

ORAL PRESENTATION

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# Evaluation of the reproducibility of the formetric 4D measurements for scoliosis

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## Introduction

Frequent assessment and monitoring of AIS patients is necessary to determine the progression of spinal deformity. Radiographs are used as the standard-of-care for evaluation, but have negative long-term effects. Surface topography is a safer option for assessment in these patients. The Formetric 4D (DIERS, International GmbH of Schlangenbad, Germany) provides fast and radiation-free images of the spine position using surface topography. The goal of this study was to measure the reproducibility of the Formetric 4D system in measuring trunk dimensions and scoliosis Cobb angles.

## Methods

Twelve young adult volunteer patients with the stature of a typical AIS patient were enrolled in the study. The volunteer patients had 30 repeated Formetric 4D measurements taken over a period of 1-2 hours on a single day. Two of the patients returned one month later to have the measurement process repeated a second time.

## Results

For each series of 30 measurements, a Standard Deviation was calculated for 12 of the most important parameters, including the Cobb angle measure. The Average Standard Deviation was then calculated by comparing the Standard Deviations from each trial. The following results were obtained (Table 1).

The two patients who were measured again one month later had measurements that were very similar. Angular measurements differed by less than one degree in all cases. Distance measurements differed by less than one millimeter in all cases but one.

**Table 1 Results of reproducibility measurements using Formetric 4D**

Parameter	Average Standard Deviation	Range
Trunk Length	6.4 mm	2.5 – 15.4
Trunk Imbalance	4.4 mm	2.7 – 6.7
Pelvic Tilt	2.0 degrees	1.2 – 4.8
Thoracic Kyphosis	3.1 degrees	1.8 – 4.4
Kyphosis Depth	6.0 mm	2.9 – 16.3
Lumbar Lordosis	2.3 degrees	1.4 – 4.4
Lordosis Depth	4.4 mm	3.0 – 6.9
Maximal Right Rotation	2.3 degrees	0.9 – 3.8
Maximal Left Rotation	1.3 degrees	0.7 – 2.2
Max Right Lateral Deviation	2.3 mm	1.0 – 4.3
Max Left Lateral Deviation	2.0 mm	0.9 – 3.9
Cobb Angle of Major Curve	3.2 degrees	1.2 – 6.2

## Discussion

Surface topography has obvious advantages to repeated radiographs in the adolescent population. If it can deliver reliable results, then it should replace radiographs in patients where curve surveillance is necessary and exposure to radiation can be avoided. This study of 12 different patients showed that repeated measurements using the Formetric 4D gave very reliable and reproducible measurements with standard deviations that are consistent with those found when taking standing radiographs.

## Conclusion

The Formetric 4D uses surface topography to measure trunk dimensions that are important in the evaluation of scoliosis. These measurements are very reproducible, with standard deviations of only a few degrees for angular measurements and only a few millimeters for

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distance measurements. The Cobb angle was calculated for each measurement on each patient and had an average standard deviation of +/- 3 degrees.

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