AUTOMATIC PATCH ISOLATION IN THE ASYMMETRY ANALYSIS OF SURFACE TOPOGRAPHY FOR ADOLESCENTS IDIOPATHIC SCOLIOSIS

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Introduction

Adolescent Idiopathic Scoliosis (AIS) is a 3D spinal deformity common in females. Radiographs for diagnosing and monitoring AIS involve harmful radiation exposure repeated at successive clinical visits. Markerless surface topography analysis can be used for diagnosing and monitoring spinal deformity using visible light instead of harmful X-Ray radiation.

Method

A total of 165 consecutive adolescents with idiopathic scoliosis with full torso ST and radiographs obtained on the same day were recruited from the Edmonton scoliosis clinic. Eligibility criteria were age between 10 and 18 years, with Cobb angle between 10° and 45°, Risser 0-5 and treated non-operatively.

ST scans of the full torso were analysed to calculate the best plane of symmetry by minimizing the distances between the torso and its reflection about the plane of symmetry. Distance between the torso and its reflection was measured and displayed as a deviation color map. This map has color patches outlining the areas of cosmetic asymmetries. In the previous studies, it was shown that this asymmetry analysis accurately predicts the severity observed on radiographs. Similarly, asymmetry analysis of changes in the maximal deviations (MaxDev) and root mean square (RMS) of deviations within the color patches helped predict which patients did not have curve progression on radiographs. However, while sensitive, the method was not very specific.

In some cases, the boundaries between color patches illustrating torso asymmetry were not clearly distinguished which affected the asymmetry parameters significantly. The objective of this study is to modify the patch isolation method and improve the match between region where asymmetry parameters are extracted and the location of the curves.

The minimum deviation used for isolating the asymmetry patches was varied between 3mm to 10 mm until the isolated patches matched the radiographs in all the subjects. 49 patients were analyzed with both methods and 165 patients were analyzed with the new method.

Results

The optimum minimum deviation for isolation of the patches was found to be 9.33mm. This minimum deviation was able to isolate all the patches from the data noise near the armpits. In addition, the number of isolated patches exactly matched the number of curves on X-Rays. 13 out of 49 patients (26.5%) had these problems and all of them were improved.

Extracted asymmetry parameters by this new method are matched to each curve and the corresponding color patch for all 165 subjects, which show a significant improvement in the markerless surface topography analysis.

Discussion

The results demonstrate that this new method can perfectly isolate the color patches with no extension in areas corresponding to other curves. This demonstrates a final step towards full automation of the method. Also, the RMS and MaxDev of the isolated patches will be extracted to create decision trees for monitoring and assessing of scoliosis similar to (A Komeili et al. 2015 and A Hong et al. 2016) which will give the clinically reliable results with high accuracy.

References


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