMENT AND CARTILAGE REPAIR PROCEDURES

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- I. Introduction
 - a. Traumatic patellar dislocations affect mainly adolescents and young adults.
 - b. 44% will develop recurrent dislocation
 - c. Surgical stabilization of the patella may reduce patfem OA
 - d. More than 100 surgical procedures have been described

- II. Proximal Realignment (soft tissue)
 - a. Goal of procedure: alter line of pull of Quadriceps.
 - i. Indications: deficient medial patellofemoral support, skeletally immature
 - ii. Caution: large Q-angle, ligament laxity

 - b. Arthroscopic Lateral Release (1970)
 - i. Indications: tight lateral constraints with minimal or absent malalignment.
 - 1. negative passive patellar tilt;
 - 2. patellar glide of 2 quadrants or less

 - ii. Surgical Description
 - 1. open or arthroscopically
 - 2. entire retinaculum is released (7 – 10 mm from patella)
 - 3. patella tilt 70 – 90 deg above horizontal

 - iii. Rehab Considerations
 - 1. Start PT within 2 days of surgery
 - 2. Patellar mobilization
 - 3. Bracing, taping, orthotics

 - iv. Limitations: long-term outcome less favorable when performed alone

 - c. Insall Procedure (1976)
 - i. Indications: weak medial structures
 - ii. Surgical Description: advancement of the medial retinaculum
 - iii. Rehab Considerations

 - d. Medial Patellofemoral Ligament (MPFL) Reconstruction (2000's)
 - i. Indications: MPFL is the major medial ligamentous stabilizer of lateral patellar dislocation; performed for patellar instability

secondary to laxity or the proximal medial restraints and not suitable for malalignment or patellofemoral arthritis.

- ii. Surgical Description
 - 1. Semitendinosus or gracilis tendon
- iii. Rehab Considerations

iv. Follow-up: effective, minimal OA

III. Distal Realignment (bony realignment)

- a. Goal of procedure: prevent recurrent dislocation; change Q-angle
- b. Hauser Procedure (1938)
 - i. Medial and distal transfer of tibial tubercle to decrease Q-angle
 - ii. Drawback: medialization also translates tubercle posteriorly
- c. Maquet Procedure (1963)
 - i. Anterior elevation of the tibial tuberosity (2 – 2.5 cm); lateral release
 - ii. Rarely performed
- d. Elmslie-Trillat Procedure (1964)
 - i. Medialization of tibial tubercle (10 mm); lateral release, medial reefing
 - ii. Skeletally mature patient
 - iii. Prevents dislocation; long-term OA possible
- e. Fulkerson Procedure (1983)
 - i. Anteromedialization of the tibial tubercle to relieve patellofemoral contact stress; without bone graft
 - ii. Commonly performed with lateral release
- f. Modified Roux-Goldthwaite Procedure
 - i. Medial transposition of lateral half of the patellar tendon
 - ii. Open physis
- g. Follow-up: frequently associated with patellofemoral arthritis within 10 years after surgery
- h. Rehab Considerations
 - i. ROM
 - ii. Weightbearing
 - iii. Quadriceps exercise

IV. Other Considerations

- a. Distal femoral osteotomy
 - i. Valgus deformities > 15 deg.
- b. Physical Therapy

V. Osteochondral Autograft Transplantation (OATS) (1991)

- a. Indications: healthy, < 50 years, no ligamentous instability, adequate alignment
- b. Surgical Description: bone plugs with articular cartilage harvested and implanted into osteochondral defect
 - i. Ideal size: less than 2 – 3 cm²
 - ii. Success rate 79% for patella
- c. Limitations: donor site
- d. Rehab Considerations
 - i. WB status
 - ii. CPM
 - iii. Patellar mobilization
 - iv. Return to activity

VI. Autologous Chondrocyte Implantation (1994)

- a. Indications: healthy, < 50 years, no instability, no malalignment, meniscus predominately intact
- b. Brief Surgical Description: articular cartilage cells harvested, grown, re-implanted
 - i. Lesion size: no upper limit
 - ii. Repair: hyaline-like cartilage
- c. Rehab Considerations
 - i. WB status
 - ii. CPM
 - iii. Patellar mobilization
 - iv. Return to activity

Lateral Release Rehabilitation Guidelines

Phase I (0 – 2 weeks)

Therapeutic Exercise

- Gentle ROM (flexion/extension)

- Flexibility (hams, gastroc-soleus- NWB)

- Muscle Re-ed (quad sets, SLR, hip add, multiangle isometrics, ankle pumps, heel slides)

Joint Mobilization

- Patellar mobs

- Assess other surrounding joints (hip, ankle)

Electrical Stimulation

- Muscle Re-ed (Russian, functional)

- Pain management (Interferential/premodulated)

- Edema control (high volt)

Cryotherapy

Gait training

- PWB-WBAT with crutches progress to FWB

Phase II (Weeks 2 – 4)

Therapeutic Exercise

- Progress knee flexion ROM if not already achieved

- Flexibility (gastroc-soleus, ITB- WB)

- Flexibility (hip flexors)

- Strengthening- closed chain exercise (wall slides, leg press, lateral step-up, heel raises)

- Balance exercises (weight shifts, tandem walking, etc.)

Electrical stimulation (if needed)

Cryotherapy (post-exercise)

Phase III (Weeks 4 – 6)

Therapeutic Exercise

- Advanced closed chain/weight bearing exercises

- Full body strengthening/conditioning (hip/pelvis/trunk)

- Dynamic flexibility of lower extremity

- Agility exercises – proprioception exercises (hops, bounds, cuts, etc.)

- Aerobic exercise (bike, jogging progressing to running)

Phase IV (> 6 weeks)

Therapeutic Exercise

- Functional testing activities

- Sport-specific activities

- Comprehensive home program

Proximal Re-alignment Rehabilitation Guidelines

Phase I (0 – 2 weeks)

Brace

ROM limited to 0 – 30 deg

Gait training

NWB

Range of motion

Immediate motion exercise days 1 – 2

Full passive knee extension immediately

Patellar mobilization

Passive knee flexion (90 deg by 2 – 3 weeks)

Flexibility

Strengthening Exercise

Ankle pumps

Quad Sets

SLR (4 planes)

Electrical Stimulation

Muscle Re-ed (Russian, functional)

Pain management (Interferential/premodulated)

Edema control (high volt)

Cryotherapy

Phase II (Weeks 3 - 6)

Brace

0 – 60 deg at week 3

0 – 90 deg at 4 – 6 weeks

Gait training

Begin ¼ WB progression over 4 weeks

Range of motion

Full passive extension

Knee flexion full by week 6

Patellar mobilization (as needed)

Strengthening Exercise

Multi-angle isometrics

Adductor squeeze with ball

Glut med progression (NWB)

Leg press 0 – 60 deg

Mini-squats – 0 45 deg

Toe calf raises

Stationary bicycle

Phase III (Weeks 6 - 12)

Gait training

Full at 8 weeks

Range of motion

Full flexion

Therapeutic Exercise

Leg presses (0 – 90 deg)

Bilateral squats (0 – 60 deg)

Unilateral step-ups progressing from 2 – 6 inch step

- Balance and proprioception drills
- Forward lunges
- Walking program on treadmill
- Bicycle
- StairMaster
- Swimming
- Nordic Track/ Elliptical

Phase IV (12 weeks to discharge)

Therapeutic Exercise

- Advanced closed chain/weight bearing exercises
- Full body strengthening/conditioning (hip/pelvis/trunk)
- Dynamic flexibility of lower extremity
- Agility exercises – proprioception exercises (hops, bounds, cuts, etc.)
- Aerobic exercise (bike, jogging progressing to running)

Distal Re-alignment Rehabilitation Guidelines

Phase I (0 – 2 weeks)

Brace

- ROM limited to 0 – 60 deg

Gait training

- NWB

Range of motion

- Immediate motion exercise days 1 – 2
- Full passive knee extension immediately
- Patellar mobilization
- Passive knee flexion (60 deg by week 2)
- Flexibility

Strengthening Exercise

- Ankle pumps
- Quad Sets

Electrical Stimulation

- Muscle Re-ed (Russian, functional)
- Pain management (Interferential/premodulated)
- Edema control (high volt)

Cryotherapy

Phase II (Weeks 3 - 4)

Gait training

- Begin ¼ WB progression at 3 weeks

Range of motion

- Full passive extension
- Knee flexion 90 deg at week 3; 110 deg at week 4
- Patellar mobilization (as needed)

Strengthening Exercise

- SLR
- Multi-angle isometrics

Adductor squeeze with ball
Glut med progression (NWB)
Stationary bicycle (submax)

Phase III (Weeks 5 - 10)

Gait training

Full at 8 weeks

Range of motion

Full flexion by 6 – 8 weeks

Therapeutic Exercise

Leg presses (0 – 90 deg)

Bilateral squats (0 – 60 deg)

Unilateral step-ups progressing from 2 – 6 inch step

Balance and proprioception drills

Forward lunges

Walking program on treadmill

Bicycle

StairMaster

Swimming

Nordic Track/ Elliptical

Phase IV (Weeks 11 – 24)

Therapeutic Exercise

Advanced closed chain/weight bearing exercises

Full body strengthening/conditioning (hip/pelvis/trunk)

Dynamic flexibility of lower extremity

Agility exercises – proprioception exercises (hops, bounds, cuts, etc.)

Aerobic exercise (bike, jogging progressing to running)

OATS: Patella Rehabilitation Guidelines

Phase I (0 – 6 weeks)

Brace

Locked at 0 degrees during ambulation/WB

Sleep in locked brace 4 – 6 weeks

Gait training

TTWB at 25% BW with brace locked in full extension

50% BW week 2 in brace

75% BW week 3 – 4 in brace

Range of motion

Immediate motion exercise days 1 – 2

Full passive knee extension immediately

CPM- 8 – 12 hours/day (0 – 60 deg; if lesion > 6 cm² 0 – 40 deg) first 2 – 3 weeks

CPM – may continue 6 – 8 hours/day for 6 weeks

Patellar mobilization

Passive knee flexion (90 deg by 2 – 3 weeks; 105 deg by 3 – 4 weeks; 120 deg by week 6)

Flexibility
Strengthening Exercise
Ankle pumps
Quad Sets
SLR (4 planes)
Heel raises at week 2
Stationary bicycle when ROM allows
Isometric leg press at week 4 (multi-angle)
Weight shifts at week 4
Pool therapy at week 4

Phase II (Weeks 6 – 12)

Brace – discontinue
Gait training
Full weight bearing at 6 – 8 weeks
Range of motion
Full passive extension
Knee flexion 120 – 125 deg by week 8
Patellar mobilization (as needed)
Strengthening Exercise
Closed chain exercise: leg press 0 – 60 deg at week 8
Mini-squats – 0 45 deg at week 8
Toe calf raises
Stationary bicycle
StairMaster at week 12
Balance and proprioception drills
Front and lateral step-ups

Phase III (Weeks 13 – 32)

Range of motion
Knee flexion should be 125 – 135 degrees
Therapeutic Exercise
Leg presses (0 – 90 deg)
Bilateral squats (0 – 60 deg)
Unilateral step-ups progressing from 2 – 6 inch step
Forward lunges
Walking program on treadmill
Bicycle
StairMaster
Swimming
Nordic Track/ Elliptical

Phase IV (8 – 15 months)

Therapeutic Exercise
Advanced closed chain/weight bearing exercises
Full body strengthening/conditioning (hip/pelvis/trunk)
Dynamic flexibility of lower extremity
Agility exercises – proprioception exercises (hops, bounds, cuts, etc.)
Aerobic exercise (bike, jogging progressing to running)
Functional activities
Low-impact sports at 6 months (swimming, skating, cycling)

Higher-impact sports at 8-9 months (jogging, running, aerobics); larger lesions – 9 – 12 months

High-impact sports at 9 – 12 months (tennis, basketball, football, baseball); larger lesions- 18 months

Autologous Chondrocyte Implantation Rehabilitation Guidelines

Phase I (0 – 6 weeks)

Brace

Locked at 0 degrees during ambulation/WB

Sleep in locked brace 4 weeks

Gait training

TTWB at 25% BW with brace locked in full extension

50% BW week 2 in brace

75% BW week 3 – 4 in brace

Range of motion

Immediate motion exercise days 1 – 2

Full passive knee extension immediately

CPM- 8 – 12 hours/day (0 – 60 deg; if lesion > 6 cm² 0 – 40 deg) first 2 – 3 weeks

CPM – may continue 6 – 8 hours/day for 6 weeks

Patellar mobilization

Passive knee flexion (90 deg by 2 – 3 weeks; 105 deg by 3 – 4 weeks; 120 deg by week 6)

Flexibility

Strengthening Exercise

Ankle pumps

Quad Sets

SLR (4 planes)

Heel raises at week 2

Stationary bicycle when ROM allows

Isometric leg press at week 4 (multi-angle)

Weight shifts at week 4

Pool therapy at week 4

Phase II (Weeks 6 – 12)

Brace – discontinue

Gait training

Full weight bearing at 6 – 8 weeks

Range of motion

Full passive extension

Knee flexion 120 – 125 deg by week 8

Patellar mobilization (as needed)

Strengthening Exercise

Closed chain exercise: leg press 0 – 60 deg at week 8

Mini-squats – 0 45 deg at week 8

Toe calf raises

Stationary bicycle

StairMaster at week 12
Balance and proprioception drills
Front and lateral step-ups

Phase III (Weeks 13 – 32)

Range of motion

Knee flexion should be 125 – 135 degrees

Therapeutic Exercise

Leg presses (0 – 90 deg)

Bilateral squats (0 – 60 deg)

Unilateral step-ups progressing from 2 – 6 inch step

Forward lunges

Walking program on treadmill

Bicycle

StairMaster

Swimming

Nordic Track/ Elliptical

Phase IV (8 – 15 months)

Therapeutic Exercise

Advanced closed chain/weight bearing exercises

Full body strengthening/conditioning (hip/pelvis/trunk)

Dynamic flexibility of lower extremity

Agility exercises – proprioception exercises (hops, bounds, cuts, etc.)

Aerobic exercise (bike, jogging progressing to running)

Functional activities

Low-impact sports at 6 months (swimming, skating, cycling)

Higher-impact sports at 8-9 months (jogging, running, aerobics); larger lesions –
9 – 12 months

High-impact sports at 9 – 12 months (tennis, basketball, football, baseball); larger
lesions- 18 months

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Patellar Proximal and Distal Influences

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Combined Sections Meeting 2009
Las Vegas, NV February 12, 2009

Session Overview

1. Theoretical overview and measures of knee alignment
2. Proximal and distal influences on patellofemoral joint function
3. Update on current intervention strategies
4. Where do we go from here? *Suggestions for future research*

Theoretical Overview

1. Law of valgus
2. Dynamic Q -angle

The bottom line for knee valgus and the Q -angle

- Evidence does not support an absolute association between the Q -angle and patellofemoral pain syndrome (PFPS)
- Problems associated with measuring the Q -angle include measurement technique variability and poor representation of the dynamic Q -angle
- Need to understand changes in the Q -angle during dynamic activities

Measures of Knee Alignment

1. Quality of movement during lateral step-down test (*Piva et al, 2006*)
2. Frontal plane projection angle (*Willson & Davis, 2008*)

The bottom line for measures for knee alignment

- Evidence suggests their usefulness as a clinical measure
- Consideration must be made regarding measurement reliability

Proximal Influences

1. Hip Kinematics
 - Stair descent
 - Running
 - Single-leg squat
 - Drop landing

- Repetitive single-leg jumping

2. Hip Strength

- “Quantifying” hip weakness
- Measurement considerations

	Hip Abductors*	External Rotators*
Ireland et al, 2003	23.3 ± 6.9	10.8 ± 4.0
Robinson & Nee, 2007	16.0 ± 8.0	16.0 ± 6.0
Cichanowski et al, 2007	29.0 ± 8.0	17.0 ± 4.0
Bolgia et al, 2008	22.5 ± 5.9	11.1 ± 3.1

* *Expressed as a percentage of body weight*

3. Interventions

- Hip strengthening
- Manual therapy

The bottom line for proximal influences

- Strong documentation of hip weakness in females with patellofemoral pain syndrome
- Conflicting evidence for the association between hip weakness and faulty hip kinematics
- Need for randomized control trials for determining the effectiveness of hip strengthening compared to traditional quadriceps strengthening programs

Distal Influences

1. Theoretical Model

- Relationship between excessive subtalar pronation and the dynamic *Q*-angle
- Changes in patellofemoral joint contact area

2. Relationship between subtalar pronation and PFPS etiology

- Limited evidence to conclusively determine absolute cause and effect
- Influence of proximal compensatory strategies for controlling subtalar pronation

3. Interventions

- Clinical prediction rule for orthosis prescription
- Considerations for orthosis prescription

The bottom line for distal influences

- Need for continued investigations for the relationship between foot function and PFPS etiology
- Evidence suggests the use of orthoses for shock attenuation

Local Influences

1. Neuromuscular considerations
 - Quadriceps amplitudes
 - Vastii timing differences
2. Interventions
 - Quadriceps strengthening
 - Patella taping
 - Patella bracing
 - o On-Track brace (<http://ontrackbrace.com/index.html>)
 - o Patella Tracking Orthosis (http://www.breg.braceup.com/pto_knee_brace.htm)
 - Knee bracing
 - o Protonics (http://www.empi.ca/b/b5_2.htm)
 - o Stability thru External Rotation at the Femur (*SERF*) (<http://www.donjoy.com/index.asp/fuseaction/products.detail/cat/4/id/185>)

The bottom line for local influences

- Additional investigations needed to understand alterations in quadriceps neuromuscular activity and PFPS
- Strong evidence for the importance of quadriceps strengthening
- Exact mechanism for the effectiveness of patella taping and patella bracing remains elusive
- Limited evidence to support the use of knee braces

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Treatment of Quadriceps and Patellar Tendon Ruptures

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- I. Incidence and occurrence
 - A. Isolated acute traumatic injury – rare

 - B. Post-operative ACL reconstruction following use of patellar tendon graft

- II. Signs and symptoms
 - A. Clinical presentation

 - B. Radiographs

 - C. MRI

- III. Traditional treatment
 - A. Surgical management

 - B. Immobilization to protect the repair

 - C. Restricted return to activities at least 6 months

IV. Current treatment and rehabilitation

A. Preoperative Planning

B. Surgical Technique

C. Immediate postoperative care

D. Progression of rehabilitation

V. Outcomes & Literature Review