

## Comparison of the Efficacy of Therapeutic Ultrasound and Transcutaneous Electric Nerve Stimulation in the Management of Pain Associated with Temporomandibular Joint Disorders: A Systematic Review

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### Abstract

**Background:** The etiology of temporomandibular joint disorders is multifactorial. Different modalities including TENS and Ultrasound therapy have been advocated for the management of pain associated with temporomandibular joint disorders. Finding the effective modality among TENS and Ultrasound therapy is therefore needed.

**Objectives:** The purpose of the study was to find the effective modality among Therapeutic Ultrasound and Transcutaneous electric nerve stimulation for the management of pain associated with temporomandibular joint disorders.

**Data Sources:** An extensive systematic literature search was performed using Pubmed, Google Scholar using combination of keywords like therapeutic, ultrasound, transcutaneous electrical nerve stimulation, temporomandibular joint disorders, myofascial pain, etc.

**Study Eligibility Criteria:** Inclusion Criteria: Studies that provide information on TENS and Ultrasound Modalities for temporomandibular joint disorders.

Exclusion Criteria: Review articles, letter to editor.

**Participants:** Patients with pain associated with temporomandibular joint disorders.

**Intervention:** TENS and Ultrasound Therapy for temporomandibular joint disorders.

**Results:** After searching the above mentioned data sources 145 articles were obtained. 145 articles were screened on the basis of title relevant to the topic of systematic review to get 59 articles. Further screening was done and 29 duplicates were obtained. After removing duplicates 30 articles were obtained. Abstracts of all 30 articles were screened to get 17 articles. Out of 17 articles, 9 articles were paid articles. 8 articles were obtained as free full text and thus, 8 studies were finally used for this systematic review.

**Conclusion:** Therapeutic ultrasound was found to be a better modality when compared with Transcutaneous Electric Nerve Stimulation therapy in the management of pain associated with temporomandibular joint disorders.

**Implication:** Both therapeutic ultrasound and TENS therapy are individually effective in the management of pain associated with temporomandibular joint disorders, however results are more effective when they are used as an adjuvant therapy to other conventional treatment modalities like analgesics and muscle relaxants.

**Keywords:** Therapeutic Ultrasound; Temporomandibular Joint Disorders; Myofascial Pain; Transcutaneous Electric Nerve Stimulation

## Introduction

### Rationale

The etiology of temporomandibular disorders (TMDs) is multifactorial. Different managements have been advocated which have proven to be effective for TMDs [1]. Transcutaneous electric nerve stimulation (TENS) therapy and Ultrasound therapy are among them.

Even though the Temporomandibular joint disorder (TMD) viewed as one syndrome, current research supports that TMD is a cluster of related disorders in the masticatory system, that has many signs and symptom [JP Okeson 1996], such as tenderness in the muscle and Temporomandibular joint (TMJ), decreased mandibular range of motion, clicking, 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 [2].

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. A wide variety of therapies proposed for TMD are orthopaedic stabilization, intraoral appliances, behavioral therapy, placebo and pharmacotherapy with analgesics, muscle relaxants and antidepressants. An alternative mode of management is TENS [3].

Transcutaneous electrical nervous stimulation (TENS) has been suggested as a treatment strategy in the therapy of TMD. By this method, controlled, low voltage electrical pulses are applied to the nervous system to reduce the symptoms of pain. It has been shown to produce an analgesic effect in symptomatic patients and a positive relaxing effect on the masticatory muscles. The method of use of TENS device is very important and successful application depends on the definitive location of pain or trigger point. Triggor point is a small, hypersensitive region in muscle, ligament, fascia, or joint capsule from which impulses are transmitted to the central nervous system and cause referred pain. Clinical trials show that excitation of an active trigger point produces the jump sign by the patient in which shortening of the muscle or fasciculation (or both) is evident. Such points are located on masseter, temporalis, and external and internal pterygoids and are involved in temporomandibular joint (TMJ) syndrome and result in referral of pain to other parts of the head and neck [4].

The use of low intensity US with short duration has been shown to have a major anti-inflammatory effect and could be related to an inhibition in release of inflammatory mediators from cells. The objectives of ultrasound treatment are to accelerate healing, increase the extendibility of collagen fibers, decrease joint stiffness, provide pain relief, improve mobility, and reduce muscle spasm. Furthermore, it increases vascular and fluid circulation, cell permeability, and increase in pain threshold and a break in pain cycle. Ultrasound therapy is also being used in conjunction with hyperthermia. It has been postulated that the combined effect of two or more methods in treatment might give a synergistic effect imparting a better therapy to the patient. In treating the head and neck, one should always use weak intensity for ultrasonic therapy. The weak intensity used for therapy is 0.1 - 0.6 W/cm<sup>2</sup> and in no case should the treatment exceed 0.6 W/cm<sup>2</sup> or a total output of 3W. A frequency of 3 MHz is recommended for more superficial lesions at depths of 1 - 2 cm. Low absorption of ultrasound waves is seen in tissues that are high in water content (e.g. fat), whereas absorption is higher in tissues rich in protein e.g., skeletal muscle) [5].

**Focussed question:** Which is the efficient method for the treatment of pain associated with temporomandibular joint disorders among therapeutic ultrasound and transcutaneous electrical nerve stimulation?

### Objectives of the Study

1. To assess the literature regarding TENS and Ultrasound therapy for temporomandibular joint disorders.
2. To compare the efficacy of TENS and Ultrasound therapy for the management of pain associated with temporomandibular joint disorders.

Methods

Eligibility criteria

Inclusion criteria:

1. Literature including clinical trials and case series mentioning the treatment modalities of temporomandibular joint disorders.
2. Literature showing follow up results of the treatment modalities.
3. PubMed search which includes articles published from 1<sup>st</sup> January 2001 upto 31<sup>st</sup> December 2016.

Exclusion criteria

1. Publication written in languages other than English.
2. Publications where the trial was performed on animals as subject.
3. Review articles on management of TMJ disorders.
4. Studies involving participants with systemic diseases (rheumatoid arthritis uncontrolled diabetes) or pain not related to TMD (toothache, neuralgia, local skin infection at area of application or psychological disturbances).

PICO:

- P: Patients with temporomandibular joint disorders.
- I: Ultrasound therapy.
- C: Transcutaneous electric nerve stimulation.
- O: Pain management.

Information sources

Internet source of evidence were used in the search of appropriate papers satisfying the study purpose: the National Library of Medicine (MEDLINE PubMed), Google Scholar and manual search using DPU college library resources. All cross reference lists of the selected studies were screened for additional papers that could meet the eligibility criteria of the study. The databases were searched upto and including December 2016 using the search strategy.

Keywords

| Primary keywords                            | Secondary keywords |
|---|--------------------|
| Therapeutic ultrasound                      |                    |
| transcutaneous electrical nerve stimulation |                    |
| Management                                  | Modality, therapy  |
| Temporomandibular joint disorders           | Myofascial pain    |

Search strategy for PUBMED

1. Therapeutic ultrasound OR transcutaneous electrical nerve stimulation AND myofascial pain.
2. Therapeutic ultrasound OR transcutaneous electrical nerve stimulation AND temporomandibular joint disorders.
3. Therapeutic ultrasound AND myofascial pain AND management.
4. Therapeutic ultrasound AND temporomandibular joint disorders AND management.
5. Transcutaneous electrical nerve stimulation AND Myofascial pain AND therapy.
6. Transcutaneous electrical nerve stimulation AND Temporomandibular joint disorders AND therapy.
7. Therapeutic ultrasound AND myofascial pain.
8. Therapeutic ultrasound AND temporomandibular joint disorders.
9. Transcutaneous electrical nerve stimulation AND myofascial pain.
10. Transcutaneous electrical nerve stimulation AND temporomandibular joint disorders.

|           | <b>Search strategy</b>  | <b>No of articles</b> | <b>No of articles selected</b> | <b>After duplicate removal</b> |
|-----------|---|-----------------------|--------------------------------|--------------------------------|
| Search 1  | Therapeutic ultrasound OR transcutaneous electrical nerve stimulation AND myofascial pain                   | 41                    | 14                             | 14                             |
| Search 2  | Therapeutic ultrasound OR transcutaneous electrical nerve stimulation AND temporomandibular joint disorders | 10                    | 4                              | 4                              |
| Search 3  | Therapeutic ultrasound AND myofascial pain AND management   | 7                     | 5                              | 1                              |
| Search 4  | Therapeutic ultrasound AND temporomandibular joint disorders AND management                                 | 1                     | 0                              | 0                              |
| Search 5  | Transcutaneous electrical nerve stimulation AND Myofascial pain AND therapy                                 | 18                    | 4                              | 1                              |
| Search 6  | Transcutaneous electrical nerve stimulation AND Temporomandibular joint disorders AND therapy               | 7                     | 4                              | 1                              |
| Search 7  | Therapeutic ultrasound AND myofascial pain  | 23                    | 12                             | 0                              |
| Search 8  | Therapeutic ultrasound AND temporomandibular joint disorders  | 5                     | 1                              | 1                              |
| Search 9  | Transcutaneous electrical nerve stimulation AND myofascial pain   | 18                    | 3                              | 0                              |
| Search 10 | Transcutaneous electrical nerve stimulation AND temporomandibular joint disorders                           | 7                     | 4                              | 0                              |
| Total     |   | 137                   | 51                             | 22                             |

**Study selection**

Preliminary screening consisted total of 145 articles out of which 8 articles were finally included in the study. The papers were screened independently by 4 reviewers. At first the papers were screened by title. Out of four reviewers, the reviewer who selected the maximum number of article were taken into consideration. The selected articles were 59 in number. Duplicates from 59 screened articles were then removed to get 30 articles and abstract of same was made ready. At the second step, 30 abstracts were again screened to remove 13 article to get 17 articles. 8 free full text articles were then obtained out of 17 abstracts. And thus 8 articles were finally selected for the study.

**Data collection process**

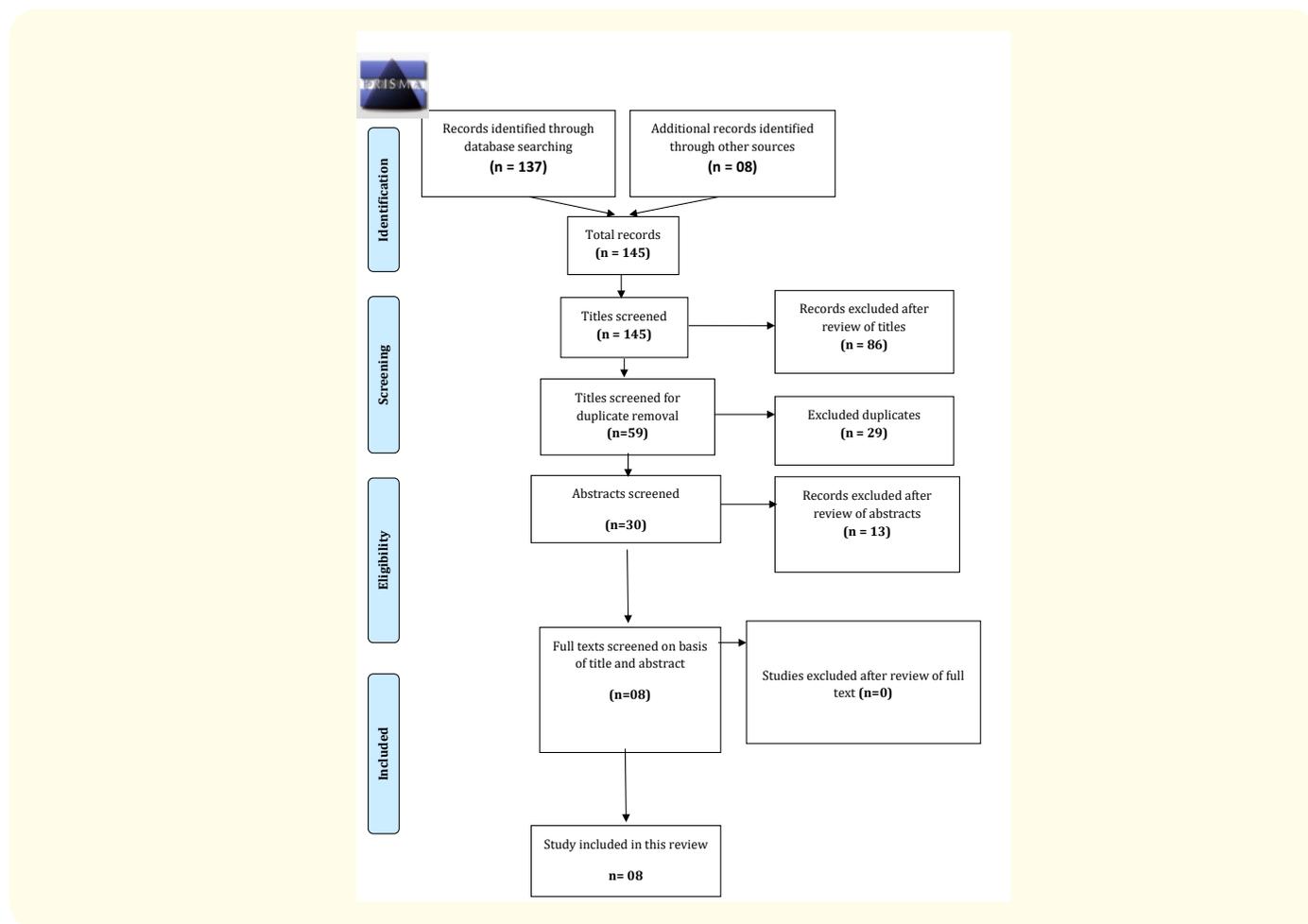
A standard pilot form in excel sheet was initially used and then all those headings not applicable for review were removed. Data extraction was done for one article and this form was reviewed by an expert and finalized. This was followed by data extraction for all the articles.

**Data items**

The data items included were

1. Author - The name of the author
2. Location - The country in which the study took place
3. Year of publication - The year in which the study was published
4. Study design - If the study was a control or a clinical trial
5. Sample size - Number of participants included in the study
6. Setting - Place where the study was conducted
7. Participant description- Patient with temporomandibular joint disorders.
8. Intervention/Comparison - Various treatment modalities for temporomandibular joint disorders.
9. Time -Time of intervention and follow up
10. Outcome variable- Analysis of which parameter is made
11. Outcome value - Result of the study
12. Conclusion - Inference obtained
13. Remarks

PRISMA 2009 flow diagram



Discussion

Temporomandibular joint disorders have multifactorial etiology, therefore treatment should be aimed towards pain reduction and restoration of jaw function. Treatment thus helps to provide a better quality of life to the patient.

The literature reveals lack of studies proving the efficacy of therapeutic ultrasound and transcutaneous electric nerve stimulation therapy in the management of pain associated with temporomandibular joint dysfunction. Therefore, a need was felt to conduct the study.

Therapeutic ultrasound helps to improve healing by decreasing joint stiffness, reduce pain and muscle spasm and increase the extensibility of collagen fibres. It helps to wash out the pain mediators by increasing the blood flow, nerve conduction changes, alterations in cell membrane permeability thus reducing inflammation.

Transcutaneous electric nerve stimulation therapy closes the channels for pain impulses and activates the endogenous analgesic systems such as endorphins (opiate like peptides) thereby increasing their plasma levels.

Following the PRISMA guidelines, 8 studies stating the treatment modalities were selected for this systematic review. Ultrasound therapy and transcutaneous electric nerve stimulation, both treatment modalities were included in the study.

### Summary of evidence

G Moger, *et al.* [3] conducted a study including 45 patients in which 30 patients received active TENS therapy and 15 patients received placebo TENS therapy. Patients were evaluated 1 week after the 1<sup>st</sup> sitting of TENS therapy, 1 week after the 2<sup>nd</sup> sitting of TENS therapy, 1 week after the 3<sup>rd</sup> sitting of TENS therapy and at the follow-up visit (1 month after the 4<sup>th</sup> 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. Pain was assessed using VAS scores and mouth opening was assessed. There were encouraging results with active TENS therapy, however the difference between active and placebo TENS therapy was not statistically significant.

B Rehmaan, *et al.* [4] conducted a study including 50 patients who were randomly divided into two groups. Group I received medications in form of Naproxen (500 mg) BD for 10 days and group II received TENS therapy thrice during 10 day period for about 30 - 40 minutes per setting. Pain assessment was done after 10 days using VAS scales. The result showed that both analgesics and TENS are effective in reducing pain, however complete remission of pain was observed in 8% of group I and 16% of group II patients. Thus, TENS was more effective in reducing pain as compared to analgesics.

J Bouffleur, *et al.* [6] conducted a study on 16 patients where all were treated with three therapeutic modalities (ultrasound, ultrasound with stretching and placebo). The modalities were applied in a random sequence with a one week interval period. Electromyographic evaluation was done before and after intervention in maximum intercuspation. The comparative electromyographic evaluation for three modalities was not statistically significant. However, the symmetry increased immediately after the ultrasound with stretching.

M Shanawas, *et al.* [7] conducted a study in 40 patients. Patients were divided into two groups where group A was treated with medication (combination of analgesics and muscle relaxants) thrice daily for five days and group B was subjected to TENS therapy in two sessions of 30 minutes each, separated five days apart, along with above medication. Results were assessed using VAS scores before and after treatment. Adjuvant TENS therapy was more effective than medication alone in relieving pain and the results were statistically significant.

A Fouda, *et al.* [5] conducted a study in two groups including 72 patients each. Group I was given pulsed ultrasound therapy in three sessions every other day for three days. Supplementary intra articular injection in the upper compartment of joint space with 0.5 ml of Solu-Medrol (equivalent to 20 mg Methylprednisolone) diluted in 0.5 ml of local anesthetic solution (mepivacaine 3%) and then ultrasonic waves applied to the affected joint. Group II was given intra articular injection in the upper compartment of joint space with 5 ml of Solu-Medrol (equivalent to 20 mg Methylprednisolone) diluted in 0.5 ml of local anesthetic solution (mepivacaine 3%). Interincisal opening was measured in mm, and pain scores were analysed using visual analogue scale (VAS). In group I, results at two, four and six days, increase in maximal mouth opening, and the difference is statistically significant. In group II there was increase in maximal mouth opening, but the difference is not statistically significant. Results at two, four and six days stated that when comparing the measurements at the second day post-operatively between group I and group II patients; it was found that there was increase in maximal mouth opening, and the difference was statistically significant. Pain scores after two days showed that the difference between Group I and Group II was statistically significant. Between group I with group II patients the difference was not statistically significant. Results at four days and six days showed that Group I, Group II and between Group I and Group II the difference was statistically significant. The ultrasonic therapy was not alone effective in relieving symptoms but more effective when used as an adjunct to the accepted modalities of therapy.

H Puri, *et al.* [8] conducted a study in which 60 patients were divided into four groups in which group A was given conventional treatment, group B was given TENS therapy, group C was given combined conventional and TENS therapy and group D was placebo group. All 4 groups were analysed under 4 parameters of VAS measurement, interincisal mouth opening, muscle tenderness and clicking. In group A, 86% cases showed complete relief of pain sensation with the use of conventional therapy. In group B, 60% cases showed complete relief of pain sensation, while the group C that is combined therapy showed maximum relief from pain of 93%. Group D patient did not show any relief. It can be concluded from this study that both conventional therapy and TENS therapy were effective in relieving the pain sensation in MPDS patients, however combined therapy was more effective in providing the faster relief from pain sensation compared to conventional therapy and TENS therapy.

B Shobha., *et al.* [2] conducted a study on 40 patients of which 20 patients active TENS therapy for 30 minutes and 20 patients received placebo TENS therapy. Patients were analysed 1 day after 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> settings and follow up 1 week after the fourth setting. Patients were analysed for type of pain, muscle and joint tenderness and mouth opening without pain. Reduction in the intensity of pain was noted in each interval of TENS therapy in both study and placebo groups. When compared from pre-treatment pain to post treatment, patients were completely free of pain in both the groups, and the difference was statistically significant [p 0.05]. Mean VAS scores between pre and post treatment was also statistically significant. Comparison of pre and post treatment mouth opening in study and placebo groups. Both study and placebo group showed significant (p < 0.05), increase in the mouth opening in each interval.

R Shalu., *et al.* [1] conducted a randomized comparative study in which 90 patients were divided in three groups, group I was healthy control patients, group II received Therapeutic Ultrasound therapy and group III received TENS therapy. Patients received therapy for 12 weeks (3 times every 2 weeks). Mean VAS scores for pain, masseter muscle thickness and intramuscular sonographic appearances was assessed. Statistically significant findings were found with Therapeutic Ultrasound than the TENS therapy. Anechoic areas disappeared or reduced by 95.6% with Therapeutic Ultrasound and 74.4% with TENS therapy.

### Limitations

1. As all the databases were not open access, the number of studies included in the review is less.
2. Unpublished data was not included in this review.

### Future Implications

1. Therapeutic ultrasound is an effective modality which can be used individually or as an adjunct to other treatment modalities with no side effects.
2. Treatment is simple and economic with both therapeutic ultrasound and TENS therapy.
3. Immediate patient relief is appreciated after treatment and repeated sessions can be done with minimal efforts.
4. More studies required to prove the efficacy of therapeutic ultrasound and TENS therapy in management of pain associated with temporomandibular joint disorders.

### Conclusion

The use of both therapeutic ultrasound and TENS therapy have been justified in the management of pain associated with temporomandibular joint dysfunction, however, therapeutic ultrasound was proved to be a better modality when compared with TENS. Both therapeutic ultrasound and TENS therapy are individually effective in relieving pain but when combined with conventional therapies including analgesics and muscle relaxants, the results are more justified.

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