Laser-induced breakdown spectroscopy as a potential tool for autocarbonization detection in laserosteotomy

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In laserosteotomy, it is vital to avoid thermal damage of the surrounding tissue, such as carbonization, since carbonization does not only deteriorate the ablation efficiency but also prolongs the healing process. The state-of-the-art method to avoid carbonization is irrigation systems; however, it is difficult to determine the desired flow rate of the air and cooling water based on previous experiments without online monitoring of the bone surface. Lack of such feedback during the ablation process can cause carbonization in case of a possible error in the irrigation system or slow down the cutting process when irrigating with too much cooling water. The aim of this paper is to examine laser-induced breakdown spectroscopy as a potential tool for autocarbonization detection in laserosteotomy. By monitoring the laser-driven plasma generated during nanosecond pulse ablation of porcine bone samples, carbonization is hypothesized to be detectable. For this, the collected spectra were analyzed based on variation of a specific pair of emission line ratios in both groups of samples: normal and carbonized bone. The results confirmed a high accuracy of over 95% in classifying normal and carbonized bone.
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