CHARACTERIZING SPASTICITY REDUCTION AFTER BOTULINUM TOXIN INJECTION WITH PORTABLE IN-CLINIC TOOL USING WEARABLE SENSORS AND MACHINE LEARNING

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INTRODUCTION: Despite the prevalence of spasticity and its management, there are few tools that can be used in clinic to quantitatively characterize it. Wearable sensors can acquire precise measurements of movement and surface electromyography (sEMG), suggesting a potential solution. We developed a tool that acquires both wearable sensor and video data with a smartphone, and show that fusing these complementary modalities enables quick and accurate kinematic measurements with sEMG from spastic muscles.

OBJECTIVE: To describe a tool for quantitative characterization of spastic kinematics and sEMG that can be used in clinic.

METHOD: Custom wearable sensors acquire 2-channels of sEMG and movement data and stream this to a smartphone recording synchronized video. Video analysis provides an initial estimate of joint kinematics, which is refined with the sensors. Participants receiving elbow flexor chemodenervation were assessed with the tool on the day of injection and a month later. Sensors were placed on the arm and forearm with electrodes over the biceps and triceps.

RESULTS: The tool captures biomechanics without explicit calibration. The high temporal resolution from the sensors captures the peak velocities and detects catch angles, as well as distinguishing harder and softer catches, and measuring phasic increases in sEMG. The system detects improvements following botulinum toxin injection including increased range of motion, greater catch angles, and catches becoming softer. These correlated with clinical measures while enabling richer characterization.

SUMMARY/CONCLUSION: A smartphone based tool using wearable sensor and artificial intelligence-powered computer vision allows quick and easy quantitative characterization of spasticity and is sensitive enough to detect changes following botulinum toxin injections.