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# Test-retest standard error of measurements for full-torso surface topography parameters obtained with the arms at 30 and 90 degrees of elevation in healthy teenagers

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## Introduction

The objective of this study was to report full-torso surface topography (ST) parameters and to determine test-retest standard error of measurement (SEM) in adolescents without spinal deformities. ST is used to quantify the external deformity of the torso due to scoliosis. A normative ST database is being developed to help interpret the ST parameters used to describe scoliosis. Test-retest SEM has not been estimated for most parameters in this population.

## Materials and methods

### Subjects

Forty-two healthy volunteers (43% females) between 10-18 years old, with a body mass index of  $19.7 \pm 3.1$  kg/m<sup>2</sup>, scoliometer measure of  $3.2^\circ \pm 1.8^\circ$ , and without pain were included.

### Data acquisition

Four Minolta 910 Laser Scanners and a positioning frame were used to record ST scans. One evaluator positioned all subjects with arms resting at 90° of elevation, marked 15 reference points, and scanned. Immediately after, subjects were repositioned and scanning repeated. ST parameters were extracted with custom designed software in Matlab by one evaluator digitizing reference points.

## ST parameters

Seven previously published parameters and 7 newly proposed measures were extracted. The total range and the range between the 10th and 90th percentile were reported for the measures extracted from 54 cross-sections of the torso.

## Statistical analyses

Test-retest SEM was calculated. SEM <4mm, <5° or <0.2 for a ratio were considered adequate based on values in patients with scoliosis.

## Results

Normative full-torso ST parameter means, standard deviations (SD), and the estimated test-retest SEMs are in Table 1. Fourteen parameters had adequate SEMs. Total range SEMs of the parameters extracted from cross-sections were inadequate for 5 out of the 6 measures. The SEMs for all but one new parameter were adequate.

## Discussion

Test-retest error was adequate for scans with the arms at 90° of elevation. For parameters obtained from torso cross-sections, the 10-90th percentile range may reduce errors compared to the total range. The percentile range excludes extreme values due to edge, motion or breathing artifacts on the scans while still providing a representation of torso deformity. Scanning with arms in this position provides an unobstructed view of the torso and may reduce error in merging.

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## Conclusion

Adequate test-retest error was found for previously published and newly proposed full-torso ST parameters. For measures of cross-sections, we recommend using the 10-90th percentile range.

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