Title: A Biomechanical Comparison of Micromotion After Ankle Fusion Using Two Fixation Techniques: IM Nail or Circular Fixation

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Intramedullary nailing and Ilizarov external fixation are percutaneous techniques that offer rigid fixation for complex ankle arthrodesis. We compared the motion allowed at the fusion site by these two methods of fixation in a cadaver model. Our hypothesis was that the Ilizarov external frame would provide superior resistance to rotation and bending forces when compared with an IM nail.

8 pairs of human cadaver lower legs were prepared preserving the foot. DEXA scanning of the calcaneus was preformed. The soft tissues were stripped retaining foot ligaments to simulate more normal forces acting at the fusion site. Either a Biomet Arthrodesis Nail or Ilizarov Taylor Spatial Frame was used to stabilize the arthrodesis site. Specimens were potted in resin and tested in the MTS machine. Resistance to axial and torsional loads was tested to determine the stiffness of the two constructs. In order to record motion at the fusion site only, a three-camera Qualisys motion capture system was utilized. Optical data recorded three-dimensional displacements and rotations of the distal tibia relative to the talus for all tests. Relative motion was correlated with specimen bone density.

No significant difference was found between the axial displacements for the IM nail group (0.15+/-0.12mm) and the external fixation group (0.17+/-0.1mm). No significant difference (p=0.07) was found between the relative rotation for the IM nail group (0.91+/-0.71degrees) and the external fixation group (-0.31+/-0.33degrees). There was no correlation between the bone mineral density and the amount of displacement or rotation recorded.

Both the IM nail and the Ilizarov external fixator were found to provide superior stiffness to axial and torsional loads allowing minimal movement at the arthrodesis site. The motion capture system provided specific information about the motion occurring at the fusion site allowing for the retention of the foot which better simulates physiologic loading. For complex ankle arthrodesis either Biomet intramedullary fixation or Ilizarov fixation will provide excellent stability throughout a range of bone mineral densities. The decision of which implant to use should rely on other factors such as the presence of osteomyelitis or the need to violate the subtalar joint. Qualisys motion capture system is an excellent method to evaluate motion at any bony interface.
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