Development of a Novel Small Animal Ankle Arthrodesis Model

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Introduction/Purpose: Ankle arthrodesis is performed for a variety of ankle joint pathology with the most common being post traumatic arthritis. It is estimated that there are nearly twenty-five thousand ankle fusions performed annually in the United States. Reported complication rates vary between studies and patient population characteristics and comorbidities. Our understanding of the biology of ankle arthrodesis is based largely upon spine fusion and long bone animal models. However, bony healing and infection is greatly influenced by local soft tissue and vascular anatomy, therefore the application of data from these models may not be entirely accurate. There is currently no small animal ankle fusion model. Accordingly, the purpose of this study is to develop a reliable small animal ankle arthrodesis model.

Methods: A total of twenty Lewis rats were included in this study. Ankle arthrodesis was performed on one extremity of fourteen rats with the other ankle serving as an internal control. An anterior approach was used to expose the tibiotalar joint. Careful technique was utilized to protect neurovascular structures. After adequate joint exposure, a power burr and sharp curette was used to remove joint cartilage. A .042 kirschner wire was then passed through the calcaneus and through the subtalar and tibiotalar joint. Six rats served as controls and their procedures did not involve any joint cartilage removal. Radiographs were taken immediately postoperatively and at 8 weeks. Bony healing was assessed in a blinded fashion by a board certified foot and ankle orthopaedic surgeon using a grading system based upon assessment of cortical bridging and joint space.

Results: Sixteen rats – eleven fusions and five controls - underwent the procedure without any perioperative complications and were included in analysis. Four rats were excluded due to a perioperative complication and/or death. The most common postoperative complication encountered was a wound complication (n=3). Of the eleven rats in the fusion group, six (55%) were determined to be fused radiographically. Two of the five controls were radiographically fused (40%).
Conclusion: This study demonstrates preliminary data from a novel small animal ankle arthrodesis model. Fifty-five percent of the rats in the fusion group fused based on radiographic evaluation at eight weeks postoperatively. Further work involves improving upon the surgical technique for fusion in this small animal model to help increase fusion rates, and using CT scans and biomechanical testing to further assess fusion. The development of a small animal ankle fusion model will enhance our understanding of the biology of ankle arthrodesis and allow for development of novel therapies aimed at increasing fusion rates and decreasing complications.

Figure 1 - A) Immediate post-op imaging of a Lewis Rat that underwent tibiotalar arthrodesis B) 8 weeks post-op imaging of the same Lewis Rat with the pin removed