

A SIMPLIFIED MODEL FOR OPTOELECTRONIC POSTURE ANALYSIS

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INTRODUCTION

The assessment of a rehabilitative treatment on the posture of a subject could be difficult to quantify. Posture related angles can be measured using optoelectronic systems if a proper model is available.

Aim of this work is to define a simplified model for posture analysis, suitable for the daily clinical routine, and to evaluate the intra-subject repeatability and the inter-subject sensitivity of the posture related angles obtained using this model.

MATERIALS AND METHODS

Twelve subjects, 6 male and 6 female, affected by a back pain syndrome were tested. A six cameras optoelectronic system (ELITE, BTS Italia) was used.

18 markers were placed on anatomical landmarks, as shown in figure. 10 hemispherical markers 8 mm in diameter, 4 hemispherical markers 15 mm in diameter on the feet and 2 spherical markers 19 mm in diameter mounted on a spacer were used. Bigger markers were used in order to ensure a proper image reconstruction, on the basis of both anatomical characteristics and positions of the cameras. On the basis of the markers, 15 segments were reconstructed, as in figure.

The inclination in the frontal, sagittal and coronal plane of each segment was computed; angles related to the rachidian segments were also computed. Excel macros were written in order to automatically translate raw angle data produced by the software (BTS Win) into their frontal, sagittal and coronal components.

The usefulness of these angles in the assessment of the posture of a subject was investigated.

The posture of each subject was acquired for 10 seconds at a frequency of 50 frames/s (leading to 500 frames as a whole). 3 trials per day, spaced by a rest period, were acquired in 3 different days, leading to 9 acquisition for each subject. A clinical evaluation of the subjects' posture was performed for a later comparison with instrumental results.

The analysis of variance (ANOVA) was performed on all measured angles. The contribution to the global variance due to the repetition of the measure and the change of subject was computed for each angle in order to assess the intra-subject repeatability and the inter-subject sensitivity of the measure.

RESULTS

The mean value of the inter-subject component of the variance is $80\% \pm 11\%$. It is greater than 90% in kyphosis, lordosis and pelvis angles in sagittal plane (referred to group A), greater than 75% for all angles in frontal plane and for the angles related to the intra/extra rotation of the foot (group B) and between 77% and 52% for the angles related to head, shoulder and hand rotation in coronal plane (group C).

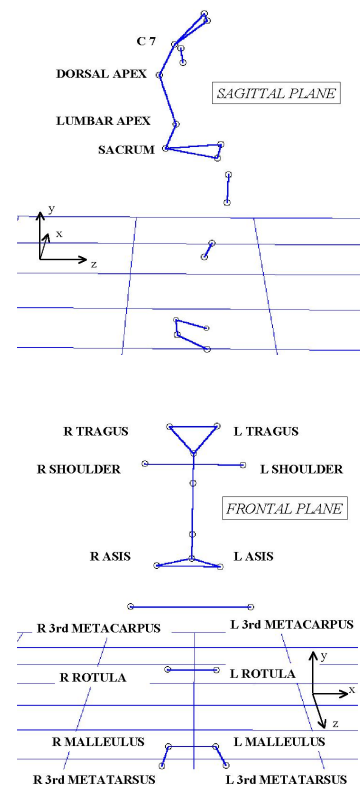
The percentage of variance explained by the trials is lower than 6% for all measured angles (groups A, B, C).

The positioning of the subject at each trial, with respect to a fixed marker on the floor, lead to a percentage of variance lower than 10% for the angles of group A, between 10% and 20% for the angles of group B and greater than 20% for the angles of group C.

CONCLUSIONS

All angles measured with the purposed method in frontal and sagittal plane are characterized by intra-subject repeatability and inter-subject sensitivity and could be used for the assessment of posture and of its variation after a treatment. When compared with the clinical evaluation of posture, the purposed approach performs better in the identification of low inclinations.

Due to the low time effort required, the purposed evaluation could be used in a clinical study, with the aim of measuring the effectiveness of different postural rehabilitation treatments. A protocol in this direction is under evaluation.



Marker placement in the purposed model for posture evaluation.

18 markers are placed on the indicated anatomical landmarks. Markers are linked with segments, as shown. On the basis of these segments 21 postural angles are computed.

In order to test the model, 9 trials were acquired for 12 subjects

Intra-subject repeatability: percentage of variance due to the trials lower than 6% for all measured angles. The free positioning of the subject in different trials is the major source of variation.

Inter-subject sensitivity: mean percentage of variance explained by the subjects $80\% \pm 11\%$