

Upper limb reachable workspace using Kinect in hemiplegic patients after structural brain lesions

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Purpose

A novel upper extremity 3-dimensional reachable workspace using Kinect sensor was introduced as a upper extremity outcome measure that demonstrates clinically meaningfulness in neuromuscular diseases and musculoskeletal conditions. The patients with hemiplegia Resulting from stroke or other structural brain lesion had shown unilateral upper extremity impairment. In this study, we examined the Kinect-based reachable workspace analysis in hemiplegic patients and investigated its usefulness.

Methods

Fifteen patients (age 58.9±16.9 years, 7 men, 8 women) with hemiplegia after structural brain lesions (8 hemorrhagic stroke, 5 ischemic stroke, 1 brain tumor, 1 neuromyelitis optica) were included. Upper extremity active range of motion was captured by the Kinect sensor, and relative surface area (RSA) was obtained. Upper extremity impairment was measured by the upper extremity motor subscale of the Fugl-Meyer Assessment and the Motricity Index arm subscale in affected side. Disability was assessed by the shortened Disabilities of the Arm, Shoulder and Hand questionnaire (QuickDASH) and the Korean version of Modified Barthel Index (K-MBI). Correlations between RSAs, impairment and disability scores were analyzed.

Results

The Mean total RSA of the affected side was significantly reduced compared to the unaffected side (0.615±0.230 vs. 0.746±0.091, p=0.001). With quadrant RSA, quadrant 1 (upper medial) and quadrant 3 (upper lateral) RSAs were apparently reduced (0.138±0.075 vs. 0.186±0.053, p=0.004; 0.170±0.081 vs. 0.232±0.017, p=0.011). The total RSA of the affected side was significantly correlated with the upper extremity motor subscale of the Fugl-Meyer Assessment (r=0.795, p=0.001) and the Motricity Index arm subscale (r=0.665, p=0.013). Also, the total RSA was correlated with QuickDASH score (r=-0.758, p=0.001) and K-MBI (r=0.665, p=0.013). Further, quadrant 1, quadrant 3, quadrant 4 (lower lateral) RSAs were correlated with the upper extremity motor subscale of the Fugl-Meyer Assessment, the Motricity Index arm subscale, K-MBI and QuickDASH score.

Conclusion

This study demonstrates that a Kinect-based reachable workspace could be a potential outcome measure for evaluating upper extremity impairment and disability in hemiplegic patients.

Keywords

Kinect; reachable workspace; upper extremity; disability; stroke; brain