

To compare the effectiveness of transcutaneous electric nerve stimulation with ultrasound therapy in management of temporomandibular disorders.

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Abstract

Background: TM joint disorder is a musculoskeletal disorder of masticatory system that affects more than one fourth of the population. Numerous treatment modalities are used in the management of TMD but most of the modalities are inefficient. Hence there is a need for this study to compare the efficacy of TENS and Ultrasound therapy in management of Temporomandibular disorder.

Material: The patients attending the outpatient unit of SRM Dental College of either gender between 19 to 45 years. A total number of 38 patients were selected for this study. A dual combo TENS, ultrasound therapeutic unit was used. The selected patients were randomly segregated into two groups namely group a -TENS and group b -Ultrasound. Both the treatments were given for 20 minutes per sittings for 8 sittings. Scorings were collected in every treatment visit from all the patients

using visual analog scale. The obtained values were subjected to statistical analysis.

Result: The treatment results were classified as positive and negative ranks and subjected to Wilcoxon’s signed rank test and the mean values of group statistics were analysed with Mann Whitney u test for analysis of statistical difference with p value < .05. There was statistically significant reduction in pain after treatment in both the groups.

Conclusion: Both the treatment modalities showed positive pain reduction. Patients showed better compliance to ultrasound therapy. Follow up results of US were promising and sustained than TENS. Further studies with larger samples are needed to substantiate our study results.

Keywords: Temporomandibular disorder, TENS, Ultrasound therapy, Frequency, VAS scale, Treatment, Randomisation

Introduction

TM joint disorder is a musculoskeletal disorder of masticatory system that affects more than one fourth of the population. TMD is characterised by many symptoms including headache, clicking, popping of the jaw, ear pain with out infection, pain in the sides of the face. Females are more commonly affected than male with a ratio of 8:1[1].Patients with TMD are treated by different modalities including pharmacological, physical, surgical, manual therapies. Physical therapy includes various treatment modalities to manage pain, in-flammation and loss of musculoskeletal function. Electrophysiological modalities such as shortwave Diathermy, Ultrasound, Laser, and Transcutaneous electrical nerve stimulation (TENS) are commonly used in clinical practice[2].Many studies[1,2,3] have been conducted in the management of TMDs using pharmacotherapy, physical therapies, muscle exercises, immobilisation and surgical interventions. None of the above remains a permanent solution in the management of TMD. On the other hand most of the treatment modalities are inefficient even as a supportive therapy. Thus there is a need for further studies in the of management of TMD[4]. Literature search has revealed that very few studies comparing the ef-fectiveness of TENS and ultrasound therapy in TMD subjects have been performed evaluating the patient's pain management at every treatment visit. Moreover size of study population in these stud-ies is meagre. Hence this study was undertaken to compare the efficacy of ultrasound therapy and transcutaneous electric nerve stimulation in management of temporomandibular disorder. Other ob-jectives were to evaluate the effectiveness of TENS and ultrasound therapy individually with visual analog scale (VAS).

Materials and Method

Patients selected for this comparative study was 38 from the out patient unit of department of oral medicine and radiology, SRM DENTAL COLLEGE, RAMAPURAM, CHENNAI. Every patient was explained about the study protocol in their vernacular language and informed consent for was obtained. Institutional review board approval was obtained (Figure 1).

The patients were selected by simple random sampling and 19 patients were allotted to group A and group B. Patients of Group A were blinded from knowing the procedure that are to be performed for Group B and in the same way group B were blind from Group A. Then quantitative pain assessment was done with visual analog scale prior to the treatment for both the groups. Group A patients received TENS therapy and Group B patients received Ultrasound therapy. Treatment was given twice week for 8 weeks. At every visit VAScore was taken. After the treatment was over the subjects were followed up till 3 months. Follow up consisted of three visits at one week, one month and three month interval.

Subjects with history of Neurologic or psychiatric disorders, Patients with history of long term pain medication for any other condition, Rheumatoid arthritis, Pain attributable to recent trauma, Recent dental surgery, Neoplasia, Dental pain, Patients who have been treated with TENS or ultrasound therapy previously without any improvement in the conditions were excluded from the study. Inclusion criteria was determined as age criteria between 15 to 50 years, Both male and female patients, Dull regional pain in the face persisting for more than 1 month in the temperomandibular region, Patients with tenderness in

the muscles of mastication, Clicking and popping on opening and closing of mouth with pain.

VAS Scale was the tool used for evaluating TMJ pain. The minimum value was considered zero which means no pain and the maximum value of 10 with worst pain in the scale. The VAS score was obtained from the first visit, during every treatment visit and also during the follow-up visits.

A first hand dual combo Ultrasound TENS unit (Figure 2) manufactured by Physio solution was selected for the treatment. This unit consists of two segments - one side for Ultrasound and another for TENS.

Technical specifications for ultrasound unit: the nominal frequency in the US unit is 3.5 MHz, 2.2 watts/cm² with both continuous and pulsed mode, a common electronic timer 0 to 99 minutes with digital display. Accessories for US unit : Ultrasound probe that can decipate 26 db of mechanical energy with the penetration power of 20 mm. Technical specifications for TENS unit: 2 output channels and frequency ranging from 0 - 250 Hz, a common electronic timer 0 to 99 minutes with digital display. Accessories for TENS unit: Two TENS electrode with positive and neutral terminals that sends electric pulses to stimulate the nerve. Two round electrode patch which passes the electric pulses to the body surface, a common electronic timer 0 to 99 minutes with digital display. Common accessories: External power cord, electrolyte gel Group A patients received tens therapy with maximum frequency of 250 Hz and intensity of 3 to 10 for 20 minutes. Intensity was adjusted as per the patient convenience. In group B ultrasound therapy was administered with maximum in-tensity of 3.5 Hz for 20 minutes for three shifts in one sitting. Treatment was given for 8 visits and VAS score was taken during every visit. 3 month follow up was planned for every

patient undergo-ing treatment. Follow up was done immediately one week after completion of treatment, after one month and finally after 3 months. Any subjects leaving the study due to intolerance of the treatment procedure were treated by alternative modalities.

Statistical Analysis

Statistical analysis was done by IBM.SPSS software with the version of 23.0. Here the study re-quires descriptive and percentage analysis for categorical variables. For Continuous variables mean and standard deviation is done. The test for significance level is marked at 0.05 as p value. Based on this value independent groups are analysed with Mann Whitney u test and for bivariate paired groups Wilcoxon signed rank test is used.

Results

Among the 38 subjects selected for the study were between the age range of 19 to 45 years who had typical TMDs (Table 1). Gender distribution in this study was 21 males and 17 females totally in both the groups (Table 2).

MINIMUM AGE LIMIT	19
MAXIMUM AGE LIMIT	45

Table 1: The maximum and minimum age limit of this study population.

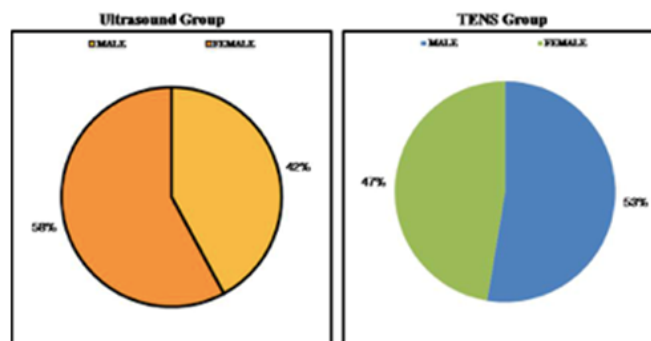


Table 2 : Gender distribution among both TENS and ultrasound group

Outcome measurements

Positive and negative ranks were correlated. Difference between the Pain Score Values from eighth week to that of first week and 3 month follow up to that of first week appears to be statistically significant. Whereas the 3 month follow up to eighth week test value do not show any statistical significance (Table 3).

		N	Mean Rank	Sum of Ranks
T8w - T1w	Negative Ranks	12 ^b	6.50	78.00
	Positive Ranks	0 ^c	0.00	0.00
	Ties	0 ^d		
	Total	12		
3 MO - T1w	Negative Ranks	12 ^e	6.50	78.00
	Positive Ranks	0 ^f	0.00	0.00
	Ties	0 ^g		
	Total	12		
3 MO - T8w	Negative Ranks	2 ^h	1.50	3.00
	Positive Ranks	2 ⁱ	3.50	7.00
	Ties	8 ^j		
	Total	12		
Test Statistics^{a,b}				
		Z	Asymp. Sig. (2-tailed)	
T8w - T1w		-3.078 ^c	.002*	
3 MO - T1w		-3.075 ^c	.002*	
3 MO - T8w		-.743 ^d	.458	
a. Groups = Tens				
b. Wilcoxon Signed Ranks Test				
c. Based on positive ranks.				
d. Based on negative ranks.				
e. *- statistically significant				

Table 3: Wilcoxon signed rank test statistics for TENS group

Positive and negative rank values of first week, eighth week and 3 follow up visits values are analysed with one another. Statistical significance is observed with the P value of 0.05 as significance when eighth week treatment values compared with that of first week (Table 4).

		N	Mean Rank	Sum of Ranks
T8w - T1w	Negative Ranks	15 ^b	8.00	120.00
	Positive Ranks	0 ^c	0.00	0.00
	Ties	0 ^d		
	Total	15		
3 MO - T1w	Negative Ranks	15 ^e	8.00	120.00
	Positive Ranks	0 ^f	0.00	0.00
	Ties	0 ^g		
	Total	15		
3 MO - T8w	Negative Ranks	2 ^h	2.00	4.00
	Positive Ranks	3 ⁱ	3.67	11.00
	Ties	10 ^j		
	Total	15		
Test Statistics^{a,b}				
		Z	Asymp. Sig. (2-tailed)	
T8w - T1w		-3.420 ^c	.001*	
3 MO - T1w		-3.419 ^c	.001*	
3 MO - T8w		-.962 ^d	.336	
a. Group b = Ultrasound				
b. Wilcoxon Signed Ranks Test				
c. Based on positive ranks.				
d. Based on negative ranks.				
e. *- statistically significant				

Table 4: Wilcoxon signed rank test statistics ultrasound group

There was a gradual reduction in VAS score from the initial treatment sitting towards the end in both the modalities. Mean values of first week vas score when compared to eighth week revealed to be statistically significant in both the treatment groups (Table 5 & 6).

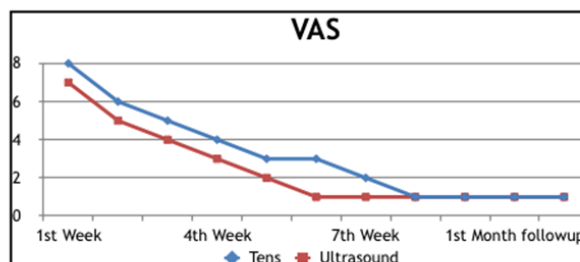


Table 5: Graphical representation showing VAS score tapering from the initial visit to the follow up visit.

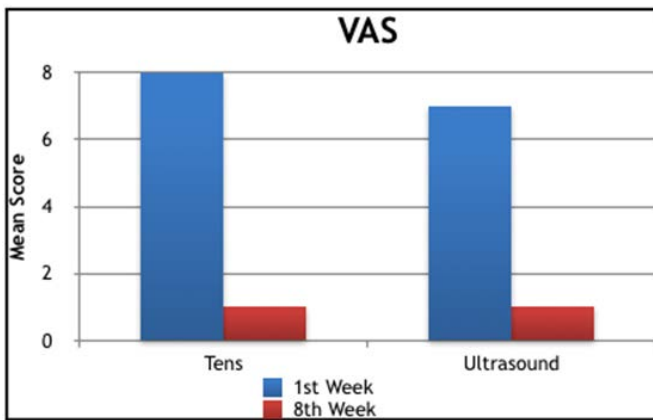


Table 6: Mean VAS score for TENS and Ultrasound (First visit to 8 th visit)

The group statistics of Mean and standard deviation (Table 7) of VAS score for TENS and Ultrasound therapy in every treatment visit were subjected to Mann Whitney u test for categorical variables (Table 8). There was no statistical significant difference in comparing both the groups.

Group Statistics					
Groups		N	Mean	Std. Deviation	Std. Error Mean
T1w	Tens	12	7.50	1.508	.435
	Ultrasound	15	6.87	1.846	.477
T2w	Tens	12	6.08	1.240	.358
	Ultrasound	15	5.40	1.549	.400
T3w	Tens	12	5.42	1.240	.358
	Ultrasound	15	4.47	1.807	.467
T4w	Tens	12	4.17	1.642	.474
	Ultrasound	15	3.13	2.100	.542
T5w	Tens	12	3.00	1.537	.444
	Ultrasound	15	2.27	2.251	.581
T6w	Tens	12	2.50	2.236	.645
	Ultrasound	15	1.27	1.792	.463
T7w	Tens	12	1.50	1.834	.529
	Ultrasound	15	.87	1.598	.413
T8w	Tens	12	1.17	1.467	.423
	Ultrasound	15	.80	1.612	.416
1 Wk FU	Tens	12	1.00	1.477	.426
	Ultrasound	15	.73	1.438	.371
1 MO	Tens	12	1.17	1.801	.520
	Ultrasound	15	.87	1.457	.376
3 MO	Tens	12	1.33	1.775	.512
	Ultrasound	15	1.20	1.699	.439

Table 7: Group statistics for every treatment visit.

	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
T1w	70.500	-.969	.332	.347 ^b
T2w	70.500	-.974	.330	.347 ^b
T3w	58.500	-1.560	.119	.126 ^b
T4w	63.500	-1.318	.188	.200 ^b
T5w	67.500	-1.111	.266	.277 ^b
T6w	58.000	-1.642	.101	.126 ^b
T7w	72.500	-.961	.337	.399 ^b
T8w	72.000	-1.015	.310	.399 ^b
1 Wk FU	78.500	-.670	.503	.581 ^b
1 MO	82.000	-.451	.652	.719 ^b
3 MO	83.500	-.349	.727	.755 ^b

Table 8: mann whitney U Test for categorical variables

Discussion

This study was conducted to check the comparative effectiveness of TENS and ultrasound. This study focuses mainly on the pain relief and also on the patients compliance towards treatment pro-tocols. Patients with Temporomandibular Disorder based on TMD RDC criteria 2014 regulated by American Association of Orofacial Pain (AAOFP) were recruited in the study[5]. RDC TMD criteria is considered as the most recommended diagnostic criteria includes both a valid screener for de-tecting any pain related TMD with the sensitivity > 0.86 and specificity > 0.98 for differentiating the most common pain related TMD[6].In the present study, age of the participants was between 19 to 45 years. The average age of the participants in TENS group 28.4 and that of ultrasound group 27.6. There was no significant difference between the mean age of the participants in both groups. Muthukrishnan et al. conducted a prevalence study in TMD subjects based on age among 3039 study subjects and the results were 437 (29.2%) subjects in the 18-30 years age group, 846 (72%) subjects in the 31-50 years age group, and 348 (94.8%) subjects in the >50 years age group had TMD[7]. Regarding gender wise distribution, 1014 (50.9%) males and 617 (59%)

females had TMDs. Our results were consistent with that of other observatory study[8]. Out of the total 38 participants there were 47 % males and 53% females in TENS group, 58% of males and 42 % of females in ultrasound group which shows no significant difference in sex distribution. Shalu Rai et al found that the incidence of TMD is more in females as compared to males about 8:1. Similarly another study conducted by Conclaves et al., observed that all symptoms of TMD were more prevalent in women than in men in the Brazilian population[9]. To measure pain VAS scale is used in our study since VAS scale is a unidimensional measure of pain intensity which has been widely used in diverse adult population. It is a continuous scale with horizontal and vertical line. The scale is anchored by 0 to 10 in numbers. Minimum value is 0 score “No Pain” and 10 is the maximum score value “The Worst Imaginable Pain”. The worthiness of VAS scale based on validity, reliability, acceptability and its ability to detect change in a study was conducted by Gillian A Hawker et al. He compared the commonly used pain evaluating modalities like VAS, numerical rating scale, Mc Gills pain questionnaire, short Mc Gills pain questionnaire, chronic pain grade scale, short form 36 bodily pain scale among one another. From this study we get to know one important factor the respondent burden time. The respondent burden time for VAS < 1 min, Numerical Rating Scale < 1 min, Mc Gills pain questionnaire - 20 mins, short Mc Gills pain questionnaire - 5 mins, chronic pain grade scale < 10 mins, short form 36 Bodily Pain Scale < 1 min. According to the author among the above modalities short form 36 bodily pain scale stands better and secondly VAS Scale. Here the 36 Bodily Pain Scale has a disadvantage in discriminating levels of pain severity which is a key factor in our study hence VAS Scale is

used as a pain assessment instrument[10]. TENS is a non invasive technique which electrically stimulates peripheral nervous system. In recent days TENS treatment is emerging as a potential treatment modality in the control of both acute and chronic pain. The mechanism by which there was substantial reduction in pain could be high frequency TENS by activating large fibres and “Close the Gate” in the dorsal horn. The effect appears quickly after the onset of stimulation but also disappears rapidly after the cessation of stimulation[11,12]. Cristina Linda et al compared 6 week TENS treatment with splint on symptomatic cases of disk displacement without reduction. They concluded that splint in several aspects is better than TENS in the treatment of anterior disk displacement without reduction[13]. Alvarez et. Al concluded that the occlusal splint and TENS did not significantly improve the signs and symptoms of TMD in subjects with bruxism[14]. In contrary we found significant difference between pre and post values of VAS score in using TENS for pain management in TMDs inspite of the difficulties faced in the patient compliance. On detailed reviewing of the literature, the application and effectiveness of TENS in the management of acute and chronic pain demonstrated that its effectiveness depends on the correct technique of application, adequate knowledge of the principles behind its application and a positive receptive attitude from the patient[15]. Ultrasound is also a non invasive physiotherapeutic modality used in the management of musculo-skeletal pain disorders. US therapy acts by producing thermal energy by increasing the blood flow and the piezoelectric vibrations produced hastens the healing process[16]. Grindler et al. has mentioned that ultrasound is potentially efficient as an adjunct to other modalities of TMD treatment compared to being used

as a single mode of management[17]. In general ultrasound is considered superior in treatment of muscular disorder in comparison with that of disk de-generations as per Esposito et al[18]. Majlesi and Unalan stated that high-power ultrasound is more effective ($P < 0.05$) than conventional ultrasound[19]. In our study reduction of pain was acquired from both the modalities and patients had better compliance to ultrasound therapy. When follow up is brought into screen US has promising and sustained result than TENS. US values are statistically significant in pain management. Results from our study justifies the use of US and TENS therapy in the treatment of TMD with the values of VAS score. Akansha et al compared TENS and US in 40 patients with TMD and showed similar result like our study, pain improvement is seen in both the modalities but when patient acceptance is taken into consideration US weighs higher[20]. This study has a few limitations like the population size and drop outs. Totally there were 11 drop outs in our study, among this 7 patients were from TENS and 4 from US with more drop out in TENS group. This may be due to the inability of the subjects to tolerate the pulsating effect of TENS. The study protocol mandates pain assessment at every treatment visit, missing a single appointment had to be considered as a drop out. Finally all the drop outs were treated with alternate treatment modality. We could have obtained better results if this evaluation could have been a cross over study.

Conclusion

The present study demonstrates the comparison between the effectiveness of TENS and Ultrasound therapy in subjects with TMD. From our study we observed that ultrasound therapy is more patient friendly and shows prolonged sustained treatment effect than that of TENS. Further studies are needed to prove

ultrasound as a one solid treatment modality in the management of TMD.

List of Abbreviations

Abbreviation	Expansion
TMD	Temporomandibular joint disorder
TENS	Transcutaneous Electric Nerve Stimulation
US	Ultrasound therapy
VAS	Visual analog scale
LLLT	Low Level Laser Therapy
DDWOR	Disk Displacement Without Reduction
SPSS	Statistical Package for Social Science
SD	Standard Deviation

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