MOMENTA OF BODY SEGMENTS CONVERTED INTO IMPACT FORCE OF A REAR HAND STRAIGHT PUNCH INTO AN UNFIXED TARGET

Genki Nakano, Akiko Imura, Yoichi Iino, and Takeji Kojima

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

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INTRODUCTION: When top-class martial artists such as champion kickboxers threw a rear hand straight punch with maximum effort into a target fixed on a wall, the contribution of the momentum of the throwing limb to an impact force or an impulse to the target was about 60％ (Yoshihuku,1987). Yoshihuku (1995) suggested that the contribution of the momenta of the other body segments reduced when the punch was thrown into an unfixed target. The purpose of this paper was to clarify the contribution of the momentum of the throwing limb to the impulse when the punch was thrown into an unfixed target similar to the human head.

METHODS: Four top-class amateur boxers and two top-class professional boxers participated in the study. They wore amateur's competition gloves (0.284kg). Reflective makers were attached to the gloves and some body segments of the subjects. An accelerometer was attached to an unfixed target whose mass (5.26kg) was similar to that of the human head. The subjects threw a rear hand straight punch into the target like they struck the opponent with a hard blow in a match. Using the data from the accelerometer and a VICON motion capture system, we determined (1) the peak value of the impact force, (2) the impulse, (3) the decrement of the momentum of the throwing limb in the impact and (4) the contribution of the momentum of the limb to the impulse ((4) = (3) / (2)).

RESULTS: Some quantities in the rear hand straight punches are shown in Table 1. The contribution of the throwing limb to the impulse exceeded 100%.

Table 1 Some quantities in rear hand straight punches by the six boxers

	Ave.	SD
Peak value of the impact force（N）	2640	540
Impulse (N・ｓ)	18.6	2.2
Decrement of the momentum of the throwing limb （kg・m/s）	19.5	2.4
Contribution of the throwing limb to the impulse （%）	105	6

DISCUSSION: That the contribution of the momentum of the throwing limb to the impulse exceeded 100% suggests a whole momentum of the limb or a part of it was enough for producing the impulse. This supports the above mentioned suggestion by Yoshihuku (1995). However, this may be due to the way of punching in boxing.
In conclusion, the decrement of the momentum of the throwing arm was almost the same with the impulse observed in the impact of a rear hand straight punch thrown by top-class boxers against an unfixed target similar in mass to the human head.

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