Spasticity index as an indicator of motor impairment and motor function of upper extremity in chronic stroke survivors

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Objectives: spasticity is often diffuse and systemic and is present in up to 95% of chronic stroke survivors with moderate to severe motor impairments. Furthermore, spasticity is closely associated with synergistic movements and disordered motor control. A spasticity index is created to represent the overall severity of a limb. In this study, we hypothesized that spasticity index of the upper extremity is correlated with motor impairment and motor function of the upper extremity in chronic stroke.

Design: Eleven chronic stroke survivors (6 males, 5 females, mean = 52.9 years old) with spastic hemiplegia participated in this study. Spasticity of shoulder, elbow, wrist, thumb and fingers were assessed using modified Ashworth scale (MAS). Spasticity index was the sum of worst MAS scores of each joint across shoulder, elbow, wrist and finger or thumb. Fugl-Meyer assessment (FMA) and Action research arm test (ARAT) were performed to assess motor impairment and motor function of the upper extremity (UE), respectively. These tests were performed at the baseline and 5~6 weeks after botulinum toxin (BoNT) injections.

Results: At the baseline, there was nearly perfect correlation (r=0.98) between FMA_UE and ARAT across 11 subjects. Spasticity index was highly correlated with both FMA_UE (r=0.81) and ARAT (r=0.80) ($p<0.05$). But both FMA_UE and ARAT had non-significant correlation with MAS scores of individual joints. At the follow-up visit for those who received BoNT injections (n=7), spasticity index was significantly decreased (9.0 vs. 7.9, $p<0.05$), however, there was no change in FMA_UE (29.3 vs. 30.1, $p>0.1$), and in ARAT (17.3 vs. 17.7, $p>0.1$). These findings are consistent with the literature that spasticity reduction does not improve motor impairment or motor function.

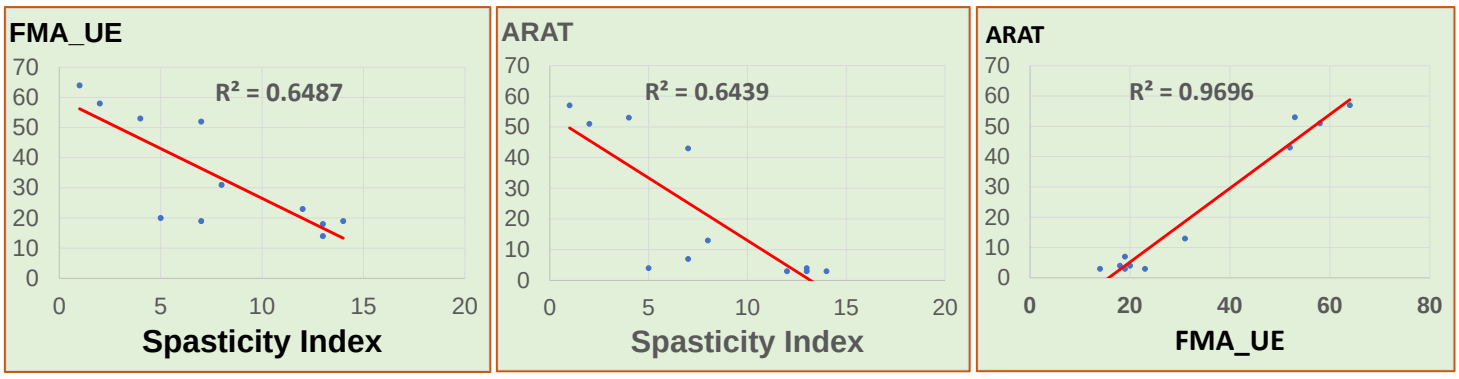

Figure 1 Correlations between FMA_UE and Spasticity Index, ARAT and Spasticity Index, and between ARAT and FMA_UE. MAS scores (1, 1+, 2, 3, 4) were converted to 1, 2, 3, 4, 5 to calculate spasticity index.

Concluding remarks: These preliminary findings demonstrated high correlations between spasticity index and motor impairment (FMA) and motor function (ARAT). The results suggest that spasticity index is a potentially useful parameter to represent the overall severity of spasticity in the upper extremity.