Efficacy of Transcutaneous Electrical Nerve Stimulation for Management of Osteoarthritis of Knee Joint: A Randomized Control Trial

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Abstract

Background: Management of osteoarthritis of knee joint is very important. **Objective:** The purpose of the present study was to observe the efficacy of transcutaneous electrical nerve stimulation (TENS) in the treatment of osteoarthritis (OA) of the knee. **Methodology:** This study was designed as randomized control trial which was conducted in the Department of Physical Medicine at Dhaka Medical College Hospital, Dhaka Bangladesh from July 2007 to December 2007 for a period of six (06) months. Patients presented with osteoarthritis at the age group of more than 30 years to 60 years with both sexes who were attended in Physical Medicine and Rehabilitation department in the Dhaka Medical College Hospital, Dhaka were selected as study population. The study populations were included by purposive sampling method after fulfilling the inclusion and exclusion criteria and were divided into two groups designated as intervention group (group A) and control group (group B). Group A was treated with TENS, therapeutic exercise, NSAID and ADL. Group B was treated with therapeutic exercise, NSAID and ADL. **Results:** A total of 60 patients with osteoarthritis (OA) of the knee joint were included in the study group. The mean age of both sexes were 46.67 ± 7.04 years and male (46.83 ± 7.73) patients were higher than female (46.56 ± 6.41). There was significant difference in improvement of pain between two groups after treatment for two week (p=0.002); however, finally it was found that there was no significant difference in improvement of pain between two groups after treatment for 6(six) weeks. There was no significant difference in improvement of range of movement (ROM) between two groups after treatment for six weeks (p=0.946). There was no significant difference in improvement of walking speed between two groups after treatment for six weeks (p=0.611). **Conclusion:** In conclusion significant decrease of pain with increase of ROM and walking speed is found in all patients group with OA knee regardless of the treatment program. [Journal of National Institute of Neurosciences Bangladesh, 2017;3(2): 75-79]

Keywords: Osteoarthritis; knee joint; transcutaneous; electrical nerve stimulation.

Introduction

There is no cure for osteoarthritis at present[1]; therefore the goal of management of symptoms of osteoarthritis (OA) of the knee is to lessen pain and stiffness, maintain

or improve mobility, and minimize disability[2]. The American College of Rheumatology (ACR) published guidelines for the treatment of OA of the knee which were updated later[3]. These are stated that for mild symptomatic OAQ, treatment may include non-pharmacologic methods like patient education, physical and occupational therapy and other therapies and pharmacologic therapy including non-opoid oral and tropical analgesics. For patients who are unresponsive to this regimen, the use of non-steroidal anti-inflammatory drugs (NSAIDs) is considered appropriate[3].

A corticosteroid injection is recommended for patients with knee OA, particularly when signs of local inflammation with joint effusion are present. Patients with severe symptoms of OA of the knee may require surgical intervention like osteotomy or total joint arthroplasty[4]. Autologous Chondrocyte Implantation may be a possible treatment. Clinical trials employing tissue-engineering methods have demonstrated regeneration of cartilage in damaged knees, including those that had progressed to osteoarthritis[5-6]. Further John Hopkins University was offering to license a technology of this kind[8], listing several clinical competitors in its market analysis.

Different modalities in physiotherapy have been shown to help improve clinical symptoms and functions of knee OA, with fewer adverse effects than medical treatment. Transcutaneous Electrical Nerve Stimulation (TENS) is among these non-invasive therapies which have been used to treat a variety of painful acute and chronic condition. This neuromodulatory method is based on the "Gate-Control theory" of pain perception as described by Melzack and Wall[9]. TENS stimulates large cutaneous (beta) fibers that subsequently transmit a faster impulse via C-fibers to inhibit the pain signals from the small fibres. Thus TENS devices were designed to be used as afferent nerve stimulators that provide adequate pain relief without involving invasive procedures. Several studies have shown that TENS may also stimulate endogenous opiates secretion[10-12]. Three important factors that determine the quality of a TENS device include[13] selection of functioning mode like stimulators, electrode type, design, the wave form of the device, which is modified by adjusting the amplitude, rate, and width controls and the proper location of electrodes. Four types of TENS device settings are currently used in clinical practice[14] which are high frequency consisting of 40 to 150 Hz, 50 to 100 μsec pulse width, moderate intensity, low frequency consisting of 1 to 4 Hz, 100 to 400 μsec pulse width, high intensity, burst frequency consisting of 1 to 4 Hz with high internal frequency, 100 to 250 μsec

pulse width, high intensity and hyperstimulation consisting of 1 to 4 Hz, 10 to 500 msec pulse width, high intensity. In this context this present study was undertaken to find out the efficacy of TENS in the management of knee OA.

Methodology

Study Population and Settings: This study was designed as randomized control trial which was conducted in the Department of Physical Medicine at Dhaka Medical College Hospital, Dhaka Bangladesh from July 2007 to December 2007 for a period of six (06) months. Patients presented with osteoarthritis at the age group of more than 30 years to 60 years with both sexes who were attended in Physical Medicine and Rehabilitation department in the Dhaka Medical College Hospital, Dhaka either directly as an outpatient or referred from other department like Orthopedics, Medicine department were selected as study population. Patients were selected by means of purposive technique. Patients presented with knee pain for more than or equal to 6 months, radiological findings showing osteoarthritis, limitation or difficulty of movement of knee joint with difficulty of walking and walking speed less than 70 meter/minute or patients without any TENS were included for this study. Patients involve in legal litigation, pregnant women, patient with pacemaker, patients under treatment with glucocorticoid or change their medication within 3 months or patients suffering from malignancy, inflammatory arthropathy or knee operation were excluded from this study.

Randomization and Blinding: The study populations were included by purposive sampling method after fulfilling the inclusion and exclusion criteria. After that the patients were divided into two groups designated as intervention group (group A) and control group (group B). This grouping was performed by computer generated simple random sampling method.

Allocation and Intervention: Group A was treated with TENS, therapeutic exercise, NSAID and ADL. Group B was treated with therapeutic exercise, NSAID and ADL. Transcutaneous Electrical Nerve Stimulation (TENS): Current, amplitude, and pulse width adjusted by the patients to produce a comfortable, firm, tingling sensation by adjusting the amplitude first, then the pulse width and then the rate. Electrode placement: 1 each on the anterior, posterior, lateral and medial sided of the painful knee. Treated time per session: 15 minutes; Schedule of treatment: 3 times a week. Therapeutic Exercise: Patients of both treatment groups were advised same type of exercise with equal duration. The exercises are isometric exercise of quadriceps muscle,

back muscle strengthening exercise. Each exercise session was 10 times repetition and 2 times daily for 6 weeks and also advised to maintain ADL instruction properly as demonstrated each patient individually. Analgesic (NSAID): As it was believed that many patients would take analgesic, when they were prescribed or not, patient in both treatment group were given Diclofenac Na 50 mg 2 times daily after meal with Omeprazole 20 mg 2 times 30 minutes before meal for first two weeks.

Follow up and Outcome Measures: All the patients were assessed initially and weekly for six weeks. The following factors were used for assessing and comparing treatments which were patient's assessment of pain by visual analogue scale, range of motion of knee joint and walking speed (meter/minute). The patients were evaluated weekly interval for 6 weeks.

Statistical Analysis: The data were compiled and coded properly. The numerical data were analyzed statistically. The results were expressed as mean ± SD unless stated and statistical analysis was done by using SPSS package for windows. Both the paired and unpaired Student's 't' test were done appropriate, $p<0.05$ was considered the level of significance. In this study, the subjects/subject's were informed about the nature of the study and written consent was taken. There was no involvement of children in the study. New drugs and new modalities of rehabilitative intervention did not use for the trial. TENS, exercise, ADL (Activities of Daily Living) training and NSAID was used for the management of OA knee symptoms and the patient was benefited. There was no involvement of privacy and no chance of physical and social risks. All the records were kept under lock and key. Every patient had the opportunity to receive or withdraw himself from the study at any time but treatment facilities were same for him or her.

Results

A total of 60 patients with osteoarthritis (OA) of the knee joint were included in the study group. All the cases were managed as out patients. The age range of the patients in the study varied from >30 to <60 years in respective of both sexes. The mean age of both sexes were 46.67±7.04 years and male (46.83±7.73) patients were higher than female (46.56±6.41) (Table 1).

Regarding pain, in comparison between two groups, there was significant difference in improvement of pain between two groups after treatment for two week (p=0.002 Table 12) but finally it was found that there was no significant difference in improvement of pain

between two groups after treatment for 6(six) weeks (p=0.564 possibly due to withdraw of NSAIDs from both groups after two weeks of treatment (Table 2).

Table 1: Mean age distribution of the patients with OA knee (n=60)

Sex	Mean age(years)	SD
Male	46.83	7.73
Female	46.56	6.41
Both sexes	46.67	7.04

Table 2: Comparative Improvement of Pain between Group A and Group B in different time points

Score	Groups		95% CI	P value
	A (n=27)	B (n=28)		
At W_0	7.41±2.26	8.21±2.32	-2.04 to -0.43	0.197
At W_1	6.04±1.83	7.00±1.98	-2.00 to 0.07	0.067
At W_2	4.48±2.06	6.25±2.07	-2.89 to 0.65	0.002
At W_3	4.41±2.27	5.36±1.83	-2.06 to 0.16	0.093
At W_4	4.30±2.28	5.04±1.91	-1.88 to 0.40	0.198
At W_5	4.22±1.97	4.50±1.55	-1.23 to 0.68	0.563
At W_6	4.11±2.03	4.39±1.55	-1.25 to 0.69	0.564

Results are expressed as mean±standard deviation (SD), n= number of patients; W_0 = at the 1st attendance (Pretreatment);W_1 = at the end of 1st week; W_2 = at the end of 2nd week; W_3 = at the end of 3rd week; W_4 = at the end of 4th week; W_5 = at the end of 5th week; W_6 = at the end of 6th week

Regarding range of motion, in comparison between two groups, there was no significant difference in improvement of ROM between two groups after treatment for six weeks (p=0.946) (Table 3).

Table 3: Comparative Improvement of Range of Motion between Group A and Group B in different time points

Score	Groups		95% CI	P value
	A (n=27)	B (n=28)		
At W_0	99.78±12.87	102.71±11.35	-9.49 to 3.62	0.373
At W_1	101.70±12.00	104.75±10.72	-9.19 to 3.10	0.325
At W_2	103.93±11.06	106.32±10.06	-8.11 to 3.32	0.404
At W_3	105.63±10.98	108.29±9.97	-8.32 to 3.01	0.352
At W_4	108.30±10.82	109.96±9.65	-7.21 to 3.87	0.548
At W_5	111.15±10.50	11150±9.23	-5.69 to 4.99	0.895
At W_6	112.96±10.26	112.79±9.09	-5.06 to 5.41	0.946

Results are expressed as mean±standard deviation (SD), n= number of patients; W_0 = at the 1st attendance (Pretreatment);W_1 = at the end of 1st week; W_2 = at the end of 2nd week; W_3 = at the end of 3rd week; W_4 = at the end of 4th week; W_5 = at the end of 5th week; W_6 = at the end of 6th week

Regarding walking speed, in comparison between two groups, there was no significant difference in improvement of walking speed between two groups

after treatment for six weeks (p=0.611) (Table 4).

Table 4: Comparative Improvement of Walking speed between Group A and Group B in different time points

Score	Groups		95% CI	P value
	A (n=27)	B (n=28)		
At W_0	65.91±4.90	65.55±4.77	-2.26 to 2.97	0.787
At W_1	68.19±4.67	67.34±4.41	-1.61 to 3.30	0.493
At W_2	70.72±4.57	68.48±4.07	-0.10 to 4.58	0.060
At W_3	71.44±4.37	70.20±3.95	-1.00 to 3.50	0.271
At W_4	72.37±4.41	71.70±3.80	-1.55 to 2.90	0.546
At W_5	73.35±4.37	72.96±3.69	-1.80 to 2.57	0.723
At W_6	74.37±4.24	73.82±3.71	-1.60 to 2.70	0.611

Results are expressed as mean±standard deviation (SD), n= number of patients; W_0 = at the 1st attendance (Pretreatment);W_1 = at the end of 1st week; W_2 = at the end of 2nd week; W_3 = at the end of 3rd week; W_4 = at the end of 4th week; W_5 = at the end of 5th week; W_6 = at the end of 6th week

Discussion

The osteoarthritis of knee is common disorder of elderly people especially after the age of 40 years[15-17]. The major symptoms of an OA knee are aching, functional limitation and stiffness. Physical therapy restores ability allowing a better functional level and the improvement occured irrespective of whether treatment was given in hospital or at home[18-21]. In this study, dufferences of outcome between the two groups were compared.

Age of the patients: In our study, the mean age of the patients in the study was 46.67 7.04 years. Out of 60 patients in the study, most of the patients of OA knee were at the age group 40 to 49 years, 28(46.67%) cases were in this group. And then 18(30.00%) patients were 3 in the age group of 50 to 59 years. The lowest groups were in the age group of 30 to 39 years, only 14(23.33%) cases was in this group. In another study[17] the mean age was found to be 52.10 12.22 years.

Outcome of treatment: The most important finding of the current study is the outcome of the patients with OA knee. The significant improvement of symptoms of group A began to appear at the end of second week and of group B began to appear at the end of third week. Significant difference of improvement was found to begin between the groups at the end of second week. At the end of 6th week no significant improvements of symptoms were found.

Shakoor et al[22] in their study in chittagong, Bangladesh found thaat quadriceps exercise and ADLs in patients with OA knee was beneficial to reduce symptoms which supports the present study. In the study all of the patients reponded very well to either groups and there was no significant difference between the treatment effects. In this study, in terms of over all assessment i.e. visual analogue scale, joint ROM index and walking speed, patient belonging to TENS, therapeutic exercise, ADL as well as NSAID (Group A) has shown no significant improvement than that of only therapeutic exercise, ADL as well as NSAID (Group B).

This perspective study was performed in the Department of Physical Medicine and Rehabilitation, Dhaka Medical College Hospital, Dhaka during a period of 6 months, lasting from Jul 2007 to Dec 2007 , to see the efficacy of Transcutaneous electrical nerve stimulation for the management of osteoarthritis of the knee. A total of 6328 patients were treated during this period.of which 501 (7.91%) were found to have been suffering from painful knee. From this patients, with osteoarthritis of knee, 60 patients were selected in the study. They were divided intwo groups. 30 patients in group A (TENS+Therapeutic exercise+ NSAID +ADL) and another 30 in group B (Therapeutic exercise+ NSAID +ADL). In both groups Patients were treated for six weeks. Out of 60 Patients studied 36(60%) were female and 24(40%) were male. The female to male ratio 1.5:1. Age distribution varied from > 30 to <60 years with a mean age was 46.67±7.04 years. Maximum patients (46.67%) belonged to age group from 40 to 49 years in both sexes and house wives were maximum in number (36.67%). Study parameters are used to assess the disease activity and functional capability of the patients, among them pain score by visual analogue scale, range of motion and walking speed index. In present study, the groups showed highly signicant improvement individually after treatment but failed to show any statistically significant difference in treatment effects between group A and group B for OA knee.

There are some limitations of this study. Sample number was small as period of study was short. Since the study was conducted in only one selected hospital (Dhaka Medical College Hospital) the study result may, however, differ from other hospitals.

Conclusion

In conclusion significant decrease of pain with increase of ROM and walking speed is found in all patients group with OA knee regardless of the treatment program. This study failed to show any significant difference in treatment effects between TENS and exercise program. However, an exercise program accompanying with TENS promoted the treatment effect in both decreased pain, increased function. Study

with longer duration should be carried out with large number of subjects. Multicenter study should be carried out to see the outcome of transcutaneous electrical nerve stimulation for the management of osteoarthritis of the knee.

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