

A comparison of the reliability and vulnerability of 3D SterEOS and 2D EOS when measuring the sagittal spinal alignment of patients with Adolescent Idiopathic Scoliosis

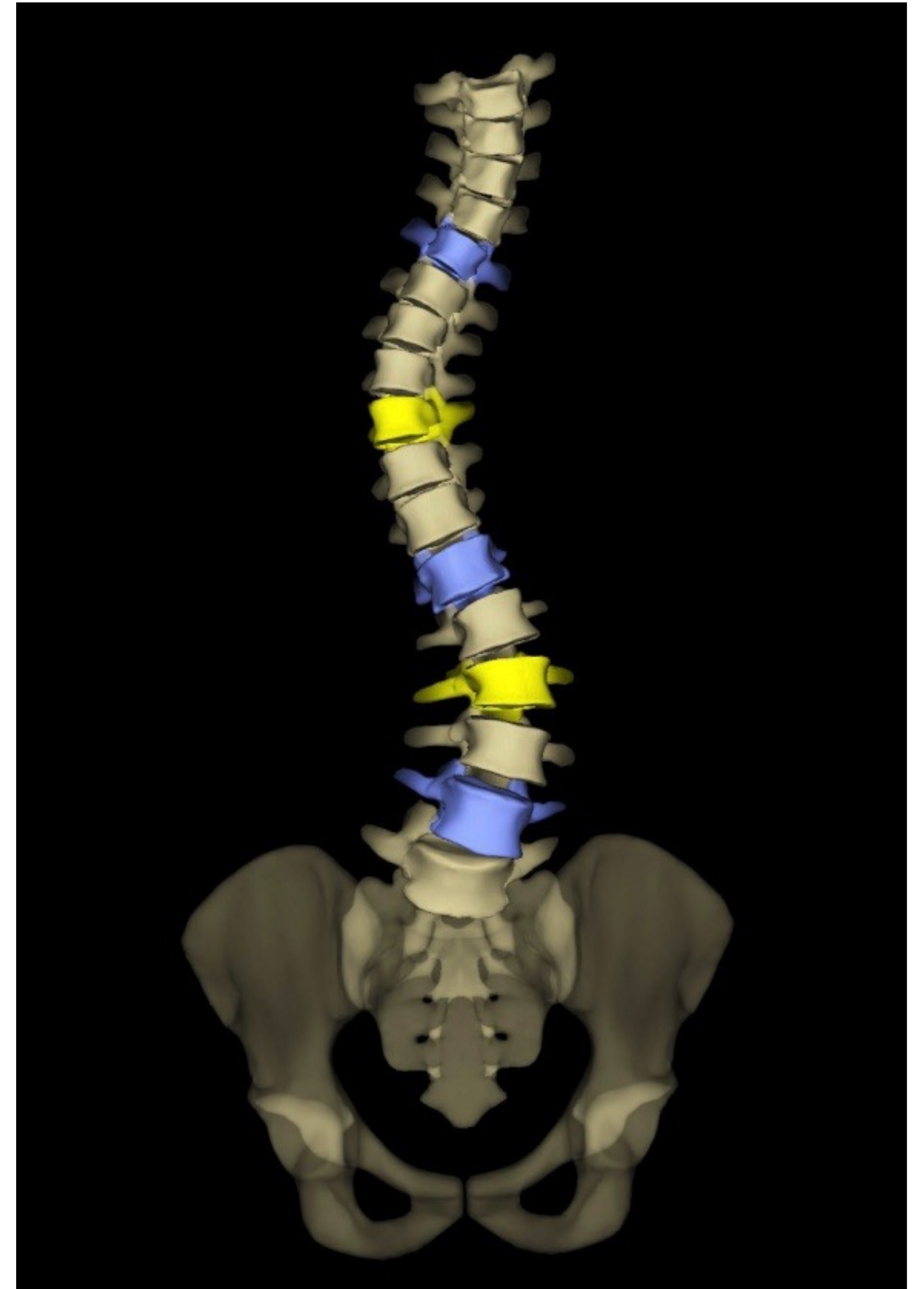
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Background

- Adolescent idiopathic scoliosis affects 3% of the population
- Key to diagnosis and treatment is understanding the exact shape of the deformity
- 2D standing EOS radiographs underappreciate the interaction between sagittal and coronal deformities.
- 3D imaging may more accurately represent the shape of the spine
- The concordance between the sagittal measurements made in 2D and 3D imaging is undefined. This is an important first step in establishing the utility of each technique.



Methods

- Retrospective case series analysis of 2D EOS and 3D SterEOS images of patients diagnosed with AIS acquired by a single surgeon between 2009 and 2017
- Each 2D EOS radiograph assessed by an independent surgeon twice at a 3 month interval
- 3D SterEOS images analysed with software
- Inter-study reliability assessed using Bland-Altman plots and intra-class correlation coefficients



Results

- 156 patients included, separated into in 3 categories dependent on maximal coronal deformity
- The inter-study reliability when measuring the TK and LL between the two study modalities was excellent in in mild group, excellent in TK and fair in LL in moderate group and fair in TK and LL in severe group respectively
- The intra-study reliability was poor in TK in severe group and LL in moderate and severe group

| | Mild deformity (45-69°) | Moderate deformity (70-89°) | Severe deformity (90°+) |
|----------------------|-------------------------|-----------------------------|-------------------------|
| N | 52 | 52 | 52 |
| Age (years) | 15.6±1.6 | 14.7±1.5 | 13.7±1.5 |
| Male: Female | 4:48 | 3:49 | 12:40 |
| Lenke classification | | | |
| 1 | 35 | 33 | 38 |
| 2 | 1 | 8 | 6 |
| 3 | 10 | 9 | 15 |
| 4 | 0 | 0 | 1 |
| 5 | 4 | 2 | 2 |
| 6 | 2 | 0 | 0 |

Table 1. The demographics of each group of patients

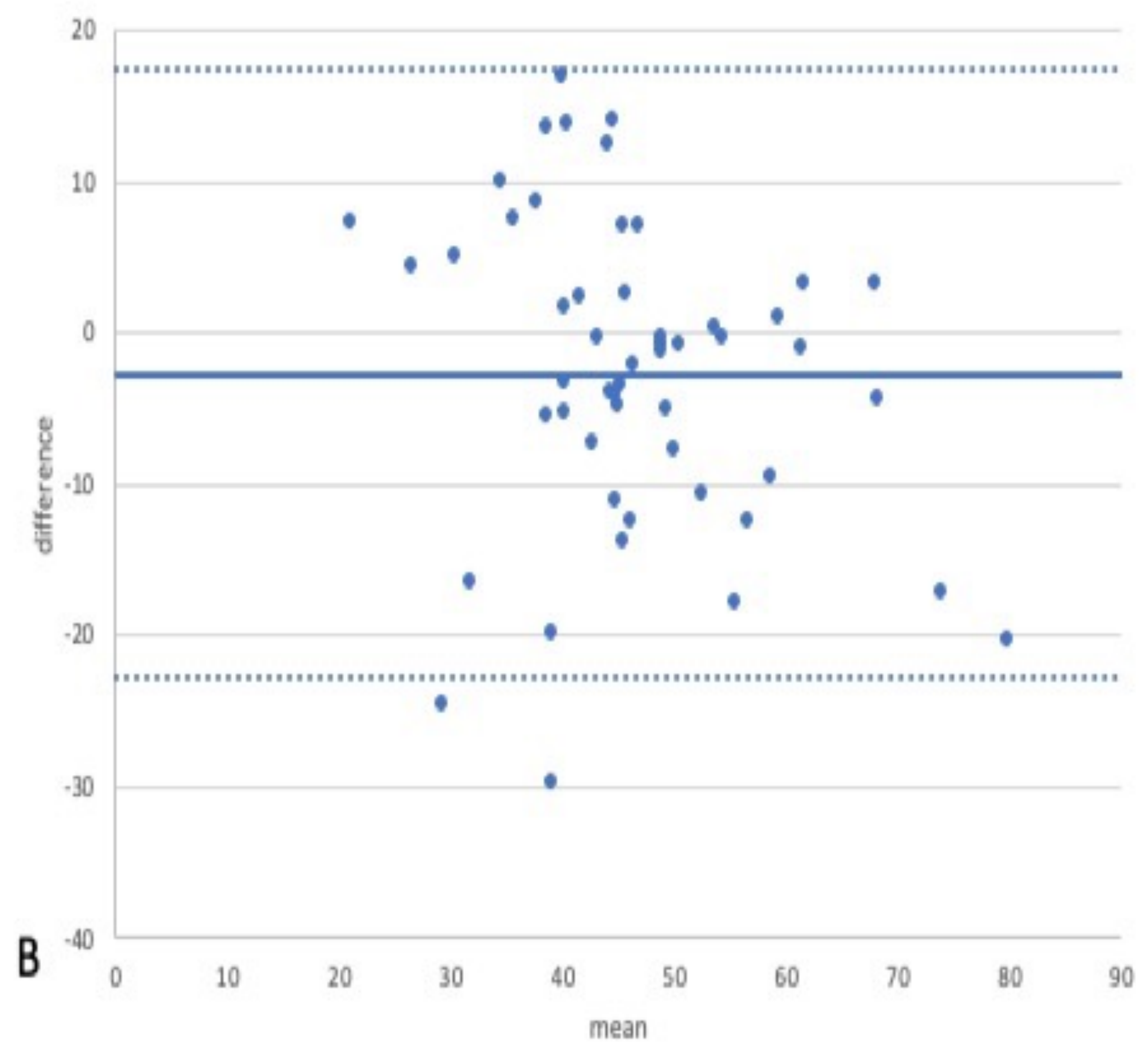
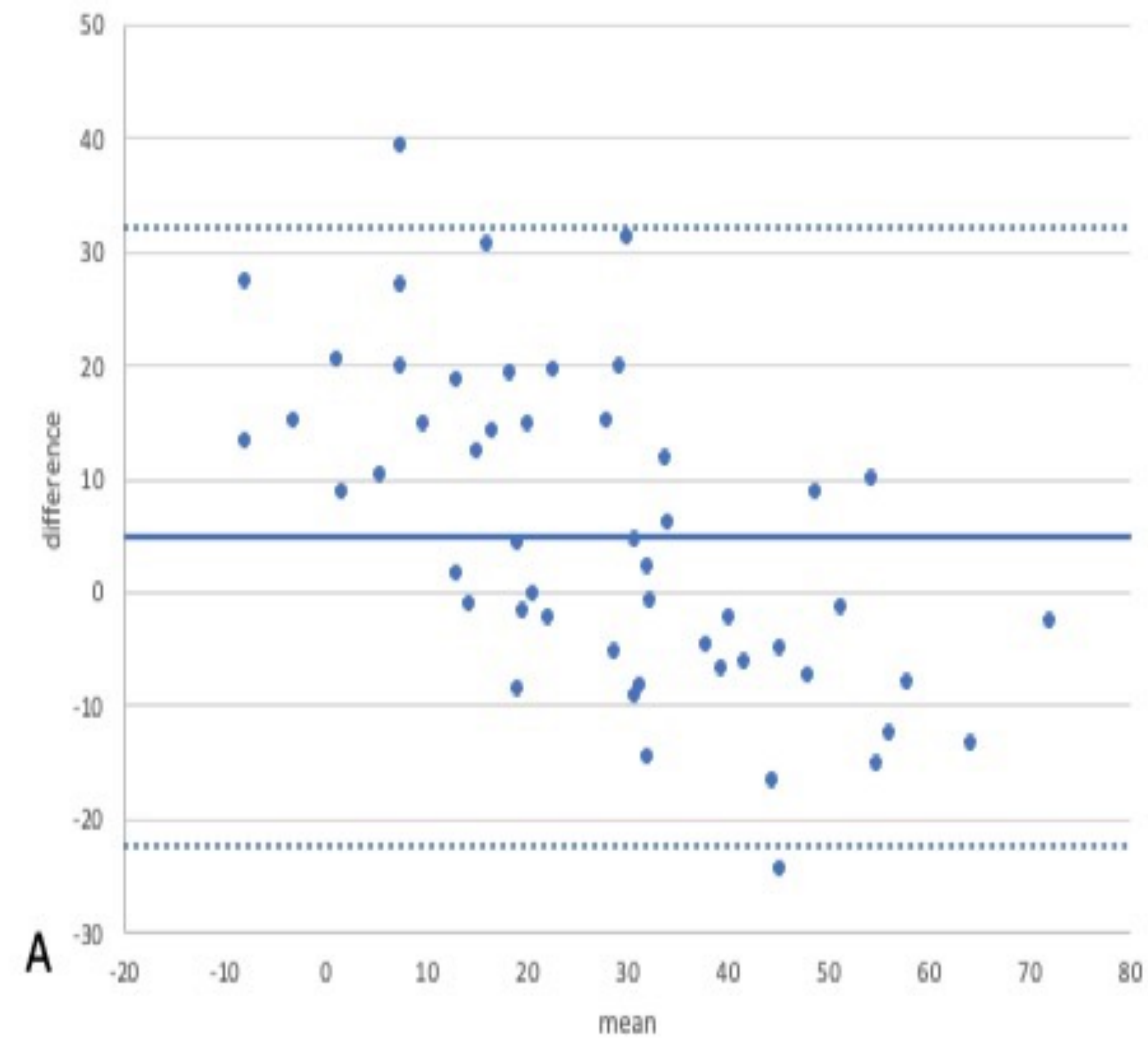
| Severity of deformity | Sagittal measurement | Manual 2D (°) (Mean±SD) | sterEOS 3D (°) (95% CI) | 95%CI difference | p value |
|-----------------------|----------------------|-------------------------|-------------------------|------------------|---------|
| Mild | TK (°) | 18.5±16.2 | 16.2±16.3 | -8.25~3.71 | 0.45 |
| | LL (°) | 48.3±11.7 | 50.0±10.2 | -2.54~6.08 | 0.42 |
| Moderate | TK (°) | 22.0±13.1 | 20.3±16.9 | -7.69~4.18 | 0.56 |
| | LL (°) | 46.6±8.8 | 48.5±11.3 | -2.01~5.94 | 0.33 |
| Severe | TK (°) | 30.4±15.2 | 25.4±23.6 | -12.75~2.84 | 0.21 |
| | LL (°) | 45.2±11.2 | 47.9±13.4 | -2.18~7.55 | 0.27 |

Table 2. Inter-rater reliability of curve measurements for all patients. ICC intraclass correlation coefficient; CI confidence interval.

Results

| Severity of deformity | Sagittal parameter | ICC | P value | 95%CI | |
|-----------------------|--------------------|-------|---------|-------|-------|
| | | | | Lower | Upper |
| Mild group | TK | 0.898 | <0.001 | 0.82 | 0.942 |
| | LL | 0.844 | <0.001 | 0.738 | 0.908 |
| Moderate group | TK | 0.758 | <0.001 | 0.614 | 0.853 |
| | LL | 0.697 | <0.001 | 0.526 | 0.814 |
| Severe group | TK | 0.735 | <0.001 | 0.566 | 0.842 |
| | LL | 0.648 | <0.001 | 0.458 | 0.781 |

Inter-rater reliability of curve measurements for all patients. ICC intraclass correlation coefficient; CI confidence interval.



The Bland-Altman plots for the Severe deformity group. (A) Within thoracic kyphosis, there is no additive bias, but there is proportional bias. (B) with lumbar lordosis, there are no additive or proportional bias.

Discussion

- There is no significant difference observed in the magnitude of spinal sagittal parameters when 2D or 3D EOS is used.
- Proportional bias increases with increasing coronal deformity exceeding 70°.
- 3D SterEOS is less vulnerable to the effects of severe coronal deformity when measuring sagittal spinal alignment.



Bottom Line

3D SterEOS is less vulnerable to the influence of coronal plane deformity than 2D EOS in evaluating the sagittal spinal parameters of AIS patients when coronal deformity exceeds 70°

Disclosures

None of the authors has any potential conflict of interest