BIOMECHANICAL DIFFERENCES BETWEEN AUTOGRRAFT VS. DEMINERALIZED ALLOGRAFT FOR “SCOLIOSIS” FUSIONS IN A CAPRINE MODEL.

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INTRODUCTION
Anterior instrumentation is being developed and used to correct scoliosis. Minimally invasive endoscopic techniques have addressed problems such as lung and muscle impairment often seen with open surgeries of the thoracic spine. Clinical follow-up has shown that effective fusions are now possible in a thoracoscopic approach using autograft material. However, donor site morbidity from autogenous iliac crest bone has promoted the use of alternative fusion materials. It is unclear whether allograft material generates effective fusions thoracoscopically when compared to fusions created using autograft.

PURPOSE
To assess spinal range of motion and fusion quality after thoracoscopic multilevel anterior scoliosis-type spinal instrumentation using iliac crest autograft (ICBG) vs demineralized allograft bone gel.

METHODS
Three groups of six goats each underwent thoracoscopic anterior discectomies from T5 to T8 and subsequent four-level anterior segmental instrumentation using 4mm instrumentation (MOSS-Miami, DePuy, Inc) (Figure 1).

The first group had autogenous ICBG; the second had demineralized caprine allograft gel; the third had no graft material and served as a control group. After a 16 week recovery period, the spines were harvested and instrumentation removed. Sagittal and coronal computed tomography (CT) images were evaluated for radiographic evidence of fusion (Figure 2). The same surgeon, who was unaware of the graft material used, evaluated the images on two separate occasions. During each evaluation, a score of ‘n’ received zero points, a score of ‘p’ one point and score of ‘f’ two points. These were then added across both evaluations with means taken within groups. Separately, the number of partial and total fusions recorded were summed and divided by the number of potential fusions. Biomechanical testing was performed through ± 2Nm of torsional load at 0.02Hz using an MTS 858 bi-axial testing machine (Eden Prairie, MN). Five cycles each of positive and negative torsion were applied with the first three
cycles serving as pre-load and the final two cycles serving as the data set. Axial force was held constant at 0 Newtons. Displacement (mm), force (N), angle (deg) and torque (Nm) were sampled at 10Hz for the duration of the test. Analysis of variance was used to compare range of motion between groups (p<0.05) and a Bonferroni correction (p<0.0167) for multiple comparisons was used.

RESULTS AND DISCUSSION
Only the ICBG group had CT evidence of full fusion. The overall percentage of both partial and complete fusion was significantly higher with ICBG (94%) than with either allograft (25%) or no graft (22%) (p<0.0001). The overall fusion rating score was also significantly higher (8.5) than either the gel (1.5) or no graft (1.5) groups (p<0.0001).

Biomechanical testing in torsion between +/- 2Nm showed that the ICBG group had the least range of motion (22.6º±8.0º) (p<0.0167) than the allograft group (36.1º±9.7º) and no bone graft group (43.5º±9.3º), which were statistically comparable (p>0.0167) (Figure 4).

Multilevel thoracoscopic scoliosis-type anterior instrumentation and fusion was technically possible in a caprine model. Demineralized allograft gel, as a sole source of bone graft, does not appear to provide early solid anterior spinal fusion after thoracoscopic discectomy and instrumentation. Autograft material alone provided greater stability in torsion at physiologic loads and was the only material that presented CT evidence of complete fusion. The morbidity associated with iliac crest bone graft harvesting cannot be outweighed for allograft usage at this time since the current evaluation demonstrates lack of early fusion and structural stability. However, explorations into alternative graft materials should be completed. The development for spinal correction without arthrodesis should also considered.

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