BIOMECHANICAL ANALYSIS OF STANDING LONG JUMP: A 3D STUDY

Chen-fu Huang , Ray-hsien Tang

National Taiwan Normal University, Taipei, Taiwan

KEY WORDS：kinematics, torque, loading jump

INTRODUCTION: Many studies had investigated 2D standing long jump, and some indicated that when jump with optimal load, the jumping performance would be improved. But till now, no study reported the 3D kinetic and kinematic data in standing long jump. The purpose of the study was to compare the kinetic and kinematic difference between restricted arm jump, normal jump, and loaded standing long jump.

METHODS: Six male junior high school students (age: 15.3±0.4 years, height: 177.2±6.11 cm, weight: 66.4 ± 5.87 kg) participated the study. All subjects did 10-mimute warm-up and performed restricted arm jump (RAJ), normal jump (NJ), and load 3.9kg standing long jump (LJ). Ten Vicon Mx13 cameras (200 Hz) were synchronized with a Kistler force platform (1000Hz）to collect the 3D biomechanical data. Sixty- nine reflective markers were placed on subjects' body and 15-segment model were used to calculate the variables. The raw data were smoothed by second order Butterworth low-pass filter with 6 Hz cut off frequency, and kinetic and kinematic variables were calculated using Visual 3D software.

RESULTS AND DISCUSSION: The LJ increased the jump distances (2.47m＞2.31m＞1.94m), the result is the similar to previous studies (Minetti ＆ Ardigo,2002). The horizontal CG takeoff velocity was enhanced (3.57m/s＞3.49m/s＞3.09m/s), too. The vertical CG takeoff velocity was enhanced in RAJ (1.93m/s＞1.71m/s＞1.56m/s), but jump distance was decreased in RAJ. The peak GRFx was decreased in RAJ (646.6N＜796N), the result is the similar to previous studies (Ashby ＆ Heegaard, 2002). The LJ had less hip extension (20.55 Nm＜27.00 Nm) and external rotation torque (10.24 Nm＜16.33 Nm), and less knee flexion torque (-19.50 Nm＜-25.34 Nm).

Table1：Kinematic variables and peak GRF of jumping performances

	RAJ	NJ	LJ
Distance (m) ＊	1.936±0.12	2.309±0.15	2.466±0.18
H Velocity (m/s) ＊	3.085±0.14	3.492±0.30	3.569±0.33
V Velocity (m/s) ＊	1.929±0.17	1.707±0.22	1.557±1.11
Peak GRFx＊	646.6±102.1	796.0±143.9	716.2±63.5
Peak Hip Tx (Nm) ＊	21.63±2.70	27.00±3.59	20.55±4.62
Peak Hip Tz (Nm) ＊	13.95±3.86	16.33±3.58	10.24±3.38
Peak Knee Tx (Nm) ＊	-18.33±3.84	-25.34±4.49	-19.50±4.85

＊p<.05 X direction: flexion (-) and extension (+); y direction: adduction (-) and abduction (+); z direction: internal rotation (-) and external rotation (+).

CONCLUSION: The LJ increased the jump distances, but RAJ decreased. The horizontal CG takeoff velocity was enhanced in LJ. The vertical CG takeoff velocity was enhanced in RAJ.

REFERENCES

Ashby, B. M. ＆ Heegaard, J. H. (2002). Role of arm motion in the standing long jump. *Journal of Biomechanics, 35,1631*-1637.

Minetti, A. E.; Ardigo, L. P. (2002). Halteres used in ancient Olympic long jump. *Nature, November 2002; 420(14)*: 141-142.