THE EFFECT OF SQUAT DEPTHS ON PEAK FORCES DURING COUNTERMOVEMENT JUMPS

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INTRODUCTION: The vertical jump is a key fundamental skill which is applied across a range of sports (Swinton, et al., 2010). The aim of the study was to examine the influence of squat depths on peak force, maximal jump height and maximal power on countermovement jump performance. We hypothesized that an increase in squat depth would generate an increase in jump height and power due to the greater time for force generation at take-off. The purpose of this study was to establish a guideline for coaches and athletes to be used in training programs, to determine the optimal squat depth for the athlete.

METHODS: Three male and three female students (21.5 ±3.5 y; 168.1 ±13 cm; 66.5 ±9.5 kg) performed countermovement jumps in a randomized fashion to the depth of 0.30, 0.45 and 0.60m.Three successful trials were collected for each squat depth. A video camera (25 frames per second, shutter speed 1/250) captured the sagittal plane movement of the lower extremity on the left side during the countermovement. Peak force generated during take-off, peak power and maximal jump height were analyzed using the Quattro Jump Software. Knee sagittal angles (flexion) were analyzed using the Vicon Peak Motus. A repeated measures ANOVA and Pearson's correlation using SPSS were used to determine differences between the different squat depths and the relationship between peak force and vertical jump height respectively.

RESULTS AND DISCUSSION: P-values for power, force, jump height and knee angle between different squat depths were analyzed and the results could be observed in Table 3. A significant difference was observed in jump height between 0.30 m and 0.60 m. A significant difference occurred in knee angle for all squat depths. We observed that when the subjects reached a depth of 0.60 m their jump height did not increase. The results of jumps at a depth of 0.60 m had the greatest variability. From the results optimal squat depth would be 0.45 m. The knee angle corresponding to this depth was 88.40 ±10.87°, and this could be used as a guideline for coaches.

Table 1: P-values for power, force, jump height and knee angle between squat depths.

Variables	0.30 m vs. 0.45 m	0.45 m vs. 0.60 m	0.3 0m vs. 0.60 m
Power (W)	0.122	0.953	0.142
Force (BW)	0.052	0.434	0.111
Jump Height (m)	0.28	0.119	0.007*
Knee Angle (º)	0.001*	0.011*	0.001*

* $p<0.05$ indicates a significant difference.

CONCLUSION AND PRACTICAL IMPLICATION: In contrast to previous literature (Kirby, et al., 2011), jump height did not increase with increasing squat depth. Once the subjects reached a depth of 0.60m the height no longer increased and the results were of great variance between participants. An optimal squat depth would be 0.45m with a knee angle of 40 ± 10.87 degrees, and this could be used as a guideline for coaches. A significant correlation was observed between peak power and jump height for all squat depths. The correlation increased with increasing squat depth. Force was found to only significantly affect jump height at a squat depth of 0.60m.

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