Introduction

Proximal Junctional Kyphosis (PJK) is the failure of the proximal portion of a fusion construct leading to a kyphotic deformity. The etiology of PJK represents an interplay between several factors including age, bone quality, and over-correction of an existing deformity. Various solutions have been posited to prevent this problem, including cement augmentation, flexible fixation, and multilevel stabilization screws (MLSS).

The use of MLSS has shown promise in both a retrospective review and a finite element analysis testing the strength of a tri-cortical screw. The aim of our study is to validate the efficacy and determine the biomechanical properties of a new instrumentation construct using a normal pedicle screw at the Upper Instrumented Vertebra (UIV) along with tri-cortical screws at the two levels below which travel from the inferior aspect of the pedicle below in a superior-medial direction capturing the vertebral body above (Figure 1).

Materials and Methods

Two human cadaveric spines (T10-T12) were matched for bone density. One spine, which served as a control was instrumented from T10-T12 with a traditional pedicle screw/rod construct (Figure 1). The second spine was instrumented with the tri-cortical construct, as described above. The specimens were then mounted to a lever-arm which performed cyclic loading from -5 Nm extension to +5 Nm flexion at 0.5 Hz for 1,000 cycles (Figures 2 & 3).

Results

Biomechanical testing demonstrated that the stiffness of the tri-cortical screws was 92.07 N/mm while the traditional pedicle screw construct demonstrated a stiffness of 75.561 N/mm.

Conclusions

A novel instrumentation construct using tri-cortical screws at the two levels below the UIV shows promise in mitigating the occurrence of PJK. Specifically, early biomechanical testing demonstrates that this tricortical screw construct has less stiffness than a traditional pedicle screw construct. This suggests that this construct may more closely mimic physiologic motion, thereby decreasing incidence of PJK.