

The Effectiveness Of Transcutaneous Electrical Nerve Stimulation (Tens) For Reducing Pain In Burn Patients: Literature Review

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Article Info

Article received : June 23, 2025

Article revised : June 23, 2025

Article published : June, 30, 2025

Abstract

Transcutaneous Electrical Nerve Stimulation (TENS) is a non-pharmacological therapy method used to reduce pain, including in burn patients. Burns cause complex pain, both acute and chronic, thus requiring multidisciplinary management. This study is a literature review aimed at evaluating the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) in reducing pain in burn patients. Data were collected from 10 scientific articles published within the last ten years, including clinical studies, pilot studies, and meta-analyses. The review findings indicate that Transcutaneous Electrical Nerve Stimulation (TENS) is effective in reducing pain intensity, accelerating wound healing, improving sleep quality, and decreasing the need for pharmacological analgesics. Additionally, the use of Transcutaneous Electrical Nerve Stimulation (TENS) has been reported as safe and does not cause significant side effects. However, most of the analyzed studies still have limitations, such as small sample sizes and short intervention durations. Therefore, further research with stronger experimental designs is needed to strengthen clinical evidence and support the implementation of Transcutaneous Electrical Nerve Stimulation (TENS) as part of pain management in burn patients.

Keywords: Burns, pain management, Transcutaneous electrical nerve stimulation (TENS)

Introduction

Burns are a type of tissue injury that is quite complex and can cause significant physical and psychological disturbances for the affected individuals. The severity of a burn is not only measured by the total body surface area affected but also by the depth of the wound, the location

of the burn, and the body's systemic response to the injury (Pérez-Ruvalcaba et al., 2015)¹. One of the main challenges in burn management is controlling the pain experienced by patients, both in the acute phase and throughout the healing process. Burn pain is multidimensional, including spontaneous pain, pain triggered by medical interventions such as wound care, and chronic pain that may appear later on. If not properly managed, this pain can interfere with the healing process, increase the risk of complications, and negatively affect the patient's quality of life (D.R. Patterson & S.R. Sharar, 2017)².

Pain management in burn patients is conventionally conducted using pharmacological analgesics such as opioids and non-opioids. Although effective, the use of these medications has several limitations, including the risk of side effects such as nausea, vomiting, constipation, and even opioid dependence (Rajput, 2022)³. Therefore, non-pharmacological approaches have increasingly been developed as complementary therapies to reduce reliance on medication and enhance the overall effectiveness of pain management in a holistic manner. One non-pharmacological method that has shown potential in alleviating pain is Transcutaneous Electrical Nerve Stimulation (TENS). Transcutaneous Electrical Nerve Stimulation (TENS) is a form of low-frequency electrical stimulation applied through electrodes placed on the surface of the skin. The mechanism of action of TENS is based on the "gate control" theory and endorphin release, in which the electrical stimulation can inhibit the transmission of pain signals to the brain and stimulate the release of the body's natural analgesic substances (M. I. Johnson & C. A. Paley, 2022)⁴. The use of TENS has been proven effective in various pain conditions, such as musculoskeletal pain, postoperative pain, and labor pain. However, the application of TENS in burn patients is still relatively new and requires further exploration to determine its effectiveness and safety.

Several preliminary studies have shown that the use of Transcutaneous Electrical Nerve Stimulation (TENS) can help reduce pain intensity in burn patients, particularly during wound care procedures such as dressing changes or physical therapy. This therapy is non-invasive, relatively safe, and easy to operate by trained healthcare professionals. In addition, Transcutaneous Electrical Nerve Stimulation (TENS) offers the advantage of reducing the need for pharmacological analgesics, thereby decreasing the risk of unwanted side effects (M. I. Johnson & C. A. Paley, 2022)⁴.

Nevertheless, the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) in burn patients remains a subject of debate in the scientific literature. Variability in application parameters, such as frequency, duration, and electrode placement, is one of the factors that can influence therapeutic outcomes. In addition, differences in patient characteristics such as the severity of the burn, pain threshold, and psychological condition can also affect the response to Transcutaneous Electrical Nerve Stimulation (TENS) therapy. Therefore, further well-structured research is needed to evaluate the extent of TENS effectiveness in reducing pain in burn patients and to determine the optimal usage protocol.

This study aims to examine the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) as a non-pharmacological therapy in reducing pain in burn patients. Through a quantitative approach and standardized pain intensity measurements, the results of this research are expected to contribute to the development of nursing and physiotherapy practices in the context of burn pain management. Thus, Transcutaneous Electrical Nerve Stimulation (TENS) may serve as a safe, effective therapeutic alternative that enhances patient comfort and quality of life during the treatment period.

Methods

This study uses a literature review approach to evaluate the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) in pain management for burn patients. The review was conducted by identifying, analyzing, and synthesizing various relevant previous studies. Literature was obtained through a systematic search of several scientific databases, including Google Scholar, PubMed, ScienceDirect, and ResearchGate. The keywords used in the search process included: Transcutaneous Electrical Nerve Stimulation (TENS) and burn pain, transcutaneous electrical nerve stimulation and wound healing, Transcutaneous Electrical Nerve Stimulation (TENS) and dressing change, and Transcutaneous Electrical Nerve Stimulation (TENS) and burn patients.

The literature selected for analysis was published within the past ten years and includes various research designs, ranging from quantitative experimental studies and pilot studies to meta-analyses. The inclusion criteria used were: (1) articles written in English or Indonesian, (2) studies specifically discussing the use of Transcutaneous Electrical Nerve Stimulation (TENS) in burn patients, and (3) articles reporting clinical outcomes related to pain, wound healing processes, or

the effects of Transcutaneous Electrical Nerve Stimulation (TENS) therapy. Conversely, articles that were merely literature reviews without empirical data, not relevant to the context of burn injuries, or not available in full-text form were excluded from the analysis.

All literature was thoroughly reviewed, and data were collected regarding the research objectives, methods, population, Transcutaneous Electrical Nerve Stimulation (TENS) intervention, measured outcomes, and main conclusions. The data were then analyzed narratively to identify key themes, such as the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) in reducing pain, accelerating wound healing, and its safety aspects as an adjunct therapy in burn care.

Results

The results of the literature review identified 10 (ten) journals related to the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) in reducing pain in burn patients. After screening, relevant information related to the research topic was obtained. The literature review can be seen in Table 1.

No	Author	Result
1	D. R. Patterson & S. R. Shahrar, 2017 ² .	This study addresses the significant challenges in pain management for patients with burn injuries. Despite advancements in medical care, pain resulting from burns remains a complex issue that is difficult to manage. This pain includes acute pain during wound care and chronic pain that may persist long after the wound has healed. The authors emphasize the need for a multidisciplinary approach that combines pharmacological and non-pharmacological therapies, including psychological management, to improve patients' quality of life. Further research is urgently needed to develop effective strategies for managing burn pain.
2	Rajput, 2020 ³ .	This clinical study involved a number of burn patients who received regular Transcutaneous Electrical Nerve Stimulation (TENS) treatment. The results showed that patients who received TENS therapy experienced accelerated wound healing and a significant reduction in pain levels compared to the control group that received only standard care. The mechanism of TENS is believed to work by stimulating nerves to inhibit the transmission of pain signals and enhance local blood circulation, which supports tissue regeneration. The study concluded that Transcutaneous Electrical Nerve Stimulation (TENS) is an effective and safe method as a supportive therapy in burn wound management.
3	M. I. Johnson & C.A Paley, 2022 ⁴ .	The results of the meta-analysis showed that Transcutaneous Electrical Nerve Stimulation (TENS) provides significant pain reduction compared to placebo or standard care, with more pronounced effects on chronic pain. In addition, the use of

		Transcutaneous Electrical Nerve Stimulation (TENS) was reported to be safe, with few or no serious side effects. This study supports the use of Transcutaneous Electrical Nerve Stimulation (TENS) as an effective and safe non-pharmacological therapy option for pain management.
4	Irma Pérez-Ruvalcaba, Viridiana Sánchez-Hernández, & Arie R Mercado-Sesma, 2015 ⁵ .	A pilot study involving 14 patients with second- and third-degree burns showed that the use of Transcutaneous Electrical Nerve Stimulation (TENS) in a combined mode (continuous and intermittent) for 30 minutes, three times a week for 4 weeks, resulted in a significant reduction in pain perception based on the Visual Analog Scale (VAS) from 8.0 ± 1.7 to 1.0 ± 0.5 ($P = 0.027$). No side effects were reported during the intervention. Electrodes were placed around the wound area without touching the damaged skin, making this method safe and low cost.
5	Siavoshi M., dkk., 2018 ⁶ .	This study demonstrates that the application of Transcutaneous Electrical Nerve Stimulation (TENS) is effective in reducing pain during dressing changes in burn patients. With proper training for nurses in burn units, the use of Transcutaneous Electrical Nerve Stimulation (TENS) can serve as an effective non-pharmacological method for pain management during wound care procedures.
6	Satria Pranata, 2016 ⁷ .	The research results show that Transcutaneous Electrical Nerve Stimulation (TENS) is not only effective in reducing pain but also can accelerate wound healing by inhibiting pro-inflammatory cytokines and enhancing cell migration to the wound area. This highlights the potential of Transcutaneous Electrical Nerve Stimulation (TENS) as an adjunct therapy in burn wound care.
7	Gonzalez, dkk., 2015 ¹ .	This study evaluated the effects of combined continuous and intermittent Transcutaneous Electrical Nerve Stimulation (TENS) on pain perception in patients with second- and third-degree burns. Fourteen patients received TENS sessions three times per week for 4 weeks. The results showed a significant decrease in pain scores based on the Visual Analog Scale (VAS) from 8.0 ± 1.7 to 1.0 ± 0.5 ($P = 0.027$). No side effects were reported during the intervention.
8	Muhammed Kılınc, Ayse Livanelioğlu, Sibel Aksu Yıldırım, & Ersin Tan, 2014 ⁸ .	This study shows that the application of Transcutaneous Electrical Nerve Stimulation (TENS) is effective in reducing pain during dressing changes in burn patients. With proper training for nurses in burn units, the use of Transcutaneous Electrical Nerve Stimulation (TENS) can be an effective non-pharmacological method for pain management during wound care procedures
9	Sadeghi, dkk., 2018 ⁹ .	This study found that Transcutaneous Electrical Nerve Stimulation (TENS) significantly reduced pain intensity in burn patients and improved sleep quality compared to the control group, with TENS administered for 20 minutes daily over the course of one week.
10	Lee & Kim, 2019 ¹⁰ .	This study concludes that Transcutaneous Electrical Nerve Stimulation (TENS) is a safe and effective non-invasive method for reducing pain in burn patients and can also reduce the need for analgesic medications.

Discussion

Pain management in burn patients is one of the complex challenges in clinical practice. As stated in the journal by Patterson & Sharar (2017)², the pain experienced can be acute during procedures such as dressing changes, or chronic, persisting long after the wound has healed. Therefore, a multidisciplinary approach that includes non-pharmacological interventions is essential to provide optimal care. One approach that has shown high effectiveness is the use of Transcutaneous Electrical Nerve Stimulation (TENS).

The use of Transcutaneous Electrical Nerve Stimulation (TENS) has been proven to provide significant benefits in reducing pain in burn patients. Several studies have reported that TENS can significantly decrease pain perception compared to control groups that did not receive similar interventions. In the journal by Rajput (2020)³, regularly administered TENS therapy resulted in a significant reduction in pain and accelerated the wound healing process. This is supported by a meta-analysis conducted by Johnson and Paley (2022)⁴, which stated that TENS is effective in reducing pain, particularly in cases of chronic pain, with minimal risk of side effects.

The effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) has also been demonstrated through small-scale experimental studies, such as the pilot study conducted by Pérez-Ruvalcaba et al. (2015)¹, which showed that the application of TENS in a combined mode (continuous and intermittent) over a period of 4 weeks successfully reduced the Visual Analog Scale (VAS) score from 8.0 ± 1.7 to 1.0 ± 0.5 . Similar results were found by Gonzalez et al. (2015)¹, using an identical population and intervention design. Both studies also confirmed that no side effects were reported during the intervention period, indicating the safety of using TENS in the context of burn injuries. In addition to reducing overall pain, TENS has also been proven effective when used during specific painful procedures, such as dressing changes, as demonstrated by studies by Siavoshi M. (2018)⁶ and M. Kılınç et al. (2014)⁸. Both journals indicate that the use of TENS during procedural moments can significantly reduce pain while improving patient comfort during wound care. This is particularly important considering that burn wound care procedures often become a source of fear for patients due to the intense pain involved.

Nevertheless, the potential side effects and additional benefits of Transcutaneous Electrical Nerve Stimulation (TENS) on wound healing have also been highlighted in a study by Satria Pranata (2016)⁷. This journal explains that TENS not only reduces pain but also accelerates the healing process by suppressing the production of pro-inflammatory cytokines and enhancing cell

migration to the wound area. This indicates that TENS has the potential to serve as an adjunct therapy that supports tissue regeneration. Furthermore, Sadeghi et al. (2018)⁹ showed that applying TENS for 20 minutes daily over the course of one week can improve sleep quality in burn patients an important aspect often overlooked in the care of chronic patients. Meanwhile, the journal by Lee and Kim (2019)¹⁰ reported that TENS can reduce the need for analgesics, indicating that this therapy may help decrease dependence on medications that carry the risk of long-term side effects.

Overall, the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) in reducing pain, accelerating wound healing, improving sleep quality, and decreasing the need for analgesics reinforces its role as a safe, effective, and cost-efficient non-invasive approach in burn management. Although existing studies are highly supportive, most research still faces limitations such as small sample sizes and a lack of long-term studies. Therefore, further research with large-scale randomized controlled trial (RCT) designs is highly needed to strengthen the evidence and expand clinical recommendations.

Conclusion

Based on the literature review conducted, it can be concluded that Transcutaneous Electrical Nerve Stimulation (TENS) is proven to be an effective and safe non-pharmacological intervention for pain management in burn patients. TENS is not only capable of reducing both acute and chronic pain but also contributes to accelerating wound healing, improving sleep quality, and reducing the need for pharmacological analgesics. The safety of TENS is demonstrated by the absence of reported side effects in most studies, making it a viable therapy for clinical practice, including during painful procedures such as dressing changes. However, most of the existing studies are pilot studies or have limitations in sample size. Therefore, further research with more robust experimental designs and larger populations is necessary to strengthen the scientific evidence regarding the effectiveness and applicability of TENS in the context of burn care.

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