IN-VIVO EVALUATION OF BIOCOMPATIBILITY OF BIODEGRADABLE FE-MN MATERIALS

Lia Stanciu, School of Materials Engineering, Purdue University
lstanciu@purdue.edu
Marine Traverson, DVM, Department of Veterinary Clinical Sciences, Purdue University
Michael Heiden, School of Materials Engineering, Purdue University
Lia A. Stanciu, PhD, School of Materials Engineering, Purdue University
Eric A. Nauman, BME, MSME, PhD, School of Mechanical Engineering, Purdue University
Yava Jones-Hall, Department of Comparative Pathobiology, Purdue University
Gert J. Breur, Department of Veterinary Clinical Sciences, Purdue University

Key Words: Bioresorbable metals, iron-manganese alloys, corrosion, in-vivo biocompatibility

The authors evaluated the biodegradability and biocompatibility of an alloy of iron and manganese in a bone model *in vivo*. Fe-Mn biodegradable materials with various porosities were first fabricated and characterized for microstructure, corrosion and mechanical properties.
Resorption of a bioabsorbable wire of chemical formula Fe30Mn and no induced porosity was evaluated in-vivo. The Fe-Mn alloy behavior in-vivo was compared to that of a traditional permanent 316L stainless steel (SS) wire after bilateral transcondylar femoral implantation in 12 rats. Evaluation of biodegradation was performed over a period of 6 months using serial radiography, post-mortem histology and macroscopic implant surface analysis. Increased bone ingrowth was noted at the iron-manganese wire-bone interface, which indicates increased osseointegration of the implant.

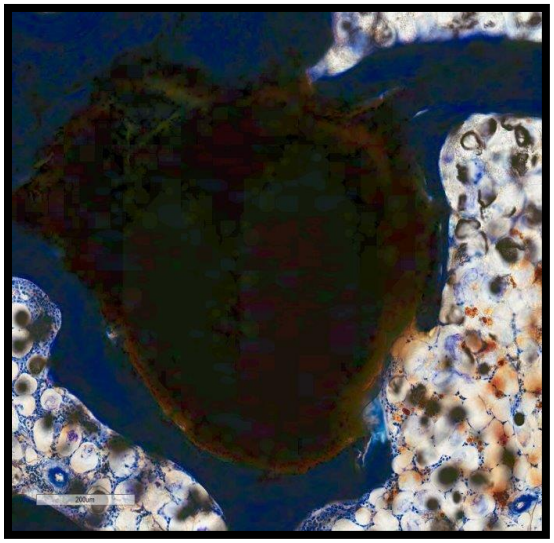

Figure 1 – Histologic sections of bone implanted with a Fe30Mn pin

Although the systemic biocompatibility of the implant was verified, histologic analysis of bone-implant interface did reveal evidence of mild local tissue irritation at the close vicinity of the implant, and poor matrix staining of necrotic bone and newly formed bone in direct contact with the corrosion layer. However, there was no evidence of systemic adverse reaction in all organs collected post-mortem.

This study supports the viability of Fe30Mn wires as degradable, relatively biologically compatible and possibly biologically active orthopedic implants in a rat model *in vivo*. However, further investigation into the biocompatibility, mechanical integrity, *in vivo* degradation processes and bone response is necessary prior to translation in a clinical settings.