

Electrostimulation of Acupuncture Points with the TENS Method

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Abstract: *Transcutaneous electrical nerve stimulation (TENS) is a non-invasive peripheral stimulation technique used to relieve pain. TENS nomenclature focuses on the output of the device rather than the physiological intention of currents. This has led to inappropriate clinical practice. Different TENS techniques are used to selectively activate populations of nerve fibres to elicit mechanisms leading to pain relief. Acupuncture-like TENS is applied with electrodes and the frequency is 1-10 Hz and the pulse duration is 0-200 ms. This type of TENS affects small diameter C fibers, and it is thought that the stimulation provides an analgesic effect by affecting the release of endorphins. It is mostly applied on chronic pain and trigger points (knot areas and bands in muscle tissue). In conclusion, TENS is a noninvasive modality that is easy to apply with relatively few contraindications. With the help of TENS therapy, nerves that stimulate the production of analgesic substances in the brain and spinal cord are stimulated. Thus, natural substances produced in the body are used in the treatment of pain.*

Keywords— TENS, to conventional TENS, low-intensity, pulse width, non-invasive.

1. INTRODUCTION

Transcutaneous electrical nerve stimulation (TENS) is a simple, non-invasive analgesic technique that is used extensively in health-care settings by physiotherapists, nurses and midwives [1, 2]. It can be administered in the clinic by health-care professionals or at home by patients who have purchased a TENS device directly from manufacturers. TENS is mainly used for the symptomatic management of acute and non-malignant chronic pain. However, TENS is also used in palliative care to manage pain caused by metastatic bone disease and neoplasm. It is also claimed that TENS has antiemetic and tissue-healing effects although it is used less often for these actions.

Electricity has been used for alleviation of pain since the era of ancient Greeks, Romans and Egyptians who used live *Torpedo marmorata* [electric ray], a type of electric fish for pain relief. In modern era, John Wesley in 18th century introduced electrotherapy for the relief of pain from sciatica, headache, kidney stone, gout, and angina pectoris. Use of electricity for relief of dental pain was first described in 19th century by a physician named Francis. In 20th century, various dental handpieces that provided an electrical current to the tooth via the bur were used to relieve pain during cavity preparation.

2. HISTORY OF TENS

In the history of modern medicine, electrical stimulation has been used in the treatment of diseases in different ways. For the first time in the world BC. In 46, Scirbonius Largus published the therapeutic effect of electric eels on headache and pain caused by arthritis. Researchers such as James Churchill used it to treat electrical stimuli they obtained with various devices in the early 19th century. The importance of TENS in pain treatment has increased with the

door control theory first put forward by Melzack and Wall in 1965. Both the explanation of the gate control theory and the reduction of neuropathic pain as a result of stimulation of thick fibers with high frequency current in a study conducted in 1967 led TENS to be the most commonly used biomedical method in pain treatment since then.

Today, the use of this method has increased due to the advantages of TENS such as being applied over the skin with superficial electrodes, easy to carry, self-application of the patient, being used everywhere and without side effects. Since TENS is easy to apply, reliable and effective in pain treatment, it has been approved by the U.S. Food and Drug Administration (FDA) after many surgical interventions, at birth and in acute and chronic pain caused by various diseases.

3. STIMULATION METHODS

Different TENS techniques are used to selectively activate populations of nerve fibres to elicit mechanisms leading to pain relief. The main techniques are conventional TENS (low intensity, high frequency), acupuncture-like TENS (high intensity, low frequency), and intense TENS (high intensity, high frequency) (Table 1). Conventional TENS is most commonly used in clinical practice and will be the main focus of this review.

Table 1. TENS techniques

	Physiological intention	Clinical technique
Conventional TENS	Selective activation of large diameter non-noxious afferents to elicit segmental analgesia	Low-intensity/high-frequency TENS at site of pain to produce 'strong but comfortable TENS paraesthesiae'. Administer whenever in pain
Acupuncture-like TENS	Activation of small diameter (motor) afferents to elicit extrasegmental analgesia	High-intensity/low-frequency TENS over muscles, acupuncture points, or trigger points to produce 'strong but comfortable muscle contractions'. Administer for 15–30 min at a time
Intense TENS	Activation of small diameter afferents to elicit peripheral nerve blockade and extrasegmental analgesia	High-intensity/high-frequency TENS over nerves arising from painful site to produce 'maximum tolerable (painful) TENS paraesthesiae'. Administer for a few minutes at a time

Conventional TENS: The International Association for the Study of Pain (IASP) describes conventional TENS as “High-frequency (50–100 Hz), low-intensity (paraesthesia, not painful), small pulse width (50–200µs)”. The intention of conventional TENS is to stimulate selectively large diameter, low threshold non-noxious afferents (A-beta) in dermatomes related to the pain. This inhibits activity in second order nociceptive transmission neurones in the central nervous system and is achieved by increasing TENS pulse amplitude to generate a strong, comfortable, non-painful paraesthesia beneath the electrodes. Further increases in pulse amplitude leads to high threshold A-delta afferent activity and a painful paraesthesia beneath the electrodes. This is not the desired outcome for conventional TENS.

Acupuncture-like TENS (AL-TENS): AL-TENS is a form of hyperstimulation described by Sjölund and colleagues in the 1970s. It can be used if patients do not respond to conventional TENS. IASP defines the characteristics of AL-TENS as “Low-frequency (2–4Hz), higher intensity (to tolerance threshold), longer pulse width (100–400µs)”. Low-frequency trains or bursts (2–4Hz) of high-frequency pulses (100–200pps) are often used in clinical practice. The intention of AL-TENS is to stimulate small diameter, high threshold peripheral afferents (A-delta) in order to activate extrasegmental descending pain inhibitory pathways. Acupuncture-like TENS (AL-TENS) is a treatment modality that can be used to temporarily reduce pain. However, there is no clear data in the literature regarding the specific duration of analgesia induced by AL-TENS.

Intense TENS: The intention of intense TENS is to stimulate small diameter, high threshold cutaneous afferents (A-delta) to block transmission of nociceptive information in peripheral nerves and to activate extrasegmental analgesic mechanisms. High frequencies (up to 200 pps) and high intensities that are just tolerable to the patient are used but only delivered for short periods of time.

Conventional TENS is most the commonly used technique and for most patients is selected in the first instance.

4. STIMULATION OF ACUPUNCTURE POINTS

Acupuncture is a methodology that consists of stimulating certain anatomical points to correct various physiological and psychological disorders. Acupuncture stimulation can be performed in a variety of ways, including electrical stimulation. Acupuncture through electrostimulation is called electroacupuncture. Electroacupuncture can be used to treat many medical conditions such as pain, musculoskeletal, neurological, gastrointestinal, and surgical anesthesia. We can say that electroacupuncture is a form of neurostimulation in some cases. This is because the proposed physiological mechanisms of acupuncture consist of the neural pathways of acupuncture points and areas containing irritated muscle, skin and nerve complexes.

Acupuncture stimulation has also been shown to affect afferent nerve fibers. Another study provides a comprehensive explanation of the neurobiological mechanisms and their physiological effects that may be present in neurostimulation. [7] investigated the relationship between acupoints and receptor areas of neurons; It has been shown that irritation at acupuncture points is actually neurostimulation. However, not all acupuncture points and acupuncture methods should be considered neurostimulants. This is because there are hundreds of acupuncture points and not all of them have any connection to the nervous system.

5. CONCLUSION

The first step in the design of electrostimulation devices is the selection of stimulation parameters. The application of the stimulation methods discussed here is the next stage of the research. Acupuncture-like electrostimulation is used. These stimulation parameters can be used in the treatment of many diseases. The use of pulse

signals with a frequency of 2-4 Hz will be effective in the acupuncture points and thus in the electrical stimulation of the body as a whole. There are three main methodologies for transcranial electrical stimulation according to the form of the stimulation signal: transcranial direct current stimulation, transcranial alternating current stimulation, and stimulation with transcranial random signals. We observed that different neuromodulation mechanisms work in the formation of the effects shown in each method.

According to this acupuncture treatment method, there is an energy network that covers the whole surface of the body. There are central points that reduce, increase, deflect, direct this energy and even direct it towards a certain point. These points are known in medicine as movement arousing or reflex arouser. The aim is to apply electrotherapy to patients by stimulating these points with the help of the designed Acupuncture-like TENS device. Thus, it is aimed that patients receive an alternative treatment by using more drugs.

6. REFERENCES

- [1] Gafarov G.A., Valehov S.E. Transcutaneous electrical nerve stimulation. New of Azerbaijan Higher Technical Educational Institutions Volume 23, №2 (2021), 47-49.
- [2] Johnson, MI (1997) Transcutaneous electrical nerve stimulation (TENS) in the management of labour pain: the experience of over ten thousand women. British Journal of Midwifery 5: 400–405.
- [3] Pope, G, Mockett, S, Wright, J (1995) A survey of electrotherapeutic modalities: Ownership and use in the NHS in England. Physiotherapy 81: 82–91.
- [4] Quarnstrom F. Electronic dental anesthesia. Anesth Prog. 1992;39:162- 77.
- [5] Johnson MI. (1998) Physical Therapy Reviews, 3, 73–93.
- [6] Searle RD, Bennett MI, Johnson MI, Callin S, Radford H. Letter to editor: transcutaneous electrical nerve stimulation (TENS) for cancer bone pain. Palliat Med 2008; 22: 878–9.
- [7] Gafarov GA. Acupuncture research methods. Journal of Applied Biotechnology and Bioengineering: 2020;7(6): 276–278.
- [8] S. Quiroz-González, S. Torres-Castillo, R. E. López-Gómez, and I. Jiménez Estrada, "Acupuncture Points and Their Relationship with Multireceptive Fields of Neurons," Journal of Acupuncture and Meridian Studies, vol. 10, no. 2, pp. 81-89, Apr. 2017.
- [9] Coşkun-Çelik E. Medulla spinalis yaralanmalı hastalardaki nöropatik ağrıya akupunktur benzeri TENS'in etkisi. Uzmanlık Tezi, 2005, İstanbul.
- [10] Alper S. Transkutan elektriksel sinir stimülasyonu. Editor Beyazova M, Gokce Kutsal Y. Fiziksel Tıp ve Rehabilitasyon 2000; 790-798.
- [11] Akyuz G. Transkutan elektriksel sinir stimülasyonu. Editor Tuna N. Elektrotterapi 2001;163-176.

- [12] T.A.Əliyev, Q.A.Qafarov, D.O.Əhmədova. "Qeyri-Ənənəvi Tibbi Üsulun Vasitələr" AzTU-nun Elmi Əsərləri №2, 2018, s 267-270.