**INTRODUCTION:**
The treatment of large diaphyseal defects remains a formidable clinical challenge. A critical-size defect, which has been defined as one which will not heal without augmentation is typically of length about 2.5-3 times the external diameter of the intact bone. [1] Cylindrical meshed titanium cages filled with bone graft have been successfully used in the spine to replace and/or fuse vertebral bodies. This technique has been used clinically to address critical-size segmental long bone diaphyseal defects.[2] The healing potential of this construct has yet to be accurately determined.

**OBJECTIVES:**
To perform a biomechanical analysis of segmental diaphyseal defect healing in the canine femur treated with a meshed titanium cage in combination with canine cancellous allograft and stabilized with an intramedullary nail.

**MATERIAL & METHODS:**
Twenty-one dogs (hounds, age 2-3 years, weight 22-26 kg) were used in the experiments. Experiment guidelines and animal care were approved by the Institutional Review Board. Under general anesthesia a 3 cm osteoperiosteal critical-size segmental defect was created in the mid-diaphysis of the canine femur using an oscillating saw. In eighteen experimental dogs cylindrical meshed titanium cage packed with allograft was implanted. A cage (DePuy Acromed, J&J) with a diameter of 20 mm and a length of 40 mm was packed with an allograft composite consisting of fresh-frozen canine cancellous croutons (Veterinary Transplant Services, Seattle, WA) mixed with canine demineralized bone matrix (Dynagraft®, GenSci, DePuy J&J). The femoral canal was reamed with the cage in place and an intramedullary statically-locked nail was inserted. The dogs were divided into three equal groups of 6 dogs each, and followed for 6, 12, and 18 weeks post surgery. The experimental dogs were compared with a control group consisting of 3 dogs with the same critical-size defect packed with the allograft composite without a cage. All specimens were assessed with biplanar radiography post mortem. For biomechanical assessment, the specimens were placed in an MTS 858 MiniBionix test system (MTS Systems Corp., Eden Prairie, MN) and subjected to axial torsion to failure at a rate of 20 deg/min. An axial load of 10 N was maintained throughout the test.

**RESULTS:**
Radiographs demonstrated that all of the control specimens (bone graft without cage) developed a nonunion, with distal interlocking screw breakage. The results of the biomechanical torsion testing for all experimental groups with the cage are depicted in Figs. 1 and 2. The mean torsional stiffness was 44.4, 45.7 and 72.5 % of the intact contralateral side at 6, 12 and 18 weeks respectively. The mean torsional strength was 50.1; 73.6, and 83.5 % of the intact contralateral side at 6, 12, and 18 weeks, respectively. The construct typically failed at the junction of the cage and proximal femur. None of the experimental animals experienced distal interlocking screw failure.

**DISCUSSION:**
In this study, a critical-size femoral defect did not heal with a standard volume of a composite of cancellous allograft and demineralized bone matrix in combination with a statically-locked IM nail. The inclusion of a cylindrical titanium mesh cage demonstrated increasing restoration of defect biomechanics at 6, 12, and 18 weeks. The cylindrical titanium mesh cage appears to be a useful adjunct in the reconstruction of a critical size bone defect.

**REFERENCES:**

**University of Miami; Miami, FL**