ASSESSMENT OF THE INFLUENCE OF EXAMINATION POSTURES ON POSTURAL STABILITY BY MEANS OF THE DTP-3 DIAGNOSTIC SYSTEM

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When examining spinal shape by means of radiographic methods, as well as non radiographic non invasive methods, standardisation of the examined person's posture is essential. Standardizing examination posture serves to enable the mutual comparison of the results from examinations when performed using different methods. Furthermore, a suitable examination posture should reduce postural sway and thus increase the reliability of such an examination. For the purpose of assessing the influence of fixation on reducing postural sway in a subject undergoing an examination, two examination postures with different degrees of fixation were proposed: posture D – a standing position with shoulders supported against a fixation frame and posture F – prone lying on a fixation bed. Those postures were compared with posture A – the free standing position.

For the examination of spinal shape and postural stability, the DTP-3 microcomputer diagnostic system was used, which makes it possible to measure a three-dimensional position of points by applying a non invasive contact method. The examination consists of palpating and marking the skin projection of the left and right lateral parts of the acromion, bilateral posterior superior iliac spine, and the processus spinosi. The marked points are scanned by touching them with the position sensor stylus and transmitted into a computer, where they are displayed as output protocols in the form of tables and graphs.

The experimental part included the measurement of 80 subjects (40 men and 40 women, aged 23.1 ± 2.5 years). Each subject was measured five times in each examination posture, and the average spinal curve was calculated, as well as the standard deviation, evaluating the postural sway of the examined subject. It results from the assessment of the effects of fixation on postural sway reduction, which increased fixation in examination postures A–D–F results to postural sway reduction, expressed by means of standard deviations in the mediolateral direction: 3.63–1.12–0.86 [mm], in the posterioanterior direction: 5.25–2.94–1.33 [mm] and in the caudocranial direction: 1.30–1.33–1.00 [mm]. It further results from the assessment that postures D and F significantly reduce postural sway towards posture A and posture F further reduces postural sway towards posture D.

Keywords: Postural sway, examination posture, non invasive diagnostics, DTP-3 microcomputer diagnostic system.

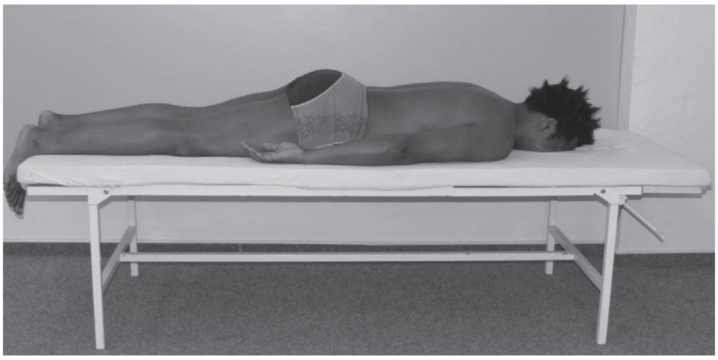
INTRODUCTION

The goal of this study is the assessment of postural sway (postural stability) in the human body and its impact on spinal shape diagnostics. Postural sway is a natural feature of neuromuscular control during the maintenance of an upright posture. There are two reasons for postural sway assessment. Firstly, the size of postural sway is given by actual neuromuscular control processes. In comparison to subjects without any spinal deformities, postural stability in subjects with adolescent idiopathic scoliosis is lower (Chen et al., 1998; Nault et al., 2002). Secondly, from the perspective of reliability of the spinal shape examination, postural sway is an undesirable phenomenon as spinal shape is not given in time by a constant curve, but rather by a curve that is to a certain extent continuously changing. It is then impossible to achieve consistency of results at repeated spinal shape examinations. The issue of postural sway constantly impacting the immediate spinal shape appears at radiographic examinations where the immediate curve is obtained in one instant of time, as well as in non invasive contact examinations where individual points of the curves are obtained in several instants of time. Therefore, a postural sway assessment should be an integral part of spinal shape examination.

The size of postural sway depends on control processes of movement, as well as on the particular posture that the subject undergoing examination is adopting (free standing, standing with fixation, sitting, lying etc.). If the aim is to utilise the size of postural sway for the assessment of the neuromuscular control process, it is essential to assess the size of postural sway in a standardized free standing position (McIlroy & Maki, 1997). If the aim is to achieve the most reliable (i.e. the most precise in the sense of random deviations) spinal shape

Fig. 1
Examination postures used for examination of spinal shape and postural sway


Legend:
Posture A – the free standing position
Posture D – standing position with shoulders supported against a fixation frame
Posture F – prone lying on a fixation bed



Posture A Posture D Posture F

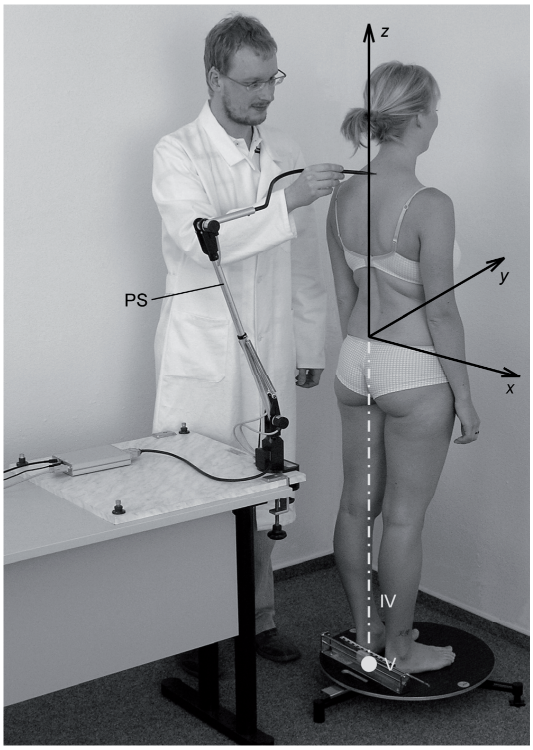
assessment, it is desirable to reduce postural sway as much as possible. Therefore, examination postures with various degrees of mechanical fixation (Fig. 1) from the perspective of postural sway were assessed in this study. These comprise posture D – a standing position with shoulders supported against a fixation frame, and posture F – a prone lying on a fixation bed. The postures were compared with posture A – the free standing position (Krejčí, 2007).

Spinal shape was assessed using the contact method described previously (D'Osualdo et al., 2002; Mannion et al., 2004; Norton, Hensier, & Zou, 2002; Norton, Sahrmann, & Van Dillen, 2004; Ovadia et al., 2007; Sliwa & Sliwa, 2001; Willner, 1981). Within this study, the contact method was implemented by means of the DTP-3 microcomputer diagnostic system (Kolisko et al., 1996; Krejčí, 2007), which enables us to perform repeated examinations in a short time interval without exposing the examined subject to X-ray. The spinal shape diagnostics may be repeated, without having to fear the negative impacts associated with the use of radiographic methods, such as X-ray and computerized tomography (Doody et al., 2000).

MATERIAL AND METHODS

Within the experimental part of the study, 80 students from the Faculty of Physical Culture of Palacký University, without any spinal difficulties, were measured, 40 men and 40 women, aged 23.1 ± 2.5 years

Fig. 2
Examination of spinal shape and postural sway using the DTP-3 diagnostic system



Legend:
PS – position sensor of the DTP-3 diagnostic system
V – point for erection of ideal vertical
IV – ideal vertical
x, *y*, *z* – coordinate axes

(mean ± SD), body mass 68.6 ± 12.0 kg, tall 172.9 ± 9.6 cm, the height of the spine (caudocranial distance between C3 and L5) 49.2 ± 3.5 cm. Sampling was done conveniently (Dempsey & Dempsey, 1996). Measurement of the spinal shape (Fig. 2) was performed in a laboratory using the DTP-3 microcomputer diagnostic system. The position sensor of the DTP-3 diagnostic system enables measurement of the positions of points with a mean error of 0.5 mm in the sphere of a 2200 mm diameter (Krejčí, 2007). On the skin surface of the examined subject, the projections of the left and right lateral parts of the acromion, bilateral posterior superior iliac spine and 22 processus spinosi C3–L5 were palpated and marked according to the procedure published by Kolisko et al. (2005). The coordinates of the anatomic points on the skin surface were scanned by touching the stylus of the position sensor of the DTP-3 system and transmitted into a personal computer for further processing. Examination of the spinal shape in individual postures A, D and F was repeated five times, the measurements following immediately after one another. In order to assess the symmetry of spinal shape, the so-call ideal vertical (IV) was calculated, which is a mathematical simulation of a plumb line erected from the centre of the intercalcaneal line (V). Orientation of the three dimensional Cartesian coordinate system x, y, z is as follows (Fig. 2): axis z is on the ideal vertical, axis x is parallel with the intercalcaneal line and in the mediolateral direction, and axis y is in the posterioanterior direction. The frontal plane is given by axes xz and the sagittal plane is given by axes yz.

We have decided to standardize the height of the spine for reasons of mutual comparison examined subjects of differing height. For this purpose we have selected a method in which the correction multiplicative constant for each subject was calculated so that the mean spine height (caudocranial distance between the pocessus spinosi C3 and L5) of measurements 1–5 in posture A corresponded after correction with the height of 500 mm. This multiplicative constant was then used to multiply the coordinates x, y, z of all processus spinosi in all measurements measured in postures A, D and F.

The postural sway of each processus spinosus in coordinates x, y, z was evaluated for each examined subject by way of standard deviations SD_x, SD_y, SD_z according to the formulas

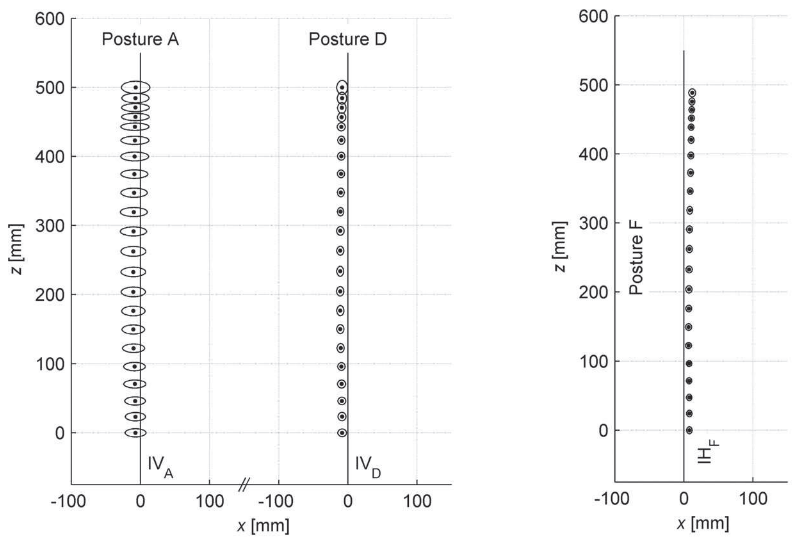
$$SD_x = \sqrt{\frac{1}{5-1}\sum_{i=1}^{5}(\bar{x} - x_i)^2},$$

$$SD_y = \sqrt{\frac{1}{5-1}\sum_{i=1}^{5}(\bar{y} - y_i)^2},$$

$$SD_z = \sqrt{\frac{1}{5-1}\sum_{i=1}^{5}(\bar{z} - z_i)^2}$$

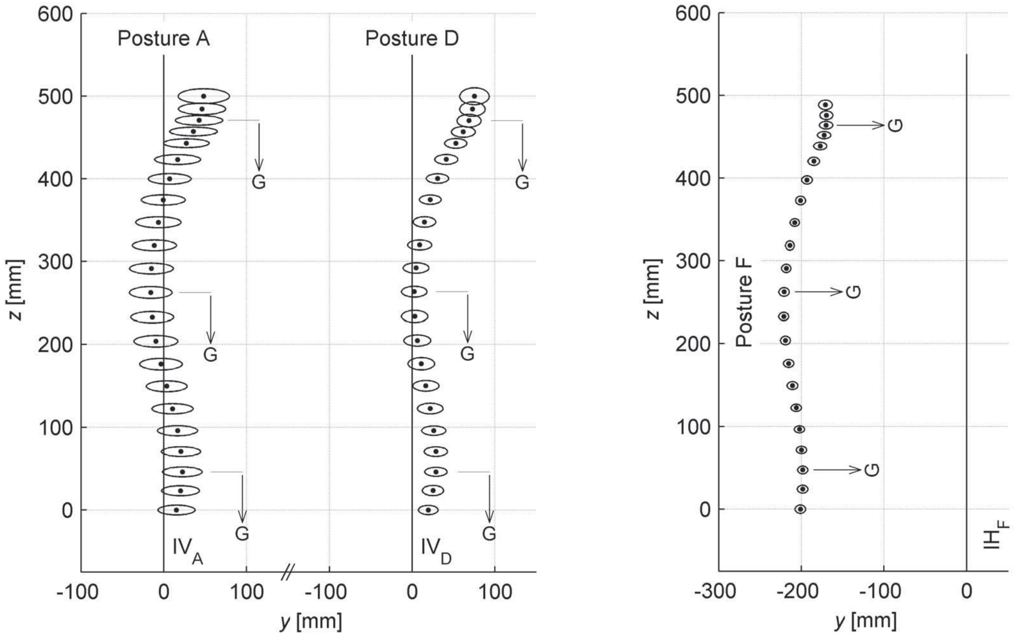
in which x_i, y_i, z_i are coordinates of a processus spinosus in i-th repetition of the measurement (the measurement was repeated five times in a selected posture), $\bar{x}$, $\bar{y}$, $\bar{z}$ is a mean position of the processus spinosus. For evaluat-

Fig. 3
Mean spinal shape and mean postural ron in the ronta plane calculated from group of 80 subjects



Legend:
Posture A – the free standing position
Posture D – standing position with shoulders supported against a fixation frame
Posture F – prone lying on a fixation bed
IV_A – ideal vertical for posture A
IV_D – ideal vertical for posture D
IH_F – ideal horizontal for posture F
• – mean position of processus spinosus
○ – mean of standard deviations expressing size of postural sway
The mean values of standard deviations are enlarged five times for better visibility!

Fig. 4
Mean spinal shape and mean postural asy in the sagittal plane calculated from group of 80 subjects



Legend:
Posture A – the free standing position
Posture D – standing position with shoulders supported against a fixation frame
Posture F – prone lying on a fixation bed
IV_A – ideal vertical for posture A
IV_D – ideal vertical for posture D
IH_F – ideal horizontal for posture F
G – direction of gravity vector in individual processus spinosi
• – mean position of processus spinosus
O – mean of standard deviations expressing size of postural sway
The mean values of standard deviations are enlarged five times for better visibility!

ing the postural sway of each processus spinosus within the entire group of subjects, examined in a selected posture, means of standard deviations MSD_x, MSD_y, MSD_z were calculated as average values of standard deviations SD_x, SD_y, SD_z in the entire group of examined subjects (Riegerová et al., 2008).

A two way repeated measurement, ANOVA (factors: "posture" and "gender"), was used to determine the statistical significance of the influence of the factor "gender" on changes in standard deviations. One way repeated measures ANOVA (factor: "posture") and post hoc Fisher LSD tests were used to determine the statistical significance of the influence of the factor "posture" on changes in standard deviations. The selected level of statistical significance was $P = 0.05$.

The effect size of the change in standard deviations between two selected examination postures was assessed based on the absolute value of the change. For the absolute value of the change $|\Delta| < 1$ mm, a change of parameter is considered to be effect size insignificant; for $|\Delta| \geq 1$ mm, such a change is considered to be effect size significant.

The calculations for the evaluation of postural sway were performed using the MATLAB 7.6 (The MathWorks, Inc., Natick, USA) and the STATISTICA Cz 8.0 (StatSoft CR, s.r.o., Prague, CZ).

RESULTS

The values of the means of the standard deviations MSD in the coordinates *x*, *y*, *z* of individual processus spinosi from the group of 80 subjects, examined in postures A, D and F, are displayed in TABLE 1, TABLE 2 and TABLE 3, together with the assessment results of the statistical and effect size significance of the changes. For better illustration, the means of standard deviations and mean positions of processus spinosi at individual postures are displayed on the Fig. 3 (the frontal plane) and Fig. 4 (the sagittal plane).

TABLE 1, TABLE 2 and TABLE 3 show that influence of the factor "gender" on changes in standard deviations is statistically significant only at one processus spinosus within a total of 22 processus spinosi in the mediolateral direction, at none of the processus spinosus in the posterioanterior direction and at five processus spinosi in the caudocranial direction. We consider that such occurrences of statistically significant

TABLE 1

Assessment of postural sway of processus spinosi in the mediolateral direction (the axis *x*) by way of standard deviations SD calculated from group of 80 subjects

Processus spinosus	Examination posture			Comparison			A2	ANOVA1			
	A	D	F	D–A	F–A	F–D	Fac	Fac	Fis	Fis	Fis
	MSD	MSD	MSD	Δ	Δ	Δ	gen	pos	D–A	F–A	F–D
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]					
C3	4.1	1.6	1.0	−2.6†	−3.1†	−0.6	NS	*	*	*	*
C4	4.0	1.4	0.9	−2.6†	−3.1†	−0.5	NS	*	*	*	*
C5	4.0	1.2	0.8	−2.8†	−3.2†	−0.4	NS	*	*	*	*
C6	4.0	1.2	0.9	−2.8†	−3.1†	−0.3	NS	*	*	*	NS
C7	4.1	1.2	0.8	−2.9†	−3.3†	−0.3	NS	*	*	*	NS
T1	4.1	1.0	0.8	−3.0†	−3.2†	−0.2	NS	*	*	*	NS
T2	4.1	1.1	0.8	−3.0†	−3.2†	−0.2	NS	*	*	*	NS
T3	3.9	1.0	0.9	−2.9†	−3.1†	−0.2	NS	*	*	*	NS
T4	3.8	1.0	0.8	−2.8†	−3.0†	−0.2	NS	*	*	*	NS
T5	3.9	0.9	0.8	−3.0†	−3.1†	−0.1	NS	*	*	*	NS
T6	3.8	1.1	0.9	−2.7†	−2.9†	−0.2	NS	*	*	*	NS
T7	3.6	1.0	0.9	−2.6†	−2.8†	−0.2	NS	*	*	*	NS
T8	3.6	1.0	0.9	−2.6†	−2.7†	−0.1	NS	*	*	*	NS
T9	3.5	1.1	0.9	−2.5†	−2.6†	−0.1	NS	*	*	*	NS
T10	3.4	1.0	0.9	−2.4†	−2.5†	−0.2	NS	*	*	*	NS
T11	3.3	1.1	0.9	−2.2†	−2.4†	−0.1	NS	*	*	*	NS
T12	3.2	1.0	0.9	−2.2†	−2.3†	−0.1	NS	*	*	*	NS
L1	3.2	1.1	0.8	−2.1†	−2.4†	−0.3	NS	*	*	*	NS
L2	3.2	1.2	0.8	−2.0†	−2.4†	−0.4	NS	*	*	*	*
L3	3.0	1.1	0.8	−1.9†	−2.2†	−0.3	*	*	*	*	NS
L4	2.9	1.2	0.8	−1.8†	−2.1†	−0.4	NS	*	*	*	*
L5	3.0	1.3	0.8	−1.8†	−2.2†	−0.4	NS	*	*	*	*
Average	3.63	1.12	0.86	−2.51	−2.77	−0.26					

Legend:
A2 – two way repeated measures ANOVA (factors: “posture”, “gender”)
ANOVA1 – one way repeated measures ANOVA (factor: “posture”)
A – the free standing position
D – standing position with shoulders supported against a fixation frame
F – prone lying on a fixation bed
Fac gen – statistical significance of influence of the factor “gender”
Fac pos – statistical significance of influence of the factor “posture”
Fis D–A – post hoc Fisher LSD test between postures D and A
Fis F–A – post hoc Fisher LSD test between postures F and A
Fis F–D – post hoc Fisher LSD test between postures F and D
MSD – mean of standard deviations calculated from group of 80 subjects
Δ – difference of parameters
† – effect size significant (absolute value of difference is greater or equal to 1 mm)
* – statistically significant ($p < 0.05$)
NS – statistically insignificant

influences of the factor “gender” are insufficient, so that the one way repeated measures ANOVA with the factor “posture” was only used for the further assessment of changes in standard deviations.

It is evident from TABLE 1 and TABLE 2 that posture D towards posture A statistically and effect size significantly reduces postural sway within all processus spinosus (C3 to L5) in the mediolateral direction and in the posterioanterior direction. It is evident from TABLE 3 that the influence of postural sway in the caudocranial direction is statistically significant at three processus spinosi, but the influence is not effect size significant at any processus spinosus.

Posture F towards posture D statistically significantly further reduces postural sway at six processus spinosi in the mediolateral direction, but the reduction is not effect size significant at any processus spinosus. Reduction in the posterioanterior direction is statistically and

TABLE 2

Assessment of postural sway of processus spinosi in the posterioanterior direction (the axis *y*) by way of standard deviations SD calculated from group of 80 subjects

Processus spinosus	Examination posture			Comparison			A2	ANOVA1			
	A	D	F	D–A	F–A	F–D	Fac	Fac	Fis	Fis	Fis
	MSD	MSD	MSD	Δ	Δ	Δ	gen	pos	D–A	F–A	F–D
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]					
C3	6.2	3.6	1.7	−2.6†	−4.5†	−1.9†	NS	*	*	*	*
C4	5.7	3.1	1.6	−2.6†	−4.1†	−1.5†	NS	*	*	*	*
C5	5.8	2.9	1.6	−2.8†	−4.1†	−1.3†	NS	*	*	*	*
C6	5.8	2.9	1.6	−2.9†	−4.2†	−1.3†	NS	*	*	*	*
C7	5.5	2.7	1.6	−2.8†	−3.9†	−1.1†	NS	*	*	*	*
T1	5.6	2.8	1.4	−2.8†	−4.2†	−1.4†	NS	*	*	*	*
T2	5.2	2.7	1.3	−2.5†	−3.9†	−1.4†	NS	*	*	*	*
T3	5.3	2.7	1.2	−2.7†	−4.1†	−1.4†	NS	*	*	*	*
T4	5.5	2.8	1.1	−2.7†	−4.4†	−1.6†	NS	*	*	*	*
T5	5.3	2.9	1.1	−2.4†	−4.3†	−1.8†	NS	*	*	*	*
T6	5.3	3.1	1.1	−2.2†	−4.2†	−2.0†	NS	*	*	*	*
T7	5.2	3.1	1.3	−2.1†	−3.9†	−1.8†	NS	*	*	*	*
T8	5.2	3.2	1.2	−2.0†	−4.0†	−2.0†	NS	*	*	*	*
T9	5.3	3.3	1.2	−2.1†	−4.1†	−2.0†	NS	*	*	*	*
T10	5.2	3.2	1.3	−1.9†	−3.9†	−2.0†	NS	*	*	*	*
T11	4.9	3.2	1.3	−1.8†	−3.6†	−1.9†	NS	*	*	*	*
T12	5.0	3.1	1.3	−1.9†	−3.7†	−1.8†	NS	*	*	*	*
L1	4.9	2.9	1.3	−1.9†	−3.6†	−1.7†	NS	*	*	*	*
L2	4.8	2.8	1.3	−1.9†	−3.5†	−1.6†	NS	*	*	*	*
L3	4.8	2.7	1.2	−2.1†	−3.5†	−1.5†	NS	*	*	*	*
L4	4.6	2.6	1.3	−2.0†	−3.3†	−1.3†	NS	*	*	*	*
L5	4.5	2.4	1.3	−2.1†	−3.2†	−1.1†	NS	*	*	*	*
Average	5.25	2.94	1.33	−2.31	−3.92	−1.61					

Legend:
A2 – two way repeated measures ANOVA (factors: “posture”, “gender”)
ANOVA1 – one way repeated measures ANOVA (factor: “posture”)
A – the free standing position
D – standing position with shoulders supported against a fixation frame
F – prone lying on a fixation bed
Fac gen – statistical significance of influence of the factor “gender”
Fac pos – statistical significance of influence of the factor “posture”
Fis D–A – post hoc Fisher LSD test between postures D and A
Fis F–A – post hoc Fisher LSD test between postures F and A
Fis F–D – post hoc Fisher LSD test between postures F and D
MSD – mean of standard deviations calculated from group of 80 subjects
Δ – difference of parameters
† – effect size significant (absolute value of difference is greater or equal to 1 mm)
* – statistically significant ($p < 0.05$)
NS – statistically insignificant

effect size significant within all processus spinosi. Influence of postural sway in the caudocranial direction is statistically significant at 18 processus spinosi, but the influence is not effect size significant at any processus spinosus.

Based on the above stated results it can be stated that increasing the level of fixation in examination postures A–D–F leads to reduction in postural sway, expressed by the average values of MSD in the mediolateral direction: 3.63–1.12–0.86 [mm], in the posterioanterior direction: 5.25–2.94–1.33 [mm] and also in the caudocranial direction between postures D and F: 1.30–1.33–1.00 [mm]. It results from the above that postures D and F significantly reduce postural sway towards posture A and posture F further reduces postural sway towards posture D.

TABLE 3
Assessment of postural sway of processus spinosi in the caudocranial direction (the axis *z*) by way of standard deviations SD calculated from group of 80 subjects

Processus spinosus	Examination posture			Comparison			A2	ANOVA1			
	A	D	F	D-A	F-A	F-D	Fac	Fac	Fis	Fis	Fis
	MSD	MSD	MSD	Δ	Δ	Δ	gen	pos	D-A	F-A	F-D
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]					
C3	1.8	2.1	1.2	0.3	−0.6	−0.9	NS	*	NS	*	*
C4	1.4	1.8	1.1	0.4	−0.3	−0.7	NS	*	*	*	*
C5	1.2	1.6	0.9	0.4	−0.2	−0.6	NS	*	*	*	*
C6	1.1	1.3	0.9	0.2	−0.2	−0.4	NS	*	*	*	*
C7	1.1	1.2	0.9	0.1	−0.2	−0.3	NS	*	NS	NS	*
T1	1.2	1.2	1.0	0.0	−0.2	−0.2	NS	*	NS	*	*
T2	1.3	1.2	1.0	−0.1	−0.3	−0.2	*	*	NS	*	*
T3	1.3	1.1	1.1	−0.1	−0.2	−0.1	NS	*	NS	*	NS
T4	1.3	1.3	1.0	−0.1	−0.4	−0.3	*	*	NS	*	*
T5	1.3	1.2	1.2	−0.1	−0.2	−0.1	NS	NS	NS	*	NS
T6	1.3	1.3	1.0	−0.1	−0.3	−0.2	NS	*	NS	*	*
T7	1.4	1.3	1.1	−0.1	−0.4	−0.3	NS	*	NS	*	*
T8	1.4	1.5	1.0	0.1	−0.4	−0.5	NS	*	NS	*	*
T9	1.4	1.4	1.1	0.0	−0.4	−0.3	*	*	NS	*	*
T10	1.4	1.5	1.0	0.1	−0.4	−0.5	*	*	NS	*	*
T11	1.3	1.3	1.0	0.0	−0.4	−0.3	NS	*	NS	*	*
T12	1.3	1.3	0.9	0.1	−0.4	−0.4	NS	*	NS	*	*
L1	1.2	1.1	0.9	−0.1	−0.4	−0.3	NS	*	NS	*	*
L2	1.2	1.2	0.9	0.0	−0.3	−0.3	NS	*	NS	*	*
L3	1.2	1.1	1.0	−0.1	−0.3	−0.2	NS	*	NS	*	NS
L4	1.2	1.2	1.0	0.0	−0.3	−0.3	NS	*	NS	*	*
L5	1.2	1.1	1.0	−0.1	−0.2	−0.1	*	NS	NS	*	NS
Average	1.30	1.33	1.00	0.03	−0.30	−0.33					

Legend:
A2 – two way repeated measures ANOVA (factors: "posture", "gender")
ANOVA1 – one way repeated measures ANOVA (factor: "posture")
A – the free standing position
D – standing position with shoulders supported against a fixation frame
F – prone lying on a fixation bed
Fac gen – statistical significance of influence of the factor "gender"
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Fis D–A – post hoc Fisher LSD test between postures D and A
Fis F–A – post hoc Fisher LSD test between postures F and A
Fis F–D – post hoc Fisher LSD test between postures F and D
MSD – mean of standard deviations calculated from group of 80 subjects
Δ – difference of parameters
† – effect size significant (absolute value of difference is greater or equal to 1 mm)
* – statistically significant ($p < 0.05$)
NS – statistically insignificant

DISCUSSION

Results of this study support the idea that suitably chosen mechanical fixation in a significant manner reduces the postural sway of the examined subject, which can be positively utilised for optimizing the process of spinal shape examination by means of radiographic methods, as well as by non radiographic non invasive methods. The issue of reducing the postural sway of an examined subject during a spinal shape examination has been studied (D'Osualdo et al., 2002; Ovadia et al., 2007; Sliwa & Sliwa, 2001), where different kinds of mechanical fixation equipment have been also proposed. However, those works do not quantify the benefit of fixation equipment from the point of view of postural sway reduction.

From the physical point of view, the proposed fixation postures D and F and free standing posture A are defined by the vector of gravity G. The direction of the vector is parallel with the axis *z* (in the craniocaudal direction) in postures A and D whereas the direction is perpendicular to the axis *z* in posture F (Fig. 3). A further difference between postures is that a mechanical fixation affects only the part of the spine in the area of the upper thoracic spine in posture D whereas a mechanical fixation affects the whole spine in posture F. Both those facts explain the results that mediolateral postural sway in posture D is reduced almost to the same size as in posture F (insignificant differences from processus spinosi C6 to L1 in TABLE 1) whereas posture F achieves a bigger reduction in posterioanterior postural sway than posture D (significant differences in all processus spinosi in TABLE 2). Posture D has the potential for bigger postural sway reduction, particularly in the posterioanterior direction. It is, therefore, essential to deal with the possibility of supplementing posture D with additional mechanical fixation in the head and pelvis area.

The number of measurement repetitions was limited to five repetitions in this study. The reason was the increasing fatigue of the postural muscles of the examined subjects. Such fatigue could influence the spine shape and thus also the results of the study.

From the perspective of spinal shape diagnostics validity, it is essential to deal with the question of the extent to which the spinal shape in examination postures with mechanical fixation resembles the spinal shape in the free standing position (posture A). It is obvious that in different examination postures the spinal shape may vary (Krejčí, 2007; Torell et al., 1985). Then it is essential to assess the existing as well as the newly proposed examination postures from the perspective of reducing the postural sway, as well as from the perspective of the extent of spinal shape change in reference to the free standing position. Such complex assessment of additional examination postures for spinal shape diagnostics have been published (Krejčí, 2007; Krejčí et al., 2008).

Although a lying position reduces postural sway, it may also affect the depth of deformity of the spine (Torell et al., 1985) therefore, it is essential to further deal with such a position. The knowledge of the appropriate characteristics (postural sway reduction, spinal shape change) for the lying posture is important when the spine is examined by computerized tomography (Ho et al., 1992) or magnetic resonance imaging (Chu et al., 2006), as these examinations are performed while the subject is recumbent. Furthermore, the lying position is more comfortable and less tiresome for the subject undergoing examination than the standing position, and this advantage may outweigh the inconvenient characteristic – impacting the spinal shape. This advantage may especially be utilized in subjects with neuromuscular control disorder, where postural sway while standing is of such a large size that it prevents the sufficient performance of an accurate spinal shape examination.

CONCLUSION

This study showed that postural sway may be significantly reduced in spinal shape diagnostics by examination postures; utilising the mechanical fixation of an examined subject during examination. The proposed and studied examination postures: posture D – a standing position with shoulders supported against a fixation frame and posture F – prone lying on a fixation bed, reduce the statistical and effect size significance of the postural sway in the mediolateral and in the posterioanterior direction with respect to posture A – the free standing position. Assessment of the above stated examination postures from the perspective of the possibility of impacting spinal shape was not carried out within this study and will be the subject of further study.

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ETHICS APPROVAL

This study was approved by the Ethical Committee of the Faculty of Physical Culture of Palacký University. All the subjects participated in this study were volunteers, and had given their informed consent.

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HODNOCENÍ VLIVU VYŠETŘOVACÍCH POLOH NA POSTURÁLNÍ STABILITU POMOCÍ DIAGNOSTICKÉHO SYSTÉMU DTP-3

(Souhrn anglického textu)

Při vyšetřování tvaru páteře jak rentgenologickými, tak neradiačními neinvazivními metodami je důležitá standardizace polohy vyšetřované osoby. Standardizace vyšetřovací polohy umožní vzájemné porovnání výsledků vyšetření různými metodami. Navíc vhodná vyšetřovací poloha by měla snížit titubaci a tím zvýšit reliabilitu vyšetření. Pro hodnocení vlivu fixace na snížení titubace vyšetřované osoby byly navrženy dvě vyšetřovací polohy s různým stupněm fixace: poloha D – stoj s oporou ramen o fixační rám a poloha F – leh na břiše na fixačním lůžku. Uvedené polohy byly porovnány s polohou A – volný návykový stoj. Pro vyšetření tvaru páteře a titubace byl využit mikropočítačový diagnostický systém DTP-3, který umožňuje měřit třírozměrnou polohu bodů neinvazivní dotykovou metodou.

Metodika vyšetření spočívá v palpaci a označení projekcí akromionů, zadních horních spin a trnových výběžků na kožním povrchu vyšetřované osoby. Označené body jsou snímány dotykem hrotu polohového snímače a přenášeny do osobního počítače, kde jsou zobrazeny do výstupních protokolů ve formě tabulek a grafů. Byl změřen soubor 80 vyšetřených osob (40 mužů a 40 žen, věk 23,1 ± 2,5 roku). Každá osoba byla v každé vyšetřovací poloze změřena pětkrát a byla vypočítána průměrná křivka páteře a standardní odchylka kvantifikující titubaci vyšetřované osoby. Z hodnocení vlivu fixace na snížení titubace vyplývá, že rostoucí stupeň fixace vyšetřovacích poloh A–D–F vede ke snížení titubace vyjádřené pomocí průměrných hodnot standardních odchylek v mediolaterálním směru: 3,63–1,12–0,86 [mm], v posterioanteriorním směru: 5,25–2,94–1,33 [mm] a ve kaudokraniálním směru: 1,30–1,33–1,00 [mm]. Z hodnocení dále vyplývá, že polohy D a F významně snižují titubaci vůči poloze A a poloha F dále snižuje titubaci vůči poloze D.

Klíčová slova: titubace, vyšetřovací poloha, neinvazivní diagnostika, mikropočítačový diagnostický systém DTP-3.

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