



Shriners Hospitals
for Children™

Twin Cities

Pediatric Specialty Care

Orthopaedics

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Affected and Contralateral Hand Strength and Dexterity in Children with Hemiplegic Cerebral Palsy

Upper Extremity Cerebral Palsy (UECP)

Multi-Center Research Grant #9196

November 17, 2014

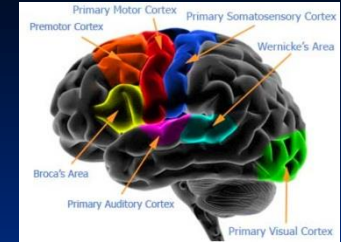
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Michelle James MD

Anita Bagley PhD

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 disturbance that occurred in the developing fetal or infant brain.

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

Hemiplegic Cerebral Palsy

- Hemiplegia is a type of CP that results from damage to one side of the brain that controls muscle movements.
- The paralysis occurs on the side of the body opposite the affected part of the brain.
- Accounts for 30-40% of CP cases
Second in frequency only to diplegia among preterm infants
(Hagberg et al. 1996)



Hemiplegic Cerebral Palsy

Shoulder: adducted

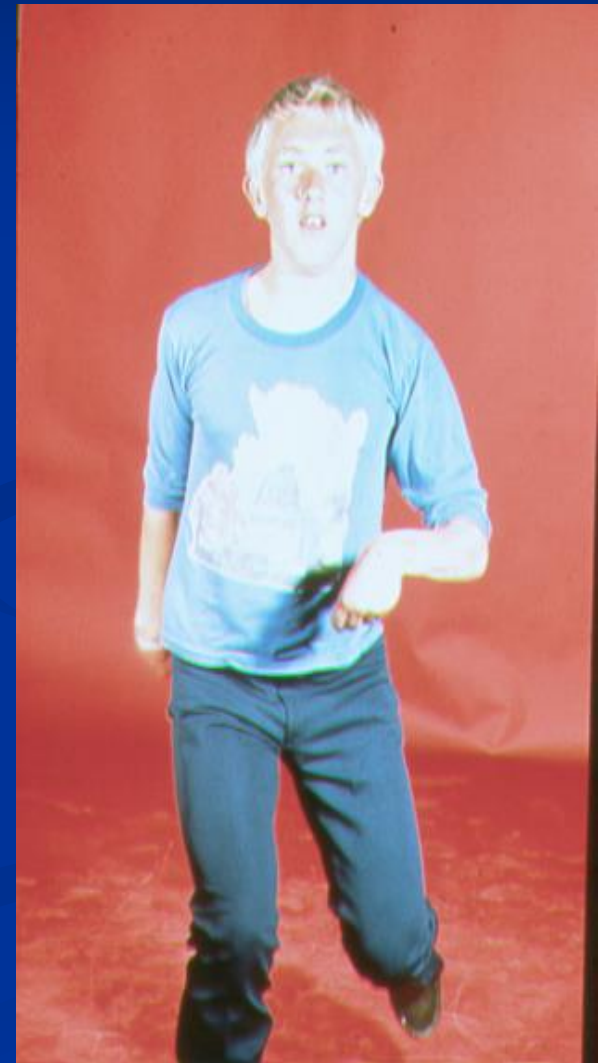
Elbow: flexed

Forearm: pronated

Wrist / fingers: flexed

Hip: flexed and adducted

Knee and ankle: flexed



Hand function in children with hemiplegic cerebral palsy



- Presentation of the affected hemiplegic hand is variable (mild to severe) with predictable patterns of spasticity and weakness
- The greater the motor impairment, the greater the sensibility impairment

Kinnucan, Van Heest 2010

Does the CNS insult that causes hemiplegic cerebral palsy cause impairment in both hands?



Dominant hand function in hemiplegic cerebral palsy

- Typically overlooked and not treated

- Delays have been reported:

Subtle deficits (Gordon 1999, Duque 2003)

Anticipatory control of grasp formation (Ronnqvist 07)

Speed in movements (Hung 2004)

Mild sensory impairments (Kinnucan 2010)

Study Aim

Determine how the affected hemiplegic hand and contralateral dominant hand compare to age matched norms for grip strength, pinch strength and dexterity.

Chicago



Greenville



Twin Cities



Northern California



Shreveport



Intermountain



Tampa



Funded by Shriners Hospitals for Children Clinical Outcomes Studies Advisory Board Grant

#9196: Comparison of functional outcomes of tendon transfer surgery, botulinum toxin injections, and regular ongoing treatment in hemiplegic cerebral palsy.





Hemiplegic UE Cerebral Palsy

Upper Limb (arm & hand) Cerebral Palsy Research Study



SHC
UECP  Shriners Hospitals
for Children
Upper Extremity
Cerebral Palsy Study

- Age 4 to 17 years
- One upper limb involved
- Must be candidate for surgery

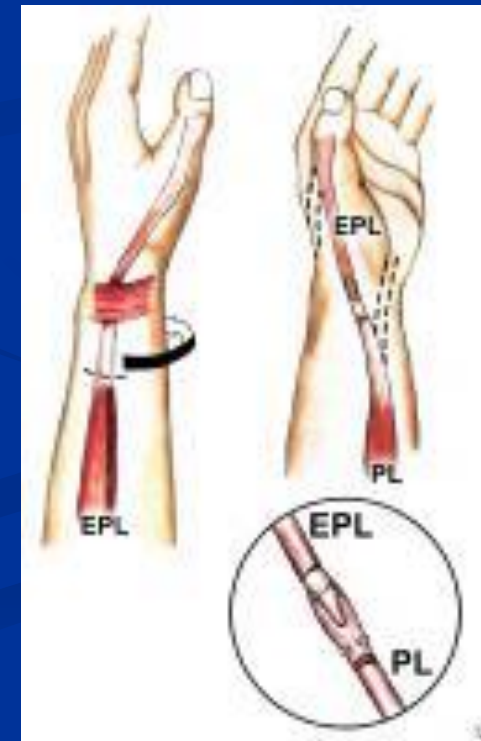
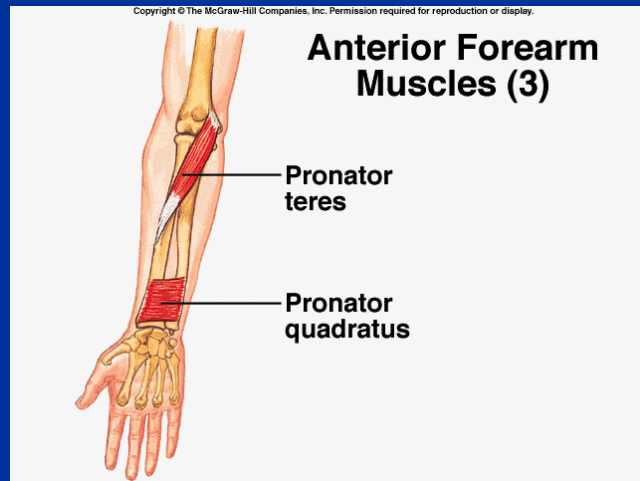
This is a randomized trial. Study subjects
will be randomized to one of three groups:

- (1) Surgery,
- (2) Botox injections,
- (3) Standard therapy

Call Wendy Tomhave in Research (612) 596-6216
or
ASK YOUR DOCTOR if you qualify

Surgical Candidate

- Pronator Teres Release
- FCU to ECRB tendon transfer
- EPL re-routing with adductor release



Demographics

- 37 children enrolled between 2006 - 2013
- 26 Males, 11 Females
 - 4 – 5 year olds: 4
 - 6 – 7 year olds: 7
 - 8 – 9 year olds: 12
 - 10 – 11 year olds: 4
 - 12 – 13 year olds: 5
 - 14 – 15 year olds: 5
- 19 Left side affected – 18 Right side affected

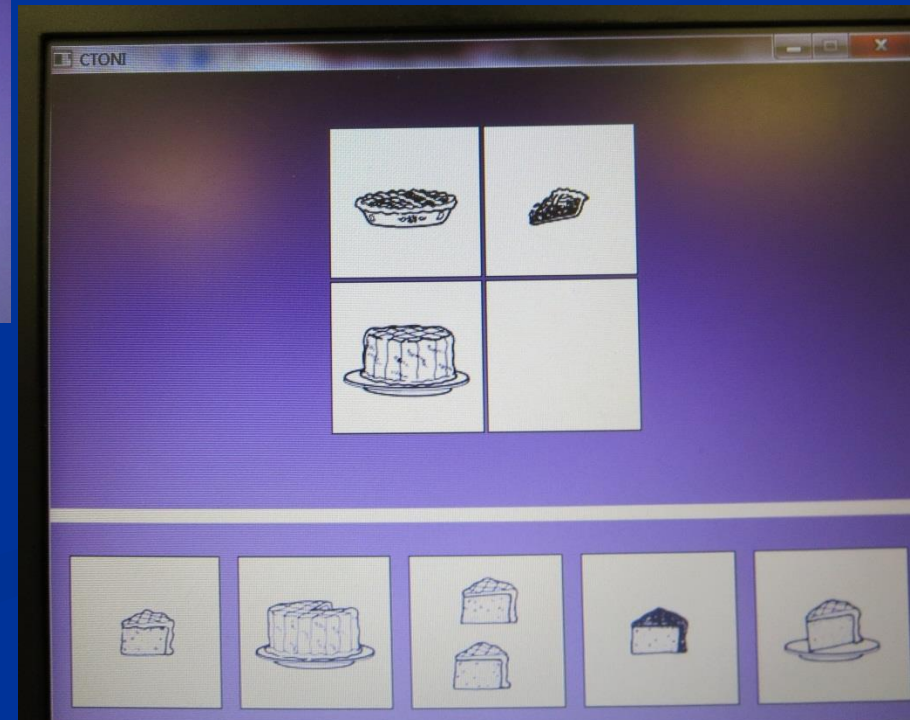
Methods: Assessment

Stereognosis Testing



Methods: Assessment

Comprehensive Test of Normal Intelligence (CTONI)



Methods: Assessment

Grip Strength



Methods: Assessment

Lateral (key) Pinch Strength



Methods: Assessment

Box and Blocks Test of Dexterity



Box and Block Test

Number of Blocks in 60 seconds

L _____

R _____

Grip Strength	Left	Right
Grip		
Key (Lateral Pinch)		
Tripod Pinch		

Results: Stereognosis



- Affected Hand:

Mean of 6.1 objects (range of 1-12)

- Unaffected Hand:

Mean of 11.1 objects (range of 5-12)

Results: Cognitive Testing

- Mean CTONI score was 82.4
- Range was 44 - 115

The CTONI Nonverbal intelligence quotient:

35 - 69 “very poor”

70 - 79 “poor”

80 – 89 “below average”

90 – 110 “average”

111 – 120 “above average”

Unaffected Hand: Dexterity and Cognition Dexterity and Stereognosis

		Correlations		
		CTONI	Stereognosis Unaff	BoxBlocks Unaff
CTONI	Pearson Correlation	1	.070	.430**
	Sig. (2-tailed)		.683	.008
	N	37	37	37
Stereognosis Unaff	Pearson Correlation	.070	1	.403*
	Sig. (2-tailed)	.683		.014
	N	37	37	37
BoxBlocks Unaff	Pearson Correlation	.430**	.403*	1
	Sig. (2-tailed)	.008	.014	
	N	37	37	37

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Results:

Affected Hand versus Unaffected Hand

■ Grip strength

Affected Mean: 2.7 kg

Unaffected Mean: 16.3 kg (p=0.001)

■ Pinch Strength

Affected mean: 1.7 kg

Unaffected mean: 5.6 kg (p=0.001)

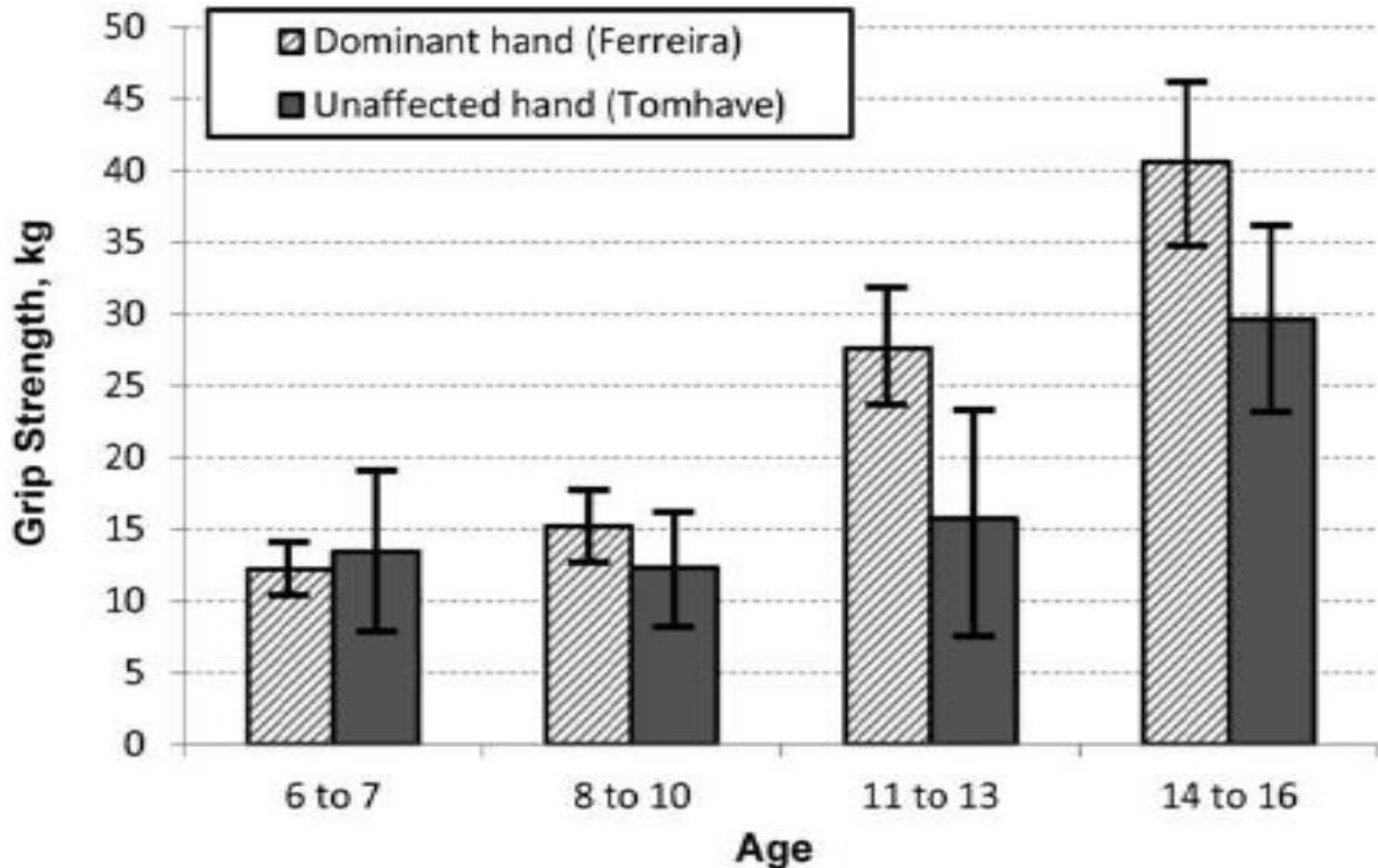
■ Box and Blocks

Affected mean: 10.8 blocks

Unaffected mean: 35.6 blocks (p=0.001)

Results:

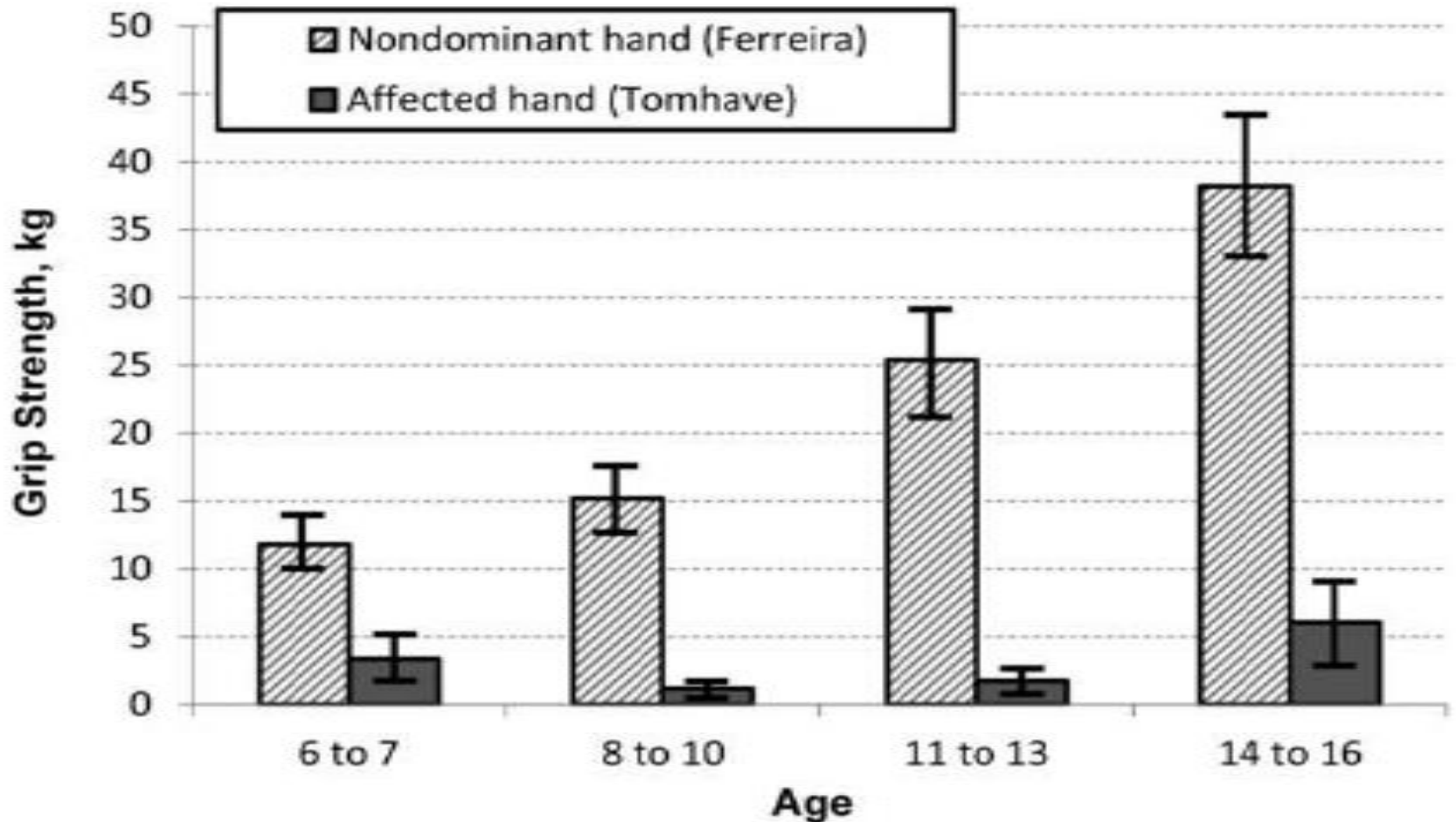
Grip Strength Unaffected Hand



Error bars are one standard deviation around the mean

Results:

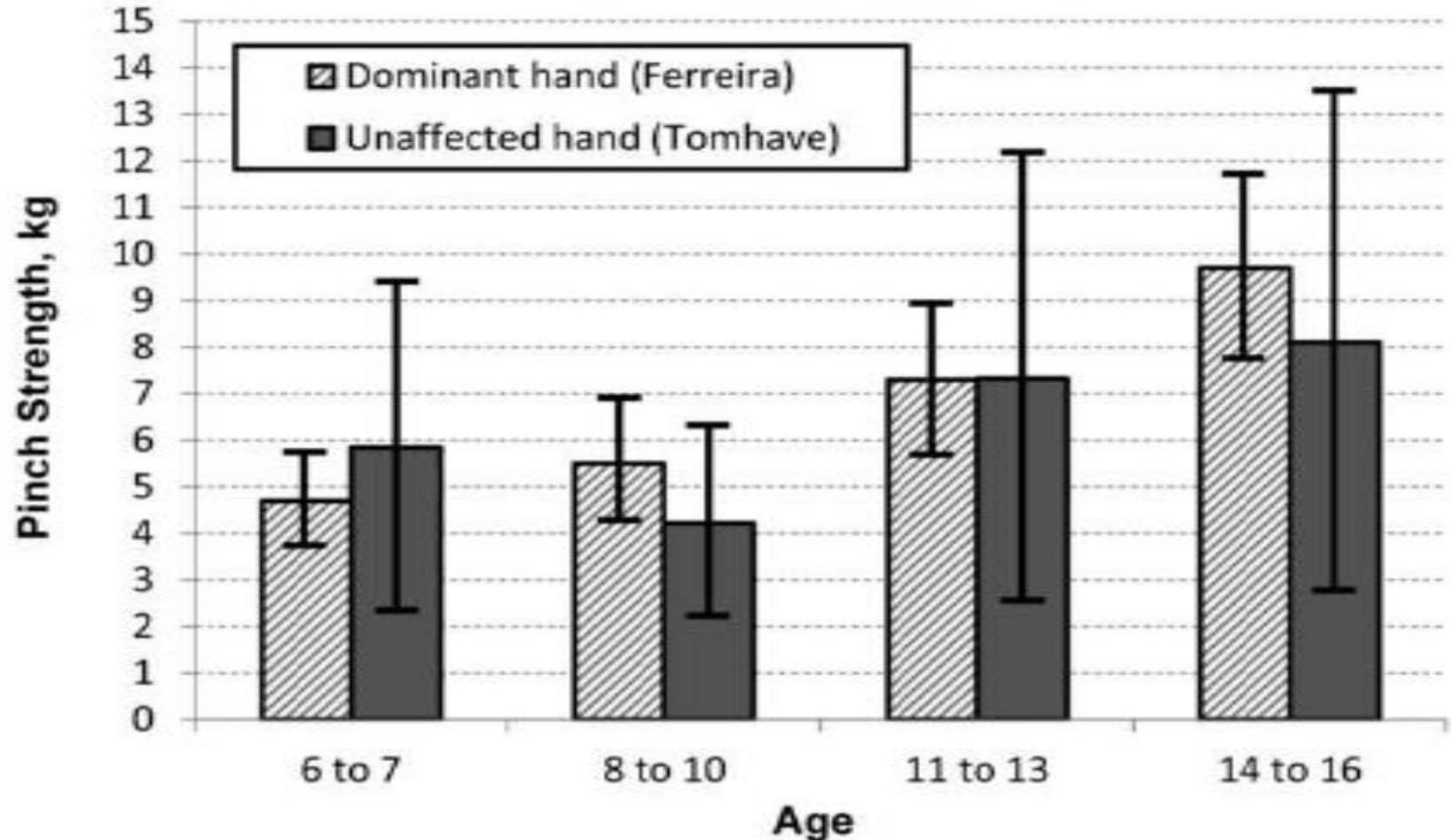
Grip Strength Affected Hand



Error bars are one standard deviation around the mean

Results:

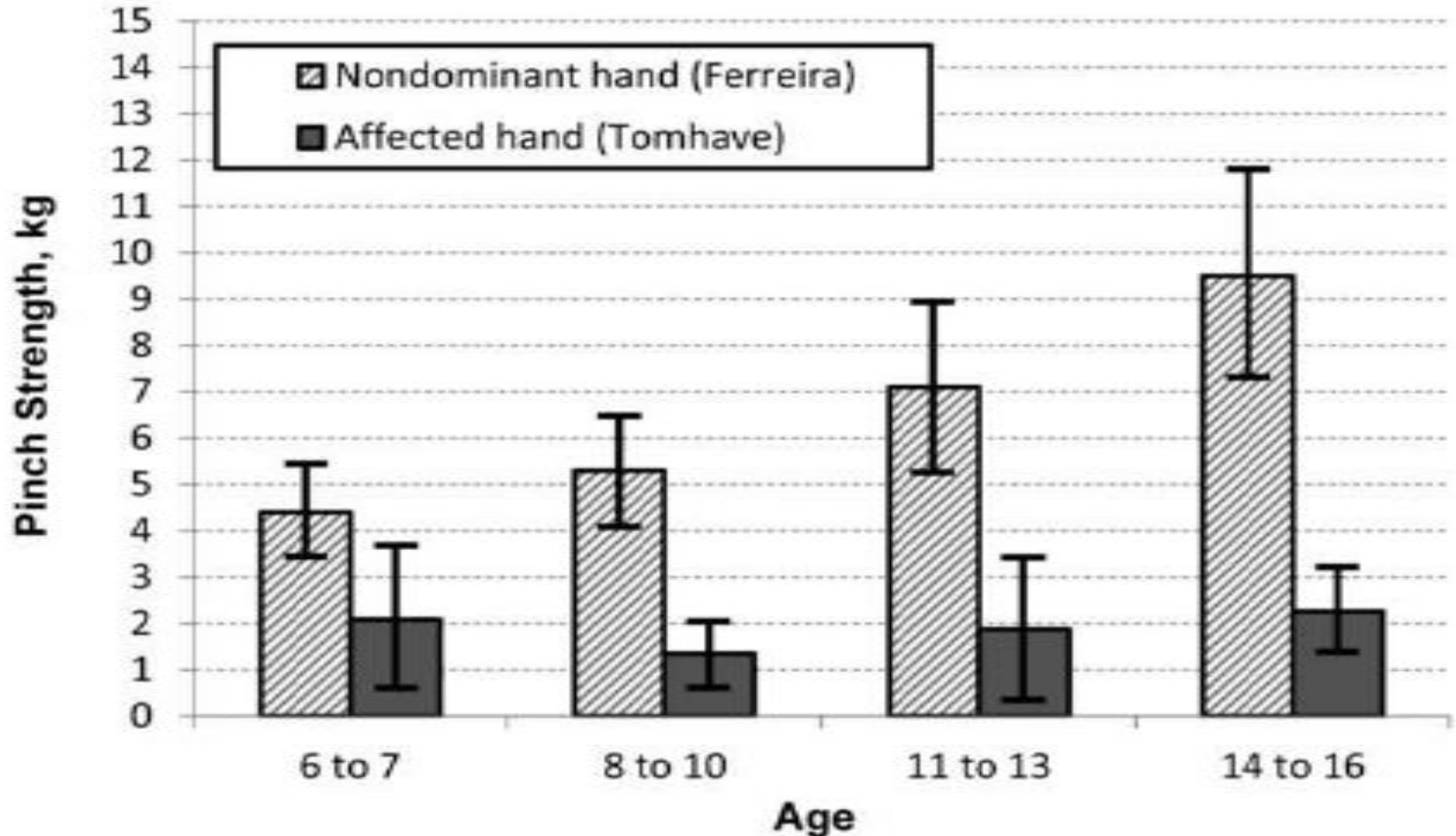
Pinch Strength Unaffected Hand



Error bars are one standard deviation around the mean

Results:

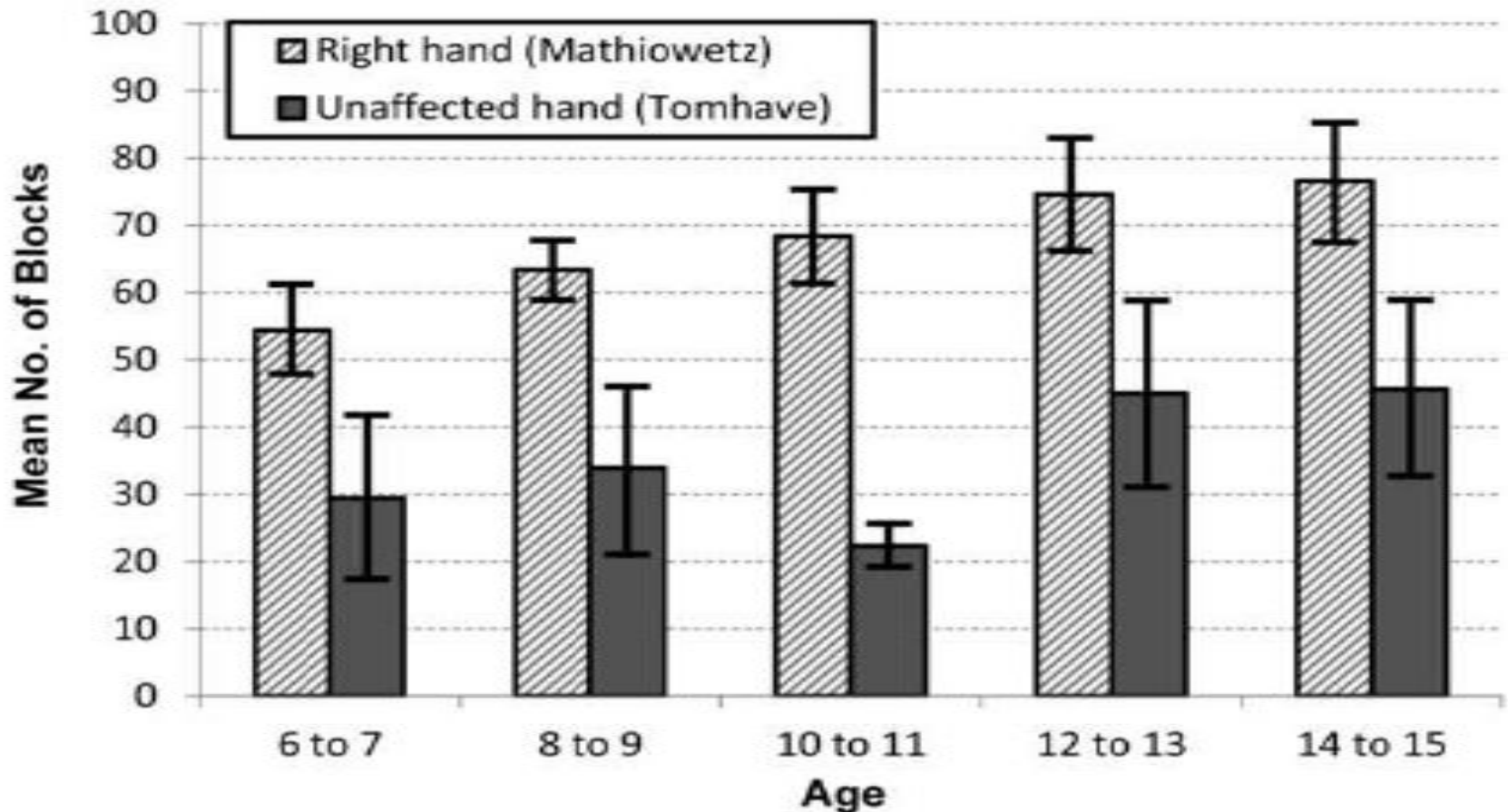
Pinch Strength Affected Hand



Error bars are one standard deviation around the mean

Results:

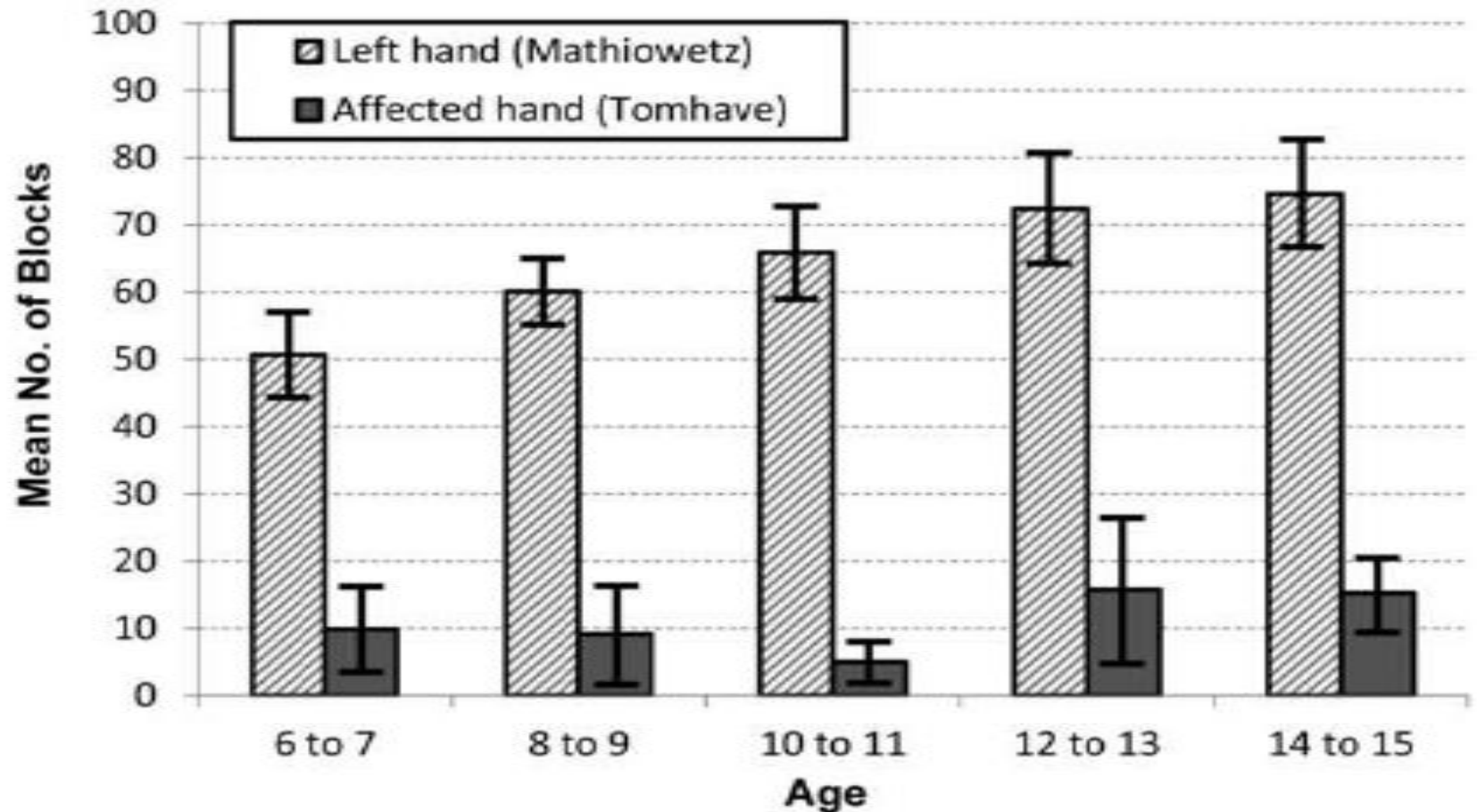
Box and Blocks Test of Dexterity: Unaffected Hand



Error bars are one standard deviation around the mean

Results:

Box and Blocks Test of Dexterity: Affected Hand



Error bars are one standard deviation around the mean

Discussion

Although it would be expected that the affected hemiplegic hand would have dexterity impairment, it was not expected that the unaffected dominant hand would have dexterity impairment.

Discussion

- Children with greater sensibility impairment in the unaffected dominant hand had greater dexterity impairment.
- Children with greater intelligence impairment had greater dexterity impairment in the unaffected dominant hand.

Conclusions

Assessment of the dexterity of the unaffected dominant hands of hemiplegic children may reveal opportunities for intervention that improve function.

Conclusion

Families should be educated about hand strength and dexterity comparisons of the affected and the contralateral hand to help them plan realistic goals for future abilities.

Thank You for your attention!

