MUSCLE TORQUE OF MALE BASKETBALL PLAYERS PLAYING AT DIFFERENT FLOOR POSITIONS

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INTRODUCTION: Changes in the values of muscle torques may be indicative of the applied training loads being effective. Torque values, especially those for flexors and extensors of upper limbs and trunk (in static conditions), may also be applied to sport selection [Busko 1998]. Generally basketball players need to be relatively strong in most of the large muscle groups of the body. Muscle strength or muscle torque is an important component of many match activities. The aim of this study was an investigation of the muscle torque of male basketball players playing at different floor positions.

METHODS: The study were carried out with 44 male basketball players belonging to the Polish national team. The mean characteristics (±SD) of the group were as follows: age 22.4±3.1 years, body mass 88.5±8.7 kg, body height 197.4±8.1 cm, duration of training 9.5±3.3 years. They were divided into 3 groups: wings, guards, centers. Their age, body height and mass, and training experience are presented in Table 1.

Table 1. Basic characteristics of group - mean values and standard deviation (±SD)

	Guards n = 17	Wings n = 15	Centers n = 12
Age [years]	22.8±3.7	21.7.±2.7	22.4±3.2
Mass [kg]	81.5±6.0	91.7±5.2***	94.4±9.1***
Height [cm]	188.6±4.7	201.0±2.7***	205.4±3.1***###
Duration of training [years]	10.9±3.2	8.2±2.9*	9.0±3.5

- wings and centers significantly different from guards (* - $p<0.05$, *** $p<0.001$),
- wings significantly different from centers (### - $p<0.001$)

Muscle torque measurements in static conditions were performed. Eleven muscle groups were studied: flexors and extensors of trunk, flexors and extensors of shoulder, elbow, hip, knee and ankle joints. Elbow flexors and extensors were examined in upright position, the arm resting on a support. Shoulder angle was 90°, the forearm perpendicular to the arm, the trunk stabilized and supported. Shoulder flexors and extensors were examined in upright position, the angle being 0°. The trunk was stabilized by the subject who was holding fast to the stand with her non-dominant hand, and the chest was pressed to the stand frame by the assistant. Flexors and extensors of the knee and trunk were examined in a sitting

position. The hip and knee angles were 90°. The subject was stabilized with belts crossing the anterior superior iliac spine and distal part of the thighs. The arms rested against the chest. Hip extensors were examined in supine position forward. Hip angle was 90°. The subject stabilized her trunk by gripping the stand. Hip flexors were examined in supine position backwards. Hip angle was 90°. The subject gripped the stand and pressed her pelvis against the support. Foot flexors were examined in a sitting position, the examined limb being bent in knee and hip joints at 90°. The subject gripped the seat and the lower limb was stabilized by a steel band around the knee.
Maximal force measurement error was 10 N and that of length - 1 cm, which amounted to an overall relative error of 4-8%, depending on the muscle group. The data were analyzed by applying ANOVA, followed by the C-test of Cochran and Cox or t-test. The level of $p<0.05$ was considered significant.

RESULTS: Absolute values of muscle torques are presented in Table 2. The lowest results of muscle torque were recorded for guards. The highest results of muscle torque were recorded for wings. Significant differences between wings and guards, centers and guards were observed only for the flexors of elbow, flexors of shoulder, for the flexors and extensors of trunk and for sums of 11 muscle groups. No significant differences were found between wings and centers. When the results were calculated per body mass no significant differences between guards, wings and centers were observed. There were no significant differences between guards, wings and centers in muscle torque topography (Table 3). No significant correlations between muscle torque and body mass were found in any group.

Table 2. Mean values (±SD) of muscle torques [Nm] and their sums (SUM) in guards, wings and centers male basketball players

Muscle group		Guards n = 17	Wings n = 15	Centers n = 12
Elbow	F	92.94±13.28	103.50±10.79*	100.81±11.27
	E	69.23±14.73	70.72±13.14	74.22±19.83
Shoulder	F	130.59±27.90	162.34±26.51**	161.32±22.54**
	E	118.60±29.23	132.72±23.20	129.87±19.70
Hip	F	191.40±44.21	194.48±46.46	187.94±34.68
	E	522.41±114.68	527.59±93.71	529.10±75.09
Knee	F	171.09±46.20	203.65±48.17	199.89±30.45
	E	282.09±95.80	292.25±111.82	266.19±52.31
Ankle	F	198.01±58.71	245.75±52.41*	217.15±32.98
Trunk	F	294.91±89.65	373.69±114.67*	376.77±64.06*
	E	548.10±143.07	710.45±225.09*	710.59±190.16*
SUM		2614.20±469,01	3023.99±488,84*	2953.34±313,03*

F - flexors, E - extensors,
- wings and centers significantly different from guards (* - $p<0.05$, ** - $p<0.01$),

Table 3. Percent muscle torque topography [%] and correlation coefficients between absolute muscle torques, sums of absolute muscle torques (SUM) and body mass in guards, wings and centers (male basketball players)

Muscle group		Percent topography			Linear correlation		
		Guards n = 17	Wings n = 15	Centers n = 12	Guards n = 17	Wings n = 15	Centers n = 12
Elbow	F	3.6±0.87	3.5±0.63	3.4±0.55	.435	.393	.470
	E	2.7±0.51	2.3±0.35*	2.5±0.66	.654@	.121	.152
Shoulder	F	5.1±1.25	5.4±0.70	5.5±0.80	.226	.75@	.483
	E	4.6±0.89	4.4±0.66	4.4±0.77	.075	.027	.197
Hip	F	7.3±1.11	6.5±1.24*	6.4±0.89*	.448	.256	-.489
	E	20.0±3.50	17.7±3.0*	18.0±2.61	.059	.189	.392
Knee	F	6.6±1.60	6.7±1.03	6.8±0.96	.470	.511	-.016
	E	10.7±2.70	9.6±2.94	9.0±1.55*	-.104	.100	.187
Ankle	F	7.5±1.26	8.1±1.18	7.4±1.31	.415	.344	.229
Trunk	F	11.2±2.22	12.4±2.82	12.8±1.69	.163	-.241	-.250
	E	20.8±3.02	23.2±5.3	23.8±4.60*	.118	.266	-.351
SUM					.257	.298	-.071

F - flexors, E - extensors,
- wings and centers significantly different from guards (* - $p<0.05$, ** - $p<0.01$),
- wings significantly different from centers (# - $p<0.05$, ## - $p<0.01$).
- correlation coefficients (@ - $p<0.05$)

DISCUSSION: Many authors have reported data concerning muscle force and muscle torques [Bober and Hay 1990, Janiak at al. 1993], as well as the topography of torques of individual muscle groups related to their sum [Bober and Hay 1990, Janiak et al. 1993]. Junior and senior rowers exhibited a similar topography [Janiak et al. 1993] and also in a study by Busko [1998] the similarity of topographies in cadet, junior and senior basketball female players was quite high. The sum of muscle torques was reported [Busko 1998] to be highly correlated with body mass in cadet and junior female players (r=0.774 and 0.628, respectively), the former being significantly higher than in seniors (r=0.384). A difference between junior and senior athletes was also reported for male rowers (r=0.707 and 0.455, respectively) [Janiak et al. 1993]. A lower correlation was reported for the sum of torques of 8 muscle groups in untrained students [Bober and Hay 1990] and the correlations between muscle torques of shoulder extensors or hip flexors and body mass were low and non-significant. In this study, no significant correlation between muscle torque and body mass were found in all the groups. In a paper Sibila & Bravnicar [1997] stated that there are differences in morphological characteristics of players playing in different playing positions in handball. Many authors have found differences among forward and back rugby players in: physiological parameters [Reilly 1997] and muscle forces [Kearney et al., 1997, Reilly 1997]. Di Salvo & Pigozzi [1997] reported differences in results of running and jumping (SJ, CMJ) tests for football players playing in different positions. There were no significant differences found between maximum isokinetic peak torques

and, VO2max reported for different soccer players (defenders, midfields, forwards) by Sentelidis et al. [1997]. In this study there are no significant differences in muscle torque between players playing in different playing positions in basketball. In a paper Matkovic et al. [1994] stated that there are differences in morphological characteristics of players playing in different playing positions in basketball. The highest values of parameters were recorded for centers and wings. The lowest results in morphological characteristics were observed for guards. In this study, significant differences in body height and body mass were observed between guards and wings and guards and centers.

CONCLUSIONS: From our study we can conclude that there are no significant differences between players playing in different playing positions in basketball. No significant correlation between muscle torque and body mass were found in any of the groups. The differences between the players playing at different positions depend on body height: height players - wings and centers, low players - guards.

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