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Therapeutic Applications of Transcutaneous Electrical Nerve Stimulation (TENS) in Dentistry: Current Evidence, Clinical Effectiveness, and Limitations

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Sujatha Paranna [1], Rahul Adwani [2], Kartik Dholakia [3], Vinit K. Singh [4], Sameer Chauhan [5], Pankaj Kumar Agrawal [6]

1. Department of Pediatric and Preventive Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, IND 2. Department of Prosthodontics and Crown and Bridge, Vidarbha Youth Welfare Society (VYWS) Dental College and Hospital, Amravati, IND 3. Department of Oral and Maxillofacial Surgery, Faculty of Dental Science, Dharmsinh Desai University (DDU), Nadiad, IND 4. Department of Orthodontics and Dentofacial Orthopedics, Vananchal Dental College, Farathiya, IND 5. Department of Prosthodontics, KM Shah Dental College and Hospital, Sumandeep Vidyapeeth (Deemed to be University), Vadodara, IND 6. Department of Oral Pathology and Microbiology, Shri Balaji Institute of Dental Sciences, Raipur, IND

Corresponding author: Pankaj Kumar Agrawal, agrawal.pankaj03@gmail.com

Abstract

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive method of pain relief using electrical impulses delivered to peripheral nerves. In dentistry, it has been explored as a method of alleviating symptoms associated with temporomandibular disorders (TMDs), orofacial pain, masticatory muscle pain, and postoperative discomfort. This narrative review outlines how TENS works, when it can be used, and the advantages and disadvantages. A search was performed on PubMed/Medical Literature Analysis and Retrieval System Online (MEDLINE), Scopus, Web of Science, and Google Scholar to identify relevant literature. All articles were published in English and between the database start date and September 2026. Evidence suggests that TENS may have advantages in certain situations; however, results can vary depending on the condition, settings, and methods used. Some articles also show little benefit. More high-quality clinical research is required to determine its effectiveness in dental situations.

Categories: Dentistry
Keywords: dental application, pain, tens, tmj, transcutaneous electrical nerve stimulation

Introduction And Background

Pain management is an essential aspect of dentistry since pain from orofacial conditions or dental procedures may limit patient compliance, acceptance, and overall quality of life [1]. While pharmacological interventions are considered the cornerstone of managing painful conditions, there is a growing interest in adjunct or alternative methods of pain control. One of the novel techniques used for pain management is transcutaneous electrical nerve stimulation (TENS), which utilizes electrical impulses to relieve discomfort by blocking the pain signals transmitted to the brain [2].

Research and development efforts have led to the production of devices that allow patients to control the intensity of electrical stimulation. The mode of action is based on the principle that sensory fibers outnumber pain fibers in the peripheral nerve system. As such, there is a need for proper patient education and technique, including electrode placement and patient comfort, to achieve the desired therapeutic effect. TENS is a nondrug treatment and therefore does not have any drug-related side effects but can sometimes irritate the skin, cause discomfort, or cause anxiety relating to the electrical stimulation [3].

The idea of using electrical impulses for pain relief can be traced back to ancient times when it was discovered that some electric fish had analgesic properties. Several researchers conducted studies on the pain-relieving property of electricity, leading to the development of modern electrotherapy. However, the underlying mechanism of action was not fully understood until 1965, when Melzack and Wall proposed the gate control theory of pain. The theory provided a rationale for the use of TENS for managing different types of pain [4].

TENS has been used as an adjunctive treatment in dentistry for the management of orofacial pain and discomfort. TENS has become an interesting treatment due to its non-invasive nature and potential to decrease medication use. However, studies on TENS have used differing parameters, different techniques and different indications and outcomes, making it difficult to get a clear picture [1,2]. The purpose of this review article is to discuss the rationale, clinical applications, and efficacy of the TENS technique in dentistry.

Review

Type of review and methodology

This narrative review explored the mechanism of action, application, effectiveness, safety, limitations, and future applications of transcutaneous electrical nerve stimulation (TENS) in dentistry. A literature search was performed using PubMed/Medical Literature Analysis and Retrieval System Online (MEDLINE), Scopus, Web of Science, and Google Scholar. All publications between database inception and September 2026 were considered. Search terms included “transcutaneous electrical nerve stimulation”, “TENS”, “dentistry”, “orofacial pain”, “temporomandibular disorders”, “masticatory muscle pain”, “pediatric dentistry”, “dental pain”, “postoperative pain”, and “electroanalgesia”. Boolean terms (AND/OR) were used to identify publications relating to the topic. Original research, randomized controlled trials, clinical studies, and systematic reviews were considered. These focused on TENS mechanism of action, application, effectiveness, or safety in dentistry and orofacial pain. Non-dental pain studies were also considered if they provided useful information on the mechanism of action. Publications not related to the purpose of the review were excluded. Duplicate publications were excluded. Articles that did not provide enough information to determine findings were also excluded. Relevant publications were identified and categorized under the key themes of the mechanism of action, orofacial pain, temporomandibular disorders (TMDs), pediatric dentistry, postoperative pain, safety, and future applications. Findings were summarized and compared based on clinical outcomes, benefits, and limitations. As it was a narrative review, there was no systematic bias analysis or meta-analysis.

Principles and mechanisms of TENS

TENS is a therapy based on the use of low-voltage electrical impulses applied through electrodes placed on the skin surface. Effects of TENS are determined by the frequency of impulse generation, the duration of the impulse, the intensity of the treatment, the site of electrode placement, and the nature of the pain syndrome. The mechanism of the pain-suppressing action of TENS is associated with a number of physiological processes, including the stimulation of the peripheral sensory nerves and the modulation of pain conduction in the central nervous system [5,6].

Gate Control Theory

The gate control theory of pain, suggested by Melzack and Wall in 1965, explains the mechanism of action of TENS. According to the theory, the stimulation of large-diameter A-beta sensory nerves inhibits the conduction of small-diameter A-delta and C fibers in the dorsal horn of the spinal cord. This leads to the suppression of nociceptive signal transfer to higher pain centers. The analgesic effect of TENS is explained by the activation of inhibitory interneurons in the spinal cord. The first theory can only partially explain the mechanism of action of TENS because it does not take into account the effect of low-frequency stimulation [4].

Activation of Endogenous Pain Inhibitory Pathways

Endogenous pain inhibitory pathways are being activated, and the analgesic effect of TENS is explained by the fact that the stimulation of peripheral nerves affects the release of neurotransmitters from presynaptic membrane endings. The stimulation of A-beta fibers leads to the inhibition of dorsal horn neurons and the blockade of pain signal transmission. The involvement of supraspinal structures in the mechanism of action of TENS is confirmed by experimental studies. The use of TENS leads to the activation of inhibitory neurons in the periaqueductal gray matter and the rostral ventromedial medulla. Thus, the analgesic effect of TENS is due to the inhibition of dorsal horn neurons by supraspinal structures. This mechanism of action is most likely realized when using low-frequency stimulators. The theory adequately explains the mechanism of the analgesic effect of TENS on pain associated with the temporomandibular joint (TMJ) and orofacial pain [7].

Peripheral Nerve Stimulation and Pain Modulation

The electrical stimulus, which is delivered through cutaneous electrodes, stimulates peripheral sensory nerves, leading to a tingling sensation in the area of the electrodes. Using conventional TENS devices, a relatively high frequency of stimulation is applied to the pain area with a comfortable intensity to relieve pain. The current stimulation can decrease the excitability of afferent nociceptive pathways, suppress the conduction of pain signals, and modulate their transmission. At the same time, the analgesic effect of TENS depends on the site and intensity of stimulation, which are selected individually for each patient, and the nature of the pain syndrome [3,8].

Components of a TENS machine

The main parts of a TENS device are the unit itself, leads, and the electrodes. The unit will produce the electrical impulse and allow the settings to be changed for frequency, pulse width, and intensity. Units can be either a clinical or portable version. The leads carry the electrical impulse from the unit to the electrodes. The electrodes carry the current to the target tissue.

The most common type of electrode used is surface electrodes. These are placed onto the skin over the target area or close to the target area. Electrodes will often be self-adhesive. The correct positioning of the electrodes will help ensure that the stimulation is delivered to the correct area. Good skin contact should also be ensured to help provide even delivery of the current. The intensity should be altered depending on the treatment plan and the patients' tolerance. Before applying the electrodes, the skin should be checked for any damage. Electrodes should not be applied over damaged areas. Electrodes should be applied following manufacturer guidelines, and correct safety measures should be taken [3,9].

Types of TENS

TENS can be categorized as conventional TENS, acupuncture-like TENS, and intense TENS based on the stimulation frequency and intensity and the resulting physiological response. Conventional TENS employs low-intensity, high-frequency stimulation to activate large-diameter, non-nociceptive sensory fibers and induce segmental analgesia. The stimulation frequency is adjusted to elicit a strong but comfortable tingling sensation and can be delivered as needed for analgesia. Acupuncture-like TENS utilizes low-frequency, high-intensity stimulation to induce tolerable muscle contractions, activate motor and associated sensory pathways, and promote analgesia through the activation of endogenous pain inhibitory systems. Intense TENS employs high-frequency stimulation at an intensity approaching or reaching the patient's maximum tolerance for brief periods, but its painful nature might limit its clinical application.

In dentistry, conventional TENS has been primarily investigated for the management of temporomandibular disorders (TMDs), masticatory muscle pain, and selected orofacial pain conditions. It is typically applied using extraoral electrodes placed over the affected musculature or corresponding nerve pathways to reduce pain and improve functional comfort. Low-frequency, acupuncture-like TENS has also been investigated for temporomandibular disorders and myofascial pain with prominent muscle involvement. In contrast, the choice of stimulation parameters depends on the specific clinical condition being treated and patient response. While TENS can be considered an adjunct to conventional dental treatments for pain relief, its efficacy is variable and not consistently supported by clinical evidence for routine use in anesthesia during dental procedures. On the other hand, intense TENS has received less attention as a standard dental treatment due to the discomfort associated with high-intensity stimulation.

Factors influencing the efficacy of TENS

Several factors determine the effectiveness of TENS, including the intensity of stimulation, the frequency of impulses, the duration of the pulse, the placement of the electrode, the treatment course, patient characteristics, and other considerations. The intensity of stimulation should be increased to the maximum tolerable level, as it significantly impacts the analgesic effect. This is explained by the fact that stimulation provokes pain inhibition through the activation of sensory nerves. It is noteworthy that repeated treatments using the same stimulation parameters might lead to diminished response, although there is a lack of sufficient evidence on the impact of TENS on the pain threshold in patients with dental pain. The proper placement of electrodes plays an important role in the treatment of the temporomandibular joint and orofacial pain. Moreover, the pain intensity, the duration of the condition, concurrent analgesic use, and the timing of assessment also impact the efficacy of TENS. The cooperation of the patient, the sensitivity of their skin, and the quality of stimulation are also essential. To achieve a better effect in individual cases, it might be necessary to adjust the stimulation parameters. Overall, additional research is needed to determine the role of TENS in the management of various dental conditions [10,11].

Clinical applications of TENS in dentistry

TENS has been investigated and used for the management and relief of pain in various oral and maxillofacial surgeries. It has been applied to the treatment of temporomandibular disorders (TMDs), masticatory muscle pain, orofacial pains, procedural dental pain, and postsurgical pain. However, a closer examination of the literature reveals that the clinical efficacy of TENS was supported in only a few clinical conditions, and in others, the evidence was inconclusive. Thus, TENS should be regarded as an adjunctive therapy to conventional analgesia rather than a stand-alone method in clinical dentistry.

Temporomandibular Disorders

TENS has been evaluated as a therapeutic intervention for the management of TMDs with masticatory muscle pain and tenderness. The application of electrical stimulation resulted in decreased pain and improved mandibular movement in some patients, although the degree of response was variable.

A study conducted by Shanavas et al. revealed that the use of TENS as an adjunct treatment to medication could be beneficial for patients with TMD. The researchers measured the amount of pain using the visual analog scale (VAS) and found that the intervention reduced discomfort in both the medication-only group and the group that received TENS as an adjunct treatment. Notably, there was a more significant pain reduction in the latter group. Therefore, the researchers concluded that TENS combined with medication could be a good treatment option for TMD [12]. Another piece of research conducted by Singh et al. aimed at exploring the effectiveness of TENS compared to a placebo. The results of the two groups proved that TENS

was a beneficial intervention for people with TMDs, as it reduced masticatory muscle pain and improved mouth opening. In conclusion, the efficiency of TENS as a management for TMDs has been proven. However, the heterogeneity of the treatment regimens and the lack of consistency in the time of treatment and follow-up prevent a stronger conclusion. More studies are needed to sufficiently prove the effectiveness of TENS for the management of TMDs [13].

Myofascial Pain Dysfunction Syndrome (MPDS)

Myofascial pain dysfunction syndromes are characterized by masticatory muscle pain, tenderness, and restricted movement. TENS is a non-invasive method for reducing musculoskeletal pain. Singh et al. evaluated the effectiveness of TENS by comparing it to the traditional trigger point injection therapy in 32 patients with MPDS. The results demonstrated that both treatments were effective in reducing discomfort. However, trigger point injections had a greater effect on the patient's condition than TENS. These findings suggest that TENS might be a valuable addition to the treatment of patients with masticatory myofascial pain who prefer non-invasive therapy [14].

TENS in Pediatric Dentistry

TENS or electronic dental anesthesia has been explored as an alternative or adjunct to the conventional method of anesthetic drug administration for managing pain during various dental procedures in pediatric dentistry. This technique involves the application of a mild electrical current via surface electrodes to reduce the sensation of pain. Dhindsa et al. compared the use of TENS with 2% lignocaine for minor dental procedures and found no difference in terms of pain scores between the two treatments, whereas TENS was associated with favorable comfort and efficacy [15]. Patil et al. conducted a trial comparing different pain relief methods in 6-12-year-old patients. Based on the evidence from the studies, it can be concluded that TENS may be a useful method to enhance patient comfort during a dental procedure. However, there is insufficient evidence to support the idea that TENS can replace the conventional techniques of local anesthesia [16]. Thus, the use of TENS should not be considered as an alternative but rather an enhancement to traditional methods of local anesthesia with pharmacological intervention. Additional clinical studies are needed to confirm the safety and effectiveness of this method in pediatric patients.

Xerostomia

TENS has been investigated as a method for the non-invasive stimulation of salivary secretion in patients with xerostomia. This approach may help improve salivary flow and alleviate symptoms of oral dryness, potentially enhancing patient comfort and quality of life. An increase in parotid salivary secretion was seen following external TENS in a pilot study by Hargitai et al. However, it is unknown whether this can be applied to patients suffering from xerostomia due to various causes such as drug use and salivary gland dysfunction. It is therefore unclear how effective TENS will be therapeutically and should be further investigated with correct clinical trial design [17].

Postherpetic Neuralgia

Postherpetic neuralgia often occurs due to damage to the sensory nerves. It was found that most large myelinated afferent fibers are involved in the process. They play an important role in the control of nociceptive transmission. Their degeneration leads to the inability to inhibit the pain signals transmitted by the C fibers. This results in intense and constant pain and the hypersensitivity of the skin. The application of TENS can reduce these uncomfortable sensations due to the activation of the large-diameter afferent fibers and their inhibitory effect on the mentioned C fibers [18].

Trigeminal Neuralgia (TN)

Trigeminal neuralgia is a nerve disease affecting the trigeminal nerve and causing intense pain over the face, jaws, or other areas. Even though the causes of the condition might be different, there are several treatments that are commonly used in the case, including medication and surgery. Methods such as microvascular decompression and other surgeries are also applicable in particular situations. One of the new approaches to trigeminal neuralgia is TENS. It seems reasonable; however, there is a need for more evidence to prove its effectiveness and benefit for patients' health [7]. A systematic review and meta-analysis performed by AlHabil et al. showed that there was a significant decrease in pain scores after TENS treatment in five clinical trials of 101 patients. However, there was a moderate degree of heterogeneity between the studies, and therefore, more high-quality clinical trials are required to determine the efficacy, safety, and long-term benefits of this treatment in patients with TN [19]. Yue et al. also conducted a retrospective study on 205 patients suffering from trigeminal neuralgia. It was found that after four weeks of treatment, the combination of TENS and pregabalin showed significantly better improvements in pain intensity, sleep quality, and quality of life compared to using only pregabalin. No significant difference was observed in the incidence of adverse reactions between groups [20]. However, future well-designed clinical trials are required to confirm the long-term effectiveness and safety of TENS in the management of trigeminal neuralgia.

TENS in Orthodontics

The placement of orthodontic separators is usually followed by discomfort and pain due to the mechanical forces exerted, causing the compression of the periodontal ligament, initiating an inflammatory response, and increasing sensitivity while chewing. Roth and Thrash (1986) examined the effectiveness of TENS for controlling periodontal pain associated with the placement of orthodontic separators in 45 adult patients. They found that patients with TENS had a significant reduction in pain intensity at 24, 36, and 48 hours compared to the control group [21].

Similarly, Jha et al. evaluated the effect of TENS and acetaminophen in controlling pain after the activation of orthodontic appliances: a randomized trial on 120 patients with fixed orthodontic appliances. The participants were divided into three groups (n = 40): TENS, acetaminophen, and control. Pain intensity was measured by the VAS at baseline, 30 minutes, six hours, and 24 hours after activation. Both TENS and acetaminophen resulted in a significantly greater reduction of pain compared to the control group, with no statistically significant difference between the two intervention groups. The results indicate that TENS may be a good non-pharmacological alternative to the conventional analgesics in the management of orthodontic pain [22].

TENS in Postoperative Pain Management

TENS has also been evaluated as a method of pain control following various other oral and maxillofacial surgical procedures. Çebi assessed the ability of TENS to reduce postoperative pain following impacted mandibular third molar surgery. A total of 30 patients who underwent bilateral mandibular third molar surgery with a total of 60 impacted teeth were included in the study. Routine postoperative treatment, including analgesics, antibiotics, and mouthwash, was provided following the first surgery, and TENS was also used following the second surgery. The intensity of pain was evaluated with a visual analog scale (VAS) at six, eight, and 24 hours and on days 2, 3, 4, and 5 following the surgery. Statistically significant differences in postoperative pain scores between routine treatment and TENS groups were observed at all time points. The study concluded that TENS can be used to manage postoperative pain following impacted third molar surgery [23].

TENS in Acute Orofacial Pain

Aside from its use in postoperative pain relief, TENS has been studied for its ability to provide relief from acute orofacial pain. Hansson and Ekblom conducted a randomized study to compare high-frequency (100 Hz) and low-frequency (2 Hz) TENS with placebo TENS in a sample of 62 patients attending a dental emergency clinic. Of the 42 patients treated with active TENS, 16 reported an increase in pain relief of greater than 50%, and four indicated complete relief of pain, while only two out of 20 patients in the placebo group experienced similar relief, with none obtaining total pain relief. The mechanical vibratory stimulation increased the effect of TENS in half of the patients (five out of 10 patients). The researcher concluded that TENS had some possible beneficial analgesic effects for patients experiencing acute orofacial pain [24].

TENS in Periodontology

Non-surgical periodontal procedures, such as periodontal scaling and root planing, can be quite painful and cause significant patient discomfort, resulting in reduced patient acceptance and treatment compliance. Ortu et al. (2025) assessed the potential benefit of using ultra-low-frequency (ULF) transcutaneous electrical nerve stimulation (TENS) during non-surgical periodontal procedures in 20 adult patients in a prospective, randomized, crossover split-mouth pilot study. Changes in pain intensity and overall patient discomfort using TENS and not using TENS were compared, as well as differences in maximum pain tolerance, mouth opening. Results revealed a statistically significant decline in pain and discomfort ($P < 0.0001$), while a statistically significant increase in mouth opening was observed using TENS ($P = 0.00062$). The researchers concluded that ULF-TENS may be beneficial to increase patient comfort during non-surgical periodontal procedures, though studies with a larger cohort of patients are needed [25].

Contraindications of TENS

TENS is indicated only in selected patients and may be contraindicated in some patients or may require the modification of the treatment parameters in others. The therapy should be avoided in patients with cardiac pacemakers or other electronic implants or under the supervision of a medical professional. People with epilepsy, those with a history of stroke or cerebral hemorrhage, and pregnant women should be subjected to additional cautions with TENS, particularly avoiding stimulation on the abdominal area or the lumbar region. The therapy should not be used to treat sudden pain of an unknown cause before a physician determines the source of discomfort, since stopping the therapy may make the condition difficult to diagnose [18].

Limitations

The use of transcutaneous electrical nerve stimulation (TENS) in dentistry has not been clearly established owing to inconsistencies in the procedures, small sample size, and short-term follow-ups in several clinical trials. Additionally, the effectiveness of TENS is variable depending on the type of clinical condition, parameters of the treatment, and the characteristics of the individual patient. Therefore, TENS should be regarded as an auxiliary measure in conventional dental treatment and not a therapeutic modality per se. TENS can prove effective in the management of orofacial pain, temporomandibular disorder, and other certain dental disorders through the delivery of electrical stimulation in a non-invasive manner. However, its use in dentistry should be based on the goals of the treatment, as well as evidence.

Future perspectives

TENS could be employed as an adjuvant treatment for certain dental diseases such as orofacial pain, temporomandibular dysfunction, dry mouth syndrome, and dental pain in children. However, more scientific studies need to be conducted in order to provide evidence-based treatment modalities and to evaluate the efficacy of TENS in treating dental diseases. Clinical trials that employ appropriate numbers of participants are essential to find out proper stimulation parameters and patients who would benefit from TENS therapy.

Conclusions

TENS offers a conservative approach that can be used for managing pain, including the pain associated with temporomandibular joint disorders, masticatory muscle pain, and some pediatric dental procedures. It can be considered an effective method for improving the comfort of the patients, as well as a useful adjunctive therapy, but its effectiveness varies based on the case and the specific treatment. However, additional research is required to evaluate the method and develop appropriate protocols.

Appendices

Table *1* shows the clinical evidence of the application of TENS in dentistry.

Clinical indication	Study design and author	Sample size	Principal findings	Limitations
Trigeminal neuralgia	Retrospective study; Yue et al. (2025) [20]	205	At four weeks, TENS plus pregabalin showed significantly greater improvements in pain severity and sleep quality than pregabalin alone. There were no differences in the rates of adverse events	Only four weeks of treatment and little evidence for long-term effectiveness and safety
TMD-related pain	Clinical study; Shanavas et al. (2014) [12]	40	TENS combined with medication (chlorzoxazone 250 mg, diclofenac potassium 50 mg, and paracetamol 325 mg) reportedly produced greater pain reduction than medication alone ($p = 0.019$, as previously reported)	There is little information regarding the size and sustainability of the treatment effect
Pain during local anesthetic administration in children	Clinical study; Dhindsa et al. (2011) [15]	180	Electronic dental anesthesia (TENS) provided pain control comparable to 2% lignocaine in selected minor pediatric dental procedures	The results of this study may not be representative of all pediatric dental procedures
Pain before local anesthetic injection in children	Comparative clinical study; Patil et al. (2021) [16]	60 (four groups of 15)	TENS was found to have the lowest mean pain score with a mean score of 2.40 on the Wong-Baker Faces Pain Rating Scale and 1.47 on the FLACC scale. When comparing all groups, the overall difference between the groups was statistically significant ($p < 0.05$)	Small sample size
Parotid salivary stimulation	Pilot study; Hargitai et al. (2005) [17]	22	External TENS increased mean salivary flow from 0.02418 to 0.04946 mL/minute in 15 participants ($p < 0.001$)	There was a small sample size, and therefore, the effectiveness on patients with xerostomia is unclear
Orthodontic pain associated with separator placement	Clinical study; Roth and Thrash (1986) [21]	45	TENS significantly reduced pain associated with orthodontic separator placement at 24, 36, and 48 hours compared to the control group	Small sample size and limited assessment of long-term effectiveness
Orthodontic pain following appliance activation	Randomized comparative trial; Jha et al. (2024) [22]	120 (three groups of 40)	Both TENS and acetaminophen significantly reduced pain compared to the control group. No significant difference was observed between TENS and acetaminophen, suggesting comparable analgesic effectiveness	Short follow-up period of 24 hours and limited assessment of long-term pain control
Postoperative pain following impacted third molar surgery	Clinical study; Çebi (2019) [23]	30 (60 impacted third molars)	TENS application, in addition to routine postoperative treatment, significantly reduced pain compared with routine treatment alone at all assessed postoperative intervals	Small sample size and potential influence of the sequential bilateral surgical design on pain comparisons
Non-surgical periodontal therapy	Prospective randomized crossover split-mouth pilot study; Ortu et al. (2025) [25]	20	ULF-TENS significantly reduced pain ($p < 0.0001$) and discomfort ($p < 0.0001$), with significant improvement in maximum mouth opening ($p = 0.00062$)	Small sample size and pilot study design; long-term effectiveness remains unclear

TABLE 1: Clinical Evidence of Application of TENS in Dentistry

TENS, transcutaneous electrical nerve stimulation; TMD, temporomandibular disorder; ULF-TENS, ultra-low-frequency transcutaneous electrical nerve stimulation; FLACC, Face, Legs, Activity, Cry, and Consolability scale

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Pankaj Kumar Agrawal, Sujatha Paranna, Rahul Adwani, Kartik Dholakia, Vinit K. Singh, Sameer Chauhan

Acquisition, analysis, or interpretation of data: Pankaj Kumar Agrawal, Sujatha Paranna, Rahul Adwani, Kartik Dholakia, Vinit K. Singh, Sameer Chauhan

Drafting of the manuscript: Pankaj Kumar Agrawal, Sujatha Paranna, Rahul Adwani, Kartik Dholakia, Vinit K. Singh, Sameer Chauhan

Critical review of the manuscript for important intellectual content: Pankaj Kumar Agrawal, Sujatha Paranna, Rahul Adwani, Kartik Dholakia, Vinit K. Singh, Sameer Chauhan

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