INTRODUCTION

Scoliosis is the most common pediatric spinal disorder, characterized by a complex three-dimensional deformity, and the threat of severe secondary complications. Early diagnosis and treatment is essential in selected patients. Bracing is the only non-surgical measure proven to have any effect on halting the progression of scoliosis but little information is available to determine optimal brace design. A method for predicting maximum deformity correction to measure brace effectiveness would represent a significant advancement in conservative spine deformity treatment. Recently, the ENSAM Biomechanics Laboratory has developed a spine and trunk finite element model (FEM) using stereoradiography which will be used for patient-specific brace design. The purpose of this in vitro study was to assess the effectiveness of our cadaveric scoliosis bracing model.

METHODS

Five human torso specimens (1 male, 4 female), from vertebrae C7 to L4, were harvested and removed of non-ligamentous soft tissues. The intercostal muscles were left intact on the rib cages. C7 and L4 were mounted and fixed to the loading device with polymethylmethacrylate (PMMA) orthodontic resin. An in vitro model of scoliosis bracing was simulated with static load horizontally applied via a pad (77 mm diameter) to the fresh trunks, positioned in a custom-designed apparatus (Figure 1). A transducer was positioned between the pad and the force applicator in order to measure the load applied to the rib cage. Biplanar (i.e frontal and lateral) radiographs were obtained while applying the loads at 2 different levels of the rib cage (over ribs 5, 6, and 7; and over ribs 7, 8, and 9) at 3 varying angles of incidence (α = 0, α = 35 deg) resulting in 6 conditions per specimen (Figure 2).

RESULTS AND DISCUSSION

After being calibrated, each set of radiographs was reconstructed with a previously-validated stereoradiographic method (Pomero et al. 2004, Laporte et al. 2004). A custom software package (Idex®) was used that was developed in collaboration between the Laboratoire de recherche en imagerie et orthopédie, (ETS - CRCHUM, Montréal, Canada) and the Laboratoire de biomécanique (CNRS ENSAM, Paris, France) (Figure 3). 3D reconstructions and measures of relative vertebral displacement between the loading conditions and neutral position were performed for future comparison with FEM predictions.

REFERENCES


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