Increased Osteoid Formation in BMP-2–Loaded Silk-Based Screws

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Background: Resorbable osteosynthesis systems are used to treat craniofacial fractures. However, conventional synthetic polyester materials are potentially associated with inflammatory reaction and negative host response and may result in incomplete bone remodeling. The authors have developed a resorbable silk fibroin–based osteosynthesis system and propose that silk screws loaded with bone morphogenetic protein-2 (BMP-2) may exhibit biocompatibility and promote bone remodeling.

Methods: Resorbable silk screws were prepared and loaded with BMP-2. The BMP-2–loaded and nonloaded silk screws were inserted into the distal femora in 15 Sprague-Dawley rats by self-tapping, similar to conventional metal systems. Animals were euthanized after 1, 3, and 6 months. The femora were explanted at the designated time points, dissected for histologic evaluation, and compared regarding osteoid formation and inflammatory response.

Results: Increasing organization of newly formed bone tissue was observed over time in both groups. No appreciable difference in inflammation was noted between the BMP-2–loaded and nonloaded silk screws. Notably, mineralized collagen around the periphery of the screw appears to be greatest and more organized in the BMP-2–loaded samples. There was greater recruitment of osteoclasts and osteoblasts around the perimeter of the BMP-2–loaded screws at 3 and 6 months.

Conclusions: The BMP-2–loaded silk-based fixation device in this study exhibited characteristics comparable to the current nonloaded silk screws with regard to integration and biocompatibility. However, functionalization of silk screws with BMP-2 appeared to allow for more organized collagen and osteoid deposition after 3 and 6 months and may increase the potential of successful remodeling. (*Plast. Reconstr. Surg.* 137: 808e, 2016.)

In plastic surgery, osteosynthesis systems are commonly used in craniomaxillofacial procedures, including traumatic bone fractures, orthognathic surgery, craniosynostosis, and bony reconstruction following head and neck cancer removal. In 2013, over 198,000 maxillofacial surgical procedures performed were reported by the American Society of Plastic Surgeons, reflecting a 150 percent increase compared with the year 2000.[1] The type of material plays a crucial role in facial fracture management.[2] Conventionally, metallic systems are routinely used for mandible fracture and orthognathic surgery because of robust mechanical properties and ease of implantation/fixation.

Although stainless steel has previously been the material of choice, titanium is currently preferred for internal devices in craniomaxillofacial surgery because of its mechanical strength, osseous integration, and superior biocompatibility.[3] However, metallic fixation systems present significant disadvantages, including permanence, stress shielding, palpability, loosening and migration, poor bone remodeling, thermal sensitivity, plate

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