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COMBINED EFFECT OF MEDIAL WEDGE SUPPORT WITH STRENGTHENING HIP ABDUCTORS AND LATERAL ROTATORS EXERCISES ON PROXIMAL MUSCLES STRENGTH IN PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME

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Abstract

In the absence of other pathologies, patellofemoral pain syndrome (PFPS), a prevalent complaint among athletes and communities, is defined as a dull, agonizing ache in the anterior or retropatellar region. To investigate the therapeutic efficacy of medial wedge support on proximal muscle strength in patients with PFPS. Twenty male and ten female patients, all between the ages of 18 and 35, were randomly divided into two equal groups. 15 patients in the experimental group (A) additionally underwent strengthening exercises for the hip abductors and lateral rotators and medial wedge support. 15 patients in the control group (B) solely engaged in hip abductors and lateral rotators strengthening activities. Hip abductor and lateral rotator strength were evaluated in both groups using a hand-held dynamometer (HHD) before and after 12 consecutive sessions separated by six weeks. The results indicate that patellofemoral pain syndrome (PFPS) patients' hip abductors and lateral rotators did not significantly differ in strength when employing medial wedge support in conjunction with strengthening activities for those muscles.

Key Words: *Hand-held dynamometer, Medial wedge support, Patellofemoral pain syndrome, Strengthening exercises.*

1. Introduction

With documented prevalence rates in physically active young adults above 25%, patellofemoral pain syndrome (PFPS) is a prevalent complaint in sportsmen and communities, particularly when repetitive lower limb loading is involved (Robinson and Nee, 2007). PFPS and patellofemoral malalignment have been linked to proximal variables, such as hip muscle weakness (Souza and Powers, 2009; Fulkerson, 2002). Numerous studies have linked hip external rotator and abductor weakness to PFPS in women (Bolgla et al., 2008; Ireland et al., 2003). According to observational research, PFPS and excessive foot pronation are connected (Barton et al., 2010). It is believed that a more pronated foot type results in excessive or prolonged foot pronation and, as a result, increased tibial and femoral internal rotation during walking (Powers, 2003).

It is generally accepted that conservative treatment, rather than surgery, should be used to control PFPS in the beginning (Dursun et al., 2001). Taping, quadriceps muscle strengthening, flexibility training, manual therapy to the lower quadrant, biofeedback, and the use of foot orthoses are examples of conservative treatment (Crossley et al., 2001; Yip and Ng, 2006; Peeler and Anderson, 2007; Iverson et al., 2008).

Clinical studies have demonstrated that foot orthoses or hip muscle exercises are effective PFP management strategies, it is thought that foot orthoses may reduce pain by limiting foot pronation and associated lower limb rotation, thereby reducing lateral patellofemoral joint (PFJ) forces (Collins et al., 2008; Mills et al., 2008; Khayambashi et al., 2008). However, there is no research examining the impact of foot orthoses, hip abductors, and lateral rotator strengthening activities on the strength of the proximal muscles in PFPS patients, to the researcher's knowledge.

Therefore, this study was investigating the combined effect of medial wedge support with strengthening hip abductors and lateral rotator exercises on proximal muscle strength in patients with PFPS.

2. Methods

2.1. Patients and Methods

Thirty patients—20 men and 10 women—were involved in the study. The patients were split into two equal groups at random. The experimental group (A) consisted of 15 patients with a mean age of 24 years and a mean BMI of 24.67 kg/m2, who also received medial wedge support in addition to hip abductors and lateral rotator strengthening exercises. The control group (B) consisted of 15 patients with a mean age of 22 years and a mean BMI of 23.07 kg/m2, who received only hip abductors and lateral rotator strengthening exercises. Between August 2017 and January 2018, this study was carried out in the outpatient clinic of the Delta University for Science and Technology's Faculty of Physical Therapy. Patients in both groups participated for six weeks, attending two sessions each week.

2.2. Evaluation instrumentation

A hand-held dynamometer (HHD) was used to evaluate hip abductors and lateral rotator strength (Kendall and McCreary, 1993). HHD was first described by Lovett and Martin in 1916 (Bohannon, 2006); it is an appropriate device that can be placed between the hand of the practitioner and the patient's tested body part, the same way as a practitioner would perform a manual muscle test.

2.3. Treatment instrumentation

2.3.1. Prefabricated medial wedge support.

The flat foot support, made in China and imported by the Elshafey Company, Kafr Elsheikh, Egypt, was the first available three-quarter-length device with lateral cutouts that served as the medial wedge support. It has 4° varus rear foot wedging and built-in arch supports. It is manufactured from medium-density ethylene-vinyl acetate.

2.3.2. Sandbag (2 Kg- 10 Kg)

3. Procedures

3.1. Assessment procedures:

3.1.1 Hip abductor and hip lateral rotator muscles strength:

Each subject's isometric strength for hip abductors and lateral rotators was measured with an HHD, as described by (Kendall and McCreary, 1993). Hip abductor isometric strength testing was performed with the subject in the side-lying position on a treatment table. The underneath leg was flexed at the hip and knee with the pelvis rotated slightly forward. To make the trunk more stable, the upper arm was holding onto the edge of the table. The participant somewhat externally rotated while abducting the upper leg to a 30° angle. The examiner stabilized the pelvis and applied pressure in the direction of adduction and mild flexion with the HHD close to the lateral malleolus (Robinson and Nee, 2007).

The participant was tested for hip lateral rotator isometric strength while seated on the edge of a treatment table with their knees and hips flexed to a 90-degree angle. The individual was instructed to grasp onto the table and spin their lower extremities so that their hip was slightly turned outward, aligning the medial malleolus with their body's midline. The examiner applied pressure into internal rotation with the HHD immediately proximal to the medial malleolus while stabilizing the lateral surface of the knee (Robinson and Nee, 2007).

3.2. Treatment procedures:

3.2.1 Prefabricated medial wedge support:

No customization of the orthoses was uundertaken. However, to ensure that the first MTPJ was just distal to the end of the orthoses, the size was customized for each patient. When possible, participants were instructed to wear shoes that could fit the orthoses (Barton et al., 2011).

3.2.2 Hip abductors strengthening exercise:

The patient was in a laying position on the unaffected side. The patient was instructed to extend the affected knee and bend the knee on the side not affected. The therapist stood behind the patient in a stride stance and fixed the pelvis. With a sandbag wrapped just proximal to the lateral malleolus, the patient was told to elevate his limb in abduction, hold for 6 seconds, then return to starting position and relax (Mohamed, 2012).

3.2.3 Hip lateral rotators strengthening exercise:

The patient sits at the edge of the plinth with his hip and knee bent 90 degrees, supported by his hand behind him. The therapist stood next to the patient on the damaged side and supported their wounded thigh. The patient was told to count to six while twisting the affected leg toward the unaffected side, then relax and resume the original position. Just proximal to the lateral malleolus, a sandbag was wrapped (Mohamed, 2012).

Hip strengthening exercises were carried out in two sets of ten repetitions each, with three seconds between each repetition and one minute resting in between sets (Mohamed, 2012). Each patient received training at 60% of their 10-repetition maximum (RM), which is the maximum amount of weight that can be raised and lowered through their range of motion precisely 10 times (Kisner and Colby, 2007). The two groups received two sessions per week, for six successive weeks.

4. Results

A statistical software program (GraphPad Prism Version 5.0; GraphPad Software, San Diego, CA, USA) was used for all analyses. Data were examined for normality and homogeneity of variance prior to final analysis. For all variables, descriptive statistics with mean and standard deviation were utilized. A paired t-test was used to compare the pre-interventional and post-interventional outcome variables within the groups. Unpaired t-tests were used to compare the pre-interventional and post-interventional outcome variables across groups.

4.1. Baseline and demographic data:

There was no statistically significant (P 0.05) difference in age or body measurements between experimental and control patients in the current investigation, as indicated in Table 1. The average ages of the experimental and control patients were 24.0 5.16 and 22.0 1.60, respectively. The body weight was similar between experimental (72.90 ± 10.54) and control (72.77 ± 11.32) patients. Experimental and control patients have a similar height (1.71 ± 0.09 vs. 1.77 ± 0.08) and BMI (24.67 ± 2.56 vs. 23.07 ± 2.88).

4.2. The effect on the muscle strength (mean ± STD):

The obtained data presented in (Table 2) revealed that there was no significant difference in the muscle strength of both hip abductors and hip lateral rotator muscles either pre-treatment or post-treatment between experimental and control patients. Noteworthy, post-treatment the hip abductors strength extremely (P < 0.0001) increased from 104.3±23.53 to 143.9 ± 27.45 in experimental patients and extremely increased (P < 0.0001) from 106.5 ± 16.91 to 146.0 ± 14.87 in control patients. Similarly, the muscle strength of hip lateral rotators was 79.99 ± 15.49 and 86.20 ± 9.03 which extremely increased (P < 0.0001) post-treatment to 117.5 ± 23.13 and 117.4 ± 14.18 for experimental and control patients respectively.

Table (1): The age and the body dimensions (mean ± STD) with normality test (in parentheses) of the experimental and the control patients:

Patients group	No. of patients	Age	Weight	Height	BMI
Experimental	15	24.0 ± 5.16a (0.19)	72.90 ± 10.54a (0.62)	1.71 ± 0.09a (0.40)	24.67 ± 2.56a (0.80)
Control	15	22.0 ± 1.60a (0.09)	72.77 ± 11.32a (0.50)	1.77± 0.08a (0.26)	23.07 ± 2.88a (0.43)
P value	-	0.16	0.97	0.10	0.12
Significance	-	Non	Non	Non	Non

Within the same column values bearing similar superscripts were non-significantly different (P≥0.05). All values were within the normal Gussian distribution (P≥0.05).

Table 2: The effect on the muscle strength (mean ± STD) with normality test (in parentheses):

Patient group	NO. of replicates	Muscle strength		
		Hip abductors		
		Pre-treatment	Post-treatment	P value
Experimental	15	104.3 ± 23.53a (0.23)	143.9 ± 27.45a* 0.23)(	P < 0.0001
Control	15	106.5 ± 16.91a (0.51)	146.0 ± 14.87a* 0.99)(	P < 0.0001
P value	-	0.77	0.80	-

Patient group	NO. of replicates	Muscle strength		
		Hip lateral rotators		
		Pre-treatment	Post-treatment	P value
Experimental	15	79.99 ± 15.49a (0.23)	117.5 ± 23.13a* (0.20)	P < 0.0001
Control	15	86.20 ± 9.03a (0.52)	117.4 ± 14.18a* (0.05)	P < 0.0001
P value	-	0.19	0.98	-

Within the same column values bearing similar superscripts were non-significantly different (P ≥ 0.05).

Within the same row values bearing asterisk were significantly different (P < 0.001). All values were within the normal Gussian distribution (P≥0.05).

5. Discussion

A prevalent complaint among both athletes and general populations is patellofemoral pain syndrome (PFPS). In the absence of additional pathology, (Robinson and Nee, 2007) described it as a dull, aching ache in the anterior or retropatellar region (Lowry et al., 2008). PFPS has been linked to patellofemoral malalignment, namely hip abductor and external rotator weakness (Ferber et al., 2003; Souza and Powers, 2009), as well as excessive foot pronation (Tang et al., 2001; Piva et al., 2003). Strengthening exercises for the hip abductors and lateral rotators (Boling et al., 2009; Mohamed, 2012) or medial wedge support were effective treatments for PFPS, according to clinical investigations (McConnell, 2002; Gross and Foxworth, 2003).

This study explored how exercising the lateral rotators and hip abductors while receiving medial wedge support affected the proximal muscles of PFPS patients. The current study's findings revealed no significant differences between the two groups in terms of mean HHD readings for hip abductors and lateral rotator strength. However, in comparing pre- and post-treatment effects within each group, there was a highly significant difference in both groups.

Several research supported these conclusions as follows: It was found that people with PFPS had stronger hip abductor muscles as indicated by HHD readings after engaging in hip abductor muscle strengthening exercises for three weeks (Ferber et al., 2011).

After an 8-week program of core muscle strengthening exercises including hip abductor and lateral rotator strengthening exercises, it was seen that hip abductor and lateral rotator muscle strength increased on HHD readings (Earl and Hoch, 2011). Furthermore, it was found that compared to the exercise-free control group, females with PFPS had stronger hip abductor and lateral rotator muscles on HHD readings after completing an isolated 8-week program of strengthening exercises (Khayambashi et al., 2008).

A 6-week hip strengthening program outperformed a 6-week knee strengthening program in terms of overall strength increases as measured by HHD readings. However, the hip regimen in this study included workouts to strengthen the hip extensors and internal rotators (Ferber et al., 2015).

Finally, from the previous discussion of these results and according to reports of other investigators in similar studies, It can be explained why there was no discernible improvement in the hip abductors' and lateral rotators' muscular strength between the pre- and post-treatment phases in group (A), which included hip abductors' and lateral rotators' strengthening activities. This may be due to the small sample size; short time of treatment and most patients of group (A) were females while most patients of group (B) were males.

6. Conclusion

According to the current study's findings, hip abductors and lateral rotators in patients with patellofemoral pain syndrome (PFPS) did not substantially differ in strength while using medial wedge support along with strengthening activities.

7. Conflict of interest:

The authors assert that this study was carried out with no conflicts of interest.

8. Disclosure statement:

The authors had no financial interest and did not receive any financial benefit from this research.

9. References

Barton, C. J., Bonanno, D., Levinger, P., & Menz, H. B., 2010. Foot and ankle characteristics in patellofemoral pain syndrome: a case control and reliability study. Journal of orthopaedic & sports physical therapy, 40(5), 286-296.

Barton, C. J., Menz, H. B., & Crossley, K. M., 2011. The immediate effects of foot orthoses on functional performance in individuals with patellofemoral pain syndrome. British journal of sports medicine, 45(3), 193-197.

Bohannon, R. W. (2006). Hand-held dynamometry: adoption 1900–2005. *Perceptual and motor skills*, *103*(1), 3-4.

Bolgla, L. A., Malone, T. R., Umberger, B. R., & Uhl, T. L., 2008. Hip strength and hip and knee kinematics during stair descent in females with and without patellofemoral pain syndrome. journal of orthopaedic & sports physical therapy, 38(1), 12-18.

Boling, M. C., Padua, D. A., & Alexander Creighton, R., 2009. Concentric and eccentric torque of the hip musculature in individuals with and without patellofemoral pain. Journal of athletic training, 44(1), 7-13.

Collins, N., Crossley, K., Beller, E., Darnell, R., McPoil, T., & Vicenzino, B., 2008. Foot orthoses and physiotherapy in the treatment of patellofemoral pain syndrome: randomised clinical trial. Bmj, 337, a1735.

Crossley, K., Bennell, K., Green, S., & McConnell, J., 2001. A systematic review of physical interventions for patellofemoral pain syndrome. Clinical Journal of Sport Medicine, 11(2), 103-110.

Dursun, N., Dursun, E., & Kiliç, Z., 2001. Electromyographic biofeedback–controlled exercise versus conservative care for patellofemoral pain syndrome. Archives of physical medicine and rehabilitation, 82(12), 1692-1695.

Earl, J. E., & Hoch, A. Z., 2011. A proximal strengthening program improves pain, function, and biomechanics in women with patellofemoral pain syndrome. The American journal of sports medicine, 39(1), 154-163.

Ferber, R., Davis, I. M., & Williams Iii, D. S., 2003. Gender differences in lower extremity mechanics during running. Clinical biomechanics, 18(4), 350-357.

Ferber, R., Kendall, K. D., & Farr, L., 2011. Changes in knee biomechanics after a hip-abductor strengthening protocol for runners with patellofemoral pain syndrome. Journal of athletic training, 46(2), 142-149.

Ferber, R., Bolgla, L., Earl-Boehm, J. E., Emery, C., & Hamstra-Wright, K., 2015. Strengthening of the hip and core versus knee muscles for the treatment of patellofemoral pain: a multicenter randomized controlled trial. Journal of athletic training, 50(4), 366-377.

Fulkerson, J. P., 2002. Diagnosis and treatment of patients with patellofemoral pain. The American journal of sports medicine, 30(3), 447-456.

Gross, M. T., & Foxworth, J. L., 2003. The role of foot orthoses as an intervention for patellofemoral pain. Journal of Orthopaedic & Sports Physical Therapy, 33(11), 661-670.

Ireland, M. L., Willson, J. D., Ballantyne, B. T., & Davis, I. M., 2003. Hip strength in females with and without patellofemoral pain. Journal of orthopaedic & sports physical therapy, 33(11), 671-676.

Iverson, C. A., Sutlive, T. G., Crowell, M. S., Morrell, R. L., Perkins, M. W., Garber, M. B., Moore, J. H. & Wainner, R. S., 2008. Lumbopelvic manipulation for the treatment of patients with patellofemoral pain syndrome: Development of a clinical prediction rule. Journal of orthopaedic & sports physical therapy, 38(6), 297-312.

Kendall, F. P., & McCreary, I., 1993. K, Provance PG. Muscles: testing and function.

Khayambashi, K., Mohammadkhani, Z., Ghaznavi, K., Lyle, M. A., & Powers, C. M., 2012. 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. Journal of orthopaedic & sports physical therapy, 42(1), 22-29.

Kisner, C., & Colby, L. A., 2007. Therapeutic exercise: foundations and techniques. Philadelphia, PA: FA Davis Co, 66-104.

Lowry, C. D., Cleland, J. A., & Dyke, K., 2008. Management of patients with patellofemoral pain syndrome using a multimodal approach: a case series. Journal of orthopaedic & sports physical therapy, 38(11), 691-702.

McConnell, J., 2002. The physical therapist's approach to patellofemoral disorders. Clinics in sports medicine, 21(3), 363-387.

Mills, K., Blanch, P., Dev, P., Martin, M., & Vicenzino, B., 2012. A randomised control trial of short term efficacy of in-shoe foot orthoses compared with a wait and see policy for anterior knee pain and the role of foot mobility. Br J Sports Med, 46(4), 247-252.

Mohamed, K. A. H., 2012. Influence of strengthening of hip abductors and external rotators in treatment of patellofemoral pain syndrome. (An Unpublished M.Sc theses, Cairo University) Egypt.

Peeler, J., & Anderson, J. E., 2007. Effectiveness of static quadriceps stretching in individuals with patellofemoral joint pain. Clinical journal of sport medicine, 17(4), 234-241.

Piva, S. R., Fitzgerald, K., Irrgang, J. J., Jones, S., Hando, B. R., Browder, D. A., & Childs, J. D., 2006. Reliability of measures of impairments associated with patellofemoral pain syndrome. BMC musculoskeletal disorders, 7(1), 33.

Powers, C. M., 2003. The influence of altered lower-extremity kinematics on patellofemoral joint dysfunction: a theoretical perspective. Journal of Orthopaedic & Sports Physical Therapy, 33(11), 639-646.

Robinson, R. L., & Nee, R. J., 2007. Analysis of hip strength in females seeking physical therapy treatment for unilateral patellofemoral pain syndrome. Journal of orthopaedic & sports physical therapy, 37(5), 232-238.

Souza, R. B., & Powers, C. M., 2009. Differences in hip kinematics, muscle strength, and muscle activation between subjects with and without patellofemoral pain. Journal of orthopaedic & sports physical therapy, 39(1), 12-19.

Tang, S. F., Chen, C. K., Hsu, R., Chou, S. W., Hong, W. H., & Lew, H. L., 2001. Vastus medialis obliquus and vastus lateralis activity in open and closed kinetic chain exercises in patients with patellofemoral pain syndrome: an electromyographic study. Archives of physical medicine and rehabilitation, 82(10), 1441-1445.

Yip, S. L., & Ng, G. Y., 2006. Biofeedback supplementation to physiotherapy exercise programme for rehabilitation of patellofemoral pain syndrome: a randomized controlled pilot study. Clinical rehabilitation, 20(12), 1050-1057.