

**Comparative evaluation between the efficacy of low-level laser therapy and trans-cutaneous electric nerve stimulation [TENS] in the management of temporomandibular joint disorders**

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**Type of Publication:** Case Report

**Conflicts of Interest:** Nil

**Abstract**

Treatment of patients with TMJ disorder is a multidisciplinary approach. This article presents a study about comparative evaluation between efficacy of low-level laser therapy and trans-cutaneous electric nerve stimulation [TENS] in the management of temporomandibular joint disorders. Total of 30 patients were included in the study and statistical analysis was performed for each patient group. Results shows low level laser therapy [LLLT] is a better treatment modality when compared with TENS for management of TMJ disorders.

**Keywords:** TENS, TMJ Disorders, laser therapy.

**Introduction**

In the modern era, less invasive surgeries are the preferred choice of treatment which led to the invention of a variety

of treatment modalities for the different diseases/disorders. Temporomandibular Disorders (TMD) is a cumulative expression term that refers to a cluster of disorders characterized by pain in the pre-auricular region, pain in TMJ, or the masticatory muscles, limitation or deviations in mandibular range of motion and noises in the TMJ during mandibular function. Myofascial pain dysfunction, Cranio-mandibular Disorder and Costen's syndrome leads to Presence of the signs and symptoms of TMDs dysfunction is in about 86% of the population, most frequently in women who are in the third decade of their life. The most common signs and symptoms of TMD's such as pain, limited mouth opening, and joint sounds could be caused by degenerative changes to the bony components of the joint itself, intracapsular

derangement of the components of the temporomandibular joint and muscle disorders<sup>1</sup>. Associated signs and symptoms are spasm of muscle, crepitation difficulty in movement of joint, reflex pain, hearing and headache. Psychological, mechanical, physiological, placebo and physical methods and pharmacological are proposed for TMD's. Among such treatments low level laser, ultrasound, massages, thermal therapy, acupuncture, exercises, electric stimulation (TENS) have been used<sup>2</sup>.

Management by physical therapy aims to

- a) Increase the awareness of the patient about the cause of the symptoms
- b) Achieve muscle relaxation
- c) Reduce muscular hyperactivity and re-establish muscle and joint movement
- d) Relieve pain, spasm, and oedema
- e) Allow for recovering of normal function

First described in 1967 by Shane and Kessler - Transcutaneous electrical nerve stimulation (TENS) is one of the most effective physical therapy techniques being used. It is a safe, non-invasive, effective and swift method of analgesia. TENS relaxes the muscles that are hyperactive in nature and functions like a neuromuscular stimulator. It causes contraction and relaxation of muscles by producing a low-frequency, a low-amplitude alternating stimulus. LLLT, a term created by Oshiro and Calderhead in 1988, means 'Low Intensity Laser Therapy'<sup>3, 4, 5</sup>. LLLT works in the spectrum of red or infrared regions making use of a single wavelength electromagnetic radiation. The physiological effects of infrared laser therapy are:-

1. Bio stimulation
2. Improved blood circulation and vasodilatation
3. Analgesia
4. Anti-inflammatory and anti oedematous effects
5. Simulation of wound healing

## **Material and Methods**

The aim of this study is to evaluate the efficacy of low level laser therapy (LLLTT) and compare it with TENS in patients suffering from TMJ pain and dysfunction. The objective of this study is to evaluate and compare the efficacy of LLLT and TENS in the resolution of sign and symptoms of TMJ dysfunction.

The study includes the effect of LLLT and TENS on the following four factors-

- Interincisal jaw opening
- Lateral excursive movements of mandible
- Protrusive and Retrusive movements of mandible
- TMJ pain

The study included 30 patients who reported to the Indoor Patient Department (IPD) and Outdoor Patient Department (OPD) of Mahatma Gandhi Dental College & Hospital, Jaipur. Patients were selected irrespective of sex, cast and socio-economic status. Informed consent for the procedure was obtained from all the patients enrolled for the study. Before the start of the treatment, the entire procedure and the associated risks were explained to the patient in local language. The patients seeking conservative treatment for TMDs were selected for the study fulfilling the following criteria's:

## **Inclusion Criteria**

- Those who were willing to participate in the study and willing to take treatment should be above 18 yrs of age.
- Clinically patient diagnosed with TMJ dysfunction.
- Decreased mouth opening or closing
- Pain at rest or opening or closing of jaw
- Bilateral and unilateral TMJ pain.
- Patients with ASA I and ASA II.

**Exclusion Criteria**

- History of recent trauma or injury around Temporo mandibular joint/ recent fracture of mandible or temporal bone.
  - Patient on Analgesic and Anti-inflammatory Drugs
  - Patient wearing any removable prosthesis
  - Ankylosed TMJ/ Hyper mobile TMJ
  - Neurological involvement
  - Skin infection i.r.t pre-auricular region
  - Patients having tumours in the maxillofacial regions.
  - Patients who are not willing to participate in the study.
  - Patients with cardiac pacemakers.
  - Patients with ASA III, ASA IV and ASA V.
  - Epileptic patient, and pregnant women(first trimester)
- Patients were divided into two groups randomly presenting signs and symptoms of TMD:

➤ **Group A – LLLT**

➤ **Group B – TENS**

Both therapies were done in either two patients separately or bilaterally (LLLТ on one side and TENS on the other side) in a single patient, in a total of 14 sessions (7 sessions of each therapy). In **LLLТ (performed with a continuous wave diode laser)**, the area of application is gently swabbed. The probe was placed perpendicular directly on the skin at the TMJ region, approximately 1cm in front of the tragus. The beam was delivered through a handheld single probe. Protective eye glasses were used for both the patients and the operator. In **TENS (performed with an electrode machine)**, the site of electrode pad placement was gently swabbed with surgical spirit to remove any skin oil or substances that may interfere with the current flow. Electrode gel was applied on the electrode pads before placement. After predetermining the position of electrode pad placement, the electrode pads were secured in place to minimize

displacement. These measurements were taken at four time intervals for each patient during the study duration-

- Before beginning the procedure (Day 0)
- After one week when 5 continuous sessions were over (Day 7)
- On 30th day before 6th session (Day 30)
- On 60th day before 7th session (Day 60)
- On 90th day as follow up evaluation (Day 90)

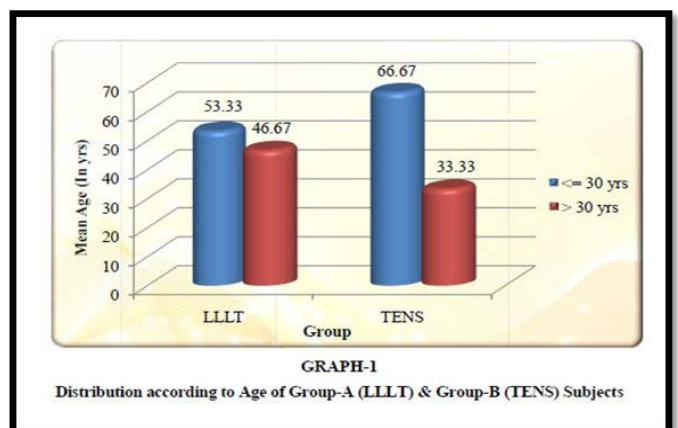
**Statistical Analysis:** The above collected data will be compared for each patients and statistical analysis done for evaluation using ‘unpaired t-test’.

**Results**

**TABLE-1**  
Distribution according to Age of Group-A (LLLТ) & Group-B (TENS) Subjects

Age group (In yrs)	LLLТ (Group-A)		TENS (Group-B)	
	No.	%	No.	%
≤ 30	8	53.33	10	66.67
> 30	7	46.67	5	33.33
<b>Total</b>	<b>15</b>	<b>100.00</b>	<b>15</b>	<b>100.00</b>

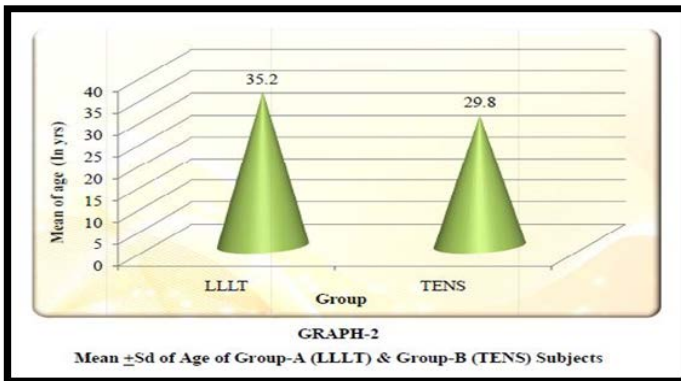
The above table shows the distribution of age of patient of Group A –LLLТ and Group B-TENS. The above table reveals that out of 15, 8 (53.33%) and 10 (66.67%) patients in Group A and Group B respectively were lying in the age group of ≤30yrs. Patients lying in the age group of > 30 years were found to be 7 (46.67%) and 5 (33.33%) in Group A and Group B respectively. The table reveals that there was almost equal distribution of patients in the two age groups categories in Group A whereas it was found to be unequal and more in ≤ 30 age group category in Group B patients.



**TABLE -2**  
Mean  $\pm$ Sd of Age of Group-A (LLLT) & Group-B (TENS) Subjects

	Group		P-value	Significance
	LLLT	TENS		
Mean $\pm$ Sd	35.20 $\pm$ 17.01	29.80 $\pm$ 14.76	> .05	NS

The above table shows the mean and standard deviation of age in Group A and Group B subjects. The mean age in Group A and Group B was 35.20  $\pm$ 17.01 and 29.80  $\pm$ 14.76 respectively. It was observed that the mean age was found to be higher in Group A as compared to Group B, although the two means statistically do not differ significantly i.e p >0.05.

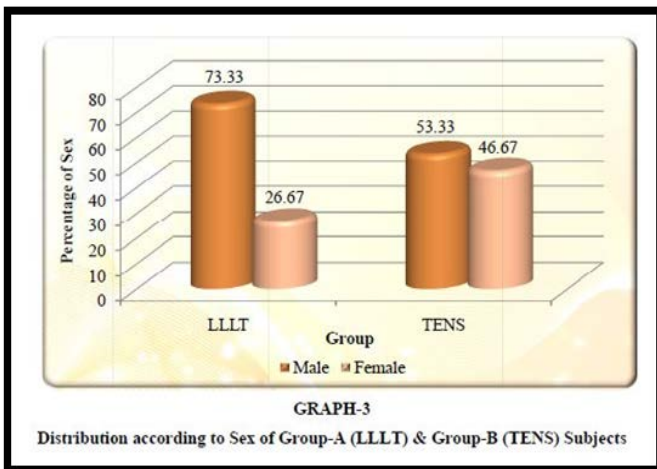


**TABLE-3**

Distribution according to Sex of Group-A (LLLT) & Group-B (TENS) Subjects

Sex	LLLT		TENS	
	No.	%	No.	%
Male	11	73.33	8	53.33
Female	4	26.67	7	46.67
Total	15	100.00	15	100.00

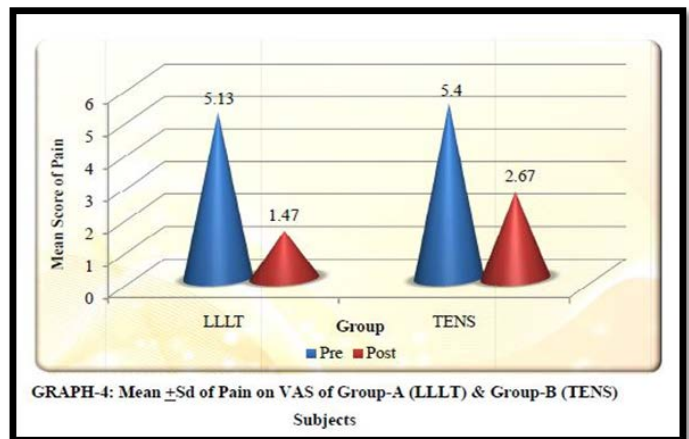
The above table reveals the distribution of the sex of patients in Group A (LLLT) and Group B (TENS). The table reveals there were more male patients in both the groups i.e 11 male (73.33%) in Group A and 8 male (53.33%) in Group-B, the female patients were found to be 4(26.67%) and 7(46.67%) in Group A and Group B respectively.



**TABLE-4**  
Mean  $\pm$ Sd of Pain on VAS of Group-A (LLLT) & Group-B (TENS) Subjects

Mean $\pm$ Sd	PAIN ON VAS		Mean Change $\pm$ Sd	P-value	Significance
	Pre	Post			
LLLT	5.13 $\pm$ 0.88	1.47 $\pm$ 0.62	3.67 $\pm$ 1.07	< .001	HS
TENS	5.40 $\pm$ 1.20	2.67 $\pm$ 0.87	2.73 $\pm$ 1.06	< .001	HS

The above table shows the mean and standard deviation of pain on VAS scale between Group A and Group B subject's pre and post operatively. The mean in Group A and Group B preoperatively were found to be 5.13  $\pm$ 0.88 and 5.40  $\pm$  1.20 respectively. Post-operatively the mean was 1.47  $\pm$  0.62 in Group A and 2.67  $\pm$  0.87 in Group B. The mean change and standard deviation was 3.67  $\pm$ 1.07 and 2.73  $\pm$ 1.06 in Group A and Group B respectively, showing statistically highly significant difference with p<.001.

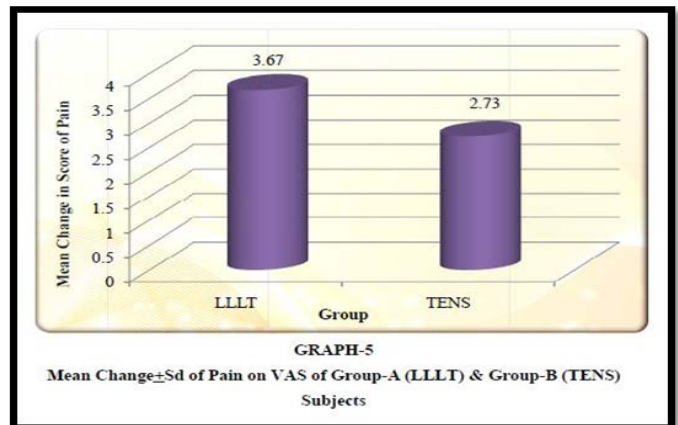


**TABLE-5**

Mean Change  $\pm$ Sd of Pain on VAS of Group-A (LLLT) & Group-B (TENS) Subjects

	Group		P-value	Significance
	LLLT	TENS		
Mean Change $\pm$ Sd	3.67 $\pm$ 1.07	2.73 $\pm$ 1.06	< .02	Sig

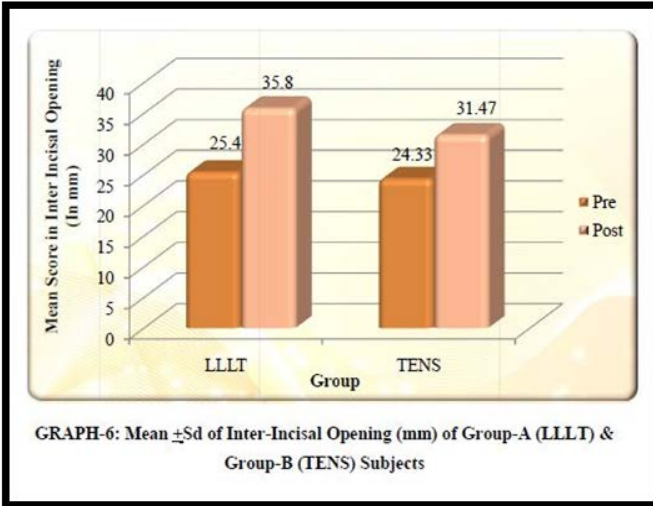
The above table shows the comparison between the mean and standard deviation of pain on VAS in Group A and Group B subjects. The mean change and standard deviation of pain in Group A and Group B was 3.67  $\pm$ 1.07 and 2.73  $\pm$ 1.06 respectively. It reveals that the mean pain reduction was found to be higher in Group A as compared to Group B. The two means statistically differ significantly i.e p <0.02.



**TABLE -6**  
Mean  $\pm$ Sd of Inter-Incisal Opening (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

Mean $\pm$ Sd	INTER-INCISAL OPENING (mm)		Mean Change $\pm$ Sd	P-value	Significance
	Pre	Post			
<b>LLLT</b>	25.40 $\pm$ 3.38	35.80 $\pm$ 3.43	10.40 $\pm$ 2.30	< .001	HS
<b>TENS</b>	24.33 $\pm$ 2.57	31.47 $\pm$ 2.16	7.13 $\pm$ 1.20	< .001	HS

The above table reveals the mean and standard deviation of inter-incisal opening between Group A and Group B subject's pre and post operatively. The mean in Group A and Group B pre-operatively were found to be 25.40  $\pm$  3.38 and 24.33  $\pm$  2.57 respectively. Post-operatively the mean was 35.80  $\pm$  3.43 in Group A and 31.47  $\pm$  2.16 in Group B. The mean change and standard deviation was found to be 10.40  $\pm$  2.30 and in 7.13  $\pm$  1.20 Group A and Group B respectively, showing statistically highly significant difference with p<.001.

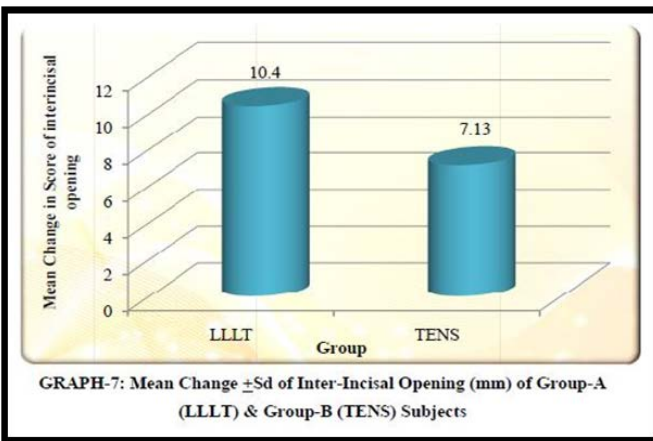


**GRAPH-6:** Mean  $\pm$ Sd of Inter-Incisal Opening (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

**TABLE-7**  
Mean Change  $\pm$ Sd of Inter-Incisal Opening (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

Mean Change $\pm$ Sd	Group		P-value	Significance
	LLLT	TENS		
<b>Mean Change <math>\pm</math>Sd</b>	10.40 $\pm$ 2.30	7.13 $\pm$ 1.20	<0.01	Sig

The above table shows the comparison of the mean and standard deviation of inter-incisal opening between the two groups i.e Group A and Group B subjects. The mean change and standard deviation of inter-incisal opening in Group A and Group B was 10.40  $\pm$  2.30 and 7.13  $\pm$  1.20 respectively. It shows that the mean post operative inter-incisal opening was found to be higher in Group A as compared to Group B, revealing that there is statistically significant difference between the two group patients i.e p<0.01.

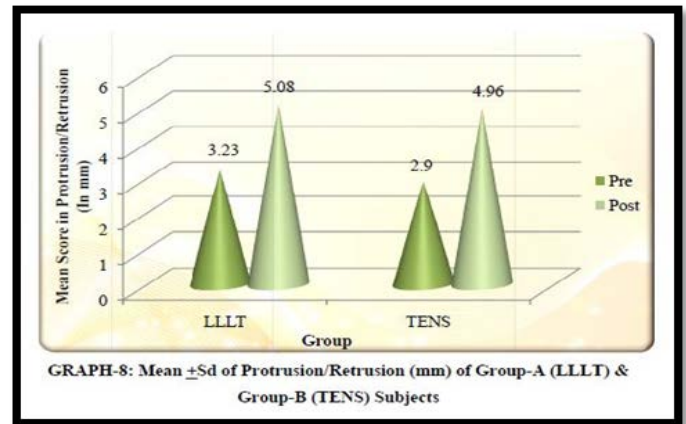


**GRAPH-7:** Mean Change  $\pm$ Sd of Inter-Incisal Opening (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

**TABLE-8**  
Mean  $\pm$ Sd of Protrusion/Retrusion (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

Mean $\pm$ Sd	PROTRUSION/RETRUSION (mm)		Mean Change $\pm$ Sd	P-value	Significance
	Pre	Post			
<b>LLLT</b>	3.23 $\pm$ 0.68	5.08 $\pm$ 0.54	1.85 $\pm$ 0.64	< .001	HS
<b>TENS</b>	2.90 $\pm$ 0.32	4.96 $\pm$ 0.64	2.06 $\pm$ 0.72	< .001	HS

The above table reveals the mean and standard deviation of protrusive/retrusive movements between Group A and Group B subject's pre and post operatively. Pre-operative mean in Group A and Group B were found to be 3.23  $\pm$  0.68 and 2.90  $\pm$  0.32 respectively. Post-operatively the mean was 5.08  $\pm$  0.54 in Group A and 4.96  $\pm$  0.64 in Group B. The mean change and standard deviation was found to be 1.85  $\pm$  0.64 and 2.06  $\pm$  0.72 in Group A and Group B respectively. It was observed that there is statistically highly significant difference between the two groups with p<.001.

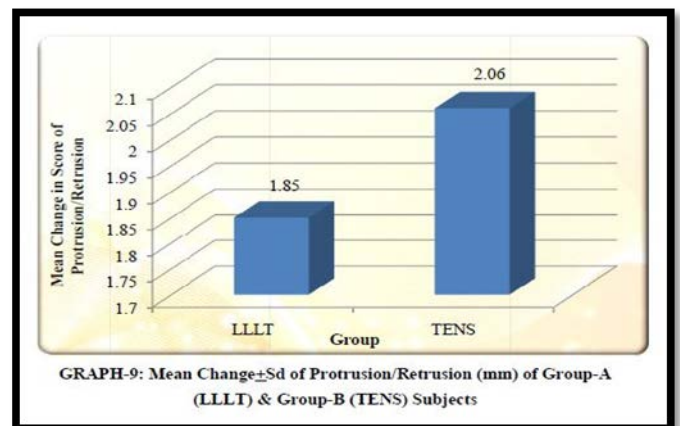


**GRAPH-8:** Mean  $\pm$ Sd of Protrusion/Retrusion (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

**TABLE-9**  
Mean Change  $\pm$ Sd of Protrusion/Retrusion (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

Mean Change $\pm$ Sd	Group		P-value	Significance
	LLLT	TENS		
<b>Mean Change <math>\pm</math>Sd</b>	1.85 $\pm$ 0.64	2.06 $\pm$ 0.72	> .05	NS

The above table shows the comparison of the mean and standard deviation of protrusive/retrusive movement between Group A and Group B subjects. The mean change and standard deviation of protrusive/retrusive movement in Group A and Group B was 1.85  $\pm$  0.64 and 2.06  $\pm$  0.72 respectively. It shows that the mean post-operative increase in the movement in antero-posterior plane was found to be higher in Group B as compared to Group A. Although there is statistically no significant difference between the two group patients i.e p>0.05.

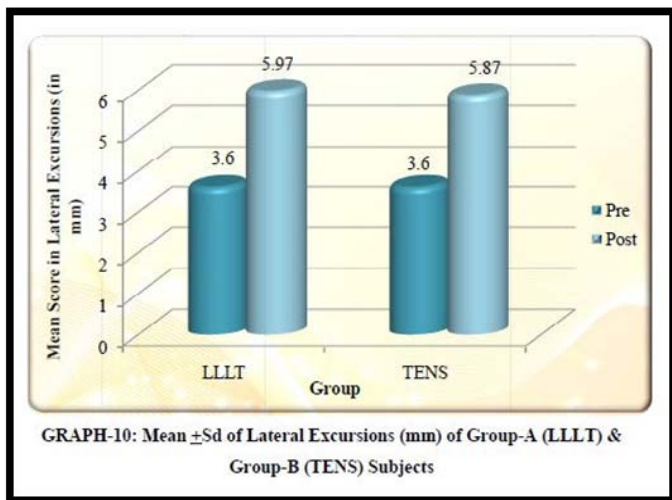


**GRAPH-9:** Mean Change  $\pm$ Sd of Protrusion/Retrusion (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

**TABLE-10**  
Mean  $\pm$ Sd of Lateral Excursions (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

Mean $\pm$ Sd	LATERAL EXCURSIONS(mm)		Mean Change $\pm$ Sd	P-value	Significance
	Pre	Post			
LLLT	3.60 $\pm$ 0.80	5.97 $\pm$ 0.62	2.37 $\pm$ 0.85	< .001	HS
TENS	3.60 $\pm$ 0.95	5.87 $\pm$ 0.72	2.27 $\pm$ 0.68	< .001	HS

The above table shows the mean and standard deviation of lateral excursion between Group A and Group B subject's pre and post operatively. Pre-operatively mean in Group A and Group B were found to be 3.60  $\pm$  0.80 and 3.60  $\pm$  0.95 respectively. Post-operatively the mean was 5.97  $\pm$  0.62 in Group A and 5.87  $\pm$  0.72 in Group B patients. The mean change and standard deviation was found to be 2.37  $\pm$  0.85 and 2.27  $\pm$  0.68 in Group A and Group B respectively. It was observed that there is statistically highly significant difference between the two groups with p < 0.001.

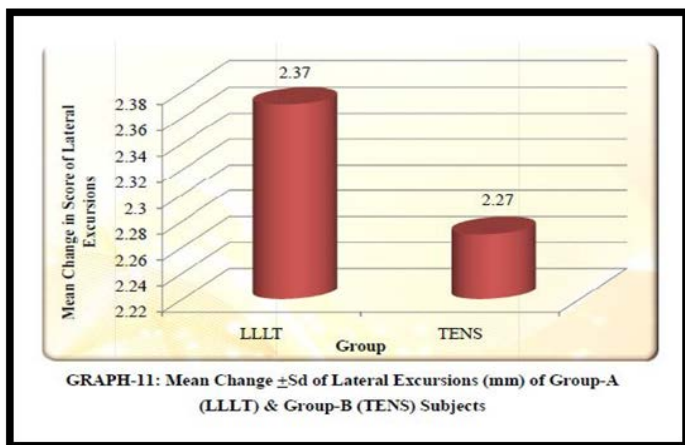


**GRAPH-10:** Mean  $\pm$ Sd of Lateral Excursions (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

**TABLE-11**  
Mean Change  $\pm$ Sd of Lateral Excursions (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

Mean Change $\pm$ Sd	Group		P-value	Significance
	LLLT	TENS		
	2.37 $\pm$ 0.85	2.27 $\pm$ 0.68	> .05	NS

The above table reveals the comparison of the mean and standard deviation of lateral excursive movement between Group A and Group B subject's. The mean change and standard deviation of in Group A and Group B were 2.37  $\pm$  0.85 and 2.27  $\pm$  0.68 respectively. It shows that the mean post-operative increase in the movement in medio-lateral plane was found to be higher in Group A as compared to Group B. Although there is statistically no significant difference between the two group patients i.e p > 0.05.



**GRAPH-11:** Mean Change  $\pm$ Sd of Lateral Excursions (mm) of Group-A (LLLT) & Group-B (TENS) Subjects

## Discussion

The high increasing incidences of temporomandibular joint related disorder led us to ascertain a technique out of

the two i.e. LLLT & TENS, which is best suited for their conservative treatment. The present study was undertaken to assess the level of effectiveness of two different techniques for the management of temporomandibular joint disorder. The primary reason for the patient to look for professional care is the relief from pain. Pain is a subjective experience and is a warning signal which express that body tissue is about to be injured. Aetiology of pain in TMJ region is multifactorial. It is now reasonably well accepted that TMD is the most common cause of pain of non-dental origin & consists of varied groups of disorders with common symptoms of masticatory dysfunction, psychophysiological or facial pain or both. Current strategies for the management of TMD's varies widely and includes exercise, acupuncture, pharmacological interventions, surgery and splint therapy<sup>6,7</sup>. Electrical modalities/electro physical therapies are emerging as a new choice of treatment in the effective management of TMD's. Several criteria are considered for the judgments of treatment effectiveness.

In this study, the criteria's considered include the range of mouth opening, pain scales and the lateral /anterior-posterior mandibular movements. Statistically highly significant difference is seen between the pre and post operative score of pain in both the groups i.e. LASER and TENS and the improvement was evidently higher in LASER group compared to TENS group. Statistically highly significant difference is noted in Interincisal opening between the pre and post operative score of both the groups, significant difference is evident statistically between the two groups. Mandibular protrusive and Retrusive movements were measured in horizontal plane using millimetre scale. Statistically highly significant difference in anteroposterior movement was shown pre and post operatively but no significant difference is evident statistically between the two groups. Lateral

excursive movements were also measured in horizontal plane using millimetre scale<sup>8</sup>. Statistically highly significant difference in media-lateral movement was present pre and post operatively but no significant difference is evident statistically between the two groups. In the similar study conducted in 2015 by Bharat Khosla et al on a sample of 30 patients diagnosed with TMD being treated by LASER and TENS in terms of pain, mouth opening, clicking, tenderness, deviation showed statistically significant difference post-operatively in all parameters in both the groups in which LASER proved to be better similar to the results of our study in terms of pain and mouth opening. Vijayalakshmi KR et al in 2014 conducted a review to assess the scientific evidence and effectiveness of various electro physical modalities that is LLLT, iontophoresis, phonophoresis, therapeutic ultra sound, TENS, micro current electrical nerve stimulation in treatment of TMD's and concluded that these modalities are helpful as adjuvant in treatment of TMJ symptoms with no modalities being beneficial over the other similar to our study in terms that both the modalities i.e. LLLT & TENS are effective but laser proved to be beneficial over TENS. In a clinical controlled study conducted by Nunez et al in 2006 to evaluate the effectiveness of LLLT & TENS in terms of mouth opening in patients with TMD's on a sample of 10 patients, they concluded that both the methods were effective in improving mouth opening with LLLT being more effective then TENS similar to our study in terms of Interincisal opening<sup>9, 10</sup>. Kato et al in 2006 compared the treatment of TMD's in between two groups LASER & TENS in a sample of 18 patients in terms of pain relief & range of normal jaw function and concluded that both the therapies were effective as a part of TMD management similar to the result of our study.

## Conclusion

Non-invasive conservative treatment modality has always been a preferred choice over the invasive surgical treatment since times by the patients as well as the doctors. Early and correct diagnosis is most crucial aspect before planning of any treatment. Various electro physical treatment modalities have been under use since decades like ultra sound therapy, LLLT, TENS etc. which some authors advocating the use of one over the other as the better one<sup>11</sup>. The conclusion derived from our study states that "On the basis of clinical findings, LLLT and TENS are effective in treating TMD's, statistically LLLT proving to be better then TENS, though both being a valuable adjunct to oral and maxillofacial surgeons armamentarium when used in an appropriate manner." [Figure 1 & figure 2]

- Longer follow-ups are needed to further validate the study.
- Limitations – sample size of the study is limited.

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Transcutaneous Electrical Neural Stimulation. Photo medicine and Laser Surgery Volume 24, Number 1, 2006.

### Legends Images



Figure 1: Showing laser machine

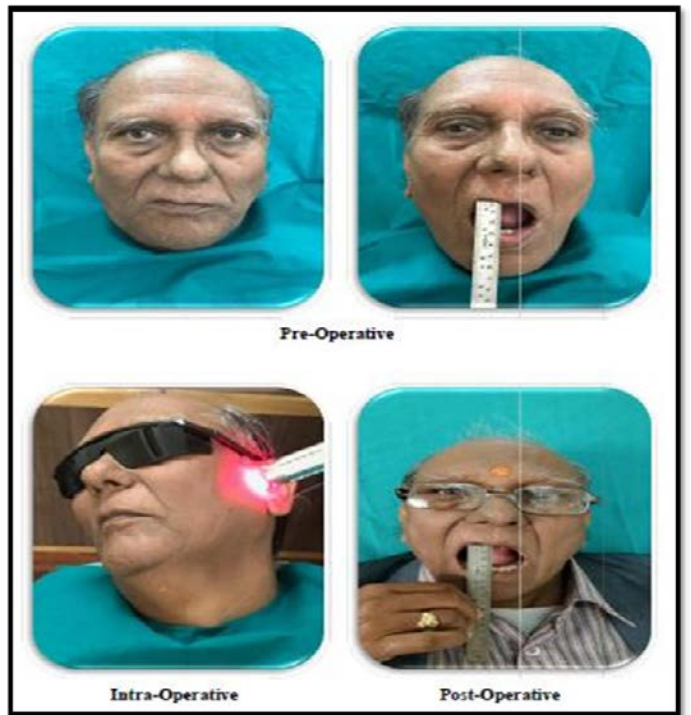


Figure 2: Showing betterment of the patient with increased mouth opening and pain reduction