CONTRIBUTION TO THE BIOMECHANICAL ANALYSIS OF THE LONG JUMP

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INTRODUCTION: The Austrian national outdoor-record for men's long jump is 8.30 m. This record was set in 1988. Since then the national record has not been broken. Therefore the purpose of this study was to examine the various parameters affecting performance during the last support phase of the long jump. The current work is an attempt to help both the coaches and the athletes to improve performance.

METHOD: Two experiments were carried out in the summers 2004 and 2005. In the first experiment four athletes executed four jumps. The participants were classified among the best ten long jumpers in Austria. The three force components were sampled in the first experiment by a force platform which was incorporated in the track (Kistler, size: 40x60 cm). The second experiment was performed during the International ATSVI Springer Meeting, two athletes executed three jumps (the same athletes). To analyse the kinematics of the last support phase, a high speed camera with a sampling frequency of 230 Hz was used. A special software program using Lab VIEW 7.1 (National Instruments) was developed to digitize the image coordinates of the joint points. All jumps were digitized and analysed. The inverted pendulum model from Chow and Hay (2005) has been modified to evaluate the change on the angular momentum (still in progress).

RESULTS AND DISCUSSION: In the first experiment the athletes tried to increase the vertical velocity and decrease the horizontal velocity from touch-down to take-off at the last support phase. Statistical analysis showed a strong negative correlation between this decreasing in the horizontal velocity and the jumping distance ($r = -0.761$, $p = 000$). In the second experiment, performed during the competition, the athletes tried to increase their take-off velocities. The statistical results showed a positive correlation between the increase of the vertical take-off velocity and the jumping distance ($r = 0.835$, $p = 0.019$), also between the increase of the vertical take-off velocity and the take-off angle ($r = 0.871$, $p = 0.021$). The take-off angles of most athletes were optimal according to Linthorne et al. (2005), who gives optimal angles in the range from 18 to 23°. The longest jumping distance (7.93 m) was obtained by the jumper with the highest vertical take-off velocity, equal to 3.5 m/s, the corresponding take-off angle was 19°. Ballreich and Kuhlow (1986) stated that the contact times were in the range between 0.10 - 0.13 s for the high performance athletes. This agrees with the results of this study. In case of low performance athletes a negative correlation between contact time and the jumping distance was given.

CONCLUSION: The vertical take-off velocity plays a major factor for the jumping distance, especially for the high performance athletes. The increase in the vertical take-off velocity results in longer jumps. The results of this study were useful for the improvement of the athlete's performances. One of the tested athletes improved his jump distance and set the Austrian indoor-record to 7.96 m.

REFERENCES:

Ballreich, R. & Kuhlow, A. (1986) (32-36) Biomechanik der Leichtathletik, Sportarten, Ferdinand Enke Verlag, Deutschland.

Chow, J. W. & Hay, J. G. (2005) Computer simulation of the last support phase of the long jump. *Medicine & Science in Sports & Exercise*, 37(1): 115-123.

Linthorne, N. P. & Guzman M. S. & Bridgett L. A. (2005) Optimum take-off angle in the long jump. *Journal of Sport Sciences*, 23(7): 703-712.