

BIOMECHANICAL ANALYSIS IN THE FIBULAR PLANE OF THE BACKBONES OF WRESTLERS ON THE NATIONAL WRESTLING TEAM

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INTRODUCTION

The backbone is an exceptional organ of movement as it is a common organ for both the left and right part of the body. There are three main functions of the backbone: protection of the nervous system and supporting function for the body, a movable axle of the body and in keeping the balance of the body. Its basic significant feature is high performance and lack of buckling, especially under dynamic load. It must be as flexible as possible to keep the force needed for movement to a minimum. As Gutmann writes: "the backbone must be as mobile as possible and as steady as required".

The aim of this paper was to determine the angle and line values of front-back curvatures of the backbone in normal posture and after a standard load and their changes under the influence of endurance training among members of the national wrestling team.

METHODS

The examinations concerned 39 selected members of the national wrestling team between the ages of 18 to 35 during a training camp which took place in Vistula. The methods included examinations of the front-back curvatures before and after a 90 min. endurance training session outside in normal posture and with a standard 30 sec. load (1/3 of the body weight of the examined) placed on the shoulders.

For evaluation of the results of selected parameters describing physiological curvatures in the examined wrestlers, a computer stand for evaluation of body posture - Posturometer M was used. The method and technique of examination conformed with generally applied principles (Mrozkowiak, 2002). The obtained results in the form of graphic allowed for a quantitative description of examined parameters. Linear values are described by the distance between selected anthropometric points on the backs of the examined wrestlers, and the angle values of physiological curvatures of the backbone, which define differences between horizontal contours of spines tops of the vertebrae in chest and loin section. Statistical analysis was applied to the following values:

1. Angular (degrees):

1. Alfa – inclination of loin-lower back section,
2. Beta – inclination of chest-loin section,
3. Gamma – inclination of upper chest section,
4. Delta – the sum of angle curvature values,
5. KLL – angle of loin lordosis ($KLL=180-(Alfa+Beta)$)
6. KKP – angle of chest kyphosis ($KKP=180-(Beta+Gamma)$)
7. KPTt – angle of trunk straightening in fibula plane,
8. KPTp – angle of trunk bend in fibula plane

2. Linear (millimeters):

9. DCK – the distance between spines of the seventh of neck vertebra (C7) and the first of low back (S1), measured along the profile of the backbone. The percentage value is related to the height of the examined competitor (WDCK)

10. DLL – the distance between the top of chest kyphosis (KP) and S1,

11. RLL – the distance between point of transition of kyphosis into loin lordosis (PL) and S1,
 12. GLL – the depth of loin lordosis, the difference between contours of the top of the loin lordosis and (LL) and PL
 13. DKP – the distance LL – C7
 14. RKP – the distance C7 – PL
 15. GKP – the depth of chest kyphosis, the difference of contours KP – PL
3. Indicators:
16. WKP = GKP/RKP (ratio: depth to length of chest kyphosis)
 17. WLL = GLL/RLL (ratio: depth to length of loin lordosis)
 18. WDCK = distance LL – C7 in relation to height (%)

RESULTS

The results were divided into two groups: results obtained before physical exertion and results after exertion. Within each examination there were two levels distinguished: 1 measurement in normal posture, 2 in a posture with standard load. This allowed the results to be processed statistically with respect to: average value, maximal and minimal, standard deviation, coefficient of variation for every examination and level as well as for all measurements. The following grades were introduced for significance of difference between examinations: very high significance of difference $\text{Alfa} < 0.001$, average significance of difference $\text{Alfa} < 0.01$, significant difference to the small extent $\text{Alfa} < 0.05$, insignificant difference $\text{Alfa} > 0.05$.

(1)Alfa, (4)Delta, (9)DCK, (11)RLL, (14)RKP – the difference between average results of measurement between all examinations was insignificant.

(2)Beta – very significant difference between results takes place for examinations: in normal posture and a posture with load both before physical exertion and after, the normal posture before physical exertion and the posture with load after physical exertion.

(3)Gamma – very significant difference between results takes place between: the normal posture before physical exertion and a posture with load after the exertion – a slight significant difference takes place between results of examinations in normal posture and the posture with load after physical exertion.

(7)KPTt – very significant difference takes place between the results of examinations: in normal posture and with load after physical exertion, in normal posture before exertion and in posture with load after exertion.

(8)KPTp – very significant difference takes place between the results of examinations: in normal posture and the posture with load before physical exertion and after it, in the posture with load before exertion and normal posture after exertion and the posture with load after exertion.

(12)GLL – very significant difference between the results of examinations takes place: in normal posture and the posture with load before and after physical exertion, the posture with load before physical exertion and the normal posture after exertion, the normal posture before exertion and the posture with load after the exertion.

(15)GKP, (16)WKP and (18)WDKP – very significant difference between the results of examinations takes place: in normal posture and the posture with load before and after physical exertion, in the posture with load before exertion and the normal posture after exertion, in normal posture before the exertion and the posture with load after the exertion.

(17)WLL – very significant difference between the results of examinations takes place: in normal posture and the posture with load before and after the physical exertion, in normal posture before physical exertion and in normal posture after it - average significant difference takes place between the results: in the posture with load before physical exertion and normal posture after exertion.

The differences between them and those given by Neumann are due to different methods of examinations and the material specifically selected by the author.

Also important are significant differences between the results of examined features before exertion: (2)Beta, (6)KKP, (8)KPTp, (12)GLL, (13)DKP, (15)GKP, (16)WKP, (17)WLL, (18)WDKP, and after exertion: (2)Beta, (5)KLL, (7)KPTt, (8)KPTp, (12)GLL, (15)GKP, (16)WKP, (17)WLL, (18)WDCK.

DISCUSSION

The most significant differences indicating the influence of physical exertion on the examined values are the differences between parameters before and after exertion in normal posture and between parameters before and after physical exertion in the posture with load. Such features have not yet been described in literature on the subject. Also important were the differences of repeated parameters in the experiment before physical exertion in the posture with load and after physical exertion in the normal posture and before physical exertion in normal posture and the posture with load after exertion. As a rule, the results obtained after physical exertion are usually worse than those obtained before exertion although the difference is not significant: (2)Beta, (8)KPTp, (12)GLL, (15)GKP, (16)WKP, (17)WLL and (18)WDCK. The most significant changes in the examined parameters before endurance exertion took place in: (2)Beta, (8)KPTp, (12)GLL, (15)GKP, (16)WKP, (17)WLL and (18)WDCK, significant to the small extent in: (6)KKP and (13)DKP. After exertion: (2)beta, (7)KPTt, (8)KPTp, (12)GLL, (15)GKP, (16)WKP, (17)WLL and (18)WDKP, average significance in: (5)KLL

Because of the application of a new method for the evaluation of body posture (Posturometer M), no relevant material could be obtained in literature on the subject.

An analysis of obtained results produced the following conclusions:

1. Within the examined group of wrestlers, no significant influence of physical exertion on any of parameters describing the normal posture and the posture with standard load was found.
2. The most significant changes of examined parameters before physical exertion took place: in inclination of chest-loin section, in bend of the trunk, in depth of kyphosis and lordosis (16)WKP, (17)WLL and (18)WDCK.
3. The most significant changes of examined parameters after physical exertion took place: in the angle of bend and straightening of the trunk, depth of kyphosis and lordosis, (17)WLL and (18)WDCK.
4. The influence on linear and angle parameters of the backbone for applied standard load before and after endurance exertion is very similar.
5. The examined backbone parameters of the wrestler before endurance exertion in the fibula plane had the following angle values (in degrees): Alfa = 11.50, Beta = 9.91, Gamma = 11.00, Delta = 32.66, KLL = 168.66, KKP = 158.92, KPTt = 1.59, and linear (mm): DCK = 346.46, DLL = 234.98, RLL = 126.66, GLL = 15.54, DKP = 304.51, RKP = 222.58, GKP = 18.70 and indicators: WKP = 0.08, WLL = 0.12, WDCK = 87.70.

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