An Investigation of the Ability of Wearable Technology to Aid Physiotherapists in Assessing Jump-Landing Movement Compared to Video Recording

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Purpose:

- Functional movement assessment is essential in screening individuals for risk of injury and planning physiotherapy (Fox et al. 2017). The Landing Error Scoring System (LESS) is a valid and reliable paper-based tool used in assessing the risk of knee injury, which requires evaluating multiple joints across two planes using two video cameras, whilst participants land from a jump. The LESS involves of 17 items concern detecting any faulty movements (errors), then counting these errors as an overall score of the LESS (Padua et al. 2009).
- This is seldom used in physiotherapy clinics and sport fields because of the space required to place cameras, lack of obtaining related clinical movement outcomes objectively, and the privacy of the subjects.
- Wearable sensors which quantify accurate clinical movement outcomes and generate a 3D avatar recording could be a potential tool for movement analysis in physiotherapy (Al-Amri et al. 2018).
- The aim of this work was compare avatar to video recording in assessing jump-landing movements.

Method:

- Eighteen healthy subjects (age: 28.11±3.34 years; height: 170±7.58 cm; and mass: 72.01±17.27 Kg) performed jump-landing movements under two conditions.
- The first condition was at their comfortable normal technique; whilst the second involved compensation by landing with knee valgus.
- Two video cameras and 17 wearable sensors placed on the upper and lower body were used to capture the movements.
- The video and avatar recordings were given a unique name (three digits number) and then two raters scored the LESS without knowing which recording belongs to the other.
- The Intraclass correlation coefficient (ICC) and Bland and Altman plots were used.

Wearable sensors can provide not only 3D avatar recording but also objective comprehensive kinematic information. Together can aid clinicians in assessing complex movements in order to make a decision and personalise physiotherapy programmes.

Result:

- The validity of avatar recording against video recording for rater 1 showed moderate to strong validity (ICC= 0.47 and 0.76) for both normal and compensate jump-landing movement, respectively. Whiles rater 2 showed moderate to fair validity (ICC= 0.42 and 0.29) for both the normal and compensate jump-landing movement, respectively.
- All Bland and Altman plots showed that the overall scores are scattered around the mean within 95% limit of agreement.

Conclusion:

- The results indicate that avatar recording is comparable to video recording in assessing individual's movement like jump-landing. However, it seems that both raters scored LESS more accurate using avatar recoding than video recording during the compensate movement. Together this suggests that avatar recording could be a promising tool to be used in assessing jump-landing movement.

References:

Al-Amri, M. et al. 2018. Inertial measurement units for clinical movement analysis: reliability and concurrent validity. Sensors 18(3), p. 719. Available at: http://www.mdpi.com/1424-8220/18/3/719.

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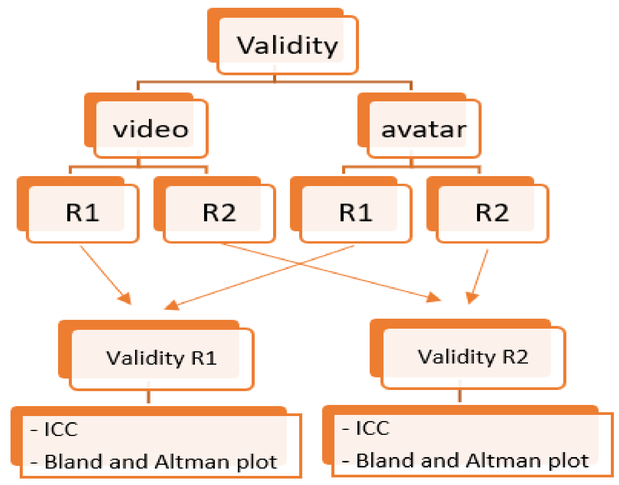
Padua, D.A. et al. 2009. The landing error scoring system (LESS) is a valid and reliable clinical assessment tool of jump-landing biomechanics: The jump-ACL Study. American Journal of Sports Medicine 37(10), pp. 1996–2002. doi: 10.1177/0363546509343200.

Flow chart of the statistical analysis of the validity the avatar recording.



Key: R1= rater 1, R2= rater 2, ICC= Intraclass correlation coefficient

Descriptive data of the overall score of the LESS

Rater	Recording	Mean	Minimum	Maximum	SD
Normal jump-landing movement					
R1	Avatar	4.89	2	9	1.74
	Video	3.61	1	8	1.85
R2	Avatar	5.11	3	9	1.36
	Video	5.17	2	8	1.65
Compensate jump-landing movement					
R1	Avatar	6.39	3	10	1.91
	Video	4.89	3	8	1.77
R2	Avatar	6.22	4	9	1.11
	Video	5.28	2	11	2.21

Key: R1= rater 1, R2= rater 2, and SD= standard deviation.

Images **A** and **B** show the video recording of the normal jump-landing movement, where Images **A** represents the sagittal view and Images **B** represents the frontal view.

Images A

Images B

Images **C** and **D** shows the avatar recording of the normal jump-landing movement, where Images **C** represent the frontal view and Images **D** represents the sagittal view.

Images C

Images D