# Clinical and microbiological evaluation of ozone-treated deep carious lesions during a stepwise excavation procedure

**Solveig Fure et al.???**

## Background

Caries excavation of very deep lesions involve risk of pulp exposure, which bring in an impaired prognosis of the pulp survival. A stepwise excavation procedure is therefor often performed. The method is based on a two-stage excavation procedure. At the first excavation all necrotic and infected dentine is removed except for a thin layer of affected dentine close to the pulp. This layer is sealed with a calcium hydroxid-containing material and the cavity is closed with a temporary filling. After an expectance period of 1-3 month the cavity is re-opened, the retaining carious dentin is removed and a permanent filling applied. The purpose of this procedure is to reduce the infection and thereby promote mineralization of the dentine during the expectance period. This will gain the removal of the retaining infected dentine without pulp exposure (Leksell et al., 1996). The drawback of this method is that most of the infected dentine has to be removed in the first stage. There is therefore still a high risk for causing exposure of the pulp.

In order to further minimize this risk a method of less invasive excavation in the first stage of the stepwise excavation procedure has been proposed (Björndal et al., 1997, 1998, 2000). In this procedure only the superficial layer of the infected, necrotic dentine is removed in the first step, prior to application of a calcium hydroxide-containing material and a temporary filling. The results of these studies have shown that there were no signs of active caries progression during the realitively long treatment period of 3-12 month. A marked reduction in bacterial growth during the period was also obtained and only few cases of pulp perforation occured during the final excavation.

The main purpose of the application of a calcium hydroxide-containing material to the infected dentine is to recieve an antimicrobial effect during the expectance period. Recently a study has revealed a signifacant reduction in the cultivable flora of samples from primary root carious lesions treated for 10 or 20 s with ozone from an ozone-generator (Baysan et al., 2000). Carious root dentine do not differ decisively from carious dentine in deep lesions. It is therefore reasonable to expect that ozone should have the same antimicrobial effect on infected dentine in deep lesions.

The aim of this study is to assess the antimicrobial effect of ozone on the remaining infected dentine following a stepwise excavation procedure of deep carious lesions.

## Material och Methods

Forty deep carious lesions are planned to be included in the study. They are selected among consecutive patients appearing for dental examination and treatment at the Dental Clinic of Adults at the Institute of Odontology, Göteborg University. In lesions to be included in the study there must be an obvious risk of pulpal exposure if they are excavated in one step. This has to be determined clinically and radiographically. The tooth must be vital as confirmed by

an electric pulp tester and have had no signs of pulpal pain besides moderate sensitivity caused by thermal or chemical stimulation. The study has to be approved by the Ethics Committee at Göteborg University and performed according to the guidelines of the Declaration of Helsinki.

***Treatment Procedure***

**First visit**

The first visit involve medical history, clinical and radiographic examination, vitality test of the tooth to be treated, information of the study and the patient´s acceptance of partcipating. Prior to the excavation anæsthesia is administred unless there are contraindications or the patient has objections. The superficial necrotic dentine is removed and the peripheral demineralized dentine is excavated completely using a rotating bur. Rubber dam is applied prior to the excavation of the central cariogenic and infected dentine using a slowly rotating bur or an excavator. A deep of around one mm of the close to pulp part of the infected dentine is left for ozone treatment.
The consistency of the retained carious dentine is assessed using an ordinary probe. It is recorded as soft if the probe readily enter the dentine, as medium if the probe enter the dentine with some resistance and hard if the dentine is not entered when firmly pressing the probe. A value of the carious dentine is also assessed by a DIAGNODent.
Using a sterile excavator a sample of the infected carious dentine is put into a preweighed sterile vial containing RTF. The samples are transported immediately to the laboratory, weighed and cultivated anærobically within 2 h.
The infected dentine is exposed to ozone from a ozone generator (KaVO HealOzone) for a period of 20 s at room temperature (20°C).
The cavity is etched and bonded with Excite according to the manufacturers instructions. A piece of rubber dam just covering the infected part of the dentine is applied and the cavity is sealed with the composite TetricCeram. During the following treatment period of around 6 months the patient is asked to be observant and report to the clinic any abnormal symtoms from the treated tooth. If the patient reports any adverse effects this shall be recorded and the patient shall be called in for an extra examintion.

**Follow-up visit**

The patient is interviewed about any adverse effects or symtoms from the treated tooth and the information is recorded.
The treated tooth is tested for vitality by an electric pulp tester and anæsthesia is administered. A rubber dam is applied and the tooth is cleaned with 35% $H_2O_2$ and 10% J. The central part of the cavity is re-opened using a rotating bur. The piece of rubber damm is exposed and removed.
The consistency of the retained carious dentine is again assessed using an ordinary probe and recorded as soft, medium or hard and by the DIAGNODent.
Using a sterile excavator a sample of the retaining carious dentine is put into a preweighed sterile vial containing RTF. The samples are transported immediately to the laboratory and weighed and cultivated anærobically within 2 h.
Remaining soft dentine is removed and the cavity is sealed with a permanent filling using the system of etch-Excite-TetricCeram.

**Microbiologic procedure**

The dentine samples are sonicated for 5 s and diluted in 10-fold stages in 0.05 M potassium phosphate buffer containing 0.4% KCl. Aliquots of 25 microl of the respective dilutions are placed in duplicate on trypticase soy agar supplemented with 5% horse blood for growth of total