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IN-VITRO EVALUATION OF THE EFFICIENCY OF DIFFERENT IRRIGATION TECHNIQUES, IRRIGANTS AND TIME OF ACTIVATION IN REMOVING CALCIUM HYDROXIDE INTRACANAL MEDICAMENT

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ABSTRACT

Calcium hydroxide $Ca(OH)_2$ is one of the most commonly used intracanal medicaments in multiple-visit non-surgical root canal treatments, aimed at improving treatment outcomes. However, complete removal of $Ca(OH)_2$ presents significant challenges and is essential before obturation to ensure a hermetic seal and prevent recontamination of the root canal. This study aimed to evaluate the efficiency of different irrigation techniques, types of irrigants, and activation times in eliminating $Ca(OH)_2$ from the root canal. In this in-vitro study, 90 extracted lower premolars were used. The root canals were prepared to an F3 ProTaper size and then randomly assigned to three main groups: Group 1 (Manual Dynamic Activation, MDA), Group 2 (Sonic Activation, SA), and Group 3 (Passive Ultrasonic Irrigation , PUI). Each group was further subdivided based on the irrigation solution used: saline, sodium hypochlorite (NaOCl), and a combination of NaOCl followed by EDTA. The activation times tested were 30 seconds and 60 seconds. The results indicated no significant difference in the overall percentage reduction of intracanal $Ca(OH)_2$ among the MDA, SA, and PUI groups. However, when assessing percentage reduction of $Ca(OH)_2$ in the apical 5 mm of the canal, MDA was the least effecient, while both SA and PUI showed better results, with no significant difference between the two. When it comes to the type of irrigant used, saline was significantly less efficient at removing $Ca(OH)_2$ from the entire canal and the apical 5mm compared to NaOCl and a combination of NaOCl with EDTA. However, there was no significant difference between the use of NaOCl alone and the combination of NaOCl with EDTA in removing $Ca(OH)_2$ from the canal and the apical 5mm. Furthermore, while there was no significant difference in the overall percentage reduction of $Ca(OH)_2$ between 30-second and 60-second activation times, the apical 5 mm demonstrated significantly better percentage reduction of $Ca(OH)_2$ with 60 seconds of activation compared to 30 seconds. In conclusion, there is no significant difference in the overall percentage reduction of $Ca(OH)_2$ among MDA, SA, and PUI, SA and PUI are more efficient than MDA in overall percentage reduction of $Ca(OH)_2$ at the apical 5 mm of the root canal. NaOCl and its combination with EDTA outperform saline in removing $Ca(OH)_2$, though NaOCl alone is equally efficient as the NaOCl-EDTA combination. Additionally, while activation time did not significantly affect overall $Ca(OH)_2$ removal, 60-second activation provided better percentage reduction of $Ca(OH)_2$ in the apical region compared to 30 seconds.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

It is well-established that the primary cause of pulpal necrosis and apical periodontitis is a bacterial infection within the root canal or the intraradicular space (Kakehashi et al., 1965; Sundqvist, 1976). These microbial colonies are abundant and predominantly reside in the main root canal, which is the most voluminous portion of the entire root canal system. The most critical stage for effectively disinfect and eliminate these bacteria within the canal space is during the preparation and instrumentation of the root canal. This is accomplished through the incorporation of both mechanical instrumentation techniques (Bystrom & Sundqvist, 1981; Klevant' & Eggink', 1983) and the application of active antibacterial irrigation solutions (Bystrom & Sundqvist, 1985; Haapasalo et al., 2010). These complementary procedures work synergistically to thoroughly clean, shape, and disinfect the root canal system, laying the foundation for a successful endodontic treatment outcome.

Isthmuses, deltas, ramifications, dentinal tubules, accessory, as well as lateral canals are the areas where it is most challenging to thoroughly clean and disinfect, as these complex anatomical features and irregularities within the root canal system provide inaccessible harbours for residual microorganisms (Nair et al., 2005; L. B. Peters et al., 2001; Vera et al., 2012). Leaving the root canal empty between treatment sessions allows any remaining bacteria to multiply and repopulate the canal space, potentially reaching levels comparable to the initial bacterial load (Bystrom & Sundqvist, 1981, 1985; Waltimo et al., 2005). To address this issue, intracanal medicaments have been promoted as a complementary strategy to enhance the chemomechanical procedures, thereby maximising the reduction of bacterial populations within the root canal system (Mcgurkin-Smith et al., 2005; Shuping et al., 2000; Siqueira et al., 2007; Sjogren et al., 1991). These intracanal medicaments have the ability to penetrate and diffuse into the intricate anatomical features of the root canal, allowing access to and facilitating the elimination of residual microorganisms that may have evaded the initial cleaning and shaping efforts.