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Original Research Article

Effectiveness of TENS and home exercises as an adjunct to drug therapy in the management of myogenous masticatory pain: a comparative study

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Abstract – Introduction: Pain relief is the primary goal of treatment in patients with myogenous temporomandibular disorder. This study evaluated the effectiveness of TENS and Home exercises as an adjunct to drugs in relieving myogenous masticatory pain. **Materials and methods**: This prospective clinical study was conducted on 60 patients with myogenous masticatory pain. Patients were randomly allocated into three groups of 20 patients each. Patients in Group A received TENS and drugs, while patients in Group B received home exercises and drugs and Group C received drugs only. The drugs prescribed were Diclofenac 50 mg and Orphenadrine 100 mg, to be taken twice daily for 5 days. All patients were followed up for three weeks. The severity of pain was recorded using the Visual Analog Scale. Inter and intragroup differences in the pain scores were analyzed using one-way ANOVA along with post hoc Tukey's test, and Paired *t*-test, respectively. $p < 0.05$ was considered as statistically significant. **Results:** There was a significant reduction in the mean pain scores in all the three groups at 1st, 2nd, and 3rd post-treatment weeks as compared to the baseline scores with $p < 0.001$. However, when the pain scores were compared across groups, maximum pain reduction was observed in group A (0.2 ± 0.04), followed by group B (0.5 ± 0.06), and the least reduction was noticed in group C (2.1 ± 0.8). This result was significant with $p < 0.001$. **Conclusion**: Both TENS and Home exercises program were effective as adjuncts to drugs, in controlling myogenous masticatory pain, as compared to drugs alone.

Introduction

Myogenous temporomandibular disorders (TMDs) are a distinctive group of conditions that arise due to pathologic and functional processes in the masticatory muscles. The most common symptom of TMDs is Myogenous Masticatory Pain (MMP), which is a common cause of orofacial pain of non-dental origin in the general population [1]. The major characteristics of Myogenous TMDs include pain, muscle tenderness, and limited range of motion [1]. Myogenous pain can restrain the daily activities and concomitantly be associated with headache, jaw pain, ear-related symptoms, sleep disturbances, and changes in the cervical and head posture [2]. The true prevalence of Myogenous TMDs in the general population is high, although the symptoms may resolve over time. However, in many patients, symptoms may persist for a year or more [3]. It has been reported that only about 3.6–7.0% of the population with TMDs seek medical assistance for pain [2].

According to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMDs), MMP has been classified into 3 clinical types as local myalgia, myofascial pain, and myofascial pain with referral [4]. Irrespective of the type, the treatment modalities for MMP are essentially focused on pain reduction and functional improvement. Pharmacological agents like analgesics and muscle relaxants play a pivotal role in the management of TMDs [3]. However, owing to the complex etiology of TMDs, effective pain control cannot be achieved with a single treatment modality and hence, a combination of treatment modalities like moist heat, ultrasound, transcutaneous electrical nerve stimulation (TENS), microwaves, laser, exercises, manual therapy, physiotherapy, pharmacological, and other physical methods, is being used [5,6]. Among them, TENS is considered the most effective physical therapy

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technique, which is safe and minimizes pain and electromyographic activity of the masticatory muscles [6,7].

On the other hand, simple manual therapies and home exercises such as slow active and passive mouth opening, jaw-closing exercises, isometric mouth exercises, mouth stretching exercises, and resistive mouth exercises, have also been found to reduce inflammation and pain, thus improving the overall muscular function [8]. These modalities are thought to bring an alteration in the stomatognathic dynamics and have a positive influence on the treatment in patients with TMDs.

Several studies in the past have compared TENS with ultrasound and laser. However, there are not many studies when it comes to home exercises and combined therapy with pharmacological agents. Hence, this study was undertaken to compare the effectiveness of TENS and home exercises as adjuncts to drug therapy for pain management in MMP.

Materials and methods

The present prospective clinical study was conducted on 60 patients with MMP who reported to our oral health center. Ethical clearance was obtained from the institutional ethics committee (SEGiEC/SR/FOD/07/2018-2019) and informed consent was obtained from all the patients, after explaining the study in detail. The sample size was calculated using G power software. With a 95% confidence interval, 80% power, and an effect size of 90%, a sample size of $n = 60$ (20 in each group) was determined. The study was conducted from January 2019 to February 2020. For this study, we included healthy adult patients with unilateral MMP, with a history of pain of at least one-week duration, with no age or gender bar.

MMP was diagnosed according to the DC/TMDs [4] which included Local myalgia, Myofascial pain, and Myofascial pain with referral. Patients with a history of maxillofacial trauma, orofacial infections, developmental anomalies in the maxillofacial region, patients with a cardiac pacemaker, cerebrovascular problems, epilepsy, patients with underweight or obesity, and pregnant women were excluded from the study. Additionally, patients allergic to adhesive tape, electrodes of the TENS machine, NSAIDs, or muscle relaxants were also excluded.

Sixty patients diagnosed with MMP, by a single experienced oral diagnostician, were randomly allocated to 3 groups of 20 patients each. The random sequence was generated using computer-generated numbers. Patients in Group A received TENS and drugs, patients in Group B were instructed to practice Home Exercises along with the drugs, while patients in Group C received only the drugs. The drugs prescribed were uniform in all the groups which included Orphenadrine 100 mg and Diclofenac 50mg, to be taken twice daily for 5 days.

TENS therapy

Equipment and stimulation procedure

Omron TENS Unit HV-F021 high frequency and low-intensity apparatus was used. Patients were made to sit in an upright position. Circular 3 cm diameter surface electrodes were placed on the trigger points or the area of pain on the affected side, and the electrodes were placed on the sigmoid notch and masseter muscle on the unaffected side. Stimulation parameters such as frequency (60 Hz–100 Hz) and short pulse duration (50–80 μs) were adjusted to produce a sensation of comfortable paraesthesia without muscle contraction. Each cycle was carried out for 30 minutes twice a week for 3 weeks. The same intensity, frequency, and pulse duration were maintained throughout the treatment period.

Home exercises program

Patients in this group were given a demonstration of slow active and passive mouth opening, closing exercises, isometric mouth exercises, mouth stretching exercises, and resistive mouth exercises. Patients were instructed to perform each exercise for 6 seconds, repeating each exercise 10 times, twice daily for three weeks. Patients in this group were given a logbook to write down the date and time of the exercises performed, which was monitored twice a week. Reminders were sent on WhatsApp (Facebook Inc.) to all the patients in this group to perform the exercises every day.

Measurement of pain intensity

Visual Analogue Scale (VAS) was used to measure the pain intensity at baseline and subsequent visits, among patients in all three groups.

Data analysis

Statistical analysis was performed using SPSS version 22.0 software. The pain scores from VAS were treated as continuous data. Intergroup mean pain scores were compared using one-way ANOVA along with post-hoc Tukey's test. Intragroup mean pain scores were compared using paired t-test. $p < 0.05$ was considered statistically significant.

Results

This study included 60 patients in total, with 20 patients in each of the 3 groups. The gender and age distribution were almost similar in the three groups with about 40% males and 60% females. About 50% of the patients were between 16 and 25 years of age, 35% to 40% were between 26 and 35 years of age and about 10–15% were above 36 years of age, in all the three groups.

Figure 1 shows the changes in the mean pain scores from baseline to week 3 follow-up visits, within each group. A significant reduction in the pain scores were seen in all the three groups with $p < 0.001$, at all the follow-up visits, with the maximum reduction seen between the baseline and the week 3 visit, indicating that all three treatment modalities were effective in reducing MMP.

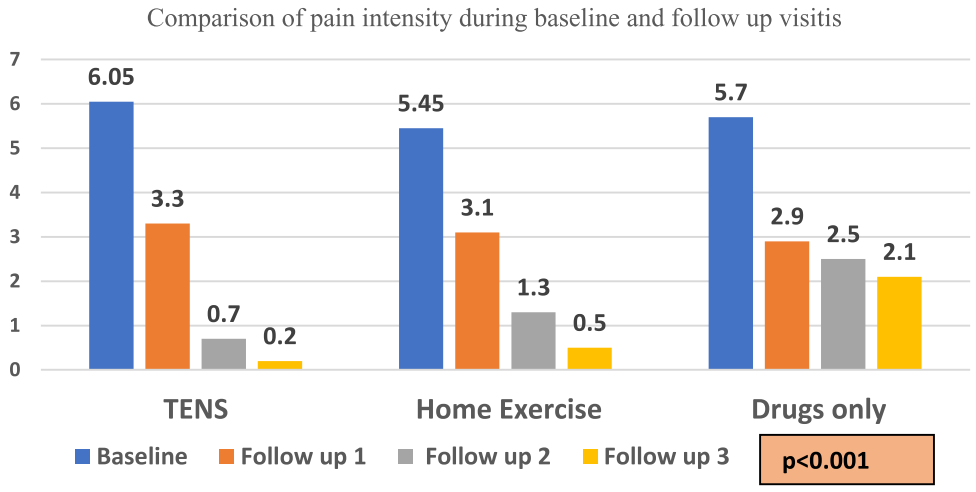

Fig. 1. Intragroup comparison of baseline and post-treatment mean pain scores in Group A, B, and C patients.

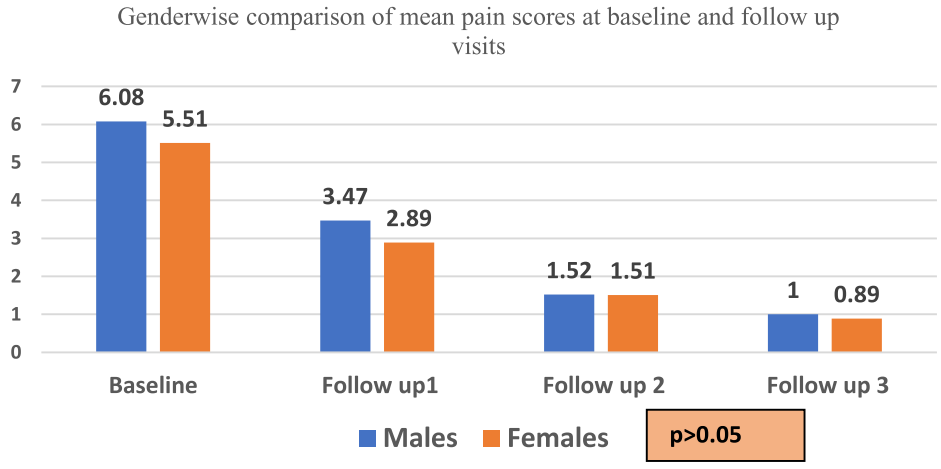

Fig. 2. Gender wise comparison of mean pain scores.

Figure 2 shows the comparison of mean pain scores between males and females. No significant differences were found in mean pain scores either at baseline or follow-up visits, between males and females with $p > 0.05$.

Table I shows the comparison of mean pain scores between the three groups. No significant differences in mean pain scores were seen between the groups at baseline visit and the first visit with $p = 0.56$ and $p = 0.73$, respectively. However, significant differences were seen in the mean pain score at the second visit. The lowest pain score was observed in group A with a mean score of 0.2 ± 0.04, followed by group B with a score of 0.5 ± 0.06 and the highest in group C with a score of 2.1 ± 0.8. This result was significant with $p < 0.001$.

Table II shows the mean difference in pain scores between groups according to the post-hoc test. At the week 3 and week 4 visits, Group A and Group B showed significantly lower pain scores as compared to group C with $p < 0.001$. However, no significant differences were found between group A and group B ($p > 0.05$) indicating that both TENS and home exercises are equally effective in reducing the pain.

Discussion

Myogenous masticatory pain is the most common symptom of TMDs, which can compromise mandibular movements, and affect the quality of life, prompting patients to seek treatment [1]. Pharmacological agents such as muscle relaxants, analgesics, and physical therapies are the first line of treatment in these patients. Non-invasive physical therapies such as TENS and home exercises program as adjuncts to pharmacological agents may modify the muscular activity and help reduce the pain further [2].

The majority (90%) of the patients in our study were less than 35 years of age. Congruent findings were reported in the literature suggesting the common age of occurrence of this condition between the second and fourth decades of life [9]. In the present study, more female patients (61.6%) reported with MMP than male (38.3%) patients, although the mean pain scores did not show any significant differences between males and females. Similar findings have been reported by several researchers [9,10]. This could be attributed to the sex hormone

Table I. Comparison of mean pain scores between the three groups.

Visit	Group	N	Mean pain score	Standard deviation	p-value
Baseline	A	20	6.05	1.23	p = 0.569
	B	20	5.45	2.18	
	C	20	5.7	1.8	
Week 1	A	20	3.3	1.3	p = 0.734
	B	20	3.1	1.65	
	C	20	2.9	1.23	
Week 2	A	20	0.7	0.37	p < 0.001
	B	20	1.3	0.97	
	C	20	2.5	1.23	
Week 3	A	20	0.2	0.04	p < 0.001
	B	20	0.5	0.06	
	C	20	2.1	0.8	

Table II. Comparison of mean difference in pain scores between groups (post-hoc test).

Week	Groups	Mean difference	P-value
Baseline	A vs B	0.69	0.54
	B vs C	−0.25	0.89
	A vs C	0.35	0.81
Week 1	A vs B	0.20	0.89
	B vs C	0.15	0.89
	A vs C	0.35	0.93
Week 2	A vs B	−0.60	0.12
	B vs C	−1.25	<0.001
	A vs C	−1.85	<0.001
Week 3	A vs B	−0.30	0.54
	B vs C	−1.60	<0.001
	A vs C	−1.90	<0.001

such as estrogen which regulates pain sensitivity, pain threshold, and tolerance. Additionally, a psychosocial stressor may also contribute to the development of MMP [11].

In our study, we have used Orphenadrine along with Diclofenac sodium in patients of all three groups. Orphenadrine is a skeletal muscle relaxant with the potent central nervous system (CNS) and peripheral actions. It is also found to have an analgesic effect which helps to relieve the pain. Additionally, the combination of anticholinergic effects and CNS penetration make orphenadrine more useful for pain of all aetiologies, including pain from muscles and headaches [12]. Moreover, it has weaker sedative properties compared to other muscle relaxants hence causes less drowsiness and considered to be safe in older individuals and patients with liver diseases [12,13].

In the present study, TENS therapy as an adjunct to drugs showed maximum pain reduction, followed by Home exercises, and the least pain reduction was seen when drugs were used alone. This finding is in line with Shanavas *et al.* [14] who reported a significant improvement in pain intensity with TENS when used as an adjunct to drugs. However, their study included subjects with all types of TMDs, and the current study was carried out specifically on patients with MMP. TENS therapy is based on the principle of blocking pain transmission by presynaptic inhibition in the dorsal horn of the spinal cord, and the release of endogenous opioids [15]. It also inhibits the abnormally excited nerve and restoration of afferent input [15].

Additionally, the minor electrical shock generated during the treatment may have a psychological effect on the patient, thereby contributing to pain reduction [16]. Several other researchers who used TENS alone in the management of MMP reported a varying degree of success in reducing the intensity of the pain [10,17–19]. A systematic review on TENS in the management of a different spectrum of TMDs found a significant and considerable (19.2–77%) reduction in painful sensations immediately after the treatment [20]. TENS not only relieved pain and improved masticatory functions [21] but also simultaneously decreased myoelectric activity of elevator muscles at rest [8]. Although TENS has been proved to be effective in different TMDs, few researchers have reported contrast findings in myofascial pain dysfunction [22] and bruxism [23]. This could be attributed to the disparity between the subjects with differences in biological, psychological, and social components affecting the TMDs, as well as the parameters used in the TENS therapy. A few subjects in the TENS group reported a tingling sensation and paraesthesia. A study by Saranya *et al.* [15] observed that Microcurrent Nerve Stimulation which uses subthreshold current showed a better and immediate effect in the relief of pain without any side effects.

Home exercises as an adjunct to drug therapy was also effective in reducing pain in patients with MMP. A significant decrease in the pain intensity was observed at the end of week

2 and 3 in the Home exercises group. This observation was similar to the studies by Bae and Park [24] and Ucar *et al.* [25] who observed that passive and active stretching exercises, isometric tension, and relaxation exercises are efficient at relieving the pain and improving the jaw opening. A systematic review by Armijo-Olivo concluded that therapeutic exercises and manual therapy were found to improve strength, coordination, and mobility and reduce the MMP [5].

Patients in the drugs-only group showed a marked reduction in pain scores in the first week. However, in week 2 and week 3, there were no further significant improvement in pain scores. Whereas in the TENS group and Home Exercises groups, mean pain scores decreased consistently from week 1 to week 3. When pain intensity between TENS and Home exercises groups were compared at week 2 and week 3, no significant differences were found, which suggests that both the therapies were equally effective in reducing the pain intensity in MMP. This was in accordance with a study by Santosh *et al.* [8] who also reported a significant reduction in muscular and TMJ tenderness in both TENS and Home Exercises. However, in our study, some patients reported side effects like drowsiness and gastric pain to the drugs, which resolved after completion of the drug course.

Conclusion

Our study showed that TENS and Home exercises as adjunct to drugs are more effective in reducing the pain intensity in patients with MMP, as compared to drugs alone. However, our study evaluated only short-term effects. MMP symptoms can reoccur over a period of time and hence, research with long-term follow-up visits should be considered for precise evaluation of the treatment. Further, studies are also required to evaluate the functional activities such as mouth opening, maximum bite force, and pre-and post-treatment effects on the quality of life in patients with MMP.

Authors' contributions

SKV, TDA, CXY were involved in designing of the study and collection of data. Rest of the authors were involved in drafting and final approval of the manuscript.

Conflicts of interests: The authors have no conflict of interests to disclose.

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