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# Root caries - Challenges, recommendations for practice

By Prof. Falk Schwendicke, Germany

## Root caries

Caries is the most common disease in humans; almost everyone experiences caries at some point in their life. Instead of primarily focusing on restorative therapy, the emphasis today is on preventing caries or arresting existing lesions, through mechanical or chemical biofilm control, dietary control, or control of demineralization and remineralization. Notably, restorative therapy remains needed in a number of cases, with different approaches being available.<sup>2</sup>

## Challenges of Root Caries

The implementation of preventive measures has contributed to the apparent decline of caries in children

and adolescents.<sup>3</sup> The average twelve-year-old child in Germany now has only 0.5 decayed or filled teeth, a decrease of almost 90% since the 1970s! This success is overshadowed by a number of observations. Firstly, a small group still has a high caries experience despite these measures. Secondly, and the focus of this article: in the older population, other forms of caries, such as secondary and/or root caries are more significant. Exposed root surfaces are also more susceptible to caries because of their composition (exposed dentin or cementum) and demineralize earlier and faster.

Root caries also exhibits a different morphology than enamel caries: On the one hand, lesions are often bowl-shaped and theoretically cleanable. On the other hand, they are not retentive; restorative treatment often requires the use of adhesive materials – while the proximity to the gingiva entails difficulties in moisture control and matrix application.

Root caries is the caries of old age, mainly occurring when root surfaces are exposed (often as a result of periodontal bone loss).<sup>4</sup> This also



**Fig. 1:** Exposed roots are at risk for caries; they demineralize earlier and faster because the dentin or cementum is not protected by enamel or the alveole.



**Fig. 2:** Despite their excellent properties, placement of resin-based composites is technically more demanding. (Courtesy Prof. B. Van Meerbeek, KU Leuven – BIOMAT, Belgium)

means that root caries is particularly relevant in aging societies – with a growing number of older people who retain a significant number of their own teeth. A look at the numbers from the German Oral Health Studies

confirms this: The number of carious root surfaces per person in the population increased from 0.27 in 1997 to 0.71 in 2005 and 0.91 in 2014. Taking into account demographic changes and population development, this means that the total number of carious root surfaces tripled from approximately 21 million to over 70 million within just 20 years.<sup>4</sup> Root caries could thus become the most common form of caries in many high-income countries, where seniors are the only growing age group, retaining significantly more teeth than before.

### Risk factors

As already explained, the risk of developing root caries increases significantly with age. Therefore, it is likely that risk factors associated with age-related changes may contribute to the development of root caries, too. Notably, the most commonly identified risk indicator is previous experience of root caries.<sup>5</sup> Caries

experience is generally a good risk indicator as it encompasses all other factors (behavior, genetics, anatomy, physiology, etc.) in retrospective. Expecting that these factors are either unchangeable or rarely altered, it is assumed that this past trajectory will continue in the future. Other relevant risk factors were the number of exposed root surfaces, inadequate oral hygiene, or existing periodontitis. The number of exposed root surfaces and periodontitis are often related, as discussed in detail below. However, the evidence on risk factors for root caries is limited and based on only a few reliable studies.

From the evidence, it can be inferred that patients who already have one or more root caries lesions are at an increased risk of developing new root caries. For these patients, in addition to routine measures, prevention strategies, close monitoring, and early intervention for new root caries lesions are recommended.



**Fig. 3:** A cervical lesion is restored with a glass hybrid. **a)** placement of EQUIA Forte HT; **b)** EQUIA Forte Coat creates a smooth surface; **c)** the finished restoration (Courtesy J. Tapia Guadix, Spain)



**Fig. 4:** In randomized controlled clinical trials, glass hybrids show promising outcomes for the restoration of cervical lesions. **a)** Cervical lesion prior to treatment; **b)** Glass hybrid restoration at baseline; **c)** Same restoration after 6.5 years. (Courtesy Prof. M. Basso, Italy)

## How to manage root caries

A range of preventive and treatment measures for caries are available, with good evidence of effectiveness in children and adults. However, there are limited meaningful studies on treatment approaches for root caries in the older patient population.

A recently published systematic review summarized the evidence on various strategies for the prevention and treatment of root caries.<sup>6</sup> This formed the basis for a consensus paper by delegates from various professional societies (European Organisation for Caries Research (ORCA), European Federation of Conservative Dentistry (EFCD), and German Society for Conservative Dentistry (DGZ)), which aimed to provide evidence-based recommendations for prevention and therapy to dentists.<sup>7</sup> The following recommendations were made there:

- Since the group of older adults is heterogeneous in terms of various aspects (e.g., oral hygiene, general health), individual needs of these patients should be considered in the planning process.
- Dental care for these patients often follows pragmatic approaches aimed at prolonging tooth survival rather than more complex procedures.
- Given that the health condition of older patients can change rapidly, frequent examination intervals are recommended.
- In cases of severe dependency, considerations should be made for tooth extractions.
- While achieving satisfactory results may not always be possible in practice, it is important to maintain good oral hygiene in older patients. Healthy oral conditions are particularly crucial for these patients, as it is known that oral and

systemic health are interconnected.

- Like for younger patients, the goal of caries prevention for older patients is to influence the etiological factors involved in caries development. Therefore, older patients at increased caries risk are advised to reduce their sugar intake, and basic fluoride application should be performed through brushing with fluoride toothpaste twice a day.
- Due to periodontal bone loss, older patients often have open interdental spaces, which are predisposed to root caries lesions (Fig. 1). These patients should practice interdental hygiene using interdental brushes and fluoride toothpaste.
- Age-related impairments lead to a decrease in the effectiveness of self-performed oral hygiene measures for many older patients. Especially for dependent patients, they may no longer be able to perform oral hygiene measures themselves. Therefore, caregivers, including family members, should be encouraged to support or take over oral hygiene measures.

For existing root caries lesions, non-invasive treatments are available. Their goal is to transform active lesions (soft, covered by plaque) into an inactive state (hard, free from plaque). Such inactive lesions should be considered as "scars" and do not require further treatment. For readily accessible lesions, an effective and simple measure is to consciously brush them during daily oral hygiene. Regular removal of the cariogenic biofilm leads to the lesion transitioning to an inactive state. High-risk patients should brush their teeth with a high-fluoride toothpaste (5000 ppm fluoride). The application of fluoride varnish or silver diamine fluoride in the dental office is also recommended for the treatment of root caries. However, it should be noted that

silver diamine fluoride can cause irreversible black staining of the treated surfaces.

Notably, for certain lesions, restorative care will be required. The following section deals with strategies to restore such lesions and discusses different material options for this indication.

## Challenges during restorative care

Root caries lesions not only differ pathogenetically but also morphologically from coronal caries, as discussed. Hence, traditional restorative treatment concepts for the management of coronal caries are less effective or sometimes not feasible at all for root caries. Root caries lesions can be located in hard-to-reach areas such as interproximal spaces, which may require sacrificing a significant amount of healthy tooth structure during restoration. Restorations of root caries lesions often have poorer durability compared to coronal restorations due to the discussed challenges. Moreover, treating older patients, who are the main risk group, often presents challenges, too. Many patients in this group are not fully capable of receiving treatment. Mobility limitations, especially in dependent patients, may require them to be cared for outside the dental office. The use of devices and materials available in the dental practice is therefore greatly restricted when treating these patients.

## Materials to restore root caries lesions

For restoring root lesions, various material categories are available:

1. resin-based composite materials,
2. conventional glass ionomers and their latest generation, the glass hybrids,
3. materials combining the properties of both material classes, like resin-modified glass ionomers.

Micro- and nano-hybrid resin composites have excellent physical properties, such as high stability against abrasion and erosion, a high flexural strength, polishability and aesthetics. Moreover, these materials can be placed adhesively, allowing for minimal invasive dentistry. Notably, the placement of resin composites requires strict moisture control – which is usually hard to achieve for root caries lesions – and involves various steps like acid etching and adhesive placement. In recent years, simplifications of these application steps has been one focus of manufacturers, for example by combining the etching and the adhesive steps, but nevertheless, their placement – especially in equigingival or subgingival situations, remains technically demanding (Fig. 2).

While only recent generations of glass ionomers (GI) are increasingly applied to restore load-bearing cavities, this material class has always been a valid alternative for cervical lesions (as abrasion and loading challenges are more limited here than occlusal-proximally). Particularly resin-modified glass ionomers have shown high survival in cervical lesions (it should be noted that in many studies these were non-caries lesions). The latest generation, the

so-called glass hybrids (Fig. 3), claim to come with high abrasion and erosion stability and improved flexural strength. This has been achieved by alterations in the chemical composition of the material, mainly the introduction of an additional, smaller glass phase and longer acrylic acid chains. Due to an additional coating step with a nano-resin, the glass surface is transformed into a smoother and aesthetically pleasing surface. In a range of laboratory studies, it has been confirmed that indeed, glass hybrids come with significantly superior properties compared with their predecessors, while retaining the advantages, namely the ease of placement and their bioactivity, particularly the release of fluoride – which is relevant for root caries lesions to protect against secondary caries. A range of studies have demonstrated that GI reduce caries risk on the restoration margins with a distance up to 300 µm. Moreover, an acid-resistant intermediate zone, consisting of dissolved calcium from tooth tissue and fluoride from the material, is likely to increase the resistance against secondary lesions.<sup>8</sup>

### Clinical evidence

There is very limited evidence on root lesion restorations. Especially comparative data is scarce. Most studies indicate that except for anatomical form and color match – where glass ionomers may show higher rate of complications – and for secondary lesions – where composites may show higher risk – the risk of failure is similar between glass ionomers and composites. Generally, the risk of restoration failure is relatively high for this indication. Moreover, caries risk has been found as a modifier of failure

likelihood, with composites showing more frequent failures, mainly secondary caries, in high-risk individuals.<sup>6,8,9</sup>

For glass hybrids, the only data available are randomized trials comparing this material against resin composites in non-caries lesions (Fig. 4). The most interesting study for root caries is one comparing a glass hybrid (EQUIA Forte, GC) and resin composite restorations (Filtek Supreme XTE, 3M) for managing sclerotic non-caries cervical lesions in 88 patients middle-aged and older patients aged 50–70 years.<sup>10</sup> Over 36 months, the survival, quality and costs of 92 restorations, placed without any mechanical preparation (which eventually resulted in high annual failure rates for both groups), were evaluated. Restoration quality was assessed after 1, 18 and 36 months using FDI-criteria. Costs were evaluated using a so-called micro-costing approach (accounting for the time used for placing the material) and, during follow-up, fee items of the statutory insurance in Germany. After 36 months, 17 glass hybrids and 19 resin composites showed total retention loss, 5 glass hybrids were partially lost. Costs were lower for glass hybrids both initially (glass hybrids: 32.57; SD 16.36 € versus resin composites: 4.25; SD 21.40 €) and over follow-up (glass hybrids: 41.72; SD 25.08 €, resin composites: 51.60; 26.17 €).

### Conclusion

Considering their improved biomechanical properties, cost-effectiveness and more forgiving nature given the complications that root lesions typically bring about, glass hybrids may be an excellent alternative for their restoration.

Nevertheless, more clinical evidence is necessary on the treatment of root caries lesions. For the future, more focus is expected on prevention, non-invasive treatments, and bioactive materials such as silver dotation and modification with silver diamine fluoride. However, for the latter, clinical data is largely absent thus far.

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