CIMT (Constraint-Induced Movement Therapy)

vs

HABIT (Hand-Arm Bimanual Intensive Therapy)

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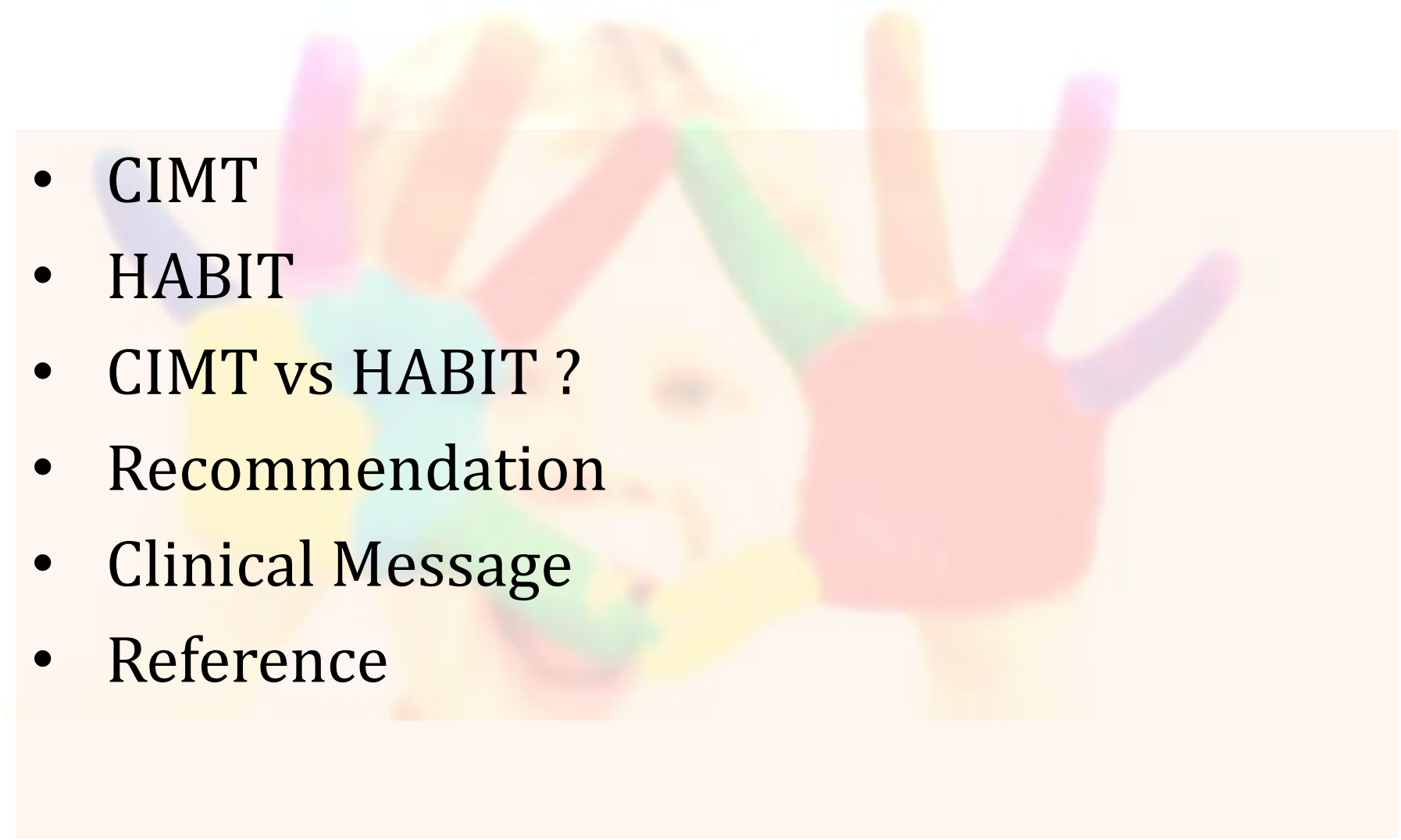
2015. 04. 04

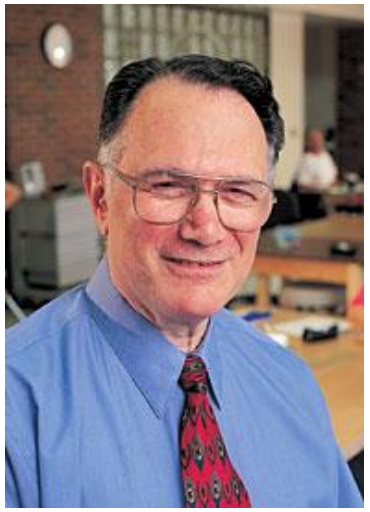
CONTENTS



- CIMT
- HABIT
- CIMT vs HABIT ?
- Recommendation
- Clinical Message
- Reference

CIMT

- Cerebral Palsy(CP)
- Spastic Hemiplegic CP
- Constraint-Induced Movement Therapy(CIMT)
  - based on research by Edward Taub, a behavioral neuroscientist
    - Monkey deafferentation
  - the brain to "rewire" itself following a major injury such as stroke or traumatic brain injury (neuroplasticity)
  - Patients can "learn" to improve the motor ability of the more affected parts of their bodies and thus cease to rely exclusively or primarily on the less affected parts.



Taub et al. 2006

- Features of CIMT
  - Constraint of the non-affected limb
  - Forced use of the involved upper extremity
  - Intensive treatment
  - Education of parents

Gordon et al 2005, Taub et al 2004

Hand rehabilitation in children

- Improved hand-movement efficiency
  - Hands to midline
  - forearm supination and pronation
  - transferring a cube between hands
  - ulnar/palmer grasping with the hands

- Investigated the protocol (length, frequency of treatment, populations participating)
    - 21 days, 6 hours / day, 126 hours
    - Modified CIMT protocol

Case-Smith et al 2010, Deluca et al 2004, Taub et al 2004

Type of restraint

- Non removable
- Bi-valve casts
- Slings
- Splints
- Glove/mitts

Table I: Considerations for selecting training environment and restraint type

Location
Individual treatment
- Less distraction
- 1:1 therapist/child ratio

Home/school
- Direct practice in everyday environment
- Activity selection varies depending on specific environment
- Can be intrusive to family/classroom
- Distracting?

Day camp
- Social
- Potential for modeling/support
- Distracting?
- Reduced treatment intensity if <1:1 ratio?
- But can supplement with non-clinicians!

Restraint selection
Casts
- Greater treatment intensity?
- Restrict mirroring?
- ↑Compliance?
- Uncomfortable

Slings
- Comfortable
- Provide too much choice?
- No protective response

Gloves/mitts
- Comfortable
- Allows gross bimanual assist
- Reduced treatment intensity?

No evidence of better efficacy for any restraint type.
Select best for individual environment and least-invasive.
Needed at all?

Outcome Measurement

- **Classification**
  - MACS

(Manual Ability Classification System)

- **Goal Setting**
  - COPM

(Canadian Occupational Performance Measure)

  - GAS

(Goal Attainment Scaling)

- **Activity - Unilateral**
  - MA2

(Melbourne Assessment 2)

  - QUEST

(Quality of Upper Extremity Skills Test)

- **Activity - Bilateral**
  - AHA

(Assisting Hand Assessment)

  - ABILHAND-Kids
  - CHEQ

(Children's Hand-Use Experience Questionnaire)

Table 1: Measurement Tools by Age Group

Assessment Category	Assessments	1-2 yrs	3 yrs	4-7 yrs	8-18 yrs	Adult
Classification Tool	Manual Ability Classification System (MACS) *(Eliasson 2006 [2a])*			X	X	
Individualized Patient Family Goals	Canadian Occupational Performance Measure (COPM) *(Law 2005 [5])*	X Care-giver Report	X Care-giver Report	X Care-giver Report	X Client if possible	X Client if possible
	Goal Attainment Scaling *(Kiresuk 1994 [5])*	X	X	X	X	X
Activity - Unimanual Capacity	Melbourne Assessment 2 (MA2) *(Randall 1999 [5])*	2.5 →			15	
	Quality of Upper Extremity Skills Test (QUEST) *(DeMatteo 1992 [5])*	1.5 →			8	
Activity - Bimanual Performance	Assisting Hand Assessment *(Krumlinde-Sundholm 2007 [2a])*	1.5 →			12	
	ABILHAND-Kids *(Arnould 2004 [5])*				6 → 15	
	Children's Hand-Use Experience Questionnaire (CHEQ) *(Skold 2011 [2a])*			6 →	18	

Tinderholt Myrhaug *et al. BMC Pediatrics* 2014, **14**:292
http://www.biomedcentral.com/1471-2431/14/292

BMC Pediatrics

RESEARCH ARTICLE Open Access

Intensive training of motor function and functional skills among young children with cerebral palsy: a systematic review and meta-analysis

Hilde Tinderholt Myrhaug[1,2*], Sigrid Østensjø[1†], Lillebeth Larun[2†], Jan Odgaard-Jensen[3†] and Reidun Jahnsen[1,4†]

- Inclusion criteria

(1) Age < 7 years

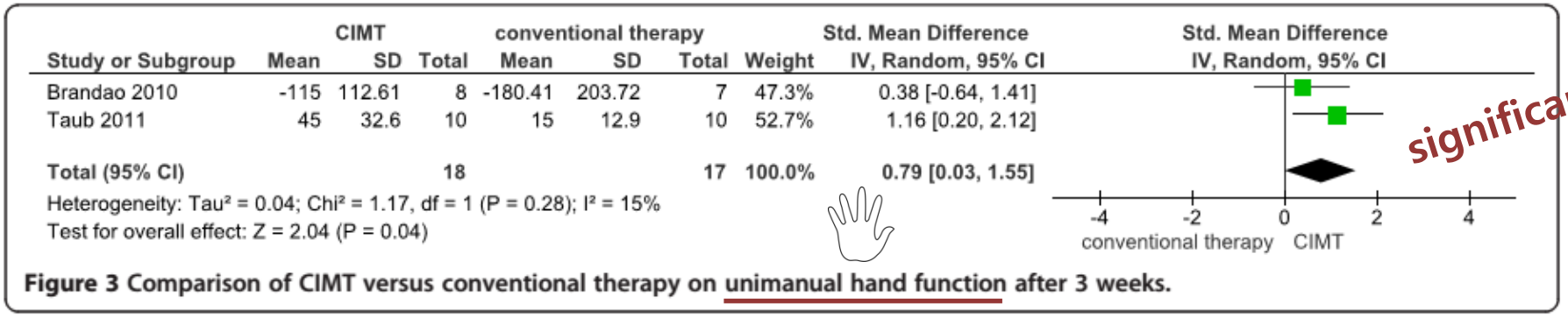
(2) Motor function(mobility,grasping),
Functional skill training (eating, playing)
Three times or more per week
at the clinic , in the kindergarten, or at home

(3) Comparison with another intervention
conventional therapy
another type of intensive intervention

- Intensive training

> 2 times per weeks

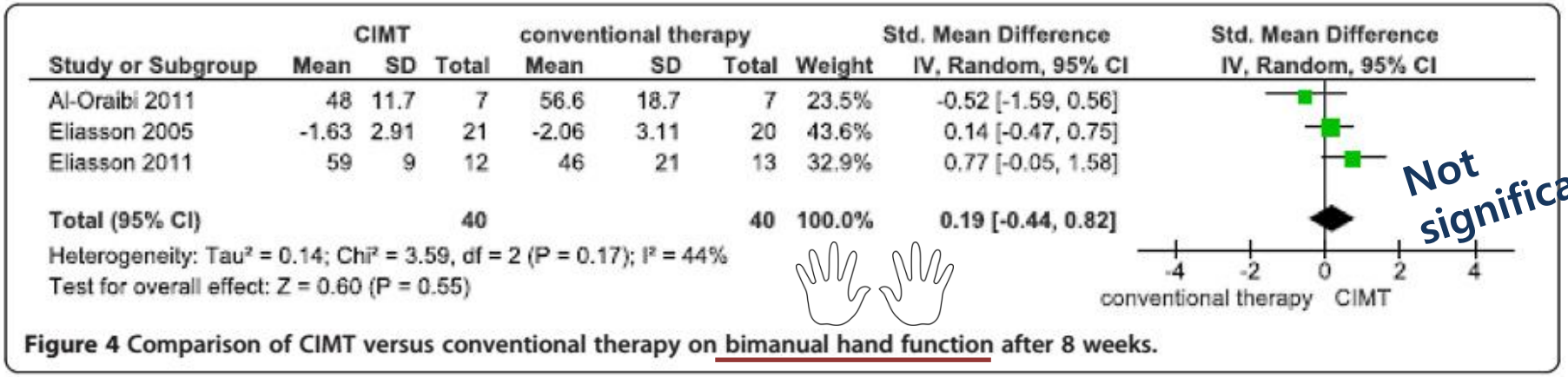
CIMT vs Conventional therapy



Study or Subgroup	CIMT Mean	CIMT SD	CIMT Total	conventional therapy Mean	conventional therapy SD	conventional therapy Total	Weight	Std. Mean Difference IV, Random, 95% CI
Brandao 2010	-115	112.61	8	-180.41	203.72	7	47.3%	0.38 [-0.64, 1.41]
Taub 2011	45	32.6	10	15	12.9	10	52.7%	1.16 [0.20, 2.12]
Total (95% CI)			18			17	100.0%	**0.79 [0.03, 1.55]**

Heterogeneity: Tau² = 0.04; Chi² = 1.17, df = 1 (P = 0.28); I² = 15%
Test for overall effect: Z = 2.04 (P = 0.04)

Figure 3 Comparison of CIMT versus conventional therapy on unimanual hand function after 3 weeks.



Study or Subgroup	CIMT Mean	CIMT SD	CIMT Total	conventional therapy Mean	conventional therapy SD	conventional therapy Total	Weight	Std. Mean Difference IV, Random, 95% CI
Al-Oraibi 2011	48	11.7	7	56.6	18.7	7	23.5%	-0.52 [-1.59, 0.56]
Eliasson 2005	-1.63	2.91	21	-2.06	3.11	20	43.6%	0.14 [-0.47, 0.75]
Eliasson 2011	59	9	12	46	21	13	32.9%	0.77 [-0.05, 1.58]
Total (95% CI)			40			40	100.0%	**0.19 [-0.44, 0.82]**

Heterogeneity: Tau² = 0.14; Chi² = 3.59, df = 2 (P = 0.17); I² = 44%
Test for overall effect: Z = 0.60 (P = 0.55)

Figure 4 Comparison of CIMT versus conventional therapy on bimanual hand function after 8 weeks.

- CIMT > Conventional therapy
  - On unimanual hand function
  - Not bimanual hand function

CIMT vs intensive intervention

Study or Subgroup	CIMT Mean	CIMT SD	CIMT Total	intensive intervention Mean	intensive intervention SD	intensive intervention Total	Weight	Std. Mean Difference IV, Random, 95% CI
Gordon 2011	80.6	10.54	21	79.4	10.54	21	42.7%	0.11 [-0.49, 0.72]
Hsin 2012	10.6	1.6	11	8.9	1.1	11	27.7%	1.19 [0.27, 2.11]
Lin 2011	11.6	9.43	10	7.23	8.35	11	29.6%	0.47 [-0.40, 1.34]
Total (95% CI)			**42**			**43**	**100.0%**	**0.52 [-0.10, 1.13]**

Heterogeneity: Tau² = 0.14; Chi² = 3.69, df = 2 (P = 0.16); I² = 46%
Test for overall effect: Z = 1.64 (P = 0.10)

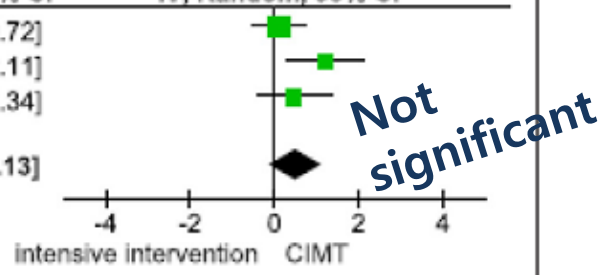


Figure 5 Comparison of CIMT versus intensive interventions on unimanual hand function after 4 weeks.

Study or Subgroup	CIMT Mean	CIMT SD	CIMT Total	intensive intervention Mean	intensive intervention SD	intensive intervention Total	Weight	Std. Mean Difference IV, Random, 95% CI
Aarts 2010	60.1	15.3	28	53.1	22.2	22	30.4%	0.37 [-0.19, 0.93]
Gordon 2011	0.8	1.73	21	0.94	1.76	21	26.3%	-0.08 [-0.68, 0.53]
Lin 2011	3.1	3.18	10	1.45	2.3	11	12.5%	0.58 [-0.30, 1.45]
Wallen 2011	62.9	29.3	25	52	28.9	25	30.8%	0.37 [-0.19, 0.93]
Total (95% CI)			**84**			**79**	**100.0%**	**0.28 [-0.03, 0.59]**

Heterogeneity: Tau² = 0.00; Chi² = 1.98, df = 3 (P = 0.58); I² = 0%
Test for overall effect: Z = 1.75 (P = 0.08)

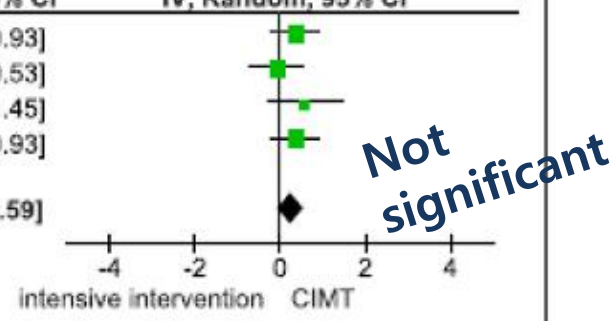


Figure 6 Comparison of CIMT versus intensive interventions on bimanual hand function after 8 weeks.

- CIMT is **not superior** to intensive intervention on unimanual or bimanual hand function?

CIMT on functional skills

Study or Subgroup	CIMT Mean	CIMT SD	CIMT Total	conventional therapy Mean	conventional therapy SD	conventional therapy Total	Weight	Std. Mean Difference IV, Random, 95% CI
Brandao 2010	74.46	9.88	8	69.15	6.31	7	26.3%	0.59 [-0.45, 1.64]
Sung 2005	25.44	5.82	18	21.15	8.73	13	49.1%	0.58 [-0.15, 1.31]
Taub 2004	2.8	1.14	9	1.2	0.82	9	24.6%	1.53 [0.45, 2.62]
Total (95% CI)			**35**			**29**	**100.0%**	**0.82 [0.26, 1.38]**

Heterogeneity: Tau² = 0.03; Chi² = 2.25, df = 2 (P = 0.32); I² = 11%
Test for overall effect: Z = 2.85 (P = 0.004)

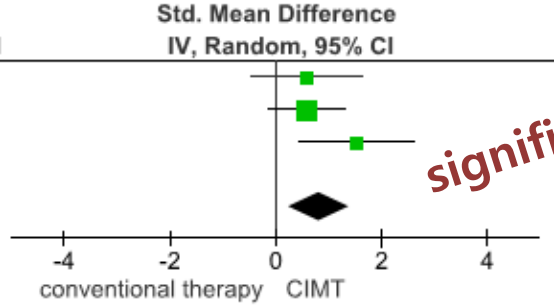


Figure 7 Comparison of CIMT versus conventional therapy on functional skills after 6 weeks.

Study or Subgroup	CIMT Mean	CIMT SD	CIMT Total	intensive intervention Mean	intensive intervention SD	intensive intervention Total	Weight	Std. Mean Difference IV, Random, 95% CI
Aarts 2010	28.4	5.9	28	23.7	6	22	33.3%	0.78 [0.20, 1.36]
Hsin 2012	2.5	0.3	11	2.4	0.4	11	15.9%	0.27 [-0.57, 1.11]
Lin 2011	2.75	1.12	10	2.14	1.01	11	14.6%	0.55 [-0.33, 1.43]
Wallen 2011	57.5	20	25	51.5	17.3	25	36.1%	0.32 [-0.24, 0.87]
Total (95% CI)			**74**			**69**	**100.0%**	**0.50 [0.16, 0.83]**

Heterogeneity: Tau² = 0.00; Chi² = 1.60, df = 3 (P = 0.66); I² = 0%
Test for overall effect: Z = 2.91 (P = 0.004)

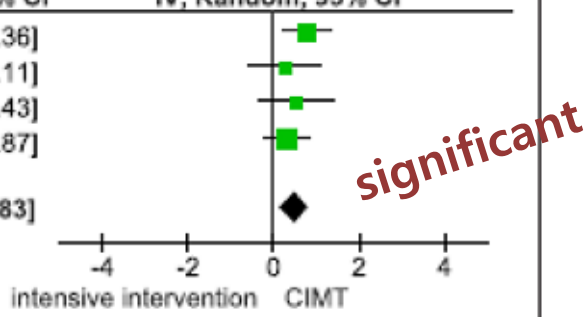


Figure 8 Comparison of CIMT versus intensive interventions on functional skills after 8 weeks.

- CIMT is superior to another therapy on functional skills

Neuroplasticity in CIMT

Contents lists available at ScienceDirect

Clinical Neurophysiology

journal homepage: www.elsevier.com/locate/clinph

Changes in diffusion tensor tractographic findings associated with constraint-induced movement therapy in young children with cerebral palsy

Jeong-Yi Kwon [a], Won Hyuk Chang [a,b], Hyun Jung Chang [a,c], Sook-Hee Yi [d], Min-Young Kim [a], Eun-Hye Kim [c], Yun-Hee Kim [a,b,*]

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- Hemiplegic CP
- N=19 (CIMT=10, conventional =9)
- tailored plastic long-arm bivalved casts
- Intervention
  - CIMT : concentrated, repetitive training of the affected upper arm
    - for 6 h per day, 5 days per week for 4 consecutive weeks (total, 120 h)
    - OTx, PTx provided 2 h of therapy per day for 4 weeks
  - Conservative : 2 h of conventional occupational therapy per week for 4 weeks

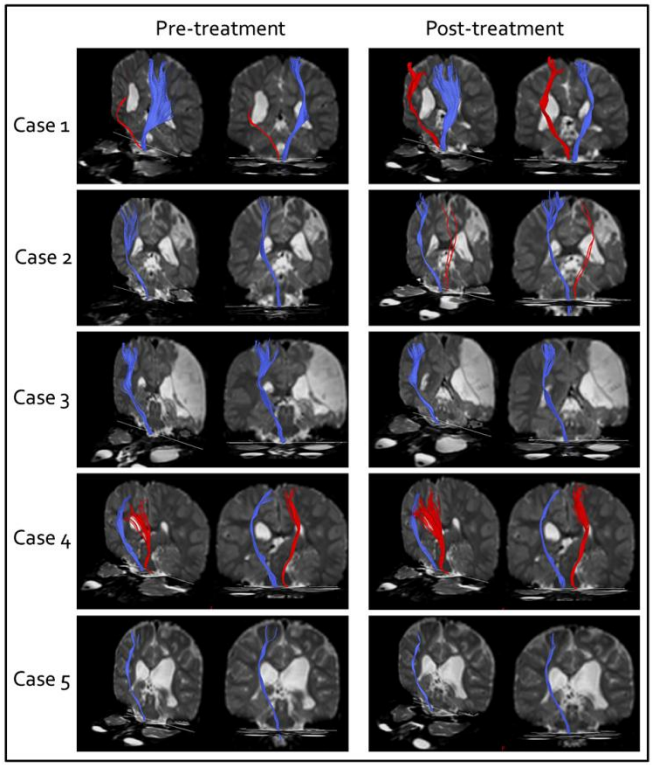


Fig. 1. Diffusion tensor tractography (DTT) at pretreatment and posttreatment in five participants. Affected and unaffected corticospinal tracts (CSTs) are demonstrated with

FA▲,ADC▼,Tract volume ▲

New Tract APPEAR !!

FA▲,ADC▼,Tract volume ▲

Table 3
Changes in the properties of corticospinal tract in diffusion tensor tractography.

	Pretreatment						Posttreatment					
	Parameter			Asymmetric index			Parameter			Asymmetric index		
	FA	ADC	Number of fibers	FA	ADC	Number of fibers	FA	ADC	Number of fibers	FA	ADC	Number of fibers
CIMT group												
Case 1	0.448	1.007	5	0.7	−1.6	48.2	0.475	0.850	101	0.4	1.6	30.9
Case 2	–	–	–	50.0	50.0	50.0	0.478	0.990	2	−2.6	3.5	48.4
Case 3	–	–	–	50.0	50.0	50.0	–	–	–	50.0	50.0	50.0
Case 4	0.475	0.889	62	−1.1	2.5	6.3	0.517	0.865	61	−4.9	0.2	10.9
Case 5	–	–	–	50.0	50.0	50.0	–	–	–	50.0	50.0	50.0

ADC, apparent diffusion coefficient; FA, fractional anisotropy; CIMT, constraint-induced movement therapy.

- CST reorganization in young children with CP in CIMT

ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2014;95:506-14

ORIGINAL ARTICLE

Diffusion Tensor Imaging Study of the Response to Constraint-Induced Movement Therapy of Children With Hemiparetic Cerebral Palsy and Adults With Chronic Stroke

Tyler Rickards, MA,[a] Chelsey Sterling, MA,[a] Edward Taub, PhD,[a] Christi Perkins-Hu, PhD,[b] Lynne Gauthier, PhD,[c] Michael Graham, BS,[a] Angi Griffin, MA,[d] Drew Davis, MD,[e] Victor W. Mark, MD,[a,f,g] Gitendra Uswatte, PhD[a,h]

From the [a]Department of Psychology, University of Alabama at Birmingham, Birmingham, AL; [b]Department of Psychology, LaGrange College, LaGrange, GA; [c]Department of Physical Medicine and Rehabilitation, Ohio State University, Columbus, OH; [d]Physical Therapy and Occupational Therapy Department, Children's of Alabama, Birmingham, AL; [e]Department of Pediatrics, Division of Pediatric Rehabilitation Medicine, and [f]Departments of Physical Medicine and Rehabilitation, [g]Neurology, and [h]Physical Therapy, University of Alabama at Birmingham, Birmingham, AL.

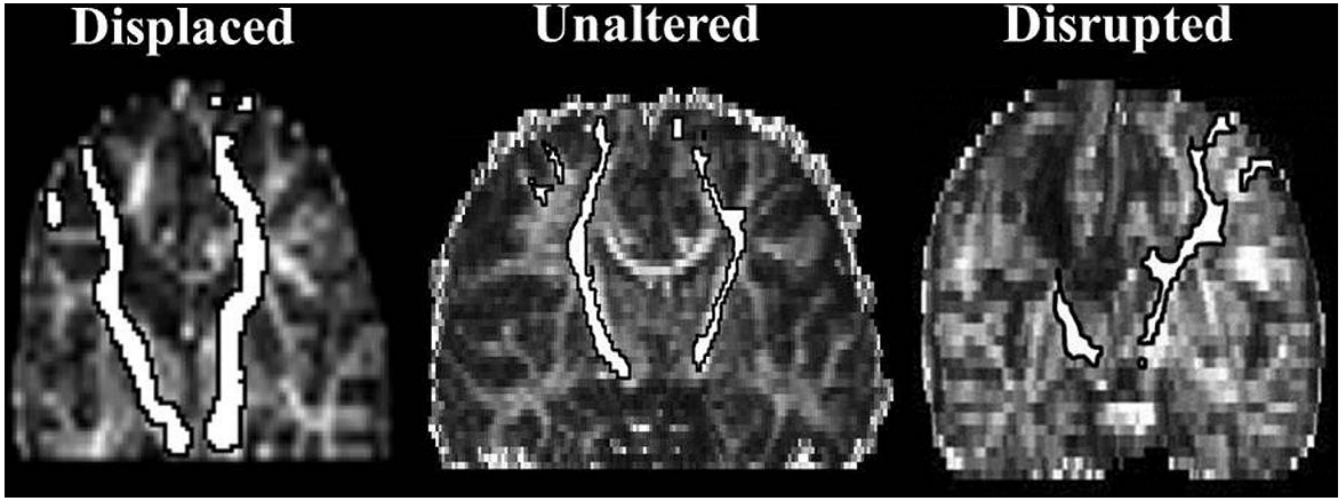


Fig 1 Probabilistic tractography example of disrupted, displaced, and unaltered CSTs, in white (outlined in black) overlaid onto the whole-brain FA image. White spots in the cortex that appear disconnected from the CST pathways are remnants of the branches of the tract whose continuity is apparent in adjoining slices.

Table 2 Clinical outcomes

Outcome Measures	Pretreatment	Posttreatment	Change	d′*
Study 1				
PMAL-R (points)	1.7±0.8	4.0±0.8	2.3±0.9†	2.67
PAFT limb preference (%)	14.9±17.0	50.8±17.5	35.9±18.2†	1.97

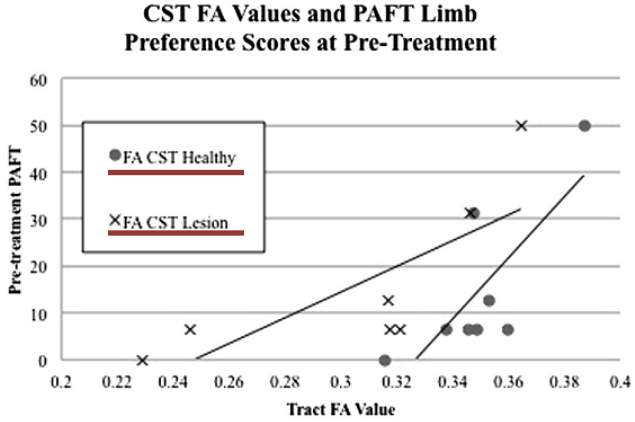


Fig 2 From study 1, a scatterplot of pretreatment mean FA values of the ipsilesional and contralesional CST and PAFT limb preference scores.

Table 3 Clinical results of participants who received CI therapy with disrupted, distorted, and unaltered ipsilesional CSTs

Study 1	PMAL-R			PAFT Limb Preference Score		
Ipsilesional CST Status	Pre	Post	Change	Pre	Post	Change
Disrupted/displaced*†	1.5±0.9	3.5±0.7	2.0±1.0	4.7±3.2	40.7±19.4	35.9±18.7
Unaltered‡	2.0±0.5	4.7±0.2	2.7±0.6	25.0±19.8	61.0±7.9	35.9±18.7

- Reduced integrity, displacement, or interruption of their CST performed worse on pretreatment motor testing.
- However, all groups have their ability to benefit from CI therapy.

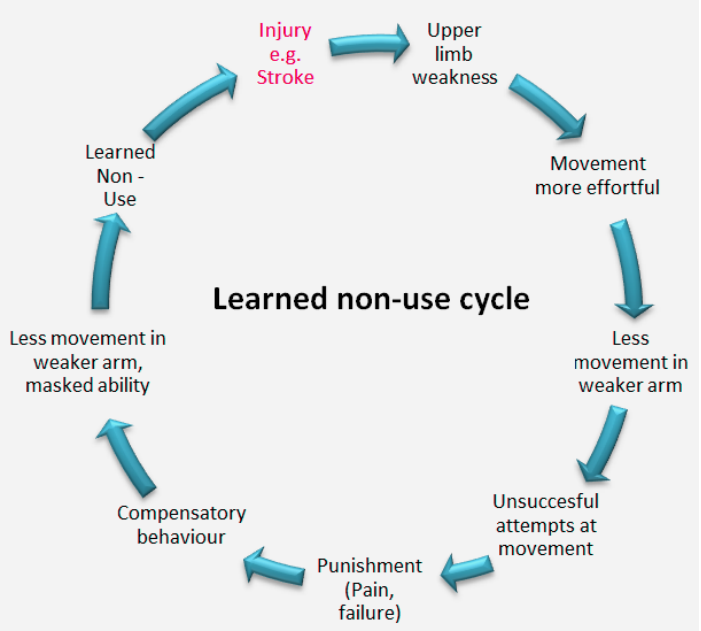
Considering factor in children

- "Learned non-use" in adult
- "**Never learned**" in children
  - 'Developmentally' focused on motor learning principles

Gordon et al 2011

- Maturation of corticospinal connection
  - Depend on activity
  - Early intensive restraint **risks** damage to the non-paretic upper extremities

Martin et al 2009



- CIMT focused on unimanual impairments, However, **BIMANUAL ACTIVITIES** is important
  - Motor planning, Two hand coordination, Functional independence, QOL

Steenbergen et al 2007

Are Two Hands Better Than One?

- In normal development
  - More active hemisphere “winning out”

Martin et al 2009

- Balancing of hemisphere after unilateral brain damage
  - Improve corticospinal connectivity
  - Restore motor function

Anttila et al 2008

- Practice bimanual activities directly !
  - Based on ‘Motor learning principle’
  - Most functional way
    - balance the cortical activity
    - improve bimanual control

Gordon et al 2011

HABIT (Hand Arm Bilateral Intensive Training)

- HABIT
  - Often used by clinicians treating the upper extemities
  - Maintain intensity
  - Progressive task-specific practice associated with CIMT
  - Engaged in **bimanual tasks**
  - Affected hand use progressed from passive stabilizer to active manipulator

Charles, Gordon et al 2006

To constrain or not to constrain, and other stories of intensive upper extremity training for children with unilateral cerebral palsy

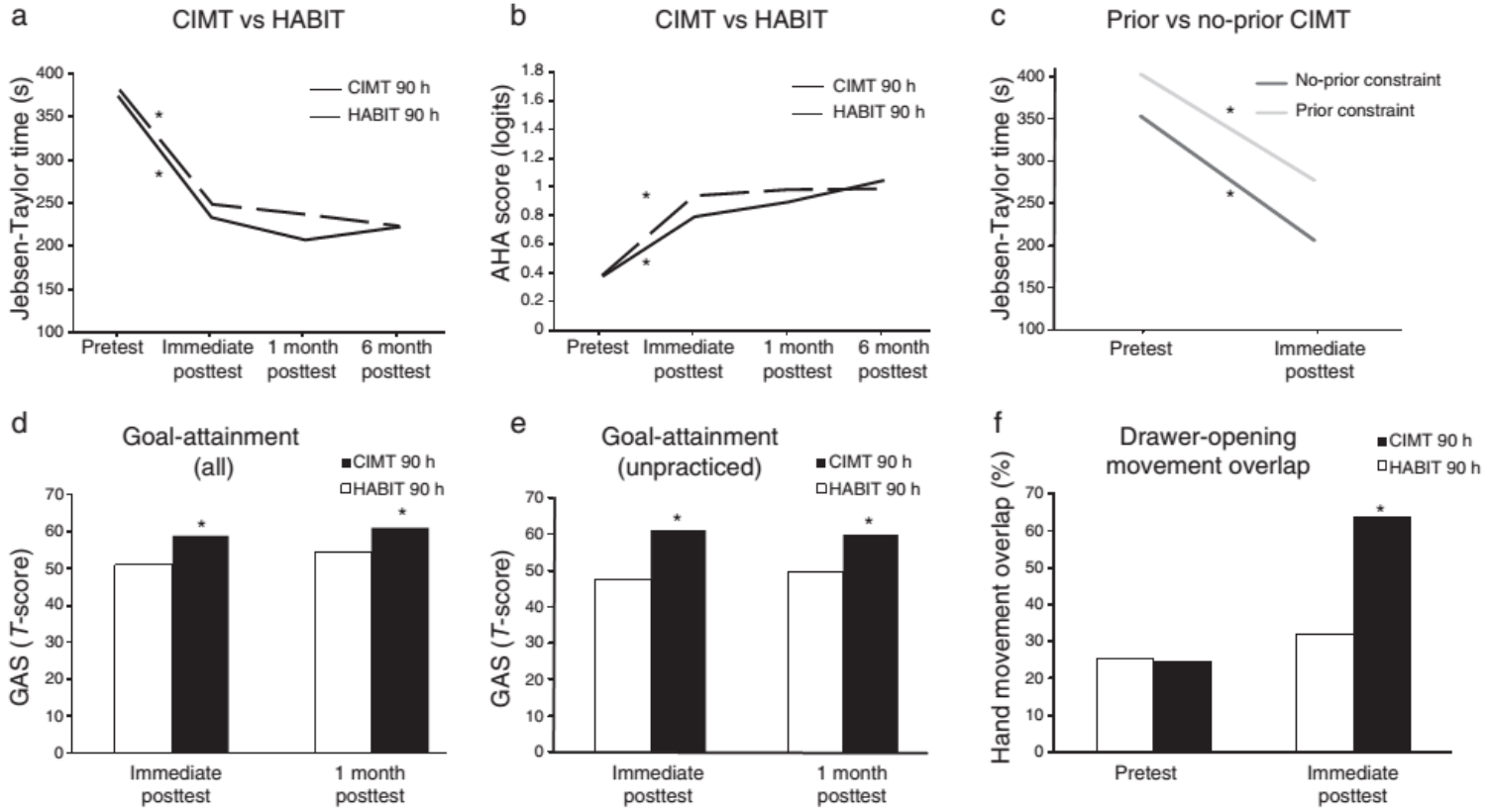
ANDREW M GORDON

Department of Biobehavioral Sciences,

Table II: Criteria for selection of constraint-induced movement therapy (CIMT) or bimanual training

	CIMT	Bimanual training
Dexterity	✔	✔
Bimanual assist quality	✔	✔
Frequency of use	✔	✔
Function (goals)		✔
Coordination of two hands		✔
Mild hemiplegia		✔
Severe hemiplegia		✔
Reduce impairments	✔	
Low IQ	?	
Behavioral problems	?	
Restraint tolerance problems		✔
Short duration available	?	
Diversity of activities		✔
Ease of administering	✔	

✔, preferred training protocol; ?, hypothesized.



- HABIT = CIMT
  - JHFT, AHA
- HABIT > CIMT
  - Greater in goal attainment
  - Greater in unpracticed goal attainment
    - Better transfer of practice
    - Combined CIMT/bimanual training leads to improved action planning
  - Bimanual coordination improved more when practiced directly

Age - Is earlier better ?

- No evidence that age influences CIMT/HABIT outcome (From 7 months to 30 years)

- No different in CIMT outcomes Deluca 2006, Kuhnke 2006
  - In age 4 - 8 vs 9 -13 years
  - Not similar mechanism
    - Older children generally attend to task more, work harder for gain

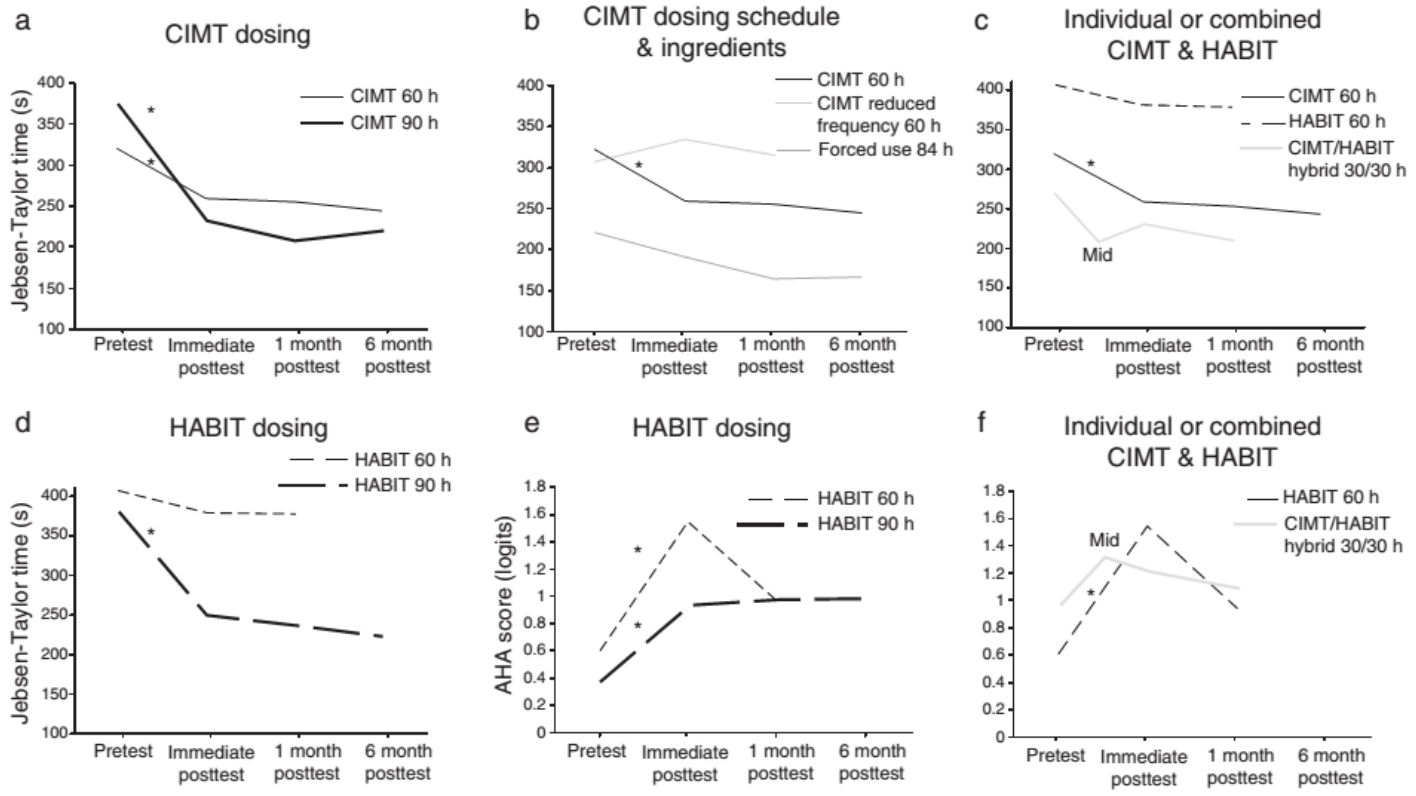
Gordon 2006, 2011

- Altered corticospinal wiring has already occurred by the time the first signs of hemiplegia emerge at approximately 6 months.

- Thus, early treatment of infants at risk may be warranted

Martin 2011

Intensity - How much is enough?



- More intensity induce favorable outcome in CIMT, HABIT
- Increased frequency is also important

CIMT vs HABIT

VS

CIMT ?

HABIT ?

CIMT vs HABIT

Developmental Neurorehabilitation, April 2013; 16(2): 133–143

informa
healthcare

Studies comparing the efficacy of constraint-induced movement therapy and bimanual training in children with unilateral cerebral palsy: A systematic review

VICKY AN-QIN DONG, IVY HSI-HSUAN TUNG, HESTER WAI-YI SIU, & KENNETH NAI-KUEN FONG

Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong, PR China

Included=7 articles

- 2 RCT
- 3 matched-pairs RCT
- 1 quasi-randomized trial
- 1 multisite RCT

Contents lists available at ScienceDirect

Research in Developmental Disabilities

The effect of intensive bimanual training on coordination of the hands in children with congenital hemiplegia

Ya-Ching Hung [a,*], Lorenzo Casertano [b], Andrew Hillman [a], Andrew M. Gordon [b]

[a] Department of Family, Nutrition, and Exercise Sciences, Queens College, City University of New York, 65-30 Kissena Blvd, Flushing, NY 11367, USA
[b] Department of Biobehavioral Sciences, Teachers College, Columbia University, 525 West 120th Street, Box 199, New York, NY 10027, USA

Research in Developmental Disabilities 32 (2011) 2724–2731

- Hemiplegic CP
- N=20 (CIMT=10, BIT=10), Age = 4-10 (Mean 6.8)
- 6h/day x 15 days = 90h
- Intervention
  - CIMT : unimanual activities with the affected limb, such as playing Connect-4 with affected hand; less-affected hand restrained by slings
  - BIT : bimanual activities such as cutting paper with the other hand orienting it
- Outcome measurements
  - Drawer opening, AHA

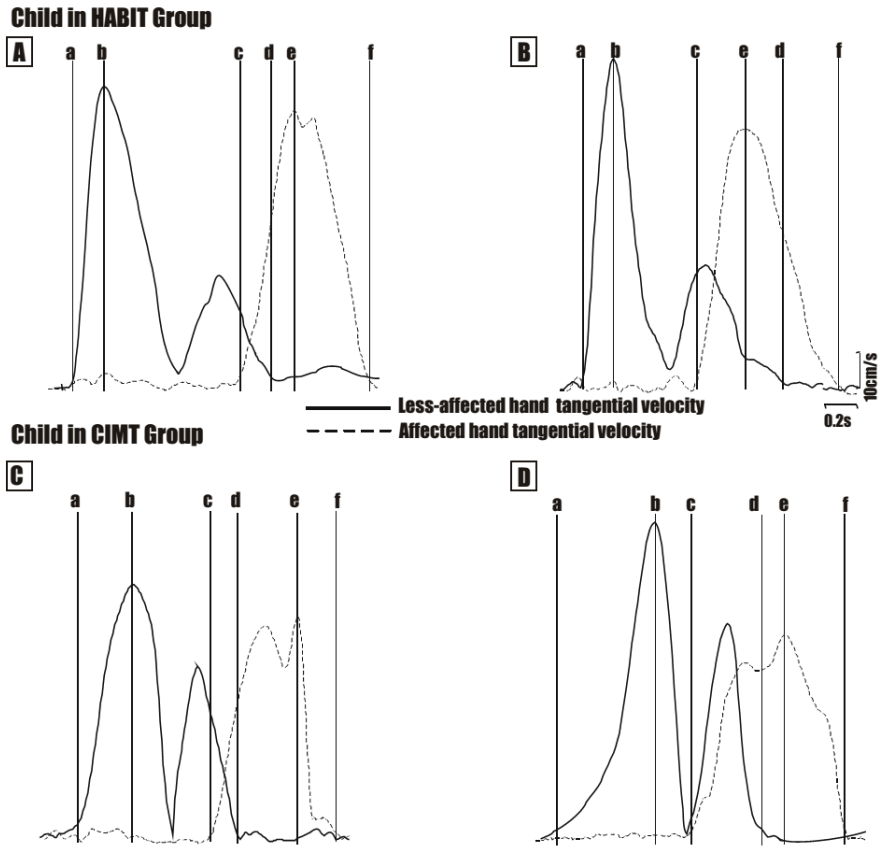


Fig. 2. Tangential velocity kinematic traces of one child with hemiplegia from each treatment group using the less-affected hand (solid traces) to open the drawer and the affected hand (dashed traces) to activate the switch. (A) Child in the HABIT group before the treatment, (B) the same subject after the HABIT treatment, (C) child in the CIMT group before the treatment, (D) the same child after the CIMT treatment. (a) Movement onset of the drawer hand. (b) Drawer hand peak tangential velocity for reaching to the drawer. (c) Onset of movement for the less-affected hand as the task hand. (d) Movement offset of the drawer hand. (e) Peak tangential velocity of the task hand. (f) Movement offset of the task hand. (c–d) Movement overlap time for the two hands. (d–f) Goal synchronization duration. Note that the velocity traces of the task hand terminate above zero if the hand does not decelerate before contacting the switch. All traces share the same scale.

Table 2
Average kinematic outcomes for participants.

Measurements (SD)	Habit ($n = 10$)	Control ($n = 10$)
Pre LAH movement overlap	24.82% (14.20)	25.54% (15.57)
Post LAH movement overlap	63.95% (35.29)	34.13% (10.43)
Pre AH movement overlap	21.14% (15.73)	17.59% (9.92)
Post AH movement overlap	21.54% (11.74)	21.53% (9.46)
Pre LAH goal synchronization, s	1.29 (0.44)	0.94 (0.39)
Post LAH goal synchronization, s	0.54 (0.30)	0.62 (0.32)
Pre AH goal synchronization, s	0.97 (0.30)	0.77 (0.24)
Post AH goal synchronization, s	0.59 (0.20)	0.64 (0.31)
Pre LAH movement time, s	2.58 (0.89)	2.11 (0.70)
Post LAH movement time, s	2.71 (0.32)	2.29 (0.53)
Pre AH movement time, s	3.78 (1.70)	2.62 (0.64)
Post AH movement time, s	3.46 (0.88)	2.93 (0.64)
Pre LAH task hand peak v, cm/s	63.54 (11.47)	70.91 (8.10)
Post LAH task hand peak v, cm/s	70.67 (17.90)	83.15 (12.40)
Pre AH task hand peak v, cm/s	78.34 (20.70)	82.07 (9.13)
Post AH task hand peak v, cm/s	84.07 (15.33)	76.57 (14.15)

Abbreviations: LAH, less-affected hand as the drawer hand; AH, affected hand as the drawer hand; SD, standard deviation; s, seconds; v, velocity.

- Both group improvement on task completion time and AHA
- BIT group > CIMT group
  - Bimanual coordination in daily activities

DEVELOPMENTAL MEDICINE & CHILD NEUROLOGY ORIGINAL ARTICLE

Randomized trial of constraint-induced movement therapy and bimanual training on activity outcomes for children with congenital hemiplegia

(2)

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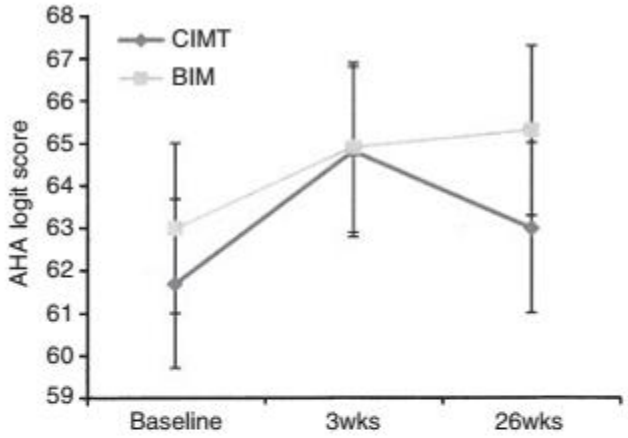
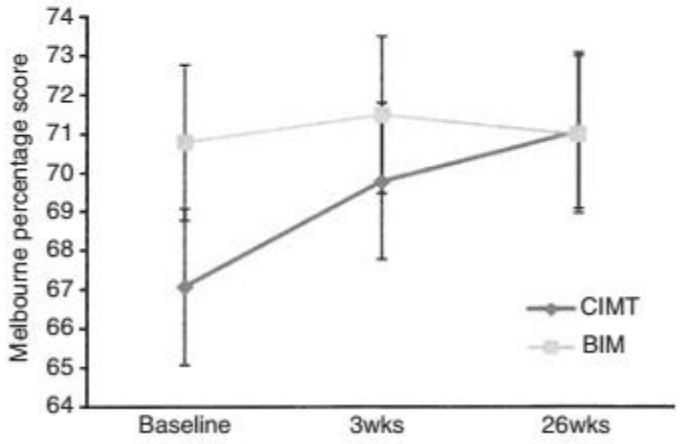
Developmental Medicine & Child Neurology 2011, 53: 313–320

- Hemiplegic CP
- N=63(CIMT=32, BIT=31), Age = 5-16 (M=10.2)
- 6h/day x 10 days = 60h in intensive day camp
- Intervention
  - Both groups provided with fine motor activities, functional goals, activities, 2-h circus training, gross UL games & debriefing.
    - BIT gp: explicit instructions on how each hand should be used before bimanual activities.
    - CIMT gp: wearing a glove on unaffected hand to prevent grasp during unimanual activities
- Outcome measurements
  - MUUL, AHA / Grip, Moving 2-pt, JTTHF

Table III: Difference and changes over time for activity outcomes between CIMT and BIM training groups

	Difference between groups		Change in CIMT		Change in BIM	
Baseline to	3wks[a]	26wks[b]	3wks[c]	26wks[c]	3wks[c]	26wks[c]
Estimated mean difference (95% CI)[d]						
MUUL	1.8 (−0.3 to 4.0)	4.4 (2.2 to 6.7)	2.8 (1.2 to 4.3)	4.5 (2.9 to 6.1)	0.9 (−0.6 to 2.5)	0.0 (−1.5 to 1.6)
	0.1	<0.001	<0.001	<0.001	0.3	0.9
AHA	1.2 (−1.2 to 3.5)	−0.7 (−3.1 to 1.7)	3.1 (1.4 to 4.7)	1.6 (−0.1 to 3.4)	1.9 (0.2 to 3.6)	2.3 (0.6 to 4.0)
	0.3	0.6	<0.001	0.06	0.03	0.008
JTTHF	−11.1 (−41.7 to 19.4)	−25.7 (−57.0 to 5.7)	−26 (−47.6 to −4.4)	−60 (−82.5 to −37.5)	−14.9 (−36.3 to 6.5)	−34.3 (−56.2 to −12.5)
	0.5	0.1	0.02	<0.001	0.2	0.002





- CIMT = BIT
  - AHA, JTTFH
- CIMT group > BIT group
  - MUUL

Bimanual Training and Constraint-Induced Movement Therapy in Children With Hemiplegic Cerebral Palsy: A Randomized Trial

Neurorehabilitation and Neural Repair
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DOI: 10.1177/1545968311402508
http://nnr.sagepub.com
SAGE

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- Hemiplegic CP
- N=42(CIMT=21, BIT=21), Age = 3.5-10 (M=6.3)
- 6h/day x 15 days = 90h in day camp
- Intervention
  - Both gps shared common intensive progressive task practice based on motor learning
  - BIT : absence of restraint and tasks were progressed bimanually. Children engaged in age-appropriate fine- and gross-motor bimanual activities such as stabilizing paper while drawing, reorienting paper while cutting.
  - CIMT : less-affected hands were restrained with slings and unimanual activities performed with paretic hands. Children performed fine- and manipulative gross-motor activities, including age-appropriate, unimanual functional and play activities
- Outcome measurements
  - AHA, JTTHF / QUEST, GAS

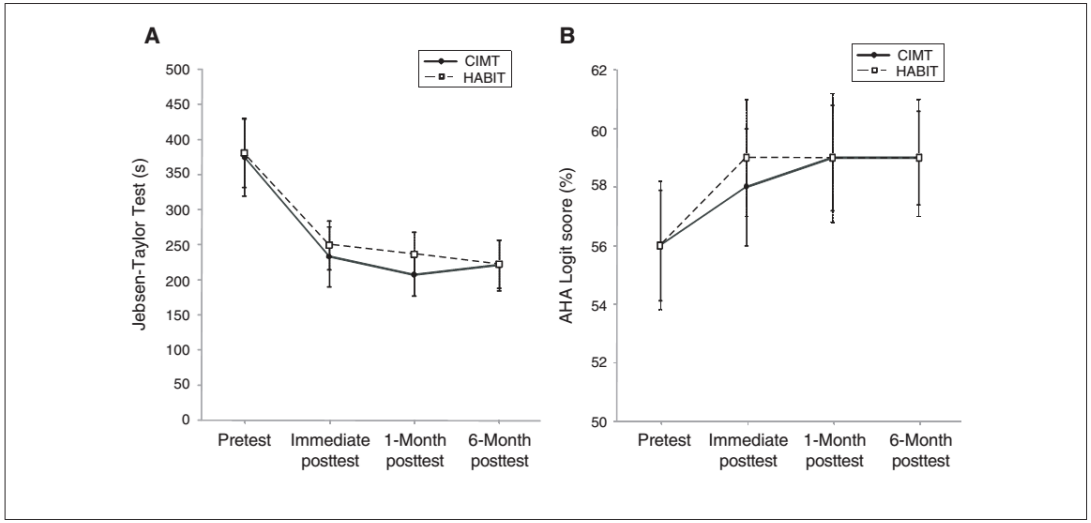


Figure 2. A. Mean ± standard error of the mean (SEM) time to complete the 6 timed items (writing excluded) of the Jebsen-Taylor Test of Hand Function. Faster times correspond to better performance. The maximum allowable time to complete each item was 180 s, resulting in a maximum score of 1080 s. B. Mean ± SEM scaled logit scores on the AHA; higher scores represent better performance. Abbreviations: CIMT, constraint-induced movement therapy; HABIT, Hand-Arm Intensive Bimanual Therapy; AHA, Assisting Hand Assessment.

	Immediate Posttest (95% CI)	1-Month Posttest (95% CI)	6-Month Posttest (95% CI)	Group Effect *P* Value (Partial η^2)	Test Session Effect *P* Value (Partial η^2)	Interaction *P* Value (Partial η^2)
GAS (*T* score—all goals)[b]						
CIMT	51.0 (47.5, 54.4)	54.5 (51.5, 57.6)	59.0 (55.8, 62.3)	—	—	—
HABIT	59.1 (55.6, 62.7)	61.3 (58.1, 64.4)	63.8 (60.5, 67.0)	—	—	—
Mean	55.0 (52.6, 57.5)	57.9 (55.7, 60.1)	61.3 (58.9, 63.7)	*P* < .001 (.264)	*P* < .001 (.235)	*P* = .412 (.022)
GAS (*T* score—unpracticed)						
CIMT	47.5 (39.4, 55.6)	49.5 (42.9, 56.1)	59.5 (53.5, 65.5)	—	—	—
HABIT	60.0 (50.3, 69.7)	60.7 (52.8, 68.6)	61.4 (54.2, 68.7)	—	—	—
Mean	53.8 (47.4, 60.1)	55.1 (50.0, 60.3)	60.5 (55.8, 65.2)	*P* < .05 (.258)	*P* = .076 (.158)	*P* = .174 (.110)

Abbreviations: CIMT, constraint-induced movement therapy; HABIT, Hand-Arm Intensive Bimanual Therapy; CI, confidence interval; GAS, Goal Attainment Scale.

[a]Other play activities included braiding hair, holding a book or cards, playing with Legos, dressing a doll, and using a remote car.

[b]Average of functional and play *T* scores; Mean, refers to the mean of the CIMT and HABIT groups.

- BIT = CIMT
  - on AHA, JTTHF
- BIT group > CIMT group
  - On GAS

ORIGINAL RESEARCH ARTICLE

Multisite Trial Comparing the Efficacy of Constraint-Induced Movement Therapy with that of Bimanual Intensive Training in Children with Hemiplegic Cerebral Palsy

Postintervention Results

ABSTRACT

Facchin P, Rosa-Rizzotto M, Visonà Dalla Pozza L, Turconi AC, Pagliano E, Signorini S, Tornetta L, Trabacca A, Fedrizzi E, GIPCI Study Group: Multisite trial comparing the efficacy of constraint-induced movement therapy with that of bimanual intensive training in children with hemiplegic cerebral palsy: postintervention results. Am J Phys Med Rehabil 2011;90:539–553.

Am. J. Phys. Med. Rehabil. • Vol. 90, No. 7, July 2011

- Hemiplegic CP
- N=105(CIMT=39, BIT=33, Control=33), Age = 2-8
- 3h/day x 30 days = 90h in rehab center
- 4h/day x 30 days = 120h at home
- Intervention
  - BIT (IRP) gp: implied a bimanual use in play and ADLs.
  - mCIMT gp: using affected hand during training program and wearing a fabric glove with a built-in volar stiff plastic splint on the dominant hand to prevent fingers flexing and grasping.
  - ST gp (Control gp): children undergoing 1 h standard treatment sessions once or twice a week
- Outcome measurements
  - Bests Scale, QUEST / General assessment, Cognitive level, GMFM

TABLE 4 Comparison among the treatment approaches (mCIMT *vs.* IRP, IRP *vs.* ST, mCIMT *vs.* ST)

	mCIMT *vs.* ST	mCIMT *vs.* IRP	IRP *vs.* ST
Besta Scale			
Global score	0.0536[a]	0.3797	0.0336[a]
Grasp	0.0463[a]	0.0591	0.4359
Bimanual spontaneous use	0.3860	0.3960	0.2195
ADL (2–6 yrs)	0.1217	0.4772	0.0610
ADL (7–8 yrs)	0.0073[b]	0.2944	0.2623
QUEST			
Global score	0.0014[b]	0.1628	0.0297[a]
Grasp	0.1401	0.2665	0.4223
Dissociated movements	0.0241[a]	0.1515	0.1417
Protective extension	0.0173[a]	0.1363	0.1340
Weight bearing	0.1722	0.2322	0.0317[a]

[a] $P < 0.05$, Mann-Whitney test.

[b] $P < 0.01$, Mann-Whitney test.

mCIMT, modified constraint-induced movement therapy; IRP, intensive rehabilitation program; ST, standard treatment.

- BIT (IRP) = mCIMT
  - Besta Scale, QUEST
- mCIMT > ST
  - Besta Scale(Global, grasp, ADL), QUEST (Global, Dissociated movement, Protective extension)
- BIT (IRP) > ST
  - Besta (global, weight bearing), QUEST (global)

Conclusion

- CIMT = HABIT
  - Improving impaired arm function, overall functional performance
  - CIMT > HABIT
    - Improving impaired arm function
  - HABIT > CIMT
    - Bimanual, functional tasks

Evidence based guideline

Cincinnati Children's Hospital Medical Center

Health Policy & Clinical Effectiveness Program

Evidence-Based Care Guideline

Pediatric Modified Constraint Induced Movement Therapy (mCIMT) plus Bimanual Training (BIT)[a]

Publication Date: December 2014

Inclusion criteria

Target Population

Inclusions:

Patients over one year of age[b] with:

- unilateral upper extremity impairment(s) associated with neurological conditions
  (e.g. cerebral palsy, traumatic brain injury, tumor resection, brachial plexus injury, etc.)
- a caregiver able and willing to commit to the time required for daily procedure and follow-up care

Table 1: Measurement Tools by Age Group

Assessment Category	Assessments	1-2 yrs	3 yrs	4-7 yrs	8-18 yrs	Adult
Classification Tool	Manual Ability Classification System (MACS) *(Eliasson 2006 [2a])*			X	X	
Individualized Patient Family Goals	Canadian Occupational Performance Measure (COPM) *(Law 2005 [5])*	X Care-giver Report	X Care-giver Report	X Care-giver Report	X Client if possible	X Client if possible
	Goal Attainment Scaling *(Kiresuk 1994 [5])*	X	X	X	X	X
Activity - Unimanual Capacity	Melbourne Assessment 2 (MA2) *(Randall 1999 [5])*	2.5 →			15	
	Quality of Upper Extremity Skills Test (QUEST) *(DeMatteo 1992 [5])*	1.5 →			8	
Activity - Bimanual Performance	Assisting Hand Assessment *(Krumlinde-Sundholm 2007 [2a])*	1.5 →			12	
	ABILHAND-Kids *(Arnould 2004 [5])*				6 → 15	
	Children's Hand-Use Experience Questionnaire (CHEQ) *(Skold 2011 [2a])*			6 →	18	

Table 2: Protocols

	Protocol 1	Protocol 2	Protocol 3
Model of Therapy	Intensive	Intensive	Frequent
Duration of Intervention	3 weeks	6 weeks	8 weeks
Duration of mCIMT/BIT	2 weeks mCIMT 1 week BIT	4 weeks mCIMT 2 weeks BIT	5 weeks mCIMT 3 weeks BIT
Dosage of treatment with therapist	1-2 hours per day for at least 3 days per week	1-2 hours per day; 3 days per week	1-2 hours per day for one day per week
Structured Practice with Caregiver	3 hours **per day** when not with therapist	2-4.5 hours **per week**	4-6 hours **per week**
Method of Constraint (in alphabetical order)	Ace Wrap Pedi-wrap Splint/Glove Removable Cast	Ace Wrap Pedi-wrap Splint/Glove Removable Cast	Ace Wrap Pedi-wrap Splint/Glove Removable Cast

(Hoare 2013 [2a], Case-Smith 2012 [2a], Eliasson 2011 [2a], Sakzewski 2011 [2a], Geerdink 2013 [2b], Eliasson 2005 [3a], Gordon 2006 [3b], Charles 2007 [4a], Eliasson 2009 [4b], Vaz 2010 [5a], Martin 2008 [5a])

Dosing

- It is recommended that a combination of mCIMT followed by bimanual training (BIT) be implemented **at least 48-63 hours** during an episode of care to expect clinically significant results

(Hoare 2013 , Case-Smith 2012, Eliasson 2011, Sakzewski 2011, Geerdink 2013, Eliasson 2005, Gordon 2006)

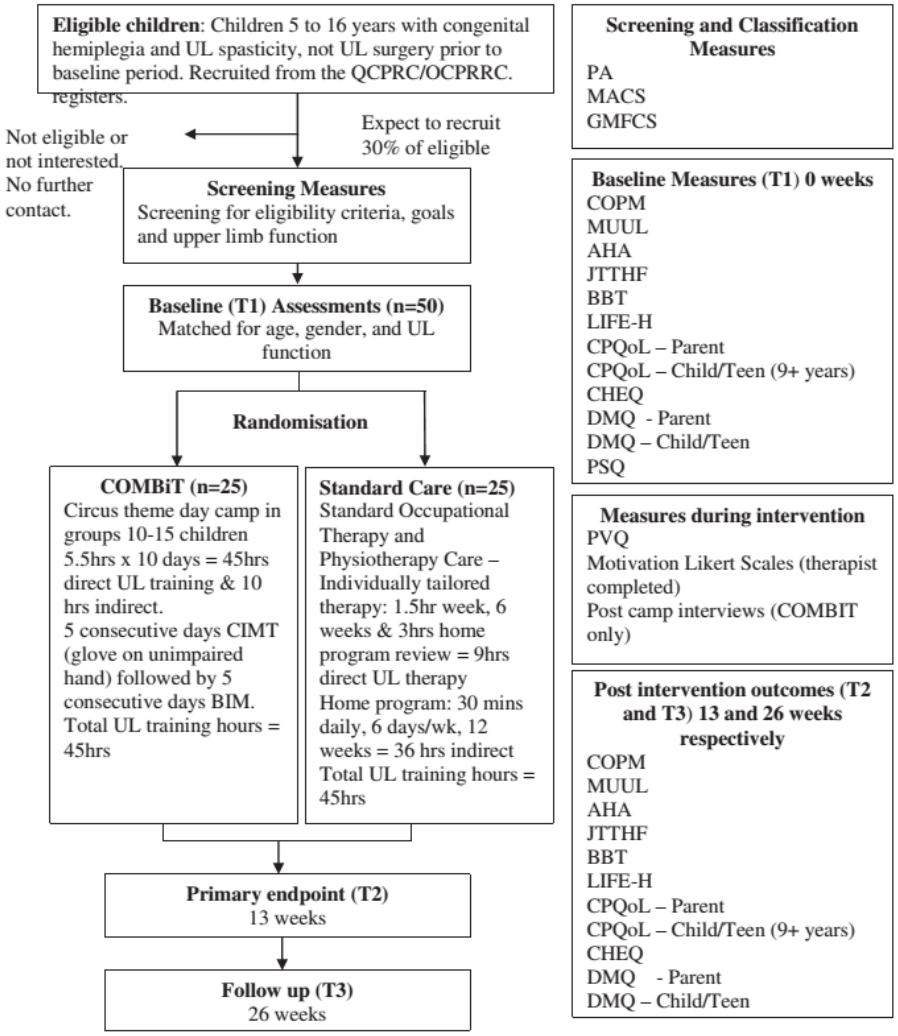
Boyd *et al. BMC Neurology* 2013, **13**:68
http://www.biomedcentral.com/1471-2377/13/68

BMC Neurology

STUDY PROTOCOL Open Access

COMBIT: protocol of a randomised comparison trial of *COM*bined modified constraint induced movement therapy and *bi*manual intensive *t*raining with distributed model of standard upper limb rehabilitation in children with congenital hemiplegia

Roslyn N Boyd[1,2*], Jenny Ziviani[2,3], Leanne Sakzewski[1,2], Laura Miller[1,2], Joanne Bowden[1], Ross Cunnington[4], Robert Ware[7,8], Andrea Guzzetta[1,9], Richard AL Macdonell[6,10,11], Graeme D Jackson[6,10,12], David F Abbott[6,10] and Stephen Rose[5]



Key:-
AHA- Assisting Hand Assessment. BBT- Box and Blocks Test. CHEQ- Children's Hand Use Experience Questionnaire. CPQoL- Adult, Cerebral Palsy Quality of Life – Adult. CPQoL- Child, Cerebral Palsy Quality of Life – Child. COPM- Canadian Occupational Performance Measure. DMQ- Child/Teen, Dimensions of Mastery Questionnaire – Child/Teen. DMQ– Parent, Dimensions of Mastery Questionnaire – Parent. GMFCS – Gross Motor Function Classification System. JTTHF- Jebsen Taylor Test of Hand Function. LIFE-H- Assessment of Life Habits. MACS- Manual Ability Classification System. MUUL- Melbourne Assessment of Unilateral Upper Limb Function. PA- Physical Upper Limb Assessment. SQ- Study Questionnaire. UL- Upper limb. PSQ- Triple P Parenting Scale Questionnaire. PVQ- Pediatric Volitional Questionnaire

Figure 1 CONSORT flow chart for COMBiT trial.

Clinical Messages

- CIMT = HABIT
  - Improving impaired arm function, overall functional performance
  - **CIMT** > HABIT
    - Improving impaired arm function
  - **HABIT** > CIMT
    - Bimanual, functional tasks

- Currently, combination of the CIMT and BIT is suggested
- Optimal component, dosage of intervention, feasibility of home practice shoulder be considered.
- Child friendly, Least invasive as possible
- Not one time miracles
- Clinicians should not constrain their thinking with constraints

Thank you for your attention