KINEMATICAL ANALYSIS OF SPINE FLECTION AND EXTENSION IN ERECT SITTING POSITION DESIGNED FOR PRACTICAL USING IN PHYSIOTHERAPY

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INTRODUCTION

Presented non-invasive method for monitoring movements of vertebrae has been developed as a supportive tool for he assessment of the long-term therapy outcome in pacients with back problems. The obtained expermental results indicate wide possibilities of practical use of the novel method.

METHOD

Fife volunteers participated in the study so far. To capture the data, the 3D system of cameras - Qualisys - was used. Qualisys works with some special markers which position records in scaned area in time. The markers were sticked at procesi spinosi and their movement from the erect sitting possition to the flection and extension under defined conditions was recorded.

The situation was solved as 2D problem in plane of symmetry of the body. For objective evaluation, the origin of coordinate system was placed to vertebra L5, which does not change its possition during monitored movements. In the next step, the vectors of translations of single markers were defined and calculated (Fig. 1).
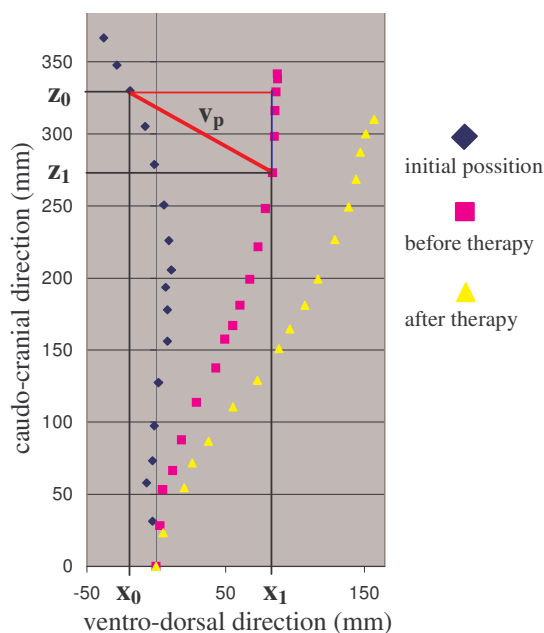

Figure. 1: Definition of vectors of translation

Magnitudes of the vectors were plotted in a graph (see Fig. 2) in the sequence vertebrae – counting from 1 to 17 in direction from cervical vertebrae.

The obtained data were evaluated by the intraindividual comparison of slopes of regression lines fitted on captured courses between and after the therapy (red elipse in Fig. 2). The higher slope means higher range of the movement and vice versa.
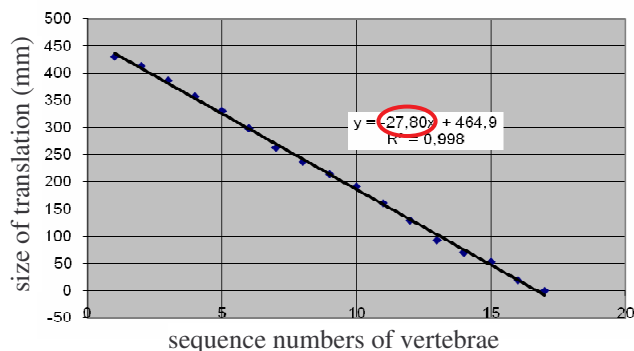

$$y = -27,80x + 464,9$$
$$R^2 = 0,998$$

Figure. 2: Data Evaluation

RESULTS AND DISCUSSION

The results are summarzed in Tab. 1. The line below the slope data gives correlation coefficients R2, magnitude of which clearly indicate practical usability of our approach. The results shows that patients with limitation to one direction have reached improvement but at the expense of movement limitation in the opposite direction. Only the patient 2 who has sometimes suffered from backpain without any movement limitations shows increse of range of movements in both directions. We can thus conclude that there exists a relationship between range of the flection and exension evidently with limitation of the total range, which is defined as summation of both. Based on comparison of the results obtained from the measurements and from patient examination by a physiotherapist, we can also assume that there is a possibility to find the blocked vertebrae as points with the highest distances from the regression lines.

CONCLUSIONS

Based on the results of all 5 volunteers, we can with very good precission conclude that the decrease or increase in magnitude of vectors of translation of single vertebrae during flection and extension of the backbone has a linear character. The range of the movement of the total backbone and of a single vertebrae can be defined by the slope of the regression line. Further development of the method and verification of its results will be realised within the frame of some diploma and PhD theses.

Table. 1: Present results of the study

Patient	1		2		3		4		5	
Flection	27,807	24,401	32,629	33,946	19,710	33,461	31,430	33,008	29,723	31,133
	0,99	0,99	0,99	0,99	0,99	0,99	0,99	0,99	0,99	0,99
Extension	7,982	12,005	7,108	13,456	13,456	13,148	13,134	12,072	15,054	7,655
	0,98	0,99	0,99	0,99	0,99	0,98	0,99	0,98	0,99	0,99