www.vompti.com

Anterior Knee Pain Case

Eric Magrum DPT OCS FAAOMPT

Orthopaedic Manual Physical Therapy Series
Charlottesville 2017-2018

Orthopaedic Manual Physical Therapy Series 2017-2018

PFPS most common

- Most prevalent knee disorder among adolescent and young- adult athletes.
- 25% of all knee injuries in sports medicine clinics

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Most Common injuries in Runners

- PFPS 21%
- ITB syndrome 11%
- Plantar fasciitis 10%
- Meniscal pathology 6%
- Shin splints 6%
- Patellar tendonitis 6%
- Achilles tendonitis 6%
- Gluteus injuries 4%
- Tibial stress fractures 4%
- Spine injuries 3%

Tauton et al Br J Sports Med 2002

- "Orthopedic Enigma"
- "Low Back Pain of the Lower Quarter"
- "Lochness Monster of the Knee"
- PFPS remains "the most vexatious clinical challenges in rehabilitative medicine"
- "Black Hole of Orthopedics"

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

How do you treat PFPS?

- Quad strengthening
- OKC exercise
- CKC exercise
- VMO strengthening
- ITB stretching
- Patellar mobs
- Biofeedback
- VMO/VL timing
- Taping
- Soft tissue mobilization – ITB, lateral retinaculum
- Orthotics
- Neuromuscular re-ed
- Hip strengthening
- Lumbopelvic stabilization
- Ultrasound

For Use of Participants Only. No Use or Reproduction Without Consent

Diagnosis of Exclusion

Table 1. *Differential Diagnoses for Anterior Knee Pain*[69]

Articular Cartilage Injuries	Intra-articular Hip Referral
Pes anserine Bursitis	L2-3 Referral
Hoffa's Disease	Symptomatic Bipartite Patella
Patellar Instability	Chondromalacia Patellae
Osteoarthritis	Intra-articular Loose Bodies
Plical Synovitis	Osteochondritis Dessicans
Quadriceps Tendinopathy	Patellar Tendinopathy
Sindig Larsen-Johansson Disease	Saphenous Neuritis
Bone Tumors	Pre-patellar Bursitis
Iliotibial Band Syndrome	Osgood-Schlatter Disease
VMO Trigger points	Meniscal Tear
Patellofemoral Arthritis	Patella stress fracture
Slipped Capital Femoral Epiphysis	Legg-Calve Perthes Disease

IJSPT 2016

Best tests/clinical findings for screening and diagnosis of patellofemoral pain syndrome: a systematic review

Chad Cook[a,*], Lance Mabry[b], Michael P. Reiman[c], Eric J. Hegedus[d]

PFPS is a multifactorial and the nebulous pathology and lack of sensitive tests to help rule out PFPS when negative, suggests that PFPS may be a diagnosis of exclusion and may be best ruled in after ruling out other contending diagnoses such as tibial–femoral osteoarthritis, plica syndrome, or other masquerading conditions. A majority of studies that have investigated the diagnostic accuracy of clinical tests for PFPS demonstrate notable quality biases and, at this stage, identifying the best tests for diagnosis of PFPS is still unknown.

Physiotherapy 98 (2012) 93–100

For Use of Participants Only. No Use or
Reproduction Without Consent

Property of VOMPTI, LLC

Clinical Classification System

- To guide rx
- Poor reliability/validity
- Cluster of signs/symptoms to help guide treatment
- Functional Outcome Measures

- "Kinesiopathological Model"
  - Aberrant movement patterns can cause musculoskeletal dysfunction and pain.

** Subjective Asterisks Signs/Symptoms **

- 46 yo female mom, recreational runner (10-15 miles/week), Exercise classes
- No specific mechanism : Increased exercise: Boot Camp class – Step ups, squats, lunges. (2 weeks)
- Chief c/o: Constant diffuse ® Anterior Knee Pain (6/10)– Medial>lateral retinaculum; Inconsistent: Sharp inferior patellar pain (9/10)
- Aching with sit/driving > 10', Sharp pain with Flexion 0-45 (squat, lunge, stair descend> ascend); aching constant. Denies effusion, mechanical symptoms. Prior history (B) anterior knee pain HS XC, ®ACL/Medial menisectomy – college IM soccer injury
- Unable to exercise/run- very apprehensive secondary to sharp severe pain with loading

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

** Physical Exam "Asterisks" Signs/Symptoms **

- Hypertrophic Infrapatellar Fat pad – Acute on chronic
- Chronic VMO atrophy
- Lateral Patellar tilt, Patella Baja
- Very tender to palpate Infrapatellar fat pad > Lateral retinaculum
- Pain with end ROM EXT (hyper EXT)
- Apprehensive for all loading – including Bilateral squat (refused)
- Gait Analysis – Antalgic, Knee EXT at terminal swing; dynamic valgus through loading response → terminal stance

Patellofemoral Pain: Proximal, Distal, and Local Factors

2nd International Research Retreat

August 31-September 2, 2011 • Ghent, Belgium

J Orthop Sports Phys Ther 2012;42(6):A1-A20. doi:10.2519/jospt.2012.0301

Consensus Statement

LOCAL FACTORS

DISTAL FACTORS

PROXIMAL FACTORS

INTERVENTIONS

What Have We Learned?

Where Do We Need to Go in the Future?

For Use of Participants Only. No Use or Reproduction Without Consent

Property of VOMPTI, LLC

Evidence-based framework for a pathomechanical model of patellofemoral pain: 2017 patellofemoral pain consensus statement from the 4th International Patellofemoral Pain Research Retreat, Manchester, UK: part 3

Christopher M Powers, Erik Witvrouw, Irene S Davis and Kay M Crossley

Br J Sports Med 2017 51: 1713-1723 originally published online November 6, 2017

The 'Best Practice Guide to Conservative Management of Patellofemoral Pain': incorporating level 1 evidence with expert clinical reasoning

Christian John Barton, Simon Lack, Steph Hemmings, Saad Tufail and Dylan Morrissey

Br J Sports Med 2015 49: 923-934 originally published online February 25, 2015

Table 1 Best Practice Guide to Conservative Management of Patellofemoral Pain

Education	Active rehabilitation	Passive interventions
1. *Ensure the patients understands potential contributing factors to their condition and treatment options* 2. *Advise of appropriate activity modification* 3. *Manage the patients expectations regarding rehabilitation* 4. *Encourage and emphasise the importance of participation in active rehabilitation*	Principles 1. *Give preference to CKC exercises to replicate function* 2. *Consider OKC exercises in early stages of rehabilitation to target specific strength deficits and movements* 3. *Provide adequate supervision in the early stages to ensure correct exercise techniques, but progress to independence as soon as possible* 4. *When independent, limit the number of exercises to 3 or 4 to aid compliance* 5. *Use biofeedback such as mirrors and videos to improve exercise quality* Specifics 1. Incorporate quadriceps and gluteal strengthening 2. *Target distal and core muscles where deficits exist* 3. *Consider stretching, particularly of the calf and hamstrings, based on assessment findings* 4. *Incorporate movement pattern retraining, particularly of the hip*	Pain reduction 1. Provide tailored patellar taping to reduce pain in the immediate term 2. Provide PFJ braces where taping is inappropriate (e.g. skin irritation) 3. Consider foot orthoses Optimising biomechanics 1. *Consider foot orthoses based on assessment findings (i.e. presence of excessive dynamic pronation)* 2. *Consider massage and acupuncture/dry needling to improve the flexibility of tight muscle and fasciae structures, particularly laterally* 3. *Consider PFJ mobilisation but only in the presence of hypo-mobility* 4. *Consider mobilisation of the ankle and first ray in the presence of sagittal plane joint restriction*

For Use of Participants Only. No Use or Reproduction Without Consent

Education

1. *Ensure the patients understands potential contributing factors to their condition and treatment options*
2. *Advise of appropriate activity modification*
3. *Manage the patients expectations regarding rehabilitation*
4. *Encourage and emphasise the importance of participation in active rehabilitation*

Active rehabilitation

Principles

1. *Give preference to CKC exercises to replicate function*
2. *Consider OKC exercises in early stages of rehabilitation to target specific strength deficits and movements*
3. *Provide adequate supervision in the early stages to ensure correct exercise techniques, but progress to independence as soon as possible*
4. *When independent, limit the number of exercises to 3 or 4 to aid compliance*
5. *Use biofeedback such as mirrors and videos to improve exercise quality*

Specifics

1. Incorporate quadriceps and gluteal strengthening
2. *Target distal and core muscles where deficits exist*
3. *Consider stretching, particularly of the calf and hamstrings, based on assessment findings*
4. *Incorporate movement pattern retraining, particularly of the hip*

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

Passive interventions

Pain reduction
1. Provide tailored patellar taping to reduce pain in the immediate term
2. Provide PFJ braces where taping is inappropriate (e.g. skin irritation)
3. Consider foot orthoses

Optimising biomechanics
1. *Consider foot orthoses based on assessment findings (i.e. presence of excessive dynamic pronation)*
2. *Consider massage and acupuncture/dry needling to improve the flexibility of tight muscle and fasciae structures, particularly laterally*
3. *Consider PFJ mobilisation but only in the presence of hypo-mobility*
4. *Consider mobilisation of the ankle and first ray in the presence of sagittal plane joint restriction*

LOCAL FACTORS

- Highly innervated tissues through knee
- Extremely high loads .5 BW- walking; 7x BW- squatting
- Pain correlated with metabolic activity (+) bone scan
- Maltracking (PFJ) vs. Malalignment (LQ)
- Pain correlates with varus rotation in extension
- Idiopathic – diagnosis of exclusion

For Use of Participants Only. No Use or Reproduction Without Consent

Sources of anterior knee pain

Roland M. Biedert, MD[a,*],
Vicente Sanchis-Alfonso, MD, PhD[b]
[a]Orthopaedic Surgery and Sport Traumatology, Institute of Sport Sciences, Magglingen, Switzerland
[b]Department of Orthopaedic Surgery, Hospital Arnau de Vilanova, Valencia, Spain

- Cartilage
- Subchondral bone
- Synovium
- Retinaculum
- Infrapatellar fat pad

Clin Sports Med 2002

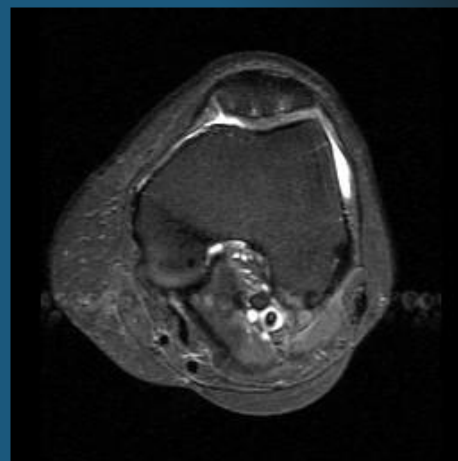
Cartilage

- Hyaline – aneural
- Pts with normal cartilage P!
- Extensive damage P! free
- Pain free probing of Grade III chondromalacia (S Dye)
- Malalignment cause of chondromalacia
  - P! from:
    - Synovitis
    - Effusion
    - Mechanical loading

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Subchondral Bone

- Rich n. supply
- Increased compression with decreased contact area
  - Increased patellar venous engorgement/pressure
- Increased metabolic activity (+ Bone Scan)

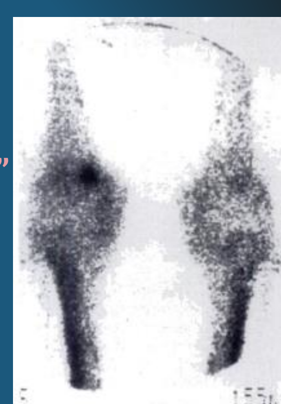


Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

The Use of Scintigraphy to Detect Increased Osseous Metabolic Activity about the Knee*

BY SCOTT F. DYE, M.D.†, AND MAILINE H. CHEW, M.D.‡, SAN FRANCISCO, CALIFORNIA

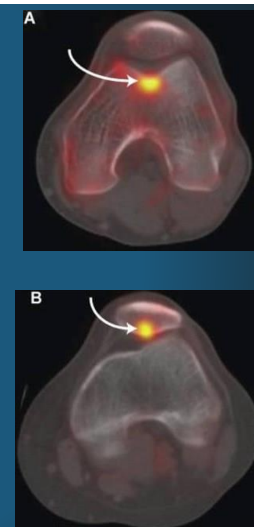
- Injected saline patellar facet
- Increased intraosseous pressure = "severe lancinating patellar pain"
- (+) Bone Scan x 14 weeks
- Sx resolution 7 months



Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

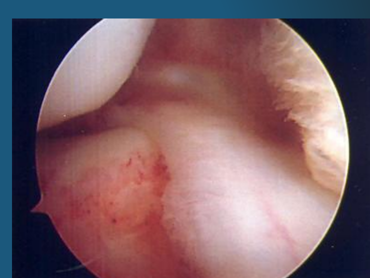
Patients with Patellofemoral Pain Exhibit Elevated Bone Metabolic Activity at the Patellofemoral Joint

- 20 PFPS patients
- Bone Scan
- Increased tracer uptake in 85% of the painful knees examined
- Correlation between increasing tracer uptake and increasing pain intensity
- Patellofemoral pain may be related to bone metabolic activity



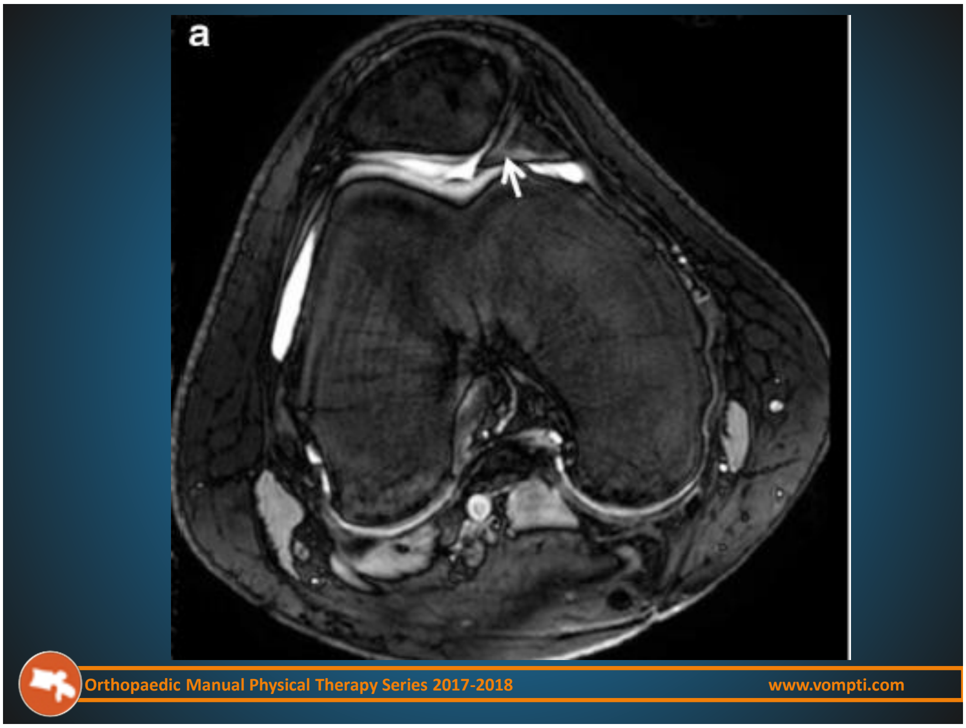
Synovium

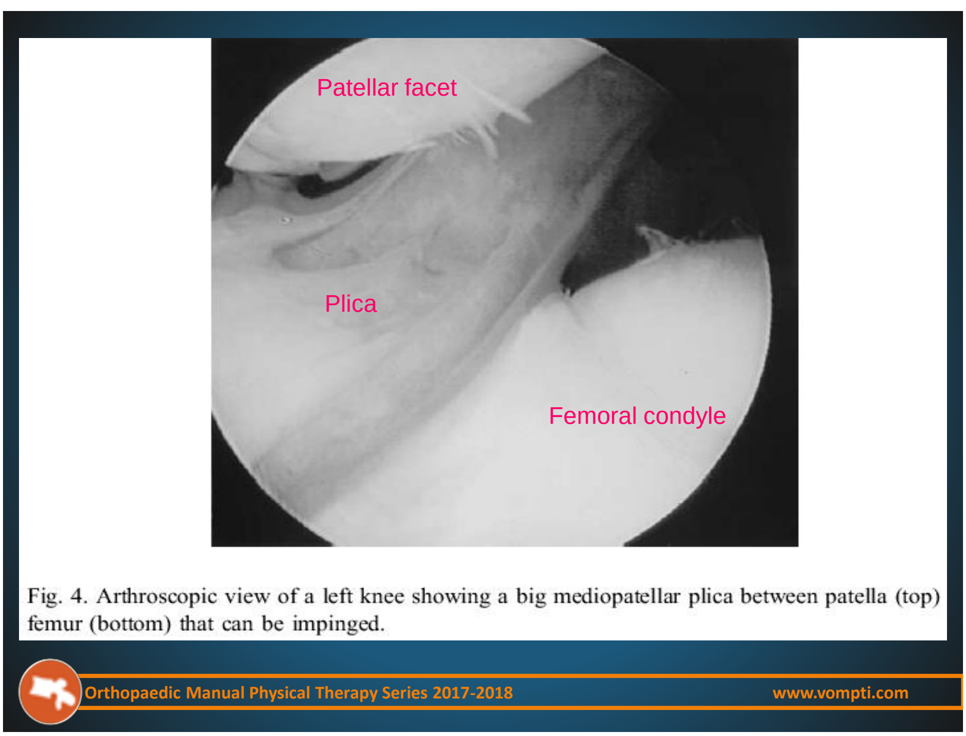
- Rich N. supply – FNEs
- Painful stimuli of synovium and plica resulted in decr quad activity
- Impingement of plica
  - Thickened, inflamed medial or suprapatellar plica between the patella and fem condyle



For Use of Participants Only. No Use or Reproduction Without Consent

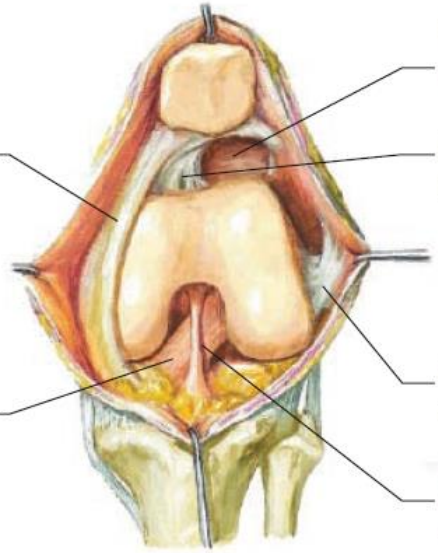
Property of VOMPTI, LLC





For Use of Participants Only. No Use or
Reproduction Without Consent

Figure 1. Illustration of an open knee demonstrating the different plicae



ETIOLOGY

The plica becomes symptomatic via several mechanisms:

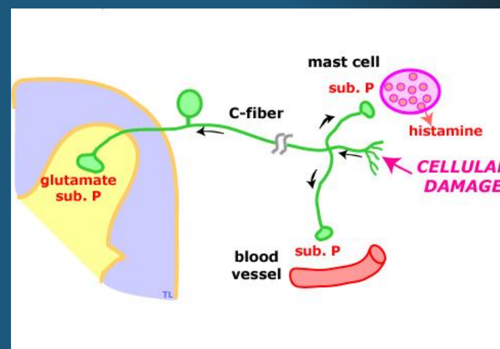
- Direct trauma/blow to the plica [10,11]
- Blunt trauma [4,7,12]
- Twisting injuries [4,7]
- Activities that involve repetitive flexion-extension of the knee (e.g., rowing, cycling, running) [1,8]
- Increased activity levels [7]
- Any mechanism resulting in intraarticular bleeding or synovitis secondary to a loose body, osteochondritis dissecans, a torn meniscus, a subluxing patella or after arthroscopy [7].

IMAJ • VOL 11 • JANUARY 2009

For Use of Participants Only. No Use or Reproduction Without Consent

Retinaculum

- FNEs – lateral and medially
- Substance P and Neural Growth Factor
  - Stimulates neural sprouting
  - Increased sensitivity to FNEs
- Histological changes
  - Hyperinnervation
  - Neovascularization



- Histological changes in lateral retinaculum
- Neural in growth
  - Myelinated and unmyelinated n. fibers
  - Substance P
    - Primary nociceptive neurotransmitter -> Enhances pain sensitivity
    - Hyperinnervation, neovascularization - Neuroma
- Secondary to chronic lateral patellar subluxation, shortened lateral retinaculum, incr contact forces at fem trochlea

For Use of Participants Only. No Use or Reproduction Without Consent

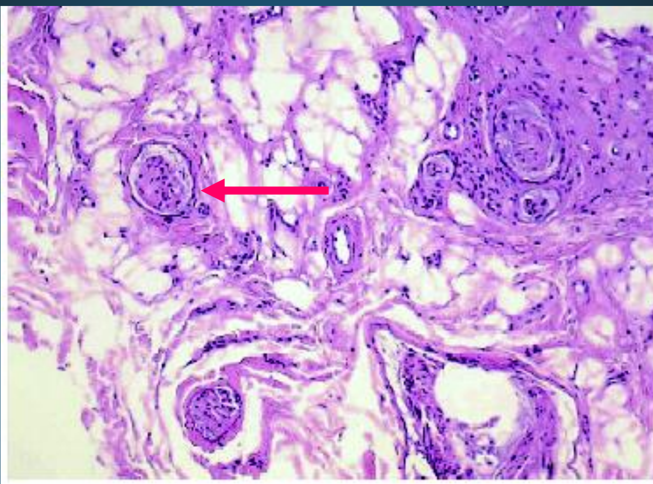


Figure 7. Nerve fibers mimicking amputation neuroma (Hematoxylin-eosin, magnification ×100) (reproduced with permission from Sanchis-Alfonso et al. 1998).

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

How to Deal With Anterior Knee Pain in the Active Young Patient

Vicente Sanchis-Alfonso, MD, PhD*†, and Scott F. Dye, MD‡ SPORTS HEALTH 2016

Homeostasis = Load Acceptance

- Anatomic Factors
- Physiological Factors
- Kinematic Factors
- Treatment Factors
  - Biopsychosocial

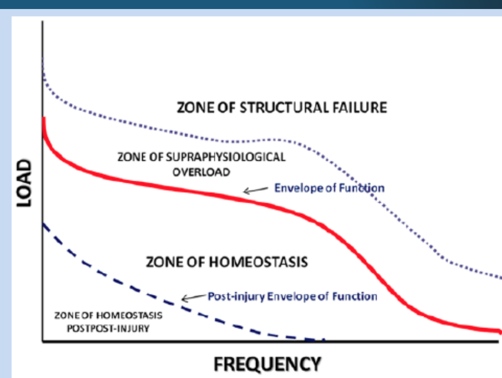


Figure 2. The envelope of function theory.[8,9]

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

Interactive Knee 1.1 © 2000 Primal Pictures Ltd.

Extra synovial

Intra capsular

Between patellar tendon & synovial membrane

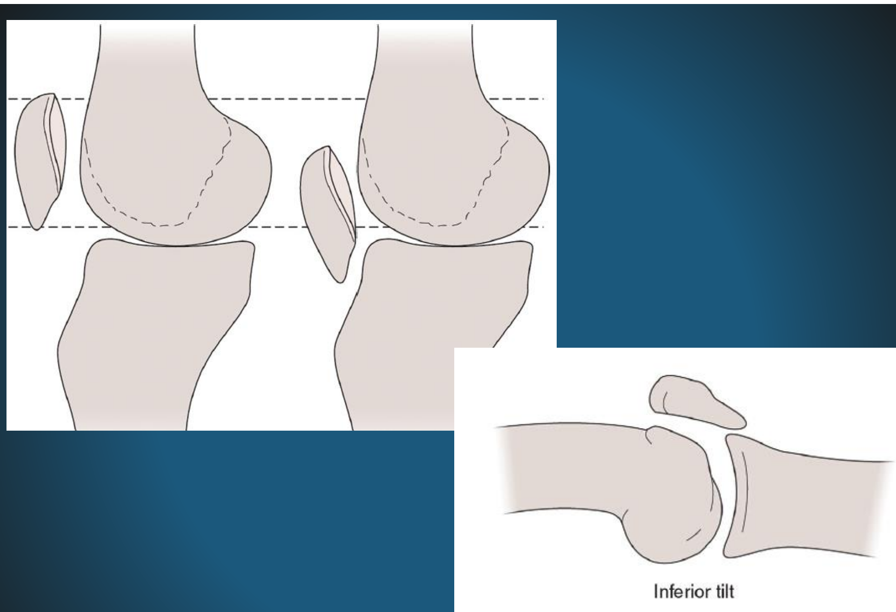
Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Infrapatellar Fat Pad

- Rich N. supply – FNEs
- Rich vascular supply
- Impingement with ecc loading
- Compression inferior pole patella with terminal knee extension - recurvatum/hyperextension
- Chronic synovial irritation = swelling fat pad
- Lateral retinacular tightness = increased tension on fat pad

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent



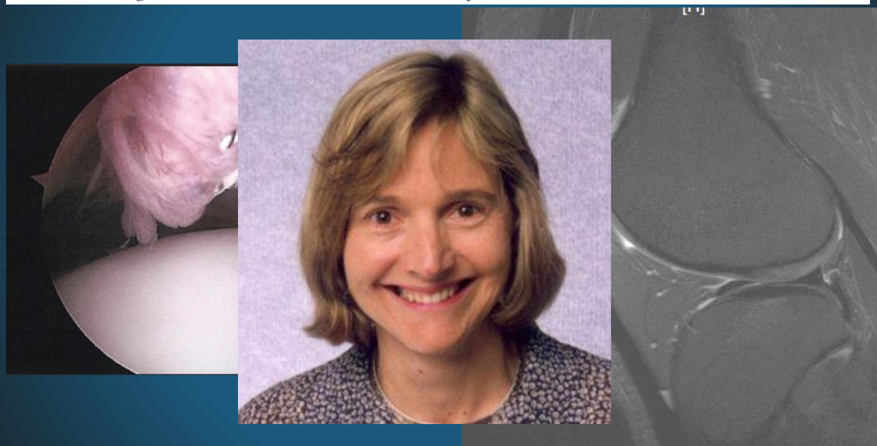
The International Journal of Sports Physical Therapy | Volume 11, Number 6 | December 2016

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or
Reproduction Without Consent

Evaluation and Treatment of Disorders of the Infrapatellar Fat Pad

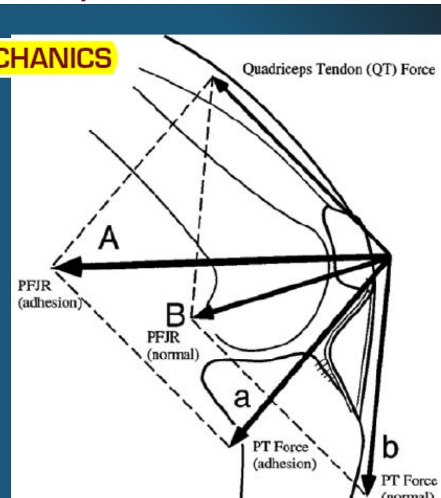
Jason L. Dragoo,[1] *Christina Johnson*[2] and *Jenny McConnell*[3]



Evaluation, Treatment, and Rehabilitation Implications of the Infrapatellar Fat Pad

INFRAPATELLAR FAT PAD BIOMECHANICS

- **Flexion: Fat Pad moves posteriorly**
- **Extension Fat Pad moves anteriorly**
- **Adhesions/scarring alter movement**
- **Patella Baja**



SPORTS HEALTH 2015

For Use of Participants Only. No Use or Reproduction Without Consent

Conscious Neurosensory Mapping of the Internal Structures of the Human Knee Without Intraarticular Anesthesia

Scott F. Dye,*†‡ MD, Geoffrey L. Vaupel,† MD, and Christopher C. Dye§

- Arthroscopic probing of various structures within the knee
- 0 (no sensation) to 4 (severe pain)

Dye SF AJSM 1998

Conscious Neurosensory Mapping of the Internal Structures of the Human Knee Without Intraarticular Anesthesia

Scott F. Dye,*†‡ MD, Geoffrey L. Vaupel,† MD, and Christopher C. Dye§

- Results:
  - Patellar articular cartilage (central ridge, med/lateral facets) 0 with 500g force
  - Grade II, III chrondromalcia: no pain
  - Infrapatellar Fat Pad; Synovium; Suprapatellar bursa, Capsule, Retinaculum: Moderate to severe pain with low force
  - Articular surfaces fem condyle, trochlea, tibial plateau: slight discomfort

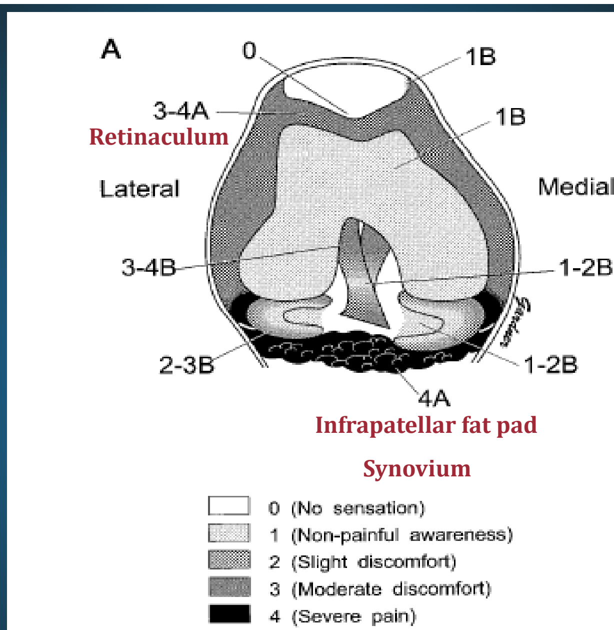
For Use of Participants Only. No Use or Reproduction Without Consent

Conscious Neurosensory Mapping of the Internal Structures of the Human Knee Without Intraarticular Anesthesia

Scott F. Dye,*†‡ MD, Geoffrey L. Vaupel,† MD, and Christopher C. Dye§

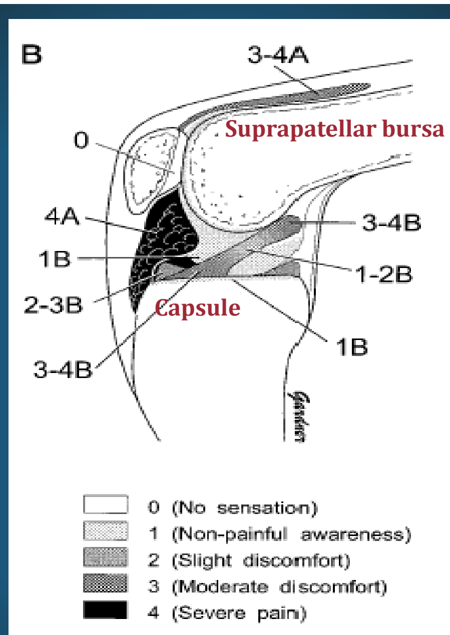
- " ... penetration of the unanesthetized anterior synovium and fat pad region during the initial examination of the right knee produced severe pain that elicited involuntary verbal exclamations from the subject and nearly resulted in cessation of the study"

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com



Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent



Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Property of VOMPTI, LLC

Somatosensory and Biomechanical Abnormalities in Females With Patellofemoral Pain *Clin J Pain* 2016

- Lower PPT
- Hyperalgesia
  - Local @ patella
  - Remote (right forearm)
- Reduced capacity to detect light touch at patella
- Suggest females with PFPS demonstrate Central Sensitization
- Altered biomechanics correlate to hyperalgesia and pain
  - Significant relationship between knee frontal plane motion and PPT values in PFPS group

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

MSK Injury

- Altered Central processing of pain → Central Sensitization
- Not just local connective tissue damage
- Multisystem
  - Connective tissue changes
  - Inflammatory
  - Neuroplasticity of Nocioceptive pathways
- Local Sensory changes → Proprioceptive changes, Neuromuscular dysfunction
- Local Muscle activation/Strength deficits
- Chronic Overloading (repetitive stress)

Courtney CA JMMT 2011

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

Neuromuscular Function in Painful Knee Osteoarthritis

Curr Pain Headache Rep (2012) 16:518–524

- **Knee Pain**
  - Central Sensitization
  - Impaired Descending pain modulation
    - Local Hyperalgesia (increased receptor field)
  - Altered Nociceptive Processing
  - Sensory
    - Proprioceptive dysfunction
    - Activation/strength changes
  - Resultant Neuromuscular dysfunction

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Similar alteration of motor unit recruitment strategies during the anticipation and experience of pain

PAIN® 153 (2012) 636–643

- Anterior knee pain (injection fat pad) – Quad output/motor pool recruitment
- Anticipation of pain (FEAR) → No nocioception, only descending afferent input
  - Reduced Motor output was observed during both anticipation and pain; changes in motor unit recruitmen persisted after pain ceased.
- CNS uses a different motor unit recruitment strategy to achieve the same force output during pain and anticipation of pain

Changes in motor recruitment with anticipation of pain persisted following resolution of pain

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

PREDICTORS OF PAIN AND FUNCTION OUTCOME AFTER REHABILITATION IN PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME

$n=51$	Change in function	Change in pain
Change in Fear-avoidance beliefs – Physical activity†	–0.57**	0.51**
Change in Fear-avoidance beliefs – Work†	–0.06	0.30*
Change in quadriceps strength‡	–0.001	–0.08
Change in hip abduction strength‡	–0.10	0.15
Change in hip external rotation strength‡	0.17	–0.14
Change in hamstrings length‡	–0.13	0.14
Change in quadriceps length‡	–0.06	0.02
Change in gastrocnemius length‡	0.43**	–0.25*
Change in soleus length‡	0.05	0.08
Change in iliotibial band/tensor fascia lata length‡	–0.01	–0.14
Change in lateral retinacular structures length†		
Patients who increased length vs the others	0.28*	–0.19
Patients who decreased length vs the others	–0.29*	0.15
Change in quality of movement†		
Patients who improved quality vs the others	0.05	–0.09
Patients who worsened quality vs the others	0.06	0.15

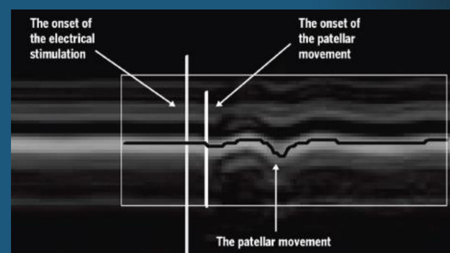
What is your Primary Treatment Objective after Initial Evaluation?

- **Education:** Decrease Apprehension/FEAR/anxiety – Anatomy/Pathology; past clinical successes; Evidence for treatment plan; Activity modification – pain free exercise (non impact).
- **Manual Therapy** (pain relief): Patellar mobs – superior, medial; Tib-Fem mobs (unload fat pad) STM – lateral tissue/ITB insertion; (? Trial taping – superior tilt, fat pad unload)
- **Exercise Prescription :** Quad activation/timing (? NMES) – Terminal Knee EXT

For Use of Participants Only. No Use or Reproduction Without Consent

Electromechanical Delay of the Vastus Medialis Obliquus and Vastus Lateralis in Individuals With Patellofemoral Pain Syndrome

FINDINGS: The EMD of the VMO was prolonged and that of the VL was shortened in individuals with PFPS. There was no significant difference in duration of the EMD between the VMO and VL for the control group.



J Orthop Sports Phys Ther 2012;42(9)

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Can the Use of Neuromuscular Electrical Stimulation Be Improved to Optimize Quadriceps Strengthening?

Neal R. Glaviano, MEd, ATC,*† and Susan Saliba, PhD, ATC, PT‡

Sports Health: A Multidisciplinary Approach 2015

Clinical Recommendations

SORT: Strength of Recommendation Taxonomy
A: consistent, good-quality patient-oriented evidence
B: inconsistent or limited-quality patient-oriented evidence
C: consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
Utilization of NMES can produce limitations such as fatigue,[4,6,7,18,34,49] patient discomfort,[10,13,37,38,47,48] and muscle damage.[3,22,26,30,32,33,41,47]	A
Minor adjustments in NMES parameters (pulse duration of 400-600 μs and pulse frequency of 30-50 Hz) can improve torque production, minimize fatigue, and improve patient comfort levels.[7,16,19,20,28]	B
Increasing the number of stimulating electrodes and electrode placement over motor points have minimized fatigue and patient discomfort while also improving torque production.[9,12,13,15,34]	B
Preconditioning NMES training sessions produce muscular adaptations that improve patient comfort levels, decrease muscular fatigue, and minimize muscle damage.[17,27,34,47]	B

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

CURRENT CONCEPTS REVIEW

Neuromuscular Electrical Stimulation Therapy to Restore Quadriceps Muscle Function in Patients After Orthopaedic Surgery

A Novel Structured Approach

J Bone Joint Surg Am. 2016;98:2017-24

TABLE I Recommendations for Quadriceps NMES Therapy by Treatment Phase in Patients After Knee Surgery

	Treatment Phase 1
Current characteristics	
Pulse waveform	Symmetrical biphasic rectangular or sinusoidal
Pulse duration	400-600 μs
Frequency	Approx. 50 Hz
Intensity	Highest tolerable
On:off time	Approx. 10:30 s*
Treatment session characteristics	
Duration	Approx. 10 min/session
Number of contractions	Approx. 15/session
Frequency	2 to 3 sessions/day
General settings†	
Electrode number and size	2 rectangular electrodes with a total area of approx. 200 cm^2
Electrode position	Over vastus medialis (distal electrode) and vastus lateralis (proximal electrode)
Knee angle	60° to 75° of flexion

Quadriceps force

- Closed Chain
  - Quad force decreases with EXT
- Open chain
  - Quadriceps force increases with EXT
- FES/NMES

For Use of Participants Only. No Use or Reproduction Without Consent

Patellar Tilt Correlates with Vastus Lateralis:Vastus Medialis Activation Ratio in Maltracking Patellofemoral Pain Patients

- Correlation with

  patellar maltracking
- VL:VM ratio imbalance
- Subset of patients
- Accurate classification

JOURNAL OF ORTHOPAEDIC RESEARCH JUNE 2012

Patellar taping for patellofemoral pain: a systematic review and meta-analysis to evaluate clinical outcomes and biomechanical mechanisms

What are the new findings?

- Tailored patellar taping immediately reduces pain with a large effect, while other techniques have only small (untailored medial patellar taping) or negligible (Kinesio Tape) effects on pain in the immediate term.
- Tailored patellar taping should be applied to control lateral patellar tilt, translation and spin, with the goal of providing at least 50% pain reduction.
- Tailored patellar taping is an effective adjunct to exercise over 4 weeks.
- The mechanism of patellar taping effectiveness appears to be facilitation of earlier vastus medialis oblique onset and enhanced knee function capacity during functional tasks.

Br J Sports Med 2014;**48**:417–424.

For Use of Participants Only. No Use or Reproduction Without Consent

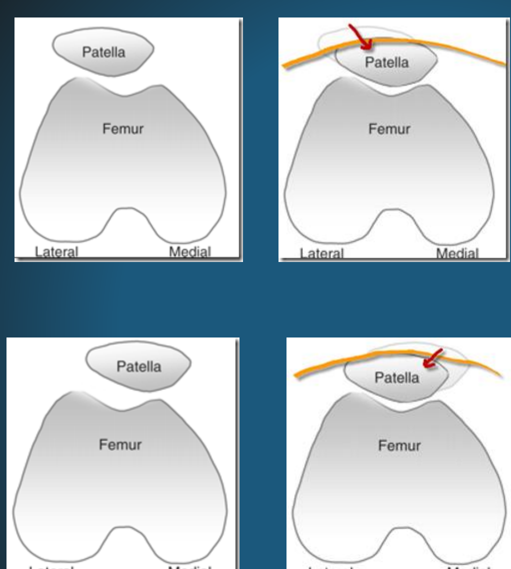
Property of VOMPTI, LLC

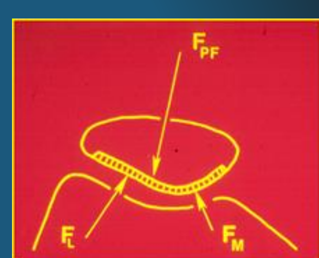
McConnell Taping Shifts the Patella Inferiorly in Patients With Patellofemoral Pain: A Dynamic Magnetic Resonance Imaging Study

- Medial/Lateral glide Patellar taping shifted the patella inferiorly
- Taping medialized the patella in participants who demonstrated lateral displacement at baseline
- Taping lateralized the patella in participants who demonstrated medial patellar displacement at baseline
- Reinforces the need to clinically identify the specific alterations in patellofemoral kinematics present in each patient so that specific interventions can be used and optimized to correct these altered kinematics and reduce pain

Increase in PF contact area

PHYS THER. 2010; 90:411-419.





Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

- Assess
- Specifically Address component:
  - –Tilt
  - –Glide
    - Medial/Lateral
    - Superior/Inferior
  - –Rotation
- Re assess functional (Step down)

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Fat Pad Unloading; Superior tilt

Dynamic Taping

- Asses – Re Assess
- Provocation
- Functional Mvt

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

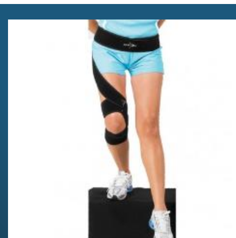
Fig. 1. The infrapatellar fat pad (IFP) is unloaded by tilting the inferior pole of the patella anteriorly (away from the fat pad), lifting the IFP tissue toward the patella, by taping from the tibial tubercle to the medial and lateral joint lines creating a “muffin top” and finally with the knee in 45° of flexion pulling the tibia forward.

Phys Med Rehabil Clin N Am 27 (2016)

Effects of femoral rotational taping on pain, lower extremity kinematics, and muscle activation in female patients with patellofemoral pain

Practical implications

- Femoral rotational taping (with and without tension) could decrease pain during the performance of a single-leg squat in female PFPS participants.
- Femoral rotational taping could correct patellofemoral kinematics of female PFPS participants demonstrating medial collapse during a single-leg squat.
- This quick, simple, and effective novel intervention may serve as an adjunct in the comprehensive management of PFPS.



J Sci Med Sport (2014)

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

Effects of Femoral Rotational Taping on Dynamic Postural Stability in Female Patients With Patellofemoral Pain

CONCLUSIONS

The femoral rotational taping improved the maximum SEBT anterior reach distance and pelvic stability in both the PFP and control groups. The PFP group, but not the controls, showed decreased hip adduction excursion and increased medial-lateral femoral stability with femoral rotational taping. Both tensioned (femoral rotational taping) and nontensioned (sham taping) tape reduced pain in the PFP group. The results support the benefit of femoral rotational taping for pain reduction and improving dynamic postural control in young females with PFP.

Clin J Sport Med 2016

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Manual Therapy

- **STM – Lateralis, Retinaculum, ITB, Quad tendon; Patellar tendon; Infra patellar Fat Pad**
- **Patellar mobilizations**
- **Tib- Fem mobilizations**
- **Self STM- ITB (Foam Roll)**

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Six sessions of manual therapy increase knee flexion and improve activity in people with anterior knee pain: a randomised controlled trial

- PFPS patients
- Control – no treatment
- Treatment group
  - Transverse friction to lateral retinaculum
  - PF tilt mobilizations
  - Medial patellar glide mobilizations with movement
- Improved active knee flexion
- Improved stair climbing
- Decreased pain

Australian Journal of Physiotherapy 2006 Vol. 52

The effects of joint mobilization on individuals with patellofemoral pain: A systematic review

Dhinu J. Jayaseelan, DPT, OCS, FAAOMPT[1,2]

CLINICAL MESSAGES

- Positive within-group trends for improving pain and function were noted in the studies reviewed, however the discrete effect of joint mobilization for patellofemoral pain syndrome is unclear due in large part to heterogeneity in study methodology.
- The relatively few articles investigating joint mobilization for patellofemoral pain have weak design and are poorly reported.

Clinical Rehabilitation

For Use of Participants Only. No Use or
Reproduction Without Consent

Joint Mobilization Enhances Mechanisms of Conditioned Pain Modulation in Individuals With Osteoarthritis of the Knee

FINDINGS: In individuals with chronic knee OA, a joint mobilization intervention resulted in a global decrease in pain sensitivity and improvement of impaired descending pain inhibition, indicating that joint mobilization may aid in facilitating central inhibitory mechanisms. Diminished baseline VPT acuity was enhanced following joint mobilization at the knee that received intervention, but not at the contralateral knee.

MARCH 2016 | VOLUME 46 | NUMBER 3 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

IJSPT

CASE REPORT

TIBIOFEMORAL JOINT MOBILIZATION IN THE SUCCESSFUL MANAGEMENT OF PATELLOFEMORAL PAIN SYNDROME: A CASE REPORT

Justin M. Lantz, DPT, OCS, FAAOMPT[1]
Alicia J. Emerson-Kavchak, DPT, OCS, FAAOMPT[2]
John J. Mischke, DPT, OCS, FAAOMPT[3]
Carol A. Courtney, PT, PhD, FAAOMPT[2]

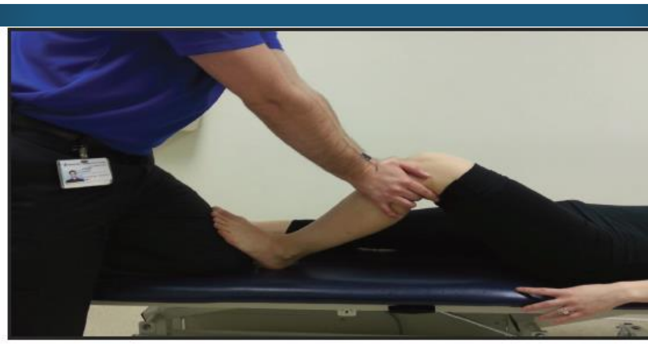


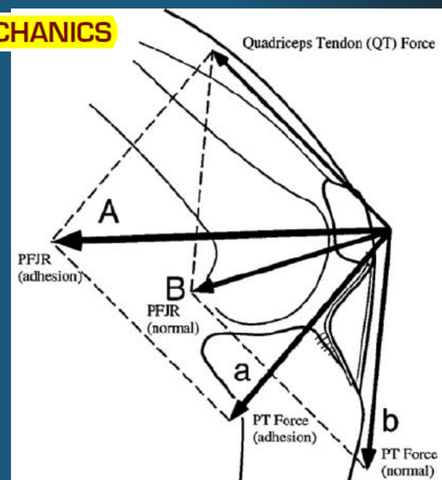
Figure 2. *Grade III tibiofemoral anterior-posterior mobilization.*

For Use of Participants Only. No Use or Reproduction Without Consent

Evaluation, Treatment, and Rehabilitation Implications of the Infrapatellar Fat Pad

INFRAPATELLAR FAT PAD BIOMECHANICS

- Flexion: Fat Pad moves posteriorly
- Extension Fat Pad moves anteriorly
- Adhesions/scarring alter movement
- Patella Baja



SPORTS HEALTH 2015

Patellofemoral Pain: Proximal, Distal, and Local Factors

2nd International Research Retreat

August 31-September 2, 2011 • Ghent, Belgium

J Orthop Sports Phys Ther 2012;42(6):A1-A20. doi:10.2519/jospt.2012.0301

Consensus Statement

- LOCAL FACTORS
- DISTAL FACTORS
- PROXIMAL FACTORS
- INTERVENTIONS

What Have We Learned?

Where Do We Need to Go in the Future?

For Use of Participants Only. No Use or Reproduction Without Consent

DISTAL FACTORS

- Delayed peak Rearfoot EVR
- Greater rearfoot EVR at initial contact
- Increased Navicular drop (greater midfoot mobility)
- Greater EVR correlated with Incr Tib IR, Hip ADD
- Limited TC DF (runners)

Kinematic gait characteristics associated with patellofemoral pain syndrome: A systematic review

Christian J. Barton[a,b,*], Pazit Levinger[b], Hylton B. Menz[b], Kate E. Webster[b]

Gait & Posture xxx (2009) xxx–xxx

Conclusions:

- Delayed timing of peak rear foot EVR
- Incr rear foot EVR at HS
- Incr Hip ADD

"…clear need for prospective evaluation of kinematic gait characteristics in a PFPS population to distinguish between cause and effect."

"Future PFPS case-control studies should consider evaluating kinematics of the knee, hip and foot/ankle simultaneously with larger participant numbers"

For Use of Participants Only. No Use or Reproduction Without Consent

Runners With Anterior Knee Pain Use a Greater Percentage of Their Available Pronation Range of Motion

- Injured runners use a significantly greater percentage of available pronation ROM.

"Eversion Buffer"

- Defining excessive pronation in the context of the joints' available ROM may be a better method of defining excessive pronation and distinguishing those at risk for injury.

Journal of Applied Biomechanics, 2013, 29, 141-146

The Efficacy of Foot Orthoses in the Treatment of Individuals with Patellofemoral Pain Syndrome

A Systematic Review

Barton CJ Sports Med 2010

- OTC Inserts greater short to medium term (6 week) improvements – pain/function
- Orthotics + Physical Therapy improvements in function (6, 12, 52 weeks) – limited evidence
- Reduce Transverse plane knee rotation – loading response (limited evidence)
- ? Benefit most

For Use of Participants Only. No Use or Reproduction Without Consent

Greater peak rearfoot eversion predicts foot orthoses efficacy in individuals with patellofemoral pain syndrome

- Static measures do not correlate with dynamic gait
- Greater Rear Foot EVR evaluated dynamically (instrumented gait analysis) predicted success with OTC inserts in patients with PFPS

Br J Sports Med 2011

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

The immediate effects of foot orthoses on functional performance in individuals with patellofemoral pain syndrome

C J Barton, H B Menz and K M Crossley *Br J Sports Med* (2010).

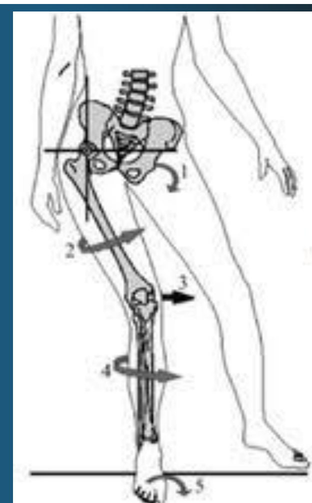
- OTC Inserts produced significant improvements – Pain/Function
- Functional Test Improvements
  - Reduce Pain Single leg Squat
  - Incr # Pain free single leg sit → stand
  - Incr success with functional tests correlated with more pronated foot type

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Property of VOMPTI, LLC

The relationship between rearfoot, tibial and hip kinematics in individuals with patellofemoral pain syndrome

- PFPS patients
- Greater Rearfoot EVR ROM correlated with
  - Greater Hip ADD peak and ROM
  - Greater Tibial INT
- Addressing entire kinetic chain
- "Regional Interdependence"



Clinical Biomechanics 27 (2012) 702–705

Can we predict the outcome for people with patellofemoral pain? A systematic review on prognostic factors and treatment effect modifiers

M Matthews,[1] M S Rathleff,[2,3] A Claus,[1] T McPoil,[4] R Nee,[5] K Crossley,[6] B Vicenzino[1]

Br J Sports Med 2016;

What are the findings?

- Longer duration of patellofemoral pain symptoms (>4 months) was the most reported prognostic factor of a poor outcome.
- Potential treatment effect modifiers were identified in this review that warrant further investigation.
- Preliminary evidence suggests greater midfoot width mobility may predict a better outcome to foot orthoses treatment.

For Use of Participants Only. No Use or Reproduction Without Consent

Foot exercises and foot orthoses are more effective than knee focused exercises in individuals with patellofemoral pain

A B S T R A C T

Objectives: To examine the effect of knee targeted exercises compared to knee targeted exercises combined with foot targeted exercises and foot orthoses in patients with patellofemoral pain.
Design: Forty adult individuals (28 women, 12 men) diagnosed with patellofemoral pain and screened for excessive calcaneal eversion were randomized to knee targeted exercises or knee targeted exercises combined with foot targeted exercise and orthoses.
Methods: The knee targeted exercises were prescribed during three supervised consultations. Individuals were instructed to perform the exercises 3 times per week during a 12-week period. The foot targeted exercises were prescribed for 2 times per week for 12 weeks with one session per week being supervised by a physiotherapist. The primary outcome was the subscale "pain" in the Knee Injury and Osteoarthritis Outcome Score (KOOS) at 4 months.
Results: Individuals randomized to knee targeted exercises combined with foot targeted exercises and foot orthoses had 8.9 points (95%CI: 0.4; 17.4) – NNT = 3 (2–16) larger improvement in KOOS pain at the primary endpoint.
Conclusions: The addition of foot targeted exercises and foot orthoses for 12 weeks was more effective than knee targeted exercises alone in individuals with patellofemoral pain. The effect was apparent after 4 months, but not significantly different after 12 months.

C.M. Mølgaard et al. / Journal of Science and Medicine in Sport 21 (2018)

Patellofemoral Pain: Proximal, Distal, and Local Factors

2nd International Research Retreat

August 31-September 2, 2011 • Ghent, Belgium

J Orthop Sports Phys Ther 2012;42(6):A1-A20. doi:10.2519/jospt.2012.0301

Consensus Statement

LOCAL FACTORS

DISTAL FACTORS

PROXIMAL FACTORS

INTERVENTIONS

What Have We Learned?

Where Do We Need to Go in the Future?

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

PROXIMAL FACTORS

PFPS patients demonstrate

- Altered Hip kinematics (run/jump/land)
- Increased frontal plane motion
- Altered transverse plane motion
- Decreased Hip ABD/EXT ROT strength
- Altered Glut Medius/Maximus NM activity (run/land/descend stairs)

Excessive Fem IR results in

- Increased lateral patellar displacement/tilt
- Increased PF stress

Functional Biomechanical Screen

(able to tolerate following 3 visits)

- Pain with sit to stand; Squat > 60, Return from squat – Dynamic valgus (concentric and eccentric)
- Single leg squat – Compensated Trendelenberg, Femoral ADD/IR; @ Extension - recurvatum/hyperextension (+ pain)
- Step down – Compensated Trendelenberg, Femoral ADD/IR
- Gait analysis – Anterior pelvic tilt; Dynamic valgus loading through stance → terminal stance (walking)

For Use of Participants Only. No Use or Reproduction Without Consent

Journal of Orthopaedic & Sports Physical Therapy
Official Publication of the Orthopaedic and Sports Physical Therapy Sections of the American Physical Therapy Association

Patellofemoral Kinematics During Weight-Bearing and Non–Weight-Bearing Knee Extension in Persons With Lateral Subluxation of the Patella: A Preliminary Study

Christopher M. Powers, PT, PhD[1]
Samuel R. Ward, PT[2]
Michael Fredericson, MD[3]
Marc Guillet, PT, MS[4]
Frank G. Shellock, PhD[5]

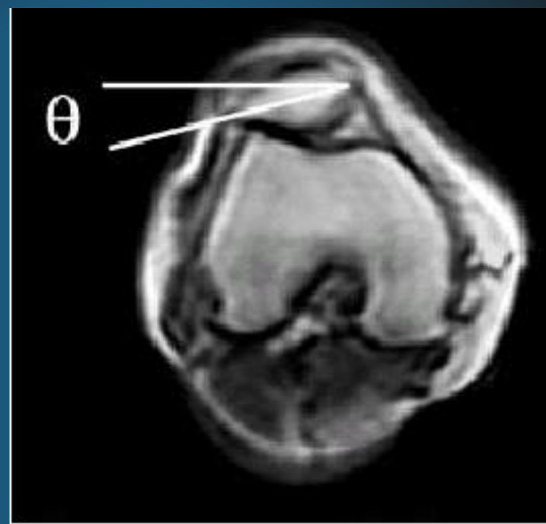
J Orthop Sports Phys Ther • Volume 33 • Number 11 • November 2003

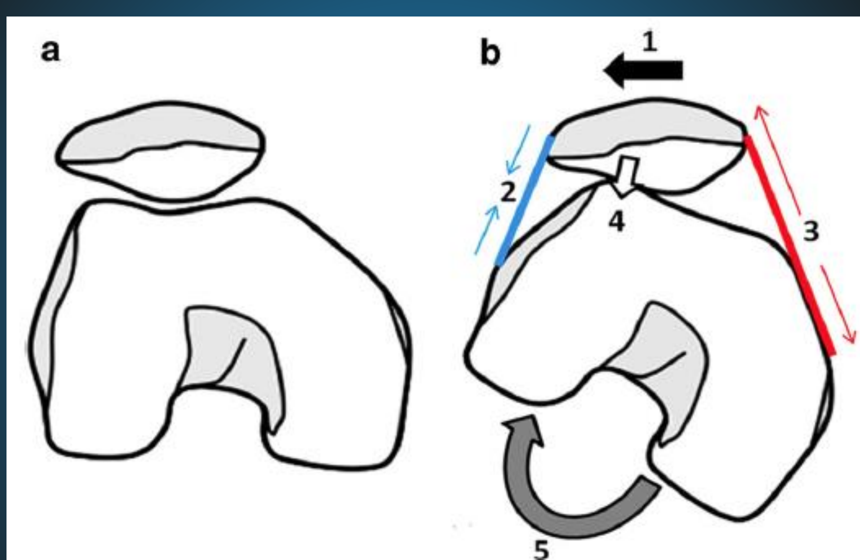
- Lateral subluxation in closed chain due to femur internally rotating under stable patella

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

- **Lateral subluxation in open chain due to patella rotating under stable femur**



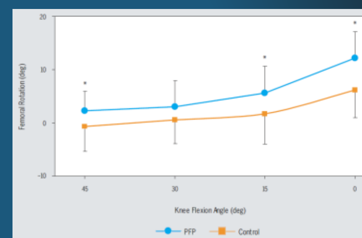


Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

Femur Rotation and Patellofemoral Joint Kinematics: A Weight-Bearing Magnetic Resonance Imaging Analysis

- Larger More heterogeneous sample
- Females with PFPS > Lateral displacement, Lateral Tilt (patella)
- > Medial Femoral Rotation
- > closer to 0 degrees flexion



JOSPT 2010

Females with patellofemoral pain syndrome have weak hip muscles: a systematic review

Australian Journal of Physiotherapy 55: 9–15

Maarten R Prins and Peter van der Wurff

- Strong evidence was found for a deficit in hip external rotation, abduction and extension strength
- Moderate evidence for a deficit in hip flexion and internal rotation strength
- No evidence for a deficit in hip adduction strength compared with healthy controls
- No evidence for a decrease in hip extension, flexion, adduction and internal rotation strength compared with the unaffected side

For Use of Participants Only. No Use or Reproduction Without Consent

Lower Extremity Kinematics of Females With Patellofemoral Pain Syndrome While Stair Stepping

- Compared to control subjects, females with PFPS descend stairs with the knee in a more flexed position and have the hip in a more adducted and internally rotated position, at foot contact during stair stepping

JOSPT Sept 2010

Gluteal muscle activity and patellofemoral pain syndrome: a systematic review

Conclusions Delayed and shorter duration of GMed EMG may indicate impaired ability to control frontal and transverse plane hip motion. Further research evaluating the value of gluteal muscle activity screening in identifying individuals most likely to develop PFPS, and the effectiveness of interventions targeting changes to gluteal muscle activation patterns is needed.

Br J Sports Med 2012

For Use of Participants Only. No Use or Reproduction Without Consent

BJSM

Altered hip and trunk muscle function in individuals with patellofemoral pain

S M Cowan, K M Crossley and K L Bennell

Br. J. Sports Med. 2009;43;584-588; originally published online 6 Oct 2008;
doi:10.1136/bjsm.2008.053553

Conclusion:

Trunk side flexion strength and neuromotor control of the GM are affected in people with PFP.

Delayed vastus medialis obliquus relative to vastus lateralis.

Results:

Stair-stepping
Delay in activation of both anterior and posterior GM
Alteration in Vasti control .
Trunk side flexion strength was significantly less (29%) in individuals with PFP .

Clinical Classification

- Classify patient
  - Subjective History
  - Objective Examination
  - Functional Biomechanical Screen
- PF maltracking (local)
- LQ malalignment (proximal > distal)
  - Guide Treatment Interventions
  - Functional Objective Outcome Measures

For Use of Participants Only. No Use or
Reproduction Without Consent

Treatment Progression

- Lumbopelvic Stability – proximal stability
- Activation – Gluts – facilitate medius
- Lower Quarter Alignment
  - Neuromuscular Re-education
- Progress Functional
- Progress Sport Specific – Gait Re training

J Orthop Sports Phys Ther • Volume 33 • Number 11 • November 2003

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Comparative Evaluation of Core Muscle Recruitment Pattern in Response to Sudden External Perturbations in Patients With Patellofemoral Pain Syndrome and Healthy Subjects

Archives of Physical Medicine and Rehabilitation 2014;95:1383-9

- PFPS Group altered trunk activation patterns
- PFPS Group:
  - Glut Medius contracted later
  - Erectors, TrA/IO contracted first and prolonged

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Do novice runners have weak hips and bad running form?

Gait & Posture 40 (2014) 82–86

- Increased Hip Int ROT
- No difference: Loading, Strength, Peak Hip ADD
- Correlation between Decreased Trunk Endurance and Hip Int ROT
- Decr Trunk endurance may lead to running related injuries
- Rehab implications: Trunk endurance and NM control versus Hip strength

For Use of Participants Only. No Use or
Reproduction Without Consent

RESEARCH REPORT

Gluteal Muscle Activation During Common Therapeutic Exercises

J Orthop Sports Phys Ther 2009;39(7):532-540. doi:10.2519/jospt.2009.2796

Lindsay J. DiStefano, J. Troy Blackburn, Stephen W. Marshall, Darin A. Padua

Journal of Orthopaedic & Sports Physical Therapy
JOSPT
| VOLUME 39 | NUMBER 7 | JULY 2009 |

© 2009 JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

TABLE 2 NORMALIZED GLUTEUS MEDIUS MEAN SIGNAL AMPLITUDE (% MVIC)

Exercise	Mean ± SD (95% CI)
Side-lying hip abduction	81 ± 42 (62, 101)
Single-limb squat	64 ± 24 (53, 75)
Lateral band walk	61 ± 34 (46, 76)
Single-limb deadlift	58 ± 25 (47, 70)
Sideways hop	57 ± 35 (41, 73)
Transverse hop*	48 ± 25 (37, 59)
Transverse lunge*	48 ± 21 (38, 57)
Forward hop*	45 ± 21 (38, 57)
Forward lunge*†	42 ± 21 (33, 52)
Clam with 30° hip flexion*	40 ± 38 (23, 57)
Sideways lunge*†	39 ± 19 (30, 47)
Clam with 60° hip flexion*†	38 ± 29 (25, 51)

Abbreviations: CI, confidence interval; MVIC, maximum voluntary isometric contraction.
** Exercises are significantly different than the hip abduction exercise (P<.05).*
† Exercises are significantly different from the single-limb squat (P<.05).

Research Report:
Gluteal Muscle Activation During Common Therapeutic Exercises
| VOLUME 39 | NUMBER 7 | JULY 2009 | © 2009 JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY
JOSPT

For Use of Participants Only. No Use or Reproduction Without Consent


Orthopaedic Manual Physical Therapy Series 2017-2018
www.vompti.com


Orthopaedic Manual Physical Therapy Series 2017-2018
www.vompti.com


Gluteal Muscle Activation During Common Therapeutic Exercises

FIGURE 4. Single-limb deadlift exercise.

Research Report:
Gluteal Muscle Activation During Common Therapeutic Exercises

JOSPT

For Use of Participants Only. No Use or
Reproduction Without Consent

TABLE 3 Normalized Gluteus Maximus Mean Signal Amplitude (% MVIC)

Exercise	Mean ± SD (95% CI)
Single-limb squat	59 ± 27 (47, 72)
Single-limb deadlift	59 ± 28 (46, 71)
Transverse lunge	49 ± 20 (39, 58)
Forward lunge	44 ± 23 (33, 54)
Sideways lunge	41 ± 20 (32, 50)
Side-lying hip abduction	39 ± 18 (31, 47)
Sideways hop	30 ± 19 (31, 48)
Clam with 60° hip flexion	39 ± 34 (24, 54)
Transverse hop*†	35 ± 16 (28, 43)
Forward hop*†	35 ± 22 (25, 45)
Clam with 30° hip flexion*†	34 ± 27 (21, 46)
Lateral band walk*†‡	27 ± 16 (20, 35)

Abbreviations: CI, confidence interval; MVIC, maximum voluntary isometric contraction.
* *Exercises are significantly different than the single-limb squat (P<.05).*
† *Exercises are significantly different from the single-limb deadlift (P<.05).*
‡ *Exercises are significantly different from the transverse lunge (P<.05).*

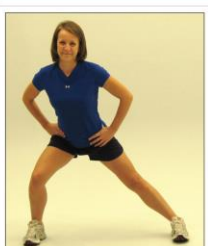


FIGURE 7. Sideways lunge.

Gluteal Muscle Activation During Common Therapeutic Exercises

FIGURE 8. Transverse lunge.

Research Report:
Gluteal Muscle Activation During Common Therapeutic Exercises
JOSPT

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

A literature review of studies evaluating gluteus maximus and gluteus medius activation during rehabilitation exercises

Physiotherapy Theory and Practice, 28(4):257–268, 2012

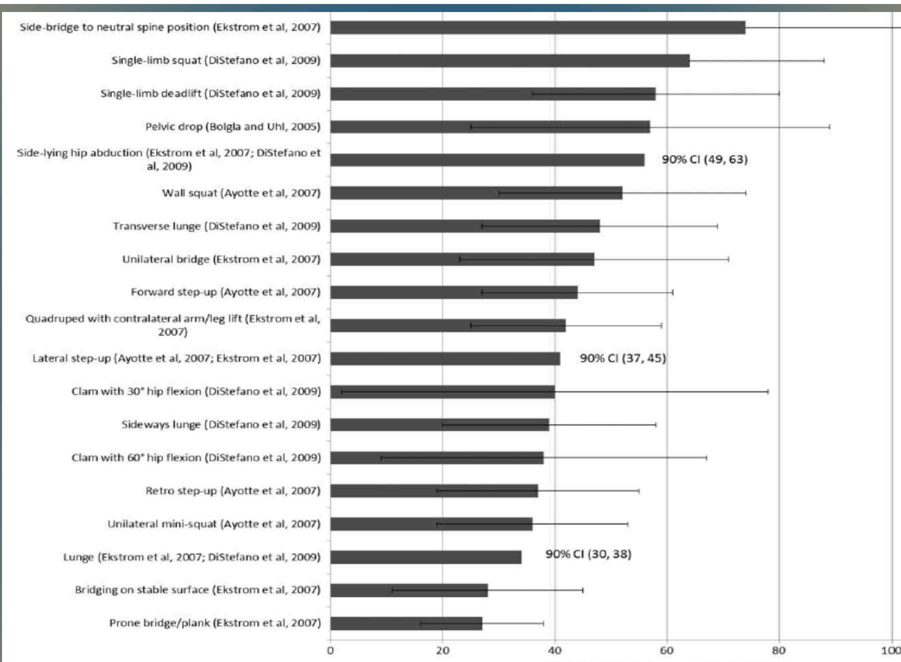


FIGURE 2 Gluteus medius percent maximum voluntary isometric contraction ranking of exercises.

For Use of Participants Only. No Use or Reproduction Without Consent

Property of VOMPTI, LLC

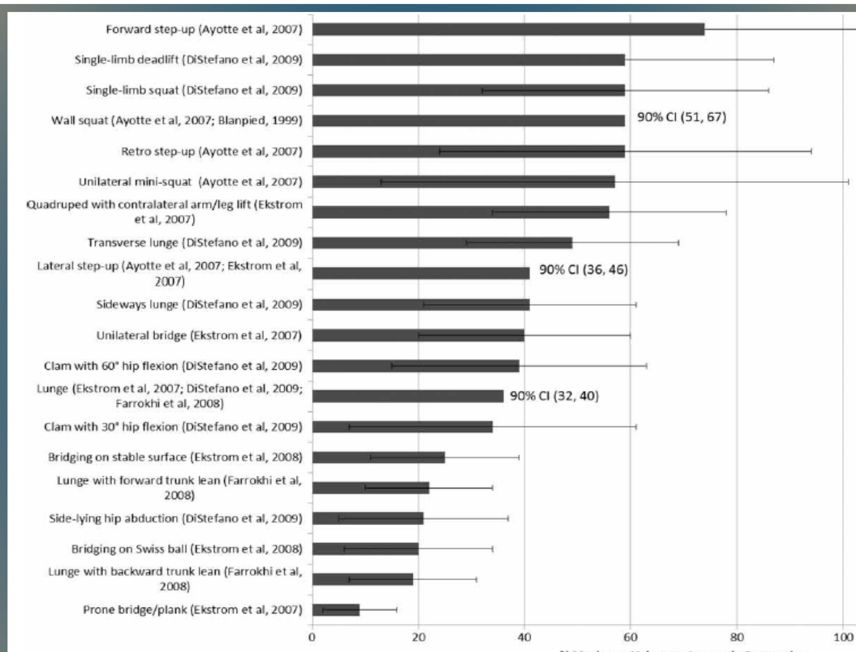
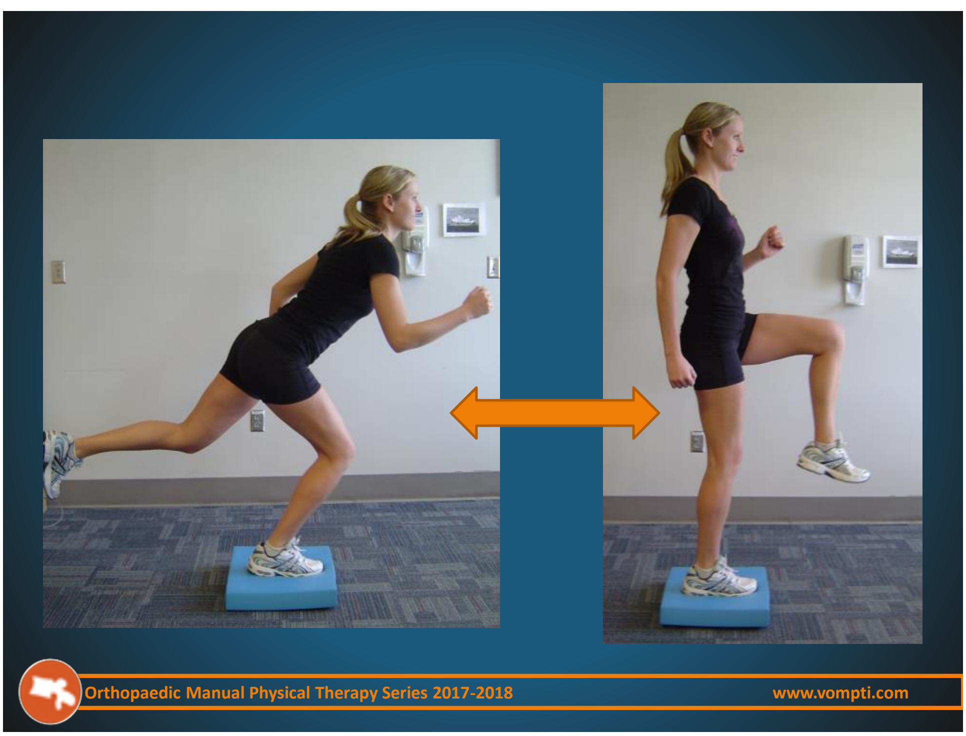


FIGURE 1 Gluteus maximus percent maximum voluntary isometric contraction ranking of exercises.

For Use of Participants Only. No Use or Reproduction Without Consent



For Use of Participants Only. No Use or
Reproduction Without Consent

Lower Extremity Injuries: Is It Just About Hip Strength?

BRYAN C. HEIDERSCHEIT, PT, PhD[1]

J Orthop Sports Phys Ther 2010;40(2):39-41. doi:10.2519/jospt.2010.0102

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Hip Strength Is Greater in Athletes Who Subsequently Develop Patellofemoral Pain

- Prospective
- Participants that developed PFPS demonstrated
  INCREASED Hip ABD strength (not knee flexion/ext differences)
- Increased Hip ADD/dynamic valgus with loading
  mechanics
- Increased eccentric ABD activation to control
  pathomechanics
- ? Compensatory pattern fails (overloaded/decreased
  endurance) → PFPS

Am J Sports Med 2015 43: 2747

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent

Neuromuscular Re- Education

– Improving performance measures
  of Speed, Strength, Power
– Improve shock absorption
– Improve Active joint stabilization
– Improve Muscle imbalances
– Improve Functional biomechanics

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

Neuromuscular Re-Education
Motor Learning

- Unconscious Incompetence

↓

- Conscious Incompetence

↓

- Conscious Competence

↓

- Unconscious Competence

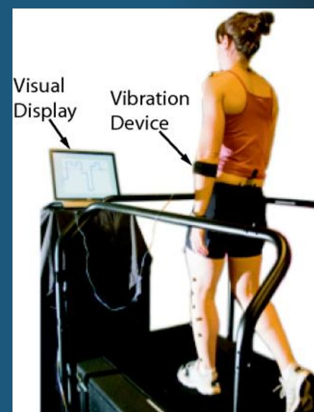
Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or
Reproduction Without Consent

The effect of real-time gait retraining on hip kinematics, pain and function in subjects with patellofemoral pain syndrome

B Noehren, J Scholz and I Davis

- Significant reduction
  - Hip ADD - running
  - Contralateral pelvic drop – running
  - Pain
  - Function (LEFI)
  - Reduction avg. vertical load rates 20%
  - Maintained at 1 month follow up
  - Hip IR (23%)
  - Hip ADD (17%) single leg squat

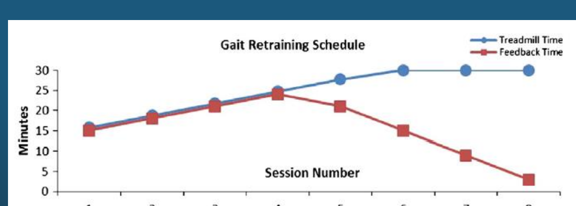


Br J Sports Med (2010).

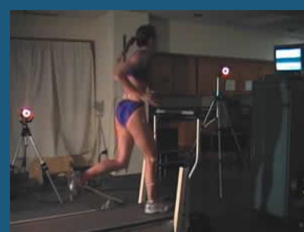
Mirror gait retraining for the treatment of patellofemoral pain in female runners

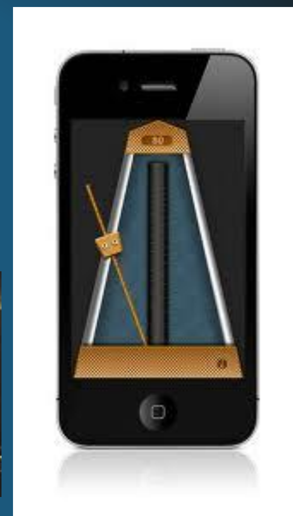
Richard W. Willy [a,*], John P. Scholz [b], Irene S. Davis [c] Clinical Biomechanics 27 (2012) 1045–1051

- Gait Re training – Mirror
- Significant Improvements in
  - Pain
  - Function
  - Hip IR/ADD
- Improvement in Central Processing
  - NM improvements
    - SL Squat
    - Step Down
- Maintained for 3 months



For Use of Participants Only. No Use or Reproduction Without Consent



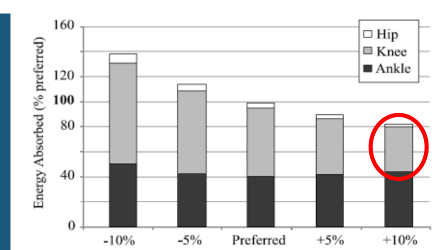


Effects of Step Rate Manipulation on Joint Mechanics during Running

Med. Sci. Sports Exerc., Vol. 43, No. 2, pp. 296–302, 2011.

BRYAN C. HEIDERSCHEIT[1,2], ELIZABETH S. CHUMANOV[1], MAX P. MICHALSKI[1], CHRISTA M. WILLE[2], and MICHAEL B. RYAN[1]

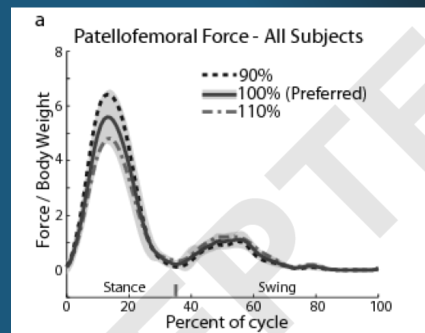
- Increased step rate 10%:
  - 34% Decrease in energy absorbed at the knee
  - Decreased step length
  - IC: Heel closer to COM
  - Decreased braking impulse
  - Decreased knee flexion
  - Increased leg stiffness
  - Decreased Hip ADD
  - Decreased COM vertical excursion



For Use of Participants Only. No Use or Reproduction Without Consent

Increasing Running Step Rate Reduces Patellofemoral Joint Forces

- **Increased step rate 10%**
- **Reduced PF forces 14%**
- **Decreased Hip, Knee Ankle Extensor; Hip ABD forces @ mid stance**
- **Decreased peak knee flexion**
  - **Most predictive of reduced PF loading**



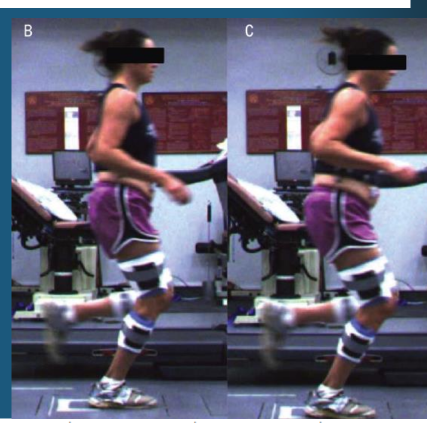
Lenhart RL MSSE 2013

Sagittal Plane Trunk Posture Influences Patellofemoral Joint Stress During Running

KEY POINTS

FINDINGS: A more upright trunk posture during running was found to be associated with higher peak PFJ stress. A relatively small increase in sagittal plane trunk flexion posture led to significant reduction in peak PFJ stress.

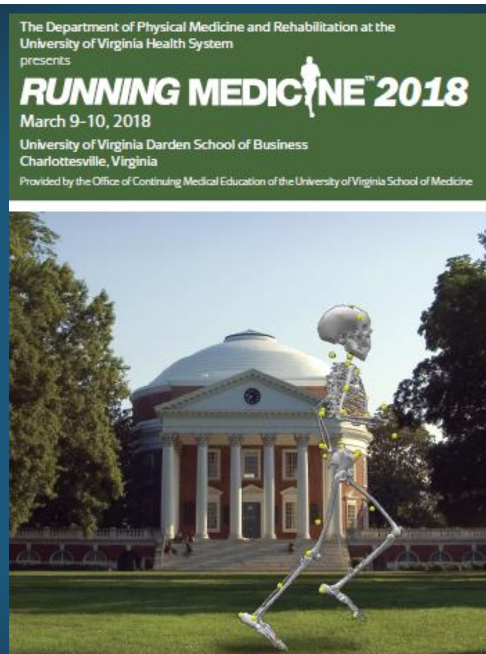
IMPLICATIONS: An upright trunk posture during running may expose an individual to a higher risk of PFP. Incorporating a slightly forward-leaning trunk posture during running may be an alternative means to reducing PFJ stress.



JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 44 | NUMBER 10 | OCTOBER 2014

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent



Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

http://patellofemoral.completesportscare.com.au/wp-content/uploads/2014/11/Managing-my-patellofemoral-pain_education_single-sheets.pdf

Orthopaedic Manual Physical Therapy Series 2017-2018 www.vompti.com

For Use of Participants Only. No Use or Reproduction Without Consent


??? Questions ???
Orthopaedic Manual Physical Therapy Series 2017-2018
www.vompti.com