Innovations with lasers could lead regenerative dentistry

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With this year, 2015, being designated as the year of light, the acknowledgment for the key role of light in many diverse areas of our world’s existence and more specifically, in areas of human health are being widely promulgated.1 Many references to the beneficial effects of light and specifically sunlight are repeatedly seen in the literature across the beneficial effects of light. The Nobel Prize in Medicine and Physiology for 2015, work by Niels Jerne Andersen and Jules Hoffmann awarded to the role of light in immunology, is a clear indication of this trend. The role of light in multitude areas is acknowledged for the key role of light in many diverse areas of our world’s existence and more specifically, in areas of human health are being widely promulgated.1 Many references to the beneficial effects of light and specifically sunlight are repeatedly seen in the literature.

Clinical laser application

Dentistry has historically been a leading clinical specialty with a wavy path from lab research to clinics. The wavy path from lab research to clinics is meant to reflect the multistep, tortuous basic science explorations in a wide range of topics that need to come to-gether, results, and clinical studies. The wavy path from lab research to clinics is meant to reflect the multistep, tortuous basic science explorations in a wide range of topics that need to come together, resulting in its activation.

Study 1: Activating TGF-β1

Based on prior reports, we believed that light can have effects on the latent TGF-β1 complex that results in a change in its conformation, resulting in its activation.

Study 2: Dentin regeneration

Laser treatments were able to induce dentin differentiation as evident by increased dentin-specific gene expression and mineralisation. To confirm the role of TGF-β in vivo, transgenic mice with lack of TGF-β receptor in all cells capable of inducing dentin (utilizing a Dental Nais phosphoprotein specific transgene) were generated. Experiments in these mice did not demonstrate any significant dentin induction following laser treatment validating the critical role of TGF-β activation in mediating its effects.

Previous studies have shown the therapeutic benefits of supplementing exogenous (recombinant) TGF-β for reparative

Fig. 1: Therapeutic outline utilizing laser-generated ROS activated TGF-β1 to direct differentiation of dental stem cells and pre-odontoblasts to induce dentin matrix and subsequent mineralization.

Fig. 2: Photobiomodulation (PBM) is a non-thermal process in-volving photophysical and photochemical reactions at various wavelengths resulting in beneficial photobiological responses. Its clinical applications could be appended as PBM therapy.

Fig. 3: The use of a variety of wavelengths at different doses can be used for various clinical applications. The following wavelengths are used in this figure PBM – Photobiomodulation, exPDT – Photodynamic therapy with endogenous chromophores and exPDT – Photodynamic therapy with exogenous chromophores (LEDs).
Laser-Dentin induction

Recent findings have revealed that low-level laser light is capable of promoting biological responses in human primary dentin. Furthermore, the application of low power lasers to demineralized dentin results in an increase in the deposition of collagen and mineral. These findings provide a promising avenue for the treatment of deep carious lesions. However, the clinical implications of these observations remain to be fully explored.

Conclusion

The use of low power lasers can be considered as a novel approach for the treatment of deep carious lesions. Further studies are needed to investigate the long-term effects of laser therapy on dental tissue and to assess its potential for clinical use.

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