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SHORT COMMUNICATION

Root canal disinfection: options to sodium hypochlorite and chlorhexidine

Desinfección de conductos radiculares: opciones al hipoclorito de sodio y a la clorhexidina

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ABSTRACT

Introduction: the use of irrigants for intraoral disinfection is indispensable for eliminating the bacterial load of the pathology present in the dental piece.
Objective: to discuss the efficacy of intra-canal irrigants such as MTAD, Tetraclean and Catremida.
Methods: bibliographic review based on the use of scientific search engines between 2018 and 2023. The search was carried out in the research databases: Pubmed, Scielo. The words used within the literature search were "irrigation and endodontics", "irrigants in endodontics", "new endodontic irrigants". The research was limited to the English and Spanish language, and only articles that talked about current irrigant solutions used in Endodontics were included.
Development: MTAD, Tetraclean and Cetrimide have the ability for smear removal, there are also promising data considering the antimicrobial activity of MTAD, especially against E. faecalis and its effect on dental stem cells in regenerative endodontics, although they are still controversial. Despite some unfavorable reactions and havoc that has been generated in the tissues of patients by the use of NaOCl, for years this irrigant continues to be the most suitable for dental practice.
Conclusions: none of the substances used individually meet the requirements of an ideal irrigant, therefore it has been found feasible to combine irrigants together with the proper instrumentation of the root canal to have a much greater impact on the outcome of endodontic treatment.

Keywords: Root Canal Irrigants; Disinfection; Bacterial Load; Cetrimonium.

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RESUMEN

Introducción: el uso de irrigantes para la desinfección intraconducto es indispensable para eliminar la carga bacteriana de la patología presente en la pieza dental.
Objetivo: argumentar sobre la eficacia de irrigantes intraconducto como MTAD, Tetraclean y Catremida.
Métodos: revisión bibliográfica a partir del uso de buscadores científicos entre el año 2018 y 2023. La búsqueda se llevó cabo en las bases de datos de investigación: *Pubmed, Scielo*. Las palabras utilizadas dentro de la búsqueda de la literatura fueron "irrigación y endodoncia", "irrigantes en endodoncia", "nuevos irrigantes endodónticos". La investigación se limitó al idioma inglés y al español, y solo se incluyeron los artículos que hablaban sobre las soluciones irrigantes actuales usados en Endodoncia.
Desarrollo: el MTAD, Tetraclean y Cetrimida tienen la capacidad para la eliminación del barrillo dentinario, también existen datos prometedores que consideran la actividad antimicrobiana de MTAD, especialmente contra *E. faecalis* y su efecto sobre las células madre dentales en la endodoncia regenerativa, aunque todavía son motivo de controversia. A pesar de algunas reacciones y estragos desfavorables que se ha generado en los tejidos de los pacientes por la utilización del NaOCl, para la práctica odontológica por años este irrigante continúa siendo el más adecuado.
Conclusiones: ninguna de las sustancias utilizada individualmente cumple con los requisitos de un irrigante ideal, debido a esto se ha visto factible la combinación de irrigantes junto con la instrumentación adecuada del conducto radicular para tener un impacto mucho mayor en el resultado del tratamiento endodóntico.

Palabras clave: Irrigantes del Conducto Radicular; Desinfección; Carga Bacteriana Cetrimonio.

INTRODUCTION

Formerly it was believed that disinfection of the root canal system occurred simply with instrumentation, however, the accumulated evidence of recent decades led to a paradigm shift, where it is proven that rotary instruments become more effective in moist canals. , so they require irrigating substances that help to reduce the amount of bacteria, eliminate the smear layer and disinfect irritating agents from the diseased tissue inside the canals, including auxiliary and lateral canals where instruments cannot reach.[1,2]

In this way, in endodontic treatment, essential procedures are performed to obtain a successful result; Among them is irrigation, which focuses on the majority elimination of residual pulp tissue, microorganisms and dentinal remains. It significantly fulfills chemical, mechanical and microbiological functions in order to avoid an infectious process secondary to the initial pathology.[3]

According to the American Association of Endodontists (AAE) the selection of an irrigating solution should not be random, its effectiveness and safety must be taken into account due to the various degrees of cytotoxicity that can cause effects such as: pain, burning, redness and burns when in contact with tissues. internal or external oral cavity, therefore it is essential that they meet optimal characteristics for their correct use in endodontic treatment without causing iatrogenesis.[3]

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It is convenient for the dentist to be able to explore the biocompatible factors of various irrigating substances with a scientific basis for their clinical practice, always keeping in mind that these solutions must make an impactful contribution to the patient's well-being. Although none of the agents could meet all irrigation requirements in endodontics, the benefits of some have been verified in the internal canals of the dental organ.[4]

Among the most important and used irrigation systems are hypochlorite. sodium (NaOCl) and chlorhexidine (CHX), both have several properties that make them effective in Endodontics. NaOCl is an antibacterial and oxidizing agent that has a rapid onset of action along with the ability to dissolve tissues within the canal; On the other hand, CHX is an antiseptic, antibacterial and metalloproteinase inhibitor that helps prevent reinfections; However, currently they are not the most used irrigants on the market.[5]

Likewise, the use of other irrigants that can comply, but not exceed some of the characteristics of the chemicals mentioned above when showing an immediate antibacterial effect with a higher capacity for disinfection of certain bacteria and an efficient dissolution of inorganic matter, Despite this, it has also been reported that its use can cause unwanted effects.[5]

In fact, chemical agents are the case ofMTAD, tetraclean and catremide have been analyzed as promising solutions to over time, as they show similar characteristics to CHX and NAOCL in its relationship with the substantivity without negatively affect the physical properties of the tooth, but more clinical studies are still needed to establish them as the ideal endodontic irrigants.[5]

Thus, the present review aims to discuss intracanal irrigants similar to NAOCL and CHX whose properties meet or are similar to these. This is the case of MTAD, Tetraclean and Catremida which will be compared with each other to verify their degree of effectiveness when performing an endodontic treatment according to the guidelines of the existing literature.

METHODS

Bibliographic review using scientific search engines between 2018 and 2023. The search was carried out in the research databases: Pubmed, Scielo. The words used within the literature search were "irrigation and endodontics", "irrigants in endodontics", "new endodontic irrigants". The research was limited to the English and Spanish languages, and only articles that talked about current irrigating solutions used in Endodontics were included.

The search included articles discussing research design, clinical and cross-sectional trials in accordance with the objective of the review. The exclusion criteria considered were: Individual case reports, systematic reviews and opinion articles. Initially, 27 articles were selected for the content of the title; subsequently, duplicates were discarded. The first phase resulted in 17 articles to be selected through full-text research.

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DEVELOPMENT

The most used irrigating solutions in endodontics are NAOCL 2,5 % OR 5,25 % and CHX 2 %, because they demonstrate great antibacterial activity and the ability to dissolve tissue remains present in root canals, however, they are has shown that 0,2 % cetrimide (CTR) can be used as a replacement for CHX since it has been shown to have bactericidal potential against anaerobic bacteria and similar substantivity to CHX. Furthermore, it can be combined with CHX to improve said bactericidal activity.[6]

Both for the analysis of the removal of tissue tissues present in the root canal and in the eradication of internal microbes, has been compare the irrigating substances together with chelating substances, it has been shown that CTR in combination with malic acid (MA) has better removal of the smear layer, this property being attributed mainly to CTR due to its surfactant effect. Within the same study, it was confirmed that CHX when combined with MA has less effectiveness in eliminating dentinal sweeping since it decalcifies the dentin of the root canal.[7]

Regarding the antibacterial effect of Tetraclean or smear clean, it has microbial properties and tissue solvency within the root canals. Unlike NAOCL, tetraclean does not have high surface tension allowing it to penetrate the dentinal tubules. It is worth mentioning that tetraclean is also used as a chelating substance that could replace EDTA.[8]

Thus, NAOCL, as it does not have properties that eliminate infected dentin, could be replaced by tetraclean, which contributes thanks to its surfactant property to eliminate said dentin, achieving excellent antimicrobial performance when entering the dentinal tubules, favoring endodontic treatments in the long term. However, it should be noted that its combination with NAOCL enhances the antibacterial activity.[9]

On the other hand, among the properties similar to NAOCL and CHX, MTAD is found, it is a mixture of 3 % doxycillin, 4,25 % citric acid and 0,5 % polysorbate.[5] It stands out mainly for its antibacterial activity, because in the results of the in vitro study by Torabinejad et al., MTAD has a strong antimicrobial efficacy against E. faecalis compared to 5,25 % NaOCl, without affecting the dentin structure. of human teeth. However, youBoth MTAD and Tetraclean do not dissolve organic tissues, so NaOCl should be used to dissolve organic tissues and have greater effectiveness.[10,11]

Within the analysis of the various properties of MTAD, its respective comparison was carried out together with those of NAOCL and CHX, obtaining as a result that MTAD is effective for the removal of the smear layer in combination with NaOCl and is biocompatible because it does not cause postoperative discomfort. after root canal treatment and is less cytotoxic than NaOCl, and no significant changes in dentin structure were evident.[12]

Likewise, when studying the properties of Tetraclean, it was found that it is less cytotoxic than NaOCL, so its biocompatibility with tissues and the action it has on the waste disposal processIt is favorable when used as an endodontic irrigant. In addition, it has great activity against the bacteria responsible for primary endodontic infection such as Prevotella intermedia, Porphyiromonas gingivalis and Enterococcus faecalis, however, it does not surpass the antimicrobial activity of NaOCL.[8]

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Table 1. Comparison of the properties of irrigants in endodontics.

Properties	NaOCL	CHX	MTAD	TETRACLEAN	CETRIMIDE
Biocompatibility	-	+	+	+	+
Ability to dissolve pulp tissue	+	-	-	-	-
Antimicrobial activity	++	+	+	+	+
Ability to remove the smear layer	-	-	+	+	+
Inhibition of E. faecalis	+	+	+	+	+

Fountain: M. Dede, 2019.

DEVELOPMENT

To obtain success in root canal treatment, it is essential to employ the procedure and the appropriate use of an ideal irrigant in conditions of perfection, including certain properties and functions, both physical and biological, in order to avoid an infectious process secondary to the incipient condition or the formation of root canals. of a root lesion that progresses after the poor action of the solvent material and the technique carried out.[3]

Irrigation is the main source of asepsis and disinfection of the root canal system that is infected by microbial biofilms of different categories, which are linked to the surfaces of the dentin, inducing an increase or decrease in the concentration of nutrients and oxygen, also drive slow metabolic states in the inner layers of cells, being inherently less susceptible to antimicrobials.[1]

Considering the difficulty in examining some areas during the structuring of the root canal system, irrigation solutions have been prioritized as an important tool, due to their ability to eliminate organic waste and emanate the smear layer, thus allowing internal disinfection. of the root canal system and promote better insertion of medication and dentinal tubule sealants.[7]

Likewise, effective chemical-mechanical conditioning of the space of the root canal system and satisfactory adhesion to the dentin is a primary requirement for the removal of dentinal components, which is why irrigation solutions have been adapted for the treatment of root canals, which include as the most notable to the NAOCL and the CHX, without having been surpassed by any other. However, there are certain irrigants with excellent virtues such as MTAD, Tetraclean and Catremida, which have managed to achieve several characteristics of the aforementioned, but have not been able to replace them currently for use due to the lack of conclusive evidence.[8]

The most commonly used irrigation agent issodium hypochlorite what is ita salt formed by hypochlorous acid (HOCl) and sodium hydroxide, it is considered a gold standard, due toto its antimicrobial activity, antifungal and antiviral of species such as enterococci and actinomyces, types of candida and as for viruses, it includes human immunodeficiency, and it also has a residual action that can last up to 72 hours.[2]

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It is used in various concentrations that vary between 2,5 % and 5,25 %; The higher the concentration, the greater the capacity.offragment peptide chains, dilute tissues, deactivate endotoxins, eliminate biofilms and act as a non-specific oxidizing agent that causes harmful effects on the dentin surface. It is easily acquired due to its low economic value in the market, it has a long useful life, although regardless of its potency, NaOCl has been condemned for its toxicity relative to contact with soft tissues, its unpleasant taste and its inability to eliminate the smear layer.[3]

On the other hand, lto chlorhexidine 2 % is used as a substitute for NaOCl, since both are effective in reducing the number of microorganisms in teeth with necrotic pulp, periapical pathology or both, has a characteristic of prolonged substantivity, is an effective antifungal agent, especially against C. Albicans, the effect of CHX on microbial biofilms is significantly lower than that of NaOCl, it has little or no ability to dissolve organic tissues and remove smear layer, it can significantly improve the integrity of the hybrid layer and the stability of the resin-dentin bond, it is biocompatible as it has low tissue toxicity and in rare cases can cause allergies.[1,2]

Due to the lack ofa single solution that by itself sufficiently covers all the required functions of an irrigant such as, for example, NaOCl, which, even though it is the most used solution in endodontic treatments, presents a great deficiency compared to the removal of the smear layer, whose elimination is a necessity due to the interference it may cause with the adhesion and penetration of the root canal filling material; Other solutions have been investigated such as MTAD, Tetraclean and Catremida that could be used as alternative irrigants to compensate for some deficiencies of NaOCl orCHX.[13]

The MTADIt contains doxycycline so its antimicrobial activity is prolonged. In addition, in a study on the effects of MTAD, it was shown that it effectively eliminates SL and does not significantly change the structure of the dentinal tubules. It has the capacity to solubilize organic and inorganic dentinal material as well as organic pulp, in turn shows antifungal effectiveness, effective in adhesion to dentin and disintegration of the E. faecalis biofilm, preserving the structure of the tooth surface without causing erosion.[5]

Tetraclean even showed a greater degree of biofilm disintegration at any interval compared to MTAD. In a recent study, its activation against bacteria from primary endodontic infections such as Prevotella intermedia and Porphyiromonas gingivalis and against Enterococcus faecalis was confirmed. Likewise, it was observed that the mechanism of action of Tetraclean acts progressively over 72 hours to eliminate the bacterial load in all the tests analyzed.[6]

Like MTAD, Tetraclean has the presence of doxycycline, an element that increases the substantivity in the dentin and releases it slowly. Unlike sodium hypochlorite, Tetraclean can achieve a deep preparation and enter the dentinal tubules due to its lower surface tension. However, both MTAD and tetraclean as derivatives of tetracyclines have an intrinsic pigmentation property, which which limits its use.[8]

In a comparative study of the antimicrobial efficacy of endodontic irrigants, it was found that Cetramide is used as a surfactant agent that significantly helps in the elimination of E. fecalis, an opportunistic microorganism that causes periapical diseases and failure in endodontic treatment. It was found that the combination with 2 % CHX had a higher percentage of bacterial destruction than CHX and MTAD alone.[14]

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Likewise, in another study where 0,2 % cetramide was used as a surfactant agent together with NAOCL to eliminate E. fecalis, it was shown to improve the antimicrobial activity of sodium hypochlorite by reducing the surface tension, not altering the pH and the angle of contact of the main irrigant and bind strongly to both the walls and membranes of the microorganisms, causing their cell rupture.[15]

On the other hand, cetramide as a combined irrigant can be used in different concentrations, so in a comparative study between CHX + CTR at 0,5 % and Ca (OH), cetramide gave statistically significant favorable results in bacterial reduction, mainly in eradication. of E. fecalis by having a lysis action on the extracellular polymeric substance matrix of said bacterial cells.[16]

In addition, Cetramide can also be used individually, revealing antibacterial properties in the treatment of root canals. However, it must be considered that Cetramide, despite having favorable bacterial disinfection properties, can often acquire higher cytotoxicity ranges. be combined with CHX compared to the combination of 5,25 NAOCL and CHX.[17]

CONCLUSIONS

Articles from recent years demonstrated studies of new intracanal irrigants such as Tetraclean, Catremida and especially MTAD due to their significant differences in terms of certain properties that define and represent in greater proportion to NaOCl andCHX, so they have been considered promising solutions for endodontic therapy, however, it is concluded that there is still not enough research nor do they have the necessary advantages to replace NaOCl as to CHX.

Conflict of interest statement
The authors declare that there are no conflicts of interest.

Author contributions
All authors participated in conceptualization, data curation, formal analysis, research, methodology, supervision, writing-original draft, writing-review and editing.

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