## Table 5: Studies on the First Choice Intervention

| Author & Year  | Study Design/ Level of Evidence | Participants | Experimental vs. Comparison Groups | Intervention | Results  | Clinical Implications |
| --- | --- | --- | --- | --- | --- | --- |
| Ohman et al 2010 | RCT,Level II | 20 infants with CMT < 5 mo with head tilt and limited ROM | (1) PT (n=10)(2) Parent (n=10) | (1) PT: PT stretches into LAT FLEX and ROT, 15 min, 3 day/wk, 10-30 sec hold; no stretching at home.(2) Parent: Parent stretches 3-5 sessions, 2x/day, 15 min total, 7 day/wk, 10-30 sec hold.Both groups:HP of prone positioning, carry infant with affected side down. | Treatment duration to achieve good ROM (ROT ≥90° and no side difference in LAT FLEX): shorter in PT vs Parent group. Treatment duration to achieve symmetric head posture, no head tilt (1 item on the SSAP): shorter in PT vs. Parent group  | Shorter treatment duration to achieve good ROM and symmetric head posture when stretching performed by experienced PT versus parents. |
| He et al 2016 | RCT,Level II | 50 infants with CMT < 3 mo, limited cervical ROM | (1) 50x Stretching (n=24)(2) 100x Stretching (n=26) | Both groups: 5-10 day training then parents implemented at home: 10 ROT and LAT FLEX stretches, 10-15 sec hold, 5x/day or 10x/day as per group assignment, weekly phone follow-up. | ROT & LAT FLEX ROM (AP): 100x group greater improvement at 1 and 2 mo post-tx. HEAD TILT (AP): 100x group greater improvement at 1 and 2 mo post-tx STRENGTH (MFS): NS SCM Thickness (US): NS  | Increased frequency of daily stretching resulted in decreased head tilt and increased ROT & LAT FLEX PROM. |
| Ohman et al 2011 | RCT, Level II | 37 infants with CMT < 11 mo  | (1) Handling strategies only (n=9)(2) Handling strategies + strength EX (n=13)(3) Handling strategies + strength EX, + PT (n=11) | (1) Handling strategies: prone when awake and supervised, carry and hold infant with affected side down, encourage ROT to affected side.(2) Handling strategies and strength EX: handling activities as in Group 1, slowly transitioning infant from sitting or standing to horizontal with 5-15 sec hold for 15-min.(3) Handling strategies + strength EX + PT: handling and strength EX as in Group 2 but PT helps 2-3 days/wk.All groups: strategies to prevent and reduce CD, stretching for infants with limited ROM (<90°in ROT and/or side difference in LAT FLEX). | Treatment duration to achieve symmetric head posture, no head tilt (1 item on the SSAP): NS | No differences in treatment duration with stretching and different types of AROM: handling, handling + strengthening, handling + strengthening + PT.  |
| Cheng, Wong et al., 2001; Cheng & Au, 1994 | Pro cohort,Level IV | 821 infants with CMT < 12 mo | n/a | Passive stretching 3x/week, 3 reps, x 15 stretches, 1 sec hold, 10 sec rest in between stretches. PT performs the EX.Parents were instructed in home program of positioning only, no stretching. | Treatment duration was significantly associated with the clinical group: (3.7 mo with SCM mass, 2.5 mo for muscular, 1.4 mo for postural CMT); age of presentation; passive ROT deficit; and involvement of the right side (p < 0.0001); difficult birth (p < 0.009)Surgery- 7.5% for SCM mass, 3.1% for muscular, and 0% for postural. | Controlled manual stretching is safe and effective treatment if initiated before 12 mo.The infant’s clinical subtype of CMT, age of presentation, and ROT deficits are factors that influence outcomes. |
| Demirbilek & Atayurt, 1999 | Retro cohort,Level IV | 57 infants with CMT < 18 mo | n/a | Passive stretching 4 to 5 x/day, 40 reps/set.Duration of holds and rest- not reported2 person stretches.Methods unclear for who instructs the parents and performs the exercises. Intensive therapy is reposted for infants status post SCM release with unclear methods. | Surgery: 0% of infants < 3 mo required surgery; 25% between 3-6 mo; 71% between 6-18 mo; 100% > 2-7 years of age. Overall 26% participants (15/57) required surgery  | Earlier initiation of treatment yields better outcomes. Greater CMT resolution if treatment is initiated < 3 mo.Retrospective study with no control group.Passive stretching methodology is not clear on the duration of holds and rest between sets and who performs the exercises. |
| Cameron et al., 1994 | Retro cohort,Level IV | 126 infants with CMT88 = early < 3 mo 38 = late > 3 mo  | n/a | Passive stretching 2x/day, 10 reps each session.Caregivers perform the stretching, 4 infants were admitted to the hospital for stretching due to no progress, and 1 required nurse coming to the home.No information on who instructs parents. | 100% of infants who initiated treatment < 3 mo resolved with no surgery; 45% of who initiated treatment > 3 mo of age required surgery, (P<0.005).  65% of infants had full resolution (full ROT and no asymmetry); 27% good results (full ROT and mild asymmetry or mild limitation and no asymmetry; and 8% poor results, no improvement.  | Early initiation of treatment before 3 mo of age yielded full CMT resolution.Parental education and frequent follow up were related to successful outcomes.Retrospective study with no control group or specific methodology for intervention. Intervention was altered in 5 children who were not making improvement, whose age at initiation of treatment was unclear. |
| Celayir, 2000 | ProCohort,Level IV | 45 infants with CMT< 4 mo  | n/a | PROM 8x/day (every 3 hours), 10 reps each session, hold 10 sec.PROM: flexion, extension, ROT, and LAT FLEX.Re-assess every 4 months until resolved with 1-month check after full resolution.Physician or surgeon instructs the parents. No PT in the center.HP of handling and positioning. | Surgery: 100% success, no surgery required for infants < 4 mo. Asymmetry: 80% achieved full ROT with no asymmetry; 20% achieved full ROT with mild asymmetry or mild rotation limitation and no asymmetry.Mean duration of treatment was 3.2 mo. | Study stresses importance of an intensive concise PROM program for all infants.Patients who received early treatment did not receive surgical intervention.Parent involvement in PROM and home program was important for successful outcomes. |

Abbreviations: AP, arthrodial protractor; AROM, active range of motion; CMT, congenital muscular torticollis; CD, cranial deformation; EX, exercise; HP, home program; LAT FLEX, cervical lateral flexion; MFS, Muscle Function Scale; min, minute; mo, month; n/a, not applicable; NS, not significant (p>.05); pro, prospective study; PROM, passive range of motion PT, physical therapy; RCT, randomized control trial; reps, repetitions; retro, retrospective study; ROM, range of motion; ROT, cervical rotation; SCM, sternocleidomastoid muscle; sec, seconds; SSAP, severity scale for assessment of plagiocephaly; tx ,treatment; US, ultrasound; wk, week; x, times; +, plus; /, per.