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DISTRIBUTION OF FORCES DURING FULCRUM BENDING RADIOGRAPHS ON ADOLESCENT IDIOPATHIC SCOLIOSIS PATIENTS

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INTRODUCTION

At the Mater Children's Hospital, approximately 80% of patients presenting with Adolescent Idiopathic Scoliosis requiring corrective surgery receive a fulcrum bending radiograph. The fulcrum bending radiograph provides a measurement of spine flexibility and a better indication of achievable surgical correction than lateral-bending radiographs (Cheung and Luk, 1997; Hay et al 2008). The patient is laid sideways over a cylindrical, padded, radiolucent bolster that touches the rib corresponding to the apex of a thoracic curve. This positioning allows gravity to exert a passive, involuntary force to correct the spinal deformity against the fulcrum bolster with little or no muscle activation. However, the magnitude and distribution of the corrective force exerted by the bolster on the patient's body is unknown. The objective of this pilot study was to measure, for the first time, the forces transmitted to the patient's ribs through the bolster during the fulcrum bending radiograph.

METHODS

A 28 x 28 line Tactilus pressure mapping system (Sensor Products LLC, NJ, USA) measuring 170cm x 40cm was placed between the patient and the foam mattress/fulcrum bolster on the x-ray table. After patient positioning, the fulcrum bending radiograph was set up and recorded by the hospital radiographer, while the Tactilus software recorded pressure information between the patient and the bolster and x-ray table at 20 frames per second. After each test, the pressure data was exported to Excel for further analysis. The contact region of the pressure mat between the patient's ribcage and the bolster was identified by visual examination of the graphical pressure profile, and the total force concentrated in this region was calculated as a proportion of the patient's body weight.

RESULTS

Pressure mat readings during fulcrum bending radiographs were taken from an initial group of 4 patients. The mean peak pressure between the bolster and patients was 16.1kPa. The corrective force applied through the bolster (as a proportion of body weight) was 12.7% for patient 1, 13.0% for patient 2, 12.0% for patient 3, and 22.8% for patient 4, giving a mean bolster force of 16.4% of body weight for the patient group.

DISCUSSION

The distribution of transmitted forces during the fulcrum bending radiograph was clearly illustrated in the graphical output of the Tactilus pressure system. Three of the four patients in this initial group showed very similar corrective forces through the fulcrum (~12% of body weight) however the fourth patient exerted a much higher corrective force. A larger group of patient data is required for further trends to be identified, including whether spinal flexibility influences the percentage of force transmitted through the bolster.

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