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Discriminant analysis of soccer tactical elements in the phases of attack and defense determined by cluster analysis

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Abstract
The aim of this study was to determine the differences between groups of tactical elements in the phases of attack and defense in soccer. It was defined 117 tactical elements of soccer game whose importance was estimated with 30 variables that indicate the basic segments of the football game. The sample of entities in this study is represented by 93 offensive and 24 defensive tactical elements that are described with 15 variables for the phase of attack and 15 variables for the phase of defense. For the determination of entities through a total of 30 variables, it was used an expert knowledge of ten competent soccer experts. Relying on their own experience and using the assessment system with grades ranging from 0 to 5 the experts graded the impact of tactical techniques on the properties (attributes) of soccer, attack and defense. In the phase of the attack there were identified three homogeneous groups of tactical elements, and several subgroups at a lower level and in the phase of defense, four groups were identified. The first discriminant function had a higher discriminative power in relation to the second discriminant function. The results have shown statistically significant difference between groups of entities (tactical elements of attack) at the level of significance $p<0.01$, with high canonical correlation coefficients (Rc1-0.93 and Rc2-0.75). Discriminant analysis for defined group of tactical elements indicates to the posibility for differentiation of potential programs and sub-programs of the tactical preparation for players and economization of training.

Key words: **soccer, tactical elements, homogeneous groups, discriminant analysis**

Saţetak
S ciljem utvrđivanja razlika između grupa taktičkih sredstava u fazi napada i obrane u fudbalu definirano je 117 taktičkih sredstava fudbalske igre čija je važnost procijenjena na 30 varijabli koje označavaju temeljne segmente fudbalske igre. Uzorak entiteta u ovom istraživanju predstavljaju 93 napadačka i 24 obrambena taktička sredstva koja su opisana sa 15 varijabli faze napada i 15 varijabli faze obrane. Za određivanje karakteristika entiteta kroz ukupno 30 varijabli, korišteno je ekspertno znanje desetorice kompetentnih fudbalskih stručnjaka. Eksperti su ocenama 0 – 5 na osnovu vlastitih spoznaja procijenili utjecaj svakog entiteta (taktičkog sredstva) na pojedine varijable koje opisuju fudbalnu igru u fazi napada i fazi obrane. Na osnovu vrednosti koeficijenata objektivnosti utvrđen je visok stupanj slaganja mišljenja eksperata oko predmeta u svim atributima napada i obrane. Izračunate su Mahalanobisove distance između taktičkih sredstava te su prikazani odgovarajući dijagrami udruživanja u klastere. U fazi napada identificirane su tri homogene grupe taktičkih sredstava i nekoliko podgrupa na nižoj nivou, a u fazi obrane identificirane su četiri grupe. Razlike između grupa taktičkih sredstava napada utvrđenih klaster analizom testirane su na multivarijatnom nivou diskriminacijskom analizom. Zbog premalenog broja entiteta u grupama taktičkih sredstava obrane, razlike između grupa testirane su na univarijatnom nivou Kruskal–Wallisovim testom. U svrhu usporedbe prosečnih ocena važnosti po grupama izračunate su aritmetičke sredine rangova taktičkih sredstava za svaku grupu. Na kraju se može zaključiti kako se Diskriminacijskom analizom utvrđenih grupa taktičkih sredstava klaster analizom ukazuje na mogućnosti njihova razlikovanja. Time se mogu identificirati potencijalni programi i potprogrami taktičke pripreme fudbalera (ekonomizacija treninga).

Ključne riječi: **fudbal, takticki elementi, homogene grupe, diskriminativna analiza**

Introduction

Soccer is currently the most popular sport with demands that are increasing, requiring greater motor and energy-supply abilities and the use of quicker and more efficient tactical techniques. In the nearest future, further development of the game dynamics is expected (Kuhn Humboldt, 2003). Tactics in soccer include technical elements applied in different situations such as a variety of group movements, measures and procedures carried out with the aim of solving certain tasks during the game (Toplak, 1985). The familiarity with the game structure includes understanding of various phases of the game and individual players' positions, which leads to the recognition of specific game situations. The players must understund those phases and transisitons from one phase to another and solve the tasks in the game by using appropriate technical and tactical programs (Lanham, 1993). Several studies exist concerning the game structure and frequency of tactical techniques used in soccer (Barišić, 1996). There are also numerous studies that analyse the impact of and correlation between specific tactics and structural elements and performance of the soccer team (Luhtanen, 1993; Jerković, Barišić, Birkić & Šimenc, 1996; Bishovets, Gadijev & Godik, 1993; Ćurčić, 2005; Yamanaka, Hughes & Lott, 1993; Hughes, 1993). Furthermore, Barišić (1996) has analyzed successful and unsuccessful performed technical-tactical elements in the game on a sample of 18 variables collected at the final eight games of the World Championships in Italy (1990). He has concluded that the winners in seven games had higher quantitative and qualitative grades of passing the ball, and the analysis of steals showed rarely use of tackling, while much more common were the interseptions of the ball in front of the opponent kick by leg (the ball coming on the ground) and by head (the ball coming in air). Jinshan, Xiaoke, Yamanaka and Matsumoto (1991) have analyzed conceded goals in 13th (Mexico, 1986) and 14th (Italy, 1990) world soccer championship. They have found that nearly 70% (80%) of goals were scored after a pass from the wing position and after shots from the central area. Argilaga and Jonsson (2003) have found that the conventional soccer analysis mainly

focuse on elementary statistics and drafts of the field that provide information such as frequency and field distribution of players' passes, shots on goal and defense formation. It turned out that players' efficiency is often driven by strategy and tactics that resulte in the same patterns of behaviour. Some of these patterns can be seen by coach, while others require much more detailed methods and analysis to be noticed. Current studies are focused on the discovery and analysis of complex internal and external separate samples (T-samples) and comparison of polar coordinates in soccer. The results show that the two approaches are used to monitor elements in the game such as measurement of the event, passing the ball, the structure of players. It should be noted that this type of analysis are useful in enhancing existing methods used in the analysis of soccer.

Nowadays, elastic mode of the game in soccer is dominating, with great responsibilities of each player. The modern style of play requires dynamism and versatility of each player individually. No matter what part of the games is, the lines must cooperate and communicate, which is influenced by certain factors and the level of communication skills of players.

The primary objective of this study was to determine the differences between the formed homogeneous groups and to determine the importance of certain homogeneous group of tactical elements for the realization of the game at every position. The secondary objective was to determine the difference in every sub-phases of the game as well in each type of game in particular. Discriminant analysis for identified groups of tactical elements by cluster analysis indicates the possibility of their differentiation. This can identify potential programs and subprograms for tactical preparation of soccer players.

Methods

Ten soccer experts assessed the importance of tactical techniques that define the structure of soccer. A soccer coach, an expert advisor, a top player or a college professor teaching soccer at the Faculty of Kinesiology, a coach of a soccer team competing in the European Football Club championships, a coach or a member of expert staff of the national soccer team participating in the European Championships or World Cups, a footballer from a team competing in the European Football Club championships or a member of the national team participating in the European Championship or World Cup were regarded experts in the research study. Relying on their own experience and using the assessment system with grades ranging from 0 to 5 the experts graded the impact of tactical techniques on the properties (attributes) of soccer, attack and defense. The entity sample comprised 117 tactical techniques of soccer in the phases of attack and defense (Table 1). If a certain soccer technical element is applied in the training process or the game itself with the aim of advancing the ball, keep it in the possession, take over its possession, pass it to a teammate or trying to score as well as obstructing the opponent from scoring at any given moment and in any given situation, then the same element represents a tactical technique.

Table 1. Attack and defense football tactical elements

1-7 Ground kicks with the: instep center, outside of the instep, inside of the instep, inside of the foot, outside of the foot, ball of the foot, heel (heel kick).	
8-12 Air-borne kicks volley and scissors kicks - forward and side volley kicks, forward and side scissors kicks, bicycle kicks (above the head).	
13, 14 Bounced-off kicks: half-volleys – forward and side half-volley kicks and punting (drop kick).	
15 Kicks with the leg closer to the oncoming ball	16 Kicks with the leg further away from the oncoming ball trajectory
17 Heading the ball (from standing)	18 Heading the ball (from jumping)
19 Heading the ball (from falling/jumping)	20 Short distance goal attacking (up to10 m)
21 Mid-distance goal attacking (10-20 m)	22 Long distance goal attacking (over 20 m)
23-36 Ball manoeuvres with the: inside of the foot dribble, outside of the foot dribble, sole of the foot dribble, back heel dribble, dribbling circles around the opponents, body feint with the outside of the foot, feint shot with the outside of the foot, fake shot with the inside of the foot, fake shot with the sole of the foot, fake shot with the heel back, body fake by moving the leg in front of the ball – outside of the foot dribble, body fake by moving the leg above the ball – outside of the foot dribble, body fake by moving the leg above the ball – inside of the foot dribble, and body fake by moving the leg behind the ball – outside of the foot dribble.	
37 - 39 Dribbling according to the positions of the attacker and his/her defender: dribbling facing the opposing defender, dribbling with the attacker's side or back to the opposing defender	
40 - 42 Dribbling according to the tactical aims in the match: purposeful dribbling (the defender uses it against the attacker when clearing or taking over the ball), positional dribbling (the attacker imposes it on the defender to create a favourable, front position), and attacking dribbling (the attacker imposes it on the defender, mostly in the goal attack zone)	
43 - 46 Advancing the ball with the:: instep center, inside of the foot, outside of the foot, sole of the foot.	
47 - 50 Advancing the ball depending on the movement direction : in a straight line, in a semi-circle, in a zig-zag line.	
51 - 53 Advancing the ball depending on the pace: basic pace, average pace, submaximal pace and maximal pace.	
54, 55 Advancing the ball depending on the tactical aims in the game: individual action (in combination with dribbling, most often as an introduction to the finishing sub-phase) and favourable position creation (most ofen in the build-up and peak of the attack).	
56 - 59 Openings (getting free): actual opening (in the direct cooperation with a co-player by passing over or/and receiving the ball), deceptive opening (enables a co-player to move into free space), supporting opening (supporting a co-player with the ball when he/she does not establish a contact with the third co-player by passing over the ball), and safety opening (the indirect participation of co-players in the attack until game focus changes).	
60 - 79 Ball control or receiving: shock absorption of parabolas with the: center of the instep, inside of the foot, upper leg, chest and the head; shock absorption of an oncoming ground ball with the inside of the foot; a bounced-off parabola reception and carried out with the sole of the foot, with the inside and the outside of the foot, with the body and the head, maneuvering an oncoming ground ball with the: center of the instep, inside and outside of the foot; manoeuvring a parabola with the: center of the instep, inside and outside of the foot, upper leg, chest and head.	
81 - 87 Ball passing depending on the direction: passing the ball to the oncoming player, passing the ball to a co-player forwards into free space, passing the ball to a co-player backwards into free space, passing the ball to a co-player across the football pitch, reverse ball passes, forward diagonal ball, backward diagonal ball, parallel cross ball	
88 - 90 Ball passing over: short distance (up to 10 m), mid-distance (10m to 30m) and long distance (over 30m).	
91 - 93 Positions' changes with the aim to: pass the ball timely and efficiently create free space for a co-player, destroy the positioning of the opposing defensive players.	
94, 95 Marking the opposing players: man-to-man marking and zone defense	
96, 97 Obstructions: obstructing opposing players and goal keeper.	
98, 99 Takeover: active and passive takeover (with and without the change of position in the basic players lineup).	
100 - 104 Clearing the ball: kicking out an oncoming ground ball in front of the opposing player, kicking out a parabola in front of theopposing player, kicking out the bounced-off ball in front of the opposing player, heading out a parabola and heading out the bounced-off ball in front of the opposing player.	
105 - 107 Ball takeover depending on the moment of takeover: before it is obtained by the opposing attacker (tackle the ball in front of the opponent), when the opposing attacker is taking hold of it (tackle the ball in front of the opponent) and after it is obtained by an opposing attacker.	
108 - 117 Ball takoever depending on the way it is done: basic takeover – frontal relationship between the defender and attacker, basic takeover – sideways relationship betwen the defender and attacker, basic takeover – the defender is behind the attacker. Ball takeover by pushing out the opposing player from the lead (by shouldering), frontal slide tackle, sideways slide tackle, slide tackle from behind oncoming ground ball takeover by tackling the ball in front of the opposing player, a parabaola takeover by tackling the ball in front of the opposing player, bounced-off ball takoever by tackling it in front of the opposing player.	

Thirty variables (Table 2) were created that determine the basic elements of soccer in relation to the teams' positions in the game and in the phases of attack and defense, the field zones, game phases, sub-phases of attack and defense and types (styles) of play in the phases of attack and defense. The experts assessed, weighted and graded the importance of each tactical technique with regard to each of these 30 attributes to the game of soccer. The research did not comprise the goalkeeper's positions in the game nor his/her tasks. This will be the subject of future analyses of soccer.

Table 2. Attributes of the game of football

	Positions of players in the game:
1	POF – positions of forwards
2	POCM – positions of centre midfielders
3	POWM – positions of wing midfielders
4	POIF – positions of inside forwards
5	POWM – positions of wide midfielders
6	POFDP – positions of front defensive players
7	POFCB – positions of front centre-backs
8	POFW – positions of front wingbacks
9	POFB – positions of full-backs
10	POBW – positions of back (rear) wingbacks
	Sub-phases of the game :
11	FSP – finishing sub-phase
12	TADLBF – transition from attack to defense after losing the ball in the finishing sub-phase
13	PASP – point of the attack sub-phase
14	TADLBA – transition from attack to defense after losing the ball at the point of attack
15	ABSP – attack build-up sub-phase
16	TADLBAB – transition from attack to defense after losing the ball in the attack build-up
17	WDS – wide defense sub-phase
18	TDABTWD – transition from defense to attack after the ball takeover in the wide defense zone
19	MDS – midfield defense sub-phase
20	TDABTMD – transition from defense to attack after the ball takeover within the midfield defense zone
21	CDS – core defense sub-phase
22	TDABTWC – transition from defense to attack after the ball takoever within the core zone
	Attack types:
23	PAC – progressive attack: continuous attack
24	PACA – progressive attack: counter-attack
25	CA – combinedattack
26	NPA – non-progresive attack
	Defense types :
27	CD – combined defense
28	CDZ – core zone defense
29	MD – midfield defense
30	WZD – wide zone defense

The group of 30 variables was condensed (Table 3) into the groups of variables of game positions, variables of sub-phases of the game, variables of the styles of play and grouped variables together with the arithmetic mean separately for the phases of attack and defense, which resulted in the assessment of the importance of tactical techniques.

Table 3. Sum total variables in the phases of defense and attack

Sum total variables for attack :
TPPA – total of the positions of players in (POF, POCM, POWM, POIF, POWM)
TPPSPA – total of the sub-phases of attack (FSP, PASP, ABSP, TDABTWD, TDABTMD, TDABTWC)
TAT – total of the attack types (PAC, PACA, CA, NPA)
TPA – total properties of play in attack (attack variables - total)
Sum total variables for defense
TPPD – total according to the positions of defense players (POFDP, POFCB, POFW, POFB, POBW)
TPPDSP – total according to the defense sub-phases (WDS, MDS, CDS, TADLBF, TADLBA, TADLBAB)
TTD – total according to the types (styles) of defense (CD, CDZ, MD, WZD)
TPD – total according to the game properties in defense (total of defense variables)

The data were processed by means of Statistica (Data Analysis Software System), version 7.1., separately for the tactical techniques of attack and defense. Descriptive parameters were calculated for all the tested variables. The normality of the distribution of variables was examined by the Kolmogorov-Smirnov test. Differences between groups of tactical elements of attack were identified by cluster analysis (a homogeneous group of offensive tactical elements A, B, C - Table 4) were tested at the multivariate level by the discriminant analysis. Differences between groups of tactical elements of defense established by cluster analysis (a homogeneous group of defensive tactical means A, B, C, D - Table 5), due to too small number of entities into homogeneous groups were tested on a univariate level, by Kruskal-Wallis test. In order to compare the average grades of importance among groups, the mean grades of rank of tactical elements for each group were calculated.

Table 4. Homogeneous groups of offensive tactical elements A, B, C defined by cluster analysis

	The list of offensive tactical elements of group A
1	Parallel cross ball
2	Backward diagonal ball
3	Mid-distance goal attacking (10-20 m)
4	Short distance goal attacking (up to10 m)
5	Heading the ball (from jumping)
6	Heading the ball (from standing)
7	Side volley kicks
8	Side half-volley kicks
9	Half-volleys – forward
10	Forward volley kicks
11	Heading the ball (from jumping)
12	Side scissors kicks
13	Forward scissors kicks
14	Bicycle kicks (above the head)

15	Advancing the ball in basic pace
16	a bounced-off parabola reception with the head
17	Shock absorption of parabolas with the head
18	Ground kicks with the heel (heel kick)
19	Body fake by moving the leg above the ball – outside of the foot dribble
20	Fake shot and dribling with the inside of the foot
21	Back heel dribble
22	Body fake by moving the leg behind the ball – outside of the foot dribble
23	Body fake by moving the leg above the ball – inside of the foot dribble
24	Dribbling circles around the opponents
25	Fake shot and dribling with the heel back
26	Fake shot and dribling with the sole of the foot
27	Sole of the foot dribble
28	Advancing the ball in a zig-zag line
29	Advancing the ball in a semi-circle
30	Advancing the ball in a straight line
31	Advancing the ball with the sole of the foot.
32	Manoeuvring a parabola with the head
33	Ball control or receiving: shock absorption of parabolas with the center of the instep
34	Ground kicks with the ball of the foot
	The list of offensive tactical elements of group B
1	Safety opening (the indirect participation of co-players in the attack until game focus changes).
2	Supporting opening (supporting a co-player with the ball when he/she does not establish a contact with the third co-player by passing over the ball)
3	Manoeuvring a parabola with the upper leg
4	Manoeuvring a parabola with the outside of the foot
5	Mid-distance (10m to 30m) passing
6	Advancing the ball in submaximal pace and maximal pace
7	Kicks with the leg closer to the oncoming ball
8	Long distance (over 30m) passing
9	Ground kicks with the outside of the foot
10	Kicks with the leg further away from the oncoming ball trajectory
11	Kicks with the outside of the instep
12	Manoeuvring a parabola with the inside of the foot
13	a bounced-off parabola reception and carried out with the outside of the foot
14	a bounced-off parabola reception and carried out with the inside of the foot
15	Maneuvering an oncoming ground ball with the outside of the foot
16	Maneuvering an oncoming ground ball with the inside of the foot
17	Actual opening (in the direct cooperation with a co-player by passing over or/and receiving the ball)
18	Passing the ball to a co-player forwards into free space
19	Passing the ball to the oncoming player
20	Ground kicks with the inside of the foot
21	Ground kicks with inside of the instep

	The list of offensive tactical elements of group C
1	Positions' changes with the aim to disturb the positioning of the opposing defensive players
2	Positions' changes with the aim to pass the ball timely and efficiently
3	Positions' changes with the aim to create free space for a co-player
4	Deceptive opening (enables a co-player to move into free space)
5	Individual action (in combination with dribbling, most often as an introduction to the finishing sub-phase)
6	Attacking dribbling (the attacker imposes it on the defender, mostly in the goal attack zone)
7	Dribbling with the attacker's back to the opposing defender
8	Dribbling with the attacker's side to the opposing defender
9	Dribbling facing the opposing defender
10	Body fake by moving the leg in front of the ball – outside of the foot dribble
11	Feint shot and dribling with the outside of the foot
12	Body feint and dribling with the outside of the foot
13	Outside of the foot dribble
14	Inside of the foot dribble
15	Short distance (up to 10 m) passing
16	Passing the ball to a co-player across the football pitch
17	Passing the ball to a co-player backwards into free space
18	Favourable position creation (most ofen in the build-up and peak of the attack)
19	Reverse ball passes
20	Positional dribbling (the attacker imposes it on the defender to create a favourable, front position)
21	Purposeful dribbling (the defender uses it against the attacker when clearing or taking over the ball)
22	Manoeuvring a parabola with the chest
23	a bounced-off parabola reception and carried out with the body
24	Manoeuvring a parabola with the center of the instep
25	a bounced-off parabola reception and carried out with the sole of the foot
26	Shock absorption of parabolas with the chest
27	Shock absorption of parabolas with the upper leg
28	Shock absorption of parabolas with the inside of the foot
29	Passing the forward diagonal ball to a co-player
30	Long distance goal attacking (over 20 m)
31	Advancing the ball with the outside of the foot
32	Advancing the ball with the inside of the foot
33	Shock absorption of parabolas with the inside of the foot
34	Advancing the ball in a zig-zag line
35	Advancing the ball with the instep center
36	Maneuvering an oncoming ground ball with the center of the instep
37	Advancing the ball on average pace
38	Ground kicks with the instep center

Table 5. Homogeneous groups of defensive tactical elements A, B, C, D defined by cluster analysis

	The list of defensive tactical elements of group A
1	*113.* sideways slide tackle
2	*114.* slide tackle from behind
3	*112.* frontal slide tackle
4	*97.* obstructing opposing goal keeper
	The list of defensive tactical elements of group B
1	*110.* basic takeover – the defender is behind the attacker
2	*116.* a parabaola takeover by tackling the ball in front of the opposing player
3	*115.* ground ball takeover by tackling the ball in front of the opposing player
4	*108.* basic takeover – frontal relationship between the defender and attacker
5	*117.* bounced-off ball takoever by tackling it in front of the opposing player
6	*107.* Ball takeover after it is obtained by an opposing attacker
7	*111.* takeover by pushing out the opposing player from the lead (by shouldering)
8	*109.* basic takeover – sideways relationship betwen the defender and attacker
9	*106.* Ball takeover when the opposing attacker is taking hold of it (tackle the ball in front of the opponent)
10	*105.* Ball takeover before it is obtained by the opposing attacker (tackle the ball in front of the opponent)
11	*97.* active takeover, change of position in the basic players lineup
	The list of defensive tactical elements of group C
1	*99.* passive takeover *(*without the change of position in the basic players lineup*)*
2	*96.* obstructing opposing players
3	*95.* Marking the opposing players *(*zone *marking)*
	The list of defensive tactical elements of group D
1	*104.* heading out the bounced-off ball in front of the opposing player
2	*103.* heading out a parabola bounced-off in front of the opposing player
3	*102.* kicking out the bounced-off ball in front of the opposing player
4	*101.* kicking out a parabola in front of the opposing player
5	*100.* kicking out an oncoming ground ball in front of the opposing player
6	*94.* Marking the opposing players: man-to-man marking

Results

According to the results of Kolmogorov-Smirnov test of normal distribution (Table 6) evaluation of the importance for each group for tactical elements of attack obtained by cluster analysis (A, B, C) has showed no significant deviation from the normal distribution (only one variable in each homogeneous group for tactical elements of attack), which was the important condition for the applying of discriminant analysis to determine differences among the groups. The average value of importance for the group of tactical elements A (Table 6) in the sum of variables that describe the phase of attack (TPPA, TPPSPA, TAT and TPA) ranges from 2.10 to 3.15, while based on the specific attributes of the game grades range from 0.99 (PASP –point of the attack sub-phase) to 3.87 (POF -positions of forwards).

The relatively high average value of importance for the group of attacking tactical elements A in the realization of the game concerning some attributes of the attack was recorded on positions of forwards (POF), positions of centre midfielders (POCM), positions of wing midfielders (POWM), finishing sub-phase (FSP), transition from defense to attack after the ball takeover in the wide defense zone (TDABTWD), progressive attack: continuous attack (PAC) combined-attack (CA). The mentioned group A is being marked by tactical elements of attack over the wing area and final phase of the attack after making the long pass (typical kicks to the head).

Table 6. Descriptive parameters

	A (*n=34*)	B (*n=21*)	C (*n=38*)
	Mean±SD	Mean±SD	Mean±SD
POF	3.87±0.64	4.20±0.60	4.42±0.46
POCM	3.73±0.77	4.76±0.22	4.52±0.58
PKVN	3.50±0.99	4.57±0.29	4.23±0.63
POIF	2.30±0.93	4.58±0.37	3.14±0.80
POWM	2.36±1.08	4.41±0.42	2.77±1.04
FSP	3.32±1.05	4.56±0.41	4.32±0.59
ABSP	1.66±0.77	4.53±0.36	3.82±0.71
PASP	0.99±0.45	4.14±0.78	2.13±0.95
TDABTWD	3.10±1.28	4.57±0.49	4.46±0.57
TDABTMD	2.27±1.27	4.62±0.37	4.37±0.49
DABTWC	1.27±0.65	4.56±0.45	2.70±1.03
PAC	3.47±0.83	4.51±0.57	4.23±0.55
PACA	2.19±1.12	3.91±0.70	2.40±0.94
CA	3.10±0.99	4.65±0.33	4.28±0.70
NPA	2.37±0.91	4.39±0.55	3.98±0.88
TPPA	3.15±0.71	4.50±0.27	3.82±0.43
TPPSPA	2.10±0.55	4.50±0.36	3.63±0.42
TAT	2.78±0.66	4.37±0.28	3.72±0.47
TPA	2.63±0.51	4.60±0.61	3.72±0.34

POF – positions of forwards, POCM – positions of centre midfielders, PKVN positions of wing midfielders, POIF – positions of inside forwards, POWM – positions of wide midfielders, FSP – finishing sub-phase, ABSP – attack build-up sub-phase, PASP – point of the attack sub-phase, TDABTWD – transition from defense to attack after the ball takeover in the wide defense zone, TDABTMD – transition from defense to attack after the ball takeover within the midfield defense zone, DABTWC transition from defense to attack after the ball takoever within the core zone, PAC – progressive attack: continuous attack, PACA – progressive attack: counter-attack, CA – combine-dattack, NPA – non-progresive attack, TPPA – total of the positions of players in attack, TPPSPA – total of the sub-phases of attack, TAT – total of the attack types, TPA – total properties of play in attack.

Average grades of importance for the group of attacking tactical elements B (Table 6) in the sum of variables that describe the phase of attack (TPPA, TPPSPA, TAT and TPA) ranges from 4.37 to 4.60, while the specific attributes of the game grades range from 3.91 (PACA – progressive attack: counter-attack) to 4.76

(POCM – positions of centre midfielders). Extremely high average grades of the importance for the group of tactical elements B in the implementation of certain game attribute of the attack were achieved in all attack positions (POF, POCM, POWM , POIF, POWM), in all sub-phases of the attack (FSP , ABSP, PASP), in all transitions from defense to attack after the ball was taken-over in different zones (TDABTWD, TDABTMD, DABTWC), as well as in most types of attacks (PACA, CA, NPA). Slightly lower average grades of importance for group B were achieved in the counterattack. Group B is characterized by group tactical elements which are applied in all sub-phases of attack that shift the focus of the game and change the pace in the development of the attack.

Table 7. Results of discriminant analysis for the evaluation of differences between groups for the tactical elements of attack

VARIABLE	Function 1	Function 2
POF	.107	.298
POCM	.266	.194
POWM	.224	.110
POIF	.424	-.179
POWM	.301	-.287
FSP	.258	.211
ABSP	.665	.453
PASP	.599	-.259
TDABTWD	.268	.304
TDABTMD	.451	.467
DABTWC	.608	-.133
PAC	.242	.151
PACA	.244	-.300
CA	.321	.224
NPA	.384	.308
Eigen- value	6.566	1.264
Canonicl R	0.932	0.747
Wilks' Lambda	0.058	0.442
Chi-Sqr.	235.780	67.812
df	30	14
p-level	0.000	0.000

POF – positions of forwards, POCM – positions of centre midfielders, POIF – positions of inside forwards, POWM – positions of wide midfielders, FSP – finishing sub-phase, ABSP – attack build-up sub-phase, PASP – point of the attack sub-phase, TDABTWD – transition from defense to attack after the ball takeover in the wide defense zone, TDABTMD – transition from defense to attack after the ball takeover within the midfield defense zone, DABTWC transition from defense to attack after the ball takoever within the core zone, PAC – progressive attack: continuous attack, PACA – progressive attack: counter-attack, CA – combinedattack, NPA – non-progresive attack

Average grades of importance for the group of attacking tactical elements C (Table 6) in the sum of variables that describe the phase of attack (TPPA -UKPOZN, TPPSPA -UKPODN, TAT – UKNAIN and TPA –UKN) range from 3.63 to 3.82, while based on the individual attributes of the game grades range from 2.13 (PASP – point of the attack sub-phase) to 4.52 (POCM – positions of centre midfielders).

Table 8. Centroids of a Group of offensive tactical elements in the area of discrimination functions

	FUNCTION 1	FUNCTION 2
A	-2.88	-0.72
B	3.78	-1.20
C	0.49	1.31

High average grades of importance for the group of attacking tactical elements C in the realization of certain attributes of the attack were recorded on the POCM – positions of centre midfielders, POF – positions of forwards, POWM - positions of wing midfielders, FSP – finishing sub-phase, ABSP – attack build-up sub-phase, TDABTWD – transition from defense to attack after the ball takeover in the wide defense zone, TDABTMD – transition from defense to attack after the ball takeover within the midfield defense zone, in the PAC – progressive attack: continuous attack and in the CA – combinedattack.

High grades in group C were characterized by individual and group tactical elements which are applied to retain ball possession and create a favorable situation, usually in the sub-phases in the middle of the field and in the final phases of attack in the development of offensive action. Due to the small number of entities in three of the four groups (A: n=4, C: n=3 and D: n=6), differences among groups of defensive tactical elements were tested by Kruskal-Wallis test. This method has contributed to the statement that grades of the importance for a group of tactical elements of defense significantly differ in all variables.

Discussion and Conclusion

Discriminant analysis has revealed the data regarding the differences in the group entities (groups of offensive tactical elements), determined by the cluster analysis, (according to the position of group centroids in the space of discriminatory function) and how certain variables contribute to this differences (based on the correlation matrix of variables with the discriminant function). Discriminant analysis, in the area of basic attributes of the game in attack phase on the sample obtained by the three groups of entities, has established the existence of two discriminatory functions that significantly differ, as well as groups obtained by cluster analysis (Table 7).

The grades of the canonical correlation coefficients (Rc) and Wilks lambda (Wλ) indicate good discrimination of groups. Besides that, we can see that the first discriminant function had a higher discriminative power in relation to the second discriminant function. Table 7 shows a statistically significant difference between groups of entities (tactical elements of attack) at the level of significance $p<0.01$, with high canonical correlation coefficients (Rc1-0.93 and Rc2-0.75). These coefficients confirm that the discriminant function significantly contributes to the differentiation of the obtained group of entities.

The first discriminant function, with the positive projections, was determined by the attributes of ABSP – attack build-up sub-phase (.67), DABTWC transition from defense to attack after the ball takoever within the core zone (.61), PASP – point of the attack sub-phase (.60), TDABTMD – transition from defense to attack after the ball takeover within the midfield defense zone (.45), POIF – positions of inside forwards (.42), NPA – non-progresive attack (.38), CA – combined-attack (.32), POWM – positions of wide midfielders (.30).

The attributes (variables) that have the highest correlation with the first discriminant function indicate the game in attack phase through the first two thirds of the field by changing the focus and pace of the game with an extended ball possession. This discriminatory function is defined by the variables that are prevalent representatives of building favorable position in the attack build-up sub-phase and point of the attack sub-phase, which is a characteristic of combined-attack and non-progresive attack. Combined-attack and non-progresive attack are implemented by an individual action (dribbling and feinting) as well as with the cooperation of two and three attackers (detection, change of places, ball transfer), especially in the attack build-up sub-phase. When you build a good numerical and positional situation, the entry of the final attack phase is accelerating and also with an individual action or with a simple combination.

The second discriminant function is defined as bipolar. On its positive pole there are variables that carry information about the organization and carrying out the attack that keep a positive result, achieved in the previous game interval: TDABTMD – transition from defense to attack after the ball takeover within the midfield defense zone (.47), ABSP – attack build-up sub-phase (.45), NPA – non-progresive attack (.31), TDABTWD – transition from defense to attack after the ball takeover in the wide defense zone (.30) and POF – positions of forwards (.30).

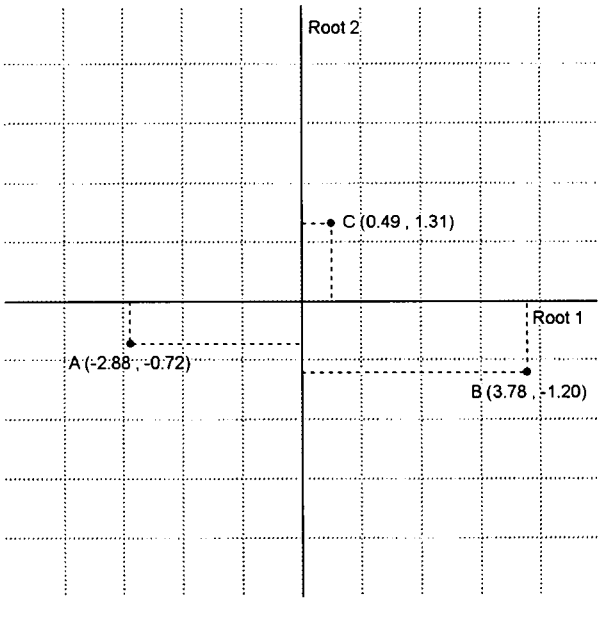
The above mentioned variables feature the regressive attack, which from the tactical point of view has its own importance or foundation, but for its effective use the attackers must be of excellent technical knowledge in terms of early openings and passing and receiving of ball at different distances. The team has occupy a large part of the field towards the horizontal and vertical relationships, the ball travels fast to free players, the volume of running is reduced, in the structure of movement running in the moderate and sub-maximal pace is dominant. On the negative pole of the second discriminant function there are variables that carry information about the organization of attack by skipping the game in the middle of the field: PACA – progressive attack: counter-attack (.30) -, POWM – positions of wide midfielders (.29) -, PASP – point of the attack sub-phase (.26) -, POIF – positions of inside forwards (.18) -and DABTWC transition from defense to attack after the ball takoever within the core zone (.13).
Counter-attack, as a surprising kind of attack, is effectively applied in combination with non-progresive attack in some intervals of the game. Its performance depends on the skills and knowledge of the players which must strive for simple forms of cooperation in order to accomplish the finishing. Based on both discriminant function and the centroid position of a group of tactical elements of attack in their coordinate system, the differences between tactical offensive elements could be determined. Further procedure of discriminant analysis has provided data on the centroid position of each of the three groups of entities in the area of discrimination functions (Table 8), which indicates the specific differences between the groups.

The first discriminant function divides the group B (classis of offensive tactical elements for the transfer of the focus of the game and for the change of the tempo in the attack development) and C (classis of tactical elements of ball possession and building a favorable situation in the realization of different types of attacks), which are located on the positive pole, from group A (classis of offensive tactical elements in the final phase of attack across the wing area) located on the negative pole (group of tactical elements A significantly differ from groups B and C according to the first discriminative function). According to the first discriminative function, the most distant are (significantly different) group A (tactical elements of attack over the wing area) and B (tactical elements for transfer the gravity of game), while group C (tactical elements of ball possession and creating a favorable situation) is between them.

In the second discriminative function on the negative pole is group B (tactical elements for transfer the gravity of game) and A (attacking tactical elements for winning the wing area and final phase of attack after pass), while on the positive pole of this function is a group C (tactical elements of keeping the ball and creating a favorable situation), or second discriminatory function largely differ group C compared to groups A and B. Groups B and C are mutually farthest on this discriminative function. Analysis of the centroid position for the group of attacking tactical elements in the coordinate system reveals that the entities do not overlap (each group entity are sufficiently distant), and each group represents a total in the technical and tactical preparation of soccer players.

Looking one-dimensionaly (Figure 1), according to the first discriminative function, the groups are in the order B, C and A. Centroid of the Group B (tactical elements for transfer the gravity of game) is located in the second box of the composition of the first and second discriminant function, the centroid of group C (tactical elements of ball possession and creating a favorable situation) is located in the first box and the centroid of group A (tactical elements of attack over the wing area) is located in the third box, which enables the describtion of the set of entities and their characteristics with respect to the first and second discriminant function. According to this centroid group position for each box, it is evident that based on the first discriminative function, classes differ with one side detached with offensive tactical elements in group A (shots on goal by the incoming balls from the air, running with the ball, dribbling and feinting) and on the other hand is the group of attacking elements B (passing and receiving the ball at larger distances), while between them is a group C, which partly consists of individual tactical elements of attack (dribbling and feinting, running with the ball), and partly of the group offensive tactical elements (passing and receiving the ball on medium and short distances and the change of place).

Figure 1. Centroids of a Group of tactical elements of attack in the area of discrimination functions



Root 1 - the first discriminant function, Root 2 - the second discriminant function, A, B, C - mean of the appropriate group of tactical elements of discriminant function

In the analysis of the second discriminant function, it is characteristic that at the positive pole are individual and group attacking tactical elements (group C), which are characterized by complex combinations in attack phase through the cooperation of a certain number of players, and on the negative pole are the individual (group A) and group (group B) tactical elements which are applied in individual actions and simple combinations. Discriminant analysis has proven that a group of entities defined by cluster analysis (relatively homogeneous group of offensive tactical elements A, B, C) are mutually significantly different, as well as the various contributions of individual attributes to the game in attack phase.

On the POFDP – positions of front defensive players, the highest grades of the importance are in tactical elements of group C (obstructing opposing players, passive takeover and marking the opposing players). Compared to them in POCM – positions of centre midfielders and POFW – positions of front wingbacks defensive players, high grades of importance have a tactical elements of group C and group B (active takeover, takeover in the middle and core zone defense), which can directly affect the number of conceded goals. Position of the full-backs–POFB and POBW – positions of back (rear) wingbacks, the most highly grades of the importance have a tactical elements of group B and group D (marking the opposing players: man-to-man marking and kicking out an oncoming ground ball in front of the opposing player) which is understandable because they are the last obstacle that opponent needs to cross to reach the goal.

When we talk about a wider zone of defense, the most highly grades of the importance have a tactical elements of group C, and the lowest tactical elements of group A (kicking out an oncoming ground ball in front of the opposing player and takeover by slide tackle) which coincides with the research conducted by Barišić (1996), so the tackling as a tactical element has lost a lot on a significance because it is an argument that players avoid by placing timely manner steals. Thus their chances for getting cards are reduced to a smaller extent possible. In the CDS – core defense sub-phase and MDS – midfield defense sub-phase, greatest grades of importance are in the tactical elements of group B (active takeover and basic takeover). For the CD - combined defens which is applied in modern soccer, the greatest grades of importance are also in a tactical elements of group B (active takeover and ball takeover). This is logical since nowadays we can found players who easily deal with the situation 1 on 1 and it takes a doubling and taking over their ability to neutralize a large radius of movement.

The obtained results lead to several conclusions that have broadened the kinesiological body of knowledge on soccer. In grouped data (homogenous groups of attacking tactical elements A, B and C, identified by the cluster analysis), it was revealed that the greatest importance in each segment of the game has a characteristic group of tactical elements. According to the first discriminative function there is significant difference from group A (tactical elements of attack over the wing area) and B (tactical elements for transfer the gravity of game), while group C (tactical elements of holding the ball) is located between them. The second discriminant function greatly differ group C versus group A and B, where the group B and C are mutually farthest.

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