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COMPARISON OF CONCENTRIC AND ECCENTRIC EXERCISES ON PAIN, STRENGTH AND ROM IN HIGH-SCHOOL FOOTBALL PLAYERS WITH PATELLOFEMORAL PAIN SYNDROME

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ABSTRACT: Patellofemoral pain syndrome is a multifactorial that can be caused by improper rear-foot eversion with pes pronatus valgus or dysfunctional dynamic knee valgus brought on by a decline in strength and power of hip abductor muscles. The objective of the study was to determine the comparative effects of concentric and eccentric exercises on pain, strength and ROM in high school football players with patellofemoral pain (PFP) syndrome. It was randomized clinical trial. 22 high school football players with PFP (positive patellar grind test) were divided into two groups. Group A received eccentric exercises and group B received concentric exercises for four days a week over a period of six weeks. Pain, range of motion and muscle strength was primary outcome measures and visual analogue scale (VAS), goniometer and manual muscle testing was used to measure changes respectively. Data was analyzed using SPSS version 25. The average age of study participants was 23 ± 2.795 years (male = 17 (77.3%), female = 5 (22.7%)). Both eccentric and concentric exercises improved pain as in concentric group, VAS pre-treatment 4.36 ± 1.566, post-treatment value 3.81 ± 1.471 (p=0.006) and in eccentric group, pre-treatment value of VAS is 4.27 ± 1.01 and post-treatment value 1.45 ± 0.522 (p=0.000). Concentric exercise didn't improve ROM (pre-treatment=104.18 ± 11.539, post-treatment= 107.72 ± 10.315 and p=0.067) and strength (p=0.157). Eccentric exercises improved both ROM (pre-treatment=107.18 ± 9.927, post-treatment value=120.90 ± 8.455 and p=0.000) and strength (p=0.008). It was concluded that both exercises improved pain in high school football players with PFP but eccentric exercises showed greater improvement in range of motion and muscle strength in this population.

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KEYWORDS: Anterior knee pain, Concentric and Eccentric exercises, Patellofemoral pain syndrome, Range of motion, Strength

INTRODUCTION

Patellofemoral pain syndrome (PFPS) relates to a variety of functional abnormalities, including dynamic knee valgus, that may be caused by a reduction in hip abductors' strength or aberrant rear-foot eversion with pes pronatus valgus. PFPS is also linked to vastus medialis/ lateralis imbalance, iliotibial tract and hamstring muscle tightness (1). Among athletes, PFPS is the most common type of etiology causing knee pain and it involves knee joint with damaged structures and sometimes without any structural damage. It is noted that in young athletes, no structural damage of the knee joint is present includingintact joint cartilage and normal Q angle(2). According to a recent study, patellofemoral pain syndrome (PFPS) is particularly common in young female athletes, such as basketball players and rhythmic gymnastics. The reasons for PFPS this ratio in this population are related to overuse injuries and muscular imbalance which can lead to pain and impairment among young athletes(3). The prevalence of PFPS in military recruits is 13.5% and in adolescent female athletes, the prevalence of this syndrome is approximately 22.7%(4). The prevalence in female adult athletes was found to be 13-26% and was higher than the males. PFPS accounts for 1.5 to 7.3 prcent of all the diagnoses of patients seeking medical care (5) and associate

A multitude of options is available for managing pain symptoms of patellofemoral pain syndrome (PFPS). In addition to conservative management, physical therapy is also used for treating PFPS(6). The treatment plan of physical therapy includes focusing on strengthening of muscles around knee joint including quadriceps and hip abductors including gluteus maximus and gluteus minimus. Aerobic exercises, muscle stretching combined with neuromuscular facilitation, weight-bearing exercises, postural retraining and patellar bracing are other options to manage patellofemoral pain syndrome (PFPS). But only single treatment option is not sufficient to treat the pain and discomfort associated with PFPS (7). Concentric and eccentric exercises are another option for managing PFPS. These exercises help in increasing the strength of muscles to manage muscular imbalances and improve overall biomechanics of the body. Concentric and eccentric contractions are two types of isotonic contractions. Concentric exercise involves increase in muscle tension to meet resistance and once muscle shortens, it is kept stable(8).

The objective of the present study was to determine the comparative effects of concentric and eccentric exercises on pain, strength and ROM in high school football players with patellofemoral pain (PFP) syndrome. Previous studies have shown that both concentric and eccentric exercises improve pain and functional limitations in patients with PFPS but there is no direct comparison of both types of exercises. The knowledge about their comparative effectiveness and optimal dosage parameters such as frequency, intensity and durations are also unclear.

MATERIALS AND METHODS

Study Design And Population: It was a randomized clinical trial (RCT). The means of Kujala patellofemoral pain rating scale of the subjects in the intervention group (pre-intervention and post-intervention values) in previous study were used to calculate sample size by using epitool software and by keeping the attrition rate 10% (9). Calculated sample size was 26.

The sampling approach employed was non-probability convenience sampling. The investigation was carried out at Multan's Barki Advance Physiotherapy Centre. Following ethics committee permission from Riphah College of Rehabilitation and Allied Health Sciences, the study was completed in six months.

Selection Criteria

The inclusion criteria of the study were both males and females. p layers aged 18 to 36 years. Patients with a positive patellar grind test, Pain at the retropatellar or peripatellar level, Retropatellar or peripatellar pain caused by squatting, stair climbing, extended sitting, or similar functional tasks that strain the PFJ in a flexed position (10). Patients who had recently undergone lower limb surgery or injuries, or who had gotten a steroid injection in the preceding six months, were not included in the study. Other exclusions included, Myositis ossificans, rheumatoid arthritis, along with other muscle disorders have been diagnosed by the recent infusion of platelet-rich plasma containing growth factors. The research not included any patients who have had physical treatment of any kind within the last six months (11). People having a history of suffering due to their jobs were also excluded.

Data Collection Tools

Patellar Grind Test: The patellar grind test is used to identify the existence of patellofemoral joint disorders, such as patellofemoral pain syndrome, chondromalacia patellae, and patellofemoral DJD. This test is also called Clarke's test. This test employs applying pressure just above the patella while the patient is set to sit in supine or long sitting with the involved knee extended. The patient is instructed to contract the quadriceps muscle gradually and gently. Pain in the patellofemoral joint shows positive test and patellofemoral dysfunction (12).

Visual Analogue Scale: It quantifies pain on a scale ranging from no pain to severe pain. VAS is typically a 100-mm-long horizontal line with word descriptions at both ends. The VAS score is calculated by measuring in millimetres from the left end of the line to the place that the patient marks (13).

MMT Grading: It is a measure of muscular

strength (14). A score of '0' indicates no activity. '1' denotes slight contractile action with no resultant movement. '2' signifies entire ROM only in the horizontal plane. '3' symbolizes the whole range of motion against the pull of gravity. '4' denotes complete ROM against the forces of gravity, and the test posture is retained with minimal difficulty. '5' denotes complete ROM against gravity, and the test position is kept at maximal resistance.

Goniometer: It is employed to gauge a joint's range of motion (15). The ranges of flexion and extension for the knee joint are 0–135º and 135-0º, respectively (16).

Cuff Sphygmomanometer: It is used to increase strength by partial vascular occlusion, with an insufflation pressure of 20 mmHg + Systolic BP at rest, and an average Systolic BP of 123.33 mmHg (17).

Data Collection Procedure

Non-probability convenience sampling was used to recruit patients who meet the inclusion criteria. Prior to data collection, participants provided written informed consent. Participants were then randomly assigned to two groups, Group A and Group B, using opaque sealed envelopes, one labeled for Group A and two labeled for Group B. The study was a single-blinded randomized clinical trial, as evidenced by the fact that the outcome assessors were blind. Over the course of six weeks of training, Group A was given eccentric exercises such as walking down stairs, lowering a weight during shoulder press, squatting, pushing up, crunching, and pulling up, all of which were performed in three sets with a repetition maximum of 10 RM. Concentric exercises were given to Group B for six weeks, four days a week, and included walking upstairs, pushing up in a bench press, the first part of a deadlift, which involves lifting the barbell off the ground, sitting up in a sit-up, pushing up from a lowered push-up, and standing up in a back squat in three sets of 10 RM. Without inflating the cuff, the first set included 30 repetitions, followed by two sets of 15 repetitions, with 20-second breaks in between. Group A performed eccentric exercises for lower limb for a period of six weeks. Group B performed concentric exercises for lower limb for a period of six weeks. Figure 1 shows CONSORT flow diagram.

STATISTIC ANALYSIS

SPSS version 25 was utilized for data entry and analysis. Statistical significance was assessed at a significance level of p=0.05. Frequency tables, pie charts, and bar charts were used to summarize group data taken across time. Following the Shapiro-Wilk test to determine if the data was normal, an inferential analysis was conducted.

RESULTS

In this study, the demographic variables used were age and gender. In the study, the male participants were 17 (77.3%) and female participants were 5 (22.7%) (Figure 2). The average age of study participants was 23 ± 2.795 years (Figure 3). According to table 1, the pre-treatment value of VAS in group receiving concentric exercises is 4.36 ± 1.566 and post-treatment value is 3.81 ± 1.471. The p-value of this outcome measure is 0.006. As the level of significance is set at 0.05, the effect of this intervention was statistically significant. The pre-treatment value of ROM is 104.18 ± 11.539, post-treatment value is 107.72 ± 10.315 and p-value is 0.067. The p-value of MMT is 0.157. The effect of intervention on ROM and MMT was not statistically significant. In other group receiving eccentric exercises, the pre-treatment value of VAS is 4.27 ± 1.01 and post-treatment value is 1.45 ± 0.522. The p-value of this outcome measure is 0.000. The pre-treatment value of ROM is 107.18 ± 9.927, post-treatment value is 120.90 ± 8.455 and p-value is 0.000. The p-value of MMT is 0.008. As the level of significance is set at 0.05, the effect of this intervention was statistically significant on all outcome measures

REFERENCING

1. Alsaleh SA, Murphy NA, Miller SC, Morrissey D, Lack SD. Local neuromuscular characteristics associated with patellofemoral pain: A systematic review and meta-analysis. Clinical biomechanics (Bristol, Avon). 2021;90:105509.

2. Vora M, Curry E, Chipman A, Matzkin E, Li X. Patellofemoral pain syndrome in female athletes: A review of diagnoses, etiology and

treatment options. Orthopedic reviews. 2017;9(4):7281.
3. Pavone V, Vescio A, Panvini FMC, Lucenti L, Caldaci A, Sapienza M, et al. Patellofemoral Pain Syndrome in Young Female Athletes: A Case-Control Study. Advances in orthopedics. 2022;2022:1907975.
4. Smith BE, Selfe J, Thacker D, Hendrick P, Bateman M, Moffatt F, et al. Incidence and prevalence of patellofemoral pain: A systematic review and meta-analysis. PloS one. 2018;13(1):e0190892.
5. Bump JM, Lewis L. Patellofemoral Syndrome. StatPearls. Treasure Island (FL) ineligible companies. Disclosure: Lindsay Lewis declares no relevant financial relationships with ineligible companies.: StatPearls Publishing Copyright © 2023, StatPearls Publishing LLC.; 2023.

6. Young JL, Snodgrass SJ, Cleland JA, Rhon DI. Timing of physical therapy for individuals with patellofemoral pain and the influence on healthcare use, costs and recurrence rates: an observational study. BMC health services research. 2021;21(1):751.

7. Saltychev M, Dutton RA, Laimi K, Beaupré GS, Virolainen P, Fredericson M. Effectiveness of conservative treatment for patellofemoral pain syndrome: A systematic review and meta-analysis. Journal of rehabilitation medicine. 2018;50(5):393-401.
8. Katsura Y, Takeda N, Hara T, Takahashi S, Nosaka K. Comparison between eccentric and concentric resistance exercise training without equipment for changes in muscle strength and functional fitness of older adults. European journal of applied physiology. 2019;119(7):1581-90.
9. Nascimento LR, Teixeira-Salmela LF, Souza RB, Resende RA. Hip and Knee Strengthening Is More Effective Than Knee Strengthening Alone for Reducing Pain and Improving Activity in Individuals With Patellofemoral Pain: A Systematic Review With Meta-analysis. The Journal of orthopaedic and sports physical therapy. 2018;48(1):19-31.
10. Willy RW, Hoglund LT, Barton CJ, Bolgla LA, Scalzitti DA, Logerstedt DS, et al. Patellofemoral Pain. The Journal of orthopaedic and sports physical therapy. 2019;49(9):Cpg1-cpg95.
11. Drew BT, Conaghan PG, Smith TO, Selfe J, Redmond AC. The effect of targeted treatment on people with patellofemoral pain: a pragmatic, randomised controlled feasibility study. BMC musculoskeletal disorders. 2017;18(1):338.
12. Deng H, Wu Y, Fan Z, Tang W, Tao J. The association between patellofemoral grind and synovitis in knee osteoarthritis: data from the osteoarthritis initiative. Frontiers in medicine. 2023;10:1231398.
13. Delgado DA, Lambert BS, Boutris N, McCulloch PC, Robbins AB, Moreno MR, et al. Validation of Digital Visual Analog Scale Pain Scoring With a Traditional Paper-based Visual Analog Scale in Adults. Journal of the American Academy of Orthopaedic Surgeons Global research & reviews. 2018;2(3):e088.
14. Bittmann FN, Dech S, Aehle M, Schaefer LV. Manual Muscle Testing-Force Profiles and Their Reproducibility. Diagnostics (Basel, Switzerland). 2020;10(12).
15. Gandbhir VN, Cunha B. Goniometer. StatPearls. Treasure Island (FL) ineligible companies. Disclosure: Bruno Cunha declares no relevant financial relationships with ineligible companies.: StatPearls Publishing Copyright © 2023, StatPearls Publishing LLC.; 2023.

16. Hancock GE, Hepworth T, Wembridge K. Accuracy and reliability of knee goniometry methods. Journal of experimental orthopaedics. 2018;5(1):46.
17. Cerqueira MS, Costa EC, Santos Oliveira R, Pereira R, Brito Vieira WH. Blood Flow Restriction Training: To Adjust or Not Adjust the Cuff Pressure Over an Intervention Period? Frontiers in physiology. 2021;12:678407.
18. Azab AR, Abdelbasset WK, Basha MA, Mahmoud WS, Elsayed AE, Saleh AK, et al. Incorporation of Pilates-based core strengthening exercises into the rehabilitation protocol for adolescents with patellofemoral pain syndrome: a randomized clinical trial. European review for medical and pharmacological sciences. 2022;26(4):1091-100.

19. Saad MC, Vasconcelos RA, Mancinelli LVO, Munno MSB, Liporaci RF, Grossi DB. Is hip strengthening the best treatment option for females with patellofemoral pain? A randomized controlled trial of three different types of exercises. Brazilian journal of physical therapy. 2018;22(5):408-16.

21. Fatimah I, Waqqar S. Effects of tibiofemoral mobilization in patients of Patellofemoral pain syndrome. JPMA The Journal of the Pakistan Medical Association. 2021;71(11):2506-10.

22. Scafoglieri A, Van den Broeck J, Willems S, Tamminga R, van der Hoeven H, Engelsma Y, et al. Effectiveness of local exercise therapy versus spinal manual therapy in patients with patellofemoral pain syndrome: medium term follow-up results of a randomized controlled trial. BMC musculoskeletal disorders. 2021;22(1):446.

20. Alonazi A, Hasan S, Anwer S, Jamal A, Parvez S, Alfaiz FAS, et al. Efficacy of Electromyographic-Biofeedback Supplementation Training with Patellar Taping on Quadriceps Strengthening in Patellofemoral Pain Syndrome among Young Adult Male Athletes. International journal of environmental research and public health. 2021;18(9).

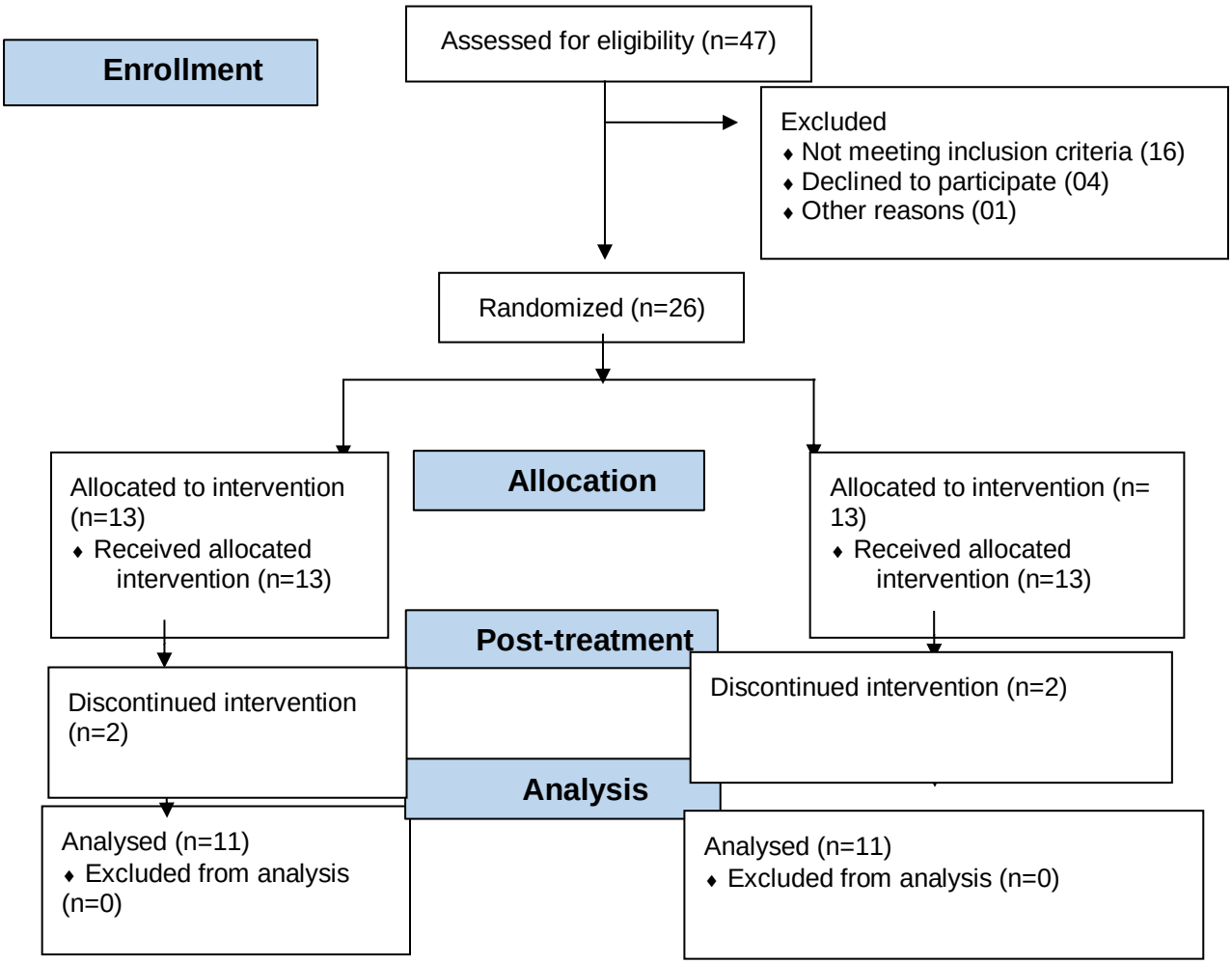

Figure 1: CONSORT Diagram

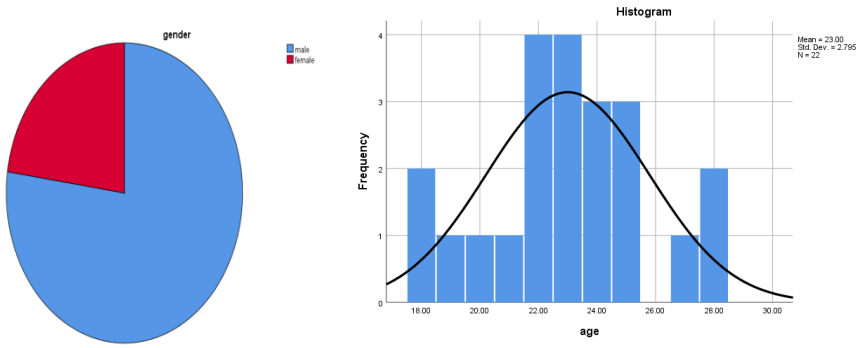

Figure 2: Gender of participants Figure 3: Age of study participants

Table 1: Within Groups Comparison of VAS, ROM and MMT

Concentric group						
	Mean		**Standard deviation**		**p-value**	
Pre-treatment VAS	4.36		1.566		0.006	
Post-treatment VAS	3.81		1.471			
Pre-treatment ROM	104.18		11.539		0.067	
Post-treatment ROM	107.72		10.315			
	Median	**Range**	**Mean Rank**	**Sum of ranks**	**p-value**	**z-value**
Pre-treatment MMT (Quadriceps)	4.00	2.00	1.50	3.00	0.157	-1.414
Post-treatment MMT (Quadriceps)	4.00	2.00				
Eccentric group						
	Mean		**Standard deviation**		**p-value**	
Pre-treatment VAS	4.27		1.01		0.000	
Post-treatment VAS	1.45		0.522			
Pre-treatment ROM	107.18		9.927		0.000	
Post-treatment ROM	120.90		8.455			
	Median	**Range**	**Mean Rank**	**Sum of ranks**	**p-value**	**z-value**
Pre-treatment MMT (Quadriceps)	4.00	2.00	4.50	36.00	0.008	-2.640
Post-treatment MMT (Quadriceps)	5.00	1.00				

Table 2: Between Group Comparison-VAS, ROM and MMT

	Mean	Std. deviation	p-value		Mean	Std. deviation	p-value
Pre-treatment VAS (conc.)	4.36	1.566	0.873	Post-treatment VAS (conc.)	3.81	1.471	0.000
Pre-treatment VAS (ecc.)	4.27	1.01		Post-treatment VAS (ecc.)	1.45	0.522	
Pre-treatment ROM (conc.)	104.18	11.539	0.521	Post-treatment ROM (conc.)	107.72	10.315	0.004
Pre-treatment ROM (ecc.)	107.18	9.927		Post-treatment ROM (ecc.)	120.90	8.455	
Pre-treatment MMT (conc.)	4.00	2.00	0.522	Post-treatment MMT (conc.)	4.00	2.00	0.007
Pre-treatment MMT (ecc.)	4.00	2.00		Post-treatment MMT (ecc.)	5.00	1.00	