

Spastic cocontraction, spasticity and impairment of motor function during active elbow extension in adults with hemiparesis.

Alexandre Chalard, David Amarantini, Joseph Tisseyre, Philippe Marque, Jessica Tallet, David Gasq.

ToNIC, Toulouse NeuroImaging Center, Université de Toulouse, Inserm, UPS, France.

Introduction. Muscle overactivity, including spasticity and spastic cocontraction, is an involuntary motor unit recruitment participating in the spastic paresis syndrome after cerebral injury such as stroke. Spasticity is defined as velocity-dependent increase in tonic stretch reflexes. Spastic cocontraction (SCC), as assessed by muscle cocontraction, refers to increased antagonist muscles recruitment triggered by the volitional command of agonist muscles in the absence of phasic stretch. It is yet to thoroughly understand the link between spasticity and SCC, and the impact of SCC on motor function in adults with acquired hemiparesis has been only sparsely and indirectly studied to date. This study aimed at i) to clarifying the link between spasticity and SCC in adults with acquired hemiparesis, and ii) to studying the contribution of spasticity and SCC of elbow flexors to the limitation of active elbow extension.

Matériel et Méthodes. Ten adults with acquired hemiparesis and ten healthy participants performed active elbow extensions at spontaneous speed, followed by elbow isometric extension contractions at 25% and 60% of their maximal voluntary contraction. Surface EMG from elbow flexors and extensors was used to compute the index of cocontraction (ICC) on the paretic limb in hemiparetic patients and on the dominant side in control participants. Spasticity with Tardieu scale, limitation of active elbow extension, and upper extremity Fugl-Meyer Assessment (FMA-UE) score were obtained in hemiparetic participants. Non-parametric Spearman correlations were performed to investigate the relationship between ICC and i) limitation of active elbow extension, ii) elbow flexors spasticity and iii) FMA-UE.

Résultats. Our results showed significant greater cocontraction in three hemiparetic patients compared with controls, and significant associations between cocontraction and i) active elbow extension limitation ($r_s = 0.81$, $p < 0.001$) and iii) Fugl-Meyer Assessment score ($r_s = -0.53$, $p = 0.017$) in hemiparetic patients. No significant correlation was found between spasticity and active elbow extension limitation.

Discussion et Conclusion. Our results showed the absence of correlation between spasticity and active elbow extension, but a significant association between cocontraction and active elbow extension. These findings allow to conclude that spasticity is an inappropriate marker of muscular overactivity during active movement in hemiparetic patients. Our results are the first to show that SCC directly contributes to elbow extension deficit in adults with acquired hemiparesis, and further confirm that spasticity and SCC have different functional repercussions and different underlying mechanisms with regards to impaired motor function. Our results showed a significant negative association between cocontraction and FMA-UE, with a moderate r_s value of -0.53 . This result highlights that impaired motor selectivity is one of the mechanisms leading to greater SCC, detrimental to active motricity. Conclusion : Our findings support the conclusion that spastic cocontraction, rather than spasticity, has significant functional repercussions on impaired active motor function in hemiparetic adults. Therapeutic innovations should be directed toward reduction of spastic cocontraction to improve motor function in acquired hemiparesis.

Déclaration d'intérêt. Les auteurs ne déclarent aucun conflit d'intérêt.