CHANGES IN POSTURE OF MEN UNDER INFLUENCE OF LOAD

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Posture of man doing his work on the work station may be evaluated by means of different methods. At the Technical University of Wroclaw there was constructed an electronical spherosomatograph, which enables the projection of spinal curves of workers doing some working activites in standing position, bent and sitting posture and so on [3]. Papers of many authors have shown, that lifting of too heavy weights may cause the damage of spine [1]. Therefore the detailed analysis of changes in spinal curves' shapes and in its inclination under the influence of loads seems to be very interesting.

The purpose of this article is to detect with the help of the electronical spherosomatograph the shapes of the spinal curves at men under different loads.

MATERIAL AND METHODS

The investigations were carried out at 50 men in the age of 19. Each investigated person held in both hands, handing down along the body, weights from 5 kg to 27.5 kg. For each person there were made 5 projections of spinal curve; first [1]-without any load, second [2]-with a load 5 kg for each hand, third [3]-with a load of 12.5 kg fourth [4]-with a load 17.5 kg and fifth [5]-with a load of 27.5kg.

For the investigation the electronic spherosomatograph was used which consists of two parts:

1. Measuring device enabling the projection of spinal curves, kyphosis, lordosis and scoliosis with the help of slider led through spinal process from the seventh neck vertebra (C7) to the fifth lumbar vertebra (L5).
2. Registering device - projecting the spinal curves on the paper tape in a scale 1:2 and memory device enabling to send the data to computer.

The obtained projections of spinal curves were analysed using the "Radius Method with Intersection Point" [4]. This method evaluates the shape of pectoral kyphosis and lumbar lordosis on the basis of 11 indexes (Fig.1).

The obtained results were statistically analysed. Significance level of the differences was examined with the help of t-Student test.

/1/ DLI = / AC:CB / x 100
/2/ CRI = / h_1:h_1 / x 100
/3/ RSI = / h_1+h_2 / : /AC+CB/ x 100
/4/ II = / BI:AI / x 100

/5/ DTI = / AF:FC / x 100
/6/ DCI = / h_1:AC / x 100
/7/ RDC = / h_1+s_1 / : $2h_1$

/8/ LTI = / CG:GB / x 100
/9/ LCI = / h_2:CB / x 100
/10/ RLC = / h_2+s_2 / : $2h_2$

Figure 1: Profile of the anatomical spinal curve indexes.

RESULTS

Arithmetic means of ten analysed indexes were presented in Table 1. The statistical analysis of the obtained results has shown that there are some changes in the shapes of spine. The greatest statistically important differences were stated at persons holding in each hand weights of 27.5 kg. Holding of smaller weights shows significantly less deviations in the pectoral kyphosis and lumbar lordosis. Simultaneously there appears the increase of depth of pectoral kyphosis. It is represented by the increase of the Curve Relation Index (CRI) and Dorsal Curve Index (DCI). In the values of these two indexes statistically important differences were stated for persons holding weights of 27.5 kg. Especialy the index (CRI) is very important because it represents the relation of the height of the curves (pectoral and lumbar) and shows the direction of changes in the shape of spines. When the load is greater, also the arithmetic mean of Curve Relation INDEX (CRI) increases from 303.74 to 572.74. The increase of depth of pectoral kyphosis is also certified by Radius Dorsal CURVE (7), on the value of which first of all influences the height of the pectoral curve (b_1).

The men with the greatest loads are characterized by significantly less (statistically important) Radius Dorsal CURVE (383.17 mm). Reverse direction of changes has been observed in the lumbar part of spines. It was stated that under the influence of loads there appears shallowing and reduction of lumbar lordosis. It is visibly shown by Lumbar Curve index (LCI) decreasing from 8.07 to 7.04mm and Radius Lumbar Curve (RLC), increasing from 311.77mm to 439.70mm. The most evident shallowing of lumbar part of the spine is visible by the greatest investigated loads.

Recapitulating the analysis of indexes of the "radius method" it may be stated that there are essential changes occuring in the shape of the spine under the loads increasing with the increase of the load. They consist mainly in decrease of the length of the spine, increase of the height and diminution of the radius of pectoral kyphosis and decrease of the height and increase of radius of lumbar lordosis. More important changes were observed in pectoral part of spine. Comparison of the shape of a spine of person without any load and holding weights has shown the statistically important differences in four quotient indexes: (CRI, II, DCI, RCC).

CONCLUSIONS

On the basis of the performed research the following conclusions may be formulated:

1. Utilization of the electronical spherosomatograph enables one to demonstrate changes of spinal curves under the influence of loads caused by holding weights in both hands.
2. Obtained projections give us a possibility to evaluate differences observed in pectoral kyphosis and lumbar lordosis in a sagital plane when the load is increasing.
3. Obtained results show that the loads 17.5 kg - 27.5 kg for each upper limb is on a border of physiological load. Increase of a load should be conducted under strict medical control and depends on flexibility of a spine.

TABLE 1
List of indexes characterizing the spine shape

Index		1	2	3	4	5
1. DLI	$\bar{X}$	198.93	186.98	218.44	210.47	210.17
	S	89.98	71.00	133.13	135.68	121.63
2. CRI	$\bar{X}$	356.20	303.31	406.36	430.68	572.74
	S	424.47	333.15	386.73	433.52	748.95
3. RSI	$\bar{X}$	9.70	9.53	9.68	9.73	10.18
	S	1.95	1.97	1.90	1.99	2.09
4. II	$\bar{X}$	6.91	7.24	8.23	8.84	9.01
	S	3.05	2.91	3.26	3.01	3.50
5. DTI	$\bar{X}$	83.19	81.53	82.05	78.79	78.81
	S	22.99	20.30	21.02	22.36	27.22
6. DCI	$\bar{X}$	10.38	10.34	10.57	10.74	11.59
	S	2.33	2.51	2.51	2.96	2.80
7. RDC	$\bar{X}$	429.31	420.30	430.33	427.95	383.17
	S	118.79	115.74	123.39	143.81	96.44
8. LTI	$\bar{X}$	111.21	112.44	103.90	101.61	97.54
	S	43.40	37.29	42.97	50.98	52.38
9. LCI	$\bar{X}$	8.07	7.77	7.45	7.37	7.04
	S	3.10	2.56	2.96	3.20	3.20
10. RLC	$\bar{X}$	311.77	334.54	329.35	387.01	439.70
	S	133.04	124.17	119.68	317.20	419.39

REFERENCES

[1] GRANDJEAN E., Fizjologia pracy, PZWL, Warszawa 1971.

[2] SLIWA W., Wykorzystanie sferosomatografu do badania krzywizn kregoslupa, Ogolnopolska Konferencja Biomechaniki, Gdansk 1987.

[3] SLIWA W., CHLEBICKA E., Zmiany w postawie ciala pod wplywem obciazenia konczyn gornych, Bezpieczenstwo Pracy, nr 5, 1990.

[4] WIELKI C., Method for measuring the curve of the spine by "Electronic Spherosomatograph", Biomechanics VI B, 1983.

[5] WIELKI C., SLIWA W., Zastosowanie metody elektronicznej do pomiarow krzywizn kregoslupa, Kultura Fizyczna Studentow. Warszawa 1983.