INTRODUCTION
The intervertebral discs, facet joints, and spinal ligaments act together to provide stability and flexibility to the lumbar spine. Disruption of these spinal components may result in an unstable condition, even under normal physiologic loads. Measuring the kinematic response following stepwise anatomical reduction can provide valuable information about contribution of specific anatomical structures [1]. Furthermore, such data can provide useful input for calibration of specimen-specific finite element (FE) model [2-3]. The objectives of the current study were:
1. To quantify the contribution of isolated ligaments, facet joints, and intervertebral discs to kinematic response of the entire L1-S1 construct.
2. To provide input for the calibration of an L1-S1 FE model.

METHODS
One cadaveric lumbar (L1-S1) spine (53/Male) was radiographed to ensure the absence of fractures, deformities and any metastatic disease. The spine was dissected by carefully denuding the paravertebral musculature avoiding disruption of spinal ligaments, facet joints and disks. The intact specimen was then mounted and tested on a 6 degree of freedom spine simulator with L1 fixed proximally and Sacrum distally [Figure 1A]. After intact testing (Construct 1), the spine was tested for six different surgical constructs (Construct 2-7) with stepwise transection of SSL, ISL, FL, FC (bilateral facetectomy), PLL, and ALL, following the sequence in Figure 1B. Unconstrained pure moments of 10 Nm were applied on the intact spine at 1 degree/sec in Flexion-Extension (FE), Lateral Bending (LB), and Axial Rotation (AR) loading modes. Following the intact testing, displacement control was used on the subsequent surgical constructs to achieve the same range of motion (ROM) as the intact spine. Displacement control protocol was adopted to avoid breaking the spine and to achieve similar tissue deformations in the soft tissue [4,5]. A total of three load/unload cycles were performed for each mode with data analysis based on the final cycle. ROM was measured using Optotrak Certus motion analysis system (NDI, Inc. Waterloo, Canada) with markers at L1, L2 L3, L4, L5 and S1 levels.

RESULTS:
The moments (N*m) applied to achieve the same rotation in the constructs were found to decrease with more components transected (Table 1). In the disc-only construct (with facet joints and all the ligaments removed), the moment decreased by 68% in FE, 39% in LB, and 86% in AR compared to the corresponding intact state. The percentage was then calculated and attributed to that component (for example, the contribution of SSL was calculated as ((moment@Construct 1)–(moment@Construct 2) x 100%). Figure 2 indicates the estimated contributions from those isolated components to the intact construct. For FE, facet joints and disc each share about 30% of the bending moment, while disc alone contributes 60% in LB and facet joint contributes about 65% in AR.

<table>
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<th>Construct</th>
<th>Moments in Flexion</th>
<th>Moments in Extension</th>
<th>Moments in LB</th>
<th>Moments in AR</th>
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REFERENCES

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