

## Proximal vs. local rehabilitation for the treatment of patellofemoral pain: an outcome-based randomized controlled trial

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**Introduction:** The gold standard for patellofemoral pain (PFP) rehabilitation has traditionally been strengthening the muscles surrounding the knee (1). More recently, it has been suggested the aetiology of PFP is related to reduced hip and core strength (2). However, no randomized controlled trial (RCT) studies have determined optimal rehabilitation for PFP nor tested this hypothesis.

**Objectives:** To compare pain, function, muscular strength, and core endurance between knee-based (KNEE) and hip/core-based (HIP) rehabilitation. We hypothesized greater improvements in visual analog scale (VAS) and anterior knee pain scale (AKPS) scores for HIP compared to KNEE. We also hypothesized greater improvements in muscular strength and core endurance measures for HIP compared to KNEE.

**Methods:** This was a single-blind RCT multi-centered study across 4 clinical research laboratories. 722 PFP patients were assessed by an AT and 199 met specific inclusion criteria (3) and volunteered to participate (male=66 female=133 20.0±7.1yrs; 67.6±13.5kg; 170.4±9.4cm). After baseline measures, PFP patients were equally randomized into a treatment protocol: KNEE or HIP and each patient visited an AT 3 times per week over a 6-week period for rehabilitation progression.

**Main Outcome Measures:** Patients completed a 10-cm VAS, describing usual pain during activity, and the AKPS. To assess strength, subjects performed 3 maximum voluntary isometric contractions of the hip abductor (HABD), hip extensor (HEXT), hip external rotator (HER), hip internal rotator (HIR), and knee extensor (KEXT) muscles against a force dynamometer (%BW). To assess core endurance, subjects performed the front plank, side bridge exercise, and horizontal extension test to assess anterior (ANT), lateral (LAT: affected side), and posterior (POST) core endurance (sec). Treatment success was a priori defined as a decrease in VAS by 2cm and/or an increase in AKPS of 8 points (4). Data were analyzed using an intent-to-treat basis. Descriptive statistics included mean and standard deviation values and 2x2 ANOVAs (group x time;  $P < 0.05$ ) were performed for each variable.

**Results:** VAS scores showed a significant decrease from PRE to POST testing for both HIP and KNEE groups but those in the HIP protocol reported significantly reduced VAS one week earlier compared to KNEE [Figure 1;  $P=0.01$ ]. AKPS scores significantly increased from PRE to POST testing for both the HIP and KNEE strengthening groups [Figure 2;  $P=0.01$ ]. HABD, HER, HIR, HEXT, and KEXT strength all showed significant [ $P=0.01$ ] increases from PRE to POST testing for both HIP and KNEE groups. Individuals who performed the HIP program exhibited greater increases in muscular strength for all muscle groups tested when compared to KNEE [HABD: (HIP=15.98%; KNEE=11.05%); HER: (HIP=10.86%; KNEE=5.49%); HIR: (HIP=9.06%; KNEE=5.77%); HEXT: (HIP=15.56%; KNEE=7.73%); KEXT: (HIP=8.74%; KNEE=5.90%)]. ANT [ $P=0.26$ ] and LAT [ $P=0.27$ ] endurance did not significantly increase from PRE to POST for either the HIP or KNEE groups. POST core endurance significantly increased from PRE to POST testing for both HIP and KNEE (11.56% vs. 5.07%, respectively).

**Conclusions:** This is the first RCT study investigating KNEE vs. HIP protocols for patients with PFP. This study demonstrated significant improvements in pain and function for one of the most common musculoskeletal injuries. Both KNEE and HIP protocols significantly improved patient-centered outcome scores along with hip and knee strength after 6-weeks of therapeutic exercise. While outcomes are similar, the HIP protocol resulted in earlier resolution of pain and greater overall gains in strength compared to the KNEE protocol.

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### References:

1. Frye J. (2012) *Sports Health*, 4:205-210
2. Bolgla L. (2012) *J Orthop Sports Phys Ther*, 42:A25.
3. Boling M. (2006) *Arch Phys Med Rehab*. 87:1428-35
4. Crossley KM. (2004) *Arch Phys Med Rehabil*. 85:815-22

		VAS	AKPS	HABD	HEXT	HER	HIR	KEXT
Hip	Pre	5.13 (1.66)	75.15 (9.66)	3.18 (1.17)	2.40 (1.00)	1.22 (0.44)	1.50 (0.55)	3.93 (1.52)
	Post	2.16 (1.91)	88.89 (10.64)	3.69 (1.11)	2.78 (1.18)	1.35 (0.55)	1.64 (0.59)	4.27 (1.32)
Knee	Pre	5.04 (1.63)	74.68 (9.19)	3.18 (1.18)	2.60 (1.14)	1.21 (0.46)	1.43 (0.62)	4.16 (1.38)
	Post	2.19 (1.96)	88.20 (10.22)	3.53 (1.28)	2.80 (1.15)	1.27 (0.42)	1.51 (0.56)	4.40 (1.56)
	<b>Fcrit, P</b>	319.46, 0.01	260.52, 0.01	49.54, 0.01	38.10, 0.01	15.74, 0.01	15.31, 0.01	16.05, 0.01

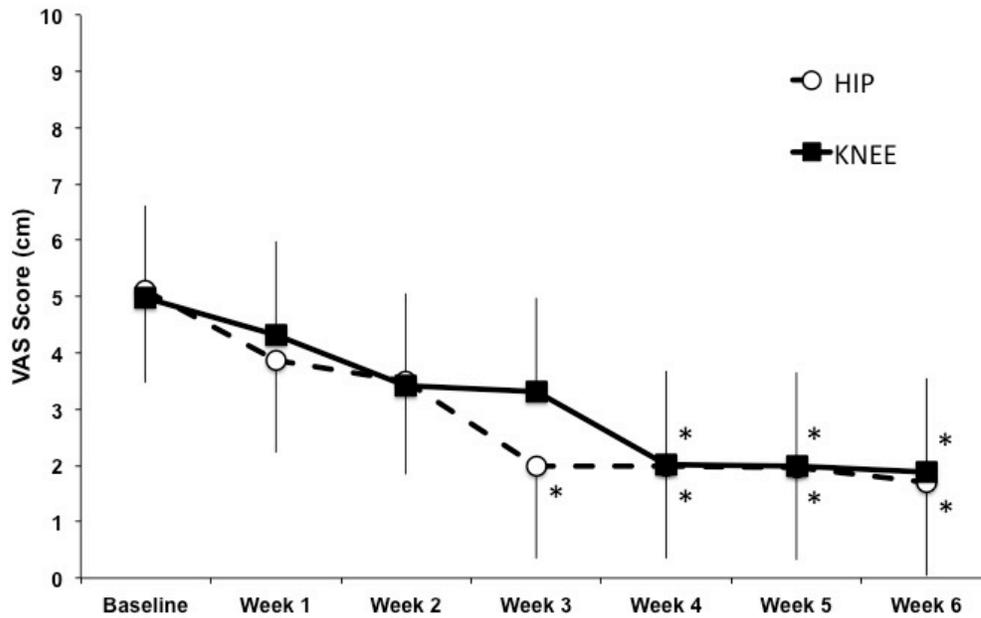


Figure 1: Mean Visual Analog Scores (VAS) measures for patellofemoral patients each week during a 6-week HIP- or KNEE-focused rehabilitation protocol. Note: \* indicates significantly different compared to Baseline scores.

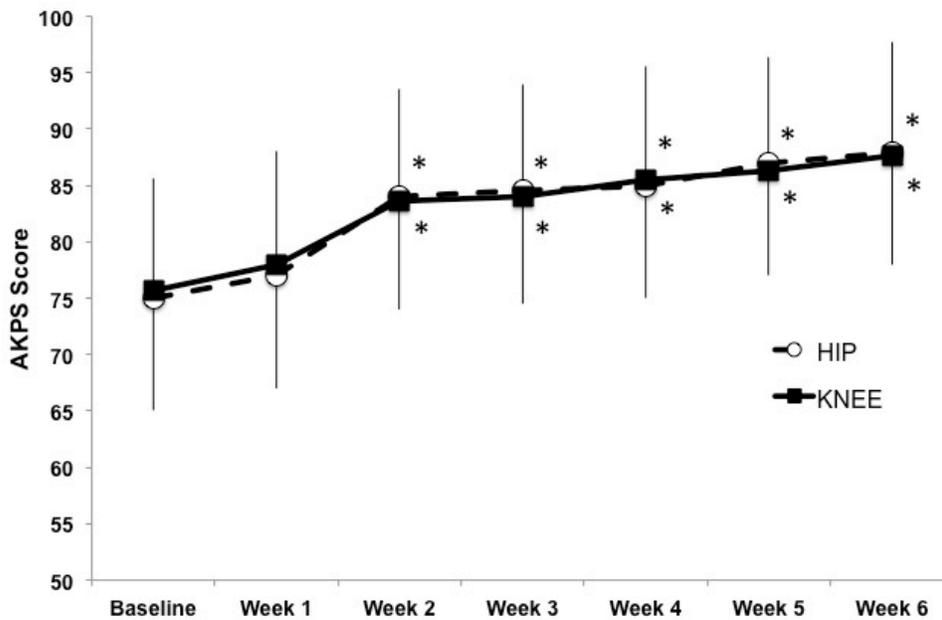


Figure 2: Mean Anterior Knee Pain Scale (AKPS) measures for patellofemoral patients each week during a 6-week HIP- or KNEE-focused rehabilitation protocol. Note: \* indicates significantly different compared to Baseline scores.