Anthropometry and properties of the 6-year-old lumbar spine

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INTRODUCTION

Studies indicate that the spine of the Hybrid III 6-year-old anthropomorphic test device (ATD) may be too stiff, which results in unrealistic seat belt interactions, exaggerated forces in the neck, and improper head excursions in sled tests.

Little work has been done to quantify pediatric spine properties, especially in the lumbar region.

Additionally, the overall anthropometry of the 6-year-old ATD, which was developed several decades ago, may not be a good representation of today’s population of children.

AIMS / OBJECTIVES

The aims of this study are to quantify the overall anthropometry and lumbar spine properties in a modern, representative sample of children, with specific attention to the lumbar spine curvature while seated in a child restraint system (CRS).

PROJECT OBJECTIVES:

1. Collect basic anthropometric and lumbar spine range of motion data from volunteers ages 5 to 7 years old.
2. Digitize bony landmarks to define posture and spine curvature while seated in an age appropriate booster seat, with emphasis on the lumbar spine region.
3. Compare results to pediatric CT scans to develop a meaningful picture of the pediatric lumbar spine, including individual variation and internal vs. external geometry.

RESULTS

Body Mass Index (BMI) is an assessment used to determine relative body fatness. BMI can greatly alter body proportion measurements, especially when evaluating children in CRS. A BMI assessment of the volunteers was conducted:

- 14% = Underweight (N=4)
- 76% = Normal BMI (N=22)
- 3% = Overweight (N=1)
- 7% = Obese (N=2)

Seated lumbar spine angle was calculated for the non-obese volunteers (N=27) = 39.5° from vertical.

Means and standard deviations (SD) were calculated for all subjects on 18 different anthropometry measurements.

CONCLUSIONS

- ATD is more upright than the volunteers:
  - A larger lumbar spine angle, larger pelvic tilt resulted in smaller angle between the lumbar spine to pelvic angle.

- Obese and overweight subjects also sat more upright, likely because they had trouble “sinking” back into the seat because of subcutaneous tissue and wider shoulders.

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