



## Comparing the Effect of Conventional TENS with Acupuncture TENS on Post-Operative Pain Relief

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### Abstract

**Background:** From the patient's point of view, the most important problem after surgery is pain. Transcutaneous Electrical Nerve Stimulation (TENS) is a safe, non-invasive, safe, and pain-free way to control pain. Since there are few studies comparing the effect of conventional TENS and acupuncture TENS in relieving acute pain, this study was performed to compare the effect of these two types of TENS on pain relief after abdominal surgery.

**Methods:** 90 patients with a Mean age of  $33.19 \pm 4.15$  undergone inguinal herniorrhaphy and appendectomy were included in the study. The patients were having pain intensity of 7 or more on the Numerical Pain Rating Scale (NPRS). They were divided into three groups by the random allocation method. Group A: Conventional TENS (CT), Group B: Acupuncture TENS (AT), and Group C: Placebo TENS. All patients received standard post-operative medications. Pain intensity was recorded on NPRS pre, immediately, and one hour post-intervention.

**Results:** Both Acupuncture TENS and Conventional TENS significantly decreased postoperative pain intensity as compared to Placebo TENS ( $p < 0.0001$ ). The results showed that the Conventional TENS was more effective than Acupuncture TENS.

**Conclusions:** This study showed that both types of TENS were effective in reducing post-operative pain. Therefore, TENS, especially the CT, can be used as an effective adjuvant method, along with other methods of post-operative pain relief.

**Keywords:** Acupuncture TENS; Conventional TENS; Postoperative; Pain

### Introduction

Pain is a multidimensional and personal experience for each patient [1,2]. Acute pain follows tissue damage associated with surgery and should resolve during the healing process [3]. The number of surgeries performed worldwide is increasing. An estimated 230 million major surgeries are performed each year worldwide [4].

Surgical injury produces numerous responses in the pain matrix, from the sensitivity of the peripheral and central pain pathways to feelings of fear, anxiety, and hopelessness [5]. Although pain decreases in most patients during the first days after surgery, some experience a steady or ascending path to pain and need for pain relief [6].

Patients report concerns about the pain that occurred after surgery [7,8]. Prevention and relief of postoperative pain is the main responsibility of health care professionals [9]. According to the Perioperative Quality Improvement Program (PQIP) in 2017-2018 [10] data from 79 hospital sites across the UK has been shown that 48% and 19% of patients have reported moderate or severe pain at the surgical site within 24 h after surgery, and this data has been repeated in the latest publication 2018-2019 [11]. In a 2016 cross-sectional study of more than 15,000 British patients undergoing surgery, 11% reported severe pain and 37% reported moderate pain in the first 24 h [12]. Optimal prevention and relief of postoperative pain are very important both from a humanitarian point of view and for providing efficient health services [9,13,14].

Transcutaneous Electrical Nerve Stimulation (TENS) is a source of physiotherapy commonly used for symptomatic management of acute and chronic pain. It works by relieving pain, replacing

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or supplementing analgesics [15]. TENS programs are usually described as high frequency, low intensity (conventional TENS or CT), or (low frequency, high intensity) acupuncture-like TENS or AT according to the output characteristics of the device [16]. CT uses Ab fibers that, according to pain gate control theory, prevent the transmission of pain information to the dorsal horn of the spinal cord. AT activates A $\delta$  and C fibers and provides analgesia using descending inhibition mechanisms [17]. TENS is delivered by silicon impregnated carbon rubber electrodes. They are secured to the site by straps and/or adhesive tape. Sterile electrode gel is the commonly used conducting medium. This helps transmit the TENS impulses through the skin [18].

Although TENS is an effective adjunctive therapy for postoperative pain, the effect of different frequencies and intensities of stimulation have not yet been systematically studied. Also, recent evidence regarding the use of acupuncture TENS in post-abdominal surgery is limited. Therefore, this study was conducted to compare the effectiveness of conventional TENS and acupuncture TENS in postoperative pain relief.

## Methods

The sample size was calculated according to previous studies and using the sample size determination formula to compare the mean in the three groups and considering  $\alpha=0.05$ ,  $\beta=10\%$  for each group of 30 people. 90 patients with a Mean age of  $33.19 \pm 4.15$  who had undergone inguinal herniorrhaphy and appendectomy in Aliebn Abitaleb Hospital, Rafsanjan, and willing to participate were included in the study. After obtaining informed written consent from patients, they were divided into three groups by random allocation. Group A: Conventional TENS (CT), group B: Acupuncture TENS (AT), and group C: Placebo TENS. All patients received standard postoperative medications as prescribed. The study method was explained in detail to all patients and demographic information was documented after obtaining informed written consent (Table 1).

A transcutaneous electrical nerve stimulation unit was used with 2 rubber electrodes. While the patient was lying on his back, after cleaning the skin around the surgical incision, the electrodes of the device on the skin of the abdomen were connected in parallel about 5 cm to 7 cm on both sides of the surgical incision. Group A received CT (frequency 100 Hz and low intensity (to the point of causing a tingling sensation at the site of the electrode) and Group B received AT (frequency 4 Hz at a maximum tolerable intensity) for 30 min and in Group C, the device was set and turned on with zero current intensity and frequency. Pain intensity was assessed using NPRS prior to intervention, immediately, and one hour post intervention. Data thus collected were further subjected to statistical analysis.

## Results

Comparison of mean and standard deviation of pain scores before the intervention between the three groups showed that the groups were homogeneous ( $p=0.43$ ) (Table 2).

Comparison of the pain scores immediately and one hour post intervention in between the three groups showed P value as 0.0001; i.e. very significant. Indicating that there was statistically significant effect post-intervention (Table 3, 4).

Additionally, the Dunn multiple comparison test was conducted to analyze which group had the most effective difference after the intervention (Table 5). It indicates that Group A was effective relative

**Table 1:** Demographic information.

	Variable	Number	Percent (%)
Age	Less than 25 years	39	4/30
	25-35 years	44	4/34
	Above 35 years	45	2/35
Gender	Female	54	8/57
	Male	74	2/42
Level of Education	Illiterate	23	18
	Under Diploma	55	43
	University Graduates	50	39
Type of Surgery	Inguinal herniorrhaphy	47	7/36
	Appendectomy	81	3/63

**Table 2:** Comparison of NPRS scores between the groups prior to intervention.

	Group A	Group B	Group C	p-value
Mean	7.22	7.45	7.16	p=0.43 Not significant
SD	1.09	.94	1.12	

**Table 3:** Comparison of NPRS scores between the groups immediately post intervention.

	Group A(CT)	Group B(AT)	Group C	p-value
Mean	3.65	5.19	7.00	p=0.0001 significant
SD	1.97	1.68	1.16	

**Table 4:** Comparison of NPRS scores between the groups one hour post intervention.

	Group A(CT)	Group B(AT)	Group C	p-value
Mean	1.52	3.69	6.83	p=0.0001 significant
SD	1.60	1.95	1.57	

**Table 5:** Dunn's multiple comparison test.

	p-value	Significance
Group A (CT) versus Group B (AT)	<0.05	significant
Group A (CT) versus Group C (Placebo TENS)	<0.05	significant
Group B (AT) versus Group C (Placebo TENS)	<0.05	significant

to Group B and that both Groups A and B were effective relative to Group C ( $P<0.05$ ).

## Discussion

The aim of this study was to compare the effect of CT and AT on pain after a TENS abdominal surgery. The results showed that both CT and AT relieved postoperative pain, but the CT was more effective. These findings were like the results of Leonard et al. [16] study comparing CT and AT in reducing pain in individuals treated with narcotics, which showed that CT had reduced pain more than acupuncture. In Mehendale and Revadkar [15] study, the results showed that the intervention groups had significant pain relief compared to the control group. Among the intervention groups, CT and acupuncture were equally effective in relieving pain. In a study conducted by Platon et al. [19] on the effect of TENS with high frequency and intensity on pain relief after surgery, the results showed that TENS reduces the recovery time and is suitable as an adjunct to conventional medications. The results of the work of Chen and Johnson on the analgesic effects of high and low-frequency TENS on pressure pain in healthy individuals showed that high-frequency TENS compared to low frequencies increased the pain threshold in individuals [20]. In a study by Chesterton et al. [21], the high frequency and high intensity of TENS had significant palliative effects on the pain threshold of healthy individuals. In animal models, Sato et al. [22] found a Gradual increase in TENS intensity daily can

delay the development of TENS tolerance. Gopal Krishnan and Sluka [23] in a study aimed at the effect of frequency and the intensity of TENS on primary hyperalgesia in rats showed that high-frequency TENS was effective in reducing hyperalgesia while low frequency and intensity TENS had no effect on hyperalgesia.

In the present study, the mean pain intensity after the intervention in the placebo group was not statistically significant. In Rakel and Frantz [24] study aimed at investigating the effect of TENS on postoperative pain, the results showed that TENS improved patients' motor function by reducing postoperative pain intensity, while placebo was not effective in reducing pain. DeSantana et al. [25] in a study to investigate the effect of high TENS frequency after inguinal hernia surgery showed that the intensity of pain in the TENS group was reduced compared to placebo at 2 and 4 h after surgery.

The results of the present study showed that there was no relationship between participants' characteristics and the analgesic effect of TENS. It should be noted that the aim of this study was not to evaluate the effect of these factors on the analgesic effects of TENS.

In this study, using random allocation, participants were matched in terms of age, sex, type of surgery, and pain intensity in the groups. Also, by considering the placebo group and comparing it with the intervention groups, we were able to determine whether the analgesic effect of the interventions was superior to the placebo effect.

## Conclusion

This study showed that both types of TENS were effective in reducing postoperative pain but may not reduce severe pain. Therefore, TENS, especially the CT, can be used as an effective adjuvant method, along with other methods of post-operative pain relief. Pain relief for patients is one of the most important nursing interventions. Since this method is non-invasive and without side effects and its use does not require much expertise or training, this method can be introduced into the care system and used its benefits by educating nurses.

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