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Materials Technology and Orthopedic Surgery: An Indissoluble Union

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Fractures and degenerative diseases of the bone segments are mostly of the chronic and traumatic diseases. These diseases have had a considerable increase in recent years and will have a further growth. The increase in the average age of the patients and the increase in traffic accidents are the primary cause. It is often necessary to perform surgery to repair the bone segment (osteosynthesis) or to replace the degenerate and non-functional joints (prosthesis). The biomaterials used in orthopedic and trauma science are devices that are implanted in the human body allowing you to restore joint function or to heal a fracture. The human body is a living, dynamic, corrosive environment and therefore the engineers have had to evolve their knowledge and their research into materials with mechanical and chemical properties similar to those of human tissues.

The following 3 concepts are to be kept in mind:

1. "Biofunctionality" the ability to play a specific function
2. "Biocompatibility" is the ability of a material to determine a favorable reaction of the host tissue in a specific application.
3. "Bioinert" enable to create adverse reactions in the body

Based on the effects on the body: biohazards, bioinert, biodegradable and bioabsorbable materials, derived from biological sources, are characterized.

Metals were the first materials used because they corresponded to certain characteristics: mechanical strength, ease of processing and adaptation, compatibility with new biological environment. They did not activate the immune system and did not induce foreign body reaction, i.e., they were bioinert. Most used metallic materials are: stainless steels (AISI 440, AISI 316L,), cobalt-chromium alloys (Co-Cr-Mo (ASTM F75, Vitallium) and Co-Ni-Cr-Mo (F562), titanium alloys (ASTM F67 e ASTM F136).

Ceramic materials are also used. They are made from a metallic and a non-metallic material. They have good mechanics and tribology, but their synthesis requires high temperatures to achieve high degrees of purity and density. Among ceramic materials most used are alumina and zirconium oxide.

The polymeric biomaterials have been developed subsequently. They are constituted by the concatenation of small units called monomers, to form long linear chains, branched and cross linked. Some examples of polymeric materials are: polyethylene, acrylic resins, polyurethanes, polypropylene, and polymethylmethacrylate. The polymethylmethacrylate is used as bone cement in the establishment of joint prosthesiss. The polyethylene is used in the coating in the prosthesis. Like all synthetic materials they deform their body when subjected to pressure or wear (abrasion or corrosion). To improve their quality, the polyethylenes are subjected to processes of cross linking and incorporation of carbon fibers.

In recent years researchers have developed materials capable of binding to tissue repair causing or becoming part of them. These materials are so-called "second generation". Among these we should mention: the hydroxyapatite (bioceramics with marked feature of osteoconduction), bioglass in the silicon (which have distinct characteristics osteoinductive), and the second generation of polymeric biomaterials (such as "polyglycolic acid (PGA)", the polylactic acid (PLA), polydioxanone (PDA), the poly-hydroxybutyrate (PHA) which are used as resorbable screws).

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