

## Secondary caries

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A series of workshops and consensus processes in which ORCA members played a role resulted in papers dealing with different aspects of caries. Two of these consensus papers summarize the knowledge on secondary or recurrent caries (Askar et al., 2020; Schwendicke et al., 2020).

According to the definition, secondary or recurrent caries is a caries lesion that developed adjacent to a restoration. It is also termed 'CARS': Caries Adjacent to a Restoration or a Sealant (Machiulskiene et al., 2020). The carious lesion (Fig. 1) can develop on the tooth surface next to the restoration ("outer lesion") and/or penetrate along the tooth/restoration interface ("wall lesion").



*Figure 1: secondary caries lesions with outer and wall lesion at the occlusal (a) and approximal (b) margin. An independent lesion is seen at a certain distance from the margin occlusally or at the root surface beneath the approximal box (c). Courtesy Prof. V. Stachniss, Marburg.*

The occurrence of CARS is linked to patient factors such as diet and oral hygiene, and to predisposing factors related to the restoration material. Compromised marginal integrity due to failure in adhesion, biodegradation or overcontouring may favour secondary caries occurrence (Nedeljkovic et al., 2015). There is ongoing discussion whether the restoration material itself modulates caries risk, like fluoride released from glass ionomer cements and antibacterial metal ions from amalgam having a retarding effect.

The presence of a restoration makes the task of detection more difficult (Askar et al., 2020; Schwendicke et al., 2020). The opacity of restorative materials, especially metallic restorations does not allow to fully appreciate a change in transparency normally observed in caries lesions in natural tooth tissues. As dental restorative materials are all to some extent radiopaque, radiography does not allow to obtain a full image of lesion depth. Furthermore, the quality of available evidence is low. A review mentioned that radiographic and visual detection methods remain the first choice whereas tactile methods suffered from low sensitivity (Brouwer et al., 2016). Non-cariou marginal defects like marginal gaps (localized loss of tooth or restoration material) or stain (percolation into the interface without demineralization) may be mistaken for secondary caries and possibly lead to overtreatment.

For a long time, dental practitioners seemed to be convinced that the interface between tooth and restoration might form a weak point facilitating lesion penetration. Therefore,

replacement of a 'defective' restoration was regarded as the best treatment option (Gordan et al., 2012). Repair in the framework of maintenance was sometimes advocated. However, until the early 2000s, this was frowned upon as being an inferior kind of clinical service. More recent evidence suggests however, that localized repair, when indicated, saves tooth substance, treatment time and will probably be less onerous for the patient. Even in the case of more extensive or expensive restorations such as fixed prostheses, removal (generally followed by replacement) was advocated by a large number of respondents in a survey by Alomari et al. (2009). However, especially in abutment crowns of large and complicated prosthetic constructions a complete replacement makes the patient face expensive and risky treatments. If the marginal defect can be accessed and treated with a minimally invasive approach, this reduces the risk of extensive damage like loss of abutments during bridge removal.

As shown in the series of bite-wing radiographs below (Fig. 2), replacing (and necessarily extending) restorations due to caries at the margins is clinically challenging. Especially cervical margins near or below the gingiva may be complicated by moisture control problems, leading to compromised restorations. This "restoration-rerestoration cycle" may finally lead to tooth loss. Even if not all patients are amenable to a change of attitude, plaque control, dietary advice and targeted fluoride application may at least slow down this cycle.



*Fig. 2: progression of caries lesions and the necessary extension of re-restorations lead to a more challenging clinical situation over the years. Eventually, repair may not be possible and extraction unavoidable.*

Minimally invasive procedures such as refurbishing (polishing to restore smooth margins), sealing (Martin et al., 2013) or repair (preparing an explorative cavity at the suspected site and restore when no more defects are present [Casagrande et al., 2017]) are at present recognized as effective solutions for defects with a limited extension. In case of a decision for repair, preparation is initiated at the suspected site. If the caries lesion extends further than initially estimated or retention of the restoration is compromised, replacement is still an option.

In case of limited lesions in patients with low progression risk, monitoring and non-operative treatment may be as suitable for secondary as for primary caries. Such non-invasive procedures are, however, not well-supported by evidence (Gordan et al., 2009).

Whatever treatment option is elected, caries risk control remains necessary to avoid labour-intensive and frustrating re-restorations. The practitioner's responsibility is to provide technically sufficient restorations and empower the patient to a preventive attitude. The patient's challenge is to create an optimal oral environment for short- and long-term clinical success of restorations.

## Conclusions

Secondary caries is defined as a lesion associated with restorations or sealants. The effect of the restorative material itself on the secondary caries seems to be limited. Further factors such as the patient's caries risk, presence and size of restoration gaps, and experience of the operator have a more important role. Current detection methods for secondary caries are only sparsely validated and likely prone for the risk of over-detection.

Consensus is resumed as follows:

1. By managing a patient's overall caries risk/susceptibility, the risk for secondary lesion occurrence is also managed to a certain extent (weak recommendation, agreement 87%, median: 10).
2. Detection methods for secondary lesions should be tailored according to patients' caries risk/susceptibility. Especially in low-risk patients, false-positive detection, and subsequent over-treatment should be avoided. This may be achieved by combining bitewing radiography and visual-tactile assessment/confirmation when screening for secondary lesions (weak recommendation, agreement 88%, median: 10).
3. When managing detected secondary lesions, dentists should adopt the minimally invasive approaches of refurbishment/reseal/repair over replacement of restorations, on a case-by-case basis (weak recommendation, agreement 100%, median: 10).

Paper patient cases: if you would like to participate in a quiz with paper patient cases of your treatment choices of CARS, please follow this link:

[https://vub.fra1.qualtrics.com/jfe/form/SV\\_0PPrejhcljGPZ2K](https://vub.fra1.qualtrics.com/jfe/form/SV_0PPrejhcljGPZ2K)

## Literature

Alomari Q, Al-Saiegh F, Qdeimat M, Omar R: Recurrent caries at crown margins: making a decision on treatment. *Med Princ Pract.* 2009;18:187-192.

Askar H, Krois J, Göstemeyer G, Bottenberg P, Zero D, Banerjee A, Schwendicke F: Secondary caries: what is it, and how it can be controlled, detected, and managed? *Clin Oral Investig* 2020; 24: 1869-1876.

Brouwer F, Askar H, Paris S, Schwendicke F: Detecting Secondary Caries Lesions: A Systematic Review and Meta-analysis. *Journal of Dental Research* 2016; 95: 143-151

Casagrande L, Laske M, Bronkhorst EM, Huysmans MCDNJM, Opdam NJM: Repair may increase survival of direct posterior restorations – A practice based study. *J Dent* 2017; 64: 30-36.

Gordan VV, Garvan CW, Richman JS, Fellows JL, Rindal DB, Qvist V, Heft MW, Williams OD, Gilbert GH: How dentists diagnose and treat defective restorations: evidence from the dental practice-based research network. *Operative Dentistry*, 2009; 34: 664-673

Gordan VV, Riley JL, Geraldeli S, Rindal DB, Qvist V, Fellows JL, Kellum HP, Gilbert GH, The DPBRN Collaborative Group: Repair or replacement of defective restorations by dentists in The Dental PBRNJ. *Am Dent Assoc*. 2012; 143: 593-601.

Machiulskiene V, Campus G, Carvalho JC, Dige I, Ekstrand KR, Maltz M, Manton DJ, Martignon S, Martinez-Mier A, Pitts NB, Schulte AG, Splieth CH, Tenuta LMA, Ferreira Zandona M, Nyvad B: Terminology of Dental Caries and Dental Caries Management: Consensus Report of a Workshop Organized by ORCA and Cariology Research Group of IADR. *Caries Res* 2020;54:7-14

Martin J, Fernandez E, Estay J, Gordan VV, Mjor IA, Moncada G: Minimal invasive treatment for defective restorations: five-year results using sealants *Oper Dent* 2013;38:125-133.

Nedeljkovic I, Teughels W, De Munck J, Van Meerbeek B, Van Landuyt KL: Is secondary caries with composites a material-based problem? *Dent Mater* 2015; 31: e247-77.

Schwendicke F, Splieth CH, Bottenberg P, Breschi L, Campus G, Doméjean S, Ekstrand K, Giacaman RA, Haak R, Hannig M, Hickel R, Hrvoje J, Lussi A, Machiulskiene V, Manton D, Jablonski-Momeni A, Opdam N, Paris S, Santamaria R, Tassery H, Zandona A, Zero D, Zimmer S, Banerjee A: How to intervene in the caries process in adults: proximal and secondary caries? An EFCD-ORCA-DGZ expert Delphi consensus statement. *Clin Oral Invest* 2020;24:3315-3321.