PREDICTING DYNAMIC POSTURAL STABILITY OF FIREFIGHTERS USING THE VERTICAL STABILITY INDEX VALUE

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INTRODUCTION

Dynamic postural stability is a key factor in injury prevention, especially for firefighters. This study evaluated whether the vertical stability index (VSI) can serve as a simpler alternative to the dynamic postural stability index (DPSI), aiming to reduce the complexity of data processing.

PURPOSE

To determine the predictive value of anterior-posterior (APSI), medial-lateral (MLSI), and vertical (VSI) as a surrogate measure for dynamic postural stability index (DPSI) values using a vertical stability index value.

METHODS

The study was a retrospective analysis of archived data from an injury prevention program conducted in local fire academy. The dataset included(n=107) firefighter's cadets. The dataset included interior-posterior, medial-lateral, vertical, and dynamic postural stability indices. Postural stability was accessed using single leg-landing task on a 40 cm by 60 cm force plate while donning a turnout coat, pants, hood, facemask, helmet, gloves, boot, and self-contained breathing apparatus. The sampling rate of the force plate data was 1500 Hz. The DPSI variable is a composite of the anterior-posterior, medial-lateral, and vertical ground reaction forces.. The anterior-posterior, medial-lateral, and vertical ground reaction forces also provide the stability indices for APSI, MLSI, and VS.

The first three seconds of the ground reaction forces immediately following initial ground contact were used to calculate the DPSI. Initial ground contact was defined as the instant the vertical ground reaction force exceeded 5% of body weight. All data was filtered using a low-pass Butterworth filter with a 20 Hz cutoff frequency. A Visual Basic for Applications script was used within Excel to reduce the ground reaction force data to create the DPSI variable. A higher DPSI value represents worse dynamic postural stability. Multiple bivariate correlations were conducted to explore the relationship of DPSI to APSI, MLSI, and VSI. The bivariate correlation was interpreted using the following scale: small (0.10), Medium (0.30), and large (0.50). Variables with correlations above 0.5 were included as predictors on a linear regression analysis, with DPSI as the criterion variable.

RESULTS

MLSI (r= 0.365) and APSI (r= 0.466) demonstrated a medium positive correlation, while VSI (r= 0.979) demonstrated a strong positive correlation to DPSI (Figure 1). Only VSI was retained for the linear regression analysis. The results of the regression analysis revealed that VSI accounted for 95.9 % of the variance in DPSI (R^2 = 0.959, $p < 0.001$)

CONCLUSION

The findings suggest that VSI is a strong predictor of DPSI.

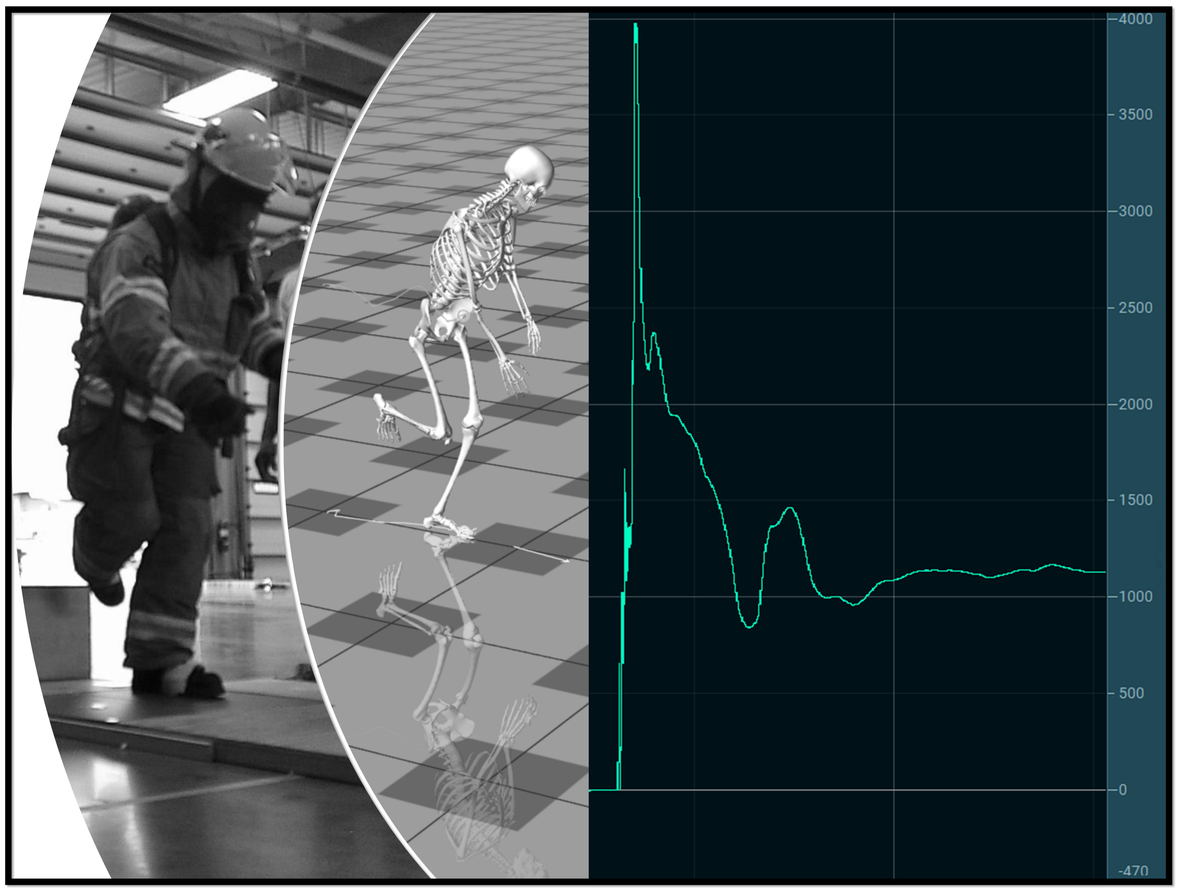

Figure 1. Single Leg Landing and Stabilization Task

PRACTICAL APPLICATION

Researchers can use VSI as a surrogate measure for DPSI. This would minimize the amount of coding required to create a Visual Basic Application script to process postural stability data. DPSI can be predicted using the following equation: Y = 0.011 + 1.02X+E, where Y is DPSI, and X is the VSI.

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REFERENCES

Sell, T. C., Pederson, J. J., Abt, J. P., Nagai, T., Deluzio, J., Wirt, M. D., . . . Lephart, S. M. (2013). The addition of body armor diminishes dynamic postural stability in military soldiers. *Mil Med, 178*(1), 76-81. doi:10.7205/milmed-d-12-00185