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COMBINED EFFECT OF MULTIPLE ANGLE ISOMETRIC EXERCISE AND ELECTRICAL STIMULATION IN TREATMENT OF KNEE OSTEOARTHRITIS

Shumahia Parveen[1], Shubham Arora[1], Dr. Sanghamitra Jena(PT)[2*]

1Researcher Scholar, Galgotias University
[2*]Assistant Professor Dept of Physiotherapy, Galgotias University, Greater Noida, U.P India

***Corresponding Author:**Sanghamitra Jena
*Assistant Professor Dept of Physiotherapy, Galgotias University, Greater Noida, U.P India
Email:sanghamitra.jena@galgotiasuniversity.edu.in

ABSTRACT:-

Background: Knee osteoarthritis is a chronic condition that not only affects the patellofemoral and tibiofemoral joints, as well as the soft tissues that surround them. One of the leading causes of pain and disability, this illness not only lowers quality of life but also places a financial strain on the patient and the healthcare system. The purpose of this study was to assess the combined effects of multiple angle isometric exercise and electrical stimulation on knee osteoarthritis symptoms, including functional capacity, muscular strength, and balance (OA).

Methodology: Thirty people were accepted as participants for this study if they had bilateral knee osteoarthritis symptoms and were using the Kellgren and Lawrence criterion, a grade of 2 and 3. Each patient consented after being told. The patients who met these requirements in total were divided into two groups at random (Group one and two). Group one of fifteen patients each underwent electrical stimulation and multiangle isometric exercise; the group two received conventional exercise and electrical stimulation. All the patients were inpatients for the whole three weeks of treatment.

Results: Pre- and post-WOMAC Scores and VAS were computed and analysed in both groups to evaluate the effectiveness compared to individuals with knee osteoarthritis who received standard exercise and electrical stimulation, of multiangle isometric exercise and stimulation. Both treatments demonstrated a substantial ($P<0.05$) effect on both groups as measured using the WOMAC Score and VAS ratings. However, compared to traditional exercise and electrical stimulation, multiangle isometric exercise was found to be more beneficial.

Conclusion: According to the results of the current study, multiangle isometric exercise & electrical stimulation was shown to be more beneficial than conventional exercise & electrical stimulation for treating knee osteoarthritis problems.

Keywords: Electrical Stimulation, Isometric Exercise,VAS, TENS, WOMAC

INTRODUCTION:

OA is a form of joint disease instigated by the collapse of joint cartilage and underlying bone[1]. The term arthritis refers to joint inflammation, and different varieties of arthritis range from those caused by cartilage wear and tear, such as osteoarthritis, to those caused by an overactive immune system. The most frequent kind of knee arthritis is osteoarthritis. It is a degenerative, "wear-and-tear" kind of arthritis that most commonly affects persons over the age of 50, though it can affect younger people as well. Joint pain and stiffness are the most prevalent symptoms of Osteoarthritis, and typically, the symptoms develop gradually over time[2]. The joints at the base of the thumbs, the two joints near the tips of the fingers, the knee and hip joints, and the joints in the neck and lower back are those that are most frequently afflicted. The joints on one side of the body are typically more troubled than the other[3]. Osteoarthritis is assumed to have mechanical stress on the joint and low-grade inflammatory processes as its primary causes. Osteoarthritis and rheumatoid arthritis are the two most prevalent types among the more than 100 distinct types of arthritis. While arthritis is mostly an adult illness, certain kinds afflict youngsters [4].

Knee osteoarthritis (KOA), commonly known as degenerative joint disease, is primarily caused by wear and strain on the articular cartilage. It is more prevalent in the elderly. There are two forms of knee osteoarthritis: primary and secondary. Primary osteoarthritis is defined as articular deterioration with no evident underlying cause. Secondary osteoarthritis is caused by either an improper distribution of force across the joint, as in post-traumatic reasons, or aberrant articular cartilage, as in rheumatoid arthritis [5]. Osteoarthritis is one of the 50 most prevalent disease and injury squeal worldwide, impacting around 250 million individuals, or 4% of the global population. Knee OA accounts for 83 percent of the worldwide disease burden [6]. Although the exact pathophysiology of OA is unclear it is believed to include a complex combination of mechanical, metabolic, biological, genetic, and immunologic factors.. Many trials have previously been made to construct diagnostic criteria for OA that integrate patient-reported joint pain in combination with consistent radiography evidence [7,8]. Secondary OA is commonly caused by very well-understood pathogenesis such as posttraumatic, dysplastic, viral, inflammatory, or biochemical aetiologies. Although the causes of primary OA are still not fully known, it is hypothesized that the sickness would be caused by a confluence of hereditary variables, age-related physiological changes, ethnicity, and physical factors[9].

Plain radiography is still widely used to diagnose OA. Kellgren and Lawrence (KL) published the first structured attempts to construct a radiographic categorization scheme for OA in 1957 [10]. Healthcare professionals may also benefit from the Kellgren and Lawrence classification in developing a cure plan to support making medical decisions, particularly in identifying which patients would gain the most from surgical intervention. Kohn et al (2016) described grading of KOA based on Kellgren-Lawrence Classification mentioned as follows:

- 0 (None): No radiographical findings
- 1 (Doubtful): Narrowing of joint space
- 2 (Minimum): Osteophyte formation, definite narrowing of joint space
- 3 (Moderate): Multiple osteophytes and some sclerosis deformity of bone end
- 4 (Severe): Large osteophytes and severe sclerosis.

Osteoarthritis is a degenerative disease that might eventually cause disability. The severity of clinical symptoms varies from person to person. However, they often worsen, grow more frequent, and become more debilitating over time. Each person's rate of advancement is likewise unique. Knee pain that is slow in start and increases with activity, knee stiffness and swelling, discomfort after extended sitting or sleeping, and pain that worsens with time are all common clinical signs. Conservative therapy for knee osteoarthritis is followed by surgical treatment alternatives if conservative treatment fails. While drugs can help delay the course of RA and other inflammatory disorders, there are currently no authorised medicines for treating diseases for the treatment of knee OA [11].

Knee osteoarthritis is a leading cause of impairment in the elderly, causing persistent joint discomfort, muscular weakness, and loss of range of motion. Exercise therapy seeks to reduce pain and impairment by improving muscular strength, joint stability, and range of motion. Electrical stimulations can cause facilitation in the substantia gelatinosa at the level of the medulla spinalis by

activating fibres. Exercises can strengthen the muscles of the leg and increase flexibility and range of motion. Physical therapy and exercise are typically effective in reducing pain and improving function. After eight weeks of aquatic exercise, compared to the patient education programme, pain and function showed improvement, and after twelve weeks, it demonstrated improvement in function activities [(12)].Isokinetic quadriceps along with hamstring improving exercises can be utilized for the treatment of KOT. Land-based workouts that emphasise the hip abductor have been shown to enhance performance and function in women with osteoarthritis of the knee that is symptomatic [(13)].

Exercise is intended to maintain range of motion (ROM), normal joint biomechanics, muscle strength and endurance, and muscle atrophy caused by pain. It is undeniable that regular exercise benefits OA patients' pain control, proprioception, strength, stability, durability, all of which recover functional autonomy. Exercise is a crucial non-pharmacological strategy that has been taken into consideration by recommendations for managing knee osteoarthritis. Additionally, electrical stimulation (ES) is said to increase muscle strength [(14)]. By impacting muscle fibres and the capillary system, ES strengthens muscles. Additionally, ES prevents muscle atrophy brought on by prolonged immobilization. The effectiveness of CPM-ES with electrical impulses in conjunction with traditional physical therapy techniques for treating OA of knee has not previously investigated. ES was used on the muscles of the upper leg while CPM was performed on the knee. The two therapy approaches were used in tandem. The purpose of this studies is to contrast the effects of common physical therapy techniques, isometric exercises, and CPM-ES combination therapy on knee OA symptoms, functional ability, and well-being, muscular strength, measurements of the knee and thigh, data from stabilometry[(15)]. Additionally, the exercise protocol used included stretching the hamstrings three times a day for 10 repetitions of each move for 10 seconds. Additionally, it incorporated multiple-angle isometric knee exercises (quadriceps, thigh abductor, and adductors). After 4 weeks, the patients learned how to strengthen their quadriceps, adductors, and abductors [(16)].

While both multi-angle isometric exercises and electrical stimuli and have been shown a fruitful therapy of knee osteoarthritis. With this outset, the present study hypothesised that there would be a substantial synergistic effectiveness of electrical stimulation and multi-angle isometric exercise in the treatment of knee osteoarthritis. This study's goal is to determine how the combined effects of multi-angle isometric exercise and electrical stimulation in the treatment of knee osteoarthritis.

Objectives:

The Objectives of the present study are:

- To assess the suitability of patients with knee osteoarthritis for electrical stimulation and multi-angle isometric exercise.
- To evaluate the effectiveness of knee osteoarthritis treatment and multi-angle isometric exercise with action potentials.

Research Question:

What is the cumulative effect of electrical stimulation and multiangle isometric exercise in curing knee osteoarthritis?

Null Hypothesis

Multiangle isometric exercise plus electrical stimulation is not useful in treatment of knee osteoarthritis.

Alternate Hypothesis

Knee osteoarthritis can be effectively treated with electrical stimulation and multiangle isometric training.

Operational definition:

- **Multi angle isometric exercise**: The patient was sat with a 90-degree bend at the hip and knee. Patient requested to extend his knee as far as possible while his leg was linked to a band with pre-set resistance at 30, 60, and 90 degrees.
  For six seconds, try against the band before relaxing. This 2-3 times were done thus at 30, 60, and 90 degrees.

- **Knee osteoarthritis**: The main cause of knee osteoarthritis (KOA), sometimes referred to as degenerative joint disease, is wear and tear on the articular cartilage. Elderly people are more likely to have it. Knee osteoarthritis comes in main and secondary types. Defining primary osteoarthritis as articular degeneration without a clear underlying cause.

- **Electrical stimulation:** The use of electrical stimulation, also known as neuromuscular electrical stimulation, is a method for inducing muscle contractions. On the skin, electrodes are applied over a pre-set region and are controlled by a device.

METHODOLOGY:

I have taken 30 subjects presenting with bilateral knee OA and age above 40 years for the purpose of this research. The total subjects were divided into two groups. 15 subjects were allocated in group 1 and other 15 were allocated in group 2. Group 1 will receive Multiangle isometric exercise along with electrical stimulation whereas group 2 will receive conventional isometric exercise with Electrical stimulation. Consent was taken from the participants. Total time of the study was 3 weeks (4 days a week). The subjects who had Primary bilateral knee OA and knee discomfort lasting for more than 3 months were taken. History of patients to rule out any cases of cardiopulmonary disease or any inflammatory or infectious pathology of knee joint, any neurological condition that limits knee mobility.

INCLUSION CRITERIA:

- The age group of the patient should be from 40 years and above.
- Only those with bilateral primary knee osteoarthritis at KL grades 2-4 and knee discomfort lasting at least three months should be treated.
- Willing to sign the consent form.

EXCLUSION CRITERIA:

- Patient with history of cardiopulmonary disease any inflammatory or infectious pathology of the knee joint.
- Those who had experienced knee surgery or prosthetic placement.
- Neurological condition that limits mobility and affects the knee joint's innervation.

INSTRUMENTS AND FUNCTIONAL TOOLS USED:

- GONIOMETER
- WOMAC
- VAS

PROCEDURE:

In this study, 30 patients with bilateral knee osteoarthritis symptoms and grade 2 and 3, as determined by Kellgren and Lawrence criteria, were accepted as volunteers. Before the research, all participants had a medical (cardiovascular, respiratory) assessment. An informed consent was signed by each patient. Patients who had undergone knee surgery in the past, had leg fractures in the past, other types

of arthritis, Parkinson's disease, a stroke, cardiac pacemakers, or had received knee hyaluronic acid injections within the previous 12 months were all disqualified from the study. Thirty patients who met these requirements in total were distributed into two groups at random (Group 1 and 2).Each group of fifteen patients was split into two.: group one received Multiangle isometric exercise & electrical stimulation; group tworeceived Conventional exercise & electrical stimulation.

The three weeks of therapy were spent with all the patients as inpatients. Throughout the course of therapy, all analgesics and myorelaxants were discontinued. Before and after the therapy, all patients had their pain during rest and activity assessed used 10-cm (VAS). To assess pain, rigidity, and social functions both pre and post therapy, the assessment of joint pain, rigidity, and functions in OA patient was done using the WOMAC OA score system. (Bellamy, 1988). The experiment shown in the accompanying figure was conducted using the approach. (Figure 3.1)

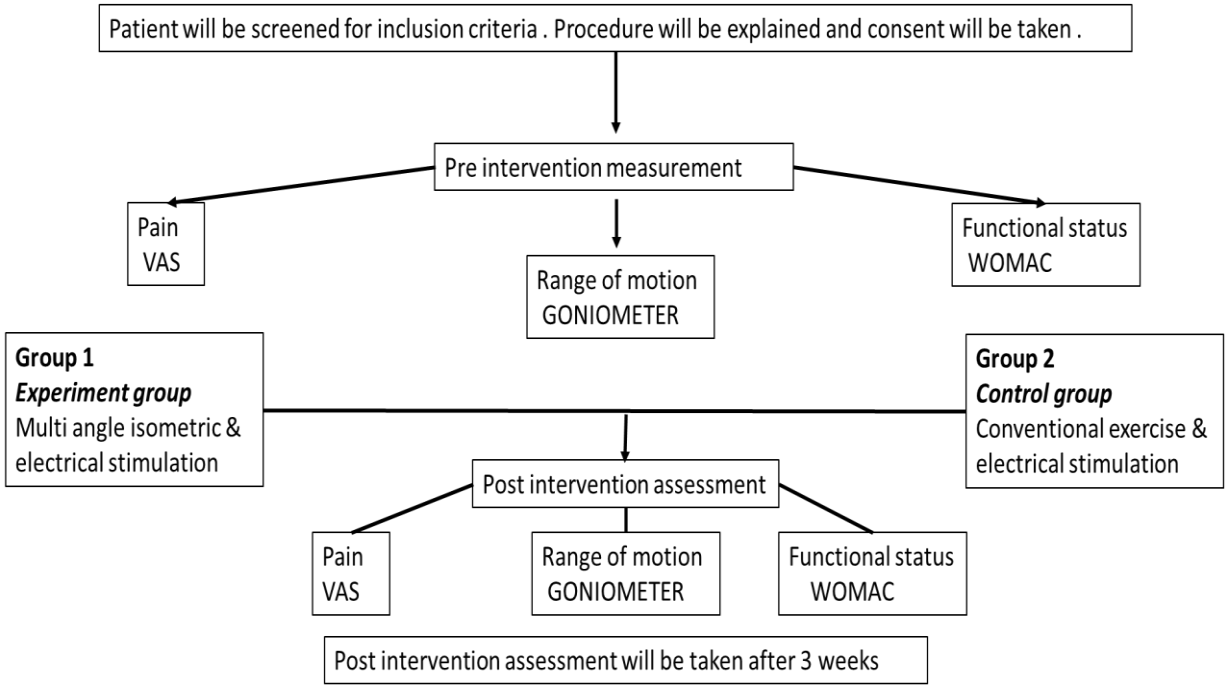

Figure 3.1. Flowchart illustrating the methods used for the experiment.

INTERVENTION

Exercise is administered independently for each group, but the intervention is the same for both. As an instance, fifteen patients in group one (Experimental Group) got electrical stimulation and multi-angle isometric exercise, whereas fifteen patients in group two received conventional exercise and electrical stimulation. For group two (Control Group), conventional exercise is provided to ensure adequate comfort and pain relief. In addition, patients with knee osteoarthritis in group one received the below-mentioned intervention.

Multiangle isometric exercise

The patient is seated with a 90-degree flexion at the hip and knee. Patient instructed to stretch his knee as far as possible against a band with fixed resistance at 30, 60, and 90 degrees, hold for 6 seconds, and then relax. This method is given for 3 sets for 10 repetitions at 30, 60 and 90 degrees.

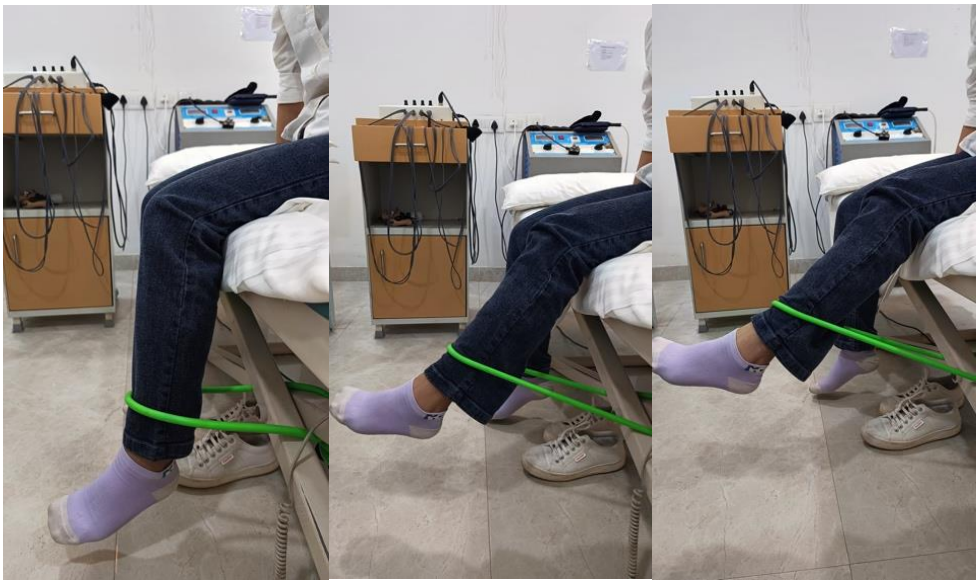

Figure 3.2. Knee Isometric exercise at Multiangle (90, 60, 30)

Electrical stimulation

- TENS

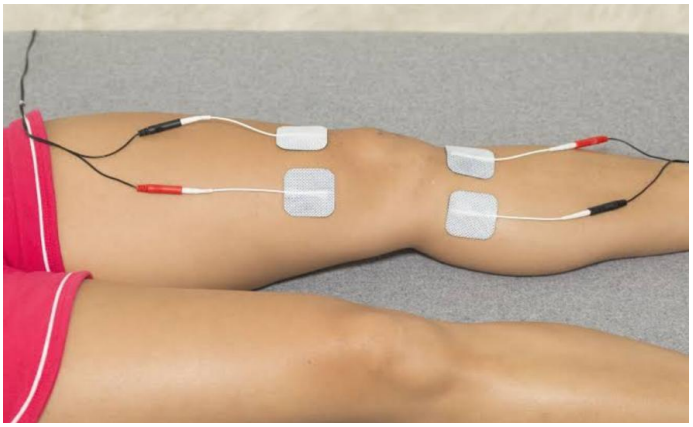

Figure 3.3. Electrode placements of E.S (TENS)

Statistical analysis

On the initial day of the intervention as well as the last days of the third weeks, observational data were collected. The software program SPSS 26.0 for Windows was used to analyse the data. The means and standard deviations of each variable were calculated. At $p<0.05$, the significance level was established. To compare differences across groups, the unpaired t-test was employed, while the paired t-test was utilized to examine differences within groups.

RESULTS:

In the present studies, a whole of 30 knee osteoarthritis patients with age range 45-65 years suffering with KOA To determine the effectiveness of multiangle isometric exercise & electrical stimulation as well as conventional exercise & electrical stimulation administered to the knee osteoarthritis patients, Pre, and Post WOMAC Score and VAS were computed and studied in both groups. When evaluated using the WOMAC Score and VAS, both treatments had a significant ($P<0.05$) impact on both groups. Although, multiangle isometric exercise & electrical stimulation was found more effective as compared to conventional exercise & electrical stimulation (Table 4.1)

Table 4.1. Pre and Post WOMAC Score and VAS of Group one (Multiangle isometric exercise & electrical stimulation) and Group Two (Conventional exercise & electrical stimulation)

Parameters	Group One	Group Two
Age Range (Years)	45-64	45-65
WOMAC Score Pre	67.13±4.14	67.6±7.43
WOMAC Score Post	55.2±3.43	65.53±7.49
WOMAC Score Pre-Post (P value)	4.57075E-09	1.03318E-09
VAS Pre	6.73±1.53	6.4±1.06
VAS Post	2.2±0.77	4.46±0.83
VAS Pre-Post (P value)	5.79805E-10	2.4588E-09

Multiangle isometric exercise and electrical stimulation in Group one patients significantly reduced the complications of knee osteoarthritis as measured by the WOMAC Score. In group one, pre (67.13) and post (55.20) scores of WOMAC represented that multiangle isometric exercise & electrical stimulation intervention mitigates the issues of knee osteoarthritis significantly ($P<0.05$). Even yet, the WOMAC Score revealed that multiangle isometric exercise and electrical stimulation were more efficient than conventional exercise and electrical stimulation (Table 4.2). While conventional exercise and electrical stimulation are shown to be somewhat useful, their effectiveness is not up to par, and as a result, this therapy cannot be regarded to lessen the complications of knee osteoarthritis (Figure 4.1).

Table 4.2. Pre and Post WOMAC Score of Group one (Multiangle isometric exercise & electrical stimulation) and Group Two (Conventional exercise & electrical stimulation)

Parameter	Group One	Group Two	Group One-Two (P value)
WOMAC Score Pre (Avg)	67.13	67.60	0.42
WOMAC Score Pre (SD)	4.14	7.43	
WOMAC Score Post (Avg)	55.20	65.53	0.000139
WOMAC Score Post (SD)	3.43	7.49	
WOMAC Score Pre-Post (P value)	4.57075E-09	1.03318E-09	

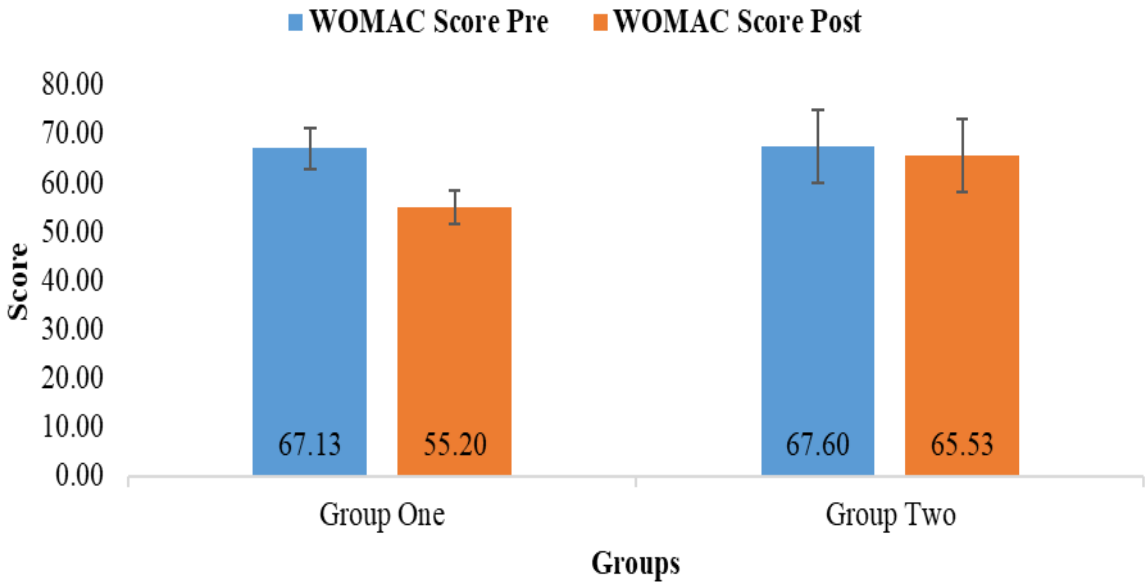

Figure 4.1. Pre and Post WOMAC Score of Group one (Multiangle isometric exercise & electrical stimulation) and Group Two (Conventional exercise & electrical stimulation)

When VAS is studied in the pre and post states of Multiangle Isometric Exercise and Electrical Stimulation in Group One Patients, it revealed similar kinds of outcomes, significantly reducing the complications of knee osteoarthritis (P<0.05). In group one, pre (6.73) and post (2.20) VAS ratings indicated that the multiangle isometric exercise and electrical stimulation intervention significantly lessens the problems associated with knee osteoarthritis (Table 4.3) Conventional exercise and electrical stimulation have been demonstrated to be slightly helpful, but due to their subpar performance, this therapy cannot be regarded as reducing the difficulties of knee osteoarthritis as represented via VAS scores (Figure 4.2)

Table 4.3. Pre and Post VAS of Group one (Multiangle isometric exercise & electrical stimulation) and Group Two (Conventional exercise & electrical stimulation)

Parameter	Group One	Group Two	Group One-Two (P value)
VAS Pre (Avg)	6.73	6.40	0.25
VAS Pre (SD)	1.53	1.06	
VAS Post (Avg)	2.20	4.47	2.35747E-06
VAS Post (SD)	0.77	0.83	
VAS Pre-Post (P value)	5.79805E-10	2.4588E-09	

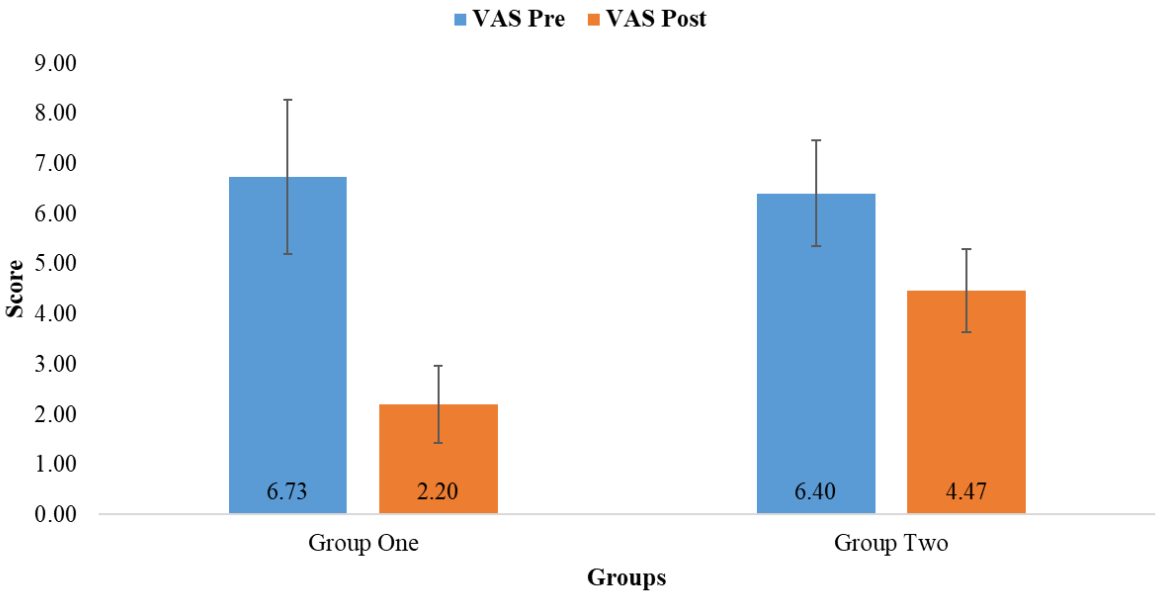

Figure 4.2. Pre and Post VAS of Group one (Multiangle isometric exercise & electrical stimulation) and Group Two (Conventional exercise & electrical stimulation)

Finally, when comparing multiangle isometric exercise & electrical stimulation to conventional exercise & electrical stimulation for treating knee osteoarthritis complications, multiangle isometric exercise & electrical stimulation was found to be more effective. This was demonstrated by both the WOMAC Score and VAS ratings that were evaluated during pre and post interventions of the therapies.

DISCUSSION

Numerous studies have recognized the significant benefits of exercise in the management of concurrent obesity and associated comorbidities as well as knee osteoarthritis. Although the benefits of continuous exercise and brief bursts of high activity have been well researched in OA patient, the similar info regarding brief bursts of little to adequate intensity exercise is lacking. Numerous studies have examined major benefit of exercise for OA patients' pain and functional state. Most of this research, however, evaluated the outcomes of repeated exercise over various lengths of time. Patient

with adequate to severe knee OA are usually overweight, inactive and have purposeful impairments that prevent them from regularly participating in long-term exercise routines or regular activities. Regular training as well as higher-intensity or longer-duration workouts may not be practical for these patients [28-30]. In the current studies, when compared to conventional exercise and ES for the treatment of KOA complications, multiangle isometric exercises and ES were presented to be more effective.

Patients with knee osteoarthritis (OA) may benefit from muscle-strengthening exercises, and electrical muscle stimulation has been shown to enhance muscle strength. In a study conducted by the Rehabilitation Centre at the GMMA, forty patients with KOA were randomly split into two groups: 20 patients were assigned to Group A and receive standard physical therapy along with the CPM-ES combination; 20 patients were assigned to Group 2 and received standard physical therapy along with isometric exercise. Five days a week for three weeks, therapies were used. Primary outcome measures were pain (VAS), WOMAC, SF-36, knee and thigh circle measurement, isokinetic test, dynamic and static balance tests, and they were evaluated at baseline and after therapy. The results of this study show that isometric exercise treatment or CPM-ES combination therapy can help patients with knee OA had improved balance in both static and dynamic circumstances [3].

As determined by the WOMAC Score and VAS in the current study, Multiangle Isometric Exercise with Electrical Stimulation in Group One Patients Significantly Reduced Knee Osteoarthritis Complications. The finding of the present study showed an agreement with the other studies [3,14]. In a related study a pre-post-quasi-experimental control group study design and quantitative research methodology were used. In Madurai, Tamil Nadu, India, the study was carried out at the MIOT Hospital and the Devadoss Hospital. A 12-week counselling and isometric exercise plan, according to the study, dramatically decreased pain and rigidity and enhanced physical activity. In hospitals that treat patient with KOA, isometric exercises and counselling must be become normal medical procedure [26]. In another similar study, patients with knee osteoarthritis (OA) may benefit from muscle-strengthening exercises, EMS has been shown to be useful in enhancing muscular power. The largest overall gains in knee functions and reduction in pain and symptom were seen in individuals with early knee OA who underwent isometric exercise plus whole body electromyostimulation[3].

In a related investigation, a randomized control trial study was designed to create the exercise and control group, an aggregate of 40 patients were indiscriminately allocated. The control group got no treatment at all whereas all participants in the exercise group engaged in isometric quadriceps and straight leg lift exercises. After six weeks, the patients with knee osteoarthritis who had been participating in the study had significantly less pain, more range of motion, and better functional capacity [31]. In a different research, Patients with knee osteoarthritis experienced reduced pain and increased functional ability after completing a four-week isokinetic, aerobic, and isometric training regimen. Isokinetic training also enhanced the preservation of the quadriceps/hamstring ratio while increasing muscular strength. The only exercise that enhanced the patellar cartilage volume was isometric [25].

Finally, it was found that electrically stimulated multiangle isometric exercise was more effective than conventional exercise. Both the WOMAC Score and the VAS ratings, which were assessed before and after the treatments, served as evidence of this finding.

CONCLUSION

In osteoarthritis (OA), the articular cartilage is lost, making it a prevalent kind of arthritis. The most frequent justification for hip and knee replacement, it is one of the main contributors to physical incapacity. In this study, the first group of fifteen patients performed multiangle isometric exercise and electrical stimulation; the second group had conventional exercise and electrical stimulation.

Throughout the entire three-week course of therapy, every patient was an inpatient. To evaluate the efficacy of multiangle isometric exercise and electrical stimulation to conventional exercise and electrical stimulation provided to knee osteoarthritis patients, pre- and post-WOMAC Scores and VAS were computed and studied in both groups. When the WOMAC Score and VAS evaluations were used to assess the effects of the therapies, both showed a significant ($P<0.05$) impact on both groups.

Compared to electrical stimulated conventional exercise, the benefits of electrical stimulated multiangle isometric exercise on knee osteoarthritis were shown to be more beneficial. This conclusion was supported by the WOMAC Score and the VAS ratings, which were evaluated both before and after the therapies.

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