Laser-assisted direct pulp capping

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The essence of conservative dentistry is conservative, that is, economical tissue management—for both hard tissues and the protection of the endodontium’s vitality. Deep cavities accompanied by pulp exposure are, indeed, a huge challenge for the pulp to preserve its vitality, but also for the dentist and treatment performed to increase, not decrease, the chance to save vital pulp for many years.

In case of very deep cavities, it is oftentimes indicated to perform an endodontic treatment. However, one should remember that the possibilities of contemporary endodontics do not limit to complete cleaning of the root canals system and its tight 3-D filling, but offers other, less radical methods of treatment. Endodontic treatment does not have to be equal with “killing” the tooth. If the image of the pulp seen in the microscope is correct, direct pulp capping performed in aseptic conditions allows to preserve the tooth’s vitality.

If small serous effusion, small bleeding accompanying possible mechanical injury during cleaning stop by itself thanks to cleaning the chamber with a piece of cotton wool soaked with NaCl, chlorhexidine, or laser-assisted pulp protection, there are good prognosis for biological treatment. If no pulpitis occurs (the application of a rubberdam and Class II to Class I cavities conversion are necessary), when the pulp capping with MTA or Biodentine is performed, the size of pulp exposure (in a reasonable scope resulting from mechanical aspects) seems to have a secondary meaning. Dried pulp, being a confirmation of its aseptic death, pus leak (at least part of the pulp inflamed), heavy bleeding difficult to stop (strong hyperaemia of the pulp, usually due to the inflammation) are the situations when different treatment protocols need to be used.

Case report

A 35-year-old patient was referred to our clinic because of a deep cavity Class II (MO) in tooth 16. Because of the cavity complexity and a desire to avoid its complication—the pulp exposure, partially cleaned cavity bottom was covered by non-hardening (UltraCal XS) and self-hardening (Ultra-Blend) calcium hydroxide. Then, the cavity was filled with a temporary filling. The patient did not report any pain, and the sensitivity to stimuli was similar to other molars in the maxilla.

Clinical findings

In order to assess the extent of the tooth core damage and its chances for biological treatment, a RTG photo of tooth 16 has been taken (Fig. 1). On the photo we can see the radiological shadow indicating the presence of fillings on the occlusal surface. The radiological shadow in the medial part of the chamber projection, not having its counterpart in this tooth’s fillings, requires intraprocedural differentiation by pumping calcium hydroxide or dental dressing into the chamber.

In the chamber projection we can additionally observe thickened tooth structure, which suggests the presence of denticles. Brightness in the area of roots requires the differentiation between irreversible pul-
pits and congestion of the pulp as a response to the calcium hydroxide use.

Treatment plan
The reasonable treatment plan included: restoration of the medial wall of the cavity in order to provide better isolation with the use of the rubberdam before the next stage of the procedure, cleaning the remaining part of the cavity, the conservative restoration with indirect or direct pulp capping if its condition allows for such a procedure, or entering "classical" endodontic treatment, if the tooth will not prognose pulp viability preserving.

Cleaning with laser
In an articaine with epinephrine infiltration anaesthesia, by means of ultrasonic scaler, the temporary filling was partially removed in order to obtain the space required for the conversion the cavity into Class I. Cleaning was continued with the use of Er:YAG laser (LightWalker, Fotona), using the contact contra-angle handpiece H14 with cylindrical optical fibre with a diameter of 1.3 mm. The laser parameters used during the procedure are presented on Figure 2 (cavity preparation) and Figure 5 (surface preparation for reconstruction).

The fibre tip of the contact contra-angle handpiece was carried out at some distance from the surface of the tooth (circa 1 mm). The wall of the cavity was restored with the composite and the self-etching system. After the conversion into Class I cavity and performing the occlusal adjustment, the rubberdam was applied and, from the tooth prepared in such a way, all temporary filling was removed (using the scaler again) revealing the pulp exposure of 1 to 1.5 mm² area in the buccal part of the cavity bottom (Fig. 6). Delicate effusion of the colourless and odourless fluid stopped after two to three minutes, confirming the theory about hyperaemia as response to the calcium hydroxide application.

Fig. 4
Fig. 2
Fig. 3
Fig. 5

Laser parameters used during the procedure.
Fig. 2: Cavity preparation.
Fig. 3: Deeper parts with the risk of pulp exposure.
Fig. 4: Laser application to exposed pulp.
Fig. 5: Preparation to the composite restoration.

Treatment of hyperaemia
In the first stage of the treatment, the exposure area was skipped, focusing on the remaining fragments of the cavity, continuing to clean it with laser on the previously mentioned parameters (Fig. 2). In order to minimise the laser’s impact on the pulp, the deepest parts of the cavity were prepared using the parameters modified to the values presented in Figure 3. Once the dentine surface was cleaned, the inner surface of the filling (unevenness between dental dressing and metal matrix after condensation) was smoothed with the diamond turbine drill.
After preparation of the whole cavity, a piece of the temporary filling previously pressed into the chamber was removed by means of endodontic hand tools (Figs. 6 & 7). The pulp behaviour during the entire visit (correct pink colour of the visible fragment of the pulp, small serous effusion without anaerobic infection after the temporary filling removal, small pulp bleeding after removal of the foreign body from the chamber, and spontaneous termination of effusion and bleeding) resulted in, after the patient gave his consent to the treatment plan, an attempt to biological treatment.

Er:YAG laser was applied on the exposed pulp (parameters shown in Figure 4) with the tip hold in 5 mm distance from the pulp in order to "defocus" the beam (to reduce the intensity of radiation). Then, the pulp was covered with Biodentine (Figs. 8–10). After the time necessary for Biodentine to harden, composite reconstruction of the occlusal surface was prepared with the materials formerly used for the reconstruction of the tooth wall (Fig. 11).

Posttreatment

The posttreatment radiographs of the tooth are shown in Figure 12. The behaviour of the pulp during the procedure gave a main reason to qualify it for the conservative treatment and the observation (for about three months). In comparison with analogical cavities treated with the use of Biodentine, but without the use of laser, in the two years’ period of observation (with a particular focus on the lack of ailments and discomfort after the anaesthesia stops), this case allows to expect tooth viability maintenance and the standardisation of the periapical tissues image during the X-ray control.

Conclusion

The use of laser increased control over the cleaning of the most damaged portions of the dentine in order to prevent further exposure, or in case they occur, reduce the associated risk for the pulp. The application of laser in the preparation of the exposed pulp makes reaching the state of homeostasis easier, additionally disinfecting the surface layer of the pulp.

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