Evaluation of a Critical Sized Bone Defect in a Porcine Tibial Model

Anthony J. Milto[1], Alexander W. Peters[1], Aamir Tucker[1], Alex Brinker[1], Michael Savaglio[1], Gremah Adam[1], Venkateswaran Ganesh[1], Zachary Gunderson[1], Paul Childress[1], Roman M. Natoli[1], Todd O. McKinley[1], Melissa A. Kacena[1],
[1]Department of Orthopaedic Surgery, Indiana University School of Medicine, Indianapolis, IN, USA

Background/Hypothesis:
Few large animal bone injury models exist. We present a porcine tibial model of metacritical and critical sized bone defects for the simulation of traumatic bone injuries.

Project Methods:
16 pigs were used in this study. The pigs were divided into 3 groups (n=4-8/group). In 12 pigs, a 25 mm osteotomy was created in the tibia and the space was filled with a 25 mm scaffold. 8 of the 25 mm scaffolds were secured with an intramedullary (IM) nail and 4 of the scaffolds were secured with plates. In 4 pigs a 40 mm osteotomy was created, filled with a 40 mm scaffold, and secured with plates. Fracture healing was assessed 3 months post-operatively using the Radiographic Union Score for Tibial Fractures (RUST) criteria.

Results:
For the 25 mm IM group, none of the 8 pigs achieved cortical bone union at 3 months post-op. In contrast, cortical union was observed in all of the 25 mm defects secured with plates. None of the 40 mm defects secured with plates achieved cortical union.

Conclusion/Potential Impact:
The failure of the 25 mm defect secured with an IM nail and the 40 mm defect secured with plates demonstrates that these are critical sized defect models. However, because the 25 mm defect secured with bridge plates did heal, we have termed this a metacritical sized defect. Identification of a defect size that can heal or not heal based on the fixation technique is a powerful translational model for testing therapies.