LONG TERM EVALUATION OF A HYDROXYAPATITE COMPOSITE CEMENT IN TOTAL HIP ARTHROPLASTIES

Introduction Long term success of total hip arthroplasty is largely dependent on cementing with polymethylmethacrylate (PMMA). PMMA continues to be the most common and consistently reliable method of fixation, although its long-term results are limited. The limitations are mainly due to its biomechanics and its limited fatigue properties. Bioactive bone cements have been developed over the past two decades in attempts to improve the long-term fixation and thereby improving long-term bony apposition. The purpose of this study was to mechanically and histologically compare a new hydroxyapatite composite resin with PMMA in the long-term fixation of canine hip arthroplasties.

Methods A new hydroxyapatite resin, CAP (Kuraray, Japan), was studied as an aid to fixation of total hip arthroplasties in dogs. The composite consists of a bio-phosphate, of which hydroxyapatite (HAp) granules (>98% hydroxyapatite granules (1)). At time of application, these components are stored in a divided cylinder and are mixed by injecting through a specially designed syringe. The composite was immediately injected with a specific texture and frequency filter algorithms, and processed similarly. After embedding, the femoral specimens were coronally sectioned at 1700 µm on an EXAKT, and the acetabular components were cut to 2000 µm. A clip gage was placed at the collar to measure local displacement between the implant and bone. Both tests resulted in micromotion displacement measurements as well as construct stiffnesses calculated from the load displacement curves. All data was analyzed using a two-way ANOVA, with a Tukey post-hoc test for multiple comparisons. A value of p<0.05 was considered to be significant.

Results Clinically, all 25 dogs reacted well to their bilateral hip arthroplasty. Mechanical tests revealed little statistical differences with respect to time or cement type. However, at one year post-op, the implants fixed with CAP had statistically more clip gage displacement when loaded in compression compared to the one and three month groups. Although there was no significant difference with respect to time or cement when considering micromotion at any one LVDT location, local displacements were much greater in the proximal stem than seen distally. Torsional tests revealed a trend that after one month, the CAP implants had a greater torsional stiffness than that of the implants fixed with PMMA.

Discussion The canine total hip arthroplasty model was valuable in the evaluation of cements used for implant fixation. Mechanical test results indicated that a hydroxyapatite composite cement could provide comparable stability to that of PMMA over a two year follow-up. Histologically, fibrous tissue is often seen along the bone/cement interface of the specimens fixed with PMMA, whereas good bony apposition is often seen along the CAP surfaces. Ultimately, the greater apposition along the hydroxyapatite composite may provide a more clinically stable implant.

Acknowledgments Supplies and funding for this project were provided by Zimmer, Inc. CAP was provided by Kuraray, Inc. The authors wish to thank S. Bukrey, R. Hori, D. Kayner, T. Nakashima, B. Nolan, P. Patil, M. Stock, K. Sweet, R. Taylor, and S. Tejwani for their assistance.