THE EXAMINATION OF BALL FIELD PLACEMENT IN SLO-PITCH HITTING

Tom Wu[1], Pierre Gervais[2], Pierre Baudin[2] and Marcel Bouffard[2]

Department of Movement Arts, Health Promotion and Leisure Studies, Bridgewater State University, Bridgewater, United States[1]
Faculty of Physical Education and Recreation, University of Alberta, Edmonton, Canada[2]

The purpose of this study was to examine the mechanical differences in the skill of slo-pitch placement hitting between the same and opposite fields. Ten elite participants participated in the study, and each participant hit six balls with each of three different stride techniques to both same and opposite fields. A three-dimensional study analysis was conducted, and the results showed that the participants had a higher linear bat velocity when hitting the ball towards the same field than the opposite field. This study supported the fact that right-handed batters can hit the ball harder and farther to the same field. Further the findings from this study showed different results than a previous baseball study, and future research studies are warranted to examine the differences between slo-pitch and baseball batting skills.

KEYWORDS: field, hitting, placement, slo-pitch, softball

INTRODUCTION: In a game of slo-pitch softball, the ball is pitched at a speed of 10-15 m/s and takes approximately 1.5 s to reach home plate (Carriero, 1984; Wu & Gervais, 2006, 2008). In baseball and fast pitch softball, the ball is thrown at a higher speed of 35-40 m/s and 20-25 m/s, respectively (Escamilla et al., 2001; Hay, 1978; Messier & Owen, 1985, 1986; Oliver, 2003). The batter only has approximately 0.5 s to hit the ball before it crosses the home plate (Hay, 1978). Since the ball is pitched at a moderate velocity in slo-pitch softball, the batter has a greater chance of hitting the ball successfully compared to baseball and fast pitch softball. A very important type of batting skill is placement hitting that is hitting a ball to a specific field either the “same” or “opposite” field (McIntyre & Pfautsch, 1982). For a right-handed batter, if a ball is hit to the same field, left field, the batter can hit the ball farther because the batter’s left elbow can almost be fully extended at ball contact, which allows the batter to generate a higher bat linear velocity (Gelinas, 1988; McIntyre & Pfautsch, 1982). If a ball is hit to the opposite field, right field, while there was a runner on the second base, the runner would have a greater chance of advancing to the third base because a right fielder would have a longer throw to the third base than a left fielder. Due to the slower speed of a pitched ball in slo-pitch, the skill of placement hitting can be executed with either an open, parallel or closed stride technique to place the ball to a specific field. The advantage of using different stride techniques is enabling the slo-pitch batter to strike the ball at the sweet spot of the bat more consistently. This batting skill has become very popular and crucial as part of a team’s main offensive strategy (Perry, 1979). The purpose of this study was to examine whether there are mechanical differences in placing the ball to the same field versus the opposite field in the skill of slo-pitch placement hitting.

METHODS: Ten right-handed skilled (class A/B division) male slo-pitch players were recruited to participate in the study. Participants had a mean age of 33.7 years, height of 1.80 m, weight of 93.50 kg and had a mean ball playing experience of 12.7 years. Potential participants were excluded from the study if they were currently injured or had a history of chronic injuries related to their training. Written informed consent was obtained from the participants before participation in the study, and this study was approved by the institutional research ethics review board. This study took place in an indoor field house to control the influence of air forces. Two reflective markers were placed on an Easton Cyclone SK37 0.78 kg and 0.86 m (28 oz and 34”) bat at the top and bottom of the bat, respectively. A Jugs Lite-Flite pitching machine (Jugs Softball, Jug Inc., Tualatin, OR) was placed 14.44 m away from the participant. Wu and Gervais (2006, 2008) reported that the pitcher's stride length was approximately equal to 0.80 m; hence, the actual distance between the batter and pitching machine was calculated as 14.44 m. Additionally, a blue mat was placed in front of the pitching machine so that the batter could not see where the balls were pitched to him. Twenty-four Jugs Lite-Flite indoor softballs, 0.30 m (12"), were used in the study. Small strips of reflective tape were placed on the surface of the balls in order to identify the instant of ball contact. The total weight of the Jugs Lite-Flite softball with the reflective tape was 0.07 kg. The balls were thrown at a speed of approximately 13.55 ± 0.77 m/s with an arc trajectory of 2.72 ± 0.22 m. The entire field was divided into three different fields (opposite, neutral and same) approximately 30° apart. The opposite, neutral and same fields were defined as an area on the field formed by lines extending from the home plate and rotating in a counter clockwise direction from the first baseline between 0° and 30°, 30° and 60° and 60° and 90°, respectively. Participants performed their regular warm-up routine and took batting practice until they were ready for testing. Each participant stood at their own self selected location in the batter's box with their own natural stance. Participants were instructed to use either a closed, open or parallel stride technique and hit the ball either to the same field or opposite field. Each participant hit six balls with each of three stride techniques to place the ball to each of two fields. The participant had 30 s to rest between each ball, and one minute to rest between each type of stride. The influence of fatigue and the risk of injury were minimal in this study. A total of 36 balls were hit by each participant, so a total of 360 trials were collected in this study. Each result for a batted ball was recorded regardless if the attempt was performed successfully or not. The order of the stride technique and designated field placement was randomized to reduce any order effect. A three-dimensional (3D) analysis was conducted with an 8-camera Qualisys motion capture system (ProReflex MCU 240, Qualisys AB, Sweden) that was operated at 240 Hz (680 x 500 pixel image sensor resolution). Three cameras were placed approximately 60° apart inside a soccer net in front of the particpant to capture the anterior view of the bat movement, and another three cameras were also placed approximately 60° apart inside another soccer net on the back of the particpant to capture the posterior view of the bat movement Additonal two cameras were placed on the right side of the participant on top of a balcony that is approximately 5 m above the ground to capture the superior view of the bat movement. A wand calibration technique was used to calibrate the volume that was 2.5 m in each of X, Y and Z directions. Data was smoothed with 4^{th} order Butterworth filter, and the optimal cut-off frequency was determined for each coordinate using residual analysis (Wells & Winter, 1980). The cut-off frequency for the x-coordinate ranged from 6.3 to 12.2 Hz; the y-coordinate ranged from 6.1 to 11.6 Hz, and the z-coordinate ranged from 6.3 to 10.8 Hz.

RESULTS: A dependent sample *t*-test was conducted at $\alpha = 0.05$ on success rate of placement hitting performance. The success rate of placement hitting performance was calculated as the number of successful hits divided by the total number of trials (3) and then multiplied by 100. Participants showed a significant success rate of 48.34 ± 3.62% when they hit the ball to the same field (left field). However, when participants hit the ball to the opposite field (right field), their success rate was only 22.70 ± 3.26%. Further, dependent sample *t*-tests were conducted at $\alpha = 0.05$ on resultant linear and angular velocities. From the results of the study, it was revealed that in some trials participants were only able to perform with a correct stride technique but not the designated ball placement location. Since the findings could still provide important insights to our understanding of the influence of different field placements on the mechanics of hitting, the average of the participant's trials that were performed with a correct stride and a fair ball with intended ball placement location in each condition was calculated and used for statistical analyses. From the results participants showed a linear bat velocity at ball contact of 31.47 ± 0.63 m/s when hitting the ball to the same field, and this was significantly greater than the linear bat velocity at ball contact of 29.62 ± 0.52 m/s when hitting the ball to the opposite field, Table 1. The significant difference was observed in the linear bat velocity but was not explicitly evident in the bat's angular velocity. This showed that the mechanics of the bat movement was not purely rotational around a fixed axis, but in fact it consisted of both linear and rotational movements.

Table 1
Placement Hitting Mechanical Variables at Ball Contact

Mechanical Variables	Same field	Opposite field	*p*
Success rate (%)	48.34 ± 3.62	22.70 ± 3.26	0.00*
Linear bat velocity (m/s)	31.47 ± 0.63	29.62 ± 0.52	0.00*
Angular bat velocity (°/s)	2029.27 ± 45.49	1991.60 ± 41.88	0.27

* Statistical significant at $p < 0.05$

DISCUSSION: In slo-pitch the ball is pitched to the batter at an arc trajectory and takes 1.5 s to reach to the home plate (Carriero, 1984; Wu & Gervais, 2006, 2008). Since how the ball is pitched and the amount of time that it takes to reach home plate in slo-pitch is different for baseball and fast pitch, the hitting mechanics in slo-pitch may be different from baseball and fast pitch. The participants from this study showed a greater success rate (48.34 %) and a higher linear bat velocity (31.47 ± 0.63 m/s) in hitting the ball to the same field (left field) than the opposite field (right field). This may explain why many coaches believe that right handed batters are capable of hitting the ball farther and harder toward the same field (left field). In addition, this study showed different findings from a previous baseball placement hitting study that was conducted by McIntyre and Pfautsch (1982). They reported that the baseball players did not show any significant difference in the linear bat velocity between the same and opposite fields. The significant differences were found in bat swing time, angular bat velocity, and angular displacement of the bat between the same and opposite fields. The difference in findings between these two studies may be due to the difference in the nature of sport. This study examined the skill of slo-pitch placement hitting while the other study examined the skill of baseball placement hitting. In baseball the ball is pitched at a much higher velocity than in slo-pitch; the baseball batter does not have as much time to adjust their stride technique as in slo-pitch. Therefore, the striding technique may explain the observed difference between this study and McIntyre and Pfautsch (1982)'s. Several important research questions remain to be answered such as the influence of pitched ball location in relation to stride technique and the body joint angles in hitting the ball towards the same field versus the opposite field. These findings will enable us to have a better understanding about the mechanics of slo-pitch hitting.

CONCLUSION: Participants from this slo-pitch placement hitting study showed a greater success rate and a higher linear bat velocity in hitting the ball towards the same field (left field). Hence, this study supports the fact that right-handed batters can hit the ball harder and farther towards the same field. Coaches may apply this finding to their game strategy. Interestingly, the findings from this study were different from a previous baseball placement hitting study that was conducted by McIntyre and Pfautsch (1982). This indicated that slo-pitch batting mechanics may be similar but uniquely different from baseball hitting mechanics, and this may be due to the nature of the sport on how the ball is pitched in slo-pitch. Future research studies are warranted to examine the mechanical differences between these two batting skills.

REFERENCES:

Carriero, J. (1984). *How to hit slow pitch softball for men and women*. New York: Sports Information Press.

Escamilla, R. F., Fleisig, G. S., Zheng, N., Barrentine, S. W. & Andrews, J.R. (2001). Kinematic comparisons of 1996 Olympic baseball pitchers. *Journal of Sports Sciences, 19,* 665-676.

Gelinas, M. P. (1988). Kinematic comparison of same and opposite-field hitting in baseball. Unpublished master's thesis, McGill University, Montreal, Quebec, Canada.

Hay, J. G. (1978). *The biomechanics of sports techniques.* Englewood Cliffs: Prentice-Hall.

McIntyre, D. R., & Pfautsch, E. W. (1982). A kinematic analysis of the baseball batting swings involved in opposite-field and same-field hitting. *Research Quarterly for Exercise and Sport*, *53*(3), 206-213.

Messier, S. P., & Owen, M. G. (1985). The mechanics of batting: analysis of ground reaction forces and selected lower extremity kinematics. *Research Quarterly for Exercise and Sport*, *56*(2), 138-143.

Messier, S. P., & Owen, M.G. (1986). Mechanics of batting: effect of stride technique on ground reaction forces and bat velocities. *Research Quarterly for Exercise and Sport*, *57(*4), 329-333.

Oliver, G. D. (2003). *The kinematics of the windmill softball pitch*.Unpublished doctoral dissertation, Texas Women University, Denton.

Perry, G. R. (1979). *Slow pitch softball*. New York: A.S. Barnes.

Wells, R.P. & Winter, D.A. (1980). Assessment of signal and noise in the kinematics of normal, pathological, and sporting gaits. In: *Human locomotion I: Pathological gait to the elite athlete* (p. 92-93). London: Canadian Society of Biomechanics.

Wu, T., & Gervais, P. (2006). The effects of spin on ball trajectories in slo-pitch. *XIV*th *Biennial Conference for the Canadian Society of Biomechanics* (p. 125). Waterloo: Canadian Society of Biomechanics.

Wu, T., & Gervais, P. (2008). An examination of slo-pitch pitching trajectories. *Sports Biomechanics, 7*(1), 88-99.

Acknowledgement
The authors would like to thank Edmonton and Big League Apparel & Sports slo-pitch players for participating in the study. In addition, the authors acknowledge equipment support from the Softball-tips.com & Baseballtips.com and the research development support from the Human Performance Scholarship Fund, University of Alberta.