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Post-operative Pain after Photo-Active Disinfection (PAD) Supplemented Single Visit Root Canal Treatment in Teeth with Symptomatic Apical Periodontitis

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Abstract

Objective: To observe the incidence of post-operative pain after single-visit Non-Surgical Endodontic Therapy (NSET) in teeth with symptomatic apical periodontitis disinfected with Photo-Activated Disinfection (PAD). **Methods:** Single-rooted teeth (*N*=30) with pulp necrosis and symptomatic apical periodontitis were included. Subsequent to chemo mechanical preparation, the teeth were randomly distributed into two groups: group I (*n*=15) which received calcium hydroxide slurry as an intracanal medicament and group II (*n*=15) which received PAD and obturation in the same visit. Postoperative pain was recorded at 4, 24, 48 and72 hours using a visual analog pain scale. One-way analysis of variance *post hoc* Tukey test was used to compare the score. **Results:** There was a significant reduction in pain after instrumentation in Groups I and II. The pain reduction was more in group I as compared to group II at 4 hours. There was no statistically significant difference seen in both the groups at 24, 48 and 72 hours postoperatively. **Conclusion:** Application of PAD as an adjunct in single visit NSET has no noticeable difference in pain perception when compared with the use of calcium hydroxide interim dressing in two visits NSET.

Keywords: Calcium Hydroxide, Photoactivated Disinfection, Postoperative Pain, Single-Visit Root Canal Treatment

1. Introduction

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage[1]. Irreversible pulpitis, pulp necrosis, and apical periodontitis are frequent causes, for which patients seek endodontic treatment. The main goal of endodontic therapy is to alleviate the pain and suffering of patients and to prevent or treat apical periodontitis. However, postoperative pain after root canal treatment is more universal with the reported incidence of 1.5%–53%[2].

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It can be attributed to the mechanical, chemical, or microbial insult of hypersensitized periradicular tissues[3]. The local tissue inflammatory response by the release of prostaglandins, bradykinins, and neuropeptides (CGRP and SP) from afferent nerve fibers after stimulation by LPS is the proposed mechanism of pain perception after endodontic therapy[4]. The mechanical injury due to over instrumentation is under operators' control and can be minimized by strictly adhering to working length and restricting the procedures up to apical constriction. Chemical and microbial injury is inevitable due to extrusion of irrigants and debris into periapical tissues irrespective of the system or technique used[5]. Role of microorganisms in causing postoperative pain is more pronounced in cases with pulp necrosis where virulence factor of residual bacteria can get triggered by alteration in the endodontic environment[6].

Hence, it becomes imperative to achieve root canal disinfection to minimize the chances of postoperative discomfort to the patient. The approaches to enhance the disinfecting effects of conventional chemo mechanical procedures include irrigation with heated sodium hypochlorite, agitation with a sonic or ultrasonic device, or use of chlorhexidine in retreatment cases[7]. The multiple-visit endodontics with the dressing of intracanal medicament in between appointments during treatment of the teeth with pulp necrosis is a recommended procedure by various authors to achieve the complete disinfection and reduce the incidence of postoperative pain[8,9]. However, due to the advancements in materials and technology in endodontics, the trend for root canal therapy is shifting more toward single-visit endodontic therapy. There is conflicting literature on the effect of single-visit versus multiple-visit endodontic therapy on postoperative pain[10]. An update of the Cochrane database review concluded that single-visit endodontics is associated with more incidence of postoperative pain[11].

Photo-Dynamic Therapy (PDT) has been proposed as an adjunct to optimize single-visit disinfection[7]. Both the in-vitro and in-vivo studies have shown promising results for PDT in the reduction of residual bacteria after conventional chemo mechanical preparation techniques[12-14]. However, there is limited literature on its effect on the incidence of post endodontic pain[15]. Thus, the present study was planned with an aim to observe the incidence of post obturation pain after single-visit endodontic therapy in symptomatic nonvital teeth disinfected with Photo-Activated Disinfection (PAD). The null hypothesis was that there is no difference in the level of postoperative pain after endodontic therapy in teeth with symptomatic apical periodontitis when calcium hydroxide is used as intracanal medicament or obturated in the same visit after use of PAD as an adjunct.

2. Material and Methodology

The study was conducted at the specialty clinic of the Department of Conservative Dentistry and Endodontics. Ethical clearance was obtained vide the letter Ref. No IESC/T-278/01.07.11 and principles of the institute's research ethics committee were followed in the conduct of the study. Patients of either gender between the age groups of 20 and 35 years having a single-rooted tooth which required endodontic treatment were screened. A detailed history of pain was taken, and the clinical and radiographic examination was carried out for all the patients. Thermal and electric tests were performed to ascertain the pulpal status. American Association of Endodontists (AAE) terminologies for the diseases of the pulp and periapical tissue were followed[16]. A total of 30 patients having teeth with a clinical diagnosis of pulp necrosis and symptomatic apical periodontitis and radiographic evidence of radiolucency <5mm were included in the study. The teeth with immature roots, crack/vertical root fractures, poor restorative, or periodontal prognosis or with any history of an antibiotic or analgesic intake in the past one month were excluded from the study.

3. Sample Size Calculation

The sample size was calculated as 15 in each group based on the formula $N=Z^2p(1-q)D/E^2$, where the prevalence of postoperative pain after root canal treatment was taken as ten per cent. Design effect was taken as one and z =1.28 assuming the statistical power to be eighty per cent.

4. Randomization

The patients were randomly allocated with Ralloc software into two groups of 15 patients each: Group I–two-visit RCT with calcium hydroxide intracanal dressing and Group II– single-visit RCT with PAD as an adjunct.

5. Endodontic Therapy

The endodontic therapy was performed following the standard operating protocol at the department. The teeth were anaesthetized with 2% lignocaine local anaesthetic injection. After achieving isolation with the help of a rubber dam, all the caries was removed, and access was opened into the pulp chamber under aseptic conditions. For obtaining the root canal working length, digital radiographs were taken, and the working length was confirmed by electronic apex locator (Root ZX, J. Morita, Japan). The root canal preparation was performed in a crown-down manner using ProTaper Universal (Dentsply Maillefer, Ballaigues, Switzerland) instruments under copious irrigation with 10 ml of 2.5% sodium hypochlorite (NaOCl) solution (Hyposol, Prevest Denpro Limited, Jammu, India). The canals were finally flushed with 10 ml of saline and dried with sterile paper points. An envelope was opened at this stage, and the procedure was performed based on study group allocation as follows:

Group I (two-visit RCT with calcium hydroxide intracanal dressing): Calcium hydroxide powder (Super Dental Products, New Delhi, India) was mixed with normal saline and slurry was placed with the help of lentulo spiral inside the root canal space. The access cavity was sealed with temporary restorative material (Cavit). The patient was recalled after one week. The canal was reopened, cleaned, and obturated at this visit with AH-Plus sealer and Gutta-percha using warm vertical compaction technique.

Group II (single-visit endodontic therapy with PAD as an adjunct): A photoactivated disinfection portable control unit system (PAD™ red system, Denfotex Light Systems Ltd., Fife, United Kingdom) containing a low power InGaAsP diode laser of 635nm wavelength was used. About 0.8ml of PAD solution (Denfotex Light Systems Ltd, Fife, United Kingdom) was injected into the canal with a Monoject (Kendall-Covidien, Mansfield, MA) needle (27G × 1¼") placed 1mm short of the working length. The solution was left inside the canal to establish a contact period of 5 minutes. Thereafter, it was agitated with a #25-sized ISO K file for 60 seconds. The endodontic mode was selected, and the device was set at 100mW output power. A 400µm diameter disposable fibre-coupled diode laser tip emitting 70% of light uniformly along the length and 30% at the tip was placed within 2mm of the root apex. The solution was irradiated for 150 seconds by moving the tip spirally in apical to coronal direction 6-7 times. After this, irrigation was performed with 10ml of sterile saline (Albert David Limited, Ghaziabad, India) and the canal was dried. Obturation was performed with AH-Plus (Dentsply Maillefer, Ballaigues, Switzerland) sealer and Gutta-percha using warm vertical compaction technique.

6. Pain Assessment

The Heft-Parker visual analogue scale (100-mm VAS) was used for the assessment of pain[17]. Each patient received instruction on how to use a 100-mm VAS to assess pain. The preoperative pain score was recorded in front of the clinician. Immediately after completion of the first visit (i.e. calcium hydroxide dressing in group I and obturation in group II), each patient received instruction to complete VAS at 4-, 24-, 48-, and 72-hour postoperative intervals. A mild analgesic (400 mg of ibuprofen) was prescribed. The patients were advised to take medicine in case it is required for pain relief. They were also asked to record the number of analgesic tablets on their VAS forms.

The data were recorded in an Excel sheet and analyzed through SPSS 16 software. One-way ANOVA post hoc Tukey test was used to compare the VAS scores.

7. Results

A total of 30 patients with no dropouts participated in the study, and the results are based on VAS records of all the patients. The baseline preoperative pain scores for the study groups were comparable with no statistically significant

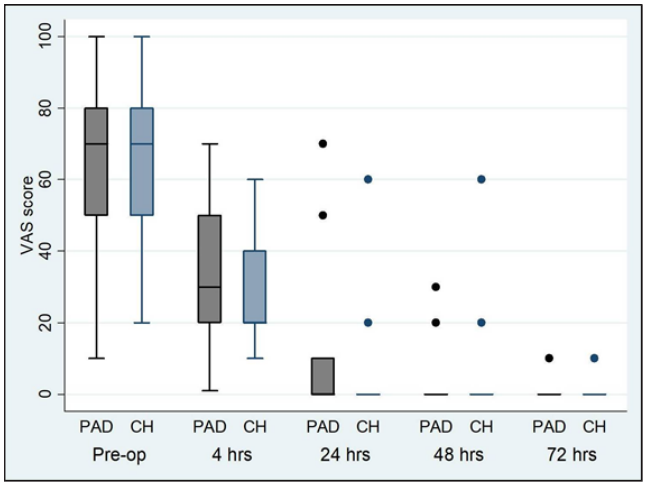


Figure 1. Comparison of pre- and post-operative pain levels (VAS scores) in PAD (Photoactivated disinfection) and CH (Calcium hydroxide) groups.

difference (p>0.05) (Figure 1). When evaluating patients experiencing moderate or severe pain, the incidence and intensity of symptoms were significantly lower with group I at 4 hours. However, the difference in VAS score was statistically insignificant at 24, 48, and 72 hours for both the study groups. None of the patients required to take any prescribed medicine for pain relief.

8. Discussion

The pain experienced after endodontic therapy, irrespective of its degree of severity, can be described as postoperative pain. It is influenced by various pre-, intra-, and post-operative factors[18]. The persistence of postoperative pain is considered as a poor indicator for tooth survival of endodontically treated teeth[19]. The success of endodontic therapy is determined by the degree of elimination of intraradicular bacteria. Root canals with the negative culture at the time of obturation are associated with a higher success rate[20]. Conventionally, two-visit endodontic therapy with placement of intracanal medicament with intent to achieve complete disinfection of root canal space is recommended for teeth with pulp necrosis and symptomatic apical periodontitis.

PAD has been proposed as a strategy for "optimized single-visit disinfection approach" to accomplish root canal treatment of such teeth in a single visit. PAD has been used as a synonym to the use of PDT in dentistry[21]. It refers to a treatment that utilizes light (low-level laser or LED of 635nm) to activate a photosensitizing agent in the presence of oxygen, resulting in the production of reactive radicals capable of inducing cell death[22]. The efficacy of PAD depends on the ability of photosensitizer dye to interact with and penetrate the cell membrane of the target microorganisms. The use of an amphiphilic PS with an affinity for both Gram-positive and Gram-negative bacteria is recommended for endodontic infections[23].

The pain experienced after endodontic therapy irrespective of single- or multiple-visit treatment is a frequent finding. The intensity of postoperative pain correlates with preoperative level and degree of tissue damage during the procedure[24]. There is a risk of a periapical insult during each visit of endodontic therapy, and multiple entry procedures can cause more postoperative pain[25]. In the present study, the postoperative pain experience in calcium hydroxide group was minimal. This could be attributed to its antimicrobial or tissue-altering effects and the ability to control the inflammatory process and induce repair[26].

Single-visit RCT is believed to be more painful because an obturated canal acts as a closed system and does not provide a vent for inflammatory exudates in the periapical tissues subsequent to the endodontic procedure. However, interesting findings were that there was a decrease in the severity of pain in teeth after single-visit RCT, which received PAD treatment as a disinfection adjunct. One possible explanation for this could be the influence of photodynamic therapy on the periapical tissues. Manufacturers recommend delivery of PAD dye with positive pressure syringe, followed by the agitation of the solution. Studies have reported that some degree of irrigant extrusion occurs even with the use of negative pressure irrigation system[27]. Thus, it is probable that some amount of photosensitizer compound may escape into the periapical tissues during the use of PAD procedure in the root canal system. Inactivation of inadvertently extruded material beyond the apex could also potentially affect the periapical host cells. It could inactivate the extruded bacteria resulting in a minimal inflammatory response. It can also modulate the host immune response and induce healing of the periapical lesion. Another possible explanation for the decrease in postoperative pain in the PAD group can be attributed to its anti-inflammatory effect. It has been documented that photodynamic therapy treatment inactivates the host-derived cytokines TNF-alpha and IL-1beta, which are associated with destructive inflammation[28]. It can also lead to decreased production of C-reactive protein which is responsible for the activation of the complement and increase in monocytic production of tissue factors. Thus, apart from the disinfection of the root canal system[29], the PAD has a potential ability to reduce postoperative pain after endodontic therapy.

9. Conclusion

The Null hypothesis of the study was accepted. There is no difference in the postoperative pain experience when the tooth with the diagnosis of pulp necrosis and symptomatic apical periodontitis is either completed in the single visit after optimized disinfection with PAD or placement of intracanal medicament in two visit endodontic therapy.

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