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Research Paper Review

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Addressing Hip Mobility in Patients with Patellofemoral Pain

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ABSTRACT

INTRODUCTION: *The study intends to examine differences in hip flexibility before and after a 6-week muscle strengthening program between those with patellofemoral pain (PFP) and healthy controls.*

METHODS*: Single-blind, multicentered, randomized controlled trial. Four clinical research laboratories. Subjects include physically active individuals (194 PFP and 37 controls). Patellofemoral pain and control subjects were randomized into either a hip-focused or a knee-focused muscle strengthening treatment program.*

RESULTS*: Subjects with patellofemoral pain who successfully completed the treatment program (n = 153) had 65%, 25%, 18%, and 12% less HADD, HER, HROT, and HIR ranges of motion (ROMs), respectively, than controls (P < 0.05). Patellofemoral pain subjects who did not successfully complete the program (n = 41) had 134%, 31%, 22%, and 13% less HADD, HER, HROT, and HIR ROMs, respectively, than controls (P < 0.05). All subjects increased their HIR, HROT, and HEXT ROMs pretest to posttest (P < 0.05), but by less than 2 degree.*

CONCLUSION*: Individuals with PFP had less hip flexibility than controls regardless of treatment outcome or time. After the 6-week muscle strengthening program, and regardless of treatment success, PFP and control subjects experienced a small but clinically insignificant improvement in hip flexibility. Hip ROM should be considered as a targeted area of focus in a rehabilitation program for physically active individuals with PFP.*

ANALYSIS

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Background Information

Patellofemoral pain (PFP) is a common condition that presents with pain and point tenderness in or around the patellofemoral joint. Pain is usually exacerbated by loading the patellofemoral joint during activity. Limited flexibility about the hip joint is suspected to be a contributing factor for this condition. However, these suspicions have been derived only from cadaveric modelling and case studies (1, 2). As such, the purpose of this study was to examine differences in hip flexibility after a 6-week muscle strengthening program in subjects with and without PFP. The impetus is to help clinicians understand whether strength training alone, flexibility alone, or the combination of both should be targeted rehabilitative areas for improving patient-reported and physiological outcomes.

The authors hypothesized that PFP subjects would exhibit reduced flexibility at baseline compared to controls. They also speculated that the control subjects, and all subjects with PFP who reported treatment success, would exhibit increased hip flexibility post-treatment, while those with PFP who did not have success with treatment would have limited change in flexibility.

PERTINENT RESULTS

There were a total of 194 PFP subjects and 37 controls included in this study. Of the 194 PFP subjects, 153 (79%) reported treatment success, while 41 reported no success. Subjects with PFP in the hip program were 80.3% compliant, while those with PFP assigned to the knee program were 81.7% compliant with the muscle strengthening programs.

The authors found a significant main effect difference in hip flexibility between groups, and a small, but significant main effect change in flexibility over time. There were no significant group-by-time interactions for any hip flexibility variables. They also showed that PFP subjects were less flexible than controls in every direction, except hip extension, regardless of treatment outcome or time.

PFP subjects who *successfully* completed the treatment program had 65%, 25%, 18% and 12% less hip adduction, external rotation, total hip rotation and hip internal rotation ROM respectively, compared to controls. PFP subjects who *did not successfully*complete the treatment program had 134%, 31%, 22% and 13% less hip adduction, external rotation, total rotation and internal rotation ROM respectively, compared to controls *(REVIEWER'S NOTE: this is to say, those who did not successfully complete the treatment program had less baseline and post-treatment passive hip ROM in all directions, compared to subjects who successfully completed the treatment program. The authors did not comment on how to possibly predict which patients may fail treatment based on hip ROM profile - no cut score/range was provided)*. Regardless of which treatment they underwent, all subjects *(minimally)* increased hip internal rotation, total rotation and extension ROM, post-treatment.

CLINICAL APPLICATION & CONCLUSIONS

These authors conducted a single-blinded RCT, examining differences in hip flexibility after a 6-week muscle strengthening program in subjects with PFP. Subjects with PFP were generally less flexible than controls in every direction, except hip extension, regardless of treatment outcome and time. All subjects increased their flexibility post-treatment by a statistically significant margin. *However, these changes were small and likely not clinically significant. Further, it remains uncertain whether limited hip flexibility is a cause or effect of PFP. The results of this study did show, however, that hip ROM is clinically important and should be targeted in the rehabilitation of active patients with PFP.*

Notably, a lack of *hip adduction* was most apparent in subjects with PFP. It is speculated that ITB tightness is clinically responsible for limited hip adduction flexibility, leading to lateral patellar tilt, lateral patellofemoral compression forces and ultimately PFP. The ITB has very few stretch properties, and as such, it is further speculated that hip adduction limitations are secondary to tightness within the TFL and gluteus maximus. *As such, clinicians could consider specifically addressing hip adduction flexibility in their treatment of PFP.*

Hip external rotation was also quite limited in PFP subjects. It is suspected that limitations in hip external rotation ROM could contribute to medial femoral rotation, and be a cause or effect of PFP. This has unfortunately not been investigated, and requires further study.

Additionally, this study demonstrated that strengthening alone is not sufficient enough to result in clinically meaningful changes in passive ROM. Rehabilitation programs focused entirely on muscle strengthening may only impart small, but not clinically meaningful, changes in flexibility. *While this is true, the PFP subjects interestingly still experienced improved pain, function and strength (documented in a previous study [3]). This suggests that consistent static stretching or mobility routines may be required to elicit changes in passive hip ROM (4-6). The authors recommend that PFP rehab programs include a focused hip static stretching component in addition to a strengthening program.*

STUDY METHODS

The authors conducted a single-blinded, randomized controlled trial. They collected data from 4 clinical research laboratories in North America. There were extensive inclusion/exclusion criteria, as follows:

Inclusion Criteria:

- Minimum Visual Analogue Scale (VAS) pain rating of 3/10 during activities of daily living (ADLs)
- Insidious onset of symptoms unrelated to trauma and persistent for at least 4 weeks
- Pain in their anterior knee during at least 3 of the following: during or after activity, prolonged sitting, stair ascent or decent, and during squatting
- Pain with palpation of the patellar facets, or pain during a step-down from a 20-cm box or during a double-legged squat
- Recreationally active (at least 30 mins/day, 3-4 days/week for the last 6 months, exclusive of pain)

Exclusion Criteria:

- Meniscal of other intra-articular pathology
- Cruciate or collateral ligament laxity or tenderness
- Patellar tendon, ITB or pes anserine tenderness
- Positive patellar apprehension sign
- Osgood-Schlatter or Sinding-Larsen-Johansson Syndromes
- Evidence of effusion
- Hip or lumbar referred pain
- History of recurrent patellar subluxation or dislocation
- History of surgery to the knee
- Nonsteroidal anti-inflammatory drug or corticosteroid use within 24 hours before testing
- History of head injury or vestibular disorder within the last 6 months
- Pregnancy

PFP and control subjects were randomly assigned to either the hip strengthening, or knee strengthening programs. Subjects met with their athletic trainer up to 3-times a week over a 6-week period for exercise progression. All exercises and progressions were demonstrated. Each participant received an exercise booklet, while progressions were based on patient feedback, patellofemoral pain, swelling and symptoms. Exercises were performed 6 days weekly for 6 weeks and logged into their home exercise booklet to track compliance.

The hip muscle strengthening program began with non-weight-bearing exercises focused on hip muscle activation. Exercises then progressed to weight-bearing activities targeting the hip and core muscles. Use of Theraband tension intensity was decided by the trainer,

based on the subject's ability to perform 10 repetitions with good form. All exercises were performed bilaterally. The hip exercise program was:

- *Week 1:* Standing hip abduction (3x10 reps); standing hip external rotation (3x10 reps); seated hip external rotation (3x10 reps).

- *Week 2:* Standing hip abduction (3x15 reps); standing hip external rotation (3x15 reps); seated hip external rotation (3x15 reps); standing hip internal rotation (3x15 reps).

- *Week 3:* Standing hip abduction (3x10 reps); standing hip external rotation (3x10 reps); standing hip internal rotation (3x10 reps), double leg balance on Airex pad (3x45 seconds).

- *Weeks 4-6:* Standing hip external rotation (3x10-15); standing hip internal rotation (3x10-15 reps); single leg balance on Airex pad (3x30-60 sec); hip extension at 45-deg angle (3x10-15 reps).

The knee muscle strengthening program also began with non-weight-bearing exercises, focused on quadriceps muscle activation. Exercise progressed to weight bearing, with no emphasis on core muscle activation. The quadriceps exercise program was:

- *Week 1:* Quadriceps isometrics (3x10 reps); standing knee extensions (3x10 reps); double leg ¼ squats (3x10 reps).

- *Week 2:* Quadriceps isometrics (3x15 reps); double leg ½ squats (3x15 reps); terminal knee extension with Theraband (3x15 reps); double leg ¼ isometric wall squats (3x45 sec).

- *Week 3:* Double leg ½ squats (3x10 reps); terminal knee extension with Theraband (3x10 reps); double leg ¼ isometric wall squat (3x45 sec); single leg ¼ squats (3x10 reps).

- *Week 4:* Double leg ½ isometric wall squat (3x30 sec); single leg ½ squats (3x10 reps); lateral step-down (4" step; 3x10 reps); forward step-down (4" step; 3x10 reps); forward ¼ lunge (3x10 reps).

- *Weeks 5-6:* Double-leg full isometric wall squat (3x45-60 sec); single leg ½ - full squats (3x15 reps); lateral step-down (6-10" step; 3x15 reps); forward step-down (6-10" step; 3x15 reps); forward 1/2 -full lunge (3x15 reps).

The authors measured pain with the VAS, function using the Anterior Knee Pain Scale (AKPS), and flexibility using passive goniometry. Hip adduction, external rotation, internal

rotation, total hip rotation and hip extension were measured. Changes in pain (≥ 2 points) and function (≥ 8 points) dictated treatment success.

Statistical Analysis:

The authors utilized a 2-way repeated measures multivariate ANOVA to determine hip ROM changes between groups and over time. They also used 2 separate two-way univariate ANOVAs for hip adduction and hip extension ($P < 0.05$). If multivariate results were significant, the resulting univariate analyses following by pairwise comparisons as post hoc measures. If any univariate results were significant, they used pairwise comparisons as post hoc measures.

STUDY STRENGTHS/WEAKNESSES

This study was relatively good in so much as it was a single-blinded RCT, employed vigorous inclusion/exclusion criteria, and recruited patients from multiple centres in North America. However, the study also had a number of limitations. It had a comparatively low control group sample size. They also did not explore a history of PFP in control subjects beyond 1-year prior to the study. They also did not take a pain history, or explore whether PFP subjects had pain anywhere else in the body that may be causing referred pain to the knee. Inter-rater reliability was also not measured. Finally, because of the rigid inclusion/exclusion criteria, the results cannot be generalized to the entire PFP population at large.

Additional References:

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