THE STUDY OF BATTING PERFORMANCE OF DIFFERENT MATERIAL BAT

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The purpose of this study was to compare the velocity of sweet spot and batted-ball velocity during swing different material bat. Three collegiate baseball players randomly swung five different material bats. The high-speed video (2000 fps) was placed 7 meter above subject to capture swing image. The swing velocities of sweet spot before impact, after impact and batted-ball velocity were calculated. The results reveal that batted-ball velocity of bamboo bat and compound bat were between alloy bat and wood bat. There are significant correlations among bat velocity before impact and batted-ball velocity. We suggest that the bamboo or synthetic material of wood and bamboo were suitable to produce baseball bat. Moreover, it is very economy and safer than alloy bat.

KEY WORDS: batting performance, batted-ball velocity

INTRODUCTION: A commonly accepted fact is that baseball became the one of most popular activity through the world. The most important equipment of baseball was ball and bat. Many manufactured produce baseball bat by different material like aluminum, ash and synthetic material. Past studies indicated that swing velocity and batted-ball velocity of alloy bat was faster than wood bat, because of alloy bat has smaller moment of inertial and light mass (Crisco et al. 2002, Fleisig et al. 2001,). In order to decrease the accident injury rate on baseball field and increase infielder safety. International Baseball Federation (IBAF) determined that baseball game which competition by above 16 years old player must use the bat, which made by wood. Therefore, the manufactured use bamboo or synthetic material of wood and bamboo to produce newly baseball bat. However, there are big gap between traditional bat and synthetic bat for batting performance. In order to understand the batting properties of these bat, this study compared the velocity of sweet spot when before impact and after impact, as well as batted-ball velocity during swing between alloy bat, wood bat, bamboo bat and compound bat.

METHODS: Three collegiate baseball players voluntarily participated in this study. Each subject randomly swung five different material bats: alloy bat, wood bat, compound bat and two kind of bamboo bat. The properties of each bat type may be found in Table 1. After finished warm-up session, participant swung each kind of bat three trails. The batting coach sits at front of subject for pitched ball to idea batting zone, and the batted-ball must line drive to batting net. Each swing has a break period for 30 second. The high-speed video (MEGA SPEED 70 k) was placed 7 meter above subject (Figure 1). The sampling rate was set at 2000 fps to capture swing image, to measure swing velocity and batted-ball velocity. The sweet spot of bat were attached maker for digitization. The sweet spot was defined as a point 15 cm from barrel end (Noble & Walker, 1994).

Table 1 Bat properties.

	Diameter(cm)	Length(cm)	Mass(g)	C.G.(cm)	Inertial(kg m^2)
Alloy	6.4	86.4	822	29.7	0.254
Wood	6.3	85.2	870	27.8	0.260
Bamboo 1	6.4	85.1	812	27.5	0.257
Bamboo 2	6.2	85.0	859	27.7	0.266
Compound	6.4	86.2	826	27.5	0.271

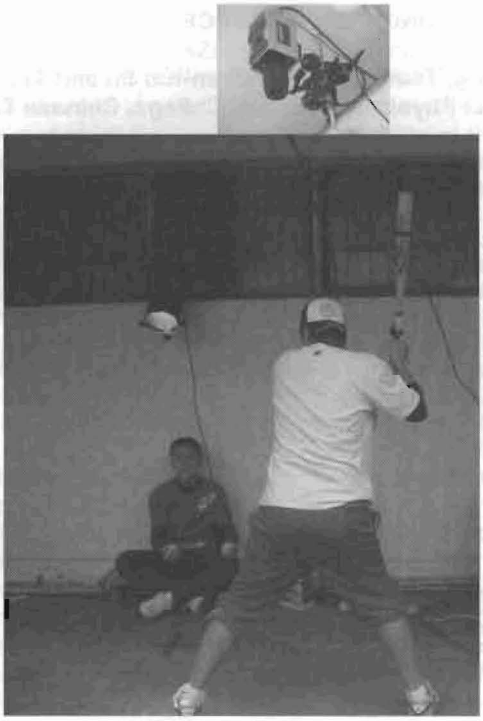

Figure 1 Experimental setup.

Analysis Methods: The swing velocities of sweet spot and batted-ball velocity were determined by Ariel Performance Analysis System (APAS) software. In this study we determined the swing phase has two parts one was before impact (phase 1) another was after impact (phase 2).

RESULTS: The velocity of bat before impact, bat after impact and batted-ball during swing each different material bat were show in Table 2. We clear understood that the rank of sweet spot velocities that bat before impact was alloy bat, bamboo bat 2, compound bat, wood bat and bamboo bat 1. Moreover, the rank of sweet spot velocities that bat after impact was bamboo bat 2, alloy bat, bamboo bat 1, wood bat and compound bat. The rank of batted-ball velocities was alloy bat, bamboo bat 1, compound bat, bamboo bat 2, and wood bat. Figure 2 show the relationship of velocity about bat before impact, bat after impact and batted-ball during swing each bat. There are significant correlations among bat velocity before impact and batted-ball velocity as shown in Table 3.

Table 2 Velocity of sweet spot (before and after impact) and batted-ball.

	Alloy	Wood	Bamboo 1	Bamboo 2	Compound
bat before impact	107.72±14.58	88.40±6.22	86.08±4.77	103.22±4.56	89.81±2.96
bat after impact	67.68±9.85	65.95±9.90	66.39±1.37	69.77±9.47	60.45±0.02
batted-ball	122.04±4.39	110.72±1.49	116.29±0.63	115.17±1.45	115.81±0.48

unit: km/h

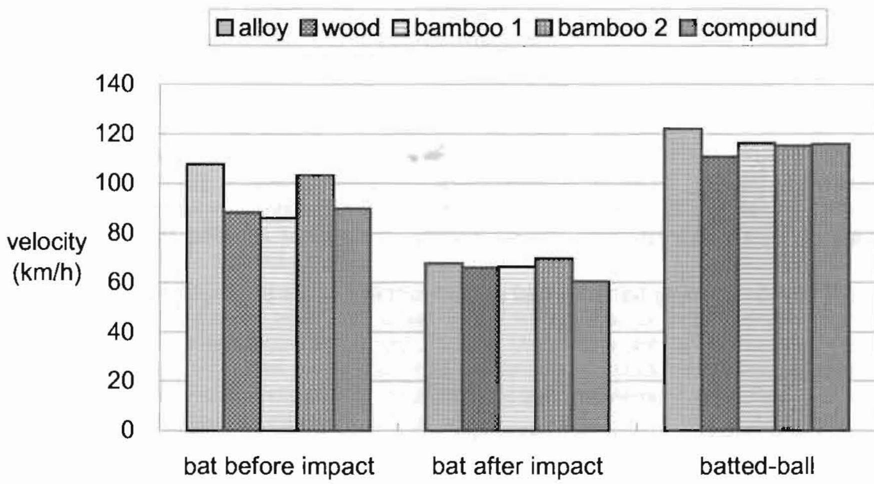

Figure 2 Sweet spot and batted-ball velocity of each material bat.

Table 3 The correlation coefficient of sweet spot before impact, after impact and batted-ball velocity.

	bat before impact	bat after impact	batted-ball
bat before impact	--	-0.162	0.723*
bat after impact		--	-0.212
batted-ball			--

*p < .05

DISCUSSION: Batted-ball velocity was an important parameter to evaluation the batting performance. There is significant correlation between the bat velocities before impact batted-ball velocity. During bat-ball impact, momentum (mass x velocity) is transferred from the bat to the ball. Increasing bat velocity increases the bat's momentum, momentum transfer, and batted ball velocity. Therefore, batted-ball velocity was easy influence by bat velocity before impact. The properties of bat like material, mass and moment of inertial were the reason to affect batted-ball. The past studies described that alloy bat performs faster swing velocity and batted-ball velocity then wood bat (Crisco et al. 2002, Fleisig et al. 2001, Greenwald et al. 2001 and Rochelle et al. 2003). In present study, the batted-ball velocity that performed by bamboo and compound bat were between alloy and wood bat. And this bamboo bat and compound bat had similar batted-ball velocity (Figure 2). These results indicate that alloy bat not only had light mass, less inertial and faster swing velocity but also had material properties of elastic. The material characteristic of bamboo and compound bat were more elastic then wood bat. Consequently, wood bat performed lower batted-bat velocity at the same situation.

CONCLUSION: The results reveal that batting performance of bamboo bat and compound bat were between alloy bat and wood bat. In the same batting situation, the batted-ball velocity of bamboo bat and compound bat were similar. Therefore, we suggest that the bamboo or synthetic material of wood and bamboo were suitable to produce baseball bat. Moreover, it is very economy and safer than alloy bat.

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