

# The relation between gap size, microbial accumulation and the structural features of natural caries in extracted teeth with Class II amalgam restorations

A stereo- and polarized light microscopic study

**The thesis concerns the etiology and pathogenesis of secondary caries**

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The work presented in this thesis was performed at the Department of Cariology and Endodontics, School of Dentistry, Faculty of Health Sciences, University of Copenhagen, during 1994-1997.

## Introduction

The terminology used for new caries in relation to restorations is secondary caries or recurrent caries, which is also the most often reported reason for replacement of restorations. It has been widely accepted that secondary caries is the result of either marginal defects or the clinically invisible microleakage occurring at the restoration and tooth interface. Despite the high frequency of new caries related to restorations, surprisingly few studies have clarified precisely what secondary caries in fact is.

The thesis consists of three parts: a review of the literature and two in vitro studies.

## Review

The first part of the review examines the great many studies on clinicians' reported reasons for replacement of restorations. Then two different study designs for estimating the longevity or service time of restorations are described and discussed. The final part describes the available information on the histopathology of secondary caries as the basis for the current understanding of the diagnosis secondary caries.

It is concluded that the design and objective of the clinical studies appeared to be important contributory factors for the over- or underestimation of secondary caries as a reason for replacement. Estimates of service time varied, but it is con-

cluded that the median age of replaced restorations represents a fair estimate of the service time of restorations in the real world.

Finally it is concluded that the current discussions related to the diagnosis of secondary caries have been based on a remarkably narrow scientific body of evidence regarding the histopathology of caries in relation to restorations. For this reason a study was designed to examine the important factors for the development of secondary caries in relation to Class II amalgam restorations.

## The in vitro studies

### *Material and methods*

The material comprised 50 extracted permanent teeth with Class II amalgam restorations. In the first part of the study, measurements of microbial accumulation, marginal gap size and dental caries were carried out in ten well-defined points on each approximal surface. After gentle removal of the restoration, the condition of the enamel and dentine cavity surface was examined at the previously mentioned points. The recording of the four study variables were made under a stereomicroscope at high magnification ( $\times 40$ ).

In the second part of the study, 33 teeth with either unaffected or precavitated lesions in the gingival enamel part were serially cut in mesio-distal direction along the gingival part of the cavity. Each specimen was photographed in a stereomicroscope before and after the cutting procedure in order to relate each section to the original topographical position. After separation, each section was prepared for polarized light examination in water and after air-drying.

### Results and discussion

Most microbial accumulation were found in the stagnation areas along the gingival margin independent of gap size. Accordingly it was also this part of the surface which most often had dental caries along the restoration margin. Apart from minor deviations caused by localized marginal defects, it was not possible to demonstrate any association between gap size and microbial accumulation, nor between gap size and dental caries. The agreement between the surface caries and the observed tissue changes after removal of the restoration was good. Analyses of the spread of the gingival lesions in polarized light demonstrated that the lesions were initiated at the enamel surface without relation to either the marginal gap or the cavity wall. The shape and spread of the lesions in the gingival enamel seemed to be determined by a combination of the direction of the rods and the cariogenic interproximal environment. Deviations from this pattern could be related to isolated large marginal defects covered by thick microbial accumulation (Fig. 1).

Taken as a whole, the findings support the view that secondary caries is a localized phenomenon which is closely associated with local conditions for the formation of microbial accumulation with cariogenic potential. Secondary caries initiation under in vivo conditions is therefore not related to »wall lesions« due to clinically undetectable microleakage, as previously believed on the basis of in vitro studies.

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The thesis is a monograph of 98 pages, and can be requested from Professor *Anders Thylstrup*. Address: Department of Cariology and Endodontics, School of Dentistry, Nørre Allé 20, 2200 Copenhagen N.

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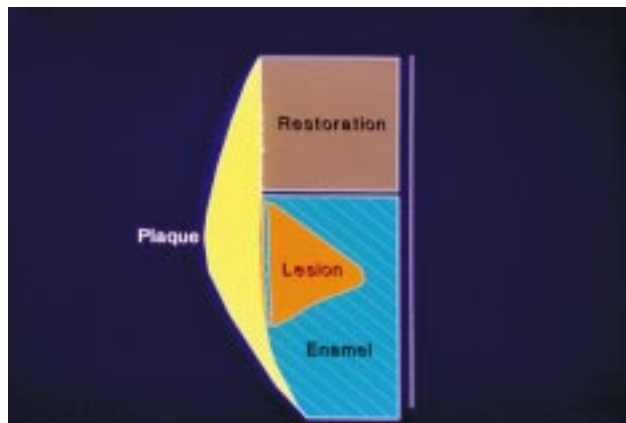


Fig. 1. Schematic drawing illustrating the relation between microbial accumulation (plaque) and the new precavitated lesion when the enamel rods run in apical direction. The surface irregularities on the restoration and on the enamel surface illustrate surface corrosion and surface dissolution, respectively.

Fig. 1. Skematisk tegning som viser udvikling af en ny tidlig carieslæsion i det gingivale område. Analyse af læsionens form og prismernes retning viser at den nye læsion er begyndt på emaljeoverfladen uafhængig af spalten. Den kariogene plak har desuden givet anledning til korrosion på fyldningsoverfladen og overfladeætsning af emaljeoverfladen.