

Effect of Proprioceptive Neuromuscular Facilitation and Proprioceptive Exercises Along with Core Stability on Pain and Physical Function in Knee Osteoarthritis

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ABSTRACT

Background: Osteoarthritis (OA) is the most common joint disorder, predominantly affecting diarthrodial joints, with knee osteoarthritis (KOA) being the most studied and impactful. Aging, obesity, mechanical stress, and muscle weakness are key contributing factors. Traditional management strategies for KOA include pharmacological treatments, lifestyle modifications, and physiotherapy interventions. PNF stretching techniques, such as Contract-Relax and Hold-Relax, work by enhancing flexibility, muscle strength, and joint stability through a combination of passive and isometric contractions. Unlike conventional stretching, PNF stretching activates both the agonist and antagonist muscles, promoting better motor control and joint function. Incorporating PNF stretching into physiotherapy protocols has shown promising results in improving the range of motion (ROM), reducing pain, and enhancing functional mobility in KOA patients.

Methodology: Based on inclusion and exclusion criteria, 50 participants in total were chosen. They were split into two groups: group A, which included

proprioceptive neuromuscular stretching exercises and group B, which included exercises for proprioceptive neuromuscular stretching exercises with core stability. For a total of four weeks, Group A and B participants engaged in exercises for the four weeks. The timed up and go test, 30 sec chair stand test, WOMAC scale were used to evaluate both groups before and after the intervention.

Result: Proprioceptive Neuromuscular Facilitation (PNF) stretching significantly improved knee osteoarthritis (KOA) patients' functional performance, mobility, and pain levels, according to the study. With improvements in the 30-second chair stand test (8.08 ± 0.75 to 12.8 ± 1.25), TUG test (18.24 ± 1.26 to 13.32 ± 1.21), and WOMAC score (52.36 ± 5.28 to 48 ± 5.89), Group A (PNF) demonstrated improved strength, balance, and decreased pain. WOMAC: 52.16 ± 3.59 to 42.04 ± 3.68 , TUG: 17.56 ± 1.73 to 13.04 ± 1.20 , and chair stand: 11.16 ± 1.46 to 17.08 ± 1.60 showed even bigger gains than Group B (PNF + core stability). According to the findings, PNF with core stability improves everyday function, decreases joint strain, and increases postural stability more efficiently than PNF.

Conclusion: According to the results, PNF stretching helps KOA patients move more freely, experience less pain, and perform better. PNF stretching and core stability exercises work best together because they improve biomechanics, strengthen the core muscles, and lessen knee joint strain. Better postural stability, easier daily tasks, and an improved quality of life are the results of these advancements.

Keywords: Knee Osteoarthritis, Proprioceptive Neuromuscular Facilitation, PNF Stretching, Core Stability, Rehabilitation, Range of Motion, Postural Stability.

INTRODUCTION

The most prevalent joint condition, osteoarthritis (OA), mostly affects the diarthrodial joints and is linked to a growing socioeconomic burden as a result of population aging. Increasing age and obesity are the two main risk factors for primary OA, however there are other factors as well.¹ Osteoarthritis (OA) is a chronic disease affecting the joint and its tissues, primarily leading to progressive damage to articular cartilage and, subsequently, to the subchondral bone and surrounding synovial structures. The epidemiology and pathogenesis of knee OA have been studied more extensively than other joints, and increasing interest has been devoted to the study of those molecular mechanisms, which led to cartilage damage due to their pivotal role in the pathogenesis of OA.²

In order to maximize motor performance and facilitate rehabilitation, proprioceptive neuromuscular facilitation (PNF) stretching techniques are frequently employed in clinical and sporting settings to improve both active and passive range of motion³.

Crepitation, joint stiffness, particularly after prolonged periods of rest or waking, pain during movement that subsides with rest, and synovitis with or without joint fluid effusion are all signs of osteoarthritis in the knee⁴. In order to maximize motor performance and facilitate rehabilitation,

proprioceptive neuromuscular facilitation (PNF) stretching techniques are frequently employed in clinical and sporting settings to improve both active and passive range of motion⁵.

Techniques-- Contract Relax: The restricted muscle is passively stretched into a stretched posture, and then it is isometrically contracted. In PNF stretching techniques, the majority of isometric contractions should be held for at least three seconds⁶.

Hold Relax: This method is really comparable to Contract Relax. When the agonist is too weak to activate effectively, this is used. The patient is made to stretch their restricted muscle, and then they are made to contract isometrically

Hold-Relax Agonist: Most familiar. It can be used to lengthen out tight muscle and increase passive range of motion. In this technique, the tight muscle is the antagonist, hence the agonist contracts⁷

The cornerstone of the treatment is physiotherapy. It includes stretching and strengthening exercises, thermotherapy, and electrotherapy (ultrasound, muscle stimulation). Additionally, braces and other supportive devices are used⁸.

Weakness in the core muscles puts more strain on the knee joint and its contact when walking. Activating the functional kinetic chain that links the stability of the lower extremities is a component of strengthening core muscles⁹.

MATERIALS & METHODS

Based on inclusion and exclusion criteria, 50 participants in total were chosen. They were divided into two groups: group A, which included proprioceptive neuromuscular stretching exercises and group B, which included exercises for proprioceptive neuromuscular stretching exercises with core stability. For a total of four weeks, Group A and B participants engaged in exercises for the four weeks. The timed up and go test, 30 sec chair stand test, WOMAC scale were used to evaluate both groups before and after the intervention.

The patients are included with the 45-65 years of age, Both male and female, Diagnosed case of Knee OA and Non operative OA patients. And the patients are excluded with the post-operative OA, History of fracture, History of dislocation, History of trauma and not willing to participate Protocol is prepared and ethical will be obtained from the IEC. The participants will be selected based on the eligibility criteria. Informed consent will be obtained from the participants and demographic data will be recorded. Participants will be randomly allocated to 2 group that is experimental group A(n=) and control group B(n=) prior assessment of the participant will be done Group A will be administered with proprioceptive neuromuscular facilitation stretching to Quadriceps, hamstrings and conventional physiotherapy treatment. Group B will be administered with proprioceptive exercises with core stability. All the instruction will be given verbally, provided demonstration and guided through a single practice trial.

STATISTICAL ANALYSIS

Results were analyzed on basis of data obtained pre and post intervention using Graph Pad Instat application. Descriptive statistics for all outcome measures were expressed as mean, standard deviations and test of significance such as paired t test.

RESULT

The study was conducted in the patients with osteoarthritis age. There was total 50 participants. In each group the 25 participants were there.

Post mean of Group A for the 30 sec chair stand test is 12.8 and for Group B is 17.08. It was done with the paired t test value is 4.216. It has a significant difference and the P value is 0.001. Post mean of Group A for the timed up and go test is 13.32 and for Group B is 13.04. It was done with the paired t test value is 0.964. It has not significant difference and the P value is 0.116. Post mean of Group A for the WOMAC scale is 48 and for Group B is 42.04. It was done with the paired t test value is 3.014. It has a significant difference and the P value is 0.001.

Table 1: Comparison of outcome measures between group A and B.

OUTCOME MEASURES	GROUP A POST MEAN ± SD	GROUP B POST MEAN± SD	STUDENT'S PAIRED T TEST	P VALUE q SIGNIFICANT
30 sec chair stand test	12.8 ± 1.25	17.08 ± 1.60	4.216	P= 0.001 Significant
timed up and go test	13.32 ± 1.21	13.04 ± 1.20	0.964	P= 0.116 Not significant
WOMAC scale	48 ± 5.89	42.04 ± 3.680	3.014	P= 0.001 Significant

Proprioceptive Neuromuscular Facilitation (PNF) stretching significantly improved knee osteoarthritis (KOA) patients' functional performance, mobility, and pain levels, according to the study. With improvements in the 30-second chair stand test (8.08 ± 0.75 to 12.8 ± 1.25), TUG test (18.24 ± 1.26 to 13.32 ± 1.21), and WOMAC score (52.36 ± 5.28 to 48 ± 5.89), Group A (PNF) demonstrated improved strength, balance, and decreased pain. WOMAC: 52.16 ± 3.59 to 42.04 ± 3.68 , TUG: 17.56 ± 1.73 to 13.04 ± 1.20 , and

chair stand: 11.16 ± 1.46 to 17.08 ± 1.60 showed even bigger gains than Group B (PNF + core stability). According to the findings, PNF with core stability improves everyday function, decreases joint strain, and increases postural stability more efficiently than PNF.

DISCUSSION

The objective of the study was to find the effect of proprioceptive neuromuscular facilitation and proprioceptive exercises

along with core stability on pain and physical function in knee osteoarthritis.

This study included outcome measures such as the 30 sec chair stand, timed up and go test, WOMAC scale which were assessed and analyzed in both groups prior and post intervention.

In group A (n=25), the treatment was proprioceptive neuromuscular stretching exercises. After giving the treatment there was a significant difference compared to the pre intervention analysis of 30 sec chair stand, timed up and go test, WOMAC scale. Prior to the intervention, the mean of Group A for the 30 sec chair stand are the (8.08 ± 0.75) and after the 4 weeks of intervention post mean was (12.8 ± 1.25). The 30 sec chair stand significantly improve after the intervention. The findings of the study demonstrate a significant improvement in 30 sec chair stand. This improvement in 30 sec chair stand suggests that improving the lower body strength and flexibility. Damian C Stanziano et.al (2019)¹⁰ their study concluded that increases the functional performance. PNF stretching stimulates the synthesis of actin-myosin cross-bridges in muscle fibers by combining isometric and isotonic contraction. Enoka Roger M et.al (2023)¹¹ their study concluded that it improves the capacity to frequently get out of a chair by increasing force output in the quadriceps, hamstrings, and glutes, three important lower limb muscles.

Prior to the intervention, the mean of timed up and go test are the (18.24 ± 1.26), while after the intervention the mean was (13.32 ± 1.21). The findings of the study demonstrate an extremely significant improvement in the people performed the proprioceptive neuromuscular facilitation exercise. Ha-Rin Ryu et.al (2024)¹² their study concluded that enhancing balance, muscle strength, and flexibility, which collectively optimize mobility. By decreasing passive resistance to stretch, PNF increases muscle and connective tissue compliance. José Afonso et.al (2022)¹³ their study concluded that it can have a better stride length, less stiffness, and quicker movement transitions are all

results of increased hip, knee, and ankle range of motion.

Prior to the intervention, the mean of WOMAC scale outcome score was (52.36 ± 5.28), while after the intervention the mean was (48 ± 5.89). The findings of the study demonstrate a significant improvement in WOMAC scale. PNF stretching helps alleviate pain associated with knee osteoarthritis. Kamyia J Somaiya et.al (2024)¹⁴ their study concluded that PNF stretching improves proprioceptive by triggering the gate control mechanism, PNF stretching activates mechanoreceptors, which aid in blocking pain signals. Stretching reduces nociceptive input from arthritic joints and acts as a natural pain reliever by inducing the release of endorphins. PNF stretching improves joint mobility by making connective tissues (collagen and titin fibers) more elastic. Cruz-Diaz et.al (2023)¹⁵ their study concluded that patients with knee OA benefit from improved functional movement and fewer movement limitations as a result.

In group B (n=25), the treatment was proprioceptive neuromuscular stretching exercises with core stability. After giving the treatment there was a significant difference compared to the pre intervention analysis of 30 sec chair stand, timed up and go test, WOMAC scale.

Prior to the intervention, the mean of 30 sec chair stand was (11.16 ± 1.46) while after the 4 weeks of intervention the mean was (17.08 ± 1.60). The 30 sec chair stand significantly improve after the intervention. The findings of the study demonstrate an extremely significant improvement in 30 sec chair stand test. Keon-Ju Park et.al (2024)¹⁶ their study concluded that this improvement in core stability improved the balance and muscle strength contribute to better performance in the 30-second chair stand test deep abdominal and spinal muscles are worked during core stability workouts, which increases the activation of stabilizing muscle groups. Performance is improved by this enhanced activation, which supports the lower extremities during the chair stand

movement. By activating sensory receptors in muscles and joints, PNF stretching improves proprioceptive feedback. This increased proprioception improves balance and spatial awareness when paired with core stability exercises, which helps test takers perform better.

Prior to the intervention, the mean of timed up and go test score was (17.56 ± 1.73), while after the 4 weeks of intervention the mean was (13.04 ± 1.20). The findings of the study demonstrate an extremely significant improvement in osteoarthritis patients. PNF stretching and core stability work together to improve flexibility and core strength, which leads to more coordinated and effective motions. Daniel W Flowers et.al (2022)¹⁷ their study concluded that posture and alignment are improved by strengthening the core muscles with stability exercises. Better performance results from this biomechanics adjustment, which lowers joint tension and compensatory movements during the TUG test.

Prior to the intervention, the mean of WOMAC scale was (52.16 ± 3.59), while after the intervention the mean was (42.04 ± 3.680). The findings of the study demonstrate an extremely significant improvement in WOMAC scale in osteoarthritis patients. By strengthening the hip and core muscles, core stability exercises lessen the strain on the knee joint and more efficiently relieve pain, as seen by higher WOMAC pain scores. Qipeng Song et.al (2020)¹⁸ their study concluded that PNF stretching and core stability improve proprioception, alignment, and joint mobility, which leads to less stiffness and improved physical function. Posture and alignment are improved by strengthening the core muscles with stability exercises. By reducing compensatory movements and joint stress during regular activities, this biomechanics optimization improves performance and lowers WOMAC pain and stiffness ratings. The endurance capacity of the lower limb and core muscles is

increased when PNF stretching and core stability exercise are combined.

CONCLUSION

According to the results, PNF stretching helps KOA patients move more freely, experience less pain, and perform better. PNF stretching and core stability exercises work best together because they improve biomechanics, strengthen the core muscles, and lessen knee joint strain. Better postural stability, easier daily tasks, and an improved quality of life are the results of these advancements.

Declaration by Authors

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