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# *Evaluation of postural function disorders of the spine in orthostatic stereotypes*

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There is no unified system for assessing the functional mobility (lability) of the spine to diagnose its hypermobility, pathological mobility and instability. In the absence of such a system, biomechanical characteristics of spinal segments, revealed in normal individuals and by clinical examination of patients, are instrumentally and metrically incommensurable with its kinematic characteristics detected in functional radiographs. **Purpose** Development of criteria and methods to assess the postural function (lability) of the spine and the rigidity of its deformations for their consideration and suggestion as a metric standard **Materials and methods** Patients (n = 43) aged 9 to 23 years with clinical and radiological signs of spinal curvatures of grades 2 to 4 (according to Chaklin) and orthopedically healthy subjects of the same age (n = 79) were examined. Instrumental analysis of the monitored postural activity of the trunk and spine in orthostatics was carried out by the optoelectronic method KOMOT. **Results and discussion** It was established that the postural characteristics of spinal deformities are significantly different in sample populations in terms of expected magnitude of curvature and variability. If in postural and in sample sets the angular characteristics of spinal curves obey the law of normal distribution, then their postural variation in samples tends to a power-law type of distribution. In orthostatic position, the power-law type of the variability distribution was reliably manifested not only with respect to the angular characteristics of spinal curvatures, but also with respect to the variability of a number of other postural parameters. As a result of the analysis of the distribution of random variables characterizing the angular curves of the spine in orthostatic stereotypes and the dependencies between their variation and the expected values in sample populations, a quantitative topographic evaluation of the functional mobility of the spine according to the index of postural lability (IPL) was proposed. **Conclusion** To adequately assess the postural function of the spine (its lability), it is necessary to have not only a single-stance recording of the parameters under study but to repeatedly register them in a feasible prolonged examination. Only mathematically expected values and root-mean-square deviations of angular parameters reflect more fully the state of spinal curvatures and have the necessary and sufficient diagnostic information. A quantitative topographic estimation of the functional mobility of the spine according to index of postural lability (IPL) is suggested. Normally, IPL is in the range of 30 to 75 %. If the index is less than 30 %, the spine is hypermobile; if it is more than 75 %, the spinal column is rigid.

**Keywords**: computer optical topography, functional mobility of the spine, index of postural lability, metric standard

Due to the complex organization and specific structure of the spine as a biomechanical system, its main adaptive role in this quality is to timely and adequately change its shape in accordance with the postural needs of the body [1, 2]. However, a number of functional disorders and diseases are known in which the mobility of the spine alters significantly, and, consequently, its ability to timely correct its shape and damp the functional load in accordance with postural needs also changes [3]. In particular, various limitations of the spine mobility, as a rule, worsen the postural function and adaptive postural and kinematic capabilities of a person [4, 5]. In the pathogenesis of certain diseases, all kinds of mobility of the spine are considered as necessary conditions, for example, in assessing the risk of coxarthrosis progression [6] or in the case of rotational mobility as a risk factor for developing chronic low back pain [7]. Limited spinal mobility in the sagittal plane affects the dynamic balance of the body and is accompanied by a loss of equilibrium and a fall [8], as well as by an impairment of the quality of life in general [9]. A number of researchers [10] believe that one of the factors contributing to progression of scoliosis is a pronounced mobility of the spine, which depends on the condition of muscles, ligaments, and intervertebral discs. The more mobile is the deformity, the more intensive is progression of scoliosis [10]. However, if non-radiographic tests of Otto and Schober [11, 12, 13] are used to assess the mobility of the spine in the normal population, functional tests for assessing its mobility are conducted in vertebrology with the predominant use of radiography. The lack of unity in the metric identity and in comparability of instrumental approaches makes it difficult to develop clear criteria for spinal mobility. Depending on the disease, the mobility of the spine is interpreted ambiguously by various authors and is mixed with such concepts as

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hypermobility, pathological mobility and instability. Because of the lack of clear quantitative criteria for spinal mobility, the definition of spinal instability in vertebrology is interpreted even more freely [14] and is based simultaneously on clinical, radiographic and biomechanical findings [15]. Purely radiographic criteria proposed for quantitative instability of the spine [16] have not been widely used, since the shooting procedures are not standardized with respect to the comparability of scales with the true dimensions of the investigated object. The errors in the images on radiographs are close or comparable to instability values themselves, and therefore in clinical practice, "instability" is mainly diagnosed by functional radiographs [17]. Due to instrumental and metric inconsistencies, explanations of the pain syndrome from the biomechanical point of view by damaging the structures of the mechanoreceptors [18] are also untenable. First, direct relationship between pain manifestations and hypermobility of the spinal segments was not revealed [19], and secondly, the participation of mechanical factors in the formation, for example, of phantom or ischemic pain is completely excluded. Thus, in our opinion, the key moment of the problem of diagnosing spinal instability is that the biomechanical characteristics of its segments, revealed in normal subjects and in clinical examination of patients, are not comparable with its kinematic characteristics detected on functional radiographs. In accordance with the "theory of measurements" [20, 21], clinical and roentgenological characteristics are variable values of qualitative ordinal scales, and biomechanical parameters are variable values of the quantitative relationship scale. Due to their different affiliation, the complex component in assessing the instability of the spine complicates or makes it impossible to adequately interpret clinical and instrumental data because it includes components that correspond to different classes of variables with unequal volumes of permissible transformations. To exclude methodological errors in the diagnostic strategy, in assessing the mobility and instability of the spine, instrumental and metric unity in the examination of the norm and pathology is necessary, as well as an adequate comparison of the variables in accordance with their class of permissible transformations [22]. In earlier studies [23], it was suggested that the postural function of the spine (its lability) be evaluated in orthostatic stereotypes by computer optical topography from the variability of the angles of spinal curves. However, the diagnostic value of the proposed criteria and indicators remain unclear. In particular, it was not established in what range of values and by what regularities the angular characteristics of spinal curves and deformities are recorded in the stereotypes of postural activity, what indicators and in what quantity are necessary for a complete evaluation of the characteristics of its postural function.

**Purpose**: development of criteria and methods for assessing the postural function (lability) of the spine and the rigidity of its deformations for their consideration and suggestion as a metric standard.

## MATERIAL AND METHODS

Forty-three patients aged 9 to 23 years with clinical and radiological signs of spinal curvatures of grade 2 to 4 (according to V.D. Chaklin) and orthopedically healthy subjects of the same age (79 persons) were examined. Instrumental topographic analysis of the monitored postural activity of the torso and spine in orthostatics was carried out with the optoelectronic method KOMOT [24]. The following topographic parameters of angular deformity of the spine were analyzed: S1_LA – dominant angle of lateral asymmetry (topographic analogue of the Cobb R-angle [25, 26]); S1_RA – rotation angle at the apex of the dominant curve; S1_IA – calculated index of the generalized angle of curvature for the two previous parameters. In the analysis, the levels of apices of compensating arches of the first and second order (S1 (S2)-L2) were additionally taken into account. Automatic diagnosis of the dominant disorders in the spinal and torso shape was performed by the criterion of normalized deviations. Thereby, the analysis of the kinematic parameters of the spine according to topograms in the dynamics of postural activity was studied not in isolation but in direct connection with other elements of a particular postural system of the torso. Depending on the abilities of the subject, the spatial characteristics of the torso and spine were evaluated by prolonged standing from 1.5 to 3.5 minutes and 8-16 topographic images were taken. Duration of the intervals between the shots ranged from 9 to 23 seconds. To analyze the information obtained, the diagnostic parameters of the output data were reflected in corresponding compound tables, for example, as for patient O., 14 years old, diagnosed with idiopathic scoliosis of grade 3-4 (Table 1). Table results presented on the scale of a real examination reflect the dynamics of quantitative and qualitative indicators of diagnostic significance characterizing the biomechanical profiles of orthostatic motor stereotypes, which are personal dynamic models of controlled postural systems.

For the analysis of postural activity, the topographic control in orthostatic position was performed with right-sided and left-sided redistribution of weight-bearing loads due to modeling of leg discrepancy with two-centimeter supports. This allowed us to increase the number and variety of possible variants of orthostatic stereotypes. The total number of postural stereotypes analyzed in orthopedically healthy subjects in the habitual position was 99 and 161 if leg discrepancy was simulated. The total number of the stereotypes in patients was 86 (due to modeling of leg discrepancy). The results obtained in each examinee were analyzed by qualitative (formalized topographic diagnosis) and quantitative changes in his postural status [23], taking into account the absolute and relative variation of the parameters listed above.

All patients participating in the study and their parents signed informed consent for this study inclusion and publication of its results without their identification.

Statistical processing of the material was carried out using data Microsoft EXCEL-2010 and AtteStat packages [27]. Regression and correlation analysis and parametric methods of variational statistics were used with calculation of the arithmetic mean (M), standard deviation (σ), coefficient of variation (CV) and standard error (m). The normality of the distribution in the analyzed postural sets (due to their small numbers from 10 to 16 topographs) was evaluated according to a number of criteria: the modified Kolmogorov criterion, the modified Smirnov criterion, the asymmetry and kurtosis criteria, the Chi-square Fisher criterion, and the Cramer -Mizes criteria, Shapiro-Wilk, Anderson-Darling and Shapiro-Francis. To assess the reliability of the differences, Student's t-test was used.

Table 1

Compound table of output parameters of topograms in the scale of a real examination of patient O., 14 y.o., diagnosed with idiopathic scoliosis of grade 3-4

| Time | PTI | PTI_F | PTI_H | PTI_S | S1_IA | S1_LA | FP | HP | SP |
|---|---|---|---|---|---|---|---|---|---|
| 13:43:22 | 3.7 | 5.2 | 2.9 | 2.3 | 36.9 | 52.1 | S3 | RS | PD |
| 13:43:34 | 3.6 | 5.0 | 2.7 | 2.3 | 37.7 | 55.2 | S3 | RS | PD |
| 13:43:47 | 4.0 | 5.7 | 3.1 | 2.4 | 43.5 | 61.6 | S 4 | RS | PD |
| 13:44:00 | 3.8 | 5.4 | 2.9 | 2.4 | 51.5 | 63.0 | S 4 | RP | PD |
| 13:44:14 | 3.7 | 5.2 | 3.0 | 2.4 | 49.8 | 62.7 | S 4 | RS | PD |
| 13:44:28 | 3.8 | 5.2 | 3.5 | 2.1 | 50.4 | 63.3 | S 4 | RS | PD |
| 13:44:40 | 3.7 | 5.2 | 2.9 | 2.5 | 50.4 | 63.7 | S 4 | RP | PD |
| 13:44:53 | 3.8 | 5.2 | 3.0 | 2.5 | 50.2 | 61.6 | S 4 | RS | PD |
| 13:45:05 | 3.6 | 5.0 | 3.0 | 2.4 | 51.9 | 65.3 | S 4 | RP | PD |
| 13:45:17 | 3.9 | 5.5 | 3.1 | 2.4 | 54.1 | 66.4 | S 4 | RP | PD |

**Note**: PTI - overall integral torso shape disorder index; PTI_F – integral index of the torso shape disorder in the frontal plane; PTI_H – integral index of the disorder in the horizontal plane; PTI_S – integral index of disorder in the sagittal plane; S1_IA – generalized angle of the dominant curve; S1_LA – angle of lateral asymmetry. Topographic automated diagnoses for frontal (FP), horizontal (HP) and sagittal (SP) projections, corresponding to scoliosis of grade 3 (S3) and grade 4 (S4); rotated spine (RS) and rotated posture (RP); posture disorders (PD) in the sagittal projection

## RESULTS

So that topographic parameters chosen for the assessment of functional mobility (lability) of the spine could be effectively used in the metric area of activity, they needed a comprehensive check for normality of distribution. It was found that for most criteria the hypothesis of the normality of distribution did not deviate in relation to the selected indicators not only in the sample of orthopedically healthy people (Table 2) but also in motor postural stereotypes in patients with idiopathic scoliosis of grades 2 to 4. Thus, in 43 patients in postural stereotypes out of 15 criteria used with a threshold value of $p = 0.1$, the hypothesis of normal distribution of the angular characteristics of the spinal deformity according to the generalized angle of curvature was rejected only with the following results: according to 8 criteria in only one patient, according to four criteria – in three patients, according to three criteria – in five, with two criteria – in ten and according to one criterion in 12 subjects. In another 12 patients from the sample population, the hypothesis of the normality of distribution was not rejected at all by any criterion.

The distribution of patients according to the severity of the curvature of the spine (Table 3) showed that in the groups formed the average values of the generalized angle of curvature grow significantly ($p < 0.001$) with an increase in the severity of the deformations in stereotypes and their corresponding inverse decrease in the coefficients of variation in sample populations.

However, the mathematically expected values of the PKV (index of the relative variation of the angular characteristics of S1_IA in the postural motor stereotype), characterizing the angular variation in postural motor stereotypes, do not show such variation in the sample population. That is, in the samples, the relative variation of the mean values of the generalized angle of curvature by stereotypes appears quite different from the relative selective variation of PKV. And, indeed, if the hypothesis about the normality of distribution with the critical value of $p = 0.1$ deviated only in 4 out of 15 criteria for the orthopedically healthy subjects in S1_IA parameter, then the PKV of the normality of distribution with the same threshold level was rejected for all 15 criteria. Thus, the indicators of the relative variation of angular characteristics in postural stereotypes are not subject to a normal distribution, but have a different character. In any case, the distribution of all the PKV variants for six classes by the eye method (NDC AtteStat module [27]) showed that the distribution curve is described by the power-law regression equation:

$$Y = 70{,}694 \times X^{(-2{,}364)}, \qquad (1)$$

where, $Y$ is the number of occurrences of the value in the range of values of the indicator for a given class; $X$ is the designation of the number of the class from one to 6 with the value of the accuracy of the data approximation $R^2 = 0.9854$. The power-law feature of distribution of the relative variation in the angular characteristics of curvatures in postural stereotypes also manifested itself in connection with their arithmetic mean values (**Fig. 1**).

Table 2

Statistical estimates of the normality of distribution of indicators for characterizing angular curvatures of the spine in postural stereotypes in orthopedically healthy individuals in habitual posture (n = 99)

| Criteria of normality of distribution | S1_LA (degrees) | | | S1_RA (degrees) | | | S1_IA (degrees) | | |
|---|---|---|---|---|---|---|---|---|---|
| | SC | P | at P = 0.1 | SC | P | at P = 0.1 | SC | P | at P = 0,1 |
| Modified Kolmogorov | 0.068841 | 0.441928 | + | 0.070391 | 0.391758 | + | 0.085472 | 0.156882 | + |
| Modified Smirnov | 0.068841 | 0.223294 | + | 0.070391 | 0.194298 | + | 0.049413 | 0878528 | + |
| Cramer-Mises | 0.068121 | 0.582597 | + | 0.136817 | 0.063176 | – | 0.12966 | 0.078893 | – |
| Anderson-Darling | 0.467055 | 0.478491 | + | 0.73375 | 0.107402 | + | 0.781438 | 0.083356 | – |
| Shapro-Fransis | 0.972845 | 0.050184 | – | 0.986329 | 0.55535 | + | 0.978734 | 0.195309 | + |
| Asymmetry coefficient | -0.25297 | 0.272314 | + | 0.202339 | 0.37993 | + | -0.26988 | 0.265861 | + |
| Criterion of axcess | 0.93932 | 0.039849 | – | -0.4522 | 0.322445 | + | -0.38368 | 0.424703 | + |
| Jarque-Bera test | 4.399342 | 0.221679 | + | 1.812553 | 0.808052 | + | 1.909111 | 0.769967 | + |
| Gupta test | 0.288407 | 0.180215 | + | 0.319099 | 0.074047 | – | 0.23892 | 0.74051 | + |
| Giri test | 0.778585 | 0.34037 | + | 0.828087 | 0.135671 | + | 0.792021 | 0.783453 | + |
| D'Agostino | 0.277921 | 0.144341 | + | 0.28373 | 0.567279 | + | 0.2818 | 0.922125 | + |
| Chi square Fisher | 27.85711 | 0.00076 | – | 6.962238 | 0.446928 | + | 16.82921 | 0.009671 | – |
| Sarcadi test | 0.067352 | 0.577325 | + | 0.104256 | 0.381988 | + | 0.163129 | 0.022908 | – |
| Epps-Pally | 0.132216 | 0.759456 | + | 0.333283 | 0.13896 | + | 0.325253 | 0.148106 | + |

**Note**: S1_LA – lateral asymmetry index; S1_RA – indicator of the rotation angle at the apex of the dominant curve; S1_IA – generalized angle of curvature; SC – statistics of the criterion for n = 99; P – shows the two-sided p-value. Conclusion: for p = 0.1 "+" – the hypothesis of normality does not deviate; "–" – the hypothesis of normality is rejected

Table 3

Statistical characteristics of the spinal curves in postural stereotypes in subjects with different deformity grades

| Parameter | | Groups of subjects examined | | | |
|---|---|---|---|---|---|
| | | Orthopedically healthy subjects (n = 99) | Grade 2 scoliosis (n = 12) | Grade 3 scoliosis (n = 15) | Grade 4 scoliosis (n = 16) |
| S1_IA (degrees) | M ± m | 4.8 ± 0.22 | 14.1 ± 1.39 | 38.2 ± 1.47 | 55.1 ± 1.28 |
| | Kv | 45.8 % | 34.1 % | 14.9 % | 9.3 % |
| | t- | – | 6.6 | 22.5 | 38.7 |
| PKV (%) | Mm ± m | 62.7 ± 7.58 | 11.6 ± 1.56 | 5.3 ± 0.7 | 4.5 ± 1.13 |
| | Kv | 120.3 % | 46.6 % | 50.9 % | 100 % |
| | t- | – | 6.7 | 7.5 | 7.6 |

**Note**: S1_IA – generalized angle of curvature of the spine according to S1_LA and S1_RA indicators in the postural motor stereotype; PKV – index of the relative variation of the angular characteristic of S1_IA in the postural motor stereotype; M – arithmetic mean of the parameter; ± m – standard error of the mean; Kv – coefficient of variation of the parameter in the sample; "t-" – Student's t-criterion of reliability of differences relative to the norm

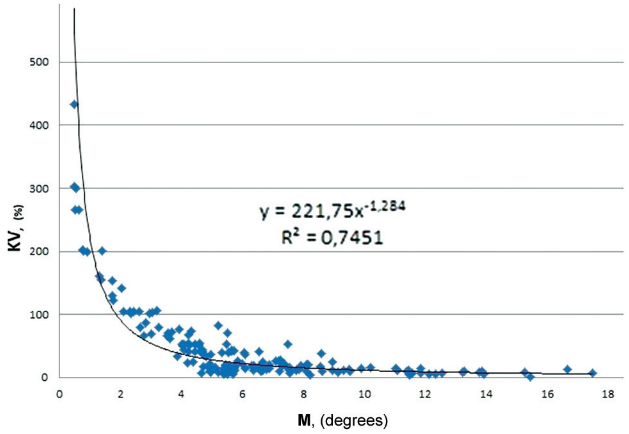


**Fig. 1** Power law of the dependence of the coefficients of variation of the generalized angle of curvature of the spine (S1_IA) on its arithmetic mean values in postural motor stereotypes in orthopedically healthy subjects. KV – coefficients of variation of S1_IA in postural stereotypes, M – its arithmetic mean values in stereotypes

DISCUSSSION

Both in the healthy norm and in the motor pathology, we revealed a similar character of the distribution of postural parameters in orthostatic stereotypes as in our earlier studies [28]. At the same time, the computational algorithms for estimating the stability of postural parameters developed in those studies appeared to be suitable for evaluating the postural function of spine curvatures. As a result, depending on the degree of variability of the curves, the angular stability or instability of spine curvatures in postural stereotypes was designated as an indicator of postural lability. Moreover, the analysis of the interrelationships between postural characteristics in stereotype sets made it possible to assess the postural function (lability) of the spine not separately in two parameters (M ± σ), but to integrate them in a single indicator that, depending on the severity, quantitatively characterizes the rigidity or mobility of the spine in a specific observed postural system. The developed index of postural lability (IPL) is expressed in percentages and is calculated by the following formula:

$$IPL = [1-0{,}134 \times \sigma \times M^{0{,}005}] \times 100\ \%, \quad (2)$$

where $\sigma$ is the standard deviation of the generalized angle of spinal curvature in the postural motor stereotype, $M$ is the mathematical expectation of the generalized angle of the curvature of the spine in a particular postural system.

Taking into account the considerable variability of the angular characteristics of spinal curvatures, both in sample and postural sets, it can be argued that in orthostatic stereotypes, not only single measurements of the angular parameters of the curve arches are diagnostic, but exclusively their mathematically expected values and standard deviations. The validity of such a statement is confirmed by the results of complex statistical testing. On most criteria with respect to the angular characteristics of spine curvatures, the hypothesis of the normality of distribution was not rejected. Consequently, based on the normal distribution properties [29], the arithmetic mean values for postural sets must coincide with their mode and median and carry all the necessary information about the location of the expected quantity, as well as the variation of its values in the postural set of the motor stereotype. However, as the study showed, a single variation criterion in a postural stereotype was not enough to characterize the lability of spine curvatures. The method of combining the basic sample characteristics (M; σ) of the angular curvature of the spine in a postural stereotype in the form of a relative variation in the variation coefficients (KV) in the mathematical aspect appeared to be suitable in a limited range of values. With average values in the stereotype of the curvature of the spine less than 6.5°, the relative angular variation exceeds the threshold of 20 % (**Fig. 1**); and when this threshold is exceeded, the variation of this sign in postural sets is considered strong. According to the standards adopted in medicine [30], strong diversity of the sign in the sample sets indicates a low degree of representativeness (typicality) of the corresponding average values and, consequently, the inexpediency of their use for practical purposes. With average values of the curvature of the spine in the orthostatic stereotype of more than 6.5 °, the relative angular variation does not exceed 20 % of the threshold (**Fig. 1**), and hence the average values are suitable for practical application, and the expected range of the angular characteristics in the general postural set with probability 99.7 % will correspond to ± 3σ deviations [30]. In comparison with the coefficient of variation, the empirically developed index of postural lability of spinal curvatures according to the calculation formula (2) in practical application turned out to be more universal. In postural stereotypes, according to the degree of correlation, the proposed indicator is almost functionally (r = -0.999974, for n = 161) associated with the expected angle of variation of the arch of curvature and is described by the linear regression equation with a high reliability ($R^2 = 0.9999$):

$$Y= -0{,}4452 \times X+44{,}498, \qquad (3)$$

where $Y$ is the expected range of postural variation of the generalized angle of curvature of the spine in degrees, and $X$ is the lability index of the arch of curvature in the postural motor stereotype in percents. Normally, the optimal values of the IPL (lability of spine curves in the orthostatic motor stereotype) for the generalized angle of curvature are in the range from 30 to 75 %. In this range of values, the optimal lability of the spine is ensured, which during the orthostatic adaptive activity adequately monitors the postural needs of the subject under examination. At IPL below 30 %, orthostatic stereotypes are accompanied by a strong angular variation of spine curvatures and topographically manifested by the rapid onset of postural decompensation [31]. At IPL more than 75 %, spinal curvatures become rigid.

An **example of calculating** the postural lability of the spine.

Patient O., 14 years old, with idiopathic C-shaped thoracolumbar scoliosis of grade 3-4 was examined. Right-side costal hump. Spondylogram determined a C-shaped deformity of the thoracolumbar spine with an apex at Th7-8, and angle of 60 ° (**Fig. 2**). According to topography data, the calculated lateral asymmetry angle (topographic analogue of the Cobb R-angle) was 61.6° (**Fig. 3**). Topographic examination showed that the patient quickly developed postural decompensation by enhancement of the C-shaped deformity (Table 1). Post-computer data processing found the range of variation in the S1_LA lateral asymmetry stereotype of 14º and, on average, ten values (61.5º) approached the magnitude of the R-image. The range of the generalized angle of curvature S1_IA was 17º. The average value (M) of S1_IA was 47.65º and the standard deviation (σ) of the S1_IA indicator was 5.77º. The index of postural lability of spinal deformity (IPL) was calculated by the formula (2):

$$IPL = [1 - 0{,}134 \times 5{,}77 \times 47{,}65^{\,0{,}005}] \times 100\,\% = 21{,}2\,\%.$$

The obtained value is less than 30 %, which corresponds to a strong angular variation of the dominant curve and is interpreted as a mobile deformity.

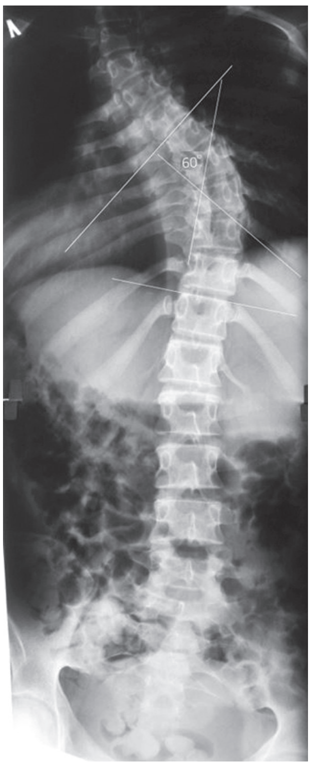


**Fig. 2** X-ray of the spine in the frontal projection of patient O., 14 years old. DS: idiopathic scoliosis of grade 3-4. Calculated R-angle of Cobb is 60º

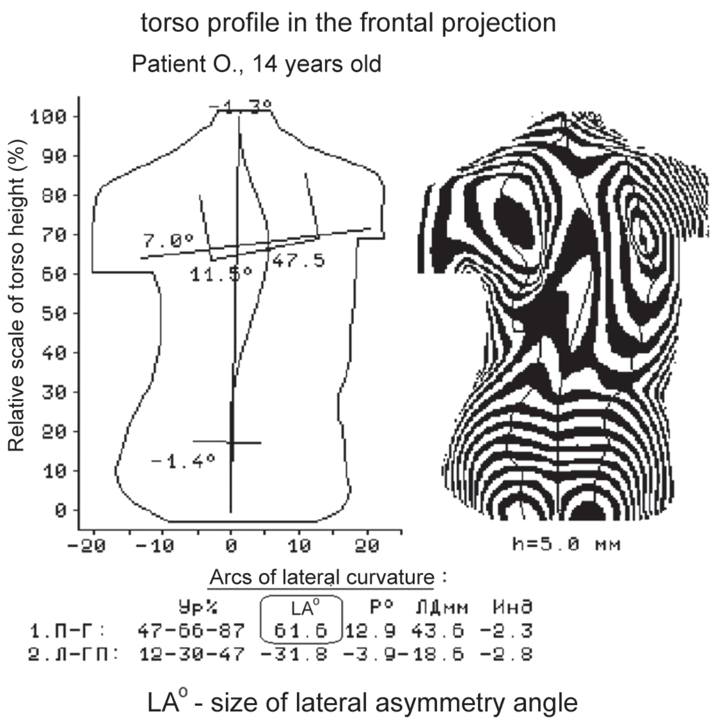


**Fig. 3** Fragment of the topogram (torso profile in the frontal projection): LAº – calculated lateral asymmetry angle (topographic analogue of the Cobb R-angle) is 61.6°

**Case 2**. Patient Ch., aged 16, applied to the Center's consultative department. According to the X-rays taken in the prone position a month before the topographic examination, C-shaped deformity of the spine with an apex at T8 and a Cobb angle of 12° was found. According to the results of topographic examination, the lateral curve in the frontal plane corresponded to a healthy norm and healthy subnorm, and in the sagittal projection – the posture was a stooped back. The average value (M) of the generalized angle of the curve in the stereotype by ten values was 5.58º, and the standard deviation (σ) was 1º. Calculation of postural lability of his spinal deformity according to formula (2) was IPL = 86.48 %, which corresponds to a rigid spinal column.

## CONCLUSIONS

1. In orthostatic stereotypes, mean arithmetic values and root-mean-square errors of angular indices of spinal curves obtained by prolonged topographic examination more fully reflect the state of spinal curvatures and, in comparison with single measurements, have a more informative and diagnostic value.

2. Postural characteristics of spinal deformities in terms of the expected magnitude of curvature and variability in sample populations are significantly different: if in the postural and in the sample sets the angular characteristics of spinal curvatures obey the law of normal distribution, then their postural variation in sample sets tends to a power-law type of distribution.

3. In orthostatic position, the power-law type of the distribution of the variability of postural characteristics was detected not only with respect to vertically and horizontally oriented kinematic elements of the torso, but also showed itself reliable with respect to the angular characteristics of spinal curvatures.

4. A quantitative topographical estimation of the functional mobility of the spine in orthostatic stereotypes is proposed based on the index of postural lability (IPL). Normally, IPL is in the range of 30 to 75 %. If the index is less than 30 %, the spine is hypermobile; if it is more than 75 %, the spinal column is rigid.

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