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Perspective

Characteristic Importance of Orthopedic Implants and Biodegradable Magnesium Implants

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DESCRIPTION

For age-related bone illnesses, such as osteoporosis fracture, there is an increasing demand for cutting-edge clinical orthopedic implants. Traditionally, Titanium (Ti) or its alloys, Cobalt-Chromium (Co-Cr) alloys, and inert stainless steel have been used to make orthopedic implants, fixators (internal and external), and prostheses. They have adequate mechanical strength, strong wear resistance, and satisfactory biocompatibility. When used in fracture fixation, these implants also have known limitations. First, the long-term implantation of bio inert metallic implants runs the risk of permanently capturing the drilled hole, which could create further challenges should revision surgery be necessary. Second, the stress shielding effects brought on by the high Young's modulus of contemporary metals may over time result in peri-implant bone loss, deteriorating fixation, and frequently revision surgery. Third, a second surgery to remove the implant may be necessary if there are unanticipated clinical problems, such as pain or reduced function. Additionally, the beam hardening and related imaging artifacts from these conventional metals have a significant negative impact on the diagnostic validity of X-ray and Computed Tomography (CT) scans.

At low weight-bearing skeletal places, synthetic polymers represent an important alternative to their metallic counterparts. The most widely used nondegradable polymers for orthopedic applications are Ultrahigh Molecular Weight Polyethylene (UHMWPE), Poly(Methyl Methacrylate) (PMMA), Polyurethanes (PU), and Polyetheretherketone (PEEK), whereas poly (l-or d,l-lactic acid), poly(glycolic acid), and Polycaprolactones (PCL) are widely used absorbable polymers for orthopaedic fixation implants with US FDA approval Nondegradable polymers are superior to metal devices since they don't generate radiographic imaging artefacts and have a low chance of refracture because there is no stress shielding. However, these nondegradable polymer implants' toxic residual monomers and wear debris could readily cause unfavorable effects, raising clinical concerns. The benefits of resorbable polymers are comparable to those of nondegradable polymers. More crucially, as the resorbable polymers' released monomers exhibit great biocompatibility during *in vivo* degradation, they have been widely used in orthopaedics. The accumulation of acidic intermediate breakdown products caused by the bulk erosion of resorbable polymers, on the other hand, might cause a non-infectious inflammatory response and pathological bone resorption. Natural polymers, such as collagen and chitosan, show superior biocompatibility. However, because of their poor mechanical characteristics, potential for containing antigens that could induce inflammatory reactions and processing challenges, no orthopedic fixators are US FDA approved.

Because of impaired osteogenesis and angiogenesis of the host bone tissue, traditional metallic and synthetic polymeric orthopedic implants have shown increasing limitations in the treatment of some difficult bone diseases, including distraction osteogenesis, nontraumatic osteonecrosis, atypical femoral fractures, and osteoporotic fractures. Numerous investigations have recently been conducted by material engineers, preclinical scientists, and clinicians into the development of orthopedic implants based on Magnesium (Mg), which may be able to overcome the shortcomings of currently available commercial orthopedic implants. Magnesium is a biodegradable metal that has a desirable Young's modulus comparable to that of natural cortical bone and strong biocompatibility, making it a potentially ground-breaking orthopedic biomaterial. However, more importantly, mounting evidence suggests that Mg ions produced from Mg-based implants following *in vivo* surgical insertion can encourage bone regeneration and hasten the recovery of bone disorders. Orthopedic implants made of magnesium may be preferable to those made of other materials for treating difficult bone problems because they have positive effects on the growth of new blood vessels and bone tissue.

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