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Micro-Raman spectroscopy characterization of dental pulp stem cells differentiation induced by calcium phosphate nanoparticles

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Highlights

Hydroxyapatite nanoparticles were successfully internalized by stem cells and calcium phosphate nodules and collagen biostimulation were observed.

Abstract

Calcium phosphates are chemical compounds used in medicine for tissue engineering. This work analyzes the process of cell differentiation by nanoparticles in dental pulp stem cells for tissues regeneration and the development of new therapeutic methods. The most widely used synthetic calcium phosphate based bioceramic is hydroxyapatite [HA, $Ca_{10}(PO_4)_6(OH)_2$]. Micro-Raman spectroscopy assays are a powerful tool for measuring and characterizing calcium phosphates nanoparticles internalized by cells because of its capability to detect the chemical bonds of nanoparticles and collagen simultaneously and evidencing their interaction within the cell-nanoparticle system. Microscope images (Fig.1a) and Raman spectra (Fig.1b) were obtained for HA-incorporated stem cells where it was possible to observe the formed nodules of calcium phosphate and the matrix in the incorporated samples. HA and collagen peaks were detected in the samples, showing that the nanoparticles induced osteogenic differentiation of the stem cells. The spectra of the nodules showed HA characteristic peaks, while matrix spectra displayed characteristic collagen peaks. Studies have been carried out for the development of new and modified calcium phosphate nanoparticles that should further improve biostimulation.

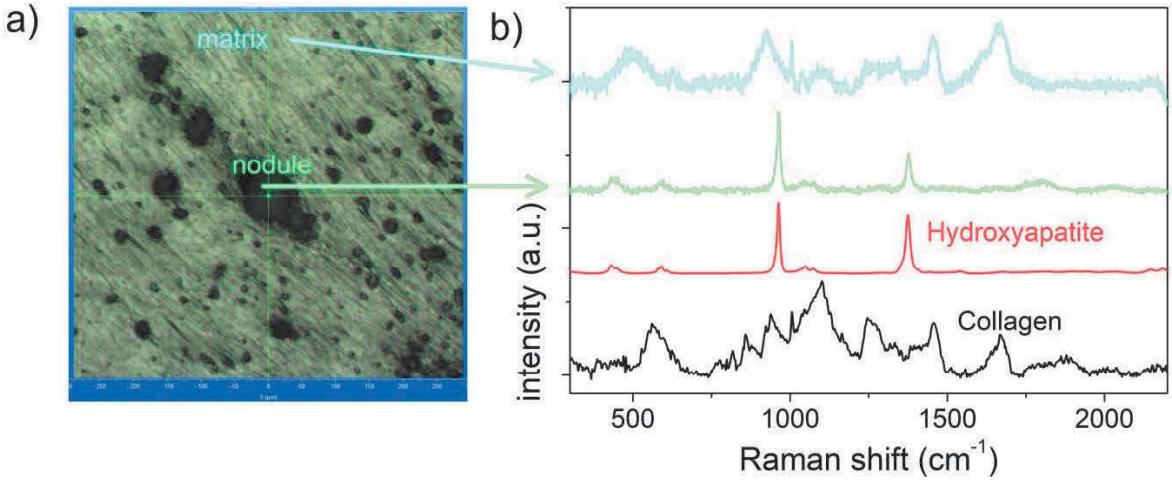

Fig.1. Nanoparticles-incorporated cells (a) showing HA nanoparticles nodules and Raman spectra (b) measured at nodules (green line), biostimulated cell matrix (cyan line) and reference spectra of hydroxyapatite (red line) and collagen (black line).

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