Original Article

Comparison of Perception of Pain Following Orthodontic Extraction with Transcutaneous Electrical Nerve Stimulations along with Pharmacological Method Over Only Pharmacological Method: A Clinical Trial

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ABSTRACT

Background: Therapeutic extraction of first pre-molars is commonly performed in fixed orthodontic treatment and often leads to post-operative pain. Although non-steroidal anti-inflammatory drugs, such as Aceclofenac are routinely used, their systemic side effects necessitate exploring non-pharmacological adjuncts, such as transcutaneous electrical nerve stimulation (TENS). **Aim:** To evaluate and compare the effectiveness of TENS when used along with pharmacological method as compared to only pharmacological method for pain control after therapeutic extraction of the 1st pre-molar in patients requiring fixed orthodontic treatment. **Materials and Methods:** This prospective split-mouth study included 20 patients aged 13–28 years undergoing fixed orthodontic treatment at Bareilly International University. Each patient received bilateral first pre-molar extractions. One side was randomly assigned to the TENS + Aceclofenac group, while the opposite side served as control (Aceclofenac only). A 15-day interval between extractions was maintained. TENS was applied extraorally for 15 min post-extraction. Pain was recorded using a 10 cm Visual Analog Scale at 2, 6, 12, 24, and 48 h post-operatively. **Results:** Pain was lower in the TENS group at all-time intervals, with a statistically significant difference observed at 24 h ($P = 0.037$). No significant differences were found at other time points. **Conclusion:** TENS proved to be a safe and effective adjunct for reducing post-operative pain following pre-molar extraction. It may be considered a valuable addition to conventional pharmacological methods in orthodontic patients.

Key words: TENS, analgesic, aceclofenac

INTRODUCTION

Therapeutic extraction of the first pre-molar teeth is one of the most frequently performed procedures in fixed Orthodontic treatment. After a short time of surgical extraction, post-operative pain may occur. According to the World Health Organization, pain is defined as "unpleasant sensory or emotional experience associated with actual or potential tissue damage." The pain that follows the extraction of any tooth is an acute, short-lasting (2 h–3 days) pain that reaches its maximum intensity during the early (first 4 h) post-extraction period.[1] Pain management post-operatively is essential as it helps to minimize discomfort to the patient. Hence, the pain control is one of the most important aspects after the extraction of any tooth.

Many pharmacological and non-pharmacological methods are used to reduce the severity and the amount of complications, such as pain and swelling, which are developed after the extraction of teeth. Non-steroidal anti-inflammatory drugs (NSAIDs) are one of the most common analgesics that are being used by dentists to help relieve pain and distress after extraction.[2]

However, the adverse effect of taking NSAID orally imposes a complication and discomfort to some patients. This includes irritation to the gastrointestinal system due to its high plasma concentration, reduced concentration systemically available due to the first-pass metabolism. Hence, to reduce such occurrences, other method of reducing post-operative pain should be explored, such as Transcutaneous electrical nerve stimulation (TENS), low-level laser therapy, and medicated adhesive patch.[3,4]

TENS is a non-pharmacological pain control method based on the method of applying different frequency electrical currents

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through the surface electrodes placed on the skin and activates a complex neuronal network to reduce pain by activating descending inhibitory systems in the central nervous system to reduce hyperalgesia. This method, which is cheap, safe, and easy to apply, can be used in addition to pharmacological agents in the treatment of post-operative pain.[5,6]

The clinical use of TENS involves the delivery of an electrical current, typically from a small battery-operated device to the skin through surface electrodes. Each session typically lasts for 5–15 min and the treatment may be repeated as often as needed, depending on the severity of pain.

The use of TENS is based on several interrelated theories on the mechanisms of pain transmission and the blocking of those mechanisms. The first of these theories was the gate control theory advanced by Melzack and Wall.[7] According to this theory, stimulation of the large, peripheral A-delta nerve fibers closes a spinal gate and prevents painful stimuli carried on the small C-fibers from gaining access to the ascending transmission system. This is the so-called "rubbing it better" effect.[7] In 1969, Reynolds showed that electrical stimulation of the periaqueductal gray region of the midbrain produces analgesia equivalent to that induced by morphine. Subsequently, this led to the discovery of several morphine-like chemicals called endorphins, which exist at various levels of the pain control pathway. Thus, an alternative explanation for the mechanism of action of TENS is that it stimulates the release of endogenous opioids in the spinal cord, which could result from activation of local circuits within the spinal cord or from activation of descending pain inhibitory pathways.[8]

Few studies have been done which used TENS as an adjunctive for post-operative pain control in surgical extraction cases, but it has not been used in therapeutic extraction cases of the 1st premolar to our best knowledge.

Hence, the purpose of this study is to address the hypothesis that TENS, in addition to the pharmacological method, can better control the post-operative pain after therapeutic extraction of teeth in orthodontic cases.

MATERIALS AND METHODS

This prospective study was conducted at the Department of Orthodontics and Dentofacial Orthopedics, Institute of Dental Sciences, Bareilly International University, Bareilly, over a period of 4 months from March 2024 to June 2024. A scientifically calculated sample size of 20 patients was determined using G*Power version 3.1 software to ensure adequate statistical power. Ethical approval for the study was obtained from the Institutional Review Board. All participants were thoroughly informed about the nature of the study and the potential side effects of the administered drug. Written informed consent was obtained from each participant, along with parental consent for those under 18 years of age.

Participants included in the study were patients aged between 13 and 28 years at the time of data collection, who were seeking fixed orthodontic treatment requiring the extraction of the first pre-molars. Only those with no history of prior orthodontic treatment and with a clinically healthy periodontal status were considered eligible.

Patients were excluded from the study if they had any contraindications to Aceclofenac or other NSAIDs, presented with painful pathological lesions, or had undergone traumatic extractions. Additional exclusion criteria included pregnancy, a history of systemic conditions, such as cardiac arrhythmias, bronchial asthma, epilepsy, and psychosomatic or emotional disorders. Patients who were undergoing antibiotic therapy at the time of the study were also excluded.

Patients undergoing fixed orthodontic treatment that required bilateral therapeutic extraction of the first pre-molars in either the maxillary or mandibular arch were included in this split-mouth study. The right and left quadrants of each subject were randomly assigned to either the TENS group or the control group. In the TENS group, patients received TENS therapy along with a pharmacological analgesic (Aceclofenac 100 mg) following extraction. In the control group, only Aceclofenac 100 mg was administered post-extraction. All extractions were performed before the placement of any fixed orthodontic components. A 15-day interval was maintained between the two extractions to eliminate potential drug carryover effects and reduce bias in pain perception.

TENS therapy was administered using a portable two-channel mini TENS machine, with extraoral electrodes placed over the extraction site. A low-level, comfortable electric current was delivered for 15 min post-extraction. TENS was applied after extraction in the respective group.

For both groups, Aceclofenac 100 mg was the pharmacological agent used. Patients were instructed not to take any additional pain-relief medications during the observation period.

Pain perception was evaluated using a Visual Analog Scale (VAS) at 2, 6, 12, 24, and 48 h following each extraction. The VAS consisted of a 10 cm horizontal line anchored by "no pain at all" (0 mm) and "worst pain experienced" (100 mm). The pain scores were recorded as linear measurements from the zero point to the mark made by each subject and analyzed accordingly.

RESULTS

The descriptive data for VAS score across each time period in the TENS group is summarized in Table 1 and Graph 1. The mean VAS score at T1 (2 h) was 9.39 ± 3.13, at T2 (6 h) was 13.78 ± 4.05, at T3 (12 h) was 14.04 ± 4.32, at T4 (24 h) was 13.78 ± 4.05, and at T5 (48 h) 6.94 ± 3.24.

Table 1: Descriptive data for VAS scores across each time period in the TENS group

Time	VAS score		*P*-value
	Mean	SD	
2 h (T1)	9.39	3.13	<0.001**
6 h (T2)	13.78	4.05	
12 h (T3)	14.04	4.32	
24 h (T4)	11.43	3.29	
48 h (T5)	6.94	3.24	

VAS: Visual Analog Scale, TENS: Transcutaneous electrical nerve stimulation, SD: Standard deviation

The values for the mean VAS score was found to be maximum at T3, followed by T2, T4, T1, and T5. On comparison of the mean VAS score in TENS group it was found that the difference in mean VAS score was statistically significant at different time intervals.

The descriptive data for VAS score across each time period in the control group is summarized in Table 2 and Graph 2. The mean VAS score at T1 (2 h) was 12.95 ± 2.63, at T2 (6 h) was 17.25 ± 4.47, at T3 (12 h) was 16.59 ± 4.02, at T4 (24 h) was 15.33 ± 3.86, and at T5 (48 h) 11.00 ± 4.27.

The values for the mean VAS score was found to be maximum at T3, followed by T2, T4, T1, and T5. On comparison of the mean VAS score in the TENS group, it was found that the difference in mean VAS score was statistically significant at different time intervals.

On comparison of pain mean VAS score between TENS and control group at different time intervals is summarized in Table 3 and Graph 3. At T1 (2 h), on comparing the mean VAS score in the TENS group and control group, the mean VAS scores were found to be 9.39 ± 3.13 and 12.95 ± 2.63, suggesting an insignificant difference at T1. At T2 (6 h), on comparing the mean VAS score in the TENS group and control group, the mean VAS scores were found to be 13.78 ± 4.05 and 17.25 ± 4.47, suggesting an insignificant difference at T2. At T3 (12 h), on comparing the mean VAS score in the TENS group and control group, the mean VAS scores were found to be 14.04 ± 4.32 and 16.59 ± 4.02, suggesting an insignificant difference at T3. At T4 (24 h), on comparing the mean VAS score in the TENS group and the control group, the mean VAS scores were found to be 11.43 ± 3.29 and 15.33 ± 3.86 suggesting a significant difference at T4. At T5 (48 h), on comparing the mean VAS score in the TENS group and control group, the mean VAS scores were found to be 6.94 ± 3.24 and

Table 2: Descriptive data for VAS scores across each time period in the control group

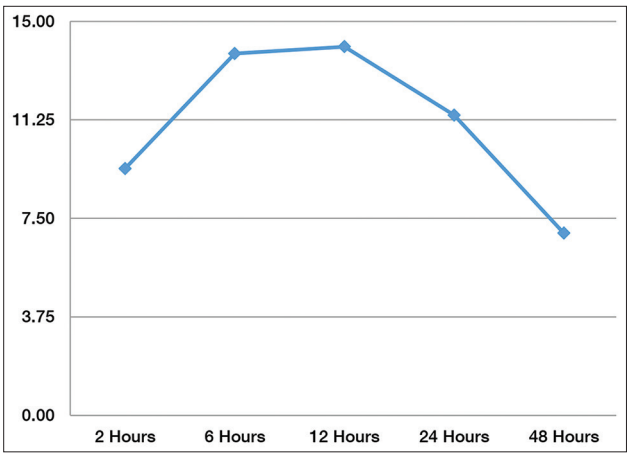
Time	VAS score		*P*-value
	Mean	SD	
2 h (T1)	12.95	2.63	<0.001**
6 h (T2)	17.25	4.47	
12 h (T3)	16.59	4.02	
24 h (T4)	15.33	3.86	
48 h (T5)	11.00	4.27	

VAS: Visual Analog Scale, SD: Standard deviation

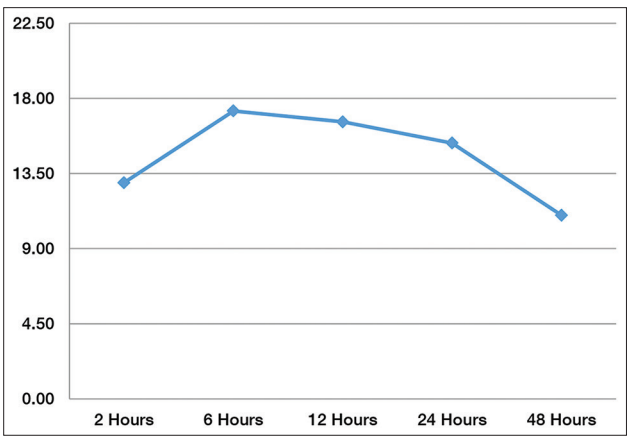
Table 3: Comparison of mean VAS scores across each time period in the TENS and control group

Time	TENS Group		Control group		*P*-value
	Mean	SD	Mean	SD	
2 h (T1)	9.39	3.13	12.95	2.63	0.391
6 h (T2)	13.78	4.05	17.25	4.47	0.569
12 h (T3)	14.04	4.32	16.59	4.02	0.668
24 h (T4)	11.43	3.29	15.33	3.86	0.037*
48 h (T5)	6.94	3.24	11.00	4.27	0.455

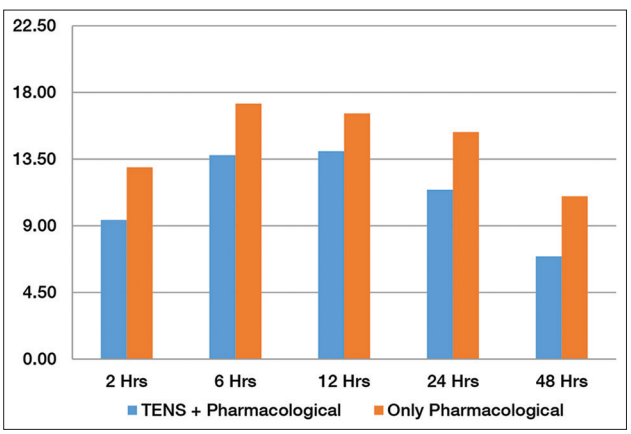
VAS: Visual Analog Scale, TENS: Transcutaneous electrical nerve stimulation, SD: Standard deviation



Graph 1: Mean Visual Analog Scale scores across each time period in the transcutaneous electrical nerve stimulation group



Graph 2: Mean Visual Analog Scale scores across each time period in the control group



Graph 3: Comparison of mean Visual Analog Scale scores across each time period in the transcutaneous electrical nerve stimulation and Control group

11.00 ± 4.27, suggesting an insignificant difference at T5.On comparison of mean VAS score among the TENS and control group, it was found that the mean VAS score in the TENS group was less than control group at all time periods (T1, T2, T3, T4, T5); however, it was statistically significant at the T4 time period only.

DISCUSSION

This study employed a split-mouth design, where each patient served as their own control to minimize intersubject variability in pain perception. Non-surgical extractions were performed. A 15-day interval between extractions ensured drug clearance before administering the next treatment with or without TENS.

In our study, the first evaluation of the extent of pain was done after 2 h post-operatively. Extent of pain was checked at 2 h post-operatively, considering the half-life of aceclofenac, which is reported to be 2–4 h.[9] The most intense post-operative pain typically occurs within the first 3–5 h.[4] Therefore, pain was re-evaluated after 6 h. Later pain was assessed in intervals of 12 h, 24 h, and 48 h, respectively.

In the TENS group, after the therapeutic extraction, it was seen that the mean maximum pain was felt at 12 h, followed by 6 h, 24 h, 2 h, and 48 h, respectively. When only a pharmacological drug was given, it was noted that the mean maximum pain was felt at 6 h after the extraction, followed by 12 h, 24 h, 2 h, and 48 h, respectively. The result was similar to the study conducted by Fisher *et al*.[10] who in their study also found that pain after extraction was found to be severe after 3–5 h of extraction as the effect of anesthesia starts disappearing after 3–5 h.

On comparing the mean VAS scores across the TENS and Control group at different time intervals it was found that no significant difference was found between TENS and Control group at T1 (9.39 ± 3.13 and 12.95 ± 2.63), T2 (13.78 ± 4.05 and 17.25 ± 4.47), T3(14.04 ± 4.32 and 16.59 ± 4.02) and T5 (6.94 ± 3.24 and 11.00 ± 4.27) time intervals.

On comparing the mean VAS scores across the TENS and Control group at T4, it was found that there was a significant difference in mean VAS scores (11.43 ± 3.29 and 15.33 ± 3.86).

Strassburg *et al*.[11] Conducted their study where extraction was done without using local anesthesia and application of TENS was done at the extraction site, where they found that that application of TENS during and after extraction was an effective method for acute pain control.[11]

A similar study was done by Cebi[12] also showed similar results to our study, where he found that patient receiving TENS in addition to routinely prescribed reported less pain than patients taking routine medication.

Jhonson *et al*., in their study, evaluated the effectiveness of TENS and found TENS as an effective non-pharmacological modality for pain control.

Although there was no significant difference in mean VAS scores at T1, T2, T3, and T5 but the mean VAS scores were less for the TENS group than the Pharmacological group, suggesting the effectiveness of TENS for pain control after extraction.

The present study was done to compare the effectiveness of TENS with aceclofenac and Aceclofenac alone in providing pain relieve after pre-molar extraction. It was found that the pain scores were higher in the control group when compared to the TENS group at all-time stamps and were significantly higher at the T4 time interval, thus suggesting the effectiveness of TENS in reducing pain after therapeutic extraction of pre-molar teeth. TENS, being non-invasive, inexpensive, easy to administer, and having no adverse tissue reaction, can thus be used as an adjunct in relieving pain after extraction.

However, the present study is the first of its kind to evaluate the effectiveness of TENS after therapeutic extraction of pre-molars in orthodontic patients, long clinical trials with a larger sample size need to be carried out in the future to evaluate the further scope of TENS therapy in therapeutic extraction of pre-molars.

CONCLUSION

In the TENS group, where TENS was administered along with the pharmacological drug (Aceclofenac 100 mg), the intensity of pain across the evaluated time points followed a descending order of T3 > T2 > T4 > T1 > T5. In contrast, in the control group, where only Aceclofenac 100 mg was administered, the order of pain was T2 > T3 > T4 > T1 > T5. Upon comparing the mean VAS scores between the TENS and control groups, no statistically significant difference was found at time intervals T1, T2, T3, and T5. However, a significant difference in pain perception was observed at the T4 time interval, suggesting that TENS may offer additional pain relief during specific stages of the post-extraction period.

REFERENCES

1. Kaur A, Gambhir RS, Mann RS, Goyal J, Gill BS, Gill S. Efficacy of power strips as an alternate pain relief method in dental extractions: A clinical trial. Int J Community Med Public Health 2017;3:1383-7.
2. Kim JC, Choi SS, Wang SJ, Kim SG. Minor complications after mandibular third molar surgery: Type, incidence, and possible prevention. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102:e4-11.
3. Sukumaran A, Jael Fiona R, Monisha B, Zulkifli N, Vijayarangan S, Madan Kumar PD. Comparison of perception of pain following orthodontic extraction with oral analgesics over adjuvant herbal patch. J Glob Oral Health 2020;3:18-22.
4. Singhal M, Goyal M, Lall AB, Tomar S, Sonal N. Evaluation of efficacy of transcutaneous electrical nerve stimulation (TENS) and low level laser therapy (LLLT) on post operative sequele following surgical extraction of impacted mandibular third molars - a randomized control trial. J Pharm Negat Result 2022;13:18-22.
5. Bjordal JM, Johnson MI, Ljunggreen AE. Transcutaneous electrical nerve stimulation (TENS) can reduce postoperative analgesic consumption. A meta-analysis with assessment of optimal treatment parameters for postoperative pain. Eur J Pain 2003;7:181-8.
6. Noehren B, Dailey DL, Rakel BA, Vance CG, Zimmerman

MB, Crofford LJ, *et al*. Effect of transcutaneous electrical nerve stimulation on pain, function, and quality of life in fibromyalgia: A double-blind randomized clinical trial. Phys Ther 2015;95:129-40.
7. Melzack R, Casey KL. Sensory, motivational, and central control determinants of pain. In: The Skin Senses. United States: Charles C Thomas Publisher; 1968. p. 423-39.
8. Walsh DM, Howe TE, Johnson MI, Moran F, Sluka KA. Transcutaneous electrical nerve stimulation for acute pain. The Cochrane Library. 2009.
9. Iolascon G, Giménez S, Mogyorósi D. A Review of Aceclofenac: Analgesic and Anti-Inflammatory Effects on Musculoskeletal Disorders. J Pain Res. 2021;30;14:3651-3663
10. Fisher SE, Frame JW, Rout PG, Mcentegart DJ. Factors affecting the onset and severity of pain following the surgical removal of unilateral impacted mandibular third molar teeth. Br Dent J 1988;164:351-4.
11. Strassburg HM, Krainick JU, Thoden U. Influence of transcutaneous nerve stimulation (TNS) on acute pain. J Neurol 1977;1;217:1-10.
12. Cebi AT. Effects of transcutaneous electrical nerve stimulation on pain after impacted third molar surgery. Med Oral Patol Oral Cir Bucal 2019;24:e404-8.