Biomechanical Analysis of Punching Different Targets in Chinese Martial Arts

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INTRODUCTION

The research of punching motion in martial arts was focus on different gloves type, skill levels and styles of punching (Smith, 1986, Powell, 1989, Whiting, 1988). Only Yoshihuku [1] has compared the punching motion with target and none. So far, no one has done a thorough study to determine the difference among punching different targets. Our hypothesis was the martial arts athletes' punching motion would be affected by different material and mass of targets. The difference will show on kinematics of the upper extremity and muscle moment calculated by inverse dynamics. The results will help us to understand the coordination of upper extremity when punch different targets.

METHODS

Nine healthy Chinese martial arts athletes of Chinese Culture University aged 18-24 years, weight 70.1±14.2 kg and height 168±4.9 cm volunteered to participate in the experiment. They have to punch three different targets that include cardboard (0.2kg), small punching bag (9.2kg) and big punching bag (29.2kg). We used a Sony PD150 digital camera and Peak Motus 6.0 motion analysis system (60Hz) to catch the kinematics data of upper extremity. Then we applied the intersegmental dynamics formula that developed by Zernicke & Smith [2] to calculate the joint moment, muscle moment and interaction between the segments. One-way repeated-measures ANOVA were carried out for each of the dependent variables in the study. The probability level was set at $P < .05$.

RESULTS AND DISCUSSION

The fist peak velocity was significantly different when punching three different targets ($P < .05$). The fastest velocity of fist was punching the cardboard target (6.98±0.72 m/s), then was punching the small bag (6.06±0.68 m/s), and the lowest velocity was punching the big bag (5.43±0.82 m/s) . The contact time was significantly different when punching different targets, too. The shortest contact time was found in punching the cardboard (0.03±0.00 sec), then the small bag (0.10±0.01 sec), and the longest contact time was found in punching the big bag (0.14±0.05 sec). The kinematics results are similar to Yoshihuku's [1] study.

Figure 1 shows similar trend of elbow and shoulder moment curve when subjects punched three different targets. The results of elbow and shoulder moment were similar with penetrating strike in previous study [3]. In all moments, only the maximum shoulder flexion moment in the cardboard (156.51±142.22Nm), small bag (90.29±64.09Nm) and big bag (61.16±40.58Nm) were significantly different (P<.05).

The shoulder muscle flexion moment was larger when subjects punch the cardboard target than small and big targets

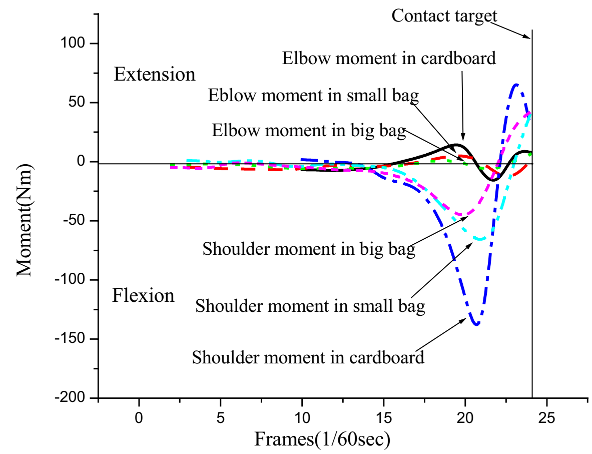

Figure 1. The subject 7 punched the different targets.The curve displayed the muscle moment of elbow and shoulder before contact

which indicated shoulder joint can fully flexion that make the fist velocity faster. On the contrary, the subjects wanted to recruit more muscle fibers and to raise the effective mass to participate when punching the heavy target. This phenomenon causes the shoulder muscle flexion moment and fist velocity decrease when punching the heavy target. The results agree with the principle of muscle loading and contraction velocity.

CONCLUSIONS

Different target mass will affect punching motion of subject's upper extremity. These results showed differences in the fist peak velocity, contact time and the maximum flexion shoulder muscle moment which could provide useful information for the athletes and coaches.

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