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Kinematics Characteristics of Side Volley Shot with Different Size of Balls

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Abstract. Eight football players in the school team were asked to perform side volley shot at three different kick elevations (on the floor, at 1/2 of the knee and at knee).Two high-speed cameras were used simultaneously to shoot the lower limbs of the players when they performing the foot volley with two different sizes of footballs, and then analyzed relevant kinematics parameter, using the motion images. The study suggests that the footballs used in futsal and eleven-a-side football show no significant difference in terms of kinematics parameters, which could be the result of the balance achieved between the two sizes of balls, for the futsal ball is smaller but heavier while the 11-a-side football is larger but lighter and that it's best to kick the ball from a lower position to make the shoot most powerful in either case.

Keywords: Football; kinematics parameter; volley.

1. Introduction

Futsal is an important type of match for promoting and popularizing football games. It's originated from Brazil, the football nation, and is regarded as "the incubator of the Brazilian soul". In 1989, FIFA took of this organization, making futsal an official match event of FIFA, and the same year, the first futsal World Cup was held in Netherlands, providing that the event was to be held every four years. Despite the fact the FIFA admitted the value and rights of futsal, FIFA modified its rules since 1995 to make them consistent with the rules for 11-a-side, for they were so different, and amended the rules again in 1999 which was implemented on January 1, 2000.

China also accelerated the pace to develop futsal. Since 2003, orderly futsal matches have been held, and including the Futsal China League and Futsal CFA Cup held by CFA and the Li-Ning Cup University Futsal held by the FUSC's Football Association. In 2006, CFA made futsal an official sport, with Guangzhou, Beijing, Shanghai, Wuhan, Dalian and Chengdu as six major pilot cities. So for, the Futsal China League and Futsal CFA Cup have been held for 4 sessions, and the Li-Ning Cup University Futsal for 5 sessions. Compared with European and the United States and many other countries, the futsal development in China is obviously falling behind, starting from a low base; however, China’s futsal techniques and tactics were improving rapidly in the recent years. In AFC Futsal Championship 2008, China's national team made to the semifinals after beating Tajikistan and Kuwait in the group stage and Uzbekistan in the knockout stage, and was therefore qualified for the Futsal Word Cup 2008 while being the highlight of that AFC Championship.

Compared with 11-a-side football, futsal has smaller field and closer goal, which enables audiences to watch the wonderful shoots by players in front of the goal and to experience more exciting games. Since the rules for futsal are slightly different from rules for 11-a-side football, the sizes of balls and goals are different. The rules regulate that the futsal uses Size 4 ball (circumference 62–64 cm, weight between 400-440g, ball pressure 0.4-0.6.), while the 11-a-side football uses Size 5 ball (circumference 68-70, weight between 410-450g, ball pressure 0.6-1.1). Studies have shown that different balls may affect the quality and acting force of the kick and collision. Some scholars contrasted the stitched ball with the modern thermally bonded ball by dropping them from 6m elevation after being socked, showing that the former has higher ground reacting force and higher falling weight. This means that the stitched football can apply larger acting force on the goalkeeper than the thermally bonded ball, requiring the goalkeeper to apply larger to block the ball. Then would the action of players in futsal and 11-a-side football has different characteristics due to the difference of ball weight and shoot height? This is a

question professional players asked frequently, and this study, based on predecessors' exploration, reveals the kinematics parameters of human's lower limb, such as ball speed, foot speed and foot speed-ball speed ratio caused by the foot volley of two different sizes of balls used in futsal and 11-a-side football, hoping it may provide players with important references for shooting at the goal in these two different type of matches.

2. Method

2.1 Participation

The study was based on 8 football players from a school team, aged 17.4±1.2, height 177.65±4.48cm, weight 67.84±8.77Kg; they were asked to kick the ball from the three positions designed respectively towards the futsal goal 11m in front of them by running up in 30-45° in three steps, and only successful shoot were used for the basis for the study.

2.2 Several key concepts

1) Foot volley: run up in 30-45°in three steps, and kick the falling ball from the side.

2) Ball speed: Refers to the instantaneous speed of the ball upon leaving the foot after the foot touches the ball.

3) Ball speed-foot speed ratio.

2.3 Experiment design

1) Design of kick height: Three heights designed for kicking the ball were the knee of the player, 1/2 of the knee height of the player and the floor respectively; however, to kick the ball from the floor is not a side volley shot.

2) Two FR-180 high-speed cameras (100Hz, shutter speed 1/250s) were used simultaneously to shoot the lower limbs of the players when they were performing the foot volley with two different sizes of footballs to get the kinematics parameters. And the balls used were Lotter futsal ball (circumference 62.5cm, weight 437g, ball pressure 0.6) and Adidas 11-a-side football (circumference 69cm, weight 415g, ball pressure 0.6, and ball pressure 0.8).

3) Motion images analysis system developed by Beijing Sport University were used to perform 3D analysis of relevant motions, thus to get such parameters as ball speed, foot speed and foot speed-ball speed ratio.

4) To avoid the impact of the sequence of the experiment and fatigue on the players tested, the experiment was carried out in a balanced sequence and allowed at least 5-minute break between the tests for players to restore themselves to their best can the next test begin till each of them contributed five successful foot volleys being kicked from the three designed positions respectively with two different sizes of balls.

2.4 Methods of mathematical statistics

Statistical software SPSS17.0 was used to compare the human kinematics parameters obtained from different kick heights, using independent samples T test and the repeated measures and one-way analysis of variance and assuming the statistical significance of all indicators as a=0.05.

3. Result and discussion

The finding of Kinematics parameters of lower limbs in Instep volley shot with two size balls show that there's no significant difference in each kinematics parameter between side volley shots with size 4 and size 5 footballs.

The finding of Kinematics parameters of lower limbs in Instep volley shot with three heights 2 show that 1) Whether it’s a size 4 or size 5 football, as the kick height of foot volley rises, the ball speed after the ball is hit by the foot decreases gradually, with the average speed of size 4 ball being 12.77±0.30m/sec, 11.95 ± 0.87m/sec and 10.51±0.47m/sec respectively, which is of significant difference ($p<0.05$) and size 5 being 12.25±0.69m/sec, 10.94±0.49m/sec and 10.21±0.84m/sec, also a significant difference ($p<0.05$); 2) Whether it’s a size 4 or size 5 football, as the kick height of foot volley rises, the foot center speed decreases gradually after hitting the ball, with the average speed being

12.84±0.65m/sec when kicking size 4 ball from the floor, much higher than those from the kick height of 1/2 knee and knee (12.23±0.71m/sec and 11.54±0.81m/sec respectively), which is of significant difference($p<0.05$); while with size 5 ball, the average foot center speeds are 12.55±0.71m/sec, 12.07±0.54m/sec and 11.34±0.69m/sec respectively, also a significant difference($p<0.05$) ; 3) In terms of the ball speed-foot speed ratio, the result shows it's smaller than 1.0, and as with size 4 ball, the ratio got from three different kick height is 0.97±0.11, 0.96±0.06 and 0.84±0.13 respectively, which is of significant difference($p<0.05$), and with size 5 ball, 0.94±0.14, 0.92±0.08 and 0.85±0.11 respectively, also a significant difference ($p<0.05$) .

As Asami & Nolte suggests that the ball speed-foot speed ratio reflects the effect of collision between the ball and the foot, and when it's higher than 1.0, it means a good kick; and Cabri et al. also indicates that the muscle tension of the kicking foot when it hits the ball is associated with the strength of the muscle, which leads to different influence on the stability of the foot when hitting the ball. Through the ball speed-foot speed ratio, the study shows that the effect of foot volleys kicked from the floor and the height of 1/2 knee is better than that of the foot volleys kicked from the height of the knee. However, the ball speed-foot speed ratio got from three different kick heights is all lower than 1.0.

With size 5 ball (for 11-a-side football), as the kick height rises, the ball speed after the collision decreases significantly, and compared with kicking the ball from the height of 1/2 knee and knee, the foot center speed after hitting the ball from the floor is significantly faster. And these results are consistent with the study made by Cai Shangming et al. In terms of the ball speed-foot speed ratio, the results of this study are all lower than 1.0, and the effect of collision with the ball is better when kicked from the floor and the height of 1/2 of the knee than when kicked from the height of keen, and this result is also consistent with the study made by Cai Shangming et al. In general, since the players included in this study were all less than 18 years old, they need intensified training in both the movement and strength when making foot volleys, in addition to overcoming the experimental site. As an excellent football player, the ball speed of is between 24 and 36m/Sec and the foot speed is between 16 and 22m/sec, it seems that the players of School Team have some work to do to catch up the great football players in the world.

4. Conclusion

There's no significant difference between the ball speed in futsal and that in 11-a-side football, which could be the result of the fact that the ball used in futsal is smaller but heavier while the ball used in 11-a-side football is larger but lighter, achieving some kind of complementary effect; and the player should kick the ball from a lower position if he wants to make the shoot most powerful, whether in futsal or 11-a-side football.

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References

[1] Armstrong, C. W, Levendusky, T. A., Spryropoulous, P., & and Kugler, L. (1988). Influence of inflation pressure and ball wetness on the impact chzaracteristics of two type of soccer balls. Science and Footbal (edited by Reilly T., Lees A., Davids K. and Murphy W. J.), pp. 394-398. London: E & FN Spoil.

[2] Asami, T., & Notle, V. (1983). Analysis of powerful ball kicking. In H. Matsui, & K. Kobayashi (Eds.), Biomechanics VII1-B. 695-700. Cliampiagn, IL: Human Kinetics.

[3] Cabri, J., De Proft, E,, Dufour, W., & Clarys, J. P. (1988). The relation between muscular strength and kick performance. In T. Reilly, A. Lees, K. Davids, & W. J. Murphy(Eds.), Science and football. 186-193. New York: E & FN Spoil.

[4] Chiu Y. H., Wong T. L., Wang J. C.& Lin C., H. (2005). The Analysis of angular momentum of side-volley soccer shots performed with thiee ball-height. XXIII International Symposium on Biomechanics in Sport Aug.2005, 22-27,58-60.

[5] Nunonae, H., Asai, T., Ikegami, Y., & Sakurai, S. (2002). There-dimensional kinetic analysis of side-foot and instep soccer kicks. Medicine and Science in Sport and Exercise, 2002,34(120):2028-2036.