

Transcutaneous Electrical Nerve Stimulation Therapy in Temporomandibular Disorder: A Clinical Study

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ABSTRACT

Aims: Though use of transcutaneous electrical nerve stimulation (TENS) in dentistry was first described in 1967 by Shane and Kessler, it has yet to gain widespread acceptance in dentistry. This study was designed to evaluate and compare the effectiveness of active and placebo TENS therapies in the treatment of temporomandibular disorder.

Methods: Thirty patients received active TENS therapy and 15 received placebo TENS therapy. VAS was used to measure changes in pain and tenderness in the muscles of mastication and TMJs during and after therapy. Also, changes in mouth opening was recorded and analyzed.

Results: A significant improvement was observed in both active and placebo TENS therapies regarding orofacial pain, muscles and TMJs tenderness and interincisal distance. None of the parameters except medial pterygoid muscle tenderness revealed any differences between the methods.

Conclusion: This study justifies the use of TENS therapy as well as placebo in the management of TMD. TENS therapy appears to be useful in relieving pain, especially muscular and chronic pain. Hence, along with TENS therapy, placebo should also be considered as a potent and independent therapeutic modality in its own right.

Keywords: TMD, Active TENS therapy, Placebo TENS, TMJ, Controlled clinical trial.

INTRODUCTION

Temporomandibular disorders are the most common chronic orofacial pain conditions confronting dentists and other health care providers.¹ Etiology of TMD remains mired in controversy. Multiple factors influence the evolution of TMD, like muscle hyperactivity, trauma, emotional stress and malocclusion along with a host of predisposing, activating and perpetuating factors.² The most common signs and symptoms of TMD are orofacial pain; muscle and TMJ tenderness; decreased mandibular range of motion; clicking, hard grating or crepitus; tense, stiffness, pain or fatigue in facial muscles; ear symptoms like tinnitus, fullness, vertigo; sensation of variable bite changes; deviation to the affected site during opening; jaw catching during opening or closing.³

The goals for management of TMD includes: Pain reduction, restoration of normal jaw function, reduction in the need for future health care and restoration of normal lifestyle functioning. A well-defined program designed to treat the disorder and reduce the contributing factors best achieves these goals.⁴

A wide variety of therapies proposed for TMD are orthopedic stabilization, intraoral appliances, behavioral therapy, placebo and pharmacotherapy with analgesics, muscle relaxants and antidepressants. An alternative mode of management is TENS.⁵

TENS is a well-known physical therapy, which is useful for the relief of pain. With TENS, electrical stimulation is transmitted to pain areas via surface electrodes, which reduces or eliminates pain.⁶ TENS is a safe,⁵ noninvasive,⁶ effective and swift method of analgesia⁷ and potential adverse reactions of other methods of pain control are eliminated.⁶

It is widely used to relieve acute and chronic pain in various conditions like muscle and joint pain, back pain, lower and upper

extremity pain, head and neck pain, etc. The use of TENS in dentistry was first described in 1967 by Shane and Kessler,⁸ but it has yet to gain widespread acceptance in dentistry.⁹ TENS studies to evaluate the effectiveness on TMJ pain are only few.⁹ As TENS is a noninvasive and nondrug therapy, if found effective, could provide the primary line of management in TMD. Better pain relief shall ultimately translate into better quality of life—the goal of all good health care. Hence, a need was felt to conduct a clinical trial to assess pain relieving effects of TENS therapy in TMD.

AIMS AND OBJECTIVES

- To determine the effectiveness of TENS in the management of pain in TMD patients.
- To determine the effectiveness of placebo TENS in the management of pain in TMD.
- To compare the effectiveness of active TENS therapy with that of placebo TENS therapy in patients with TMD.

MATERIALS AND METHODS

This randomized placebo-controlled, single blind study was carried out in the Department of Oral Medicine and Radiology, College of Dental Sciences, Davangere.

Study groups comprised of 45 TMD patients of either sex between 15 and 60 years of age. Diagnosis of TMD was made based on the standard diagnostic criteria.¹⁰

TENS unit, KODYS TENS-III,¹¹ a pocket sized first Indian hand-held transcutaneous electrical nerve stimulator (TENS) was used. It is completely battery operated.

Inclusion criteria were orofacial pain, especially, in the preauricular region during function and palpation, tenderness in

one or more muscles of mastication,³ patients being treated with some other therapy were considered, provided a washout period of at least one week was allowed before inclusion in this study.

Exclusion criteria consisted of clinical and/or radiographic evidence of organic changes in the TMJ,¹² pain attributable to recent trauma, dental surgery, metabolic diseases,¹² vascular disease,¹² neoplasia,¹² psychiatric disorders,¹² heart diseases and cardiac pacemakers,¹³ pregnancy,¹³ bleeding disorders,¹³ neurological disease involving head and neck like Bell's palsy,¹³ undiagnosed dental pain¹³ and patients who have been treated with TENS previously, without any improvement in the condition.

All the subjects included in the study were explained the need and design of the study, benefits of the therapy, possible side effects and chances of being allocated to the placebo group. Patients were randomly assigned to one of the following two groups: Group A (n = 30) received active TENS therapy and group B (n = 15) received placebo TENS therapy.

The following parameters were recorded at the baseline visit, 1 week after the 1st sitting of TENS therapy, 1 week after the 2nd sitting of TENS therapy, 1 week after the 3rd sitting of TENS therapy and at the follow-up visit (1 month after the 4th sitting of TENS therapy) and analyzed type of pain (continuous or intermittent), intensity of pain on VAS, muscles and joints tenderness and maximum mouth opening without pain.

Detailed specific examinations for signs and symptoms of TMD were carried out as suggested by Widmer CG, Huggins KH and Friction J.¹⁰ Following clinical examinations, patients were subjected to transcranial and panoramic radiographs. At baseline and every treatment visits, all the participants received TENS therapy for 30 minutes.⁷ Group A (30) patients were given active TENS therapy, whereas group B (15) patients were provided with placebo TENS therapy.

TENS therapy technique^{6,13} was carried out as described by Wessberg GA,⁵ Esposito CJ⁶ and Giessler et al.⁷ The placebo subjects were exposed to identical treatment conditions with the exception that there was no current output from unit.

Statistical analysis was carried out using paired t-test, unpaired t-test, Wilcoxon's signed rank test, Mann-Whitney U test and Chi-square test.

RESULTS

1. Evaluation of pain: Comparison of pain intensity (VAS) before and after therapy (Table 1). Both active TENS and placebo TENS groups showed significant reduction in mean pain at weekly intervals. Though it was observed that the pain reduction in the active treatment group (66.1%) was more than in the placebo group (57%), the difference between the groups was not statistically significant.

At the follow-up visit, 23.3% of subjects were completely pain-free in active TENS group, and no subject was pain-free in the placebo TENS group and the difference was statistically significant ($p < 0.05$).

2. Comparison of changes in the tenderness (VAS) of masticatory muscles and TMJs before and after therapy (Tables 3 to 7): In our study, in both active TENS and placebo, there was gradual but significant decrease in tenderness in all masticatory muscles and TMJs at weekly intervals. The decrease in tenderness was slightly more in active TENS therapy than in placebo but the difference was not statistically significant except for medial pterygoid muscle ($p < 0.05$).
3. Maximum mouth opening (Table 8): Both active TENS group and placebo TENS group showed significant increase in maximum mouth opening without pain at each week interval.

At the follow-up visit, there was 13% increase in mouth opening in active TENS therapy group and 12% in the placebo group. Though the mouth opening increase in the active treatment group was more than in the placebo group, the difference between the groups was not statistically significant.

DISCUSSION

Although a vast array of therapeutic modalities have been offered to TMD patients, there is paucity of clinical trials, especially randomized controlled clinical studies, to suggest appropriate management of these patients. As most patients have a self-limiting disorder and that a variety of different therapies appear to result in similar improvements in pain and dysfunction, caution is urged with regard to use of invasive and other irreversible treatments, particularly in the initial management of TMD patients.¹⁴

Age in the present study is consistent with other studies¹⁵⁻¹⁷ where common age of occurrence was reported to be in the second to fourth decades of life. Regarding sex our finding is similar to the observations of Beaton RD et al¹⁸ who observed lack of any significant gender differences in their study. Contrary to this, a female predominance has been reported in many studies, particularly in those seeking treatment.^{1,16,17,19,20}

Evaluation of Pain (Tables 1 and 2)

The efficacy of TENS therapy in reducing TMD pain observed in our study is similar to the observations made by Moystad A, et al,⁹ List T and Helkimo M,²¹ and Mehta N et al.²² List T and Helkimo M²¹ have reported 57% reduction in pain following TENS therapy in patients with myogenic craniomandibular disorders. Mehta N et al²² have observed 57% reduction in pain following TENS therapy in patients with joint or muscle pain.

However, Wessberg GA et al⁵ and Giessler PR and McPhee PM⁷ reported higher success rate compared to our study. Wessberg GA et al⁵ have observed 95% success immediately after TENS therapy and 86% success 1 year after the therapy in 21 patients treated for myofascial pain dysfunction. Giessler PR and McPhee PM⁷ have reported that 63.6% of patients with joints and muscle pain were pain-free after TENS therapy compared to 23.3% in our study.

The difference in pain reduction in the above studies compared to our study could be attributed to the disparity between the samples with regard to differences in biological, psychological, and social components affecting the TMDs as well as stimulation parameters used in the TENS therapy.

In the placebo TENS (Table 1), results are similar to the observations made by Moystad A et al.⁹ They have reported a significant reduction in pain following placebo TENS therapy in 19 subjects with rheumatoid arthritis of TMJ. However, contrary to our result, Mehta N et al²² have reported only 4.5% reduction in muscle pain and 14.3% reduction in joint pain following placebo TENS therapy.

On intergroup comparison (Tables 1, 3 and 5), significant pain reduction was observed in both active TENS and placebo TENS therapy groups. Similar to our observation, many authors^{9,23-27} have emphasized the strong tendency among patients with TMDs to respond favorably to placebo therapies. Moystad A et al⁹ treated 19 patients involving TMJ rheumatoid arthritis and found that there was no statistically significant difference in pain reduction between the active TENS and placebo TENS therapy methods. The significant reduction in TMD pain in patients belonging to placebo group in our study could be attributed to placebo effects of TENS therapy, as its provision is an expression of reassurance and care on the part of the therapist.

Muscles and Joints Tenderness (Tables 3 to 7)

Similar to our study, Giessler PR and McPhee PM⁷ have also observed that TENS therapy was effective in relieving muscle pain. A comparable observation made in our study was also reported by List T and Helkimo M²¹ who used TENS therapy in patients with primarily myogenic craniomandibular disorders and found that 57% of patients benefited subjectively (p < 0.01) and clinically (p < 0.001).

Maximum Mouth Opening (Table 8)

Our result is similar to observations made by Linde C et al²⁸ who found mandibular range of movement improved following TENS in patients with internal derangements of TMJ. Mehta N et al²² observed increase in the interincisal distance in patients with orofacial pain after TENS therapy, which is similar to our observation but there was no significant increase in placebo therapy group, which is in contrast to our result.

Table 1: Comparison of pain intensity on VAS at different intervals

Groups	No.	1st visit	2nd visit		3rd visit		4th visit		PO	
			Mean ± SD	Diff. (1-2)	Mean ± SD	Diff. (1-3)	Mean ± SD	Diff. (1-4)	Mean ± SD	Diff. (1-PO)
TNS (I)	60	43.9 ± 29.3	34.3 ± 26.6	9.7 ± 15.2 (21.9%) p < 0.001	34.0 ± 22.1	20.0 ± 20.4 (45.3%) p < 0.001	19.8 ± 21.3	24.2 ± 23.4 (54.9%) p < 0.001	14.9 ± 18.5	29.0 ± 25.2 (66.1%) p < 0.001
Placebo (II)	30	37.2 ± 31.5	27.5 ± 29.4	9.7 ± 20.8 (26%) p < 0.05	19.7 ± 25.1	17.5 ± 25.9 (47%) p < 0.001	16.2 ± 21.1	21.0 ± 26.9 (56%) p < 0.001	15.8 ± 20.0	21.3 ± 25.8 (57%) p < 0.001
I vs II			p = 1.00, NS		p = 0.62, NS		p = 0.57, NS		p = 0.18, NS	

NS: Not significant

Table 2: Number of subjects with improvement in pain

		Pain free subjects					Improved (Vas less than 20)				
		1st visit	2nd visit	3rd visit	4th visit	PO	1st visit	2nd visit	3rd visit	4th visit	PO
Pain	TENS	–	4 (13.3%) NS	6 (20%) NS	5 (16.7%) NS	7 (23.3%) NS	–	2 (6.6%) NS	6 (20%) NS	8 (26.7%) NS	14 (46.7%) NS
	Placebo	–	1 (6.6%) NS	1 (6.6%) NS	0 NS	0 NS	–	1 (6.6%) NS	5 (33.3%) NS	7 (46.7%) NS	7 (46.7%) NS
TENS vs Placebo		–	NS	NS	NS	P < 0.05, S	–	NS	NS	NS	NS

NS: Not significant; S: Significant

Table 3: Comparison of Masseter muscle tenderness

Groups	No.	1st visit	2nd visit		3rd visit		4th visit		PO	
			Mean ± SD	Diff. (1-2)	Mean ± SD	Diff. (1-3)	Mean ± SD	Diff. (1-4)	Mean ± SD	Diff. (1-PO)
TNS (I)	60	29.8 ± 25.3	21.8 ± 21.7	8.1 ± 11.6 (27%) p < 0.01	14.8 ± 17.8	15.1 ± 17.1 (51%) p < 0.001	13.8 ± 17.5	16.1 ± 18.0 (54%) p < 0.01	8.4 ± 14.5	21.4 ± 21.0 (72%) p < 0.001
Placebo (II)	30	28.0 ± 25.4	21.0 ± 19.2	7.0 ± 17.7 (25%) p < 0.01	16.0 ± 16.7	12.0 ± 20.7 (43%) p < 0.001	15.0 ± 16.7	13.0 ± 22.9 (46%) p < 0.01	14.5 ± 16.3	13.5 ± 22.9 (48%) p < 0.001
I vs II			p = 0.73, NS		p = 0.46, NS		p = 0.49, NS		p = 0.11, NS	

NS: Not significant

Table 4: Comparison of medial pterygoid muscle tenderness

Groups	No.	1st visit	2nd visit		3rd visit		4th visit		PO	
			Mean ± SD	Diff. (1-2)	Mean ± SD	Diff. (1-3)	Mean ± SD	Diff. (1-4)	Mean ± SD	Diff. (1-PO)
TNS (I)	60	37.0 ± 25.4	29.8 ± 22.9	7.3 ± 12.6 (20%) p < 0.01	23.5 ± 21.6	13.5 ± 19.6 (36%) p < 0.001	20.0 ± 19.4	17.0 ± 21.1 (46%) p < 0.001	12.3 ± 16.2	24.8 ± 23.4 (67%) p < 0.001
Placebo (II)	30	36.7 ± 22.9	28.5 ± 24.2	8.2 ± 13.1 (22%) p < 0.01	22.8 ± 23.5	13.8 ± 15.4 (38%) p < 0.001	19.8 ± 21.8	16.9 ± 15.0 (46%) p < 0.001	22.2 ± 25.9	14.5 ± 19.5 (40%) p < 0.001
I vs II			p = 0.75, NS		p = 0.94, NS		p = 0.97, NS		p < 0.05, S	

NS: Not significant; S: Significant

Table 5: Comparison of temporalis muscle tenderness

Groups	No.	1st visit	2nd visit		3rd visit		4th visit		PO	
			Mean ± SD	Diff. (1-2)	Mean ± SD	Diff. (1-3)	Mean ± SD	Diff. (1-4)	Mean ± SD	Diff. (1-PO)
TNS (I)	60	23.0 ± 25.2	17.8 ± 22.3	5.3 ± 12.6 (23%) p < 0.01	12.3 ± 17.7	10.7 ± 17.8 (47%) p < 0.001	11.4 ± 19.0	11.6 ± 20.0 (50%) p < 0.001	7.6 ± 16.5	15.4 ± 21.8 (67%) p < 0.001
Placebo (II)	30	14.2 ± 16.9	10.3 ± 13.4	3.8 ± 8.4 (27%) p < 0.05	6.5 ± 10.7	7.7 ± 12.2 (54%) p < 0.01	6.0 ± 10.5	8.2 ± 13.9 (58%) p < 0.01	5.3 ± 7.8	8.8 ± 14.4 (62%) p < 0.01
I vs II			p = 0.58, NS		p = 0.41, NS		p = 0.40, NS		p = 0.13, NS	

NS: Not significant

Table 6: Comparison of lateral pterygoid muscle tenderness

Groups	No.	1st visit	2nd visit		3rd visit		4th visit		PO	
			Mean ± SD	Diff. (1-2)	Mean ± SD	Diff. (1-3)	Mean ± SD	Diff. (1-4)	Mean ± SD	Diff. (1-PO)
TNS (I)	60	35.4 ± 26.3	28.2 ± 24.3	7.3 ± 15.2 (21%) p < 0.001	20.4 ± 20.8	15.0 ± 17.1 (42%) p < 0.001	17.4 ± 20.2	18.0 ± 21.6 (51%) p < 0.001	13.7 ± 19.3	21.8 ± 24.5 (62%) p < 0.001
Placebo (II)	30	30.5 ± 24.1	20.7 ± 21.1	9.8 ± 15.1 (32%) p < 0.01	16.3 ± 19.6	14.2 ± 18.8 (47%) p < 0.001	15.2 ± 18.4	15.3 ± 16.5 (50%) p < 0.001	16.7 ± 21.7	13.8 ± 19.7 (45%) p < 0.001
I vs II			p = 0.46, NS		p = 0.83, NS		p = 0.55, NS		p = 0.13, NS	

NS: Not significant

Table 7: Comparison of TMJ tenderness

Groups	No.	1st visit	2nd visit		3rd visit		4th visit		PO	
			Mean ± SD	Diff. (1-2)	Mean ± SD	Diff. (1-3)	Mean ± SD	Diff. (1-4)	Mean ± SD	Diff. (1-PO)
TNS (I)	60	42.8 ± 27.3	34.7 ± 25.3	8.2 ± 13.9 (19%) p < 0.001	25.7 ± 22.7	17.1 ± 18.5 (40%) p < 0.001	21.9 ± 22.3	20.9 ± 20.8 (49%) p < 0.001	17.5 ± 25.3	25.3 ± 22.2 (59%) p < 0.001
Placebo (II)	30	34.7 ± 25.4	22.2 ± 21.9	12.5 ± 18.6 (36%) p < 0.001	17.7 ± 20.4	17.0 ± 20.4 (49%) p < 0.001	18.3 ± 20.4	18.5 ± 19.9 (53%) p < 0.001	16.3 ± 18.2	17.7 ± 20.4 (47%) p < 0.001
I vs II			p = 0.22, NS		p = 0.97, NS		P = 0.57, NS		P = 0.06, NS	

NS: Not significant

Table 8: Comparison of maximum mouth opening at different intervals (mm)

Groups	No.	1st visit	2nd visit		3rd visit		4th visit		PO	
			Mean ± SD	Diff. (1-2)	Mean ± SD	Diff. (1-3)	Mean ± SD	Diff. (1-4)	Mean ± SD	Diff. (1-PO)
TNS (I)	30	3.8 ± 9.0	39.2 ± 8.9	0.9 ± 2.4 (2%) NS	42.1 ± 7.9	3.8 ± 5.3 (10%) p < 0.001	42.2 ± 8.5	3.9 ± 5.4 (10%) p < 0.001	43.4 ± 7.8	5.1 ± 6.1 (13%) p < 0.001
Placebo (II)	15	39.1 ± 7.0	41.3 ± 7.9	2.2 ± 4.6 (6%) NS	42.9 ± 6.8	3.8 ± 6.0 (10%) p < 0.05	43.7 ± 7.0	4.5 ± 6.4 (12%) p < 0.05	43.9 ± 7.1	4.7 ± 6.4 (12%) p < 0.001
I vs II			P = 0.62, NS		P = 0.70, NS		P = 0.91, NS		P = 0.87, NS	

NS: Not significant

Since 1950, it has been accepted that placebo plays an important role in all therapy, and on an average contributes to 30 to 40% of the effect in pain reduction.^{9,26} The placebo TENS therapy has performed similar to the active TENS therapy in our study and this may clearly indicate that there is a significant role for placebo in the management of TMJ disorders. The placebo effects of treatments in chronic facial pain and jaw dysfunctions have been reported and may account for a third to two-thirds of responses in patients with mandibular dysfunction.²⁹

CONCLUSION

The results from our study are encouraging, the use of TENS therapy has shown favorable results in TMD pain management, especially in relieving muscular pain and chronic pain. Hence, our results justify the use of this therapeutic regimen in the management of TMD. The small size of the sample in the present study requires replication of these findings in a larger sample of patients, possibly using a crossover design to minimize the effects of confounding factors and to maximize assay sensitivity for detecting difference between different treatments.

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