# The Diode Laser - The Diode Laser for Pulp Capping. - *By Dr. Glenn A. van As*

## **Introduction**



In last months edition of Dentistry Today, I brought up the importance of laser safety with emphasis on the role of eye protection for all lasers. The shorter laser wavelengths such as diode lasers (810 - 1064 nm) are absorbed by pigment, and therefore can cause damage to the retina and to other areas of the eye including the cornea and lens. For this reason, it is imperative that laser eye protection be worn by all dental personnel and patients that are within the Nominal Ocular Hazard Zone ( 3-7 ft for the Picasso Diode Lasers). In this months article, I will switch topics and discuss the role of the diode laser and its antibacterial and hemostatic qualities for both indirect and direct pulp capping. This will be the first of a two part series that will look at the role of the diode laser in the discipline of endodontics. In this month we will examine how the diode laser can be used in a preventative fashion when pulpal a exposure is directly or indirectly encountered. Next month the benefit of this soft tissue wavelength during actual endodontic therapy will be examined.

#### Introduction

**Pulp Capping** is defined as follows: " Application of a protective agent to an exposed pulp (direct pulp capping) or the remaining thin layer of dentin over a nearly exposed pulp (indirect pulp capping) in order to allow the pulp to recover and maintain its normal vitality and function". (1)

Therefore, it can be seen that pulp capping represents an elective procedure that borders somewhat between restorative dentistry and endodontic therapy. Where possible, the maintenance of pulp vitality can provide for an improved long term prognosis for patients tooth from both a biomechanical and esthetic viewpoint. (2) In the last decade as lasers have become more popular in restorative dentistry, there has been an increased interest in what role lasers with their antibacterial, and hemostatic abilities may provide in ensuring successful long term results for teeth which are in jeopardy of requiring endodontic therapy. In general, patients have a higher degree of successful long term retention of the pulp when anterior teeth that are fractured are treated (3.4) whereas posterior teeth treated with deep decay have lower success rates (5,6). Past studies from Santucci (7), Moritz (8,9) have shown success rates of 90% (54 month), and 89-93 % success respectively for laser pulp caps when compared to control groups where the success rate with traditional methods yielded much lower chances of avoiding endodontics (48% and 68%). These treatment results were completed in the late 1990s with CO2 and Nd:YAG lasers, but more recent studies from Olivi (2) and Todea (10, 11) have focussed on the role of erbium and diode lasers respectively for pulp capping with similarly exceptionally positive results.

There are several factors that should be considered prior to pulp capping (either direct or indirect) any tooth on a patient. The tooth with deep caries should be asymptomatic to temperatures, sweets or percussion prior to intervention, and a tooth with a mechanical exposure will be a better candidate for laser pulp capping than a carious exposure. In cases of

anterior trauma, the restorative dental treatment should occur within 48 hours of the traumatic incident. Younger patients will tend to have greater success than older ones. If a direct exposure does occur, success is more commonly seen when active bleeding subsides quickly, and when the exposure is limited to a diameter of 0.5-1.5mm. There should be an absence of radiographic lesions, and the tooth should test to cold normally.

The diode laser serves two functions for pulp capping. Since all lasers are antibacterial, the laser will help reduce bacteria (dentin disinfection) at the site of the pulp cap, and in cases of direct exposures, the laser helps with hemostasis as well (12,13). It must be remembered that of the four laser wavelengths used in dentistry (Diode, NdYAG, CO2, and Erbium) that the diode and NdYAG lasers will penetrate more deeply (500-1000 microns) which can lead to more thermal damage deeper into the pulp. The hemostatic effect of the diode laser is better than the erbium lasers which are not as well absorbed in hemoglobin. Therefore, every attempt should be made to use lower settings with diode lasers when considering a direct pulp cap. In addition, the clinician should limit direct contact of the diode tip to a period of time that allows for coagulation and bacterial reduction while minimizing collateral thermal damage due to higher power settings or extended time of use. Fig. 1 ( Courtesy of Dr. Giovanni Olivi, Rome, Italy)



W: Warming area of reversible

damage 35 to 50°C.

- F : Flowable Composite.
- C : Composite restoration to fill preparation.

After Laser pulp capping several agents can be used to protect the pulp, including the two most popular CaOH (Dycal), MTA (Mineral Trioxide Aggregate). Both agents are biocompatible, promote dentinal bridges, have alkaline pHs. MTA has a better seal, is insoluble, and is difficult to remove but is expensive and requires a wet field to set. CaOH has been tested long term, doesn't change the color of the tooth (gray MTA can), is inexpensive and requires a dry field to work. Recent alterations of MTA can set quicker (10 minutes for MTA Angelus ) and whiter versions can be used with less fear of staining of the tooth. Fig. 2 (Courtesy of Dr. Giovanni Olivi, Rome, Italy). Some clinicians will not place any base but will place a base but etch the tooth and place a flowable resin followed by a composite resin directly over the pulp cap.

#### Protocol Indirect Laser Pulp Cap

In the case of an indirect pulp cap, the preparation is encroaching upon the pulp but there is not an actual exposure of the pulp. Blushing (pink discoloration) may be noticed, but bleeding should not be present. The clinician should in this case only be concerned with the bacterial decontamination capabilities of the laser, and not the hemostatic abilities of the Picasso diode laser. After caries removal is completed, the diode laser is brought over. The tip should **NOT** be initiated as the clinician wishes for the laser energy to exit beyond the tip. The laser should be used in a low to moderate setting (0.5-0.8w CW) for 30-60 seconds in a **non contact** fashion. The tip should not touch the dentin and should remain 1-3mm away from the tooth structure. Visible changes to the dentin should NOT occur, and after the laser is used, the restoration can be restored in a typical fashion. The tooth should be followed at regular intervals with thermal, percussion, radiographic and vitality tests to ensure that endodontic therapy for irreversible pulpitis, necrosis of the pulp or calcification does not occur.(Table 1).

Item	Indirect Pulp Cap (Dentin Disinfection)
1	Select disposable tip for Picasso Laser or strip, cleave the fiber. I prefer 5mm- 90 degree disposable tips for pulp capping.
2	<b>Do NOT initiate the tip</b> , as the laser energy needs to penetrate into the dentin. Antibacterial qualities of the laser are desired.
3	Set the laser to <b>0.5 - 0.8 w CW</b> and hold tip in non-contact 1-3mm away from deepest areas of preparation.
4	Move laser in a slow circular fashion for <b>30-60 seconds</b> and cover the deepest area of the preparation without actually touching dentin.
5	Restore tooth in preferred fashion. Base may be used, and final restoration afterwards.
6	Monitor the tooth at regular follow up intervals with pulp vitality testing and radiographs to check for signs of irreversible pulpitis, pulpal calcification or necrosis.

#### Protocol Direct Laser Pulp Cap

In direct pulp cap procedures there is a physical exposure of the pulp tissue and bleeding is observed. The size of the exposure should be small (less than 1.5mm), and ideally if it happens it occurs just at the end of the preparation of the tooth. If the clinician feels that a pulp exposure is possible from the radiograph or the extent of caries and the increasing depth of the preparation, the diode laser can be used to disinfect the preparation prior to any exposure using the same settings and procedure that is used in Table 1. This will reduce the bacterial burden in the dentin of the preparation. The difference with a direct pulp cap is that the diode in addition to being used to disinfect the pulp, is also used to help with hemostasis. Bleeding is stopped with an **INITIATED** Tip used at settings of **0.6-0.8w CW (1.2 - 1.6 w Pulsed)**, with a **DABBING** 

motion directly applied to the pulp exposure for 10 seconds or so. The clinician will see the bleeding coagulate with a layer of thin charring (zone of necrosis) with a deeper zone of coagulation and finally beneath the coagulation a deeper layer of reversible warming of the pulpal tissues (Figure 1). The pulp exposure can be covered with a base (CaOH, other base, or MTA), and the final restoration should be placed afterwards. If the pulp exposure occurs suddenly and unexpectedly, the disinfection portion of the pulp cap can be done either before the pulp exposure is completed (if the bleeding is not heavy) or with a new uninitiated tip after hemostasis of the exposure, if the direct pulp cap is treated first. Dentin disinfection always is best done with an uninitiated tip. (See Table 2 below).

Step	Direct Pulp Cap- (Dentin Disinfection and Hemostasis)
1	Select appropriate single use disposable tip (5mm 90 degree tip)
2	If no direct exposure has occurred, but it is expected, then use protocol above in table one to DISINFECT the dentin first. (see Table 1).
3	Complete preparation and caries removal where pulp exposure occurs.
4	Take 5mm 90 degree tip and <b>INITIATE</b> it at 0.5 w on articulating paper for 5 seconds.
5	Touch initiated tip in a <b>DABBING</b> motion at <b>0.5-0.8w CW</b> for <b>10</b> <b>seconds</b> or until pulp stump coagulates (thin black layer) and bleeding stops.
6	If pulp exposure occurs prior to <b>DISINFECTING</b> the dentin then grab a new tip that is not initiated and use settings from Table 1 to disinfect the dentin.
7	Monitor the tooth at regular follow up intervals with pulp vitality testing and radiographs to check for signs of irreversible pulpitis, pulpal calcification or necrosis.

#### Table 2 - Protocol Direct Laser Pulp Cap





Fig. 3 Deep MO Prep on upper molar.

Flg. 4 Diode Laser completed direct pulp cap.



Fig. 5 Pulp cap Completed.

Fig. 6 Completed restoration.

The Picasso Lite and Picasso 7w diode lasers can be used to help with pulp exposures and deep preparations where pulp proximity exists. The disinfecting and hemostatic abilities of the laser are beneficial to the success of restorations that encroach, or in fact directly expose the pulp.

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