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Comparative Evaluation of Effect of Dentin on the Ph of Chlorhexidine Based Intracanal Irrigants

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Abstract: *The aims of endodontic treatment in cases of apical periodontitis are to reduce as much as possible the number of microorganisms inside the root canal system and to inactivate toxins produced by them. Chlorhexidine has a wide spectrum of antimicrobial activity and is known for its property of substansivity. It is also known that dentin exerts a buffering effect under wide pH variations, and may be responsible for decreasing the antimicrobial activity of drugs inside the root canal. The objectives of this study were to assess the pH of different solutions of chlorhexidine gluconate in presence of dentin at various time interval. Dentin powder was obtained from extracted human teeth and added as 1.8% to the volume of the solutions. A pH meter was used at five different moments to assess pH in medium: immediately after preparation and after 24 h, and 7, 14. Results were analyzed by one way ANOVA test. Statistically significant differences were observed in the every group and least change in pH was observed in 20% chlorhexidine gluconate at all time intervals when compared to the other groups(P < 0.05).*

Keywords: *Chlorhexidine gluconate. pH, QMiX, substantivity*.

I. Introduction

The aim of irrigation in endodontic therapy is to eliminate micro organisms from the root canal system. Therefore, some form of irrigation and disinfection is necessary to remove residual tissue and to kill microorganisms. Chemical treatment of the root canal can be arbitrarily divided into irrigants, canal rinses and inter-appointment medicaments (1). Chlorhexidine (CHX) is used widely as an endodontic irrigant and medicamen Different Chlorhexidine gluconate based irrigating solutions are widely used in the process because of their antimicrobial activity. The antimicrobial activity of chlorhexidine based irrigating solutions is pH dependent & is optimal at a pH level of 5.5-7.0 (2). There are reports that dentin influences the pH of irrigating solutions and medicaments. In light of incidence of decrease in Antimicrobial activity of irrigating solutions by alteration of pH in presence of dentin (3), this study deals with evaluation of pH change of five different chlorhexidine based intracanal irrigants in presence of dentin. The aim of the study is to evaluate the effect of dentin on the pH of Chlorhexidine gluconate based irrigating solution. a)2% Chlorhexidine gluconate b)2% Chlorhexidine digluconate c) 20% Chlorhexidine gluconate d)QMiX at different time intervals i.e immediately, after 24 hrs, after 7 days and after 14 days.

II. Materials And Methods

Ten extracted human teeth were cleaned and autoclaved at 121_C for 15 min, as described by Haapasalo et al. (3). Then, teeth were cut perpendicularly to their axes immediately below the enamel–cement junction using carborundum abrasive disks (Moyco Union Broach, York, PA, USA). Dentin powder was obtained by using spherical dental burs #4 (KG-Sorensen, Sa˜o Paulo, Brazil) inside the root canal, without coolant, in low speed hand piece. All dentin power was stored in plastic flasks.

Solutions are taken in flask and pH was determined in 1 ml of each of them. Dentin powder was added as 1.8% of the medication volume (4). solutions were individually placed in plastic flasks and divided into the following groups: G1 – 2% chlorhexidine gluconatel (Fo´ rmula & Ac¸a˜ o, Sa˜o Paulo, Brazil); G2 – 2% chlorhexidine digluconate ; G3 – 20% chlorhexidine gluconate Group4 – QMiX. A pH meter with electrodes sensitive to hydrogen ions was used to determine the pH of the mixtures (pH Meter, Model E520, Metrohm Herisau, Switzerland). The microelectrode was calibrated at pH 7 using standardized solutions before any measurement, and after use, it was washed with plenty of distilled water. pH was assessed at four different moments: immediately after preparation and after 24 h; 7 and 14.

III. Results

The results were compared using One Way ANOVA and Posthoc test: Bonferroni-Holm to evaluate the pH change fron within the groups at different time interval and amongst the at different time interval. Significant difference was found within the groups at different intervals (table 1) and also within the groups (table 2) with overall reduction in pH of solutions with time. Least variation of pH was seen in 20% Chlorhexidine gluconate solution when compared to other groups (graph 1)

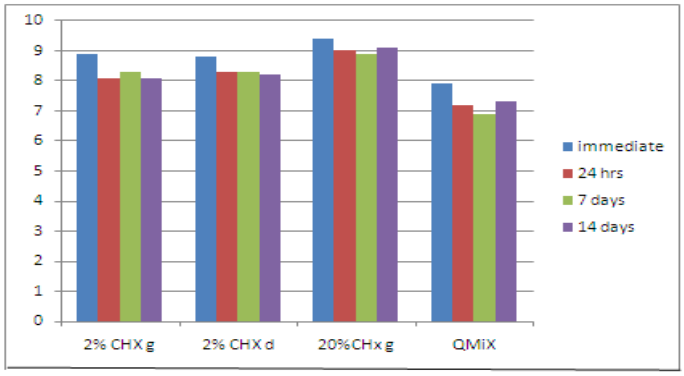
Table 1: mean p values amongst the group.

	immediately	24 hrs	7 days	14 days	P value	difference
2%chxg	8.8±0.12	7.92 ± 0.13	8.24 ± 0.08	8.06 ± 0.05	<0.001*	Imme vs 24 <0.001*
						Imme vs 7 <0.001*
						Imme vs 14 <0.001*
						24 vs 7 0.001*
						24 vs 14 0.06
						7 vs 14 0.06
2 % chx d	8.8 ± 0.07	8.28 ± 0.08	8.26 ± 0.05	8.16 ± 0.11	<0.001*	Imme vs 24 <0.001*
						Imme vs 7 <0.001*
						Imme vs 14 <0.001*
						24 vs 7 0.66
						24 vs 14 0.09
						7 vs 14 0.11
20 % Chx	9.4 ± 0.1	9 ± 0.15	8.9 ± 0.1	9.08 ± 0.08	<0.001*	Imme vs 24 <0.001*
						Imme vs 7 <0.001*
						Imme vs 14 <0.001*
						24 vs 7 0.26
						24 vs 14 0.34
						7 vs 14 0.01
QMix	7.88 ± 0.04	7.2 ± 0.07	6.9± 0.14	7.26 ± 0.05	<0.001*	Imme vs 24 <0.001*
						Imme vs 7 <0.001*
						Imme vs 14 <0.001*
						24 vs 7 0.002*
						24 vs 14 0.17
						7 vs 14 0.0007*

Table 2: mean p values within the group

	2 % chx g	2 % chx d	20 % chx	qmix	P value	Difference
immed	8.8±0.12	8.8 ± 0.07	9.4 ± 0.1	7.88 ± 0.04	<0.001*	2 % chx g vs 2 % chx d 1
						2 % chx g vs 20 % chx <0.001*
						2 % chx g vs qmix <0.001*
						2 % chx d vs 20 % chx 0.001*
						2 % chx d vs qmix <0.001*
						20 % chx vs qmix <0.001*
24	7.92 ± 0.13	8.28 ± 0.08	9 ± 0.15	7.2 ± 0.07	<0.001*	2 % chx g vs 2 % chx d <0.001*
						2 % chx g vs 20 % chx <0.001*
						2 % chx g vs qmix <0.001*
						2 % chx d vs 20 % chx 0.001*
						2 % chx d vs qmix <0.001*
						20 % chx vs qmix <0.001*
7	8.24 ± 0.08	8.26 ± 0.05	8.9 ± 0.1	6.9± 0.14	<0.001*	2 % chx g vs 2 % chx d 0.68
						2 % chx g vs 20 % chx <0.001*
						2 % chx g vs qmix <0.001*
						2 % chx d vs 20 % chx 0.001*
						2 % chx d vs qmix <0.001*
						20 % chx vs qmix <0.001*
14	8.06 ± 0.05	8.16 ± 0.11	9.08 ± 0.08	7.26 ± 0.05	<0.001*	2 % chx g vs 2 % chx d 0.11
						2 % chx g vs 20 % chx <0.001*
						2 % chx g vs qmix <0.001*
						2 % chx d vs 20 % chx 0.001*
						2 % chx d vs qmix <0.001*
						20 % chx vs qmix <0.001*

Graph 1: comparative evaluation of pH changes amongst and within the group



IV. Discussion

The difficulty in eliminating microorganisms, remain in the root canal system and dentinal tubules, even after cleaning and filling procedures, underscores the need for complete root canal preparation with intracanal dressing (5,6) .Chlorhexidine gluconate solutions are widely used in root canal irrigation because of their known property of antimicrobial activity & substantivity. As there are optimal conditions for the action of

any certain compound, pH plays a determinant role in their use. As for 2%CHX gluconate the study predicts that the pH must significantly get modified by the presence of dentin to values higher than the optimum for its antimicrobial activity. These findings are in agreement with previous reports (3) . Chlorhexidine is cationic biguanides that seem to act by absorbing onto the cell wall of micro organisms resulting in leakage of intracellular components. A study conducted to assess the pH of 2% Chlorhexidine gel & calcium hydroxide alone or in combination,as well as the influence of dentin on pH of these compounds and concluded calcium hydroxide with propylene glycol as the vehicle always showed high pH, demonstrating that this a compound not affected by the presence of dentin (7). Anastasia Agrafioti et al (2013) Conducted a study to evaluate the alteration in pH of Calcium hydroxide, 2% Chlorhexidine gel & their combination after adding dentin powder from the root canal walls & the pulp chamber floor at different time intervals as immediate, after 24 hrs, on day 7 & 14. A significant decrease in pH of Calcium hydroxide was observed after 14 days when dentin from root canal walls was added whereas the pH value of combination was not influenced by root canal dentin & a reduction was observed after 14 days as in control group. The pH value did not alter even after 14 days when pulp chamber floor dentin was added. However, in certain conditions pH levels may allow survival or growth of some bacterial strains as they vary in their pH tolerance ranges & most grow wel in 6-9 pH. E.coli, P. vulgaris, Enterobacter aerogenosa & Pseudomonas can survive in pH 8-9.These species can cause secondary infections in root canal. Chlorhexidine as well as tetracyclines have a unique feature in that dentine medicated with it acquires antimicrobial substantivity. The positively charged ions released by CHX can adsorb into dentine and prevent microbial colonization on the dentine surface for some time beyond the actual the period of time of application of the medicament (8) Antimicrobial substantivity depends on the number of CHX molecules available to interact with the dentine. Therefore, medicating the canal with a more concentrated CHX preparation should result in increased resistance to microbial colonization.

The antibacterial substantivity of three concentrations of CHX solution (4%, 2% and 0.2%) after 5 min of application has been evaluated. Results revealed a direct relationship between the concentration of CHX and its substantivity (9). Modulating effect of dentine on CHX The root canal milieu is a complex mixture of a variety of organic and inorganic compounds. Hydroxyapatite, the main component of dentine, is the major representative of inorganic components present. In addition, inflammatory exudate, entering the apical root canal in purulent infections, is rich in proteins, such as albumin. The relative importance of the various organic and inorganic compounds in the inactivation of root canal disinfectants have been studied restrictively (3).

Difficulties in designing experiments that will give reliable and comparable data have been some of the greatest challenges for researchers for many years. Haapasalo et al. (3) introduced a new dentine powder model for studying the inhibitory effect of dentine on various root canal irrigants and medicaments. They investigated the modulating effect of dentine on the antibacterial activity of saturated CA(OH)2 solution, 1% NaOCl, 0.5% and 0.05% CHX acetate and 2/4% and 0.2/0.4% IKI. Dentine powder had an inhibitory effect on all medicaments tested. The effect was dependent on the concentration of the medicament as well as on the length of time the medicament was pre-incubated with the dentine powder before adding the bacteria.

V. Conclusion

Thus, based on the results of this research it can be concluded that pH plays a key role in the antibacterial property of Chlorhexidine gluconate based solutions. Further research needs to be conducted to determine the effect of these alterations on the antimicrobial activity.

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