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The Effects of Isolated Hip Abductor and External Rotator Muscle Strengthening on Pain, Health Status, and Hip Strength in Females With Patellofemoral Pain: A Randomized Controlled Trial

STUDY DESIGN: Randomized controlled trial.

OBJECTIVES: To examine the effectiveness of isolated hip abductor and external rotator strengthening on pain, health status, and hip strength in females with patellofemoral pain (PFP).

BACKGROUND: Altered hip kinematics resulting from hip muscle weakness has been proposed as a contributing factor in the development of PFP. To date, no study has examined clinical outcomes associated with isolated hip muscle strengthening in those with PFP.

METHODS: Twenty-eight females with PFP were sequentially assigned to an exercise (n = 14) or a no-exercise control group (n = 14). The exercise group completed bilateral hip abductor and external rotator strengthening 3 times per week for 8 weeks. Pain (visual analog scale), health status (WOMAC), and hip strength (handheld dynamometer) were assessed at baseline and postintervention. Pain and health status were also evaluated at 6 months postintervention in the exercise group. Two-factor mixed-model analyses of variance were used to determine the effects of the intervention on each outcome variable.

RESULTS: Significant group-by-time interactions were observed for each variable of interest. Post hoc testing revealed that pain, health status, and bilateral hip strength improved in the exercise group following the 8-week intervention but did not change in the control group. Improvements in pain and health status were sustained at 6-month follow-up in the exercise group.

CONCLUSION: A program of isolated hip abductor and external rotator strengthening was effective in improving pain and health status in females with PFP compared to a no-exercise control group. The incorporation of hip-strengthening exercises should be considered when designing a rehabilitation program for females with PFP.

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KEY WORDS: *anterior knee pain, clinical trial, patella, rehabilitation, self-report*

Patellofemoral pain (PFP) is a common musculoskeletal diagnosis for which individuals seek medical attention.[35] Common clinical symptoms of PFP include retropatellar or peripatellar pain associated with squatting, climbing stairs, running, sitting, and kneeling.[8] The pain that accompanies such tasks limits participation in activities of daily living and sport. Despite the considerable attention directed toward understanding the etiology of PFP, the most appropriate intervention strategies for this condition remain unknown.

With respect to the etiology of PFP, there is growing empirical evidence that impaired muscular control of the hip can affect patellofemoral joint kinematics and kinetics in multiple planes.[21] For example, biomechanical studies have demonstrated that females with PFP exhibit greater frontal[33] and transverse plane[27,28] motion at the hip during activities such as stepping, landing from a jump, and running, compared to pain-free controls. It has been theorized that increased frontal plane hip motion may affect the lateral forces acting on the patella by increasing the "dynamic" quadriceps angle.[21,22] In turn, internal rotation of the femur has been suggested to be a contributor to altered patellofemoral joint kinematics (lateral patella tilt and displacement) in

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weight bearing.[23,26] This line of evidence suggests that abnormal hip kinematics may play a role in the pathogenesis of PFP.

Impaired hip muscle performance is a common impairment observed in patients with PFP[1,5,17,25,27] and has been shown to be associated with altered hip kinematics in this population.[27,28] A recently published systematic review concluded that there is strong evidence that females with PFP demonstrate impaired strength of the hip musculature, as compared to control subjects.[24] As such, hip strengthening has been advocated as an intervention for persons with PFP.[11,18,30]

Randomized controlled trials (RCTs) evaluating interventions for persons with PFP primarily have focused on quadriceps strengthening,[29] generalized lower extremity strengthening,[3,31] patella taping,[32] and foot orthotics.[7,12] To date, 3 RCTs have assessed the influence of hip muscle strengthening on PFP symptoms.[10,14,20] In studies by Fukuda et al[14] and Nakagawa et al[20] quadriceps strengthening was compared to a program consisting of both hip and quadriceps strengthening. Results demonstrated that the combination of hip and quadriceps strengthening was better than quadriceps strengthening alone in reducing PFP[14,20] and improving functional status.[14] Dolak et al[10] compared the influence of isolated hip strengthening versus quadriceps strengthening prior to the initiation of a weight-bearing exercise program. Results revealed that 4 weeks of isolated hip strengthening prior to the initiation of 4 weeks of weight-bearing exercise reduced self-reported symptoms earlier than when 4 weeks of quadriceps strengthening was performed prior to the same weight-bearing program. Although the studies of Nakagawa et al,[20] Fukuda et al,[14] and Dolak and colleagues[10] provide evidence in support of hip strengthening for persons with PFP, the isolated influence of hip muscle strengthening on PFP has yet to be determined. Given that isolated quadriceps strengthening has been shown to reduce patellofemoral symptoms,[14,20,29] it would appear important to study hip strengthening in isolation to truly evaluate the effectiveness of this approach as an independent intervention for PFP.

The purpose of the current study was to examine the effectiveness of isolated hip abductor and external rotator strengthening on pain, health status, and hip strength in females with PFP. We hypothesized that females assigned to the hip-strengthening group would exhibit significant reductions in pain, improved health status, and improved hip muscle performance immediately following the intervention period, as compared to a no-exercise control group. We further hypothesized that the improvements in pain and function in subjects assigned to the hip-strengthening group would be retained at 6-month follow-up. The findings of this study provide experimental evidence for the use of isolated hip strengthening for reducing pain and improving health status in persons with PFP.

METHODS

Potential participants were identified and recruited over a 12-month period. Patients thought to be candidates for the study were evaluated for specific inclusion/exclusion criteria by a single physician. To be considered for the study, patients had to be female and have a diagnosis of PFP. The diagnosis of PFP was based on the location of symptoms (peripatellar and/or retropatellar) and the reproduction of pain with activities commonly association with this condition, such as stair descent, squatting, kneeling, and prolonged sitting. Patients were screened by physical examination to rule out ligamentous laxity, meniscal injury, pes anserine bursitis, iliotibial band syndrome, and patellar tendinitis as possible causes of current symptoms. Patients were excluded from participation if they reported a history of previous patella dislocation, patellar fracture, or knee surgery.

Patients were invited to participate in the study if they had a diagnosis of bilateral PFP lasting at least 6 months (both knees), and had not previously received physical therapy. Only patients with bilateral symptoms were considered, based on the following rationales: first, we sought to create the most homogenous study sample possible; second, we felt that patients with bilateral pain would likely present with greater physical limitations compared to those with unilateral pain; and third, the majority of patients who were screened for this study presented with bilateral symptoms (72%).

In total, 67 females were screened for participation (**FIGURE 1**). Forty-eight of the 67 patients screened met the study inclusion criteria. Of the 48 patients who qualified, 28 agreed to participate and were sequentially assigned in an alternating fashion to the exercise or control group (**FIGURE 1**). In general, the patients enrolled in the study were relatively sedentary and only participated in activities of daily living (they did not participate in sport or recreational exercise).

Prior to participation, all patients provided written informed consent. Participants were aware of an alternative treatment group in the study but had no knowledge of intervention details. The study protocol was approved by the Institutional Review Board of the University of Isfahan.

Intervention

Patients assigned to the control group were instructed to take 1000 mg of Omega-3 and 400 mg of calcium daily for 8 weeks (placebo intervention). These individuals received no exercise training and were asked to refrain from exercise throughout the duration of the 8-week intervention. In addition, patients were allowed to take over-the-counter pain and/or anti-inflammatory medication as needed.

The exercise group completed supervised hip-strengthening exercises 3 times per week for 8 weeks. Each session consisted of a 5-minute warm-up (walking

around the gym at a self-selected pace), 20 minutes of hip-strengthening exercises, and a 5-minute cool-down (walking at a self-selected pace). All strengthening exercises were completed bilaterally. As with the control group, individuals in the exercise group were asked to refrain from exercise-related activity beyond that of the supervised program and were allowed to take over-the-counter pain and/or anti-inflammatory medication as needed.

Each participant in the exercise group followed a standardized exercise program. Resistance and repetitions were progressed at 2-week intervals (**TABLE 1**). Thera-Band elastic tubing (The Hygenic Corporation, Akron, OH) was used to provide exercise resistance.

Isolated hip abductor strengthening was performed as patients stood on both feet, with elastic tubing tied just above the ankle at one end and attached to a rigid pole at the other (**FIGURE 2**). The tubing length for hip abduction was individualized across patients based on their lower limb length (distance from anterior superior iliac spine to medial malleolus). The distance between the exercise limb and the pole was adjusted to remove slack from the tubing. The patients were allowed to hold on to a pole for balance during the exercise. The exercise was performed by abducting the hip to approximately 30°, while keeping the pelvis level.

Isolated hip external rotator strengthening was performed with patients seated at the edge of a treatment table and the knee flexed to 90° (**FIGURE 3**). A strap was used to stabilize the thigh to prevent sagittal and frontal plane hip motion. Elastic tubing was tied around the ankle and was secured to a rigid pole. The tubing length for hip external rotation strengthening was individualized across patients based on their thigh length (distance from anterior superior iliac spine to medial femoral epicondyle). The distance between the exercise limb and the pole was adjusted to remove slack from the tubing. The exercise was performed by externally rotating the hip to approximately 30°.

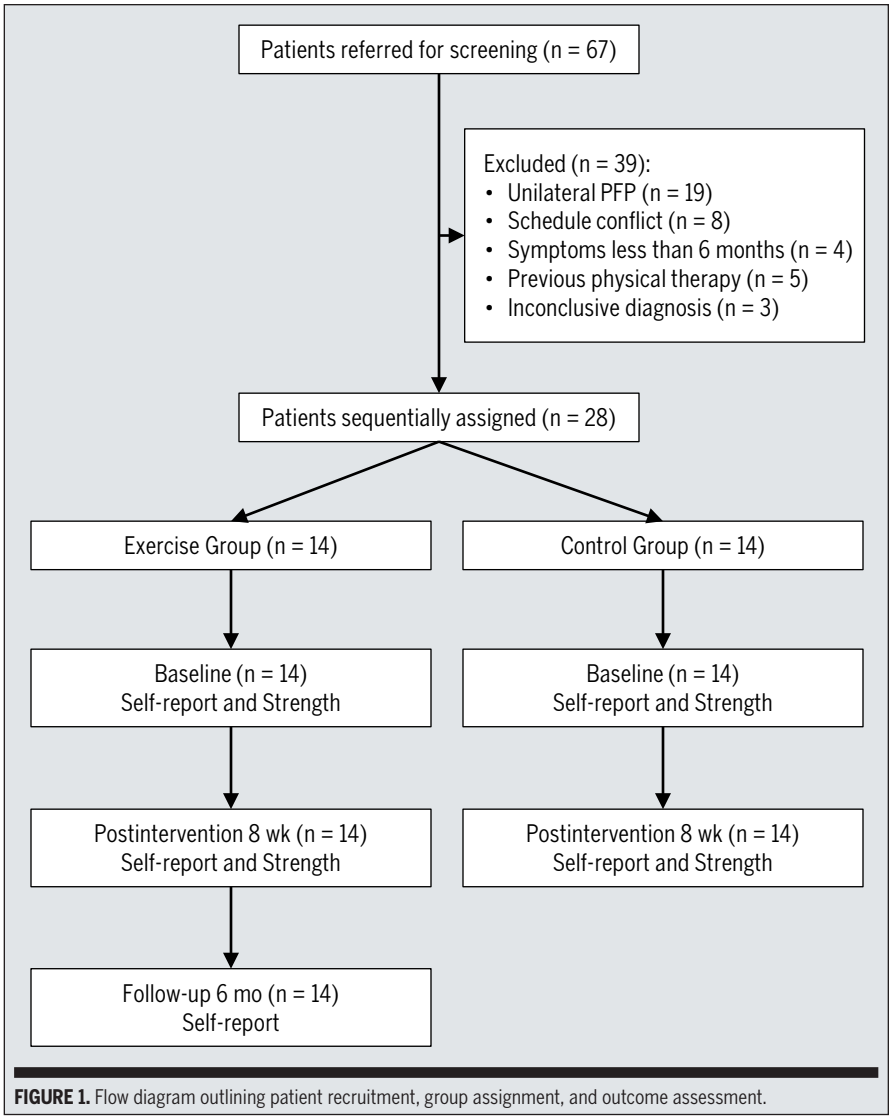

FIGURE 1. Flow diagram outlining patient recruitment, group assignment, and outcome assessment.

Outcome Measures

For patients assigned to the exercise group, outcome measures were obtained on 3 occasions: baseline (preintervention), week 8 (postintervention), and 6 months postintervention. Patients assigned to the control group were assessed on 2 occasions: baseline (preintervention) and week 8 (postintervention). Only 2 assessments were performed for the control patients, as these individuals were given the option to seek treatment as needed after the 8-week intervention period. As such, valid comparisons to the exercise group at 6-month follow-up were not possible. All outcome measurements were recorded by a single tester who was not blinded to group assignment.

Patients' self-report of pain intensity was quantified using a 10-cm visual analog scale (VAS), ranging from zero as "no pain" to 10 as the "worst pain possible." Individuals were asked to rate their response based on the average pain of both knees while performing activities that aggravated symptoms during the previous week (eg, stairs). The 10-cm VAS is a valid and responsive outcome measure for PFP, with a minimal clinically important difference of 2 cm.[9]

Self-reported health status was quantified using the Western Ontario and McMaster Universities (WOMAC)

TABLE 1 Standardized Exercise Progression Using Elastic Tubing

Weeks	Set 1*	Set 2*	Set 3*	Frequency per Week
1-2	Red (20)	Green (20)	Blue (20)	3
3-4	Red (25)	Green (25)	Blue (25)	3
5-6	Green (20)	Blue (20)	Black (20)	3
7-8	Green (25)	Blue (25)	Black (25)	3

**Values are band color, indicating resistance, with repetitions in parentheses. Resistance designation: red, medium; green, heavy; blue, extra heavy; black, special heavy.*

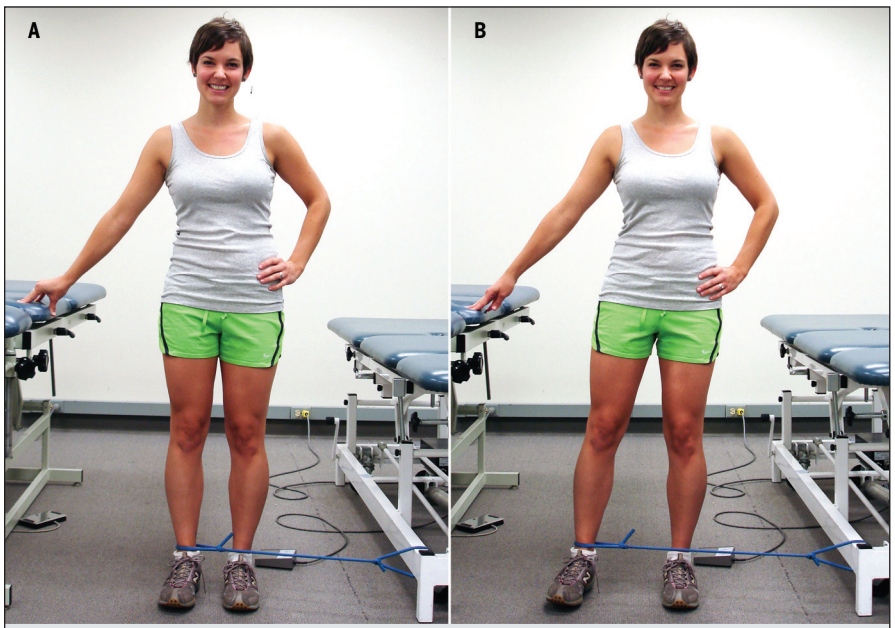

FIGURE 2. Patient (A) starting and (B) ending position for the hip abduction exercise.

questionnaire. The WOMAC is a 24-item questionnaire that assesses pain, stiffness, and physical function.[19] This outcomes tool has been shown to be a valid outcome measure for knee and hip osteoarthritis,[2] and has been reported to be significantly correlated to an outcome measure specifically designed for PFP.[16] Given that participants in the current study had bilateral symptoms, patients were instructed to respond to the WOMAC based on both knees. The total summed score for the Likert scale version used in the current study ranges from 0 to 96 (pain, 0-20; stiffness, 0-8; and physical function, 0-68), with higher scores indicating worse health status.

Bilateral isometric hip strength was quantified by a single tester using a handheld dynamometer (Commander Power Track II; JTECH Medical, Salt Lake City, UT). The use of handheld dynamometry to assess hip strength has been shown to be reliable.[6] To assess hip abduction strength, patients were positioned in sidelying on a treatment table. The pelvis was stabilized by a strap placed proximal to the iliac crest and secured around the table. The hip of the test limb was abducted 10° and the dynamometer pad was placed 10 cm proximal to the lateral femoral epicondyle. Patients were asked to abduct their hip with maximum effort into the dynamometer pad for 5 seconds (against manual resistance).

Hip external rotation isometric strength was assessed with patients seated at the edge of a treatment table with the knee flexed to 90°. A strap was used to stabilize the thigh of the tested limb against the treatment table. The dynamometer pad was placed just proximal to the medial malleolus. Patients were asked to externally rotate their hip with maximum effort into the dynamometer pad, against manual resistance, for 5 seconds.

For both of the strength tests described above, verbal encouragement was provided to facilitate a maximum performance. Three trials were performed, with a 20-second rest between each trial. The highest value recorded of the 3 trials was selected for statistical analysis.[15] Strength was normalized to body weight by dividing the force recorded by the dynamometer by body weight in Newtons [force N/body weight N × 100].

Statistical Analysis

Independent-samples *t* tests were used to assess for group differences at baseline. Separate 2-factor mixed-model analyses of variance (ANOVAs) (2 groups by 2 time points), with time as the repeated factor, were used to determine the effects of the intervention program on all outcome variables (baseline to the end of the 8-week intervention). If a significant interaction was observed, paired *t* tests were used to determine whether the exercise or control group changed over time.

Paired *t* tests were used to determine whether self-reported pain and health status in those patients assigned to the exercise group at baseline differed from those at the 6-month postintervention time point. Parametric tests were justified, based on the data being normally distributed and the variance being equal between groups. All statistical analyses were conducted with SPSS software (IBM Corporation, Armonk, NY), using a significance level of $P \leq .05$. Data are presented as mean ± SD.

RESULTS

At baseline, demographic characteristics, VAS scores, WOMAC scores, and hip strength were simi-

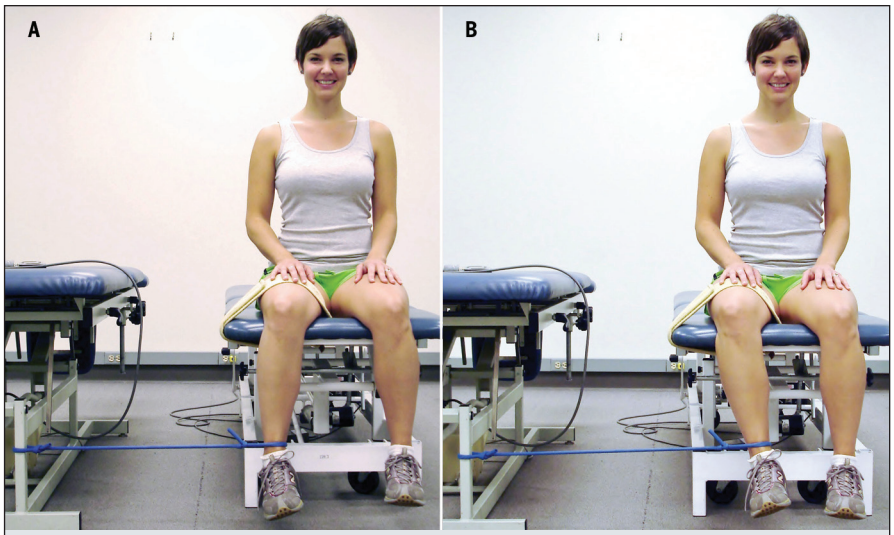

FIGURE 3. Patient (A) starting and (B) ending position for the hip external rotation exercise.

TABLE 2 Demographic and Outcome Measures at Baseline

Variable	Exercise Group*	Control Group*	*P* Value
Age, y	28.9 ± 5.8	30.5 ± 4.8	.42
Height, cm	158.2 ± 5.8	160.9 ± 4.6	.19
Weight, kg	60.8 ± 10.4	62.6 ± 10.6	.64
VAS, cm†	7.9 ± 1.7	6.6 ± 2.0	.10
WOMAC‡	54.0 ± 18.1	55.9 ± 13.5	.76
Right hip abduction strength§	11.6 ± 2.3	12.3 ± 2.9	.53
Left hip abduction strength§	11.2 ± 2.7	12.5 ± 3.7	.28
Right hip external rotation strength§	8.6 ± 2.3	8.9 ± 2.1	.67
Left hip external rotation strength§	7.0 ± 1.8	7.5 ± 1.6	.47

Abbreviations: VAS, visual analog scale; WOMAC, Western Ontario and McMaster Universities questionnaire.
**Data are mean ± SD.*
†0 to 10 cm, with larger numbers indicating more pain.
‡0 to 96, with larger numbers indicating worse health status.
§Strength data are Newtons of force divided by body weight in Newtons (force N/body weight N × 100).

lar between groups (**TABLE 2**). Patients in both groups were moderately to severely impaired with respect to pain and health status. No patients dropped out of the study and no adverse effects were reported.

Self-Reported Outcomes

The ANOVA evaluating changes in self-reported pain intensity from baseline to the end of the 8-week intervention revealed a significant group-by-time interaction ($F_{1,26}$ = 58.9, P<.001). Post hoc testing revealed that pain significantly decreased in the exercise group (P<.001) and did not change in the control group (**TABLE 3**). At the 6-month follow-up, the pain intensity reported by the exercise group remained significantly decreased compared to baseline (P<.001) (**TABLE 3**).

The ANOVA evaluating changes in WOMAC scores from baseline to the end of the 8-week intervention revealed a significant group-by-time interaction ($F_{1,26}$ = 61.4, P<.001). Post hoc testing revealed that WOMAC scores decreased in the exercise group (P<.001) and did not change in the control group (**TABLE 3**). At the 6-month follow-up, the WOMAC scores of the exercise group remained significantly decreased compared to those at baseline (P<.001) (**TABLE 3**).

Strength

The ANOVAs evaluating changes in right and left hip abduction strength from baseline to the end of the 8-week intervention revealed a significant group-by-time interaction ($F_{1,26}$ = 48.5 and $F_{1,26}$ = 67.6, respectively; P<.001). Post hoc testing revealed that right and left hip abduction strength increased in the exercise group (P<.001). In the control group, right hip abduction strength did not change, and left hip abduction strength decreased slightly (**TABLE 4**).

The ANOVAs evaluating changes in right and left hip external rotation strength from baseline to the end of the 8-week intervention revealed a significant group-by-time interaction ($F_{1,26}$ = 57.4 and $F_{1,26}$ = 46.7, respectively; P<.001). Post hoc testing revealed that right and left hip external rotation strength increased in the exercise group (P<.001) and did not change in the control group (**TABLE 4**).

DISCUSSION

Hip weakness is a well-documented impairment in females with PFP[24] and has been postulated to contribute to abnormal patellofemoral joint kinematics and kinetics.[21,22] The current study examined the effectiveness of isolated hip abduction and external rotation strengthening on self-reported pain intensity, health status, and hip strength in females with PFP. Results revealed that the hip-strengthening program used in the current study significantly decreased pain and improved health status. In contrast, self-reported pain intensity and health status in the control group did not change from those measured at baseline. Importantly, the

TABLE 3 Results of Self-Report Measures in Response to Intervention*

	Baseline	Postintervention (8 wk)	Follow-up (6 mo)	Difference (8 wk-baseline)	Difference (6 mo-baseline)
Exercise group					
VAS†	7.9 ± 1.7	1.4 ± 1.9	1.7 ± 2.7	−6.4 ± 2.7; 95% CI: −7.9, −4.9‡	−6.2 ± 1.4; 95% CI: −7.9, −4.3‡
WOMAC§	54.0 ± 18.1	10.7 ± 16.1	10.8 ± 17.7	−43.3 ± 20.1; 95% CI: −54.9, −31.7‡	−43.2 ± 7.7; 95% CI: −55.9, −30.0‡
Control group					
VAS†	6.6 ± 2.0	6.7 ± 2.4	NT	0.1 ± 1.7; 95% CI: −0.9, 1.1	NT
WOMAC§	55.9 ± 15.7	59.9 ± 12.6	NT	4.1 ± 10.3; 95% CI: −1.9, 10.0	NT

Abbreviations: NT, not tested; VAS, visual analog scale; WOMAC, Western Ontario and McMaster Universities questionnaire.
**Data are mean ± SD.*
†0 to 10 cm, with larger numbers indicating more pain.
‡Significant at P<.001
§0 to 96, with larger numbers indicating worse health status.

positive outcomes observed in the exercise group were sustained over baseline values at a 6-month follow-up.

Because all demographic and dependent variables of interest were similar at baseline, the improvements in pain intensity and health status in the exercise group at the conclusion of the 8-week intervention may be attributed to the hip-strengthening intervention. On average, the changes in pain and WOMAC postintervention were 6.4 and 43.3, respectively, for the exercise group, which far exceeded the minimal clinically important difference reported for both measures.[9,13] The standardized response means associated with these changes were large (2.4 and 2.2 for the VAS and WOMAC, respectively), and, therefore, we are confident that the observed changes in the exercise group were clinically relevant.

The findings of the present study support the growing body of literature which suggests that hip strengthening may be a viable intervention for PFP.[10,14,20] Mascal et al[18] were the first to demonstrate that an exercise program focusing on hip and trunk strength was effective in decreasing pain, improving hip kinematics, and restoring function in 2 patients with PFP. Subsequent studies by Earl and Hoch,[11] Boling et al,[4] and Tyler et al[30] demonstrated that exercise programs which incorporate hip strengthening result in improved pain and functional outcomes in females with PFP. It should be noted, however, that control groups were not utilized in these studies.

TABLE 4 Results of Hip Strength Assessments in Response to Intervention*

	Baseline	Postintervention (8 wk)	Difference (8 wk-Baseline)	Difference, 95% Confidence Interval
Exercise group				
Right abduction	11.6 ± 2.3	15.3 ± 2.5	3.7 ± 1.6†	2.8, 4.6
Left abduction	11.2 ± 2.7	15.9 ± 3.1	4.7 ± 1.9†	3.6, 5.8
Right external rotation	8.6 ± 2.3	11.8 ± 2.2	3.2 ± 1.4†	2.4, 3.9
Left external rotation	7.0 ± 1.8	10.9 ± 2.6	3.9 ± 1.9†	2.9, 5.0
Control group				
Right abduction	12.3 ± 2.9	11.2 ± 2.5	−1.1 ± 1.9	−2.2, 0.1
Left abduction	12.5 ± 3.7	11.4 ± 3.1	−1.1 ± 1.8‡	−2.2, −0.1
Right external rotation	8.9 ± 2.1	8.3 ± 2.3	−0.6 ± 1.3	−1.4, 0.1
Left external rotation	7.5 ± 1.6	7.3 ± 1.9	−0.2 ± 1.3	−0.9, 0.6

**Strength data are mean ± SD Newtons of force divided by body weight in Newtons multiplied by 100 ([force N/body weight N] × 100).*
†Significant at P<.001.
‡Significant at P = .04.

Our findings are consistent with the results of 3 RCTs that incorporated hip strengthening into an exercise program for females with PFP.[10,14,20] Nakagawa et al[20] concluded that the combination of hip abductor, hip external rotator, and knee extensor exercises was more effective than knee extensor strengthening alone in decreasing perceived pain during functional activities in females with PFP. Fukuda et al[14] reported that improvements in PFP and function were greater when knee-strengthening exercises were supplemented with hip-strengthening exercises. Similarly, Dolak and colleagues[10] reported that 4 weeks of isolated hip strengthening prior to the initiation of 4 weeks of weight-bearing exercise reduced self-reported symptoms earlier than when 4 weeks of quadriceps strengthening were performed prior to the same weight-bearing program. Although these studies provide evidence that combined hip and quadriceps strengthening is more effective than quadriceps strengthening alone, definitive inferences regarding the influence of hip strengthening could not be determined. For example, the outcomes observed from an intervention that combined hip and knee strengthen-

ing could be codependent and may not occur from hip strengthening in isolation.

To our knowledge, this is the first study to test the isolated effects of hip strengthening in females with PFP symptoms. The fact that isolated hip strengthening was effective in reducing pain intensity and improving health status supports the contention that hip strengthening is a viable intervention in this population. Future studies should consider comparing isolated hip strengthening to other exercise interventions (ie, quadriceps exercise, weight-bearing exercise) to identify the most efficient rehabilitation approach for this population.

Although significant improvements in pain and health status were observed in subjects assigned to the exercise group, the mechanism(s) underlying these changes cannot be determined from the current study. However, based on the findings of Mascal et al,[18] it is reasonable to suggest that improvements in hip abduction and external rotation strength, which ranged from 32% to 56%, might have resulted in changes in hip kinematics during functional activities. Given that excessive hip adduction and internal rotation have been postulated to adversely affect patellofemoral joint kinematics and kinetics,[21,22] it is possible that the changes in hip muscle performance might have resulted in a decrease in patellofemoral joint loading and, therefore, pain. However, care must be taken in attributing changes in patellofemoral symptoms to improved hip kinematics after strengthening in isolation, as recent research suggests that changes in hip kinematics may be more related to skill acquisition (skilled practice) as opposed to improvements in hip strength.[34]

There are several limitations of our study, acknowledged as follows. First, our study sample consisted of a relatively small, homogenous group of subjects (females with chronic bilateral symptoms). Whether or not the results of the current investigation may be generalized to other populations with PFP (eg, males and those with acute symptoms) remains to be seen. Second, we did not obtain self-reported pain and health status data in the control group at the 6-month follow-up, as these subjects were allowed to seek treatment following the conclusion of the intervention period. However, the chronic nature of PFP symptoms required for study inclusion (greater than 6 months) suggests that the control group would have continued to have symptoms and limited function at the follow-up.

A third limitation is that we did not quantify strength in the exercise group at the 6-month follow-up. Therefore, care must be taken in attributing the continued improvements in pain and health status specifically to improved hip muscle performance. Lastly, the investigator who was responsible for obtaining the functional outcome and strength measures was not blinded to the participants' group assignment. While this lack of blinding would have had no influence on the self-reported outcomes, potential bias must be acknowledged regarding the strength testing. Lastly, patients in both groups were allowed to take over-the-counter pain and/or anti-inflammatory medications as needed. Although a medication log was not obtained from the study participants, none of the subjects reported taking pain medication during the study.

CONCLUSION

An 8-week program of isolated hip abductor and external rotator strengthening was effective in improving pain and health status in females with PFP, as compared to a no-exercise control group. The observed improvements in the exercise group were maintained at a 6-month follow-up. Taken together, our results support the use of hip-strengthening exercises as a viable option for this population. ◉

KEY POINTS

FINDINGS: Eight weeks of isolated hip abductor and external rotator strengthening was effective in reducing pain intensity and improving health status in females with PFP.

IMPLICATION: The incorporation of hip-strengthening exercises should be considered when designing a rehabilitation program for females with PFP.

CAUTION: The relatively small sample size limits generalizability to the PFP population as a whole. Also, it is not known whether the results of the current study would apply to males with PFP.

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