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Original Research Article

Comparison of Effectiveness of Ultrasound plus Strengthening Exercises and Transcutaneous Electric Nerve Stimulation in Managing Functional Activity and Pain in Patients with Acute Knee Osteoarthritis

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ABSTRACT

Introduction: In elderly population, osteoarthritis is very common, affecting mostly knees, hands, hips, spine, and feet. Knee osteoarthritis can be commonly classified into acute or chronic stage. In the present study, four weeks interventions with ultrasound plus strengthening exercises and transcutaneous electric nerve stimulation were given to patients with acute knee osteoarthritis to observe the efficacy of these modalities.
Method: A total of purposively selected 50 confirmed cases of acute knee osteoarthritis aged 31-65 years were considered for the present study and were collected from the Government Medical College, Jammu, Jammu & Kashmir, India. The subjects were divided into two groups for intervention. Group A consisted of 25 subjects who were treated with ultrasound plus strengthening exercises for four weeks. Group B consisted of 25 subjects who were treated with transcutaneous electric nerve stimulation (TENS) for 4 weeks.
Results: Statistically significant differences ($p<0.022$-0.002) were found in functional activity score (before and after treatment) and pain (after treatment) between the two sets of data. When male and female acute knee osteoarthritis patients treated with ultrasound plus strengthening exercises were compared, statistically no significant differences ($p>0.05$) were found in any case between them. Similarly, when male and female acute knee osteoarthritis patients treated with TENS were compared, statistically significant differences ($p<0.035$-0.017) were found in weight and BMI only between them.
Conclusion: It might be concluded that ultrasound plus strengthening exercises were more effective than transcutaneous electric nerve stimulation for increment of functional activity and reduction of pain in patients with acute knee osteoarthritis.

Key Words: Acute knee osteoarthritis patient. Ultrasound plus strengthening exercises. Transcutaneous electric nerve stimulation.

INTRODUCTION

Osteoarthritis (OA) is one of the most common musculoskeletal disorders resulting in chronic degenerative joint disease. [1,2] In elderly population radiographic evidence of Osteoarthritis is approximately 85%, [3] affecting mostly knees, hands, hips, spine, and feet. [4-6] Patients with knee OA present mostly with pain, articular stiffness, crepitation, articular

edema, joint deformities, articular instability, decrease in range of motion (ROM), physical activity limitations and muscle weakness. [6,7] Hence pain relief with pharmacologic [8,9] and non-pharmacologic strategies [10-13] have been studied widely.

Knee joint being major weight bearing joint consists of: Tibiofemoral joint and Patellofemoral joint. Osteoarthritis is a chronic degenerative disorder primarily affecting the articular cartilage of synovial joint, with eventual bony remodelling and overgrowth at margins of the joints. [14] Knee Osteoarthritis can be commonly classified into acute or chronic stage. Some peculiar features of Knee Osteoarthritis are – pain initially on weight bearing later becomes continuous even at rest, swollen joints due to synovitis, stiffness sets in which gradually results in deformity. [15] Signs and symptoms of end stage OA include- severe pain, loss of joint motion and movements of involved joints, joint effusion, and abnormal gait mechanics. [16] Osteoarthritis is steadily becoming the most common cause for middle age and for those above the age of 65 years. [17]

Physiotherapy provides very effective non-pharmacological interventions knee osteoarthritis [18] and procedures prescribed by physiotherapists are considered important and play a fundamental role in patients' treatment. In this context, kinesiotherapy (KIN) comprising of different types of therapeutic exercises, such as stretching, strengthening (isotonic, isokinetic, and isometric) and aerobic exercise, [19] and electrotherapy are frequently used for the treatment of different musculoskeletal disorders. [20-22] Electrotherapy includes ultrasound (US), a modality of treatment that uses sound waves to generate heat within a body part, and transcutaneous electrical nerve stimulation (TENS), a method of pain relief in which a special device transmits low-voltage electrical impulses through electrodes on the skin to an area of the body that is in pain. [8] In the present study an attempt has been made to observe the efficacy of ultrasound plus strengthening exercises and transcutaneous electric nerve stimulation in patients with acute knee osteoarthritis.

MATERIALS AND METHODS

Subjects

The present cross-sectional study was based on purposively selected 50 confirmed cases of acute knee osteoarthritis aged 31-65 years. The samples were collected from the Government Medical College, Jammu, Jammu & Kashmir, India. The subjects were divided into two groups for intervention. Group A consisted of 25 subjects (21 females and 04 males) who were treated with ultrasound plus strengthening exercises for four weeks. Group B consisted of 25 subjects (21 females and 04 males) who were treated with transcutaneous electric nerve stimulation for 4 weeks. The study was approved by the Institutional Ethics Committee.

Anthropometric Measurements

Three anthropometric variables, such as, height, weight and BMI were taken on each subject using the techniques provided by Lohman et al. [23] and were measured in triplicate with the median value used as the criterion.

The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm. Weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. BMI was then calculated using the formula weight (kg)/height^2 (m) ^{2}. Functional activity and pain score of the patients were measured by Samual-Greenguard Questionnaire (SGQ) and Visual Analog Scale (VAS).

Ultrasound with Knee Strengthening Exercises

In this group, patients of acute knee osteoarthritis were treated with ultrasound along with knee strengthening exercises for four weeks. Session started with patients of this group to perform the exercises, such as, Isometric Quadriceps Exercise, Patellar

Mobility Exercise, End Range Extension and Active Knee Flexion-extension. One set consisted of 10 repetitions; one repetition was held for 10 seconds followed by 10 seconds rest between each successive repetition and the rest period of 2 minutes between the 2 successive sets. Patients were asked to perform 2 sets per session per day. After the completion of exercises, patients were given continuous Ultrasound therapy with 1.5 Watt/cm^2 for 10 minutes with frequency of 1 MHz. For this, subjects were made to sit with knee partially flexed with a pillow underneath the knee. Acoustic gel was applied to the treatment head as well as to the skin over the knee joint to allow perfect contact and allow maximum transmission of the sonic waves. The patients of this group were treated in the similar manner for 5 sessions/week for 4 weeks.

Transcutaneous Electric Nerve Stimulation (TENS)

In this group, patients were treated with transcutaneous electric nerve stimulation for 4 weeks. Patients of this group were positioned for treatment lying supine on the treatment bed. Knee undergoing treatment was slightly flexed and supported with pillow. The area of the skin was cleansed with alcohol to improve skin conductivity. Four rubber electrodes with acoustic gel spreaded evenly over them to improve conductivity were applied to either side of the affected knee joint aligned longitudinally along the length of the limb. The electrodes were secured using Velcro straps. Stimulation frequency was 80 Hz continuous, phase duration was 200 ms, and the current intensity will be strong but comfortable. Each TENS treatment session lasted 30 minutes. The patients of this group were treated in the same way 5 times /week for 4 weeks.

Statistical Analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured and derived variables. Student's t-test was used for the comparison of various variables between patients treated with ultrasound plus strengthening exercises and TENS. Data were analyzed using SPSS (Statistical Package for Social Science) version 20.0. A 5% level of probability was used to indicate statistical significance.

RESULTS

Table 1: Descriptive statistics of selected variables in acute knee osteoarthritis patients treated with ultrasound plus strengthening exercises and TENS

Variables	PUS+SE (n =25)		PTENS (n =25)		t-value	p-value
	Mean	SD	Mean	SD		
Age (years)	50.76	6.41	49.24	4.94	0.964	0.340
HT (cm)	160.20	6.19	158.56	5,52	1.013	0.326
WT (kg)	61.64	12.66	62.00	7.05	0.124	0.902
BMI (kg/m^2)	24.02	4,81	24.78	3.52	0.631	0.531
SMQBT (%)	44.36	6.53	39.08	5.07	3.192	**<0.002**
SMQAT (%)	41.20	6.18	37.40	5.14	2.364	**<0.022**
VASBT	7.16	1,28	6.84	0.85	1.041	0.303
VASAT	4.68	1.60	5.84	0.94	3.123	**<0.003**

PUS+SE = patients with ultrasound plus strengthening exercises, PTENS = patients with TENS, HT = height, WT = weight, BMI = body mass index, SMQBT = Samual-Greenguard Questionnaire score before treatment, SMQAT = Samual-Greenguard Questionnaire score after treatment, VASBT = Visual Analog Scale before treatment, VASAT = Visual Analog Scale after treatment.

Table 2: Descriptive statistics of selected variables in male and female acute knee osteoarthritis patients treated with ultrasound plus strengthening exercises

Variables	Female patients (n =21)		Male patients (n =04)		t-value	p-value
	Mean	SD	Mean	SD		
Age (years)	50.43	6.93	52.50	1.73	0.584	0.565
HT (cm)	160.52	6.39	158.50	4.45	0.591	0.560
WT (kg)	61.00	12.83	65.00	12.91	0.571	0.574
BMI (kg/m^2)	23.67	4.81	25.87	5.09	0.832	0.414
SMQBT (%)	44.86	6.47	41.75	7.13	0.868	0.395
SMQAT (%)	41,28	6.67	40.75	2.87	0.156	0.878
VASBT	7.28	1.27	6.50	1.29	1.131	0.270
VASAT	4.76	1.64	4.25	1.50	0.578	0.569

Table 1 showed the descriptive statistics of selected variables in acute knee osteoarthritis patients treated with ultrasound plus strengthening exercises and TENS. Statistically significant differences (p<0.022-0.002) were found in SMQ score (before and after treatment) and VAS (after treatment) between the two sets of data.

Table 3: Descriptive statistics of selected variables in male and female acute knee osteoarthritis patients treated with TENS

Variables	Female patients (n =21)		Male patients (n =04)		t-value	p-value
	Mean	SD	Mean	SD		
Age (years)	48.95	4.25	50.75	6,70	0.710	0.485
HT (cm)	158.76	5.37	157.50	4.93	0.436	0.667
WT (kg)	60.57	6.17	69.50	7.37	2.582	**<0.017**
BMI (kg/m^2)	24.14	3.18	28.12	3.74	2.240	**<0.035**
SMQBT (%)	38.90	5.17	40.00	5.10	0.389	0.701
SMQAT (%)	37.28	5.26	38.00	5.10	0.250	0.805
VASBT	6.86	0.91	6.75	0.50	0.226	0.823
VASAT	5.86	1.01	5.75	0.50	0.204	0.840

The descriptive statistics of selected variables in male and female acute knee osteoarthritis patients treated with ultrasound plus strengthening exercises were shown in table 2. Statistically no significant differences (p>0.05) were found in any case between them.

Table 3 showed the descriptive statistics of selected variables in male and female acute knee osteoarthritis patients treated with TENS. Statistically significant differences (p<0.035-0.017) were found in weight and BMI between the two sets of data.

DISCUSSION

Osteoarthritis is widely believed to result from local mechanical factors acting within the context of systemic susceptibility. [24] For clinicians, researchers and policymakers, it is important to be able to determine the most successful treatment protocol for managing functional activity and pain in patients with acute knee osteoarthritis. In the present study, four weeks interventions with ultrasound plus strengthening exercises were given to 25 patients and transcutaneous electric nerve stimulation for four weeks were given to another 25 patients. Statistically significant differences were found between the two sets of population in functional activity (before and after treatment) and pain (after treatment) (table 1). The findings of the present study showed that patients treated with ultrasound plus strengthening exercises had increased their functional activity with 7.12%, whereas, using transcutaneous electric nerve stimulation, the increment was 4.30%. So far decrement of pain was concerned, patients treated with ultrasound plus strengthening exercises had the value of 34.64% and with transcutaneous electric nerve stimulation, the decrement was 14.62%. Thus, it might be concluded that ultrasound plus strengthening exercises were more effective than transcutaneous electric nerve stimulation for increment of functional activity and reduction of pain in patients with acute knee osteoarthritis. As it is known that ultrasound is a modality of treatment that uses sound waves to generate heat within a body part [8] and knee strengthening exercises program aims to reduce the medial knee load and pain and improve function in people with medial compartment osteoarthritis. [25] Rutjes et al. [26] failed to confirm that transcutaneous electric nerve stimulation was effective for pain relief in patients with acute knee osteoarthritis. The findings of the present study followed the same direction. The limitation of the study was small sample size, especially in male patients. For this reason, when the comparison of functional activity and pain between male and female patients were done, no significant differences were found (except in two cases). More extensive studies are required considering greater sample size to validate the data.

CONCLUSION

From the findings of the present study, it might be concluded that ultrasound plus strengthening exercises were more effective than transcutaneous electric nerve stimulation for increment of functional activity and reduction of pain in patients with acute knee osteoarthritis.

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