

## Reproducibility of Structural Light Assessment **D** Posture Telediagnosics: Preliminary Reliability Study

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**Abstract:** The study was designed to determine reliability of back evaluation performed utilizing the 3 dimensional telediagnostic measurement system. The measurement module is based on structured light method. Measurement data is archived and securely accessible for remote investigator over the Internet. Presented, originally developed system combines postural telediagnostic screening and monitoring. The study was designed to determine reliability with 4 investigators using back evaluations performed and analyzed remotely using telediagnostic system. Investigators assessed anatomical back landmarks of the seventeen back three dimensional clouds of dots. The technique for 3D image acquisition of back shape is based on temporal phase shifting and Gray codes. Acquired “images” were transferred to Telediagnostic Center for clinical evaluation. Spine parameters and deformation indexes like Posterior Trunk Symmetry Index (POTSI), Deformity in the Axial Plane Index (DAPI), kyphosis and lordosis angle were measured. Interrater Correlation Coefficient for the POTSI, DAPI, kyphosis and lordosis angles has values 0,9178; 0,9432, 0,9055 and 0,934 respectively. The reliability revealed very good results for intertester reliability. The technique is well suited for analysis of the back in standing position. The safety and procedure of presented examination method was highly accepted by examined persons.

## Introduction

The study was designed to determine reliability of back evaluation performed utilizing the 3 dimensional telediagnostic measurement system. Rasterstereography and structured light methods are used for noninvasive follow-up of patients with trunk deformities [1-5]. These methods allow obtaining 3-dimensional back shape analysis, without radiation exposure, to supplement radiologic and clinical examinations in orthopedic diagnostics, screening and biomechanics [1-5].

Marker based approach is utilized most frequently. The patient can be examined automatically in a various positions. However mostly the standing, habitual position is most frequently used.

The aim of the study was to determine the reliability of 3-dimensional back surface analysis and reconstruction telediagnostic markerless system, of the spine in test subjects [3].

## Material and Methods

Preliminary analysis was performed on selected cases from database of patient's cohort. Measurement data is archived and securely accessible for remote investigator over the Internet. Presented, originally developed system combines postural telediagnostic screening and monitoring. The study was designed to determine reliability with 4 investigators (2 physiotherapists and 2 orthopaedic surgeons) using back evaluations performed and analyzed remotely using telediagnostic system. Investigators assessed anatomical landmarks of the seventeen back three dimensional clouds of dots, namely accordion, lower angle of scapula, waist, posterior superior iliac spine, and others. The technique for 3D image acquisition of back shape is based on temporal phase shifting and Gray codes. Acquired "images" were transferred to Telediagnostic Center for clinical evaluation. Investigators assessed anatomical landmarks of the seventeen back three dimensional clouds of dots, namely acromion, lower angle of scapula, waist, posterior superior iliac spine, and others. Spine parameters and deformation indexes like Posterior Trunk Symmetry Index (POTSI), Deformity in the Axial Plane Index (DAPI), kyphosis and lordosis angle were measured. Intraclass Correlation Coefficient was calculated utilizing trial edition of MedCalc software (Version 11.3.0.0; <http://www.medcalc.be>). The study was performed on seventeen subjects who undersigned informed consent forms were assessed utilizing 3D Orthoscreen system. Data of the one subject with missing data from one rater. Clouds of dots of sixteen subjects were finally analyzed. The study group consisted of 9 females and 7 males. Subjects were in average age 39 y.a. (range 9 - 69). The exams were

performed at the Recreational Center in West Pomerania located at the sea coast (distance 463 km) and transferred via ftp server. Data were retrieved in Clinical facility in Warsaw from the server directly on line utilizing combined application for acquisition and analysis of 3 dimensional clouds of dots of the back shapes of the patients.

### Results

Interrater Correlation Coefficient for the POTSI, DAPI, kyphosis and lordosis angles has average values 0,9178; 0,9432, 0,9055 and 0,934 respectively.

Tab. I. Intraclass Correlation Coefficient for selected postural assessment measures: <sup>a</sup>The degree of absolute agreement among measurements. <sup>b</sup>Estimates the reliability of averages of kratings.

Measurements	Measures	Intraclass correlation <sup>a</sup>	95% Confidence Interval
POTSI	Average <sup>b</sup>	0,9178	0,8257 to 0,9678
DAPI	Average <sup>b</sup>	0,9432	0,8795 to 0,9778
Kyphosis	Average <sup>b</sup>	0,9055	0,7995 to 0,9630
Lordosis	Average <sup>b</sup>	0,934	0,8599 to 0,9742

Questionnaires were used to assess whether the diagnostic procedure is accepted and safe. All patients confirmed its safety and acceptance.

### Discussion

Only a few stationary systems have provided data on its reliability. Hackenberg et al. [4] found that rasterstereography provides an objective assessment of back surface rotation in standing posture avoiding the risk of errors due to forward bending and may be an alternative to traditional examination techniques. Mohokum et al. [5] determined reliability with 3 investigators using of rasterstereography 3-dimensional back surface analysis and reconstruction of the spine in healthy test subjects. The intertester-reliability for the kyphotic angle spine parameter was 0.979 (95% CI). The study presented here concern the reliability of the unique, remotely operating system for 3 dimensional spine assessment.

### Conclusions

The postural assessments can be performed on remote The reliability revealed very good results for intertester reliability. The technique is well

sited for analysis of the back in standing position. The safety and procedure of presented examination method was highly accepted by examined persons. The reliability revealed very good results for intertester reliability. The structural light 3D remote postural assessment allows the analysis of the back in standing position. There are only a few methods available for noninvasive follow-up of patients with spinal deformities but the presented one is unique suitable for telediagnostic and screening.

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