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Diverse applications of lasers in dentistry

Recent literature

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When considering whether to work with lasers and in which field they could be applied, recent studies provide many application options and issues for practitioners to consider. The following presents some of the newest research on possible areas of application and further investigation.

Petrov et al. used a femtosecond laser with a high repetition rate, which is probably the future of lasers for hard-tissue removal to achieve fast and more precise ablation in dentine and enamel.[1] They concluded that the ultra-fast femtosecond laser used in their work holds the promise of a significant drilling ability without collateral thermomechanical effects. It achieved high processing efficiency, overcame disadvantages of other laser systems reported, and can be used to develop an instrument for cavity preparation based on fast and precise ablation. Their further aim is to exceed the speed of conventional drilling instruments and thus to reduce the treatment time, which in turn will bring comfort to the patient.

Levine published an article on how to choose the right laser for one's practice, which readers may find of interest.[2]

Hashimoto et al. investigated fluoridated hydroxyapatite for application as an implant coating for titanium bone substitute materials for dental implants.[3] They concluded that fluoridated hydroxyapatite coatings are suitable for real-world implantation applications.

Giannelli et al. carried out a double-blind, randomised, single-centre, split-mouth clinical trial investigating the efficacy of and patient-reported outcomes after one year of treatment of severe periodontitis with a laser and light-emitting diode (LED) procedure adjunctive to scaling and root planing.[4] Their study confirmed the efficacy of combined phototherapy and scaling and root planning, which had emerged from previous clinical trials, extending its field of application to severe periodontitis.[4]

Belcheva et al. carried out a study whose aim was to evaluate the positive effects of the carbon dioxide laser (10,600 nm) with acidulated phosphate fluoride gel on enamel acid resistance.[5] Their conclusion was that this combination was more effective in protecting the enamel surface and resisting demineralisation than was carbon dioxide laser irradiation or fluoride alone.[5]

Campos et al. published a double-blind study on immediate laser-induced haemostasis in anticoagulated rats subjected to oral soft-tissue surgery.[6] There has been much controversy about the management of patients on oral anticoagulants requiring oral surgical procedures. The haemostatic properties of high-power lasers were perceived to be potentially helpful during oral soft-tissue surgeries in anticoagulated patients. The authors concluded that laser-induced haemostasis is an alternative for intra- and postoperative bleeding control in patients on anticoagulation therapy.[6]

As oncological treatment can result in changes in the oral cavity, Carvalho et al. drafted a guide, based on a systematic review, directed at the team of health professionals involved in the oral care of oncological patients.[7] The review concentrated on randomised clinical trials involving paediatric and adult oncological patients, focusing on the prevention and treatment of oral complications.[7] The studies included in the review emphasise the provision of Low Level Laser Therapy, among other interventions, to minimise the severity of oral problems in such patients.[7]

Tani et al. carried out an *in vitro* study that compared photo-biomodulation potentiality using red (635 ± 5 nm) or near-infrared (808 ± 10 nm) diode lasers and violet-blue (405 ± 5 nm) LED operating in a continuous wave with a 0.4 J/cm energy density, on human osteoblast and mesenchymal stromal cell viability, proliferation, adhesion and osteogenic differentiation.[8] They concluded that the 635 nm laser had a potential effective option for promoting/improving bone regeneration.[8]

Ghouth et al. carried out a systematic review of the evidence on the use of laser Doppler flowmetry in the assessment of the pulpal status of permanent teeth compared with other sensibility and/or vitality tests. They concluded that, despite the higher reported sensitivity and specificity of laser Doppler flowmetry in assessing pulp blood flow, this data is based on studies with a high level of bias and serious shortfalls in study design.[9] More research is needed to study the effect of different laser Doppler flowmetry's parameters on its diagnostic accuracy and the true cut-off ratios by which a tooth could be diagnosed as having a normal pulp.[9]

Kaur et al. compared soft-tissue wound healing using diode lasers (810 nm) versus the conventional scalpel approach as an uncovering technique during second-stage surgery for implants.[10] They found that it can minimise surgical trauma, reduce the amount of anaesthetic required, improve visibility during surgery owing to the absence of bleeding and eliminate postoperative discomfort.[10]

Efficiency in debonding porcelain laminate veneers was studied by Al-Balkhi et al. using several laser parameters and two different application modes of the Er:YAG laser (contact and non-contact mode).[11] Their finding was that the Er:YAG laser is an effective tool in debonding porcelain laminate veneers. The non-contact application mode was more efficient in reducing debonding time than the contact application mode, but resulted in a higher change in pulp temperature.[11]

Kellesarian et al. carried out a comprehensive review to assess the effectiveness of erbium lasers in the removal of all-ceramic fixed dental prostheses and found that the benefits of lasers over mechanical instrumentation for crown removal encompassed efficient restoration retrievability without restoration or tooth surface damage and a relatively easier and more time-effective procedure with no prerequisite for anaesthetic agents.[12] It is, however, imperative for clinicians to be well trained and exhibit adequate knowledge regarding recommended power settings and laser-safety parameters with reference to interactions between light and different tissues and ceramics.[12]

The effect of Er:YAG (Smart 2940D Plus, DEKA) and Er,Cr:YSGG (Waterlase iPlus, BIOLASE) lasers on the shear bond strength between orthodontic brackets and dental porcelain in comparison

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with conventional acid etching with 9 % hydrofluoric acid (Ultradent Products) was investigated by Mirhashemi et al.[13] They concluded that with the laser groups the failures were mostly adhesive, while they were mostly cohesive with the controls.[13] They found that the Er:YAG laser with the specifications they used was not a suitable alternative to hydrofluoric acid etching.[13] In the case of the Er,Cr:YSGG laser, although the conditioning outcome met the bond strength requirement for orthodontic brackets (6–8 MPa) they concluded that the bond strength must be further improved by fine-tuning the irradiation parameters.

Yassaei et al. assessed the efficacy of an Er:YAG laser and pastes containing casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) with and without fluoride and their combination for prevention of white spot lesions in the enamel.[14] They found that the Er:YAG laser was able to decrease demineralisation.[14] It further proved to be a potential alternative to preventative dentistry and was more effective when combined with CPP-ACP products.[14] This would be useful especially for orthodontics.

Sarmadi et al. evaluated patients' experiences of two excavation methods, the Er:YAG laser and rotary bur, and the time required with these methods, as well as objective assessments of quality and durability of restorations over a two-year period.[15] Their conclusions were that the Er:YAG laser technique was more time-consuming than the rotary bur, but despite this, the laser technique caused less discomfort and was preferred as an excavation method by patients.[15]

Li et al. carried out a meta-analysis to systematically evaluate the applications of Er:YAG lasers for the removal of caries and cavity preparation in children.[16] They concluded that the time required for Er:YAG laser treatment was longer than that for the conventional mechanical method, but there was less pain associated with the Er:YAG laser treatment.[16] There were no significant differences in the complete retention rate, marginal discoloration and marginal adaptation when compared with the conventional method.[16]

Pinheiro et al. assessed the utility of dental acid etchants containing 37 % phosphoric acid and methylene blue dye as a sensitising agent for photodynamic therapy to reduce *Streptococcus mutans* in dentinal caries.[17] They concluded that this treatment can be used as a photosensitising agent for photodynamic therapy to reduce the *S. mutans* burden in dentinal caries.

Laser dentistry offers many application options and numerous research approaches that might be interesting to investigate or to stay up-to-date with for practitioners. This consideration of recent literature has shown that there is still much potential for the increased use and application of lasers in the different fields of dentistry.

Literature

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Kurz & bündig

Zahnmedizinern, welche Laser zukünftig in ihrer Praxis einsetzen möchten oder wissenschaftliche Erkenntnisse zu den passenden Einsatzgebieten suchen, bieten aktuelle Studien viele Einblicke in nutzbringende Anwendungsbereiche. Der Autor stellt diverse aktuelle Studien der Laserforschung und -nutzung wie zum Beispiel zur Verwendung von Lasern zur Implantatfreilegung oder zur Auswahl des geeigneten Lasers für das persönliche Tätigkeitsfeld vor. Kurze Auszüge und Zusammenfassungen geben Anwendern einen ersten Eindruck und bieten ihnen eine Übersicht zu den gegenwärtigen Einsatzmöglichkeiten und Forschungsansätzen, u. a. zum Einsatz der Lasertherapie zur Minimierung oraler Beschwerden von Krebspatienten. Der Autor offeriert dem Leser verschiedene Optionen für die interessante Lektüre oder weiterführende Recherche.

Die Laserzahnmedizin bietet viele Anwendungsoptionen, sowie zahlreiche interessante Forschungsgebiete, bei welchen es sich für Anwender lohnt, auf dem neusten Stand zu bleiben. Die hier aufgezeigte Literatur verdeutlicht, dass noch sehr viel Potenzial zum vermehrten Einsatz von Lasertechnik in den diversen Feldern der Zahnmedizin besteht.

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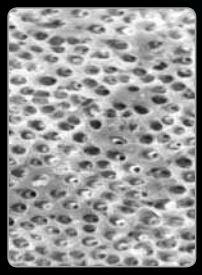
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