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## Review

## Is secondary caries with composites a material-based problem?

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## ABSTRACT

**Objective.** Secondary caries (SC) is one of the most important reasons for the failure of composite restorations, and thus has wide-reaching implications for the longevity of affected teeth and the health expenditure. Yet, it is currently not known whether secondary caries with composites is a material-based problem. The objective was to review literature with regard to SC around composite restorations to obtain better insights in the mechanisms behind SC with composites.

**Methods.** Using Pubmed and Medline, international literature was searched for all articles about the clinical diagnosis, incidence and prevalence, histopathology and factors involved in the onset and development of SC around composite restorations. Additional studies were included after checking the reference lists of included papers.

**Results.** SC with composites is to some extent associated to the restorative material, as significantly more caries occurred with composites than with amalgam. On the other hand, the class of the composite restoration (class V versus others and class I versus class II) was also determining for the development of SC, suggesting also other influencing factors than the material itself. The mechanisms behind the development of SC are much less clear and are most probably multifactorial. Even though the role of gaps and microleakage is questioned by some researchers, there are also indications that interfacial failure may play a role. Interfacial gaps larger than 60  $\mu\text{m}$  seem to predispose interfacial demineralization, and may thus lead to caries. The question is therefore whether such interfacial gaps occur clinically? Initially, a gap may originate through polymerization shrinkage and through failure to obtain a good bond. Higher incidences of SC are observed in practice-based than in university-based studies, which may be attributed to different caries risk profiles of the included patients, or to the technique-sensitive placement procedure of composites. More research is necessary to investigate whether large gaps may arise through degradation processes. Apart from

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these factors, composites also seem to favor the growth of cariogenic bacteria on their surface, which has been associated with specific surface properties, release of components and lack of antibacterial properties.

*Significance.* Current literature suggests that the restorative material might influence the development of secondary caries in different ways. However, it should be emphasized that patient-related factors remain the most important determinant of secondary caries.

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## 1. Introduction

During the past decade, composites have become the most commonly used restorative materials [1,2]. They have gradually replaced amalgams, which have been the standard restorative material for more than 100 years, not only because of their desirable esthetics, ease of handling and minimally invasive preparation technique, but also because dental amalgams have been associated with environmental pollution [3,4] and even with alleged negative health effects due to release of mercury [5,6]. In addition, thanks to their bonding potential to the tooth tissues, good mechanical properties and lower cost compared to other indirect restorations, the application of composites has expanded to a wide variety of clinical situations, some of which previously could only be treated with indirect prosthetic restorations. Nowadays, composites are not only used to restore decayed or traumatized teeth, but they are also routinely used both as direct and indirect restoratives to improve esthetic properties of discolored or malpositioned

teeth. All in all, the use of these versatile materials is still on the rise.

However, a number of clinical studies have reported shorter longevity and higher failure rates for composite restorations compared to amalgams [2,7–13]. One of the main reasons for failure was secondary or recurrent caries [8–10,12–17]. It is clear that these findings evoked scientific debate, as premature renewal or replacement of restorations is a heavy burden on health care expenditure. In addition, secondary caries (SC) always results in further tooth structure loss and may weaken the remaining tooth. Especially in case of extensive secondary-caries lesions and repetitive restorative interventions, this may eventually lead to premature loss of the tooth.

Various definitions of SC have been proposed in scientific literature and medical dictionaries. First, the terms 'secondary' and 'recurrent' caries are used interchangeably, with the difference that 'secondary caries' is used more commonly in European papers, while 'recurrent caries' is typically used in North America [18]. As for the meaning of these terms, it

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