Degradation and Bone-Contact Biocompatibility of Two Drillable Magnesium Phosphate Bone Cements in an In Vivo Rabbit Bone Defect Model

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Summary

In recent years, magnesium-phosphate based cements (MPC) indicated their potential to overcome existing problems of traditional bone cements. In this study [1], we evaluated two newly developed, resorbable and drillable [2] MPC for the first time in vivo regarding their biocompatibility, degradation behavior and biomechanical properties. Both new materials exhibited promising characteristics and have shown to be excellent candidates for further investigations in more complex in vivo models and potentially clinical use.

Introduction

The use of bone-cement-enforced osteosynthesis is a growing topic in trauma surgery. Despite their widespread use, most traditional cements lack certain clinically important features like drillability or are not able to unite adequate biomechanical features as well as desired degradation behavior in vivo.

Methods

Two newly developed MPC pastes with different amounts of phytic acid (IP 6) as setting retarder were implanted in an orthotopic defect model of the lateral femoral condyle of New Zealand White Rabbits for 6 weeks. After explantation, their resorption behavior and material characteristics were evaluated by means of X-ray diffraction (XRD), porosimetry measurement, histological staining, peripheral quantitative computed tomography (pqCT), cone-beam computed tomography (cbCT) and biomechanical load-to-failure tests, using both new and already well-established methods [3].

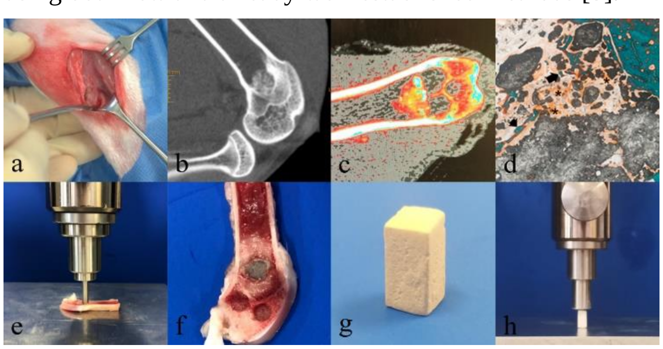

Figure 1: Methods used for analyzing the new materials: implantation (a), cbCT (b), pqCT (c), histology (d), biomechanical measurements of the implants (e,f) and material cuboids (g,h)

Results and Discussion

Both MPC displayed comparable results in biomechanical properties (compressive strength, stiffness) and resorption kinetics after 6 weeks in vivo. Bone-contact biocompatibility was excellent without any signs of inflammation. Initial resorption and bone remodeling could be observed.

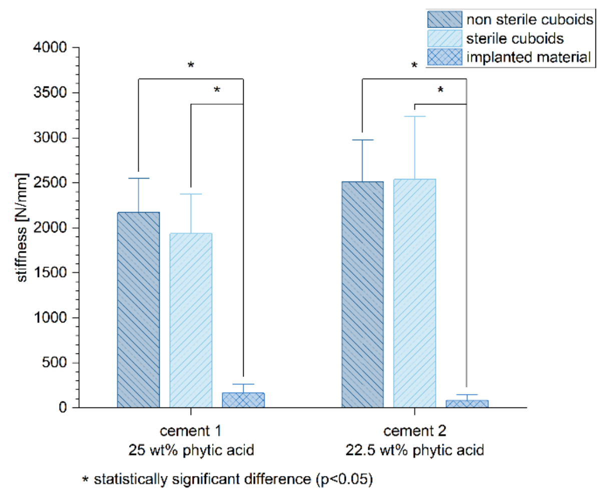

Figure 2: Reduction of the stiffness of the implanted bone cements after 6 weeks in vivo compared to their non-implanted counterparts

Conclusions

The new MPC pastes with IP 6 as setting retardant have the potential to be a valuable alternative in distinct fracture patterns. Drillability, promising resorption potential and high mechanical strength confirm their suitability for use in more complex animal models and potentially in clinical routine.

Acknowledgments

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