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# Evaluation of the Upper Extremity in Patients with Hemiparesis Type Cerebral Palsy

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## Tendon transfer surgery in upper-extremity cerebral palsy is more effective than botulinum toxin injections or regular, ongoing therapy

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Affiliations + expand

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### Abstract

**Background:** For children with upper-extremity cerebral palsy (CP) who meet standard indications for tendon transfer surgery, we hypothesized that surgical treatment would result in greater functional improvement than treatment with botulinum toxin injections or regular, ongoing therapy.

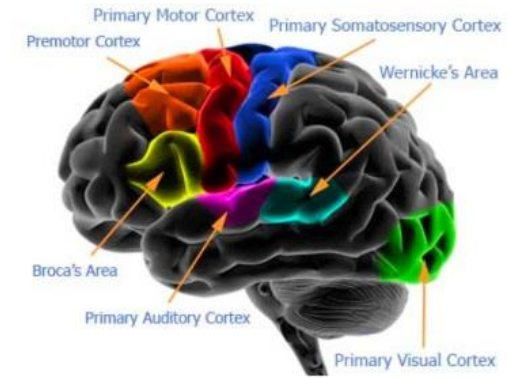
**Methods:** Thirty-nine children with upper-extremity CP, who were four to sixteen years of age and surgical candidates for the transfer of the flexor carpi ulnaris to the extensor carpi radialis brevis, pronator teres release, and extensor pollicis longus rerouting with adductor pollicis release, were prospectively assigned, either randomly (twenty-nine patients) or by patient/family preference (ten patients), to one of three treatment groups: surgical treatment (Group 1); botulinum toxin injections (Group 2); or regular, ongoing therapy (Group 3). Seven centers participated. Assessment measurements included active range of motion, pinch and grip strength, stereognosis, and scores as measured with eight additional functional or patient-oriented outcome instruments. Thirty-four patients (twenty-five randomized and nine from the patient-preference arm) were evaluated twelve months post-treatment as the study cohort.

**Results:** For the primary outcome of the Shriners Hospital Upper Extremity Evaluation (SHUEE) dynamic positional analysis (DPA), significantly greater improvement was seen in Group 1 than in the other two groups ( $p < 0.001$ ). Improvements in SHUEE DPA reflected improved supination and wrist extension during functional activities after surgical treatment. Group 1 showed more improvement in the Pediatric Quality of Life Inventory (PedsQL) CP module domain of movement and in the Canadian Occupational Performance Measure (COPM) score for satisfaction than Groups 2 and 3. Both Groups 1 and 3 showed more improvement in pinch strength than did Group 2.

20 years studying children with CP hemiplegia

- botox in the upper extremity
- tendon transfer and muscle release surgery
- rehabilitation – stretching and splinting

# Cerebral Palsy



*Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitations, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. Rosenbaum*

- Occurs 1 in 323 live births
- Spastic Cerebral Palsy is the most common type – 35% of the cases
- Severity can range from mild to moderate

Rosenbaum P, Paneth N, Leviton A. A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol.* 2007;49(Suppl 109):8-14.

<https://www.cdc.gov/ncbddd/cp/facts.html>

# Spastic Hemiplegic Cerebral Palsy

The affected side reflects the imbalance of muscle forces with predictable patterns of spasticity and weakness.



# Initial Assessment

- Make the session playful: two handed interesting toys
- Interview the parent while observing the child play
- Observe the child's arm and hand positions at rest and during active use
- Learn their therapy and orthotic history
- Understand the parent/child's specific goals for therapy



# Muscle Tone Assessment

Spasticity of the muscle can be detected by performing the passive opposite movement and feeling the abnormal contraction of the muscle

## Ashworth Scale of Spasticity

0 = No increase in muscle tone

1 = Slight increase in muscle tone

2 = Increase in tone through most of range  
but the part is easily moved

3 = Considerable increase in tone, passive  
movement is difficult

4 = Affected part is rigid in flexion or extension

Common spastic muscles in CP hemiplegia include:

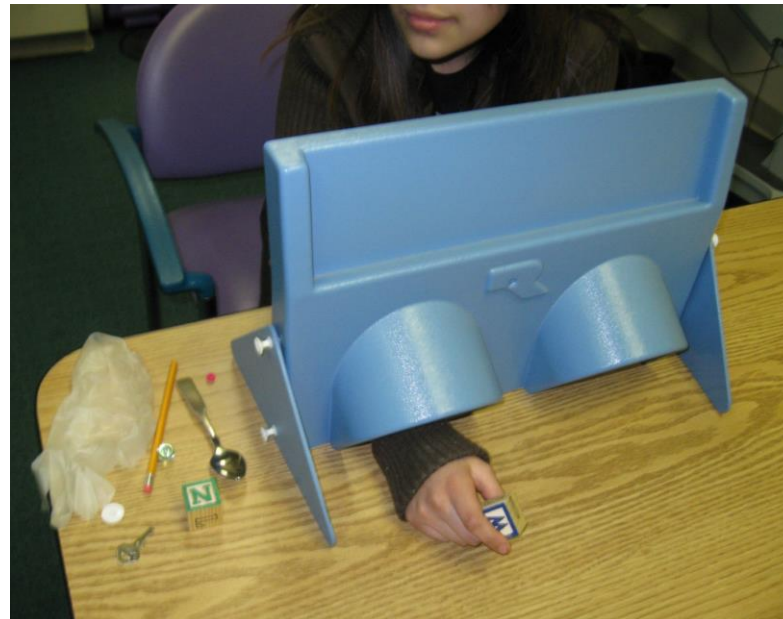
Biceps, Pronator Teres, FCU, Adductor Pollicus

## Stereognosis Testing: The Tactile Recognition in Identifying Objects Placed within the Hand

- **Tizard in 1954** was the first investigator to point out that children (50%) with hemiplegic cerebral palsy have concomitant sensory deficits.
- **Van Heest Study:** Stereognosis was found to be the most sensitive discriminator of the degree of sensory impairment

Child is given 12 objects and asked to name each with vision occluded

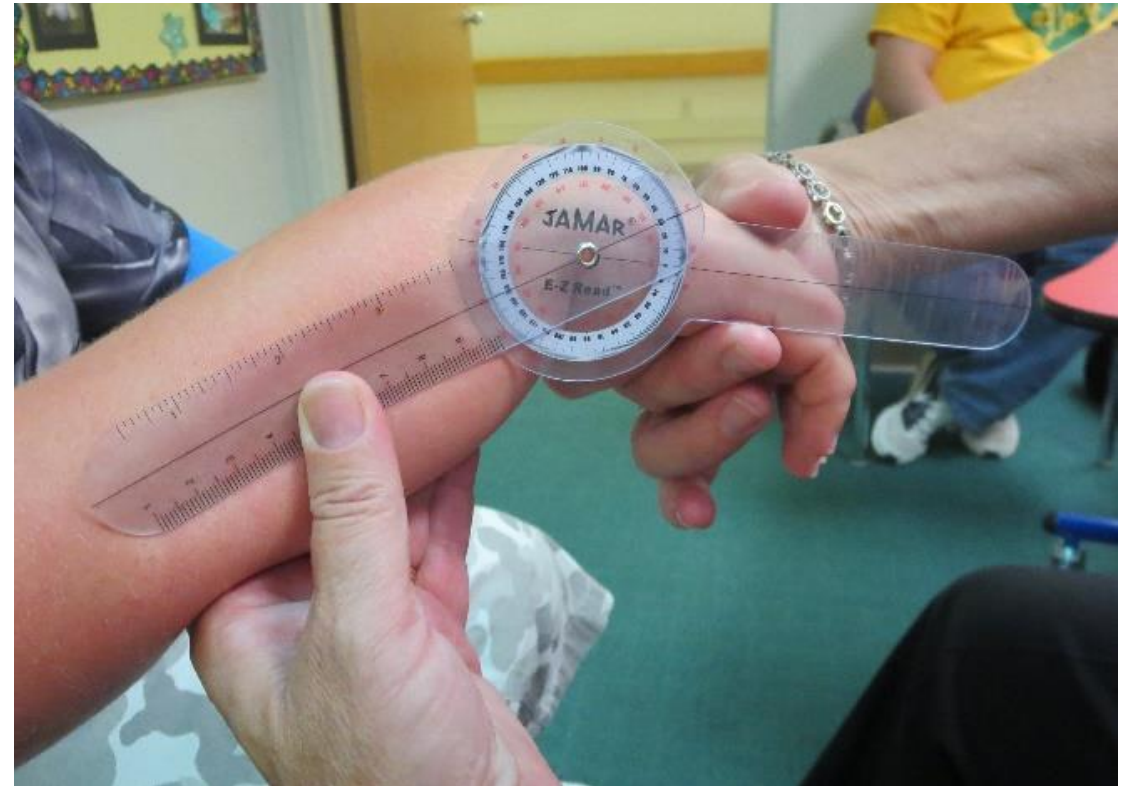
Safety pin	Block
Bead	Key
Glove	Penny
Spoon	Pencil
Paper clip	Marble
Button	String





# Range of Motion Testing

- Shoulder flexion and external rotation
- Elbow extension
- Forearm supination
- Wrist extension and radial deviation
- Wrist/finger extension
- Thumb abduction



# Grip Strength Testing

- Squeeze the two handles together as hard as possible
- Average of 3 separate maximum voluntary contractions

- Normative data
  - Mathiowetz – norms – ages 6-19
  - Lee Valkov – norms – ages 3-5



# Pinch Strength Testing

Measure two different grasp patterns

- 3 Point pinch
- Key/lateral pinch

Normative data

- Mathiowetz - ages 6 - 19
- Lee Valkov - ages 3-5



# Box and Blocks Test of Manual Dexterity

- Standardized to measure unilateral gross dexterity skills
- Norms
  - Jongbloed ages 3 - 10
  - Mathiowetz ages 6 – 19



- Test kit consists of a large wooden box with a center divider, with 200 2-inch blocks on one side.
- Child is asked to move blocks one at a time over the partition as quickly as possible
- Score is the number of blocks moved in 1 minute, for each hand

# Box and Blocks Test

- Dexterity in unaffected hands of children with CP hemiplegia as measured by the box and blocks test was statistically significantly less than published norms.
- Assessment of dexterity of the dominant hand may reveal opportunities for therapeutic intervention that improve fine motor function.

Tomhave, Van Heest, Bagley, James. Affected and contralateral hand strength and dexterity measures in children with hemiplegic cerebral palsy. *J Hand Surg Am.* May 2015; Vol 40, Issue 5: 900-907

## SCIENTIFIC ARTICLE

### Affected and Contralateral Hand Strength and Dexterity Measures in Children With Hemiplegic Cerebral Palsy

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**Purpose** To determine how the affected hemiplegic hand and contralateral dominant hand in children with hemiplegic cerebral palsy compare with age-matched norms for grip strength, pinch strength, and dexterity.

**Methods** We enrolled 37 children with hemiplegic cerebral palsy (26 boys; average age, 9.8 y). Grip and pinch strength and Box and Blocks Test for dexterity were measured in both hands. Affected and contralateral hands results were analyzed and compared with each other and with norms for age and sex.

**Results** Affected hands had significantly less grip and pinch strength than the contralateral hands. Subjects transported significantly fewer blocks in one minute with the Box and Blocks Test (mean, 10.8 blocks) with the affected hand than the contralateral hand. Compared with normative values, affected-side grip and pinch strengths were significantly less, whereas contralateral hand grip and pinch strengths were similar. Dexterity in both affected and contralateral hands was significantly less than normative values. Decreased dexterity in the contralateral hand was correlated with decreased nonverbal intelligence quotient.

**Conclusions** Dexterity of the contralateral hand is diminished in children with hemiplegia. Assessment of the contralateral hand may reveal opportunities for therapeutic intervention that improve fine motor function. (*J Hand Surg Am.* 2015; ■(■):■-■. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)

**Type of study/level of evidence** Therapeutic IV.

**Key words** Cerebral palsy, dexterity, hemiplegia.

**H**AND IMPAIRMENT IN CEREBRAL palsy is due to a nonprogressive disturbance of the developing fetal or infant central nervous system that affects movement and posture causing activity

limitations.<sup>1</sup> In hemiplegia, the central nervous system disturbance causes impairment on one side of the body. The degree of impairment of the contralateral limb is unclear because strength and dexterity have not been established. In spastic hemiplegia due to cerebral palsy, some have considered the affected hemiplegic hand to be an “assisting hand” and the contralateral hand a “good” and “unimpaired” hand.<sup>2-4</sup>

The affected assisting hand can present with a combination of spasticity, weakness, and dystonia.<sup>5,6</sup> The extent of limb involvement and the degree of abnormal tone patterns vary among individuals. Most commonly in spastic hemiplegia, the resting posture includes elbow flexion, forearm pronation, wrist ulnar deviation and flexion and thumb adduction and

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# Shriners Hospital Upper Extremity Evaluation: SHUEE

Video based evaluation: 16 bimanual tasks

Dynamic segmental alignment

Thumb (in palm/closed/open)

Fingers (flexion/neutral/extension)

Wrist (flex/neutral/ext) (ulnar/radial dev)

Forearm (extreme pro/pro/neutral/sup)

Elbow (extreme flexion/ flexion/extension)

Percentage score

addressograph

Shriners Hospital Upper Extremity Evaluation Page 2

Dynamic Positional Analysis (Place an X in appropriate observation)

Spontaneous Functional Analysis						Activity	Thumb Segment			Finger Segment			Wrist Segment			Forearm Segment				Elbow Segment				
							palm	close	open	flexion	neutral	extension	flexion	neutral	extension	extreme pronation	pronation	neutral	supination	extreme flexion	flexion	extension		
0	1	2	3	4	5	Money from wallet																		
0	1	2	3	4	5	Fold paper																		
0	1	2	3	4	5	Tear paper																		
0	1	2	3	4	5	String bead																		
0	1	2	3	4	5	Unscrew bottle cap																		
0	1	2	3	4	5	Pull playdough apart																		
0	1	2	3	4	5	Cut playdough with knife																		
						Throw large ball																		
						Accept coins/change																		
						Receive 5																		
						Take hand to mouth																		
						Touch opposite ear with palm																		
						Place sticker on ball																		
0	1	2	3	4	5	Put socks on																		
0	1	2	3	4	5	Fasten shoe																		
						Crawl																		

Functional Classification System

0 Does not use-Extremity not utilized in any capacity for completion of task.

1 Poor passive assist-Uses as stabilizing weight only

2 Passive assist-Can hold onto object placed in hand & may stabilize it for use by other hand

3 Poor active assist-can actively grasp object & hold it weakly

4 Active assist-Can actively grasp object, stabilize it well, & may manipulate it against other hand

5 Spontaneous use, partial to complete-Performs bimanual activities easily; may use hand spontaneously or without reference to other hand

Grasp / Release Analysis

Position	Grasp		Release	
Wrist Flexion	Y	N	Y	N
Wrist Neutral	Y	N	Y	N
Wrist Extended	Y	N	Y	N

Comments: (Web space, MCP instability)

# Shriners Hospital Upper Extremity Evaluation: SHUEE

- Hemiplegic Cerebral Palsy: Ages 3-18
- Administered in 15 minutes, scored in 30
- SHUEE assists in clinical decision-making
  - Therapy
  - Orthotics
  - Botox
  - Orthopedic Surgery

- Measures outcomes for research

- Available free of charge at:

[Shriners Hospital Upper Extremity Evaluation | RehabMeasures Database \(sralab.org\)](http://Shriners Hospital Upper Extremity Evaluation | RehabMeasures Database (sralab.org))

**SHUEE Scoring Form**

Patient Name \_\_\_\_\_ Patient # \_\_\_\_\_

Date	Initials	Spontaneous Functional Analysis					Dynamic Positional Analysis					Grasp / Release			
		Total Score		Percentage			Total Score		Percentage			Total Score	%		
		/ 45					/ 60					/ 6			
		/ 0	/ 1	/ 2	/ 3	/ 4	/ 5	Thumb	Finger	Wrist	Fore-arm	Elbow	Flex	Neut	Ext
								/ 12	/ 12	/ 12	/ 12	/ 12	/ 2	/ 2	/ 2

Comments, e.g. intervention & date, score changes, etc.

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# Assisting Hand Assessment

- Developed for children with hemiplegic cerebral palsy or obstetric brachial plexus palsy
- Semi-structured play session– videotaped and scored at a subsequent viewing
- Measures how effectively the affected hand and arm is used in bimanual performance.





# Assisting Hand Assessment

- The AHA test kit includes interesting toys that encourage bimanual hand use
- Three versions
  - Small Kids: 18 months to 5 years
  - School Kids: board game for children 6-12 years
  - Older kids: sandwich and present tasks 13-18
- 22 activities: 4 point rating scale
  - 4 = effective
  - 3 = somewhat effective
  - 2 = ineffective
  - 1 = does not do



# AHA

## 22 Activities:

- General usage (initiates, chooses AH when closer to objects)
- Arm use items (moves upper arm, moves forearm, reaches)
- Grasp – release (varies types of grasp, puts down, stabilizes, readjusts)
- Fine motor adjustments (calibrates, moves fingers)
- Coordination (orients objects, coordinates arms)
- Pace (proceeds, pace)

# AHA Summary

- Excellent functional assessment
- Breaks down a wide range of arm and hand skills
- 15 minutes to administer, 30 minutes to score
- Specialized training to become a certified rater



[AHA 18-18 – Handfast \(ahanetwork.se\)](http://ahanetwork.se)

# Rehabilitation

## Treatment: Promote Arm Flexibility

- Educate the family how to perform PROM
- Older children SROM
- Support above and below the joint, hold at end range
- To gain flexibility, therapists may use handling techniques:  
Joint mobilization, Joint compression/distraction, weight bearing, massage



# Rehabilitation

## Treatment: Strengthen Scapular Stabilizers

- To stabilize the scapula and stretch the tight muscles in the front of the shoulder
- Focus on activities to engage the shoulder girdle
  - Wheelbarrow walking and UE weight bearing
  - In supine, scapular protraction exercises
  - In sitting work on squeezing your shoulder blades together
  - Rolling over a bolster on extended arms to pick up objects
  - “Big ball war”
  - Side-sitting with UE weight bearing and reaching
  - Wall push ups

# Rehabilitation

## Treatment: Strengthen the Antagonists

- Elbow extension, forearm supination, wrist extension and thumb abduction
- Therapists select specific exercises based on patient assessment and skill level including AROM, isometric / resistive strengthening, therapeutic exercise and activities



# Rehabilitation

## Promote Bimanual Arm and Hand Use



# Promote Independence in Activities of Daily Living

## Loop Method for Shoe Tying





# Promote Fine Motor Activities



# School Activities: Handwriting

## Positioning:

- table height
- paper tilt

## Pencil grasp

- how they hold their pencil
- where the movement is occurring
- thumb web space, open arch
- letter formation



# Treatment: Rehabilitation Hand Splinting



# Splinting: Wrist Extension / Thumb Abduction



# Splinting: Elbow Extension / Supination / WHO



# Resources for Treating Children with Hemiplegic Cerebral Palsy

- Passive range of motion stretching
- Active range of motion strengthening
- Bimanual hand use activities
- Fine motor activities
- Grip strengthening
- Self dressing tips
- Shoe tying
- Handwriting



[wendytomhave.com](http://wendytomhave.com)

# Thank You for Your Attention!



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