Development and validation of an immersive virtual reality-based version of the Box and Block Test to assess post-stroke manual dexterity.

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Abstract

Objective: To develop and validate an immersive virtual reality-based version of the Box and Block Test (BBT-VR) to assess the manual dexterity and the hand kinematic among patients with stroke, using the Oculus Quest headset and controllers.

Methods: A sample of 23 healthy subjects and 22 patients with stroke were recruited from two different hospitals. Participants were asked to perform the classical Box and Block Test (BBT) and BBT-VR three times with both hands. Concurrent validity was assessed through correlations between these two tests and reliability of the BBT-VR through correlation on test-retest. Usability of the BBT-VR was also evaluated with the *System Usability Scale* (SUS). Difference of hand kinematic data extracted from the BBT-VR such as velocity and smoothness (SPARC) were assessed between healthy subjects and patients with stroke.

Results: Results showed strong correlations between the BBT (62.6 ± 20.72) and the BBT-VR (44.3 ± 20.8) ($r=0.816$; $p<0.001$). Reliability on test-rest were considered as excellent (ICC >0.8; $p<0.001$) and mean usability score according to the SUS was of 78.7 ± 12.34% corresponding to an almost excellent usability rating. Healthy subjects demonstrated significantly higher mean velocity (+0.07 m/s), peak velocity (+0.205 m/s) and SPARC (+1.668) than patients with stroke.

Discussion - Conclusion: The BBT-VR seems to be a usable, valid and reliable test to measure manual dexterity. Virtual reality equipments are now affordable. The BBT-VR would then allow to assess manual dexterity throughout the rehabilitation process from rehabilitation center to patient's home integrating a telemedicine program. The BBT-VR would also allow following recommendation of including kinematic assessments.

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