Evaluation of a Sequential Cognitive and Physical Treatment Approach for Patients with Patellofemoral Pain: A Randomized Controlled Trial

Mitchell Selhorst, Todd Degenhart, Michael Jackowski, William Rice, Shaun Coffman

Nationwide Children's Hospital
Sports and Orthopedic Physical Therapy

Prevalence of Patellofemoral Pain (PFP)

PFP is easy!
Then why do we fail?

80% of individuals completing rehab still report pain.

Up to 91% of patients report persistent or recurring pain that lasts for years.

What is PFP?

• The underlying cause of PFP remains unknown
• Multi-factorial clinical diagnosis
• Can arise from any innervated patellofemoral joint structure, or combination of structures
• “One-size-fits-all” approach unlikely

Previous Classification Systems

Difficult to implement
Unsupported
Recent Classification Systems
Selfe et al 2016

- Patients With PFP
  - Strong
  - Weak and Tighter
  - Weak and Pronated Foot

91% of patients fell into multiple subgroups
Only addresses physical impairments

Psychosocial Impact

Injury ≠ Pain
Stress  Happiness  Anxiety  Sleep  Injury  Fear  CNS Processing  Home Life  Depression  Experience  =  Pain

Our PFP Algorithm

A Sequential Checklist

- Psychosocial factors
- Flexibility
- Lower extremity mechanics
- High level strengthening
  - Return to sport

Study Objective

- The purpose of this study is to assess the efficacy of the PFP algorithm to treat individuals with PFP.
  - Function
  - Pain
  - Patients perceived improvement
Methods

- Single-blinded randomized controlled trial
- Nationwide Children’s Hospital PT clinics

### Table 1. Inclusion and exclusion criteria

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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</thead>
<tbody>
<tr>
<td>Patient at least 12 years of age</td>
<td>Tenderness to palpation of the patellar tendon, inferior pole of the patella, or tibial tubercle as the primary complaint.</td>
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<tr>
<td>Poppatellar knee pain</td>
<td>Other diagnosis of the knee including: patellar tendinitis, iliotibial band syndrome, Osgood-Schlatter’s disease, Sinding-Larsen’s Johansson’s disease, fracture, or ligamentous injuries.</td>
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<td></td>
<td>Prior knee surgery</td>
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<td></td>
<td>History of patellar subluxation or dislocation</td>
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</table>

Interventions

Both groups attended PT 2 x/week for 4-6 weeks

Session lasted 45-60 minutes

Interventions were individualized to the patient and based on therapists’ discretion

Comparator Group

- Impairment-based approach addressing the lower quarter
- Exercise, manual therapy, taping, orthoses, modalities, and patient education
- Specific attention paid to hip and quadriceps strength, flexibility, and lower extremity mechanics
PFP Algorithm

Psychosocial Factors
Flexibility
Functional Malalignment
High Level Strengthening

Goal-Based Treatments

Best Research Evidence
Clinical Expertise
Patient Values

Fear-Avoidance Subgroup

Sufficient Primary Muscle Flexibility
Quadriceps, Soleus, Gastrocnemius, WB DF

FLEXIBILITY SUBGROUP

Functional Malalignment Subgroup

Sufficient Secondary Muscle Flexibility
Hamstring, Hip flexors, IT band, and Adductors

FUNCTIONAL MALALIGNMENT SUBGROUP

Functional Strengthening Subgroup

Passed Single Leg Squat Test
Passed on Lateral Step Down Test
Scored > 90%* all tests
Single Leg Hop Test
Triple Hop Test
Cross-over Hop Test
Timed step down Testing

FUNCTIONAL STRENGTHENING SUBGROUP
Fear-Avoidance Group Testing
Fear Avoidance Belief Questionnaire: Physical Activity subscale
− Scores ≥15/24 associated with increased FAB

Fear-Avoidance Group
• Pain Science Education
• Biopsychosocial Approach to treatment
  − Graded Exposure
  − Activity Pacing
  − Goal Setting
  − Problem Solving
  − Cognitive Restructuring
  − Attention Diversion
  − Maintenance Strategies

Flexibility Subgroup Testing (Primary)
Prone Quadriceps Flexibility
<150 deg positive
Prone Gastroc Flexibility
<12 deg positive
Prone Soleus Flexibility
<20 deg positive
WB DF ROM
<48 deg positive
Flexibility Subgroup

Functional Malalignment Subgroup Testing

Malalignment Subgroup
Functional Strengthening Testing

- Single Leg Hop for Distance
- Triple Hop for Distance
- Cross-over Hop for distance
- Timed Step Down Test

Limb Symmetry Index
  - Involved limb/uninvolved limb = LSI %
  - LSI of >90% passes

Functional Strengthening Subgroup

Outcomes

Baseline, 3 weeks, 6 weeks and 6 months

**Primary Outcome**
  Anterior Knee Pain Scale

**Secondary Outcomes**
  Numeric Pain Rating Scale
  Global Rating of Change
Sample Size
A priori calculations determined a sample size of 50 necessary (25 in each group)

*Alpha* = 0.05

*Beta* = 0.20

*MCID* of Anterior Knee Pain Scale = 10

*Standard deviation* = 12.4

Data Analysis
We used an intent-to-treat design
Multiple-imputation model used for missing data

Repeated-Measures Analysis of Covariance
Covariates = Duration of Symptoms
Fear-Avoidance Beliefs Questionnaire
Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All Patients (n=55)</th>
<th>PFP Algorithm (n=28)</th>
<th>Comparator (n=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>14.3 ± 1.8</td>
<td>14.2 ± 1.9</td>
<td>14.4 ± 1.7</td>
</tr>
<tr>
<td>Sex (% female)</td>
<td>66</td>
<td>64</td>
<td>67</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.8 ± 6.0</td>
<td>23.2 ± 5.8</td>
<td>24.5 ± 6.2</td>
</tr>
<tr>
<td>Duration of symptoms (weeks)</td>
<td>16 (6; 38)</td>
<td>16 (6; 49)</td>
<td>12 (6; 30)</td>
</tr>
<tr>
<td>Bilateral knee pain, (% yes)</td>
<td>47</td>
<td>46</td>
<td>48</td>
</tr>
<tr>
<td>Sport Participant, (% yes)</td>
<td>92</td>
<td>96</td>
<td>88</td>
</tr>
<tr>
<td>FABQ-PA</td>
<td>12.8 ± 4.8</td>
<td>14.2 ± 5.5</td>
<td>11.3 ± 3.4</td>
</tr>
<tr>
<td>Anterior Knee Pain Scale (AKPS)</td>
<td>73.7 ± 9.6</td>
<td>73.3 ± 9.8</td>
<td>74.1 ± 9.5</td>
</tr>
<tr>
<td>Pain (NPRS)</td>
<td>6.0 ± 2.3</td>
<td>6.3 ± 2.1</td>
<td>5.8 ± 2.5</td>
</tr>
</tbody>
</table>

**Function**

Baseline 3 week 6 week 6 month

**PFP algorithm**

- Adjusted Difference: 4.4 (0.8, 7.9)
- P value: 0.02

**Comparator**

**Pain**

Baseline 3 week 6 week 6 month

**PFP algorithm**

- Adjusted Difference: 0.8 (1.3, 0.8)
- P value: 0.05
Perceived Improvement

Baseline 3 week 6 week 6 month

Global Rating of Change

PFP algorithm Comparator

0.19 0.4 (-0.2, 1.2)

Assessing the PFP Algorithm

AKPS at 6 months

Successfully Passed 19/28 Did not Pass Only 1/3rd of patients successfully passed 9/28

Discussion

• The PFP algorithm resulted in quicker and greater improvements in function and pain.

• Successfully completing all aspects of the PFP algorithm may improve long-term function.
PFP Algorithm Strengths

Patients cannot be classified into multiple subgroups

System addresses important psychosocial factors
  – A third of patients had elevated fear-avoidance beliefs

Adaptability regarding clinicians strengths and evolving evidence

PFP Algorithm Weaknesses

Cutoffs for treatment have not been validated and optimal thresholds are unknown.

Mechanism is not understood
  – Sequential approach
  – Addressed psychosocial factors
  – Required test-retest of important impairments

Study Limitations

Clinicians could not be blinded

Fear-avoidance beliefs never reassessed
  - Unclear if interventions were successful

Sample only included adolescent patients
  - Unknown if similar results seen in adults
Conclusion

A sequential cognitive and physical treatment approach resulted in superior outcomes when compared to a traditional impairment-based approach.

Future Research

Validating impairment thresholds for each treatment subgroup.

References

References


