SCIENTIFIC ARTICLE

The Effect of Treatment on Stereognosis in Children With Hemiplegic Cerebral Palsy

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Purpose To determine if rehabilitation alone or combined with surgery or botulinum toxin injection improved stereognosis in children with hemiplegic cerebral palsy.

Methods Inclusion criteria were children with spastic hemiplegic cerebral palsy who had stereognosis testing 2 separate times with documentation of intervening treatment. Sixty-three children were included, 30 girls and 33 boys at an average age of 9.1 years (range, 4.4−16.0 years). Twelve standardized objects were used for manual identification. Baseline and postintervention stereognosis results were recorded for the hemiplegic and the dominant limb of each patient. The patients were separated into 3 groups based on intervening treatment: surgery with rehabilitation (27 patients), botulinum toxin injection with rehabilitation (19 subjects), and rehabilitation alone (7 subjects). Results were also analyzed by patient age group.

Results Baseline testing of the hemiplegic limb revealed that 27 patients (43%) exhibited severe stereognosis impairment (0−4 objects identified correctly), 18 (28%) were moderately impaired (5−8 objects), 13 (21%) were mildly impaired (9−11 objects), and 5 (8%) had intact stereognosis (12 objects). There was no statistically significant difference in change in stereognosis scores postintervention among the 3 different treatment groups or between patients who had surgery and those who did not have surgery. There was no statistically significant difference in stereognosis function or postintervention change based on patient age at time of testing.

Conclusions In this study, 92% of children with spastic hemiplegic cerebral palsy had stereognosis impairment with a wide spectrum of severity. After operative or nonoperative treatment interventions, stereognosis as a secondary outcome measure was not changed. *(J Hand Surg Am. 2016;41(1):91−96. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic III.

Key words Cerebral palsy, hand, pediatric, stereognosis.

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By definition, children diagnosed with cerebral palsy (CP) present with disorders of movement and balance.[1] In addition to the motor skills deficiencies that are inherent to the disorder, 46% to 97% of children with spastic hemiplegic CP also have a high prevalence of sensory deficits.[2−4] A correlation has been established between more profound motor dysfunction and greater sensory impairments.[5]

Controversy has existed as to the role of sensory status of the hand in surgical reconstruction for CP. Recent reports suggest that sensory status of the hand may actually be improved after surgery. Dahlin and colleagues[6] found a significant improvement in

stereognosis at 6 and 18 months after surgery in their study of 38 patients with spastic hemiplegic CP who underwent surgical reconstruction of the affected limb with various procedures. This is in contrast to authors who had previously reported no change in the sensation of the hand after reconstructive surgery.[7–11] Auld and colleagues[12] recently performed a systematic review of the literature and found 5 previous studies in the English language that evaluated the change in tactile function after intervention in children with CP. These did not show any significant change in tactile function after intervention.

The purpose of this study was to verify or refute previously published reports regarding the effect of treatment interventions on stereognosis function in the hemiplegic hand. We report on the changes in sensory function, as measured by stereognosis testing in children with hemiplegic CP after intervention with therapy alone or with botulinum toxin injections or surgical reconstruction. Our null hypothesis was that interventions aimed to improve hand and wrist position would not improve stereognosis.

MATERIALS AND METHODS

Inclusion criteria for this study were age 4 to 16 years, diagnosis of spastic hemiplegia due to CP, documentation of 2 valid stereognosis tests at different times, and documentation of treatment occurring between the 2 tests. Exclusion criteria consisted of spastic hemiplegia due to any other cause, athetoid type of CP, inability to comply with stereognosis testing for any reason, and insufficient data regarding nature of the intervention.

Two data sets were combined for this study. The first data set was collected on children with stereognosis testing data from 2 separate evaluations at least 1 year apart from Shriners Hospital for Children—Twin Cities, Minnesota. Thirty-three children were assessed with an average time between the 2 tests of 41 months (range, 2–118 months). The second data set was part of a multicenter randomized trial that compared tendon transfer surgery in upper extremity CP to botulinum toxin injections and regular ongoing therapy.[13] In the second data set, each child was assessed with stereognosis testing upon entry in the study and 12 months later at completion of the study. Thirty children were assessed with an average time between the 2 tests of 12 months. Institutional review board approval was obtained for each study population.

The senior author for this paper (A.V.H.) was the principal investigator in the multicenter study and was the treating physician for the single institution data set; thus, treatment protocols for rehabilitation, botulinum toxin injections, surgical techniques, and stereognosis testing protocols were the same for both data sets. These 2 data sets were combined to achieve adequate power for statistical analysis of differences between the treatment groups

Sixty-three children met inclusion criteria including 30 girls and 33 boys with an average age of 9.1 years (range, 4.4–16.0 years) at the time of initial testing. Spastic hemiplegia affected the left side in 26 children and the right side in 37 children. All children received rehabilitation services. The patients were separated into 3 groups for data analysis, surgery with rehabilitation (n = 27), botulinum toxin injection with rehabilitation (n = 19), and rehabilitation alone (n = 17). Children in the surgical treatment group underwent an average of 3.5 concomitant procedures, as listed in Table 1.

Children in the botulinum toxin treatment group underwent 1 to 3 injections into the biceps (3 children), pronator teres (16), flexor carpi ulnaris (17), and thumb adductor (14) muscles. Dosing was 1 to 2 units/kg each in the biceps, pronator teres, and flexor carpi ulnaris and 0.5 to 1.0 units/kg in the thumb adductor. Each 100-unit injection was diluted in 1 mL of normal saline; placement was verified by electrical stimulation.

All children underwent stereognosis testing of both the affected and the unaffected upper limbs as described previously.[5] The test used 12 objects (block, pencil, spoon, paper clip, safety pin, penny, button, pill, glove, string, marble, key). The 12 objects were shown to the child to verify that he or she had the verbal skills to name the objects. Each object was then placed separately into the child's hand behind a screen. The child was asked to name the object, and correct scores were summed and recorded.

The average change in stereognosis between the 2 test dates was recorded for both affected and unaffected upper extremities in all patients and compared among the 3 treatment groups. Results were also analyzed with the 3 groups collapsed into 2: patients treated surgically (surgery group) and patients treated nonsurgically (botulinum toxin and rehabilitation groups).

In order to determine the effect of age on the ability to succeed at the test, patients were separated into 3 groups: those younger than 7 years of age at initial test (group 1; n = 16), ages 7 to 11 (group 2; n = 33), and those older than 11 (group 3; n = 14). Mean change in stereognosis for each group was recorded and compared for significance. We defined a clinically significant change in stereognosis as an improvement