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POSTOPERATIVE PAIN EXPERIENCED BY PATIENTS TREATED WITH 810NM DIODE LASER AGAINST CONVENTIONAL ENDODONTIC THERAPY IN NECROTIC PULP AND CHRONIC PERI-APICAL LESION: A RANDOMIZED CONTROL TRAIL

Dr. Krishna Prasada L[1], Syed Manzoor Ul Haq Bukhari[2]

[1]"MDS, DNB, MBA", Head of Department, KVG Dental College, Kurungibagh, Sullia, Dakshin Kannad Karnataka State, India

[2]Postgraduate Student, KVG Dental College, Kurungibagh, Sullia, Dakshin Kannad, Karnataka State, India

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Corresponding author: Syed Manzoor ul haq Bukhari

Abstract:

Usual endodontic treatments may lead to post-treatment pain. The recent advance of laser use to reduce post-op pain, its efficacy and accuracy is still unknown. Therefore, this study has been conducted to assess the post-operative pain in patient undergoing laser vs conventional endodontic treatment in necrotic teeth with apical lesions. Fifty patients having necrotic pulp in maxillary centrals incisors with chronic periapical lesions were randomly divided into two groups (n = 25). All patients were treated with two visits of conventional root canal treatment with ProTaper Universal. In experimental group root canals were irradiated with 200 µm fiber optic at both visits; in the control group the diode laser fiber was placed in root canal with no activation acting as placebo. Results suggested post-operative pain reduced gradually and significantly from six hours to 48 hours and no pain at all after seven days in both groups. The pain scores between experimental and control groups showed statistically significant difference after six hours, 12 hours and 24 hours (p= 0.03, p= 0.02 and p= 0.018 respectively). In conclusion, Diode laser disinfection in the range of 810 nm of root canal can reduce the postoperative pain experienced after conventional root canal treatment in cases of necrotic teeth with periapical lesions

Introduction

Pain which begins after initiation of root canal treatment can be defined as post-op pain. Usual endodontic treatments may lead to post-treatment pain, the intensity and duration of which depends on the treatment procedure which the patient has undergone, also the experience of the endodontist, use of instrumentation, persistence of microorganisms and on the patient's perception of pain. Postoperative pain after root canal treatment (RCT) has been reported in literature from 1.5 to 53% (1). It may persist from few hours to many days after endodontic therapy(2). There is a clear indication of interactions between periapical tissues and microorganisms, because flare-ups are more likely to occur in necrotic cases than in vital case(3). The prime objective of endodontic treatment is to achieve a disinfected root canal system using chemo-mechanical means(4). The modern endodontic instruments such as hand, rotary instruments, ultrasonic and sonic devices which are used along with irrigants for cleaning of the root canal system can lessen the bacterial load to a significant amount. Laser is a relatively new approach for disinfection of root canals, the bactericidal effect of lasers is based on dose dependent heat generation and photo disruptive effects(5). Diode lasers emit radiation within the visible (mostly 660 nm) and infrared (810 to 980 nm) range of the electromagnetic spectrum. Due to the higher absorption coefficient in water (0.68 cm-1), diode lasers have penetration depth into the dentine up to 750 µm(6) while as conventional irrigants are only capable of penetrating to a depth of 100-300 µm (7). The pharmacological medication, non-pharmacological strategies used in conventional endodontic treatment has its own side effect and limitations. The recent advance of laser use to reduce post-op pain, its efficacy and accuracy is still unknown. Therefore, this study has been conducted to assess the post-operative pain in patient undergoing laser vs conventional endodontic treatment in necrotic teeth with apical lesions.

Material and method

The study was initiated subsequent to approval of Institutional Ethics Committee. Informed consent of patients willing to participate in the study was obtained in a given format. A detailed medical and dental history and the associated signs and symptoms of the patients were recorded Patients in the age group of 18-35 years, diagnosed as having necrotic teeth with chronic periapical lesions, requiring endodontic retreatment, referred to Department of Conservative Dentistry and Endodontics, KVG Dental College and Hospital, Sullia were randomly selected. Inclusion criteria for the study was both male and female patients aged 18-35 years, Teeth with score >/= 3 according to Orstavik criteria, patients suffering from necrotic pulp in maxillary central incisors permanent teeth with closed apex, associated with or without sinus tract, patients with healthy dental and periodontal status;

positive patients' acceptance for participation in the study. *Exclusion criteria:* open apex, greater than grade I mobility, pocket depth greater than 4 mm, non-restorable tooth, previous endodontic treatment; patients taking analgesics 12 hours before the intervention; patients who had received antibiotics in the last month; patients with acute pain at the time of intervention, Pregnant and lactating mothers, Teeth that cannot be isolated with rubber dam, anatomically difficult canals. Teeth with developmental anomalies.

First visit: The teeth were locally anaesthetized (lidocaine 4% solution with epinephrine in concentration of 1:100000). A standard access preparation was prepared with a sterile high-speed endodontic access bur #2 (Dentsply Maillefer) and Endo Z carbide bur until the orifice was exposed. After access was achieved the tooth and the rubber dam was placed. Patency of the root canal was obtained using stainless steel hand k- files size #15 (MANI, INC.). The root canals were instrumented with hand files and ProTaper gold rotary files (Dentsply Maillefer) in a crown-down motion up to file size #4 for all cases. In total 10 ml of 2.5% sodium hypochlorite was used for irrigation between each file and the next using a 25-gauge needle. 5 ml of 17% EDTA (P***rime Dental***) was used at the end of the procedure to remove the smear layer. 5 ml of saline solution was the final irrigants used to neutralize all the previously used solutions.

Random sequence generation (www.randomdraws.com) was used to randomly assign participants into groups. N=25/group

Experimental group: The root canals were irradiated with the light supply of Denlase diode laser using a wavelength of 810 nm at 1.2 W power in continuous wave mode. Laser beam was directed into the canal by the fiber optic cone with a diameter of 200 µm for 10 sec each for 40 sec. The tip of the fiber optic cone was placed in the canal 1mm short of the working length and optic fiber was led in slow, circular, spiral-forming movements from the apical to the coronal part, while the laser is activated., in a helicoidal movement touching the canal walls. This was done to ensure equal diffusion of light inside the root canal lumen. The root canals were irradiated with the light supply of Denlase diode laser using a wavelength of 810 nm at 1.2 W power in continuous wave mode. Laser beam was directed into the canal by the fiber optic cone with a diameter of 200 µm for 10 sec each for 40 sec. The tip of the fiber optic cone was placed in the canal 1mm short of the working length and optic fiber was led in slow, circular, spiral-forming movements from the apical to the coronal part, while the laser is activated.

Control group: Conventional endodontic treatment as above, after which the fiber optic was placed inside the root canals without activation (placebo). Canal was obturated with the modified single cone technique using the ProTaper Universal gutta-percha points size F4 and gutta-percha points size 25 as auxiliaries with AH plus root canal sealer. All the teeth were restored with IRM as a temporary filling. At the end of the second visit, all patients were instructed to record pain level on the pain scale chart after 6, 12, 24 and 48 hours and after 7 days. The patients were instructed to submit the pain scale charts after the 7th day. Patients were referred for final restorations. Any patient who reported the intake of an analgesic during this period was excluded from the study.

The Numerical rating scale (NRS) consists of asking the pain patient to rate his or her perceived level of pain intensity on a numerical scale from 0 to 100, with the 0 representing one extreme (e.g., 'no pain'), and the 100 representing the other extreme (e.g. 'pain as bad as it could be').

Results:

A total of 50 patients were included in the study. The mean age (years) of participants in experimental group was 26.96±5.54 and in control it was 27.96±5.37. Demographic data analysis using two-sample t analysis showed that there was no significant difference in age between the experimental and control groups (p=0.5205) as shown in Table no.1. The experimental and control groups had 11 male and 14 female participants each. Chi-squared analysis showed no significant difference in gender between the groups as shown in Table no.2. Multivariate analysis with Wilk's Lambda correction Table no.3. showed that the mean pain score differed statistically significantly within the experimental and control groups when assessed at different time points (0.01). Post-operative pain reduced gradually and significantly from six hours to 48 hours and no pain at all after seven days in both groups. The pain scores between experimental and control groups showed statistically significant difference after six hours, 12 hours and 24 hours (p= 0.03, p= 0.02 and p= 0.018 respectively). After 48 hours the pain scores between groups showed no statistically significant difference (p= 0.057). On seventh day, pain assessment revealed absence of pain in both groups.

Table 1: Age of participants

Age (years)	Experimental Group	Control group
Mean	26.96	27.96
SD	5.548874	5.373391
Min	18	18
Max	35	36
t-test	-0.64732	
p-value	0.5205^{ns}	

SD= standard deviation, Min= minimum, Max= Maximum, t=Two sample t test, *: p<0.05 (Significant), ns: p> 0.05 (not significant)

Table 2: Gender distribution of participants.

Gender	Experimental	Control
Male	11	11
Female	14	14
X^2	0	
p-value	1^{ns}	

X2: Chi square test, Significance level: p<0.05, ns: non-significant

Table 3: Mean and SD values of pain intensity of different time periods within each group.

	Group	Mean	SD	95% Confidence Interval		p
				Lower Bound	Upper Bound	
Six hrs.	Experimental	2.400	0.931	1.469	3.331	0.02*
	Conventional	3.600	0.881	2.719	4.481	
Twelve hrs.	Experimental	1.600	0.660	0.940	2.260	0.03*
	Conventional	2.800	1.560	1.240	4.360	
Twenty-four hrs.	Experimental	1.200	0.440	0.760	1.640	0.018*
	Conventional	2.400	1.740	0.660	4.140	
Forty-eight hrs.	Experimental	0.800	0.735	0.065	1.535	0.057
	Conventional	1.200	0.754	0.446	1.954	
week	Experimental	0	0	0	0	-.
	Conventional	0	0	0	0	.

Discussion

Removal of vital and necrotic remnants of pulp tissues, microorganisms, and microbial toxins from the root canal system is essential for endodontic success. Although this might be achieved through chemomechanical debridement it is impossible to shape and clean the root canal completely(8). Relatively, new approaches to disinfecting the root canals include the use of high-power diode lasers (9). The first use of laser in endodontics was reported by Weichman and Johnson in 1971, who attempted to seal the apical foramen *in vitro* with a high power carbon dioxide (CO_2) laser(6). The of lasers for root canal advantage of complete canal sterilization, near complete removal of debris and smear layer from the root canal walls(10). Garcez *et al*.(11) achieved higher antimicrobial effect when they used the optical fiber in disinfection of the root canal. In the present study, diode laser was used to evaluate the postoperative pain in patients having necrotic teeth with chronic periapical lesions.

The present study used an 810 nm diode laser for disinfection of the root canal at 1.2 in continuous wave mode, with a fiber optic cone of 200µm diameter for 10 sec each for 40 sec. The fine diameters of optic fibers (200 to 320 µm) enables effective delivery of laser light to the root canal for reduction of bacterial contamination. Various authors recommended power settings in the range of 1 to 1.5. is presented(12, 13). The system used to evaluate the periapical status of the teeth were evaluated using radiographic scoring system, termed the periapical index (PAI) which was proposed by Orstavik, which is an ordinal scale of 5 scores ranging from 1 (healthy) to 5 (severe periodontitis with exacerbating features). (14). PAI score of 3 or > 3 as per Orstavik criteria were included in this study since the score of 3-5 indicates initial signs of apical periodontitis to severe periodontitis with periapical radiolucency.

Bijur PE validated Numerical Rating Scale of Acute Pain for Use in the Emergency and found NRS can be used for all practical reasons(15). The NRS has several practical advantages over the other measures. First, it is extremely simple to administer and score, and can be administered either in written or verbal form while as visual analog scale VAS, on the other hand, must be given in written form.(16).

The tissue penetrating effect of laser therapy may affects may cause a local effect on vascularity causing decrease in inflammation via its effect on immunoglobulins, lymphokines, substance p, histamine also have been shown to increase lymphatic drainage. Neuronal effects include increase in action potential of neurons causing leaser postoperative pain(17). In the present study the experimental group showed that the mean pain score differed statistically significantly within the experimental and control groups when assessed at different time points, usually lasting 2 to 3 days after treatment (18, 19) and the intensity gradually decreases over time(20, 21). The pain scores for both groups were the highest on the first day and the pain scores between experimental and control groups showed statistically significant difference after six hours, 12 hours and 24 hours and showed a daily decrease thereafter. After 48 hours the pain scores between groups showed no statistically significant difference. On seventh day, pain assessment showed absence of pain in both groups was observed.

As already known the microorganisms are prime cause of postoperative pain, the low pain perceived in the experimental group can also be related to the fact destructive effect of laser irradiation on root canal microorganism which are resistant to chemical means of disinfection. It's also suggested intracanal irritation with a laser may have a positive effect on microorganism present beyond the root apex(22)

Various studies have reported association of sex and age with post-operative pain (23, 24) studies have reported contrary to it(25-27). In the present study, no significant difference in age and sex between the experimental and control group was seen. this. Apical gauge of the root varies with each patient and couldn't be standardized.

Moreover, pain is an emotive response and is subjective in nature and depends on patient's pain threshold which can give variations in the final pain score.

Conclusion

Diode laser disinfection in the range of 810 of root canal can reduce the postoperative pain experienced after conventional root canal treatment in cases of necrotic teeth with periapical lesions. Thus, based on the findings of this study, it may be concluded that the intracanal disinfection with 810 nm diode laser a laser may have a positive effect on postoperative pain outcome and can be used supplemental to current treatment protocol

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