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Comparative Evaluation of Microhardness of Human Root Dentin When Exposed to Two Different Intracanal Calcium Hydroxide Combinations: An In Vitro Study

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ABSTRACT

Aim: The objective of this study was to evaluate the effect of calcium hydroxide - distilled water mix and calcium hydroxide points on microhardness of human root dentin after 7 and 14 days application.

Materials and methodology: Thirty freshly extracted human mandibular premolars were used in this study. Access preparation was done and the root canals were instrumented till 40 K file size. All the teeth were decoronated at cementoenamel junction and the teeth were then randomly divided into three groups with ten teeth in each group. Teeth in Group I were filled with calcium hydroxide - distilled water mix. In group II calcium hydroxide points were inserted and group III was control group which had root canals filled with saline. The teeth in all groups were sectioned longitudinally into two equal slabs, mounted in acrylic blocks and were subjected to Vickers microhardness tester after 7 and 14 days period.

Statistical Analysis: The data was analysed by one way Anova and Tukeys test.

Results: There was no significant reduction in microhardness values between group I and group 2 after 7 days of period but there was more reduction in microhardness values of group I compared to group II after 14 days of period. Both after 7 and 14 days period, the microhardness reduction was lowest with the control group.

Conclusion: The reduction in microhardness can be due to application of calcium hydroxide combinations which can have adverse effects on root making it susceptible to fracture.

Keywords: Calcium hydroxide - distilled water mix, Calcium hydroxide points, microhardness test.

INTRODUCTION

The main objective of endodontic therapy is to prevent and control pulpal and periapical infections. Microbial flora play an important role in pathogenesis of periapical lesions and success of root canal therapy totally depends on their elimination from complex root canal system. Adequate chemomechanical preparation helps to reduce this microbial load, however complete elimination is difficult to achieve[1]. Intracanal medicaments used in between appointments helps to clear out the remaining existing bacteria[2]. Amongst all the intracanal medicaments available calcium hydroxide enjoys more popularity and is acknowledged to be more effective than others due to its excellent antimicrobial activity[2], biocompatibility, induction of hard tissue

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formation[1], inhibition of tooth resorption[3]. The antibacterial action of calcium hydroxide is due to its diffusion into calcium and hydroxyl ions and ability of hydroxyl ions to diffuse into dentinal tubules[5,6]. Despite these variable advantages, calcium hydroxide exhibits certain disadvantages like poor handling properties, distribution throughout the canal and complete removal from the canal is problematic. To mask these demerits, calcium hydroxide powder is mixed with various vehicles like distilled water, saline, polyethylene glycol, iodoform etc. for easy handling[7,8]. However, calcium hydroxide when mixed with vehicle affects the physical and chemical properties of the compound[9]. These alterations may also affect the microhardness of root dentin making tooth structurally weak[10]. To overcome these demerits of various calcium hydroxide combinations An innovative solution is calcium hydroxide releasing gutta percha points which claims to have enhanced mobility and greater release of hydroxyl ions through dentin[11].They contain calcium hydroxide instead of zinc oxide at a concentration of 50-54% (wt %). They serve as an effective alternative to calcium hydroxide paste and are available in ISO sizes of 15 to140. Thus this study aims to evaluate the microhardness of root dentin when exposed to two different intracanal calcium hydroxide combinations i.e. calcium hydroxide - distilled water mix and calcium hydroxide points after 7 and 14 days.

MATERIALS AND METHODS

Thirty freshly extracted human mandibular premolars were selected for the study. Clinical and radiographic examination was done to rule out any defects or canal obliterations. All teeth were cleaned thoroughly, debris and calculus was curetted out. Teeth were then stored in distilled water until their use. Teeth were decoronated at cementoenamel junction with a diamond disc, pulp tissue was extirpated and biomechanical preparation was completed by step back method upto 40 K (Mani) file size. Intermediate irrigation in between instrumentation was done with saline. All teeth were then randomly divided into three groups. Group I had 10 teeth in which calcium hydroxide powder (Neelkanth Finecham, Jodhpur,India) distilled water mix was inserted (fig 1). Excess calcium hydroxide was intentionally allowed to extrude beyond apex. Group II had ISO size 40 calcium hydroxide points (Hygiene, Coltene) (fig 2) inserted in root canals of 10 teeth along with 2-3 drops of water. Group III was control group in which canals of 10 teeth were filled with saline. Teeth in all groups were sealed apically with composite (Tetric Ceram, Ivoclar Vivadent) and coronally with a cotton pellet followed by composite. After 7 and 14 days period teeth were sectioned longitudinally into two equal slabs. The specimens were cleaned and rinsed with water. From 30 teeth 60 slabs were obtained. These were embeded in acrylic cylinders with the treated surface facing upwards and then sectioned horizontally to achieve 2 mm thin sections (fig 3). The specimens were polished with silicon carbide paper of various grits.

MICROHARDNESS TESTING

Microhardness testing was done with Vickers microhardness tester **(**Reichert Austria Make, Sr.No.363798) (fig 4) with a 100g load applied for 15 seconds dwell time. Indentations were made in middle third region of root 1mm away from central canal region. Microhardness values were calculated using the formula VHN =P x 1.8544 / d^2 (P=load applied in kg and d=arithmetic mean of the diagonals d1 & d2 caused by the indentation).

STATISTICAL ANALYSIS

The microhardness values for three groups were arranged in tabular form and statistical analysis was performed. Data was analysed by one way Anova and Post hoc Tukeys test. The p value was set at 0.05.

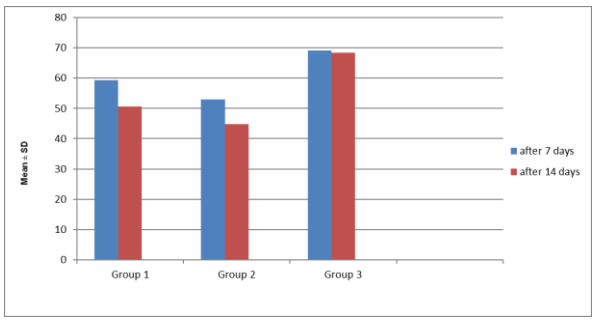
RESULTS

There was no significant reduction ($p<0.001$) in microhardness values between group I and group II both after 7 days period. However there was significant difference in hardness values between group I and group II after 14 days period of application . The reduction in microhardness was lowest in the control group. The mean microhardness values of groups given in table1.graph 1 shows the bar diagram with mean values of all the groups.

Table 1: mean microhardness values of all the groups.

Groups	Mean microharness values after 7 days	Mean microharness values after 14 days
Control groups	69.06	68.45
Group 1	59.3	44.89
Group 2	53	50.67

Graph 1: Mean microhardness values of all the group.



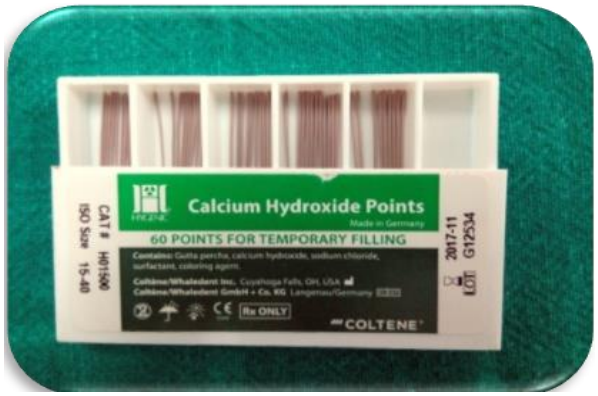
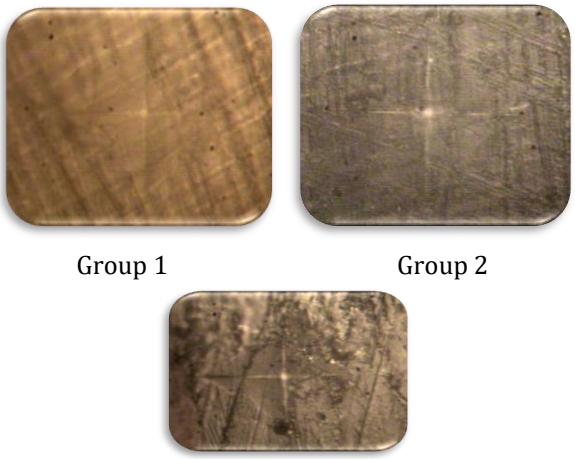


Fig 1: Calcium hydroxide points (Hygiene,Coltene.

Fig 2: Horizontal sections of teeth embedded in acrylic with treated surface facing upwards.

Fig 3: Samples subjected to Vickers microhardness tester (Reichert Austria Make, Sr.No.363798) for testing.



Group 1 Group 2

Group 3

Fig 4: Vickers microphotographs of the three groups

DISCUSSION

A number of intracanal medicaments are available today for their use in between appointments for disinfection of root canal system. Out of these calcium hydroxide is one of the most popular intracanal medicament.Calcium hydroxide is slow acting antimicrobial agent. The antimicrobial action is due to release of hydroxyl ions and their effects on bacterial cells lead to denaturation of proteins, damage to the DNA and cytoplasmic membrane[12]. For optimal effect, Ca(OH)2 should be in direct contact with the dentinal walls, throughout the whole canal[12].

Calcium hydroxide powder with aqueous, viscous or oily vehicles improves its handling properties. Various studies have showed that long term exposure of calcium hydroxide reduces the microhardness and fracture resistance of root dentin. But None of the studies till date have determined microhardness of dentin after calcium hydroxide points placement. So this study aimed to evaluate and compare the microhardness of dentin when exposed to calcium hydroxide distilled water mix and calcium hydroxide points after 7 and 14 days. In the present study microhardness was used as a parameter to assess the strength of the teeth, It is influenced substantially by other fundamental properties of the material such as yield strength, tensile strength, modulus of elasticity and crystal structure stability. Thus, it can be used as an indicator of the overall strength or resistance to deformation. Currently two types of microhardness testing methodologies are present, viz; Knoops and Vickers, but vickers microhardness testing was employed as it is more sensitive to measurement errors, less sensitive to surface conditions and small specimens can be tested with good accuracy[13]. In the present study, there was no significant reduction in microhardness values between group I and Group 2 after 7 days. The control group had least reduction in microhardness values. Hasselgreen et al in his study found that there is reduction in microhardness when calcium hydroxide is in proximity to root dentin[14]. However there was a significant difference in reduction of microhardness values after 14 days with calcium hydroxide distilled water group showing more reduction in microhardness than calcium hydroxide points group.the greater reduction in microhardness of dentin with the calcium hydroxide distilled water mix compared to calcium hydroxide points could be explained dut to the better penetrating ability of calcium hydroxide distilled water into the dentinal tubules. The results of this study are in correlation with the studies that evaluated effect of calcium hydroxide for a longer duration. White et al in their study have found that, calcium hydroxide when placed n root canals for 5 weeks ,resulted in a 32% decrease in the strength of bovine dentin[15]. Another study by Doyon et al, showed that calcium hydroxide treated teeth for 180 days had significant decrease in peak load at fracture when compared to exposure for 30 days[16]. Theory by Andreason states that proteolysis by calcium hydroxide weakens tooth upto 50% in a year.this could be explained due to disruption of links in collagen fibres and hydroxyappetite crystals followed by reduction in microhardness of root dentin[17].

CONCLUSION

The present observations of the study suggested that both the calcium hydroxide combinations which were tested in the study led to reduction of dentine microhardness after 7 days of application in the canals. The effect of calcium hydroxide points was milder after 14 days of application in the root canals when compared to calcium hydroxide distilled water mix. Further research testing is required to test the clinical relevance of these findings.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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