

Laser Technology for Removal of Caries

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Summary and Conclusions

SBU's appraisal of the evidence

Caries is the most common cause of toothache and tooth loss. Laser is a new method for removing carious dental hard tissues (enamel and dentine).

- Laser is equal to a rotary bur for removing carious dental hard tissues (Evidence Grade 3)*.
- It takes longer to remove carious dental hard tissues by laser than by rotary bur (Evidence Grade 3)*.
- The scientific evidence is insufficient* to determine whether laser treatment may be harmful to the dental pulp.
- The scientific evidence is insufficient* to determine whether cavity preparation by laser compromises the longevity of a restoration.
- Adult patients prefer laser treatment to a rotary bur (Evidence Grade 3)*, but the scientific evidence is insufficient* to draw conclusions about children's perception of laser treatment.
- The scientific evidence is insufficient* to draw definite conclusions about the cost-effectiveness of the method. The method has been assessed as equal to a rotary bur for removal of carious dental hard tissues, but more expensive. Based on today's costs it can therefore not be considered to be cost-effective.

* Criteria for Evidence Grading SBU's Conclusions, see page 2.

TECHNOLOGY AND TARGET GROUP Dental hard tissue damaged by caries may need to be removed, after which the tooth is reshaped and restored by a filling or a crown. The conventional method of removing carious dental hard tissues is by rotary bur. An alternative method is the application of an erbium laser beam. In Sweden this technology is not widespread.

When the laser beam encounters the tooth surface, the light is absorbed by water molecules in the dental hard tissues. As a result the water heats up rapidly and vaporises. The reaction creates high localised pressure and a micro-explosion, which results in removal of dental hard tissue.

Removal of caries is often painful and the pain is more intense in deep lesions close to the dental pulp, which is richly supplied with blood vessels and nerves. Compared with a rotary bur the laser is quieter and vibrates less. It is claimed that laser treatment is less painful, reducing the need for local anaesthesia.

Potential target groups for the method are children and adults with caries lesions which are so deep that the carious dental hard tissues have to be removed.

PRIMARY QUESTIONS

- Is laser an effective method for removing carious tissue? (outcome: complete caries removal)
- Is the method associated with risks of biological complications? (outcome: pulpal effects)
- Are there technical complications associated with the method? (outcome: longevity of the restoration)
- Do patients perceive laser treatment more favourably than treatment with a rotary bur?
- What is the cost of laser removal of carious dental hard tissues? Is the method cost-effective?

PATIENT BENEFIT

Complete caries removal

Application of laser technology to remove carious dental hard tissue has been evaluated in three studies assessed as medium quality for this outcome. All three studies reported that the laser was equal to the rotary bur in achieving complete caries removal.

Treatment time

The time required to remove carious tissue has been evaluated in four studies assessed as medium quality for this outcome. One study showed that laser application took three times as long as the rotary bur to remove carious tissue, two studies reported that it took twice as long and the fourth study reported only that it took longer with the laser than with the rotary bur.

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Effects on the dental pulp

If treatment causes the temperature in the dental pulp to rise, the risk of pulpal damage increases. Four studies which evaluated the effect on the dental pulp have been identified. With respect to this outcome the quality of the studies was assessed as low because the follow-up time was short and the presentation of the results unclear.

Longevity of the restoration

If a treatment compromises the potential for restorative material to adhere to the prepared tooth surface, then there is an increased risk of failure or loss of the restoration. Two studies which include the longevity of the restoration as an outcome have been identified. The studies were assessed as low quality for this outcome because the follow-up times were only 6 and 3 months respectively.

Patient perception

Patient perception has been evaluated in three studies assessed as medium quality with respect to this outcome. In one of the studies the need for local anaesthesia was less for laser treatment than for the rotary bur. In another, most of the patients perceived laser treatment as less uncomfortable than treatment with the rotary bur, but no difference in use of local anaesthesia was reported. The third study showed that adult patients preferred laser treatment to the use of the rotary bur. This study included children and adolescents: the number was however, limited and the study was therefore assessed as having low quality with respect to this patient group.

ETHICAL ASPECTS Because of the present uncertainty about potential complications associated with the method it is questionable whether laser treatment can be justified on ethical grounds. The use of laser means that treatment will be more expensive. At present the extra cost is borne by the patient.

ECONOMIC ASPECTS The present purchase price of laser equipment (Er:YAG-laser) is 550 000–630 000 Swedish kronor (SEK). According to calculations made by SBU, if the dentist does on average 5–10 laser treatments per day, the cost per item of treatment will be about SEK 300 more than for treatment by rotary bur. With less frequent laser use, fewer than two per day, the increase in cost will be much greater, due to the relatively high cost of the laser equipment. As the method is assessed as equal to the rotary bur for removal of carious tissue, but is obviously more expensive, it cannot be considered cost-effective. This assessment is based on present-day costs and does not take into account the implied benefit that laser treatment is less painful.

Criteria for Evidence Grading SBU's Conclusions

Evidence Grade 1 – Strong Scientific Evidence. The conclusion is corroborated by at least two independent studies with high quality, or a good systematic overview.

Evidence Grade 2 – Moderately Strong Scientific Evidence. The conclusion is corroborated by one study with high quality, and at least two studies with medium quality.

Evidence Grade 3 – Limited Scientific Evidence. The conclusion is corroborated by at least two studies with medium quality.

Insufficient Scientific Evidence – No conclusions can be drawn when there are not any studies that meet the criteria for quality.

Contradictory Scientific Evidence – No conclusions can be drawn when there are studies with the same quality whose findings contradict each other.

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The complete report is available only in Swedish.