TEMPOROMANDIBULAR DISORDERS. A SYSTEMATIC REVIEW.

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ABSTRACT

Temporomandibular disorders (TMD) are a group of disorders affecting the temporomandibular joints and the muscles of mastication. Signs of TMD primarily includes pain in and around temporomandibular joint. Although surgical options are available for treatment of many tmj dysfunctions, pain management and treatment associated with TMJ disorders could be potentially relieved with self-managed care or non surgical treatment.

The rationale behind this systematic review is to evaluate the numerous physiotherapeutic treatment methods and summarize the evidence from randomized clinical trials (RCTs) that examined their effectiveness on pain relief in temporomandibular disorders (TMD).

An Electronic search of PubMed, Saud digital library (SDL) and Cochrane Databases was conducted. Reviewers retrieved 475 articles from the three databases. A total of 10 articles were included in the systematic review.

Physiotherapy compared to other treatment modalities was found significantly more effective when combined with other adjunctive treatments such as manipulative therapy.

Review of comparison of different non-invasive therapies of TMD suggested that Physical therapy including manipulative therapy and Therapeutic Ultrasound had significant positive results in reducing (TMD) symptomology.

I. INTRODUCTION

Temporomandibular disorders (TMD) are a group of disorders affecting the Temporomandibular joints and the muscles of mastication. TMJ disorders are divided mainly into joint and muscle disorders, and their diagnosis is important in the treatment plan and prognosis(1). Symptoms of TMD primarily includes pain in and around temporomandibular joint. The pain that often accompanies this condition can compromise mandibular movements and lead to a reduction in quality of life. Bad posture, malocclusion, parafunctional habits, and other clinical conditions can lead to the development of TMD, which may also be associated with psychological factors.(2) The Temporomandibular joint (TMJ) is a diarthroidal synovial joint. Synovitis is a painful inflammation of the synovial membrane and can cause an overproduction of the synovial fluid. Being highly
vascularized and innervated, the inflammation of the synovial membrane is a very painful condition. Synovitis can accompany a displaced disc. Usually the synovial fluid accumulates in the direction of the displacement. (3) Although surgical options are available for treatment of many TMJ dysfunctions, pain management and treatment associated with TMJ disorders could be potentially relieved with self-managed care or nonsurgical treatment. Preliminary retrospective research has pointed the role of physical therapy to be one of the most effective among conservative treatments. (4) Owing to the complexity and multifactor etiology of TMD, a number of treatment options have been proposed, such as LLLT, acupuncture, ultrasound, massage therapy, TENS, and physical therapy. The rationale behind this systematic review is to evaluate various physiotherapeutic treatment methods and their significant effectiveness on pain relief in Temporomandibular joint disorders (TMJD).

II. MATERIALS AND METHODS

This systematic review was carried out in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (2012) guidelines and review was registered in PROSPERO database with reg. no CRD197355. Search strategies were based on four elements of PICO framework comparing low level laser, TENS treatment and physical therapy and whether there is evidence of their effectiveness in relieving TMD symptomology. Data used in this review were systematically searched from articles in English language for studies published from the year 2000 up to May 2020 utilizing the key words including combinations of “TENS” OR “Physiotherapy” OR “Laser Therapy” OR “TMJ disorders” OR “TMD”. Search was conducted in four data portals, PubMed, Cochrane, Scopus, Saudi Digital Library.

III. INCLUSION & EXCLUSION CRITERIA

Articles that met the following criteria were eligible to be included: 1) Articles written in English language 2) Randomized control clinical trials which evaluated treatment of temporomandibular disorders, 3) studies in which intervention included the treatment in at least one group with counselling techniques 4) Participants age in the trials ranging from 20 – 40 years old.

Studies with systemically compromised patients or any other health issues and studies where control group is not described and were not a clinical trial were excluded. Duplicates were removed using Mendeley version 1.19.4.

Data extraction

Articles meeting the inclusion criteria were read in full by two independent reviewers and data extracted onto an individualized form that included the type and place of study; age of participants; qualification of the control or comparison group; type of therapy, power and length of laser wave; number of sessions; evaluation and results of the outcomes, and follow-up period.

Bias evaluation

After extraction of data, final studies included in the systematic review were evaluated for quality of clinical trial and risk of bias by two reviewers independently using Jadad scale. The middle score between them was registered. (Table.1)
IV. RESULTS

475 articles in total were initially extracted, 190 duplicate studies were removed, the rest of the 285 studies were screened for inclusion & exclusion criteria and 235 studies were excluded. 10 articles then were chosen for this systematic review after assessment of eligibility. (Figure. 1) shows PRISMA flow diagram of the study selection stages. All 10 articles were clinical trials and were organized into (three) groups according to the type of physiotherapeutic treatment modality evaluated: 5 studies assessing the efficacy of Low level laser therapy,(1, 8-11) 2 assessing physiotherapy compared to manipulative or splint therapy(5, 6), 3 studies evaluating TENS(7, 12, 13).

1) JADAD scale for risk of bias assessment.
LOW LEVEL LASER

Laser phototherapy is a non-invasive treatment modality that has been used widely in management of many conditions including myoarticular disorders. It is often used by clinicians for pain relief and tissue regeneration, and this technique has been proven to be beneficial in treatment of TMD symptomology.

Low-level laser therapy (LLLT) were compared in these studies with varying wavelengths and densities. The laser type most commonly used was GaAlAg(8, 9, 11). Wavelengths ranged between red and infrared laser and the number of sessions ranged from (three sessions – twelve sessions) in total. The energy density used ranged from 3 J/cm² to 89.7 J/cm².

Túlio Silva Pereira et al, 2014 (1) compared low level laser in regards to wavelengths evaluating the efficacy between red and infrared laser, both lasers (red and infrared) showed similar results of improvement compared to placebo group.

All of the studies used an adapted visual analog scale (VAS) for measuring pain intensity upon palpation. Túlio Silva Pereira et al, 2014 (1) used a numbering rating scale for recording pain, as well as an Oral Health Impact Profile (OHIP-14) questionnaire to measure the quality of life was performed. Not all studies evaluated mouth opening(10, 11), Venezian et al, 2010(8) used an Electromyographic analysis (EMG) to evaluate muscle activity. However they reported no significant statistical difference in the EMG activity between the groups before and after laser treatment. They compared the energetic doses of laser between 25 J/cm² and 60 J/cm² and found that the active dose of 25 J/cm² produced a slightly better response in pain level reduction in muscle which was
maintained 30 days after treatment completion, whereas active doses of 60 J/cm² showed painful symptoms returning 30 days after treatment was completed.

Túlio Silva Pereira et al, 2014 (1) was the only author to evaluate pain measurements 180 days post treatment. Irradiation of 4 J/cm² on (TMI) and 8 J/cm² in the muscles was used, utilizing both (red and infrared) laser and reported a significant difference in achieving diminution of pain after 180 days follow up favoring infrared laser.

Azamsadat Madani et al, 2019 (11) compared the use of low level laser therapy (LLLT) with laser acupuncture therapy (LAT) utilizing the same settings for both and reported an effective reduction in pain and an increasing excursive and protrusive mandibular motion in TMD patients. LAT was suggested to be a suitable alternative to LLLT, as it provided effective results while taking less chair time.

Erkan Sancakli et al, 2015 (10) evaluated (LLLT) in relation to location of laser application, comparing between laser, directed at points of greatest pain in patients with chronic masticatory muscle pain and at pre-established points in the affected muscles. Mandibular mobility was examined, and Pressure Pain Threshold (kg/cm²) measurement was calibrated using Pain Test (TM Model FPK; Wagner Instruments, Greenwich, CT, USA) on the masticatory muscles. Laser applied at the points of greatest pain revealed statistically better results, although there was a statistically significant reduction in PPT values of the muscles in both groups that received active laser treatment.

**TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS)**

Transcutaneous electrical nerve stimulation (TENS) therapy is a popular physical therapy useful for relieving pain by use of controlled low voltage electrical pulses applied to the nervous system. It is non invasive, safe, affordable to patients and a very effective method of providing pain relief(7).

Rai S, et al 2016 (7) compared (TENS) to Therapeutic Ultrasound (Th US). Therapeutic ultrasound is a noninvasive therapeutic method, the frequency used is in the range of 1.0 and 3.0. MHz accelerates healing, alleviates pain, decreases joint stiffness,increases the extendibility of collagen fibers, and reduces muscle spasm.

Visual analog scale (VAS) was utilized for scoring muscle pain, massage impression. Sonographic appearances were taken of the Masseter muscle pre and post treatment. After receiving treatment 3 times every 2 weeks, both (Th US) and (TENS) group found decreased thickness in masseter muscle following treatment with no statistically significant difference between two groups. However, (Th US) therapy was better subjectively on the basis of (VAS) scores of muscle pain, massage impression, impediment to daily life, and the basis of intramuscular sonographic appearance of the masseter muscle.

Annalisa Monaco et al, 2012 (12) evaluated the effects of a single session of 60 mins of (TENS) in patients with unilateral TMD in remission on surface electromyographic (sEMG) and kinesiographic activity of masticatory muscles. sEMG values of masticatory muscles of both sides in the TENS group were significantly reduced. Kinesiographic results showed that the vertical component of the interocclusal distance was significantly increased after TENS group.

Harneet Singh et al, 2014 (13) allocated patients with (TENS) therapy once a week for 4 weeks and were followed up in the fifth week. TMJ pain was measured before, during, and at the completion of the treatment with a Visual Analogue Scale (VAS). They reported that in (TENS) therapy, there was a significant continuous improvement at different visits for pain, tenderness of muscles, and maximum mouth opening including follow-up visit, and were less than the values in placebo drug therapy.

**PHYSICAL THERAPY**

Selvam, P. Senthil et al, 2017(5) suggested that a better treatment option to correct TMJ disorder would be manipulative treatment alongside physiotherapeutic modalities rather than physiotherapy alone.

Manipulative treatment in a physical therapy intervention, are characterized by fine manipulative techniques, less invasive than other interventions, individually adapted to tissue quality, in order to maintain or restore the circulation of body fluids.

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Temporomandibular joint manipulative treatments included: Distraction glide, TMJ self-distraction technique, lateral glide, and cervical joint, thoracic joint manipulation. Results were measures of range of motion pain, using a visual analog scale (VAS), Temporo-mandibular Disability Index & Fonseca’s Questionnaire. The author reported after 20 sessions a significant improvement in all of the outcome measures in patients who received physiotherapy modalities and exercises along with the manipulative therapy when compared to patients who received physiotherapy and exercises alone.

ISMAIL, F et al, 2007(6) evaluated the efficacy of physical therapy in addition to splint therapy on treatment outcome in patients with arthrogenous (TMD). Patients underwent Michigan splint therapy along with physical therapy twice a week for 12 weeks and reported that active jaw opening was significantly higher, whereas the passive jaw opening was not statistically significant between groups who received splint therapy alone and patients receiving both treatments. For the subjective parameters no significant differences were found between the two groups. However, some patients still exhibited myofascial pain after treatment in both groups.

V. DISCUSSION

TMD is a complex disorder and its etiology is multifactorial. Therefore, a number of treatment options have been proposed, such as (LLLT), acupuncture, ultrasound, massage therapy, (TENS), physical and psychological treatment. (LLLT) is a low-cost, noninvasive form of treatment that offers pain relief, reduction in inflammation and enhanced tissue regeneration.

Thus, our objective in this study is to evaluate the various physiotherapeutic treatment modalities and to assess the superiority of those treatments in relieving (TMD) symptomology compared to others.

Concerning the parameters of (LLLT) there were too many variations to compare, that can be explained by many factors, including methodological differences among studies. Furthermore, the effect of a low-level laser increases with the depth of penetration into musculoskeletal tissues. Wavelength and energy density play important roles in light penetration and absorption. Only two studies(8, 11) used similar densities. The active dose of 25 J/cm² which produced a mildly superior response in muscle pain level reduction, which was maintained 30 days after treatment completion unlike the active dose of 60 J/cm² which showed pain returning, 30 days after completion of treatment.

Túlio Silva Pereira et al, 2014 (1) compared wavelengths (red and infrared laser). The results showed that infrared lasers were more effective than the red laser in achieving remission of painful symptoms which was maintained for 180 days of the study. There was no statistically significant difference between them regarding the other evaluation time.

The laser type most commonly used for analgesia was GaAlAg. They have been reported to penetrate to depths of 1–5 cm in soft tissue, which should be adequate to achieve a therapeutic effect in muscle disorders. Although different doses were utilized, this finding suggests that the GaAlAg laser should be the principal type to be tested in future standardized randomized clinical trials, measuring its outcomes to obtain evidence. (16)(10)

Most of the (LLLT) studies involved in this systematic review evaluated pain measurements subjectively, surface EMG was considered by Venezian et al, 2010(8) in an attempt to detect changes in the muscular activity with the use of low level laser therapy, Bodere, et al. (16) demonstrated that in patient groups with myofascial pain or neuropathic pain, the EMG activities of the masseter and temporal muscles at rest are higher than that of control group. Clinical assessment should also involve an objective and quantitative evaluation of pain, Erkan Sancakli et al, 2015 (10) utilized PPT measurements, which enhances the quality of data and enables outcome standardization and comparison.

All of the (LLLT) studies(1, 8-11) demonstrated favorable results in terms of improvement in TMD symptoms. Although almost all placebo groups in these studies revealed a slight reduction in (VAS) values post treatment. Conti, 1997(14) reported that TMD has a self-limiting aspect, with remission periods of the symptoms, which in part could be an explanation of the responses in the placebo group, and also the reduction of pain during the actual treatment. However, Venezian et al, 2010(8) reported that pain returned 30 days after completing the treatment for the placebo group. additionally, a good relationship between the patient and the professional, associated with the use of high technology, can be attributed to an emotional and mental element, for instance

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their desire to recover and relief pain may have influenced the physiological process. Or perhaps could be the methodological quality of trials that may have contributed to these results. (14, 15)

(LLLTT) may be considered an alternative in the relief of symptoms of clinical TMD manifestations. However, in these studies (8-11), only the short-term effects were investigated. Additional research should be conducted in order to investigate the long-term effects of (LLLTT) in the treatment of TMD and to establish a viable standardized protocol.

The effect of (TENS) on (sEMG) activity and kinesiographic pattern of patients with TMD in remission was investigated by Annalis Monaco et al, 2012 (12) the results suggested that TENS is effective in reducing the activity at rest of masseter and anterior temporalis muscles, and in increasing the interocclusal distance. TENS therapy in one study(13) that received treatment once in a week for 4 weeks showed a reduction in pain, which was more effective than the placebo drug therapy. After the fourth visit, the percentage difference in pain reduction was found to be significantly lower than baseline, and at the follow-up visit fifth visit, the pain level slightly decreased to a 17.6% (P < 0.0008) as the treatment was stopped for 1 month. Thus, considering the variable protocols of (LLLTT) and its lack of evidence regarding long term effect. (TENS) therapy can be a better modality for the treatment of continuous pain and the relief of these symptoms for longer times in TMJ pain disorders.

In a study by Rai S, et al 2016 (7), the (VAS) scores of impediments to daily life after treatment found better results in patients who received (Th US) than those who received (TENS). Additionally, better massage impression compared to those received (TENS) found a statistically significant difference between the two groups.

Similar results were seen in a study by El Fatih et al (17) they demonstrated that the group who received (Th US) showed a higher success rate with 93.3% pain improvement compared to the (TENS) who received a success rate of 53.3%.

In a study done by Selvam, P. Senthil et al, 2017(5) there was a reduction in pain with manipulative therapy in a combination with physiotherapeutic treatments such as ultrasound, (TENS), hot water pack, and exercises and resulted in an improvement in pain and range of motion after four months. The positive therapy effect on TMD may be explained by neural plasticity which could have been induced by these therapeutic interventions.

If therapies that target the TMJ masticatory system such as (occlusal splints, physiotherapy, osteopathic manipulation and others) can induce appropriate neural plasticity, then it is possible that considerable neurologic improvement of the patient may be achieved.

In the studies(5-7) physiotherapy compared to other treatment modalities was found significantly more effective when combined with other adjunctive treatments such as manipulative therapy, and can be regarded as an initial approach in selected TMD patients. (5)

VI. CONCLUSION

(LLLTT) was found to be an effective method in controlling pain in patients with TMD. However, studies lacked the standardized protocol for its methodology and the long-term effect should be further investigated. Physical therapy including manipulative therapy and Therapeutic Ultrasound had significant positive results in reducing TMD symptomology as compared to TENS therapy, although primarily etiology of the pain needs to be identified to achieve success of the treatment in the long term. Treatment options should be decided based on the diagnosis and the likely origin of the pain. Each treatment modality has its own advantages and disadvantages and the onus lies on the clinician to decide on the best available treatment option.

Declaration of Conflict of Interest

The authors declare that they have no conflict of interest.

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