Validation of DANU System During the 5-0-5 Change of Direction Test

Introduction

In multidirectional sports, change of direction (COD) speed is fundamental for performance yet is a primary mechanism for non-contact lower limb injuries [1]. Monitoring spatiotemporal parameters during COD is therefore essential for performance optimisation and injury risk management. Laboratory-based force plates remain the criterion standard but lack ecological validity in constrained testing environments [2]. Wearable sensor technology offers a promising field-based alternative; however, most validation work has focused on linear gait patterns [3], with limited examination during COD tasks where ground contact characteristics differ substantially. This study evaluated the concurrent validity of the DANU system for measuring contact time during a 5-0-5 COD task compared to force plate measures.

Methodology

Thirty-two team sport players (17 male, 15 female) completed at least four trials of a 5-0-5 COD over Kistler force plates sampled at 1000 Hz, alternating their plant foot. Trials were repeated if participants did not maintain full contact with the force plates. Ground contact time from force plates was determined using a custom Python (3.11) script identifying initial and final contact when vertical force exceeded a 20 N threshold. The DANU system (in-sock pressure sensors and shank IMU, 250 Hz) provided contact time metrics via their analytics platform using proprietary algorithms. Descriptive statistics and mean differences assessed bias. Validity was evaluated using Pearson correlations, intraclass correlation coefficients (ICC(2,1)), mean absolute error (MAE), root mean square error (RMSE), and Bland–Altman analysis.

Results

Across 121 paired observations (deceleration, plant, and acceleration steps), the DANU system demonstrated excellent agreement with force plate measures. Mean bias was −1.7 ms (SD = 14.4 ms), with 95% limits of agreement from −30.0 to 26.6 ms. Pearson $r = 0.950$ ($p < 0.001$, $r^2 = 0.902$), ICC(2,1) = 0.949, MAE = 11.0 ms, RMSE = 14.5 ms.

Conclusion

The DANU system demonstrated excellent concurrent validity for contact time measurement across COD phases, with minimal systematic bias, strong correlation ($r = 0.950$), and excellent

reliability (ICC = 0.949). These findings support its use as a valid field-based alternative to force plates for assessing temporal characteristics of COD performance, offering practitioners a more accessible monitoring tool in applied settings.

References

[1] Dos'Santos T, et al. *Strength Cond J.* 2019;41(1):87–104.

[2] Mason R, et al. *Physiol Meas.* 2023;44(11).

[3] Alanen AM, et al. *Scand J Med Sci Sports.* 2021;31(8):1332–1353.