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Bone Regeneration Using Plasma Processes and Nanoparticles

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Tissue engineering is generally based on the seeding of cells, already differentiated ones or stem cells, on porous scaffolds followed by direct implantation in the tissue defect [1-3]. However, this approach is still facing many challenges such as death of a large number of seeded cells during and after implantation, nosocomial infections, low revascularization of tissues or delivery of drugs or stimuli at wrong times. One promising approach to solve a part of these challenges is to embed specifically engineered multifunctional nanoparticles into these scaffolds. Silica-based mesoporous nanoparticles are particularly well suited for the bone tissue regeneration due to their slower dissolution rate in physiological media, their high surface density and their intrinsic bone regeneration properties. A second promising and complementary approach is to use cold atmospheric plasmas to disinfect the scaffold and to activate bone cells for improving their adhesion, proliferation and differentiation on the scaffolds before and after implantation. However, the challenge with plasma is to deliver the reactive species at the right time and optimized concentrations to activate bone cells without generating short or long term negative biological effects. In this work, it is shown how ionized gas can be used more efficiently and safely to both disinfect scaffolds and to promote bone cells attachment, proliferation and activity. The effects of cold plasma jet species on bone cells is discussed and compared with the effects of silica mesoporous nanoparticles.

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