

APPROACH VELOCITY PROFILES OF ELITE MALE AND FEMALE LOWER-LIMB AMPUTEE LONG JUMPERS

¹Benjamin L. Patritti, ²Kathy J. Simpson and ³Lee Nolan

¹Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital, Boston, MA, USA

²Department of Kinesiology, University of Georgia, Athens, GA, USA

³Laboratory for Biomechanics and Motor Control, Karolinska Institute, Stockholm, Sweden email: leen@ihs.se

INTRODUCTION

The approach velocity is accepted as a key determinant of successful long jump performance for elite able-bodied athletes [1,2]. Whether a similar relationship underlies the performance of disabled athletes, such as lower-limb amputees, is not well known. There is evidence that greater approach speed at take-off (TO) contributes positively to distance jumped for male below-knee amputees (BKA) and also for male above-knee amputees (AKA) with some slight adjustments in technique [3]. However, compensatory kinematics due to a prosthetic knee joint likely influences the regulation of velocity on the long jump approach [4]. The aim of this study was to compare approach velocity profiles of elite AKA and BKA, and the relationship between approach velocity and distance jumped.

METHODS

The velocity profiles of the approach runs of 14 AKA (male = 6, female = 8) and 20 BKA (male = 11, female = 9) were investigated during the long jump finals at the 2004 Paralympic Games. Approach velocities were sampled (100 Hz) using a laser Doppler device (Laveg, Jenoptik, Germany) positioned behind the long jump pit and targeted on the torso of each athlete during the run up. Velocity for the entire run up was recorded for each successful jump, corrected for perspective error and smoothed using Laveg Sport[®] software. Mean (\pm SD) data of selected velocity variables for positions 0m (take-off (TO) board), 1m, 6m, and 11m before the take-off board were calculated for each group using the greatest official distance jump of each athlete (Table 1). Differences between classification (AKA vs BKA) for each gender were determined using Students t-test. Relationships between variables were analysed using Pearson correlation and linear regression. Significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

Female AKA approach velocity and distance jumped were lower than female BKA (Table 1), and lower than those reported for skilled able-bodied jumpers [1]. Likewise, the male athletes ran slower and jumped less far with increasing level of amputation, supporting previous research [3]. The positive relationship between approach velocity and distance

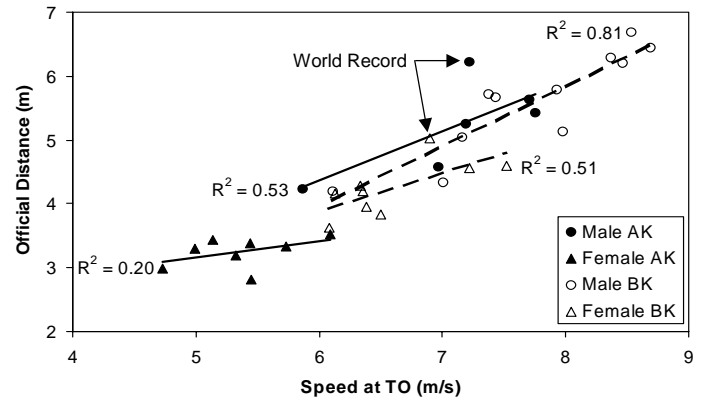


Figure 1: Relationships between approach velocity and distance jumped for male and female AKA and BKA athletes.

jumped was strongest for male BKA athletes (Figure 1). Male AKA and female BKA athletes showed a slightly weaker relationship, partly conforming to the accepted long jump model [2,3]. Female AKA, however, exhibited a weak relationship indicating that for a given increase in approach velocity, the gain in distance jumped is minimal. Female AKA had a greater increase in approach velocity between 11-6m compared to the other athletes (Table 1). They also were the only group to have a relationship ($r = -0.77$) between this variable and distance jumped, and the only group to exhibit a weak relationship ($r = 0.25$) between average velocity at 11-6m and distance jumped. Thus, female AKA may be compensating for their slow approach velocity by continuing to accelerate between 11-6m from the TO board. This has a negative effect on their jump performance. The mechanisms which prevent female AKA from performing long jump technique in the same manner as female BKA or male AKA are not known and warrant detailed kinematic analysis.

REFERENCES

1. Lees A, et al. *J Sport Sci* **11**, 303-314, 1993.
2. Lees A, et al. *J Sport Sci* **12**, 61-78, 1994.
3. Nolan L and Lees A. *Ergonomics* **43**, 1637-1650, 2000.
4. Simpson KJ, et al. *Proc NACOB*, Waterloo, 465-466, 1998.

Table 1: Means (\pm SD) for distance jumped and approach velocity variables for the male and female AKA and BKA groups.

	MALE		FEMALE	
	AKA	BKA	AKA	BKA
Official distance (m)	5.23 \pm 0.72	5.59 \pm 0.83	3.25 \pm 0.24	4.25 \pm 0.43
Velocity at TO (m s ⁻¹)	7.12 \pm 0.69	7.73 \pm 0.79	5.36 \pm 0.43	6.60 \pm 0.50
Av. velocity 11-6m from TO board (m s ⁻¹)	7.31 \pm 0.71	8.08 \pm 0.68	5.32 \pm 0.23^o	6.76 \pm 0.49
Av. velocity 6-1m from TO board (m s ⁻¹)	7.67 \pm 0.59	8.30 \pm 0.66	5.67 \pm 0.24	7.05 \pm 0.45
Δ velocity 11-6m from TO board (m s ⁻¹)	0.51 \pm 0.42*	0.54 \pm 0.58*	0.70 \pm 0.32*	0.25 \pm 0.48
Δ velocity 6-1m from TO board (m s ⁻¹)	-0.22 \pm 0.44 ^A	-0.41 \pm 0.64 ^A	0.36 \pm 0.42	0.34 \pm 0.43

^A: negative (-) sign denotes decrease in velocity; **bold**: significant difference between classifications (AKA and BKA) for each gender;

^o: significant difference between Av. velocity 11-6m vs. 6-1m for a given group; *: significant difference between Δ velocity 11-6m vs 6-1m for a given group.