

A Comparative Study of Perturbation and Proprioceptive Circuit Exercises in Knee Osteoarthritis Patients

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Abstract: Introduction: Knee osteoarthritis commonly seen in India. The conventional physiotherapy treatment (electrical modalities and general strengthening exercises) for osteoarthritis and there have been various studies conducted in perturbation exercise and proprioceptive circuit exercise to improve the quality of life in knee osteoarthritis patient, but there appears to be no study to analyze the comparative effectiveness of these exercises. Hence, this study came into existence. Aim: To analyze the comparative effect of proprioceptive circuit exercise and perturbation exercise for improving the functional ability in knee osteoarthritis patients. Method: The demographic detail of the patients was taken and they were randomly divided into two groups i.e A and B. Hot pack, strengthening exercises of hip and knee followed by proprioceptive and perturbation exercises was given with respect to the group. Result: On the comparison between the mean value of group A and group B 52.96 and 48.42 respectively. The t-value was 3.8325 and $p < 0.0001$. There was a significant difference in proprioceptive and perturbation exercises. Conclusion: The study concludes that there is a significant improvement in giving proprioceptive exercise and perturbation exercise. But the proprioceptive exercises found to be more beneficial than perturbation exercise to improve functional ability in knee osteoarthritis patients.

Keywords: Knee Osteoarthritis, Perturbation exercises, Proprioceptive exercises, WOMAC

1. Introduction

Osteoarthritis (OA) is the most common form of degenerative arthritis and is a widespread, slowly developing disease that increases in prevalence with increasing age.^[1,2]

Arthritis of the knee joint is commonly seen type of arthritis in the lower limb which involves the degeneration of the articular cartilage, narrowing of the joint space between the articulating bones, the formation of the osteophytes and bony spurs. This result in pain around the knee decreased the range of motion, affects the activity of the daily living and the performance at the workplace.

The knee joint looks like a very simple joint, but actually, it is among one of the most complex joints of the human body. The complexity of the knee joint is about its anatomy, forces around the joint during various activities performed, type of mechanism of movement causing injuries and the factors controlling the joint during its movement.

Other than the soft tissue injuries around the knee, osteoarthritis of the knee is one of the most commonly observed condition. For prevention of injuries secondary to osteoarthritis and for relieving the stresses from the knee, strengthening exercises for hip-knee various types of mobilization to the knee which mostly performed in day to day clinical practice.

The knee joint is the most commonly affected large weight-bearing joint, where the disease can be particularly disabling because of the consequent difficulties in rising from a chair,

climbing stairs, kneeling, standing, and walking. The presence of pain, combined with muscle weakness, increased body sway, and impaired balance, put affected individuals at risk of falls and decreased activity.^[3]

The proprioceptive and perturbation exercises contribute to prevent of fall, improve balance, controls the symptom of pain and stability in knee osteoarthritis patients. Prevalence of OA in India is reported to be in the range of 17-60.6%.^[4] Impairments of balance, joint proprioception, and kinesthesia are also related to knee OA and may persist even after knee replacement surgery.^[5,6] These impairments may result in falls and increased cost of management.^[7]

A proprioceptive exercise is based on the notion that when a patient performs balance-keeping exercises on unstable surfaces, proprioception responses occur first among those generated by the somatic senses. These responses allow compensatory adjustments in the lengths of various muscles, their tension levels, and the position of the joints to facilitate joint movements.^[8] Proprioceptive training improves knee functions in osteoarthritis patients, and quadriceps muscle strengthening is known to mitigate the symptoms of knee osteoarthritis and improve knee function.^[9]

There have been various studies conducted on perturbation and proprioceptive circuit exercise on knee osteoarthritis. The purpose of this study is to analyze the comparative effectiveness of these exercises to improve the quality of life in knee osteoarthritis patients.

2. Methodology

Study Design: Comparative study

Study population: 48 Knee osteoarthritis patient

Method of randomization: Systematic random sampling

Study Centre: YCRH Hospital, Physiotherapy Department, Latur

Material used: Hydrocollator pack unit

Treatment couch

Weight cuff

WOMAC index

TheraBand Stability Trainer

Participation Criteria

Inclusion criteria

Age above 40 years, both genders, all patients medically diagnosed knee osteoarthritis or fulfilling the criteria of Kellgren and Lawrence 1 and 2; **Grade 1:** Doubtful narrowing of joint space and possible osteophytic lipping; **Grade 2:** Definite osteophytes and possible narrowing of joint space; **Grade 3:** Moderate multiple osteophytes, definite narrowing of joint space, and some sclerosis and possible deformity of bone ends; **Grade 4:** Large osteophytes, marked narrowing of joint space, severe sclerosis and definite bony deformity of bone ends.^[10]

Exclusion criteria

Obese; patient with valgus and varus deformity; the post-operative case of lower limb; balance impaired individual; the disorder of the central nervous system.

Outcome measure: The Western Ontario and McMaster Universities arthritis index (WOMAC), a self-administered health status instrument, is valid, reliable, and responsive to change in patients with osteoarthritis of the knee. It has satisfactory test-retest reliability for function and acceptable overall inter-rater reliability.^[11-13]

The WOMAC has three clinical subscales (pain, stiffness, and physical function), and its lower score shows with less pain, stiffness, and better function. Pre and post score of WOMAC score of both the groups was used for Data analysis.

3. Study Procedure

Approval from the Institutional Ethical Committee of the MIP college of physiotherapy was obtained. Patients were explained about the procedure, benefits, right to withdraw and consent for the study was taken by maintaining confidentiality in their detail and their language of understanding was preferred. The patients who meet with the inclusion criteria were included in the study. The demographic detail of the patients was taken and then they were divided into two groups, group A and group B by systematic random sampling. The intervention was done thrice a week (alternate day) for three consecutive weeks and the patients was asked to perform strengthening exercises at home everyday. Data were collected on the Excel sheet and the master chart was formulated. Then Data was analyzed statistically. Before starting with the

Interventional exercises, hot pack and strengthening exercises of the hip and knee was given to both the groups.

Method for data collection

Total 79 participants, out of which only 48 completed the study (14 were dropouts, 13 met with exclusion criteria and 4 not willing to participate in the study). Baseline assessment was done according to assessment proforma which includes demographic data and WOMAC.

Intervention

Group A

24 patients, moist pack, proprioceptive circuit exercises, and general hip-knee strengthening exercises. The exercise program consisted of repetition of walking in place and four different types of proprioceptive circuit exercise, including half squat, straight lunge, side lunge, and one-legged balance exercise, on a TheraBand Stability Trainer.^[14]

Group B

24 patients, moist pack, perturbation exercises, and general hip-knee strengthening exercises. Patients removed their shoes and stood without any equipment. They received unpredictable perturbation exercises in medial, lateral, anterior, and posterior directions. The patients placed their arms out in front, parallel to the ground over the therapist's shoulders, without touching the therapist; this would enable them to support themselves when they lost balance.^[15]

The therapist was positioned to stabilize the subject when the subject began to lose balance. If the initial movement was tolerated, the patient progressed to a single-limb stance. The stance was progressed from double-limb to single-limb stance. Assessment of symptoms was ongoing to minimize flare-ups during the perturbation training. Careful questioning at each session helped to determine if the previous session was well tolerated or if latent pain occurred despite the careful assessment during treatment.^[15]

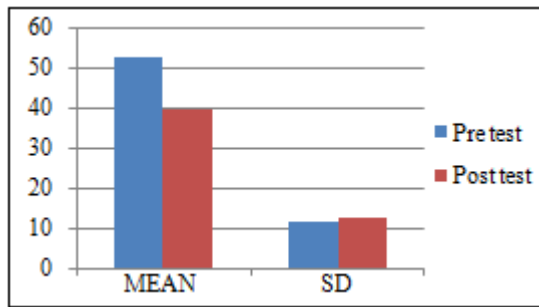
4. Results and Statistical Analysis

The study was to analyze the comparative effect of proprioceptive circuit exercise and perturbation exercise for improving the functional ability in knee osteoarthritis patients. 48 patients diagnosed with osteoarthritis were included in the study. SPSS version 25.0 (Statistical Package for the Social Sciences) free trial version was used to statistically analyze the data obtained from the study.

The collected data were statistically analyzed by using paired 't' test in pre and post values within the group A and B. Post and post values were compared between group A and group B by using unpaired 't' test. The probability error was checked at ($p < 0.001$) for all tests.

Table 1: Group A

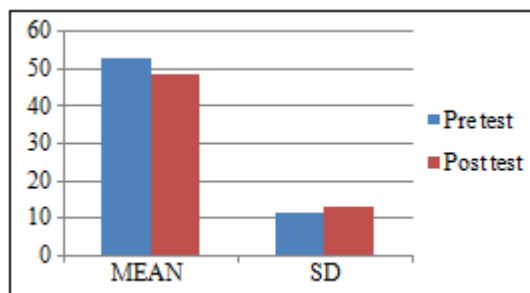
| | MEAN | SD | t-test | p-value |
|-----------|-------|-------|--------|---------|
| Pre test | 52.96 | 11.4 | 7.2598 | <0.0001 |
| Post test | 39.58 | 12.75 | | |



Graph 1

Table 2: Group B

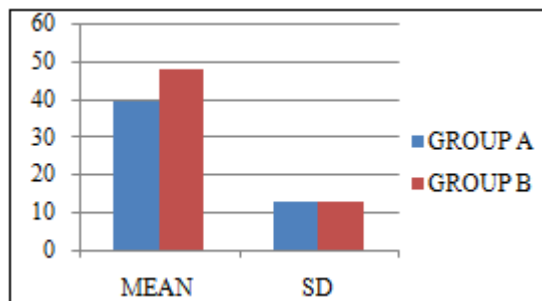
| | Mean | SD | t-test | p-value |
|-----------|-------|-------|--------|---------|
| Pre test | 52.96 | 11.42 | 9.3623 | <0.0001 |
| Post test | 48.42 | 12.71 | | |



Graph 2

Table 3: Comparison of Group A And B

| | Mean | SD | t-value | p-value |
|---------|-------|-------|---------|---------|
| Group A | 39.58 | 12.75 | 2.4055 | 0.0202 |
| Group B | 48.42 | 12.71 | | |



Graph 3

The table-1 result shows that there was a significant difference between pre and post-treatment score in group A. The mean value of pre and post treatment was 52.96 and 39.58 respectively. The t-value was 7.2598 and $p < 0.0001$ these values suggest that there is a significant difference in giving a proprioceptive exercise in improving functional ability in knee osteoarthritis patients.

The table-2 result shows that there was a significant difference between pre and post-treatment score in group B. The mean value of pre and post treatment was 52.96 and 48.42 respectively. The t-value was 9.3623 and $p < 0.0001$ these values suggest that there is a significant difference in giving perturbation exercise in improving functional ability in knee osteoarthritis patients.

The table-3 result shows that there was a significant difference between post and post score of group A and group

B. The t-value was 2.4055 and p-value 0.0202. These values suggest that there is a significant difference in giving proprioceptive exercise and perturbation exercise to improve functional ability in knee osteoarthritis patients.

5. Discussion

This research study proved the effectiveness of giving proprioceptive exercise and perturbation exercise in improving functional ability in knee osteoarthritis patients. Patients with degenerative knee osteoarthritis show reduced quadriceps strength and a decline in proprioception and balance.^[16,17] Reduced proprioception in patients with osteoarthritis weakens their thigh muscle strength and could limit their walking ability and dynamic balance.^[18] A combined application of proprioceptive circuit muscle-strengthening exercise and proprioceptive exercise is more effective than a single muscle strengthening training program in terms of improving joint stability.^[18]

Also, joint pain may have harmful effects on muscle function (muscle strength and activation) and senses (proprioception and balance).^[19] Diminished knee joint proprioception is highly correlated with the level of pain^[20], and the interaction between proprioception and muscle strength is closely related to functional body movements.^[21] Also, exercise on an unstable surface might be helpful for improving the muscle strength and alignment of lower extremities as well as for improving physical function related to the knee joint.^[22]

The risk of falls in patients with knee OA^[7,23-25] has been attributed, in part, to decreased balance, agility, muscle function, proprioception, and the ability to respond to perturbations.^[5,18,26-30] Therefore, it may be important to design interventions to address these impairments, with careful attention to the type and dose of exercise to address balance and proprioception.^[26,31,32] Therefore proprioceptive and perturbation exercises along with the moist hot pack and strengthening exercises were chosen for the study.

In the present study group A received the proprioceptive exercises and demonstrated a significant difference between the pre and post-treatment WOMAC score. The mean value of pre and post treatment was 52.96 and 39.58 respectively. The t-value was 7.2598 and $p < 0.0001$ these values suggest that there is a significant difference in giving a proprioceptive exercise in improving functional ability in knee osteoarthritis patients.

In this study group B received the perturbation exercises presented with the significant difference between pre and post-treatment WOMAC score. The mean value of pre and post treatment was 52.96 and 48.42 respectively. The t-value was 9.3623 and $p < 0.0001$ these values suggest that there is a significant difference in giving perturbation exercise in improving functional ability in knee osteoarthritis patients.

The result of group B of this study goes with the study performed by Daniel Rhon, et al.¹⁵ in 2013 who demonstrated with significant improvement in WOMAC score with p-value 0.001. This study also concluded that proprioceptive exercises presented with more beneficial

effects than perturbation exercise on improving functional ability in osteoarthritis patients.

As this study proved the effectiveness of perturbation and proprioceptive exercises separately on a short term basis, the combination therapy along with other manual therapy can be used for short term and long term effects to manage the knee osteoarthritis symptoms to delay or prevent the need for surgical intervention.

So it is suggested that apart from our day to day physiotherapeutic treatment approach proprioceptive and perturbation exercises can also be added in knee osteoarthritis patients. Moreover, it is difficult to generalize the populations because the population in itself is a heterogeneous group and most of the available kinds of the literature of studies on comparison types or similar treatment method always faces the problem in maintaining the homogeneity of the population for the research. Therefore a higher or lower range can be obtained in their respective studies.

6. Conclusion

This study confirmed that there was a significant improvement after giving proprioceptive exercise and perturbation exercise in improving functional ability in knee osteoarthritis patient. This study also concluded that proprioceptive exercises presented with more beneficial effects than perturbation exercise on improving functional ability in osteoarthritis patients.

7. Future Scope

Future studies can be performed for longer duration and on larger sample size with multiple outcome measures.

8. Conflict of Interest

There was no conflict of interest.

9. Source of Funding

Nil

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