THE EFFECTS OF PLYOMETRIC VERSUS WEIGHTS TRAINING ON DROP-JUMP LANDINGS

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INTRODUCTION

Vertical jumping is important in many sports, and both plyometric and weights training are believed to improve muscle strength and attenuate landing impact (1,2). However, their effects on drop-jump landings and landing strategies are unclear. This study aims to compare the effects of plyometric and weights training on drop-jump landings.

METHODS

Subjects were male college students who were recreational athletes. Both the plyometric group (n=17, age 19.0±0.6 years; height 1.71±0.1 m; mass 65.8±12.0 kg) and the weights group (n=17, age 19.9±1.6 years; height 1.71±0.1m; mass 64.7±9.1 kg) trained for 30 minutes 3 times a week for 6 weeks under supervision. Subjects in the control group (n=15, age 20.3±1.7 years; height 1.70±0.1 m; mass 64.3±10.4 kg) did not receive any intervention.

Subjects were tested at baseline and 6 weeks later. Knee extensor muscle strength of the dominant leg was measured eccentrically at 180°/sec (1) using an isokinetic dynamometer (Biodex System 4 Pro, Biodex Medical Systems, Shirley, NY, USA). Subjects performed 3 maximum repetitions and the peak torque was recorded.

Drop jump height was set at 60cm. An eight-camera motion analysis system (Motion Analysis Corp., Santa Rosa, CA, USA) was used to record three dimensional movements of the lower limb at 100Hz. A 20-marker set was placed on selected anatomical landmarks to define a rigid link model of the lower limb. Subjects wore their own sports shoes for the jumps. They were given standardized instructions to step off the platform with the dominant leg extended, and land as softly and as naturally as possible without losing their balance, onto two force plates (1000Hz, 9286AA, Kristler Instruments, Amherst, NY, USA) which were placed 20cm in front of the jumping platform. After proper jump technique was demonstrated, subjects performed practice jumps to familiarize themselves with the jumping technique. Once a consistent jumping pattern was achieved, subject performed a single drop jump which was used for analysis.

Biomechanical variables measured included peak vertical ground reaction force (VGRF), peak VGRF loading rate, knee flexion angle at impact, peak knee flexion angle and knee range of motion during the landing phase. All force data were normalized to body mass. Although data were collected for both the right and left legs, only the dominant leg was chosen for analysis. One-way ANOVA was used to examine for between group differences in landing parameters while paired t-tests were used to examine for differences between pre and post tests.

RESULTS AND DISCUSSION

Both the plyometric and weights group had significant gains in quadriceps strength post training compared to the control group ($P<0.05$). However, none of the landing parameters showed a significant difference across the 3 groups.

When pre-test and post-test results were examined, there was a significant reduction in peak VGRF post training only in the plyometric group. Although not statistically significant, subjects in the plyometric group also achieved a reduction in peak VGRF loading rate, and an increase in peak knee flexion angle and knee range of motion during landing. The reduction in the peak VGRF in this group appeared to be due to a change in the landing pattern, with subjects exhibiting greater knee flexion during landing. These changes were not seen in the weights or control group.

CONCLUSIONS

Plyometric training may alter landing strategies and these effects were not observed after weights training. Hence plyometric training appears to be more effective than weights training in atteunuating impact forces during drop-jump landings. Future work should examine if similar changes in landing strategies would be present when drop jumping from higher heights.

REFERENCES

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	Plyometric Group (n=17)		**Weights Training Group (n=17)**		**Control Group (n=15)**	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Quadriceps strength (Nm/kg)	3.39±0.54	3.81±0.76*	4.16±0.96	4.51±1.02*	3.55±0.66	3.52±0.62
Peak VGRF(BW)	3.11±1.44	2.47±1.71*	3.50±1.56	2.97±1.81	4.44±2.67	4.57±2.62
Peak VGRF loading rate (BW/s)	95.3±72.7	83.1±67.4	101.8±59.3	126.7±119.3	136.9±81.5	145.7±83.1
Knee flexion angle at impact (°)	156.2±5.8	156.6±4.1	157.9±5.6	157.6±4.7	157.2±6.4	157.4±7.3
Peak knee flexion angle (°)	80.2±19.6	70.8±17.0	78.4±17.7	79.0±22.4	81.9±22.5	78.2±15.3
Knee range of motion (°)	76.0±17.0	85.8±14.9	79.5±16.2	78.6±19.9	75.2±18.1	79.3±15.4

Table 1: Effects of plyometric and weights training versus control on landing parameters (mean±SD). *significant pretest-post test differences at $P<0.05$. VGRF=vertical ground reaction force; BW=body weight