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INFLUENCE OF CALCIUM HYDROXIDE POINTS ON THE QUALITY OF INTRACANAL DRESSING FILLING

INFLUÊNCIA DO USO DE CONES DE HIDRÓXIDO DE CÁLCIO NA QUALIDADE DO PREENCHIMENTO DE CANAIS RADICULARES COM MEDICAÇÃO INTRACANAL

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ABSTRACT

Purpose. The aim of this study was to evaluate, in vitro, the quality of calcium hydroxide [$Ca(OH)_2$] paste filling (Ultracal, Ultradent) associated or not with $Ca(OH)_2$-containing gutta-percha points (Calcium Hydroxide Plus Points™, Roeko) in curved root canals. Material and Methods. One hundred and twenty roots of extracted human teeth, randomly divided into three curvature ranges (mild - 0 to 14°; moderate - 15° to 29°; severe - >30°) were used. After chemomechanical preparation, the roots were assigned to 4 groups (n=30), according to the technique of intracanal dressing placement: group 1 - $Ca(OH)_2$ paste was applied with a lentulo spiral; group 2 - $Ca(OH)_2$ paste was applied with a lentulo spiral and a $Ca(OH)_2$ point was inserted into the canal; group 3 - $Ca(OH)_2$ paste was applied with a Navitip™ tip (supplied with Ultracal system); group 4 - $Ca(OH)_2$ paste was applied with a Navitip™ tip and a $Ca(OH)_2$ point was inserted into the canal. The roots were cleared and the quality of apical third filling was assessed by a calibrated experienced examiner. The specimens were examined under stereomicroscopy and scored 1 to 4 (i.e., from inadequate to complete root canal filling). The results were analyzed statistically by ANOVA and Duncan's post hoc test at 5% significance level. Results. There were no statistically significant differences ($p>0.05$) among the curvature degrees in groups 1, 3 and 4. Severely curved roots in group 2 presented bordering significance ($p=0.05$). The groups that associated the use of $Ca(OH)_2$ paste and points (2 and 4) showed better apical filling than the other groups, but this difference was statistically significant ($p<0.001$) only for roots with severe curvature. Conclusion. According to the results of this study, the curvature degree did not influence the quality of filling. The techniques that used $Ca(OH)_2$-containing gutta-percha points yielded better filling of the apical third in roots with severe curvature.

Uniterms: Calcium hydroxide; Gutta-percha; Root canal; Intracanal dressing.

RESUMO

Objetivo. O objetivo deste estudo foi avaliar, in vitro, a qualidade do preenchimento de canais radiculares curvos com a pasta de hidróxido de cálcio [$Ca(OH)_2$] Ultracal (Ultradent), associada ou não a cones de guta-percha contendo hidróxido de cálcio (Calcium Hydroxide Plus Points™, Roeko). Material e Métodos. Cento e vinte raízes de dentes humanos extraídos, aleatoriamente distribuídas em 3 faixas de curvatura (leve - 0 a 14°; moderada - 15° a 29°; severa > 30°) foram utilizadas. Após o preparo químico-mecânico, as raízes foram divididas em 4 grupos (n=30) de acordo com o método de aplicação da medicação intracanal: grupo 1 – aplicação da pasta de $Ca(OH)_2$ com espiral de lentulo; grupo 2 – aplicação da pasta de $Ca(OH)_2$ com espiral de lentulo, seguida da introdução de um cone de $Ca(OH)_2$; grupo 3 – aplicação da pasta de $Ca(OH)_2$ com a ponta Navitip™ (fornecida com o Sistema Ultracal); grupo 4 – aplicação da pasta de $Ca(OH)_2$ com a ponta Navitip™ seguida da introdução de um cone de $Ca(OH)_2$. As raízes foram diafanizadas e avaliadas quanto à qualidade do preenchimento do terço apical dos canais por um examinador calibrado. Os espécimes foram examinados em lupa estereoscópica e classificadas por escores de 1 a 4 (desde preenchimento inadequado até preenchimento total dos canais). Os resultados foram comparados através da análise de variância e teste post hoc de Duncan com nível de significância de 5%. Resultados. Não se observaram diferenças estatisticamente significantes ($p>0.05$) entre os graus de curvatura dos grupos 1, 3 e 4 quanto ao preenchimento dos canais. A curvatura severa no grupo 2 apresentou significância limítrofe ($p=0,05$). Os grupos que associaram pasta e cones de $Ca(OH)_2$ (2 e 4) apresentaram melhor preenchimento apical em relação aos demais grupos, porém essa diferença foi estatisticamente significante ($p<0,001$) somente para as raízes com curvatura severa. Conclusão. De acordo com os resultados deste estudo, o grau de curvatura não influenciou na qualidade do preenchimento. As técnicas que utilizaram cones de guta percha contendo $Ca(OH)_2$ promoveram um melhor preenchimento do terço apical em canais radiculares com curvatura severa.

Unitermos: Hidróxido de cálcio; Guta-percha; Canal radicular; Preenchimento intracanal.

INTRODUCTION

The disinfection of the root canal system is one of the most important aspects that account for the success of endodontic therapy. The use of a calcium hydroxide [$Ca(OH)_2$]-based intracanal dressing between sessions has a major role in decreasing the microbial population within the root canals[6].

For optimal effect, $Ca(OH)_2$ should be in intimate contact with the dentinal walls, along the whole canal extension[5,6,7]. Nevertheless, three-dimensional filling is not easily obtained, especially in curved canals, in which failures occur mostly in the apical third[4,15,17,18].

An alternative for intracanal dressing is the use of $Ca(OH)_2$-containing gutta-percha points. The similarity between $Ca(OH)_2$ and conventional gutta-percha points facilitates their placement into root canals up to the working length[2,11,13,14].

There are no studies in the literature that associate the use of $Ca(OH)_2$ paste and points. Therefore, this *in vitro* study evaluated the quality of $Ca(OH)_2$ paste filling, associated or not with $Ca(OH)_2$-containing gutta-percha points in curved root canals.

MATERIAL AND METHODS

The research project was submitted to review by Research Ethics Committee of Lutheran University of Brazil and the designed methodology was approved (Process #2004-138H).

One hundred and twenty roots were selected from extracted human first molars and single-rooted teeth. Buccolingual and mesiodistal radiographs were taken to confirm absence of anomalies of form and size, full development of roots and presence of a single canal *per* root. Maxillary first molars with more than one canal in the mesiobuccal root were included in the study, but only the main canal was used. The length of the roots was standardized between 14 and 18 mm by sectioning the crowns at the cementoenamel junction. The roots were classified according to their degree of curvature as mild (0 to 14°), moderate (15° to 29°) and severe (above 30°), as proposed by Fontanella, et al.[8] (2004). Measurements were standardized by determining the initial position of curvature at the apical third. Forty roots were selected for each of the three ranges of curvature degree.

A size 10 K-type file was introduced into the canal until the tip of the instrument was visualized at the apical foramen. Working length (WL) was calculated by subtracting 1 mm from this measurement. Before shaping, the apical foramen was provisionally sealed with sticky wax. The cervical third was prepared with sizes 1, 2 and 3 LAXXESS instruments at 650 rpm. The middle and apical thirds were shaped according to the step-back technique up to a size 50 K-type file, the size 30 K-type file being the memory file. At each change of instrument, the canals were alternately irrigated with 2 mL of 1% sodium hypochlorite and 2 mL of 17% trisodium EDTA. The canals were dried with size 30 absorbent paper points.

Intracanal dressing consisted of a $Ca(OH)_2$ paste (Ultracal™; Ultradent Products Inc., South Jordan, UT, USA) and size 30 $Ca(OH)_2$-containing gutta-percha points (Calcium Hydroxide Plus Points™; Roeko, Langenau, Germany), which were delivered to root canals following different protocols. Prior to the placement of intracanal dressings, the sample received a stratified randomization to guarantee uniform distribution of the different curvature degrees in each group of treatment.

- Group 1: A size 25 lentulo spiral (Maillefer Instruments SA, Ballaigues, Switzerland) carrying small portions of $Ca(OH)_2$ paste was placed into the canals at 2 mm from the working length and powered at low speed until paste reflow was observed. Thereafter, a size 80 absorbent paper point (Dentsply Ind. e Com. Ltda., Petrópolis, RJ, Brazil) was used at canal entrance to condense the intracanal dressing towards the root apex.

- Group 2: Root canals were filled in the same way as described for group 1. However, after the paste was condensed, a size 30 $Ca(OH)_2$-containing gutta-percha point was introduced into the canal up to the working length.

- Group 3: Root canals were filled using a NaviTip™ tip (supplied with Ultracal kit). The NaviTip™ tip was attached to Ultracal syringe and introduced into the canals up to 2 mm from the working length. The syringe embolus was then pushed and the syringe was pulled backwards slowly, until paste reflow was observed. Thereafter, a size 80 absorbent paper point (Dentsply Ind. e Com. Ltda) was used at canal entrance to condense the intracanal dressing towards the apex.

- Group 4: Root canals were filled in the same way as described for group 3. However, after the paste was condensed, a size 30 $Ca(OH)_2$-containing gutta-percha point was introduced into the canal up to the working length.

Canal entrance was cleaned and the wax was removed from apical foramen. Both areas were sealed with conventional glass ionomer cement (Ketac-fill plus, ESPE, Seefeld, Germany), light-cured composite resin (Heraeus-Kulzer, Hanau, Germany) and Araldite resin handled according to the manufacturers' instructions.

The teeth went through a clearing process[3,10] by immersion in 5% nitric acid (Química Delaware, Porto Alegre, RS, Brazil) for 72 h (the solution being changed every 24 h), washing in running water for 4 h and successive dehydration in 80% alcohol for 12 h, 90% alcohol for 1 h and 99% alcohol for 3 h (changed every hour). The teeth were then placed in methyl salicylate (Química Delaware Ltda., Porto Alegre, RS, Brazil), which rendered them transparent.

The cleared roots were examined under a stereomicroscope (GSZ, Zeiss, Germany) at 16X magnification and the quality of canal filling was assessed. A calibrated experienced examiner, blinded to curvature degrees and groups of treatment, examined all surfaces of the apical third of each root and attributed scores to the specimens according to the following ranking scale:

Score 1: inadequate root canal filling – 0-50% of intracanal space was filled (Figure 1); Score 2: root canal filling with great failures – 51-70% of intracanal space was filled (Figure 2); Score 3: root canal filling with minor failures – 71-85% of intracanal space was filled (Figure 3); Score 4: complete root canal filling – 86-100% of intracanal space was filled (Figure 4).

Intra-examiner reliability was assessed by Intraclass Correlation Coefficient (ICC) after reexamination of 15 specimens. Data referring to the quality of filling obtained with the different techniques, as a function of curvature degree, were described as means and standard deviations. Analysis of variance compared the results of the groups at curvature levels and Duncan's *post hoc* test identified the differences. Significance level was set at a=0.05. Data were assessed using SPSS software, version 11 (Statistical Package for the Social Sciences, Adobe Systems Inc., San Jose, CA, USA) and Sigma Plot (Sigma-Aldrich Corp. St. Louis, MO, USA).

RESULTS

During clearing procedures, 5 specimens were lost because of infiltration of liquids used in the process.

Intraclass Correlation Coefficient was 0.72. Means and standard deviations of the scores attributed to each group are shown Table 1.

Regarding the degree of curvature, it was observed that in groups 1 (lentulo), 3 (Navitip™) and 4 (Navitip™ + point) there were no statistically significant differences (p>0.05) among the curvature ranges. In group 2 (lentulo + point) there was bordering statistical significance (p=0.05) for severe curvature in comparison to the other curvature degrees.

Regarding the filling techniques, the groups that associated the use of $Ca(OH)_2$ paste and points (2 and 4) showed better filling of the apical third than the groups that received $Ca(OH)_2$ paste alone as intracanal dressing (1 and 3). However, this difference was statistically significant (p<0.001) only for the roots with severe curvature.

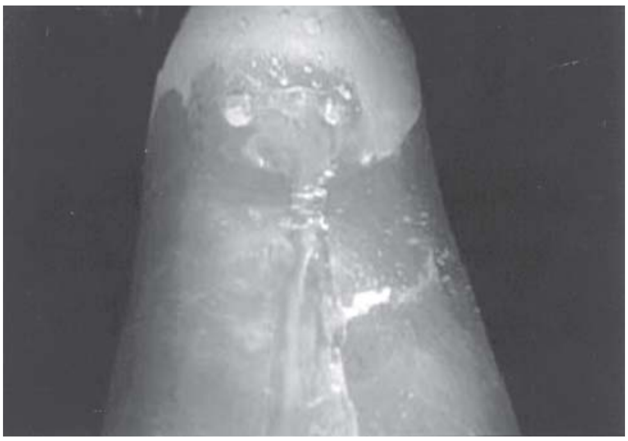

FIGURE 1- Example of score 1

DISCUSSION

This study evaluated the quality of intracanal dressing placement in root canals filled with Ultracal $Ca(OH)_2$ paste. This paste has a new injectable application system, NaviTip™, which was developed for use in curved canals. Lentulo spirals, which are still the most indicated instruments for this purpose, were also used in comparison

FIGURE 2- Example of score 2

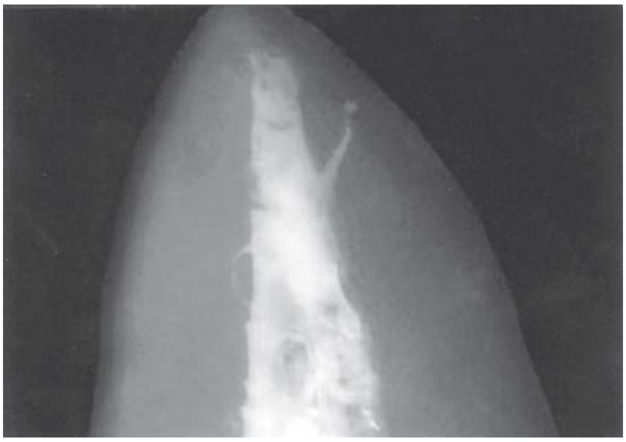

FIGURE 3- Example of score 3

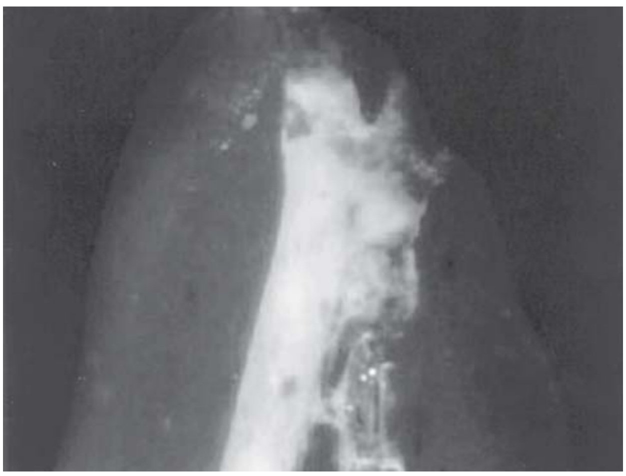

FIGURE 4- Example of score 4

to the manufacturer-supplied tips[4,5,12,15,17,18]. The hypothesis that the placement of $Ca(OH)_2$ points into canals filled with $Ca(OH)_2$ paste would produce an embolus effect and improve apical filling quality was also investigated.

The roots used in this study were classified in each of the curvature ranges not only by their angulation. The initial position of curvature was also considered because both parameters determine the severity of root curvature[1,11].

Apical foramen was provisionally sealed with wax prior to application of intracanal dressing to prevent air escape from the canal. Foramen patency could produce a falsely adequate filling that would not reflect the clinical situation[18].

The findings of this study indicate that, under the investigated conditions, the quality of root canal filling was not influenced by curvature degree in the groups filled using lentulo spiral, Navitip™ and Navitip™ + point. There were no statistically significant differences (p>0.05) among the three curvature ranges (mild, moderate and severe) for these groups. These results are not consistent with those of Torres and Luft[17] (2003), who reported better root filling quality in teeth with mild curvature than in severely curved roots, regardless of the technique used. This discrepancy of results may stem from the variability of root anatomy. Far more than curvature, the complexity of the root canal systems, with its numerous ramifications, is a variable difficult to control and may either facilitate or impair the filling of the canals.

Bordering statistical significance (p=0.05) was observed in group 2 (lentulo + point) when degree of curvature was compared. In this case, the action of the $Ca(OH)_2$ point seemed to be beneficial for filling severely curved canals but did not affect the quality of filling in the other curvature ranges.

Regarding the filling technique, groups 2 and 4 presented higher scores than the other groups in mild and moderate curvature ranges, but this difference was not significant statistically (p>0.05). The superiority of the techniques employing $Ca(OH)_2$ points was established in roots with severe curvature. In this range, groups 2 and 4 presented better root canal filling (p<0.001) than the other groups in which $Ca(OH)_2$ paste alone was used.

The results of this study are in agreement with those of Estrela, et al.[5] (2002), who reported an adequate root canal filling when a $Ca(OH)_2$ paste prepared with an aqueous vehicle was used as an intracanal dressing. In the present study, in all groups, $Ca(OH)_2$ paste was condensed at canal entrance towards the apex using a paper point of great diameter. In the groups where $Ca(OH)_2$ points were used, condensation of the intracanal dressing occurred in apical third. These findings suggest that the physical embolus action of the $Ca(OH)_2$ point resulted in better filling quality, pushing the paste into an intimate contact with root canal walls. Therefore, a similar effect may be expected if conventional gutta-percha points are used in the same way. Further studies should be carried out to investigate this possibility.

The filling obtained with use of Ultracal paste alone corroborates the findings of previous studies. This system seems to be inadequate for use in curved canals because the diameter of the tip supplied with the kit (0.76 mm) is not compatible with that of severely curved root canals. According to Staehle, et al.[16] (1997), needles with diameters greater than 0.6 mm can be employed only for straight canals enlarged apically at least up to a size 50 file, which did not occur in the present study.

In view of these findings, it seems clear that the quality of curved root canal filling with an aqueous calcium hydroxide paste is considerably improved when $Ca(OH)_2$ points are also used. The association of paste and points seemed to make the difference, mainly in canals with more accentuated curvatures.

CONCLUSIONS

According to the methodology proposed and based on the results of this study, the following conclusions may be

TABLE 1- Means and standard deviation (±SD) of filling scores for each technique of intracanal dressing placement and curvature degree

Technique	Degree of Curvature			
	Mild	Moderate	Severe	*p*
Lentulo (n=29) (Group 1)	2.3 ± 1.2	2.0 ± 1.0	2.0 ± 0.9	0.76
Lentulo + Point (n=29) (Group 2)	2.6 ± 0.7	2.5 ± 1.0	3.3 ± 0.5	0.05
Navitip (n=29) (Group 3)	2.1 ± 0.8	2.2 ± 0.6	1.7 ± 1.0	0.39
Navitip+ Point (n=28) (Group 4)	2.9 ± 0.7	2.8 ± 0.7	2.8 ± 0.4	0.89
p	0.22	0.23	<0.001	

p = Statistical significance by analysis of variance.

drawn:

1. All techniques were unable to fill root canal apical third completely.
2. When lentulo spiral, Navitip™ tip and Navitip™ + $Ca(OH)_2$ points were employed, the curvature range did not influence the quality of apical third filling.
3. When lentulo spiral was associated with $Ca(OH)_2$ point, canals with severe curvature presented better filling than those with mild to moderate curvatures.
4. The techniques that associated $Ca(OH)_2$ paste and point (lentulo + point and Navitip™ + point) yielded better filling quality at root canal apical third in roots with severe curvature.

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