



Comparing Effect of Strengthening Exercises Versus Faradic Stimulation in Knee Osteoarthritis: A Pilot Study

Hadeer Nabil¹, Helen Amir², Yacoub Nada³, Mohamed Zaki⁴, Hadeer Hamada⁵,
Merna Ahmed⁶, Marina Ashraf⁷

1. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries,
Faculty of physical Therapy, Beni-Suef University

2. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries,
Faculty of physical Therapy, Beni-Suef University

3. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries,
Faculty of physical Therapy, Beni-Suef University

4. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries,
Faculty of physical Therapy, Beni-Suef University

5. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries,
Faculty of physical Therapy, Beni-Suef University

6. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries,
Faculty of physical Therapy, Beni-Suef University

7. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries,
Faculty of physical Therapy, Beni-Suef University



Abstract

Background: Osteoarthritis (OA) may affect elderly people due to biomechanical changes and physiological changes like obesity and anatomical location.

Objective: This study aimed to compare between the effects of functional faradism versus isometric quadriceps strengthening program in reducing pain as well as improving functional limitation, quadriceps muscle strength and joint stiffness associated with knee osteoarthritis.

Method: The study included 6 patients divided into 2 equal groups. Group A participants received sessions of functional faradism conducted over 5 weeks. While, group B participants performed strengthening exercise program in the form of isometric quadriceps, straight leg raising, and isometric hip adduction exercise for 5 weeks.

Results:

Group A participants showed a significant improvement in Quadriceps muscle strength, joint function together with decreasing pain than participants of Group B.

Conclusion: A 5-week isometric quadriceps exercise program with faradic stimulation was beneficial in increasing quadriceps muscle strength while reducing pain and functional disability in patients with knee osteoarthritis.



Introduction

Osteoarthritis (OA) is a musculoskeletal disorder which is common in old patients. Osteoarthritis is more common in elderly females than elderly males (2 :1). OA may affect elderly people due to biomechanical changes and physiological changes like obesity, anatomical location (knee jointis are commonly affected than other joints).



Knee OA can cause inflammation in synovium, degeneration of meniscus, erosion of articular cartilage leads to weakness in subchondral bone. This can lead to decrease range of motion and the patient will have limitations of functions, weakness of quadriceps muscle, weakness in extensors lead to decrease stability of joint.

Clinical evidence and studies focus on appropriate strengthening of quadriceps in prevention and rehabilitation of knee OA. However, pain and limitation in range of motion often make it different to the conventional strengthening program.

Conventional strengthening program includes strengthening exercises for quadriceps muscles. Gradually resistive exercises also have positive effect on quadriceps muscle strength for better quality of life. Neuromuscular stimulation may be an alternative approach for muscle strengthening training program. Faradic current may be a 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 a neuromuscular stimulation which can be useful in improving muscle mass, strengthening muscles and increase function in knee OA. For strengthening 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.

Case Report

6 patients with knee Osteoarthritis (3 women and 3 men) were randomly divided into 2 equal groups. Group A received the functional faradism for 5 days per week for 4 weeks, while the group B received strengthening exercises. Maximum isometric quadriceps muscles strength was assessed with Resistance exercise. Pain was measured through Visual Analogue Scale (VAS).

Hypothesis

Experimental Hypothesis (H1): Functional faradism will have a significant effect over conventional strengthening exercises in reducing pain, joint stiffness, functional limitation, quadriceps muscle strength associated with



with knee osteoarthritis.



Null Hypothesis (H0): Functional faradism will have no significant effect over conventional strengthening exercises in reducing pain, joint stiffness, functional limitation, isometric quadriceps muscle strength, and quality of life in patients with knee osteoarthritis.



Methodology

Isometric strengthening exercises like isometric quadriceps, straight leg raising, and isometric hip adduction were performed by all participants in group B.

The degree of pain of knee OA in all patients was measured by Visual Analog Scale (VAS) score (0 representing no pain, 10 representing the worst imaginable pain) before and after functional faradism and strengthening exercises program.

Protocol

Functional Faradism was carried out by sitting patients in a regular chair (hip and knee angles were kept at about 90°). Then, the standard carbon rubber stimulation electrodes were placed over the femoral nerve and transversely over the quadriceps muscle motor points. When electrical stimulation intensity was applied, motor points were identified as the area that produced the most visible muscle contraction. Electrodes were securely fastened using straps to control electrical stimulation intensity, which was set to maximum comfortable stimulation according to patient's tolerance.

Participants were instructed to perform voluntary isometric knee extensor contractions followed by electrical stimulation. The parameters of functional faradism included pulse duration of 400seconds, rectangular biphasic symmetric current as well as, stimulation frequency of 80 Hz. The session lasted 30 minutes and consisted of 10 seconds of stimulation followed by 20 seconds of rest five days per week for 5 weeks (25 days)





Strengthening Exercises:

Isometric quadriceps exercise was performed while patients positioned in supine lying while a towel roll placed under their knees; they were instructed to press their knees against the roll. Strengthening of quadriceps muscle was the purpose of the exercise. The patient was instructed to use their thigh muscles as much as possible to keep knee straight. This exercise was performed for 3 sets of 10 repetitions.

For the isometric hip adduction exercise patients lied in supine position with a pillow between their knees. They were told to do an isometric hip adduction while pressing the pillow between their knees and holding the adduction for 5 seconds.

Straight leg raising (SLR) exercise was performed from supine lying. Patients were instructed to do maximum isometric contraction in quadriceps muscle before the lifting phase of (SLR) then, to lift their leg up to 10 cm above the plinth and hold the contraction for 10 seconds. Finally, knee extension exercise was performed while the patients were in sitting position and their knees flexed from 30 to 0 degrees. Then, patients were instructed to extend the knee by using their thigh muscles as much as possible to keep knee straight. This workout consisted of three sets of ten repetitions. Both types of conventional strengthening exercises were performed 5 days per week for 5 weeks (25 days).





Result

Pain, muscle weakness and physical dysfunction form a vicious circle in OA of the knee as well as, influence the progression of the disease. Thus, Quadriceps muscle strengthening is pivotal in prevention and treatment of OA of the knee.

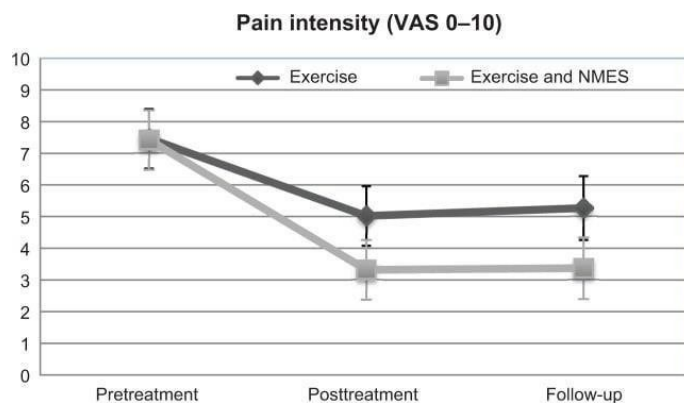


In case of using faradic current in knee OA, functional faradism shows significant improvement in increasing Quadriceps muscle strength. These effects were revealed during the 5 weeks treatment period.

Using visual analogue scale in group A patients before applying faradic current on quadriceps the scale scored 9. After 1 week of using faradic current, the VAS score was reduced to 7. After 3 weeks of using faradic the scale scored 4. After 4 weeks of using faradic the scale recorded 1.

By using visual analogue scale in group B patients before applying any strength exercise, the scale was 8 and after first week of exercise decreased to 7. After 2 weeks of exercise there was an obvious improvement in patients' pain, as the score of visual analogue scale was 4. After 4 weeks of exercise the scale recorded 2. This indicated that strengthening exercise had advantageous effect in knee osteoarthritis.

Electrical neuromuscular stimulation was the better rehabilitative approach in increasing muscle strength, muscle fiber size and reducing pain and disability among the patients with musculoskeletal disorders. In support to the implementation of neuromuscular stimulation to the quadriceps muscle ,neuromuscular stimulation training of short duration appeared to offset the changes in quadriceps structure and function, as well as reduced joint pain, joint stiffness with knee OA.





Discussion

The purpose of study was to compare between the effect of functional faradism versus isometric exercises in strengthening quadriceps muscle and thereby reducing pain, joint stiffness and functional limitation in knee OA.

The result showed improvements in reducing pain, joint stiffness and functional limitation in both groups but on comparison, group A patients received functional faradism shows the significant improvements than group B patients.

In rats with knee OA strengthening exercises effectively increased muscle cross-sectional area, the ultimate load supported during the exercise training, the biomechanical characteristics and the structure of the tendon as well as alleviated cartilage degeneration. There was a biological and biomechanical link between the cartilage and subchondral bone. The main functions of strength training were relieving pain, alleviating stiffness, enhancing muscle strength, improving physical function, and increasing the shock absorption ability of the lower extremity muscles during walking, pain decreased from 8 to 2 on the visual analogue scale by the end of 5th week.

Functional faradism showed significant improvement in increasing muscle strength, muscle fiber size and reducing pain and disability among the patients with musculoskeletal disorders. With the implementation of neuromuscular stimulation to the quadriceps, the changes in quadriceps structure and function, as well as joint pain with knee OA decreased from 8 to 1 on the visual analogue scale by the end of 5th week.

The reduction of pain, joint stiffness and functional limitation in both groups may be attributed to increase in quadriceps muscle strength and thereby improving function which led 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 showed improvement in both groups. On comparison, functional faradism was statistically significant in reducing pain, joint stiffness, functional limitation and quadriceps muscle strength than conventional strengthening exercises alone. The protocol was given for 5 days in a week for 5 weeks. Therefore, functional faradism was the better option.





Conclusion

According to the findings of this study, both groups improved in terms of decreasing pain, joint stiffness, functional limitations, and isometric quadriceps muscular strength. But group A that received functional faradism has been found to be much more effective than strengthening workouts during a 4-week period in all the criteria to be compared, relieving patients' complaints as proven by the scores recorded on VAS.

This investigation might offer justification for the clinical application of functional faradism.



References

- Hunter DJ, Eckstein F. 2009. Exercise and osteoarthritis. *J Anat* 214: 197– 207
- Mairet S, Maïsetti O, Rolland E, et al. 2008. Neuromuscular and architectural alterations of the vastus lateralis muscle in elderly patients with unilateral knee osteoarthritis. *Ann Readapt Med Phys* 51: 16– 23.
- Petterson SC, Barrance P, Buchanan T, et al. 2008. Mechanisms underlying quadriceps weakness in knee osteoarthritis. *Med Sci Sports Exerc* 40: 422– 427.
- Raghav, Sumit & Singh, Anshika. (2020). 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. 8. 2948-2956.
- Marco Aurélio Vaz et al. 2012. Neuromuscular electrical stimulation (NMES) reduces structural and functional losses of quadriceps muscle and improves health status in patients with knee osteoarthritis. *Journal of Orthopaedic Research* Volume 31, Issue 4: 511-516
- Lewek MD, Rudolph KS, Snyder-Mackler L. 2004. Quadriceps femoris muscle weakness and activation failure in patients with symptomatic knee osteoarthritis. *J Orthop Res* 22: 110– 115.