BIOMATERIALS AND NANOTECHNOLOGY IN DENTAL OSSEOINTEGRATION

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Introduction: The osseointegration is a process of bone ingrowth into the surface of a load-carrying implant. Due to its low elastic modulus, excellent biocompatibility and resistance to corrosion, titanium is the most applicable material in dental implantology. The dental tissue is characterized by continuous demineralization and remineralization processes. As a bone-specific non-collagen, modular extracellular matrix protein, the osteonectin has selective properties to bind to insolubilized type I collagen and hydroxyapatite, initiating bone mineralization. It also influences the osteoblasts differentiation, maturation and survival, regulating cells behavior and new bone formation. Our goal was to identify the most suitable materials for a successful osseointegration.
Materials and Methods: A systematic review of 57 articles, published in the past 10 years within PubMed, Web of Science, Scopus and Google Scholar databases, supplying information about morphology of dental implants osseointegration, was conducted.
Results: According to the reported data, for a better osseointegration the implants are coated with various bioactive molecules and inorganic elements such as: nanodots, nanorods and nanotubes, which increase the cell adhesion and osteogenic differentiation. It was determined that microtopography of the implant leads to induction of the extracellular mechanical signals and their transformation into intracellular biochemical signals. The Wnt/β catenin signaling pathway plays an important role in osteogenic differentiation, induced by ordered-micro and disordered-nano patterned structures. The micro-patterned structures influence on geometry, aspect ratio, alignment morphology and behavior of the mesenchymal stem cell (MSCs). Variation of cell morphology can be a trigger mechanism in rearrangement of cytoskeleton, inducing its mechanical stimulation. Mechanotransduction has an important role in micromorphology of the induced osteogenesis, with a remodeling action on actin cytoskeleton, caused by microtopography signal, though the mechanotransductive pathways, determining the osteogenic differentiation of the (MSCs) into osteoblasts and osteocytes, ensuring deposition of the collagen matrix and formation of a new bone.
Conclusion: The osseointegration process can be influenced by external coating of the implant surface with nanoparticles, the microtopography of the implant playing a significant role in osseointegration. The micromorphology and remodeling action on the actin cytoskeleton, can be influenced by mechanotransduction, triggering the osteogenic differentiation of the (MSCs).
Keywords: osseointegration, new bone, dental implant, nanoparticles, mesenchymal stem cells