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COMPARATIVE EFFECT OF THE FUNCTIONAL FARADISM OVER STRENGTHENING EXERCISES IN REDUCING PAIN, JOINT STIFFNESS, FUNCTIONAL LIMITATION AND IMPROVING ISOMETRIC QUADRICEPS MUSCLE STRENGTH AND QUALITY OF LIFE IN PATIENTS WITH KNEE OSTEOARTHRITIS

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Abstract

Objective: This study was conducted to determine the comparative effect of the functional faradism over strengthening exercises in reducing pain, joint stiffness, functional limitation and improving isometric quadriceps muscle strength and quality of life in patients with knee osteoarthritis.

Method: 32 patients with Osteoarthritis of Knee (18 women and 14 men) were randomly divided into group A and group B (16 patients in each group). Group A received the functional faradism for 5 days a week for 4 weeks, whereas the group B received strengthening exercises. Maximum isometric quadriceps muscles strength was assessed with the hand held dynamometer. Pain and the functional status of the patients were measured through WOMAC index.

Results: Data analysis reported pain, joint stiffness, functional limitation reduced and maximum isometric quadriceps strength improved significantly at the end of 4th week compared with the post-treatment values in both the groups. On between group comparisons pain, joint stiffness, functional limitation and maximum isometric quadriceps muscles strength in functional faradism group were significantly improved ($p<0.05$) than group B received strengthening exercises at the end of 4th week.

Conclusion: functional faradism has been shown significant effect in reducing pain, joint stiffness, functional limitation and improving isometric quadriceps muscle strength among the patients with knee osteoarthritis.

Keywords: Functional Faradism, Hand-Held Dynamometer, WOMAC Index, Quadriceps Isometric Exercise, Osteoarthritis of Knee

Introduction

Osteoarthritis (OA) is more common musculoskeletal disorder among elderly population. Elderly female are more frequently than elderly male1,2. The incidence of OA is predicted to high dramatically in future due to biomechanical changes and high rate of physiological changes i.e. obesity of world population3. On anatomical location, the knee joint is more prone to this disorder as compared than others in human body over the age of 60 years2. Osteoarthritis of knee causes inflammation of synovium, erosion of articular cartilage weakening of subchondral bone, degeneration of menisci4. These intra and extra articular changes lead to decrease in the range of motion and increase in joint stiffness and pain5. In conjunction to progression of osteoarthritis, OA has negative impact on musculoskeletal system. OA also has negative impact on over well- being and quality of life in elderly population. Muscle strength weakness is a major problem among OA of knee. Especially knee extensors are more affected in terms of weakness6.

Previous data evident that the weakness of muscle strength is associated with muscle mass7. Therefore, evaluating or determining the above parameters permit allow for better understanding on how these intra and extra articular changes in joint surface affect functionality in OA patients. Patients with knee OA have remarkable limitation in terms of function and well being8. Patients also have complained of decreasing proprioception of knee joint. These changes are associated with quadriceps muscle weakness9. Several studies revealed that joint stabilization is also weakness associated with knee extensors weakness 10. Moreover studies conducted on animal model presented that weakness of muscle cause risk of high rate of degeneration of knee joint11. This helps in providing evidence that weakness of knee extensors might be risk factor for the early and progressive degeneration at the joint in knee osteoarthritis12.

Clinical evidence focuses the appropriate role of quadriceps muscle strengthening in prevention and rehabilitation of knee OA13. However, pain and restricted range of motion make it often different to the conventional strengthening program. Conventional strengthening program includes strengthening exercises for quadriceps muscles. Progressive resistive exercises and drill exercises also have positive impact on quadriceps muscle strength for better quality of life and wellbeing. Neuromuscular stimulation may be an alternative approach for muscle strengthening training program. Faradic current may be the better mode of electrical stimulation to build up muscle mass and strength. Voluntary muscular contraction followed by faradic current at the same time may results functional faradism. Functional faradism is an integral part of neuromuscular stimulation which can be useful in improving muscle mass, muscle strength and function in knee OA. To strengthen the muscle and increase muscle fiber size, each muscle contraction followed by faradic stimulation simultaneously may be better and useful rehabilitative approach in knee OA. Although previous studies found increase in muscle mass, muscle strength and function after

implementation of faradic current stimulation14. But no study has been done on the effect of functional faradism on pain, disability, muscle strength and quality of life in patients with knee osteoarthritis. Purpose of this study was to compare the effect of functional faradism versus strengthening exercises in improving pain, disability, muscle strength and quality of life in patients with knee OA.

Hypothesis

Experimental Hypothesis (H1) - There will be significant effect of Functional faradism over conventional strengthening exercises in reducing pain, joint stiffness, functional limitation and isometric quadriceps muscle strength and quality of life in patients with knee osteoarthritis.

Null Hypothesis (H_0) - There will be no significant effect of Functional faradism over conventional strengthening exercises in reducing pain, joint stiffness, functional limitation and isometric quadriceps muscle strength and quality of life in patients with knee osteoarthritis.

Methodology

It is an experimental design study. This study was approved by research committee of Subharti College of Physiotherapy, Swami Vivekanand Subharti University Meerut. 48 patients with osteoarthritis of knee recruited from physiotherapy OPD and referred patients from medicine and orthopedics OPD in CHHS hospital, Swami Vivekanand Subharti University. Only 32 patients were selected on the basis of inclusion and exclusion criteria. Male and female having mean age of 57 year, clinically diagnosed with knee OA, no hip and knee surgery, no musculoskeletal and joint injuries besides knee OA and no cardiopulmonary complications. All patients had have investigation reports and documents to support the clinical diagnosis of knee OA. The consent form was taken from all selected patients at the time of assessment and recruitment.

Testing Procedure

Hand-Held Dynamometry

Maximal isometric knee extensor strength was obtained via hand held dynamometer. Participants were positioned on the quadriceps table according to the testing's recommendations. Patients were seated with 90^0-90^0 flexion at hip and knee joint[15]. After a warm-up and a familiarization session, each patient performed three maximal isometric knee extensor contractions with the knee fixed at a flexion angle of 90°. Each contraction lasted for 5 seconds and a 30 seconds interval was observed between consecutive contractions. Peak strength values from each isometric contraction were obtained. The highest value from the three maximal isometric contractions was used for data analysis.

WOMAC Index

The Western Ontario and McMaster Universities Arthritis Index (WOMAC), including all three subscales (measured by a Likert version and the possible range of scores is 0 = none to 4 = extreme) [16] were used to determine the degree of functionality of the knee OA patients before (pre) and after (post) functional faradism and strengthening exercises program.

Protocol

Functional Faradism

A stimulator, designed for this study, was used for the strengthening the knee extensors. The intervention was performed with subjects seated on a regular chair (hip and knee angles maintained at approximately 90°). Adequate positioning of the standard carbon rubber stimulation electrodes (5cm × 7.5cm) was over the femoral nerve and transversely over the quadriceps muscle motor point. Motor points were identified as the area that produced greatest visible muscle contraction when electrical stimulation intensity will be applied. The electrodes will securely fastened using Velcro straps and for the control of the electrical stimulation intensity, which was set at the maximum that could be comfortably tolerated by the patients. Subjects were instructed to do voluntary isometric contractions of the knee extensors followed by electrical stimulation. Functional faradism parameters included rectangular biphasic symmetric current, pulse duration of 400 μs and stimulation frequency of 80 Hz. The session was given for 30 min and was comprised of 10 s of stimulation followed by 20 s of rest for 5 days/week for a period of 4 weeks (20 days).

Strengthening Exercises

Isometric quadriceps exercise: Patients were in supine position with legs straight with the towel roll placed under the knee, patients were asked to press the knee on the roll. This exercise aimed to strengthen quadriceps muscle**.** The patient was instructed to maximally activate their thigh muscles in order to straighten their knee. This exercise was of 3 sets of 10 repetitions each.

Terminal knee extension exercise: The knee extension exercise was performed with the patient in a sitting position with the knee flexed from 30 to 0 degrees. The patients were instructed to maximally activate their thigh muscles in order to straighten their knee. This exercise was of 3 sets of 10 repetitions each. Both modes of conventional strengthening exercises were given for 5 days/week for a period of 4 weeks (20 days).

Data Analysis

All analysis was obtained using SPSS version 20.0. Demo graphic data of the patients including age, height, body mass and BMI was summarized. The dependent variables for the statistical analysis were hand-held dynamometry and WOMAC Index. A base line data was taken at the beginning of the study (pre-test values) on 1st day and after the completion of the treatment sessions (post-test values) on 20th day to analyze the difference between the groups. Paired and un-paired t-test was used to evaluate the score difference between the groups. A level of 0.005 was used to determine the statistical significance.

Result

Table-1 Characteristics of patients with knee osteoarthritis in both groups

Groups	Age (year)	Height(cm)	Body Mass (kg)	Body Mass Index (kg/m^2)
Group A	58	157	70	28.4
Group B	54	159	73	28.9

Table-2 Pre and post score of WOMAC index of group A (Functional faradism group)

Variable	Pre-score (1st Day)		Post-score (20th Day)		t-value	P-value
WOMAC Domain	Mean	S.D	Mean	S.D		
Joint Pain	12.3	4.3	5.1	3.4	4.698	0.000
Joint Stiffness	5.4	1.9	3.1	1.6	3.703	0.000
Functional Limitation	41.7	5.4	26.3	11.7	4.780	0.000

Graph-1 showing Pre and post score of WOMAC index of group A

Table-3 Pre and Post WOMAC score of group B (Strengthening exercises group)

Variable	Pre-score (1st Day)		Post-score (20th Day)		t-value	P-value
WOMAC Domain	Mean	S.D	Mean	S.D		
Joint Pain	11.3	3.1	8.3	3.9	2.408	0.022
Joint Stiffness	5.4	1.8	3.9	1.6	2.491	0.018
Functional Limitation	39.7	6.9	30.6	13.1	2.458	0.019

Graph-2 showing pre and post score of WOMAC index of group B

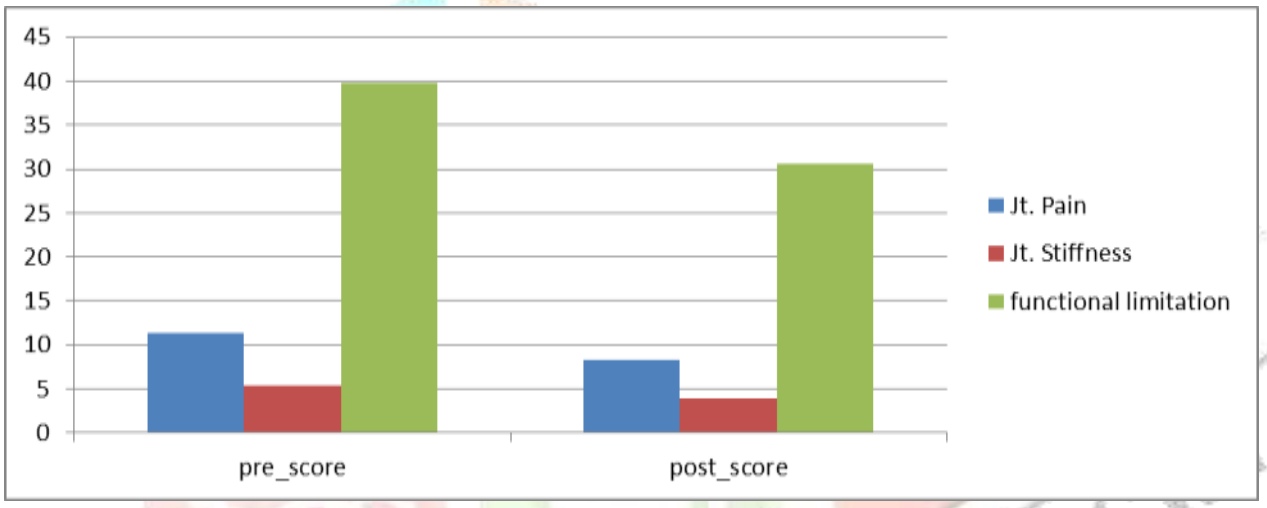
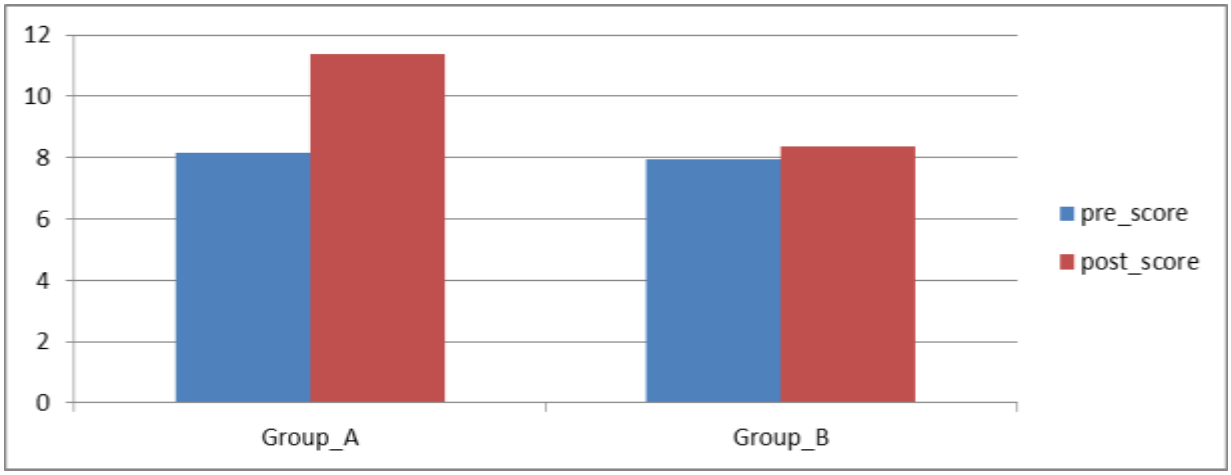


Table-4 Comparison of Pre and post isometric quadriceps muscle strength score of group A and group B

Groups	Pre-score (1st Day)		Post-score (20th Day)		t-value	P-value
	Mean	S.D	Mean	S.D		
Group A	8.16	1.73	11.36	1.62	5.400	0.000
Group B	7.94	1.62	8.37	1.71	2.020	0.052

Graph-3 showing comparison of Pre and post isometric quadriceps muscle strength score of group A and group B



Discussion

The study was designed to determine the effect of functional faradism over strengthening exercises on pain, joint stiffness, functional limitation and quadriceps muscle strength in patients with knee OA. The purpose of study was to compare the effectiveness between functional faradism and strengthening exercises in order to increase strength of quadriceps muscle and thereby reducing pain, joint stiffness and functional limitation. As progression in terms of pre to post data collection, we found the significant results which support the experimental hypothesis H1.The results of the study demonstrated that functional faradism and strengthening exercises shown impact in terms of increasing muscle strength of quadriceps muscle and reducing pain, joint stiffness and functional stiffness individually in their group.

Table-1 represents the base line data of characteristics of individuals were recruited in this study on the basis of selection criteria. Table 2 and table 3 reports the pre and post data of WOMAC domain in both groups. The result shows improvements in terms of reduce pain, joint stiffness functional limitation in both groups but on comparison, group A received functional faradism shows the significant improvements than group B received strengthening exercise in reducing pain, joint stiffness and functional limitation. Table 4 shows pre to post data of quadriceps muscle strength in order to increasing muscle strength in both groups. Functional faradism shows significant improvement in increasing muscle strength. These effects were shown during the 5 weeks of treatment period.

Regarding in support the result of the study, previous literatures stated that electrical neuromuscular stimulation is the better rehabilitative approach in increasing muscle strength, muscle fiber size and reduce pain and disability among the patients with musculoskeletal disorders. In support of the implementation of neuromuscular stimulation to the quadriceps muscle strength, Marco Aurelio Vaz et al found neuromuscular stimulation training of short duration appears to offset the changes in quadriceps structure and function, as well as reduce joint pain, joint stiffness with knee OA[17]. The study conducted by Further Deyle et al Falconer et al and Fisher et al at different time reported same effects of exercise program on pain and function[18]. Their study stated that the exercise program shown the improvement effect in reducing pain and increasing muscle strength in impaired quadriceps strength. So, it may be hypothesized that improvement on muscle strength is one of the main cause of reducing pain and disability.

In present study, the reduction of pain, joint stiffness and functional limitation in both groups may be attributed to increased quadriceps muscle strength and thereby improve function which leads to reduce pain and disability. The results of this study reports that the functional faradism was an effective protocol for reducing pain, joint stiffness, functional limitation and improving quadriceps muscle strength. Analysis of data shows the

improvement in both groups. On comparison, functional faradism was statistically significant in reducing pain, joint stiffness, functional limitation and quadriceps muscle strength than strengthening exercises. The protocol was given for 5 days in a week for 4 weeks. Therefore, functional faradism was a better option to manage the conditions treat.

Conclusion

This study concludes that both groups shown improvement in reducing pain, joint stiffness, functional limitation and improving isometric quadriceps muscle strength but on comparison muscle group A received functional faradism has been shown significant effect in reducing pain, joint stiffness, functional limitation and increasing isometric quadriceps muscle strength than strengthening exercises over a 4-weeks period. This study may provide a rationale for the clinical use of functional faradism.

Conflict of Interest- No conflict of interest

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