

Somatosensory Plasticity in Hemiplegic Cerebral Palsy following Constraint Induced Movement Therapy

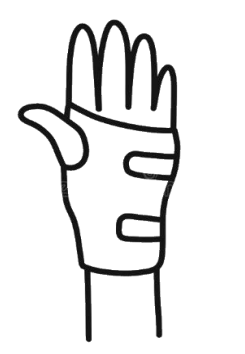
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Background



Children with hemiplegic cerebral palsy (HCP) experience motor and sensory deficits¹



Constraint-induced movement therapy (CIMT) involves intensive motor movement practice, with casting of the unaffected hand so as to encourage use of the affected hand²



CIMT is an effective intervention to improve motor function in children with HCP, but its potential for to improve sensory function has been under-investigated²

Objective

To measure change in clinical sensory function and sensory neural processing in children with HCP following a somatosensory-enhanced CIMT intervention

Methods

Eligibility Criteria

- ✓ Diagnosis of HCP
- ✓ Between age 5 and 12 years

Data Collection

- Clinical sensory, motor and magnetoencephalography (MEG) data collected at baseline and one-week post-CIMT.
- MEG signal was measured in the primary somatosensory cortex (S1), 20ms, 50ms, 70ms, 100ms and 140ms following tactile stimulation of the hemiplegic or non-hemiplegic hand
- Minimal clinically important difference (MCID), the smallest difference score which must be reached to observe meaningful change in function, was evaluated for clinical measures for which an MCID value has been published

Sensory Measures	Sensory Function
Semmes-Weinstein Monofilaments (SWM)	Tactile registration
2-point discrimination	Tactile discrimination
Stereognosis	Touch-object recognition
Proprioception	Limb position sense
Kinesthesia	Limb movement sense
Motor Measures	Motor Function
QUEST [®] Total	Overall quality of hand use
QUEST [®] Grasp	Quality of grasp movement
Grip Strength	Strength of grip movement
Jebesen-Taylor Hand Function Test (JTHFT)	Fine motor movement

MEG Measures
Amplitude of S1 response to tactile stimulation
Latency of S1 response to tactile stimulation

Table 1. Clinical sensory, motor and MEG measurements administered at baseline and 1-week post CIMT; [®]Quality of Upper Extremity Test

CIMT Intervention

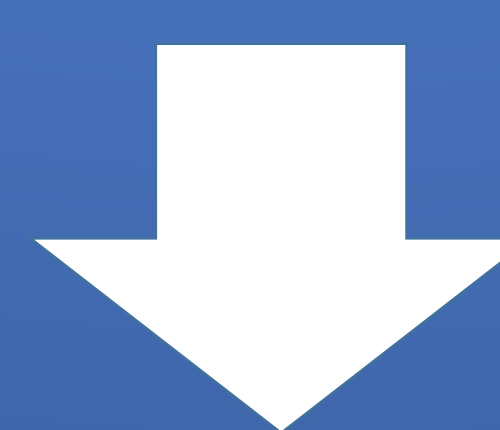
Week 1 	Non-removable below elbow cast worn on non-affected hand for 24 hours/day at home and in the community
Week 2 	Removable cast worn for 4 hours/day Unimanual sensory and motor activities, 4 hours/day
Week 3 	Removable cast worn for most of day Bimanual sensory and motor activities, 1 hour/day

Analysis

- Clinical outcomes and MEG signal amplitude and latency tested for change from baseline to follow up
- Wilcoxon signed-rank tests performed for ordinal or non-normal data, paired t-tests performed for all other outcomes
- Effect size calculated where significant change found

Constraint therapy for children with hemiplegic CP may improve light touch and brain processing of sensory information

For more information about Constraint-induced movement therapy, point your phone at this QR code



Results

Participants

- 12 children with HCP, 9 males 3 female
- Age range 5.0 – 12.9 years (mean age 7.5 years ± 2.4)
- 10 right hand affected, 2 left hand affected

Results

Measure	t/Z [†]	p	d/r [†]	MCID [§]	Mean Difference
Tactile Registration (SWM)	2.39 [†]	.02	0.76 [†]	N/A	N/A
Quality of Hand Use (QUEST Total)	3.24	.007	0.32	±5 pts	+7.14
Quality of Grasp (QUEST Grasp)	3.24	.007	0.34	±5 pts	+8.64
Fine motor movement (JTHFT)	-2.62	.03	0.40	± 54.7s*	-64.88 seconds
MEG Signal Amplitude	-2.22	.04	1.05	N/A	N/A

Table 2. Results of statistical analysis, *seconds, [§]Minimal Clinically Important Difference

A) Unaffected Hemisphere

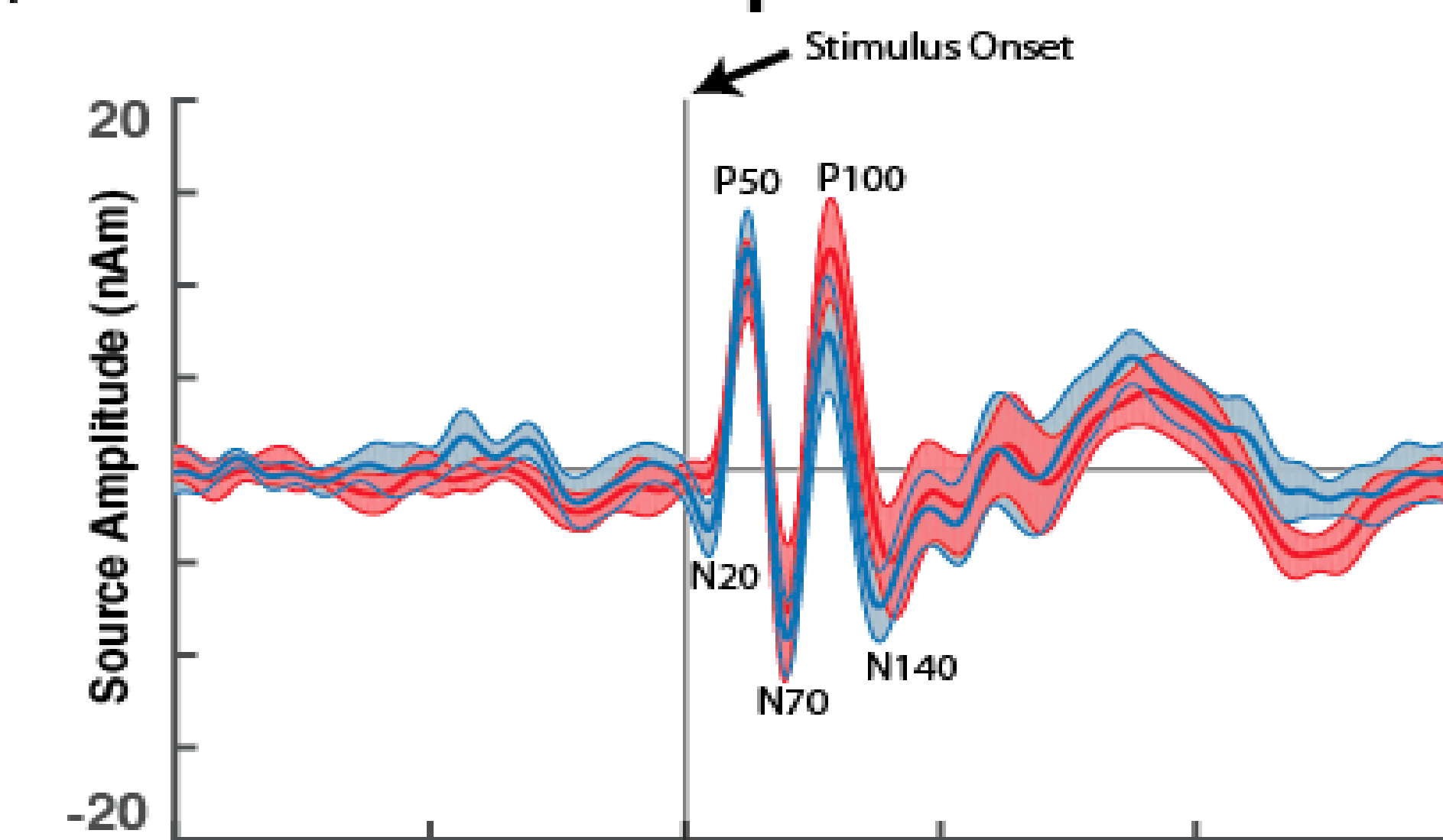
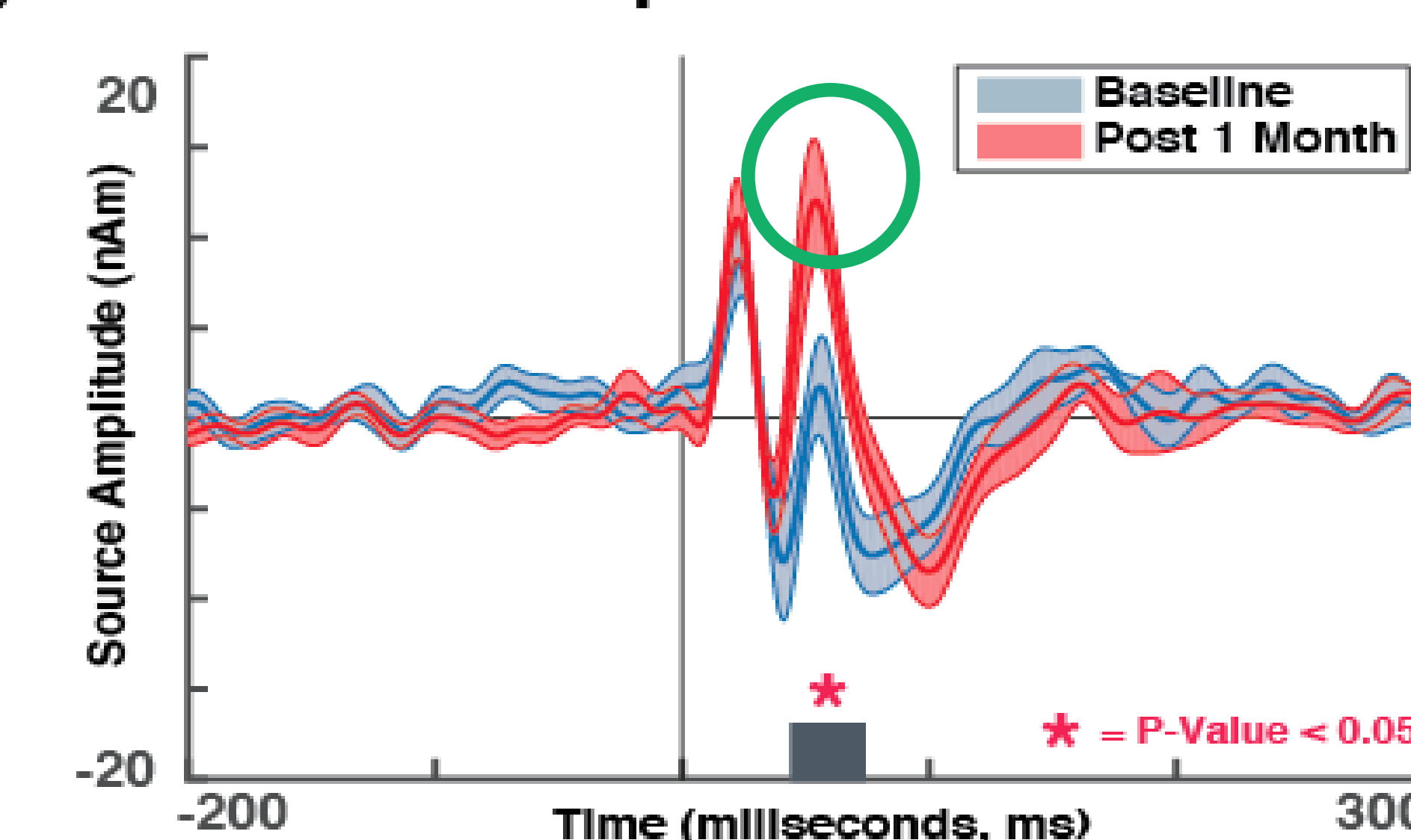


Figure 1. Group averaged sensory signal amplitude and latency response before (blue line) and after CIMT (red line), for affected and unaffected hemispheres. Significant ($p < .05$) amplitude differences are found 100ms post-stimulus onset, between baseline and post-CIMT in the affected hemisphere only.

B) Affected Hemisphere



Conclusions

- Somatosensory-enhanced CIMT may optimize motor and sensory improvements and enhance somatosensory neural processing in the primary motor cortex
- Clinicians treating children with HCP should screen for sensory deficits and incorporate somatosensory activities into CIMT protocols
- Further investigation into the relationship between somatosensory enhanced CIMT and sensorineural recovery is warranted

Acknowledgements

This project was funded in part by the Ontario Brain Institute through the Childhood Cerebral Palsy Neuroscience Discovery Network (CP NET), and by Bloorview Research Institute's Graduate Student awards and Ward Family Summer Student Research Program. A special thank you to child and family participants, and to Stephan Bostan, Linda Fay, Sophie Lam-Damji, Yvonne Ng and Terence Fedchak for their involvement in the project.

References

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