

Transcutaneous Electrical Nerve Stimulation and Ultrasound Massage Therapy as an Adjuvant in Controlling Pain Modality in Temporomandibular Joint Disorders: A Comparative Study

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ABSTRACT

Introduction: The temporomandibular joint disorders (TMJDs) consist of varieties of pathologies affecting the temporomandibular joint, the masticatory muscles, and associated structures. The majority of these patient's who have TMJ pain and dysfunction visits to the dental practice. Electrophysical modalities such as transcutaneous electrical nerve stimulation (TENS), ultrasound massage therapy, microwave, laser, and manual therapy techniques are used to relieve pain and restore normal mouth opening.

Aims and Objectives: This study aims to evaluate and compare the efficacy of TENS and ultrasound massage therapies in TMJDs and concerning the effectiveness of physical therapy interventions.

Study Design: The study comprised 40 patients received with temporomandibular disorders (TMDs) will be included in the study with the mean age of 18–50 years.

Materials and Methods: A total of 40 patients with TMDs, according to research diagnostic criteria (RDC) for TMD/RDC, participated in the study with the age group of 18–50 years, all the patients were randomly divided and treated with ultrasound massage therapy and TENS therapy, and pain intensity, mouth opening, and reduction in the tenderness of muscles of mastication individually were evaluated using visual analog scale, at every follow-up visits.

Results: In TENS therapy, a significant improvement in reduction of pain as well as in tenderness of masseter, temporalis, medial pterygoid, lateral pterygoid, and accessory muscles on both right and left sides of TMJ when compared to ultrasound massage therapy was found. Improvement in the mouth opening by TENS therapy than US massage therapy in management of TMDs was also found.

Conclusion: The results of our study showed a significant decrease in pain and tenderness of muscles by TENS therapy rather than ultrasound massage therapy in the management of TMDs. These therapies bring favorable safety characteristics to clinics being non-invasive modalities.

Key words: Pain, Physiotherapy, Temporomandibular disorders, Transcutaneous electrical nerve stimulation therapy, Ultrasound massage therapy

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INTRODUCTION

Temporomandibular disorders (TMDs) represent a heterogeneous group of pathologies affecting the temporomandibular joints, the jaw muscles, or both. They are the most common orofacial pain conditions of non-dental origin and are frequently encountered in

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clinical practice.^[1] TMDs include conditions affecting the masticatory musculature, temporomandibular joint (TMJ), and associated structures.^[2] Clinical presentation of TMDs is characterized by several symptoms such as orofacial pain, limitations of jaw movement, joint noises, headache or earache, dizziness, and ear symptoms such as tinnitus, vertigo, and deviation of mandible on opening and closing to affected side. In addition, patients often report with depression, poor sleep quality, and low morale.^[3]

Treatment for TMDs can be non-surgical and surgical, although most TMDs patients respond on non-surgical treatment that can be coordinated by a dentist.^[4] Many conservative forms of therapies have been the first line of management of TMDs. The non-surgical treatment includes education, self-care, physical therapy, physiotherapy, intraoral removable appliances, relaxation techniques, and pharmacological applicators.^[5] Various forms of physical therapy intervention such as transcutaneous electrical nerve stimulation (TENS) and therapeutic ultrasound massage therapy can be potentially effective in the management of TMDs.^[6]

According to the available literature, a very few studies have been done in comparing both treatment modalities. Hence, this study is intended to conduct and to correlate the efficacy of TENS therapy and ultrasound massage therapy in TMJDs. Therefore, a need was felt to conduct a study to assess the efficacy between TENS therapy and ultrasound massage therapy in evaluating TMJDs.

MATERIALS AND METHODS

This study was carried out in the Department of Oral Medicine and Radiology, Teerthanker Mahaveer Dental College and Research Center, Moradabad, Uttar Pradesh, India. This study was carried out to evaluate the efficacy of TENS Therapy and Ultrasound massage therapy in management of temporomandibular joint disorders, in the Department of Oral Medicine and Radiology, Teerthanker Mahaveer Dental College and Research Center, Moradabad, Uttar Pradesh, India.

A total of 40 patients were included for the study with the age group of 18–50 years of either gender. Patients were clinically designated for TMJDs using research diagnostic criteria and were included in the study, traumatic conditions of TMJ region, TMJ ankylosis patients, patients with cardiac pacemakers and cardiac arrhythmias, pregnant ladies, any history of patients suffering from seizures, vascular disorders and neurological pain, any history of patient suffering from benign and malignant neoplastic conditions of TMJDs, mentally disabled patients, and patients with undiagnosed dental pain or who has skin lesions or facial abrasion at the

site of acoustic gel placement were excluded from the study.

These subjects were informed in detail about the treatment modality being provided to them and a required to sign a written informed consent. These patients were subjected for radiographic examination to rule out any bony changes in the condylar region as well as odontogenic infection. The subjects were divided into two groups, of which Group I (TENS) and Group II (Th. ultrasound massage). The data were recorded in the given case pro forma. Pain was evaluated using visual analog scale and the evaluation was done later, for pain intensity, mouth opening and masticatory muscle tenderness such as masseter, medial pterygoid, lateral pterygoid and temporalis and other accessory muscles, on both right and left side of TMJs. Machine that has been used was a combined ultrasound and TENS unit manufactured by relief medical system [Figures 1 and 2]. Power supply with two channels and four adhesive percutaneous electrodes for TENS and for ultrasound massage therapy a transducer head is provided and coupling gel that is to be applied on the area before the application of transducer head of ultrasound massage which serves as a medium for the transmission of energy and the therapy was done in the figure of “8” motion. TENS therapy was provided with frequency of 2–50 Hz and pulse width 10–100 ms, intensity according to the tolerance of the patient and



Figure 1: Ultrasound massage therapy machine



Figure 2: transcutaneous electrical nerve stimulation therapy machine

time duration for 40 min in each session [Figure 3], in a week for 4 weeks and on each visit, subjects were evaluated for pain intensity, mouth opening, and masticatory muscle tenderness and for accessory muscles. The ultrasound massage therapy was provided with a frequency of 1 MHz, pulse continuous, setting at 1:1, 1:3, 1:5, and 1:10 for 10 min in each session, in a week for 4 comparative weeks [Figure 4], Later, the data were tabulated and subjected to statistical analysis using, Microsoft Excel 2007 and analyzed using the SPSS statistical software 19.0 version. The intragroup comparison for the different time intervals was done using repeated measures ANOVA to find the difference between the individual time intervals. The intergroup comparison for the difference of mean scores between two independent groups was done using the unpaired/independent *t*-test.

RESULTS

A total of 40 patients with TMDs are taken, out of which 20 patients treated with TENS therapy and 20 patients with



Figure 3: Patient receiving transcutaneous electrical nerve stimulation therapy



Figure 4: Patient receiving US massage therapy

ultrasound massage therapy, reduction of pain, as well as in tenderness of masseter, temporalis, medial pterygoid, lateral pterygoid, and accessory muscles on both right and left sides of TMJ at different time intervals between TENS and ultrasound massage therapy in the 2nd, 3rd, 4th, and 5th follow-up visits were observed.

In TENS therapy, a significant improvement in reduction of pain as well as in tenderness of masseter, temporalis, medial pterygoid, lateral pterygoid, and accessory muscles on both right and left sides of TMJ when compared to ultrasound massage therapy was found. Improvement in the mouth opening by TENS therapy than US massage therapy in the management of TMDs was also found.

DISCUSSION

TMJ disorder includes any condition occurring from muscular and/or mechanical stress or trauma to the jaw and it is a major cause of non-dental pain in orofacial region. Among the most traditional treatment for TMD, physical therapy modalities and manual techniques are widely used, these modalities and techniques are applied to the TMJ and surrounding musculature such as temporalis, masseter, and on other accessory muscles such as sternocleidomastoid and trapezius is often also treated.

In the present study, it was observed that the distribution of age group is 18–50 years. In which the age of occurrence was second to the fourth decades of life, which is accordance with the studies done by Singh *et al.*, 2014,^[7] Mukkannavar, 2008,^[8] Kamtane and Sable, 2017,^[9] Moger *et al.*, 2011,^[10] and Shanavas *et al.*, 2014.^[11] All these authors stated that occurrence of disorder is at the age group between 2nd to 5th decade of life.

The predominance of females (65%) is greater than male patients (35%), noted in this study. This predilection of females is similar to the work done by Geissler and McPhee, 1986^[11] and Kamtane and Sable, 2017.^[9]

In comparison with the reduction of pain between the TENS and US therapy in all 2nd, 3rd, 4th and 5th, follow up visits, a significant reduction in pain between two therapies is seen [Table 1] which is statistically significant. Which is in accordance to the studies conducted by Rai. S. *et al.*, in 2016^[12] and Trakoo A. *et al.*, 2014.^[13]

In our study, it was found that TENS therapy showed comparatively reduction in pain from 1st visit to 5th follow-up visits than the US massage therapy, they found that the US massage therapy is better than TENS therapy, but in this study, it was found that TENS therapy is better than US massage which is in harmony with studies done by Rai *et al.* in 2016^[12] and Aarti *et al.*, 2014,^[13] they found in their

studies that the US massage therapy is better than TENS therapy. However, in our study, it was found that TENS therapy is better than US massage therapy.

In the present study the TENS therapy showed reduction in the tenderness of masseter muscle on the left side between TENS and US massage therapy which is non significant in 2nd and 3rd visit, where as a significant improvement is seen in the reduction of tenderness in 4th and 5th follow up visits. Similarly, on the right side of masseter muscle, it was found that there is no reduction in pain between the two therapies in the 2nd and 3rd visits but in follow-up 4th and 5th visits. It showed a significant improvement in reduction of pain. It was observed that TENS therapy showed reduction in tenderness of both right and left masseter muscles [Table 2], which is in accordance with the study done by Aarti *et al.*, 2014.^[13] A similar study done by Arora *et al.*, 2014,^[14] stated and compared the US massage therapy and ozone therapy in TMDs. They reported where the ozone therapy

showed significant reduction of pain and tenderness of masticatory muscles.

In our study, a significant reduction in the tenderness of the left and right temporalis muscles with both TENS and US massage therapies was found. In the 2nd, 3rd, and 4th visits, it showed as no improvement between two therapies. However, in the 5th follow-up visit, a significant improvement is seen in the left temporalis muscles in both the therapies. Similarly, the reduction in tenderness of the right temporalis muscle showed no improvement in the 2nd visit, but in follow-up 3rd, 4th, and 5th visits, a significant reduction in tenderness of muscle by both therapies was found. The right and left temporalis muscle when compared, a reduction in tenderness was found by TENS therapy and it was observed to be more beneficial than US massage therapy [Table 3], which is in accordance with the study done by Aarti *et al.*, 2014^[13] and Arora *et al.*, 2014.^[14]

Table 1: Intergroup comparison of percentage reduction in pain at different time intervals between transcutaneous electrical nerve stimulation and ultrasound

Groups	Mean	Std. deviation	P value	Significance
Reduction at II nd visit				
Ultrasound	13.28	13.51	0.001	Significant
Transcutaneous electrical nerve stimulation	23.12	11.45		
Reduction at III rd visit				
Ultrasound	26.53	12.97	0.001	Significant
Transcutaneous electrical nerve stimulation	44.43	15.06		
Reduction at IV th visit				
Ultrasound	46.99	20.36	0.001	Significant
Transcutaneous electrical nerve stimulation	62.96	21.93		
Reduction at V th visit				
Ultrasound	48.65	22.58	0.001	Significant
Transcutaneous electrical nerve stimulation	66.40	25.44		

Table 2: Intergroup comparison of percentage reduction in tenderness of the left and right masseter muscle at different time intervals between transcutaneous electrical nerve stimulation and ultrasound

Groups	Left masseter		P value	Significance	Right masseter		P value	Significance
	Mean	Std. deviation			Mean	Std. deviation		
Reduction at II nd visit								
Ultrasound	3.03	10.05	0.519	Non-significant	00.00	00.00	1.000	Non-significant
transcutaneous electrical nerve stimulation	00.00	00.00			00.00	00.00		
Reduction at III rd visit								
Ultrasound	48.48	45.61	0.750	Non-significant	33.33	18.25	0.458	Non-significant
Transcutaneous electrical nerve stimulation	40.00	54.77			50.00	50.00		
Reduction at IV th visit								
Ultrasound	78.78	26.96	0.001	Significant	61.11	31.03	0.041	Significant
Transcutaneous electrical nerve stimulation	100.00	00.00			92.85	18.89		
Reduction at V th visit								
Ultrasound	78.78	26.96	0.001	Significant	61.11	31.03	0.001	Significant
Transcutaneous electrical nerve stimulation	100.00	00.00			100.00	00.00		

When both therapies were compared with right and left medial pterygoid muscle tenderness, TENS therapy showed significant reduction, so it is more beneficial in reducing tenderness. It is in harmony with the research done by Aarti *et al.*, 2014^[13] and Arora *et al.*, 2014.^[14] There is no significant improvement found in the 2nd, 3rd, and 4th follow-up visits of tenderness of the left medial pterygoid muscle but in the 5th visit, it showed a significant reduction in tenderness of the left medial pterygoid muscle with both the therapies. However, the right side of medial pterygoid muscle also found no significant improvement of tenderness in both 2nd and 3rd visits. However, in the follow-up, 4th and 5th visits found to be a significant improvement with both TENS and US massage therapy.

Similarly in intragroup comparison of both left and right medial pterygoid muscles, by TENS and US massage therapy, both showed a significant reduction in tenderness with P value of 0.001 [Table 4].

Similarly, no improvement observed in reduction in tenderness of the left lateral pterygoid muscle between both therapies in the 2nd visit, whereas the regular follow-up 3rd, 4th, and 5th visits showed a significant reduction in tenderness of the left pterygoid muscle. Similarly, on the right side of the lateral pterygoid muscle, no improvement was found in both 2nd and 3rd visits between two therapies. However, a significant improvement found in the right lateral pterygoid muscle. However, TENS therapy showed a significant reduction in tenderness of the left and

Table 3: Intergroup comparison of percentage reduction in tenderness of the left and right temporalis at different time intervals between transcutaneous electrical nerve stimulation and ultrasound

Groups	Left temporalis	Std. deviation	P value	Significance	Right temporalis	Std. deviation	P value	Significance
	Mean				Mean			
Reduction at II nd visit								
Ultrasound	00.00	00.00	1.000	Non-significant	00.00	00.00	1.000	Not significant
Transcutaneous electrical nerve stimulation	00.00	00.00			00.00	00.00		
Reduction at III rd visit								
Ultrasound	53.33	38.005	0.458	Non-significant	30.00	18.257	0.001	Significant
Transcutaneous electrical nerve stimulation	62.50	47.87			72.91	17.67		
Reduction at IV th visit								
Ultrasound	93.33	14.90	0.765	Non- Significant	63.33	34.15	0.010	Significant
Transcutaneous electrical nerve stimulation	87.50	15.95			85.41	20.77		
Reduction at V th visit								
Ultrasound	100.00	00.00	1.00	Significant	63.33	34.15	0.001	Significant
Transcutaneous electrical nerve stimulation	100.00	00.00			100.00	00.00		

Table 4: Intergroup comparison of percentage reduction in tenderness of the left and right medial pterygoid at different time intervals between transcutaneous electrical nerve stimulation and ultrasound

Groups	Left medial pterygoid	Std. Deviation	P value	Significance	Right medial pterygoid	Std. deviation	P value	Significance
	Mean				Mean			
Reduction at II nd visit								
Ultrasound	5.55	13.60	0.513	Non-significant	00.00	00.00	0.479	Non-significant
Transcutaneous electrical nerve stimulation	00.00	00.00			12.50	25.00		
Reduction at III rd visit								
Ultrasound	55.55	40.36	0.516	Non-significant	27.77	25.45	0.192	Non-significant
Transcutaneous electrical nerve stimulation	38.88	34.69			54.16	41.66		
Reduction at IV th visit								
Ultrasound	75.00	29.34	0.668	Non-significant	27.77	25.45	0.001	Significant
Transcutaneous electrical nerve stimulation	83.33	16.66			87.50	15.95		
Reduction at V th visit								
Ultrasound	75.00	29.34	0.001	significant	27.77	25.45	0.001	Significant
Transcutaneous electrical nerve stimulation	100.00	00.00			100.00	00.00		

right lateral pterygoid muscles than US massage therapy [Table 5], which is in harmony to studies done by Aarti *et al.*, 2014^[13] and Arora *et al.*, 2014.^[14]

However, it was found that there was no improvement in the reduction in the tenderness of left accessory muscles in between both the therapies. Similarly, on the right side, it showed no improvement in the tenderness of muscles in both 2nd and 5th follow-up visits, whereas a definite reduction in the tenderness was noted on the 3rd and 4th follow-up visits. We observed that the TENS therapy showed a significant reduction in the tenderness of both the left and right accessory muscles compared to US massage

therapy [Table 6], which is in accordance with studies done by Aarti *et al.*, 2014 and Saloni *et al.*, 2014.

In the present study, there was a reduced mouth opening in the 2nd visit, whereas in follow-up 3rd, 4th, and 5th visits, a significant improvement in mouth opening between the TENS therapy and US massage therapy was seen. However, in intragroup comparison of mouth opening between the TENS and US massage therapy, increased mouth opening was found with TENS therapy, with $P \leq 0.001$, which is statistically significant [Table 7]. Which is in accordance to studies done by Rai S. *et al.* 2016^[12], Kamtane S. *et al.*, 2017,^[9] Ucar M. *et al.*, 2014,^[2]

Table 5: Intergroup comparison of percentage reduction in tenderness of the left and right lateral pterygoid at different time intervals between transcutaneous electrical nerve stimulation and ultrasound

Groups	Left Lateral pterygoid	Std. deviation	P value	Significance	Right lateral pterygoid	Std. deviation	P value	Significance
	Mean	Mean						
Reduction at II nd Visit								
Ultrasound	00.00	00.00	1.000	Non-significant	00.00	00.00	0.479	Non-significant
Transcutaneous electrical nerve stimulation	00.00	00.00			7.14	18.89		
Reduction at III rd visit								
Ultrasound	56.25	23.46	0.038	Significant	29.16	34.35	0.192	Non-significant
Transcutaneous electrical nerve stimulation	83.33	18.25			57.14	30.21		
Reduction at IV th visit								
Ultrasound	79.16	30.53	0.010	Significant	37.50	28.46	0.001	Significant
Transcutaneous electrical nerve stimulation	100.00	00.00			90.47	13.11		
Reduction at V th visit								
Ultrasound	79.16	30.53	0.023	Significant	37.50	28.46	0.001	Significant
Transcutaneous electrical nerve stimulation	100.00	00.00			100.00	00.00		

Table 6: Intergroup comparison of percentage reduction in tenderness of the left and right accessory at different time intervals between transcutaneous electrical nerve stimulation and ultrasound

Groups	Left accessory	Std. deviation	P value	Significance	Right accessory	Std. deviation	P value	Significance
	Mean	Mean						
Reduction at II nd visit								
Ultrasound	00.00	00.00	1.000	Non-significant	00.00	00.00	0.685	Non-significant
Transcutaneous electrical nerve stimulation	00.00	00.00			16.67	33.33		
Reduction at III rd visit								
Ultrasound	66.67	00.00	0.192	Non-significant	00.00	00.00	0.001	Significant
Transcutaneous electrical nerve stimulation	50.00	13.60			63.89	44.790		
Reduction at IV th visit								
Ultrasound	100.00	00.00	0.897	Non-significant	66.67	0.00	0.020	Significant
Transcutaneous electrical nerve stimulation	87.50	15.95			91.67	16.66		
Reduction at V th visit								
Ultrasound	100.00	00.00	1.000	Non-significant	100.00	0.00	1.000	Non-significant
Transcutaneous electrical nerve stimulation	100.00	00.00 ^a			100.00	00.00		

Table 7: Intergroup comparison of percentage gain in mouth opening at different time intervals between transcutaneous electrical nerve stimulation and ultrasound

Groups	Mean	Std. deviation	P value	Significance
Improvement at II nd visit				
Ultrasound	0.49	1.20	0.234	Non-significant
Transcutaneous electrical nerve stimulation	1.46	2.83		
Improvement at III rd visit				
Ultrasound	1.32	1.88	0.016	Significant
Transcutaneous electrical nerve stimulation	4.08	4.04		
Improvement at IV th visit				
Ultrasound	2.65	3.62	0.012	Significant
Transcutaneous electrical nerve stimulation	5.02	5.11		
Improvement at V th visit				
Ultrasound	3.14	4.70	0.013	Significant
Transcutaneous electrical nerve stimulation	5.02	5.11		

Knezevic M. *et al.*, 2008^[15], Bijjarangi *et al.*, 2015^[16] and Moger G. *et al.*, 2011.^[10]

CONCLUSION

TMDs are known as the most commonly occurring chronic orofacial pain conditions challenging dentists and other oral health providers. The main goal of treatment for TMDs is to relieve pain. Various treatment modalities are proposed in available literature. Another mode of management in TMDs is TENS and ultrasound massage therapies. The results of our study showed a significant decrease in pain and tenderness of muscles by TENS therapy rather than ultrasound massage therapy in the management of TMDs. These therapies bring favorable safety characteristics to clinics being non-invasive modalities.

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