The Influence of Judo Special Training on Spinal Shape Changes

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In a formation of the posture in humans, a significant role is attributed to the spine curves and position of pelvis. Many authors stress the relation between inclination of the pelvis and position of the spine and its curvatures. Apart from this anatomo-biomechanical relation in which the role of the abdominal muscles tension should not be omitted, the effect of training overpressure on the spine is also well recognized.

In some sport disciplines, specificity of training exerts marked effect on the anterio-posterior spine curvatures. Increase of the thoracic kyphosis or lumbar lordosis may produce typical overloading and degenerative phenomenon and may become a source of pain.

On the other hand, decrease of the anterio-posterior spine curvatures may reduce the shock-absorbing function, resistance to force as well as the protection of the central nervous system against microshocks and traumas.

The purpose of the present investigation was to examine the anterio-posterior spine curvatures in the representatives of the track sports.

MATERIAL AND METHOD

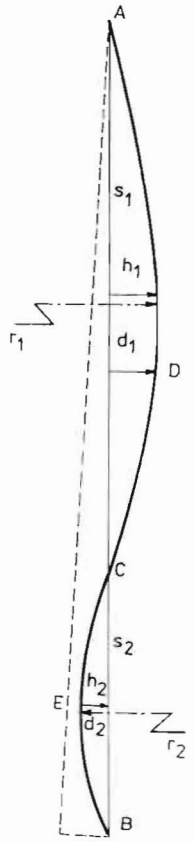
The study was performed on 44 judo sportsmen (males) in the age ranging from 19 to 34 years, practising sport from 2 to 15 years. For comparison, a group of 150 students of the Technical University in Wroclaw, in the age 19-20 years, who apart from the physical training

classes (2 hours once a week), were not involved in any sport discipline.

The spine curvatures were registered by means of an electronic spherosomatograph designed and made in the Technical University in Wroclaw. This device registers on the paper or projects on the screen the spine curvatures in the frontal and saggital plane with the error not exceeding 3%.

At the same time the co-ordinates of the particular spine curves are transmitted to the computer memory. Appropriate programs calculate within a few seconds the parameteres characterizing the size of the particular fragments of the spine curve.

Analysis of the spine curves was performed by the «Radius Method with Intersection Point» elaborated by Professor Wielki (Fig. 1). This method describes the spine curves by giving the Radius Dorsal Curve, Radius Lumbar Curve, Dorso-Lumbar Index, Inclination Index and others.



A. upper point - C_7
C. intersection point
D. top of cyphosis
s_1 half - cord of cyphosis
h_1 height of cyphosis
r_1 radius of cyphosis
d_1 distance between the top and cord of cyphosis

B. lower point L_5 +4 cm
E. top of lordosis
s_2 half - cord of lordosis
h_2 height of lordosis
r_2 radius of lordosis
d_2 distance between the top and cord of lordosis

Fig. 1. The physiological curves of the spine.

RESULTS

The results obtained in the group of judo sportsmen and students, statistically analyzed, are given in Table 1. The Table 1 depicts the mean values and standard deviations of ten indices elaborated by Prof. Wielki [1] as well as ten other parameters.

TABLE 1
List of parameters examined in judo sportsmen and students

Groups / Parameters	Judo sportsmen $\overline{X}$	Judo sportsmen S	Students $\overline{X}$	Students S	Statistically significant level
1. DLI	188.81	47.58	203.40	56.10	
2 CRI	338.91	238.54	230.70	207.40	0.01
3. RSI	10.44	2.08	10.70	2.51	
4. II	6.07	3.19	7.22	3.42	0.05
5. DI	93.36	19.16	91.91	25.83	
6. DCI	11.26	1.84	11.30	2.62	
7. RDC [mm]	392.29	87.05	395.52	117.51	
8. LI	104.31	32.09	108.82	54.61	
9. LCI	8.59	2.97	9.40	3.40	
10. RLC [mm]	293.71	98.32	268.20	128.91	
11. h_1 [mm]	37.32	8.90	37.10	9.90	
12. h_2 [mm]	16.48	7.56	18.90	8.20	
13. TL [mm]	515.82	30.38	527.40	30.80	0.05
14. BH [cm]	176.80	7.25	176.90	5.61	
15. Angle of the pelvis inclination [deg.]	30.80	3.21	31.60	2.91	
16. Tension of dorsal muscles [kG]	158.49	20.64	131.52	17.38	0.01
17. Chest circumference [cm]	98.17	8.30	90.72	4.82	0.01
18. Chest amplitude [cm]	9.28	2.57	7.50	2.69	0.01
19. Lung vital capacity [ml]	5464.64	637.16	5186.62	648.92	0.05
20. Body weight [kg]	78.51	14.62	68.93	9.02	0.01

These are:

1. Dorso-Lumbar Index (DLI). Relation of the size of the dorsal cord, multiplied by 100, gives us the general characteristics of the spine.

2. Curve Relation Index (CRI). Relation between the height (h_1) of the dorsal curve to the height (h_2) of the lumbar curve multiplied by 100.
3. Relation Summation Index (RSI). Relation of the sum of heights ($h_1 + h_2$) to the sum of the 2 cords (AC + CB) multiplied by 100.
4. Inclination Index (II). Relation between the measurements of the horizontal passing through the lower point B (L_5 + 4 cm) to the vertical passing through the upper point A (C7). Thus, B1 to A1, multiplied by 100, gives us the inclination of the spine.
5. Dorsal Index (DI). Indicates the position of the top of the curvature (D) of the dorsal curves if more than 100, the top is below the height (h_1) of the curve. This index gives particular characteristics of the dorsal curve.
6. Dorsal Curve Index (DCI). Relation between the height of the dorsal curve (h_1) to its cord (AC) multiplied by 100.
7. Radius Dorsal Curve (RDC). Size of the radius of the circle closest to the curve of the dorsal spine. It is the sum of the square of the height (h_1) of the dorsal curve and the square of half the cord (S_1) divided by $2h_1$.
8. Lumbar Index (LI). Indicates the position of the top (E) of the lumbar parts of the spine. If more than 100, the top below the height (h_2) of the curve. This index shows particular characteristics of the lumbar parts.
9. Lumbar Curve Index (LCI). Relations between the height of the lumbar curve (h_2) to its cord (CB) multiplied by 100.
10. Radius Lumbar Curve (RLC). Size of the radius of the circle closest to the curve of the lumbar spine. It is the sum of the square of the height (h_2) of the lumbar curve and the square of half the cord (S_2) divided by $2h_2$.
11. Length of spine (TL).
12. Height of the dorsal curve (h_1).
13. Height of the lumbar curve (h_2).
14. Body height (BH).
15. Angle of the pelvis inclination.
16. Tension of dorsal muscles.
17. Chest circumference.
18. Chest amplitude.
19. Lung vital capacity.
20. Body weight.

At the same body weight in both groups examined (judo sportsmen and students) the analysis revealed 3 statistically significant differences,

namely, length of spine (TL), Curve Relation Index (CRI) and Inclination Index (II), both values being lower in the former group (Fig. 2).

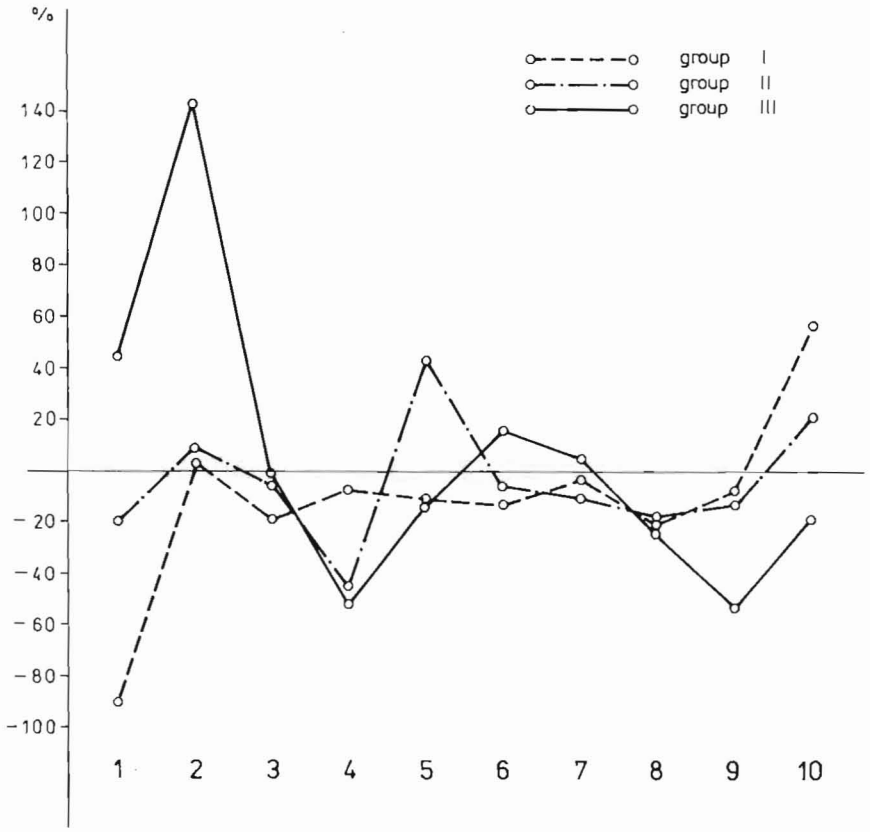


Fig. 2. Profiles of indices characterizing the spine shape.

The reason of these differences has been only partially elucidated. It is conceivable that the increased muscle force contributes to assuming of more erect position by the longitudinal axis of the spine, despite the

higher body weight (by 10 kg) in the sportsmen. Besides, lack of statistical differences in the angle of pelvis inclination also supports this hypothesis. On the other hand, the differences in chest circumference, inspiration-expiration amplitudes as well as lung vital capacity, speak in favour of the effect of training upon the chest respiratory mobility and lung ventilatory efficiency in judo sportsmen (Fig. 3).

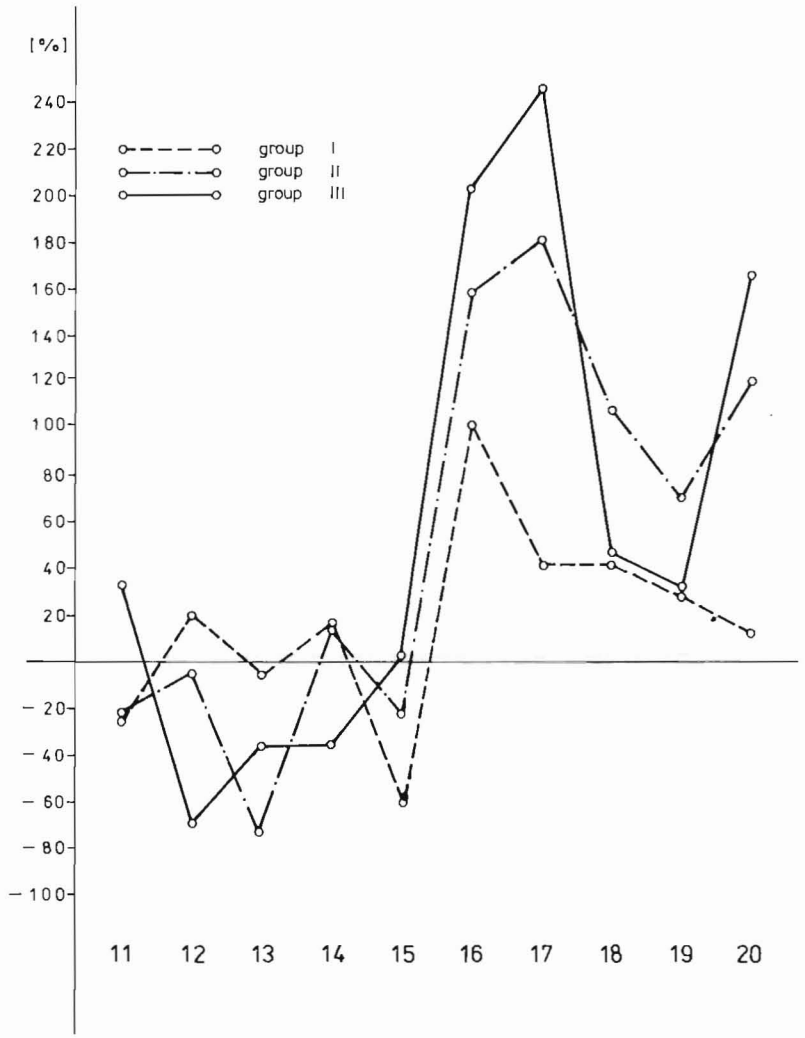


Fig. 3. Profiles of indices characterizing the body position.

To analyze the effect of judo special training on the examined parameters with regard to the period of practise, the judo sportsmen were divided into 3 groups (Tabl. 2). The first one included those who had practised this sport for 1-5 years, the second — for 5-10 years and the third — those with the period of practise above 10 years. The analysis revealed that the characteristic changes in Dorso-Lumber Index (DLI) and Curve-Relation Index (CRI) as well as heights of chest kyphosis and lumbar lordosis, appear mostly after 10 years of training. With the subsequent time of training, there appear favorable changes in the range of chest circumference and increase of the dorsal muscles force. Noteworthy is also the fact that the angle of pelvis inclination maintained almost the same, the differences between the groups examined not exceeding 1%.

TABLE 2

List of parameters according to the period of practice subgroups

Subgroups / Parameters	I		II		III		Statistically significant level		
	$\overline{X}$	S	$\overline{X}$	S	$\overline{X}$	S	I-II	II-III	I-III
1. DLI	152.82	35.94	185.53	48.52	228.09	58.29		0.05	0.01
2. CRI	231.81	162.90	251.00	159.21	533.92	393.5		0.05	0.01
3. RSI	10.18	2.77	10.49	2.00	10.65	1.47			
4. II	6.98	3.25	5.72	3.31	5.50	3.02			
5. DI	88.61	22.73	103.00	24.11	88.46	10.64	0.05		
6. DCI	10.95	2.38	11.14	1.92	11.68	1.23			
7. RDC [mm]	392.64	141.24	383.76	53.59	400.46	66.32			
8. LI	96.82	25.90	120.11	40.11	96.00	30.26			
9. LCI	9.15	2.96	8.98	3.14	7.65	2.86			
10. RLC	339.27	146.42	294.06	86.62	247.80	61.92			
11. h_1 [mm]	35.20	11.60	35.33	7.89	41.42	7.21		0.05	0.05
12. h_2 [mm]	19.64	9.35	17.50	7.40	12.31	5.93		0.05	0.05
13. TL [mm]	525.50	23.63	504.92	30.71	516.03	36.81	0.05		
14. BH [cm]	177.75	7.54	177.64	7.01	174.98	7.21			
15. Angle of the pelvis inclination [deg.]	29.83	2.11	30.94	3.94	31.64	3.57			
16. Tension of dorsal muscles [kG]	149.58	21.74	156.21	20.47	166.67	19.72			
17. Chest circumference [cm]	92.67	7.19	99.37	8.73	102.46	8.97	0.05		0.01
18. Chest amplitude [cm]	8.67	2.17	10.41	3.01	8.75	2.52			
19. Lung vital capacity [cm]	5366.67	891.00	5642.10	515.36	5384.60	505.12			
20. Body weight [kg]	71.96	12.10	79.72	15.26	83.85	16.49			

RESULTS AND DISCUSSION

From the results obtained it follows that the statistically significant differences concern only the length and inclination of the spine, which has no effect on a formation of posture of the individuals in both groups.

The reason of the above may be sought in the extensive training which, not earlier than after 10 years, results in the increase of thoracic kyphosis and decrease of lumbar lordosis.

It is to be noted that in the course of the studies, some disproportions were noted between the shape of the curve radius and curve height of the spine. This evidences the need of further analysis of the diagnosic value of the parameters examined.

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