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PATELLOFEMORAL PAIN SYNDROME

Friday, February 28, 2025

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INTRODUCTIONS

Dr. Daniel G. Stewart,
PT, DPT

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INTRODUCTIONS

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Consultant Physio for ActivForce

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AGENDA

- Introduction to Patellofemoral Pain Syndrome
- Common causes, risk factors, anatomical structures involved
- Signs & Symptoms
- PT Assessment: Range of Motion for knee flexion, hip abduction, and Ankle inversion
- PT Assessment: Muscle Testing for knee extension, gluteus medius, and Ankle inversion
- Discussion on Treatment and Rehabilitation Strategies
- Case Study: Patient profile, cause of injury, assessment findings, and treatment plan
- Q&A

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PATELLOFEMORAL PAIN SYNDROME

PATELLOFEMORAL PAIN SYNDROME

- Also called Runner’s Knee or Jumper’s Knee
- It is a common condition causing knee pain, particularly in the anterior aspect of the knee
- PFPS occur due to overloading of the front of the knee, behind the patella.
- It results from poor patellar tracking within the trochlear groove, leading to increased stress on the patellofemoral joint.
- More common to athletic people, specifically in sports involving running or jumping.

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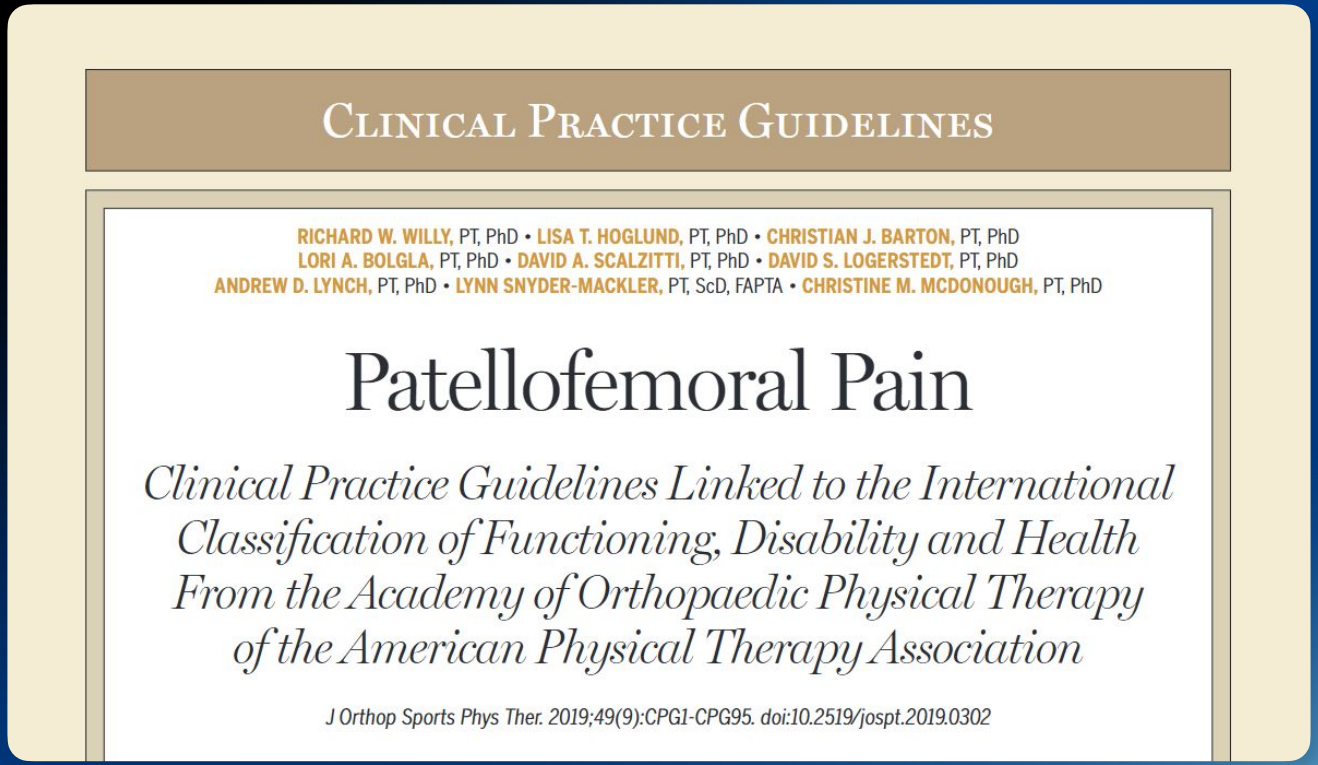


CLINICAL PRACTICE GUIDELINES

RICHARD W. WILLY, PT, PhD • LISA T. HOGLUND, PT, PhD • CHRISTIAN J. BARTON, PT, PhD
LORI A. BOLGLA, PT, PhD • DAVID A. SCALZITTI, PT, PhD • DAVID S. LOGERSTEDT, PT, PhD
ANDREW D. LYNCH, PT, PhD • LYNN SNYDER-MACKLER, PT, ScD, FAPTA • CHRISTINE M. MCDONOUGH, PT, PhD

Patellofemoral Pain

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Academy of Orthopaedic Physical Therapy of the American Physical Therapy Association

J Orthop Sports Phys Ther. 2019;49(9):CPG1-CPG95. doi:10.2519/jospt.2019.0302

CLINICAL PRESENTATION

- Vague and Diffuse anterior knee pain, often around or behind the patella.
- Can be acute or present gradually
- Pain Aggravated by lower limb loading
  - Going downstairs (worse than upstairs)
  - Deep squatting, lunges, or running
- Swelling: Minimal or absent
- Crepitus: Possible but not always clinically relevant

[RESEARCH REPORT]

NATALIE J. COLLINS, PhD[1,2] • BILL VICENZINO, PhD[1] • RIANNE A. VAN DER HEIJDEN, MD[3] • MARIENKE VAN MIDDELKOOP, PhD[3]

Pain During Prolonged Sitting Is a Common Problem in Persons With Patellofemoral Pain

458 patients with PFPS - retrospectively questioned about their symptoms

- 94% difficulty with squatting
- 92% difficulty with stairs
- 91% difficulty with running
- 54% pain on sitting (movie goers or theatre goers sign)
- 19% pain on sitting after exercise

CLINICAL PRESENTATION

Quadriceps
- muscle atrophy
- weakness
- Inhibition

Decreased muscle strength of:
- Hip Abductors
- Hip Extensors
- Hip External Rotators

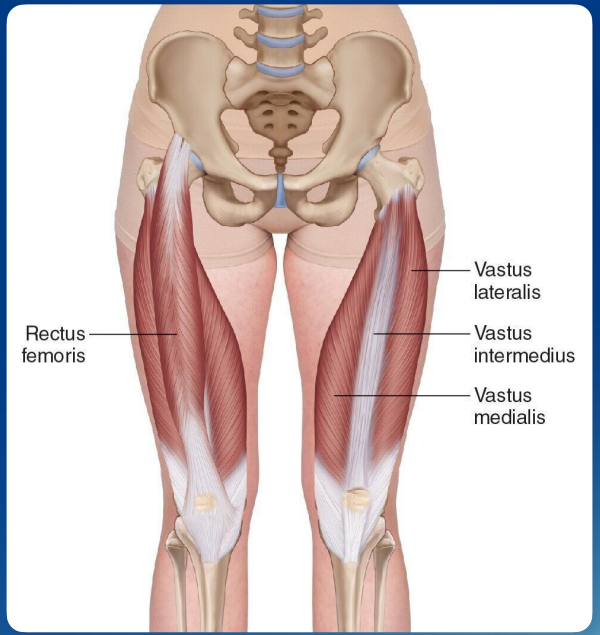
Reduced rate of Force Development
- Hip Abductors
- Hip Extensors

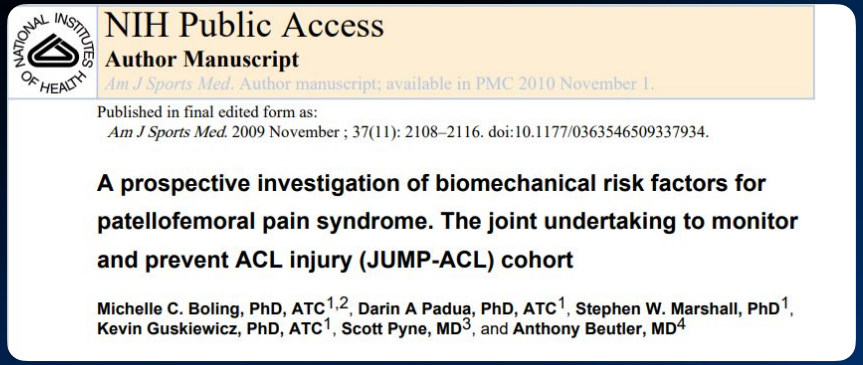
RISK FACTORS FOR PFPS

Demographics

X 2 at likely for female US Navy Recruits (Boling et al)

X 1.5 more likely for single sport young females (Hall et al)





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Author Manuscript
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Published in final edited form as:
Am J Sports Med. 2009 November ; 37(11): 2108–2116. doi:10.1177/0363546509337934.

A prospective investigation of biomechanical risk factors for patellofemoral pain syndrome. The joint undertaking to monitor and prevent ACL injury (JUMP-ACL) cohort

Michelle C. Boling, PhD, ATC[1,2], Darin A Padua, PhD, ATC[1], Stephen W. Marshall, PhD[1], Kevin Guskiewicz, PhD, ATC[1], Scott Pyne, MD[3], and Anthony Beutler, MD[4]

1597 US Navy recruits

Prospectively studied for onset of PFPS

Followed for 2.5 years in Naval college

- Battery of testing at start of service
  - Jumps
  - 6 isometric strength tests with HHD
  - Postural alignment

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DROP JUMP AND MAX VERTICAL JUMP

Decreased Knee Flexion Angle at Landing

Decreased GRFs on landing

ISOMETRIC STRENGTH WITH HHD

Deprendent Variable	Injured (Mean ± SD)	Non-injured (Mean ± SD)	F value	P value
Knee flexion strength (%BW)	0.23±0.06	0.25±0.05	7.67	0.01
Knee extension strength (%BW)	0.46±0.09	0.52±0.12	13.22	0.01
Hip extension strength (%BW)	0.30±0.07	0.32±0.09	2.09	0.15
Hip internal rotation strength (%BW)	0.21±0.04	0.22±0.04	1.31	0.25
Hip external rotation strength (%BW)	0.21±0.04	0.22±0.05	0.99	0.32
Hip abduction strength (%BW)	0.35±0.09	0.38±0.09	3.83	0.05

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Hip abduction strength (%BW)	0.35±0.09	0.38±0.09	3.83	0.05

0363-5465/101/2929-0190$02.00/0
THE AMERICAN JOURNAL OF SPORTS MEDICINE, Vol. 29, No. 2

Intrinsic Risk Factors for the Development of Patellar Tendinitis in an Athletic Population

A Two-Year Prospective Study*

Erik Witvrouw,†‡§ PT, PhD, Johan Bellemans,‡ MD, PhD, Roeland Lysens,‡ MD, PhD, Lieven Danneels,‡ PT, and Dirk Cambier,† PT, PhD

From the †Department of Physical Therapy, Faculty of Medicine, University of Gent, Gent, Belgium, and ‡Faculty of Physical Therapy & Rehabilitation Sciences, Catholic University of Leuven, Leuven, Belgium

- 282 Physical Education students evaluated at start of year
- 24 developed PFPS in the 2 year study
- 7 % of Males (11 total) vs 10% Females (13 total) Can test in Prone

TABLE 2

Univariate Analysis of the Different Physical Fitness Tests of the Eurofit Test and the Cardiorespiratory Exercise Capacity of Subjects with Patellofemoral Pain Syndrome (PFPS) and Subjects with No Pain (Controls)

	PFPS (N − 24)		Control (N − 258)		P-value
	Mean	8D	Mean	8D	
Flamingo balance (sec)	8	3.22	6.98	3.77	0.21
Vertical jump (cm)	52.63	3.63	56.02	6.28	0.01*
Standing broad jump (cm)	240.96	13.77	243.89	16.35	0.41
Bent arm hang (sec)	44.88	16.95	43.24	13.63	0.60
Shuttle run (see)	20.15	1.12	20.22	1.21	0.80
Plate tapping (no. repetitions)	92.96	9.88	93.48	8.65	0.79
Arm pull (no. repetitions)	69.42	7.52	72.69	10.91	0.17
Leg lifts (no, repetitions)	17.74	1.51	17.99	1.67	0.49
Sit and reach (no. repetitions)	28.24	6.90	29.86	6.31	0.25
Sit ups (no. repetitions)	26.56	3.43	27.18	3.40	0.41
Maximal O_2-uptake (ml/kg/min)	55.09	10.14	54.99	9.81	0.96

*Significant difference between groups ($P < 0.05$).

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TABLE 3
Univariate Analysis of the Different General Joint Laxity Tests in Subjects with Patellofemoral Pain Syndrome (PFPS) and Subjects with No Pain (Control)

Test	PFPS (N = 24)		Control (N = 258)		P-value
	Mean	SD	Mean	SD	
Extension little finger (deg)	88.71	29.53	84.86	28.17	0.58
Mobility shoulders (cm)	109.83	21.93	100.92	21.22	0.06
Extension elbow (deg)	180.81	4.39	182.85	4.12	0.41
Thumb-forearm (deg)	105.06	13.40	86.65	13.51	0.01[a]
Extension knee (deg)	185.21	6.32	181.53	5.62	0.37
Medial patellar mobility (cm)	1.92	0.35	1.82	0.38	0.20
Lateral patellar mobility (cm)	0.92	0.24	0.80	0.30	0.06
Total patellar mobility (cm)	2.85	0.51	2.62	0.58	0.06

[a] Significant difference between groups ($P < 0.05$).

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Medial patellar mobility (cm)	1.92	0.35	1.82	0.38	0.20
Lateral patellar mobility (cm)	0.92	0.24	0.80	0.30	0.06
Total patellar mobility (cm)	2.85	0.51	2.62	0.58	0.06

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TABLE 4
Univariate Analysis of the Flexibility of the Different Measured Muscles in Subjects with Patellofemoral Pain Syndrome (PFPS) and Subjects with No Pain (Control)

Muscle	PFPS (N = 24)		Control (N = 258)		P-value
	Mean	SD	Mean	SD	
Hamstring (deg)	90.78	20.06	93.60	16.47	0.442
Quadriceps (deg)	124.62	12.46	132.21	16.39	0.028[a]
Gastrocnemius (deg)	32.12	5.35	35.22	6.59	0.038[a]

[a] Significant difference between groups ($P < 0.05$).

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[RESEARCH REPORT]

RICHARD B. SOUZA, PT, PhD, ATC, CSCS[1] • CHRISTOPHER M. POWERS, PT, PhD[2]

Differences in Hip Kinematics, Muscle Strength, and Muscle Activation Between Subjects With and Without Patellofemoral Pain

JANUARY 2009 | VOLUME 39 | NUMBER 1 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

[RESEARCH REPORT]

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Differences in Hip Kinematics, Muscle Strength, and Muscle Activation Between Subjects With and Without Patellofemoral Pain

TABLE SUBJECT CHARACTERISTICS

Variable	PFP (n = 21)	Controls (n = 20)	*P* Value
Age (y)	27 ± 6	26 ± 5	.48
Height (m)	1.7 ± 8.1	1.7 ± 6.0	.65
Mass (kg)	64.7 ± 10.4	62.9 ± 6.6	.52

Abbreviation: PFP, patellofemoral pain.
** Values are mean ± SD.*

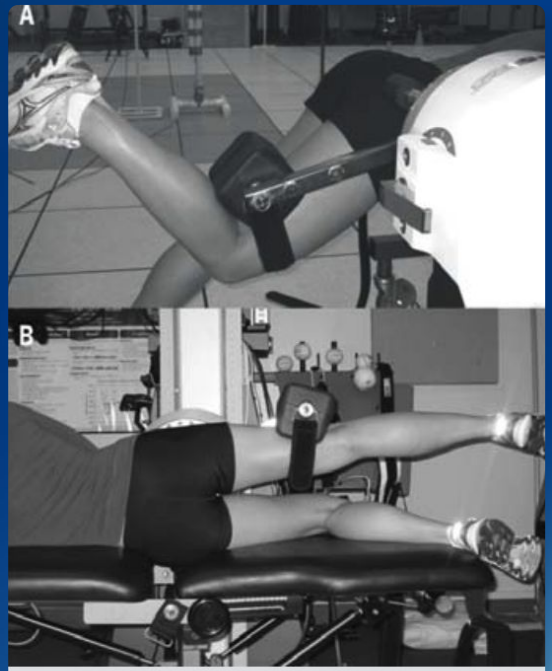

FIGURE 1. Hip muscle strength testing positions using the BTE dynamometer. (A) hip extension, (B) hip abduction.

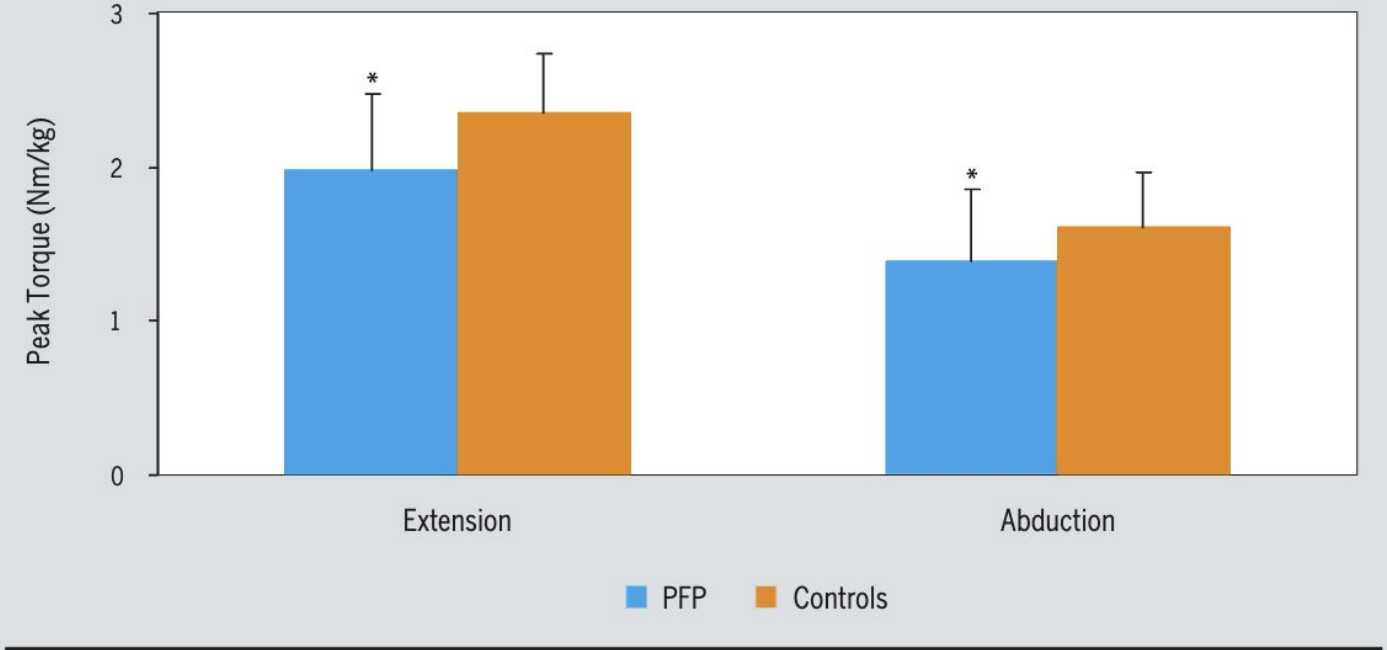

FIGURE 4. Comparison of peak hip torque production during isometric strength testing. Data are mean ± SD. *Individuals with patellofemoral pain (PFP) significantly less than controls ($P<.05$).

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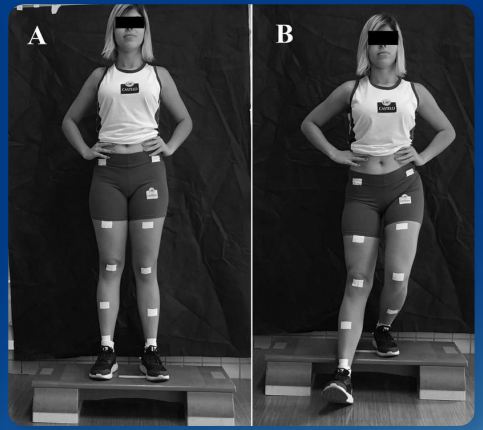

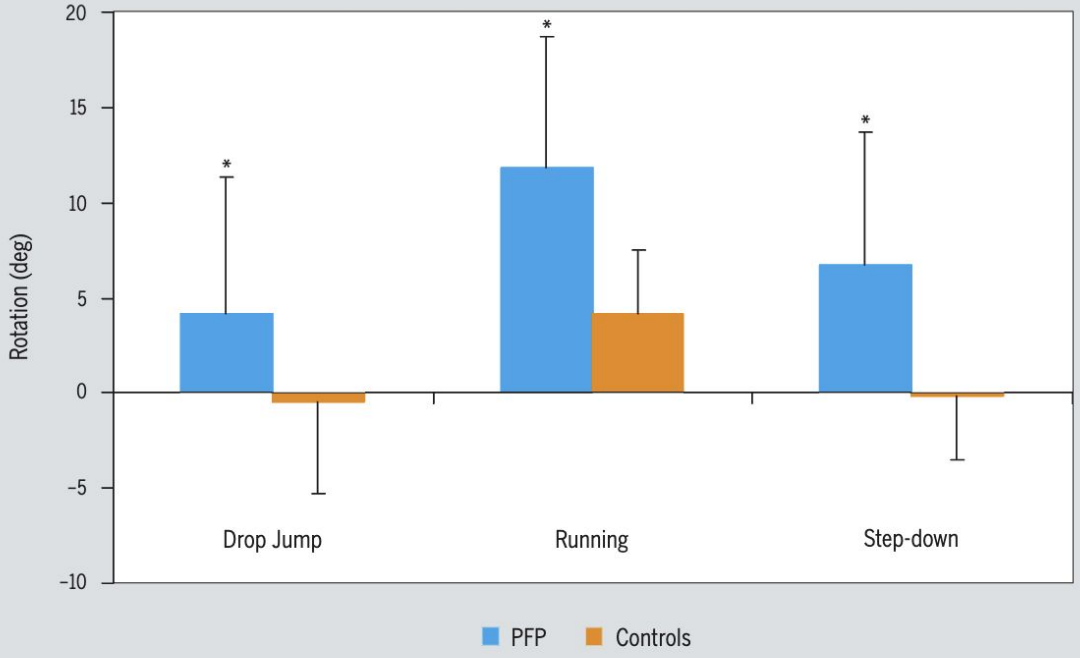

FIGURE 2. Comparison of peak hip internal rotation across the functional tasks evaluated. Data are mean ± SD. Negative values represent external rotation and positive values represent internal rotation. *Individuals with patellofemoral pain (PFP) significantly greater than controls, when averaged across all tasks ($P<.05$).

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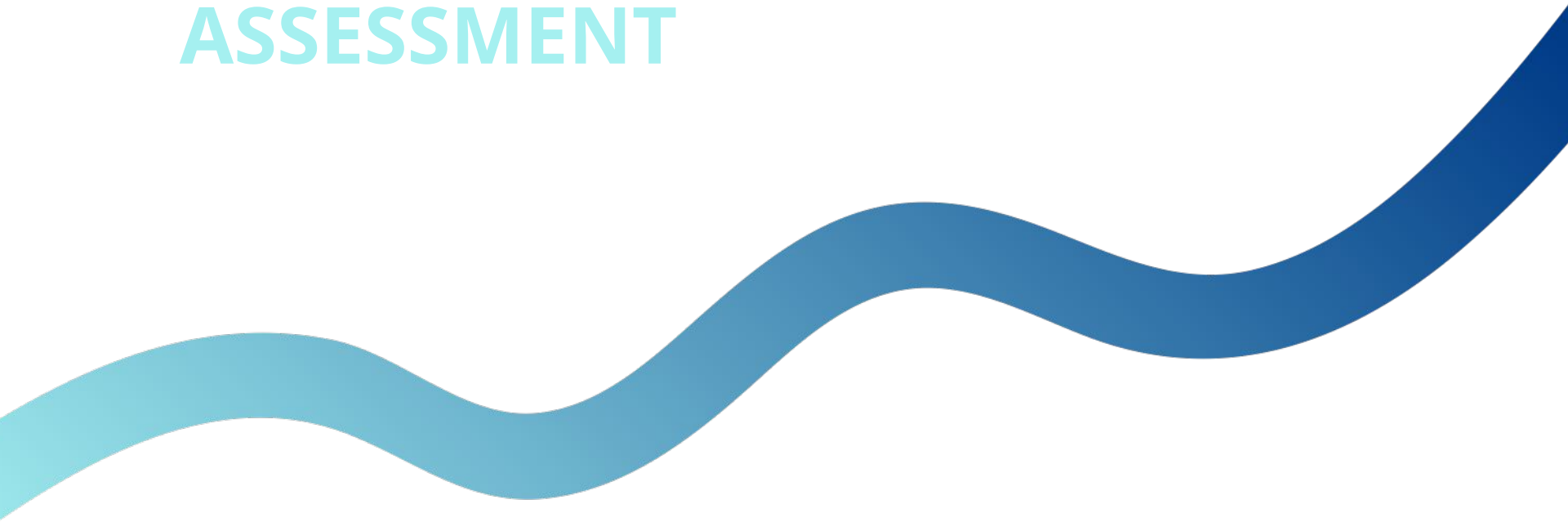
CLINICAL ASSESSMENT



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RANGE OF MOTION: KNEE EXTENSION WITH GONI

Knee Extension

- Can test in Supine, Prone, and Standing
- Pay attention to Quadriceps length

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MUSCLE TESTING: KNEE EXTENSION

Knee Extension

Knee Extension with Strap:

- Can test in Sitting
- Testing at different angles: **Neutral, Mid range, End Range, etc**
- **Can be with or without a strap**

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THOMAS TEST QUAD LENGTH

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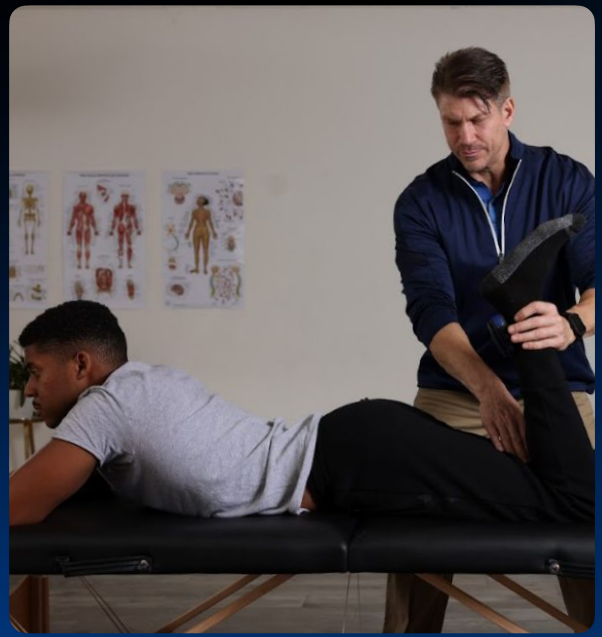

RANGE OF MOTION: KNEE FLEXION

Knee Flexion

- Can test in Supine, Prone, and Standing
- Pay attention to Quadriceps length

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RANGE OF MOTION: HIP ABDUCTION

Hip Abduction

- Can test in Supine or Sidelying
- Make sure to watch for compensations of hip hiking

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MUSCLE TESTING: HIP ABDUCTION (GLUTEUS MEDIUS)

Hip Abduction

Sidelying with Strap:

- Can test in Sidelying or Supine
- Testing at different angles: **Neutral, Mid range, End Range, etc**
- **Can with or without a strap**

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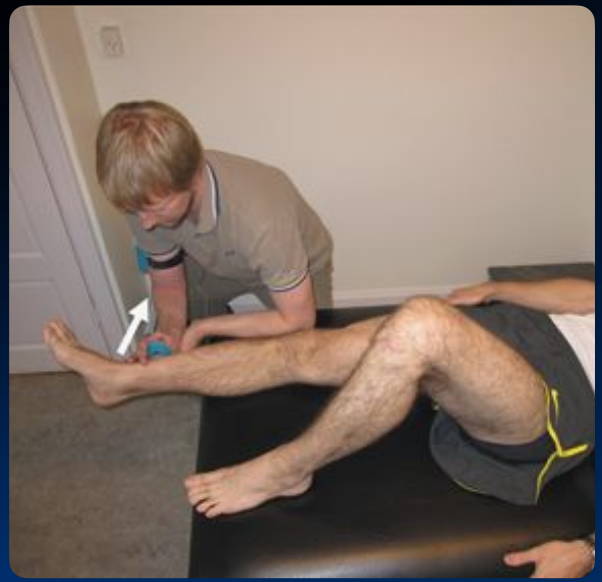

MUSCLE TESTING: HIP ABDUCTION (GLUTEUS MEDIUS)

Hip Abduction

Supine without Strap

- Can test in Supine or Sidelying
- Testing at different angles: **Neutral, Mid range, End Range, etc**
- **Can with or without a strap**

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MUSCLE TESTING: HIP EXTERNAL ROTATORS

Hip External Rotation

Sitting with strap:

- Can test in Sitting
- Testing at different angles: **Neutral, Mid range, End Range, etc**
- **Can with or without a strap**

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MUSCLE TESTING: HIP EXTENSION

Hip Extension

Prone without strap:

- Can test in Prone
- Testing at different angles: **Neutral, Mid range, End Range, etc**
- **Can with or without a strap**

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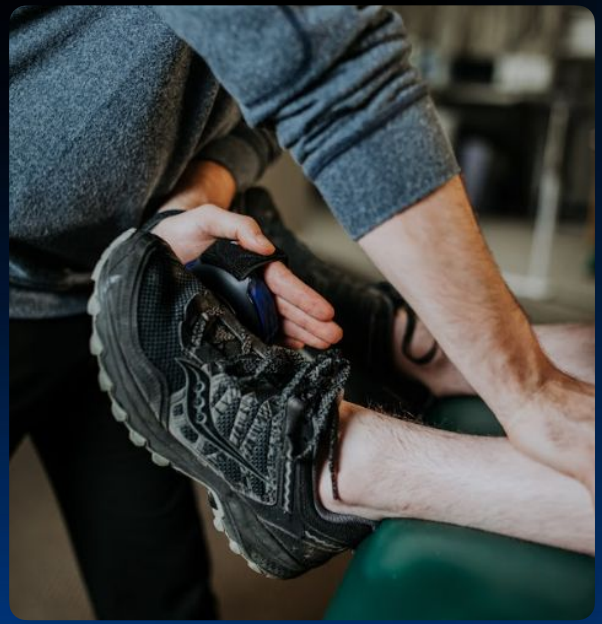
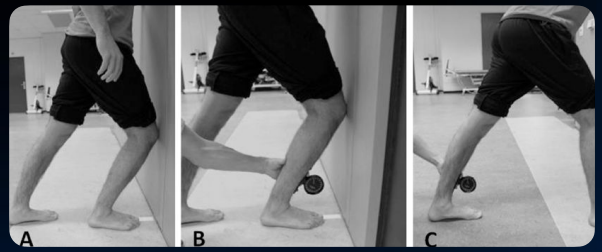
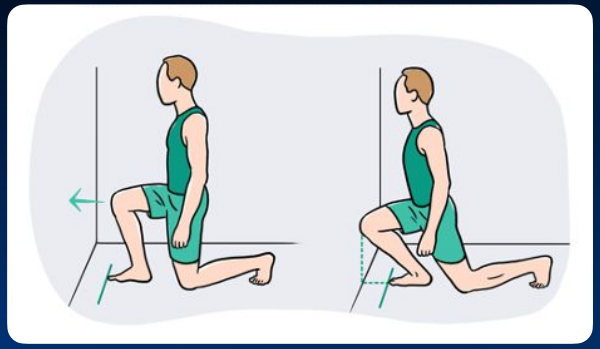


RANGE OF MOTION: ANKLE INVERSION

Ankle Inversion

- Can test in Supine and Sitting





RANGE OF MOTION: ANKLE DORSIFLEXION LENGTH TEST

- Can test in standing
- To measure flexibility of ankle dorsiflexion
- Patient to lunge forward with knee towards the wall while keeping their heel flat on the ground

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MUSCLE TESTING: ANKLE INVERSION

Ankle Inversion

- Can test in Supine and Sitting
- Testing at different angles: **Neutral, Mid range, End Range, etc**
- **Can be with or without a strap**

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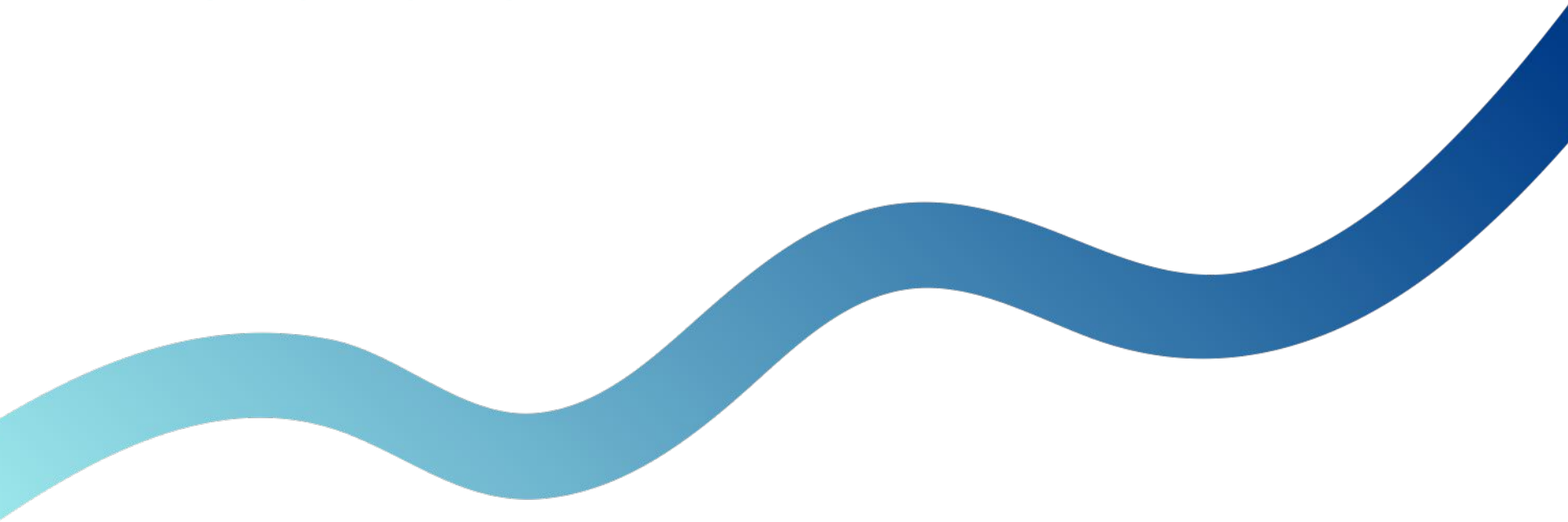
CASE STUDY



PATIENT PROFILE

24yo female office worker

Recreational runner training for a half marathon.

Signs and Symptoms:

Gradual onset of right anterior knee pain over the past three months

(+) Diffuse anterior knee pain, mild quadriceps atrophy, tenderness around the patella, and occasional crepitus

Mild knee valgus noted during functional activities such as squatting and step-down tasks further contributing to her discomfort.

Aggravating Factors:

Prolonged sitting, running, and descending stairs

Mechanism of Injury:

Possibly d/t increased running mileage on uneven terrain, muscle imbalances, and excessive foot pronation

PT MANAGEMENT

Goal:
To reduce pain, improve muscle balance, enhance knee stability, and correct biomechanics.

1.
Hip Abduction Strengthening

Single-leg glute bridges

2.
Quadriceps Activation & Knee Extension Strengthening

Terminal knee extensions (TKE) with resistance band

Step-downs from a 6-inch step

3.
Ankle Pronation and Foot Mechanics Correction

Short foot exercises (foot arch strengthening)

Single-leg balance exercises on an unstable surface

4.
Functional Progressions & Gait Retraining

Gradual return to running with a focus on cadence and reduced knee valgus

PT ASSESSMENT

1.
Hip Abduction Strength

Weakness of Gluteus Medius

2.
Knee Extension Strength

Weakness of Quadriceps muscle

3.
Knee Flexion ROM

Tightness of the quadriceps muscle

4.
Ankle Inversion Strength

Anterior Tibialis Weakness

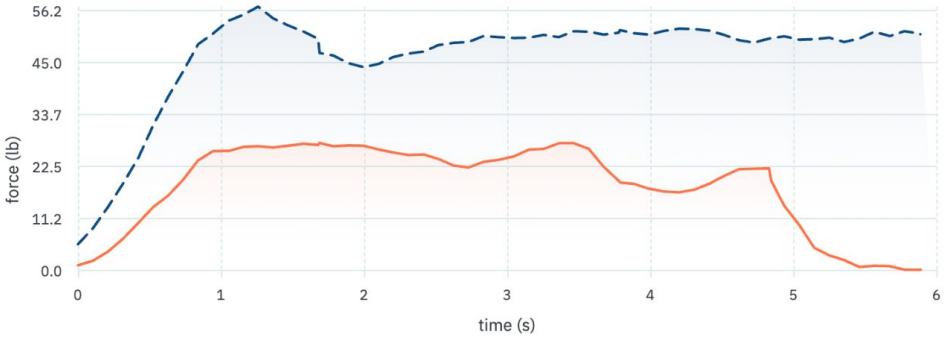
HIP ABDUCTION STRENGTH

Hip Abduction Side-lying, Hip Abduction Side-lying — Strength

Hip | Abduction | Side-lying

Graph | Illustration

Data	Right	Left
Peak Force	27.4 lb	56.8 lb
Time to Peak Force	1.7 s	1.3 s
Average Force	17.9 lb	46.5 lb
Strength Difference	**29.4 lb**	
Percent Difference	**107.3 %**	



- Weak right hip abduction peak force
- Delayed time to peak force
- Much weaker average force

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KNEE EXTENSION STRENGTH

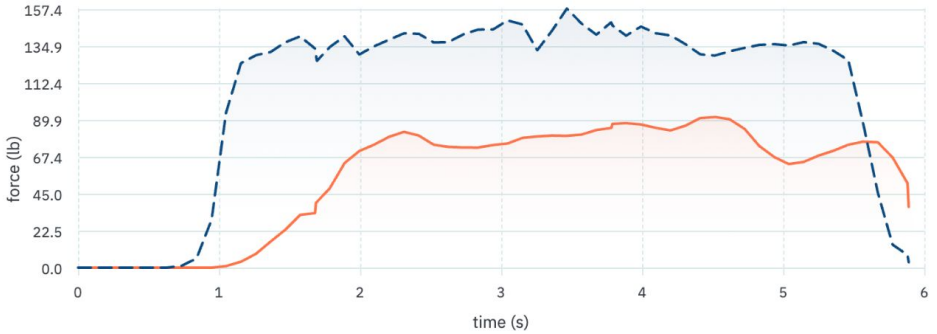
Knee Extension Seated, Knee Extension Seated

Strength

Knee | Extension | Seated

Graph | Illustration

Data	Right	Left
Peak Force	91.6 lb	157.5 lb
Time to Peak Force	4.5 s	3.5 s
Average Force	55.5 lb	106.0 lb
Strength Difference	**65.9 lb**	
Percent Difference	**71.9 %**	



Weakness of Quadriceps muscle

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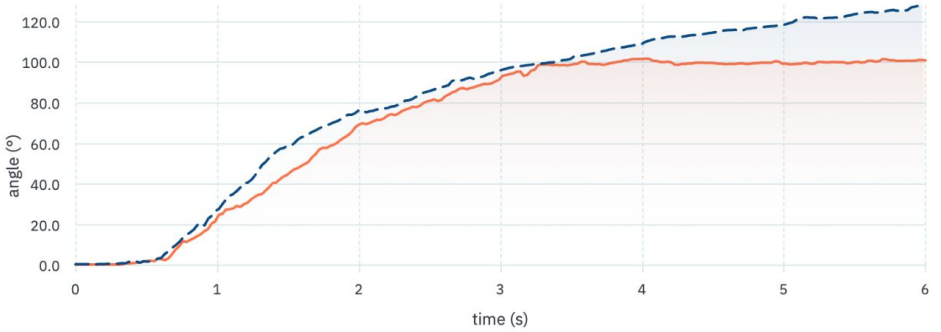
KNEE FLEXION PROM

Knee Flexion Prone, Knee Flexion Prone ROM

Knee | Flexion | Prone

Graph | Illustration

Data	Right	Left
Max Angle	101.4°	127.8°
Time to Max Angle	4.0 s	6.0 s
Angle Difference	**26.4 °**	
Percent Difference	**26.0 %**	



Tightness of the quadriceps muscle

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ANKLE INVERSION STRENGTH

Ankle Inversion Seated, Ankle Inversion Seated — Strength

Ankle | Inversion | Seated

Graph | Illustration

Data	Right	Left
Peak Force	13.5 lb	29.7 lb
Time to Peak Force	1.4 s	5.8 s
Average Force	8.2 lb	22.4 lb
Strength Difference	**16.2 lb**	
Percent Difference	**120.0 %**	

Tibialis Anterior &
Posterior Weakness

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Review

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

Christian John Barton,[1,2,3,4] Simon Lack,[1] Steph Hemmings,[1] Saad Tufail,[1] Dylan Morrissey[1,5]

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*

[Italics] = based on expert opinion without supporting Level 1 evidence.

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*

British Journal of Sports Medicine
2015;49:923-934.

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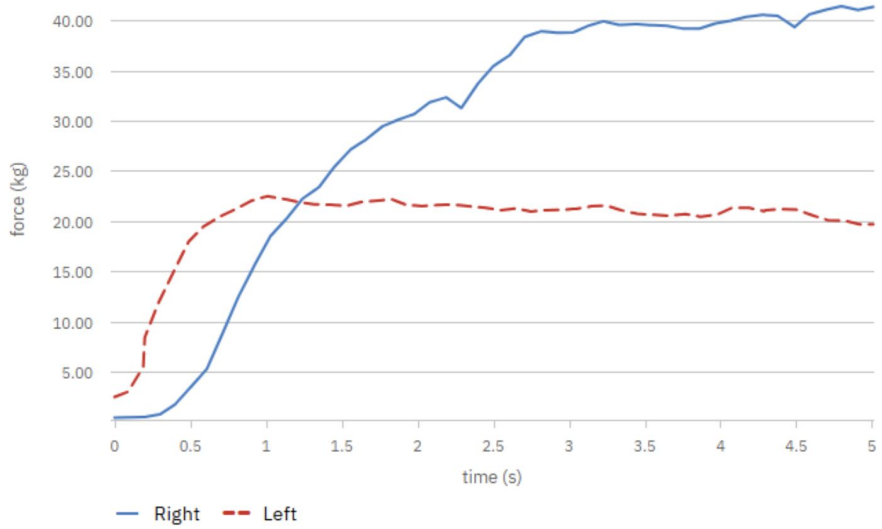
FIRST VISIT



Peak Force (kg)

Right	41.45 kg
Left	22.52 kg
Strength Difference	18.93 kg
Percentage Difference	59.17%

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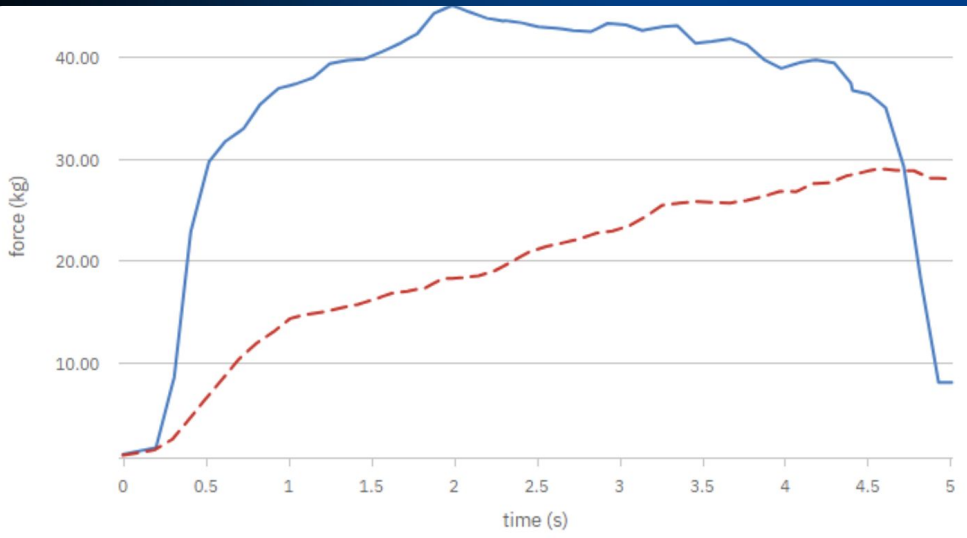
SECOND VISIT



Peak Force (kg)

Right	45.06 kg
Left	29.08 kg
Strength Difference	**15.98 kg**
Percentage Difference	**43.11%**

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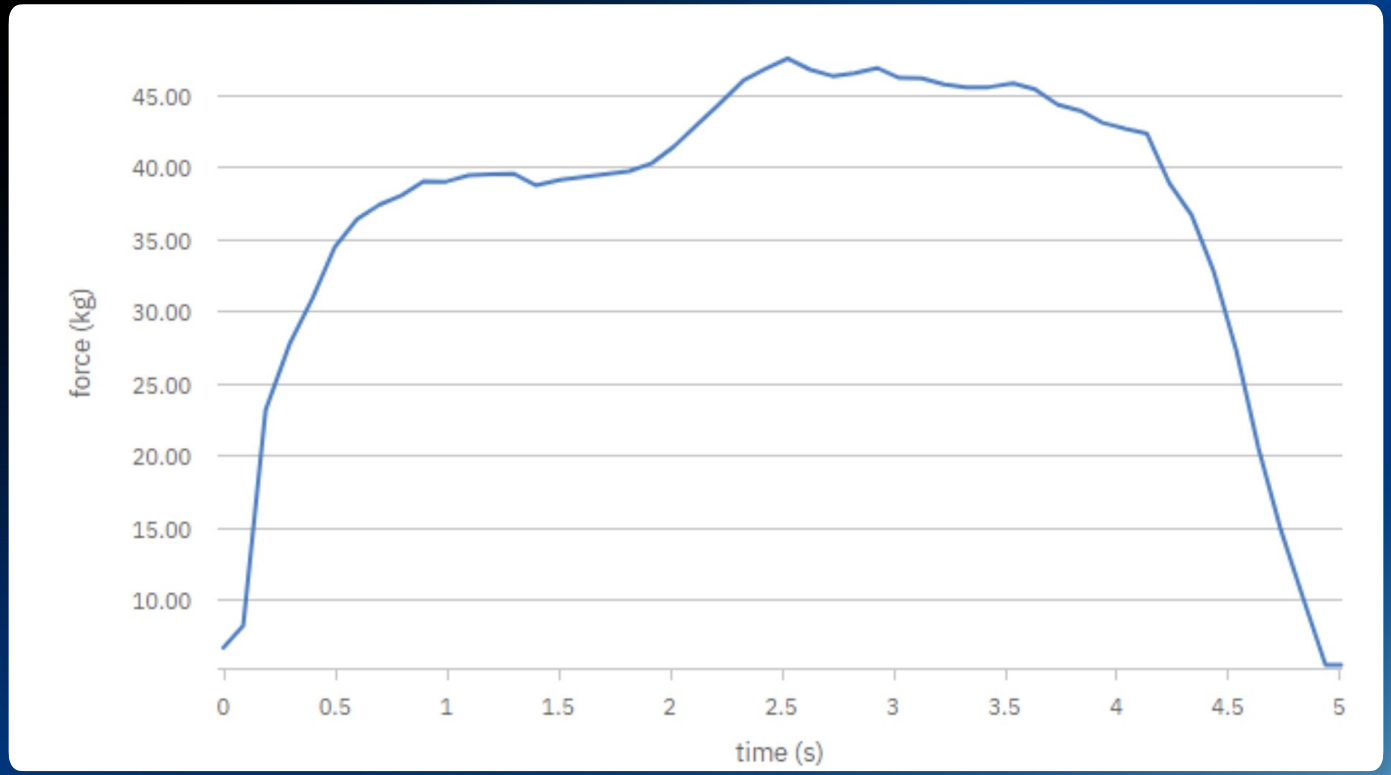
TAPING


45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
force (kg)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
time (s)

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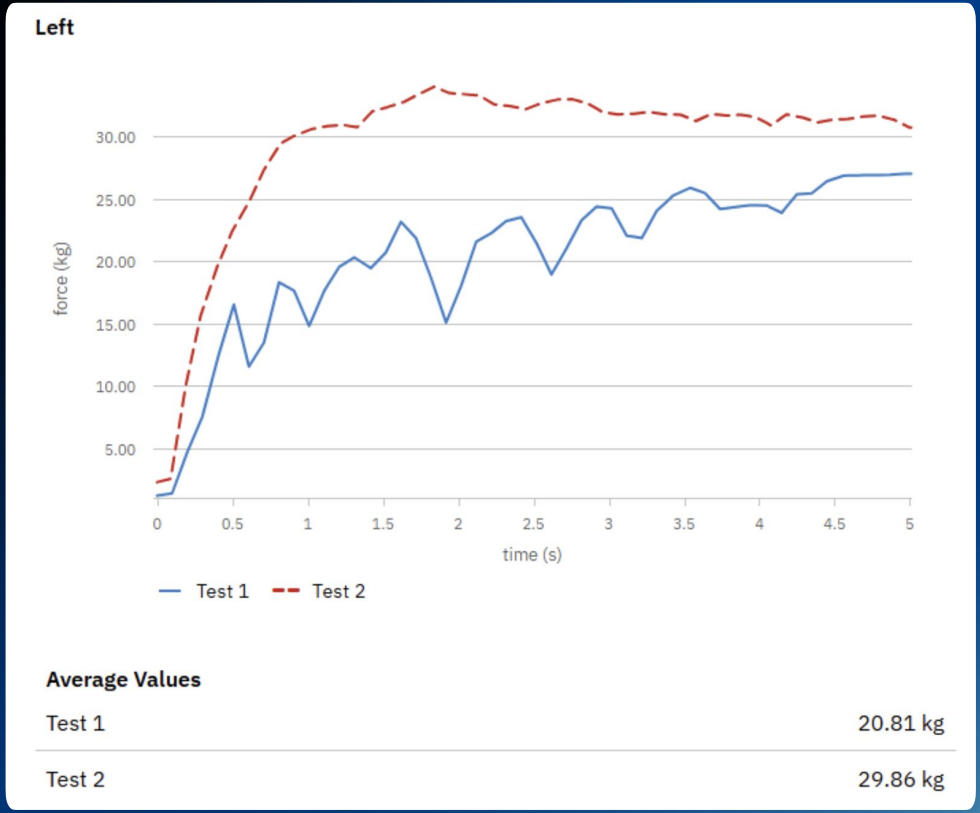
PRE VS POST



KNEE EXTENSION SEATED @60 DEGREES

	Peak Force (kg)	Av. Force (kg)	Pain VAS	% difference (to right)
Right	47.58	37.39	0	
Left (no tape)	27.02	20.81	6/10	55.12%
Left (with tape)	33.97	29.86	2/10	33.38%

QUESTIONS?