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THE RELATIONSHIP BETWEEN PLAY POSITIONS, VERTICAL JUMP AND SPRINTING SPEED IN YOUNG FOOTBALL PLAYERS

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Abstract

Objective: This research aims to investigate the relationship between power and sprint performance and describe the differences between player profiles in different play positions.
Methods: Thirty-three football players (age: 16±3 years, body height: 173±8 cm., body mass: 60±6 kg.) participated in the research with an assessment of power performance: Squat Jump (SJ), Counter Movement jump (CMJ), as well as speed performance in 30 meters (with 10 meters split time) distances.
Results: No significant differences were found between different play positions in vertical jump variables and speed performance variables ($p > 0.05$). Speed in the 0-10m distance has shown significant correlation to SJ (r= 0.57) and CMJ (r= 0.50), as well as to speed in the 10-30m distance (r=0.63). Speed in the 10-30m distance has shown significant correlation to SJ (r=0.64) and CMJ (r=0.60). Predicting speed performance in the 0-10m distance, as well as in the 10-30m distance, is more influenced by SJ than CMJ.
Conclusion: Power is taken into account as a special impact factor in developing sprinting speed in young football players. Compared to the vertical jump without eccentric contraction in knee joint (SJ), the vertical jump with eccentric and concentric contraction in knee joint (CMJ) has given higher results and it has simultaneously achieved lower correlations compared to the vertical jump without eccentric contraction in knee joint in relation to speed in 0-10m and 10-30m distances. SJ has shown bigger impact than CMJ in relation to 0-10m acceleration (starting speed) and to the running phase of reaching maximum speed in the 10-30 m distance.

Keywords: Squad jump, countermovement jump, sprint performance.

1. Introduction

Individual and team performance in football depends not only on technical, tactical and mental factors, but above all on athletes' athletic skills (Stolen, T. et al. 2005). The adequate way of performing motor skills is closely related to the hierarchy of intertwining physical abilities, which in themselves include a wide range of training exercises, training in isolation or in a combined way, in order to achieve optimal performance. Explosive actions with change of direction (sprints, jumps, duels, kicks) represent profile requirements of a modern football player even at a young age (Schlumberger, A. 2006), and this is the reason why such exercises are given special attention. Sprint running in football, both in the initial phase and in the phase of reaching maximum speed, is significantly influenced by the acquisition of key elements, such as: maximal strength, power, speed of alternating movements and intra- and inter-muscular coordination. Power training plays a significant role in this segment. Power as a maximal strength component is influenced by the latter and as such it results in increased sprint performance (Schmidbleicher, D. 1992; Hoff, J. et al. 2001). Sprint performance should be observed in many dimensions, both in the initial acceleration phase (0 to 10m), in the phase of reaching maximum running speed (36 to 100m) and in the transition phase, i.e. between them.
Immediately after the beginning of the acceleration action, magnus adductor and gluteus maximus muscles are considered to make the most important contribution to speed performance. Different training methods are

proposed to improve energy production of these muscles. Some of them aim at hypertrophy, while the others aim at specific adaptations of the nervous system. However, trainings must include general power exercises (hypertrophy and neuronal activation) and specific velocity (speed-strength) and specific movement (sprint-associated exercises) strength training. While developing training strategies, a trainer should keep in mind that strength, power and speed are naturally related to each other, because all of these are a result of the same functional systems. While heavy resistance training results in type (II b) to type (II a) muscular fibres transformation, we understand that we should aim for optimal balance between specific and non-specific training components. To achieve this, they must take into consideration the specific strength training demands of each individual based on the performance capacity in each specific sprint phase. (Delecluse, Ch. 1997).

Based on the fact that 96% of all sprints during a football match do not reach a length greater than 30m and 49% of these sprints are less than 10m, we understand that both the acceleration and the phase of reaching maximum speed represent fundamental factors of sprint performance in football players (Young, WB., Bnton, D., Duthie, G., Pryor, J. 2001).

Initial acceleration in short distances (up to 10m) and reached speed in long distances (20-30m) represent different forms of sprint running. Initial acceleration can be significantly improved with jump force exercises (Delecluse et al. 1995), while simple sprint running in distances over 20-50m does not result in a significant improvement of the sprinting start or acceleration (Zafeiridis et al. 2005). Jump force training(CMJ)in relation to sprint running up to 10m has shown high correlation (r = 0.94) in Norwegian professional football players (Wisloff et al. 2004). Furthermore, maximal strength (1 RM) is observed to have shown a correlation with the acceleration phase and movement speed in sprint performance (Bührle, M., Schmidtbleicher, D. 1997).

In addition to maximal strength, the vertical jump force and horizontal force influence certain phases of linear speed. Horizontal force exercises with load pulling (e.g.weight sled) are characterized by maximum speed reduction, step length reduction, step frequency reduction and contact time increase of the foot with the ground, compared to simple sprinting, i.e. the one without loads. These changes observed through kinematic analysis represent increased muscular activity of the knee and hip extensors, which generate high tension with focused concentric force, thus presenting a significant effect on the sprint power phase (Zafieridis et al. 2005).

Not only the initial acceleration, but also the power ability for rapid change of movement can be improved much more effectively with the combination of jump force exercises rather than with just simple sprinting exercises.

2. Methods

The participants in the research were regular football players (age: 16±3 years, body height: 173±8 cm, body mass: 60±6 kg) from two elite football teams in North Macedonia who trained three times a week with their respective clubs, regularly participating in elite competitions and championships of the country. Sprint running tests in 30m (with 10m split time) distance were performed on a synthetic grass football field. Players participated in three running tests and the best running time was used for data analysis. The running distance divided by the running time (m/sec) was used to calculate the maximum running speed. Speed measurements were performed with the help of photocell equipment (POWERTIMER - NEWTEST). Lower extremities power tests included: high jump force without eccentric contraction phase in knee joint (SJ) and high jump force with eccentric and concentric contraction phase in knee joint (CMJ)performed in an indoor gym. All players participated in all three tests and the best result was used for data analysis. Jump force measurements were performed using digital equipment (OPTOJUMP - MICROGATE). Special attention was paid to all players in both speed and power tests to ensure that they have received a proper rest time, at least five minutes between each test for the necessary recovery. Mean values and standard deviation were calculated for each test and each play position. Variance analysis was used to define if there were differences between play positions in relation to running performance and vertical force performance of lower extremities. The relationship between speed and power performance was calculated using Spearman's correlation test(r) with a statistical significance level p<0.05. The contribution of the most influential factor of sprint running in both distances is described using the regression analysis.

3. Results and Discussion

Table 1 shows the results of descriptive statistics including mean values and standard deviations of vertical jump performance (in cm) and sprint running (in m/sec) as a whole and divided in groups based on play positions. We can see that strikers achieved higher scores compared to the general mean values and compared to other play position groups. In both jump power performance tests (SJ and CMJ) and both speed tests (SPEED 0-10m and SPEED 10-30m), defenders as well as midfielders showed poorer results compared to the overall mean values, while no major difference was found between these two groups.

Table 1. Descriptive statistics (mean±SD) of football players

	SJ	CMJ	SPEED 0-10m	SPEED 10-30m
All players	28.92 ± 6.95	32.08 ± 7.34	5.44 ± 0.18	7.49 ± 0.25
Defenders	27.53 ± 4.34	31.88 ± 6.07	5.44 ± 0.15	7.48 ± 0.26
Midfielders	27.74 ± 7.78	30.34 ± 8.79	5.41 ± 0.12	7.46 ± 0.18
Strikers	31.22 ± 8.31	33.61 ± 7.70	5.46 ± 0.27	7.54 ± 0.30

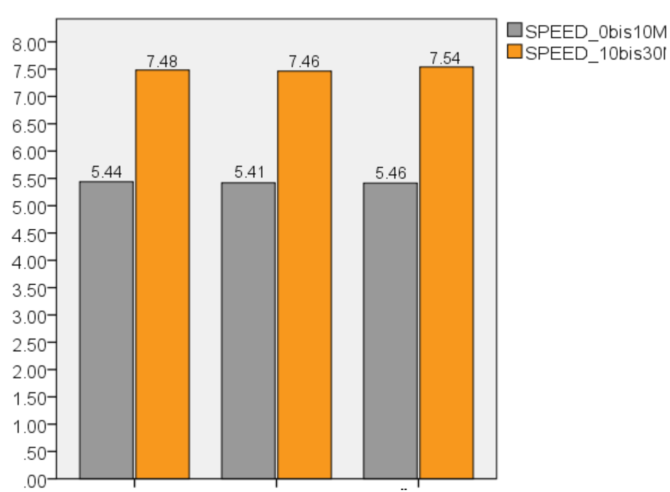

Figure 1. Speed results in 0-10m and 10-30m distances in m/sec

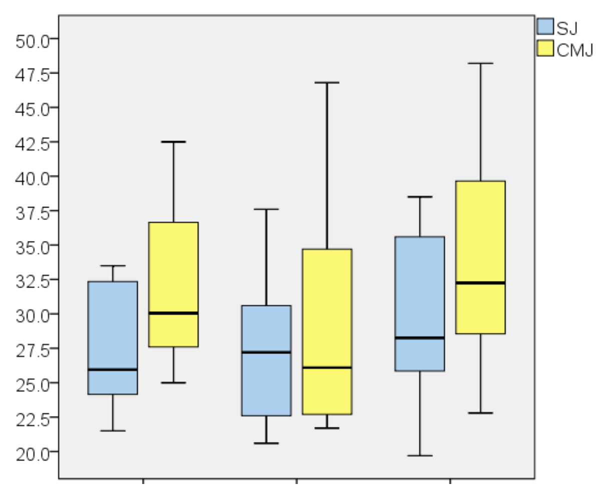

Figure 2. SJ and CMJ results in cm

Table 2. shows the variance analysis (ANOVA) between different play positions compared to jump force and speed tests. There was no statistically significant difference in play positions of SJ, CMJ, SPEED 0-10m and Speed 10-30m (p > 0.05). While they were not included in the diffentiated methods of the training process for

improving the above-mentioned performance components, it can be verified that there are no evident differences between the play positions (Kollath, E.& Quade, K. 1993 and Neto et al. 2007).

Table 2. Tests between subjects' effects

	F	Sig.	n^2
SJ	1.02	.37	.06
CMJ	.50	.60	.03
SPEED 0-10m	.14	.86	.00
SPEED 10-30m	.25	.74	.01

** Play position*

Table 3 shows significant correlation between power tests (SJ and CMJ) and speed tests (SPEED 0-10m and SPEED 10-30m). We can see that SJ has shown higher correlation than CMJ both at speeds up to 10m (r = .57) and speeds ranging 10-30m (r = .64). Since SJ represents (pure) jump force without eccentric contraction in knee joint, it is considered a relevant factor in increasing football players acceleration speed. Having in mind that CMJ is performed with eccentric and concentric contraction in knee joint (energy is supposed to be charged in the eccentric phase of muscle stretch which then influences in rapid muscle contraction in the concentric phase), it reaches the biggest height compared to SJ, but it does not show higher correlation than SJ in relation to the two sprint distances in football players participating in the research.

Table 3. Correlations between power and speed

	SJ	CMJ
SPEED 0 - 10m	0.57**	0.50**
SPEED 10 -30m	0.64**	0.60**

*** Correlation is significant at 0.01 level (two-tailed)*

Table 4. using the regression analysis, shows the explainable part of the variance and the influence of both jump force variables in both sprint running distances. SJ and CMJ together explain33% of the variance of the SPEED 0-10m variable, and 44% of the variance of the SPEED 10-30m variable. Power has a significant influence on the 0-10m acceleration speed (F (2,33) = 8,125, p = .001) and on the linear running phase 10-30m. (F (2,33) = 12,623, p = .001).By comparing these two types of jump force in young football players, we can easily understand that SJ as a vertical force (concentric), pure, without eccentric contraction in knee joint, of the lower extremities, has significant influence (SPEED 0-10m, β = .46, p = .048 and SPEED 10-30m, β = .43, p = .047) on typical sprint distances, while CMJ as a vertical force with flexion in knee joint (eccentric/concentric) does not have significant influence (SPEED 0-10m, β = .13, p = .553and SPEED 10-30m, β = .27, p = .201)on running distances mentioned in the research.

Table 4. Regression Analysis

		R^2	B	β	Sig.
SPEED 0-10m.	SJ	.33	.013	.46	.048
	CMJ		.003	.13	.553
SPEED 10-30m.	SJ	.44	.016	.43	.047
	CMJ		.009	.27	.201

4. Conclusions

Play positions show no significant differences in relation to vertical jump force and running speed in short distances. The jump force without eccentric contraction in knee joint (SJ) of the lower extremities plays an important role on typical running distances in young football players. The increase of maximal strength and power level in creases the readiness of physiological adaptation (neurological, recruiting, frequent and hypertrophic adaptations), thus improving the sprint start performance. Recorded evidence shows that elite football players, compared to lower categories football players, show greater significant differences in sprint performance in distances up to 10m than those up to 30m (Cometti, G., Mafiuletti, NA., Pousson, M., Chatard, JC., Maffulli, N. 2001). Apparently, the initial phase of sprint running and that of rapid change of directions, present in real football matches, represent an independent running component in relation to the phase of reaching maximum speed in linear running. Jump force exercises have obvious influence on the performance of running acceleration (0-10m), and also on the distance of linear running (over 20m), while typical sprint training is supposed to have an influence on linear running (over 20m), but they do not have obvious influence on the distance of running acceleration (0-10m). This clearly speaks of the nature of these two different forms of sprinting and the focus of planning the training process with strength training in order to achieve the optimal level of speed in typical play distances with young football players. In addition, differential conditional training, while having in mind the characteristics of play positions, could have an influence on another conditional level, thus expecting differences between the play positions. However, the analysis of 10-20m and 20-30m sprint distances in relation to the vertical jump force in young football players would shed more light on similar researches.

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