Validation of Opto-Jump Measurement System Reliability Against Gold Measurement

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Introduction

A fitness revolution in the 1970's launched running to the forefront of recreational fitness thus increasing the need for knowledge of proper technique to mitigate risk of injury. As a result, there has been increased development of devices measuring running gait characteristics which were once limited to elite and well-funded athletes. It is important to scrutinize the reliability and application of new systems to prevent propagation of false knowledge of techniques that could risk athlete injury. Previous research conducted by Ogueta-Alday et. al. (2013) validated the application of treadmill-based gait analysis. Accurate gait analysis can inform a range of athletes regarding orthotics, performance, fatigue, and drive consumer metrics by way of personalization of fit.

Purpose

The purpose of this study is to validate the reliability of the Opto-jump test apparatus against a gold measure for future applications in running gait analysis by investigative step frequency.

Methods

Six participants were recruited (mean ± standard deviation: age: 22.3 ± 0.8 years; stature: 182.8 ± 2.6 cm; mass: 77.2 ± 1.8 kg) and provided written consent via a Sheffield Hallam approved participation form. Participants were asked to run at predetermined individualised speeds for two one-minute trials. These speeds were standardized across participants through experimental calculation of anaerobic threshold and resultant speed, to control for level of exertion per participant. Data was collected over a 10 second time frame beginning at time 30-40 s to allow for proper adaptation to standard running gait. Unique steps were defined at first sight of forefoot eversion upon initial heel touchdown. The time of alternating heel contacts was recorded for analysis of step frequency. A high-speed camera was placed ~2 m behind the treadmill, perpendicular to the frontal plane, and focused to capture the full width of the treadmill with visibility of the full touchdown to launch foot movement; with a frame rate of 1,000 Hz.

Table 1 Compiled Means ± SD of individuals per test averaged across two trials.

ID	HSV	OPTO-JUMP
1	2.646 ± 0.039	2.647 ± 0.038
2	2.789 ± 0.045	2.789 ± 0.033
3	2.657 ± 0.021	2.657 ± 0.024
4	2.657 ± 0.034	2.657 ± 0.044
5	2.884 ± 0.046	2.890 ± 0.064
6	2.727 ± 0.032	2.729 ± 0.053

Results

The results in Table 1 are expressed as mean ± SD with statistical significance considered for values $p < 0.05$ and represent step frequency. An initial Bland-Altman (Bland & Altman, 1999), shown in Figure 1, analysis showed an agreement between the two methods using MATLAB 2018R software. This correlation was validated and quantified by obtaining Spearman's rho coefficient ($\rho = 0.873$, $p < 0.01$) and determining the Root Mean Squares value ($r = 0.053$). Concurrent validity was assessed using the intraclass correlation coefficient (ICC = 0.851) via IBM SPSS V.24 software.

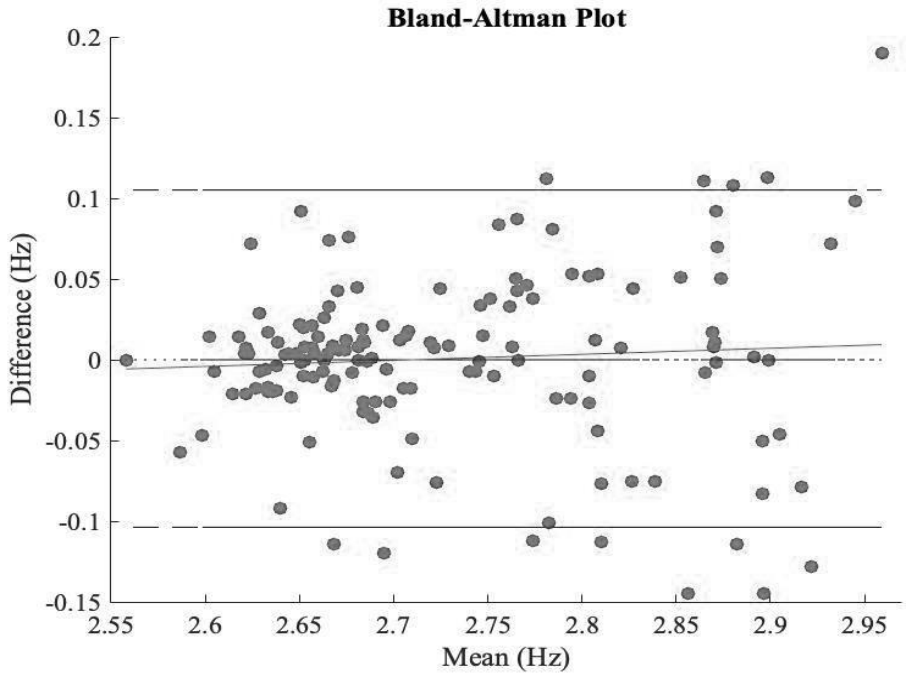

Figure 1 Bland-Altman graphical analysis of Left & Right feet across both observed measures.

Discussion & Conclusion

The primary outcome of this study was the validation of an automated method to analyse running step frequency. This automated method proposes greater time efficiency and demonstrates consistent reliability when compared to a gold measure. This study validates the previous findings of Ogueta-Alday et. al. (2013).

Word Count: 517

References

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