TAJ June 2023; Volume 36 Number-1

ISSN 1019-8555
The Journal of
Teachers Association
RMC, Rajshahi

Original Article

Comparison of the Efficacy of Transcutaneous Electrical Nerve Stimulation and Short Wave Diathermy on Patients with Chronic Nonspecific Low Back Pain

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Abstract

Background: Transcutaneous electrical nerve stimulation (TENS) is widely used as a therapeutic adjunct in the management of low back pain. It is a relatively safe, non-invasive, and easy-to-use modality, making it an attractive treatment option. For more than four decades, TENS has been applied in the treatment of acute and chronic pain syndromes.

Short wave diathermy (SWD) is a modality that produces deep heating by converting electromagnetic energy to thermal energy. Short wave diathermy (SWD) is also a popular therapy for low back pain.

Methods: This randomized controlled clinical trial was conducted to evaluate the comparative efficacy between TENS and SWD on chronic nonspecific low back pain patients. One hundred twenty patients with chronic low back pain were treated according to inclusion & exclusion criteria. Patients were equally distributed in three groups. Group-A patients (n=40) were treated with NSAID+ADL, Group-B patients (n=40) were treated with NSAID+ADL+TENS, and Group-C patients (n=40) were treated with NSAID+ADL+SWD. Written informed consent was obtained from all patients. Data were calculated and analyzed by computer-based software SPSS (Statistical Package for Social Science) Windows 16.0 version.

Main outcome measure (s): Subjective pain intensity score, visual analogue scale, tenderness index, disability due to pain, spinal mobility index, and Oswestry disability index.

Results: The mean duration of pain was found to be 23.90±2.57 months in group A, 21.0+1.50 months in group B and 22.1±1.89 months in group C. The visual analog score was improved individually in group-A, group B and Group C after treatment, which was statistically significant (P<0.05). Oswestry disability questionnaire score was also improved individually in group-A, group B and Group C after treatment, which was statistically significant (P<0.05). In the case of comparison between Group B and Group C, this was not statistically significant (P>0.05). In this current study, it was observed that the entire variable individually improved in Group-A, Group B, and Group C. So, all three treatment groups benefited from drugs and therapy. However, these were not statistically significant (P>0.05) between Group B and Group C.

Conclusion: Beneficial effects of TENS and SWD were seen in the study population, but no firm conclusion could be drawn.

Keywords: TENS, SWD, chronic low back pain.

TAJ 2023; 36: No-1: 63-73

Introduction

Low back pain (LBP) is defined as an uncomfortable sensation in the lumbar and buttock region originating from neurons near or around the spinal canal that are injured or irritated by one or more pathologic processes.[1] LBP is commonly categorized into acute, sub-acute, and chronic. Acute LBP is usually defined as a period of

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complaint of six weeks or shorter, sub-acute LBP as a period between six and twelve weeks, and chronic LBP as a period of complaints of more than twelve weeks.[2] Nonspecific low back pain is tension, soreness, and/or stiffness in the -lower back region for which it is not possible to identify a specific cause of the pain or inflammatory processes.[3]

Mechanical LBP ranks as the second most common symptom-related reason for seeing a physician. According to the COPCORD study, the prevalence of chronic nonspecific low back pain in Bangladesh is 6.6%.[4]

The management of LBP encompasses drug treatments, exercise, patient education, physical therapy, and other non-pharmacological therapies.[5] Transcutaneous electrical nerve stimulation (TENS) is widely used as a therapeutic adjunct in the management of low back pain.[8] Shortwave diathermy (SWD) is also a popular therapeutic modality for low back pain.[10]

The most common sites of Low back pain are around L4/L5 and L5/S1 spine.[9] The benign mechanical causes are divided into static (postural) and kinetic (faulty biomechanical) types. The treatment goals are to relieve pain, reduce muscle spasms, improve strength and range of motion, promote early return to activity, and ultimately improve functional status.[1]

TENS is a non-invasive therapeutic modality. TENS units stimulate peripheral nerves via skin surface electrodes at well-tolerated intensities.[23] The development and application of TENS were based on the *Gate Control Theory15*. According to this theory, the stimulation of large diameter (A-beta) primary sensory afferents activates inhibitory interneurons in the substantia gelatinosa of the spinal cord dorsal horn and, thereby, attenuates the transmission of nociceptive signals from small diameter A-delta and C fibers.[16]

Several types of TENS applications, differing in frequency, amplitude, pulse width, and waveform, are used in clinical practice. The two most common application modes include 1) high frequency or conventional TENS (40 to150 Hz, 50 to 100 uses pulse width, low intensity) and 2) low frequency or so-called acupuncture-like TENS (1 to 4 Hz, 100 to 400 uses pulse width, high intensity). Conventional TENS is associated with a faster onset and shorter duration of analgesia compared to acupuncture-like TENS 16.

Short wave diathermy (SWD) is a modality that produces deep heating via the conversion of electromagnetic energy to thermal energy. Oscillation of high-frequency electrical and magnetic fields produces movements of ions, rotation of polar molecules, and distortion of non-polar molecules, with resultant heat generation.[9] As electromagnetic energy is delivered to the tissue via continuous SWD, increased average molecular kinetic energy leads physiologically to the thermal effect of vasodilatation, increased rate of nerve conduction, increased collagen extensibility, and increased nociceptive threshold.[10]

Most physicians believe that physical therapy and multidisciplinary treatment programs are effective for chronic low back pain. This can be due to the absence of clear evidence-based clinical guidelines explained by Delitto et al.[15]

Materials and Methods

General: To determine the effectiveness of TENS and SWD in the management of chronic nonspecific low back pain.

Specific: To compare the outcome of chronic nonspecific low back pain with/ without TENS and SWD.

It was a randomized controlled clinical trial done at the Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka. The study population was selected from the Department of Physical Medicine and Rehabilitation, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka. The sample size was 120 patients. Subjects were selected purposively according to the availability of the patients who fulfilled the inclusion criteria and then randomly allocated into three groups by lottery. Patients of both sexes aged between 21-65 years having low back pain for > 3 months were included in the study. Pregnant women, patients

who had undergone vertebral column surgery, individuals with contraindications against electrotherapy, such as skin lesions, abnormal sensitivity, infections & blood diseases, and patients with pacemakers were excluded from the study.

The main outcome variables were:

Subjective pain intensity score, visual analog scale, tenderness index, disability due to pain, spinal mobility index, and Oswestry Disability Index

Study Procedure:

Patients with chronic low back pain for at least three months duration attended the Department of Physical Medicine and Rehabilitation, NITOR, Dhaka, according to inclusion & exclusion criteria. After evaluation, the patients were randomized by drawing a lottery through numbers created by a computer into three groups: A) Controls (n=40); B) TENS (n=40); C) SWD (n=40) in Group B TENS machine operated with a low frequency of 0.5 to 10 Hz and high intensity of 15 to 50 mA. Electrodes placed the paravertebral region over the lower back for 20 minutes 3 times/week for up to 8 weeks. Moreover, in Group-C, SWD, Condenser pads were applied to the back with spacing between skin and electrodes provided by a 1 to 2-inch layer of terry cloth and were applied for 20 minutes three times a week for up to eight weeks. Diathermy Machine(SWD) operated at a frequency of 27.33 megacycles. The output amperage of the shortwave apparatus was between 15 and 25 amperes. NSAID & ADL were advised in Group-A and, B, and C. NSAID was prescribed in the form of Naproxen 250 mg twice daily orally along with ADL advice to all the groups.

Data were processed and analyzed using the computer software SPSS (Statistical Package for Social Science). The test statistics used were descriptive statistics, Chi-square (X^2), and F-test (Analysis of variance). The test Level of significance was set at 0.05, and $P<0.05$ was considered significant.

Results

Table I: Age distribution of the study subjects (n=120)

Age	Study group			
	Group A (n=40)	Group B (n=40)	Group C (n=40)	P-value
21-40 yrs	19(47.5)	18(45.0)	22(55.0)	
41-60 yrs	17(42.5)	17(42.5)	14(35.0)	
> 60yrs	04(10)	05(12.5)	04(10)	
Means ± SD	41.82(±11.95)	42.70(±12.52)	40.52(±13.40)	0.718

Table I shows the age distribution of patients. The difference in ages of patients among Group-A, B, and C are not statistically significant.

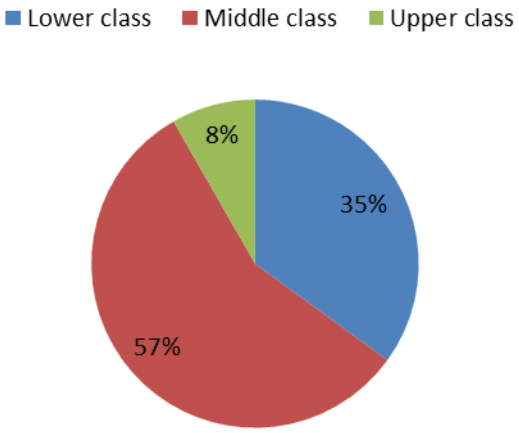

Figure I: shows the socioeconomic conditions of the study subjects. 57% of patients are from middle-class families.

Table II: Distribution of the occupation of the study subjects

Occupation	Group A n=40(%)	Group B n=40(%)	Group C n=40(%)	P-Value
Service	6(15)	5(12.5)	6(15)	0.568
Business	5(12.5)	4(10)	5(12.5)	0.954
Housewife	9(22.5)	08(20)	7(17.5)	0.307
Driver	04(10)	5(12.5)	6(15)	0.669
Teacher	3(7.5)	3(7.5)	3(7.5)	1.001
Nurse	2(5.0)	2(5.0)	2(5.0)	1.000
Day Laborer	3(7.5)	6(15)	5(12.5)	0.030
Student	5(12.5)	5(12.5)	5(12.5)	1.000
Others	3(7.5)	2(5.0)	3(7.5)	0.459

Table II Shows majority in all the groups were Housewife, who was 9 (22.5%) persons in Group-A and 08 (20%) persons in Group B, and 7(17.5%) persons in Group C.

Table III: Treatment Response in Group-A

	Mean±SD	P value
Subject pain intensity		
Pre-treatment score W_0	3.21±0.72	
Post-treatment score W_8	2.56±0.62	0.007
Pain score (VAS)		
Pre-treatment score W_0	7.06±0.81	0.004
Post-treatment score W_8	6.55±0.77	
Tenderness index		
Pre-treatment score W_0	2.49±0.71	0.020
Post-treatment score W_8	1.94±0.64	
Disability due to pain		
Pre-treatment score W_0	2.05±0.72	0.021
Post-treatment score W_8	1.38±0.69	
Spinal mobility index		
Pre-treatment score W_0	5.33±0.28	0.009
Post-treatment score W_8	5.37±0.27	
Oswestry disability index		
Pre-treatment score W_0	54.00±4.96	0.002
Post-treatment score W_8	12.00±4.05	

Table III shows significant improvement in Subjective pain intensity, VAS, tenderness index, disability due to pain, spinal mobility index, and Oswestry disability index in Group-A.

Table IV: Treatment Response in Group-B

Parameter	Mean±SD	P value
Subject pain intensity		
Pre-treatment score W_0	3.27±0.66	
Post-treatment score W_8	2.11±0.67	0.001
Pain score (VAS)		
Pre-treatment score W_0	7.11±0.83	0.002
Post-treatment score W_8	6.11±0.75	
Tenderness index		
Pre-treatment score W_0	2.72±0.46	0.001
Post-treatment score W_8	1.88±0.58	
Disability due to pain		
Pre-treatment score W_0	2.44±0.61	0.021
Post-treatment score W_8	1.61±0.50	
Spinal mobility index		
Pre-treatment score W_0	5.41±0.33	0.004
Post-treatment score W_8	5.45±0.32	
Oswestry disability index		
Pre-treatment score W_0	53.40±4.96	0.002
Post-treatment score W_8	12.00±4.05	

Table IV Shows significant improvement in Subjective pain intensity, VAS, tenderness index, disability due to pain, spinal mobility index, and Oswestry disability index in Group B.

Table V: Treatment Response in Group-C

Parameter	Mean±SD	P value
Subject pain intensity		
Pre-treatment score W_0	3.15±0.48	
Post-treatment score W_8	1.35±1.08	0.001
Pain score (VAS)		
Pre-treatment score W_0	7.15±0.75	0.001
Post-treatment score W_8	5.25±0.16	
Tenderness index		
Pre-treatment score W_0	2.90±0.30	0.001
Post-treatment score W_8	1.30±1.08	
Disability due to pain		
Pre-treatment score W_0	2.10±0.64	0.001
Post-treatment score W_8	0.90±0.71	
Spinal mobility index		
Pre-treatment score W_0	5.36±0.32	0.001
Post-treatment score W_8	5.49±0.26	
Oswestry disability index		
Pre-treatment score W_0	48.87±5.71	0.001
Post-treatment score W_8	12.25±4.05	

Table V Shows significant improvement in Subjective pain intensity, VAS, tenderness index, disability due to pain, spinal mobility index, and Oswestry disability index.

Table VI: Comparative study of Group-A, Group B, and Group-C

	Study Group			P value
	Group-A Mean±SD	Group-B Mean±SD	Group-C Mean±SD	
Subject pain intensity				
Pre-treatment score W_0	3.21±0.72	3.27±0.66	3.15±0.48	0.824
Post-treatment score W_8	2.56±0.62	2.11±0.67	1.35±1.08	0.001
Pain score (VAS)				
Pre-treatment score W_0	7.06±0.81	7.11±0.83	7.15±0.75	0.935
Post-treatment score W_8	6.55±0.77	6.11±0.75	5.25±0.16	0.001
Tenderness index				
Pre-treatment score W_0	2.49±0.71	2.72±0.46	2.90±0.30	0.064
Post-treatment score W_8	1.94±0.64	1.88±0.58	1.30±1.08	0.030
Disability due to pain				
Pre-treatment score W_0	2.05±0.72	2.44±0.61	2.10±0.64	0.162
Post-treatment score W_8	1.38±0.69	1.61±0.50	0.90±0.71	0.004
Spinal mobility index				
Pre-treatment score W_0	5.33±0.28	5.41±0.33	5.36±0.32	0.752
Post-treatment score W_8	5.37±0.27	5.45±0.32	5.49±0.26	0.001
Oswestry disability index				
Pre-treatment score W_0	54.00±4.96	53.40±4.96	48.87±5.71	0.272
Post-treatment score W_8	12.00±4.05	12.00±4.05	12.25±4.05	0.070

Table VI Shows that the treatment responses of Group-A were compared with the other two groups. There were no significant differences in pre-treatment assessment, and the improvement during treatment in all three groups was significant.

Table II: Comparative study of Group-A, Group B, and Group C (ANOVA-F)

	F	P value
Subject pain intensity		
Pre-treatment score W_0	0.025	0.824
Post-treatment score W_8	8.760	0.001
Pain score (VAS)		
Pre-treatment score W_0	2.620	0.935
Post-treatment score W_8	12.79	0.001
Tenderness index		
Pre-treatment score W_0	2.890	0.064
Post-treatment score W_8	5.080	0.030
Disability due to pain		
Pre-treatment score W_0	0.591	0.162
Post-treatment score W_8	3.900	0.004
Spinal mobility index		
Pre-treatment score W_0	3.410	0.752
Post-treatment score W_8	5.318	0.001
Oswestry disability index		
Pre-treatment score W_0	2.33	0.272
Post-treatment score W_8	10.22	0.070

Table II: Shows the treatment responses of Group-A compared with the other two groups

Discussion

This current study observed that the mean age in Group-A was 41.82±11.95 and 42.7±12.52 in Group B, and 40.52 ± 13.40 in Group C. The mean age differences among all groups are not significant. In Shakoor MA et al.[7] study, the mean age was 42.22 ± 8.07 years in a study conducted with 102 choric low back pain patients. The above study findings are all similar to the current study.

This study observed that most patients came from the middle class, followed by the poor class. Poor people in our country have to do heavy work, including repetitive twisting, bending, heavy weight lifting, Etc. Shakoor et al.[7,] in a study with patients with chronic low back pain, that the maximum number of patients were from the middle socioeconomic group. So the above findings are consistent with the present study.

In this study, the mean pain duration was 23.9± 2.57 months in Group-A and 21.0 ± 1.5 months in Group B, and 22.1 ± 1.89 months in Group C. Almost similar observations were also made by Shimada et al. 19 and Kramer.[20]

This current study observed that the entire variable individually improved in Group-A, Group B, and Group-C. All therapies were helpful. However,

there was no significant difference in improvement between TENS and SWD.

VAS was better in patients who took TENS or SWD than in those who did not. Nevertheless, these difference was not statistically significant. Subjective pain intensity and tenderness index improved in both groups and were statistically significant ($P<0.05$), but in between the groups, these were not statistically significant($P>0.5$). Disability due to pain and spinal mobility index-both the variables improved at the end of week eight and were statistically significant ($P<0.05$). Deyo et al.[13] showed all most similar observations.

Gibson et al.[21] compared the effect of SWD and exercise on patients with LBP and found no difference between their effects. This is also consistent with the present study.

Conclusion

The number of patients studied was small, and there were some limitations of this trial. Beneficial effects of drugs, ADL training, TENS, and SWD were seen in this study. Considering the information gathered from this study, all the tested therapies improved the patients with chronic low back pain. However, TENS and SWD showed no significant difference in improvement for the patients with chronic LBP.

Conflict of interest: None declared

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