

Abstract: Poster Presentation

ID:046_P

The clinical utility of a three-dimensional motion analyzer that can be operated using two portable devices

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Introduction Verification of the movements of the target patient is essential for physiotherapy. However, specialized equipment is costly and requires facilities. The openCAP enables simple 3D motion analysis using two portable devices. However, it is still being determined whether OpenCAP has sufficient precision for the analysis conducted by physiotherapists. Therefore, this study verified the potential of OpenCAP by targeting joint movements while standing up.

Methods OpenCAP is an open-source software developed at Stanford University and released in 2022, allowing two portable devices to verify operation. It can be measured by installing dedicated software on portable devices and synchronizing them. The measurement can be taken at 60 Hz for a maximum of 30 seconds, and the analysis is sent to Stanford's server via the Web, with the results returned within 5 minutes. An iPhone and an iPad (iOS 16.4.1), were used for functional testing. Both devices were set up so that the subject's entire body was visible, and the software-defined calibration was performed. The experiment was conducted on one subject. Standing movements were initiated and completed in the sitting position. The left and right hip, knee and ankle joints were compared between the subject wearing shoes and the barefoot subject. The video frame rate was 60 Hz.

Results The joints that could be measured with OpenCAP were the trunk and pelvis, the shoulder, elbow, and wrist joints of the upper limb, and the hip, knee, and ankle joints of the lower limb. In terms of joint movements during the sit-to-stand movement, there were no differences in the angles of the shoulder, elbow, and hip joints between right and left for any movement. For the trunk, pelvis, and knee joints, a difference of about 5 degrees was observed when the subjects maintained a stationary posture in the sitting position. However, there were almost no left-right differences in flexion and extension during movement. Ankle and wrist joints showed a left-right difference of approximately 15 degrees.

Discussion The results revealed that the OpenCAP has sufficient functionality for measuring shoulder, elbow, trunk, pelvis, hip, and knee joint motion. Ideally, it can be used in hospitals and gymnasiums where a space of 4m squares can be secured. As only one person can be analyzed and the movements of caregivers and others cannot be measured, the OpenCAP could be a valuable instrument for measuring movement changes such as sports movements and nervous system disorders.

Keywords motion analysis, portable devices, OpenCAP, kinematics