

The Effect of Scrambler with Stretching on Psychological Change in Breast Cancer Patient

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Purpose The purpose of this study was to confirm the effects of scrambler and stretching application on depression, anxiety, and pain, which are psychogenic changes in breast cancer patients. **Methods** The subjects of this study were randomly assigned to 24 breast cancer patients, 12 in the scrambler and stretch application group, and 12 in the transcutaneous nerve muscle electrical stimulation and stretching application group. They were applied for 1 hour a day, 5 times a week, for a total of 3 weeks. Within-group changes were analyzed by a paired t-test, and between-group changes were analyzed using an independent t-test, with a significance level of 0.05. **Results** As a result of this study, depression was significantly reduced in the intra-group change between the experimental group and the control group ($p < 0.05$), and there was also a significant difference in the intra-group change ($p < 0.05$). Anxiety and pain were significantly reduced in the within-group change ($p < 0.05$) and there was no significant difference in the between-group change ($p > 0.05$). **Conclusion** By disrupting pain signals of C-fibers with electrical stimulation, reducing the intensity of pain so that the brain cannot recognize it as pain, it is presumed to improve depression, anxiety, and distress, thus potentially impacting the enhancement of quality of life.

Key Words Breast cancer, Depression, Anxiety, Scrambler, Stretching

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1. Introduction

Pain in breast cancer patients includes local nerve damage caused by the intercostobrachial nerve, axillary nerve damage during surgery, neuroma formation, and nerve entrapment due to scar fibrosis.¹⁾ Currently, there is no standard treatment for central neuropathic pain, and the only medications frequently used for pain treatment are antiepileptics, antidepressants, and non-steroidal anti-inflammatory drugs.²⁾ In addition, the limitations and risks of pain treatment are being recognized, and more and more weight is being placed on non-pharmacological treatment methods for continuous pain management.³⁾

Electrical stimulation can improve cognitive control, motivation, and mood, including pain, disability, anxiety,

fear, avoidance, worry, depressive states, mood regulation, and quality of life.^{4,5)}

Scrambler treatment is a type of electrical analgesic that uses a device that sends painless signals through electrodes attached to the skin near the painful area. It has been used to treat various types of chronic pain, such as phantom limb pain, back pain, and cancer-related pain.^{6,7,8,9,10)}

While the traditional treatment is TENS(transcutaneous electrical nerve stimulation), Scrambler therapy is a novel approach to controlling pain by providing 'no-pain' information through the cutaneous nerves, thereby blocking pain information that may be affected by depression, anxiety and distress.^{2,11,12,13,14)} The principle of TENS targets A-beta fibers to inhibit pain transmission, while scrambler therapy produces painless information from surface receptors of C-fibers.¹⁵⁾

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Scrambler therapy is a non-invasive method of transcutaneous neuromodulation, and it transmits normal messages to the central nervous system by using the plasticity of the nervous system, regulates or readjusts the pain system, interferes with the transmission of pain signals by manipulating physiological or pathological information, and relieves acute pain after trauma, intractable pain, postoperative pain, and managing chronic pain.^{3,4,12,16} It is an adjunctive treatment to pharmacological therapy for the treatment of chronic drug-resistant cancer pain, which can significantly reduce analgesic requirements, improve quality of life in cancer patients.¹⁷

Scrambler therapy has been found to be effective in reducing pain in patients undergoing fasciotomy¹⁸ and has also been reported to reduce itching in the treatment of burns.¹⁹ Additionally, its application has been reported to effectively reduce pain in patients with severe pain caused by postherpetic neuralgia,²⁰ indicating its utility across various conditions and confirming the therapeutic effects of scrambler therapy.

The purpose of this study was to investigate the effect of scrambler treatment on the reduction of depression, anxiety, and distress compared to TENS in breast cancer patients.

II. Materials and Methods

1. Subject

The subjects of this study were 24 people in their 40s and 50s who were diagnosed with breast cancer. The composition of the population is G*Power based on the previous study by Moon et al.,²¹ power ($1-\beta = 0.90$), effect size ($d = 0.8$), and significance level ($\alpha = 0.05$), and 11 people were calculated.

Considering the dropout rate, 2 additional subjects were recruited for a total of 24 subjects. The intervention method and the purpose of the experiment were fully explained to all subjects, and those who expressed their willingness to participate voluntarily participated in the experiment by obtaining informed consent based on the Declaration of Helsinki.

The subjects were randomly selected by a lottery

and classified into Scrambler with stretching group(SSG) 12 persons and TENS with stretching group(TENSSG) 12 persons. The selection criteria for subjects were those who had completed surgical treatment, chemotherapy, and radiation treatment within 6 months of being diagnosed with breast cancer, and those who did not have cognitive decline or other diseases. All subjects applied 15 minutes of general superficial heat treatment and 5 minutes of deep heat treatment, and the experimental group applied additional stretching along with scrambler treatment.

The study was conducted on breast cancer patients who had been adequately informed about the purpose and methods of the experiment and had consented to participate. Patients who had undergone spinal surgery, suffered from fractures, malignant tumors, neurological symptoms, or had given birth within one year were excluded from the study.

2. Experiment procedure

All subjects applied 15 minutes of general superficial heat treatment, 5 minutes of deep heat treatment, and 10 minutes of stretching. In addition, 30 minutes of scrambler treatment was applied to the experimental group and 30 minutes of TENS to the control group.

To relieve depression, anxiety and distress through pain control in breast cancer patients, the painful area was identified and marked with a medical pen, and the electrode was attached to a point 3 to 4 cm away and the intensity was applied within the allowable range. It was applied 30 minutes a day, 5 times a week for 3 weeks. The scrambler device used CALMARE™ model MC-5A (GEOMC Co., Seoul), and the expression of the stimulus waveform is as follows; 500Ω load, output frequency range: 42-53Hz, output voltage range: 11.875-118.75V p-p, output current range: 11.875-23.78mA p-p.

Stretching was applied to the pectoralis minor, trapezius, and rhomboid after scramble treatment, for a total of 10 minutes, 10 times for 30 seconds. For the pectoralis minor stretching, 90° elbow joint flexion, maximal abduction and external rotation of the upper arm joint were performed in a sitting position. And trapezius stretching was performed in the supine posi-

tion with abduction, flexion, and external rotation of the upper arm joint. And, for rhomboid stretching, flexion of the elbow joint and extension of the humerus joint were performed followed by medial rotation.

The control group applied TENS for 30 minutes a day, 5 times a week for 3 weeks after attaching electrodes to the painful areas. In the control group, stretching was applied to the pectoralis minor, trapezius, and rhomboid in the same way as the experimental group.

3. Measurement method

3.1 Depression measurement

The degree of depression was measured using the Beck Depression Scale-II. The Beck Depression Scale-II consists of 21 multiple-choice questions and measures the degree of depression for the past 2 weeks from the time of evaluation. The total score of the Beck Depression Scale-II ranges from 0 to 63, and the higher the score, the more severe depression and various symptoms are experienced. The reliability of this tool is 0.94.²²⁾

3.2 Anxiety measurement

Anxiety was measured using the Beck Anxiety Inventory(BAI). The BAI is an evaluation of how much anxiety has been experienced in the past week in a 21-item scale from 0 to 3 points in a Likert method and consists of a total score of 0 to 63 points. A high score on the BAI indicates high anxiety, and Cronbach's alpha is 0.78.²³⁾

3.3 Distress measurement

For the measurement of distress, a distress thermometer developed by the National Comprehensive Cancer Network was used to measure the psychological pain of cancer patients. For the measurement of pain, a distress thermometer developed by the national comprehensive cancer network was used to measure the psychological pain of cancer patients. This tool uses a visual analog scale consisting of 0 to 10 points and marks all the mental pain felt by cancer patients for a week in the corresponding number. In addition, it marks extreme pain as 10 points and no

pain as 0, so the higher the score, the higher the pain, and the reliability is 0.86.²⁴⁾

3.4 Data analysis

All the collected data were used with the statistical program SPSS for window ver21.0. A Shapiro-wilk test was performed to confirm the normal distribution of the subjects, and a paired t-test was performed to confirm the intra-group changes between the experimental group and the control group. The difference between the experimental group and the control group was determined using an independent t-test, and the significance level was set at $\alpha = 0.05$.

III. Results

1. General characteristics of subjects

The subjects of this study were a total of 24, and the average age of the experimental group was 50.25 ± 5.36 years, the average height was 158.75 ± 4.75 cm, and the average weight was 57.16 ± 7.54 kg. The average age of the control group was 49.50 ± 4.6 years, the average height was 160.58 ± 3.23 cm, and the average weight was 52.25 ± 6.46 kg. Postoperative chemotherapy totaled 9(75 %) in the experimental group and 7(58.3 %) in the control group, and radiation therapy totaled 10 (83.3 %) in the experimental group and 9(75 %) in the control group. Lymphedema symptoms appeared in 7 (58.3)% of the experimental group and 6(50 %) of the control group. The general characteristics of the research subjects are as follows(Table 1).

2. Changes in depression

As for the change in depression, there was a significant difference between the experimental group and the control group after 3 weeks($p < 0.05$) and between-group change after 3 weeks($p < 0.05$)(Table 2).

3. Change in anxiety

As for the change in anxiety, there was a significant difference between the experimental group and the control group after 3 weeks ($p < 0.05$), and there was no significant difference between the group changes

Table1. General characteristics of subjects

	SSG(n=12)		TENSSG(n=12)		p
Height(cm)	158.75±4.75		160.58±3.23		0.508
Age(years)	50.25±5.36		49.50±4.66		0.671
Weight(kg)	57.16±7.54		52.25±6.46		0.833
	Presence	Absence	Presence	Absence	
Anticancer Treatment(%)	9(75)	3(25)	7(58.3)	5(41.6)	
Radiation therapy(%)	10(83.3)	2(16.6)	9(75)	3(25)	
Lymph edema(%)	7(58.3)	5(41.6)	6(50)	6(50)	

SSG: Scrambler with stretching group, TENSSG: Transcutaneous Electrical Nerve Stimulation with stretching group, Mean±SD

Table 2. A comparison of between pro-post

		SSG	TENSSG	t	P ³⁾
Depression	Pre	22.00±2.69	21.91±2.39		
	Post	18.58±1.83	20.50±2.06		
	difference ¹⁾	3.41±2.02	1.41±1.50	-2.404	0.025*
	t	5.857	3.261		
	p ²⁾	0.001*	0.008*		
Anxiety	pre	24.50±2.50	23.08±3.17		
	post	19.00±1.53	20.33±1.87		
	difference ¹⁾	5.50±2.02	2.75±3.27	-1.905	0.070
	t	9.420	2.905		
	p ²⁾	0.001*	0.014*		
Distress	pre	4.75±0.75	4.50±1.00		
	post	3.16±0.57	3.75±1.05		
	difference ¹⁾	1.58±0.66	0.75±0.75	-1.680	0.107
	T	8.204	3.447		
	p ²⁾	0.001*	0.005*		

SSG: Scrambler with stretching group, TENSSG: Transcutaneous Electrical Nerve Stimulation with stretching group, EG: experimental group, CG: control group, ¹⁾Difference: post-pre, ²⁾Paired t-test, ³⁾Independent t-test, Mean±SD, *p<0.05

(p> 0.05)(Table 2).

4. Change in distress

As for the change in pain, there was a significant difference between the experimental group and the control group after 3 weeks (p<0.05), but there was no significant difference between the group changes(p> 0.05)(Table 2).

IV. Discussion

The purpose of this study is to confirm the effect of scramble therapy and stretching application on the psychogenic changes of depression, anxiety, and distress in breast cancer patients after 3 weeks.

Mealy et al. reported that scrambler therapy could improve persistent central neuropathy pain, depression, and anxiety in a study of 22 patients aged 18 years or older with neuromyelitis Optica spectrum disorder, an autoimmune disease of the central nervous

system.²⁾ This was consistent with the relief of pain, depression, and anxiety in this study.

In this study, there was a significant difference in the change in depression after 3 weeks in both the experimental group and the control group, and in the change between groups, there was a significant difference after 3 weeks. It is thought that the scrambler treatment stimulates pain-free fibers in the skin and blocks pain signals from reaching the brain, thereby managing pain and reducing depression.

Marineo et al. compared scramble treatment 10 times a day with drug treatment in 52 patients with chronic neuropathic pain.⁸ As a result, they found that scramble therapy was more effective than drug treatment and could relieve chronic neuropathic pain. This was consistent with the reduction in distress in this study.

In addition, Kashyap et al. studied the efficacy of scramble therapy for pain management of head, neck, and chest cancer in 40 cancer patients, and reported that scrambler therapy was an effective treatment for pain management due to head and neck cancer and chest cancer.⁷⁾

Cebalo et al. (2020) studied the effect of TENS on anxiety and fear during dental procedures in 125 children aged 9 to 14, and found that the application of TENS resulted in less anxiety after the procedure.²⁵⁾

As for the change in anxiety in this study, there was a significant difference in the change within the group in both the experimental group and the control group after 3 weeks, and there was no significant difference in the change between the groups. Because there are no studies on anxiety and stress, it is difficult to compare the electrical stimulation of scramble therapy, but looking at the TENS results above, it is thought that scramble therapy probably has a positive effect on anxiety and stress. The positive reasons are as follows.

Bigalke et al. (2023) Anxiety, sympathetic nerves, and blood pressure were studied in 88 healthy men and women, and it was reported that anxiety was related to increased blood pressure and sympathetic nerves.²⁶⁾ And Clancy et al (2014) reported that vagus nerve stimulation using TENS reduced sympathetic

nerve activity in 48 healthy people. This suggests that Scramble therapy can suppress psychological anxiety by not only suppressing pain but also suppressing the excitement of the sympathetic nerves.²⁷⁾

Fanti et al. (2003) conducted a placebo-controlled study on electroacupuncture and analgesics during colonoscopy in 30 patients scheduled to undergo colonoscopy, and found that electroacupuncture reduced patient discomfort, anxiety, and pharmacological side effects.²⁸⁾ It was also reported that dementia prevention gymnastics and elastic band exercises were helpful in reducing depression and maintaining grip strength.²⁹⁾

Adults with symptoms of temporomandibular joint disorder were treated with low-level laser therapy (LLLT) and transcutaneous electrical nerve stimulation (TENS) applied to the masseter and neck muscles. The study results revealed that, compared to TENS therapy, LLLT treatment led to increased jaw opening range, and a decrease in tenderness threshold of the masseter muscle.³⁰⁾

As for the change in distress in study, after 3 weeks, there was a significant difference in the change within the group in both the experimental group and the control group, and there was no significant difference in the change between the groups. This is a direct pain reduction caused by the scramble treatment and is thought to be an indirect effect in reducing anxiety and suffering.

In conclusion, it disrupts the pain signals of C-fibers with electrical stimulation, reducing the intensity of pain so that the brain cannot recognize it as pain, thereby improving the patient's quality of life by improving depression, anxiety, and distress.

Therefore, it has been shown to be safe and effective in clinical trials. More research is needed in the future to confirm its efficacy and compare it with other treatments.

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