

Effects of Proprioceptive Training on Muscle Strength, Functional Ability and Joint Position Sense in Patients with Knee Osteoarthritis: A Randomized Clinical Trial

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Abstract

Aim: The aim of the study was to evaluate the effectiveness of proprioceptive training on muscle strength, functional Ability and joint position sense in patients with Knee Osteoarthritis. **Methods:** 30 subjects with Knee Osteoarthritis were included and divided into two groups A and B. After pre-test measurements of muscle strength, functional ability and joint position sense group A was given Conservative physiotherapy only and group B was given Proprioceptive Training and Conservative physiotherapy for four days a week for six weeks. Post-test measurements were done after 3 and 6 week. Peak torque, WOMAC, Joint reposition error was used as pre and post outcome measures. **Analysis:** Pre assessment scores and after 3 and 6 weeks post treatment assessment scores were analyzed using unpaired t-test and repeated ANOVA at 95% confidence interval in SPSS version 16 for Windows. **Results:** The analysis revealed that Proprioceptive training with Conservative physiotherapy produced significant improvement. The mean improvement in Experimental group in terms of muscle strength was 67.48 degree, functional ability was 47.21 degree and joint position sense was 43.20 degree after 3 and 6 weeks intervention. **Conclusion:** This intervention is a promising adjunct to the management of the Knee Osteoarthritis. The proprioceptive training offers an effective intervention for knee strength, joint position sense and functional ability of the patients.

Keywords: Knee Osteoarthritis; Proprioceptive Training; Strengthening Exercise; Stretching.

Introduction

Osteoarthritis (OA) is a prevalent, ubiquitous, disabling condition that most often affect the knee joint. The cardinal feature of knee OA includes the pain but the patients also report muscle weakness, instability, fatigue and early morning stiffness [1]. The prevalence of OA increase with age, thus the physiological functions associated with the aging process decreases [2]. The pathophysiological changes in OA involves dehydration & degeneration

of both intraarticular and periarticular structures such as articular cartilages subchondral bone, synovial membrane, capsules and ligaments which in turn leads to distraction of mechanoreceptors that manifest as impaired static and dynamic proprioception and kinesthetic sense [3].

The ensuing arthrogenic inhibition also affects the surrounding muscles especially the quadriceps which undergo structural and functional changes leading to altered activation and recruitment patterns. Quadriceps being the primary active stabilizer of the knee [4]. Its changes in OA thus compromises proprioception. The impaired proprioception, decrease muscle strength, restricted joint mobility and pain leads to the accelerate progression of OA that in turn leads to poor functional independence [5].

The number of arthritic persons and the ensuing social impact are projected to increase by 40% in the next 25 years a more global perspective in knee and hip OA prevalence has also been reported by the World Health Organization. In NHANES III, the overall prevalence of knee OA worldwide increased to 37.4% in subjects 60 years of age and older.

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Radiographic evidence of OA increased with age, from 27% in subjects younger than age 70, to 44% in subjects age 80 or older [6]. There was a slightly higher prevalence of radiographic changes of OA in women than in men. The prevalence of osteoarthritis (OA) of the knee in adults, the leading cause of disability is arthritis [7].

In physiotherapy treatment for OA included the use of individual or combined treatments comprising of electrotherapy, exercise therapy and manual therapy. Therapeutic exercise strategies for OA knee were aimed at flexibility, strength, endurance and balance. These interventions were shown to improve proprioception but they were likely to be non-specific to the proprioceptive impairments so the use of specific strategies like proprioceptive training may be necessary to individualize the therapeutic program in knee OA patients.

Methods

Participants

The sample consisted of 30 volunteers, both male and female, with no history of musculoskeletal disease. Their ages ranged from 50 to 70 years. Each volunteer was randomly assigned to group A (Experimental group) and group B (Control group).

Independent variables were Proprioceptive training, Strengthening exercise and Moist heat pack and dependent variable were Muscle strength, Functional ability and Joint position sense Outcome measures were Peak torque, WOMAC and Joint reposition error

Study Protocol

30 subjects of Knee osteoarthritis were selected according to inclusion criteria and allocated with 15 subjects each into group A and B. All the patients received a written explanation of the trial before entry into the study and then gave signed consent to participate. Subject in both the groups were pre-tested by Peak Torque, WOMAC and Joint reposition error. Group A was given only Conservative physiotherapy (Strengthening exercise). It was given for 4 times per week for 6 weeks (total 30 sessions). Group B was given Proprioceptive Training and Conservative physiotherapy. It was given for 4 times per week for 6 weeks (total 24 sessions). For both groups Post-test measurements were done after 3 and 6 weeks.

Proprioceptive Training

1st and 2nd weeks: First phase (Static)

1. Standing upright position (30s) on a firm surface, then on a soft surface (a mat).
2. Single leg stance with closed eyes (first the affected limb, then the non- affected limb) for 10 s on a firm surface, then on a soft surface (a mat).
3. Half-step position for 10 s.
4. One-leg balance for 10 s.

3rd and 4th weeks: Second stage (Dynamic), in addition

1. Forward stepping lunge
2. T-band kicks exercise

5th and 6th weeks: Third phase (Functional), in addition

1. Walking exercise on a firm surface, then on a foam surface
 - (a) Toe skipping with toes straight ahead for 20m, toes pointing outward for 20m and toes pointing inward for 20 m.
 - (b) Heel skipping with toes straight ahead for 20 m, toes pointing outward for 20m and toes pointing inward for 20 m.
2. Squatting exercise:
 - (a) Against a wall and away from the wall.
 - (b) One leg squats on the affected and non-affected limb.

Conservative Physiotherapy

Moist Hot Pack

A Moist hot pack will be given after positioning the subjects in each group in long sitting position around the knee joint for 15 minutes for a period of four consecutive days.

Strengthening Training

1st Week

5 min fixed bike exercise without resistance

Range of motion and active stretching exercise applied to hamstring and quadriceps muscles

Quadriceps isometric strengthening exercise

Hamstring muscle isometric exercise.

2nd Week (in addition)

Short arc terminal extension exercise for the knee joint

Isometric exercise for the adductor and abductor muscle of hip joint.

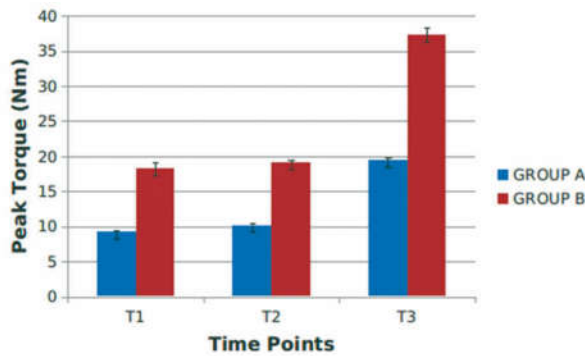
3rd Week (in addition)

Short arc terminal extension exercise with resistance for the knee joint

Isometric strengthening exercise with resistance for the hamstring muscles

Results

The analysis revealed that there was statistically significant difference between pre and post scores in both groups. Group B was showing more improvement than group A at p value < 0.05.



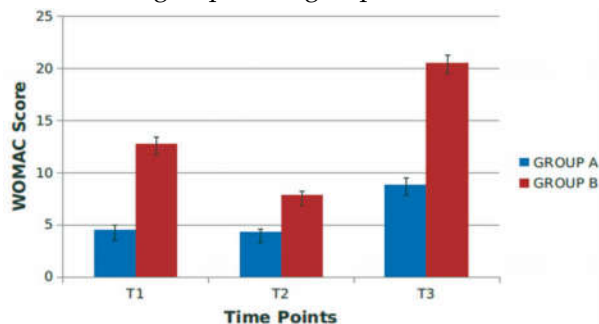
Comparisons of mean difference of peak torque between Group A and Group B

T1 Baseline- 3 Weeks

T2 3- 6Weeks

T3 Baseline- 6 Weeks

The graph above shows values of Peak Torque of among baseline, after 3 weeks and after 6 weeks within and between group A and group B. The mean and standard deviation of group A for was 18.2±0.937 at baseline, at 3 weeks was 19.13±0.363 and at 6 weeks was 37.33±1.013. The mean and standard deviation of group B was 9.2 ±0.175 at baseline, at 3 weeks was 10.2±0.279 and at 6 weeks was 19.4±0.363. Statistical significant difference was found in Peak Torque among baseline, after 3 weeks and after 6 weeks within and between group A and group B.



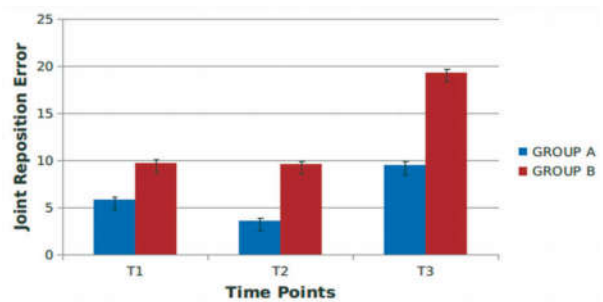
Comparisons of mean difference of WOMAC between Group A and Group B

T1 Baseline-3 Weeks

T2 3- 6 Weeks

T3 Baseline- 6 Weeks

The graph above shows values of WOMAC of among baseline, after 3 weeks and after 6 weeks within and between group A and group B. The mean and standard deviation of group A was 12.73±0.651 at baseline, at 3 weeks was 7.8±0.439 and at 6 weeks was 20.53±0.723. The mean and standard deviation of group B was 4.53±0.496 at baseline, at 3 weeks was 4.33±0.252 and at 6 weeks was 8.86±0.639. Statistical significant difference was found in WOMAC among baseline, after 3 weeks and after 6 weeks within and between group A and group B.



Comparisons of mean difference of joint reposition error between Group A and Group B

T1 Baseline- 3Weeks

T2 3- 6 Weeks

T3 Baseline- 6 Weeks

The graph above shows values of Absolute Angular Error % of among baseline, after 3 weeks and after 6 weeks within and between group A and group B. The mean and standard deviation of group A was 5.85±0.326 at baseline, at 3 weeks was 3.61±0.243 and at 6 weeks was 9.47±0.452. The mean and standard deviation of group B was for was 9.73±0.345 at baseline, at 3 weeks was 9.61±0.33 and at 6 weeks was 19.35±0.391. Statistical significant difference was found among baseline, after 3 weeks and after 6 weeks within and between group A and group B.

Discussion

The aim of the study was to compare the effect of proprioceptive training on muscle strength, function ability and joint position sense in knee OA patients. Statistical analysis reveals that Proprioceptive training with Conservative physiotherapy produced significant improvement as evaluated by Peak torque,

WOMAC, Joint reposition error after 6 weeks intervention. The results obtained from this study show the efficacy of proprioceptive training in Knee Osteoarthritis. The two groups had equal number of subjects and there were no significant difference with respect to their age, gender which could have altered the results of the study.

The results are supported by study done by Lin et al⁸ who conducted a randomized clinical trial to compare the effectiveness of proprioceptive training versus strength training and proprioceptive training led to greater improvements in knee reposition sense.

Panics G et al [9] showed the effect of proprioception training on knee joint position sense and stated its significant effect in improving the joint position sense. Liu-Ambrose et al [10] conduct a randomized clinical trial to see the effect of proprioceptive or strength training on the neuromuscular function.

Esch et al [11] conducted a study in which proprioception was related to functional ability in two ways. First poor proprioception has a weak direct relationship with limitations in functional ability. Poor proprioception is directly related to limitation in functional ability. Second, poor proprioception aggravates the impact of muscle weakness on limitation of functional ability. Results show that poor proprioception has a weak direct relationship with limitations in functional ability.

In the present study the joint position sense, muscle strength and functional ability are measured in Knee OA patients. Results show that in the absence of adequate motor control through a lack of accurate proprioceptive input, muscle weakness affects a patient's functional ability to a greater degree. Study done by Pai et al [12] stated that joint position sense is worse in subjects with Knee OA. These may further lead to functional impairments. Decline in proprioception with age and of further impairment among patients with Knee OA were found.

In this study the Experimental group show improvement in proprioception as measured by Absolute Angular Error % (the changes in the absolute error were 16.97 ± 3.3 experimental Group versus 26.75 ± 2.81 control group). The effect size for all outcome measure are large in between group ($d=.8$). The analysis reveals that proprioceptive training with Conservative physiotherapy produced significant improvement in experimental group. The mean improvement in Experimental group in terms of muscle strength was 67.48 degree, functional ability was 47.21 degree and joint position sense was 43.20 degree after 3 and 6 weeks intervention.

Conclusion

The results of the study lead us to conclude that Proprioceptive Training with Conservative Physiotherapy proving to be efficient in the treatment of Knee Osteoarthritis than other group which receive only Conservative Physiotherapy. Both the treatment is beneficial for the patients of Knee Osteoarthritis but significant improvement in functional ability, muscle strength and joint position sense was seen in the patients who received Proprioceptive Training with Conservative Physiotherapy. Present study provides scientific evidence for use of Proprioceptive Training in Knee Osteoarthritis so that the treating clinician can choose effective treatment option for Knee Osteoarthritis patients.

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