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THE IMPORTANCE OF MEDICAMENTAL ROOT CANAL TREATMENT IN MODERN ENDODONTICS

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Abstract: This article discusses the importance of chemical treatment of root canals during endodontic procedures, its main methods, and the mechanisms of action of commonly used antiseptic agents. Particular attention is given to the properties and clinical applications of sodium hypochlorite, ethylenediaminetetraacetic acid (EDTA), chlorhexidine, and hydrogen peroxide. The article also examines the correct sequence of irrigation solutions, the treatment of narrow and difficult-to-access root canals, and the prevention of errors that may occur during the procedure.

Keywords: endodontics, root canal, medicamental treatment, irrigation, sodium hypochlorite, EDTA, chlorhexidine, smear layer, disinfection.

Endodontic treatment is an important branch of dentistry that aims to eliminate inflammation and necrotic processes in the dental pulp, remove microorganisms from the root canal system, and prevent pathological changes in the periapical tissues. The success of treatment depends not only on mechanical enlargement of the canal but also on reducing microorganisms and organic debris that remain in its complex anatomical structures. In addition to the main canal, the root canal system includes lateral branches, the apical region, and dentinal tubules. These anatomical structures may provide suitable conditions for microorganisms to survive. Therefore, mechanical preparation alone is not sufficient to clean the entire root canal system completely.

Medicament-based treatment is the process of treating root canals with special chemical and antiseptic agents. Its main purposes are to reduce the number of microorganisms, dissolve necrotic tissues, remove the smear layer formed during

mechanical preparation, and prepare the canal for proper and hermetic obturation. Infectious processes inside root canals, especially in cases involving necrotic pulp, are associated with a complex microbial environment. Microorganisms can form biofilms, attach to canal walls, and survive in areas that are difficult for mechanical instruments to reach. For this reason, the antimicrobial activity of irrigation solutions and their ability to dissolve organic debris are very important. Mechanical preparation produces a smear layer on the dentin surface. This layer consists of organic and inorganic components. It may block the openings of dentinal tubules and prevent disinfecting solutions from penetrating deeper into the dentin. Removing this layer helps clean the canal walls and improve the quality of subsequent obturation. Sodium hypochlorite is one of the main antiseptic agents widely used for root canal irrigation. The presentation includes solutions with concentrations ranging from 0.5% to 5.25%. This substance has broad antimicrobial activity and is particularly effective in dissolving necrotic pulp tissue and other organic debris. The mechanism of action of sodium hypochlorite involves damaging the cellular components of microorganisms, denaturing proteins, and breaking down organic tissues. These properties improve the effectiveness of root canal cleaning when sodium hypochlorite is used together with mechanical preparation. However, sodium hypochlorite must be used carefully. If the solution passes beyond the root apex into the periapical tissues, it may cause pain and chemical tissue damage. Therefore, during irrigation, it is important to ensure that the needle moves freely inside the canal, the solution is delivered in a controlled manner, and excessive pressure is not applied in the apical region. Ethylenediaminetetraacetic acid (EDTA) is a chelating agent that binds to calcium ions in the mineral component of dentin. As a result, the inorganic part of dentin is softened, making it easier to remove the mineral components of the smear layer. The presentation indicates an EDTA concentration of 15–17% for chemical treatment. EDTA can be used to make instrument movement easier, especially in narrow and difficult-to-access canals. It

is also important for the final cleaning of canal walls. However, EDTA does not dissolve organic tissues as effectively as sodium hypochlorite. Therefore, the functions of these two agents complement each other. Mixing EDTA with sodium hypochlorite at the same time is not recommended because their interaction may reduce the amount of active chlorine in sodium hypochlorite. It is more appropriate to use them separately according to a suitable irrigation protocol. Since prolonged exposure to EDTA may increase dentin erosion, its application time should be carefully controlled.

Chlorhexidine is an antiseptic used in dentistry. The presentation includes a 2% solution. It acts on bacterial cell membranes and disrupts their permeability. One of the important properties of chlorhexidine is its ability to maintain antibacterial activity on the dentin surface for a certain period. However, chlorhexidine cannot dissolve organic tissues and cannot replace EDTA in removing the smear layer. Furthermore, chlorhexidine must not be mixed directly with sodium hypochlorite because their interaction may produce an undesirable precipitate. Therefore, the compatibility of different irrigation solutions must be considered when changing from one solution to another.

The presentation indicates a hydrogen peroxide concentration of 3%. During decomposition, it produces oxygen bubbles that may help remove debris through a mechanical cleaning effect. However, its ability to dissolve tissues and its antimicrobial activity are not equal to those of sodium hypochlorite. Therefore, hydrogen peroxide should not be considered a replacement for the main irrigation solution. Its use should be evaluated according to its limited properties. During medicament-based root canal treatment, irrigation solutions are commonly delivered using endodontic syringes and special needles. Particular attention should be paid to the effective distribution of the solution throughout the canal, the free movement of the needle, and the prevention of apical extrusion.

Another important method is passive ultrasonic irrigation (PUI). In this technique, the irrigation solution inside the canal is activated by ultrasonic vibrations. As a result, the solution may reach complex anatomical areas more effectively, and debris removal may improve. However, the results also depend on canal anatomy, the properties of the solution, and the application technique. During chemical enlargement, EDTA-based solutions or gels may be used. They act on the mineral component of dentin and make it easier for instruments to pass through narrow canals. At the same time, mechanical preparation must be performed carefully to prevent excessive weakening of the dentin walls.

One of the important stages of medicament-based treatment is the correct sequence of irrigation solutions. Sodium hypochlorite is used to dissolve organic debris and disinfect the canal, while EDTA is used to remove the inorganic component of the smear layer. At the final stage, the canal is dried using paper points, and its readiness for obturation is assessed. The effectiveness of medicament-based treatment depends not only on the type and concentration of the solution but also on its volume, contact time, canal anatomy, and application technique. Failure to replace the irrigation solution regularly, persistence of the smear layer, or incomplete canal cleaning may negatively affect the treatment outcome. Inserting the irrigation needle into the canal with excessive force or delivering the solution under high pressure increases the risk of apical extrusion. In addition, mixing chemical agents without considering their compatibility may reduce their effectiveness and lead to undesirable reactions. Therefore, careful selection and correct use of irrigation solutions are essential for safe and effective endodontic treatment. For this reason, it is necessary to select an irrigation protocol according to the clinical situation, consider the interactions between different agents, and follow safety guidelines during medicament-based treatment. After assessing whether the canal has been properly cleaned and dried, hermetic obturation is performed.

Medicament-based root canal treatment is an essential part of endodontic treatment and plays an important role in reducing microorganisms and tissue debris within the root canal system. Sodium hypochlorite is known for its ability to dissolve organic matter and its antimicrobial activity, while EDTA affects the mineral component of dentin and helps remove the smear layer. The use of chlorhexidine and hydrogen peroxide should be evaluated by considering their biological properties and limitations. Modern irrigation methods, including ultrasonic activation, the correct sequence of irrigation solutions, and compliance with safety requirements, help improve the effectiveness of root canal cleaning. Therefore, thorough chemical treatment, proper mechanical preparation, and high-quality hermetic obturation are closely related factors that contribute to the long-term success of endodontic treatment.

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