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ARTICLE REVIEW

Antibacterial capacity of calcium hydroxide on non-vital teeth

Capacidad antibacteriana del hidróxido de calcio en dientes no vitales

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ABSTRACT

Introduction: calcium hydroxide is applied in endodontics, since it has an alkaline pH and has a bactericidal effect on pulp infection.
Objective: to describe the antibacterial effects of calcium hydroxide in non-vital pulp infections.
Methods: a search for information was carried out in Scopus, SciELO, Dialnet and Redalyc databases. A search formula was used, using the terms "Calcium Hydroxide", "Bactericide", "Antibacterial", "Dentistry" and "Stomatology". A search formula using Boolean operators was used to relate the terms.
Results: It was identified that calcium hydroxide stimulates calcification, generates a mechanical barrier for apical healing, controls and prevents postoperative pain, disinfects root canals; among its benefits it was found that it does not affect the future development of the root of the dental piece. It can be used in different odontological treatments such as root fractures, luxations and avulsions, in internal reabsorption, especially in pulp necrosis.
Conclusions: Calcium hydroxide is used as an obturator because due to its alkaline property it reduces the proliferation of bacteria in necrotic dental pieces, it also favors apical healing and favors the sealing of the dental piece ducts.

Keywords: Calcium Hydroxide; Dentistry; Antibacterial; Endodontics; Dental Pulp Necrosis.

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RESUMEN

Introducción: el hidróxido de calcio es aplicado en la endodóntica, pues al poseer un pH alcalino tiene un efecto bactericida en la infección pulpar.
Objetivo: describir los efectos antibacterianos del Hidróxido de Calcio intraconducto en infecciones en pulpas no vitales.
Métodos: se realizó una búsqueda de información en las bases de dato Scopus, SciELO, Dialnet y Redalyc. Se empleó una fórmula de búsqueda, usando los términos "Hidróxido de Calcio", "Bactericida", "Antibacteriano", "Odontología" y "Estomatología". Se empleó una fórmula de búsqueda empleando operadores booleanos para relacionar los términos.
Resultados: se identificó que el hidróxido de calcio estimula la calcificación, genera una barrera mecánica de cicatrización apical, controla y evita dolores post operatorios, desinfecta los conductos radiculares; dentro de sus beneficios se encontró que no afecta el desarrollo futuro de la raíz de la pieza dental. Puede ser usado en diferentes tratamientos odontológicos como las fracturas radiculares, luxaciones y avulsiones, en la reabsorción interna, sobre todo en necrosis pulpar.
Conclusiones: el hidróxido de calcio es usado como obturador pues por su propiedad alcalina reduce la proliferación de bacterias en piezas dentales necróticas, además que favorece a la cicatrización apical y favorece al sellamiento de los conductos de la pieza dental.

Palabras claves: Hidróxido de Calcio; Odontología; Antibacterianos; Endodoncia; Necrosis de la Pulpa Dental.

INTRODUCTION

The dental professional specialized in endodontics, as well as general dentists, should have an adequate level of knowledge for the care of dental emergencies that may lead to pulp problems. Post-treatment pulp complications are very frequent in daily dental care, requiring treatment with analgesics, steroidal and non-steroidal anti-inflammatory drugs, and intra-ductal medication is recommended by several protocols.[1]

Intra-canal medication is helpful and necessary to reduce or eliminate the bacterial load of certain pathogens that have been trapped in the root canal during manual root canal instrumentation; this avoids aggravation, and therefore better results. However, some agents used for this purpose may cause damage to the apical and periapical tissues.[2]

For an agent to be used as an intra-oral medication it must possess certain properties; for example, it must be soluble and not set so that the apical tissues can absorb and take full advantage of its properties.

Calcium hydroxide is one of the most commonly used intra-oral medications in endodontic practice to prevent and reduce the bacterial load due to its alkaline pH (12,6 – 12,8).[3,4]

On the other hand, calcium hydroxide is useful to stop small hemorrhages produced by pulp contacts during dental surgery due to its analgesic and anti-inflammatory action, its effect as a direct or indirect coating for reversible pulpitis and as a base for dentin sensitivity.[5]

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The form of uses of this agent is varied. Calcium hydroxide powder can be mixed with distilled water or physiological saline and in the case of necrotic pulps, it is mixed with camphorated paramonochlorophenol and physiological saline to achieve a greater and better antimicrobial and fungal effect.[3,6]

Given the variety of utilities of this agent, and due to the dispersion of the literature on the subject, the present bibliographic review was carried out with the objective of describing the antibacterial effects of intraconduit calcium hydroxide in non-vital pulp infections.

METHODS

A review of the literature on the antibacterial effects of intraconduit calcium hydroxide on non-vital pulp infections was carried out between April and May 2023 at the Regional Autonomous University of Los Andes.

A search for information was carried out in the Scopus, SciELO, Dialnet and Redalyc databases. A search formula was used, using the terms "Calcium Hydroxide", "Bactericide", "Antibacterial", "Dentistry" and "Stomatology" and their English translations, as well as Boolean operators to relate the terms.

The filters used were: articles in Spanish and English, published in the period 2016-2023, that addressed the uses of calcium hydroxide in dental care as a bactericide or antibacterial in the treatment of pulp conditions.

To select the articles, two of the authors applied the search strategy and proceeded to select the articles. Subsequently, a screening was performed, eliminating articles that did not meet the inclusion criteria after reading the abstract and title. Subsequently, a second screening was performed, reviewing the full-text articles, and eliminating those that were not of interest for the fulfillment of the results of the present study. After this, a third researcher reviewed the process, reaching consensus on the articles that generated discrepancies during the selection, forming the final sample (n=27 articles).

RESULTS

Calcium hydroxide is a whitish powder obtained from calcination of calcium carbonate. Its production depends on the fusion between water and calcium oxide.[3,6,7]

The literature consulted suggests several properties of calcium hydroxide that support its use. Among them, the antibacterial effect is pointed out,[8,9,10] besides being a coadjuvant in the reduction of edema and inflammations in root canals.

A study by Veintimilla et al.,[11] used a sample of 20 distal roots of upper molars, which were instrumented because of severe damage to the root canals. Calcium hydroxide was applied to each of the roots, and 100 % of the roots showed a considerable decrease in inflammation, as well as a reduction in bacterial infections, thus sealing the root canals.

Marchena et al.,[12] carried out an investigation that included 16 patients with deep caries, to whom calcium hydroxide was applied for three months. It was evidenced that in 100 % of the cases, the carious process was completely stopped, suggesting an antibacterial action, as well as the dilution of the necrotic tissue of the canals of the dental pieces.

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This is supported by the results of studies such as one carried out in Cuba, where 32 patients with immature apices and pulp necrosis were analyzed, to whom a treatment based only on calcium hydroxide was applied. It was obtained as results that in 89,5 % of the cases there was a favorable evolution of the dental pieces, due to the fact that this material has a pH of 12,8. This high alkalinity hinders the proliferation of bacteria, destroying the exudate and reducing edema and inflammation in the area.[13]

Other studies,[14,15] suggest that among the most relevant properties of calcium hydroxide is its capacity to stimulate tooth calcification, activating reparative events by osteoblastic stimulation, thus increasing the pH of dental tissues. It also shows its potential in the reduction of edema, sensitivity and even inflammation in periapical tissues, favors the destruction of exudate, sealing of canals, control of periapical abscesses and avoids the resorption of root inflammations.

Brito et. al.,[16] also reported that calcium hydroxide has antibacterial properties due to the decomposition of calcium and hydroxyl ions, which are responsible for transformable or non-transformable inactivation of anaerobic or aerobic microorganisms.

Giani et al.,[17] evaluated the bioactive materials used in dentistry, finally affirming that calcium hydroxide tends to achieve changes at the biological and even structural level of dentin or pulp tissue, protecting it in cases of damage.

Marchena et al.,[12] carried out a study in which it was verified that calcium hydroxide, when applied to periapical lesions or carious processes of dentin, completely stops this process, since its main benefit encompasses the creation of both reparative dentin and mineralized tissue, due to its high pH level and calcium release.

Similarly, the study suggested that the main properties are the generation of barriers for apical healing, the repair of apical periodontitis, the prevention of postoperative pain, the disinfection of root canals, as well as helping to induce apical closure. Likewise, it avoids possible reinfections and proliferation of microorganisms, benefiting the dissolution of necrotic tissues, among others.[12]

For its use, specific vehicles such as distilled water should be used. Its storage should be in a closed flask to prevent the formation of carbonate due to its contact with air.[7,18]

In this regard, an investigation carried out in Loja-Ecuador, emphasized that this material was mixed with physiological saline solution in 100 % of the cases and in each of the replacements carried out during the 30 days of treatment, being effective its use in this way.[19]

Similarly, Guzman et al.,[14] point out that in dental cases where calcium hydroxide is intended to be applied as part of the treatment, such material should be mixed with distilled water, saline, iodoform or anesthetic solutions before its application in the patient to obtain better results.

However, other vehicles such as propylene glycol and chlorhexidine with favorable properties have been suggested to be mixed with calcium hydroxide as an intraconduit medication.[20]

Calcium hydroxide is used in treatments that include root fractures, luxations, periodontal lesions, in pulps with necrosis, hemorrhages, deep caries, among others. In this regard, Rodriguez et al.,[5] point out that it is a useful material in endodontic treatments where there is severe trauma such as avulsions, root fractures, luxations, internal reabsorptions, endoperiodontal lesions, among others.

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The benefits of calcium hydroxide when used in dental pieces with severe pulp damage such as pulp necrosis, are centered on its reparative capacity and even in the formation of mineralized tissue of the tooth.

Cardoso et al.,[21] when analyzing the different treatment alternatives for teeth with lesions, found that calcium hydroxide is the only material that guarantees the normal formation and non-affectation of the root of the tooth after its use, especially in severe dental trauma such as pulp necrosis.

In a study carried out in Cuenca by Intriago et al.,[22] 106 root canals were instrumented. It was found that when calcium hydroxide was applied to the damaged canals, these tend to repair progressively because this material contributes to the dissolution of the necrotic tissue as well as to the formation of dentin that repairs the affected area. This avoids possible risks of damage to the root of the tooth, proving that this method is more efficient for necrotic removal and improvement of root canals.

Disadvantages

Calcium hydroxide has disadvantages such as its lack of adhesion in dental tissues or with other restorative materials, generating filtrations in the repaired area.

Paredes et al.,[1] selected 80 people with necrotic teeth without fistula, which were treated with calcium hydroxide. The study identified that in 60% of the cases there were leaks in the repaired area, due to its poor adhesion with the dental tissues, generating discomfort in the patients and the need for a new dental repair.

Another study carried out in Mexico found the same disadvantages, identifying leaks in 95 % of the patients in whom this material was applied due to deep caries and necrotic pulp tissue.[23]

CONCLUSIONS

The properties of calcium hydroxide include its bactericidal action, its action in the reduction of edema, abscesses, pulp inflammation, pulp protection, disinfection of root canals, elimination of necrotic tissue, among others. Its main disadvantage lies in its lack of adhesion in dental tissues or with other restorative materials, generating filtrations in the repaired area. Calcium hydroxide, being an intraconductive medication that maintains a high alkaline pH, is highly efficient in eradicating the proliferation of bacteria in the affected area, hence its usefulness in cases of severe dental damage such as pulp necrosis and non-vital dental pieces.

Conflict of interest
The authors declare that there is no conflict of interest.

Authors' contribution
All authors participated in the conceptualization, formal analysis, project management, writing - original draft, writing - revision, editing and approval of the final manuscript.

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