ANALYSIS OF ANATOMICAL AND ANTHROPOMETRIC PARAMETERS OF VERTEBRAE IN CHILDREN WITH THORACIC IDIOPATHIC SCOLIOSIS USING 3D-CT-NAVIGATION

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Objective. To analyze anatomical and anthropometric parameters of vertebrae measured by a navigation system in children with thoracic idiopathic scoliosis.
Material and Methods. A total of 20 patients aged 14—18 years with Grade 3 and 4 (according to V.D. Chaklin classification) right-sided thoracic idiopathic scoliosis were examined. Anatomical and anthropometric features of the thoracic and lumbar vertebrae were assessed using CT data in the navigation system. The total Cobb angle of scoliotic curve, rotation of apical and periapical vertebrae, external transverse and longitudinal diameters of the roots of vertebral arches at the T2—L5 levels, and the coefficients of asymmetry of vertebral bone structures were determined.
Results. The angle of scoliosis deformity ranged from 33.7° to 107.9° (mean: 61.4°), the angle of rotation of the apical vertebra — from 9.3° to 40.2° (mean: 21.09°). Positive correlation between the magnitude of scoliotic arch deformity and asymmetry coefficients of longitudinal diameter of the arch roots of the apical vertebrae was found. A pronounced asymmetry of right and left transverse diameters of arch roots of the T3—T4 vertebrae, despite the absence of structural compensatory counter curve and torsional changes in these vertebrae.
Conclusion. There are certain regularities and correlations between the type of idiopathic scoliosis and the absolute and relative values of vertebral parameters not only at the top of the curve, but also throughout the whole curvature arch.
Key Words: idiopathic scoliosis, Lenke 1, anatomic and anthropometric parameters, rotation of the apical vertebra, transpedicular fixation, children.

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Nowadays surgical treatment of children with idiopathic scoliosis continues active development and impovement. In recent years, transpedicular screw fixation systems gets increasing applications in correction of spinal deformities in patients with idiopathic scoliosis. Transpedicular screws are widely used as supporting elements for dorsal spinal systems, as all three columns of the spine can be effectively manipulated during spinal deformity correction, a significant outcome of the correction can be achieved, and reliable stabilization can be preserved in the long-term [1, 3, 4, 15]. After transpedicular fixation has been implemented into the practice of spinal surgery, a question came up whether it is possible to place transpedicular screws into vertebral bodies with allowance of the anatomo-anthropometric features of vertebral pedicles [14]. The normal anatomy of vertebral bodies was assessed in some research papers [7, 12, 16, 17] to evaluate anatomical and anthropometric parameters of vertebrae in terms of using transpedicular fixation. In the 1990s, spinal surgeons started using thoracic transpedicular fixation more frequently in surgical treatment of patients with idiopathic scoliosis [6, 10, 15]. Studies have recently been published where the anatomoical and anthropometric parameters of deformed vertebrae in idiopathic scoliosis were assessed using cadaver material and the CT and MRI data [5, 11, 13]. However, authors of these papers discussed the data related to the main parameters of scoliotic vertebrae for different types of spine curvature. There are no available studies devoted to the analysis of anatomical and anthropometric parameters of vertebrae in one single type of idiopathic scoliosis and assessment of the regularities observed for these features depending on the type of spine curvature.

Our study aims to analyze anatomical and anthropometric parameters of vertebrae in children with idiopathic thoracic scoliosis using a navigation system.

Material and Methods

A total of 20 patients aged 14–18 years with Grade 3 and 4 (according to V.D. Chaklin's classification) idiopathic thoracic scoliosis were examined. The sex distribution was typical of that for idiopathic scoliosis: 2 male and 18 female patients. All patients had right-sided thoracic scoliotic curves.

Idiopathic scoliosis was diagnosed according to the routine inpatient examination that included clinico-neurological, instrumental, and radiological methods (X-ray and CT of the spine), MRI of the craniovertebral region, the thoracic and lumbar spine.

Anatomical and anthropometric parameters of thoracic and lumbar vertebrae were assessed using the CT data. Examination was carried out on a Brilliance CT64 computed tomography scanner (USA). CT scanning was performed in the prone position in order to achieve maximum similarity to patient's position on an operating table. CT scans were recorded (slice thickness, 1 mm) and imported into the navigation system equipped with the "Spine Map 3D" software using a data carrier; all required measurements were performed [2]. The sequence of operations when analyzing the anatomo-anthropometric parameters of vertebrae was as follows: the total Cobb angle (angle scoliosis), rotation of the apical vertebra (RAV), rotation of the proximal (RPPV) and distal (RDPV) periapical vertebrae, the external transverse (trd) and longitudinal (lngd) diameters of right (R) and left (L) vertebral pedicles were determined at the level from T2 to L5 vertebrae (Fig. 1).

The areas of the right (SR) and left pedicles (SL) were calculated as a product of trd by lngd. The following coefficients were introduced to reveal the regularities of the scoliotic process characterized by asymmetric development of vertebral bone structures: KAtrd – the asymmetry coefficient of transverse diameters of pedicles determined as the trdR/trdL ratio; KAlngd – the asymmetry coefficient of longitudinal diameters of the pedicles determined as the lngdR/lngdL ratio; KAS – the asymmetry coefficient of pedicle areas determined as the SR/SL ratio.

It should be mentioned that it is difficult to provide an accurate numerical value of pathological rotation of the apical, and especially periapical, vertebrae at the apex of scoliotic curve (expressed in degrees) because of the pronounced spatial changes in the relationships between the anatomical structures of the deformed vertebrae in children with idiopathic scoliosis and because it is impossible to assess rotation of periapical vertebrae in the plane where rotation of the apical vertebra takes place. In order to increase the accuracy of determining the RAV, RPPV, and RDPV, we have developed a method for measuring vertebral body rotation in children with idiopathic scoliosis in the navigation system, when one of the lines is drawn through the point lying on the base of a spinous process and through a point on the anterior edge of the vertebral body that is maximally distant from the point on the base of the spinous process; the second line is oriented perpendicularly to the horizontal plane of the table in the navigation system until it crosses the first line. The angle formed between the intersecting lines is the angle of vertebral rotation (Fig. 2).

All studied anatomical and anthropometric parameters of the vertebrae and various asymmetry coefficients were compared by calculating the descriptive statistics. The distributions of vertebral metric parameters along the spine were compared using multivariate analysis of dispersion and the Hotelling's T-squared test. The Kolmogorov–Smirnov test was used to verify the normality of marginal distributions. Correlation analysis, the method of correlation pleiades modified by V.P. Terentjev, and visual analysis of box plots were employed to reveal regularities in the relationships between the parameters.

Results

According to our findings, the Cobb angle determined using the aforedescribed procedure, ranged from 33.7 to 107.9° (mean, 61.4°). The angle of RAV ranged from 9.3 to 40.2° (mean, 21.09°); the angle of RPPV, from 2.1 to 36.6° (mean, 17.7°); the angle of RDPV, from 6.3 to 30.0° (mean, 17.1°). The absolute magnitudes of the transverse and longitudinal diameters of vertebral pedicles, their areas and their asymmetry coefficients are listed in Tables 1–3.

The data on the trd, lngd, and areas of the pedicles are presented in tables as the mean and the standard error of the mean; for asymmetry coefficients, the data are presented as the median, minimum, and maximum values.

In multivariate analysis of dispersion, the Hotelling's T-squared test for linked samples was used for the trd, lngd, and areas of the vertebral pedicles in order to compare en masse the right and left pedicles. Table 4 shows the results of this test. The Kolmogorov–Smirnov test was used for all three parameters to verify that the samples are homogeneous with respect to each sample. In none of the observations the test rejected the hypothesis on normal distribution of the parameter (the test significance $P > 0.05$).

The results of using the Hotelling's test allow one to suggest that there is unambiguous and drastic difference between the populations of the transversal and longitudinal diameters of the right and left pedicles.

Box plots were built to reveal the anatomical and anthropometric features of vertebrae in the primary scoliotic curve (Figs. 3–7).

Visual analysis of the plots allows more meticulous consideration of the difference between the diameters of the right and left vertebral pedicles that were revealed above using the Hotelling's test.

Hence the trdR values decreased in the upper thoracic spine, starting from the T2 level (5.3 ± 0.9 mm) and reached the minimum at the T4 level (2.9 ± 0.8 mm). The size then increased in the craniocaudal direction to reach its maximum at the T11 level (16.7 ±

2.4 mm). Next, a small decrease in the parameter until the L1 level (6.1 ± 1.6 mm) was observed.

The regularity of changes in the trdL values on the box plot was different. The size of vertebrae changed more smoothly and gradually starting from the T2 level (6.5 ± 0.9 mm) with the minimum values achieved at the T7 level (3.6 ± 1.2 mm). The trdL values then increased towards the T12 vertebra to reach the value of 7.4 ± 1.0 mm.

It should be mentioned that the direction of changes in size of trdR and trdL for lumbar vertebrae was similar and was characterized by increasing size of transverse diameters of pedicles in craniocaudal direction; the maximum values were reached at the L5 level (Fig. 3).

Visual analysis of changes in lngd of pedicles also showed significant differences in the thoracic spine. The lngdR value increased smoothly in the craniocaudal direction, starting from the T2 level (10.6 ± 1.6 mm) to reach its maximum at the T11 level (11.7 ± 2.4 mm). Then it slightly decreased at the T12 level (15.7 ± 1.9 mm). The distribution of values of the lngdL parameter in the thoracic spine was different. The lngdL size decreased, starting from the T2 level (11.5 ± 1.6 mm), reaching its minimum values at the T7 level (9.7 ± 1.8 mm). The lngdL parameter then increased in the craniocaudal direction to reach its maximum at the T11 level (17.3 ± 1.7 mm).

Dependences of lngdR and lngdL of pedicles on the vertebra's position in the lumbar spine were also similar and decreased in the craniocaudal direction; the minimum values were achieved at the L5 level (Fig. 4).

The following regularities were detected when assessing the asymmetry coefficients of trd and lngd of pedicles in the thoracic spine. The KAtrd was characterized by the maximum deviation from unity at the T4 (0.60 (range, 0.30–1.30)) and T8 levels (1.38 (range, 0.93–2.45). Contrariwise, the KAlngd in the upper thoracic spine had near-unity values and gradually increased to reach its maximum value (maximum asymmetry) at the T7–T8 level (1.31–1.32), while further decreasing in the caudal direction. In the lumbar spine, the KAtrd and KAlngd were close to unity, thus characterizing the absence of pronounced structural changes (Fig. 5).

The following features were revealed when assessing the areas of pedicles, which represent their physical parameters. The SR value decreased starting from the T2 level (56.2 ± 15.2 mm^2) to reach its minimum at the T4 level (31.8 ± 10.5 mm^2). Then it increased in the craniocaudal direction and reached its maximum at the T11 level (121.3 ± 27.8 mm^2). The SR further increased to the L2 level (83.8 ± 25.1 mm^2), followed by an increase in the caudal segments of the lumbar spine.

The SL value decreased smoothly from the T2 level (75.6 ± 17.0 mm2) and reached its minimum at the T7 level (36.6 ± 16.9 mm2). Next, it increased in the craniocaudal direction and reached its maximum at the T12 level (125.3

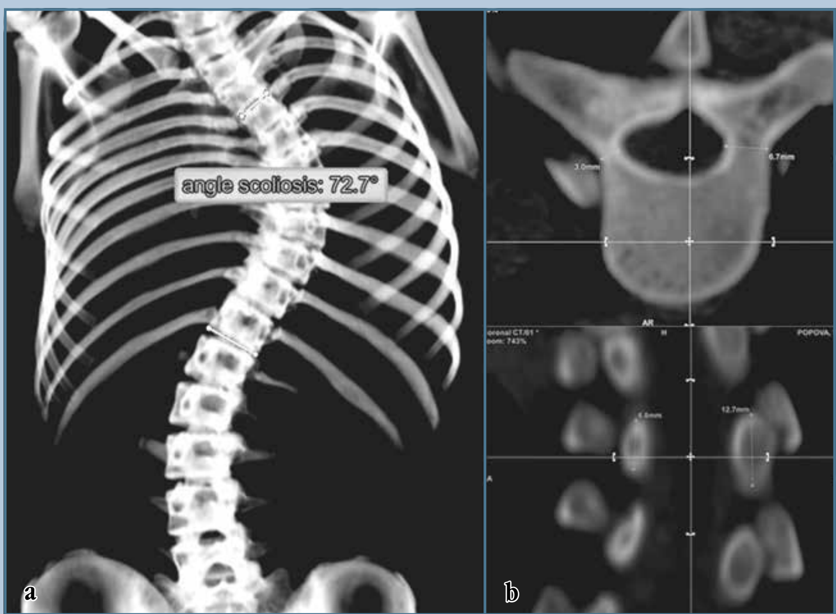

Fig. 1
CT scan of 17-year-old patient P. with Grade 4 idiopathic right-sided thoracic curved scoliosis recorded using the Spine Map 3D software: **a** – Cobb angle; **b** – the transverse and longitudinal diameters of the pedicle of the apical vertebra

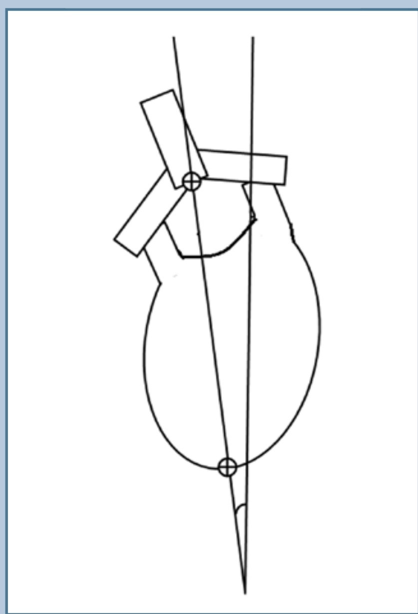

Fig. 2
Method for measuring rotation of vertebral bodies in children with idiopathic scoliosis using a navigation system

Table 1

Transverse diameters of vertebral pedicles and their asymmetry coefficients (M ± m)

Vertebrae	trdR, mm	trdL, mm	KAtrd	Vertebrae	trdR, mm	trdL, mm	KAtrd
T2	5,3 ± 0,9	6,5 ± 0,9	0,82 (0,54–0,98)	T10	6,4 ± 1,3	5,1 ± 1,3	1,27 (0,84–1,69)
T3	3,3 ± 1,0	5,3 ± 1,1	0,63 (0,25–1,00)	T11	7,3 ± 1,2	6,8 ± 1,4	1,06 (0,82–1,97)
T4	2,9 ± 0,8	4,6 ± 0,8	0,60 (0,30–1,30)	T12	7,0 ± 1,0	7,4 ± 1,0	0,91 (0,79–1,27)
T5	3,5 ± 1,0	4,5 ± 1,1	0,76 (0,33–2,55)	L1	6,1 ± 1,6	6,2 ± 1,4	0,96 (0,59–1,50)
T6	4,4 ± 1,1	4,2 ± 1,2	0,98 (0,57–2,22)	L2	6,2 ± 1,7	6,3 ± 1,2	0,95 (0,59–1,41)
T7	4,8 ± 1,0	3,6 ± 1,2	1,31 (0,72–3,11)	L3	8,5 ± 1,7	7,9 ± 1,2	1,11 (0,79–1,33)
T8	5,1 ± 0,7	3,6 ± 1,0	1,38 (0,93–2,45)	L4	10,4 ± 1,9	10,3 ± 1,5	0,97 (0,76–1,73)
T9	5,6 ± 0,9	4,3 ± 1,2	1,33 (0,86–2,30)	L5	14,5 ± 2,0	15,6 ± 2,1	0,93 (0,74–1,38)

trdR – the transverse diameter of the right pedicle of the curve; trdL – the transverse diameter of the left pedicle of the curve; KAtrd – the asymmetry coefficient of the transverse diameters of pedicles, which is determined as the trdR/trdL ratio.

Table 2

Longitudinal diameters of the vertebral pedicles and the asymmetry coefficient (M ± m)

Vertebrae	lngdR, mm	lngdL, mm	KAlngd	Vertebrae	lngdR, mm	lngdL, mm	KAlngd
T2	10,6 ± 1,6	11,5 ± 1,6	0,91 (0,80–1,04)	T10	15,6 ± 1,7	14,8 ± 1,9	1,02 (0,90–1,50)
T3	10,7 ± 1,3	12,0 ± 1,7	0,90 (0,66–1,17)	T11	16,7 ± 2,4	17,3 ± 1,7	0,96 (0,73–1,24)
T4	10,9 ± 1,3	10,8 ± 1,5	0,98 (0,85–1,31)	T12	15,7 ± 1,9	16,8 ± 2,1	0,92 (0,87–1,04)
T5	11,6 ± 1,2	10,1 ± 1,3	1,11 (0,95–1,59)	L1	14,3 ± 1,3	14,8 ± 2,0	0,96 (0,84–1,38)
T6	12,6 ± 1,5	9,7 ± 1,3	1,30 (1,03–1,58)	L2	13,5 ± 1,1	14,6 ± 1,0	0,94 (0,79–1,04)
T7	12,7 ± 1,5	9,7 ± 1,8	1,31 (1,01–1,90)	L3	13,9 ± 1,0	14,3 ± 1,0	0,97 (0,91–1,15)
T8	13,3 ± 1,6	10,2 ± 1,4	1,32 (1,04–1,67)	L4	13,3 ± 0,9	13,3 ± 1,2	1,00 (0,86–1,16)
T9	13,8 ± 1,7	11,8 ± 1,6	1,12 (0,74–1,66)	L5	12,9 ± 2,4	12,7 ± 2,1	1,02 (0,90–1,25)

lngdR – the longitudinal diameter of the right pedicle of the curve; lngdL – the longitudinal diameter of the left pedicle of the curve; KAlngd – the asymmetry coefficient of the longitudinal diameters of pedicles, which is determined as the lngdR/lngdL ratio.

Table 3

The transverse diameters of the pedicles multiplied by longitudinal diameters and the corresponding asymmetry coefficients (M ± m)

Vertebrae	SR, mm^2	SL, mm^2	KAS	Vertebrae	SR, mm^2	SL, mm^2	KAS
T2	56,2 ± 15,2	75,6 ± 17,0	0,76 (0,44–1,02)	T10	100,0 ± 26,2	76,3 ± 29,0	1,28 (0,78–2,53)
T3	36,4 ± 12,9	64,7 ± 18,5	0,57 (0,21–1,07)	T11	121,3 ± 27,8	118,1 ± 31,0	0,97 (0,68–2,21)
T4	31,8 ± 10,5	50,5 ± 13,2	0,59 (0,29–1,70)	T12	110,2 ± 26,9	125,3 ± 27,9	0,88 (0,73–1,18)
T5	41,1 ± 13,1	46,2 ± 14,4	0,77 (0,32–3,92)	L1	87,0 ± 27,5	93,0 ± 28,2	0,93 (0,50–2,06)
T6	55,1 ± 15,7	41,3 ± 15,8	1,29 (0,67–3,08)	L2	83,8 ± 25,1	92,0 ± 20,8	0,87 (0,61–1,36)
T7	60,7 ± 15,9	36,6 ± 16,9	1,76 (0,80–4,73)	L3	118,6 ± 24,9	112,9 ± 21,7	1,08 (0,76–1,29)
T8	68,0 ± 13,7	37,1 ± 12,8	1,94 (1,15–3,88)	L4	138,9 ± 27,6	136,8 ± 23,7	0,99 (0,72–1,48)
T9	78,0 ± 17,0	51,8 ± 19,0	1,55 (0,73–3,09)	L5	187,8 ± 46,3	199,2 ± 41,4	0,94 (0,67–1,27)

SR – area of the right pedicle; SL – area of the left pedicle; KAS – the asymmetry coefficient of areas of pedicles of a vertebra determined as the SR/SL ratio.

± 27.9 mm^2). The SL then decreased to the L2 level (92.0 ± 20.2 mm^2) and subsequently increased in the caudal segments of the lumbar spine (Fig. 6).

Figure 7 illustrates the significant features of the dependence between the asymmetry coefficients of the areas

Table 4
Comparison of the mean transverse and longitudinal diameters and areas of the pedicles for the right and left sets

Parameters	T-squared statistic	Noncentral F-distribution with 16 and 4 degrees of freedom	Significance level of P value
Transverse diameters	482,5	6,4	0,043
Longitudinal diameters	1225,4	16,5	0,0075
Areas	436,2	5,7	0,052

of pedicles in the thoracic spine. The KAS values were characterized by the maximum deviation from the unity at the T4 (0.59 (range, 0.29–1.70) and T8 levels (1.94 (range, 1.15–3.88)), while approaching the unity in the caudal direction. In the lumbar spine, the KAS values were near-unity, thus demonstrating that there were no pronounced structural changes (Fig. 7).

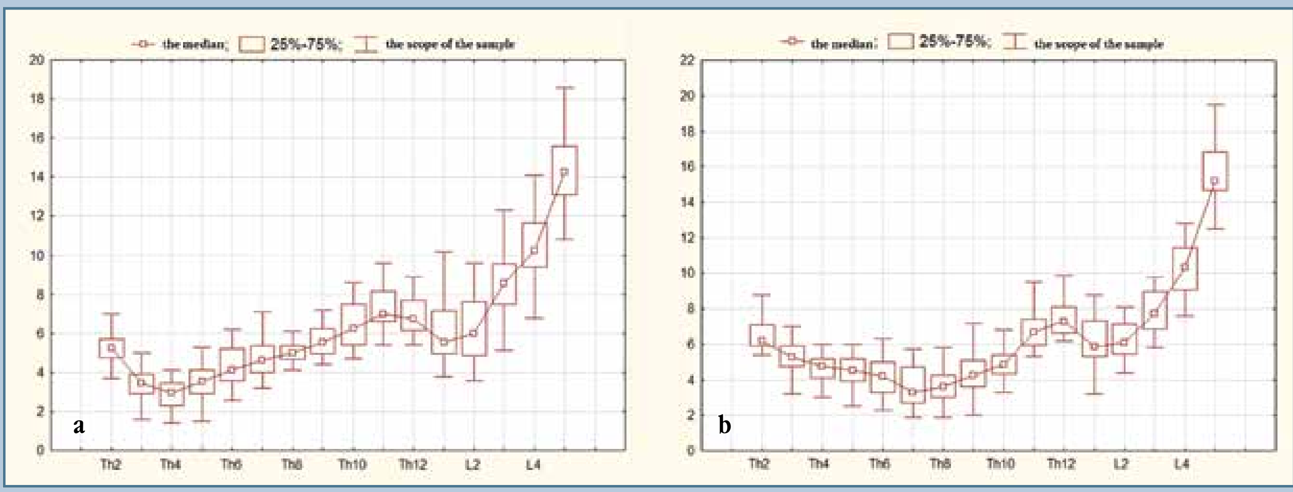

Fig. 3
Joint box plot for the transverse diameters of right (a) and left (b) pedicles of thoracic and lumbar vertebrae

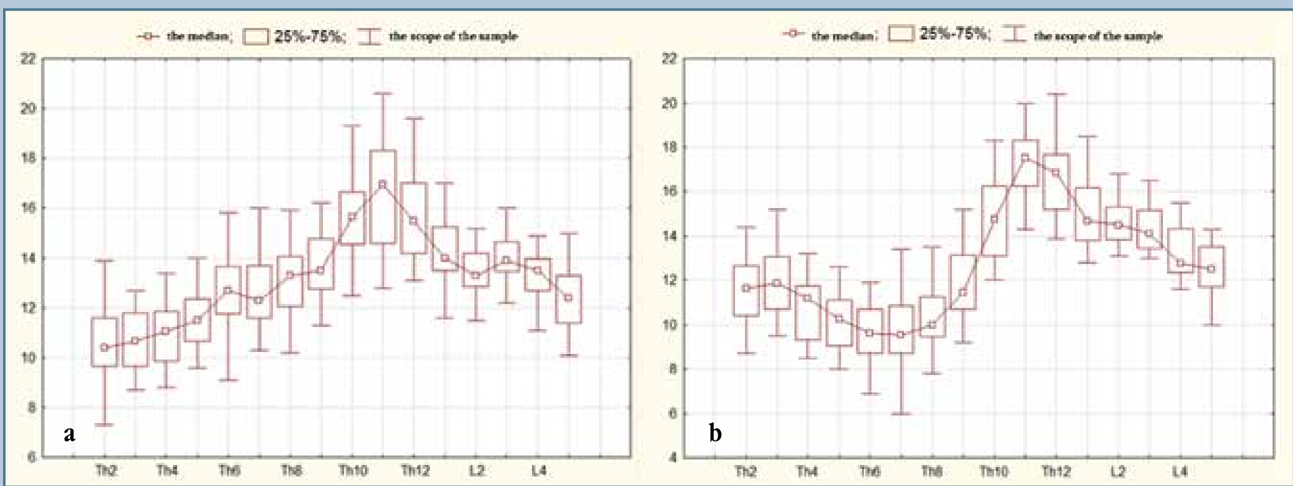

Fig. 4
Joint box plot for the longitudinal diameters of right (a) and left (b) pedicles of thoracic and lumbar vertebrae

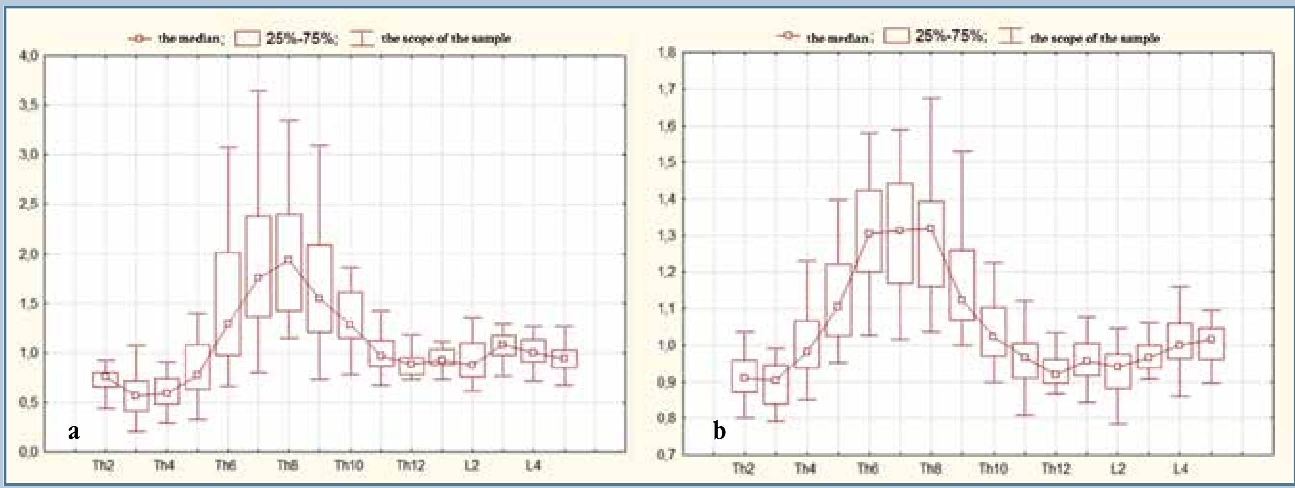

Fig. 5
Joint box plot for the asymmetry coefficients of right **(a)** and left **(b)** pedicles of thoracic and lumbar vertebrae

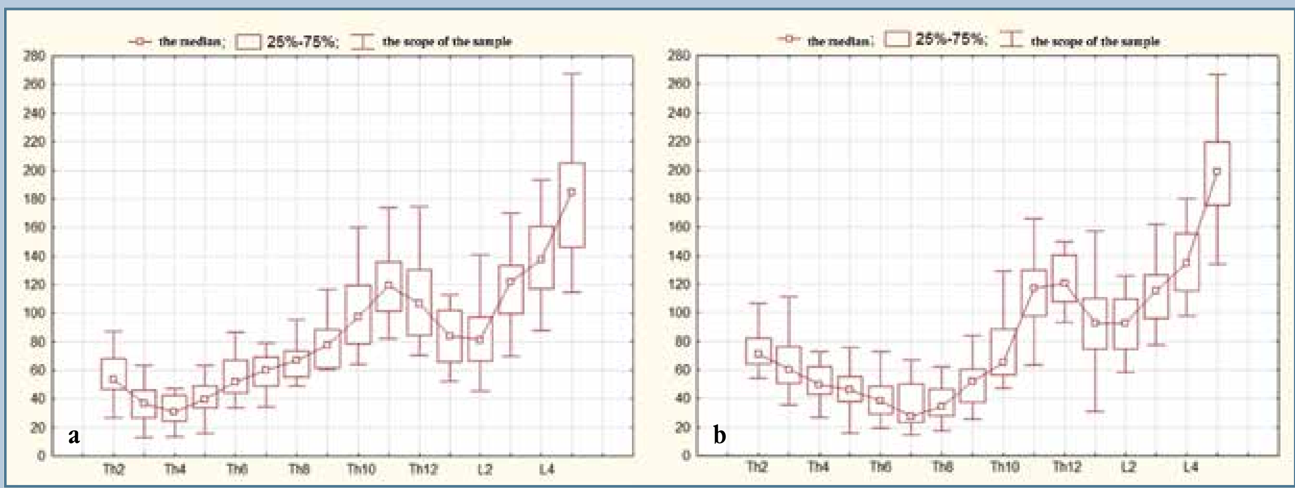

Fig. 6
Joint box plot for the intermultiplied diameters of right **(a)** and left **(b)** pedicles of thoracic and lumbar vertebrae

The analysis using the method of correlation Pleiades modified by V.P. Terentjev was performed for ten parameters: the Cobb angle and another nine anatomical and anthropometric parameters of the apical vertebra (Fig. 8).

The diagram shows the relationship between the parameters, whose correlation coefficient r differs significantly from zero (significance level, $P < 0.05$).

The pleiade of the level $|r| > 0.7$ (solid line in Fig. 8) consisting of such parameters as RAV, the Cobb angle, and KAlngd comes under notice. This emphasizes the clinical significance of the relationship between RAV as a local parameter characterizing the spatial position of the vertebra, the Cobb angle as a global parameter, and the ratio between the longitudinal diameters of pedicles of the apical vertebra representing the structural deformity of the apical vertebra. The parameter lngdL of the apical vertebra is also added at the level of the pleiade $|r| > 0.5$ (dashed line in Fig. 8). One can see strong correlations between the asymmetry coefficient of the areas of pedicles, the asymmetry coefficient of transverse diameters of pedicles, and the transverse diameter of the left pedicle of the apical vertebra, which form a pleiade at the level $|r| > 0.5$.

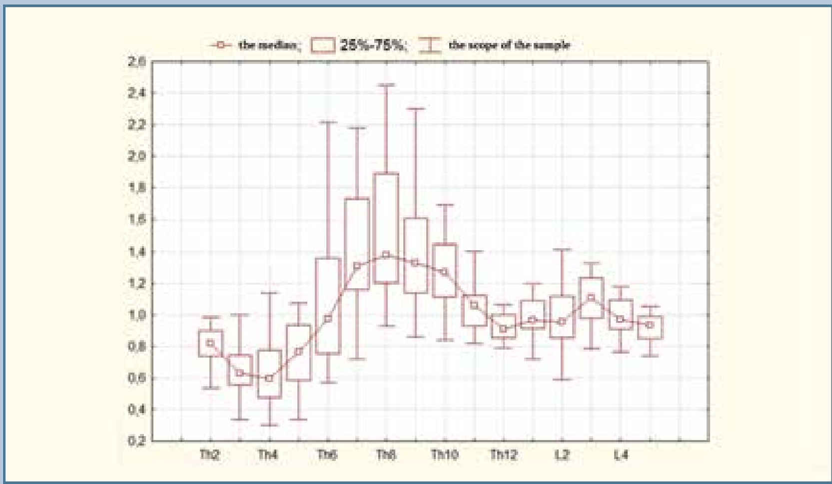

Fig. 7
Joint box plot for the asymmetry coefficients of the areas of pedicles of thoracic and lumbar vertebrae

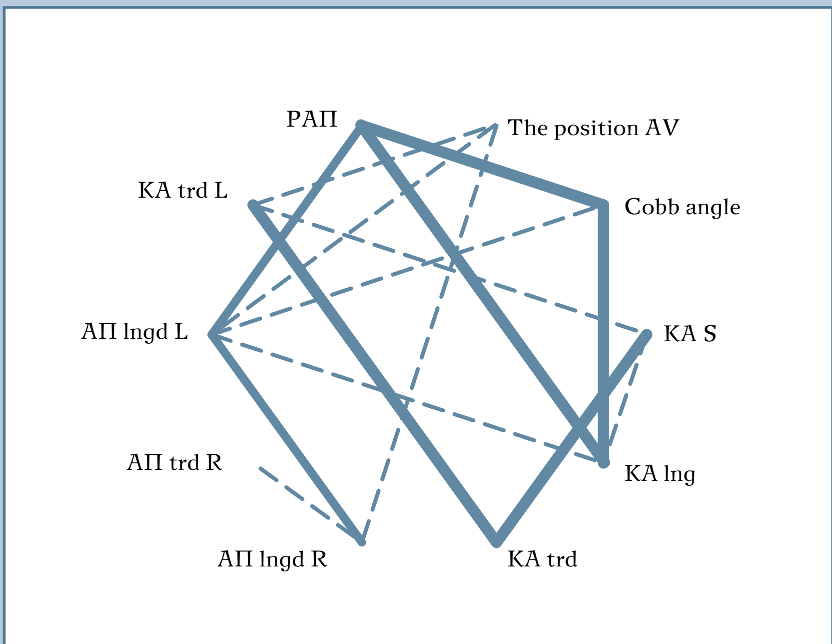

Fig. 8
Correlation Pleiades modified by Terentjev: solid line – Pearson correlation coefficients (r) with the absolute magnitude > 0.7: |r| > 0.7; dashed lines – the range 0.5 < |r| < 0.7; line thickness is proportional to the corresponding value of the absolute magnitude |r|; RAV – rotation of the apical vertebra; AV – apical vertebra; L – the left pedicle of the vertebral arch; R – the right pedicle of the vertebral arch; trd – transverse diameter of vertebral pedicles; lngd – longitudinal diameter of vertebral pedicles; KAS – the asymmetry coefficient of the areas of vertebral pedicles; KAlngd – the asymmetry coefficient of the longitudinal diameters of vertebral pedicles; KAtrd – the asymmetry coefficient of the transverse diameters of vertebral pedicles

Discussion

There are studies demonstrating that the parameters of vertebral pedicles in patients with idiopathic scoliosis can be evaluated more precisely using the navigation system software rather than using the data obtained by CT examination of the spine. Hence Kuraisi et al. [8] studied the morphology of vertebrae in children with idiopathic thoracic scoliosis and revealed the difference between the transverse diameters of pedicles obtained by routine CT examination of the spine and those obtained by examination using the navigation system. According to the analysis, more accurate parameters of vertebral bone structures were obtained when using the navigation system for assessment [8]. Interesting and ambiguous conclusions were made by the researchers who studied the features of vertebral anatomy according to the MRI data. Hence Catan et al. [5] examined the morphology of the vertebra in 13 adolescents with Grade 1, 3 and 4 idiopathic scoliosis according to the Lenke classification [9] and revealed no statistically significant difference between the transverse diameters of the vertebral pedicles on the convex and concave sides in patients with right-sided thoracic deformity. Taking these facts into account we believe that the evaluation method for obtaining the digital parameters is the key aspect in achieving accuracy and reliability of the analysis of the features of anatomical and anthropometric parameters of vertebral structures in the scoliotic curve.

Some researchers [16, 17] report a certain similarity between the craniocaudal gradient of the diameters of the vertebral pedicles in normal condition and in patients with scoliosis. However, the variation in diameters of pedicles at the apex of the primary scoliotic curve is clearly associated with the scoliotic process caused by asymmetric growth of the vertebral bone structures and represents its features depending on type of idiopathic scoliosis. According to our findings, there are certain regularities in changes in the anatomical and anthropometric features of pedicles (in particular, their transverse and longitudinal diameters) depending on vertebral localization in the primary scoliotic curve.

We would like to emphasize the revealed regularity that consists in the pronounced asymmetry between the transverse diameters of the right and left pedicles in the upper thoracic spine at the T3–T4 level in patients with idiopathic right-sided thoracic scoliosis, despite the absence of structural compensatory curve and torsional changes in these vertebrae. In all patients involved in the study group, transverse diameters of the left vertebral pedicle predominated over those of the right ones as confirmed by their asymmetry coefficient, whose median was 0.60–0.63 for the T3–T4 level.

It is important to mention that an analysis of the severity of scoliotic changes at the apex of the primary scoliotic curve in children with thoracic idiopathic right-sided scoliosis showed a strong correlation (Pearson correlation coefficient $|r| > 0.7$) between the Cobb angle and rotation of the apical vertebra, on the one hand, and the introduced by authors asymmetry coefficient of longitudinal diameters of the pedicle at the level of the apical vertebra, on the other hand. According to the results, the higher the Cobb angle – the greater the rotation magnitude and the higher the asymmetry coefficient of longitudinal diameters of the pedicles of the apical vertebra are. Simultaneously, we would like to draw one's attention to the absence of correlation of the Cobb angle and RAV with the transverse diameter of the left pedicle and asymmetry coefficient of transverse diameters of the apical vertebra.

Hence, one can state that the revealed strong correlation between the magnitude of the primary scoliotic curve, rotation of the apical vertebra, and the asymmetry coefficient of the longitudinal diameters of vertebral pedicles at the level of apical vertebra in children with idiopathic right-sided thoracic scoliosis represents the features of formation and development of structural changes taking place in vertebrae as a result of the scoliotic deformation process.

Conclusions

The analysis of the features of the anatomical and anthropometric parameters of vertebrae in children with idiopathic right-sided thoracic scoliosis using 3D-CT navigation allowed us to detect certain regularities and correlations between the absolute and relative values of vertebral parameters and the type of idiopathic scoliosis not only at the apex of the curve, but also throughout the entire curve.

A positive correlation between the scoliotic curve magnitude and the asymmetry coefficient of longitudinal diameters of pedicles of the apical vertebra was revealed. Meanwhile, no correlation between the Cobb angle and the asymmetry coefficient of transverse diameters of the pedicles of the apical vertebra was observed. The unique regularity consisting in the pronounced asymmetry of the transverse diameters of right and left vertebral pedicles at the T3–T4 level was also detected; the absolute and relative parameters of transverse diameters of the left-sided pedicles predominated over the right-sided ones in children with idiopathic right-sided thoracic scoliosis. These changes were observed in all cases, despite the absence of structural compensatory curve and torsional changes in upper thoracic vertebrae.

The revealed features of parameters of vertebral bone structures in children with idiopathic right-sided thoracic scoliosis make it possible to perform rational preoperative planning and accurately determine the levels for positioning the screws during surgical intervention.

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