Validation of Internal Parameters of Adolescent Idiopathic Scoliosis Evaluated using ScolioSIM Solution – Preliminary Results

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Validation of Internal Parameters of Adolescent Idiopathic Scoliosis Evaluated using ScolioSIM Solution - Preliminary Results

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1. Introduction

Non-ionizing investigation of Adolescent Idiopathic Scoliosis (AIS), which is one of the most prevalent spinal deformities in adolescents, remains insufficiently developed and tested. However, the ability to monitor AIS progression without ionizing methods would support decreasing the long-term risk of developing malignancies associated with the exposure to multiple X-ray imaging. New technologies in optical 3D digitalisation and artificial intelligence allow better precision in prediction of the internal spinal alignment, and thus extraction of reliable intrinsic parameters of AIS. Here, preliminary results in comparing the main clinical parameters generated with the ScolioSIM simulator from surface [1] with these evaluated by clinical experts from X-ray images in daily practise are presented.

2. Materials and Methods

In this study, the back surfaces of eighteen AIS patients (12 females and 6 males, age: 12.1 ± 1.8 years, (mean ± SD)) aged between 9 and 15 years old, were optically digitalised. On bi-planar radiographic images the most relevant clinical parameters such as Cobb angle, height, weight were collected (primary Cobb: 21 ± 12.6°, height: 1.6 ± 0.1 m, weight 46.8 ± 16.6 kg). Using the ScolioSIM simulator, the internal spinal alignment, back 3D surface and asymmetry curves, parameters of the deformity were calculated, and patient-specific deformity models were generated. These two modalities were manually fused over five markers (DL DR, C7, T12, S) visible on optical surface digitalised with Artec Eva 3D optical scanner and radiographic images (EOS system) and then diagnostic results were compared (Fig. 1).

3. Results

The internal spinal alignment is approximated by the 5th degree of B-Spline which is proved enough to describe the curve's deformity [3]. Calculation of inflection points was done automatically in both, frontal and sagittal planes, thus avoiding subjective estimation of the observers. In the case presented on Fig. 1 ScolioSIM generated the following Cobb angles: C1: 28.7°, C2: 22.7°, and C3: 18.1. Similar values were evaluated from X-ray images by clinical expert: C1: 26.5°, C2: 21.4°, and C3: 16.5. Presented values are within the clinically acceptable error range of ±5° for Cobb angle.

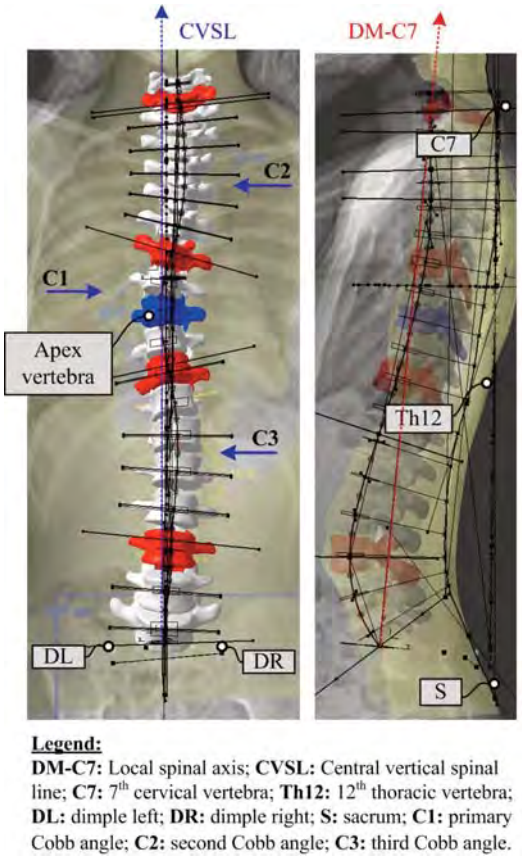

Figure 1: Comparison of Cobb angles extracted by observer and ScolioSIM

4. Discussion and Conclusions

Traditionally, AIS is diagnosed and monitored on X-ray images using Cobb technique. This technique is highly dependent on expertise of observes and it has a high inter and intra observer variability (often hard to identify end vertebra for referencing), thus Cobb angle values often differs [2]. Compared to diagnosis evaluated by clinical experts, ScolioSIM tool showed better precision in extracting main Cobb angles, and measures were within acceptable ±5°.

5. References

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