Ultrasonic therapy as an adjunct treatment of temporomandibular joint dysfunction

Atef Abd El Hameed Fouda

Department of Oral and Maxillofacial surgery, Faculty of Oral and Dental Medicine, Cairo University, Egypt

Article history:
Received: 13 March, 2014
Accepted: 15 March, 2014
Available online: 03 April, 2014

Abbreviations:
TMD: Temporomandibular joint dysfunction, TMJ: Temporomandibular joint

Keywords:
Ultrasound, TMD, TMJ Steroid injection, Pain, Interincisal opening

Corresponding Author:
Fouda A.*
Professor of Oral and Maxillofacial Surgery
Email: atef.fouda@dentistry.cu.edu.eg
Phone: +201093440600, +201125410541.

Abstract
Up till now no single treatment modality for temporo-mandibular dysfunction (TMD) being effective, so the search for modification in or combination of treatment modalities have been tried. The current study was designed to study the effect of ultrasound as adjunct treatment with corticosteroids on TMD symptoms. One hundred forty four patients who did not respond significantly to previous TMD treatment were selected. Patients received articular injection in the upper compartment of joint space with steroids plus application of pulsed ultrasound. Inter-incisal opening measured in mm, and pain scores evaluated using visual analogue scale (VAS). Results showed that the combined treatment is superior to corticosteroids injection alone. In Conclusions; ultrasonic waves is recommended to be used as adjunct treatment with other conservative treatment modalities of TMD. Ultrasound being non invasive method when combined with other promising line of treatments may synergize its effect.

1. Introduction

1.1 Use of Ultrasound
Applications of ultrasound in medicine for therapeutic purposes have been accepted for many years. Low power ultrasound frequency has been widely applied since the 1950s for physical therapy (Miller and Smith, 2012).

The therapeutic ultrasound in dentistry involved for treatment of TMD. (Brown, 1984) The American Academy of Craniofacial Disorders and the Minnesota Dental Association have cited physical therapy as an important treatment. Physical therapy is intended to relieve musculoskeletal pain, reduce inflammation, and restore oral motor function. Numerous physical therapy interventions are potentially effective in managing TMD, including electrophysical modalities, exercise, and manual therapy techniques. Electrophysical modalities include interventions such as ultrasound, microwave, laser, and transcutaneous electrical nerve stimulation (TENS). (Sturdivant and Fricton, 1991).

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. (Esposito et al., 1984).

Furthermore it Increases vascular and fluid circulation, cell permeability, and Increase in pain threshold and a break in pain cycle. (Grieder et al., 1971).

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 (Young et al., 1990). 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/cm² and in no case should the treatment exceed 0.6 W/cm² or a total output of 3 W. (Grieder et al., 1971). 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) (Speed, 2001).

Kropmans and colleagues analyzed 24 scientific papers concerning the therapeutic outcome of various surgeries and physical therapy, which included ultrasound therapy and found that no significant difference occurred in various therapies instituted for TMD (Kropmans et al., 1999).

Another study evaluated the effectiveness of a treatment based on short-wave diathermy, a pulsed short-wave diathermy, ultrasound therapy and laser therapy and found that there was no statistically significant difference in success rate between any of the four tested treatment, although each individually was significantly better than placebo treatment. The time of improvement appeared to vary between the four methods, and found a shorter period of improvement after short-wave diathermy and mega pulse than following ultrasound and laser (Gray et al., 1994).

1.2 Corticosteroid injection
Single intra-articular injection of corticosteroids used in the treatment of 160 patients, all of whom had painful conditions in the temporomandibular joint and all of whom have been available for follow-up periods of one year or more. In certain cases of intractable pain in the temporomandibular joint after conservative treatments have been unsuccessful, a single intra-articular injection of up to 40 mg of prednisolone trimethylacetate has been shown to be useful for permanent relief (Paul, 1977).

1.3 Intra-articular injection
Consequently, pharmacologic approaches to TMD have paralleled those for symptomatic treatment of osteoarthritis, including non-steroidal anti-inflammatory drugs (NSAIDs) and intra-articular injections of either steroids or hyaluronic acid into the superior joint space. However, use of these agents remains controversial in light of decades of mixed reports of intra-articular injections either accelerating TMJ destruction or triggering regeneration. (Dionne, 1997) As in the case of osteoarthritis, no agents are available to reverse the underlying TMJ disease. Consequently, current pain reduction techniques are effective in the early stages of the disease, but fail to alleviate the severe, chronic pain caused by advanced joint degeneration. There is a need for sustained release agents that effectively reduce pain and have minimal systemic side effects, enabling long-term administration. (Tanaka et al., 2008) In a controlled study of adults with TMJ arthritis, a single intra-articular injection of corticosteroid (methylprednisolone) diluted with lidocaine significantly reduced joint pain and other symptoms for 4-6 weeks. (Alstergren et al., 1996) Although the best method has yet to be determined Some clinicians have suggested that a single corticosteroid injection is beneficial for patients with severe TMJ pain, while further injections do not provide added pain relief, and may increase the risk of joint degeneration and other complications (Schindler et al., 2005) However, in a recent randomized, blinded study, hyaluronic acid injections reduced pain to a greater extent than corticosteroids (Bjornland et al., 2007). To date, the question of whether physical therapy interventions are effective in the management of TMD remains unanswered. Thus, the purpose of this study was to evaluate the effectiveness of ultrasound therapy plus intra articular corticosteroid injection in the management of TMD.

2. Objective of Research
Ultrasound is non-invasive and proved to be effective as physical therapy in treating a lot of joint and muscular dysfunction. However its introduction in TMD treatment would add to improve the percentage of cure and extend the symptom free periods for patients.

3. Materials and Methods
3.1 Study hypothesis
Many patients presented with TMD who tried with conservative and even surgical treatment seeking for ending of their problem are disappointed. The percentage of permanently cured patients is not satisfactory. A lot of conservative treatment modalities may need lab work, or long follow up to get effect and or expensive. Searching for improving the patient
natural mechanism to fight the disease is the goal of any successful treatment.

3.2 Patient selection
In the current study one hundred forty four patients with TMD who did not respond significantly to previous conservative treatment as; occlusal splints, arthrocentesis, prolotherapy; anti-inflammatory medical treatment were selected from the outpatient clinic of Oral and maxillofacial surgery department, Cairo university.

3.3 General inclusion criteria
Diagnosis of temporomandibular disorder, Adult subjects (>18 years of age), Musculoskeletal dysfunction, Pain impairment, No previous surgery in the temporomandibular region and No other morbid conditions in the region of TMJ as rheumatic disease, neurological disease.

The selected cases should fulfill the following Helkimo (1974) index:

Slightly impaired movement = index 1, Moderate dysfunction = DII, Muscle pain sensitivity to pressure in four places=severe disorder, Pain associated with two or more movements=severe disorder, and Sensitivity to posterior pressure=severe disorder.

Patients were divided into two groups each one included 72 patients randomly selected:

3.4 Study groups
**Group I:** Pulsed ultrasound at a frequency of 1 MHz, with pulse repetition rate of 120 Hz, and intensity of 1 W/cm2 for 5 min/session was applied to the patients. Treatment continued for three sessions performed every other day. 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%). After intra-articular injection ultrasonic waves applied to the affected joint, masseter muscle, temporalis muscle, geniohyoid muscles, and sternomastoid muscle in a circular motion.

**Group II:** 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 measured in mm, and pain scores using visual analogue scale (VAS) were recorded in tables preoperatively and post-operatively at 2, 4, 6 follow up days.

3.5 Statistical analysis
The data were entered in an Excel spreadsheet, and the statistics were done using computer software. Paired T-test was used; with significant level was ≤ 0.05.

4. Justification of Research
Many patients presented with TMD who tried with conservative and even surgical treatment seeking for ending of their problem are disappointed. The percentage of permanently cured patients is not satisfactory. A lot of conservative treatment modalities may need lab work, or long follow up to get effect and or expensive. Searching for improving the patient natural mechanism to fight the disease is the goal of any successful treatment.

5. Results
Maximum mouth opening, measured for both groups, and data analyzed with results showed that; there is no significant difference between pre-operative records; regarding mouth opening and pain scores; between test groups.

Results at two days; when comparing the measurements at the second day post-operatively with pre-operative measurements of the same group (**Group I**), it was found that there is increase in maximal mouth opening, and the difference is statistically significant.

However when comparing the measurements at the second day post-operatively with pre-operative measurements of patients within **Group II**, it was found that there is increase in maximal mouth opening, but the difference is not statistically significant.

When comparing the measurements at the second day post-operatively between **group I** and **group II** patients; it was found that the difference between the groups is statistically significant.

Results at four days; when comparing the measurements at the fourth day post-operatively with pre-operative measurements of the same group (**Group I**), it was found that there is increase in maximal mouth opening, and the difference is statistically significant.

Results at four days; when comparing the measurements at the fourth day post-
operatively with pre-operative measurements of patients related to **Group II**, it was found that there is increase in maximal mouth opening, but the difference is not statistically significant.

When comparing the measurements at the second day post-operatively between **group I** and **group II** patients; it was found that there is increase in maximal mouth opening, and the difference is statistically significant.

Results at six days; when comparing the measurements at the six day post-operatively with pre-operative measurements of the same group (**Group I**), it was found that there is increase in maximal mouth opening, and the difference is not statistically significant.

When comparing the measurements at the six day post-operatively with pre-operative measurements of the patients in **Group II**, it was found that there is increase in maximal mouth opening, but the difference is not statistically significant.

When comparing the measurements at the six day post-operatively between **group I** and **group II** patients; it was found that there is increase in maximal mouth opening, and the difference is statistically significant.

Pain scores: measured for both groups and analyzed data showed that; there is no significant difference between pre-operative records between test groups.

Results at two days; when comparing the scores at the second day post-operatively with pre-operative scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing the scores at the second day post-operatively with pre-operative scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

Results at four days; when comparing pain scores at the second day post-operatively between **group I** with **group II** patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the second day post-operatively between Group I with Group II patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively between **group I** with **group II** patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively between **group I** with **group II** patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively between **group I** with **group II** patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively with pre-operative pain scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively with pre-operative pain scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively with pre-operative pain scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively between **Group I** with **Group II** patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively with pre-operative pain scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively with pre-operative pain scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively between **Group I** with **Group II** patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively with pre-operative pain scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively with pre-operative pain scores of the same group (**Group I**), it was found that there is decrease in pain scores, and the difference is statistically significant.

When comparing pain scores at the fourth day post-operatively between **Group I** with **Group II** patients; it was found that there is decrease in pain scores, and the difference is statistically significant.

6. Discussion

I agree with previous studies which concluded that the ultrasonic therapy was not alone effective in relieving symptoms but more effective when used as an adjunct to the accepted modalities of therapy (Grieder et al., 1971), so the selection of ultrasound as line of treatment in the current study accompanied with intra-articular steroid injection.

The mechanism of ultrasound action is based on massage and thermal effect. Thermal effects of ultrasound may include increased blood flow vasodilatation, waste removal, acceleration of lymph flow, and stimulation of metabolism. It is estimated that thermal effects can occur with elevation of tissue temperature to 40-45° C for at least 5 min. (Ter Haar., 1999) because temporomandibular joint dysfunctions associated with symptoms of muscle spasm (Grieder et al., 1971) Reduction in muscle spasm, and Increased extensibility of collagen fibers due to local ultrasound effect may help in cure (Ter Haar, 1999).
Pain relief is theorized to be related to washout of pain mediators by increased blood flow (Esposito et al., 1984) The results of the current study prove that ultrasound in concomitant with steroids help fast relief of pain to great extent.

Whereas the therapeutic application of ultrasound uses intensities between 1 and 3 W/cm² (Dyson, 1985) achieved in the current study and the length of time the temperature is maintained was 5 minutes per session that fall in the range reported by (Esposito et al., 1984).

(Ariji et al., 2010) reported successful treatment of fifteen patients with TMD by massage treatment alternately on the masseter and temporal muscles. I think that tissue massage using ultrasound therapy is better than manual massage in that; it massages deeper tissues beside its heating effect without unwanted skin manifestations. Furthermore application of ultrasound should include most of tender muscles.

**Conclusion**

Ultrasound at power levels mentioned in the current study was capable of causing heating, and biologic effects to human tissues. Thus a reasonable amount of palliation can be achieved by utilizing the ultrasound therapy for therapeutic effect in dentistry either alone or in conjunction with other available conservative treatments modalities.

The author declares that; Approval from the ethics committee of the institution sponsoring the study (Cairo University Ethical Committee), and Informed consent from all patients participating in the study were obtained.

Ultrasound therapy is promising with little or no complications could be used with or without other treatment modalities for compromised patients.

**Research Highlights**

The treatment was easy to apply, economic and with short time sessions. The effect of the treatment was felt by the patient immediately after session. Repetition of treatment is none effort job. Many patients could be treated in no time.

**Limitations**

The main limitation of the current study wan in patient refuse to be injected with corticosteroids, so searching for another adjunct treatment with ultrasound may break this limiting factor. Larger patients’ number could be included if solving this limiting factor.

**Recommendations**

Continuation with ultrasound as therapeutic physical treatment with treatment modalities as with splint therapy and arthrocentesis etc.

**Funding and Policy Aspects**

Researches on ultrasound intensities and improving penetration and tissue response may put our feet on right direction.

**Justification of Research**

The research continued to be applied to big number of population.

**Author’s Contribution and Competing Interests**

No conflict of interest in the current study.

**References**


