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Comparison of Apical Leakage Patterns Shown by Two Different Methods

Comparação do Padrão de Infiltração Apical Mostrado por Dois Diferentes Métodos

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RESUMO

Objetivo: Comparar a infiltração apical usando penetração de corante e métodos eletroquímicos, usados nos mesmos espécimes.
Método: Foram selecionados 31 dentes humanos unirradiculares, anteriores, com canais retos. Os espécimes foram divididos aleatoriamente, respectivamente em: grupo experimental, dois controles positivos e dois controles negativos. Os canais radiculares do grupo experimental e do grupo controle negativo foram obturados e o controle positivo foi deixado sem preenchimento. A superfície externa de cada dente foi coberta com duas camadas de esmalte de unha, com exceção de 2mm apicais e a porção coronária dos canais. A infiltração em cada dente foi medida usando-se o teste eletroquímico. Dois fios de cobre foram usados como elétrodos e a solução salina foi usada como meio eletrocondutivo. Em seguida a porção coronária das raízes foi obturada com cimento de Oxido de Zinco e Eugenol e coberta com duas camadas de esmalte de unha. Os dentes foram imersos em fucsina básica a 2% durante 48 horas e foram lavados em água corrente. As raízes foram então longitudinalmente seccionadas e foi avaliada a infiltração de corante em cada dente.
Resultados: Nenhuma correlação foi enconrtada entre os resultados obtidos com os dois métodos utilizados (P =.297).
Conclusão: Estudos adicionais são necessários antes da avaliação da infiltração marginal apical.

DESCRITORES

Endodontia; Corantes de Rosanilina; Cavidade da Polpa Dentária.

ABSTRACT

Purpose: To compare the apical leakage using dye penetration and electrochemical methods each successively used on the same teeth.
Methods: 31 freshly extracted anterior single root human teeth with straight root canals were selected. The specimens were divided randomly, respectively into experimental group, two positive and two negative controls. Root canal of the case group and negative group were filled, and positive group were left unfilled. The external surface of each tooth was coated with two layers of the nail polisher, except for the apical 2mm and coronal portion. Leakage of each tooth was measured by using electrochemical test. Two copper wires were used as electrodes and normal saline solution was used as electrolyte. Then coronal portion of root were filled with the aid of ZOE cement and coated with two layers of the nail polisher. The teeth immersed in 2% basic fuchsine for 48 hours and were washed in tap water. The roots were then split longitudinally and dye leakage was assessed for each tooth.
Results: No correlation was found among the results obtained with the two methods (P-Value=.297).
Conclusions: Several studies are necessary before evaluation of the marginal leakage.

DESCRIPTORS

Endodontics; Rosaniline Dyes; Dental Pulp Cavity.

INTRODUCTION

It is generally accepted that incomplete root canal obturation which may permit penetration of microorganisms and their toxins is an important cause of endodontic failures (COHEN; BURNS, 1991). Thus, the hermetic sealing of the root canal space is one of the major objectives in root canal therapy. Most endodontic failures occur as a result of a persistent or secondary intrarradicular infection (SUNDQVIST; FIGDOR, 1998).

The effectiveness of root canal filling materials, and obturation techniques in providing an apical seal has been evaluated by various techniques, dye leakage and bacterial leakage, electrochemical method, radioisotope labeling and fluid filtration.

The use of organic dyes is the oldest and most commonly method in the study of effectiveness of the apical seal. Tracers such as methylene blue procion blue, eosin red, silver nitrate, and India ink have been used (GOING, 1972). Fluorescent dyes were found to be particularly useful as tracers because they are detectable in dilute concentration. With regard to the dye, it may by expect that it's molecular or particle size and PH will influence the degree of penetration. The ionic exchange and chemical reactivity of the ion, as well as the physical and chemical nature of the filling material, influenced the depth of marginal penetration (GOING; MASSLER; DUTE, 1960).

The dye leakage evaluation is the most commonly used technique, likely because this is the simplest method to carry out. Despite the wide use of dye penetration as a method for leakage evaluation, it has significant limitation, the range of error is great, and if not controlled precisely, a number of variables could significantly change the results, and quantities measurements can not be obtained (DELIVANIS; CHAPMAN, 1982).

Jacobson and von Franunhofer (1976) described an electrochemical technique. In this technique the tooth is immersed in an ionic solution. When leakage occurs the solution penetrates through the apical seal, a stainless steel wire placed through the coronal opening into the root canal. Another stainless steel wire is submerged into the solution. The two stainless steel electrodes are connected via a multimeter to a constant power supply. It is assumed the magnitude of the current detected, will indicate the degree of the penetration (DELIVANIS; CHAPMAN, 1982).

The purpose of this study was to measure the apical leakage using dye penetration and electrochemical method each successively on the same teeth and find the correlation.

METODOLOGY

Thirty one extracted single rooted maxillary and mandibular anterior teeth were used. After extraction all teeth were stored in saline solution .To remove organic debris, the teeth were placed in 5.25% NaOCl for one hour. The crowns were removed at the cementoenamel junction, with a high speed bur and water spray. A K-file ISO #10 (Kerr, Romulus, MI) was introduced into the root canal of each root until it reached the anatomical apex. Working length was 1mm short of that position.

All canals were instrumented by the conventional step-back preparation using H-files (Maillefer Densply) to a size ISO 40. Salin Solution was used as irrigation solution. To achieve different sealing quality, the specimens were divided randomly into 3 groups of 9 teeth each, two positive and two negative control. The first group was obturated without sealer and lateral condensation technique; the second group was obturated with PD sealer with a single guta percha cone (Diadent Korea). The third group was filled with PD sealer and a lateral condensation technique.

The samples were stored in a humidifier for 24 hours to allow the sealer to set. A No 3 gates-glidden (Maillefer Densply) drill was used to remove the coronal portion of gutta-percha to the depth that the remaining gutta-percha was approximately about 7mm. Two layers of nail polish were applied to the external surface of all of the roots except in apex. In the positive controls, the teeth were left unfilled and in negative controls, the root surface was cowered completely with nail polish. The roots were stored in saline solution at room temperature for one month.

In the first stage leakage was measured by the electrochemical method, as described by Jacobson and von Fraunhofer (1976). Each sample was mounted in a Plexiglas plate and apical 4mm of the root immersed in a plexiglas box that filled with saline solution. The coronal portion of the tooth was filled with about 1/4cc of saline solution.

A stainless steel wire immersed in saline solution and a stainless steel file was inserted into the coronal portion of the root canal which was filled with saline solution. Each sample was subjected to a constant power supply of 8 volts (Z-IC, 8V1A.siehe ECA) and measurements of the flow of the electrical current were

obtained. This measurement was kept for comparison with the dye leakage technique.

The coronal portion of each sample was filled with Cavit (3M ESPE US) and covered with two layers of nail polish and was immersed in two percent solution of basic fuchsine for a period of 48 hours. After removal from the dye, the teeth were rinsed in tap water and allowed to dry. The teeth were carefully sectioned with a diamond disk longitudinally. The extent of dye penetration in a coronal direction was measured with a stereo-microscope (Zeiss Germany). For each specimen the correlation of the electrochemical reading with the evaluation obtained with the dye penetration method was evaluated by Pierson's correlation coefficient.

RESULTS

The negative control teeth showed no flow of electrical current. They also did not show any penetration of dye. The maximum recorded current for the positive controls was 300µA, and they showed complete dye penetration.

The results obtained in electrochemical method ranged from 3.1µA to 54.7µA.None of the teeth reached the maximum recorded current as measured for the positive controls. The results obtained in dye penetration method ranged from 2.6 mm to 6.8mm. The correlation coefficient of the electric readings with the evaluation obtained by the dye penetration method was (r=0.204) No correlation was found among the results obtained with the two methods (P-Value=.297) (Figure 1).

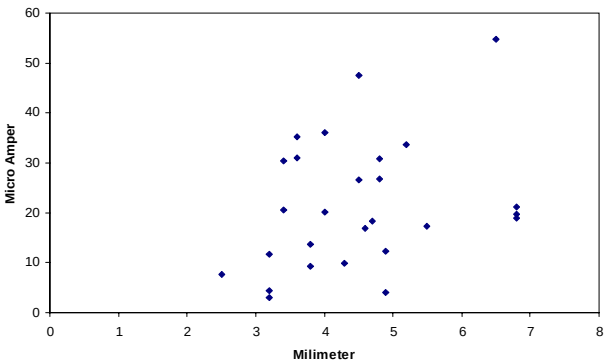

Figure 1. Scattering diagram of dye penetration results and electrochemical leakage evaluation (r=0.204).

DISCUSSION

The aim of this study was to compare and correlate the quantitative measurements recorded by electrochemical method and dye penetration method on the same teeth.

The previous studies that measure and compare different methods of evaluation of apical leakage mostly failed to show a correlation.

Mattlof et al. (1982) compared the dye and isotope penetration. They found a correlation between radioactive urea and methylene blue, radioactive albumin and methylene blue, but they did not find a correlation between radioactive calcium chloride and methylene blue. According to the authors the lack of correlation between radioactive calcium chloride and methylene blue dye was due to the exchange with the inert calcium in the apatite mineral surrounding the canal. Dilivamis and Chapman (1982) compared the electrochemical method to the dye penetration or the radioisotope method, they found a correlation at the two ends of the electric score range. They stated that correlation was not satisfactory at the middle ranges. Barthel et al. (1999) found no correlation between a dye penetration study and a bacterial leakage study, whereas De Gee, Wu and Wesselink (1994) and Pommel, Jacquot and Camps (2001) found no correlation between a dye penetration study and a fluid filtration technique.

In the present study, the correlation coefficient showed that there is not a good correlation between the electrochemical method and dye penetration technique Fuchsine a synthetic dyestuff, is a mixture of rosaniline and pararosaniline. Its molecular weight is comparable with methylene blue. The lack of correlation among two methods that are compared in this work can be explained by the difference in causes that influence the phenomena.

The electrochemical leakage evaluation is based on the principle that an electric current will flow between two pieces of metal when both are immersed in an electrolyte and are connected by an external power source. It is assumed that magnitude of the current is directly proportional to the degree of leakage. Current magnitude is controlled by diffusion of ion through the interface between the filling material and tooth structure. Any change in ion concentration can affect the results.

Accumulation of corrosion products with time or the filling material that undergo composition change, and released ionic compounds may affect the results of the electrochemical leakage determination. Seidler (1954) has emphasized that all sealer undergo dimensional changes, these changes occur upon setting and dissolution in fluids. Dissolution of inorganic salts that used in sealer formulation may affect the ionic concentration.

The dye penetration method is a passive method where the phenomena of capillarity tube may be of prime importance. In addition to leakage different factors may influence the depth of dye diffusion. According to Going, Massler and Dute (1960) the ionic exchange and chemical reactivity of the ion as well as the physical and chemical nature of the filling material, influenced the depth of marginal penetration. It seams likely that factors such as difference in experimental technique, length of exposure to the dye , air entrapped in void , and the type of tracer used, may affect the extent of dye penetration. A greater penetration of dye was recorded after longitudinal splitting than decalcification and clearing of the specimens.

According to Ahlberg, Assavanop and Tay (1995) methylene blue when used as tracer demonstrated a higher level and wider variation of the penetration when compared with Indian ink. The classical dye penetration and a dye extraction technique where the root dissolved in acid to remove all the dye, were compared a fluid filtration technique by Camps and Pashly (2003). They find that the fluid filtration technique gives results similar to the dye extraction technique, but they did not find a correlation between classical dye penetration method and fluid filtration technique. Because there is not something common between physical mechanisms that influence the leakage measuring in two methods the lack of correlation is not surprising.

CONCLUSION

According to the results of this study there was not a significant correlation between dye penetration and electrochemical leakage evaluation. It seems that several studies by different methods are necessary before evaluation of the marginal leakage.

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