Physical Therapy Management of Congenital Muscular Torticollis:

A 2024 Evidence-Based Clinical Practice Guideline from the American Physical Therapy Association Academy of Pediatric Physical Therapy

Supplemental Digital Content

Supplemental tools can be downloaded from the APTA Pediatrics website (https://pediatricapta.org/clinical-practice-guidelines)

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Supplemental Digital Content for: Sargent B, Coulter C, Cannoy J, Kaplan SL. Physical therapy management of congenital muscular torticollis: A 2024 evidence-based clinical practice guideline from the American Physical Therapy Association Academy of Pediatric Physical Therapy. *Pediatr Phys Ther.* 2024; 36(4).

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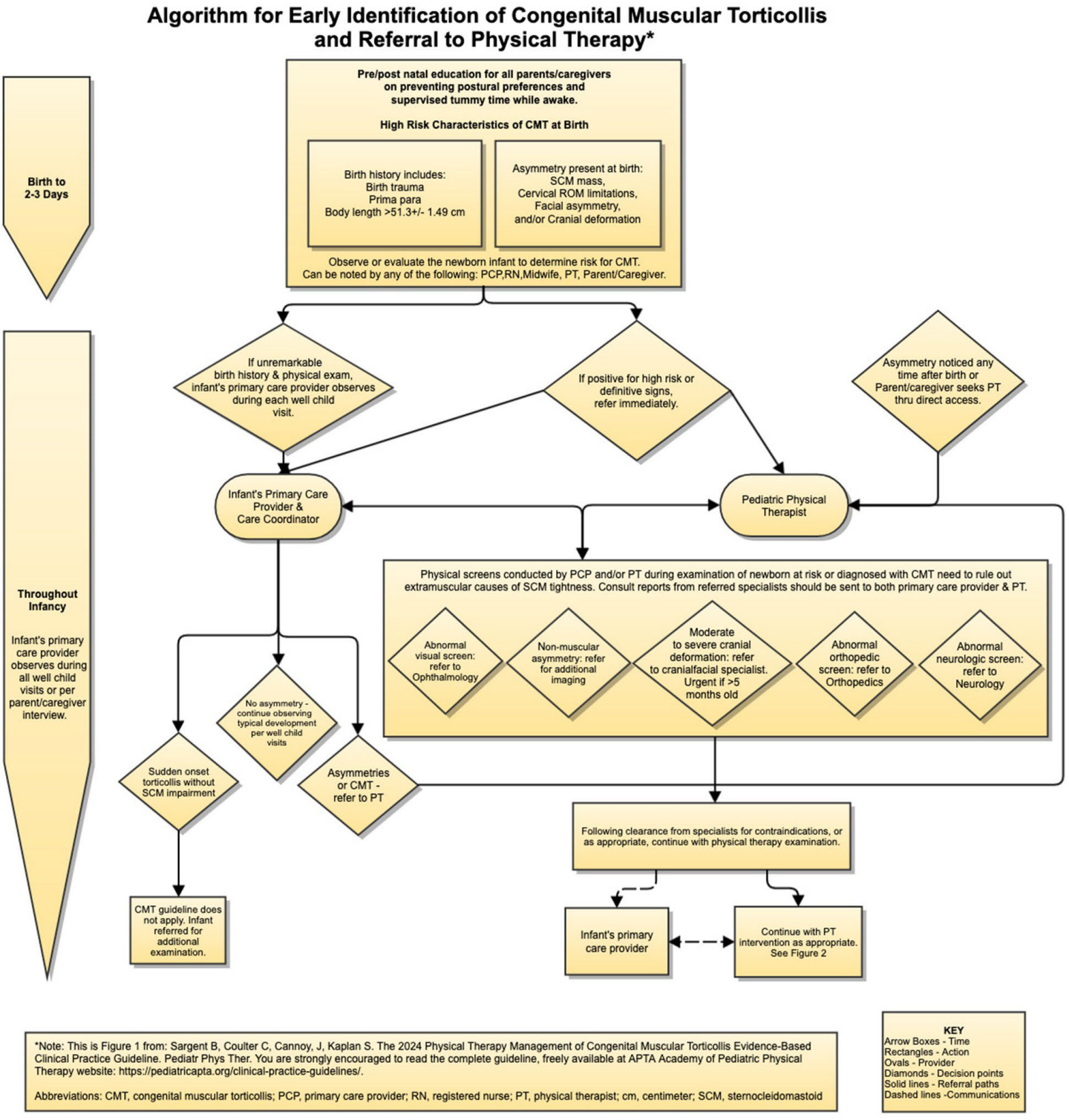
Supplemental Digital Content 1: Referral Flow Diagram



*Note: This is Figure 1 from: Sargent B, Coulter C, Cannoy, J, Kaplan S. The 2024 Physical Therapy Management of Congenital Muscular Torticollis Evidence-Based Clinical Practice Guideline. Pediatr Phys Ther. You are strongly encouraged to read the complete guideline, freely available at APTA Academy of Pediatric Physical Therapy website: https://pediatricapta.org/clinical-practice-guidelines/.

Abbreviations: CMT, congenital muscular torticollis; PCP, primary care provider; RN, registered nurse; PT, physical therapist; cm, centimeter; SCM, sternocleidomastoid

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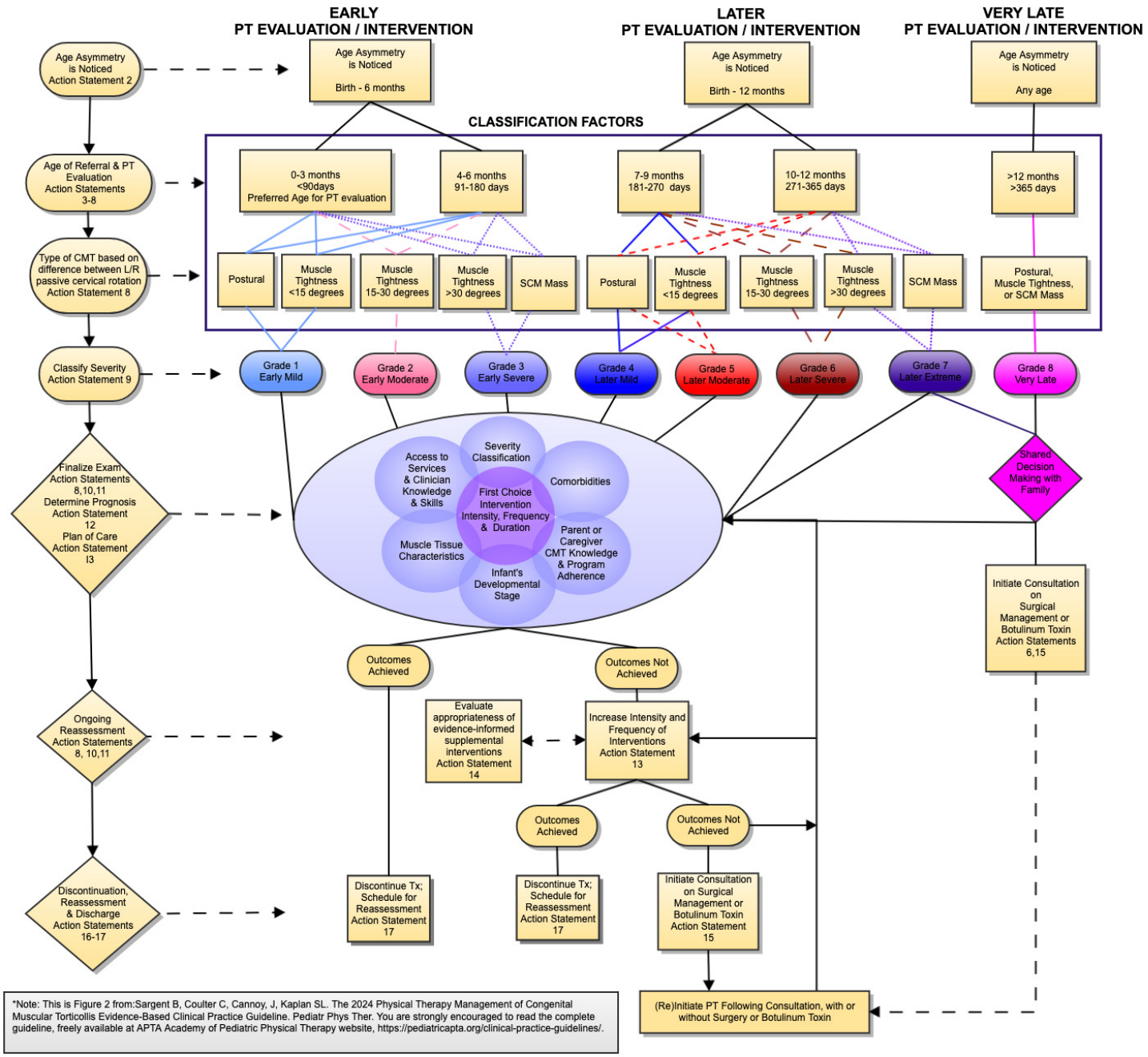
Supplemental Digital Content 2: 2024 Classification of Severity and Management of CMT

CMT Severity Grading Scale and Decision Tree for 0-12 months



*Note: This is Figure 2 from:Sargent B, Coulter C, Cannoy, J, Kaplan SL. The 2024 Physical Therapy Management of Congenital Muscular Torticollis Evidence-Based Clinical Practice Guideline. Pediatr Phys Ther. You are strongly encouraged to read the complete guideline, freely available at APTA Academy of Pediatric Physical Therapy website, https://pediatricapta.org/clinical-practice-guidelines/.

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Supplemental Digital Content 3: Summary and Status of Action Statements for the 2024 Congenital Muscular Torticollis Clinical Practice Guideline

I. EDUCATION, IDENTIFICATION AND REFERRAL OF INFANTS WITH ASYMMETRIES / CONGENITAL MUSCULAR TORTICOLLIS (CMT)
P **Action Statement 1: EDUCATE EXPECTANT OR NEW PARENTS/CAREGIVERS OF NEWBORN INFANTS TO PREVENT ASYMMETRIES/CMT.** Health care providers (eg, prenatal educators, physicians, midwives, obstetrical or other nurses, lactation specialists, or physical therapists) should educate and document instruction to all expectant or new parents/caregivers of infants before or within the first 2 to 3 days of life on the importance of supervised prone/tummy play 2 or 3 times daily when the infant is awake, full active movement throughout the body, prevention of postural preferences, and the role of pediatric physical therapists in the comprehensive management of postural preference and optimizing motor development if concerns are noted. (Revised and Updated, Evidence Quality: **V**, Recommendation Strength: **Best Practice**)
A **Action Statement 2: ASSESS NEWBORN INFANTS FOR ASYMMETRIES/CMT.** Health care providers (eg, prenatal educators, physicians, midwives, obstetrical or other nurses, lactation specialists, or physical therapists) and parents/ caregivers must assess and document the presence of neck and/or facial or cranial asymmetry within the first 2 to 3 days of life, using passive cervical range of motion and/or visual observation as their respective training or experience supports. (Revised and Updated, Evidence Quality: **I**, Recommendation Strength: **Strong**)
A **Action Statement 3: REFER INFANTS WITH ASYMMETRIES/CMT TO THEIR PRIMARY CARE PROVIDER AND A PHYSICAL THERAPIST.** Health care providers (eg, physicians, midwives, obstetrical or other nurses, lactation specialists, or physical therapists) and parents/caregivers should refer infants identified as having postural preference, reduced cervical range of motion, a sternocleidomastoid (SCM) mass, and/or craniofacial asymmetry to their primary care providers and a physical therapist with expertise in infants as soon as the asymmetry is noted. (Upgraded, Revised and Updated, Evidence Quality: **I**, Recommendation Strength: **Strong**)
II. PHYSICAL THERAPY EXAMINATION AND EVALUATION OF INFANTS WITH ASYMMETRIES / CMT
B **Action Statement 4: DOCUMENT INFANT HISTORY.** Prior to initial screening, physical therapists should obtain and document a general medical and developmental history of the infant, including 6 specific health history factors: chronological and corrected age, age of onset of symptoms, pregnancy and birth history, head posture/preference, other known or suspected medical conditions, and developmental milestones. (Revised, Evidence Quality: **II-IV**, Recommendation Strength: **Moderate**)
B **Action Statement 5: SCREEN INFANTS FOR NONMUSCULAR CAUSES OF ASYMMETRY AND CONDITIONS ASSOCIATED WITH CMT.** When infants present with or without a primary care provider referral, and a professional or parent/caregiver indicates concern about head or neck posture and/or developmental progression, physical therapists should perform and document a review of the neurological, musculoskeletal, integumentary, and cardiopulmonary systems, including screens of vision, gastrointestinal history, postural preference and the structural and movement symmetry of the neck, face and head, trunk, hips, and upper and lower extremities, consistent with state practice acts. (Revised and Updated, Evidence Quality: **II-IV**, Recommendation Strength: **Moderate**)
B **Action Statement 6: REFER INFANTS FROM PHYSICAL THERAPIST TO THEIR PRIMARY CARE PROVIDER IF INDICATED BY SYSTEMS REVIEW.** Physical therapists should document consultation with or referral of infants to their primary care providers for additional diagnostic testing when a systems review identifies: nonmuscular causes of asymmetry (eg, poor visual tracking, spinal conditions, abnormal muscle tone, extra-muscular masses, and gastroesophageal reflux disorder); associated conditions (eg, craniofacial asymmetry); asymmetries inconsistent with CMT (eg, head lateral flexion and rotation to the same side or the side of torticollis changes); changes in the infant's color during screening of neck passive range of motion (PROM); history of acute torticollis; history of late-onset torticollis at 6 months or older; an SCM mass at 6 months or older, or an SCM mass that changes shape and location or increases in size at any age; the infant is older than 12 months and either facial asymmetry and/or 10°-15° of difference exists in passive or active cervical rotation or lateral flexion ROM. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)
B **Action Statement 7: REQUEST IMAGES AND REPORTS**. Physical therapists should request, review, and include in the medical record all images and interpretive reports completed for the diagnostic workup of an infant with suspected or diagnosed CMT to inform prognosis. (Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)
B **Action Statement 8: EXAMINE BODY STRUCTURES**. Physical therapists should perform and document the initial examination and evaluation of infants with suspected or diagnosed CMT for the following 7 body structures: • Infant posture and tolerance to positioning in supine, prone, sitting, and standing for body symmetry, with or without support, as appropriate for age. (Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Bilateral PROM into cervical rotation and lateral flexion using an arthrodial protractor or goniometry. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Bilateral active range of motion (AROM) into cervical rotation using an arthrodial protractor or goniometry and cervical lateral flexion functional strength using the Muscle Function Scale. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • PROM and AROM of the trunk and upper and lower extremities, inclusive of screening for possible developmental dysplasia of the hip. (Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Pain or discomfort at rest, and during passive and active movement using a standard scale, such as the Face, Legs, Activity, Crying, and Consolability Scale. (Revised and Updated, Evidence Quality: **III**, Recommendation Strength: **Weak**) • Skin integrity, symmetry of neck and hip skin folds, presence and location of an SCM mass, and size, shape, and elasticity of the SCM muscle and other cervical muscles. (Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Craniofacial asymmetries and head/skull shape using a quantitative measurement method or standard classification, such as the Argenta Classification Scales. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)

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Supplemental Digital Content 3: Summary and Status of Action Statements for the 2024 Congenital Muscular Torticollis Clinical Practice Guideline (cont)

II. PHYSICAL THERAPY EXAMINATION AND EVALUATION OF INFANTS WITH ASYMMETRIES / CMT (cont)
B **Action Statement 9: CLASSIFY CMT USING THE CMT SEVERITY GRADING SCALE.** Physical therapists should classify and document CMT severity using the CMT Severity Grading Scale, choosing 1 of 8 grades (Figure 2, SDC 2) based on infant's age at examination, the presence of an SCM mass, and the difference in cervical rotation PROM between the left and right sides. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)
B **Action Statement 10: EXAMINE ACTIVITY AND DEVELOPMENTAL STATUS**. During the initial and subsequent examinations of infants with suspected or diagnosed CMT, physical therapists should examine and document the types of and tolerance to position changes, and motor development for movement symmetry and milestones, using an age-appropriate, norm-referenced standardized test, such as the Test of Infant Motor Performance, Alberta Infant Motor Scale, or gross motor subtests of the Peabody Developmental Motor Scales, third edition. (Revised and Updated, Evidence Quality: **II,** Recommendation Strength: **Moderate**)
B **Action Statement 11: EXAMINE PARTICIPATION STATUS**. The physical therapist should obtain and document the parent/caregiver responses regarding: • Positioning when awake and asleep. (Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Infant time spent in prone while awake, consistent with Safe Sleep Recommendations. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Whether the parent/caregiver alternates sides when holding the infant for breast or bottle. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Infant time spent in equipment/positioning devices, such as strollers, car seats, or swings. (Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)
B **Action Statement 12: DETERMINE PROGNOSIS.** Physical therapists should determine and document the prognosis for resolution of CMT and the episode of care after completion of the evaluation and communicate it to the parents/caregivers. Prognoses for the extent of symptom resolution, the episode of care, and/or the need to refer for more invasive interventions are related to: the age of initiation of treatment, CMT Severity Grade (Figure 2, SDC 2), intensity of intervention, presence of comorbidities, rate of change, and adherence with home programming. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)
III. PHYSICAL THERAPY INTERVENTION FOR INFANTS WITH CMT
B **Action Statement 13: PROVIDE FIVE COMPONENTS AS THE FIRST-CHOICE INTERVENTION.** Physical therapists should provide and document these 5 components as the first-choice intervention for infants with CMT: • Neck PROM when PROM is limited. (Upgraded, Revised and Updated, Evidence Quality: **I**, Recommendation Strength: **Strong**) • Neck and trunk AROM. (Reaffirmed, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Development of symmetrical movement. (Reaffirmed, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Environmental adaptations. (Reaffirmed, Evidence Quality: **II**, Recommendation Strength: **Moderate**) • Parent/caregiver education. (Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)
C **Action Statement 14: EVALUATE EVIDENCE-INFORMED SUPPLEMENTAL INTERVENTION(S) FOR APPROPRIATENESS TO AUGMENT THE FIRST-CHOICE INTERVENTION.** Physical therapists may provide and document evidence-informed supplemental interventions, after evaluating their appropriateness for managing CMT or postural asymmetries, as adjuncts to the first-choice intervention when the first-choice intervention has not adequately improved range or postural alignment, and/or when access to services is limited, and/or when the infant is unable to tolerate the intensity of the first-choice intervention, and if the physical therapist has the appropriate training to administer the intervention. (Revised and Updated, Evidence Quality: **I-V**, Recommendation Strength: **Weak**)
B **Action Statement 15: INITIATE CONSULTATION WHEN THE INFANT IS NOT PROGRESSING AS ANTICIPATED.** Physical therapists who are managing infants with CMT or postural asymmetries should initiate consultation with the infant's primary care provider and/or specialists about other interventions when the infant is not progressing as anticipated. These conditions might include when asymmetries of the head, neck, and trunk are not starting to resolve after 4-6 weeks of comprehensive intervention or after 6 months of intervention with a plateau in resolution. (Revised and Updated, Evidence Quality: **II**, Recommendation Strength: **Moderate**)
IV. PHYSICAL THERAPY DISCONTINUATION, REASSESSMENT, AND DISCHARGE OF INFANTS WITH CMT
B **Action Statement 16: DISCONTINUE DIRECT SERVICES WHEN THESE 5 CRITERIA ARE ACHIEVED.** Physical therapists should discontinue direct physical therapy services and document outcomes when these 5 criteria are met: cervical PROM within 5° of the non-affected side, symmetrical active movement patterns, age-appropriate motor development, no visible head tilt, and the parents/caregivers understand what to monitor as the child grows. (Reaffirmed, Evidence Quality: **II-III**, Recommendation Strength: **Moderate**)
B **Action Statement 17: REASSESS INFANTS 3-12 MONTHS AFTER DISCONTINUATION OF DIRECT SERVICES, THEN DISCHARGE IF APPROPRIATE.** Physical therapists should complete a full evaluation to assess for reoccurrence of CMT and evidence of atypical development if the parent/caregiver or primary care provider observes asymmetrical posture OR 3-12 months following discontinuation from direct physical therapy intervention OR when the child initiates walking. (Revised and Updated, Evidence Quality: **II-III**, Recommendation Strength: **Moderate**)

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Supplemental Digital Content 4: Psychometric Properties of Assessment Tools Commonly Used in the Management of Congenital Muscular Torticollis

Author & Year	Assessment	Participants	Outcome	Intra-rater Reliability	Inter-rater Reliability	Validity
Rahlin, et al., 2022	Therapy Behavior Scale Ver 2.2	10 infants with CMT, 0-6 mo	Behavior	ICC 0.95 (0.81-0.99) and 0.92 (0.73-0.98)	ICC 0.88 (0.71-0.95)	NA
Rahlin, et al., 2022b	Functional Symmetry Observation Scale Ver 2	13 pediatric physical therapists	Spontaneous posture and movement	NA	NA	Content: Consensus among experts on all items ranged from 85-100%.
Seager, et al., 2019 from Chen et al., 1995**	Electronic Pendular Goniometer	12 infants with CMT, 0-12 mo	PROM CS ROT	ICC 0.71-0.79* quality fair*	ICC 0.87-0.91* quality fair*	NA
Seager, et al., 2019 from Klackenberg, et al, 2005	Standard Goniometer	23 infants with CMT, 1-5 mo	PROM CS ROT	ICC 0.98-0.99* quality poor*	NA	Concurrent: Standard goniometer or protractor vs. still photography ICC 0.74-0.90***
Seager, et al., 2019 from Klackenberg, et al 2005	Large Protractor	23 infants with CMT, 1-5 mo	PROM CS LF	ICC 0.97-0.98* quality poor*	NA	
Seager et al., 2019 from Ohman et al., 2009	Muscle Function Scale - Ver 1 described in words, Ver II described in deg	68 infants with CMT, 0-2 yrs	Strength CS LF, Ver 1 Strength CS LF, Ver II	Kappa 0.96–0.99* ICC 0.94–0.98* quality excellent* Kappa 0.96–0.99* ICC 0.93–0.97* quality excellent*	Kappa 0.96* ICC 0.92–0.96* quality excellent* Kappa 0.96* ICC 0.90–0.95* quality excellent*	Content: rated positively by panel of experts
Seager et al., 2019 from Rahlin et al., 2010	Still Photography	30 infants with CMT, 4.5-16 mo	Head tilt	ICC 0.79-0.84* quality excellent*	ICC 0.72-.99* quality excellent*	NA

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Supplemental Digital Content 4: Psychometric Properties of Assessment Tools Commonly Used in the Management of Congenital Muscular Torticollis (cont)

Author & Year	Assessment	Participants	Outcome	Intra-rater Reliability	Inter-rater Reliability	Validity
Seager et al., 2019 from Murgia et al., 2016	ROM Limitation Scale	109 infants with CMT, 0-18 mo	AROM CS ROT PROM CS ROT PROM CS LF	Kappa 0.72* 0.73* 0.41*, quality fair*	Kappa 0.80* 0.83* 0.49*, quality fair*	NA
Seager et al., 2020	Visual Estimation	31 infants with CMT, 4-24 mo	Head tilt AROM CS ROT	ICC 0.84 ICC 0.85 (0.23-0.97)	ICC 0.58 SEM 4.3º ICC 0.79 (0.15-0.99)	NA

Table adapted from: Castilla A, Gonzalez M, Kush L, Sargent B. Informing the physical therapy management of congenital muscular torticollis clinical practice guideline: a systematic review. *Pediatr Phys Ther*. 2023;35(2):190-200.

Abbreviations: AROM, active range of motion; CMT, Congenital Muscular Torticollis; CS, cervical spine; ICC, interclass correlation coefficient; LF, lateral flexion; mo, month; NA, not applicable; NR, not reported; PROM, passive range of motion; ROT, rotation; SEM, standard error measurement; Ver, version; yrs, years; ( ), 95% Confidence Intervals.
*Data from Seager et al 2019 systematic review.
** Data collected from personal communication between Seager et al 2019 and author of original study.
***Reported as reliability in Klackenberg et al., 2005 and Seager et al., 2019 articles. Upon further review of data determined to be concurrent validity.

Supplemental Digital Content 5: Randomized Controlled Trials of the First-Choice Physical Therapy Intervention for Infants with Congenital Muscular Torticollis

Author & Year	Study Design/ Level of Evidence	Participants	Experimental vs. Comparison Groups	Intervention	Results	Clinical Implications
Song, et al., 2021	RCT with some concerns using RoB 2, Level I	61 infants with CMT, < 3 mo, >15° head tilt	EG1: Dev EX; passive stretching (n=21) EG2: Dev EX; active or active-assist EX (n=19) EG3: US of affected SCM (n=20)	All groups: 30-min treatment, 3x/week until head tilt measured with AP was ≤ 5º EG1 and EG2: 15 min EX to control the infant's posture and use the major muscles according to the developmental stages. EG1: 15 min active or active-assist EX using positioning, eye tracking, tonic neck reflex, righting reaction. EG2: 15 min cervical ROT and LAT FLEX stretches, 10-20x, 10 sec hold, 1-min rest. EG3: US at 3MHz, 1 to 5 W/cm^2 with 1-cm Doppler probe for 30 min	ROT PROM (AP): passive stretching group greater improvement than active or active-assist EX group or US group. SCM Thickness (US): NS SCM A/N ratio (US): NS	For infants with CMT, passive stretching was more effective than active or active assist EX or thermotherapy for improvement in cervical ROT PROM.
He, et al., 2016	RCT with some concerns using RoB 2, Level I	50 infants with CMT < 3 mo, limited cervical ROM	EG1: 50x Stretching (n=24) EG2: 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 PROM (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	For infants with CMT, increased frequency of daily stretching resulted in decreased head tilt and increased cervical ROT & LAT FLEX PROM.

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Supplemental Digital Content 5: Randomized Controlled Trials of the First-Choice Physical Therapy Intervention for Infants with Congenital Muscular Torticollis (cont)

Author & Year	Study Design/ Level of Evidence	Participants	Experimental vs. Comparison Groups	Intervention	Results	Clinical Implications
Ohman, et al., 2011	RCT with high risk of bias using RoB 2, Level II	37 infants with CMT < 11 mo	EG1: Handling strategies only (n=9) EG2: Handling strategies + strength EX (n=13) EG3: Handling strategies + strength EX, + PT (n=11)	EG1: prone when awake and supervised, carry and hold infant with affected side down, encourage ROT to affected side. EG2: handling activities as in Group 1, slowly transitioning infant from sitting or standing to horizontal with 5-15 sec hold for 15-min. EG3: 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.
Ohman, et al., 2010	RCT with high risk of bias using RoB 2, Level II	20 infants with CMT < 5 mo with head tilt and limited ROM	EG1: PT (n=10) EG2: Parent (n=10)	EG1: PT stretches into LAT FLEX and ROT, 15 min, 3 day/wk, 10-30 sec hold; no stretching at home. EG2: 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.

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; RoB 2, Cochrane risk-of-bias tool for randomized trials, version 2; 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

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Supplemental Digital Content 6: Randomized Controlled Trials of Evidence-Informed Supplemental Intervention for Infants with Congenital Muscular Torticollis

Author & Year	Study Design/ Level of Evidence	Participants	Experimental vs. Comparison Groups	Intervention	Results	Clinical Implications
Chen, et al., 2020	MA of 2 RCTs with high risk of bias using the RoB 2, Level II	95 infants with CMT, 1-12 mo	EG: TCM massage + stretching (n=48) CG: Stretching (n=47)	Mo, et al., 2010: **F:**5x/wk **I:** NR **T**: 35-45 min **D**: 16 wks Pang, et al., 2014: **F:**1x/d **I:** NR **T:** 45 min **D**: 8 wks	Effective rate (percentage of infants with CMT that improved): NS (RR=1.0, 95% CI=0.94-1.06, *p*=0.99)	For infants with CMT, TCM was no more effective than stretching for overall improvement.
Cui, et al., 2019	RCT with high risk of bias using RoB 2, Level II	68 infants with CMT, <1yr, SCM mass with head tilt	EG: Modified Tuina (n=34) CG: Text-book Tuina (n=34)	**F:** 6 d/wk **I:** NR **T:** ~20min in EG; NR in CG **D:** 60 d	SCM limb diameter (US): Improvement greater at 30 days & 60 days in the modified Tuina group ($p<0.05$) Effective rate: Improvement greater at 30 days in the modified Tuina group (P<0.05)	For infants with CMT, modified, vs text-book tuina, was more effective for overall improvement and to decrease SCM lump diameter.
Keklicek & Uygur, 2018	RCT with high risk of bias using RoB 2, Level II	29 infants with CMT, 0-6 mo with head tilt of 5-20°	EG: STMo and HP (n=14) CG: 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 are encouraged to connect with PT 2-3x/wk via phone application. STMo group only: STMo 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.	STMo and a HP, compared to only a HP, does not improve outcomes after 12 and 18 weeks of intervention.

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Supplemental Digital Content 6: Randomized Controlled Trials of Evidence-Informed Supplemental Intervention for Infants with Congenital Muscular Torticollis (cont)

Author & Year	Study Design/ Level of Evidence	Participants	Experimental vs. Comparison Groups	Intervention	Results	Clinical Implications
Giray, et al., 2016	RCT with some concerns using RoB 2, Level I	33 infants with CMT, 3-12 mo	EG1: EX+ inhibitory KT on involved SCM (n=12) EG2: EX+ inhibitory KT on involved SCM + facilitory KT on uninvolved SCM (n=10) CG: 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	For infants with CMT, KT for 3 wks provided no added benefit to PT intervention.
Kwon and Park, 2014	RCT with some concerns using RoB 2, Level I	20 infants with CMT, < 3 mo with entire SCM involvement, palpable SCM mass	EG: EX + US + Microcurrent on (n=10) CG: 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).	For infants with CMT, the addition of microcurrent resulted in shorter tx duration.

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Supplemental Digital Content 6: Randomized Controlled Trials of Evidence-Informed Supplemental Intervention for Infants with Congenital Muscular Torticollis (cont)

Author & Year	Study Design/ Level of Evidence	Participants	Experimental vs. Comparison Groups	Intervention	Results	Clinical Implications
Haugen, et al., 2011	RCT with high risk of bias using RoB 2, Level II	32 infants with CMT, 3-6 mo with cervical ROM limitations	EG: Manual therapy and PT CG: 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.

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; MA, meta-analysis; 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; RoB 2, Cochrane risk-of-bias tool for randomized trials, version 2; 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; TCM, Traditional Chinese Massage; TOA, Torticollis Overall Assessment; TOT collar, Tubular Orthosis for Torticollis; tx ,treatment; US, ultrasound; wk, week; x, times; +, plus; /, per

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Supplemental Digital Content 7: Studies of Long-Term Outcomes of Congenital Muscular Torticollis

Author & Year	Study Design / Level of Evidence	Participants	Residual CMT	Developmental Outcome
Watemberg, et al., 2016	retrospective cohort, Level III	173 infants with postural CMT followed from initiation of Rx for CMT to 2 years (Israel)	At 2 yrs, 21.7% (n=26/120) had evidence of CMT.	At initiation of tx for CMT, motor delay and DP were more common in infants with CMT and functional motor asymmetry versus CMT and no functional motor asymmetry (n=173). At 1-2 yrs, 27.2% (n=11/33) of infants with motor asymmetry at initiation of tx for CMT, continued to have motor asymmetry.
Cabrera-Martos, et al., 2015	prospective cohort, Level II	175 infants with DP with or without torticollis followed from initiation of tx for DP and/or torticollis until standing without support (Spain)	NA	Infants with DP without torticollis acquired creeping and unsupported standing later than infants with DP and torticollis when adjusting for the severity of DP and age at referral to treatment. There was no difference in the age of acquisition of rolling and sitting. Mean age of acquisition of skills in all infants was 7.5 mo for rolling, 8.7 mo for sitting without support, 11.3 mo for creeping, and 12.3 mo for standing without support.
Ohman, 2013	cohort, Level II	58 children with history of CMT followed up at 3.5-5 yrs (Sweden)	7% had a head tilt.	At 3.5-5 yrs, 7% (3/58) had a head tilt considered to be distinct (2) or extensive (1, received surgery). At 3.3-5 yrs, 26% (15/58) had some degree of asymmetry in PROM. The clinical significance is uncertain because only children with CMT were followed. All had ≥ 85° of rotation PROM to each side, and 7 children had a lateral flexion PROM difference between sides of only 5-10°; it's not clear if age matched children without CMT would present with similar results.
Ohman and Beckung, 2013	case control, Level III	81 children with and without history of CMT followed up at 3.5-5 yrs (Sweden)	NA	At 3.5-5 yrs, infants with a history of CMT, as compared to without a history of CMT, are at no greater risk for motor delay (assessed using MABC-2).

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Supplemental Digital Content 7: Studies of Long-Term Outcomes of Congenital Muscular Torticollis (cont)

Author & Year	Study Design / Level of Evidence	Participants	Residual CMT	Developmental Outcome
Schertz, et al., 2013	prospective cohort, Level II	68 children with history of CMT followed up at 7-9 yrs (Israel)	NA	Presence of NDD assessed via clinical assessments (n=38; DSM-IV-TR for ADHD and ASD; BOT-2 or MABC for DCD, MAASE for LI) or telephone interview (n=30; DCD-Hebrew for DCD; parent report for ADHD, ASD, DCD, LI) At 7-9 yrs, 32% (n=22/68) of children with a history of CMT were diagnosed with a NDD (8.8% [n=6/68] ADHD only, 8.8% [n=6/68] ADHD + DCD, 10.3% [n=7/68] DCD only, 1.5% [n=1/68] LI, and 2.9% [n=2/68] LI + ADHD + DCD). Prevalence of DCD and ADHD in this sample of children with a history of CMT in Israel is higher than reported in other samples, which is 4% for DCD in the general population of children in the United Kingdom and 7% for ADHD in the general population of children in the United States).
Ohman, 2009	Case control, Level III	122 infants with and without CMT at 2-18 mo of age (Sweden)	At 10 mo, 47% (n=27/57) had evidence of CMT. At 18 mo, 6 infants still had evidence of CMT.	At 2 mos, gross motor function of 38% (n=11/25) of infants with CMT, compared to without CMT (11%, n=4/35), was ≤ 10th percentile (assessed using AIMS). – significantly different between groups At 6 mos, gross motor function of 19% (n=11/54) of infants with CMT, compared to without CMT (3%, n=1/39), was ≤ 10th percentile (assessed using AIMS). At 6 mos, infants with CMT, compared to without CMT, spent less time in prone. - both gross motor function and time spent in prone significantly different between groups. At 10 mos, gross motor function of 23% (n=13/57) of infants with CMT, compared to without CMT (10%, n=4/39), was ≤ 10th percentile (assessed using AIMS). – not significantly different between groups. At 18 mo, all infants with and without CMT achieved the total score on the AIMS. Both CMT and prone time had an impact on motor development at 2 and 6 months of age. Prone time had a higher impact and also had an impact at 10 mo of age.

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Supplemental Digital Content 7: Studies of Long-Term Outcomes of Congenital Muscular Torticollis (cont)

Author & Year	Study Design / Level of Evidence	Participants	Residual CMT	Developmental Outcome
Schertz, et al., 2008	prospective cohort, Level II	83 infants with history of CMT followed at 8-15 mo (Israel)	NA	At initiation of tx for CMT (performed at 2.9 [SD 1.5] mo), gross motor function of 34% (n=35/101) of infants with CMT was ≤ 10th percentile (assessed using AIMS). – lower than the general population At 8-15 mos, gross motor function of 9.6% (n=8/83) of infants with history of CMT was ≤ 10th percentile (assessed using AIMS). - not different from general population At 8-15 mos, cognitive function of 13.6% (n=9/66) of infants with history of CMT was classified as below normal (assessed using CAT-CLAMS). - not different from general population

Abbreviations: ADHD, Attention deficit hyperactivity disorder; ASD, autism spectrum disorder; AIMS, Alberta Infant Motor Scale; BOT-2, Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition-Short Form; CAT-CLAMS, Clinical Adaptive Test/Clinical Linguistic Auditory Milestone Scale; CMT, congenital muscular torticollis; DCD, developmental coordination disorder; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, 4th edition; DP, deformational plagiocephaly; LI = language impairment, MABC = Movement Assessment Battery for Children 1st/2nd editions; MAASE, A test for spoken language processing (in Hebrew); mo, month; NDD, neurodevelopmental disorder; tx, treatment; wk, week; yrs, years

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Supplemental Digital Content 8: International Classification of Functioning, Disability and Health (ICF) and International Statistical Classification of Diseases and Related Health Problems (ICD) 10 Codes associated with Congenital Muscular Torticollis

ICF codes	CMT presentation
Impairments of Body Structures and Functions	
B7108 Mobility of joint functions, other specified	Cervical Passive & Active ROM
B7300 Power of isolated muscles and muscle groups	Strength of lateral neck flexion and cervical rotation; strength of neck and back extensors in prone; symmetrical strength of SCM in pull to sit.
B7350 Tone of isolated muscles and muscle groups	Hyper or hypotonia; spasm
B7600 Control of simple voluntary movements	Active visual pursuit toward the shortened side; symmetrical movements of trunk; UE and LEs in developmental positions
S7103 Joints of head and neck region	Cervical AROM, PROM
S7104 Muscles of head and neck region	Presence of a SCM mass
S7108 Structure of head and neck region, other specified	Facial and skull symmetry
S7401/ S5001 Hip Joint	Hip Dysplasia
Activity Limitations	
D110 Watching	TIMP, AIMS, AROM, ocular torticollis
D440 Fine hand use	Hands to midline; hemi-syndrome
D445 Hand and arm use	Hands to midline; hemi-syndrome; AIMS, AROM
Participation Restrictions	
D7600 Parent-child relationships	Parent comfort and knowledge with positioning and home programming
D7601 Child-parent relationships	Infant engagement with parent during feeding and play
D920 Recreation and leisure	AIMS, attention to toys

Abbreviations: AROM, active range of motion; AIMS, Alberta Infant Motor Scales; CMT, congenital muscular torticollis; ICD, International Statistical Classification of Diseases and Related Health Problems; ICF, International Classification of Functioning, Disability and Health; LEs, lower extremities; PROM, passive range of motion; ROM, range of motion; SCM, sternocleidomastoid; TIMP, Test of Infant Motor Performance; UE, upper extremities

ICD 10 Codes

The following codes may be used by a variety of health care professionals and are offered for reference; they are not intended to be directional for billing purposes.

Q67.0 Facial asymmetry
Q67.3 Plagiocephaly
Q68.0 Congenital deformity of sternocleidomastoid muscle
Q79.8 Other congenital malformations of musculoskeletal system
P15.2 Sternomastoid injury due to birth injury
M43.6 Torticollis

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Supplemental Digital Content 9: Operational Definitions

Brachycephaly. Cranial deformation with flattening of the entire posterior surface of the head.

Cervical rotation. Movement of the cervical spine in the transverse plane, such that the chin turns toward or past the ipsilateral shoulder.

Congenital muscular torticollis (CMT). Congenital muscular torticollis is a common pediatric orthopedic condition, described as a postural deformity of the neck evident at birth or shortly thereafter. It is typically characterized by a head tilt to one side and the neck rotated to the opposite side, due to unilateral shortening or muscle imbalance of the sternocleidomastoid muscles. It may be accompanied by cranial deformation or developmental dysplasia of the hip (DDH), and less frequently, atypically present as a head tilt and neck rotation to the same side. CMT has been associated with DDH, brachial plexus injury, lower extremity deformities, early developmental delay, persistent developmental delays, facial asymmetry, which may impact function and cosmesis, and temporomandibular joint dysfunction.

Cranial deformation. A distortion of the shape of the skull resulting from mechanical forces that occur pre or postnatally. This term includes plagiocephaly and brachycephaly.

Lateral cervical flexion, side bending, or head tilt. Movement of the cervical spine in the coronal plane, such that the infant's ear approaches the ipsilateral shoulder.

Plagiocephaly. Cranial deformation with flattening of one side of the head.

Postural preference. Synonymous with positional preference. Refers to the preferred head and neck asymmetry that an infant gravitates to in all positions.

Sternocleidomastoid mass. Synonymous with fibromotosis colli, tumor, pseudotumor or node. A condition in which the sternocleidomastoid muscle is enlarged due to fibrosing of muscle cells with identifiable histological changes. It is referred to as a 'mass' throughout this document.

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Supplemental Digital Content 10: Development of the Guideline

This CPG is the product of many people's work and support. At each phase of the update, the GDG has benefitted from the work and advice of clinicians, methodologists and the families with whom we work. The following outlines the phases of this update, and formally acknowledges the contributors in each phase. Contributors are listed alphabetically.

Phase 1: Organization and manuscript development, determination of scope, literature search, abstract review:

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All first round reviewers declared an absence of conflicts of interest with the topic, process and/or financial relationships.

Phase 5: External review of the revised CPG by the public & AGREE II ratings:

Following edits based on the first round review, a revised CPG draft was posted for public comment on the APTA Pediatrics website. Notices were sent through the APTA Pediatrics electronic newsletter, posted on a physical and occupational therapy social media website, and sent individually to clinicians who had inquired about commenting on the updated CPG. Comments were and may be submitted to torticolliscpg@gmail.com.

This CPG was evaluated by these reviewers using the AGREE II,[25] an established instrument designed to assess the quality of clinical practice guidelines:

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Phase 6: Submission for publication to *Pediatric Physical Therapy:*

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Phase 7: Dissemination of guideline:

APTA Academy of Pediatric Physical Therapy Web page
PEDro, ECRI, G-I-N Library Submission – Sandra L. Kaplan, PT, DPT, PhD
Presentation at the APTA Pediatrics Annual Conference (2024)

Phase 8: Plan for monitoring guideline uptake:

The GDG recommends a survey of pediatric PTs in 2025, similar to Kaplan et al, 2017 to assess implementation of the 2024 CMT CPG guideline.

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Kate Daniels, MLIS, AHIP, Clinical librarian, Children's Healthcare of Atlanta, 2024 CMT CPG updated search
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Richard Shiffman, MD, BridgeWIZ developer.

Conflict of Interest Statements:

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