PROPOSAL FOR BIOMECHANICAL SUPPORT TO SOCCER COACHES IN INSTRUCTING YOUNG PLAYERS

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The purpose of this study was to implement a method to support coaches in training young soccer players through the use of biomechanical tools to: a) improve individual techniques and b) research body movement in this sport. In order to develop this project, soccer techniques have been considered as a hierarchical set of movements that are fundamental to the game (Meinel, & Schnabel, 1987; Grosser, & Neumaier, 1986; Hay, & Reid, 1988) or technical elements. Starting from these basic concepts, it was possible to perform an analysis, both qualitative and quantitative, of a variety of technical elements. The project has been developed in various stages, starting with the identification and classification of the technical elements and ending with training recommendations.

KEY WORDS: soccer, hierarchical classification, technical element, video recording.

INTRODUCTION: A so-called "Technical Ability Program" has been developed for the National University of Mexico (Pumas) Soccer Club. This program was requested because of a lack of adequate individual technique among the players. It is directed to the "basic forces" (male players whose ages range between 12 and 17 years and whose teams are in one year age groups).

The suggested methodology to accomplish this program consists of the following stages:
1) hierarchical classification of the soccer technical elements;
2) identification of the most common technical elements performed during Soccer games;
3) evaluation of the effectiveness and precision in performing some technical elements;
4) learning of the 3D movement kinematics via simultaneous recording of specific technical elements by three video cameras; and
5) proposing specific training sessions for the practice of technical elements and immediate feedback to correct performance errors.

METHODS: The classification of the technical elements was performed in a hierarchical form by using a Block Diagram Methodology. The scheme is a "tree" where the main branches are the movements performed with the ball, in order to recover the ball, without ball, and by the goalkeeper. Starting from this general idea, the tree can grow until each leaf becomes a specific technical element (see Figure 1). In order to determine which technical elements were the most commonly performed during a game, videos of several national and international soccer matches were observed and precisely analyzed. As a result of this study, the different technical elements were counted (examples are shown in Table 1). While the two first stages have been developed, a large number of the Pumas professional team video sequences have been collected specifically for this purpose, including some taken from TV broadcast. In the third stage, two technical elements have been selected for evaluation purposes:
1) The precision of the penalty kick, without the goalkeeper, was chosen by evaluation. The players were asked to hit the ball with the instep at a target in the upper right corner (relative to the player) of the goal. The best players of the six basic forces teams participated in this evaluation. In order to know if the kick was performed as planned, the sagittal plane projection at the kicking moment was recorded mainly to check whether the instep was used. In addition, an observer stood behind the player to verify whether or not the ball hit the predetermined target (see Figure 2, Table 2).
2) The purpose of the second evaluation was to determine effectiveness of the player when performing a throw-in perpendicular to the touch line. This was accomplished by video taping the movements of the player in the sagittal plane. The distance was measured and the ball's release angle and velocity were calculated by using the appropriate video frames (see Figure 3, Table 3).

Some the three simultaneous video recordings were carrying out on several techniques performed by the "Pumas" professional team players (see heading in Figure 4). These sequences were kinematicly analyzed using a "Non-Anatomical Marker Procedure" (Espinosa-Sánchez, 1999). This stage was difficult to develop because of the players' availability during training sessions. In the last stage of the project, the recommendations to the coaches were to:

1) train athletes mainly in the more common technical elements, taking into account age, ability, and mature players (Brown, 1992);
2) use video recording in order to improve each element by systematic observational strategies (recording, watching the video together with the players, correcting performance, and recording again - attempting a motor learning procedure (Knudson, & Morrison, 1997));
3) qualitatively analyze the movements using observational and/or deterministic models (Knudson, & Morrison, 1997; Hay, & Reid, 1988) to establish some movement patterns;
4) practice target precision in wall sessions; and
5) develop routine exercise sequences that are actually the concatenation of technical elements to be performed in musical sessions in order to increase coordination, fluency, and rhythm.
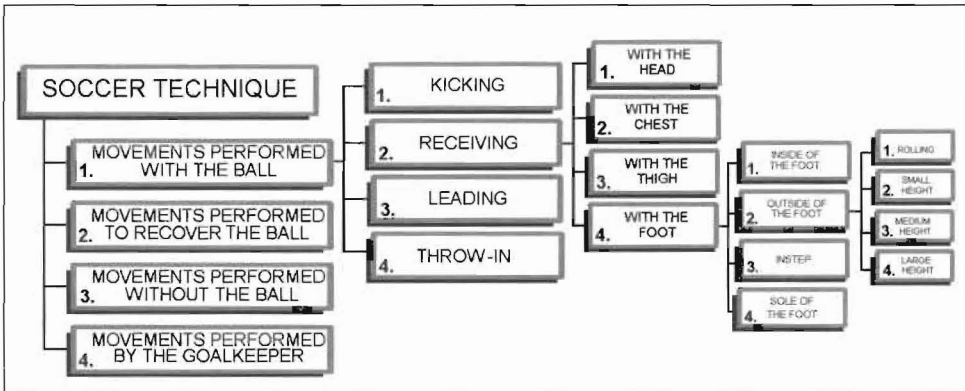
RESULTS:

Figure 1. Part of the hierarchical classification block diagram.

Figure 2. Kicking the ball with the instep.   **Figure 3.** Throw-in sagittal projection.

Table 1. Some Technical Elements Performed during a National and an International Game.

TECHNICAL ELEMENT	PUMAS vs. CHIVAS (Dec/98)	HOLAND vs. BRASIL (Jul/98)
Kicking the ball ground, rolling	291	435
Kicking the ball half volley	26	4
Heading	16	28
Receiving with the foot	188	555
Receiving with the chest	17	10
Leading the ball rolling	108	86
Leading the ball rolling changing direction	69	59
Feinting with a direction change	10	6
Blocking the ball with the head	67	53
Tackling, hook slide	22	74
Throw-in	21	53
Goalkeeper drop kick	11	2
Goalkeeper middle-high two hands catch	2	13

Table 2. Precision Evaluation.

TEAM AGE	NUMBER OF PLAYERS	NUMBER OF PLAYERS / %	NUMBER OF PLAYERS / %
		FAILED TO TARGET	FAILED KICKING WITH INSTEP	SUCCESSFUL IN KICKING
12	13	11 / 85%	12 / 92%	1 / 8%
13	16	11 / 69%	9 / 56%	1 / 6%
14	10	2 / 20%	10 / 100%	0 / 0%
15	13	10 / 77%	12 / 92%	0 / 0%
16	14	10 / 71%	7 / 50%	2 / 14%
17	20	14 / 70%	13 / 65%	1 / 5%

Table 3. Effectiveness Evaluation.

PLAYER	THROW-IN DISTANCE [m]	RELEASE ANGLE [o]	RELEASE VELOCITY [m/s]
1	15.5	34.2	10.6
2	17.7	30.3	11.4
3	16.5	35.3	11
4	19.9	31.6	12.5
5	18.1	25	12
>> 6	21.7	36.4	13.2
7	17.5	27	12
8	17.7	29	11.9
9	18.6	27	11.9
10	16	30.7	11.1
11	14.4	27.5	10
12	17.4	28.1	11.8
13	19.5	24.7	12.5
14	18	38	11.5
15	21	24	13.3

DISCUSSION: The technical elements hierarchical classification has been useful in understanding the soccer movements, but certainly the method does not cover the large amount of possible game situations. These possibilities could endlessly increase the number of tree branches and leaves, producing a complicated and unsettled procedure. For example, the different ball height possibilities, when receiving the ball in the air, could be grouped in small, medium, and large height (relative to the players stature). Another simplification could be done for the different ways (foot postures) a ball can be kicked: instep and inside and outside the foot. The names usually given to the best known technical movements caused confusion when communicating with the coaches. A standardized vocabulary should be established. Sometimes the TV game broadcast videos included, for one movement sequence, several different views. This was very convenient for our purposes. Although,

sometimes a single view was obtained and was not enough to correctly describe the movement. If the athletes' techniques are improved by developing precise and effective players, the movement sequences could be considered the good movement sequences, even if this is not always the result.

Figure 4. Ball heading three views from three simultaneous video recordings.

CONCLUSION: The "Technical Ability Program" is currently being developed and a technical video database is being created. In coordination with the Pumas Club authorities, the coaches were motivated to use the qualitative analysis tools and to spend more training session time on the technical practice. Despite the efforts made to standardize the training programs, some coaches do not want to change their so-called technique-tactic vision and methods.

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