STRENGTH CHARACTERISTICS OF TEAM HANDBALL PLAYERS

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The contemporary team handball is characterized by a considerable degree of direct struggle and close encounter between the players. In this respect the play is similar to what is known in ice hockey as body play. The element of the play requires good bodily condition and considerable strength (Dziaski and Naglak, 1983). It suggests the need for strength training under high loads and low dynamics. The aim of the game is to score a goal; the means of which is a quick and accurate throw, this requires strength training under low loads and high velocity. Considering this, the game can be said to require extensive strength practice. Which raises the question of selecting the proper training methods for developing a player with the kinds of strength specific to the task. The nature of the above requirements made us seek features characterizing the player's strength in order to furnish the coach with instant and accurate information on the player's natural potential (disposition) and his present strength.

MATERIAL AND METHOD

For this study we examined 15 players of the First League team (AZS Politechnical University, Wroclaw). General parameters of body build and torques of selected muscle groups were measured. The registration of torques in time functions made it possible to calculate and analyze the strength release dynamics, i.e., the tangential force. The examined muscle groups and their position in the joints where the maximum torques were measured under static conditions have been presented in Figure 1. The average age of the players was 23.9 years. The length of time they had played on the Polish National Team was 9.3 years. This team compared very favorably with other national teams (Table 1). Table 1 consists of data on the examined players who played in the following positions: play makers (n=7), pivot (n=4) and wing (n=4).

RESULTS

General strength value of the players was estimated on the basis of indices of the absolute strength which is the sum of torques of 6 muscle groups $\frac{1}{2}\left(\sum M_{max}\right)$ The average value of the absolute strength for the whole team was $\bar{x}$ = 715.8 ±

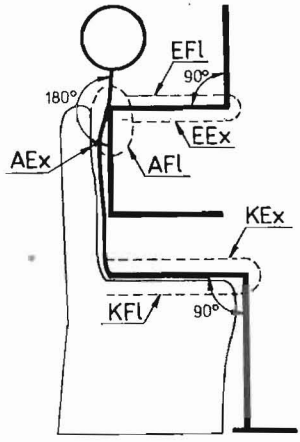

Figure 1. Body position in which the torques of AEx and AFl muscle groups were measured, i.e., of arm extensors and flexors: of EEx and EFl, i.e., elbow extensors and flexors and KEx and KFl, i.e., knee extensors and flexors.

TABLE 1. HEIGHT IN CM AND BODY MASS IN KG OF AZS PLAYERS COMPARED WITH STAWIARSKI'S DATA (1979) ON THE POLISH NATIONAL TEAM AND THE WORLD LEADING TEAMS.

Playing position	Body charact.	AZS		Polish national team		World's best teams	
		$\bar{x}$	$S\bar{x}$	$\bar{x}$	$S\bar{x}$	$\bar{x}$	$S\bar{x}$
play maker	height	188.4	6.37	186.3	5.57	187.0	6.36
	mass	87.6	4.69	85.2	5.83	86.2	7.33
pivot	height	186.2	3.83	188.3	3.31	184.5	6.08
	mass	84.0	5.74	85.7	1.67	83.8	6.66
wing	height	181.0	5.96	181.2	8.89	182.3	5.66
	mass	78.7	2.59	77.2	9.06	80.8	6.44

205.8 Nm, of which 17.9 and 32.6% fall to the elbow and arm-joint flexors and extensors respectively. Relative strength of each player was obtained by dividing the obtained general strength value by body mass. Its mean value was $\bar{x} = 8.5 \pm 2.27$ Nm/kg. There was a positive and a negative relationship between some measures of relative strength and body mass. However, for the examined group the respective coefficients of direct correlation were 0.403 and 0.162, which meant that they were statistically insignificant. This result may be due to the relatively small difference between players in respect to body mass and levels of strength training.

TABLE 2. MAXIMUM TORQUE AND THE TANGENTIAL TORQUE OF 50% MAXIMUM TORQUES OF SIX MUSCLE GROUPS ($G_{50\%M_{MAX}}$).

Muscle's groups	torque [Nm] $\bar{x}$	torque [Nm] $S\bar{x}$	tan.torque [Nm^{-1}] $\bar{x}$	tan.torque [Nm^{-1}] $S\bar{x}$
AEx	103.5	35.4	233.4	105.7
AFl	129.9	39.7	278.4	134.7
EEx	51.0	16.8	178.1	72.9
EFl	77.3	25.9	209.1	102.2
KEx	215.0	61.1	360.5	150.4
KFl	139.1	54.8	279.0	157.7

TABLE 3. MEANS AND STANDARD DEVIATIONS OF TANGENTIAL TORQUE [Nms^{-1}] FOR SIX MUSCLE GROUPS WITH REGARD TO THE DIVISION OF THE PLAYERS ACCORDING TO THEIR PLAYING POSITION.

Muscle's groups	wing (n=7) $\bar{x}$	wing (n=7) $S\bar{x}$	play maker (n=4) $\bar{x}$	play maker (n=4) $S\bar{x}$	pivot (n=4) $\bar{x}$	pivot (n=4) $S\bar{x}$
AEx	205.4	32.9	262.7	92.8	209.2	151.2
AFl	331.2	90.4	318.7	139.6	155.2	70.6
EEx	186.3	35.4	191.4	90.4	139.0	78.1
EFl	212.7	54.8	249.3	106.9	135.0	88.7
KEx	343.7	189.7	377.3	102.9	347.8	171.2
KFl	398.5	187.7	257.8	124.9	196.7	94.3

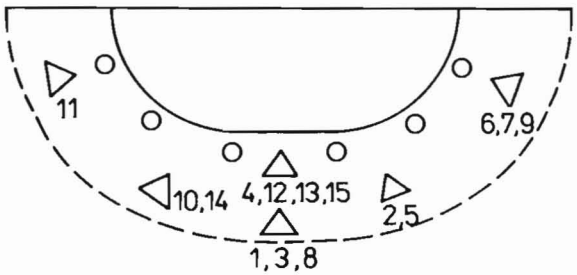

Figure 2. Diagramic line-up of team handball players during attack. Playmakers Nos.: 1, 2, 3, 5, 8, 10 and 14. Pivots Nos.: 4, 12, 13 and 15. Wings Nos.: 6, 7, 9 and 11.

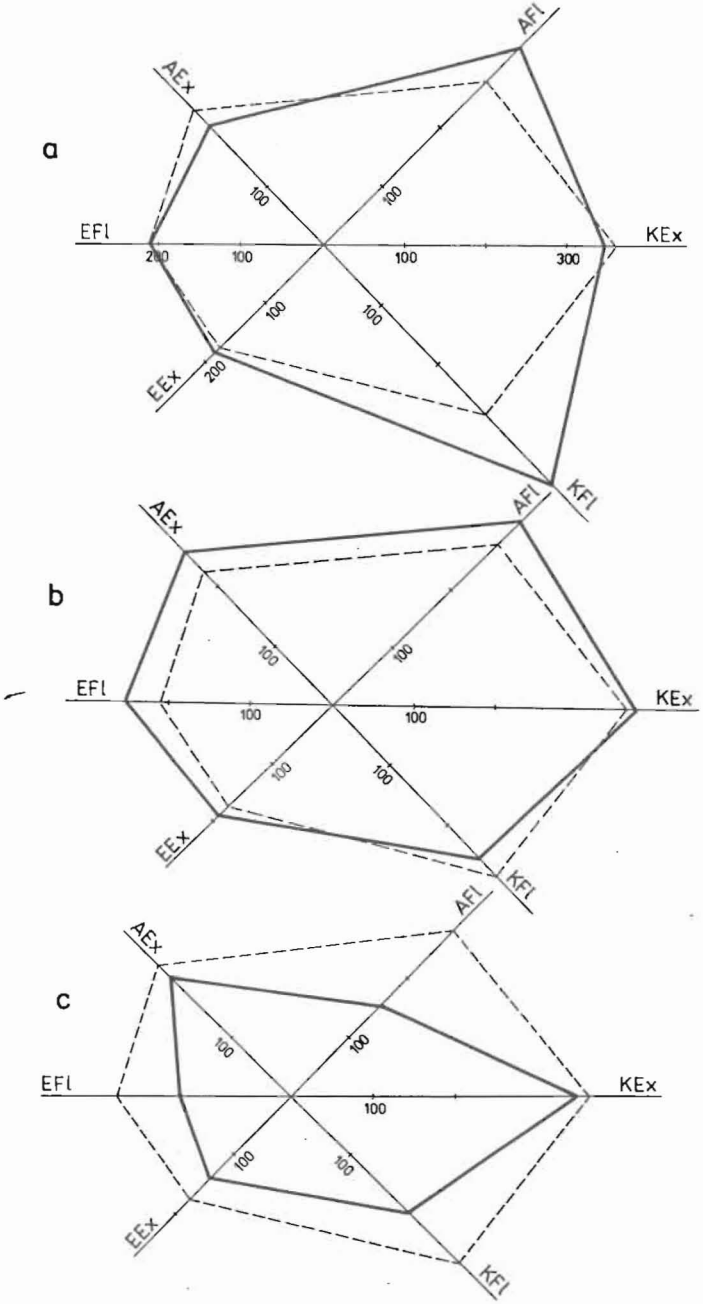

Figure 3. Distribution of tangential torque values (G 50 % M_{MAX}) among the six muscle groups for the three player groups: a) wing, b) playmakers, c) pivot. Dashed lines indicate mean values for the whole team.

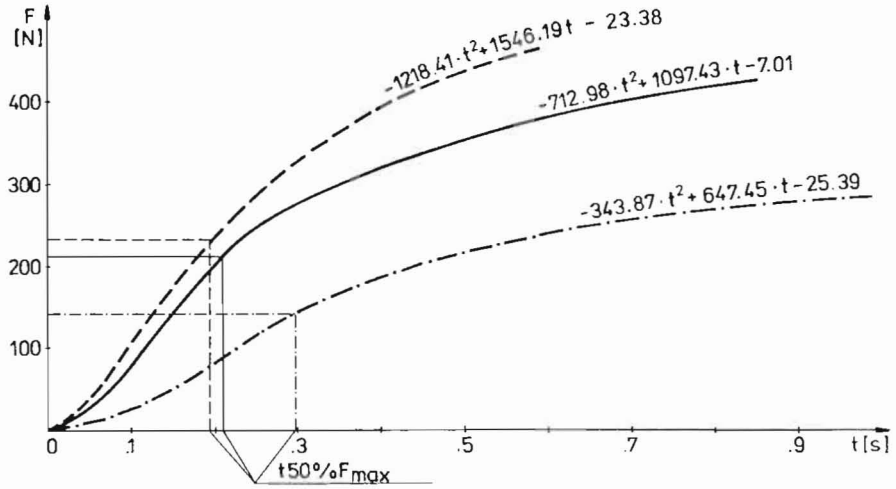

Figure 4. Averaged F(t) of arm flexors (AFl) for the wing (dashed line), the playmakers (continued line), and the pivot (dot-dash line).

In the introduction, the play and the requirements concerning the strength preparation of the players have been characterized. In view of that, the dynamics of the release is the feature that describes the strength disposition of players. In order to show this, the tangential torque of 50% maximum torques for each muscle group ($G_{50\%Mmax}$) was calculated (Table 2).

The obtained results formed a pattern fairly proportional to the torques of the muscle groups. Only the tangential torque of the elbow-joint muscle, which produced 25% of the total tangential torque of all muscle groups, was bigger in percentages than the torques of other muscles.

Detailed characteristics of tangential torque were produced with regard to the division of the team into formations: playmakers, pivot and wing (Figure 2). The most versatile as well as the most proficient player should be the playmakers, capable of strong throws from a distance as well as good jumping ability. The pivots should be characterized by considerable static strength; the wing players are required to show great skill, agility and jumping proficiency. The distribution of tangential torque for the three player groups has confirmed a generally higher than average value of the strength release dynamics for playmakers and has revealed a relatively low value of that characteristic for the pivots (Figure 3). The latter ones are also inferior to the remaining groups in respect of ξM_{max} (by ca 100 Nm), and in respect to relative strength they are particularly inferior to the wings. The detailed data on the average values and tangential torque deviations are included in Table 3.

Figure 3 completes the statistical data. It presents graphically the distribution of the above-discussed features of muscle strength in a selected group of players in comparison to the whole team. Such profiles, individual profiles in particular, are a useful tools for supplying the coache with valuable research results. Most of the discussed data do not differentiate the player groups statistically. It was only for the AFL (arm-joint flexors) that a significant difference was determined between the pivots and the playmakers ($t = 1.97$, a significant difference within 10%), as well as the pivot and the wing ($t = 2.656$, a significant difference within 5%).

For that muscle group (AFL), the average position F(t) was calculated (see Figure 4). The curves are described well by a polynomial of the fourth degree.

However, in order to compare the differences, coefficients k for 50% maximum force were calculated.

$$0.5\,F_{max} = F_{max}\left(1 - e^{-kt_{0.5F_{max}}}\right)$$

The coefficient k is 3.615 s for wings, 3.176 s for playmakers, and 2.334 s for pivots. The coefficient characterizes adequately the nature of the players' strength in respect of the dynamics of its release. When constantly checked, the value of the coefficient can become a good exponent of the strength training results. The values obtained here are considerably lower than the values of the coefficient k determined for sprinters' hip and knee extensors, which is 6.93 s (Kania, 1975). Neglecting the differences resulting from the comparison of different muscle groups, it seems that the development of the strength dynamics of the examined players is a source of great reserves.

Another important characteristic of handball players should be that they have maximum strength expressed in the sum of torques of muscle groups. That measurement revealed that within the team tested, the pivot players were the weakest. According to accepted opinions pivot players should be the strongest.

CONCLUSION

Considering the two basic functions of a player, i.e., scoring goals and body positioning (or a defending position), the players should be characterized by great absolute strength and strong release dynamics. The former value can be expressed by the sum of torques of big muscle groups of the extremities and the trunk. The relative strength index (Mm/body mass) testifies indirectly to the muscle proficiency. Fidelus and Skorupski (1970) employed that index for the examination of sportsmen of different disciplines and age groups, and determined, that seniors had higher indices than juniors, whereas shot putters, discus-throwers, and weight-lifters were higher than runners and jumpers. Tangential force, which corresponds with the throw dynamics, was examined by different authors and calculated by means of various methods (Stothart, 1973; Willems, 1973). The present data on tangential torque and the differences between the players and the formations seem to be very useful. It is recomemded to conduct this simple evaluation during different training periods.

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