The synergistic effects of CO_2 laser treatment with calcium silicate materials of antibacterial and cementogenesis efficacy

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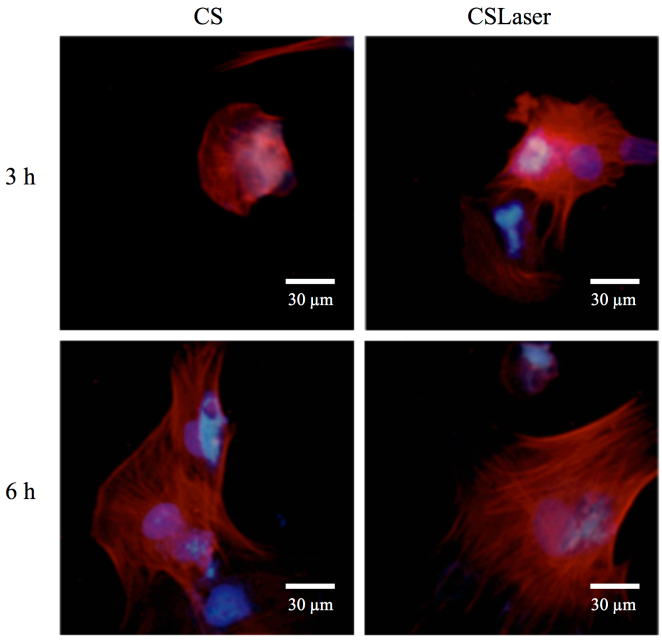
Calcium silicate-based material (CS) has been successfully used in dental clinical applications. Some researches show that the antibacterial effects of CO_2 laser irradiation are highly efficient when bacteria are embedded in biofilm, due to a photo-thermal mechanism. The purpose of this study was to confirm the effects of CO_2 laser irradiation on CS, with regard to both material characterization and human periodontal ligament cell (hPDLs) viability. CS was irradiated with a dental CO_2 laser using directly mounted fiber optics in wound healing mode with a spot area of 0.25 cm^2, and then stored in an incubator at 100% relative humidity and 37 °C for 1 day to set. The hPDLs cultured on CS were analyzed, along with their proliferation and odontogenic differentiation behaviors. The results indicate that the CO_2 laser irradiation increased the amount of Ca and Si ions released from the CS, and regulated cell behavior. CO_2 laser-irradiated CS promoted cementogenic differentiation of hPDLs, with the increased formation of mineralized nodules on the substrate's surface. It also up-regulated the protein expression of multiple markers of cementogenic and the expression of cementum attachment protein. The current study provides new and important data about the effects of CO_2 laser irradiation on CS. Taking cell functions into account, the Si concentration released from CS with laser irradiated may be lower than a critical value, and this information could lead to the development of new regenerative therapies for dentin and periodontal tissue.



References

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