RESEARCH ARTICLE

Role of transcutaneous electrical nerve stimulation in temporomandibular joint disorders

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Abstract

Objective: To compare the efficacy of transcutaneous electrical nerve stimulation with commercially available analgesics in alleviating symptoms of temporomandibular disorders.

Method: The cross-sectional, interventional study was conducted from March 11, 2020, to August 31, 2023, at the Oral and Maxillofacial Surgery Department of the Armed Forces Institute of Dentistry, Rawalpindi, Pakistan, and comprised patients aged 18-65 years who were experiencing pain or distress in the temporomandibular joint region. The participants were divided into intervention group A and control group B. Group A treatment involved applying electrodes near the temporomandibular joint, with parameters adjusted as per the treatment guidelines. Group B subjects received only analgesics along with basic care recommendations. Pain intensity was assessed using visual analogue scale, while functional impairment and adverse effects were monitored. Data was analysed using SPSS 24.

Results: Of the 130 patients initially assessed, 100(77%) were included; 50(50%) in each group. In group A, there were 33(66.0%) females and 17(34.0%) males with overall mean age 42.8±10.12 years. In group B, there were 30(60%) females and 20(40%) males with overall mean age 46.98±14.09 years. Pain intensity was significantly lower in group A compared to group B post-intervention (p=0.009). Group A subjects also showed significant post-intervention improvement in terms of mouth opening compared to group B patients (p<0.05). There was no significant intergroup difference with respect to adverse effects (p>0.05).

Conclusion: Transcutaneous electrical nerve stimulation was significantly more effective than commercially available analgesics in alleviating symptoms of temporomandibular disorders.

Keywords: Analgesia, Electric stimulation therapy, Pain management, Temporomandibular joint disorders, Transcutaneous electric nerve stimulation. (JPMA 74: 1645; 2024)

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Introduction

The temporomandibular joint (TMJ) is a hinge joint with bi-arthrodial properties, allowing for the intricate movements required for mastication.[1] Temporomandibular disorder (TMD) is a condition that occurs when the TMJ and its associated anatomical structures are afflicted.[2,3] Approximately 25% of individuals worldwide exhibit signs or symptoms of TMDs. In addition, TMDs occur 1.5 to 2.5 times more in females than males.[4] It is a prevalent disorder characterised by pain, dysfunction and discomfort in TMJ, and surrounding structures. It affects a substantial portion of the population, resulting in limitations to daily activities, diminished quality of life, and substantial healthcare expenditure.[5,6]

Diverse treatment modalities are being investigated for managing TMDs, aiming to relieve pain and enhance mandible function.[7] Although non-surgical and surgical methods are available to treat TMDs, the conservative method is the initial and primary treatment option.[8] Pharmacological therapies, including the use of nonsteroidal anti-inflammatory drugs (NSAIDs), anti-depressants, and muscle relaxants, constitute non-surgical treatment. The second component comprises occlusal and physical therapy techniques, such as low-level laser therapy (LLLT), transcutaneous electrical nerve stimulation (TENS) and ultrasound.[9]

TENS has acquired recognition as a non-invasive, drug-free pain management technique for TMD. It entails the application of low-frequency electrical currents over the skin through surface electrodes.[10-12] These electrical currents stimulate sensory nerves and modulate pain signals transmitted to the central nervous system (CNS) to alter pain perception. TENS is utilised in patients with TMDs to target the muscles and nerves surrounding the TMJ, promoting muscle relaxation, reducing muscle spasms, and relieving discomfort.[13]

Understanding the comparative efficacy of TENS and analgesics while treating TMD is crucial for healthcare

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professionals.[7] By identifying the advantages and disadvantages of both approaches, clinicians can select the most appropriate treatment option for specific patients.[14] In addition, patients with TMDs can benefit from a thorough comprehension of the potential benefits and drawbacks of TENS and analgesics, enabling them to actively participate in treatment decisions.[15]

By comparing TENS to other treatment modalities, studies have assessed its efficacy, safety and practicability in reducing pain and enhancing mandible function in TMD patients.[16]

Despite the growing recognition of TENS as a non-invasive approach to managing TMDs, there is a lack of comprehensive comparative analysis regarding its efficacy compared to commonly used analgesics for TMD treatment.[17]

The current study was planned to close this gap in literature by evaluating the efficacy of TENS and analgesics in terms of pain reduction and functional improvement, by assessing patient satisfaction with both modalities, and by examining the potential side effects associated with TENS and analgesic use.

Patients and Methods

The cross-sectional, interventional study was conducted from March 11, 2020, to August 31, 2023, at the Oral and Maxillofacial Surgery Department of the Armed Forces Institute of Dentistry, Rawalpindi, Pakistan. After approval from the institutional ethics review committee, the sample size was calculated using OpenEpi calculator with 95% confidence level, 80% power, group ratio 1:1 and level of significance 0.05.[18] The sample was raised using non-probability convenience sampling technique.

Those included were patients aged 18-65 years who were experiencing pain or distress in the TMJ region. Patients with contraindications for TENS or analgesic use, such as pacemakers, epilepsy, or pregnancy, were excluded, and so were those who had previously received TENS or analgesic treatment for TMDs. Patients with severe medical conditions who could not continue with the study period or endanger their health were also excluded.[19] Informed consent was obtained from all the subjects, and those not willing to participate were not included.

The participants were divided into intervention group A and control group B. Group A treatment involved applying electrodes near the TMJ. TENS parameters, including frequency, pulse duration and intensity, were established as per the TMD treatment guidelines (Digital TENS BE-660, Besmed, Taiwan) (Figure). Group B subjects received only analgesics. The analgesics were naproxen 500mg twice daily, and diclofenac potassium 50mg twice daily. Both groups were advised basic care, such as hot therapy and jaw exercises.

Figure: The transcutaneous electrical nerve stimulation (TENS) machine used in the study.

The treatment lasted 15-60 minutes, multiple times daily, or as required.[13] The patients were evaluated after 4 weeks in each case.

Outcome measures included pain intensity and functional impairment. Before and after the intervention, pain intensity was measured using the visual analogue scale (VAS), with scores ranging from 0=no pain to 10=worst imaginable pain. Any adverse effects or side effects associated with the use of TENS or analgesics were noted. The adverse effects analysed included headache, nausea, dizziness, skin irritation, gastrointestinal disturbances and sleep disturbance.

Data was analysed using SPSS 24. Descriptive statistics were employed to analyse baseline characteristics, including age and gender distribution. Data normality was assessed using Kolmogorov-Smirnov test. Intergroup analyses were conducted using t-tests. Continuous variables were compared using one-way analysis of variance (ANOVA). Correlation coefficient (r-value) was calculated for each adverse effect. Paired samples correlations were conducted to assess the association between adverse effects within each group, while paired samples t-tests were used to determine the significance of differences between the groups. $P<0.05$ was considered statistically significant.

Results

Of the 130 patients initially assessed, 100(77%) were included; 50(50%) in each group. In group A, there were 33(66.0%) females and 17(34.0%) males with overall mean age 42.8±10.12 years. In group B, there were 30(60%) females and 20(40%) males with overall mean age 46.98±14.09 years. Mean duration of TMD was 15.22±3.18 in group A and 14.98±3.09 months in group B. Mean pain

Table-1: Baseline characteristics.

Baseline characteristics	TENS Group (n=50)	Analgesic Group (n=50)	*t*-test	*p*-value*
Mean Age (years)	42.8±10.12	46.98±14.09	21.47	0.030**
Gender n(%)				
Male	17 (34.0)	20 (40.0)	12.33	0.052**
Female	33 (66.0)	30 (60.0)	21.00	0.030**
Mean Duration of TMD (months)	15.2±3.18	14.98±3.09	125.83	0.005**
Mean Pain intensity (VAS)	7.2±2.80	7.0±2.67	71.00	0.009**

*T-Test; **significance at $p<0.05$; TENS: Transcutaneous electrical nerve stimulation; TMD: Temporomandibular disorders.

Table-2: Outcome pain intensity and mouth opening before and after the intervention.

Group	Mouth opening before intervention (mm)	Mouth opening after intervention (mm)	Pain intensity before intervention	Pain intensity after intervention (post 4 weeks)	*p*-value*
TENS	11.30±2.09	32.42±8.91	7.2±2.80	3.1±0.91	<0.001**
Analgesic	12.01±2.14	24.27±4.65	7.0±2.67	4.8±1.21	0.11

*ANOVA; **significance at $p<0.05$; TENS: Transcutaneous electrical nerve stimulation

Table-3: Intergroup comparison of adverse effects.

Adverse effects	TENS Group n (%) (n=50)	Analgesic Group n (%) (n=50)	*r*-value*	*p*-value**
Headache	6 (12)	4 (8)	-1.000	0.258
Nausea	2 (4)	7 (14)	1.000	0.374
Dizziness	2 (4)	3 (6)	1.000	0.258
Skin irritation	0 (0)	1 (2)	1.000	0.258
Gastrointestinal disturbances	1 (2)	8 (16)	1.000	0.500
Sleep disturbance	2 (4)	4 (8)	1.000	0.205

*Paired Samples Correlations: **Paired Samples T-Test, significance at p<0.05; TENS: Transcutaneous electrical nerve stimulation.

intensity at baseline was 7.2±2.80 in group A and it was 7.0±2.67 in group B (Table 1).

Pain intensity was lowered significantly in group A compared to group B post-intervention (p=0.009). Group A subjects also showed significant post-intervention improvement in terms of mouth opening compared to group B patients (Table 2).

There was no significant intergroup difference with respect to adverse effects (Table 3).

Discussion

In the current study, the participants most frequently reported jaw pain, facial pain, jaw clicking and popping, restricted jaw movement and migraines. The finding provided important insight into the clinical manifestations of TMD.[20]

The TENS group experienced a significant reduction in pain intensity, suggesting that TENS is an effective method for alleviating TMD-related pain, whereas the analgesic interventions did not demonstrate significant improvements. Compared to the other categories, the incidence of adverse effects was relatively low with TENS. These findings highlighted the significance of contemplating potential adverse effects when assessing the benefits and risks of various treatment options.[7]

The current findings were consistent with the study[21] according to which 5-60% of the general population suffered from at least one of the signs of. Also, 48% of TMD patients displayed clinical symptoms in a study,[22] including muscle tenderness and difficulty opening the mouth. TMDs were the most prevalent orofacial pain disorders unrelated to dental issues. One of the study subgroups that was treated with microcurrent electrical nerve stimulation (MENS) demonstrated a significant improvement in VAS scores. TENS and MENS subgroups demonstrated comparable improvements in VAS scores.[21] Based on these results, the study concluded that both TENS and MENS were equally effective in enhancing functional mouth-opening. The study considered TENS and MENS as first-line treatments for acute and chronic masticatory muscle discomfort, and offered effective options for enhancing mouth-opening function.[22]

A study strongly supported the current findings that TENS therapy can provide rapid pain relief in masticatory muscles and enhance masticatory function in TMD patients with muscle pain.[23] The study examined the immediate effects of TENS on muscle pain caused by TMDs on 36 participants with TMD. Before and after TENS treatment, objective measurements of maximum mouth-opening and maximum bite force were obtained. The severity of pain was measured using VAS. The afflicted muscles were treated with TENS for 20 minutes at frequencies between 100Hz and 200Hz. Using the Global Rating of Change (GRC) instruments, the treatment's effects were assessed. In the TMD group, pain intensity decreased significantly following TENS treatment. Only the TMD group exhibited a significant increase in maximum mouth-opening, but both groups demonstrated a significant improvement in maximum bite force following TENS. According to GRC scales, the majority of TMD patients reported positive changes, except for one patient who reported negative emotions. These findings suggested that TENS therapy provided rapid pain relief in masticatory muscles in TMD patients.[23] TENS therapy may aid trunk muscle activity and partially restore motor neuron activation.[24,25]

The current study had limitations as it had a relatively short follow-up post-intervention. A longer follow-up could have provided insights into the sustained efficacy and potential long-term outcomes of the interventions. Future research with extended follow-up periods may further elucidate the

effectiveness and durability of TENS and analgesics in managing TMD symptoms.

Conclusion

Both TENS and analgesics demonstrated promising outcomes in relieving TMD-related symptoms, but TENS exhibited superior efficacy in improving mouth opening and reducing pain intensity compared to analgesics. Additionally, both interventions were well-tolerated, with no significant differences observed in adverse effects between the two groups. TENS may offer a valuable non-invasive alternative or adjunct therapy for individuals suffering from TMDs, potentially providing effective pain relief and improving functional outcomes.

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References

1. Okoje VN, Aladelusi TO, Abimbola TA. Managing temporomandibular joint dislocation in ibadan: a review of 11 cases. Ann Ib Postgrad Med 2017;15:96-10.
2. Maini K, Dua A. Temporomandibular Syndrome. Treasure Island, FL: StatPearls Publishing; 2024.
3. Murphy MK, MacBarb RF, Wong ME, Athanasiou KA. Temporomandibular disorders: a review of etiology, clinical management, and tissue engineering strategies. Int J Oral Maxillofac Implants 2013;28:e393-414. doi: 10.11607/jomi.te20
4. Warren MP, Fried JL. Temporomandibular disorders and hormones in women. Cells Tissues Organs 2001;169:187-92. doi: 10.1159/000047881
5. Kapos FP, Exposto FG, Oyarzo JF, Durham J. Temporomandibular disorders: a review of current concepts in aetiology, diagnosis and management. Oral Surg 2020;13:321-34. doi: 10.1111/ors.12473
6. Alrizqi AH, Aleissa BM. Prevalence of Temporomandibular Disorders Between 2015-2021: A Literature Review. Cureus 2023;15:e37028. doi: 10.7759/cureus.37028
7. Gil-Martínez A, Paris-Alemany A, López-de-Uralde-Villanueva I, La Touche R. Management of pain in patients with temporomandibular disorder (TMD): challenges and solutions. J Pain Res 2018;11:571-87. doi: 10.2147/JPR.S127950
8. Abouelhuda AM, Khalifa AK, Kim YK, Hegazy SA. Non-invasive different modalities of treatment for temporomandibular disorders: review of literature. J Korean Assoc Oral Maxillofac Surg 2018;44:43-51. doi: 10.5125/jkaoms.2018.44.2.43
9. Rezazadeh F, Hajian K, Shahidi S, Piroozi S. Comparison of the Effects of Transcutaneous Electrical Nerve Stimulation and Low-Level Laser Therapy on Drug-Resistant Temporomandibular Disorders. J Dent (Shiraz) 2017;18:187-92.
10. Shanavas M, Chatra L, Shenai P, Rao PK, Jagathish V, Kumar SP, et al. Transcutaneous electrical nerve stimulation therapy: An adjuvant pain controlling modality in TMD patients - A clinical study. Dent Res J (Isfahan) 2014;11:676-9.
11. Martimbianco ALC, Porfírio GJ, Pacheco RL, Torloni MR, Riera R. Transcutaneous electrical nerve stimulation (TENS) for chronic neck pain. Cochrane Database Syst Rev 2019;12:CD011927. doi: 10.1002/14651858.CD011927.pub2
12. Hsieh YL, Yang CC, Yang NP. Ultra-Low Frequency Transcutaneous Electrical Nerve Stimulation on Pain Modulation in a Rat Model with Myogenous Temporomandibular Dysfunction. Int J Mol Sci 2021;22:9906. doi: 10.3390/ijms22189906
13. Johnson M. Transcutaneous Electrical Nerve Stimulation: Mechanisms, Clinical Application and Evidence. Rev Pain 2007;1:7-1. doi: 10.1177/204946370700100103
14. Beutler LE, Someah K, Kimpara S, Miller K. Selecting the most appropriate treatment for each patient. Int J Clin Health Psychol 2016;16:99-10. doi: 10.1016/j.ijchp.2015.08.001
15. Garrigós-Pedrón M, Elizagaray-García I, Domínguez-Gordillo AA, Del-Castillo-Pardo-de-Vera JL, Gil-Martínez A. Temporomandibular disorders: improving outcomes using a multidisciplinary approach. J Multidiscip Healthc 2019;12:733-47. doi: 10.2147/JMDH.S178507
16. Chellappa D, Thirupathy M. Comparative efficacy of low-Level laser and TENS in the symptomatic relief of temporomandibular joint disorders: A randomized clinical trial. Indian J Dent Res 2020;31:42-7. doi: 10.4103/ijdr.IJDR_735_18
17. Wu M, Cai J, Yu Y, Hu S, Wang Y, Wu M. Therapeutic Agents for the Treatment of Temporomandibular Joint Disorders: Progress and Perspective. Front Pharmacol 2021;11:596099. doi: 10.3389/fphar.2020.596099
18. Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version: 3.01. [Online] 2013 [Cited 2022 August 10]. Available from URL: https://www.openepi.com/Menu/OE_Menu.htm
19. Kapos FP, Exposto FG, Oyarzo JF, Durham J. Temporomandibular disorders: a review of current concepts in aetiology, diagnosis and management. Oral Surg 2020;13:321-34. doi: 10.1111/ors.12473
20. Eweka OM, Ogundana OM, Agbelusi GA. Temporomandibular pain dysfunction syndrome in patients attending Lagos University Teaching Hospital, Lagos, Nigeria. J West Afr Coll Surg 2016;6:70-87.
21. Ryan J, Akhter R, Hassan N, Hilton G, Wickham J, Ibarag S. Epidemiology of Temporomandibular Disorder in the General Population: a systematic review. Adv Dent & Oral Health 2019;10:555787. DOI: 10.19080/ADOH.2019.10.555787.
22. Saranya B, Ahmed J, Shenoy N, Ongole R, Sujir N, Natarajan S. Comparison of Transcutaneous Electric Nerve Stimulation (TENS) and Microcurrent Nerve Stimulation (MENS) in the Management of Masticatory Muscle Pain: A Comparative Study. Pain Res Manag 2019;2019:8291624. doi: 10.1155/2019/8291624
23. Abe S, Miyagi A, Yoshinaga K, Matsuka Y, Matsumoto F, Uyama E, et al. Immediate Effect of Masticatory Muscle Activity with Transcutaneous Electrical Nerve Stimulation in Muscle Pain of Temporomandibular Disorders Patients. J Clin Med 2020;9:3330. doi: 10.3390/jcm9103330
24. Jung KS, In TS, Cho HY. Effects of sit-to-stand training combined with transcutaneous electrical stimulation on spasticity, muscle strength and balance ability in patients with stroke: A randomized controlled study. Gait Posture 2017;54:183-7. doi: 10.1016/j.gaitpost.2017.03.007
25. Konishi Y, McNair PJ, Rice DA. TENS Alleviates Muscle Weakness Attributable to Attenuation of Ia Afferents. Int J Sports Med 2017;38:253-7. doi: 10.1055/s-0042-118183

Author Contribution:

SMF: Research idea conception, study design, data collection and writing.
TZ: Data entry, analysis and writing.
RN: Final approval and editing.
AT: Literature search and drafting.
SSZ: Data collection and editing.