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Root Canal Filling with Calcium Hydroxide Using Different Techniques

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Several different techniques for placing calcium hydroxide into root canals have been proposed, such as amalgam carriers, vertical pluggers, McSpadden compactors, Lentulo drills, files and special syringes. Because correct filling of the root canal is necessary for calcium hydroxide paste to act effectively, the aim of this research was to study different techniques of root canal filling with calcium hydroxide pastes in dog teeth. The placement of calcium hydroxide with a file, absorbent paper points and vertical pluggers presented the lowest number of empty spaces in the three thirds of the root canal, followed by the Lentulo drill and the McSpadden compactor.

Key Words: calcium hydroxide, intracanal dressing, techniques for placement of dressings.

INTRODUCTION

The use of an intracanal dressing increases the power of the sanitization process achieved by cleansing and shaping the root canal, making this medication an important aspect of root canal treatment (1,2). The selection of intracanal medication depends on the root canal microbiota and on the mechanism of action of the medication. Currently, calcium hydroxide is the most used intracanal dressing, due to its antimicrobial effect within the root canal, which is caused by its dissociation and its indirect and direct actions in the dentinal tubules. Estrela et al. (3) reported that the enzymatic effect of calcium hydroxide inhibits bacterial enzymes, leading to an antimicrobial effect and to tissue enzymatic activation which creates a mineralizing effect. These properties result from its high pH, which also determines a high release of hydroxyl ions.

Estrela et al. (4) studied the biological effect of pH on enzymatic activity of anaerobic bacteria. Because enzymatic sites are located on the cytoplasmatic membrane which is also responsible for such vital functions as metabolism, cellular growth and division, participation in the last stages of cell wall formation, lipid biosynthesis, electron transportation and oxidative phosphorylation, the authors believe that hydroxyl ions from calcium hydroxide develop their mechanism of action on the cytoplasmatic membrane. The effect of the high pH of calcium hydroxide alters the integrity of the cytoplasmatic membrane through chemical damage to organic components and transport of nutrients or through the destruction of phospholipids or unsaturated fatty acids of the cytoplasmatic membrane, which can be observed through the process of lipid peroxidation, a saponification reaction.

Taking into account the invasion of microorganisms within the dentinal tubules, the intracanal dressing must act at these sites and its action through direct and indirect contact must be considered (5,6). In order that calcium hydroxide can express its full efficacy, it is necessary to promote the dissociation and diffusion of hydroxyl ions, which requires the correct filling

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of the root canal.

Several different techniques for placing calcium hydroxide into root canals have been proposed (7-16). Cvek et al. (7) proposed the use of an injection syringe or Lentulo drill aided by effective lateral condensation. Webber et al. (14) highlighted the use of a plastic transporter that drives calcium hydroxide paste into the root canal followed by vertical compression, until its complete filling. Anthony and Senia (8) and Lopes et al. (15) suggested the use of a Lentulo drill. Krell and Madison (11) described the use of a Messing gun, stressing the simplicity and efficacy of this method. Leonardo and Leal (16) recommended the use of a special endodontic syringe with a long G-27 needle (Calen system). Estrela and Bammann (13) described root canal filling using files, absorbent paper points and vertical pluggers. Dunsha and Gutmann (9), evaluating different clinical methods for placing calcium hydroxide (amalgam carriers, Lentulo drill, injectable pastes, McSpadden compactors), pointed out that the clinician should know how to evaluate the situation and choose the most suitable method to promote the expected results. Sigurdsson et al. (12), comparing the Lentulo drill, endodontic file and syringe, reported that the best results were obtained with the Lentulo drill.

Because the correct filling of the root canal is necessary for calcium hydroxide paste to act effectively, the aim of this investigation to compare different techniques of root canal filling with calcium hydroxide pastes in dog teeth.

MATERIAL AND METHODS

The mandibles from 3 dogs were sectioned into blocks. Each block involved the 2nd and 3rd premolars (12 root canals). The specimens were kept in saline for 7 days. Teeth were prepared using the cervical preparation technique and a #50 K-type file (Maillefer, Ballaigues, Switzerland), 1 mm short of the apical foramen. The cervical third was flared using a #2 Gates-Glidden drill. Sodium hypochlorite (1%, 5 ml) was used with each file for irrigation during instrumentation. Teeth were kept in 17% EDTA (pH 7.2) for 3 min and then irrigated again with 1% sodium hypochlorite and dried.

All 12 root canals were filled with calcium hydroxide (Quimis, Mallinkrodt Inc., St. Louis, MO, USA), using saline solution as the vehicle. The calcium hydroxide had a viscosity of 3501 cP, 0.1 rpm (Reometer Digital Brodfield, model DV-III-LV, Philadelphia, PA, USA) corresponding to a toothpaste consistency. The 12 root canals were filled with each of 3 techniques: 1 = placement with file; 2 = placement with McSpadden compactor; 3 = placement with Lentulo drill.

In group 1, all root canals were filled using the last file used in preparation. Simultaneously to penetration-removal and counter-clockwise rotation movements of the file, the paste was condensed and compressed using files, absorbent paper points and vertical pluggers, until the cervical third was filled. Teeth were then radiographed in order to compare the compactness of calcium hydroxide paste. After root canals had been filled, they were emptied using a #10 file (K-type file, Maillefer) and irrigated with saline. New radiographs were taken to verify if canals were fully emptied so they could be reused.

In group 2, the 12 root canals were filled using #45 (25 mm) McSpadden compactors. An extra-large amount of calcium hydroxide paste was placed in the pulp chamber. The drill was introduced 3 mm short of the instrumentation apical limit and activated with constant speed and penetration-removal movement, turning to the right for 10 s. Movements were repeated more than once until the cervical third was filled. At this point, vertical compression was performed in the same way as in group 1, but using a vertical plugger. A radiograph was taken and root canals were completely emptied followed by a new radiograph as in group 1.

In group 3, a #4 Lentulo drill (25 mm) was used in the same way as the McSpadden compactor in group 2 and a radiograph was taken to evaluate paste compactness.

Three periapical radiographs (Ektaspeed EP21, Eastman Kodak Co., Rochester, NY, USA) were taken of each tooth of the three groups (1st initial; 2nd radiographs with graded square-lined transparency showing filled canal; 3rd after complete paste removal). All radiographs were made with the same machine (Spectro 70X, Dabi-Atlante, 60 KV, 10 mA, Ribeirão Preto, SP, Brazil) with a 4-cm film-focus distance and 0.5-s exposure. Radiographs were processed at once for the three groups, using a time-temperature method. All radiographs presented good quality image with satisfactory contrast and sharpness.

Techniques were evaluated considering the number of squares with empty spaces observed in the

radiographs with graded square-lined transparency. The parameter established was the number of squares completely filled in comparison with those with empty spaces of any size.

RESULTS AND DISCUSSION

The filling technique using the last file employed in the canal preparation, aided by absorbent paper points and vertical plugger, presented the lowest numbers of empty spaces in the three roots thirds followed by the Lentulo drill and McSpadden compactor. The apical third was the most difficult to be completely filled (Table 1).

Regarding the comparison between the use of these rotary instruments to fill root canals with calcium hydroxide paste, Lopes et al. (15) stressed that this difference may be related to the geometric shape of instruments. The McSpadden compactor has a larger straight section than the Lentulo drill, and when removed from the root canal, displaces the paste to the lateral, increasing the percentage of empty spaces.

Another factor that should be considered is that calcium hydroxide paste does not have a radiopaque substance, thus the paste should be very well condensed within the root canal to avoid empty spaces.

Because the calcium hydroxide paste used in this study had a saline vehicle, it acquired a hydrosoluble character, and thus its placement was more difficult and required the use of absorbent paper points and a vertical plugger to aid compression. Consistency is also an important aspect. A paste thicker than toothpaste that is placed using a file provides a better filling. When this type of paste is placed with rotary instruments, a higher number of empty spaces can be observed.

Table 1. Number of squares showing empty spaces and filling percentage of the 3 filling techniques.

	Empty spaces	Percent filling
File		
Apical	5	96.8%
Middle	3	98.1%
Third	0	100%
McSpadden compactor		
Apical	25	83.8%
Middle	23	85.1%
Third	6	96.1%
Lentulo drill		
Apical	16	89.6%
Middle	11	92.9%
Third	5	96.8%

Percentage of filling is based on the total number of squares in the graded square-lined transparency X the number of squares with empty spaces of any size.

Width and curvature of the root canal can influence complete or incomplete filling. Obviously, the wider and straighter the root canal, the easier will be the introduction. When Sigurdsson et al. (12) compared placement techniques of calcium hydroxide paste, using Lentulo drill, endodontic file and syringe (Calasept paste system, Scania Dental, AB) in mesiobucal canals of maxillary molars, prepared until instrument #25, they concluded that the Lentulo drill presented the best results, filling the entire working length.

It is opportune to remember that the understanding of the mechanism of action of calcium hydroxide pH on the control of bacterial enzymatic activity allowed Estrela et al. (4) to suggest the hypothesis of an irreversible bacterial enzymatic inactivation that occurs under extreme conditions of pH during long periods of time and also, a temporary bacterial enzymatic inactivation that occurs when pH returns to its ideal level for enzymatic action in time to allow this one to return to its normality. The irreversible enzymatic inactivation was reported by Estrela et al. (5) in an *in vitro* study that established the direct antimicrobial effect of calcium hydroxide on microorganisms, such as *Micrococcus luteus* (ATCC 9341), *Staphylococcus aureus* (ATCC 6538), *Pseudomonas aeruginosa* (ATCC 27853), *Fusobacterium nucleatum* (ATCC 25586), *Escherichia coli* and *Streptococcus sp*., during intervals of 0, 1, 2, 6, 12, 24, 48, 72 hours and 7 days. The alteration of the integrity of the cytoplasmatic membrane favoring the destruction of the microorganisms analyzed occurred after 72 hours. The reversible enzymatic inactivation can be observed in another study carried out by Estrela et al. (6) who evaluated the indirect antimicrobial effect of calcium hydroxide on dentinal tubules infected by different microorganisms, at intervals of 0, 48, 72 hours and 7 days. The results showed that calcium hydroxide was ineffective by distance action (indirect action) at 7 days against *Streptococcus faecalis* (ATCC 29212), *Staphylococcus aureus* (ATCC 6538), *Pseudomonas aeruginosa* (ATCC 27853) and *Baccillus subtilis* (ATCC 6633).

In addition to this research that supported the hypothesis suggested, Estrela et al. (4), studying the dentinal diffusion of hydroxyl ions of calcium hydroxide, observed that the change of pH on dentinal mass surface could require some time.

Properties such as hydrosolubility or not of the vehicle employed (viscosity differences), acid-base characteristic, higher or lower dentinal permeability and level of calcification can influence the speed of diffusion of hydroxyl ions. For a medication to attain its complete antimicrobial and mineralizing effectiveness, the correct filling of the root canal is necessary.

RESUMO

Estrela C, Mamede Neto I, Lopes HP, Estrela CRA, Pécora JD. Obturação do canal radicular com hidróxido de cálcio usando diferentes técnicas. Braz Dent J 2002;13(1):53-56.

Diferentes técnicas de colocação de hidróxido de cálcio têm sido propostas, como os insersores de amálgama, condensadores verticais, compactadores McSpadden, Lentulo, limas e seringas especiais. Considerando o preenchimento completo do canal radicular necessário para a efetiva ação do hidróxido de cálcio, o objetivo deste trabalho foi analisar a obturação de canais radiculares de dentes de cães com hidróxido de cálcio usando diferentes técnicas. A obturação do canal radicular com hidróxido de cálcio usando lima, pontas de papel absorvente e condensadores verticais apresentou o menor número de espaços vazios nos três terços do canal, seguido pelo Lentulo e pelo compactador de McSpadden.

Unitermos: hidróxido de cálcio, medicação intracanal, técnicas de obturação.

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