INFLUENCES OF THE MASS OF BOXING GLOVES ON THE IMPACT FORCE OF A REAR HAND STRAIGHT PUNCH

Genki Nakano, Yoichi Iino and Takeji Kojima

Department of Life Sciences, Graduate School of Arts and Sciences, the University of Tokyo, Tokyo, Japan

KEY WORDS: peak of the impact force, impulse, unfixed target, boxing glove

INTRODUCTION: The purpose of this paper was to investigate the influences of the mass of boxing gloves on the impact force of a rear hand straight punch thrown into an unfixed target whose mass (4.36kg) was similar to that of the typical human head.

METHODS: Nine male collegiate boxers whose varsity had been the title holder of Japan University Championship for the last two years threw rear hand straight punches into the unfixed target at full power wearing seven kinds of gloves (10, 12, 14 and 16oz gloves with no added weight and 10oz gloves with added lead weights of 2, 4 and 6oz: 10oz is official). The target was free to move straight horizontally without a noticeable frictional force. The orders of trials were randomized. Several punches were measured for each glove. A minimum of 1 minute rest was taken between two consecutive punches. Accelerations of the target were recorded using an accelerometer attached to the target at 10kHz, and then were low-pass filtered with a cutoff frequency of 500Hz. The peak of the impact force and its impulse were determined using the acceleration data and the mass value of the target: the acceleration became 0 at the end of the impact. The averaged data of the two trials with the largest impact forces for each glove for each boxer was used for later analysis. One-way repeated measures ANOVAs were used to investigate combined effects of the glove on the impact force using the gloves without added weights and to investigate effects of the mass of the glove on the force using the gloves with added weights. A post hoc test was performed using Holm's method if an ANOVA showed a significant effect. Comparisons between two same mass gloves (e.g. 12oz glove with no added weight and 10oz glove with 2oz lead weight) were also performed to test the effects of the cushioning on the impact force using Holm's method.

RESULTS: The duration of the impact force ranged from 18.5ms to 28.8ms. Table 1 shows the peak value of the impact force and its impulse for each glove. The effect of the gloves with no added weight on the peak impact force was significant ($p<0.01$) However, post hoc tests showed no significant differences between any pair of gloves. The effect of mass of the gloves on the impact force was not significant. The peak impact forces of the two same mass gloves were significantly different only between 16oz and 10+6oz ($p<0.05$).

Table1 The peaks and impulses of the impact forces.

		10oz	12oz	14oz	16oz	10＋2oz	10＋4oz	10＋6oz
Peak of the impact force(N)	Ave.	2090	2140	1920	1900	2050	2100	2130
	SD	460	540	330	420	540	550	520
Impulse(N・s)	Ave.	18.6	18.7	19.0	19.1	21.6	21.9	21.8
	SD	2.1	1.8	1.2	1.9	4.2	1.3	1.6

DISCUSSION: The peak impact forces of the larger mass gloves with no added weight tended to be lower than the smaller ones. It is suggested that the peak impact forces of the gloves with no added weight depend on the cushioning rather than the mass of the gloves if the punching motions were the same irrespective of the masses of the gloves.

CONCLUSION: The difference in cushioning rather than mass of the glove would affect the magnitude of the peak impact force.

Acknowledgement: The authors thank Prof. Y. Yoshifuku who advised us about the experiment.