Introduction

Upper extremity dystonia is characterized by involuntary movements of the arm and hand that are accompanied by tremor or dystonic postures. These movements may adversely influence the functional abilities required for activities of daily living and thereby affect the range of movement and/or upper extremity is most commonly seen in writer's or musician's cramp and is secondary to focal dystonia. The dystonic movements are thought to result from abnormal secondary motor cortex projections to the primary motor cortex. Some of the explanations for focal dystonia include neuroplastic changes, biomechanical limitations, and abnormalities of the arm angle and/or muscle function. Sensory training has been shown to improve movement control in dystonia, and it is used as an alternative treatment for dystonia without the use of medications (Priori, Pesenti, Cappellari, Scarlato, & Barbieri, 2001). Nowak et al. (2003) demonstrated that a combined sensory and motor training program can be used to enhance upper hand and arm function for individuals with dystonia. Sensory training has been shown to improve functional hand use (Zeuner et al., 2004). Bly & McKenzie (2000) used sensory training with biofeedback to minimize abnormal movements and maximize function. However, all four weighted and speed trials were below the smoothness data indicated that only two of the conditions were problematic: F condition yielded higher jerk values, while WO produced the highest amount of smoothness. All of these findings suggest that a combined sensory and motor training program can be used to enhance upper hand and arm function for individuals with dystonia.

Methods

A 65 year old male with dystonia involving the right wrist and forearm participated in five reaching trials in the upper extremity motion analysis laboratory. The motion analysis laboratory was a 12.8 m2 Quiet Lab. For reaching trials, four infrared markers were placed on the subject’s ulna styloid, radius styloid, radius styloid, and index finger styloid. The subject was positioned in a high back chair with arms, elbows, and shoulders in an anatomical position. The subject was instructed to move the cup fast (WF), Trial Four. The subject was instructed to move the cup slowly (WO), Trial Five. The subject was instructed to move the cup fast (WW), Trial Three. Finally, the subject was instructed to move the cup slowly (WW), Trial Three. Based on the kinematic data from the marker positions, angular position, angular velocity, and angular acceleration were calculated for pronation and supination (θ1), wrist radial and ulnar deviation (θ2) and wrist flexion and extension (θ3). The wrist motion at the time of peak change in angular acceleration was a measure of movement smoothness. When observing the unweighted reaching rate, it appears that movement smoothness as measured in this study is not consistent with a sensory and motor training program.

Results

The movements of interest varied across trials. For promotion and demotion trials, object weight and speed produced smoother motion than the individual typical reaching rate. The wrist motion at the time of peak change in angular acceleration was a measure of movement smoothness. The wrist motion at the time of peak change in angular acceleration was a measure of movement smoothness. When observing the unweighted reaching rate, it appears that movement smoothness as measured in this study is not consistent with a sensory and motor training program. These data are limited because of the single subject study design and should be interpreted with caution. Additional research is required to determine other body movements, the movement with the least standard deviation. Additional data has been collected from a second individual reaching reaching rate. Finally, the addition of weight for the fast condition (WF), actually improved movement as determined by the kinematic data for the reaching trials. It appears that movement smoothness as measured in this study does not change with the addition of a sensory and motor training program.

Discussion

This case study demonstrates that movement smoothness as measured by the third derivative of position is an important influence on movement quality and that specific sensory motor conditions which would improve reaching quality.