Nanotechnology in dentistry: novel approaches to enhance osseointegration

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Nanotechnologies have several applications in dentistry encompassing the diagnosis, prevention and therapy of oral diseases. Different nanobiomaterials are currently used in restorative dentistry including adhesives and nanocomposites. Specifically, the use of nano fillers (nanoparticles and nanoclusters) enhanced the mechanical properties of restorative materials as well as their aesthetic and biomimetic integration. Nanotechnologies have also led to development of a novel generation of dental implants with specific nanotopography to enhance osseointegration and long-term results. There is evidence that surface nano-irregularities can provide attachment sites for plasmatic proteins and differentiating cells that will form new bone in contact with the implant surface. This means that surface characteristics and nanotopography can affect peri-implant bone healing at different stages eliciting specific biological events, from protein absorption to cell migration and early bone formation. A large number of nanostructured dental implants are under development or available in the market. Implant nanosurfaces can be obtained by either substractive and additive methods. However, dental implants do not display nanofeatures alone but rather a combination of microtopographical, chemical and/or physical characteristics, with clear difficulties to identify one specific parameter such as nano-topography to be responsible for clinical results. Nanotopography, infact, can be the result of different physical and or chemical treatments. Each technique has advantages and limitations and no single method can generate composite layers combining inorganic and organic materials to create nanotextured surfaces.