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Effect of E.D.T.A. (Smear Clear™) in removal of calcium hydroxide after its use as intracanal medication

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This study was carried out to determine if a final irrigation with E.D.T.A. (Smear Clear™) after the intracanal medication with calcium hydroxide ($Ca(OH)_2$) can reduce the residuals of the paste in oval canals. Twenty eight root canals of upper human canines were prepared apically until files nº 50, by means of rotational technique with K3 and Gates-Glidden burs #2 and 3 and irrigation of sodium hipochloryte. The root canals were dried with paper points. The $Ca(OH)_2$ in powder was mixed with a 20% of mineral coal, to pigment it and to this mixture distilled water was added, to obtain a paste. With a lentulo spiral the canals were filling, leaving the paste for 7 days. The paste was retired of two ways: in group 1 (14 canals), the paste was eliminated by means of hand filed with files type K nº 50 and irrigation with 10 ml of distilled water and in group 2 (14 root canals), after this same procedure, the root canals were filled with Smear Clear™ for 5 minutes. The root canals were dried, and roots were divided in mesio-distal sense, and both hemisections of the root canal were digitalized to 20X. The areas with paste residuals were quantified by means of Auto-CAD software. In group 1 it was observed residuals of the paste in the 9.25% of the dentinal surface, whereas in group 2 percentage of residual paste was 2.24%, with statistical difference between both groups (p=0.001). Conclusions: A final irrigation with Smear Clear™ reduces significantly the residuals of the paste of $Ca(OH)_2$ used like intracanal medication.

In the treatment of teeth with necrotic pulp, the most important clinical procedure is to eliminate the microorganisms and their products from the infected root canal with instrumentation and antiseptic solution irrigation [1]. In spite of their relevance, these procedures do not guarantee the elimination of the microorganisms [1-3]. To improve the disinfection several medicaments have been recommended to be placed in to the root canal.

Among them, calcium hydroxide ($Ca(OH)_2$) has shown to have antibacterial properties against the majority of the bacteria founded in endodontic infections [1,2]. This bactericidal effect attributes to hydroxyl ions [1,4] that spread through the dentinal tubules producing high pH levels in dentine [5], as well as by the carbon dioxide (CO_2) absorption [6], which is an essential metabolite for some bacteria present in infected root canals [7]. $Ca(OH_2)$ used as intracanal medication in the treatment of teeth with endodontic infection and periapical lesion, it is possible to obtain a greater percentage of periapical repairs [2-8]. It is indicate also for other clinical situations, like radicular reabsorption or apicoformation [9]. Also, $Ca(OH)_2$ has been used like an apical plug in cases of wide foramens, to avoid overfilling [10].

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Nevertheless Porkaew et al [11] and Foster [12] has pointed their concern about the residuals of the $Ca(OH)_2$ that can remain in the root canal after their elimination before the filling of the root canal, indicating the difficulty to remove it completely. Thus, it has been questioned the effect that could have these residuals in the endodontic therapy, since after made its biological functions, there is no necessity that the used $Ca(OH)_2$ remains in the root canal.

The objective of this study is to evaluate the permanence of residuals of aqueous paste of $Ca(OH)_2$ used as intracanal medication, after its removal by conventional technique, as well as to verify how it can improve the use of the Smear Clear™, that is preparing with ethylene-diamine-tetra-acetic acid (E.D.T.A.) and a surfactant agent in the removal of such residuals, since this chelating has the capacity to catch ions of calcium.

MATERIAL AND METHODS

Twenty eight upper canine of recent extraction were used, which stayed in distilled water. To all the pieces the coronary access was done with a bur number 4 to high rotation. After exploration of each root canal, Gates-Glidden burs number 3 and 2 at low rotation were used to obtain the radicular access in the cervical and medium thirds. One file K type nº15 was introduced in each root canal until being observed in foramen; of this length was subtracted one millimeter, and it was considered as root canal length. The preparation of the root canals was carried out with K3 files taper.04 (Sybron Endo, U.S.A.) to 300 r.p.m. irrigating

between each instrument with 5.25% NaClO, until number 50 as master file, making telescope until file 70 taper 04.
The root canals were dry with medium sterile paper points (Pearson, EUA). Chemically pure $Ca(OH)_2$ in dust (Productos Químicos Monterrey, México) with mineral coal (Productos Químicos Monterrey, México) in a proportion of 80%-20% were placed in a new capsule of an amalgamator (Whipp Mix, U.S.A) by 1 minute, to obtain a homogenous mixture. This was mixed in a slab glass with distilled water until a thick consistency was obtained.
All the root canals were fill with the paste by means of lentulo #40 (Zipperer, Germany), verifying radiographically their filling until the work length. The coronal access was sealed with Cavit R (Espe, Germany), leaving specimens in atmosphere of humidity to the 100% to 37 C by one week. After this time, a sagital cut was carried out in mesio-distal sense with a disc of carbide at low speed without getting to perforate the root canal, being retired later the coronal seal. The teeth were randomly divided in two equals groups of 14 upper canines.
The paste of each root canal was retired in two ways: the group 1 with stainless steel file number 50 K type by means of movements of filled and reaming until the work length, with 10 ml of distilled water as irrigation solution and a hypodermic needle gauge 27, arriving this on approximately 1 mm less from the root canal length. The root canals were dry by means of aspiration and medium paper points.
The paste of the group 2 was retired in a similar way that group 1. After it, the root canals were flooded with Smear Clear™ (Sybron Endo U.S.A.) by means of a hypodermic needle gauge 27, arriving this on approximately 1 mm short from the root canal length, leaving this solution by 5 minutes. Later, the root canals were dried in the same way as group 1. The pieces of both groups were divided with a slight blow of chisel and hammer.
The hemisections of each tooth were photographed in a Zeiss stereomicroscope in a 20X objective. These images were digitalized in a HP 6300 scanner, and evaluated with Auto-CAD program. With this program, the total surface of the root canal was measured as well as the surfaces that where remained $Ca(OH)_2$ residuals (identifiable by the mineral coal). Data evaluation was blind. The results are presented in percentage and the differences of the residuals of the pasted remains in the surfaces were evaluated statistically by means of Student's t-test. A p-value of <0.05 was considered statistically significant.

RESULTS

A digitalized image of the hemisections and its root canal can be observed in figure 1.

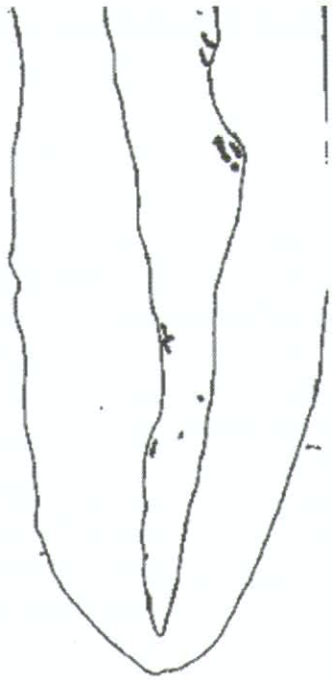

Figure 1. Digitalized image of a hemisection inner surface from Group 2. It is possible to see that majority of paste residuals (black dots) remained on the root canal irregularity, which are zones difficult to reach to the files.

The results of the surface in which remained residuals of the paste of $Ca(OH)_2$ is shown in figure 2, where the group in which Smear Clear™ was applied it shows minor amount of residuals of the paste in the root canals. Also it can be observed statistically significant difference between both groups ($p=0.001$).

DISCUSSION

Among the antiseptics used as intracanal medication, $Ca(OH)_2$ in paste is the most commonly used. Byström [1]; Souza et al., [8] and Sjögren et al., [2] have shown that the use of $Ca(OH)_2$ in a infected root canal, allows to obtain greater percentage of periapical repair that without its use. This is due to several factors; one of them is its bactericidal action against most of the microorganisms that remains in dentinal tubules and ramifications of the root canals contaminated after the preparation of the main root canal [1-3]. At the same time, exists others indications for the use of $Ca(OH)_2$ in endodontic, like the apexification, external reabsorption and radicular perforation [9]. When $Ca(OH)_2$ is placed in contact with the dentine, exists a penetration of hydroxyl ions in the dentinal tubules, that reacts with CO_2, and form calcite crystals, that cause precipitation which provoke physical lock of the dentinal tubules, reducing therefore the dentinal permeability [13]. Also $Ca(OH)_2$, when penetrates in the dentine causes changes in it, like disinfection [1-4] due to alcalinizating

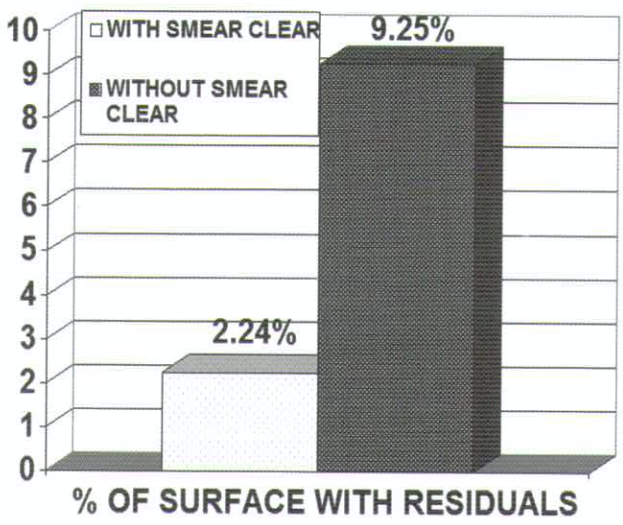

Figure 2. Percentage of dentinal surface where remained residuals of $Ca(OH)_2$ paste with and without the use of Smear Clear™.

[5]. Guigand et al., [14] observed that placing $Ca(OH)_2$ or calcium oxide in root canals, was a diffusion of calcium ions of these materials through the dentinal tubules, until 600 microns of the root canal.

The main objective of the intracanal medication is it antibacterial capacity. Once exerted this activity, there is no reason that so that $Ca(OH)_2$ remained in the root canal. Porkaew et al., [11] and Foster [12] indicated the possibility that $Ca(OH)_2$ residuals that remains in the root canal after its use, could have a negative effect in the seal of the filling by possible dissolution. Nevertheless, if this is possible, it must have filtration by apical foramen (due to a filling defect) or by coronary filtration. In these two situations, independently of the presence or not of $Ca(OH)_2$ residuals, the endodontic retreatment would be indicated. Holland et al., [15] placed $Ca(OH)_2$ in vitro, retiring it through instrumentation and increasing the caliber of master file until to 300 microns. They observed that in spite to eliminate a great amount of dentine (with any remainder of the medicament in its walls), there was significant diminution of the apical filtration. They indicate that the changes produced in the dentine, at tubules level, it was enough to improve the seal of the endodontic filling. On the other hand, Cruz et al., [16] placed in vitro $Ca(OH)_2$ pastes in prepared root canals, retiring pastes through instrumentation and irrigation, filling them later. They observed that in the root canals medicated with $Ca(OH)_2$ before his filling, there was less apical filtration that in the controls where this medicament was not used.

In this study, was observed that the use of Smear Clear™, was a significant diminution of the residuals of $Ca(OH)_2$ paste of like intracanal medication. In group 1, in the 9.25% of the dentinal surface was observed residuals of the paste, whereas Smear Clear™ was placed, this value diminish to 2.24%. Kenee et al., [17] do not observed differences in $Ca(OH)_2$ residuals, between a final irrigation with NaClO or E.D.T.A. This could be due to these authors used an E.D.T.A. without surfactant agent.

Eliminate all medicaments before the filling it is very difficult to do totality. Wilcox [18] showed that in the endodontic retreatment generally remain residuals of the filling materials on the dentinal walls, and point out the difficulty to eliminate completely of the root canal such materials. We observed in this study that most of the residuals of the paste remained lodged in irregularities of the root canal, where the files are not able to clean these zones in many of the root canals. Thus, the presence of $Ca(OH)_2$ by a time in these zones and no touched with instruments, would help to the chemical debridement of the tissue residuals and/or potentially present bacteria, collaborating in the action of the sodium hypochlorite [19].

It is important to indicate that the tooth selected for this study has critical anatomical conditions for the removal of any material of its root canal, since its morphology in the cervical and medium thirds tends to be oval [20]. The greater bucal-lingual diameter does that the instruments have much difficulty to reach the ends of the oval, making difficult the mechanical removal of the material that was placed. Cleaning and shaping the root canals with more circular form represents minor difficulty [21].

A good filling of the root canal requires of a suitable interphase between the cement of filling and the dentinal wall. Although minimum residuals of $Ca(OH)_2$ do not interfere with apical seal [15-16]. The application of Smear Clear™ after the mechanical removal of $Ca(OH)_2$ paste with irrigation before the filling, improves the condition of the dentinal walls of the root canal to receive the definitive filling. Under the conditions of the present study, we can conclude that: 1) The collocation of E.D.T.A. (Smear Clear™) in the root canal improves the removal of $Ca(OH)_2$ residuals in the dentinal wall that remains after their removal with irrigation with NaClO. 2) More studies are necessary to study the removal of $Ca(OH)_2$ pastes in root canals of different anatomy.

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Efecto de E.D.T.A. (Smear Clear™) en la remoción del hidróxido de calcio, luego de su uso como medicación intraconducto

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El objetivo del presente estudio fue determinar si una irrigación final con E.D.T.A. (Smear Clear™) después de la medicación intraconducto con pasta de $Ca(OH)_2$ puede reducir los residuos de la misma, en conductos ovales. 28 conductos de caninos superiores fueron preparados apicalmente a la lima 50 por técnica rotatoria con instrumentos K3 y fresas Gates-Glidden 2 y 3 e irrigación con hipoclorito de sodio. Los conductos fueron secados con puntas de papel. $Ca(OH)_2$ en polvo fue mezclado con carbón mineral en proporción de 80%-20% para pigmentarlo y se añadió agua destilada para obtener una pasta. Con una espiral lentulo los conductos fueron llenados, dejándola por 7 días. La medicación intraconducto fue retirada de dos maneras: en el grupo 1 (14 conductos) fue eliminada mediante limado manual con instrumentos tipo K #50 e irrigación con 10 ml de agua destilada. En el grupo 2 (14 conductos), después del mismo procedimiento, los conductos se inundaron con Smear Clear™ por 5 minutos. Los conductos fueron secados y las raíces fueron divididas en sentido mesio-distal. Ambas hemisecciones del conducto fueron digitalizadas a 20X. Con el software AutoCAD fueron cuantificadas las áreas donde permanecían residuos de la pasta. En el grupo 1, en 9.25% de la superficie fueron observados residuos, mientras que en el grupo 2, el porcentaje fue de 2.24%, observándose diferencia estadística significativa entre grupos. En conclusión, la irrigación final con Smear Clear™ reduce de manera significativa los residuos de la pasta de $Ca(OH)_2$ usada como medicación intraconducto.