Investigating Injuries: Patellar Tendinopathy

Introductions

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Learning Objectives

- Describe the anatomy, biomechanics, and pathophysiology of Patellar Tendinopathy
- Perform a structured clinical assessment for Patellar Tendinopathy
- Utilize ActivForce handheld dynamometry to objectively assess quadriceps strength and tendon loading capacity
- Explain the clinical role of musculoskeletal ultrasound imaging and Blood Flow Restriction (BFR) training

Agenda

- Introduction: Understanding Patellar Tendinopathy
- Clinical Presentations
- Mechanisms of injury
- Common Causes and Risk Factors
- Clinical Assessment
  - Range of Motion (ROM)
    - Knee Flexion/Extension
  - Muscle Testing
    - Quadriceps Strength
    - Hip Abductors and Extensors
- Case Study
  - Smartphone Clinicians Guide to Patellar Tendinopathy: Use of ActivForce, Ultrasound Imaging and Blood Flow Restriction
  - Data Review and Analysis
- Treatment and Rehabilitation Strategies
- Q&A

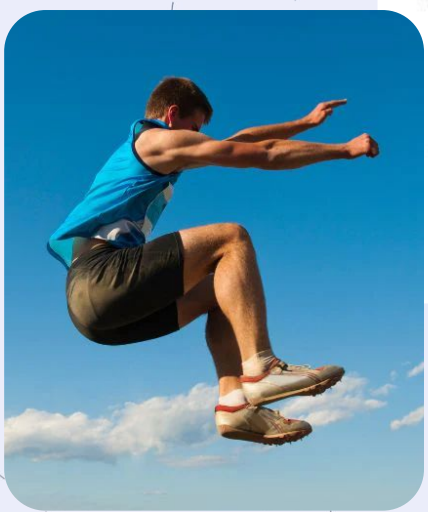
Understanding Patellar Tendinopathy

What is Patellar Tendinopathy?

- Also known as “Jumper’s Knee”
- Overuse injury affecting the knee extensor mechanism
- Common in jumping and explosive sports
- Characterized by localized pain at the inferior pole of the patella
- Typically associated with load-related pain

What is Patellar Tendinopathy?

- Common in athletes aged 15–30
- Higher prevalence in elite jumping athletes
- Reported prevalence:
  - ~45% in elite volleyball athletes
  - ~14% in recreational athletes
- More common in male athletes



Clinical Presentations

Common symptoms:

- Localized pain at inferior pole of patella
- Pain with jumping, squatting, or running
- Morning stiffness
- Pain during resisted knee extension
- Reduced athletic performance

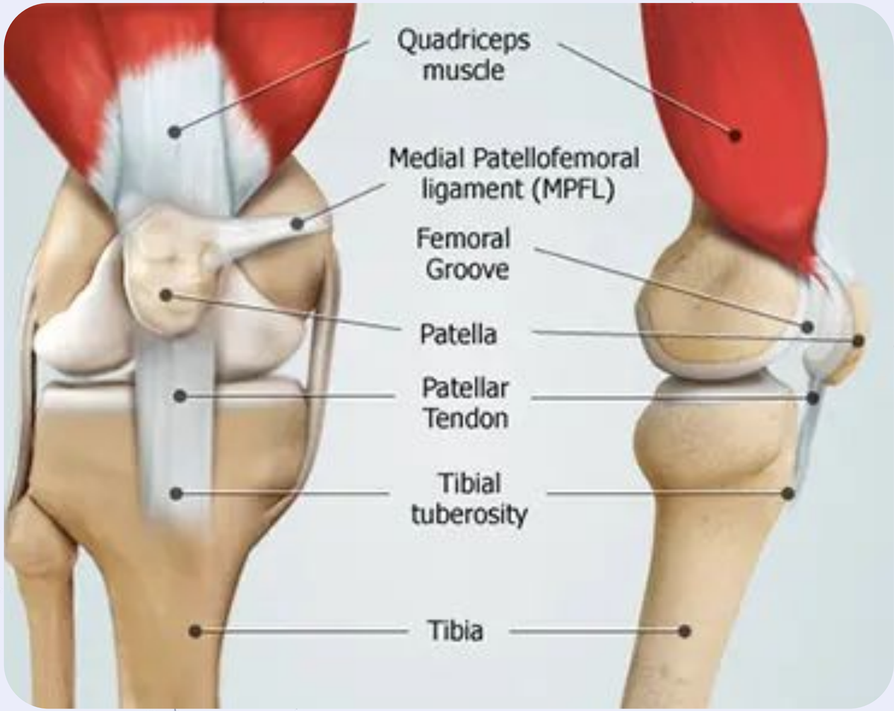
Anatomy

Structures involved in the knee extensor mechanism:

- Quadriceps muscle group
- Quadriceps tendon
- Patella (sesamoid bone)
- Patellar tendon
- Tibial tuberosity

Function:

- Transmission of force from quadriceps to tibia
- Enables knee extension
- Important for shock absorption during landing



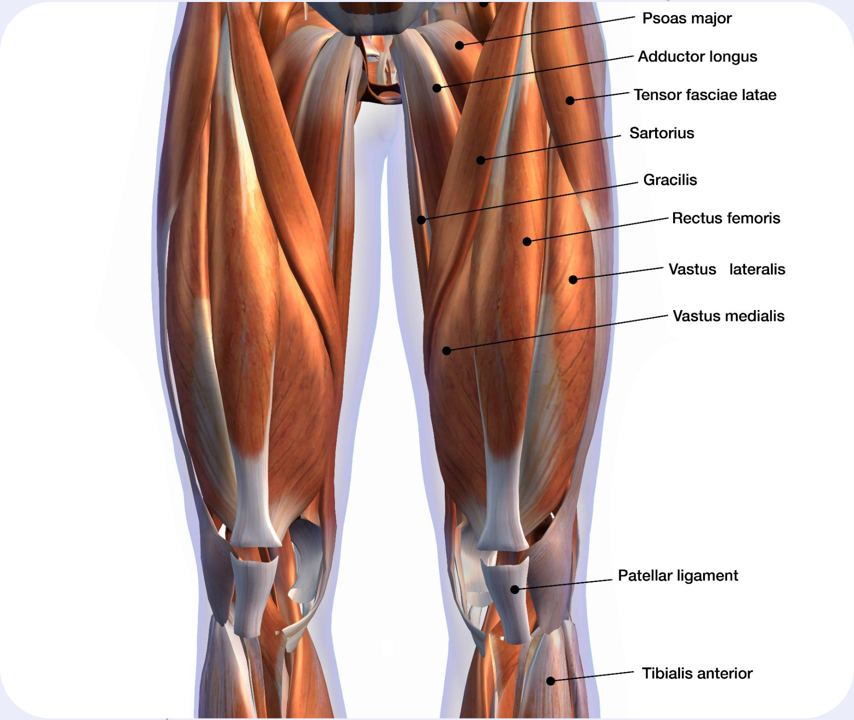
Anatomy - Quadriceps Muscle Group

Primary knee extensor muscles

- Rectus femoris
- Vastus lateralis
- Vastus medialis
- Vastus intermedius

Function

- Knee extension
- Eccentric control during landing
- Shock absorption during deceleration



Anatomy - Quadriceps Muscle Group

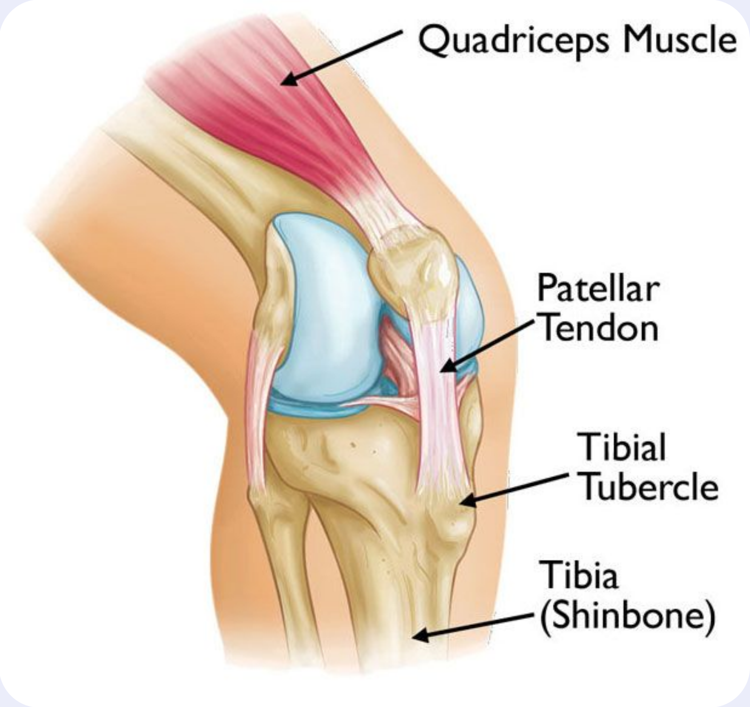
Link: youtube.com/shorts/kL1Y-D4P5Q4

Anatomy - Patellar Tendon Structure

- Connects inferior patella to tibial tuberosity
- Composed primarily of Type I collagen fibers
- Designed to handle high tensile loads
- Works as part of the extensor mechanism

Mechanical role

- Transfers quadriceps force to extend the knee
- Stores and releases elastic energy during jumping



Mechanism of Injury

- Chronic mechanical overload
- Repetitive micro-tearing of tendon fibers
- Degenerative changes:
  - Collagen disorganization
  - Increased ground substance
  - Neovascularization

Common mechanisms:

- Repetitive jumping and landing
- Sudden increase in training volume
- Repeated knee extension loading
- Insufficient recovery between sessions

Mechanism of Injury

Sports commonly associated:

- Volleyball
- Basketball
- Track and field
- Soccer

Link: youtube.com/shorts/7_ErV4C-hcs

Key Concept: Tendinopathy is degenerative (tendinosis) rather than inflammatory.

Risk Factors

Intrinsic Factors

- Quadriceps tightness
- Hamstring tightness
- Increased Q-angle
- Muscle imbalance
- Reduced ankle dorsiflexion

Extrinsic Factors

- Sudden increase in training
- High training volume
- Hard playing surfaces
- Poor biomechanics

Clinical Assessment:

Range of Motion

Knee

- Flexion
- Extension

Range of Motion

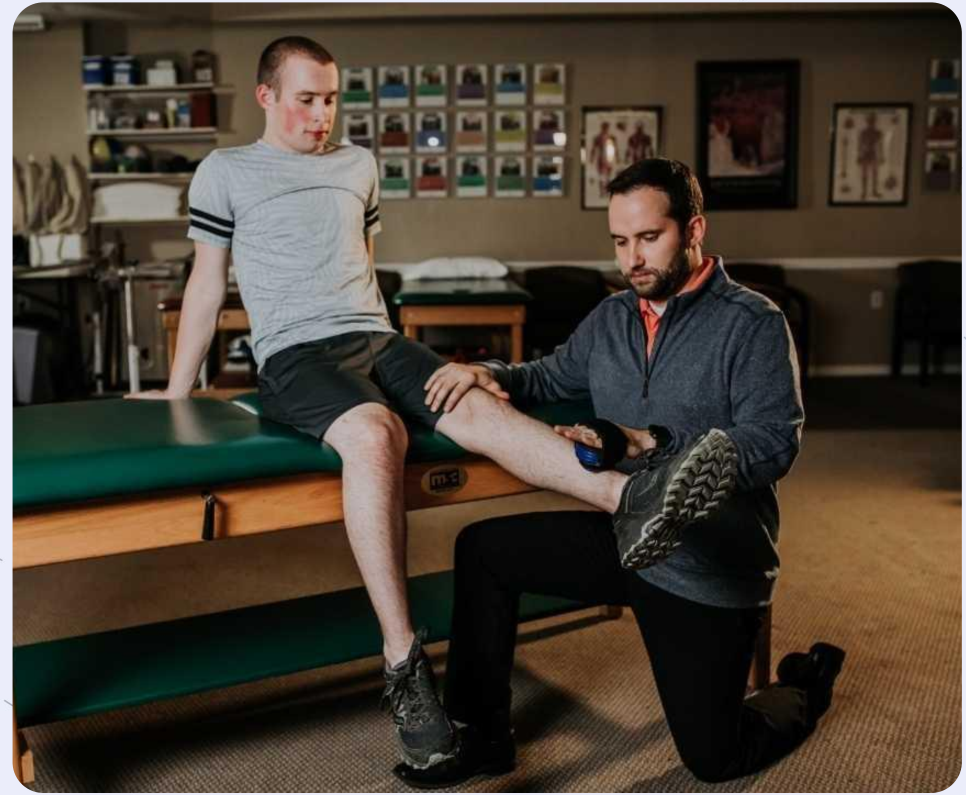
Hip

- Extension
- Rotation

Muscle Testing

Quadriceps

- Knee Extension Strength



Muscle Testing

Hip Muscles

- Hip abductors
- Hip extensors

Case Study

A Data-Driven Approach to Anterior Knee Pain: Integrating Dynamometry, Ultrasound, and BFR

A tale of two presentations of inferior patellar pain

Case 1

- Male
- Mid 30s
- Distance trail runner
  - Increased frequency of running Camelback Mountain in Phoenix, AZ
  - Training for Rim2Rim2Rim Grand Canyon run (~45 miles/10k elevation)
- 3 month history of worsening infrapatellar pain

Case 2

- Female
- Mid 30s
- Distance trail runner
  - Increased frequency & duration of indoor cycling in summer due to outdoor heat
- 1 month history of worsening infrapatellar pain

Objective Exam

Exam Finding	Case 1	Case 2
Primary pain location (patient report)	Proximal patellar tendon (PT)	Proximal patellar tendon (PT)
Active knee flexion	Full and pain-free	Sharp end range pain
Active knee extension	Full and pain-free	Sharp end range pain
Selective Tissue Testing: Knee Extensors	**Strong and painful**	**Strong and pain free**
Palpation	TTP over proximal PT - mild with deep pressure	TTP over proximal PT- exquisite with deep pressure
Ligamentous/Meniscal Testing	Negative	Negative
Step down test	Reproduces anterior knee pain localized to tendon	Minimal symptoms

Ceiling effect of MMT for Knee Extension

> Percept Mot Skills. 2000 Jun;90(3 Pt 1):747-50. doi: 10.2466/pms.2000.90.3.747.

A broad range of forces is encompassed by the maximum manual muscle test grade of five

R W Bohannon [1], D Corrigan

Affiliations + expand

PMID: 10883753 DOI: 10.2466/pms.2000.90.3.747

Abstract

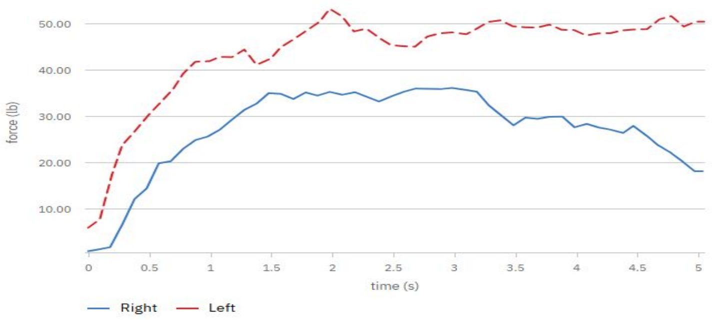
This retrospective study summarizes the range of knee extension forces associated with the manual muscle test grade of 5. The range of the forces (>560 Newtons) was large and encompassing of more than 86% of measurable forces. These findings help to explain the insensitivity of manual muscle testing and why it has such a profound ceiling effect.

Dynamometry

Case 1 Initial Evaluation

Knee Extension Seated

Force over time



Average Values

Right	27.58 lb
Left	44.31 lb

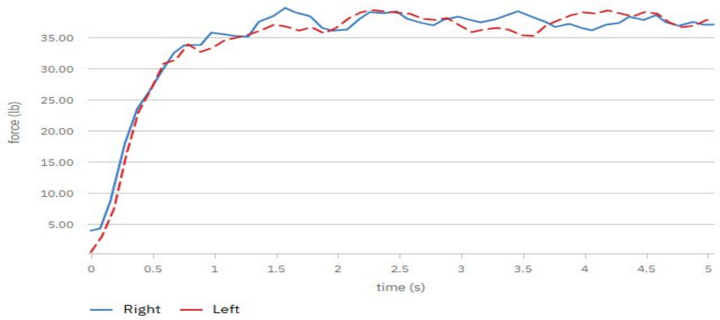
Peak Force (lb)

Right	36.02 lb
Left	53.11 lb
Strength Difference	17.08 lb
Percentage Difference	38.35%

Case 2 Initial Evaluation

Knee Extension Seated

Force over time



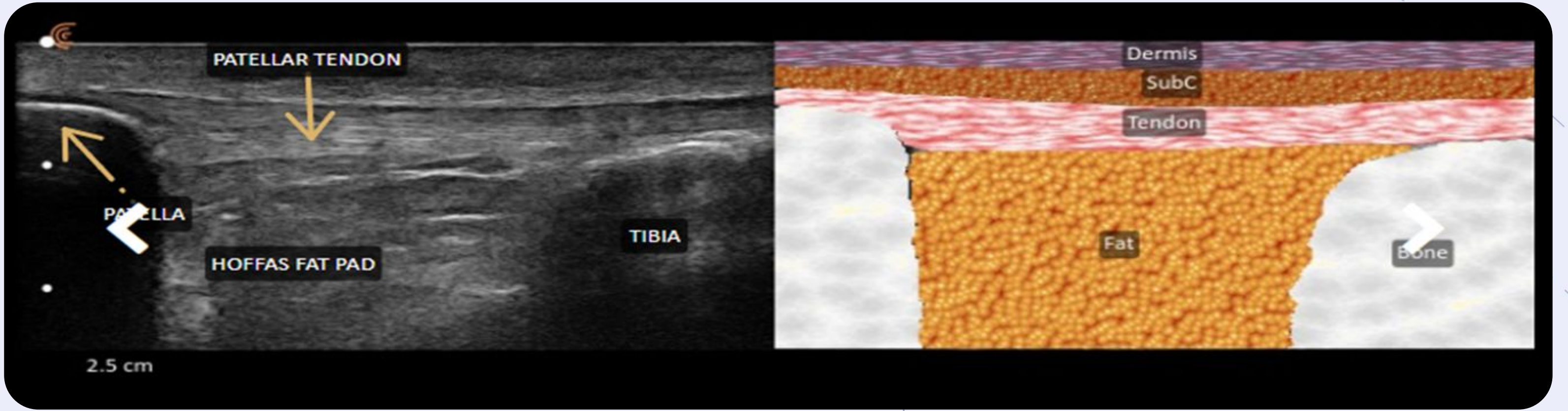
Average Values

Right	35.13 lb
Left	34.70 lb

Peak Force (lb)

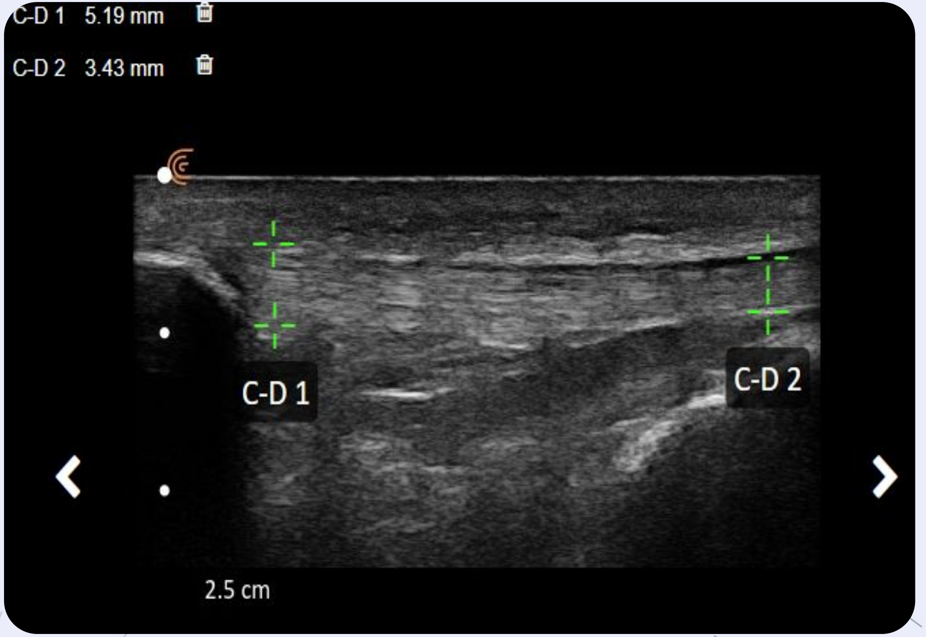
Right	39.68 lb
Left	39.33 lb
Strength Difference	0.35 lb
Percentage Difference	0.89%

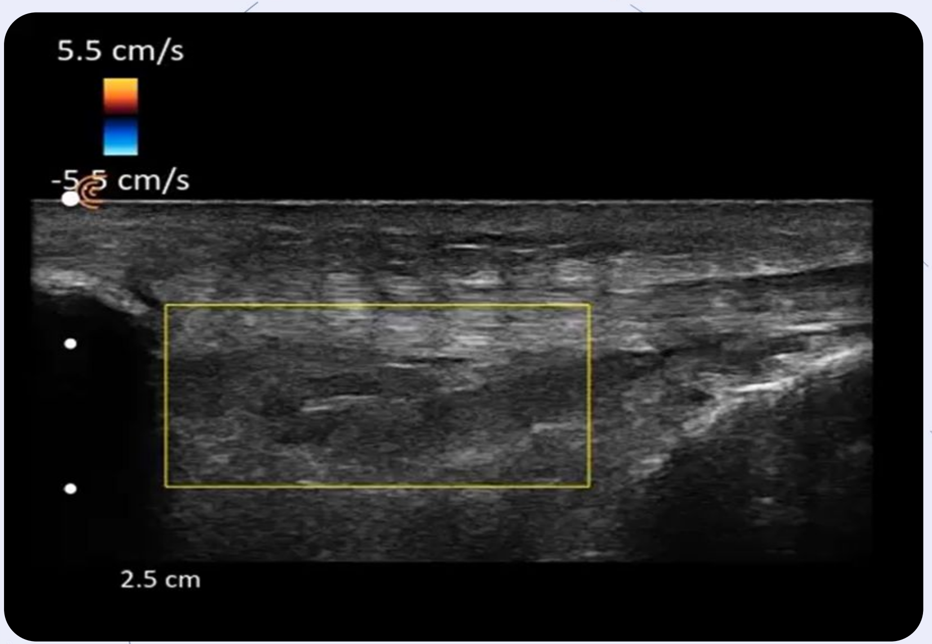
Ultrasound Imaging



Tendon State	Thickness
Mild tendinopathy	4–5 mm
Moderate tendinopathy	5–7 mm
Severe tendinopathy	>7 mm

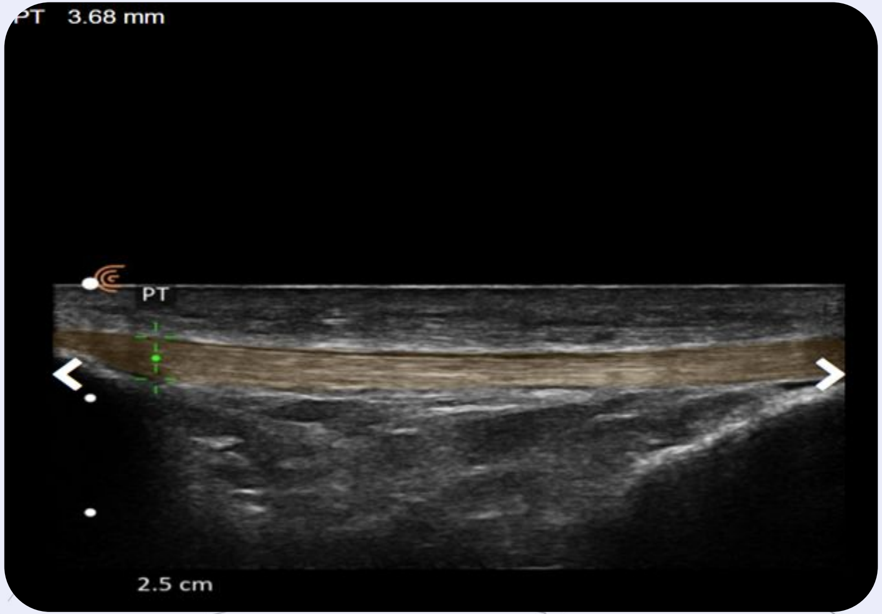
Case 1 - Ultrasound Confirmed Patellar Tendinopathy





Focal proximal tendon thickening (~5-6 mm compared to 4mm contralaterally) with normal Doppler activity supports patellar tendinopathy rather than fat pad irritation.

Case 2 - Ultrasound Confirmed Fat Pad Syndrome



Rheumatol Int (2017) 37:757–764
DOI 10.1007/s00296-016-3647-4
Rheumatology INTERNATIONAL
CrossMark

IMAGING

Sonographic characterization of Hoffa's fat pad. A pilot study

Erika Vera-Pérez[1] · Guadalupe Sánchez-Bringas[2,3] · Lucio Ventura-Ríos[3] · Cristina Hernández-Díaz[3] · Socorro Cortés[4] · Marwin Gutiérrez[3] · Carlos Pineda[5]

Findings consistent with hypervascularity of the infrapatellar fat pad without evidence of patellar tendinopathy.

Treatment & Rehabilitation Strategies

Treatment

	Case 1 – Patellar Tendinopathy	**Case 2 – Hoffa's Fat Pad Irritation**
Primary pathology	Proximal patellar tendon overload	Infrapatellar fat pad irritation
Strength testing	**Extension strength deficit on dynamometry**	**Symmetrical strength bilaterally**
Initial symptom driver	Load intolerance	Mechanical compression
Primary management focus	Progressive tendon loading	Mechanical modification
Activity modification	Reduce high-load activities (running, jumping)	Temporary cycling modification
Key intervention	**BFR-assisted strengthening protocol**	**Bike fit correction + anti-inflammatory care**

Case 2 - Hoffa's Fat Pad Management

Intervention	Strategy
Mechanical correction	Crank arm length reduced **175 mm → 160 mm**
Saddle position	Adjusted to **heel-on-pedal method** for proper knee extension
Load modification	Temporary reduction in cycling intensity
Anti-inflammatory treatment	**Iontophoresis with dexamethasone** prescribed by PCP
Outcome	**Symptoms resolved within one week with no recurrence**

Pain was driven by **mechanical compression rather than contractile deficit**, so correction of biomechanics resolved symptoms rapidly.

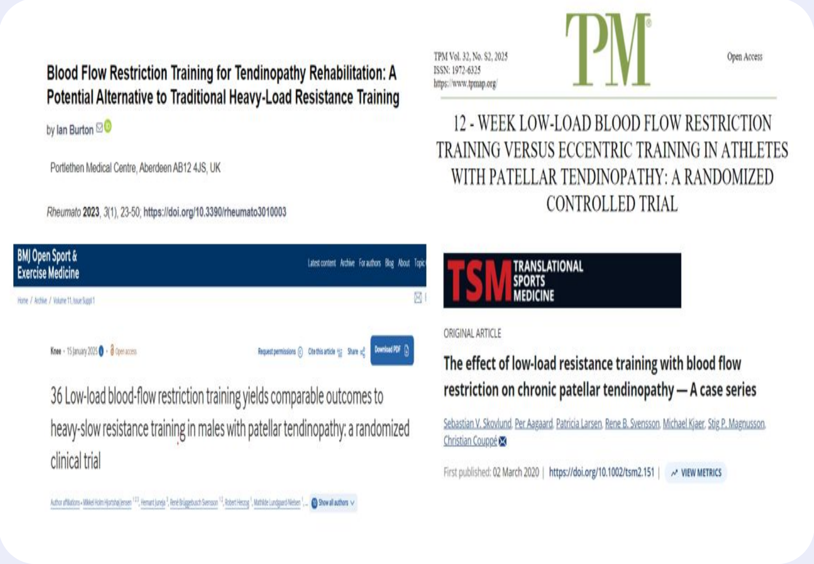
Case 1 - Patellar Tendinopathy Management

Intervention	Strategy
Strength deficit identified	**Dynamometry confirmed quadriceps weakness**
Loading tolerance	Isometric loading painful
Primary initial rehab approach	**Low-load Blood Flow Restriction training**
Load prescription	**20–40% 1RM using dynamometry values**
BFR structure	30-15-15-15 repetition scheme @ 70-80% LOP
Monitoring	Dynamometry used to guide progressive loading


Randomized Controlled Trial > Med Sci Sports Exerc. 2022 Apr 1;54(4):582-589.
doi: 10.1249/MSS.0000000000002824.

Low-Load Blood Flow Restriction and High-Load Resistance Training Induce Comparable Changes in Patellar Tendon Properties

Christoph Centner, Simon Jerger [1], Benedikt Lauber, Olivier Seynnes [2], Till Friedrich [1], David Lolli [1], Albert Gollhofer [1], Daniel König [3]


Blood Flow Restriction Training for Tendinopathy Rehabilitation: A Potential Alternative to Traditional Heavy-Load Resistance Training

by Ian Burton

Portlethen Medical Centre, Aberdeen AB12 4JS, UK

Rheumato 2023, 3(1), 23-50; https://doi.org/10.3390/rheumato3010003

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12 - WEEK LOW-LOAD BLOOD FLOW RESTRICTION TRAINING VERSUS ECCENTRIC TRAINING IN ATHLETES WITH PATELLAR TENDINOPATHY: A RANDOMIZED CONTROLLED TRIAL

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36 Low-load blood-flow restriction training yields comparable outcomes to heavy-slow resistance training in males with patellar tendinopathy: a randomized clinical trial

TSM TRANSLATIONAL SPORTS MEDICINE

ORIGINAL ARTICLE

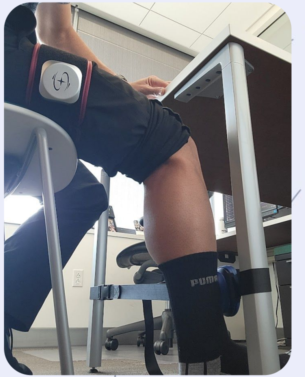
The effect of low-load resistance training with blood flow restriction on chronic patellar tendinopathy — A case series

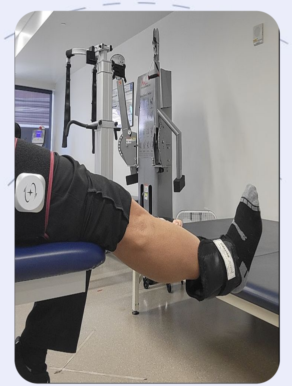
Sebastian V. Skovlund, Per Aagaard, Patricia Larsen, Rene B. Svensson, Michael Kjaer, Stig P. Magnusson, Christian Couppé

First published: 02 March 2020 | https://doi.org/10.1002/tsm2.151 | VIEW METRICS

Case 1 - Intervention

Phase	Intervention
Weeks 0–4	Blood Flow Restriction strengthening **2–3x/week**
	Load prescribed using **dynamometry-derived % max force**
	Low-load quad focused strengthening (20–40% 1RM) @ 70% LOP
Weeks 4–8	Transition to **progressive heavy slow resistance program at gym**
Weeks 8-12	**Power/plyometrics** incorporated into gym-based strengthening
Outcome	**Returned to hiking pain-free at 12 weeks & running at 16 weeks**



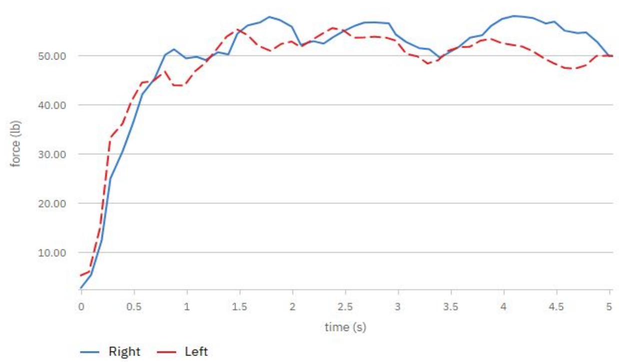


Isometric Knee Extension + BFR	**Open Chain Knee Extension + BFR**	**Closed Chain Step-Down + BFR**
Establish **tolerance + force output** • Use **ActivForce to determine %MVC & provide biofeedback**	• Load based on prior **MVC output** • Progress to **dynamic contractions**	• Transition to **functional loading** • Emphasize **eccentric control + alignment**

Case 1 - Outcome

Knee Extension Seated

Force over time

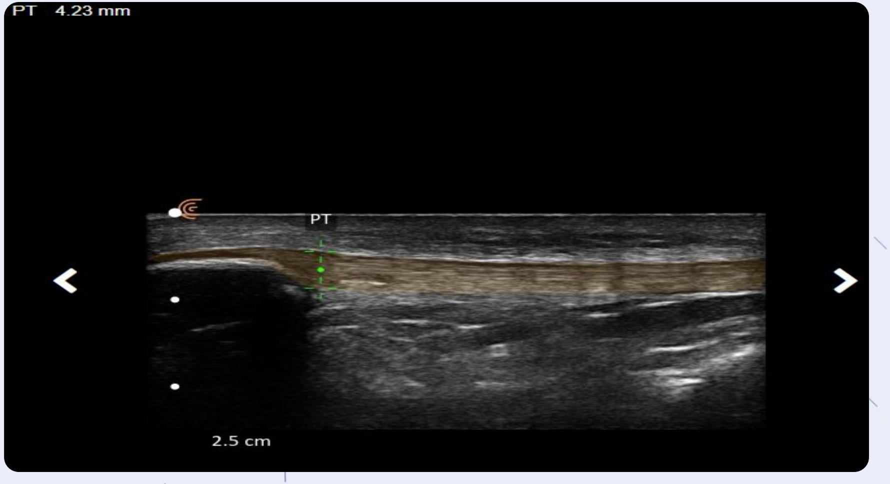


Average Values

Right	50.35 lb
Left	48.48 lb

Peak Force (lb)

Right	58.01 lb
Left	55.56 lb
Strength Difference	2.46 lb
Percentage Difference	4.31%



Data Driven Approach to Patellar Tendon Pain

- **Measure the Impairment**
  • Dynamometry provides objective strength assessment beyond manual muscle testing
- **Identify the Tissue**
  • Diagnostic ultrasound helps differentiate tendon pathology from adjacent structures such as Hoffa's fat pad
- **Target the Treatment**
  • Tendinopathy → progressive loading strategies (BFR when load intolerance exists)
  • Fat pad irritation → biomechanical correction and symptom management
- **Objective data improves clinical decision making.**
  Dynamometry and ultrasound together help physical therapists refine diagnosis and guide more precise treatment strategies.

- **Better measurement → better diagnosis → better rehabilitation.**

Questions?

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