SHORT COMMUNICATION

Dentistry Transformed: Laser Science Soars!

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The integration of laser technology and photobiomodulation (PBM) into dentistry significantly enhances precision, reduces invasiveness, and increases patient comfort, impacting fields from endodontics and implantology to soft-tissue surgeries.[1] This discussion aims to provide an overview of the current applications, challenges, and prospects of laser and PBM in dental care.

Laser therapy, utilised in dentistry since the 1970s, spans various fields, such as periodontics, implantology, and restorative dentistry. It benefits from the additional biostimulating effects of laser beams at the cellular level, aiding in infection removal, tissue regeneration, and cosmetic procedures. However, the potential for adverse effects, like thermal damage, necessitates careful device selection and operator proficiency for optimising outcomes and minimising risks.[2,3] In peri-implantitis management, lasers effectively facilitate re-osseointegration by cleaning, removing biofilm, and disinfecting implant surfaces, preserving surrounding tissue, and reducing implant failure risks.[4]

Photobiomodulation therapy offers significant benefits in dental pain reduction and tissue healing, including the treatment of oral mucositis. Its effectiveness across various dental fields is well-documented, with anti-inflammatory and pain-relieving effects depending on the dosage.[5,6] In periodontal care, the application of PBM can be assessed by examining its established effects on the body's inflammatory reaction to microbial invasion in periodontitis, correlating these responses with the impacts of PBM at both cellular and molecular levels.[5]

In the treatment of soft tissues, their precise and minimally invasive nature allows for accurate interventions with minimal discomfort and healing time for patients. It is employed in a variety of procedures, such as gingival contouring, frenectomies, lip reshaping, correction of high-smile line, gingival depigmentation, benign tumour excision, pre-malignant lesion ablation, esthetic management of vascular lesions, such as lip haemangiomas, periodontal infra-bony treatment, peri-implantitis elimination, and bone tissue regeneration. The benefits of laser dentistry include reduced bleeding due to the coagulative effect of laser energy; decreased risk of infection through sterilisation of the operative field; and often the elimination of the need for sutures due to the formation of a coagulum that acts as a biological seal over the wound, reducing postoperative discomfort and preventing distortion and asymmetries at the surgical site. Furthermore, lasers can enhance tissue regeneration and wound healing. Studies have shown that specific wavelengths, such as CO_2, diode, Nd:YAG, Er,Cr:YSGG, and Er:YAG lasers are particularly effective for soft-tissue applications, offering a high degree of precision and patient comfort.[7,8]

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Despite the benefits lasers offer in dentistry, challenges, such as cost, equipment obsolescence, safety concerns, and the need for specialist training remain significant.[9] Photobiomodulation faces its own set of challenges, notably the variability in study designs and light irradiation devices and parameters, complicating the creation of standardised treatment protocols. Optimal dosimetry for PBM is recognised to range from 2 to 8 J/cm^2 for stimulatory benefits and 10–30 J/cm^2 for analgesia and anti-inflammatory effects. However, the practical application of these dosages is hindered by complexities in ensuring consistent energy delivery and the nuances of optical transport techniques.[10]

Furthermore, laser therapy involves a myriad of parameter variables, such as irradiation time, energy density, beam spot size, etc. These variables significantly influence the interaction between light and tissue, and their optimisation is essential for effective treatment. The depth of the target tissue and its optical properties, including refraction and scattering indexes, also play a crucial role in the outcomes of laser treatments.[2]

The future of laser dentistry looks bright with the development of pulse technology, which promises to enhance precision, reduce damage to surrounding tissues, and improve patient outcomes by delivering energy in short, controlled bursts.[11] This advancement is expected to make treatments like cavity preparation, periodontal therapy, and soft-tissue surgeries more efficient and comfortable for patients. The integration of dental-derived stem cells with laser technology for improving osseointegration in dental implants signifies an innovative step forward in oral reconstruction and implantology, showing promise in enhancing success rates and cellular attachment.[12]

Additionally, lasers are enabling new preventative measures, such as inducing changes in tooth enamel to make it denser and more resistant to decay.[13]

In conclusion, the advancements in pulsed laser technology and other innovations are poised to transform dental treatment, aligning with the shift toward holistic and patient-centric approaches.

These developments promise to foster wider acceptance and innovation across global dental practices. As research and clinical trials expand and as all-tissue lasers and PBM devices become more accessible, a decrease in costs and increased affordability are anticipated. This, coupled with technological advancements, is expected to broaden the application of lasers and PBM in dental practices worldwide, suggesting that such technologies could become integral to global dental care, enhancing procedures and patient outcomes.

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