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Directing Some Biomechanical Indicators to Improving Heading Ball from Flying Position of Soccer Players

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Abstract: Defining the effect of using some specific exercises on some biomechanical indicators on the accuracy of soccer players in heading the ball from flying and reaching forecasting mathematical equations that represent a guiding scientific basis to improving the particulars of ball heading from flying performance for the search sample. The researchers used the Experimental on the fast video analysis 125 Hz, The search sample included 4 players from Zagazig University team, each player had performed 4 trials to heading the ball from flying, the researchers determined the place where the player would perform the skill of hitting the ball by head from flying. This point was determined as 3-yard distance from the mark of the penalty kick inside the field and towards the goal, the researchers placed 2 cameras by a wire that is equipped with a control device. The best vertical distance for the researchers recommend the training of the players to choose the right timing when performing the skill of heading the ball from flying, the soccer player needs to decrease the velocity of the shoulder during flying before the moment of heading the ball from flying, which results in a bigger chance to hit the ball with greater accuracy in the direction of the divided goal, the angel of the neck and right foot ankle has a main and effective role in directing the ball towards the target, as the value of this angel of 108.741° &149.285° degrees.

Key words: Soccer · Heading · Fast Video 125 Hz · Specific Exercises · Biomechanical

INTRODUCTION

Heading is an action unique to soccer. in heading a player intentionally strikes the ball using his head considering that this technique involves a significant impact to the head,a delicate part of the body.it is essential to instruct soccer players,particularly beginners, on how to head the ball properly.in terms of heading instruction, the following 3 points have traditionally been emphasized ; 1) keeping the player eyes on the ball; 2) making ball contact with the forehead ; and 3)pulling arms back. However these coaching points are based on experience only. Most of the past research on heading has focused on the risk of head /brain injury; [1, 2] or the effect of ball impact on the brain [3-7].

In many matches, we notice that the soccer player gets into a great confusion inside the 18-yard zone, especially when receiving a cross pass at a height of 1.2 to 1.5 meters and relatively far from him. The player gets puzzled as this height is not suitable to directly kick the ball by foot or even have control over it. Such a situation requires heading the ball from flying position for targeting directly. Consequently, this method of aiming results in more efficiency and increases the scoring rate, which in turns affects the results of the games. In recent years, a controversy has developed over the role of repeated soccer headers in causing brain injury in soccer players. Several studies have examined the brain injury risks [8- 11] considering that the soccer players encounter some technical difficulties during the games implementing this skill.

This study aims to define the effect of using and, determining the contributive ratios between some specific exercises on some biomechanical indicators on the accuracy of soccer players in heading the ball from flying,reaching forecasting mathematical equations that represent a guiding scientific basis to improving the particulars of ball heading from flying performance.

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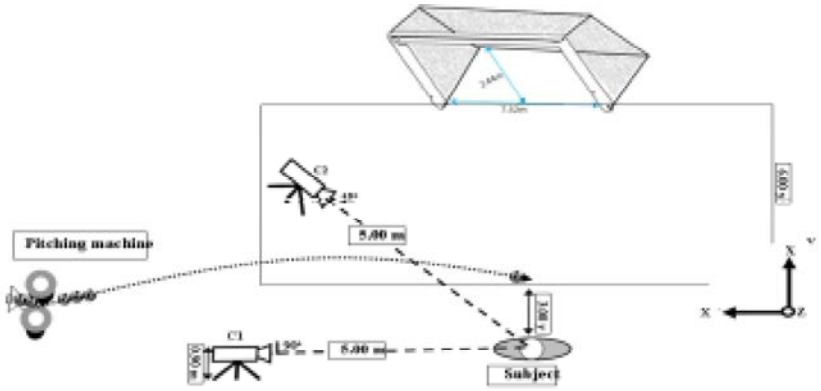

Fig. 1: Experimental setup (head view)

MATERIALS AND METHODS

Sample: Experimental method was used; the search sample included 4 players from Zagazig University team. The players were chosen by the intentional method, as each player had performed 4 trials to heading the ball from flying. As such, the number of attempts subject to analysis became 32 attempts, Their age, height, weight, body mass index were 214.25±0.95 months, 1.65±0.009 meter, 66.25±1.5 kg, 24.11±0.65 kg/m2, respectively (Mean±SD).

Statistical Analysis: The researchers used the SPSS 15.0, statistical program for data processing.

Basic Study: The researchers determined the place where the player would perform the skill of hitting the ball by head from flying. This point was determined as 3-yard distance from the mark of the penalty kick inside the field and towards the goal. A calibration was placed as a scale of 1x1 meter. Two high speed cameras (125 Hz) fast imaging, the researchers placed 2 cameras in the following format: the first one was placed perpendicular to the middle of the scale from the left side, at a distance of 5 meters and a height of 90 cm, while the other camera was placed at the same distance and height but with a 45-degree angel inside the field and facing the scale (Fig. 1). The researchers then made the synchronization between the 2 cameras by a wire that is equipped with a control device. The researchers also placed the ball throwing soccer machine (pitching machine) JUGS at 20-meter distance from the middle of the scale from the left side, as the velocity of the set reached 40 km/hr and the angel of throwing the ball is 30°.

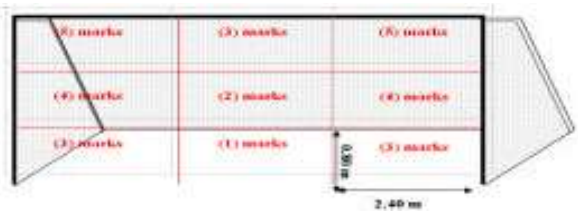

Fig. 2: The divided goal at equal areas

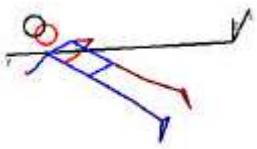

Fig. 3: Position of hitting the ball by head from flying

The researchers divided the goal into 9 rectangles of equal areas of 2.4 × 0.8meters (Fig. 2)

The researchers performed the pre-measures on Saturday 6/2/2010 at 3pm, in the soccer field of the stadium of Zagazig University, the Faculty of Physical Education of Zagazig University. They started by applying the specific exercises for a period of 8 weeks at the rate of 3 sessions per week and for 20 minutes per session. Thus, the specific exercises totaled 8 hours, each player performed 24 trials in week for the Specific Exercises, with 2.5 minutes every training unit. After eight weeks and until Wednesday 7/4/2010 on which day the researchers performed the post measures.

The Specific Exercises

First Exercise: Heading the ball from flying while ball is in still hanging position at a suitable height of 1.2 meters from ground (Fig.3), considering the technical points during performance and concentrating on performance correction.

Second Exercise: Heading a hanging ball from flying, such that its height from ground is 1.2 meters and the ball moves towards the player from front after the trainer leaves it from his hand while it is in hanging position. The player is to meet the ball with his forehead and there should be a flying period through determining the suitable place of rising to touch the ball by forehead.

Third Exercise: Heading the ball from flying with the use of the Ball Throwing Machine (with a velocity of 20 km/hr – an angel of 39 degrees – at a distance of 6 yards from the player). The machine is to be placed a little to the side and in front of the player. The player has to meet the ball by forehead and hits into the parts of the goal as determined by the trainer.

Fourth Exercise: Heading the ball from flying with the use of the Ball Throwing Machine (with a velocity of 40 km/hr – an angel of 25 degrees – at a distance of 12 yards from the player). The machine is to be placed in front of the player and to the side of the right post on the goal line. The player meets the ball with forehead and hits into the parts of the goal as determined by the trainer. The performance is repeated by placing the machine beside the left post.

Fifth Exercise: Heading the ball from flying by using the Ball Throwing Machine (with a velocity of 40 km/hr, an angel of 25 degrees and at a distance of 12 yards from the player). The position of the device is at right of the player, parallel to him and a little ahead. The player heads into and beside the post that is near to the ball and repeats the performance to heading into the post that is far from the place of throwing the ball.

Sixth Exercise: To repeat the previous exercise with the device placed on the left side of the player, parallel to him and a little ahead. The player shoots inside the pole that is close to the ball and then repeats the performance to shoot into the far pole from the place of throwing ball.

Seventh Exercise: Hitting the ball by head from flying, using the device of throwing balls, with 50 km/hr velocity, 45 degrees angel and 20-yard distance from the player. The location of the device is to the right of the player, parallel to him and behind a little. The player shoots after the ball bounces from the ground inside the pole that is near the ball and then repeats the performance to shooting into the pole that is far from the place of throwing ball.

Eights exercise: The player hits the ball from flying after he moves 6 yards forward to rise from the determined place for heading and uses the Ball Throwing Machine (with a velocity of 40 km/hr, a 35-degree angel and a 20-yard distance from the player). The device is positioned to the right of the player, parallel to him and a little behind. The player heads inside the post that is close to the ball and then repeats the performance to heading beside the post that is far from the place of throwing the ball.

Ninth exercise: Two players stand: the first is at 6 yards far and the other is at 10 yards far. Using the Ball Throwing Machine, the first player attempts to hit the ball by head from flying in the determined area before the other player. The machine is placed to the right of the player, parallel to him and a little behind as the player is heading the ball.

RESULTS AND DISCUSSION

It is shown from Table 1 that there are significant statistical differences between the averages of the vertical displacements on the arrowed axis (Z) for all selected anatomical points in favor of the post measuring. This confirms the effect of the suggested exercises in improving the skill of hitting the ball by head. The researchers attribute this as to the selection of the suitable time to start flying until reaching the ball on the right time results in the success of performing the skill of hitting the ball by head from flying. The wrong timing of flying, whether being later or earlier, results in the occurrence of a flaw either by the arrival of the player before the ball at the moment of collision. This leads to a displacement on the arrowed axis (Z) that is larger than its counterpart in case the timing of flying of the player becomes late, as it results in the late arrival of the payer after the passing of the ball at the point of collision. This in turns results in a less displacement on the arrowed axis (Z). Therefore, the players have to choose the right timing from the start of passing the ball from a teammate till the arrival to the collision point. However, as we used in this research the ball throwing machine and determined the point of collision between the ball and the head of the player and also predetermined the height, velocity and direction of the ball, hence the only dependent variable is

Table 1: Significant differences of the selected anatomical points and the ball an instant hit the ball head

	After		before			
Anatomical points	Mean	Variance	Mean	Variance	t test	% Rate of improve
Head x	0.45556	0.10255	0.50687	0.18587	0.386	10.122
Head y	1.589367	0.058935	1.56750	0.231805	0.1681	1.394
Head z	1.19484	0.035763	0.97312	0.058722	*3.195	22.784
Left shoulder x	0.363943	0.12022	0.40401	0.165196	0.291	9.91762
Left shoulder y	1.361579	0.046697	1.38509	0.18847	0.2	1.6977
Left shoulder z	1.10101	0.024183	0.94647	0.0356	*2.8424	16.3302
right shoulder x	0.205916	0.103683	0.31201	0.226113	0.768	34.0045
right shoulder y	1.636393	0.031197	1.59395	0.247408	0.3183	2.66259
right shoulder z	1.075737	0.013525	0.91052	0.043943	*3.0174	18.1454
Left hip x	0.170841	0.09108	0.19531	0.116722	0.224	12.5291
Left hip y	1.091383	0.02204	1.06704	0.155281	0.2292	2.28118
Left hip z	0.834083	0.011737	0.74990	0.007753	*2.4254	11.2257
right hip x	0.067805	0.082558	0.09565	0.163745	0.251	29.1173
right hip y	1.29488	0.019644	1.20675	0.24544	0.671	7.30277
right hip z	0.704924	0.007395	0.57116	0.023559	*3.218	23.4183
Left knee x	0.011164	0.06841	0.03061	0.103197	0.214	63.5251
Left knee y	0.814803	0.032938	0.78049	0.113985	0.3602	4.39577
Left knee z	0.697192	0.018449	0.69719	0.018449	0.095	0.74125
right knee x	-0.9458	0.063878	-0.5405	0.102328	0.479	74.9734
right knee y	0.945317	0.035246	0.84607	0.18165	0.8723	11.7293
right knee z	0.531129	0.005628	0.43483	0.013233	*2.7132	22.1457
Left toe x	-0.33693	0.08864	-0.2749	0.142735	0.544	22.5529
Left toe y	0.512617	0.052848	0.47698	0.049603	0.3898	7.47082
Left toe z	0.653877	0.067731	0.43423	0.091884	*2.1676	50.5827
right toe x	-0.28729	0.075727	-0.2772	0.07056	0.17	5.24232
Right toe y	0.575179	0.096353	0.48399	0.148995	0.6916	18.8407
Right toe z	0.377973	0.034123	0.19275	0.028229	*2.7092	96.091
Ball x	0.530756	0.098996	0.56954	0.201664	0.279	6.8104
Ball y	1.651306	0.06832	1.66012	0.213043	0.07	0.53132
Ball z	1.27637	0.030924	1.2828	0.125421	0.07	0.50122

*Significantly different at p<.05 =2.131

the player and the choosing of the right timing to head the ball from flying. Therefore, the researchers recommend the training of the players to choose the right timing when performing heading the ball from flying.

It is also shows from the same previous table that there are no significant statistical differences for the two pre- and post- measures between the remaining of the average displacements on the horizontal, vertical and height axes (X.Y.Z) for the ball of heading the ball from flying. The researchers attribute this to the ball throwing machine, as the trainer can automatically control the direction, height and velocity of the ball without interference from the trainer. As such the ball always reaches at the same height, velocity and direction. It is on the player to choose the right timing to start flying to hit the ball by head.

It is shown from Table 2 that there are significant statistical differences between the mean of the horizontal velocities of the right and left hip (vx.vy) in favor of the post-measuring than the pre-measuring. The velocity of the left hip increased from 1.68861 meter / sec to 2.326, meter / sec and the velocity of the right hip increased from 1.268 to 2.395. The researchers attribute this to the effect of the selected specific exercises in improving the velocity rate. As a consequence, the body velocity has increased in the direction of the ball at the moment of hitting the ball by head which results in increasing the velocity of the ball after heading the ball. It is also clear from the same previous table that there are significant statistical differences for the velocity of the ball (v y) as the velocity of the ball increased from 4.80339 to 6.99527 as a result of gaining this velocity from the velocity of the hip at

Table 2: Significant differences of the selected anatomical points and the ball an instant hit the ball head

	After		Before			
Anatomical Points	Mean	Variance	Mean	Variance	t test	%Rate of improve
Head(v x)	0.66535	0.98197	0.8532	1.90107	0.688	22.0135
Head (v y)	4.08586	2.08188	3.2594	4.01675	1.244	25.3547
Head(v z)	-0.7303	0.91405	1.3141	5.73454	0.928	44.4272
Left shoulder(v x)	1.65021	1.60010	1.9496	2.59725	0.576	15.3583
Left shoulder (v y)	2.91684	1.22803	3.1252	3.02819	0.395	6.66767
Left shoulder (v z)	-0.5301	0.15330	-0.496	4.20997	0.065	6.94359
right shoulder (v x)	1.05254	0.92730	1.2824	6.17841	0.317	17.9278
right shoulder (v y)	3.31811	1.53135	2.4636	2.06518	1.811	34.6845
right shoulder (v z)	-0.8968	0.59679	-0.696	5.23558	0.357	28.8220
Left hip (v x)	2.32608	0.37913	1.6886	0.40750	*2.61	37.7507
Left hip (v y)	2.75654	0.78180	2.9706	2.89309	0.408	7.20772
Left hip (v z)	-0.5772	0.20326	-0.434	1.22309	0.462	33.0377
right hip (v x)	2.39506	0.95781	1.2688	2.23880	*2.62	88.7537
right hip (v y)	2.72642	0.69539	3.1275	1.89893	0.989	12.8253
right hip (v z)	-0.5683	0.27178	-0.299	2.55105	0.622	96.0020
Left knee (v x)	1.28547	0.78933	1.3003	1.22327	0.04	1.1395
Left knee (v y)	3.08761	0.46982	3.1594	1.85677	0.169	2.27418
Left knee (v z)	-0.2598	0.80332	0.3252	1.31105	1.498	179.895
right knee (v x)	1.56567	2.0201	1.9184	2.06603	0.603	18.3898
right knee (v y)	1.87352	1.52472	2.5833	1.64582	1.376	27.4767
right knee (v z)	0.49638	0.72013	1.1086	1.39481	1.518	55.2231
Left toe (v x)	0.58109	3.30923	1.4523	1.86865	1.528	59.9882
Left toe (v y)	2.92516	1.78217	3.0491	5.1327	0.166	4.06429
Left toe (v z)	0.40246	3.41915	1.6259	3.66520	1.578	75.2461
right toe (v x)	1.40661	3.41023	0.4675	1.77869	1.568	200.877
right toe (v y)	1.73009	2.01153	1.6741	3.14212	0.091	3.34722
right toe (v z)	1.66748	3.43675	2.020	3.21826	0.503	17.4529
ball (v x)	-4.6740	3.84392	-4.227	21. 358	0.362	10.5877
ball (v y)	6.99527	1.33859	4.8034	9.49048	*2.23	45.6319
ball (v z)	-0.8258	1.84526	-1.533	15.7793	0.620	46.1356
Accuracy	4.1875	0.5625	1.5	1.3333	*9.44	179.167

**Significantly different at p<.05 =2.131

the moment of heading the ball. Therefore, the players are advised, when heading the ball, to hurry to meet the ball (i.e. go to the ball) and not wait until it comes to them. It is also clear from the same table that there are significant statistical differences between the averages of the pre and post measures in favor of the post-measure for the accuracy of the heading the ball from flying, as the mean of the pre-measuring of the accuracy of hitting the ball by head reached from 1.5 to 3.8125. The researchers attribute this to the effect of the selected specific exercises in improving the accuracy of heading the ball from flying by hitting the ball from its lower half, which makes it fly to the upper corner of the goal, thus achieves the highest mark in the test of heading the ball from flying.

This specific variable has not been examined by previous studies [12]. However, they discussed the importance of transferring momentum to the ball in order to best absorb the force of ball - head contact. All but one participant in this investigation added velocity to the ball. A rising ball kicked with average force 10 meters away may have a horizontal speed up to 50 m/sec. If such a ball were to strike an unprepared player with an effective head mass of 5 kg, the mean head acceleration would be 106 g with an HIC of 844 g2.5-secs. Such situations are clearly concussive and dangerous. Asami and Nolte [13] measured speeds of regulation soccer balls kicked by professional players ranging from 28 to 34 m/sec. Speeds of 27 to 54 m/sec were recorded for balls inflated to 1.0 atmosphere, values of HIC range from 190 to 1020 g2.5-sec[6]. For balls inflated to 0.3 atmospheres, the corresponding HIC values range from 70 to 380 g2.5-secs.

Table 3: Regression analysis and rates of contribution to the anatomical points of the moment of hitting the ball head

Anatomical points	Average	Standard error	Residuals	F	P1	p2	P3	%
left shoulder v(X)	1.6502	2.59611	1.43568	27.87	1.667			%65.01
right toe v(Z)	1.6674	1.61654	0.53201	48.29	1.342	0.863		%87.34
Left knee v(x)	1.2854	1.44777	0.36382	41.62	0.932	0.762	0.787	%90.57

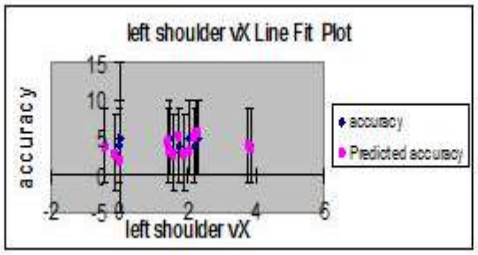

Fig. 4: First indicator in Table 3

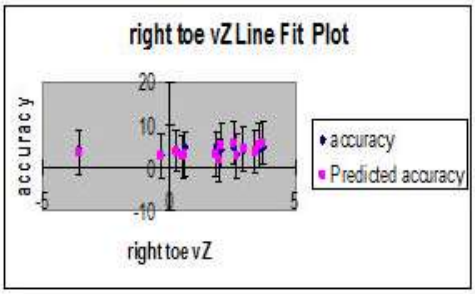

Fig. 5: Second indicator in Table 3

The results of Table 3 and Fig.4 show that the indicator of the left shoulder v(X) is the most contributive indicator in the accuracy of heading as its contribution reached 65.01%. The researchers attribute this result such that the light slant of the shoulder, along with the decrease of the velocity of the left shoulder, provides the player with a bigger chance to choose the right timing to head the ball which results in fixing the joint of the shoulder and transfers the momentum of strength to the most movable joint, i.e. the joint of the neck, hence this velocity transfers to the ball at the moment of heading it from flying. This agrees with the results of Table (3) as they show the value of the correlation coefficient of the left shoulder v(X) and the accuracy of hitting the ball by head as it reached -0.6694, which is a negative correlation, i.e. as the left shoulder v(X) decreases it results in better accuracy. From the above, the forecasting equation of the regression is:

$$y = a + b_1 . x_1$$

y = accuracy, a = residuals, b_1 = left shoulder v(x), X_1 = average left shoulder v(x)

$$y = 1.43568 + 1.667 \times 1.6502 = 4.1875$$

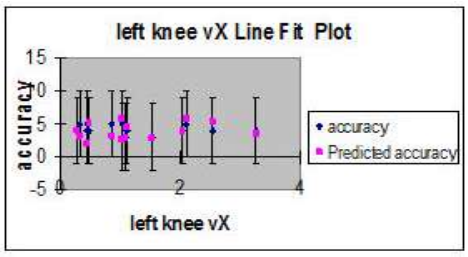

Fig. 6: Third indicator of Table 3

The researchers attribute this such that the soccer player needs to decrease the velocity of the shoulder during flying before the moment of heading the ball from flying, which results in a bigger chance to hit the ball with greater accuracy in the direction of the divided goal.

The results of Table 3 and Fig.5 show that the indicator of the right toe v (z) is the second contributive indicator in the accuracy of heading as its contribution increased from 65.01% to 87.34%. this agree with Table 3, correlation of right toe v(z) is 0.5339 and accuracy of heading from flying – because the position of body is rise in heading from flying less then the velocity during the depression rate. From the above, the forecasting equation of the regression line is as follows:

$$y = a + b1 . X1 + b2 . X2$$

$$y = 0.53201 + 1.342 . 1.6502 + 0.8638 . 1.6674 = 4.1875$$

The researchers attribute this such that the suitable velocity of the right toe v z is the main reason of the right timing to reach the ball on the right time as the success in heading the ball depends on choosing the right time to hit the ball by head, as the less velocity of dashing results in the arrival of the player after the ball passes in front of him. As well, the more velocity of the player results in the arrival of the player before the ball. In both cases it results in fewer chances to head the ball at the right time and consequently affects the accuracy of shooting at the goal.

The results of Table 3 and Fig.6 show that the indicator of left knee v x is the Third contributive indicator in the accuracy of heading as its contribution increased from 87.34% to 90.57%. The researchers

Table 4: Significant differences in rate of the angles on the three axes of displacements for the moment, heading the ball

	After		Before			
Anatomical Points	Mean	Variance	Mean	Variance	t test	% Rate
Neck	108.746	55.82806	93.61	63.0738	*5.815	16.16446
Left hip	161.039	87.155	154.82	79.912	*2.434	4.0126
Left knee	131.89	1562.47	142.68	869.642	0.9811	7.56284
Left ankle	132.577	387.51	129.51	78.888	0.5954	2.36464
Right hip	154.134	165.619	152.75	276.213	0.3279	0.902714
Right knee	167.903	47.171	166.67	66.1929	0.4693	0.73853
Right ankle	149.285	72.725	131.31	52.963	*6.134	13.6924

Table 5: Regression analysis and rates of contribution to the angles of the moment, heading the ball

Anatomical Points	Average	Standard error	Residuals	F	p1	p2	P3	%
Neck	108.741	0.9395	0.0451	312.401	0.0381			%95.41
left hip	161.039	0.9376	0.035	157.371	0.0032	0.0236		%95.74
right ankle	149.286	0.8752	0.0229	121.432	-0.000	-0.0109	0.0399	%96.55

attribute this such that the jumping up moved from right toe v z to left knee v x, that is contribute, player reach the ball in time. From the above, the forecasting equation of the regression line is as follows:

$$b\ 3.\ x3+ + b2.\ x2\ \text{Accuracy} = a + b_1.\ x_1$$

Table 4 shows that there are significant statistical differences between the mean of the angels values of the post measuring and pre measuring in favor of the post measuring of the neck angel, as the value of the angels in the pre measuring was 93.61° degrees, while it is 108.746° in the post measuring and an improvement ratio of 16.16446. The researchers attribute this such that the specific exercises that were applied on the sample affected positively the values of the angels. It also becomes clear from the same table that there are significant statistical differences between the mean values of the angels for the pre measuring and the post measuring in favor of the post measuring of the angel of the left hip, as the value of the angel in the pre measuring was 154.82° degrees while it is 161.039° degrees in the post measuring, with an improvement ratio of 4.0126. It is also clear from the same table that there are significant statistical differences between the average of the angels values of the post measuring and pre measuring in favor of the post measuring for the angel of the right foot ankle, as the value of the angel was 131.31° degrees in the pre measuring, while its value was 149.285° degrees in the post measuring, with an improvement ratio of 13.6924. The researchers attribute this such that the specific exercises that were applied on the sample affected positively

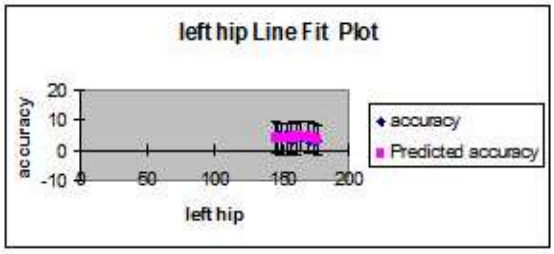

Fig. 7: First indicator of Table 5

the values of the angels as they made the body of the player more stretched which led to more smooth movement during flying to head the ball and consequently achieving the highest accuracy to hit the ball by head from flying [12], this is consistent with Most headers are taken at angles from 80° to 100° [9]. Because of the shape of sinusoidal functions, the cosines of such angles are ˜ 0 and the sin of such angles is ˜ 1. In turn, a rule of thumb for effective mass in routine heading performed with ideal technique (neck strong and stiff, no head wobble) is to use one half the body weights.

It is shows from Table 5 and Fig.7 that the indicator of the neck angel is the most contributive angels to contribute to the accuracy of heading the ball from flying, as its contribution ratio is 95.41% and the correlation coefficient is -0.55516, which is a negative correlation coefficient, i.e. as the value of the angel gets less, the accuracy of hitting the ball by head from flying becomes less. The researchers attribute this result such that the angel of the neck has a main and effective role in directing the ball towards the target, as the value of this angel of 108.741° gives a bigger chance to the player in

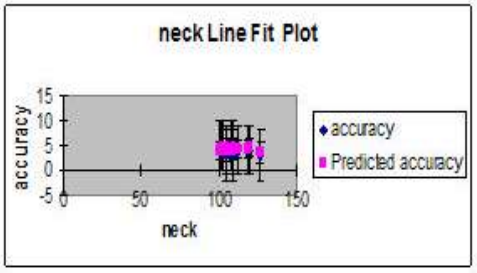

Fig. 8: Second indicator of Table 5

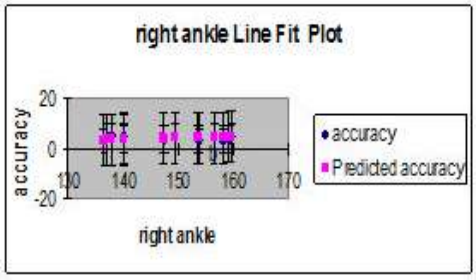

Fig. 9: Third indicator of Table 5

the process of directing the ball to the right upper corner of the goal. However, in case of decreasing the value of this angel to 90° and less, it would result in directing the ball in a straight line towards the middle of the goal and as such the ball becomes handy to the goal keeper. From the above, the equation of the regression line becomes as follows: $y = a + b_1 X1$

$$Y=0.0451564+ 0.0381. 108.7416=4.1875$$

Table 5 and Fig.8 show that the indicator of the angel of the left hip is the second largest indicators contributing as it raised the contribution ratio from 95.41% to 95.74%. It also scored second largest correlation coefficient as the value of the correlation coefficient with accuracy reached -0.5518, i.e. there is a negative relationship between the accuracy of hitting the ball by head and the value of the angel of the left hip at the moment of heading the ball from flying. The researchers attribute this to the rapid movement of the slope of the hip in the direction of the ball for the momentums of the movement to transfer from the hip to the head. From the above, the forecasting equation of the regression line is as follows:

$$Accuracy = a + b1. X1 + b2. X2$$

It is shows from Table 5 and Fig.9 that the indicator of the angel of the left hip is the third largest indicator contributing to heading the ball from flying, as it raised the contribution ratio from 95.74% to 96.55%. Also, the angel of the right ankle scored the third largest correlation coefficient as the correlation coefficient was -0.5274, i.e. there is a negative relationship between the accuracy of heading the ball and the value of the angel of the right foot ankle at the moment of heading the ball from flying. The researchers attribute this to the process that follows the process of going up and pushing the ground by foot and consequently the flying of the player in the air at the moment of heading the ball from flying. This is consistent with prior studies [14], from the above, the forecasting equation of the regression line is as follows:

$$Accuracy = a + b1.x1 + b2.x2 + b3.x3$$

REFERENCES

1. Matser, E.J. and A.G. Kessel, 2001. A dose- response relation of header and concussions with cognitive impairment in professional soccer players. J. Clinical and Experimental Neuropsychol., 23: 770-774.
2. Putukian, M., 2004. Heading in soccer; it is safe ?.Current sports Medicine Reports, 3: 9-14.
3. Schneider, K. and R. Zernicke, 1988. Computer simulation of head impact; Estimation of head – injury risk during soccer heading.International J. sport Biomechanics, 4: 358-371.
4. Babbs, C.F., 2001. Biomechanics of heading a soccer ball; implications for player safety. The Scientific World J.,1: 281-322.
5. Kirkendall, D.T., S.E. Jordan and W.E. Garrett, 2001. Heading and head injuries in soccer. Sports Med., 31: 360-86.
6. Jordan, S.E., G.A. Green, H.L. Galanty, B.R. Mandelbaum and B.A. Jabour, 1996.Acute and chronic brain injury in United States national team soccer players. Am. J. Sports Med.,24:205-210.
7. Shewchenko, N., C. Withnall, M. Keown, R. Gittens and J. Dvorak, 2005. Heading in football. Part 2: biomechanics of ball heading and head response. British J. sports Med., 39: 26-32.
8. Matser, E.J., S.G. Kessels, M.D. Lezak, B.D. Jordan and J. Troost, 1999. Neuropsychological impairment in amateur soccer players. JAMA, 282: 971-973.
9. Matser, E.J., S.G. Kessels, M.D. Lezak, B.D. Jordan and J. Troost, 1998. Chronic traumatic brain injury in professional soccer players. Neurol., 51: 791-796.
10. Sortland, O. and A.T. Tysvaer, 1989. Brain damage in former association football players. Neuroradiol., 31: 44-48.

11. Tysvaer, A.T. and E.A. Lochen, 1991. Soccer injuries to the brain: A neuropsychologic study of former soccer players. The American J. Sports Med., 19: 56-60.
12. Mawdsley, H.P., 1978. A biomechanical analysis of heading. Momentum, Edinburgh, 3: 16-20.
13. Asami, T. and V. Nolte, 1983. Analysis of powerful ball kicking. In Matsui, H. and K.Hkobayashi(eds.), Biomechanics VIII-B, Vol. 4B. Human Kinetics Pub., Champaign, pp: 965-970.
14. Babbs, C.F., 2001. Biomechanics of heading a soccer ball: implications for player safety. The Scientific World, 1: 281-322.