



FEASIBILITY OF AN EXERCISE PROTOCOL ON STABLE AND UNSTABLE SURFACES ON LOWER EXTREMITY FUNCTION, PAIN AND BALANCE IN POSTMENOPAUSAL WOMEN WITH OA KNEE. - A PILOT STUDY

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Abstract

Introduction: Osteoarthritis is a degenerative condition characterised by the gradual deterioration of articular cartilage in weight-bearing joints, such as the hip and knee. In India, the prevalence of knee joint involvement is exceptionally high with 62.35 million individuals in 2019.

Methodology: The study was conducted with patients at the Physiotherapy Outpatient Department (OPD) of the Co-Operative Institute of Health Sciences, Thalassery, Kannur district, Kerala, India. Twelve patients who met the specified inclusion and exclusion criteria were enrolled in the trial. The participants were assigned to three groups in a random manner for a duration of six weeks to partake in an exercise protocol.

Objectives: The primary goal is to assess the feasibility of the exercise protocol and the secondary objective is to determine its effectiveness in enhancing lower extremity function, balance, and pain.

Results: According to the results, the feasibility of the exercise program, was generally well and highly efficacious in the management of knee osteoarthritis in postmenopausal women.

Conclusion: This, provides evidence to support the feasibility and acceptability of the exercise protocol for postmenopausal women with degenerative osteoarthritis knee joints.

Keywords: Osteoarthritis, Postmenopausal women, Exercise, 6-week protocol, Efficacy and OA Knee

1. Introduction

Osteoarthritis (OA) is a degenerative condition characterized by the gradual deterioration of articular cartilage in weight-bearing joints, such as the hip and knee ¹ The prevalence of OA in India has notably risen from around 23.46 million individuals in 1919 to 62.35 million individuals in 2019 ². OA is a significant contributor to disability and ranks as the fourth most prevalent cause of years lived with disability ³. Osteoarthritis is a prevalent condition globally, ranking as the 10th most common non-fatal disease. Musculoskeletal disorders are attributed to approximately 22-39% of cases. The prevalence of OA exhibits a clear positive correlation with advancing age, as this condition is

characterised by an irreversible progression. According to research findings, there is a higher prevalence of OA among males compared to females before the age of 45. However, after reaching the age of 45, the occurrence of OA becomes more prevalent among women ⁴. Menopause is characterised as the cessation of a woman's reproductive capacity after the decline of ovarian follicular activity. The transition process transpires throughout the latter stages of a woman's forties or early fifties and is characterised by a gradual and extended timeframe, spanning approximately 5 to 8 years ⁵.

Due to low oestrogen levels, women were more likely to develop osteoporosis, osteoarthritis, and fragility fractures. The incidence of knee joint OA rises during perimenopause and menopause ⁶. OA affects multiple components of joints, extending beyond the cartilage. Numerous alterations occur within the subchondral bone during the progression of a disease. Oestrogen plays a crucial role in the regulation of both cartilage matrix formation and matrix enzyme activity. Oestrogen receptors are present within articular cartilage. Additionally, it exerts regulatory control over cartilage metabolism via the modulation of cytokines and second messengers. Furthermore, OA can be stabilised by reducing subchondral bone remodelling ^{7,8}.

Muscle coordination and balance are critical for elderly, especially those with reduced bone mineral density. According to statistics, 10% of the 200 million women worldwide with osteoporosis are under 60, while 20% are over 70. Additionally, 40% of these women are 80, and 67% are 90 ⁹. OA patients have weaker bones, making them more likely to experience fractures, according to several studies. Joint inflammation can cause pain and restrict movement by interfering with afferent impulses that control joint positioning. This causes changes in the dynamic stability of the muscles around the joint, causing functional instability that hinders ADL ^{10, 11}. The present study aims to check the feasibility 6-week exercise protocol that is performed on stable and unstable (mini trampoline) platforms on lower extremity function, balance and pain in postmenopausal women with chronic osteoarthritic knee joints.

2. Objectives

1. The primary objective is to find the feasibility of the exercise protocol.
2. The secondary objective is to gain some insight into the relative efficacy of exercise protocol in improving lower extremity function, balance and pain.

3. Materials and Methods

3.1 Study design

The study employed a mixed methods approach and was conducted with patients at the Physiotherapy Outpatient Department (OPD) of the Co-Operative Institute of Health Sciences in Thalassery, Kannur district, Kerala, India. The study used a pre-post quantitative design to assess the effectiveness of the intervention, and a randomized controlled pilot trial to evaluate the efficacy of the exercise protocol. The trial included three groups: a control group, a group that followed the exercise protocol on stable surfaces with conventional exercises, and a group that followed the exercise protocol on unstable surfaces (specifically, mini trampolines) in addition to conventional exercises. The evaluation compared the results before and after the intervention, following a six-week period.

3.2. Participants

The trial enrolled a total of 12 patients who met the specified inclusion and exclusion criteria. The participants were randomly assigned to three groups and participated in a six-week fitness program. The assessment of feasibility and safety includes evaluating adherence rate, dropout rate, and the occurrence of adverse events.

3.2.1 Inclusion Criteria

Postmenopausal women aged 50 to 65 (with no menstrual cycle for 12 months) who consent to participate in the study and have radiographic evidence of grade II-III Kellegren-Lawrence criteria for diagnosed OA and clinical evidence of unilateral tibiofemoral primary OA.

3.2.2 Exclusion Criteria

2° OA, ligament tears, medically unstable conditions, locomotor or neurological disorders, CVS disorders, open wound/skin diseases, bone tumors, systemic inflammatory conditions, lower extremity deformities, metabolic diseases, hyperthyroidism, kidney/liver diseases, subjects with balance issues, subjects with a history of lower extremity surgery, subjects with a BMI over 30, subjects with surgically induced menopause.

3.3 Method

Group A served as the control with Conventional exercise protocol, Group B performed Conventional exercise protocol and exercise protocol on stable surfaces, and Group C engaged Conventional exercise protocol and exercise protocol on an unstable surface (a mini trampoline). The participants' measurements were taken at the start of the study and 6 weeks after intervention reassessed using questionnaires and an exercise logbook which included a description and illustration of the exercises and the progression of each protocol. The effectiveness of exercise intervention was evaluated using the KOOS, TUGT, and MMT assessments.

Group A received conventional exercises, such as quadriceps and hamstring isometrics, SLR exercises with increasing weights, retro walking, and interferential therapy, for approximately 40 minutes. The participants in the control group will be instructed to sit for a longer duration with a towel placed beneath their knee or tibia. They will perform 10 repetitions of contractions for 5 minutes each, totalling 15 contractions. The exercise grade and delivery will be based on the subject tolerance and weighted for 5 minutes. Walking comfortably under supervision for 10 minutes. Quadripolar interferential therapy using a beat frequency of 10-100 Hz for 10 minutes. The exercise program consists of five days per week for six weeks.

Group B performed the following exercises for 40 minutes. Along with lateral step-up exercises, forward step-up exercises, and mini-squat Conventional exercise protocol exercises, there were also lateral step-up exercises, forward step-up exercises, and mini-squat exercises. Each exercise was performed for 10 reps on each leg). On a stable platform, participants engaged in 20 minutes of Conventional exercise Protocol followed by 20 minutes of experimental intervention. The exercise program consists of five days per week for six weeks.

Group C engaged in activities on a mini trampoline for a total of 40 minutes. The session began with 20 minutes of Conventional exercise Protocol, followed by 20 minutes of interventional exercises conducted by a physiotherapist on a small trampoline with a safety belt. There is a 1-minute break between each trampoline workout. The exercises were provided for 5 days per week over a period of six weeks.

4. Results and Discussion

4.1 Feasibility of the exercise protocol

The exercise program's feasibility was determined by recording adherence in an activity logbook. There was high adherence, three drop-outs, no significant adverse events, and reduced overall pain. Almost one out of every five sessions resulted in significant pain events, which usually resolved shortly. Following the 6-week intervention period, the intervention groups showed significant gains in function, strength, and mobility. In our study, 83% said their exercise sessions were "appropriate," while 16% said they were "too long." In terms of the difficulty of executing the exercises, 66% said they were "appropriate." 16% indicated that "some exercises are difficult to perform" and 16% reported that "all exercises are difficult to perform." The amount of supervision was rated "just right"

by 100% of patients. Concerning the negative effects of the workout session, 16% reported them to be present."83% said that the benefits of exercise sessions on muscle strength were "not there." 66% reported a gain in lower extremity strength, 60% reported an increase in balance, and 66% reported an increase in flexibility. The final item on the questionnaire concerned the improvement seen in daily activities 58% reported an increase in sit-to-stand behaviours 66% indicated an improvement in stair climbing, 61% reported an improvement in squatting action, 83% reported an improvement in walking, and 63% reported decreased pain while standing for an extended period. According to the results of the feedback form, the exercise protocol program was generally well received.

4.2 Efficacy of exercise protocol in improving lower extremity function, balance and pain

A comparative analysis was conducted to evaluate the effectiveness of exercise among three distinct groups (A, B, C). The results from the pretest indicated that the three assessment measures, namely KOOS, TUGT, and MMT, yielded statistically insignificant outcomes for groups A, B, and C, respectively. However, a noteworthy outcome was observed in all three tests conducted on the post-test groups. The statistical significance levels for KOOS group A, group B, and group C were found to be $p = .007$, $p = .031$, and $p = .015$, respectively. Similarly, in the MMT test, both Group A ($p = .015$) and Group C ($p = .015$) exhibited statistically significant findings. In the TUGT test, all three groups demonstrated significant results in the post-test. Specifically, Group A exhibited a significant result with a p-value of .035, Group B with a p-value of .006, and Group C with a p-value of .058. The findings clearly indicate that exercise is highly efficacious in the management of knee osteoarthritis in postmenopausal women (Table 1, Table 2 and Table 3).

Table 1 Pre-test to post-test comparison of KOOS in respective groups A, B and C

Group	Pre-test		Post-test		t	df	Sig.
	Mean	Std. Deviation	Mean	Std. Deviation			
Group A	57.2500	3.59398	63.0000	4.16333	6.734	3	.007
Group B	59.0000	2.94392	63.2500	2.98608	3.833	3	.031
Group C	61.5000	4.35890	70.5000	1.91485	5.058	3	.015

Table 2 Pre-test to post-test comparison of MMT in respective groups A, B and C

Group	Pre-test		Post-test		t	df	Sig.
	Mean	Std. Deviation	Mean	Std. Deviation			
Group A	3.2500	.50000	4.5000	.57735	5.000	3	.015
Group B	3.5000	.57735	4.2500	.96335	3.000	3	0.057
Group C	3.2500	.50000	4.5000	.57735	5.000	3	.015

Table 3 Pre-test to post-test comparison of TUGT in respective groups A, B and C

Group	Pre-test		Post-test		t	df	Sig.
	Mean	Std. Deviation	Mean	Std. Deviation			
Group A	15.0000	.81650	13.2500	.95743	3.656	3	.035
Group B	15.2500	.95743	13.5000	1.00000	7.000	3	.006
Group C	13.7500	.95743	13.0000	.81650	3.000	3	.058

4.3 Discussion

Knee pain decreases movement, causes weight gain, and strains the joints. This study did not cover patients with BMIs beyond 30, therefore joint effects of obesity are unknown. Knee osteoarthritis treatment includes medication, physical therapy, and surgery. However, medicine has side effects, and surgery is only for advanced knee osteoarthritis. Exercise is a key technique to increase and maintain bone mass at any stage of life because bone responds to variations in habitual mechanical loading. In this study Bone loading exercises are compared on stable and unstable surfaces and relative changes in muscle strength. The proprioceptive deficit may result from joint discomfort,

inflammation, or stress in senior OA patients. This causes abnormal tissue pressure, impaired joint position perception, and injury risk. So proprioceptive exercises should be part of the therapy plan since they activate and regulate muscle activity, which helps elderly people manage joint motions¹². OA knee diminishes joint proprioception and weakens the quadriceps in elderly people. Disease-related deficits may explain these people's weaker balances. Previous research suggests that quadriceps weakness is the main risk factor for knee pain, disability, balance, and joint deterioration in osteoarthritis patients. By synchronizing muscular units, proprioceptive workouts stabilize dynamically. Proprioceptive exercises are routinely advised to all OA knee patients¹³. In the present study MMT, TUGT, and KOOS tests showed significant results indicating that the quadriceps and hamstring muscle strength, balance, and lower limb functions after bone loading activities are stable even in unstable surfaces. Raizah et al. also found lower proprioceptive acuity in knee osteoarthritis patients¹⁴. Strengthening these sensorimotor weaknesses may decrease knee osteoarthritis progression and minimize disability. Research shows that quadriceps strengthening workouts reduce knee osteoarthritis discomfort¹⁵. Our investigation confirms a significant impact on lower extremity function, balance, and pain in postmenopausal women with degenerative OA.

5. Conclusion

The study demonstrates that the exercise protocol is feasible and well-received among postmenopausal women with degenerative osteoarthritis in the knee joints. The study shows improvements in pain, balance, and lower extremity function for all three groups, with greater gains seen in participants who used the trampoline for exercise. Weight-bearing exercises are a low-cost and safe non-pharmaceutical treatment strategy for protecting musculoskeletal health and preventing fractures in elderly postmenopausal women.

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