

ACCURACY AND THROWING VELOCITY IN HANDBALL

Ioannis Bayios, Konstantinos Boudolos, University of Athens, Greece

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INTRODUCTION: Accuracy and throwing velocity in handball are regarded as basic parameters of performance during competition. Several investigators have studied the relationship between the velocity of movement of the upper limbs and accuracy in hitting the target, which has led to interesting theories (Schmidt, 1982, Elias et al., 1990, Hore, 1996). In general, the results of these studies suggest the existence of a significant negative relationship between speed and accuracy (Fitts 1954). The aim of the present study was the comparative analysis of accuracy in combination with ball velocity while performing shots in handball, using as subjects athletes of various levels and non-athletes.

METHODS: In order to measure accuracy, an innovative electronic device was used which was placed on the inner side of a goal post and functioned as a 'target-pointer' (by means of a red light) and 'hit-detector'. The ball velocity was measured by means of another innovative device, which consisted of a laser beam emitter and an electronic circuit laser beam receiver. The determination of ball velocity was made based on the diameter of the ball and the time (in μ sec) that the laser beam was interrupted by the passing of the ball.

Three groups of subjects took part in the experiments: one group of 15 handball athletes, the best League A¹ scorers (age 24.86 ± 2.91 yrs), another group of 12 handball athletes, the best League A² scorers (age 26.84 ± 5.67 yrs) and a random sample of 15 physical education students (21.72 ± 0.89 yrs). Accuracy and ball velocity were examined in three types of throw: (a) *on the spot*, (b) *with a cross-over step* and (c) *with a vertical jump*. The results were analyzed using one-way ANOVA and Pearson correlation (SPSS and STATISTICA 5.0 package).

Table 1. Mean values (\pm SD) of deviation from the accuracy (in cm) and of ball velocity (in m/s), in the three types of throw for the three groups of subjects.

		on the spot	with a cross-over step	with a vertical jump
Group A ¹	Accuracy	20.90 \pm 7.79 cm	18.45 \pm 7.57 cm	22.62 \pm 7.14 cm
	Ball velocity	23.51 \pm 2.23 m/sec	26.27 \pm 3.21 m/sec	22.74 \pm 2.16 m/sec
Group A ²	Accuracy	22.94 \pm 5.44 cm	19.57 \pm 8.84 cm	24.31 \pm 8.39 cm
	Ball velocity	20.08 \pm 1.12 m/sec *	23.22 \pm 1.86 m/sec *	20.54 \pm 1.63 m/sec
Students	Accuracy	38.91 \pm 12.57 cm *+	41.55 \pm 13.70 cm *+	35.88 \pm 14.34 cm *+
	Ball velocity	16.85 \pm 1.58 m/sec *+	18.90 \pm 1.98 m/sec *+	15.54 \pm 1.42 m/sec *+

* = significantly different from group A1 (p<0.05)

+ = significantly different from group A2 (p<0.05)

RESULTS: The values of accuracy and ball velocity were examined separately in each group of subjects and in each type of throw, and the results are presented in Table 1.

As shown in Fig. 1, accuracy varied in each group of subjects and in each type of throw. The greatest accuracy was achieved by group A1 and group A2 and in the throw with a cross-over step, with mean values below 20 cm. The group of students, on the other hand, being different from the two groups of athletes, exhibited the least accuracy in the throw with a cross-over step (mean value 41.55 cm).

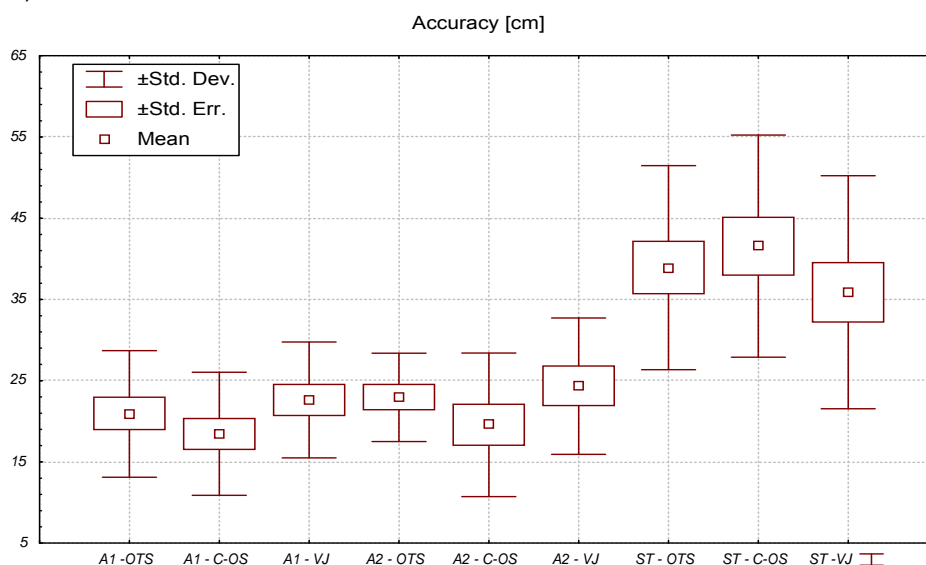


Fig. 1. Means, standard deviations and standard errors of accuracy in the three groups of subjects (A1, A2 and students) in the three types of throw (OTS - on the spot, C-OS - with cross-over step, VJ - with a vertical jump).

One way ANOVA performed for the three groups of subjects in each type of throw revealed that in all three types of throw examined, there was a significant difference in accuracy among groups, attributed to the higher deviation from the target observed in the student group (on the spot: $F_{ratio} = 16.422$, $p \leq 0.001$; with a cross-over step: $F_{ratio} = 22.493$, $p \leq 0.001$; with a vertical jump: $F_{ratio} = 6.825$, $p \leq 0.003$).

With regard to throwing velocity, a significant difference among groups was found in all types of throw examined (on the spot: $F_{ratio} = 54.585$, $p \leq 0.001$; with a cross-over step: $F_{ratio} = 33.578$, $p \leq 0.001$; with an a vertical jump: $F_{ratio} = 20.795$, $p \leq 0.001$), which was attributable to the fact that all three groups differed significantly from each other. In all the three types of throw the A1 group threw the ball with higher velocity compared to the A2 group and the students group, while ball velocity in the A2 group was higher than in the student group. This observation is consistent with the quantitative and qualitative level of the three groups of subjects. In all groups the highest ball velocity was achieved in the throw with a cross-over step. An explanation for this may be that the throw with a cross-over step involves

an initial run-up and, thus, a higher elastic energy transferred from the feet to the fingers of the upper limb (Atwater 1979).

The ball velocity values attained in the throw on the spot and in the throw with a vertical jump were very similar in all groups of subjects. This was probably due to the fact that in the throw on the spot there is no initial run-up to benefit the ball velocity, but the ground forces give a certain advantage, whereas during a throw with a vertical jump the lack of ground forces is counteracted by the speed gained with the initial run-up.

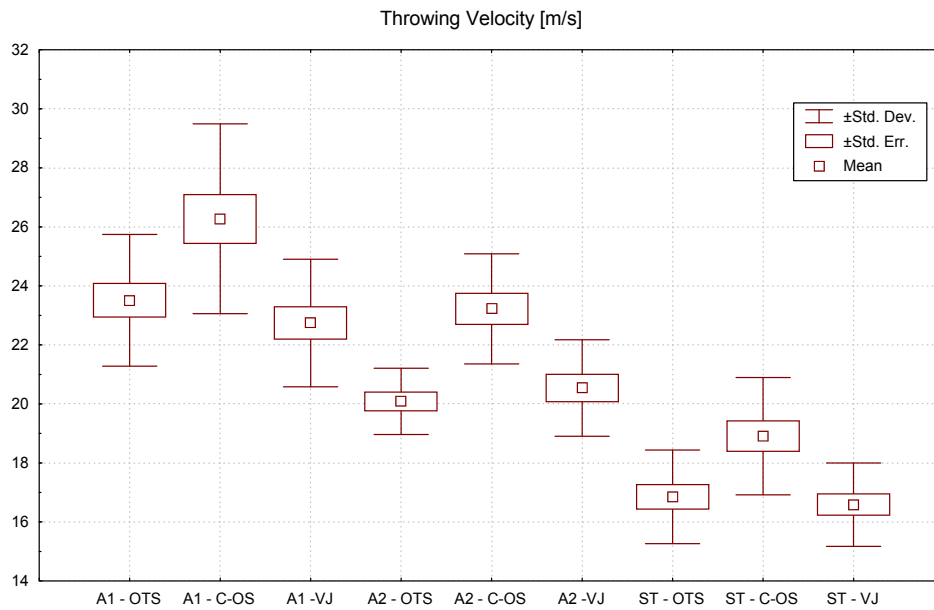


Fig. 2. Means, standard deviations and standard errors of throwing velocity in the three groups of subjects (A1, A2 and students) in the three types of throw (OTS - on the spot, C-OS - with cross-over step, VJ - with a vertical jump).

The relationship between accuracy and throwing velocity was studied separately in each group of subjects and in each type of throw. The results showed that (Table 2):

Table 2. Correlation coefficients (r) between accuracy and ball velocity in the three types of throw for the three groups of subjects.

	on the spot	with a cross-over step	with a vertical jump
Group A¹ (N= 15)	r=-.727, p = .002	r=-.162, NS	r=-.670, p=.006
Group A² (N= 12)	r=.153, NS	r=-.044, NS	r=-.507, NS
Students (N= 15)	r=-.414, NS	r=-.526, p =.044	r=.064, NS

NS = not statistically different (p<0.05)

a) in group A1 there was a significant negative relationship between accuracy and ball velocity when throwing the ball on the spot (r=-.727; p<0.01) or with a vertical jump (r=-.670; p<0.01),

b) in the group of students the accuracy was significantly related to ball velocity only when the throw was performed with a cross-over step ($r=-.526$; $p<0.05$) and
c) in group A2, no relationship was observed between the two variables in any of three types of throw.

CONCLUSIONS: In the present study the throwing performance of three groups of subjects was assessed both by the level of accuracy and the magnitude of ball velocity in their throws. The performance of the best scorers in the League A¹ group significantly exceeded that of the other groups for the variables studied in the three types of throwing examined by the present study. The throwing velocity has a profound effect on accuracy in two of the three types of throw in group A1, whereas such an effect was not observed in group A2; a similar effect but less profound was observed only in one of the three types of throw in the group of students.

The contribution of a handball player in a game is highly dependent on ability to combine the attainment of the highest possible ball velocity with the greatest accuracy in all types of throw, regardless of the technique used.

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