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ORIGINAL ARTICLE

The Effectiveness of Trans-Electrical Nerve Stimulation (TENS) in Reducing Pain Caused by Orthodontic Movement; A Randomized Controlled Trial

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ABSTRACT

Objective: To check the effectiveness of TENS therapy in reducing pain caused by orthodontic movement.

Methods: This was a single-blinded parallel-arm randomized controlled trial among patients presented for treatment of increased overjet using the split-mouth technique. Ethical consent was obtained from 45 patients. An initial levelling and alignment of dentition were achieved, followed by extraction of maxillary pre-molars, and canines were distalized, maintaining 100grams of force. The TENS pads were placed on the cheeks. One side was supplied with active impulses, considered an interventional side, while the other was not supplied with impulses and was marked as the control side. Pain intensity was measured on the tested tool (NRS scale) during resting and clenching (T1). The patient was instructed to use the device the same way for a total of five more times, at T2 (2hrs), T3 (6hrs), T4 (24hrs), T5 (48hrs), and T6 (72hrs). The data were analyzed using SPSS version 24, Chi-square test was applied to compare the pain intensity.

Results: Among 45 patients (77.8% female and 21.2% male), the mean age of 19.0 ± 4.13 years. The average pain intensity on rest at 0 and 2 hours was 1.33 ± 1.108, which was at peak T3 (6 hours) 1.87 ± 1.546 and T4 (24 hours) 1.71 ± 1.359. However, it significantly decreased at T5 (48 hours) and T6 (72 hours) of intervention, which were 1.38 ± 0.8 and 1.31 ± 1.04, respectively. This difference was statistically significant ($p<0.05$). The same pattern of pain reduction was seen in patients with clenching ($p<0.05$). This showed that the pain intensity was decreased, but the pattern was not linear, as indicated that the pain at T3 and T4 was increased, but later, it was significantly decreased at T5 and T6. A negative correlation was observed between pain intensity and interval of TENS applied onward from the 4th interval in both groups (TENS applied on rest and TENS applied on clenching). Pain score at 72 hours was significantly low compared to post TENS applied ($p<0.001$).

Conclusion: TENS efficacy is insignificant at T1 and T2, with a significant increase in pain during T3 and T4; however, at T5 and T6, there was a significant reduction in pain which indicates a greater efficacy of the device reducing pain compared to the placebo.

Key Words: Orthodontic, Pain, Periodontal and Trans-electrical nerve stimulation

INTRODUCTION

Experiencing pain or discomfort during orthodontic treatment is common due to tooth movement facilitated by a constant or intermittent force.[1] Nearly 91% to 94% of patients experience pain during orthodontic treatment, which affects their quality of life and ultimately makes it difficult for them to maintain their oral hygiene with proper compliance.[2]

The severity and incidence of orthodontic pain are much higher than the pain felt when tooth extraction occurs.[3] A research study in this regard states that after initial arch-wire insertion, corrective pain usually begins within 4 hours and increases over the next 24 hours.[4, 5] Most patients see an orthodontist three to four weeks after the initial orthodontic wire is inserted. An orthodontist may not be fully aware of the degree of pain and discomfort experienced by the patient.[6]

There have been various strategies in practice for the reduction of such pain. Among these strategies, pharmacological management is commonly used. However, due to the serious adverse consequences of these drugs especially, painkillers the researchers have started to find alternative ways of treatment.[7] The non-pharmacological treatment of pain includes the application of cold packs, psychological assurance, application of TENS, massage, manual physical therapy, and acupuncturing techniques.[8] The application of TENS is somehow new in orthodontic procedures however it may be used to reduce acute post procedure pain and also reduce the negative consequences of painkillers.[9]

There have been various strategies used for the treatment of orthodontics and their associated pain. Among these nonsteroidal anti-inflammatory drugs (NSAIDs) were the most common ones.[10] However, there is evidence about the effectiveness of vibratory stimulation and TENS.[11] Secondly, the low-level laser and Pulsed electro-magnetic field (PEMF) were in practice, which was commonly used for pain reduction after orthodontic procedures.[12] the drug NSAID has crucial systemic adverse effects including hepatic and renal toxicity and also alters the coagulation process. These potential side effects have led some authors to emphasize the need to reduce orthodontic pain without using the drug as the first line of choice.[13]

Several clinical studies have begun to focus on non-pharmacological methods to reduce pain, and it has been confirmed that TENS can have a positive effect on postoperative morbidity.[14] In the present study, In this study we evaluated the effectiveness of TENS in reducing the periodontal pain caused by the retraction of canines after orthodontic power chain placement. This gave us the baseline information about the effectiveness of TENS in the reduction of pain without the side effects of NSAIDs.

MATERIALS AND METHODS

This was a single-blinded parallel arm randomized control trial among patients presented for the treatment of increased overjet using split mouth technique, conducted in Islamic International Dental Hospital, Orthodontic Department. Islamabad from September 2019 to March 2020. Assuming population standard deviation σ=2.81, population variance σ^2 7.896, test value of the population mean μ_0 = 4.3, anticipated population mean μ_a = 6.23, a sample of 45 participants were included in the study using sample random sampling techniques. After getting the ethical approval (Ref. No. IIDC/IRC/2019/06/003) from the university and consent form patients visited for correction of increased overjet and extraction of bilateral first pre-molars. This was followed by the retraction of canines by orthodontics.

Patients were diagnosed via extra/intra oral photographs, study models and also the radio graphics. All class II division I

malocclusion patients with periodontally and systemically healthy individuals and those who had increased overjet and advised for extraction of bilateral upper first pre-molars were included in the study. Patients with Cardiac pacemakers or a history of epilepsy were excluded.

The patients were prepared by first leveling and aligning their maxillary dental arch with Nickel Titanium wires. The extraction of bilateral first pre-molars after which retraction of canines was done on heavy stainless steel wires by placing power chains from canines to second molars. A dual channels TENS device was applied for 10 minutes on the right and left side to check its effectiveness. For the intervention side, the knob with the pulsation of the average intensity of 3.5 was applied while another side was used as a control with an intensity of 1, where pain at each interval was measured using the NRS scale.

The patient was instructed to use the device exactly and the same way a total of five more times. First at T2 (2hrs), T3 (6hrs), T4 (24hrs), T5 (48hrs), and T6 (72hrs) respectively. Data analyzed by SPSS version 24. Initially, descriptive statistics were estimated for quantitative (ratio, continuous and discrete variables) and qualitative (nominal/ordination). The two groups were then compared concerning pain intensity using Chi-square test.

RESULTS

Total patients were 45 with each patient receiving TENS pads on both cheeks either the left or right, out of these patients 35 (77.8%) were female, and 10 (21.2%) were male. The mean age of the participants were 19.0 years with a standard deviation of 4.13 (ranging from 12 to 27 years of age). Results from paired t-test indicate that average pain at resting and clenching was significantly decreased on the intervention side. The mean pain score at rest on placebo side was 1.7 ± 0.7, while it was 1.5 ± 0.8 on the intervention side. Similarly, the mean score of pain on placebo side at clenching was 2.1 ± 1.3 as compared to 1.9 ± 1.0 at the intervention side and the difference was statistically significant (P= 0.001)

Table 1: Comparing mean pain score between the intervention and the placebo side

		Mean	Std. Deviation	P-Value
Intervention at rest	AvgTR	1.5222	0.82158	P= 0.001
Placebo at rest	AvgR	1.7444	0.79344	
Intervention at clenching	AvgTc	1.9333	1.08967	P= 0.001
Placebo at clenching	AvgC	2.1148	1.31897	

Comparing the effectiveness of TENS at clenching and rest in the first session of treatment indicate that the mean pain score TR1 was low 1.33 ±1.108 compared to that of R1 (placebo) 1.80 ±1.254. Furthermore, the average pain score in the Intervention group at Clenching (TC1) was 1.49 ±1.199 as compared to placebo (C1) 2.42 ± 2.039 at the respective interval. The difference was statistically significant (p=0.02)

Table 2: Comparison of Mean Pain Score among the different groups at interval 1

Groups	Mean ± Std.	95% Confidence Interval for Mean		P-Value
		Lower	Upper	
Intervention group at Rest (TR1)	1.33 ±1.108	1.00	1.67	0.002
Intervention group at Clenching (TC1)	1.49 ±1.199	1.13	1.85	
Placebo group at rest (R1)	1.80 ±1.254	1.42	2.18	
Placebo group at Clenching (C1)	2.42 ± 2.039	1.81	3.03	

The comparative analyses of pain reduction at the second session of treatment also showed significant reduction. The mean pain score at rest on the intervention side was 1.53 ± 0.99 as compared to 1.91± 1.25 on the placebo side. Similarly, the placebo group on clenching had a pain score of 2.58± 1.9 as compared to the interventional group 1.56± 1.05, this indicates a significant decrease (p=0.001)

Table 3: Comparison of Mean Pain Score among the different groups at interval 2

Groups	Mean ± Std.	95% Confidence Interval for Mean		P-value
		Lower	Upper	
Intervention group at Rest (TR2)	1.53 ± 0.99	1.24	1.83	0.001
Intervention group at Clenching (TC2)	1.56± 1.05	1.24	1.87	
Placebo group at rest (R2)	1.91± 1.25	1.53	2.29	
Placebo group at Clenching (C2)	2.58± 1.9	1.98	3.18	

Tr: Tens applied on resting, Tc: Tens applied on clenching, R: placebo side on resting, C: placebo side on clenching

Comparing the outcome of TENS applied and placebo on resting and clenching on a third and fifth interval has not differed significantly, however, the pain reduced significantly at the end of the course of treatment.

Table 4: Comparing the pain score among the different groups at interval 5

Groups	Mean Std. Deviation	95% Confidence Interval for Mean			P-Value
		Lower Bound		Upper Bound	
Intervention group at Rest (TR5)	1.31	1.041	1.00	1.62	0.068
Intervention group at Clenching (TC5)	1.78	1.277	1.39	2.16	
Placebo group at rest (R5)	1.20	.457	1.06	1.34	
Placebo group at Clenching (C5)	1.49	1.342	1.09	1.89	

DISCUSSION

Pain from orthodontic treatment is a common problem that requires attention as it affects a patient's quality of life. Various strategies and ongoing research have been identified to reduce orthodontic pain.[15] The result of the present study indicates that the TENS appliance had an insignificant effect in reducing pain which was not the case in the study of Roth et al, where they claimed that TENS is an effective non-pharmacological method of controlling post adjustment tooth pain.[14] However, in their study, the TENS was applied after placement of separators while in this present article TENS was applied during the retraction of canines bilaterally.[14]

The present study also indicates that the association between TENS application and reduction in pain was insignificant for resting and clenching. This finding contradicts the finding of Jung et al, where they concluded that the application of pain was

significantly reduced in both the resting and clenching groups on the experimental side when compared with the placebo side.[16] However, they have used both PEMF devices while in the present study we used the TENS device.

The average pain experienced by the patient on the NRS scale on rest was 1.63, while on clenching was 2.007. Patients experienced the most pain during rest in the 3rd and 4th recorded intervals at 1.97 and 1.86. Pain on clenching was the most during the 3rd and 4th interval with 2.34 and 2.57 respectively. The mean pain score at rest was 1.58 ± 1.199 at the first interval at rest which was decreased to 1.37 ± 1.302 at TR6 (TENS applied at rest 6 i.e. 72hrs). This shows the pain intensity decreased, but the decreased pattern was not linear as indicated that the pain at TR2 and TR3 and TR4 was increased.

A study was conducted on spinal cord patients in Peshawar, where TENS was applied as a pain-relieving regime on spinal cord patients. They followed the patient for over 6 weeks. The finding indicated that the decrease in pain is not linear. There was a fluctuation in pain reduction. Initially, it was decreased and randomly it increased in the following sessions. However, just like the present study, it was effective in the final few sessions.[17] The present study indicates that a decrease in the pain intensity was high on clenching as compared to those on rest. However, in both groups, the pain decreased to a possible lower level after 72 hours.

There was variation in the reduction of pain at each interval of intervention. A steady reduction was observed at each interval but, pain reduction was not significant at the 3rd and 5th sessions of treatment. Jung et al. also reported that after the power chain was applied and retraction of canines was started, the maximum pain was experienced at T3 (6hours) and T4 (1 day) in both clenching and resting groups which was decreased over the period of time.[16] Similarly, Ngan et al also reported similar results which reached a maximum at T2 (6hours) after insertion of initial archwire and then gradually decreased. NRS scores were significantly lower than the NRS scores in the control group.[19]

This research involves the comparison of pain differences between interventional and placebo sides after applying TENS pads. Different variables were observed and recorded that can influence the outcome of the study which included gender, age, TENS application in reducing pain between the experimental and control side.[19] It's obvious that pain is a subjective response; the perception of pain depends on sex, age, psychological condition, and pain threshold, in this study a split mouth design was done to avoid all components related to differences between subjects. The study by Kala et al, indicates that mean pain scores on a visual analog scale of subjects undergone through TENS application for treatment of orthodontic pain were significantly less than those who were on placebo or without TENS application ($p<0.05$).[20].

CONCLUSION

It is concluded that the efficacy of TENS in relieving the orthodontic pain was insignificant, the pain score was significantly low at 72 hours as compared to the initial post-procedure stage. Pain on clenching was high as compared to that at rest. Application of TENS fastens the pain lowering process as indicated from the results of pain score of individuals.

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