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Synthesis and Characterization of Biomaterials

Since materials for clinical applications interact with biological systems for therapeutic purposes, scientists and engineers must investigate novel biomaterials. By interacting with the host biological system, we must design and develop these materials having in mind both, technical properties and potential to replace a diseased or defective tissue's native function. However, during biomaterials' design we must consider not only numerous medical concerns, but also biology, chemistry, tissue engineering, and materials engineering. They can be derived from nature or synthesized through a variety of processes involving polymers, ceramics, composites, and biodegradable metals.

For orthopaedic applications, absorbable biomaterials such as natural and synthetic polymers or metals (zinc, iron, and magnesium) have emerged as a temporary support alternative. Synthetic polymers can be manufactured in a variety of sizes and shapes, and their degradation can be controlled by altering their composition or processing techniques. However, the incorporation of stabilisers, plasticizers, and antioxidizes during polymer synthesis can result in an adverse host tissue responses due to the leaching of harmful products. In addition, the release of acidic degradation products causes non-infectious inflammatory responses, an increase in foreign body reactions, pathological bone resorption, and an accelerated rate of polymer implant degradation.

In recent years, magnesium (Mg) and its alloys have acquired popularity as absorbable metallic implant materials. Mg and its alloys, as biodegradable metals for orthopaedic applications, have shown mechanical properties similar to bone, including elastic modulus and density. Concerns have been expressed about Mg-based devices due to their rapid and unpredictable degradation rate and loss of mechanical stability prior to fracture repair. To overcome these limitations, alloying, coatings and surface treatments have been used. Extensive *in vitro* and *in vivo* research has identified optimal biological properties that qualify Mg-based devices for orthopaedic clinical applications, including osteoinductive and osteoconductive properties, angiogenesis, and enhanced osseointegration.

The presentation will summarize the achievements in the development of advanced biomaterials for healing and engineering of cartilage, bone, tendon, nerve, and microvascular tissues, utilizing a variety of biocompatible polymeric and Mg-based materials as well as different fabrication techniques.