by Scolioscan (E_Cobb 29.3 ± 11.8°, SPA 18.4 ± 8.5°), statistically significant correlation (r = 0.816, p < 0.001) was found between E_Cobb and SPA. Correlation were 0.629 for upper thoracic curves (UTC, defined as curves with apices at T6.5 or above); 0.873 for upper spinal curves (USC, apices between T7 to T12.5); and 0.740 for lower spinal curves (LSC, apices at L1 or below) (all with p < 0.001). Conversion formulae to predict E_Cobb from SPA were [predicted E_Cobb = P_Cobb = 7.39 + 1.26 x SPA] for USC and [P_Cobb = 10.08 + 0.96 x SPA] for LSC. For curves with E_Cobb below 30°, the absolute difference between P_Cobb and E_Cobb was ≤ 5° in 66.6% and 62.4% of USC and LSC; while P_Cobb underestimated E_Cobb by > 5° in 6.0% and 7.2% of USC and LSC. In addition, tall stature was associated with stronger correlation between E_Cobb and SPA. Similar degree of correlation was seen between males and females or between different quartiles of BMI.

Conclusions and significance

Scolioscan gives satisfactory accuracy of measurement for curves with (a) apices at T7 or lower, (b) E_Cobb < 30° and also for patients with taller stature. Ultrasound for quantitative assessment of spinal deformity in AIS can be considered in lieu of conventional radiographs, with results to be interpreted according to various degree of accuracy under different clinical conditions.

O25

A novel approach to sagittal profiling of adolescent idiopathic scoliosis using 3D ultrasound

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Introduction

Sagittal profile differences between normal and scoliotic spine are needed to be investigated at the early stage to determine the possibility of the development of vertebrae rotation [1]. Though radiographic Cobb is the gold standard for assessing spinal sagittal curvature, X-ray is radioactive. Non-ionizing three-dimensional (3D) ultrasound had been demonstrated to be feasible in evaluating vertebrae features and coronal curvatures of the spine [2, 3, 4]. Yet no study has reported the reliability and accuracy of 3D ultrasound on sagittal curvature analysis. In this study, the reliability and validity of 3D ultrasound on assessing spinal sagittal curvature of patients with scoliosis were investigated.

Methods

Twenty-one AIS patients, both males and females (Age: 15.7±1.3 years; Cobb's angle range 11.1 to 41.9°), underwent 3D ultrasound and EOS X-ray scanning of the spine. X-ray Cobb (XCA) was measured on sagittal X-ray image (Fig. 1a), while spinous processes and laminae of the vertebrae were identified from B-mode images. Sagittal images were then generated to measure the thoracic and lumbar ultrasound spinous process angle (USSPA) (Fig. 1b) and ultrasound laminae angle (USLA) respectively (Fig. 1c). The reliability (intraclass correlation coefficients (ICC) for the intra- and inter-observer variability) and validity (linear regression analysis and Bland-Altman method, with mean absolute difference (MAD)) were tested for two ultrasound angles as compared to the X-ray Cobb (XCA).

Results

The ICC showed very reliable measurements of both ultrasound methods (ICC≥0.941). Moderate and significant linear correlations were seen between the ultrasound methods and XCA (Thoracic (R^2≥0.574) / Lumbar (R^2≥0.635)) (Fig. 2) and the Bland-Altman plot showed a good agreement between both ultrasound angles and XCA (Fig. 3). The MADs of both ultrasound angles, corrected by the linear regression equations, and XCA showed no significant difference (MAD: USSPA 6.4±4.8°/6.1±4.4° and USLA 7.5±4.9°/5.3±4.2°; p≥0.326 for thoracic / lumbar respectively).

Conclusion

Good correlations were found between 3D ultrasound and Cobb angle, without differences in reliability and validity using spinous processes and laminae. Other than coronal deformity, sagittal deformity of spine of AIS patient can also be assessed by non-ionizing and relatively inexpensive ultrasound imaging.

Trial Registration

N/A

Consent to publish

Signed informed consents were obtained from all subjects and of the guardians of patients aged below 18 prior to the start of the study. All patients (or parents of the subjects for those under 18 years of age) provided informed consent

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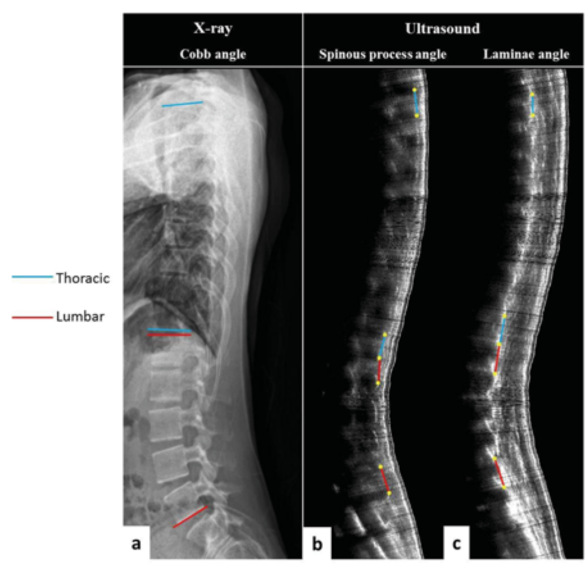

Fig. 1 (abstract O25). **a**) Measurement of X-ray Cobb's angle (XCA); **b**) Measurement of ultrasound spinous process angle (USSPA); **c**) Measurement of ultrasound laminae angle (USLA) (Thoracic and lumbar angles are defined by the angle between the blue and red lines respectively)

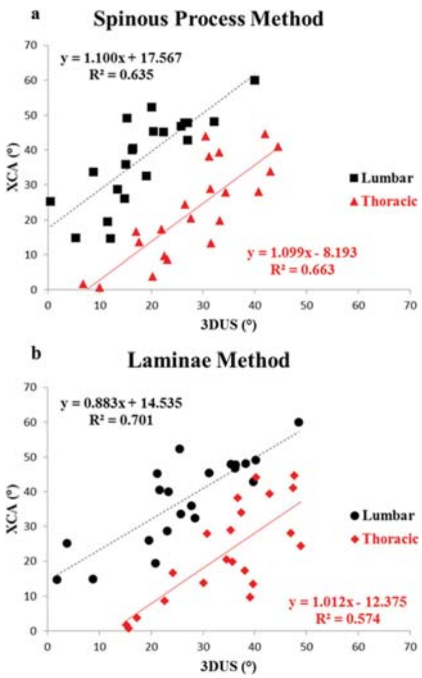

Fig. 2 (abstract O25). a) Correlations (**R^2**) and equations between the X-ray Cobb's angles (XCA) and the ultrasound spinous process angles (USSPA) for the thoracic and lumbar region; **b**) Correlations (**R^2**) and equations between the X-ray Cobb's angles (XCA) and the ultrasound laminae angles (USLA) for the thoracic and lumbar region

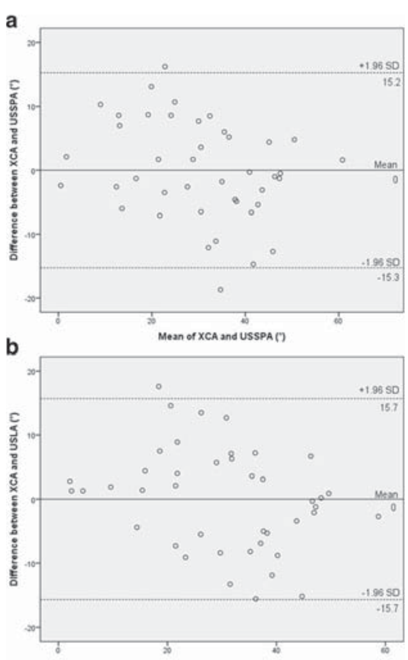

Fig. 3 (abstract O25). Bland-Altman plots that shows the differences between X-ray Cobb's angles (XCA) and the sagittal ultrasound angles corrected with the linear regression equations. **a** Ultrasound spinous process angle (USSPA) and **b** ultrasound laminae angle (USLA). SD: standard deviation

O26

Is cortical function associated with postural control altered in adolescents with idiopathic scoliosis?

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Introduction

Adolescent idiopathic scoliosis (AIS) is a multifactorial condition with unclear aetiology. Neurological impairments related to sensorimotor information processing have been suggested to play an important role in scoliosis mechanisms [1-3]. Previous studies have shown poorer postural performance and difficulty in reweighting sensory inputs following sensory deprivation in AIS group compared to age-matched controls [4,5]. Electroencephalography (EEG) has been used to document cortical activity associated with postural control. This study uses EEG frequency domain analysis to document cortical activity associated with postural control in adolescents with AIS compared to healthy control adolescents (CTRL).

Objective

To compare cortical activity associated with sensorimotor information processing related to postural control in open and closed-eyes conditions in adolescents with AIS and in CTRL.

Methods

Thirteen girls with a 15 to 45° AIS (13±1 years, 163±7 cm, 51±9 kg) and 14 age-matched CTRL girls (13±1 years, 158±11 cm, 50±9 kg) were recruited on two sites. EEG data was acquired using Electrical Geodesic systems. Participants stood in an upright standing posture with eyes open looking at an immobile fixation cross, approximately 2 m in front of the participant, for two minutes followed by two minutes with eyes closed. Fast Fourier Transformations (FFT) were performed to measure the power of the different frequency bands in both conditions. Cortical regions of interest (ROI) were central (electrodes C3, C4), frontal (F3, F4), parietal (P3, P4), temporal (T3, T4) and occipital (O1, O2). Significant differences were computed with $p<0.05$.

Results

During the "eyes closed" condition, differences between the AIS group and the CTRL group were found in beta and gamma frequency bands. The average power of beta signal was significantly larger in AIS group at the frontal, parietal, temporal and occipital ROI (Fig. 1). Also, the average power of gamma frequency was significantly larger in AIS group at the central, frontal, parietal and temporal ROI (Fig. 2).

Conclusions and significance

Our findings show enhanced beta and gamma frequency activity in adolescents with AIS compared to CTRL when holding a standing position while eyes closed, suggesting that more attention and vigilance are required in adolescents with AIS to maintain balance [6]. This may reflect less efficient cortical sensorimotor information processing associated with postural control in AIS. Future studies will assess if asymmetrical power within these ROI and frequency bands could be related to spine deformation progression.

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