STUDY OF BIOMECHANICAL PROPERTIES OF SELF-REINFORCED BIOABSORBABLE IMPLANTS FOR USE IN SMALL BONE FIXATION IN THE HAND

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Abstract

Bioabsorbable fixation devices offer a useful option to treat small bone fractures of the hand, if the prerequisite of reliable and stable osteofixation is met. In a biomechanical study in tranversally osteotomized cadaver metacalpal bones, bioabsorbable self-reinforced (SR) poly-L/DL-lactide (P(L/DL)LA) 70/30 and polylactide-polyglycolide (PLGA) 80/20 miniplatings were compared with standard metallic fixation methods. One hundred twelve fresh-frozen metacarpals from humans had three-point bending and torsional loading after transverse osteotomy followed by fixation using seven methods: dorsal and dorsolateral 2.0-mm SR-PLGA plating, dorsal and dorsolateral 2.0-mm SR-P (L/DL)LA plating, dorsal 1.7-mm titanium plating, dorsal 2.3-mm titanium plating, and crossed 1.25-mm Kirschner wires. In apex dorsal and palmar bending, dorsal SR-PLGA and SR-P(L/DL)LA plates provided stability comparable with dorsal titanium 1.7-mm plating. When the bioabsorbable plates were applied dorsolaterally, apex palmar rigidity was increased and apex dorsal rigidity was decreased. Bioabsorbable platings resulted in higher torsional rigidity than 1.7-mm titanium plating. In another biomechanical study in obliquely (radial to ulnar orientation) osteotomized pig metacarpal bones, we compared the stabilities of various bioabsorbable fixation devices with metallic fixation devices. 1.5 mm self-reinforced poly-L-lactide (SR-PLLA) pins provided fixation rigidity comparable with 1.5 mm Kirschner wires in dorsal and palmar apex bending, whereas in lateral apex bending and in torsion the rigidity was equal to that of 1.25 mm Kirschner wires. 2.0 mm SR-P(L/DL)LA screws provided rigidity comparable with that of 1.5 mm Kirschner wires in all testing modes. The bioabsorbable plate considerably enhanced the bending stabilities of the fixation system, but a single interfragmentary screw provided only limited rotational rigidity. The results demonstrate that using ultra-high strength SR implants, adequate fixation stability for hand fracture fixation can be achieved. These findings suggest that bioabsorbable miniplating can be used safely in the clinical stabilization of metacarpal and phalangeal fractures.

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ADHESION AND GROWTH ON HUMAN OSTEOBLAST LIKE MG 63 CELLS IN CULTURES ON CALCIUM PHOSPHATE-BASED BIOMATERIALS

CULTURES ON CALCIUM PHOSPHATE-BASED BIOMATERIALS

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Introduction

Calcium phosphate-based ceramics, such as hydroxyapatite(HAp) or tricalcium phosphate (TCP) are promising materials for orthopaedic and dental surgery. They closely resemble the mineral phase of the bone extracellular matrix, so that they could be expected to be osteoinductive and osteoconductive, i.e. promoting regeneration of the damaged bone tissue [1-4]. They could be used for construction of solid, permanent bone replacements as well as biodegradable scaffolds for new bone formation [5]. After reinforcement with synthetic polymer-based or carbon fibres, which improve their mechanical properties, they could also serve for bone fixation [3]. Because of their basic nature, these materials can be applied as pH stabilizing fillers for neutralization of acids released from various biomaterials, e.g. polyesters [4]. Calcium phosphate cements can be utilized as carriers for delivery of various drugs, such as antibiotics, cytostatics, anti-inflammatory or anti-ischemic agents [3, 6].
The physicochemical properties and bioactivity of these materials could be further modified by addition of various