

Intramedullary cement osteosynthesis (IMCO): a pilot study in sheep

ABSTRACT

The application of bone substitutes and cements has a long standing history in augmenting fractures as a complement to routine fracture fixation techniques. Nevertheless, such use is almost always in conjunction with definite means of fracture fixation such as intramedullary pins or bone plates. The idea of using biomaterials as the primary fixation bears the possibility of simultaneous fixation and bone enhancement. Intramedullary recruitment of bone cements is suggested in this study to achieve this goal. However, as the method needs primary testings in animal models before human implementation, and since the degree of ambulation is not predictable in animals, this pilot study only evaluates the outcomes regarding the feasibility and safety of this method in the presence of primary bone fixators. A number of two sheep were used in this study. Tibial transverse osteotomies were performed in both animals followed by external skeletal fixation. The medullary canals, which have already been prepared by removing the marrow through proximal and distal drill holes, were then injected with calcium phosphate cement (CPC). The outcomes were evaluated postoperatively by standard survey radiographs, morphology, histology and biomechanical testings. Healing processes appeared uncomplicated until week four where one bone fracture recurred due to external fixator failure. The results showed 56% and 48% cortical thickening, compared to the opposite site, in the fracture site and proximal and distal diaphyses respectively. This bone augmentative effect resulted in 264% increase in bending strength of the fracture site and 148% increase of the same value in the adjacent areas of diaphyses. In conclusion, IMCO, using CPC in tibia of sheep, is safe and biocompatible with bone physiology and healing. It possibly can carry the osteopromotive effect of the CPCs to provide a sustained source of bone augmentation throughout the diaphysis. Although the results must be considered preliminary, this method has possible advantages over conventional methods of bone fixation at least in bones with compromised quality (i.e. osteoporosis and bone cysts), where rigid metal implants may jeopardize eggshell cortices.

Keyword: Biomaterial; Calcium phosphate cement (CPC); Fracture; Impending fracture; Internal fixation; Intramedullary cement osteosynthesis (IMCO); Osteoporosis