Pediatric CIMT Evidence Table

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Citation	Design	Objective	Participants	Intervention	Findings	Level of Evidence & Quality Score
Group Design						
2010 Facchin et al.[1]	RCT (multi-center)	To compare the effects of an mCIMT program, bimanual training program, and standard treatment	N= 105 Hemiplegic C.P. Age: 2-8 years	***Group 1****:* mCIMT (volar glove) + intensive rehab program (3h/day) x 7d/week x10 weeks ***Group 2;*** Bimanual+intensive rehabx7d/weekx10 weeks ***Group 3:*** Traditional Rehab (1 hr/1-2x/week) x10 weeks	• Both the mCIMT and bimanual groups significantly improved paretic hand function on QUEST & Besta Scale. Standard treatment group did not. • Grasp improved in mCIMT more than bimanual training (p<.01) • Bimanual spontaneous use in play (p=.0005), ADLs in children aged 2-6 years (p<.0001), and unaffected limb (p=.02) improved more in bimanual than mCIMT group	I 7/7
2010 Boyd et al.	RCT (single blind matched pairs)	To determine if CIMT is more effective than bimanual training to improve UL function, participation & QoL	N= 52 Hemiplegic CP Age: 5-16 years	***Group 1:*** CIMT (mitt) worn 6h/day during group therapy x 5d/week x 2 weeks at camp ***Group 2:*** 6h/day bimanual therapy in a group x 2 weeks at camp (Used Circus training theme)	• Methods paper. See Sakzewski et al. 2011(a,b.c) below for results	II n/a
Sakzewski et al., 2011a	Same as above	Same as above	N=63 Hemiplegic CP Age= 5-16 years	***Same as above***	• CIMT group had greater outcomes at 26 weeks (p<.001) • Both groups had significant improvement in bimanual performance at 3 weeks, and gains were maintained by the bimanual group at 26 weeks (p=.008) • There were minimal differences between the two training approaches	II 6/7
Sakzewski et al., 2011b	Same as above	To determine if CIMT is more effective than bimanual training to improve occupational performance & participation	N=64 Hemiplegic CP Age: 5-16 years	***Same as above***	• Both groups made significant changes on occupational performance and participation outcomes at 3 weeks on COPM (p<.001) and LIFE-H for the CIMT group (p=01) & bimanual group (p=.06) and results were maintained at 26 weeks • There were minimal differences between the two training approaches	II 6/7
Sakzewski et al., 2011c	Secondary analysis of 2010 study above	To determine the characteristics of best responders in an RCT comparing CIMT to bimanual training (above)	Same as above	***Same as above***	• Immediately after intervention, poorer baseline hand function predicted a best response for unimanual capacity on the MUUL • At 26 weeks, the CIMT group were 21 times more likely to have a favorable outcome than the bimanual group on the MUUL • Children with left hemiplegia achieved a best response on the COPM 3.9 times more than those with right hemiplegia	II n/a

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2010 Hoare et al.[11]	RCT (study protocol)	To describe an RCT comparing mCIMT to bimanual therapy on improving bimanual UE function following Botox	N=40 Hemiplegic CP Age:18 mo-6 years	Not described	• Study not completed	II n/a
2010 De Brito et al.[2]	RCT	To evaluate effects of mCIMT followed by bimanual functional training on ADLs	N=16 Hemiplegic CP Age: 4-8 y	***Intervention Phase 1:*** 2 weeks mCIMT(elbow & shoulder sling & resting hand splint) x 3h/day (constraint worn 10 h/day) ***Intervention Phase 2:*** 1 week functional bimanual training 3 x 45 min/day ***Control:*** 3 weeks conventional OT 1 x 45 min/week	• Both control and intervention groups improved with significant differences in PEDI functional skills (P=0.0027) and independence (p=0.0492) • Both control and intervention group improved on JTTHF (not statistically significant)	II 6/7
2010 Aarts et al.[3]	RCT	To investigate if 6 week mCIMT followed by 2 week bimanual (mCIMT-BiT) improves affected limb use	N=50 Right sided hemiplegic CP Age: 2.5-8 years	***Intervention*:** mCIMT-BiT group (re-movable hand & arm sling) worn 3h/day for 3d/week x 6 weeks, followed by bimanual for 2 weeks. ***Control:*** OT/PT usual therapy 1.5h/week x 8 weeks + encouragement to use affected hand 7.5h/week	• Significant improvement in AHA, ABIIL, COPM, & GAS scores for intervention group • Improvement in MUUL scores for intervention group (not statistically significant)	II 5/7
2010 Psychouli et al[8]	Randomized Crossover Design	To identify most appropriate splint from children's and parent's perspectives	N= 9 Hemiplegic CP Age: 5-11 years	**Intervention:** Participants wore 1 of 3 splint styles for minimum 1h/day for 4 days and moved on to trialing remaining 2 styles for 12 day intervention **Splint 1:**CIMT using hand splint (mitt) **Splint 2**:CIMT using hand splint up to level of elbow **Splint 3:** Long arm splint from fingertips to shoulder	• Affected limb movement improved with all splints, • Greatest movement in effected limb elicted with mid-arm splint (as measured by actomometer) • Parents preferred mid arm splint to others & had most negative attitude toward long arm splint	II 2/7
2009 Smania et al.[4]	Randomized Crossover Design	To compare the effects of mCIMT with conventional physiotherapy	N=11 Hemiplegic CP Age: 1-9 years	***Intervention:*** mCIMT (cotton mitt) worn 8h/day for 5 weeks with 1 hour therapy 2x/week ***Control:*** no restraint, regular therapy 2x/week for 5 weeks	• mCIMT program caused significant improvement of paretic arm use and function. Trend shown toward improvement of bimanual function. • Effects maintained at 4 week follow up.	II 5/7
2009 Saczewski et al.[6]	Cross sectional cohort study	To explore relationship between unimanual and bimanual performance for children with CP	N= 85 (total) Hemiplegic CP=70 Age:5-16 years	Compared sensation, grip strength, and movement efficiency between CP sample and 15 typically developing children matched by age and sex	• Strong relationship between unimanual and bimanual performance (MUUL) • Directionality remains unknown therefore cannot assume improvement in unimanual performance will lead to gains in bimanual	III 5/7
2008 Kuhnke et al.[15]	Cohort with control	To determine whether the type of corticospinal organization or re-organization influences the efficacy of CIMT	N=16 Congenital hemiparesis Age:10-30 y	**Group 1:** Ipsi-periventricular lesions **Group 2:** Cortico-subcortical lesions **Intervention(both groups):** Constraint *(*Mitt and sling) worn10h/day for 12 days + group and individual therapy for ~ 9 h/day for 6/7 days/ week	• Both groups significantly improved on WMFT • Post-treatment speed to execute tasks was statistically different & clinically relevant between groups (those with ipsi-perventricular lesions were slower to execute movements than those with cortico-subcortical lesions)	III 5/7
2009 Eliasson et al.[7]	Cohort Design with control	To investigate if 2 week day camp model of CIMT is feasible post Botox & to investigate replicability of previous study	N=16 (total) Hemiplegic CP Age: 8-17 years	**Intervention Group (CIMT + Botox):** Restraining mitt (allowing gross hand movements for stabilization & bimanual tasks)worn ~7h/day x 9 days (over 2 weeks of camp) **Control (CIMT only-no Botox):** Same treatment as above	• Significant improvement in JTHFT in CIMT group • Immediate improvement in MUUL in Botox + CIMT group, not sustained 6 months post; no improvement in CIMT only • No change in AHA for either group • Significant improvement in grip strength, in hand manipulation (IHM), task specific performance in CIMT only, improvement in Botox + CIMT	III 3/7

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2009 Park et al.[12]	Cohort with control	To investigate mCIMT following Botox on UE function	N=32 Hemiplegic CP Age: 1-9 years	**Intervention*:* Botox + CIMT** CIMT (long arm cast) worn all waking hours for 3 weeks (6/7 days of the week) + direct therapy 2h/day **Control: Botox only** No CIMT, direct therapy (OT & PT) 2h/day	• Significant improvements in MTS, MAS, ROM, and PRS for both groups • Significant improvement in PMAL in CIMT group	III 2/7
2010 Cope et al.[9]	Cohort without concurrent control	To investigate effectiveness of CIMT and examine use of fMRI to describe changes in the brain	N=10 Hemiplegic CP Age: 7-14 years	CIMT (short arm bi-valved cast) worn 90% of waking hours + therapy 4h/day x 5d/week (40h total)	• Positive functional changes reported in parent questionnaire, not statistically significant • Improvements in ROM (not significant), MUUL (weak significance with small effect size) • Sig. improvement in kinematic analysis of UE • 2/7 children showed greater activation in 1° motor area of contralateral side on fMRI post CIMT	IV
2009 Stearns et al.[13]	Before-after design (A-B-A-A)	To determine if improvements in hand function and changes in muscle activation are associated with functional gains after 2 week CIMT	N=6 Hemiplegic CP Age: 5-8 years	**Intervention:** Bi-valve cast worn 8-12h/day + therapy 4h/day for 5d/week for 2 weeks. Phase A: 2 weeks baseline assessment Phase B: 2 weeks of OT intervention Phase A-2: 2 weeks post intervention assessment Phase A-3: 3 months after intervention	• Significant improvement in grip strength from baseline to all phases except at 3 month follow up • Pinch gauge, Modified 9-hole peg, & Box and Block test showed significant improvement • EMG was inconclusive	IV
2008 Wallen et al.[16]	Cohort study without control group	To determine feasibility of family focused mCIMT model & to collect preliminary data for an RCT	N=10 Hemiplegic CP Age: 2-8 years (eligible from 6 mos onwards)	Constraint (mitt with solid volar insert) worn 2h/day targeting specific movements during child's daily activities 7d/week for 8 weeks. Weekly therapy 1 time/week to support individualized home program.	• Statistically significant improvement in COPM, GAS, • AHA scores & MUUL improved but were not statistically significant • 8/10 participants PMAL's improved (statistically significant) • No statistically significant change in MTS	IV
2007 Juenger et al.[17]	Cohort study without control group	To assess neuro-modulative effects of CIMT in congenital hemiparesis	N= 10 Congenital hemiparesis Age: 10-30 years	CIMT (tailored glove inhibiting finger flexion and an elbow sling) worn 9h/day for 12 day training camp, consisting of 2 h/ day of individual therapy + 7 h/day group therapy.	• Improvement in time & quality of movement and increased passive and active movement of paretic hand on WMFT • Significantly increased cortical activation after CIMT for 4 patients on fMRI.	IV
2007 Sutcliffe et al.[18]	Cohort without concurrent control	To demonstrate change in cortical activity patterns after mCIMT & explore baseline predictors of change	N=5 Hemiplegic CP Age: 7-13 years	Continuous (24h) cast from elbow to fingertips for 3 weeks with therapy 1x/week. Weekly therapy 1 time/week to support home program.	• All participants showed contra lateral activation post intervention on fMRI • Significant improvement shown on PMAL • Inconsistent changes on QUEST and AHA • Significant improvement on limb disregard index	IV
2007 Charlets et al.[19]	Before-After design (A-B-A-B-A)	To investigate long term effects of CIMT & effect of a second course on involved limb function	N=8 Hemiplegic CP Age: 5-11 years	Arm and hand sling worn 6h/day with structured practice for 10/12 consecutive days in group setting	• Significant improvement on JTTHF, BOT-2, & caregiver functional use survey after first intervention were retained at 6 and 12 months • There were further improvements after second intervention but were not statistically significant	IV

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2009 de Bode et al.[14]	Case Series (Feasibility Study)	To evaluate if shortened CIMT protocol results in improvements in UE function & changes in brain imaging (sensorimotor cortex)	N=4 Hemiplegia post cerebral hemipherectomy Age: 12-22 years	Hand splint worn 90% of waking hours for 11 days + therapy 3h/day x 3d/week (total stimulation time 30h).	• Immediate improvements on AAUT and BBT • No improvements in FM • fMRI did not show increased activation, but subtle shifts in location of activation were seen • fMRI is a useful tool to detect re-organization in the remaining hemisphere	IV
2009 Buesch et al.[20]	Single Case Series	To examine if CIMT is feasible for community settings and improves function	N=2 Obstetric brachial plexus palsy Age: 12 years	Forearm and hand splint worn 4-6 hours per day for 7d/week with structured therapy for 3-4.5 weeks of intervention.	• Slight improvement (not significant) on MUUL & AHA • No improvement on the 9 hole peg test	IV
2008 Fergus at al.[23]	Case Report	To describe qualitative and quantitative changes in UE function after CIMT	N=1 Stroke at 11 months ABI Age:13 months	CIMT (soft-removable mitt) *Phase 1:*Splint worn 6 h/day during daily activities *Weaning:* Decreased constraint time by 1h/wk x 5 weeks *Phase 2:* 9 weeks of CIMT + home exercise program 1h/day + less structured play	• Flexion, reach, grasp and release and hand to hand transfers improved on video analysis • Improved willingness to use & performance on PMAL	V
2007 Boll [illegible]	Case Study	To describe functional recovery post CIMT	N=1 Neonatal stroke Age: 7 months	Held arm and hand back	No contributions for guidelines	V
Qualitative Study Design						
2010 Gilmore et al.[10]	Qualitative	To explore the experiences of children participating in mCIMT within a circus themed day-camp	N=32 Hemiplegic CP Age:9-11 years	Day camp (sample taken from a larger INCITE trial) Semi-structured interviews examined the child's experience.	3 main themes emerged from interview data. • Glove experience- discomfort & frustration • Doing the camp- effort, travel, fun, group experience, and activity choices • Gains- achieved goals and improved function Self determination theory described enhancers & barriers. • Enhancers outweighed the barriers	n/a
Single Subject Research Design (SSRD)						
2007 Dickerson et al.[26]	(ABA) SSRD	To describe effects of CIMT for a 24 month old in the home environment	N=1 Hemiparesis post prenatal stroke Age:24 months	CIMT (removable splint) worn for most of waking hours + 6h/day therapy during 21 day home intervention	• Improvement in grasp, release, reach, sustained grasp, push/pull, and finger feeding on video analysis.	IV 9/ 14
2009 Coker et al.[21]	(A-B-A-B) SSRD	To evaluate effectiveness of mCIMT for a child <1 y	N=1 Neonatal Stroke Age: 9 months	Cloth mitt worn 1 h/day for 7d/week. Structured practice in home 3d/week & in clinic 4d/week for 30 days with one month off and then another 30 days.	• Improved scores on PDMS-2 & GMFM • Improved reaching, weight bearing, and approaching midline as measured on video analysis	IV 7/ 14
2008 Martin et al.[22]	(A-B-A-A) SSRD	To explore changes associated with a CIMT trial on a child's function at all ICF levels.	N=1 Spastic CP Age: 3 years, male	CIMT (bi-valved removable cast covering mid-upper arm to fingertips) worn ~7.5h/day with active therapy 4h/day for 6 d/week for 2 week intervention	• Improved satisfaction and performance on COPM • Increased use of both hands on PEDI • Increased grip strength both hands, no change in pinch strength of hemiplegic hand	IV 7/ 14

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2008 Cope et al.[24]	SSRD	To explore short and long term effects of mCIMT on child & family	N=1 R sided hemiplegia with suspected CP Age:12 months	CIMT (non-removable hand and arm cast) + therapy 8h/week for 2 week home intervention	• No sig. improvement on PDMS, PMAL & TAUT • Increase in UE function, gross motor skills and speech and communication on Knox questionnaire • Findings support mCIMT safe intervention and parents were pleased with the changes.	V 6/ 14

Abbreviations

AAUT	Actual Amount of Use Test
ABIL	ABILHAND-Kids
ADL	Activities of daily living
BBT	Box and Block Test
BOT-2	Bruininks Osteretsky Test of Motor Performance-2
CAPE	Children's Assessment of Participation and Enjoyment
COPM	Canadian Occupational Performance Measure
CP	Cerebral Palsy
fMRI	Fucntional Magnetic Resonance Imaging
FM	Fugl Meyer Test of Motor Recovery
GMFCS	Gross Motor Functional Classification System
JTTHF	Jebsen-Taylor Test of Hand Function
LIFE-H	Assessment of Life Habits
MACS	Manual Ability Classification System
MAS	Modfied Ashworth Scale
MCIMT	Modified Constraint Induced Movement Therapy
MTS	Modified Tardieu Scale
MUUL	Melbourne Assessment of Unilateral Upper Limb Function
PEDI	Pediatric Evaluation of Disability
PMAL	Pediatric Motor Activity Log
PRS	Upper Limb Physicians Rating Scale
QUEST	Quality of Upper Extremity Skills Test
ROM	Range of Motion
SFA	School Function Assessment
SSRD	Single Subject Research Design
WMFT	Wolf Motor Function Test

Note: Quality Scores for Single Study Research Designs obtained using AACPDM Singe Subject Quality Tool; Quality Scores for Group Designs obtained using AACPDM adaptation of Sackett's Levels of Evidence (2008) and AACPDM Quality Assessment Scale for studies Levels I, II, or II