LOCATION OF LINEAR POSITIONAL TRANSDUCER AFFECTS RELIABILITY OF INJURY RISK VARIABLES DURING A JUMP-LANDING TASK

J. L. Pryor[1], N. Kemmis[1], K. Belal[1], P. Rosbrook[1], J. B. Qiao[1], D. K. Sweet[1], R. R. Pryor[1], D. Hostler[1], D. P. Looney[2], R. L. Begalle[1]

[1]University at Buffalo, Buffalo, NY, [2]US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA

Abstract

Background: Linear positional transducers (LPT) are a common tool to evaluate kinetic and kinematic performance variables, but their use as a tool to evaluate injury risk remains understudied. A jump-landing task is a common injury risk model, but LPT placement during this task for optimal reliability is unknown. **PURPOSE**: To evaluate the test-retest reliability and differences in kinetic and kinematic LPT variables at three locations during a jump-landing task. **METHODS**: 20 males completed three standardized jump-landings at three different LPT locations (n = 60 for each location). The LPT locations were Takeoff (next to a 30 cm tall box from which the subjects jump), Halfway (mid-way between the Takeoff and Landing), and Landing (located 0.5 * height (cm) in front of the box). A popular commercially available LPT was used to record eccentric mean velocity, eccentric peak power and force, dip or eccentric depth, and contact time. Separate one-way repeated measures ANOVAs analyzed differences in device variables among locations. Coefficient of variation and intraclass correlation coefficients (ICC) characterized reliability. ICC's were calculated across all three positions. **RESULTS**: Eccentric peak power, eccentric peak force, and dip were lowest at Takeoff and progressively increased from Halfway to Landing (all, $p < 0.01$). This trend was reversed for average eccentric mean velocity and contact time (all, $p < 0.01$). ICCs were high for eccentric peak force (0.95), contact time (0.93), dip (0.92), and eccentric peak power (0.90) but low for eccentric mean velocity (0.67). The coefficients of variation were not consistent across variables nor LPT location (Takeoff, Halfway, Landing): eccentric mean velocity (7.4%, 6.1%, 6.5%), eccentric peak power (8%, 10.6%, 11.3%), eccentric peak force (5.8%, 7.6%, 7.3%), dip (7.2%, 6.4%, 6.9%), and contact time (6.9%, 6.7%, 5.5%). CONCLUSIONS: LPT reliability across variables and location was not uniform but generally acceptable (CV < 11%) with good to excellent ICC. LPT location should be consistent and based upon the variable of interest. **PRACTICAL APPLICATION**: The use of a LPT during a jump-landing task could provide valuable information for practitioners and researchers if used in a consistent location. More research is required to establish which location offers the best construct validity.

Introduction

Lower body injuries are common among occupational, athletic, military, and recreational settings. These injuries range from minor (ankle sprain) to severe cases (ACL tear). Severe and/or chronic reoccurring lower body injuries affect short- and long-term physical, mental, and financial health. To mitigate these consequences, there is great need to explore potential tools to assess injury risk to inform injury prevention interventions. Advances in technology have developed real time movement tracking tools such as a linear positional transducer (LPT), but the reliability of LPT devices during a jump-landing task, a common model to study lower body injury risk, remains unknown.

Purpose

1) To evaluate the test-retest reliability of a LPT at three locations during a jump-landing task.
2) To assess if LPT location causes differences within variables during a jump-landing task.

Methods

- 20 males completed three standardized jump-landings at three different LPT locations (n = 60 for each location)
- The LPT locations were 1) **Takeoff -** where the device was located next to the 30 cm box, 2) **Halfway** - where the device was located halfway between the box and landing, and 3) **Landing -** where the device was located at the landing
- A popular commercially available LPT device (GymAware, Braddon, ACT, Australia) was used
- Separate one-way repeated measures ANOVAs analyzed differences in device variables among locations
- Coefficient of variation, intraclass correlation coefficient $_{(2,1)}$, and standard error of the measurement characterized reliability

Scan the QR code to view a video of the standardized jump-landing task.

Figure 1. The standardized jump-landing task with the LPT at the Landing location.

Results

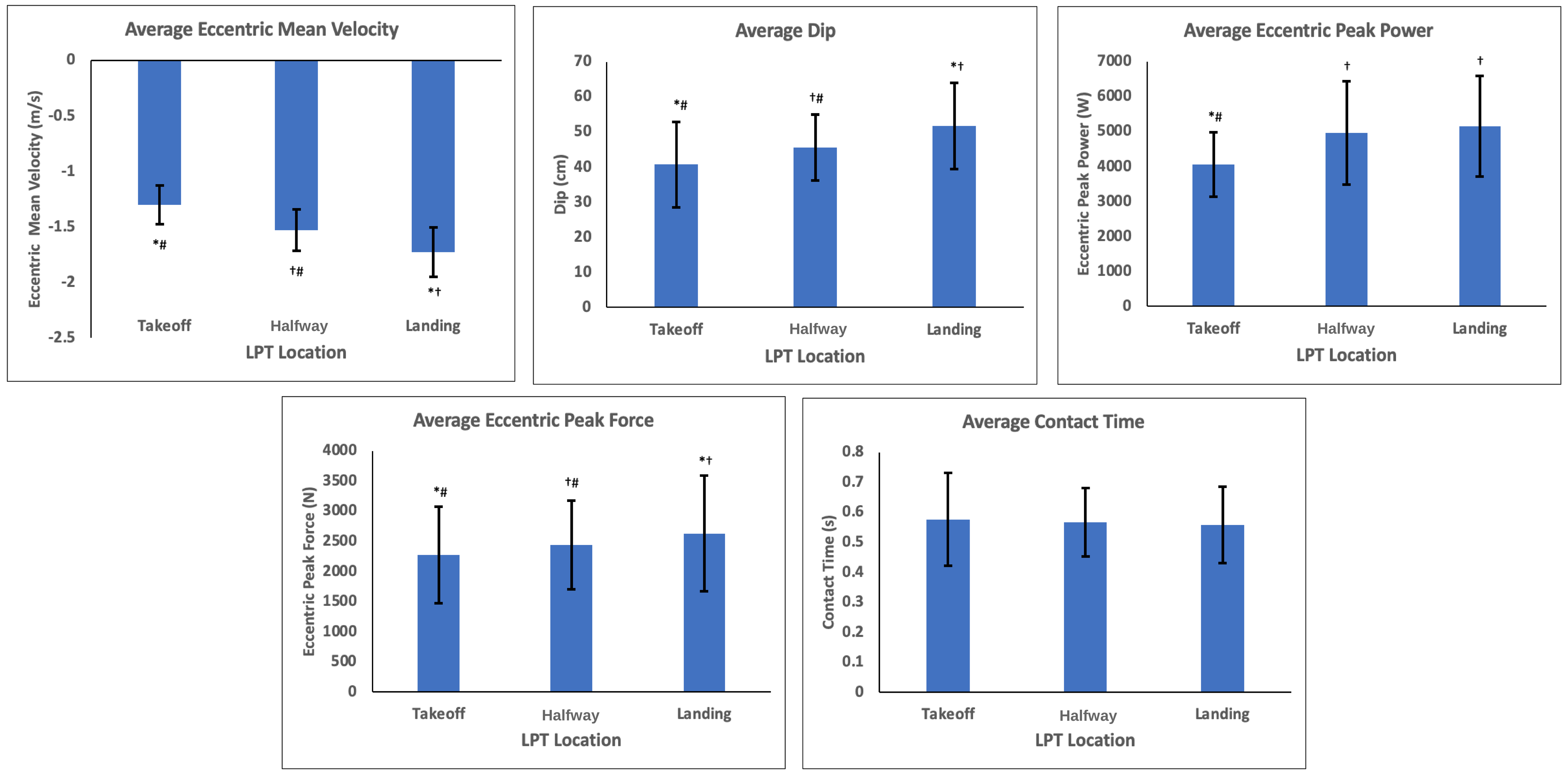

Figure 2. Mean differences among linear positional transducer (LPT) location. † $p < 0.01$ from Takeoff, * $p < 0.01$ from Halfway, # $p < 0.01$ from Landing. Data are presented as mean ± standard deviation.

Table 1. Coefficient of variation (%) at each LPT position

Device Position	Takeoff	Halfway	Landing
Dip	7.2	6.4	6.9
Eccentric Mean Velocity	7.4	6.1	6.5
Eccentric Peak Power	8.5	10.6	11.3
Eccentric Peak Force	5.8	7.6	7.3
Contact Time	6.9	6.7	5.5

Table 2. Standard error of measurement for each LPT variable

Device Position	Takeoff	Halfway	Landing
Dip (in)	± 1.0	± 1.0	± 1.1
Eccentric Mean Velocity (m/s)	± 0.3	± 0.3	± 0.3
Eccentric Peak Power (W)	± 17.7	± 22.0	± 23.5
Eccentric Peak Force (N)	± 10.8	± 12.7	± 13.5
Contact Time (sec)	± 0.2	± 0.2	± 0.2

Table 3. Intraclass correlation coefficient (ICC) values across LPT position

	ICC Value	95% Confidence interval
Dip	0.92	[0.88 , 0.95]
Eccentric Mean Velocity	0.67	[0.49 , 0.79]
Eccentric Peak Power	0.90	[0.84 , 0.94]
Eccentric Peak Force	0.95	[0.93 , 0.96]
Contact Time	0.93	[0.89 , 0.96]

Conclusion

- LPT reliability across variables and location was not uniform but generally acceptable (CV < 11%) with good to excellent ICC. LPT location should be consistent and based upon the variable of interest.
- The use of a LPT during a jump-landing task could provide valuable information for practitioners and researchers if used in a consistent location. More research is required to establish which location offers the best construct validity.

Acknowledgements

Funding provided through the Department of Defense MTEC award #W81XWH-22-9-0014.

The views expressed in this poster are those of the authors and do not reflect the official policy of the U.S. Government, Department of Energy, Department of the Army, or Department of Defense.