INTRODUCTION:
Supination external rotation (SER) ankle fractures are common and account for 45-75% of all ankle fractures. When significantly displaced or associated with any talar displacement, they require fixation. The most widely accepted method involves a 3.5mm interfragmentary lag screw augmented with a one-third tubular neutralization plate. In other long bone fractures, such as the proximal humerus, locked plating has been shown to be advantageous. This is specifically true in osteoporotic bone and when comminution is present. Previous authors have evaluated locked constructs in the distal fibula demonstrating equivocal biomechanical stability.[1][2] Previous work has been performed using 3.5 mm locked plates with limited fixation distally. A combination locked plate with 2.7mm distal screws has recently been introduced providing more fixation options. However, no biomechanical studies have been performed on this construct. We hypothesized that this construct would provide a statistically significant improvement in construct stiffness and peak load at failure when compared to conventional plating techniques.

METHODS
Twenty Osteoporotic Sawbones were acquired from Pacific Research Laboratories (Vashon, WA). An alignment jig was created to allowing an osteotomy to be made in each sawbone consistent with the oblique fracture seen in SER injuries. This was standardized to simulate an AOROTA 44-B2 fracture, translating from anterior inferior to posterior superior at an angle of 60 degrees and initiated anteriorly 2cm from the tip of the fibula. Following the creation of the fracture, each specimen was reduced and fixed with one 3.5mm diameter interfragmentary lag screw in standard fashion. In the first group, 10 samples were treated with a one third tubular neutralization plate with three proximal and three distal 3.5mm screws (Synthes Inc, Westchester, PA). In the second group, a lateral locking plate (Synthes Inc) was placed with three 3.5mm locking cortical screws proximally and three 2.7mm locking cortical screws distally. Following instrumentation, all samples were tested in axial external rotation to failure at a constant displacement rate of 10° per minute on an electromagnetic test frame (MTS Corp, Eden Prairie, MN). [3] Torsion and rotation were acquired digitally at 50 Hz. Stiffness, displacement at failure and peak torque was calculated for each group. A paired t test was used to determine statistical significance between groups. Statistical significance was set to p < 0.05 a priori.

RESULTS:
Mean peak torque (±1 SD) born by the samples instrumented with the 1/3 tubular plate was 679 ± 62.2 N*mm compared to 635 ± 106 N*mm in the locked plate treatment group (p = 0.345, Table I). There were no statistically significant differences in construct stiffness between the 1/3 tubular plate or the locking plate: 25.6 ± 4.58 N*mm / ° and 28.8 ± 5.40 N*mm / ° respectively (p = 0.161, Table 2). The mean displacement at failure was 82.7 ± 18.4° in the 1/3 tubular plate group and 96.2 ± 29.5° in the locked plate group (p = 0.342).

Table I: Summary of mean peak failure torque (±1 SD)

CONCLUSIONS
Our investigation failed to demonstrate a difference between standard screw and plate construct and locked plating construct in an osteoporotic sawbone model. There are several limitations to our study. The number of specimens tested may not have been enough to detect a difference between both groups. Further, we only tested these samples in torsion to failure and did not analyze fatigue as this may be a more common method of construct failure. Lastly, our model did not include comminution as a variable, which may be a situation in which locked plating may be more advantageous. However, this work does add to the current understanding of fixation about the fibula. Locked plating with smaller screws does provide for more options for hardware placement in the distal fibula which is required in sometimes complex situations, but in this study locked plates were not biomechanically superior to standard plate techniques.

SIGNIFICANCE
This work provides the surgeon with an increased biomechanical understanding of fibula fracture fixation. This locked plate construct demonstrates no biomechanical advantage over standard lag screw and neutralization plate construct in an osteoporotic sawbone model.

REFERENCES

Figure 1: Test setup for mechanical testing

A Biomechanical Evaluation of Locking versus Conventional Fibula Plating for Supination External Rotation Fibula Fractures.

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