GoIMPLANT - Tough, strong and resorbable orthopaedic implants

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Bioresorbable materials are promising candidates in the field of bone regeneration. Hydroxyapatite (HAp) and tricalcium phosphate (TCP) are one of the most used implant materials in the reconstructive surgery to repair damaged hard tissues[1]. Calcium phosphates (CaP) have excellent biomaterial properties due to their similarity to the inorganic component of the bone matrix. However, their clinical applications are restricted because of inherent brittleness and poor shape ability[2]. To capitalize the advantages and overcome drawbacks of CaP, it is combined with biodegradable polymer (e.g. polylactic acid, polycaprolactone) to generate biocomposite material. Calcium phosphate and biodegradable polymer composites have received a great deal of interest in orthopedic and dental applications, which is attributed to their good osteoconductivity, biodegradability and high mechanical strengths[3].

The aim of the project is to develop a novel hybrid-nanocomposite orthopedic implant, which will combine high strength, high toughness, be resorbable and cause no allergic or inflammatory reactions in patients. Use of such implants (e.g., screws, plates etc.) will avoid a second operation of implant removal for many patients (temporary bone fixation, implants for children, etc.) thus reducing patient's pain, risk and treatment costs. The implants will be 3D engineered to fit individual patient's needs. At present a proper material for such implants does not exist: they are either metallic or ceramic with poor fracture toughness and non resorbable, or made of polymers, having too poor mechanical properties and too frequently inducing inflammatory reactions.

The novelty of our approach is the use of high pressure techniques, which permit obtaining a perfect adhesion between the inorganic and organic component of the implant, and also compact the nano-particles/polymer composite to 100% density while the bio-compatible nanostructure is preserved.

References

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