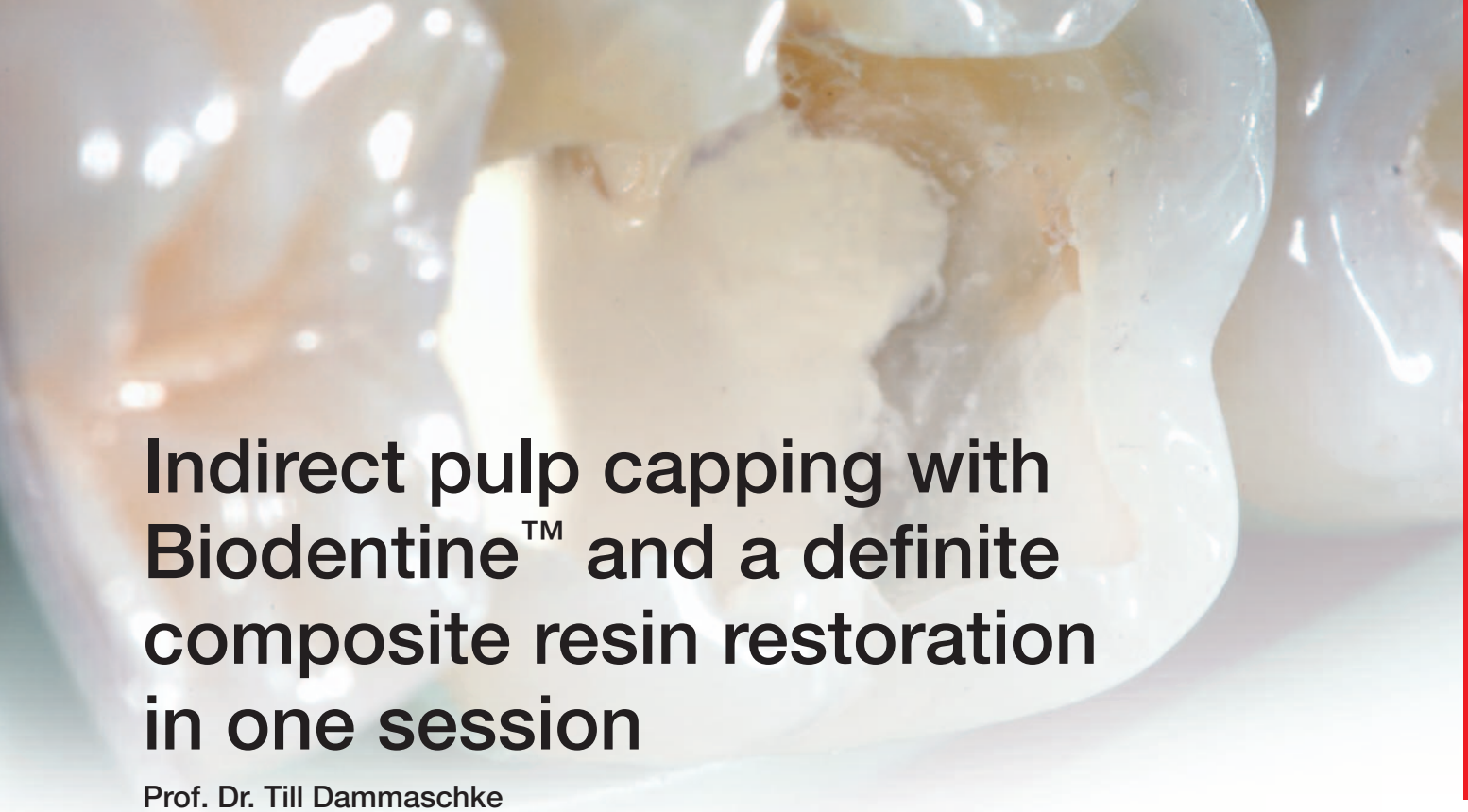

Indirect pulp capping with Biodentine™ and a definite composite resin restoration in one session

Prof. Dr. Till Dammaschke

Introduction

Indirect capping of the dental pulp is defined as medication of a thin layer of dentine that remains above the vital pulp after cavity preparation (Schäfer et al. 2000). Clinically, this situation usually arises during the excavation of a profound caries. But also after a dental trauma, the pulp of a caries-free tooth may be capped indirectly (Staehle and Pioch 1988).

Because there is only a minimal dentine layer remaining above the vital pulp tissue, there is the danger that an irreversible inflammation of the pulp may occur via dentine tubules: on the one hand, by microorganisms which have already penetrated into the tissue or on the other hand by cytotoxic components of the restoration materials. With a pulp capping material, the caries-free dentine should be sealed and disinfected and the pulp tissue should be stimulated to form tertiary dentine (Ricucci et al. 2014). The formation of tertiary dentine is also referred to as a reaction dentine. Reaction dentine is defined as a dentine formed by surviving post-mitotic primary odontoblasts (Smith 2012).

The indirect pulp capping thus serves to protect vital tissue, especially after caries removal. If there is already an existing reversible pulpitis, the preconditions for pulp healing should be created by indirect pulp capping (Dammaschke 2016).

Maintaining pulp vitality and thus a successful indirect capping presupposes a curable pulp, thus the pulp tissue should be healthy or only reversibly damaged. In the case of teeth which have profound periodontal defects or have already been repeatedly extensively restored, regenerative capacity of the pulp is reduced (Duda and Dammaschke 2009).

For the success of an indirect capping is also important that aseptic operation can be ensured throughout the treatment. Since the presence of microorganisms in the area of the pulp capping is inevitably associated with a considerable reduction in the prognosis (Kakehashi et al. 1965, Ricucci and Siqueira 2013), an indirect capping should be carried out whenever possible under rubber dam (Dammaschke 2016).

Therefore, the removal of the irritation factors (caries), the control of the infection and the biocompatibility of the pulp capping material are important prerequisites for a successful vital maintenance (Seltzer and Bender 1984).

Clinical Case

A 23-year-old male patient came for a routine check-up. Diagnostic assessment as well as a radiograph showed signs of a deep carious lesion occlusal on tooth 36 ***(Fig. 1)***. The patient was informed about the need of having the carious lesion treated. The tooth was tested positive on CO_2 snow sensitivity and negative on percussion. After thorough information of the patient, an anesthetic (Septanest, 1.7 ml; Septodont, St. Maur-des-Fossés, France) was injected for terminal anesthesia and a rubber dam was put in place. Following the cavity preparation occlusal and distal ***(Fig. 2)*** the carious dentine was excavated. To avoid unnecessary removal of unaffected dentine and iatrogenic pulp exposure, the excavation of the profound caries on tooth 36 was performed with a self-limiting polymer round bud bur (Polybur P1; Komet, Lemgo, Germany) ***(Fig. 3)***. After cavity toilet with NaOCl (3 %) for clearing and disinfecting, Biodentine™ (Septodont, St. Maur-des-Fossés, France) was chosen for indirect pulp capping. Mixed as recommended by the manufacturer, Biodentine was applied onto the cavity floor with cement pluggers as (sub)base for indirect capping and to protect the underlying pulp tissue ***(Fig. 4)***. After mixing, Biodentine™ needs at least 15 min to set before the treatment could be continued. Then, the entire cavity (including the Biodentine™ surface) was treated with a self-etching dentine adhesive (Optibond XTR; Kerr, Orange, CA, USA). Finally, the cavity was restored with a composite filling material (Grandio; VOCO, Cuxhaven, Germany) ***(Fig. 5)***.

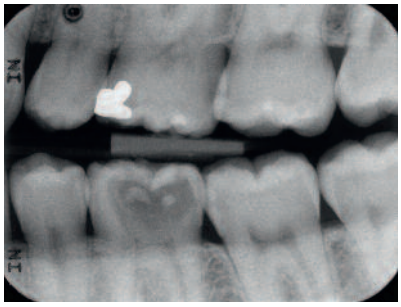

Fig. 1: Bitewing Radiograph revealed signs of a deep carious lesion occlusal on tooth 36 of a 23-years-old male patient.

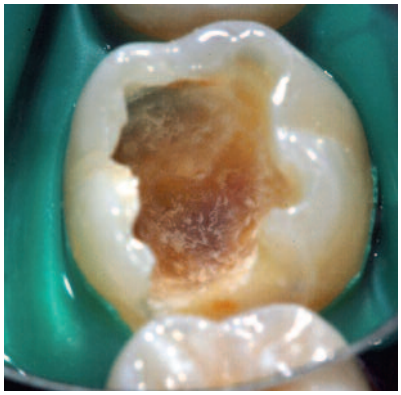

Fig. 2: Cavity preparation under rubber dam and incomplete caries excavation on tooth 36.

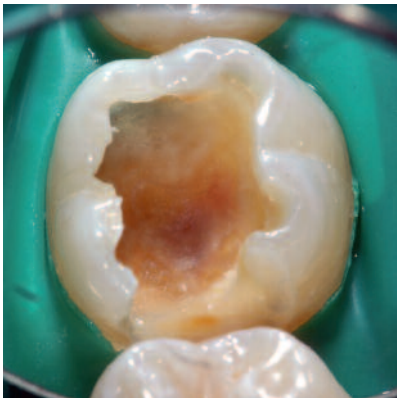

Fig. 3: To avoid unnecessary removal of unaffected dentine and iatrogenic pulp exposure, the excavation of the profound caries on tooth 36 was performed with a self-limiting polymer round bud bur (Polybur P1; Komet, Lemgo, Germany).

Fig. 4: For indirect pulp capping Biodentine (Septodont; St. Maur-des-Fossés, France) was applied to the cavity as a subbase with cement pluggers. Biodentine was used as pulp protection material (maintaining pulp vitality) and base at the same time. Biodentine™ should not be prepared with rotating instruments and should not come into contact with water during setting time.

Fig. 5: After allowing 15 minutes for Biodentine™ to set, the cavity was directly restored with composite (Grandio, VOCO, Cuxhaven, Germany) at the same appointment. For this, the entire cavity (including the Biodentine surface) was treated with a self-etching dentine adhesive (Optibond XTR; Kerr, Orange, CA, USA). The use of self-etching dentine adhesives is favorable to avoid an etching with phosphoric acid and rinsing with water of the Biodentine™. There is no need to use e.g. glass ionomer cement under the composite restoration.

Fig. 6: Composite (occlusal-distal) filling 3.5 years after restoration of tooth 36. The patient reported about no discomfort on tooth 36 at any time after indirect pulp capping, e.g. upon contact with cold food, drinks and air, or other subjective symptoms.

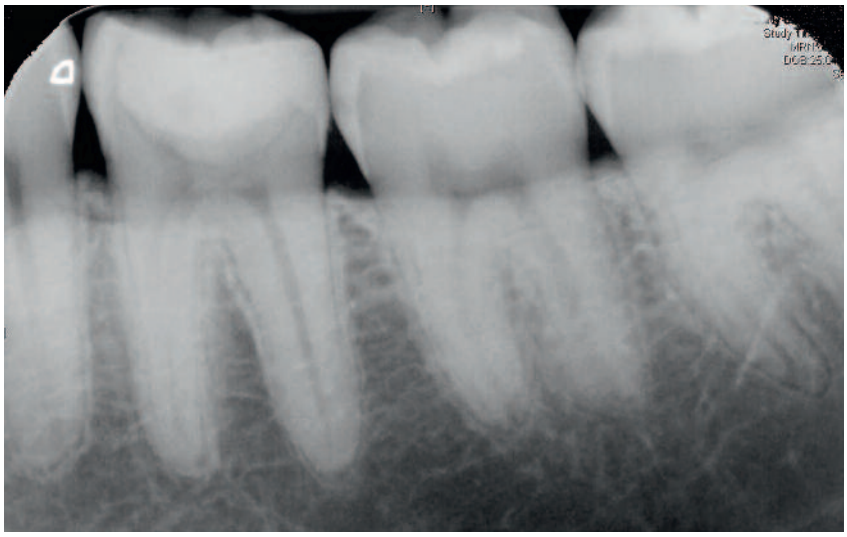

Fig. 7: The dental film recorded 3.5 years after indirect capping does not show any pathological findings apical of tooth 36. (Caries mesial on tooth 37).

At the follow-up visit 3.5 years after indirect pulp capping tooth 36 was clinically normal *(Fig. 6)* and again tested positive for sensitivity and negative for percussion. The dental film recorded at that time did not show any pathological findings apically *(Fig. 7)*. The patient reported about no discomfort on tooth 36 at any time after pulp capping, e.g. upon contact with cold food, drinks and air, or other subjective symptoms.

Discussion

The primary aim of a pulp capping material is to induce a specific hard tissue formation by pulp cells that seal the exposure site and ultimately contribute to continued pulp vitality (Schröder 1985). Recently, it was shown that clinically and histologically Biodentine™ is significantly superior to Dycal even in direct pulp capping (Jalan et al. 2017). Used for pulp capping, this cement offers some benefits compared to calcium hydroxide: It is mechanically stronger, less soluble and produces tighter seals (Pradelle-Plasse et al. 2009). This qualifies it for avoiding three major drawbacks of calcium hydroxide, i.e. material resorption, mechanical instability and the resultant failure of preventing microleakage (Dammaschke et al. 2014). Thus, in the present case report Biodentine was used for indirect pulp capping: as pulp protection material (maintaining pulp vitality) and base at the same time. Then, the cavity was restored with a composite resin during the same appointment. This treatment option offers several advantages: for successful pulp capping it is important to seal the cavity against bacterial invasion in a one-stage procedure (Duda and Dammaschke 2009, Dammaschke et al. 2010).

When opting for this one visit approach it is, however, important to wait for Biodentine™ to set (minimum 15 minutes after mixing) before proceeding with the restorative treatment. During the setting time the cement should not be prepared with rotating instruments and should not come into contact with water.

To bypass the long setting time of calcium silicate cements, it has been suggested to use light-curing resins as lining materials. Recently, it was shown that already 3 min after mixing of Biodentine™ shear bond strength of light-curable composite resins on Biodentine™ were similar to those after 15 min and 2 d. Thus, the final adhesive composite resins restoration can be placed over Biodentine™ shortly after mixing

(Schmidt et al. 2017). Self-etching dentine adhesives should be preferred for this procedure to avoid an etching with phosphoric acid and rinsing with water of the Biodentine™ surface.
There is no need to use e.g. glass ionomer cement under the composite restoration. After setting, the mechanical properties like compressive strength, flexural strength, E-module and Vickers hardness of Biodentine™ are comparable to human dentine (Pradell-Plasse et al. 2009, Camilleri 2013, Kaup et al. 2015b). Furthermore, the shear bond strength of Biodentine™ to human dentine is comparable to glass ionomer cements (Kaup et al. 2015a).
The excavation of the profound caries was performed with a self-limiting polymer round bud bur (Polybur P1; Komet, Lemgo, Germany). This was done to avoid unnecessary removal of unaffected dentine and iatrogenic pulp exposure on tooth 36. The hardness of the polymer is less than healthy and higher than cariously altered dentine. As soon as the blades hit healthy dentine, they become flat and thus the disposable instrument becomes unusable. Thus, no healthy dentine is removed. But the dentine surface does not look longer as smooth and hard as it will be after excavation with a stainless steel bud bur ***(Fig. 3)***. The remaining only partial dematerialized dentine causes fewer x-rays to be absorbed. This thin line of partial dematerialized dentine may be misinterpreted as secondary caries in radiographs ***(Fig. 7)***.

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Till Dammaschke started studied sociology, political science and history at the University of Göttingen (Germany) in 1986. From 1987 to 1993, he studied dentistry at the University of Göttingen (Germany). Till Dammaschke is working at the Department of Operative Dentistry at the University of Münster (Germany) since 1994 . In 1996, he completed his doctoral thesis at the University of Göttingen (Germany).
In 2012, he was appointed as Professor. Since 2015 Till Dammaschke is head of the section "Cariology and Paediatric Dentistry" in the Department of Periodontology and Operative Dentistry in Münster (Germany).
Till Dammaschke has nearly 100 national and international publications in scientific dental journals (more than 30 in “Web of Science”, e.g. Journal of Endodontics, International Endodontic Journal, Journal of Dentistry, Dental Materials, Clinical Oral Investigations, Quintessence International, Journal of Adhesive Dentistry), is co-author in books (e.g. Torabinejad M (ed.) Mineral Trioxide Aggregate: Properties and Clinical Applications.), and peer reviewer of more than 30 national and international dental scientific journals.

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