EFFECT OF FORCE CHARACTERISTICS AND REACTION ABILITY ON VERTICAL JUMPING IN YOUNG BASKETBALL PLAYERS

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INTRODUCTION AND PURPOSE

A vast quantity of scientific literature exists on the mechanisms and determinants of jumping ability. Yet, the influence of: a) the maximum isometric push-off force, b) the speed by which maximum push-off force is developed, and c) the reaction ability to drop jump on the effective use of horizontal and drop vertical velocities in vertical jumping has not been thoroughly investigated. It was, thus, the purpose of this study to investigate the relationship and influence of these parameters on vertical jumping in young basketball players.

METHODS

Nine young male basketball players (age: 13.34 yrs; height: 1.71m; weight: 60.2Kg) were tested on: a) maximum isometric push-off force (F_{max}); b) vertical countermovement jumps with (CMJ_w and without (CMJ_{wo}) the use of the arms; c) vertical jump from a flexed hip, knee, and ankle joint position (SJ); d) drop vertical jumps from heights of 18 (DJ,,), 36 (DJ_{36}), and 42cm (DJ_{42}); e) vertical jumps with one step (CMJ,), and horizontal velocities of 1.5 (CMJ_2) and 2.2mlsec (CMJ_3); and f) vertical jumps with self-paced horizontal velocity with (CMJ,) and without (CMJ_{fwo}) the use of the arms. Two pairs of photo cells and two 1-D dynamometers were used for data collection.

RESULTS AND CONCLUSION

Table 1 presents differences between vertical countermovement jumps (CMJ_w or CMJ_{wo}) and vertical jumps with initial horizontal velocity (CMJ,, CMJ_2, CMJ_3, CMJ_{fw}, and CMJ_{fwo}). No significant differences ($p<.05$) between these jumps were found. Nor were significant differences found between vertical jumps from a flexed hip, knee, and ankle joint position (SJ) and drop jumps (DJ,,, DJ,,, and DJ_{42}) (Table 2). Evaluation of F_{max} (M=1.8 times body weight), percent of F_{max} achieved during the first 100ms (PCFM,,) (56% of F_{max}), and reaction ability (ratio between best DJ and SJ jumps) (-2.5%).

Table 1. (n=9) Comparison between various CMJs and CMJ with initial horizontal velocities

Jumps	Mean	SD	Mean	SD	t-score
CMJ_w vs. CMJ_{fw}	36.35	6.9	37.89	6.1	-0.497
CMJ_{wo} vs. CMJ,	30.45	6.4	30.45	6.4	0.004
CMJ_{wo} vs. CMJ,	30.45	6.4	30.02	4.4	0.165
CMJ_{wo} vs. CMJ,	30.45	6.4	31.68	4.9	-0.458
CMJ_{wo} vs. CMJ_{fwo}	30.45	6.4	31.99	4.7	-0.528

showed that these performance characteristics of this group of young basketball players were inferior to previously reported values. F_{max} was reported to be 2.8 times body weight; $PCFM_{100}$ was reported to be 70-75% of F_{max} (Papadopoulos, 1997); for reaction ability, DJ was reported to be 120-125% of SJ (Schmidtbleicher, 1994). It is of interest that the observed performances in CMJ or SJ were not influenced by either the increase in initial horizontal velocity (CMJ,, Table 1), or vertical velocity (DJ_{18-42}, Table 2). According to Schmidtbleicher et al. (1990), vertical jumping performance of subjects with: a) decreased ability to develop maximum force quickly (reflected in $PCFM_{100}$ and b) poor reaction ability (reflected in the ratio of DJ/SJ), does not increase when the push-off time decreases (which is the case, for example, when the drop jump height increases).

Table 2. (n=9). Comparisons between SJ and drop jumps

Jumps	Mean	SD	Mean	SD	t-score
SJ vs. DJ,,	27.49	4.6	25.44	4.9	0.913
SJ vs. DJ,,	27.49	4.6	26.82	4.2	0.325
SJ vs. DJ_{42}	27.49	4.6	26.08	4.4	0.546

It is also of interest that the preferred horizontal velocities (2.11 and 2.14m/sec for CMJ_{fw} and CMJ_{fwo}, respectively) were similar to the highest assigned horizontal velocity (CMJ,). Subjects, however, increased the push-off time by 83msec in CMJ_{fwo} and 23msec in CMJ_{fwo}. It can be speculated that subjects, knowing their limited ability to reach maximum force quickly and poor reaction ability, increased the push-off (contact) time to maximize performance. It was concluded that, in vertical jumping, effective utilization

of horizontal and drop vertical velocities is influenced by F_{max}, PCFM,, and reaction ability. Strategies aiming to increase vertical jumping ability, which do not consider F_{max}, PCFM,,, and reaction ability, appear to be ineffective.

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