INTRODUCTION
Fitting a thoracolumbosacral orthosis (TLSO) for patients after trauma or surgery requires a great deal of effort and expertise by an experienced orthotist. The current method of fabricating a custom TLSO begins with casting the torso of the patient which is often done while the patient is lying in a trauma unit. Obtaining a cast in this manner is challenging for the orthotist to maintain spinal stability while moving the patient into supine and prone positions and also increases the risk of patient injury and discomfort. In this study, we used a less invasive computed tomography (CT) scans of a patient’s torso, to create a custom TLSO. The aim of the study was to compare the anthropomorphic measurements using the three-dimensional (3D) reconstruction of a torso surface model from CT scan to the traditional hand molding method for fabrication of TLSO.

METHOD
Subjects: Twenty eight male subjects with pre-existing CT scans were evaluated in whom conventional TLSO fitting was performed. University of Michigan institutional review board approval was obtained before initiating the study.

Procedure: Patients received CT scans on a 64 slice multi-detector CT scanner utilizing “Trauma Chest Abdomen Pelvis” protocol. Images were acquired 1.25 mm x 1.25mm from the lung apices to the lung bases and 5mm x 5mm through the symphysis pubis with a Display Field of View optimized to the patient body habitus. Retrospective reconstructions of 1.25mm x 1.25mm for the entire data set with the Display Field of View set to include all skin surfaces. A 3D volume rendered image in STL format is then created demonstrating the entire scanned volume including skin surfaces. Image was then exported to TracerCAD® system (OWW, Ohio). The conventional TLSO plaster model of subjects torso was digitized utilizing Provel Digitizer (Provel Inc, Washington USA) and a 3D model was created with TracerCAD® system. Virtual Comparison: Circumference, anterior-posterior (A-P), medial-lateral (M-L) at 0, 10, 20, 30 and 40cm (0 being cranial, 40 caudal). Intervals are virtually measured and compared for the two models generated for each subject.

Data analysis: Pearson correlations were first used to assess the relationship between the CT and conventional TLSO. Five exactly corresponding reference marks from 0-40 cm were used to compare circumference, A-P, and M-L measurements in both methods.

RESULTS
Twenty eight male subjects mean age 53.31 and mean body mass index (BMI) 27.91 kg/m² were evaluated. In general, correlations were high with an average correlation .72 however; there was some variability (.43-.93). The circumference measurement was the most highly correlated between the two methods (.71 - .93). Correlations were lowest for the 40 cm measurement.

DISCUSSION AND CONCLUSION
We found that 3D model measurements from CT scan and from plaster models were strongly related overall although this varied by measurement level and site. Data corresponding to 0, 10, 20 and 30 were significantly higher than the level at 40. This can be probably explained by the different technology used in both methods and soft tissue compression at caudal level. This study provides preliminary support for the use of the CT method given its relation to conventional method. Future studies will be needed to evaluate the comfort and fit of a TLSO fabricated from CT scan method measurement vs. traditional hand molding method.

REFERENCES