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ORIGINAL ARTICLE

Effects of Knee Muscles Strengthening with and without Core Stability Exercises after Platelet-Rich Plasma Therapy in Knee Osteoarthritis - RCT

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Author`s Contribution

[1] Substantial contributions to the conception or design of the work for the acquisition, analysis or interpretation of data for the work, [1] Drafting the work or reviewing it critically for important intellectual content, [1] Final approval of the version to be published, [1] Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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A B S T R A C T

Background: For the management of early knee OA, after platelet-rich plasma therapy, proximal stability, and lower limb strengthening are essential in improving the symptoms in knee osteoarthritic patients.

Objective: To compare the effects of knee muscle strengthening exercises with and without core stability exercises after PRP therapy on pain, functional mobility, range of motion, and balance.

Methodology: From March 2023 to September 2023, this Randomized Controlled Trial was conducted at physiotherapy department of The University of Lahore Teaching Hospital. Sample size was calculated to be 72. The inclusion criteria was grade 1 or 2 knee osteoarthritis according to Kellgren Lawrence radiological criteria, age 45 to 60, and both genders. All patients received PRP therapy, without any systematic or pathological condition and were randomly assigned into two groups. Group A received knee exercises and group B received knee and core stability exercises. Both Groups were assessed at baseline and after 6th week using the Visual Analogue Scale, the WOMAC scoring, the Berg Balance Scoring and TUG scoring, and goniometry, to measure pain, functional mobility, range of motion, and balance respectively. Wilcoxon signed ranks sum test and Mann Whitney U test were used to determine mean difference of outcomes within and between groups, using SPSS software.

Results: The results showed there was a significant difference between both groups when the mean of variables was compared, including VAS, WOMAC, Berg Balance Scale, TUG test, and knee ROM, taken at baseline and 6th week and calculated as $p<0.05$, after intervention except WOMAC stiffness and WOMAC physical activity. It indicated improvement in pain, functional activity, balance, and range of motion after intervention in group B.

Conclusion: In summary, core stabilization exercises with knee exercises after platelet-rich plasma treatment are beneficial for pain reduction, functional activity level, knee mobility, and maintenance of balance.

Keywords: core stability exercises, fall risk, pain, platelet rich plasma therapy.

Introduction

Osteoarthritis (OA) is a chronic degenerative joint disease that impedes healthy aging. The knee is the most affected joint reported between the ages of 50 and 75, with a 16%-17% prevalence.[1] Osteoarthritis (OA) is reported as the 10th leading cause of disability worldwide.[2] The incidence of Knee OA occurs primarily in older people. There is a pool of growth factors in autologous platelet-rich plasma which appears to offer a simple solution for delivering the growth required for tissue repair[3] and the growth factors released from platelet α-granules may enhance the body's natural healing response.[4] and is classified as "orthobiologics."[5] The majority of the growth factors in the alpha granules found in PRP are secreted within the first 10 minutes of injection, and the majority of the remaining growth factors are produced

during the first hour.[6] Results from ongoing clinical trials suggest that PRP can improve cartilage repair and reduce arthritis symptoms.[7]

The quadriceps, and hamstrings with knee OA are much less active as compared to normal subjects with the same age. Patients with knee OA can effectively manage their pain and improve their functional abilities with exercise therapy, which includes both general and specific resistance training.[8] Primarily isometric exercises have been developed to reduce post-injection inflammation, increase proprioceptive control of the treated lower extremity, and strengthen hip and knee flexors and extensor muscles[9] that are crucial for knee osteoarthritis treatment. Hip abductors and adductors need to be strengthened because they are involved in joint loading and/or OA symptoms.[10] These exercises are designed to reduce post-platelet-rich plasma injection inflammation, improve the knee proprioceptive control of the treated lower extremity, and strengthen hip and knee flexors and extensors through physiotherapy including isometric exercises.[9] The group that received core and hip strengthening with traditional knee physical therapy had earlier reductions in pain levels compared to the group that only underwent a knee strengthening program. Therefore, the beneficial effects of hip and core strengthening in KOA patients are warranted.[11]

One of major arising healthcare issue is osteoarthritis that affects mostly knees, and mostly patients with knee osteoarthritis presented with complain of low back pain, even after platelet plasma therapy, in early stages of knee osteoarthritis. A range of therapeutic interventions after PRP has been introduced in treating knee osteoarthritis, some of which are advocated for knee and hip muscles strengthening exercises. However, no studies have been presented that described the combined effects of core stabilization with hip and knee exercises after platelet-rich plasma injection. This gap shows the need of conduction of more studies with which low back pain can also be addressed after PRP therapy and more improvement of clinical outcomes in knee osteoarthritic patients.

Methodology

It was a Randomized Controlled Trial study conducted from March 2023 to September 2023, with ethical approval reference number REC-UOL-388-05-2023, included the patients with knee osteoarthritis who received platelet-rich plasma therapy, presented in the Physical Therapy Department of the University of Lahore teaching hospital, Lahore. It was a single-blinded study in which the assessor was unaware of the treatment given to both groups. The sample size for this study was calculated as 72 found with convenient sampling technique and patients were divided into 2 groups with simple randomization by randomly giving the numbers from 1-36 and added them to group A and remaining 36 added in group B. Each group had 36 patients. The sample size was calculated using the OpenEpi tool.[12]

The inclusion criteria of the selected population included patients aged 40-60 years, with pain in one or both knees with or without low back pain after bilateral or unilateral platelet-rich plasma therapy taken within past 3 months, body mass index (BMI) ≥25 Kg/m2, and patients that had diagnosed with knee osteoarthritis (grade 1 and 2) according to Kellgren Lawrence radiological criteria. The data collection procedure included assessment for eligibility as defined in inclusion/exclusion criteria, then they were randomly assigned into two groups. The control group received knee and hip strengthening exercises with standard conventional physiotherapy treatment, after PRP therapy. The experimental group patients followed core stability exercises, and knee and hip muscle strengthening exercises with standard conventional physiotherapy treatment, after PRP therapy. Each group was given three sessions per week, for 6 weeks. The assessment was done at baseline and then done at 6th week post-treatment. The goniometry was used to assess knee ROM as it has excellent reliability and valid tool for measuring joint ROM. Pain was measured through the good reliable Visual Analogue Scale as its validity showed strong correlation with acute and chronic pain. Western Ontario and McMaster University Arthritis Index (WOMAC) was found reliable scoring to assess the functional status. Timed up and go test was found with high inter-rater reliability of 0.99 and Berg Balance Scale was used to assess the balance in knee osteoarthritis with strong correlations in predicting falls.

The intervention included standard conventional treatment given to both groups which was the application of an electrical heating pad with low-frequency TENS (transcutaneous electrical nerve stimulation) between 80 Hz and 120 Hz (according to the patient tolerance) to the affected knee for 10 minutes with passive knee range of

motion exercises, knee isometrics and strengthening exercises after PRP therapy with home plan included knee isometrics exercises with 20 reps and 10 seconds hold, 3sets a day and heating therapy for 10 minutes before exercise.

Strengthening exercises application on his abductors, adductors, extensors, and flexors (10 reps, 1 set each) with Thera band. Resistance was according to patient tolerance and increased gradually according to the Thera Band colors as given below:

Thera bands	Resistance
Yellow resistance band	1-6 pounds (lightest)
Red resistance band	2-7 pounds (light)
Green resistance band	2-10 pounds (light-medium)
Blue resistance band	3-14 pounds (medium)
Black resistance band	4-18 pounds (heavy)
Silver/gold resistance band	10-40 pounds (heaviest)

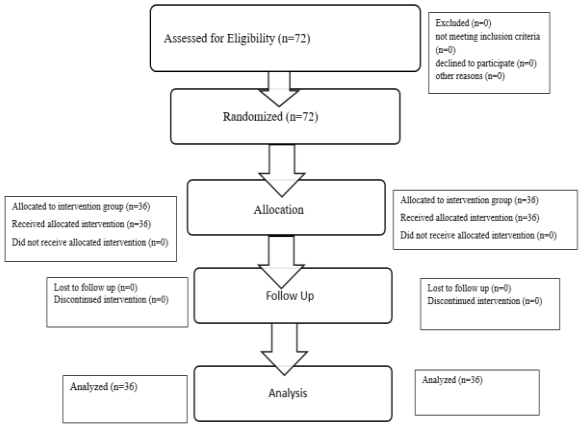

Figure 1: CONSORT Diagram

Results

The statistical analysis was done by entering the data using SPSS Version 21.

Table 1 shows a descriptive analysis of demographics of data including 72 patients including age, gender, and body mass index found through the Chi-Square test, which were normally distributed.

Table 1: Descriptive Statistics

	N	Mean ±Std. Deviation	p***- value
AGE	72	50.01±6.45	0.09
BMI	72	28.05±2.24	0.0487

The Figure 1 included histogram showed the frequency distribution of patients according to ages.

The results of tests of normality as measured by Kolmogorov-Smirnov and Shapiro-Wilk test showed by significant p-value (<0.05) that the data was not normally distributed in both groups.

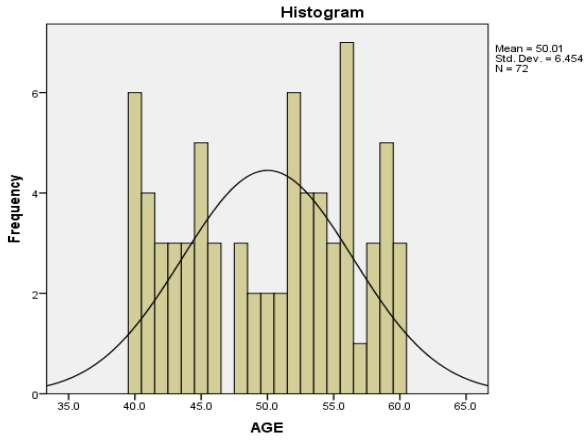

Figure 1

The figure 2 included PIE chart showed the 43.1% of males and 56.9% of females.

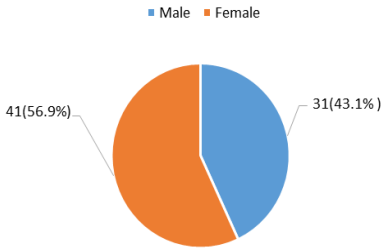

Figure 02

Table 2 summarized the mean difference in between Group A and B, of the outcome variables involved. The numeric pain rating scale, WOMAC, Balance Berg, TUG scores, knee ROM, and showed that there was a significant difference between these groups, after intervention as compared to the significant difference that was reported between means of both groups before intervention. The WOMAC stiffness and WOMAC function results indicated no significant difference between groups before or after treatment. p** values are obtained from the mean differences calculated using the Mann-Whitney U test.

Table 3 summarized the mean difference within Group A and B, of the outcome variables involved. All variables showed significant difference within each group. p values are obtained from the mean differences calculated using the Wilcoxon sign test in group A and group B respectively.

	BEFORE INTERVENTION			AFTER INTERVENTION		
VARIABLES	GROUP A (mean±std. deviation)	GROUP B (mean±std. deviation)	significant difference between groups A & B P**	PRP+KNEE EXERCISES GROUP A (mean±std. deviation)	PRP+ CORE STABILITY+ KNEE EXERCISES GROUP B (mean±std. deviation)	significant difference between groups A & B P**
VAS PAIN	8.97±.810	9.08±.806	0.284	7.22±.1.12	3.17±.811	<0.001
WOMAC PAIN	18.47±.1.10	18.61±.1.17	0.304	17.00±.1.24	9.58±.2.61	<0.001
WOMAC STIFFNESS	8.39±.1.02	8.83±.1.0	0.33	3.39±.1.07	3.39±.1.07	**0.500**
WOMAC FUNCTION	57.75±.4.487	57.17±.4.501	0.292	28.69±.5.98	28.69±.5.98	**0.500**
TOTAL WOMAC	84.61±.4.61	84.61±.4.68	1.000	49.08±.6.18	41.67±.6.64	<0.001
BERG BALANCE	19.47±.3.35	20.08±.2.86	0.204	34.50±.6.69	50.78±.3.287	<0.001
TUG SCORE	46.22±.8.72	45.61±.9.53	0.388	20.88±.7.03	10.36±.1.67	<0.001
ROM	43.55±.8.46	43.47±.7.20	0.482	110.36±10.25	127.27±.9.73	<0.001

VARIABLES	GROUP A (before treatment-after treatment) (mean±std. deviation)	p Value	GROUP B (before treatment-after treatment) (mean±std. deviation)	p Value
NPRS PAIN	1.75±1.45	<0.001	5.91±1.10	<0.001
WOMAC PAIN	1.53±1.79	<0.001	9.02±2.78	<0.001
WOMAC STIFFNESS	5.06±1.31	<0.001	5.44±1.42	<0.001
WOMAC FUNCTION	29.90±6.25	<0.001	28.47±7.25	<0.001
TOTAL WOMAC	36.5±6.04	<0.001	42.94±7.52	<0.001
BALANCE (BBS)	-14.93±7.16	<0.001	-30.69±3.58	<0.001
BALANCE (TUG)	23.69±11.04	<0.001	35.25±9.39	<0.001
ROMS	-67.59±14.57	<0.001	-83.80±12.96	<0.001

Discussion

The main finding of this study was the effectiveness of core stability exercises coupled with knee and hip muscles strengthening exercises in improving the pain, balance, physical function and knee range of motion.

A previous study was conducted in which core stability exercises were performed with hip exercises in hip osteoarthritic patients, and reported the improvement in symptoms.[13] In our study we reported improvement in pain, physical function as well as knee range of motion and balance after core stability exercises with knee exercises, in knee osteoarthritic patients.

In previous research, it was concluded that the patients with grade IV knee osteoarthritis had improvement in knee pain and gait just after core muscles training.[14] In our study we studied the effects of core muscles training with knee muscles strengthening in patients with early knee OA who had taken PRP therapy, as symptoms started improving with PRP and if we added knee exercises with core muscles training caused significant improvement in symptoms (pain, balance, physical function, balance and knee ROMS), we didn't take patients with grade 4 knee OA, as PRP therapy has very less or no effects in improving symptoms.

In a randomized controlled trial it was investigated that doing knee exercises is more effective after PRP therapy in improving the outcomes i.e. pain, muscles strength, quality of life and functional status as compare to PRP therapy alone.[15] But in our study, we investigated the effects of knee as well as core training after PRP therapy that improved the outcomes included pain, functional status as well as balance and knee ROMS, more than the patients who received only knee exercises after PRP therapy.

In this study, we focused on strengthening the core muscles by strengthening the lower back and abdominal muscles in knee osteoarthritic patients, because it had a significant impact on knee mechanics and can limit the increased stress on the knee, thereby alleviating knee osteoarthritis symptoms as mentioned in a systematic review that different biomechanical and clinical causes were revealed for the concurrent existence of KOA and LBP and

further high quality methodologies were being required for assessing the effects of knee exercises, on pain and functionality, with lumbar muscles training in knee OA patients.[16]

Additionally, in a study after core training, no negative effects, other than improved pain and functionality, were reported in the intervention group.[17] Also in our study no adverse effect/s were reported due to knee and core strengthening exercises. Moreover, there was significant improvement in gait due to improved balance in both groups but there was more improvement in group B.

A systematic review and meta-analysis of 31 studies had been conducted in which it was stated that in advanced knee osteoarthritis, PRP therapy is effective in improving pain but functionality showed improvement in early stages after PRP therapy,[16] Also some studies reported significant improvement of symptoms in early stages of KOA, after PRP therapy.,[18]In this study, included patients were with early stages of knee OA administered with PRP injection in knee which showed improvement in clinical outcomes.

In a past study, patients with knee OA were also tested for ankle stiffness because they had decreased ankle dorsiflexion and increased ankle plantar flexion. The exercise increased ankle range and reduced stiffness.[19] In our study we didn't evaluate the effects of exercises on ankle stiffness and ankle range of motion however we evaluated the walking speed by timed and up go test which can be due to increase in reduction in ankle stiffness.

There was a statistically and clinically significant difference in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores compared to placebo at baseline then at 12th month and hyaluronic acid (HA) at 6th month, so PRP found to be provide better outcomes as compared to other injectables.[20] So, we included knee osteoarthritic patients who received PRP therapy which showed significant improvement in all outcomes taken.

Due to less finance, this study was carried out to a single region, for further studies multiregional investigation can be carried out. In this study only 6 weeks exercise program was carried out. Therefore, we did not include the long-term effects of the exercise program The Results will be clearer if exercise treatment period will be extended and longer follow-ups.

It is recommended that a control group can be involved in further studies and pre and post radiographic evaluation can also be involved. The Pilates can also be involved in intervention program. Ankle stiffness evaluation can also be added with its exercises to reduce the ankle plantarflexion and increase ankle dorsiflexion.

Conclusion

The findings of this study showed conventional physical therapy with and without core stability exercises after platelet-rich plasma therapy in osteoarthritic patients was effective for reducing pain and increasing balance, functional activity level, and knee range of motion. However, conventional physical therapy with core stability exercises after platelet-rich plasma therapy showed greater improvements in outcomes. This can be due to improved postural alignment and neuromuscular control following core stability exercises with knee exercises, which improved the outcomes after PRP therapy.

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