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[Intervention Review]

Lasers for caries removal in deciduous and permanent teeth

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ABSTRACT

Background

Despite considerable improvements in oral health, dental caries continue to be a public health issue. The most frequently used, and universally accepted technique, to remove caries is through mechanical ablation of decayed tissues by means of rotating drills (diamond or tungsten carbide, or both). In the past few decades, the introduction of adhesive filling materials (resin composites) has affected cavity filling procedures by reducing its retention needs, with advantages for dental tissue conservation. Consequently, new minimally invasive strategies were introduced into dental practice, such as the use of lasers to perform highly controlled tissue ablation. Laser use has also raised expectations of limiting pain and discomfort compared to using drills, as well as overcoming drill phobia.

Objectives

The main objective of the review was to compare the effects of laser-based methods to conventional mechanical methods for removing dental caries in deciduous and permanent teeth.

Search methods

We searched the following electronic databases: Cochrane Oral Health's Trials Register (searched 22 June 2016), Cochrane Central Register of Controlled Trials (CENTRAL; 2016, Issue 5) in the Cochrane Library (searched 22 June 2016), MEDLINE Ovid (1946 to 22 June 2016), Embase Ovid (1980 to 22 June 2016), ProQuest Dissertations and Theses (1980 to 22 June 2016), Zetoc (limited to conference proceedings) (1993 to 22 June 2016), and ISI Web of Knowledge (limited to conference proceedings) (1990 to 22 June 2016). We checked the reference lists of relevant articles to identify additional studies. We searched the US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform for ongoing trials.

Selection criteria

We included randomised controlled trials, split-mouth trials and cluster-randomised trials (irrespective of their language) comparing laser therapy to drill ablation of caries. We included participants of any age (children, adolescents and adults).

Data collection and analysis

Two review authors independently screened titles and abstracts of citations identified by the review search strategy. Two review authors independently evaluated the full text of relevant primary studies, assessed risk of bias and extracted data. We used standard methodological procedures expected by Cochrane.

Main results

We included nine randomised trials, published between 1998 and 2014, involving 662 participants. The population consisted of both children and adolescents in four trials, only adults in four trials, and both children/adolescents and adults in one trial. Four studies examined only permanent teeth, and five studies evaluated both deciduous and permanent teeth. Six trials used Er:YAG (erbium-doped yttrium aluminium garnet) lasers, two trials employed Er,Cr:YSGG (erbium, chromium: yttrium-scandium-gallium-garnet) lasers, and one trial used Nd:YAG (neodymium-doped yttrium aluminium garnet) laser.

Overall, the trials had small sample sizes, and the majority were at unclear or high risk of bias. The primary outcomes were evaluated in a limited number of trials (removal of caries (four trials (but only two reported quantitative data)); episodes of pain (five studies)). There was insufficient evidence to suggest that either lasers or drill were better at caries removal (risk ratio (RR) 1.00, 95% confidence interval (CI) 0.99 to 1.01; 2 studies; 256 treated caries; $P = 0.75$; $I^2 = 0\%$; low-quality evidence).

The incidence of moderate or high pain was greater in the drill group compared to the laser group (RR 0.40, 95% CI 0.28 to 0.57; 2 studies; 143 participants; $P < 0.001$; $I^2 = 50\%$). Similarly, the need for anaesthesia was significantly higher in the drill group than in the laser group (RR 0.25, 95% CI 0.10 to 0.65; 3 studies; 217 children/adolescents; $P = 0.004$; $I^2 = 0\%$).

In terms of marginal integrity of restoration, there was no evidence of a difference between laser and drill comparisons evaluated at 6 months (RR 1.00, 95% CI 0.21 to 4.78; 3 studies), 1 year (RR 1.59, 95% CI 0.34 to 7.38; 2 studies), or 2 years (RR 1.00, 95% CI 0.21 to 4.74; 1 study).

There was no evidence of a difference for durability of restoration between laser therapy or drill at 6 months' follow-up (RR 2.40, 95% CI 0.65 to 8.77; 4 studies), at 1 year (RR 1.40, 95% CI 0.29 to 6.78; 2 studies) or at 2 years' follow-up (RR 0.50, 95% CI 0.02 to 14.60; 1 study).

Only two trials investigated the recurrence of caries, but no events occurred during 6 months' follow-up.

There was insufficient evidence of a difference between laser or drill in terms of pulpal inflammation or necrosis at 1 week (RR 1.51, 95% CI 0.26 to 8.75; 3 studies) and at 6 months (RR 0.99, 95% CI 0.10 to 9.41; 2 studies).

Authors' conclusions

Given the low quality of the body of evidence, we concluded that evidence was insufficient to support the use of laser as an alternative to traditional drill therapy for caries removal. We found some evidence in favour of laser therapy for pain control, need of anaesthesia and patient discomfort, but, again, the body of evidence was of low quality. Additional well-designed, randomised trials investigating the most relevant outcomes are needed.

PLAIN LANGUAGE SUMMARY

Lasers for the removal of decay in first and permanent teeth

Review question

This review addressed the issue of whether there is an advantage to laser therapy for the removal of decay in teeth and patient pain, compared to a traditional drill, in children, adolescents and adults.

Background

Dental decay is a cavity formation in teeth resulting from the destruction of dental tissue caused by bacteria under certain conditions, including poor oral hygiene and excessive sugar intake. Symptoms may include pain and difficulty with eating, and complications may include tooth loss, infection or inflammation of the gum. Rotating drills are traditionally used to remove decay. However, this mechanical tool may have unexpected side effects, such as the removal of too much or too little decay, in addition to discomfort due to pain, noise and vibration. Laser therapy is a potential alternative to a mechanical drill.

Study characteristics

Cochrane Oral Health provided the search strategies and carried out the search in several electronic databases. We selected nine randomised trials for inclusion in this review that were conducted between 1998 and 2014. The evidence in the review is up to date as of 22 June 2016. The trials involved a total of 662 participants, with 1498 teeth treated. Three studies were conducted in the USA,

one in Taiwan, one in China, one in Bulgaria, one in Germany, one in Turkey and one in the UK. The population consisted of both children and adolescents in four trials, only adults in four trials, and both children/adolescents and adults in one trial.

Key results

Despite the number of included studies, only a few trials adequately and completely reported information on the primary outcomes. Two trials reported on removal of decay, and there was not enough evidence to conclude that either lasers or drills were better at decay removal. Only five trials reported on episodes of pain, which was significantly reduced in people treated with lasers. There was no difference in terms of side effects, such as inflammation or death of dental pulp, between the two interventions.

Quality of the evidence

The overall quality of the evidence for the nine studies was low. Only one study adequately randomised participants, and none of the included studies was at low risk of bias. This review highlights the need for high-quality studies comparing laser therapy and mechanical drills in the treatment of dental decay.