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Efficacy of transcutaneous electrical nerve stimulation versus ultrasound on pain and disability in subjects with osteoarthritis of knee joint

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Abstract

Background: Osteoarthritis (OA) is a disease chiefly involving deterioration of articular cartilage, which leads to gradual development of pain, stiffness, and loss of motion in weight bearing joints. Among the weight bearing joints knee joints are affected most. Transcutaneous electrical nerve stimulation could be more effective in subjects with knee osteoarthritis in reducing pain and disability than that of therapeutic ultrasound when added over the isometric quadriceps exercise.

Objectives: To compare the effectiveness of TENS to therapeutic Ultrasound when both were added over the isometric quadriceps exercise in subjects with knee osteoarthritis.

Methods: This four-week study conducted on 30 patients with knee osteoarthritis. These subjects were divided in to two groups of 15 each. The group-A received TENS and isometric quadriceps exercise, Group-B received therapeutic ultrasound and isometric quadriceps exercise.

Results: There was significant difference between pre and post intervention level of pain in Group-A and Group-B with respective t-values of 7.049 ($p < 0.001$) and 10.102 ($p < 0.001$). There was a significant difference between pre and post intervention levels of disability index in group-A and group-B with respective t-values of 7.531 ($p < 0.001$) and 6.259 ($p < 0.001$). The inter group analysis with unpaired t-test showed significant difference in mean values of difference in pain between group-A and group-B with t-values of 3.565 ($p < 0.01$). The unpaired t-test showed significant difference in mean values of difference in disability index between group-A and group-B with t-values of 3.465 ($p < 0.01$).

Conclusion: The study showed that with common intervention of isometric quadriceps exercise for both the groups; significant reductions were seen in pain and disability in subjects with knee osteoarthritis after four weeks of intervention with TENS than that of therapeutic ultrasound.

Keywords: Osteoarthritis, TENS, therapeutic ultrasound, knee joint, isometric quadriceps exercise

Introduction

Joint disease is commonplace in clinical medicine. Various surveys indicate that about 1%-5% of the population under 45 years and 15%-85% of older individuals suffer from some form of arthritis, mainly osteoarthritis and rheumatoid arthritis [1]. These conditions are characterized by progressive deterioration and loss of articular cartilage over the years mainly in weight bearing joints leading to subchondral bony thickening and development of osteophytes about the joint margin. Among the weight bearing joints, the knee joints are affected the most.

Osteoarthritis (OA) occurs in two clinical patterns i.e. primary & secondary. Primary osteoarthritis is one of the commonest degenerative joint disease affecting individuals above 50 years of age. It is less common among males in their midlife; but the frequency increases steadily particularly in women, to reach 82%-85% of population over the age of 70 years [1, 2]. Secondary OA can occur at any age in any previously damaged or congenital abnormal joints. The relationship to age and previously injury accounts for the view that its form of arthritis is essentially a wear and tear phenomenon. As it is a condition due to degenerative process, all types of pharmacological means fail to reverse the Age disease process. Although non-steroidal anti-inflammatory drugs (NSAIDs) are widely used to treat pain and stiffness associated with OA of knee joint, the side effects with NSAIDs can limit their use [3].

Physiotherapy is non-pharmacological intervention for OA of knee joint recommended by the American college of Rheumatology and the European League against Rheumatism [4]. For the treatment of OA Knee, physiotherapy plays a vital role in relieving pain and preserving the maximal function before surgical intervention is considered [5]. Different modalities are used for management of osteoarthritis like exercises, Transcutaneous Electrical Nerve Stimulation (TENS), Interferential therapy (IFT), Therapeutic Ultrasound (US), Thermotherapy, Actinotherapy, Massage, Manual techniques like Mobilization and Manipulation etc. many meta-analyses as well as systemic reviews are in favor or in contradiction regarding the use of the above therapeutic modalities [6-10]. The purpose of this study was to compare the effects of transcutaneous Electrical Nerve Stimulation (TENS) and Therapeutic Ultrasound (US) on pain and disability in subjects with knee osteoarthritis (OA).

Aims and objectives of the study: To compare the effectiveness of TENS compared to therapeutic Ultrasound in subjects with osteoarthritis knee.

Materials and Methodology

Sample Size: Thirty subjects were selected for the study from the outpatient Department of Physiotherapy.

Sampling and Allocation Methods: Convenient sampling method was adopted for the study and then subjects were allocated randomly into any one of the study groups. Group-A received TENS and exercise, Group-B Therapeutic Ultrasound, and exercise.

Research Design: Quasi-experimental study comparative in nature.

Inclusion Criteria: Both male and female subjects aged between 40 to 60 years diagnosed with OA knee.

Exclusion Criteria: Subjects were excluded those had received any physiotherapy treatment in last 6 months, or had undergone any knee surgeries or inflammatory disease or sustained any injuries, or any active bone infection or tumor, implanted cardiac pacemaker.

Instrumentation and tools used

- TENS Unit
- Therapeutic Ultrasound unit
- Treatment Couch
- Aqua sonic gel
- Sand bags

- Visual analog scale
- WOMAC index

Intervention protocol

Out of thirty subjects in Group-A were given TENS, exercise and 15 subjects in Group-B were given therapeutic Ultrasound and exercise. The subjects in all groups were treated 4 times a week once daily with a total duration of 4 weeks.

Group-A

Subjects in group-A [n=15] received high-rate surged TENS frequency of 100 Hz and pulse width of 0.2 ms on the painful area for 40 minutes and isometric quadriceps exercises were repeated for 10 times with 6 seconds hold and 10 seconds rest between each repetition [10-14, 16, 17].

Group-B

Subjects in Group-B [n=15] received therapeutic ultrasound of 1 MHz in continuous mode and intensity of 1 Watt/cm² over the painful area for 5minutes and isometric quadriceps exercises were repeated for 10 times with 6 seconds hold and 10 seconds rest between each repetition [2, 10, 15-18].

Method of data collection

To find out the difference in outcomes; visual analog scale and WOMAC osteoarthritis index were employed.

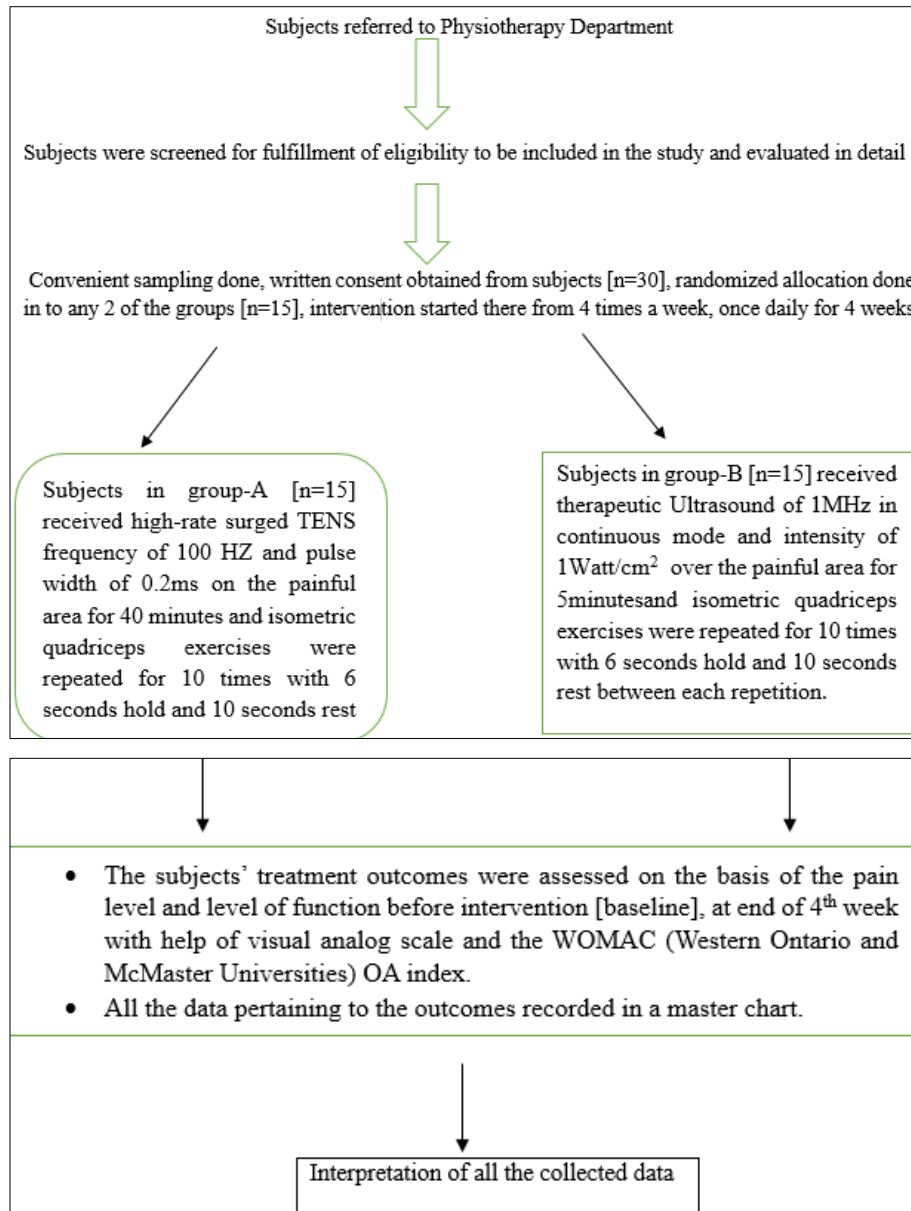
Selection of tool

VAS, WOMAC osteoarthritis index are internationally standardized and highly reliable tool for quantifying pain and disability respectively.

A visual Analogue Scale (VAS) is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. For example, the amount of pain that a patient feels ranges across a continuum from none to an extreme amount of pain. From the patient's perceptive, this spectrum appears continuous; their pain does not take discrete jumps, as a categorization of none, mild, moderate, and severe would suggest. It was to capture this idea of an underlying continuum that the VAS was devised.

The WOMAC (Western Ontario and McMaster Universities) OA index was used to assess patients with osteoarthritis of the hip or knee using 24 parameters. It could be used to monitor the course of the disease or to determine the level of functional disability.

Flow chart about stepwise procedures



Results

Statistical analysis was performed by using the Microsoft Excel. Results are calculated by using 0.05 levels of significance. [α]

Intragroup analysis

Table 1: Mean and standard deviation of age for the subjects of Group-A and Group-B.

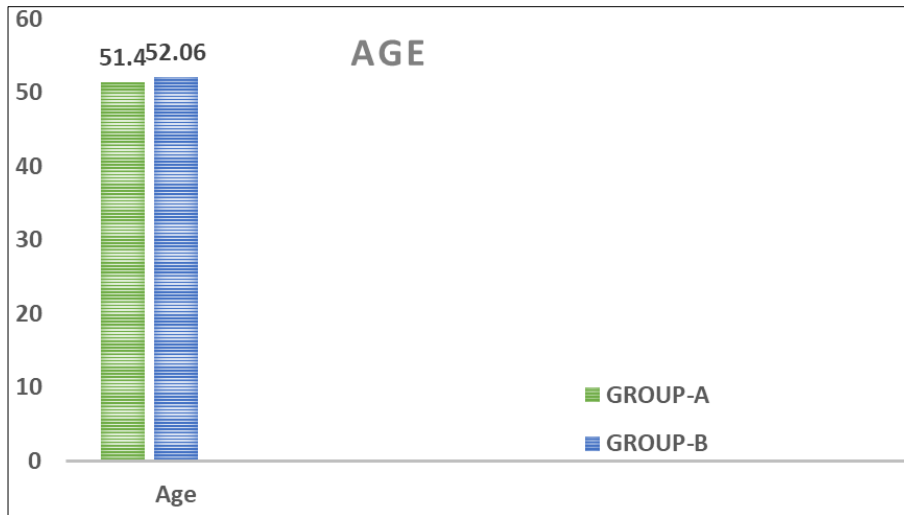
Demographic Data	Group-A		Group-B	
	Mean	S.D.	Mean	S.D.
Age	51.4	7.10	52.06	5.43

It describes the Mean and Standard deviation of age for the subjects of Group-A and Group-B comes out to be 51.4±7.10, 52.06±5.43 respectively.

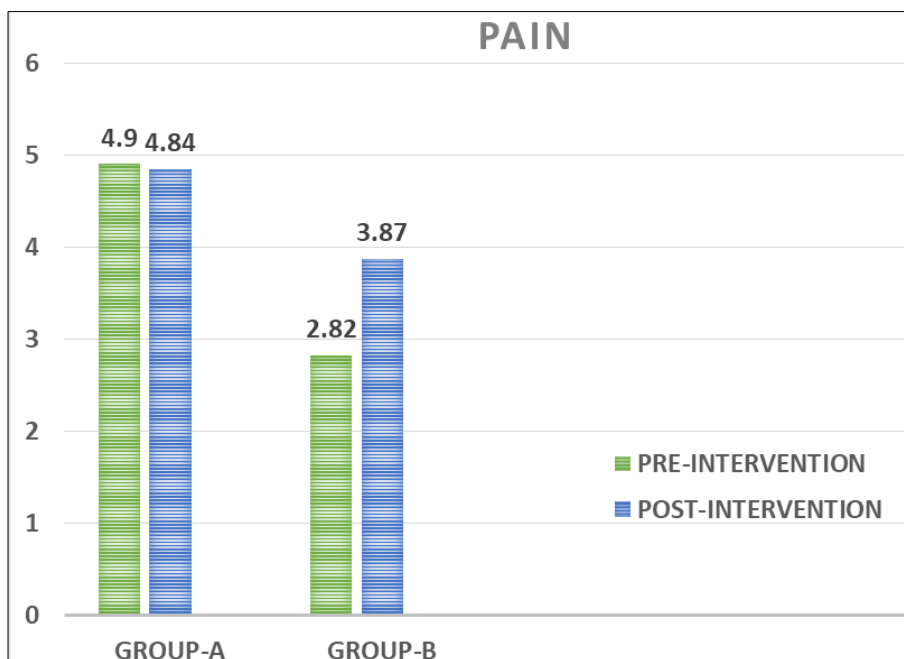
Table 2: Mean, Standard deviation of Pain for the subjects of Group-A and Group-B

Pain	Group-A		Group-B	
	Mean	S.D.	Mean	S.D.
Pre-Intervention	4.9	1.64	4.84	1.86
Post-Intervention	2.82	0.988	3.87	1.64

It describes the Mean and Standard Deviation of pain for the subjects of Group-A and Group-B at pre-intervention and post-intervention levels. For Group-A it comes out to be 4.9±1.64, 2.82±0.988 for Group-B it comes out to be 4.84±1.86, 3.87±1.64 respectively.



Graph 1: Mean, standard deviation of age for the subjects of Group-A and Group-B



Graph 2: Mean, Standard deviation of pain for the subjects of Group-A and Group-B

Table 3: Comparison of Mean values for pain at pre and post-intervention within subjects of Group-A and Group-B

Pain	Group-A		Group-B	
	t-value	p-value	t-value	p-value
Pre vs post	7.049	$p \leq 0.001$	10.102	$p \leq 0.001$

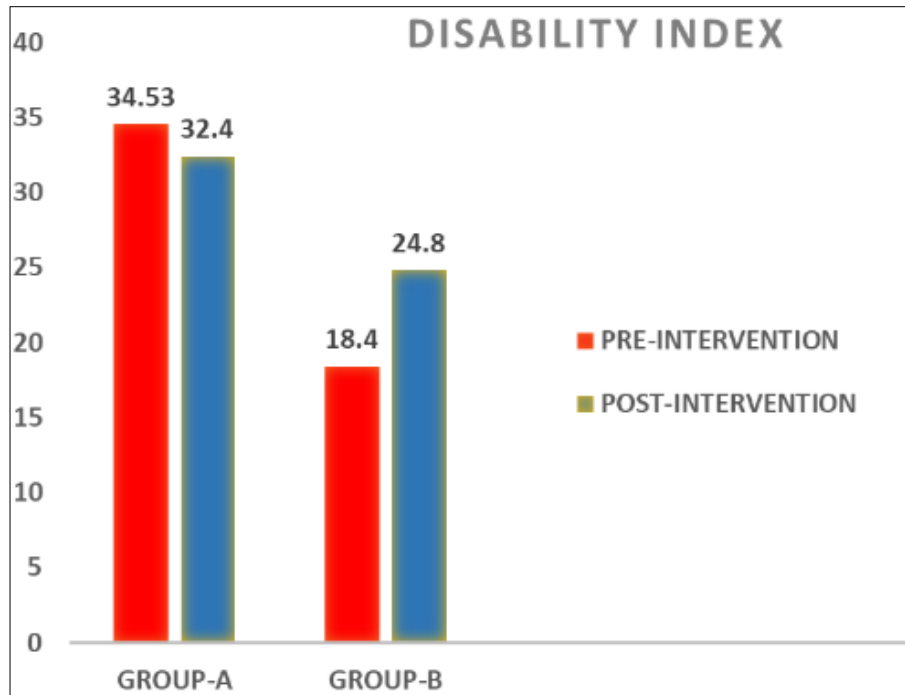
It describes paired t-test done between pre & post intervention for pain values with Group-A & Group-B. The t-values are 7.049, 10.102 respectively.

Tables 4: Mean, Standard Deviation of disability index for the subjects of Group-A and Group-B

Disability index	Group-A		Group-B	
	Mean	S.D.	Mean	S.D.
Pre- Intervention	34.53	9.76	32.4	6.25
Post-Intervention	18.4	4.95	24.8	7.03

It describes the mean and standard deviation of disability index for the subjects of Group-A and Group-B at pre-intervention and post-intervention levels. For group-A it

comes out to be 34.53 ± 9.76 , 18.4 ± 4.95 for Group-B it comes out to be 32.4 ± 6.25 , 24.8 ± 7.03 respectively.



Graph 3: Mean, Standard deviation of Disability index for the subjects of Group-A & Group-B

Table 5: Comparison of mean values for disability index at Pre and Post-intervention within subjects of Group-A and Group-B

Disability Index	Group-A		Group-B	
	t-value	p-value	t-value	p-value
Pre vs Post	7.531	$p \leq 0.001$	6.259	$p \leq 0.001$

It describes paired t-test done between pre & post-intervention for disability index values for subjects within Group-A and Group-B. The t-values are 7.531 and 6.259 respectively.

Intergroup Analysis

Table 6: Comparison of mean values of differences in pain between Group-A&B

Mean Values of difference between groups	Group-A & B	
	t-value	p-value
Pain	3.565	$p \leq 0.01$

It describes un-paired t-test done between Group-A&B for mean values of differences in pain, which is 3.565.

Tables 7: Comparison of mean values of differences in disability index between group-A&B

Mean values of difference between groups	Group-A & B	
	t-value	p-value
Disability Index	3.465	$p \leq 0.01$

It describes unpaired t-test done between group-A&B for mean values of differences in disability index, which is 3.465.

Discussion

The intra group analysis was performed with paired t-test for comparing the values of pain and disability index at pre and post intervention levels of pain in Group-A and Group-B with respective t-values of 7.049 ($p \leq 0.001$) and 10.102 ($p \leq 0.001$). There is a significant difference between pre and

post intervention level of disability index in Group-A and Group-B with respective t-values of 7.531 ($p \leq 0.001$) and 6.259 ($p \leq 0.001$).

The inter group analysis was performed with an unpaired t-test for pain and disability for both groups. The un-paired t-test showed significant difference in mean values of difference in pain between Group-A and Group-B with t-values of 3.465 ($p \leq 0.01$). The unpaired t-test showed significant difference in mean values of difference in disability index between Group-A and Group-B with t-values of 3.465 ($p \leq 0.001$).

In this study there is greater reduction of pain and disability in Group-A as compared to Group-B because the effects of TENS acts on pain modulation and increases the local blood supply which decreases swelling around the joint and improves functional ability of the joints.

However, the application of therapeutic Ultrasound produces temporary increase in the extensibility of collagenous structure like tendon, ligament, and joint capsule [3]. However, in this study TENS was found to be more effective in managing pain and disability than therapeutic Ultrasound when added over isometric quadriceps exercise in subjects with osteoarthritis knee.

Conclusion

The study showed that with common intervention of isometric quadriceps exercise for both the groups; significant reductions were seen in pain and disability in subjects with knee osteoarthritis after four weeks of intervention with TENS than that of therapeutic ultrasound.

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflicts of interest.

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