



REVIEW ARTICLE

Dental Caries in Geriatric Dentistry: An Update for Clinicians

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Introduction

Caries is a progressive infectious disease that, without treatment, leads to the destruction of the dental organ and can damage the surrounding tissues. According to the WHO, it is the third global scourge affecting all ages of life.

Over the past 40 years, prevention campaigns for children and adolescents have led to a decline in the prevalence of caries. The CAOD index for children aged 6 to 12 years decreased from 4.20 in 1987 to 1.23 in 2006 and there is an increase in the number of children who have no cavities [1].

The impact of these preventive actions is to preserve teeth throughout life. Although for a long time dental caries was the disease of children and young adults, and edentulousness that of elderly patients, the new generation of subjects over 65 years of age are increasingly dentulous, and are therefore more exposed to the risk of caries.

The risk of caries is an infectious risk which can have negative consequences on the health and quality of life of elderly patients: Development of remote infections (endocarditis), systemic disease imbalances (diabetes), aggravation of acute pathologies (aspiration pneumonia), discomfort, pain and difficulties chewing. This underlying infectious context has a greater impact on elderly patients who are the most vulnerable [2-9].

Access to care is a subject often mentioned in geriatrics. Annual dental check-ups are neglected in fragile patients and follow-up is no longer ensured on a regular basis. Access to dental care becomes difficult for the most dependent patients, especially those who are institutionalized. As a result, the first signs of fragility

and dependence are accompanied by degradation in oral status with an increased development of gingival and carious pathologies [10,11].

Therefore, current geriatric odontology is oriented towards conservative care. This means caring for and preventing caries in elderly patients who have retained their natural dentition, whatever their state of health and their degree of autonomy.

This article provides an update on the specific features of caries in the geriatric population as well as adapted preventive and curative strategies.

Specific Features of Caries in Geriatrics

In 2010, the report by the HAS (French High Health Authority) took into account studies on dental caries in the French population [1]. The report highlighted the fact that the proportion of adults that had at least one decayed tooth to be treated was 33-50%, 30-60% of the residents in long-term care facilities had conservative care needs and 44% had at least one decayed tooth. The study, which targeted people living at home, reported that 37% of these patients had caries.

In the United States, studies show a prevalence of caries of more than 40% in adults aged 75 years and older and the demand for conservative care is increasing [12-15].

The prevalence and incidence of caries in elderly patients are the highest among all age groups and increase with institutionalization. Patients in long-term care have more cavities than people living at home [16].

Location and distribution

In the elderly, caries mostly affects teeth roots.



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Coronal fissure caries is rarer, compared to other age groups. This can be explained by anatomical and physiological changes. On one hand, age-related periodontal atrophy exposes dental roots. On the other hand, there is physiological wear and tear and attrition blunts the coronal relief and modifies the points of interdental contact. Therefore, biofilm, food debris, is no longer retained at the coronal level but accumulates in interdental spaces [17].

The distribution within the oral cavity is characteristic [18]. The carious process begins at the vestibular and interproximal surfaces, at the level of the tooth neck [17]. In the most dependent patients, particularly in patients with cognitive disorders, caries increase due to a lack of follow-up and the absence of care. This leads to coronal fracture and the tooth is reduced to a root remnant.

Clinical forms

The mechanism of how caries occur is the same regardless of the age of the patient. It may be primary, initiated by an acid attack by bacteria directly on the exposed root surface or secondary, by infiltration of previously treated caries or a fixed prosthesis (crown, bridge).

Two clinical forms of root caries are found in geriatrics:

-Active caries: It is soft, chalky and yellow to light brown. They are close to the marginal gingiva and often covered with bacterial plaque. There may or may not be cavitation.

-Arrested caries is hard, smooth when probed, shiny and dark brown to black, located at a certain distance from the marginal gingiva.

Due to the localization in the root, the three dental tissues concerned are cementum, dentin and enamel. Enamel dissolves at a pH of 5.5, but cementum demineralizes at a pH of 6.7. Cementum is more sensitive to the acidification of the oral environment. Cementum caries propagate twice as fast as coronal enamel caries [19].

Risk factors

Diet, bacterial plaque and host are the risk factors commonly described by the Selwitz diagram [20]. They are highly present in the geriatric population with a more significant and interdependent incidence.

Diet: Dietary habits and conditions change with age, even in autonomous patients. Masticatory efficiency decreases, taste changes, leading to foods being selected. Sarcopenia affects the masticatory muscles, causing weakness when masticating fibrous or hard food. The discrimination of sweet tastes is preserved but is gradually reduced for salty tastes. Therefore, the patient leans towards a soft diet, easier to chew but

sticky, more tasty but rich in carbohydrate [21,22].

The frequency of food intake also changes with age. Snacking is more frequent throughout the day and the risk of caries increases more with the frequency of snacking than with sugar intake [23].

Nutrition is at the heart of management in institutionalized dependent patients, and must be adapted to the associated disorders such as dry mouth, swallowing disorders and muscle weakness. The adaptation of textures (soft, smooth or mixed), splitting meals in a context of dehydration and generalized fatigue modifies the mixing of food. Stagnation of the food bolus is observed in contact with the labial surfaces of the teeth, especially in the premolar-molar area.

Bacterial plaque or biofilm: At any age, the commensal flora present in the oral cavity is made up of different bacterial species. They can colonize dental surfaces and gums by agglomerating in the form of bacterial plaque, also called dental biofilm. They proliferate all the more as they are "fed" by the food residues deposited on teeth and gums after meals. Local pathologies (caries, gingivitis) can develop in case of selective proliferation of pathogenic species, depending on the permissiveness of the host.

In the elderly, the commensal flora is not as rich (245 bacterial species) as in young adults (500 species) [24]. In healthy elderly subjects, fusobacterium nucleatum polymorphum, few mutans streptococci and no lactobacilli and actinomyces are found [25,26]. Other bacteria are present on carious and pre-carious root sites; Pseudoramibacter alactolyticus, propionibacterium, atopobium, Olsenella, and Selenomonas. In patients with rampant caries, there is a significant amount of mutans streptococci and lactobacilli and flora composed of bifidobacterium, Veillonella, enterococci and Candida albicans [27-29].

The number of pathogenic microorganisms increases with the acidity of the oral environment and a decrease in oral pH promotes a build-up of bacterial plaque.

To prevent the proliferation of bacterial plaque, daily oral and prosthetic hygiene are essential. They consist of removing bacterial plaque and food debris from the teeth, prostheses and mucous membranes. The mechanical action of brushing and the detergent action of toothpaste help to break up and remove biofilm from dental surfaces. Hygienic care also reduces oral acidity. Depending on their degree of autonomy and dexterity, elderly patients must be provided with appropriate hygienic care, or even assisted by caregivers [30].

Host: In the elderly, physiopathological gingival recessions expose the dental cervix and root surfaces. Anatomical modifications (widened interdental spaces, old restorations, isolated teeth) foster plaque retention and complicate hygienic care.

The major risk is the reduction of salivary flow, very common in geriatrics. Mouth dryness is caused by physiological (atrophy of the salivary parenchyma) and hormonal factors as well as lack of stimulation. Salivary secretion is affected by general pathologies (dehydration, diabetes, rheumatoid arthritis) and the regular intake of antisialic medicines, very commonly prescribed in geriatrics. Hypoptyalism creates an acidic environment, which is favorable to the risk of caries. The composition of the saliva is modified in case of hypoptyalism with a decrease in immunoglobulin, lysozyme and mucin levels. Saliva decreases, becomes less fluid and prevents the natural self-cleaning of food debris. Mastication is disturbed and it becomes difficult to triturate dry, hard food. Salivary impregnation cannot be assured. All these elements weaken the moisturizing, lubricating, immunological and antibacterial role of the salivary flow [24,31,32].

Therapeutic Strategy

In the elderly, all these conditions are favorable to the development of caries. Modification of the salivary flow, local conditions (presence of removable prostheses, gingival recessions), changes in eating habits and deficient daily hygiene practices are all factors that foster the formation of a biofilm (bacterial plaque) and increase the risk of caries. The entire therapeutic strategy must integrate all the risk factors even though actual control of all these factors is impossible. To be adapted and accessible, management must take into account local conditions as well as the general and cognitive status of the patient.

In geriatrics, according to the Si/Sta classification of Mount and Hume, caries are mainly encountered in site 3 (tooth neck) at all stages of progression. Sites 1 and 2, dedicated to occlusal and proximal sites respectively, are less common in geriatrics [33]. This classification is of clinical interest in the treatment of carious lesions. It classifies lesions according to the cario-susceptible site and the stage of progression. This classification is chosen for its simplicity and its direct application.

Table 1 summarizes the 5 stages of the Si/Sta classification.

The therapeutic strategy must be preventive as well as curative and care must be simple and fast with techniques and materials adapted to the specific features of geriatrics. This is the whole point of minimal intervention dentistry, which was initially developed in pediatric odontology [34]. Stage 0 and stage 1 focus on

preventive therapies, while stages 2, 3 and 4 require curative care.

Minimal Intervention Dentistry

Minimal intervention dentistry enables the risk management of caries by a preventive and/or curative approach depending on the stage of lesions and using a technique adapted to geriatric patients [35].

The obvious and essential prerequisite is the introduction of adapted daily hygiene practices, more or less assisted according to the degree of autonomy of the patient [30]. Oral hygiene is the major component in the prevention of oral diseases, especially caries [36,37].

Scaling should be done regularly to avoid periodontal disease.

Treatment of stage 0 and 1 carious lesions

The aim is to prevent carious lesions but also to interrupt or even re-mineralize early lesions. The preventive part of minimal intervention dentistry is based on the application of topical materials: Paste, gel and varnish [38,39].

Regular follow-up of the patient is essential in order to assess the stability or progression of caries. It is done every three months when the risk of caries is high and every 6 months for low risks.

Fluorine [38-41] inhibits the demineralization of dental surfaces and promotes their remineralization by the formation of fluorine-enriched hydroxyapatite.

At high concentrations it inhibits bacterial metabolism and therefore, the formation of bacterial plaque.

Fluorine concentration and the form depend on the risk of caries.

Patients at low risk use fluoride toothpaste with a concentration of 1,100 ppm for daily brushing.

If the risk of caries increases, a toothpaste with a higher fluorine concentration of 5,000 ppm should be used. For patients with a high risk of caries, it is supplemented by the application of a high-concentration (22,600 ppm - 5%) fluoride varnish after dental surfaces are cleaned and dried. This application is renewed every 3 to 6 months. Their ease of implementation makes it possible to use them regardless of the patient's compliance.

Amorphous Calcium Phosphates are casein derivatives containing casein phosphopeptides and amor-

Table 1: Stages of evolution according to the classification of carious cervical lesions.

Stage 0	Colored cemento-dentin surface and more or less eroded.
Stage 1	Superficial cavitation which concerns the external third of the dentine, the amelo-dentinal junction is spared.
Stage 2	Cavitation of the middle third of the dentine, it extends in an apical and proximal direction.
Stage 3	Distinct cavitation of the internal third of the dentine, it extends towards the proximal surfaces.
Stage 4	Deep cavitation, creeping, extending all the way around the root canal. There is a risk of coronal fracture.

phous calcium phosphate (CPP-ACP). This molecule binds to bacterial plaque and exposed dentin and interacts with hydrogen ions to form an electro-chemically neutral calcium-hydrogen-phosphate compound that can be incorporated by the enamel upon remineralization. PCP-ACPs are soluble in acidic media and re-balance the salivary pH. The combination of fluoride with calcium phosphate enhances the result and allows deeper re-mineralization of dental structures than fluoride alone [42,43]. It is applied in the dental office after cleaning and drying of the dental surfaces or by the patient himself after each brushing. Amorphous Calcium Phosphates are used in addition to fluoride in patients with a high risk of caries.

Chlorhexidine is in the form of a 0.12%, 1% or 2% gel or varnish. Chlorhexidine reduces the risk of caries by decreasing bacterial concentration.

Its effectiveness is recognized especially in patients with poor oral hygiene and patients with dry mouth [44-46].

In geriatrics we choose the gels or varnishes that adhere to the dental surfaces and do not require the compliance of the patient.

Chlorhexidine in addition to fluoride and amorphous calcium phosphates is for patients with bacterial plaque-induced gingivitis and who are at a high risk for caries.

In patients with a high risk of caries, it is applied once a day after brushing for 4 weeks.

Inflammation and the risk of caries are then re-evaluated.

In cases of dry mouth, a milder alcohol-free formula is chosen for the mucous membranes.

In a context of dry mouth, the application of local saliva substitutes improves hydration, lubrication and self-cleaning. The use of BiNa increases pH, decreases acidity and therefore, improves a site that is conducive to the development of caries.

Treatment of stage 2 and 3 lesions

This concerns filling carious lesions while preserving dental tissues as much as possible. The curative component of minimally invasive dentistry is based on a less invasive cavity preparation technique and the use of cariostatic, bioactive and fluorinated fillers: Glass ionomer cements (GIC).

They are obtained by an acid-base reaction between glass fluoroaluminosilicate and polyalkenoic acid [47]. They allow deep cavities to be closed (pulp tolerance) and can be used under conditions unfavorable to bonding.

GIC exhibit intrinsic properties of adhesion to dentin and enamel and of bioactivity by releasing fluoride ions to the tooth and saliva [48,49].

We distinguish:

- Traditional GICs
- GIC Modified by the addition of resin. They were introduced to compensate for the lack of resistance, to facilitate handling and improve the optical properties.
- Condensable or high viscosity GIC: Better mechanical strength, easy installation, significant fluorine release.

The protocol is summarized in the [Table 2](#).

Conclusion

The preservation of dental capital is a real challenge

Table 2: Conservative treatment in geriatric dentistry.

Beforehand		
Implementation of adapted ± assisted hygienic care		
Complete descaling		
Stages of progression -clinical forms		
Stages 0 and 1		Stages 2 and 3
Aim of treatment		
To prevent the carious lesions Interruption and/or remineralization of early lesions		To close carious lesions while preserving dental tissues as much as possible
Preventive care		Curative care
Protocol-materials		
Brushing twice a day Soft manual or electric toothbrush (20/100e) + Fluoride toothpaste 1,100 ppm to 5,000 ppm	Cleaning and drying teeth + Application of varnish, gel or mouthwash Fluorine at 22,600 ppm or Amorphous Calcium Phosphate or Chlorhexidine: 0.12% mouthwash or 1 or 2% gel	Removal of infected dentin with a manual (excavator) or rotary (low speed) instrument + Disinfection of the affected dentine with chlorhexidine 0.12% + Isolation of the tooth from the saliva with or without a surgical drape + Conditioning of the cavity with 10% polyacrylic acid for 10 seconds, rinsing, gentle drying + Activation of the capsule/mixing of the glass ionomer cement (GIC) + Filling with the GIC, rapid sculpting +/- photopolymerization
Follow-up		
Every day	Follow-up in 3 months, then 6 months, then annually	Follow-up every 3 months, then every 6 month

Note: Stage 4-Objective = prevention of pain and infection (bite, abscess) - Treatment = extraction(s) according to the patient's general health status.

for modern geriatric dentistry. Minimal intervention dentistry is a technique of choice in the management of root caries. While its efficacy is unquestionable in children, this technique shows good results in the elderly. Based on prevention, remineralization of early lesions and minimal surgical preparation, it offers a realistic and adapted alternative to this population.

Conflicts of Interest Statement

The authors declare that they have no conflict of interest.

Ethics Statement

In accordance with the ethical standards.

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