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Evaluation of Effect of 15% and 17% EDTA Using 5.25% Sodium Hypochlorite and 2% Chlorhexidine as Irrigants on the Incidence of Dentinal Microcrack Formation During Root Canal Preparation Using Stereomicroscope: An in vitro Study

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Abstract

In the present study, effect of 15% and 17% EDTA using 5.25% NaOCl and 2% Chlorhexidine as irrigant was evaluated on incidence of dentinal microcracks formation during root canal preparation using stereomicroscope.75 freshly extracted premolars were divided into 1 Control and 4 Experimental groups (n =15). Teeth in all Groups were coronally flared with GG Drills. Canals were prepared with Protaper File system. In control group only saline used as irrigant, while 2% CHX, 5.25% NaOCl and 17% and 15% EDTA in experimental groups. Crowns were removed 2mm above CEJ using Diamond Discs. Dentinal cracks were evaluated under stereomicroscope 25x. Chi square Test, Fisher's Exact Test and Kruskal

Wallis, One way ANOVA test were used for Statistical analysis. Least (Zero) number of dentinal microcracks were seen highest with the Group1 followed by Group 2, group 4, group 5 and group 3 whereas, Maximum (Two) number of dentinal microcracks were seen highest with the Group 3.It was concluded that least number of dentinal microcracks was seen with control group whereas, maximum number of dentinal microcracks with Group 3 in 5.25% NaOCl+ 15% EDTA.

Keywords: Chelating Agent, Dentinal Microcracks, Irrigants.

Introduction

A successful root canal treatment, ensures the removal of all contents of the root canal system before and during cleaning and shaping of the canals.[1] Thorough cleaning entails the use of instruments to physically remove substances, irrigating systems to flush loosened materials away, and chemicals to dissolve contents from inaccessible regions.[1] Because nickel-titanium (NiTi) was first introduced to endodontics in 1998[2], advancements in NiTi rotary instruments have led to various design concepts and new techniques for root canal preparation[3,4]. NiTi's superelasticity allows them to be used in continuous rotation with a decreased incidence of canal transportation [5, 6]. Rotary instrumentation is associated with less apical extrusion of debris and microorganisms [7, 8] and requires less time compared with hand instrumentation [9].

Despite these advantages, instrumentation with NiTi rotary files can potentially induce microcrack formation in the canal walls at different levels along roots [10, 11]. In a study conducted by Yoldas O et al in 2012, up to 60% of prepared teeth showed dentinal microcracks[12]. Also Bier et al[13] observed cracks in the horizontal sections of 16% of the roots instrumented with the ProTaper system. While instrumentation, the contact between instruments and dentin creates many momentary stress concentrations in dentin that may cause dentinal defects [14]. Such stresses are transmitted through the root to the surface where they might overcome the bonds holding dentin together [15]. Liu et al [16] observed cracks at the apical root surface in 25% of the roots instrumented with the ProTaper. During root canal preparation, lubricants are used for emulsifying and suspending the debris produced by the mechanical action of files[16]. Another function of lubricants is to facilitate mechanical action of endodontic hand or rotary files (Ruddle 2002)[17] . The use of pastetype lubricants is routinely recommended in order to reduce stresses oninstruments and improve hard tissue debridement [18].Because of complexity of root canal anatomy & limitation of instrumentation, irrigation has gained increasing attention since mechanical instrumentation cannot sufficiently disinfect root canals. Irrigants are required to eradicate microbial flora.

Thus, the purpose of this study is to evaluate the effects of 5.25% Sodium Hypochlorite & 2% Chlorhexidine Gluconate using 15% & 17% EDTA on Dentinal microcrack formation during Root Canal Preparation using Stereomicroscope.

Materials and methods

A total seventy five freshly extracted premolars for orthodontic purpose were used and randomly divided into 1 control group and 4 experimental groups (n =15). The teeth in all the Groups were were coronally flared with Gates Glidden Drills. Canals were prepared with Protaper File system (Dentsply Maillefer, Ballaigues, Switzerland) till S2. In control group (group 1) only saline was used as an irrigant. The difference between the experimentalgroups was the following: in

group 2, 5.25% NaOCl with 17% EDTA; in group 3, teeth were irrigated with 5.25% NaOCl with 15% EDTA ; in group 4, 2% CHX with 17% EDTA was used for

irrigation; and in group 5, 2% CHX and 15% EDTA was used as an irrigant. Root canals were irrigated with 10 ml of either 15% EDTA/17% EDTA for 1 minute, followed by 10 ml of 5.25% NaOCl for 2 minutes or 15% EDTA /17% EDTA for 1 minute, followed by 10 ml of 2 % Chlorhexidine for 2 minutes in order to achieve effective removal of both the organic and inorganic components of the smear layer. This irrigation protocol was repeated thrice for each sample of the tooth. The crowns were removed 2mm above the cementoenamel junction to achieve straight - line access and

a reference horizontal plane using Diamond Discs. Here 15% and 17% EDTA were used as Chelating agents in coordination with the irrigants as 5.25 % NaOCl and 2 % CHX. The root surfaces were observed under stereomicroscope under magnification 25 X. The presence of any dentinal defects or cracks was noted.

Microscopic Observation

Horizontally sectioned (decoronated) root surfaces at the level of 2mm above the cementoenamel junction were then observed under stereomicroscope at a magnification of 25 X and images

were blindly evaluated by 2 operators for presence of microcracks. Statistical analysis was performed using Chi square test, Fisher Exact test, and Kruskal - Wallis test at 5% level of significance.

Results

This in vitro study was carried out with the aim to evaluate the effects of 5.25% Sodium Hypochlorite & Chlorhexidine Gluconate using 15% & 17% EDTA on Dentinal microcrack formation during Root Canal Preparation using stereomicroscopic analysis. The Data so obtained was tabulated (Figure I) and subjected to statistical analysis along with mean values respectively (Figure II). Group comparison was performed using Chi square, Kruskal wallis Test and Fisher exact test to analyse the effects of 5.25% Sodium Hypochlorite & Chlorhexidine Gluconate using 15% & 17% EDTA on Dentinal microcrack formation between the experimental groups. A *p* value of <0.05 was used to determine significance. Least (Zero) number of dentinal microcracks were seen highest with the Group1 followed by Group 2, group 4, group 5 and group 3 whereas, Maximum (Two) number of dentinal microcracks were seen highest with the Group 3 .

Irrigation combination groups	Total no. of Samples(N=30)	No of dentinal microcrack			
		0	1	2	Total
Group 1	6	5	1	0	1
Group 2	6	3	2	1	3
Group 3	6	0	3	3	6
Group 4	6	4	2	0	2
Group 5	6	3	3	0	3

Note: No. of dentinal microcracks are according to the Scoring criteria of 0, 1 and 2 respectively

Figure 1: Dentinal micro cracks in different groups

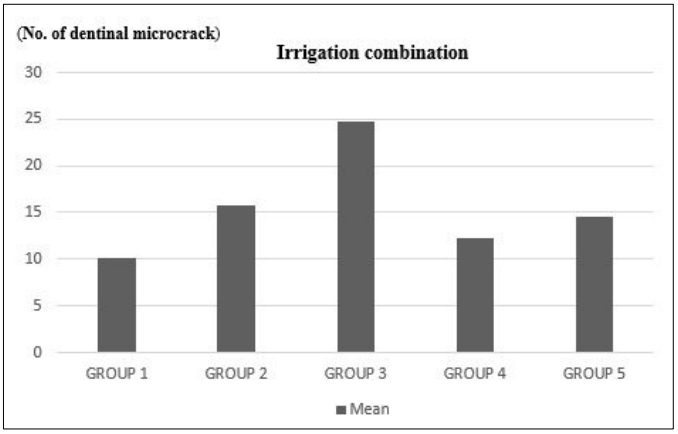

Figure 2: Mean values of dentinal microcracks with different Irrigation combinations

Discussion

The main objectives of endodontic treatment are cleaning, shaping and obturating the root canal system in 3 dimensions and preventing reinfection. It has been found that mechanical endodontic instruments although provides 90% of canal debridement, but alone it cannot accomplish the biologic objectives as irregularities in the canal system that hinders complete debridement. [25] EDTA is widely used as a chelator in endodontic therapy. Chelation is a physico-chemical process which involves the uptake of

multivalent positive ions by specific chemical substances. In the specific case of root dentine, the agent reacts with the calcium ions in the hydroxyapatite crystals. This process can cause changes in the microstructure of the dentine and changes in the Ca: P ratio. In this in vitro study, presence of Dentinal Microcracks has been evaluated. A total seventy five freshly extracted premolars for orthodontic purposes were used and randomly divided into a control group and 4 experimental groups (n = 15).

In all the groups; between instrumentations, each canal was subjected to 2 different irrigating solutions in combination with 2 different chelating agents irrigants as mentioned below:

GROUP 1 (Control) - Normal Saline

GROUP 2 - 5.25% NaOCl + 17% EDTA

GROUP 3 - 5.25 % NaOCl with 15% EDTA

GROUP 4 - 2% CHX with 17% EDTA

GROUP 5 - 2 % CHX with 15% EDTA

The Cervical Third of the sectioned root surface were observed under stereomicroscope with magnification 25 X. Thus, the presence of any dentinal defects or cracks was noted. The results showed that Least number of dentinal microcracks were seen with the Group 1 followed by Group 2, group 4, group 5 and group 3 , whereas Maximum number of dentinal microcracks were seen with the Group 3. Hence, it was concluded that Group 3 showed Maximum No. of Dentinal Microcracks whereas, Group 1 showed least number of Dentinal Microcracks respectively. Thus, irrigation has a central role in endodontic treatment. The irrigants facilitate removal of microorganisms, tissue remnants, and dentin chips from the root canal space during and after instrumentation through a flushing mechanism. Irrigating solutions also help prevent

packing of the hard and soft tissue in the apical root canal, which could otherwise cause a variety of complications such as transportation, zipping, and extrusion of infected material into the periapical tissues. Some irrigating solutions can dissolve organic or inorganic tissue. Chelators were first introduced to endodontics by Nygaard-Ostby (1957)[19], who recommended the use of a 15% EDTA solution (pH 7.3) with the following composition: Disodium salt of EDTA (17 g);

Distilled water (100mL); 5M sodium hydroxide (9.25 mL) .Also, studies have reported that chelators cause decalcification of dentin.Thus, it is important to understand mechanism of dentin matrix destruction by chemical solutions. EDTA removes calcium ions (Ca^{2+}) from mineral tissue, including dentin. Root canal irrigants may alter the chemical and structural composition of dentin by changing its permeability and solubility characteristics.

Nevertheless, further long term clinical studies are necessary to confirm these results and evaluate their relevance to treatment outcome.

Conclusion

Thus, within the limitation of the study it is concluded that least number of dentinal microcracks was seen with control group whereas, maximum number of dentinal microcracks with Group 3 in 5.25% NaOCl+ 15% EDTA.

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