

# The effectiveness of laser application in stage 3/4 periodontal disease



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## Aim of the review

To review literature on the effectiveness of the diode laser (DL), and the Er,Cr:YSGG laser as an adjunct to conventional periodontal treatment in stage 3/4 periodontal disease, compared to professional mechanical plaque removal (PMPR) alone. Periodontal indices such as periodontal pocket depth (PPD), bleeding on probing (BOP) and clinical attachment loss (CAL) will be reviewed.

## How does laser application work in periodontal treatment?

The use of dental lasers was approved by the FDA in 1990 and stands within the dental therapist's (DT's) scope. This includes biofilm disruption, calculus removal, and decreasing periodontopathic bacteria (non-surgical treatments). The General Dental Council (GDC) said: 'one must be confident, indemnified, and fully qualified to deliver this treatment.'<sup>1</sup> PMPR utilising ultrasonic and hand scalers is known to be an effective approach when treating periodontal disease. However, this is not bactericidal and complications can arise, such

as with hard-to-reach areas and remaining microorganisms within dentinal tubules and the smear layer, which can result in poor periodontal regeneration.<sup>2</sup>

Lasers are usually classified into two groups: deeply penetrating into tissues (DL) and shallow penetrating (Er,Cr:YSGG).<sup>3</sup> Each laser provides a different treatment, due to the varied way the tissues absorb the energy (Table 1). The Er,Cr:YSGG laser is absorbed by water molecules and hydroxyapatite, aiding the ablation of calculus. The cooling system and a shallow penetration depth minimise the risk of thermal damage. Yet, the DL is absorbed by pigment and provides photobiomodulation and a bactericidal effect.<sup>4</sup> When laser energy is used it can be reflected, scattered, absorbed or transmitted into the tissues: there are different wavelengths, powers, timings, pulses and emissions that can be operated. Discussions with Knysak<sup>5</sup> (laser training professional) revealed that the order of TX for these lasers can vary; however, they are usually used as an adjunct to PMPR and as dual-wavelength. The order of treatment stated: USS, HS's, Er,Cr:YSGG,

and DL. It has been mentioned, ideally, a combination of lasers provides the oral tissues with different interactions.<sup>6</sup> Furthermore, Jia *et al.*<sup>7</sup> state that dual-laser use may become more of a trend, further validating the gap in this research.<sup>7</sup>

Laser treatment for periodontal disease has become an emerging topic of research in recent years due to the potential to improve quality of life (QoL) through advancing dentistry. Overall, best evidence consensus highlights the difficulty in gaining an accurate recommendation due to the variety of lasers and the absence of a set volume of irradiation in each clinical study.

The inspiration to review the current research arose whilst working closely with a dental hygienist using the Er,Cr:YSSG and DL and seeing her passion for her treatment outcomes. To explore this further, I attended a webinar: 'Transforming Hygiene and Therapy and Enhancing Patient Care using Laser Technology'<sup>8</sup> The cases presented were showing PPDs reduced by 7 mm; this form of outcome could revolutionise periodontal treatment, which in turn could improve QoL.

**Methodology**

A systematic search using the database PubMed was carried out. Specific terms, Boolean operators and truncators were applied. Two papers were sent by corresponding authors.

The inclusion and exclusion criteria were applied to exclude any papers which did not meet the criteria.

Records identified through database searching (n = 34)

Records sent by corresponding authors (n = 2)

Records included (Met criteria) (n = 8)

Cohort study (CS) (n = 1)

Split mouth trial (SMT) (n = 1)

SMT/RCT (n = 1)

Network meta-analysis (n = 1)

Systematic Review (SR) (n = 3)

Umbrella Review (n = 1).

**Results**

All studies were reviewing clinical parameters and the two lasers as a adjunct to PMPR, in comparison to conventional treatment alone. Two SMT differed, as one over three months promoted the Er,Cr:YSGG laser as promising,<sup>9</sup> which a separate umbrella review<sup>10</sup> and a systematic review<sup>11</sup> confirmed. The other argues that the Er,Cr:YSGG laser holds no clinical significance compared to the DL long-term. Similarly, a NMA found the DL to be more effective and that the Er,Cr:YSGG laser exhibited similar results to PMPR alone. One CS reviewed a dual-laser application, showing a 12 mm reduction in PPD. Two SRs<sup>12</sup> also recommended dual-laser application, however, stated DL is more effective than the Er,Cr:YSGG laser.

The majority of the literature agrees recommendation is difficult due to heterogeneity within laser settings.

**Conclusion**

Overall, it is clear the answer remains unknown. The majority of the studies show laser application, both dual-use and individual, show better clinical outcomes than conventional treatment alone. Although not all parameters are exaggeratedly clinically significant, it can be argued many gaps within current research could play a role in this, such as small sample sizes, heterogeneity amongst laser parameters and a lack of longitudinal studies.

An analysis of the cost of therapy vs benefit to the patient and clinician can also be debated. Patients, our ultimate oral healthcare consumers, would hold cutting-edge technology in high regard and would expect the best results. Verma *et al.*<sup>13</sup> state that ‘... the

**Table 1 Lasers: how they work and their use. Please note each laser produces many operatives. Those listed within this table are those that are in the DT’s scope of practice within periodontal treatment**

Lasers	How it works	Action
Er,Cr:YSGG	Shallow penetration of soft tissues (mid-infrared range).	Removal of calculus (which contains water content) and biofilm which reduces bacteria from within the pocket
Er:YAG	Highly absorbed by water molecules within the hydroxyapatite crystals they also have a cooling system to prevent damage to surrounding tissues.	Can also be used to prep cavities Bactericidal effect.
Think of these two lasers from the same ‘laser family’; they are similar.		
(shallow penetrating laser/superficial penetration)	Erbium lasers are well absorbed in water; their penetration depth can be as shallow as 5 lm, thus offering ablation with minimal thermal-related side effects. <sup>11</sup>	
Diode laser	Deep penetration into tissues.	Sulcular debridement from within the periodontal pocket
NDYAG laser	Absorbed by pigment such as melanin and haemoglobin molecules in soft tissues.	Targets gram-negative bacteria, causing a reduction of periodontopathic bacteria (without tip initiation) and slows down recolonisation
Think of these two lasers from the same ‘laser family’; they are similar.		
(deep penetrating lasers that achieve the low-level laser outcome)		Photobiomodulation, which causes bio-stimulatory effects on osteoblasts, periodontal ligament stem cells and fibroblasts).

*‘The inspiration to review the current research arose whilst working closely with a dental hygienist using the Er,Cr:YSSG and DL and seeing her passion for her treatment outcomes.’*

laser proved to be an effective tool to increase efficiency, specificity, ease, and cost and comfort of the dental treatment’. However, the question remains, is it financially worth it for the patient, especially with the cost-of-living

crisis at present and with the debated current research? In one example, a perio clinic<sup>14</sup> set their rates from anywhere between £350–£1,650 in 2022 depending on the severity of the case. This range of price seems

typical among a variety of practices' pricelists. Although pricing can remain similar to periodontal surgery<sup>15</sup> the application of lasers is far less invasive and also costs less for full mouth treatment compared to a single implant. Selvaganesh *et al.*<sup>16</sup> explores from a business perspective that the DL is more cost-effective. There is also the positive of utilising the dental hygienist/dental therapist within the practice, allowing for a multidisciplinary approach, achieving the best interest for the patient in line with GDC principles<sup>17</sup> whilst using the laser for other treatments listed by Theodoro *et al.*<sup>6</sup>

**Recommendations**

- Firstly, a set standard of laser settings should be established. This could be accomplished by studying each laser separately via split-mouth RCTs, trialling different settings
- After the most beneficial parameters for each laser are established, well-conducted RCTs with a large sample size should be conducted trialling different lasers in conjunction with PMPR in comparison to PMPR alone
- Dual-laser treatment should then be studied also using well-conducted RCTs with large sample sizes
- All should be completed over a long period to get a true understanding of the benefits.

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