THE EFFECTS OF PRACTICE ON THE KINETICS OF VERTICAL AND HORIZONTAL JUMPING

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INTRODUCTION

The purpose of the study was to determine the effects of practice on the kinetics of the vertical and horizontal jump. The relationship between peak power and the distance jump is also determined to provide a better understanding of skill acquisition concepts for jumping. The peak power components of velocity and force are considered critical factors in the production of power (Kaneko, Fuchimoto, Toji, & Suei, 1983). Ground reaction force curve production for vertical and horizontal jumps provides an interaction between velocity of the center of mass and muscle contractile forces from the lower extremity. The point of interaction between velocity and force over time provides peak power output (Dowling & Vamos, 1993). In terms of skill acquisition, practice is considered an important variable affecting performance (Schmidt, 1988). As learners perform practice trials, they develop a motor program for the movement pattern. Inherent within the concept of a motor program for jumping is the relationship between the kinetic components (i.e., peak power, force and velocity) of the movement (Schmidt, 1988). A change in the nature of the relationship between the kinetic components of the movement as a function of practice would suggest that learning has taken place, as motor learning is defined as "a set of processes associated with practice or experience leading to a relatively permanent change in the capability of responding" (Schmidt, 1988, p. 346). Therefore, it is important to account for the relationship between movement kinetics and performance outcome (i.e., distance and height jumped) as a function of learning through practice.

METHOD

Twenty-three active volunteer subjects were randomly assigned to either a practice or a control group. Subjects in the practice group performed five maximal horizontal and vertical jumps daily over a ten day period. Knowledge of results was provided, however, no other motivational or verbal instructional cues were used to enhance performance. The test design utilized a pre/post test on both a control and practice group. Testing included the mean result of three maximal vertical and horizontal jumps from an AMTI force plate. Vertical and Horizontal distance measures were taken from a vertical jump stand and horizontal tape measurement. Vertical force output was measured from the Fz (vertical) plane. Horizontal jump measures were computed as the resultant output from the Fx (horizontal) plane and Fz force plane. Vertical and horizontal distance, peak force, peak velocity and peak power measures were provided from the software output.

RESULTS

The pre/post test mean differences in displacement, peak power, peak velocity and peak force were used to determine the effect of practice on the kinetics of horizontal and vertical jumping.

Horizontal Jumping. A two-way (test by group) Analysis of Variance (ANOVA) was calculated on the displacement scores. There was a significant main effect for test ($F(1,21)=10.09$; $p<0.01$), however, there was group main effect. The interaction failed to reach significance at the $p<0.05$ level, however, the interaction approached significance ($F(1,21)=3.00$; $p<0.09$) (Figure 1).

Two-way (test by group) ANOVA's were calculated on the peak power scores and the peak velocity scores. Both analyses yielded a significant main effect for test ($F(1,21)=7.94$; $p<0.01$) for peak power and ($F(1,21)=6.93$; $p<0.02$) for peak velocity. All other main effects and interactions failed to reach significance at the $p<0.05$ level (Figure 2 and 3).

In addition , a two-way (test by group) ANOVA was performed on the peak force scores. The tests of the two main effects and interaction failed to reach significance ($p>0.05$).

Vertical jumping. A two-way ANOVA was calculated on the vertical displacement scores. There was a significant main effect for test ($F(1,21)=13.29$; $p<0.01$) and a significant interaction ($F(1,21)=4.46$; $p<0.05$). The main effect for group failed to reach significance ($p>0.05$). Post hoc Tukey HSD for unequal N's were calculated to determine the nature of the interaction. The post test displacement scores for the practice group were significantly different from the post test results of the control group and the pre test scores for the control and practice groups ($p<0.05$). All other pair wise comparisons failed to reach significance ($p>0.05$) (Figure 4).

Two-way (test by group) ANOVA's were calculated on the peak power, peak velocity and peak force scores. All main effects and interactions failed to reach significance ($p>0.05$).

FIGURE 1 HORIZONTAL - DISPLACEMENT - ROTOFMEANS

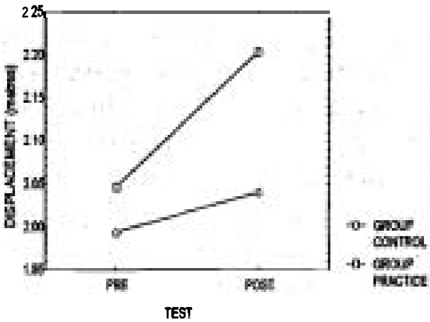


FIGURE 2 HORIZONTAL - PEAK POWER - PLOT OF MEANS

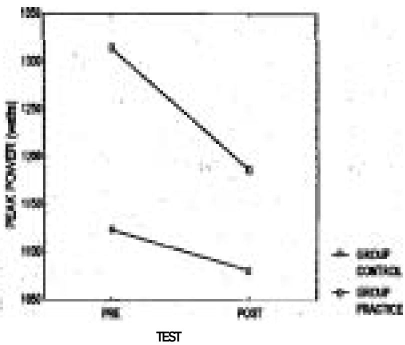


FIGURE 3 HORIZONTAL - PEAK VELOCITY - PLOT OF MEANS

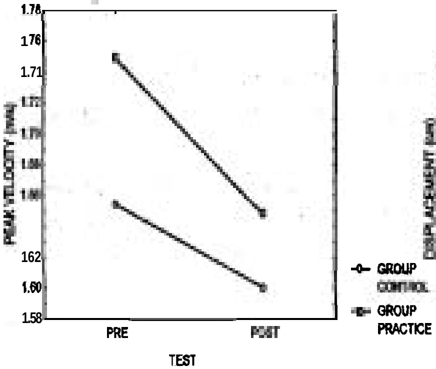
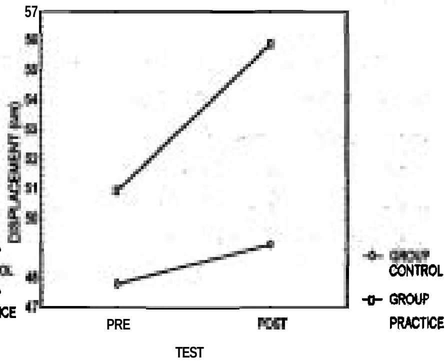


FIGURE 4 VERTICAL - DISPLACEMENT - PLOT OF MEANS



DISCUSSION

The results of the present investigation suggest that vertical jump performance can be increased (see Figure 4), as a result of practice, without a concurrent increase in peak power, peak force or peak velocity ($p>0.05$). In terms of horizontal jumping, both the practice and control groups increased in the distance jumped from pre test to post test. The practice group had greater improvement than the control group; however, the difference was not significant ($p>0.05$). The trend was similar to that of the vertical jump results ($p<0.09$)(Figure 1). The pre/post test differences in the kinetic variables were inconsistent with what would normally be predicted for jumping performance. There was a significant decrease in peak power and peak velocity (Figures 2 and 3). Peak force did not change from pre test to post test.

The acquisition of jumping skill seems to involve more than a change in the relationship between force and velocity in generating peak power. Aragon-Vargas & Gross (1997) suggest that changes in the kinematic variables associated with vertical jumping play an important role in determining vertical jump performance. That is, evidence supporting the acquisition of jumping skill may come from changes in the phasing of the different body segments and not necessarily concurrent increases in the peak power exerted while jumping. To more fully understand the learning process, consideration for changes in the movement kinematics and movement kinetics is necessary. In addition, further research attempting to understand potential changes in movement impulse would lead to a more thorough understanding of the processes associated with jumping skill acquisition.

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