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ORIGINAL ARTICLE/ARTICOLO ORIGINALE

Efficacy of three different irrigation techniques in the removal of smear layer and organic debris from root canal wall: a scanning electron microscope study

Efficacia di tre diverse tecniche di irrigazione canalare nella rimozione del fango dentinale e dei detriti organici: analisi al microscopio elettronico a scansione

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KEYWORDS
Conventional irrigation;
EndoActivator;
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Organic debris;
Smear layer.

Abstract
Aim: Aim of this study was to compare the removal of smear layer and organic debris within the tooth canal among conventional needle irrigation, EndoVac and Endoactivator.
Methodology: Eighty single-rooted extracted human teeth were prepared with rotary NiTi instrumentation and randomly separated into 4 groups. Twenty teeth were used as positive control (Group 1), irrigated with only saline. Teeth assigned to Group 2 (n = 20) received irrigation with a conventional syringe and a 30-gauge needle (NaviTip, Ultradent, South Jordan, UT);

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samples in Group 3 ($n = 20$) were rinsed with an irrigation device based on apical negative pressure (EndoVac, Discus Dental, Culver City, CA) and teeth in Group 4 ($n = 20$) were treated with a sonic irrigation system (EndoActivator, Dentsply Tulsa Dental, Tulsa, OK, USA). The amount of residual smear layer and debris was evaluated under a scanning electron microscope, and a semi-quantitative score was assigned to each root at the coronal, middle and apical thirds; the chi-square test was used to compare the results of the S.E.M. analysis.

Results: EndoActivator performed the best cleansing for both smear layer and organic debris in all root canal thirds, followed by EndoVac and conventional irrigation ($p > 0.001$). EndoVac and conventional irrigation showed better cleaning in the coronal area, whereas EndoActivator performed an homogeneous cleansing at all levels.

Conclusions: The EndoVac system and the EndoActivator system demonstrated significantly more efficacy in cleansing root canal walls than conventional needle irrigation.

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PAROLE CHIAVE
Irrigazione convenzionale;
EndoActivator;
EndoVac;
Detriti organici;
Fango dentinale.

Riassunto

Obiettivi: Lo scopo dello studio è quello di comparare la capacità di rimozione del fango dentinale e dei detriti organici di tre diverse tecniche di irrigazione canalare: Siringa convenzionale, EndoVac, EndoActivator.

Materiali e metodi: 80 denti monoradicolati sono stati alesati con strumenti in NiTi e divisi in 4 gruppi. 20 campioni sono stati utilizzati come controllo positivo ed irrigati quindi solo con soluzione salina (Gruppo 1). I denti del Gruppo 2 (n = 20) sono stati irrigati con siringa convenzionale (NaviTip, Ultradent, South Jordan, UT); i campioni del Gruppo 3 (n = 20) sono stati trattati con uno strumento di irrigazione a pressione negativa (EndoVac, Discus Dental, Culver City, CA) e quelli del gruppo 4 (n = 20) con un sistema di irrigazione sonica (EndoActivator, Dentsply Tulsa Dental, Tulsa, OK, USA). I residui di fango dentinale e di detriti organici all'interno del canale radicolare sono stati valutati tramite l'utilizzo di un microscopio elettronico a scansione ed un sistema di punteggio semi-qualitativo considerando tre diverse zone del canale: apicale, medio e coronale. I dati ottenuti sono stati sottoposti a test statistico (test chi-quadro).

Risultati e conclusioni: La miglior rimozione di fango dentinale e detriti organici è stata ottenuta con l'EndoActivator, seguito dall'EndoVac e dall'irrigazione convenzionale ($p < 0.001$). L'Endovac e l'irrigazione convenzionale hanno ottenuto i migliori risultati nella parte coronale del canale mentre l'EndoActivator ha deterso il canale a tutti i livelli.

L'EndoActivator e l'Endovac hanno mostrato una maggiore capacità di rimozione di fango dentinale e detriti organici rispetto all'irrigazione convenzionale.

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Introduction

The aim of an endodontic treatment is to eliminate micro-organisms from infected radicular canals using a biomechanical procedure combined with an antibacterial therapy to achieve the periapical tissue healing.[1] In clinical practice, the goal of instrumentation is to remove some hard tissue from the root canal, facilitate satisfactory delivery of irrigants to the apical anatomy and give the canal system a shape that allows both a predictable and a permanent root filling.[2] Mechanical instrumentation alone or with saline irrigation cannot predictably eliminate the bacteria from infected root canals,[2,3] whereas instrumentation combined with adequate irrigation is mandatory to complete the cleaning process and reduce the microbial load in the canal system.

The goal of irrigants is to increase mechanical debridement by flushing out debris, disinfecting the root canal system and dissolving pulp tissue. At present, there is no unique irrigant that meets all the conditions listed above,[4] therefore, the method of choice has been the alternating use of ethylenediaminetetraacetic acid (EDTA) and sodium hypochlorite solutions.[5] Although this conventional irrigation has been widely used and accepted in contemporary clinical practice, its action is insufficient to completely remove debris from the irregularities of the root canal anatomy.[6] For this reason, numerous alternative irrigation methods have been proposed.[7]

The ability of an irrigant to reach the apical portion of the canal depends on the size of mechanical instrumentation, canal anatomy and delivery system;[8] for optimal effectiveness, irrigants must have direct contact with the entire root canal wall.[5] Therefore, different manual and mechanical agitation techniques have been proposed to deliver the irrigant solution into the apical area of the root canal: needle irrigation, hand files, rotary brushes, gutta-percha cones, ultrasonic and sonic devices.[7]

This study focused on apical-negative pressure irrigation and sonic systems.

The EndoVac system (Discus Dental, Culver City, CA) is the apical-negative pressure irrigation device, and it has been described by Schoeffel.[9]

It has been developed to overcome the vapour lock effect and grant a better and safer disinfection of the apical third of the root canal than other irrigation techniques.[4,9]

The ''vapour lock effect'' is a well-known physical phenomenon based on air entrapment by an advancing liquid front in a closed-end microchannel,[10] and the penetration capability of the fluids depends on the depth and diameter of

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