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Root caries in elderly patients: A narrative review

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ABSTRACT

Root caries is a common condition that affects oral health in the elderly, due to risk factors such as gum recession, reduced saliva, and systemic diseases, in addition to the use of medications, characterized by the deterioration of dental tissues in the region of the roots of the teeth due to caries. Prevention and treatment include regular dental care, topical fluoride, and remineralizing agents to prevent lesion progression. In cases of cavity formation, restorative treatment is indicated. In extreme cases of tooth substrate loss, tooth extraction may be the only choice. This work aimed to describe the characteristics of root caries lesions and review the literature on their concept, particularities, and management, in addition to discussing the different forms of intervention and choices of material adopted. For this, articles were researched between the years 2013 and 2023, through searches in Scielo, Pubmed and Banco Periódico da Capes databases, using as descriptors: root caries AND/OR elderly AND/OR dentistry. Within the inclusion criteria, complete articles were selected, relevant to the topic, that could be accessed in full, whether in Portuguese or English. Awareness about the importance of oral health in the elderly and access to adequate dental services are essential to prevent and treat root caries in this population. Promoting healthy oral hygiene habits and educating about risk factors also play a crucial role in reducing the incidence of this disease and increasing the quality of life among the elderly.

Keywords: Root caries, Therapy, Diagnosis.

1 INTRODUCTION

Root caries (RC) is a progressive and chronic lesion, mainly affecting the root surface and potentially involving cementum, dentin, or enamel near the cement junction (DIAS et al., 2020). This problem is related to the aging of the individual and to parafunctional causes, which can lead to gingival retraction, leaving the tooth root exposed, which suffers a more accelerated wear due to the absence of enamel in the region. All this, added to a high microorganic load and cariogenic diet, influences the process of pH changes, microbial dysbiosis and, consequently, demineralization of this tooth portion (ASKAR et al., 2020).

Therefore, it is also necessary to highlight the influence of oral biofilm in this process. Microorganisms play a crucial role in human health by contributing to the development of the immune system and promoting resistance to pathogens. However, they have the potential to infect the tissues of the hopedeiro, negatively impacting the individual. S. mutans, as well as A. *viscosus* and *A. naeslundi are identified as the most common in CR* (TAKAHASHI, 2016).

Global epidemiological indicators, based on various diagnostic criteria such as the root caries index (CRI), the decayed, full and healthy root index (RDFS), and the International Caries Detection and Evaluation System (ICDAS) criteria for root caries, suggest that the prevalence of root caries ranges from 23% to 96% of the adult population (USAGA-VACCA et al., 2021).

Usaga-Vacca et al. (2021) also mention that the variation in diagnostic criteria and methodologies used in different studies may contribute to the reported prevalence rates. In addition, factors such as age, oral hygiene practices, diet, systemic health conditions, and access to dental care may influence the prevalence of RC.

Therefore, approaches that are more targeted to certain population types should be preferred, aiming at the appropriate treatment of root caries lesions. All of this revolves around an accurate diagnosis as well as understanding the dynamic process of its development (BIDINOTTO et al., 2018).

2 METHODOLOGY

A search for articles was conducted in the Scielo, Pubmed, and Capes Periodical Databases, searching for publications from the last 10 years (from 2013 to 2023). The articles were selected by reading the titles and abstracts to determine their relevance to the proposed theme.

The search for articles was done using the descriptors: tooth root, carie, aged, descriptors duly registered in the Decs/Mesh descriptor library, with the boolean operator AND. Respecting the established time limit. The search resulted in a total of 59 articles.

The following criteria were adopted for the exclusion of articles and their problematization in relation to: a) articles that had no influence on the area cited and the topic addressed; b) articles that related the descriptors to other areas of health and scientific knowledge other than dentistry; d) incomplete publications or those in which only abstracts were made available, e) and duplicate articles.

After the pre-selection, they were submitted to the criteria already mentioned here and from their fulfillment, a more careful analysis of the publications was initiated, taking into account the pertinence and relevance within the construction of the project, to include them. A total of 37 articles were selected to be part of this review.

3 NARRATIVE REVIEW

3.1 CONCEPT AND PREVALENCE

RC is defined as a non-cavitated or cavitated lesion below the cement cement junction without involving the adjacent enamel (ALQRANEI et al, 2020). It is a problem that results from the imbalance in the process of dental demineralization and remineralization, linked to the consumption of fermentable carbohydrates, the individual's level of exposure to the cariogenic challenge, and oral hygiene practices. Such a condition affects a large proportion of the world's population, regardless of

gender, age, and ethnicity (WHO, 2020). With the aging population and the maintenance of teeth in the elderly, caries control, especially on root surfaces, becomes crucial (SUBBIAH & GOPINATHAN, 2018).

Throughout the In recent decades, studies conducted in different countries have reported an average prevalence of RC in the elderly between 30-60% (MITWALLI et al., 2019). Due to factors that alter oral health in the elderly population, the WHO has included oral health as an important component of its active aging policy, which promotes healthy living, disease prevention, and a focus on improving the quality of life of older adults, aiming to reduce the proportion of untreated coronal and root caries (HENDRE et al., 2017).

CR has the ability to develop rapidly, as the acids produced by the bacteria during this process spread in the biofilm towards the cementum or dentin, covering the surface of the root that lacks enamel and dissolving it. The tooth naturally responds to this invasion by forming hypermineralized sclerotic dentin to slow microbial advancement toward the pulp (WONG et al., 2017; OLIVEIRA et al., 2018).

The gingival margin of the CR lesion may lie below the gingiva, which makes it difficult to remove the biofilm. These lesions are usually large from a mechanical point of view and deep from a biological point of view, due to their proximity to the pulp chamber, and have a tendency to bypass the root, which makes restorative treatment more challenging (SLAYTON et al., 2018; MEYER-LUECKEL et al., 2019).

The appearance of caries in the elderly occurs differently compared to young adults, mainly due to its location, which is more frequent in the root region. This often occurs as a result of associated periodontal diseases and the physiological changes that occur in this age group, such as reduced salivary flow, resulting from the chronic use of various medications (VAN STRIJP and VAN LOVEREN, 2018; ZHANG et al., 2020).

3.2 MICROBIOTA ASSOCIATED WITH ROOT CARIES

The oral cavity is home to a great diversity of microorganisms, made up of more than 1,000 different species. Some of these microorganisms have the ability to produce acids as a result of the metabolism of carbohydrates from the diet. This leads to a reduction of pH in the dental biofilm. In this condition, the physicochemical balance between tooth minerals, biofilm fluid, and saliva is disrupted, resulting in the dissolution of the mineral content of dental tissues and the appearance of carious lesions (TAN et al., 2017; CAVAZANA et al., 2018).

There is still no clear consensus on the microbiota associated with CR. Distinct patterns and individual differences in microbial composition were observed, although the predominance of *Actinomyces spp*. has been associated as a potential causative agent of this condition (PATEL et al., 2018). However, *Actinomyces spp*. has recently been evidenced to be metabolically active in both

decayed root surface biofilms and healthy root surfaces (SEIFO et al., 2019), suggesting that these organisms are more site-specific related rather than dysbiosis.

Other studies indicate that *S. mutans* and *Lactobacillus* play a relevant role in root caries. The joint presence of these species has been correlated with a higher risk of CR (URQUHART, et al., 2019).

According to Vanstrijp et al. (2018), the composition of dental plaque in active or inactive CR lesions is composed of less than 10% of *S. mutans* and 73% *of Lactobacillus spp*. in relation to the total microbiota. This indicates that other microbial species may also contribute to the development and progression of root caries.

The results present in the literature indicate that the microbiota associated with root caries is more diverse and complex than previously thought. While *S. mutans and Lactobacillus spp*. have been considered important cariogenic organisms, their prevalence in root caries lesions is relatively low. This suggests that a more comprehensive understanding of microbial ecology and interactions within the biofilm is needed to fully understand the etiology and progression of root caries (WIERICHS et al., 2018; WONG et al., 2017; ZHAO et al., 2018).

3.3 CLASSIFICATION AND DIAGNOSTIC SYSTEMS

The diagnosis of root caries is mainly based on clinical findings. Regarding clinical signs, they are based on the difference in cement color, changes in the contour of the root surface, and evident cavitation (ALQRANEI et al., 2020). The detection of root caries lesions by tactile and visual means continue to be the most indicated for diagnosis (FEE et al., 2020).

Lesions in early stages, with no obvious signs of cavitation, can hinder early detection. Thus, the diagnosis of root lesions should be based on the activity of caries lesions (ALQRANEI et al., 2020). Although some authors argue that the presence of cavitation is not sufficient for diagnosis, hardness or "softening" should be taken into account as a diagnostic criterion, as well as the location, close to the gingival margin, where biofilm retention may occur (PRETTY, 2017).

CR lesions can be classified as active and inactive, related to coloration and hardness. Active lesions are characterized as yellowish or brownish lesions, with the presence of biofilm and a leathery consistency. Inactive lesions, on the other hand, are brownish or black, with a firm consistency and usually without the presence of accumulated biofilm. The use of interproximal radiographs may also be indicated to aid in the diagnosis of root lesions, especially when they are subgingival (ALQRANEI, 2020).

3.4 ROOT INJURY MANAGEMENT

After the diagnosis of this lesion, it is necessary to restore oral health through the treatment of choice. The extent, depth of the lesion, sensitivity, and desired aesthetics directly influence the choice of treatment. Another point to be observed is the degree of risk of caries to which the patient is exposed (SARFATI & TIRLET, 2018).

It is recommended to treat active root carious lesions according to their location and depth, prioritizing non-invasive strategies that promote the remineralization of the lesions (DAMÉ-TEIXEIRA et al., 2017).

3.4.1 Prevention

The preventive approach to avoiding tooth decay involves essential care, such as proper oral hygiene, including regular brushing of teeth at least three times a day with a soft-bristled brush and flossing correctly to reach hard-to-reach areas. These measures are essential to remove plaque and prevent the accumulation of biofilm, thus contributing to the prevention of caries. (PHILIP, et al., 2018; DIAS, et al., 2020).

In addition, it is important to offer patients appropriate oral hygiene instructions that are tailored to their individual abilities. In some cases, such as in older adults with special needs, it may be necessary to rely on the collaboration of caregivers to ensure proper oral hygiene. Preventing tooth decay is an ongoing effort that requires the active participation of the patient, caregivers, and oral health professionals. By taking these preventative measures, it is possible to significantly reduce the risk of developing tooth decay and maintain good oral health. (DIAS, et al., 2020).

No less important, another means of prevention is through a balanced diet, where reducing the consumption of sucrose (sugar) helps prevent caries. Sucrose is a substrate for cavity-causing bacteria, which produce acids that damage tooth enamel. Having a balanced diet, with low consumption of sugary foods and drinks, contributes to the prevention of caries (DA, et al., 2014).

Use of antimicrobial agents such as chlorhexidine 0.12% and fluoride are commonly used in the prevention of caries. Chlorhexidine is an effective antiseptic against bacteria present in the mouth, while fluoride strengthens tooth enamel, making it more resistant to demineralization caused by the acids produced by bacteria. Fluoride is widely used in gel form for professional application, in toothpastes and mouthwashes. Fluoride remains the most effective and cost-effective protective agent in preventing caries. Therefore, its use is fundamental in prevention protocols (PHILIP, et al. 2018).

The relationship between fluorides and caries prevention is well established through epidemiological observations, chemical studies, animal experiments, and clinical trials. Fluoride interferes with carious lesions by reducing demineralization and activating enamel and dentin remineralization, which slows the progression of the disease. It also acts to reduce the solubility of

enamel and dentin in acid, promoting remineralization and resulting in the reduction of caries (FERREIRA, et al., 2013).

Another alternative for prevention would be Silver Diamino Fluoride (DFP), a bactericidal agent that reduces the growth of cariogenic bacteria, inhibits demineralization and promotes the remineralization of enamel and dentin. Its application in adequate concentrations has been shown to be effective in the prevention and treatment of root caries in the elderly (ZHAO, et al., 2018).

It is essential that the use of fluorides, whether in the form of toothpastes, gels or other products, is done according to the personalized recommendations of the oral health professional, taking into account factors such as age, risk of caries, history of dental diseases and individual conditions. In this way, it is possible to take advantage of the benefits of fluoride in the prevention of caries, maintaining oral safety and health (PINHEIRO, et al., 2020).

3.4.2 Invasive Management

Non-invasive treatment is not always a viable choice, especially when the RC lesion already has aesthetic impairment, such as dark brown or black lesions. It is necessary to associate measures to control diet, oral hygiene, and the use of fluorides associated with restorative interventions (HEASMAN et al., 2017).

Invasive interventions involve the selective removal of decayed tissue and restoration of the resulting cavity, and aim to stop the cavitation process and restore the tooth while maintaining its function and appearance by replacing the affected parts of its structure. However, it is worth noting that these interventions are curative and should be accompanied by non-invasive interventions to comprehensively treat and prevent disease progression. (PARIS, et al., 2020).

During the restoration procedure, difficulties related to the clinical characteristics of RC may arise, such as moisture control, access to the cavity, adhesion to different types of substrates, subgingival location, cavity shape that is not always retentive, marginal maladaptation, and proximity to the pulp. (PARIS, et al., 2020).

Regarding the particularity of root lesions in elderly patients, age-related changes in tooth structure can contribute to a high rate of failure in restorations. Over time, the dentin tubules decrease in diameter and number, which causes a reduction in permeability, hypomineralization of the root dentin, and alteration of its mechanical properties. In addition, the adhesion of restorative materials to root tissues is difficult to perform, especially when performed on sclerotic dentin, which is common in root carious lesions (FEJERSKOV & NYVAD, 2017, GÖSTEMEYER, et al., 2019).

The longevity of dental restorations is influenced by several factors, such as the choice of restorative material, the type of adhesion, the quality of light curing, finishing and polishing, patient habits, and periodic maintenance. Proper use of insulation, whether relative or absolute, can minimize

restoration failures by controlling humidity. However, in cases of subgingival root carious lesions, it is challenging to apply isolation with a rubber sheet, making it necessary to assess the need for clinical crown augmentation or access through gingival flaps, following the principles of minimal-intervention dentistry (BURROWS, 2020; GAVRIILIDOU & BELIBASAKIS, 2020).

3.5 CHOICE OF RESTORATIVE MATERIAL

In dentistry there are several restorative materials available, with composite resin and glass ionomer being the most used, so that in each treatment plan, it is possible to choose the most appropriate material for the case. Restorative materials, in addition to their primary function of restoring function and aesthetics, must meet requirements such as the maintenance of pulp vitality and periodontal health (NOBRE, et al., 2022).

Glass ionomer-based materials are considered fluoride reservoirs and are often used to restore root caries lesions. These materials can be "replenished" with topical applications of fluoride as well as fluoride that lies in the medium. Recent evidence shows that fluoride-releasing restorative materials inhibit the emergence of recurrent caries on restored root surfaces (FERREIRA, et al., 2013).

In recent years, high-viscosity glass ionomer cements (VSC) have been the preferred option for the restoration of CR lesions in the elderly. The quality of the product and the primary properties of the restorative CIV are closely related to its performance, and may be temporary or permanent. However, they have aesthetic insufficiency for dental mimicry (NAVARRO, et al., 2021)

Some regions have relevant aesthetic interference, and there is a need for perfect camouflage of the region. In terms of aesthetics, composite resins have shown excellent results, as they are able to faithfully reproduce dental characteristics and offer a wide range of color options. For aesthetic involvement in the buccal surfaces of maxillary anterior teeth, composite resin should be considered the best treatment option (DIAS et al., 2020).

4 DISCUSSION

The prevalence of CR in the elderly reaches 30-60%, mainly due to the increase in life expectancy and the prolonged maintenance of functional dentition (SUBBIAH & GOPINATHAN, 2018). It is estimated that by 2050 the world population over 65 years of age will increase from 12% to 22% and root caries is believed to be one of the main challenges (ALQRANEI et al., 2017). According to the findings of Paris et al (2020), aging is related to a reduction in intrinsic capacities and an increase in general diseases. Because oral health is intertwined with systemic health, disease consequences and interventions need to be considered.

CR develops through repeated cycles of demineralization associated with the loss of the organic collagen matrix in the dentin. As the structure of dentin and cementum is less mineralized than that of

enamel, the pH value required for tooth loss is higher in dentin than in enamel, 6 and 5.4, respectively (DAMÉ- TEIXEIRA et al., 2017). This fact may explain the rapid progression of acids produced by bacteria in the biofilm towards dentin and cementum (WONG et al., 2017).

Although there is still no consensus regarding the microbiota of root caries, a predominance of *Actinomyces spp. has been found, however* S. mutans *and* Lactobacillus *play a relevant role in RC (URQUHART, et* al., 2019). According to Takahashi & Nyvad (2016), Actinomyces species are dominant even in advanced stages of the disease and, while in enamel bacterial invasion occurs only after adamantine destruction, root surfaces are invaded at an early stage of the caries process.

The diagnosis of RC should be based on the signs and symptoms and the tactile and visual method is the most indicated to establish the activity of the lesions (FEE et al., 2020). Yellowish lesions, with the presence of biofilm and leathery consistency, are characterized as active lesions, while darkened lesions, firm consistency, and no biofilm accumulation characterize inactive lesions (ALQRANEI, 2020).

According to Usaga-Vacca et al. (2021), some factors such as age, diet, oral hygiene practices, and systemic conditions can influence the prevalence of RC. Thus, preventive measures such as proper hygiene result in effective control of bacterial biofilm (PHILIP, et al., 2018). In addition, a balanced diet with low consumption of sugary foods also contributes to the prevention of caries disease (FEIJÓ & IWASAKI, 2014).

The non-invasive management of RC consists of the frequent use of fluoride toothpastes together with diet control, which is already effectively found in the literature, different from restorative treatment (FERREIRA et al., 2013). According to the findings of Ekstrand (2016) suggests that toothpaste with a high concentration of fluoride provides better caries prevention in CR lesions in the elderly population than traditional toothpaste containing fluoride.

The treatment of RC is based on the activity of the disease and becomes quite challenging due to the difficulty in controlling humidity, as well as the retention of the restorative material and difficulty in performing absolute isolation, in cases that are subgingival (SCHWENDICKE & GÖSTEMEYER, 2017). Therefore, there is no gold standard treatment for these lesions, making it necessary to control the progression and measure the prognosis of each lesion (ALQRANEI et al, 2020).

When progression cannot be prevented and cavities form, invasive treatment should be performed. The invasive management of RC consists of sealing the cavities with the purpose of paralyzing the progression of the disease and restoring the tooth (ABOU NEEL et al, 2016). According to Spezzia (2017), glass ionomer cement, both conventional and resin-modified and high-viscosity, can be indicated for the treatment of RC. However, glass ionomers, even with their ability to chemically bind to the tooth structure, have inferior aesthetics to composite resin (HEASMAN et al, 2017).

It is important to note that for long-term restorations, it is necessary to evaluate primary properties of the material such as compressive strength, microhardness, resistance to abrasion/acid erosion, and fluoride release (NAVARRO, et al., 2021). According to Dias et al (2020), in a systematic review, they found that the composite resin has a higher survival rate than the conventional glass ionomer, as well as the resin-modified one.

5 CONCLUSION

- The tissues that form root structures have characteristics in relation to tooth enamel and these characteristics can influence the response of each of the dental tissues to cariogenic challenges.
- In general, RC has a higher incidence in the elderly than in younger patients due to the increase in factors related to aging. However, early diagnosis through clinical examination is essential to identify lesions in their early stages.
- Management of RC can be based on prevention, such as through healthy eating habits and proper oral hygiene.
- Restorative treatment is often compromised by the inaccessibility of the lesion, and both glass ionomer cement and composite resin can be used.

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