

EFFICACY OF AMITRIPTYLINE AND TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION IN MANAGEMENT OF TEMPOROMANDIBULAR DISORDERS

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Abstract

Temporomandibular disorders (TMDs) comprise of a group of musculoskeletal and functional conditions affecting the temporomandibular joint (TMJ), masticatory musculature, and associated structures, frequently resulting in pain, functional limitation, and reduced quality of life. Amitriptyline has demonstrated analgesic benefit in orofacial pain, while transcutaneous electrical nerve stimulation (TENS) has emerged as a non-invasive adjunctive modality for symptomatic control. A prospective clinical study was conducted on patients reporting in the OPD of Guru Nanak Institute of Dental Sciences and Research, Kolkata who were diagnosed with TMDs. Participants were allocated into two groups alternatively. Group A received amitriptyline 10 mg once daily at night, while Group B received amitriptyline 10 mg combined with weekly TENS therapy for six weeks. Clinical assessment included Visual Analogue Scale (VAS), maximum mouth opening (MMO) and TMJ clicking. Assessments were performed at baseline and weekly for six weeks. Intergroup comparison revealed a statistically significant difference in VAS score reduction during the fourth week–fifth week interval in both groups, with Group B showing greater pain reduction ($P=0.020$). There was a change in the mean and standard deviation of MMO in both the groups but the difference was not statistically significant for any of the successive time interval. The frequency and severity of TMJ clicking diminished during treatment in both groups. Improvement was more pronounced in the combined therapy group. Low-dose amitriptyline is effective in reducing pain and improving clinical symptoms in patients with temporomandibular disorders. Adjunctive TENS therapy enhances symptomatic relief and may accelerate clinical improvement.

Keywords: Orofacial pain, Conservative management, Magnetic resonance imaging, Temporomandibular Joint

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Introduction

A temporomandibular disorder (TMD) is a musculoskeletal disorder within the masticatory System. TMD is a prevalent disorder most commonly observed in individuals between the age group of 20 and 40. Approximately 33% of the population has at least one TMD symptom (such as pain and difficulty in mouth opening, pain in muscles of mastication, reduced mouth opening, tenderness and clicking in TMJ).¹ In up to 70% of cases, TMD are accompanied by malpositioning of the temporomandibular joint (TMJ) disc, termed "internal derangement."² Some terms described in literature that suggested

etiologic factors, such as oculomandibular disturbance and myoarthropathy of the TMJ. Others stressed pain, such as myofascial pain-dysfunction syndrome, and temporomandibular pain/dysfunction syndrome.³ Certain clinical measures have been found to play a contributing role in increasing the likelihood of developing persistent TMD such as masticatory muscle and TMJ pain that is familiar on mandible mobility.⁵

Conservative therapy remains the first-line treatment for most TMD patients. Amitriptyline, a tricyclic antidepressant, has demonstrated analgesic efficacy in chronic neuropathic and musculoskeletal

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pain conditions through modulation of central pain pathways and enhancement of descending inhibitory mechanisms. The physical modalities used to treat TMD include electrotherapy, transcutaneous electrical nerve stimulation (TENS), heat therapy, cryotherapy, ultrasound, iontophoresis, anesthetics, and acupuncture.⁶

TENS is defined as the application of electrical stimulation to the skin for pain control. It is a well-known form of physical therapy, which is useful for the relief of pain.⁷ The present study was undertaken to evaluate whether adjunctive TENS therapy provides additional symptomatic benefit over pharmacotherapy alone in patients with temporomandibular disorders.

Aim

To compare the efficacy of TENS combined with low-dose amitriptyline against amitriptyline alone in providing symptomatic relief in temporomandibular disorders.

Objectives

1. To assess pain reduction using VAS.
2. To evaluate changes in maximum mouth opening.
3. To assess TMJ clicking.

Materials and Methods

Study Design

Patients reporting to the OPD of Oral and Maxillofacial Surgery and Department of Oral Medicine and Radiology, Guru Nanak Institute of Dental Sciences & Research, Panihati,

Study Population

Patients with a chief complain of pain, clicking in temporomandibular joint, reduced mouth opening, deviation/deflection on mouth opening, were diagnosed with the help of clinical history and examination were included in the study irrespective of sex, caste, color, race, & religion. MRI was done for diagnosing temporomandibular disorders.

Study Timeline:

The study was conducted after approval from the Institutional Ethics Committee of Guru Nanak Institute of Dental Sciences and Research, time period between 2024-2025

Inclusion Criteria

1. AGE : 18 years and above.
2. SEX: both males and females
3. Pain on movement of jaw
4. Limited mouth opening(less then 35 mm)
5. Presence of pain and functional limitation
6. Presence of TMJ clicking.
7. Willingness to participate and comply with follow-up visits.

Exclusion Criteria

1. History of previous surgery of jaw or TMJ
2. History of maxillofacial trauma/fracture
3. Patient under 18years
4. Any metabolic disorders affecting joints
5. Active seizure disorders, Parkinson's disease, stroke with head and neck symptoms.
6. History of cervical spondylitis
7. Autoimmune diseases like rheumatoid arthritis

Group Allocation

Group A- Amitriptyline 10 mg once daily at bedtime for six weeks.

Group B- Amitriptyline 10 mg once daily at bedtime + TENS therapy once in a week for six weeks.

Diagnostic Assessment

Clinical diagnosis was supplemented with magnetic resonance imaging (MRI) to evaluate internal derangement and disc position.

Outcome Measures

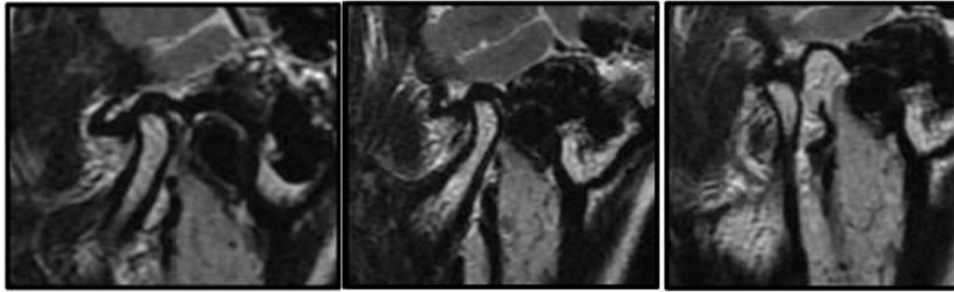
Patients were evaluated at baseline and weekly for six weeks using:

1. Visual Analogue Scale (VAS)
2. Maximum mouth opening (MMO)
3. TMJ clicking

PROCEDURE :

- Patients with temporomandibular joint disorders were examined under clinical and radiological guidelines were included in the study. In group A, tablet Amitriptyline 10mg once daily at night before bed was given whereas group B patients along with tablet Amitriptyline 10 mg, TENS therapy was given for 30mins once every week for a period of 6 weeks.

Recordings/ Observations: - All the measurements are taken on pretreatment day (T0),on 1st week(T1), 2nd week(T2), 3rd week(T3), 4th week(T4), 5th week(T5) and 6th week(T6).



**Fig 1- T2 WEIGHTED NON CONTRAST MRI
IMAGE SHOWING POSITION OF
DISC AT VARIOUS MOUTH POSITION
(A)CLOSED (B)INTERMEDIATE (C)OPENED**

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Fig 2- APPLICATION OF TENS THERAPY

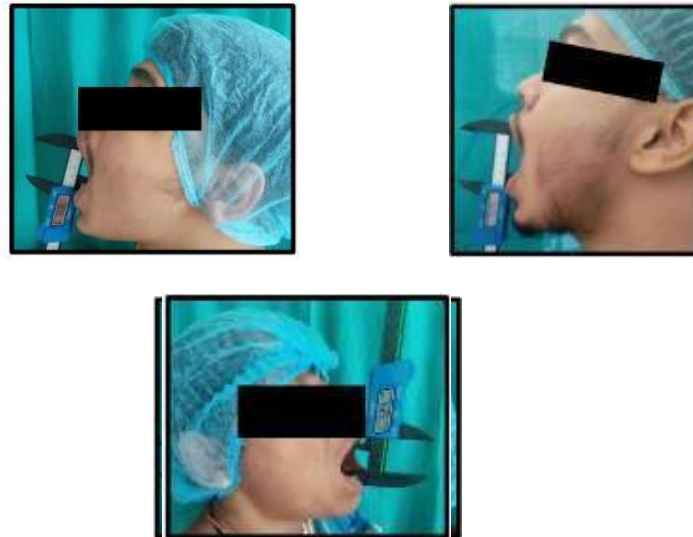


Fig 3- MAXIMUM MOUTH OPENING



Fig 4- AUSCULATION OF TMJ

Statistical Analysis

Data were analyzed using GraphPad Prism Version 10.1.2. Normality assessment was performed using the Shapiro–Wilk test. Descriptive statistics were expressed as mean $\pm$ standard deviation, median, and range. Inferential statistics included Chi-square test, Fisher's

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exact test, independent samples t-test, Mann–Whitney U test, repeated measures ANOVA, Friedman test, and two-way ANOVA. Statistical significance was established at $P \leq 0.05$.

Results

Twenty patients completed the study, with ten patients in each treatment group. Females constituted 55% of the study population and males 45%. No significant difference in gender distribution was observed between groups ($P = 0.37$). The mean age was 30.90 ± 12.47 years in Group A and 39.10 ± 11.99 years in Group B, with no statistically significant difference ($P = 0.15$), indicating satisfactory baseline comparability.

Pain intensity measured using VAS demonstrated progressive reduction throughout the treatment period in both groups. In Group A, mean VAS scores decreased from 9.20 ± 1.69 at baseline to 3.00 ± 3.20 at week six. Repeated measures ANOVA demonstrated a significant improvement over time ($F = 25.67$, $P < 0.0001$). In Group B, mean VAS scores decreased from 9.50 ± 0.85 at baseline to 3.30 ± 3.13 at week six. Out of all the intergroup comparisons (T4-T5) Group A v/s (T4-T5) Group B showed a statistical significant difference. The Mean in VAS for Group B at T4-T5 time interval was significantly high as compared to the mean in VAS score of Group A.

There was a change in the mean and standard deviation of MMO in both the groups but the difference was not statistically significant for any of the successive time interval. Patients receiving combined therapy exhibited earlier improvement compared with the pharmacotherapy only group. Improvement in TMJ clicking was more pronounced in the combined therapy group. For Group A, the proportion of participants exhibiting clicking remained unchanged across all seven time points, with 4 subjects (40%) demonstrating clicking at baseline and similar proportions observed throughout the post- treatment period. Cochran's Q test showed no statistically significant change over time ($P = 0.19$). In Group B, clicking was present in all 10 subjects (100%) at baseline and showed a gradual decline to 9 (90%) at T3, 8 (80%) at T4 and T5, and 7 (70%) at T6. Although this represented a downward trend, Cochran's Q test did not reach statistical significance ($P = 0.051$).

Time Period	Comparison Group	Mean $\pm$ SD		Standard Error	P value	95% Confidence Interval	
T1-T2(Group A)	T1-T2(Group B)	1.60 $\pm$ 1.265	0.7 $\pm$ 1.252	.702	.955	-1.38	3.18
T2-T3(Group A)	T2-T3(Group B)	2.10 $\pm$ 2.28	0.5 $\pm$ 0.850	.702	.412	-.68	3.88
T3-T4(Group A)	T3-T4(Group B)	0.7 $\pm$ 0.153	0.3 $\pm$ 0.124	.702	1.000	-1.88	2.68
T4-T5(Group A)	T4-T5(Group B)	0.5 $\pm$ 1.212	3.2 $\pm$ 0.325	.702	.020	-4.78	-.22
T5-T6(Group A)	T5-T6(Group B)	0.3 $\pm$ 1.141	1.1 $\pm$ 0.241	.702	.605	-.88	3.68

Table I Inter-group comparison of mean VAS scores across the group at different time periods by using one way ANOVA with a tukey post hoc test

Time Period	Comparison Group	Mean $\pm$ SD		Standard Error	P value	95% Confidence Interval	
T1-T2(Group A)	T1-T2(Group B)	5.18 $\pm$ 2.5	1.14 $\pm$ 2.32	.711	0.651	-2.14	.412
T2-T3(Group A)	T2-T3(Group B)	6.16 $\pm$ 3.23	2.44 $\pm$ 1.24	.711	0.749	-1.68	2.88
T3-T4(Group A)	T3-T4(Group B)	2.60 $\pm$ 1.24	3.53 $\pm$ 0.45	.711	1.000	-3.88	4.68
T4-T5(Group A)	T4-T5(Group B)	1.75 $\pm$ 3.22	3.2 $\pm$ 0.325	.711	.999	-4.79	-.221
T5-T6(Group A)	T5-T6(Group B)	1.14 $\pm$ 2.32	1.14 $\pm$ 0.241	.711	1	-.89	3.69

Table II Inter-group comparison of mean maximum mouth opening across the group at different time periods by using one way ANOVA with a tukey post hoc test

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Table III Inter group comparison of presence and absence of clicking using Pearson's chi square test

Time Period	Comparison Group	Chi square Value	P value
T1(Group A)	T1(Group B)	2.51	0.641(NS)
T2(Group A)	T2(Group B)	3.25	0.841(NS)
T3(Group A)	T3(Group B)	3.61	0.641(NS)
T4(Group A)	T4(Group B)	5.41	0.541(NS)
T5(Group A)	T5(Group B)	8.14	0.841(NS)
T6(Group A)	T6(Group B)	9.26	0.952(NS)

Discussion

Temporomandibular disorders (TMD) are a class of degenerative musculoskeletal conditions associated with morphologic and functional deformities that affect up to 25% of the population. Conservative treatments include cognitive behavioral therapy, self-paced exercises, manual therapy, occlusal splints, medications. Amitriptyline, a tricyclic antidepressant, its analgesic effects are from its inhibition of serotonin (5-HT) and nor-epinephrine reuptake, which enhances their concentrations in the synaptic cleft and modulates descending pain pathways. While the agents or physical modalities used to treat TMD include electrotherapy, heat therapy, cryotherapy, ultrasound, iontophoresis, anesthetics, and acupuncture.⁶ An alternative mode of management is Transcutaneous Electric Nerve Stimulation (TENS). It is not only safe to use, but it also reduces pain and electromyographic (EMG) activity of muscles of mastication. The additional benefit observed with TENS may be explained by the gate-control theory proposed by Melzack and Wall, as well as stimulation-induced endogenous opioid release. However, the original theory did suggest that descending inhibitory pathways might exist and that these spinal neurons are under descending influences.⁸ Intergroup comparison revealed a statistically significant difference in VAS score reduction during the fourth week–fifth week interval, with Group B showing greater pain reduction. This suggests an additive or synergistic effect of TENS when combined with Amitriptyline. Findings reported by Singh et al. demonstrated superior pain reduction among patients receiving TENS compared with placebo treatment, supporting the role of neuromodulatory approaches in improving patient comfort and reducing symptom severity.⁸ Similar outcomes were described by Ferreira et al., who observed significant reductions in pain intensity following active TENS application in patients with myofascial TMD when compared with placebo intervention.⁹ The present findings are consistent with these observations and further suggest that combining TENS with pharmacological therapy may facilitate earlier symptom resolution. In Group A and B statistically significant improvement in MMO was observed from the third week onward compared to baseline. However, intergroup comparison of MMO at successive intervals did not reveal statistically significant differences between Group A and Group B. This suggests that while TENS may offer superior pain relief, improvement in mouth opening is likely influenced by reduction in muscle spasm, inflammation, and patient compliance, which are effectively addressed by Amitriptyline alone as well. Comparable findings have been reported by Patil et al., who demonstrated significant improvement in mouth opening following administration of TENS in patients with myofascial TMD.¹⁰ In the present study, a reduction in the frequency of clicking was observed in both groups over the treatment period. This improvement can be attributed to decreased muscle hyperactivity, improved joint lubrication, and reduced intra-articular inflammation. Although Group B showed earlier resolution of clicking in a greater number of patients, the difference between groups was not statistically significant. This finding suggests that conservative therapy primarily addresses symptom modulation rather than anatomical disc repositioning. Previous findings by Najafi S et al. reported reduction in TMJ joint sounds following repeated TENS sessions and proposed that improvement may result from reduction in muscle spasm and altered neuromuscular activity surrounding the joint. One of these mechanisms refers to direct stimulation of motor neurons. Stimulation of motor neurons cause rhythmic contractions in the muscles and, consequently, increased blood flow, decreased edema, muscle hypoxia and inflammation.¹¹ The principal finding of the present study is that

- Both therapies were effective
- The combination of amitriptyline and TENS produced superior clinical improvement and earlier symptom relief.

The strengths of this study were it is a prospective design, standardized treatment protocol, multiple clinically relevant outcome measures, MRI-supported diagnosis was used and repeated assessments were done over six week whereas the limitations of this study were small sample size, single-center study, short follow-up duration,

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lack of long-term outcome assessment, limited evaluation of psychosocial variables and absence of blinding of treatment providers.

Conflict of Interest

We have no conflict of interest.

Funding

There was no funding or financial incentive for any author in this paper.

Conclusion

Within the limitations of the present study, low-dose amitriptyline demonstrated effectiveness in reducing pain and improving clinical outcomes in patients with TMD. The addition of TENS resulted in earlier symptomatic improvement and contributed to enhanced pain control and functional recovery during the treatment period. These findings support the role of multimodal conservative management in the treatment of TMDs and reinforce the value of integrating non-invasive physical therapy modalities into routine Oral and Maxillofacial Surgery practice. Further multicentric studies with larger sample sizes and longer follow-up periods are recommended to validate long-term effectiveness and optimize treatment protocols.

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