ANALYSIS OF MARGINAL ADAPTATION AND REDUCTION OF WHITE CONTRAST ARTIFACT IN CONE-BEAM COMPUTED TOMOGRAPHY IMAGES OF TEETH WITH SEALING MATERIALS FOR FURCAL PERFORATION

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ABSTRACT

The sealing material to be used in root perforations must offer adhesion to the dentin walls, be biologically tolerated by periapical tissues, easy to manipulate, radiopaque, and create an environment for tissue regeneration. The marginal adaptation and the reduction of the white contrast artifact in CBCT images of teeth with furcation area perforation sealers will be evaluated. 180 human lower molars will be divided into 9 groups according to the cement: G1- Portland Cement; G2- PBS HP White Cement; G3- MTA Ângelus® Gray Cement; G4- MTA Ângelus® White Cement; G5- Bio-C Repair Cement; G6- MTA Flow Cement; G7- BioDentine Cement; G8- Portland Cement, with calcium oxide added at a concentration of 5%; and G9- Portland Cement, with calcium oxide added at a concentration of 10%. Analysis of the marginal adaptation of the materials will use scanning electron microscopy examination, with a magnification of 100x. The area of the furcation perforation will be divided into four quadrants, constituting five categories. The different types of sealing material will be compared considering the marginal adaptation score, using Fisher's exact test, with a significance level of $\alpha = 5\%$. The CBCT images will be acquired using the Prexion tomograph. The measurements of the sealer material dimensions will be taken using a digital caliper with 0.01mm precision in the axial plane. Analysis of variance (ANOVA) and Tukey's test will be applied for statistical analysis. The significance level will be $\alpha = 5\%$. The study will enable a greater understanding of the clinical management of root perforations.

Keywords: Cone beam computed tomography; Furcation perforation; MTA.

INTRODUCTION

The treatment of root perforations varies greatly. However, there is an agreement that the possibility of successfully treating them depends on the direct influence of factors such as: location, size, characteristics, root length, degree of

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contamination, sealing technique, time elapsed between the moment of perforation and treatment, and the compatibility of the material used (Fuss & Trope, 1996). Countless materials have been used in the treatment of endodontic perforations, but the different results obtained demonstrate that there is still no ideal material (Tsesis & Fuss, 2006).

With the advent of cone beam computed tomography (CBCT), there was a revolution in information in health studies (Ambrose, 1973; Azevedo et al., 2008). This tool has contributed to the planning, diagnosis, treatment, and prognosis of various pathologies (Ambrose, 1973; Hounsfield, 1973). However, the images from CBCT are affected by materials with a high atomic number, generating artifacts, which result in low-quality images that lead to a limited interpretation of the three-dimensional image.

In this way, the study of the marginal adaptation of different perforation sealant materials in the furcation region is explained through scanning electron microscopy image analysis, chemical characterization of the sealant-dentin interface through energy-dispersive X-ray spectroscopy (EDX), as well as the evaluation of the change in the dimension of the perforation sealant material in images obtained by micro-computed tomography (micro-CT).

METHODOLOGY

The present work will be a comparative evaluation between the following perforation sealing materials: G1- Portland Cement (Votorantin, São Paulo, SP, Brazil); G2- PBS HP White Cement (MJS Industry and Commerce of Health Materials Ltda – ME, Pouso Alegre, MG, Brazil); G3- MTA Angelus® Gray Cement (Angelus Ind. Prod., Londrina, PR, Brazil); G4- MTA Angelus® White Cement (Angelus Ind. Prod., Londrina, PR, Brazil); G5- Bio-C Repair Cement (Angelus Ind. Prod., Londrina, PR, Brazil); G6- MTA Flow Cement (Ultradent, South Jordan, UT, USA); G7- Biodentine Cement (Septodont, Saint-Maur-des-Fosses, France); G8- Portland Cement (Votorantin, São Paulo, SP, Brazil), added with calcium oxide (Quimis, Mallinkrodt Inc., St Louis, MO, USA) at a concentration of 5%; and G9- Portland Cement (Votorantin, São Paulo, SP, Brazil), added with calcium oxide (Quimis, Mallinkrodt Inc., St Louis, MO, USA) at a concentration of 10%.

Drillings will be performed in the furcation area. The 180 teeth will be randomly divided into ten experimental groups (n=10) according to the sealing material. The perforations will be filled with the experimental materials to be tested, and there will be a control group (without material).

The furcation area of each specimen will be divided into four quadrants and classified into scores according to the presence or absence of gaps between the sealing material and the wall of the perforation, constituting five different categories: score 0 – absence of cracks in the drilling area; score 1 – presence of a crack in up to 1/4 of the area or in 1 quadrant; score 2 – presence of a crack in up to 2/4 of the area or 2 quadrants; score 3 – presence of a crack in up to 3/4 of the area or 3 quadrants; score 4 – presence of a crack in the entire drilling area, or total absence of adaptation.

The analysis of the scanning electron microscopy images of the tested materials will have a magnification of 100X. When necessary, a magnification of 500X will be used. The evaluations of the margins with marginal adaptations of the drilling sealant materials will be carried out by two specialists. When there is no consensus, a third examiner will conduct the final analysis.

The different types of sealing material will be compared considering the marginal adaptation score, using Fisher's exact test with the aid of SPSS software (Statistics for Windows 19.0 – SPSS Inc., Chicago, IL, USA). The significance level will be $\alpha = 5\%$.

The chemical characterization of the dentin-sealer material interface will be performed using energy-dispersive X-ray spectroscopy (EDX). The microanalysis measurements by EDX will be conducted in the interface region of the dentin sealer material in all quadrants of each specimen.

The CBCT images will be measured by two examiners, and the measurements of the perforation sealing material in the CBCT images will be performed in the axial plane, in the vestibulo-lingual and mesio-distal directions. The analysis of variance (ANOVA) and Tukey test will be applied for statistical analysis. The significance level will be $\alpha = 5\%$.

The measurements of the dimension of the sealing material of the furcation perforation of the specimens will be carried out by two examiners, using a digital caliper of 0.01 mm. When there is no consensus, a third examiner will be required.

EXPECTED RESULTS

This project represents a scientific advancement in the field of dentistry and health promotion and reinforces a line of research, generating new knowledge through scanning electron microscopy, X-ray dispersion spectroscopy, and cone beam computed tomography, which will enable a better understanding of the clinical management of root perforations.

In this context, the study aiming to develop a new cement with better sealing properties for the treatment of perforations in the furcation area, combined with clinical and radiographic findings, will allow for a more in-depth and well-founded understanding of the treatment of these accidents.

CONCLUSION

Conducting a study with this focus will enable the improvement of dental materials used in the sealing of furcation perforations and will allow the development of a new material as a less costly alternative to MTA, thus benefiting individuals with a history of perforated teeth and clinical indication for tooth extraction.

SCHEDULE OF EXECUTION

Activity (number)	**Duration (months)**
1- Bibliographic Research	**18 months**
2- Selection of samples (periapical radiographs)	**3 months**
3- Sample preparation (removal of dental crowns, creation and filling of perforations in the furcation area with test materials)	**2 months**
4- Sample preparation (sample preparation for scanning electron microscopy)	**3 months**

5- Analysis of the marginal adaptation of sealing materials	**3 months**
6- Chemical characterization of the dentin-sealer material interface (analysis performed by X-ray dispersion spectroscopy)	**3 months**
7- Measurement of specimens (sealant material measurements on the tooth)	**2 months**
8- Acquisition of CTC images	**1 month**
9- Measurement of CTC images	**1 month**
10- Data analysis	**1 month**
11- Publication of the results	**1 month**
12- Activity report	**1 month**
13- Participation in evaluation seminars (interim and final results)	**1 month**
14- Accountability	**2 months**

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