Comparison of ground reaction forces during the take off phase of pole vault and long jump

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Introduction

Women's pole vault is a new challenge for athletic scientists. Further scientific research is required for the establishment of the most appropriate technique, as the performance of elite female athletes appears not to be a projection of the technique of male elite vaulters at a lower jump height (Schade et al 2004). During take off phase, the athlete is subjected to ground reaction forces (GRF), which in turn determine the take off performance (Hay 1993). There is a general agreement between coaches and scientists that the take off phase of pole vault and long jump is quite similar. However, no research data justify the above suggestion. The purpose of the study was to compare the take off dynamic pattern of the two events.

Method

Twelve Greek female pole vaulters took part in the study (Body Mass 57.6 ± 5.31 kg, Height 1.65 ± 0.05 m, Best Record 4.00 ± 0.30 m). GRF were measured with a portable force platform (Kistler, 9286AA), covered with a tartan surface and placed at the take off area, individually located. Data were sampled at 1000 Hz. Bioware analysis system for Win95 was used. Each subject was asked to perform 4 trials of pole vault and 4 trials of long jump with maximal effort from a full length approach. The most representative trial of each subject was selected for further analysis. A paired samples t-test for establishing significant differences was used (p<0.05) (SPSS 10.0).

Results

Figure 1 shows A: Vertical (Fz), B: Horizontal (Fy) and C: Lateral (Fx) GRF pattern during the take off phase of pole vault (PV) and long jump (LJ) (values relative to BW). The critical phases of contact time (impact, spring like, compression, lift) as well as the parameters presented as means (SD) in Table 1, are noted in Fig.1. The difference of means, expressed as percentage of LJ values (% diff), is also shown in Table 1. Negative sign indicates that PV values are smaller than LJ's. All parameters examined were significantly different (Table 1).

Discussion/Conclusion

All 3 components of GRF are greater at LJ. The greater approach velocity & the arm swing at LJ, in addition with the energy loses due to pole plant at PV, can be hold responsible for the differences. However, the ratio Fzmax/Fymax is 9.4% greater at PV, indicating different GRF pattern during impact phase. The 46.2% smaller Fxmin value at PV during impact, suggests restriction to Lateral force due to pole contact. The time ratios (%) of compression & lift phases are good indicators of an efficient take off. PV's results are closer to previous data (Lees et al 1994). Prolonged lift time & greater Horizontal force (Fymin) characterize LJ. The GRF-time diagram (Fig.1) indicates that the difference in contact time derives from the duration of lift phase. In conclusion, while the dynamic pattern of the two events seems similar, there are specific GRF and time related differences.

References
