## Table 6. Studies on Supplemental Interventions

| Author & Year | Study Design/ Level of Evidence | Participants | Experimental vs. Comparison Groups | Intervention | Results | Clinical Implications |
| --- | --- | --- | --- | --- | --- | --- |
| Kwon and Park 2014 | RCT, Level II | 20 infants with CMT < 3 mo with entire SCM involvement, palpable SCM mass | (1) EX + US + Microcurrent on (n=10)  (2) EX + US + Microcurrent off (n=10) | Both groups:  Intervention 3x/wk; US 5 min + EX (ROM, postural training, manual SCM stretching [3 x 15 reps, 1 sec hold, 5-10 sec rest]) 20 min + Microcurrent 30min (on/off) as per group assignment.  Both groups:  HP of ROT & LAT FLEX stretches, 10x/session, 6x/day; Positioning and handling to promote ROT towards affected SCM. | ROT PROM (AP): 1,2,3 mo post-tx was significantly greater in microcurrent group vs. control; NS at 6 mo.  SCM Thickness, CSA, red pixel intensity (SE): 3 mo post-tx significant differences in microcurrent group vs. control.  Tx duration: shorter in microcurrent group (2.6 mo) compared to control (6.3 mo). | The addition of microcurrent resulted in shorter  tx duration. |
| Kim et al, 2009 | Control trial, Level III | 15 infants with CMT | (1) Microcurrent (n=7),  (2) PT (n=8) | Both groups:  Intervention 3x/wk for 2 wks as per group assignment:  (1) 30 min Microcurrent + 2 min stretching,  (2) 30 min ROM exercises + postural training + stretching (control). | ROT PROM (AP): improvement greater in microcurrent group.  Head Tilt in supine (AP): improvement greater in microcurrent group.  Crying: less incidence in microcurrent group. | Greater improvement in head tilt and ROT PROM after 2 wks microcurrent and stretching intervention versus PT. |
| Giray et al 201627 | RCT, Level II | 33 infants with CMT, 3-12 mo | (1) EX+ inhibitory KT on involved SCM (n=12)  (2) EX+ inhibitory KT on involved SCM + facilitory KT on uninvolved SCM (n=10)  (3) EX only (n=11) | All groups:  30 min EX 2x/wk for 3 wks consisting of ROM, stretching, strengthening, head and trunk strengthening; KT applied after EX as per group assignment.  Parents performed intervention 3x/day during 3 mo follow up period. | ROT & LAT FLEX PROM (AP): NS  STRENGTH (MFS): NS  CD (SSAP): NS | KT for 3 wks provided no added benefit to PT intervention. |
| Ohman et al 2015 | RCT, Level II | 29 infants with CMT ≤12 mo with LAT FLEX muscle imbalance | (1) Inhibitory KT on involved SCM (n=16)  (2) No KT (n=13) | (1) KT muscle relaxation technique to involved SCM.  (2) No KT. | STRENGTH (MFS): Significant difference between groups with KT applied: significantly lower scores on the involved side with KT & significantly higher scores on the uninvolved side with KT. | When KT applied to the involved SCM, immediate improvement in scores on the MFS. |
| Ohman et al 2012 | Retro cohort, Level IV | 28 infants with CMT <12 mo with LAT FLEX imbalance | (1) Muscle-relaxing KT on involved SCM (n=13)  (2) Facilitory KT on involved SCM (n=8),  (3) Muscle-relaxing KT on involved SCM + facilitory KT on uninvolved SCM (n=7) | (1) Muscle-relaxing KT on involved SCM.  (8) Facilitatory KT on involved SCM.  (3) Muscle-relaxing KT on involved SCM + facilitatory KT on uninvolved SCM. | STRENGTH (MFS): Significant decrease in the difference between MFS scores after KT applied with either technique. MFS score on the unaffected side and the muscle-relaxing technique were significantly associated with a decrease in the difference between the MFS scores on the unaffected and affected sides. | When KT applied, there is an immediate decrease in the difference between MFS scores on the unaffected and affected side. |
| Lee et al, 2017 | Pro cohort, Level IV | 102 infants with CMT <6 mo | (1) Intervention initiated before 6 wks (n=55)  (2) Intervention initiated after 6 wks (n=47) | Both groups:  30 min, 3x/wk consisting of US (3 min), massage (5-7 min), manual passive stretching (ipsilateral neck ROT and contralateral LAT FLEX for 10-30 sec, 10x), no HP. | SCM thickness (US): change in SCM thickness greater when treatment started before 6 wks compared to after 6 wks.  Head tilt in supine (photo): NS between groups.  ROT & LAT FLEX PROM and CD (TOA): NS between groups. | Greater improvement in SCM thickness when intervention started before 6 wks compared to after 6 wks. |
| Lee et al, 2017 | Pro cohort, Level IV | 70 infants with CMT <6 mo | (1) Grade I (<15° difference in cervical ROT; n=22)  (2) Grade II (15-30° difference in cervical ROT; n=32)  (3) Grade III (>30° difference in cervical ROT; n=16) | All groups:  30 min, 3x/wk for 6 mo consisting of US (3 min), massage (5-7 min), manual passive stretching (ipsilateral neck ROT and contralateral LAT FLEX for 10-30 sec, 10x). | Head tilt in supine (photo): Significant difference between groups before intervention, but not after 3 or 6 mo of intervention.  ROT & LAT FLEX PROM and CD (TOA): Significant difference between groups before intervention, after 3 mo of intervention, and after 6 mo of intervention with Grade I having the highest score, Grade II the middle score, and Grade III the lowest score at all time points. | Infants with CMT of different severity levels exhibit differences in TOA scores at the initiation of PT intervention and within the first 6 mos of intervention. |
| Chon et al, 2010 | Retro cohort,  Level IV | 32 infants with CMT <3 mo | (1) CMT with SCM tumor  (2) muscular CMT | 30 min, 5x/wk of 4 sets of 15 stretches with 3 min rest. MST protocol: (1) SCM stretching and (2) myofasical release with sustained finger pressure for 5-10 sec.  HP consisting of gentle stretching, massage, education (adequate head positioning and handling skills). | SCM thickness (US): in both groups, significant difference between sides pre-intervention, but not post-intervention.  ROT PROM (AP): in both groups, significant improvement from pretest to post test.  CD (radiological exam): in both groups, significant improvement from pretest to post test. | Infants with CMT with or without SCM tumor demonstrated improvements in SCM thickness, ROT PROM and CD after MST. |
| Haugen et al, 2011 | RCT, Level II | 32 infants with CMT 3 – 6 mo with cervical ROM limitations | (1) Manual therapy and PT  (2) PT only | Both groups:  PT in the home consisting of 8 wks of encouragement of symmetrical motor performance through a variety of methods, but no stretching the neck against resistance from the child.  Manual therapy visit at the hospital at baseline and after 4 wks, with manual therapy provided as per group assignment. | Changes in CMT symptoms (worse, unchanged, better, much better based on video analysis): NS  LAT FLEX PROM (worse, unchanged, better based on video analysis): NS  LAT FLEX AROM (worse, unchanged, better based on video analysis): NS | Manual therapy for 3 wks provided no added benefit to PT intervention. |
| Emery, 1994 | Pro cohort, Level IV | 100 infants with CMT < 2 years with restricted neck ROM in LAT FLEX or ROT | n/a | (P)ROM 2x/day, 5 reps, 10 sec hold.  Active EX home program-  Positioning and handling EX, prone positioning, and righting reactions in infants > 64 mos.  TOT collar was provided in infants > 4.5 mos with > 6° of head tilt.  PT instructs parents  2 person stretch. | 0% (100/101) infants achieved full PROM and complete resolution; 1 required surgery.  Duration of care = 4.7 months. Infants with SCM mass were correlated with surgery and longer duration of care.  30% subjects were fit with TOT collar. | The longer duration of care was correlated with the greater limitation in ROT (r= .42). Although, the earlier intervention was initiated, the quicker the CMT resolution. However, the restriction in passive ROT was found to be a better indicator of the episode of care length. |
| Keklicek & Uygur 2018 | RCT, Level II | 29 infants with CMT 0 – 6 mo with head tilt of 5-20° | (1) STMo and HP (n=14)  (2) HP only (n=15) | Both groups:  Instruction in HP consisting of positioning, handling strategies, environmental adaptations, strengthening exercises, and stretching (5x for each set with 30 sec stretch, 10 sec rest) performed after each diaper change. Caregivers encouraged to connect with PT 2-3x/wk via phone application.  STM group only: STM 3x/wk for 12 wks. | ROT PROM (AP): Improvement greater in STMo group after 6 wk of intervention, but NS at 12 wks and 18 wks.  LAT FLEX PROM (AP): NS  LAT FLEX AROM (MFS): NS  Head Tilt (photo): Improvement greater in STMo group after 6 wks of intervention, but NS at 12 wks and 18wks. | STM and a HP, compared to only a HP, does not improve outcomes after 12 and 18 weeks of intervention. |

Abbreviations: AP, arthrodial protractor; AROM, active range of motion; CMT, congenital muscular torticollis; CD, cranial deformation; CSA, cross sectional area; DTSM, difference in thickness of the sternocleidomastoid muscles; EX, exercise; goni=goniometer; HP, home program; KT, kinesiotaping; LAT FLEX, cervical lateral flexion; MFS, Muscle Function Scale; min, minute; mo, month; mod, moderate; MST, myokinetic stretching; n/a, not applicable; NS, not significant (p>.05); obs, observation; photo, photography; pro, prospective; PROM, passive range of motion PT, physical therapy; RCT, randomized control trial; reps, repetitions; retro, retrospective; ROM, range of motion; ROT, cervical rotation; SCM, sternocleidomastoid muscle; SE, sonoelastography; sec, seconds; SSAP, severity scale for assessment of plagiocephaly; STM, soft tissue massage; STMo, soft tissue mobilization; TOA, Torticollis Overall Assessment; TOT collar, Tubular Orthosis for Torticollis; tx ,treatment; US, ultrasound; wk, week; x, times; +, plus; /, per.