Quantitative Assessment of Pediatric Hand Function Using Touchscreen Technology

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The role touchscreen technology plays in our society has increased in recent years. Currently established objective assessments of upper extremity function, such as the Jebsen-Taylor Hand Function Test¹ and the Functional Dexterity Test, ² were designed long before touchscreens became ubiquitous.

The purpose of this project was to develop a novel hand-function test using touchscreen technology and then test its validity in children with neuromuscular and congenital problems as well as those with normal hand function. The goal was to create a valid clinical tool for evaluating upper-extremity function.

Methods
The test was developed on the Apple iOS platform using an Apple iPhone 4. We designed four different tasks that are believed to be representative of ability to use a touchscreen. These included touching dots on a 3x4 grid, dragging shapes, using the camera and texting using the onscreen keyboard. The test was designed to take between 60 and 120 seconds, with each patient performing a pre-test in order to become familiar with the tasks. Each section was timed independently, and an overall time was recorded.

A total of 161 patients were included in our study. Their ages ranged from 3 to 25 years. Patients younger than 9 years of age were not asked to complete the texting portion of our test, and those with less than 6 months of touchscreen experience were excluded. Demographic information collected included the patient’s age, gender, years of experience with touchscreens, dominant hand and diagnosis.

Results
Patients were classified as having either normal (n = 87) or impaired (n = 74) hand function based on assessment by a pediatric orthopedic hand specialist. The group with impaired hand function was comprised exclusively of patients with neuromuscular and congenital problems. Each patient was placed into one of seven age groups (3 to 4 years, 5 to 6 years, 7 to 8 years, 9 to 10 years, 11 to 12 years, 13 to 14 years, and 15 years and older). No gender or dominant-hand differences were observed. In patients without impaired hand function, completion time decreased with increasing age. When the test times of patients with neuromuscular and congenital deficiencies were compared with those of patients with normal upper extremity function, T-test showed a statistically significant increase in completion time (P<0.05) in four of the seven age groups tested.

Conclusion
These data show that our test potentially discriminates between age-matched patients with normal hand function and those with impaired hand function caused by neuromuscular and congenital abnormalities such as brachial plexopathies and syndactyly. Expansion of sample size is likely necessary to achieve statistical significance within the age groups that did not demonstrate it in our study. In addition to evaluating for the differences between patients with and without upper extremity impairments, we believe our test could serve as a reliable and standardized method to assess recovery in patients after major upper extremity surgery. Our upper extremity test using touchscreen technology is novel and relevant to the way many people interact with their environments, and it allows for a valid unbiased quantification of upper extremity function.

REFERENCES