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ORIGINAL ARTICLE

A COMPARATIVE STUDY BETWEEN THE EFFICACY OF NMES AND QUADRICEPS ISOMETRIC EXERCISES VERSUS TENS AND QUADRICEPS ISOMETRIC EXERCISES IN PATIENTS SUFFERING FROM ACUTE KNEE OSTEOARTHRITIS

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ABSTRACT: BACKGROUND AND OBJECTIVES: Knee osteoarthritis (OA) is a painful and degenerative joint disease, the pain, joint stiffness associated with this condition have a dramatic impact on physical mobility and function. This study was done to assess the effectiveness of NMES and Quadriceps isometric exercises versus TENS and Quadriceps isometric exercises in patients suffering from acute Knee Osteoarthritis. **METHODS:** All the subjects were clinically diagnosed by orthopaedician with acute knee osteoarthritis were screened after finding their suitability as per the inclusion and exclusion criteria and were requested to participate in the study. Participants in the study were briefed about the nature of the study and their intervention. After briefing them about the study, their informed written consent was taken. 60 Acute knee osteoarthritis patients were randomly divided into two groups with n= 30 each group, Group A- received Neuromuscular electrical stimulation (NMES) and Quadriceps isometric exercises**,** where Group B- received Transcutaneous electrical nerve stimulation and Quadriceps isometric exercises**.** The treatment was given 5 days a week. The total treatment duration was for 4 weeks. **OUTCOME MEASURES:** The patients were evaluated at the beginning of the intervention program, and again at the beginning of treatment of day1, day 15 and 4th week. All the patients were requested to come for a follow up measurement after 4 week of treatment program. All the patients were assessed for pain and functional outcome by taking their VAS and WOMAC score. **RESULTS:** Group A which received Neuromuscular electrical stimulation (NMES) and Quadriceps isometric exercises showed great improvements from baseline to 4th week on pain intensity and functional outcome assessed using VAS and WOMAC respectively. Group B showed slight improvements from baseline to 4th week till the treatment was given to them but showed mild reduction of pain and improve functional outcome after the treatment was stopped. After analysis group A showed significance with P = 0.001. **CONCLUSION:** Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises and Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises showed effectiveness in reducing the pain intensity and improving the functional outcome but Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises showed superior hand over Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises.

KEYWORDS: Acute knee osteoarthritis, Neuromuscular electrical stimulation (NMES), Transcutaneous electrical nerve stimulation, Quadriceps isometric exercises, visual analogue scale, functional outcome.

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INTRODUCTION: Knee osteoarthritis (OA) is a painful and degenerative joint disease, Pathologic changes in OA involve progressive hyaline joint cartilage loss with concomitant changes in the subchondral bone and the development of osteophytes.[1]

The osteoarthritis research society international disease state working group defined osteoarthritis as "A progressive disease representing the failed repair of joint damage that, in the preponderance of cases, has been triggered by abnormal intra-articular stress."[2]

OA is seen mostly in middle and advanced age groups and its frequency increases with age. Although its frequency is similar in both sexes below the age of 55, there is an increase in women after the age of 55.[3]

Multiple factors have been shown to affect the progression of Osteoarthritis, including the presence of polyarticular disease, increasing age, associated intra-articular crystal deposition, obesity, joint instability and/or malalignment, muscle weakness and peripheral neuropathy.[4]

Kellgren-Lawrence Classification: Knee Osteoarthritis[5]

Grade I: Unlikely narrowing of the joint space, possible osteophytes.

Grade II: Small osteophytes, possible narrowing of the joint.

Grade III: Multiple, moderately sized osteophytes, definite joint space narrowing, some sclerotic areas, possible deformation of bone ends.

Grade IV: Multiple large osteophytes, severe joint space narrowing, marked sclerosis and definite bony end deformity.

Knee pain could reduce the exercise tolerance of people who have Osteoarthritis knee pain. The strength of the knee muscles of people with Osteoarthritis knee is usually weaker than that in normal subjects.[6]

NMES can be used for: (1) preservation of muscle mass and function during prolonged periods of disuse or immobilization; (2) recovery of muscle mass and function following prolonged periods of disuse or immobilization; (3) improvement of muscle function in different healthy populations: elderly subjects, recreational athletes and competitive athletes; and (4) preoperative strengthening.[7]

The pain modulating effect of tens is assigned to peripheral components which may be regulated by central mechanisms. The inhibitory effect of tens is based on the 'Gate Control Theory' of pain perception as described by Melzack and Wall. The use of tens to relieve knee pain in osteoarthritis of the knee is recommended in various clinical guidelines as a conservative treatment to relieve knee pain.[8, 9]

Strengthening exercise to the quadriceps can improve the stability of the knee joint. Stronger knee muscles could theoretically provide better protection of the knee joint by reducing the excessive stress and strain on the lax joint capsule where the nociceptors are located, to reduce knee pain during movement.[10, 11]

Isometric resistance training exercises required the individual to generate tension in the muscle without changing the joint angle which produce moderate degree of muscle fatigue at the end of the final repetition of the set for exercises, providing less pain, improving knee OA symptom and quality of life.[12,13]

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Objectives of the study: The main objectives of the study are:

1. To assess the effectiveness of neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises in Acute Osteoarthritis of Knee.
2. To assess the effectiveness of transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises in Acute Osteoarthritis of knee.
3. To compare the effect of neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises versus transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises in Acute Osteoarthritis of knee.

METHODOLOGY:

Source of data

Study will be conducted at:

1. Outpatient department of Orthopaedics in Kempegowda Institute of Medical Science Hospital and Research Center, Bangalore.
2. Inpatient department of Orthopaedics in Kempegowda Institute of Medical Science Hospital and Research Center, Bangalore.
3. Outpatient department of Kempegowda Institute of Physiotherapy, Bangalore.

Methods of collection of data:

(A) **Study design:** A Comparative study.
Sample size: 60 (30 subjects in each group)
Sample design: Randomized study technique.

Materials used:

Fig. 1: Material

Fig. 2: NMES

DOI: 10.14260/jemds/2014/2468

Fig. 3: TENS

Inclusion criteria:

1. Unilateral Osteoarthritis of Knee (tibiofemoral compartment) with x-ray findings showing symptoms of acute Osteoarthritis knee
2. Grade I, II Kellgren-Lawrence Classification: Knee Osteoarthritis.
3. Crepitus on active range of motion.
4. Tenderness on the joint line.
5. Patients with age group over 45 years.
6. Both Gender.
7. Osteoarthritis knee for three months

Exclusion criteria:

1. Traumatic knee pain
2. Inflammatory and Infectious condition
3. Fracture
4. Ruptured ligament
5. Rheumatoid Arthritis, Gouty Arthritis, Psoriatic Arthritis
6. Active synovitis
7. Meniscopathy
8. Chronic knee Osteoarthritis
9. Any recent Surgical intervention of the lower extremity
10. Tumors/malignancy
11. Grade III, IV Kellgren-Lawrence Classification: Knee Osteoarthritis
12. Obesity

Measurement tools: Intensity of pain and functional outcome were the parameters considered for the study. The pain intensity was assessed using Visual Analog Scale (VAS) and the functional outcome was assessed by using Western Ontario McMaster osteoarthritis Index (WOMAC) scale.

VAS: pain intensity can be measured by VAS. A 10 cm line marked with numbers 0-10 can be used where 0 symbolizes no pain and 10 is maximum pain.

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Western Ontario and McMaster Universities Index of Osteoarthritis [WOMAC]: Since its development in 1982, it is most frequently used to assess pain, stiffness, and physical function in patients with knee Osteoarthritis. It is a self-reported scale which has proper reliability and validity.

PROCEDURE: Randomized sampling technique was chosen for this study. 60 samples were selected for the study based on inclusion and exclusion criteria, the sample who were qualified to take part in the study were explained about the pros and cons of the study with their written informed consent form. 60 samples with acute knee osteoarthritis were selected and 30 samples in each group were distributed respectively.

Baseline measurements of pain intensity and functional 0utcome of all the subjects were measured using VAS and WOMAC scale respectively and recorded as per pretest data for statistical analysis.

Intervention:

Group A: 30 subjects in this group were given neuromuscular electrical stimulation (NMES) and Quadriceps isometric exercises**.** Treatment was given for 1 session per day; each session lasted 20 minutes, 5 times a week for 4 weeks**.**

For Neuromuscular electrical stimulation**,** in sitting position with knee flexed to 60 degrees, and the leg will tie to the application table by Velcro tape passing through ankle in order to inhibit joint movement that would result from quadriceps contraction. Two active electrodes are positioned over the motor points of vastus medialis and vastus lateralis muscles, with one dispersive electrode closing the stimulation loop. Followed by supervised quadriceps isometric exercise in sitting position with a towel roll under the knee, perform for 10 seconds holds and 10 seconds relaxes, 10-15 repetition.

Group B: 30 subjects in this group were given transcutaneous electrical nerve stimulation (TENS) in supine position, two channels with 4 electrodes (5*5cm.) over painful knee region with intensity in the tactile sensation threshold.

Channel 1: Two electrodes 'A' superiorly and 'A1' inferiorly in the medial aspect of painful knee region.

Channel 2: Two electrodes 'B' superiorly and 'B1' inferiorly in the lateral aspect of painful knee region. Each session lasted 20 minutes, 5 times a week for 3 weeks.

Followed by supervised quadriceps isometric exercise in sitting position with a towel roll under the knee, perform for 10 seconds holds and 10 seconds relaxes 10- 15 repetition.

Baseline measurement of pain intensity and functional outcome measure were assessed using VAS and WOMAC scale again pre-treatment measurements were taken on day 1, day 15th the patient were requested to come back for follow up Measurement after 4th week of the end of the treatment program.

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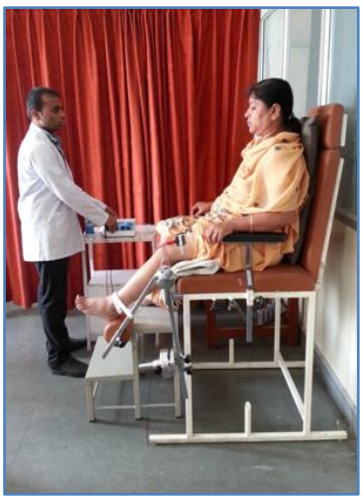

Fig. 4: Lateral view

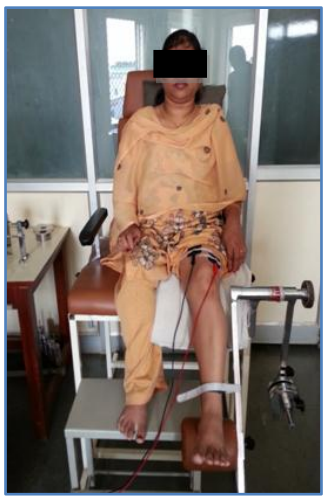

Fig. 5: Anterior view

Patient receiving neuromuscular electrical stimulation (NMES) in sitting position,

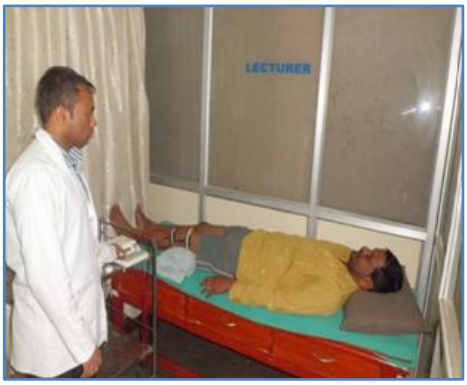

Fig. 6: TENS (Supine Position)

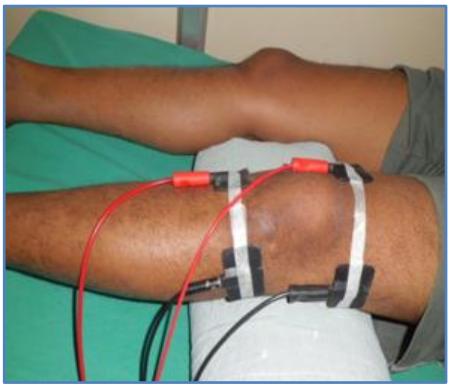

Fig. 7: Electrode Placement on knee joint Electrode placement of Transcutaneous electrical nerve stimulation (TENS) for acute osteoarthritis knee

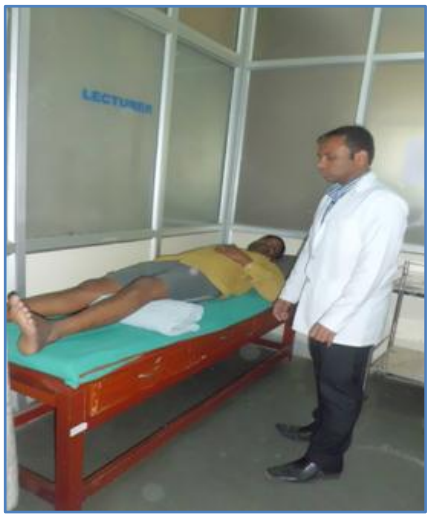

Fig. 8: Quadriceps isometric exercises in supine position, by placing towel roll under the knee joint

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DISCUSSION: The chief objective of this study was to compare the efficacy of Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises and Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises in Acute Osteoarthritis of Knee in reducing the pain intensity and improving the functional outcome assessed by VAS and WOMAC score respectively. The study was detailed and tailored to find which parameter of the treatment was better in the two groups after 4th week of treatment.

Overall 60 subjects who met with the inclusion criteria were randomly allocated into two groups. The subjects, who fell into age group of 45-65 yrs. of both the sexes and who were suffering from Acute Osteoarthritis of Knee were selected. 30 subjects from group A were treated with Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises while 30 subjects from group B were treated with Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises.

Pretreatment values of pain intensity using VAS and WOMAC on baseline, day 15, and after 4th week were assessed. These values were statistically analyzed using Student t test (two tailed, independent), Student t test (two tailed, dependent), and Chi-square / Fisher Exact test. The statistical analysis done for both the groups showed reduction in pain intensity and improvements in functional outcome.

It also showed that subjects from group A showed marked significant improvements in functional outcome and pain reduction from baseline to day 15th of the treatment and maintained the improvements till after 4th week. Whereas subjects from group B showed slight improvements from baseline to 4th week till the treatment was given to them but showed mild reduction of pain and improve functional outcome after the treatment was stopped. Hence, group A treated with Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises showed higher significance than group B treated with Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises. Based on this data we accept the alternate hypothesis and reject the null hypothesis.

These results were significant at P=0.001 and it strongly supports the earlier findings of Omer Kocaman (2008) Effect of isometric exercises and Electrical stimulation was compared on patient with knee Osteoarthritis and concluded that Electrical stimulation as efficient as the exercise treatment in knee Osteoarthritis, Quadriceps weakness and atrophy prevention.[3]

The results of this study also has got strong evidences from the study done by Carol Grace T. Vance (2012) Conducted study to find out the effect of transcutaneous electrical nerve stimulation on pain and function in patient with knee Osteoarthritis which suggested that both High frequency and Low frequency transcutaneous electrical nerve stimulation decreases pain at rest and on activity with have effect on function in patient with knee Osteoarthritis.[14]

This study implies that both Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises and Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises can be used for treating patient with Acute Osteoarthritis of Knee.

CONCLUSION: This study can be concluded by stating that both Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises and Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises have got beneficial effect in reducing the pain intensity and improving the functional outcome in patients with Acute osteoarthritis of knee.

Both the treatments showed significance in reducing the pain levels and improving the functional outcome from baseline to 4th week of the treatment. But only subjects in group A showed marked improvements in measurements taken in the follow up 15 day and 4th week. Group B subjects showed slight improvements from baseline to 4th week till the treatment was given to them but showed mild reduction of pain and improve functional outcome after the treatment was stopped.

When both the treatment regimens were taken into consideration for significance, Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises and Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises showed effectiveness in reducing the pain intensity and improving the functional outcome but Neuromuscular electrical stimulation (NMES) with Quadriceps isometric exercises showed superior hand over Transcutaneous electrical nerve stimulation (TENS) with Quadriceps isometric exercises.

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