A proximal progressive resistance training program targeting strength and power is feasible in people with patellofemoral pain

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Co-authors: Danilo de Oliveira Silva, Brooke Patterson, Prof Kay Crossley, Tania Pizzari, Guilherme Nunes
Exercise is the cornerstone of treatment

Successful outcome at 1 year = 41 – 67% (Collins 2008; van Linschoten, 2009)
Favorable outcomes at 5-8 years = 43% (Lankhorst 2016)
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Favorable outcomes at 5-8 years (Lankhorst 2016).
Proximal muscle rehabilitation is effective for patellofemoral pain: a systematic review with meta-analysis

Simon Lack,1 Christian Barton,1,2,3,4 Oliver Sohan,1 Kay Crossley,5 Dylan Morrissey1,6

Hip and knee focused exercise seems to help

Hip targeted more beneficial in short term

What prescription principles?
Proximal muscle rehabilitation is effective for patellofemoral pain: a systematic review with meta-analysis

Simon Lack, 1 Christian Barton, 1,2,3,4 Oliver Sohan, 1 Kay Crossley, 5 Dylan Morrissey 1,6

Type of exercise reported according to studies’ titles

14 RCTs

- Neuromuscular
- Strength
- Endurance
- Power
- Undetermined

13

[^1]
[^2]
[^3]
[^4]
[^5]
[^6]
Hip extensor rate of force development

Original research
Hip rate of force development and strength are impaired in females with patellofemoral pain without signs of altered gluteus medius and maximus morphology

Guilherme S. Nunez, Christian John Barton, Filipe Viana de Souza

Department of Physiotherapy, School of Allied Health Science, University of Campinas, Brazil

Department of Exercise and Sports Science, School of Allied Health Science, La Trobe University, Australia

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Hip extensor rate of force development

Control Group

PFP Group

Torque (%BM)

Control Group

PFP Group

90% Max

60%

30%

0 400 800 1200 1600 2000

t (ms)
Clinically measured hip muscle capacity deficits in people with patellofemoral pain

Guilherme S. Nunes, Danilo de Oliveira Silva, Tania Pirizzi, Fabio Vandone Serrao, Kay M. Creedley, Christian John Barton
<table>
<thead>
<tr>
<th></th>
<th>PFP group (n=16)</th>
<th>Control group (n=16)</th>
<th>Mean difference (95% CI)</th>
<th>p value</th>
<th>Effect size (95% CI) and % of difference*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strength (%BM)</strong></td>
<td></td>
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</tr>
<tr>
<td>Isometric – hip abductors</td>
<td>117.9 (23.4)</td>
<td>149.9 (38.7)</td>
<td>32.0 (8.9 to 55.1)</td>
<td>&lt;0.01</td>
<td><img src="image" alt="21%" /></td>
</tr>
<tr>
<td>Isometric – hip extensors</td>
<td>82.3 (33.1)</td>
<td>110.3 (31.0)</td>
<td>28.0 (4.9 to 51.1)</td>
<td>0.02</td>
<td><img src="image" alt="25%" /></td>
</tr>
<tr>
<td>10 RM – hip abductors</td>
<td>53.1 (13.9)</td>
<td>62.1 (10.3)</td>
<td>9.0 (0.2 to 17.9)</td>
<td>0.05</td>
<td><img src="image" alt="15%" /></td>
</tr>
<tr>
<td>10 RM – hip extensors</td>
<td>58.2 (14.7)</td>
<td>70.8 (14.1)</td>
<td>12.6 (2.2 to 23.0)</td>
<td>0.02</td>
<td><img src="image" alt="18%" /></td>
</tr>
<tr>
<td><strong>Power (W/kg)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Squat</td>
<td>14.2 (4.0)</td>
<td>18.6 (5.4)</td>
<td>4.4 (1.0 to 7.8)</td>
<td>0.01</td>
<td><img src="image" alt="24%" /></td>
</tr>
<tr>
<td>Hip abduction</td>
<td>1.9 (0.8)</td>
<td>2.6 (0.9)</td>
<td>0.8 (0.2 to 1.4)</td>
<td>0.02</td>
<td><img src="image" alt="31%" /></td>
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Study aims

1. Feasibility of a 12-week progressive resistance training program targeting proximal muscle strength and power

2. Clinical outcomes and changes in hip strength and power
Exercise program

- 12-week (3 x per week)
- 3-5 exercises targeting hip and trunk and tailored to individual
- 5-8 physiotherapy consultations (exercise only)
The muscles ability to move against resistance

Greater resistance is needed for about 8-12 repetitions in a slower controlled manner

Generally the rest time is about 2-3 minutes between sets
How quickly a given load can be moved or force generated

Exercise against heavy resistance in an explosive manner for a low number of repetitions and 3-6 sets

An extended rest (3-5 minutes) is often needed to fully recover
Feasibility Outcomes

→ Proportion of eligible participants willing to participate

→ Recruitment rate

→ Proportion of prescribed exercise tasks, including all sets, completed each week

→ Drop outs

→ Adverse events
Clinical Outcomes

→ Global rating of change
→ Worst pain in previous week
→ Anterior knee pain scale
→ KOOS – Patellofemoral
→ Hip muscle capacity (isometric strength; 10 repetition maximum; Power)
1 Adverse outcome (pain flare)

Typically progressed well (strength 3-5 weeks; power 4-8 weeks)

Very poor exercise adherence data after first 3-4 weeks (Physitrack)
A proximal progressive resistance training program targeting strength and power is feasible in people with patellofemoral pain

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<th>Post Mean (SD)</th>
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<td>83 (34)</td>
<td>96 (34)</td>
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<td><strong>10 Repetition Maximum</strong></td>
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Effect size (95% CI) and percentage change:
- Hip abduction: 11-16%
- Hip extension: 34-35%
- Power: 22-28%
Exercise is the cornerstone of treatment

Successful outcome at 1 year = 41 – 67%  (Collins 2008; van Linschoten, 2009)
Favorable outcomes at 5-8 years = 43%  (Lankhorst 2016)
### Isometric strength

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### 10 Repetition Maximum

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### Power

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### Effect size (95%CI)

- **Favours improvement**
  - Pre: -4
  - Post: -2
  - Mean difference: -3
  - Effect size (95%CI): -4

- **Favours worsening**
  - Pre: 0
  - Post: 2
  - Mean difference: -1
  - Effect size (95%CI): 0

#### Additional variables

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<tr>
<td><strong>Worst pain last week</strong></td>
<td>5.7 (1.57)</td>
<td>1.0 (1.3)</td>
<td>4.7 (3.7; 5.7)*</td>
<td></td>
</tr>
<tr>
<td><strong>AKPS</strong></td>
<td>76 (12)</td>
<td>90 (9)</td>
<td>-14 (-20; -8)*</td>
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</tr>
<tr>
<td><strong>KOOS-PF</strong></td>
<td>74 (18)</td>
<td>89 (10)</td>
<td>-15 (-24; -5)*</td>
<td></td>
</tr>
<tr>
<td><strong>Kinesiophobia</strong></td>
<td>34 (8)</td>
<td>29 (6)</td>
<td>5 (-1; 10)</td>
<td></td>
</tr>
<tr>
<td><strong>Physical activity level</strong></td>
<td>3,567 (5,092)</td>
<td>5,944 (5,955)</td>
<td>-2,376 (-6,606; 1,853)</td>
<td></td>
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</tbody>
</table>
Global scale of perceived recovery

- Completely-recovered: 1
- Markedly better: 3
- Moderately better: 6
- Same: 0
- Moderately worse: 0
- Markedly worse: 0
Limitations

• Small group

• No control or comparison group

• Young adults (18-47 y/o)

• Mixed-sex cohort
TAKE HOMES

1. Prescribing strength and power is feasible
2. Moderate-large improvements in strength + power
3. Associated with large improvements in pain + function
4. Does better exercise prescription improve long term outcomes?