MEASUREMENT OF HUMAN TRUNK TRANSFORMATION BY BREATHING OF SCOLIOSIS PATIENTS

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INTRODUCTION

Scoliosis is a disease that spine is curved sideways when viewed from the front. Most of cause is idiopathic in adolescence. Scoliosis effect progresses thoracic deformity, affect the respiratory and cardiovascular. Early detection of scoliosis is important for patients. Ready-made diagnosis scoliosis research (Seno 2013) has exposure from X-ray or ambiguous evaluation. It is known to clinically that relationship of thoracic deformity and scoliosis are dynamically changed constantly by the respiratory motion. The detection systems of the respiratory motion were developed (Eun Mi C 2008)(Gorton George E 2012) but they need large-scaled exclusive equipments and evaluates the relationship using only still images. Therefore it is difficult to obtain the change of the shape continually and could not perform an accurate evaluation. We developed the system which obtain a trunk shape continually using a depth sensor. In this paper, I present a new method to evaluate the shape change of the human trunk by the breathing of the patient of scoliosis using this system.

MATERIALS AND METHODS

This system measures stage of scoliosis progression using torsion angles of the trunk by respirometry. Patients take a deep breath on their stomach, put a depth sensor behind a patient and record the shape of body trunk during a deep breathing. We used Kinect made by Microsoft Corporation as the depth sensor. The sensor can capture the continuous depth value with 30 frames per second, and store the values. Moreover, with the depth value, we can obtain images using a camera in this depth sensor and can confirm the trunk shape visually. From these depth values, we compute the torsion angles using a ellipse approximation method. We compute the torsion angle as follows:

1. Obtaining the depth values of body trunk along perpendicular plane of the body.
2. Performing ellipse approximation (Masuzaki 2014) with each slice plane as shown in Figure 1.
3. From the ellipse thus obtained, computing angles of long diameter and short diameter.

We evaluate the torsion angle data of scoliosis patients with the aid at the Asahikawa Medical University Hospital. The experimental participants were 2 males and a female of scoliosis aged between 10 and 16 years. We measured their torsion data by deep breath three times. Moreover, we also measured the data of non-scoliosis at Future University Hakodate, too. The experimental participants were 3 males of non-scoliosis aged between 22 and 24 years.

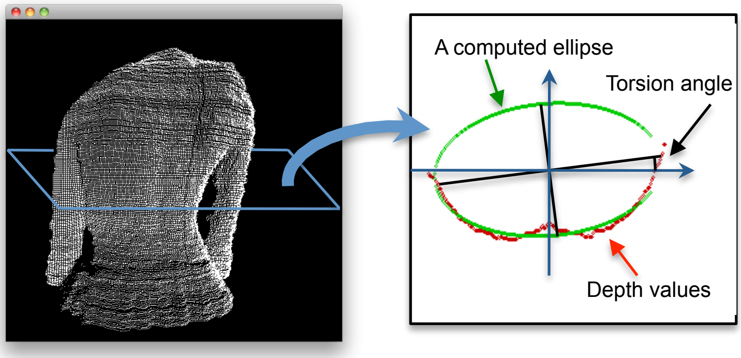

Figure 1: Computing a torsion angle from the ellipse approximation.

RESULTS

Variation widths of the torsion angles of the non-scoliosis patients were observed between 0.014 and 0.028 radian. Variation widths of the torsion angles of scoliosis patients were between 0.157 and 0.301 radian. In the t-test, t-value was $t(6)=0.070$, $p<0.10$ and these results were different between scoliosis and non-scoliosis. Figure 2 shows example of graphs of the torsion angle of a lumbar part of the scoliosis patient and the non-scoliosis with the breathing movement.

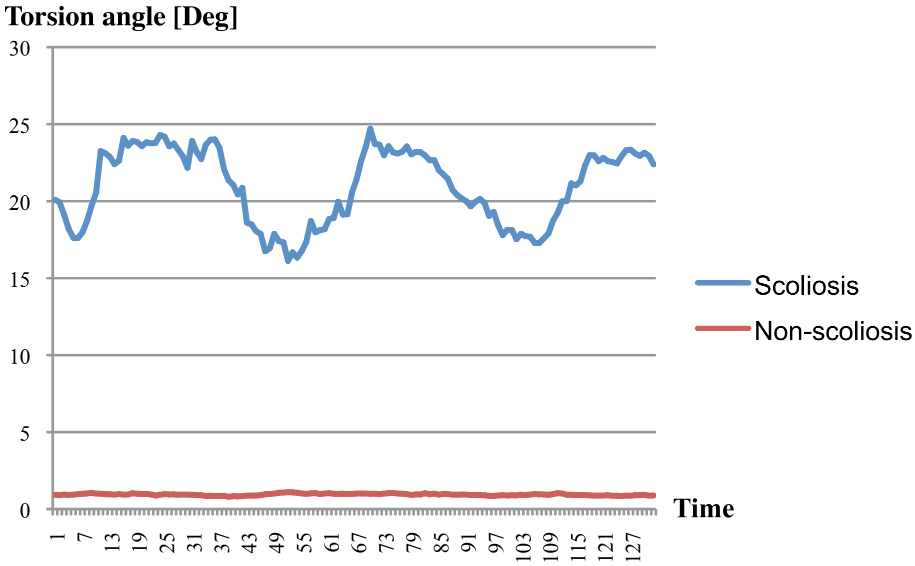

Figure 2: Torsion angle of a lumbar part with the breathing.

DISCUSSION

In this paper, we described about the relationship between the breathing movement of the scoliosis patient and the deformation of the human trunk. It is known that the human trunk of the scoliosis patient is twisted in intake movement clinically.

In our experiment, we showed that we could detect the torsion angles of the human trunk of the scoliosis patients and there was a difference between the scoliosis patient and non-scoliosis statistically. Our method can evaluate breathing movement exactly in comparison with conventional methods (Eun Mi C 2008)(Gorton George E 2012) to get the deformation of the trunk continually. As a result, this method is effective for the evaluation of the scoliosis.

Moreover, we can easily evaluate the torsion of the human trunk by making use of an inexpensive sensor commercially, such as the Kinect of Microsoft. As a result, by using this system, an early detection and early treatment are brought to be possible.

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