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

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The American Physical Therapy Association Academy of Pediatric Physical Therapy welcomes comments on this guideline. Comments may be sent to torticolliscpg@gmail.com. This guideline may be reproduced for educational and implementation purposes.

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ABSTRACT

Background: Congenital muscular torticollis (CMT) is a postural condition evident shortly after birth. The 2013 CMT Clinical Practice Guideline (2013 CMT CPG) set standards for the identification, referral, and physical therapy management of infants with CMT, and its implementation resulted in improved clinical outcomes. It was updated in 2018 to reflect current evidence and 7 resources were developed to support implementation. **Purpose:** This 2024 CMT CPG is intended as a reference document to guide physical therapists, families, health care professionals, educators, and researchers to improve clinical outcomes and health services for children with CMT, as well as to inform the need for continued research. **Results/Conclusions:** The 2024 CMT CPG addresses: education for prevention, screening, examination and evaluation including recommended outcome measures, consultation with and referral to other health care providers, classification and prognosis, first-choice and evidence-informed supplemental interventions, discontinuation from direct intervention, reassessment and discharge, implementation and compliance recommendations, and research recommendations. (***Pediatr Phys Ther 2024;36:370–421)***

Key words: clinical practice guideline, congenital muscular torticollis, infant, pediatrics, physical therapy

WHAT THIS EVIDENCE ADDS

Current evidence: The physical therapy management of congenital muscular torticollis is informed by a clinical practice guideline (CMT CPG) that was published in 2013[1] and updated in 2018.[2] Implementing the CMT CPG[1] recommendations not only improved outcomes[3] but also led to research to align documentation with the best practice recommendations,[4] develop a clinical decision algorithm,[5] and provide guidance for intervention and follow-up.[6] To support the implementation of the CMT CPG,[2] 7 resources were developed by the American Physical Therapy Association Academy of Pediatric Physical Therapy (APTA Pediatrics)[7] and a state-of-the-art review for pediatricians was published.[8]

Gap in the evidence: The 2018 CMT CPG[2] does not include evidence published after 2018.

How does this study fill this evidence gap? This 2024 CMT CPG was updated based on current evidence on the physical therapy management of CMT through June 2023, the guideline development group's clinical and professional experience, trends in practice changes, the impact of previous versions of the CMT CPG, and external review both by content experts, including parents/caregivers of infants with CMT, and the general public.

Implications of all the evidence: This 2024 CMT CPG informs the physical therapy management of congenital muscular torticollis on: education for prevention, screening, examination and evaluation including recommended outcome measures, consultation with and referral to other health care providers, classification and prognosis, first-choice and evidence-informed supplemental interventions, discontinuation from direct intervention, reassessment and discharge, implementation and compliance recommendations, and research recommendations.

DOCUMENT ORGANIZATION

This 2024 Congenital Muscular Torticollis Clinical Practice Guideline (2024 CMT CPG) is an update of the 2013 and 2018 Congenital Muscular Torticollis Clinical Practice Guidelines (2013 and 2018 CMT CPG).[1,2] It is intended as a reference document to guide physical therapists (PTs), families, health care professionals, and educators to improve clinical outcomes and health services for children with congenital muscular torticollis (CMT), as well as to inform future research. Accepted international methods of evidence-based practice were used to systematically search peer-reviewed literature, assign levels of evidence (Table 1), summarize the literature, formulate action statements, and assign grades for each action statement (Table 2).

Table 3 (also available as Supplemental Digital Content 3, available at: https://links.lww.com/PPT/A548) summarizes the 17 action statements with their 2024 status. They are organized with 4 major headings: Education, Identification, and Referral of Infants with Asymmetries/CMT; Physical Therapy Examination and Evaluation of Infants with Asymmetries/CMT; Physical Therapy Intervention for Infants with CMT; and Physical Therapy Discontinuation, Reassessment, and Discharge of Infants with CMT. Following the summary (Table 3), descriptions of the clinical practice guideline (CPG) purpose, scope, and methods are followed by an action statement with a standardized profile of information based on the Institute of Medicine's (IOM's) criteria for transparent CPGs.[9] Research recommendations are placed within the text where the topics arise and are collated at the end of the document. Evidence tables on psychometric properties of assessment tools, randomized controlled trials (RCTs) of the first-choice intervention, RCTs of evidence-informed supplemental interventions, and long-term outcomes are available as Supplemental Digital Content 4-7, available at: https://links.lww.com/PPT/A545, and at https://pediatricapta.org/clinical-practice-guidelines/.[7]

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Levels of evidence are assigned based on a combination of a risk of bias assessment and the quality of the outcome measures used in a study (Table 1). Recommendation grades A-C are consistent with the levels of evidence in the BRIDGE-Wiz software deontics used to structure the recommendation statements to align with the IOM recommendations for transparency.[9,10] Theoretical/Foundational (Grade D) and Practice Recommendations (Grade P) are not generated with BRIDGE-Wiz. Grade D is based on basic science or theory, and Grade P is determined by the Guideline Development Group (GDG) to represent current best physical therapy practice or exceptional situations for which studies cannot be performed (Table 2). Research recommendations identify missing or conflicting evidence, for which studies might improve examination and intervention efficacy or minimize unwarranted variation.

Status Definitions

These terms in the Summary of Action Statements table indicate changes from the 2018 CMT CPG recommendations.[2]

- *New* – the action statement was not in the prior version.
- *Upgraded* – the action statement grade was increased.
- *Downgraded* – the action statement grade was decreased.
- *Revised* – the action statement has been reworded for clarity.
- *Reaffirmed* – the action statement is unchanged.
- *Updated* – the action statement has new references.
- *Retired* – the action statement was withdrawn.

TABLE 1: Levels of Evidence

Level	Criteria
I	Evidence obtained from high-quality diagnostic studies, prognostic or prospective studies, cohort studies or randomized controlled trials, meta-analyses, or systematic reviews (critical appraisal score greater than 50% of criteria)
II	Evidence obtained from lesser-quality diagnostic studies, prognostic or prospective studies, cohort studies or randomized controlled trials, meta-analyses, or systematic reviews (eg, weaker diagnostic criteria and reference standards, improper randomization, no blinding, and <80% follow-up) (critical appraisal score less than 50% of criteria)
III	Case-controlled studies or retrospective studies
IV	Case studies and case series
V	Expert opinion

TABLE 2: Recommendation Grades for Action Statements

Grade	Recommendation	Quality of Evidence
A	Strong	A preponderance of level I studies, but at least 1 level I study directly on the topic supports the recommendation
B	Moderate	A preponderance of level II studies but at least 1 level II study directly on topic supports the recommendation
C	Weak	A single level II study at less than 25% critical appraisal score or a preponderance of level III and IV studies, including consensus statements by content experts support the recommendation
D	Theoretical/ Foundational	A preponderance of evidence from animal or cadaver studies, conceptual/theoretical models/principles, basic science/ bench research, or published expert opinion in peer-reviewed journals supports the recommendation
P	Best Practice	Recommended practice based on current clinical practice norms, exceptional situations where validating studies have not or cannot be performed and there is a clear benefit, harm, or cost, and/or the clinical experience of the guideline development group
R	Research	There is an absence of research on the topic, or higher-quality studies conducted on the topic disagree with respect to their conclusions. The recommendation is based on these conflicting or absent studies

SUMMARY AND STATUS OF ACTION STATEMENTS FOR THE 2024 CONGENITAL MUSCULAR TORTICOLLIS CLINICAL PRACTICE GUIDELINE

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

Action Statement	Status	Page
I. EDUCATION, IDENTIFICATION AND REFERRAL OF INFANTS WITH ASYMMETRIES/CONGENITAL MUSCULAR TORTICOLLIS (CMT)		382
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. (Evidence Quality: **V**; Recommendation Strength: **Best Practice**)	Revised, Updated	382
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. (Evidence Quality: **I**, Recommendation Strength: **Strong**)	Revised, Updated	385
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. (Evidence Quality: **I**, Recommendation Strength: **Strong**)	Upgraded, Revised, Updated	386
II. PHYSICAL THERAPY EXAMINATION AND EVALUATION OF INFANTS WITH ASYMMETRIES/CMT		387
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. (Evidence Quality: **II-IV**, Recommendation Strength: **Moderate**)	Revised	387
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. (Evidence Quality: **II-IV**, Recommendation Strength: **Moderate**)	Revised, Updated	388
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; a 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. (Evidence Quality: **II**, Recommendation Strength: **Moderate**)	Revised, Updated	389
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. (Evidence Quality: **II**, Recommendation Strength: **Moderate**)	Updated	391

(*continues*)

TABLE 3: Summary and Status of Action Statements for the 2024 Congenital Muscular Torticollis Clinical Practice Guideline
(*Continued*)

Action Statement	Status	Page
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. (Evidence Quality: **II**; Recommendation Strength: **Moderate**) • Bilateral PROM into cervical rotation and lateral flexion using an arthrodial protractor or goniometry. (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. (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. (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. (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. (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. (Evidence Quality: **II**; Recommendation Strength: **Moderate**)	Revised, Updated	391
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) 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. (Evidence Quality: **II**, Recommendation Strength: **Moderate**)	Revised, Updated	397
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. (Evidence Quality: **II**; Recommendation Strength: **Moderate**)	Revised, Updated	398
B **Action Statement 11. EXAMINE PARTICIPATION STATUS**. The physical therapist should obtain and document the parent/caregiver responses regarding: • Positioning when awake and asleep. (Evidence Quality: **II**; Recommendation Strength: **Moderate**) • Infant time spent in prone while awake, consistent with Safe Sleep Recommendations. (Evidence Quality: **II**; Recommendation Strength: **Moderate**) • Whether the parent/caregiver alternates sides when holding the infant for breast or bottle. (Evidence Quality: **II**; Recommendation Strength: **Moderate**) • Infant time spent in equipment/positioning devices, such as strollers, car seats, or swings. (Evidence Quality: **II**; Recommendation Strength: **Moderate**)	Revised, Updated	399
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. (Evidence Quality: **II**, Recommendation Strength: **Moderate**)	Revised, Updated	401
III. PHYSICAL THERAPY INTERVENTION FOR INFANTS WITH CMT		402
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. (Evidence Quality: **I**; Recommendation Strength: **Strong**) • Neck and trunk AROM. (Evidence Quality: **II**; Recommendation Strength: **Moderate**) • Symmetrical movement. (Evidence Quality: **II**; Recommendation Strength: **Moderate**) • Environmental adaptations. (Evidence Quality: **II**; Recommendation Strength: **Moderate**) • Parent/caregiver education. (Evidence Quality: **II**; Recommendation Strength: **Moderate**)	Revised, Updated	403

(*continues*)

TABLE 3: Summary and Status of Action Statements for the 2024 Congenital Muscular Torticollis Clinical Practice Guideline
(*Continued*)

Action Statement	Status	Page
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. (Evidence Quality: **I-V**, Recommendation Strength: **Weak**)	Revised, Updated	405
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. (Evidence Quality: **II**, Recommendation Strength: **Moderate**)	Revised, Updated	407
IV. PHYSICAL THERAPY DISCONTINUATION, REASSESSMENT, AND DISCHARGE OF INFANTS WITH CMT		409
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. (Evidence Quality: **II-III**, Recommendation Strength: **Moderate**)	Reaffirmed	409
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. (Evidence Quality: **II-III**, Recommendation Strength: **Moderate**)	Revised, Updated	410

Background of the 2024 Congenital Muscular Torticollis Clinical Practice Guideline

CMT is a common postural condition evident shortly after birth. It is typically characterized by cervical lateral flexion to one side and cervical rotation to the opposite side due to unilateral shortening or muscle imbalance of the sternocleidomastoid (SCM) muscles. The 2013 Congenital Muscular Torticollis Clinical Practice Guideline (2013 CMT CPG)[1] from the American Physical Therapy Association Academy of Pediatric Physical Therapy (APTA Pediatrics) set standards for the identification, referral, and physical therapy management of infants with CMT. Implementing the 2013 CMT CPG[1] recommendations not only improved outcomes[3] but also led to research to align documentation with the best practice recommendations,[4] develop a clinical decision algorithm,[5] and provide guidance for intervention and follow-up.[6]

Current conventions are to update CPGs every 5 years. The 2013 CMT CPG[1] was updated by the 2018 CMT CPG[2] to reflect current evidence. To support implementation of the 2013 and 2018 CMT CPG,[1,2] implementation resources were developed by APTA Pediatrics[7] and a state-of-the-art review for pediatricians was published.[8]

Purpose of the 2024 Congenital Muscular Torticollis Clinical Practice Guideline

The 2024 CMT CPG is intended as an updated reference document to guide PTs, families, health care professionals, and educators to improve clinical outcomes and health services for children with CMT, as well as to inform the need for continued research related to the physical therapy management of CMT. This document replaces the 2018 CMT CPG[2] and 2013 CMT CPG.[1]

Specifically, for infants (birth to 12 months) and toddlers with CMT, the purposes of the 2024 CMT CPG are to:

- Update the evidence and guidance for physical therapy management of CMT to improve clinical outcomes and health services for infants with CMT in the areas of: education for prevention, screening, examination and evaluation including recommended outcome measures, consultation with and referral to other health care providers, severity classification and prognosis, first-choice and evidence-informed supplemental interventions, discontinuation from direct intervention, and reassessment and discharge.
- Identify areas of knowledge translation necessary to implement and maintain compliance with best practices for physical therapy management of CMT within 4 groups: (1) the general community focusing on expectant parents/caregivers and parents/caregivers of infants; (2) health care and educational delivery systems that establish policy and funding for physical therapy management of CMT; (3) academic programs for all health care and educational professionals providing services to infants and their families; and (4) across health care settings, including prenatal classes, community birth settings, hospitals, offices of primary care providers, outpatient pediatric physical therapy practices, and early intervention programs.
- Identify areas of research necessary to strengthen the evidence for physical therapy management of CMT.

The Scope of the Guideline

The 2024 CMT CPG is based on the 2018 CMT CPG,[2] a systematic review of literature from January 2017 through June 2022,[11] and critical appraisals of the literature published from June 2022 through June 2023. It is assumed throughout the document that the PT has newborn and early childhood experience.

The CPG addresses these aspects of CMT management for infants and toddlers:

- Parent/Caregiver education to prevent or identify postural preference and the role of pediatric physical therapy in its management.
- Diagnostic and referral processes.
- Importance of early assessment and referral of infants with asymmetries/CMT to primary health care providers and PTs.
- Reliable, valid, and clinically useful screening, examination, and evaluation procedures that should be documented.
- Determination of a severity classification and prognosis for physical therapy intervention and duration of care.
- First-choice physical therapy intervention and evidence-informed supplemental interventions.
- Conditions for referral to the infant's primary care provider and/or specialist for consideration of additional tests and interventions.
- Criteria for discontinuation of direct physical therapy intervention, the importance of a reassessment, and criteria for discharge.
- Important outcomes of intervention and infant and family characteristics affecting outcomes.

Changes in the 2024 Congenital Muscular Torticollis Clinical Practice Guideline

The following changes to the 2018 CMT CPG were made in this 2024 CMT CPG:

- One action statement was upgraded, revised, and updated with new literature; 13 action statements

were revised for clarity and updated with new literature; 1 action statement was revised for clarity; 1 action statement was updated with new literature; 1 action statement was reaffirmed; and no action statements were retired.

- Action Statement 3 was upgraded to a Grade A Strong Recommendation based on consistency of results: (1) reevaluation of a cohort study that demonstrated a dose-response relationship of physical therapy intervention with earlier intervention resulting in improved outcomes and decreased treatment duration[12]; and (2) several cohort studies that consistently supported that earlier physical therapy intervention for infants with CMT results in better outcomes,[12-14] shorter episodes of care,[12,14,15] reduced need for surgical interventions,[14,16,17] and reduced risk of secondary complications, such as cervical spine dysmorphism[18] and mandibular asymmetry.[19] Demonstration of a dose-response relationship is considered strong evidence for a causal relationship between the exposure and the outcome because increasing levels of exposure, in this case, earlier physical therapy intervention, is associated with an increasing chance of improved outcome.[20]
- Within Action Statement 13, the recommendation for the use of cervical passive range of motion (PROM) if PROM is limited was upgraded to Strong with a level I RCT that supported that passive stretching was more effective at improving passive cervical rotation than thermotherapy or handling for active and active-assisted movements,[21] combined with a previous level I RCT that demonstrated a dose-response relationship of stretching with higher frequency of stretching resulting in greater improvement in head tilt and cervical passive rotation and lateral flexion range of motion (ROM).[22]
- There are 3 revised and updated evidence tables: Supplemental Digital Content 4 (Psychometric Properties of Assessment Tools Commonly Used in the Management of Congenital Muscular Torticollis), Supplemental Digital Content 5 (Randomized Controlled Trials of the First-Choice Physical Therapy Intervention for Infants with Congenital Muscular Torticollis), and Supplemental Digital Content 6 (Randomized Controlled Trials of Evidence-Informed Supplemental Interventions for Infants with Congenital Muscular Torticollis; all available at: http://links.lww.com/PPT/A545). One evidence table was reaffirmed, Supplemental Digital Content 7 (Studies on Long-Term Outcomes of Congenital Muscular Torticollis, available at: http://links.lww.com/PPT/A545).

Statement of Intent

This guideline is intended to inform clinicians, family members, educators, researchers, policy makers, and payers. It is not intended to serve as a legal standard of care. As rehabilitation knowledge expands, clinical guidelines are promoted as syntheses of current research and provisional proposals of recommended actions under specific conditions. Standards of care are determined based on all clinical data available for an individual child and are subject to change as knowledge and technology advance, patterns of care evolve, and child/family values are integrated. This CPG is a summary of practice recommendations that are supported with current published literature that has been reviewed by parents/caregivers, health care providers, and academic program members. These parameters of practice should be considered guidelines only, not mandates. Adherence to them will not ensure a successful outcome in every child, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate decision regarding a particular clinical procedure or intervention plan must be made using the clinical data presented by the child/family, the diagnostic and intervention options available, the child and family's values, expectations, and preferences, and the clinician's scope of practice and expertise. Significant departures from accepted guidelines should be documented in the child's records at the time the relevant clinical decisions are made; clinicians are strongly encouraged to publish the clinical reasoning and results of alternative approaches.

METHODS

The GDG was approved by APTA Pediatrics to update the 2018 CMT CPG[2] in accordance with Academy procedures. APTA Pediatrics did not influence the content of the guideline, and there was no external funding to support this revision of the guideline. The purpose, scope, and content outline builds on the 2013 CMT CPG[1] survey; its content validity is further supported by evidence of the integration of recommendations into practice.[6]

Search Strategy

This CPG update is based on a systematic review (January 2017-June 2022) of the physical therapy evidence for diagnosis, prognosis, and intervention of CMT to inform the 2024 CMT CPG.[11] Refer to Castilla et al[11] for details of the search strategy, study selection, study appraisal, data extraction, and results for the 15 included studies; 4 studies informed physical therapy assessment for infants with CMT, 5 studies informed prognosis, and 6 studies informed intervention.

To ensure that the updated CMT CPG used the most current evidence, a comprehensive search of 5 databases (CINAHL, Cochrane Library, PsycInfo, PubMed, and Web of Science) was completed from June 2022 to June 2023 by an

information services librarian using the same search as the Castilla et al, 2023 systematic review.[11] The search resulted in 433 studies.

Selection Criteria

Studies meeting the following 2 criteria were added to those from the 2018 CMT CPG[2] and the 2023 systematic review[11]: participants included infants and children diagnosed with CMT and studies informed the physical therapy management of CMT. All study designs were included. Studies were excluded on 4 criteria: only focused on plagiocephaly, dissertations, and abstracts, published in a language other than English when an adequate English translation could not be obtained, and no statistical analysis of results.

Study Appraisal and Data Extraction

Of the 433 studies, 1 newer study informed the management of CMT. This retrospective study compared stretching and stretching preceded by traditional Chinese massage[23] and was appraised using the Risk of Bias in Non-randomized Studies—of Interventions assessment tool.[24] Two reviewers independently appraised the study, scores were compared for agreement, and discrepancies were resolved via discussion. In addition, the study was assigned a level of evidence using criteria from Table 1. Levels of evidence range from level I, as the highest, to level V, as the lowest.

Data were extracted to maintain consistency with the 2018 CMT CPG[2] and the 2023 CMT systematic review.[11] Evidence tables that were revised and updated with new evidence as follows: Supplemental Digital Content 4 (Psychometric Properties of Assessment Tools Commonly used in the Management of CMT), Supplemental Digital Content 5 (Randomized Controlled Trials of the First-Choice Intervention for Infants with CMT), and Supplemental Digital Content 6 (Randomized Controlled Trials of Evidence-informed Supplemental Interventions for Infants with CMT). Supplemental Digital Content 7 (Studies of Long-Term Outcomes of Congenital Muscular Torticollis) was reaffirmed. All supplemental content available at: http://links.lww.com/PPT/A545. Strengths and limitations of the evidence are included in the Aggregate Evidence Quality and Supporting Evidence and Clinical Interpretation section of each action statement.

Recommendation Formulation

Each 2018 recommendation was evaluated for its currency and consistency with the updated literature. The decision to develop a new recommendation or reaffirm, revise, upgrade, or retire an existing recommendation was informed by the evidence, the GDG's clinical and professional experience, trends in practice changes, and the reported impact of the 2013 and 2018 CMT CPGs.[1,2]

External Review Process

External review is consistent with the IOM's recommendations for trustworthy guidelines.[9] The purposes are to ensure clarity, quality, and comprehensiveness of the CPG and to identify potential bias, lapses in logic or alternative perspectives. A first draft of the 2024 CMT CPG was reviewed by 2 parents/caregivers of infants with CMT and 10 professionals representing CPG methodology, lactation specialists, midwifery, pediatric medicine, pediatric nursing, pediatric surgery, and physical therapy practice, research, and knowledge translation. Both a rating scale to assess the clarity and implementation feasibility of the 17 action statements and an open-ended invitation for comments and edits were used to gather feedback.

After addressing the first round of suggested edits, the rating scale of the 17 action statements and a second draft of the 2024 CMT CPG was posted for public review on the APTA Pediatrics website; invitations to review were distributed to APTA Pediatrics members via its electronic newsletters, a social media posting, and direct email notices to volunteers. Non-members could review if notified by APTA Pediatrics members. During the public review, the 2024 CMT CPG was reviewed by 55 PTs, 1 parent, and 1 other health care professional.

To assess the clarity and implementation feasibility of the 17 action statements without the additional information provided in the 2024 CMT CPG, both groups of reviewers were asked to rate the action statements on a 3-point scale for clarity (clear, somewhat clear, not clear) and feasibility (feasible, somewhat feasible, not feasible) before reviewing the entire 2024 CMT CPG. Of the 17 action statements, 94% were rated as clear and 71% as feasible by at least 75% of reviewers. Suggested edits were addressed, and the final draft was submitted to *Pediatric Physical Therapy* for editorial review.

Appraisal of Guidelines for Research & Evaluation (AGREE) II Review

The 2024 CMT CPG was evaluated by 2 external reviewers using AGREE II.[25] Domain scores for the 2024 CMT CPG ranged from 92% to 100%. The reviewers unanimously agreed to recommend the guideline for continued use.

Plan for Revision

Per current standards, this CPG will be reviewed for potential updates or reaffirmation within 5 years as the body of evidence expands. The guideline revision will be organized by Barbara Sargent, PT, PhD, PCS.

Language

The 2013 CMT CPG and 2018 CMT CPG are referenced the first time they appear and are used without reference hereafter. In contrast, this document is referred to as the 2024 CMT CPG. Additionally, the generic phrase "primary care provider" is used to reference pediatricians, physicians (MD or DO), advanced practice nurses, physician assistants, or other primary health care providers. A list of International Classification of Functioning, Disability, and Health (ICF) and International Classification of Diseases, tenth revision, codes and a glossary of terms are provided in Supplemental Digital Content 8 and 9, available at: https://links.lww.com/PPT/A545.

CONGENITAL MUSCULAR TORTICOLLIS

Incidence and Evaluation of Congenital Muscular Torticollis

CMT is a condition evident shortly after birth, affecting 3.9%[26] to 16%[27] of newborns. It is typically characterized by cervical lateral flexion to one side and cervical rotation to the opposite side due to unilateral shortening or muscle imbalance of the SCM muscles, with or without an SCM mass. An SCM mass is a benign fibrotic mass or enlargement of the SCM and is synonymous with fibromatosis colli or tumor.[28]

A comprehensive physical therapy examination and evaluation is essential as CMT may co-occur with other medical conditions, such as craniofacial asymmetry,[29] and up to 18% of cases of asymmetrical head and neck posturing may be due to nonmuscular causes, eg, cerebral palsy, visual impairments, scoliosis, gastroesophageal reflux disorder (GERD), and acute respiratory distress that require referrals to other health care professionals.[30,31]

Importance of Early Referral

The evidence is strong that earlier physical therapy intervention results in better outcomes,[12-14] shorter episodes of care,[12,14,15] reduced need for surgical interventions,[14,16,17] and reduced risk of secondary complications, such as cervical spine dysmorphism[18] and mandibular asymmetry.[19] Petronic et al found that if started before 1 month of age, 98.6% of infants with CMT achieve good outcomes (no head tilt, >100° passive cervical rotation, >65° passive cervical lateral flexion) with an average treatment duration of 1.5 months; waiting until 1 to 3 months of age prolongs the treatment duration to 5.9 months with 89% of infants achieving good outcomes; waiting until 3 to 6 months prolongs the treatment duration to 7.2 months with 62% of infants achieving good outcomes; and waiting until after 6 months of age prolongs the treatment duration to 9.8 months with only 19% of infants achieving good outcomes.[12] Infants with CMT and an SCM mass typically are identified earlier but may have longer episodes of care.[14,32,33]

Infants diagnosed with CMT are not expected to spontaneously resolve or resolve with 1-2 sessions of parent/caregiver training on neck stretching; therefore, immediate referral to physical therapy is recommended for optimal outcomes.[8] Physical therapy management of CMT is comprehensive and addresses these 5 components as the first-choice intervention: (1) neck PROM if PROM is limited; (2) neck and trunk active range of motion (AROM); (3) development of symmetrical movement; (4) environmental adaptations; and (5) parent/caregiver education.

Physical therapy intervention for infants with CMT is highly effective when provided in early infancy, so early referral and initiation of physical therapy intervention is recommended to improve clinical outcomes, shorten episodes of care, reduce burden on families, and decrease cost of care for infants with CMT.[8]

ACTION STATEMENTS

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 PTs) 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 PTs in the comprehensive management of postural preference and optimizing motor development if concerns are noted.

(Evidence Quality: V; Recommendation Strength: Best Practice)

Action Statement Profile

Aggregate Evidence Quality: Level V based on clinical experience of the GDG.

Benefits:

- Increases parent/caregiver self-efficacy in caring for their infant.
- Informs parents/caregivers on the importance of supervised tummy time to optimize motor development within the first 6 months.
- Informs parents/caregivers about the role of pediatric PTs in providing a comprehensive and supportive plan

of care to manage postural preference associated with CMT and cranial deformation (CD).

- Teaches parents/caregivers to initiate early surveillance for postural preference and to bring concerns to the infant's primary care provider or, in states with direct access, to a pediatric PT.
- May reduce the episode of care and improve outcomes if postural preference is identified and comprehensively managed early.

Risk, Harm, and Cost:

- May increase parent/caregiver anxiety about the potential for CMT and CD.
- May marginally increase the cost of care if perinatal care providers and educators do not incorporate education into usual care and it requires a separate child encounter.
- May increase the time needed to spend with a newborn and parents/caregivers during health care encounters.

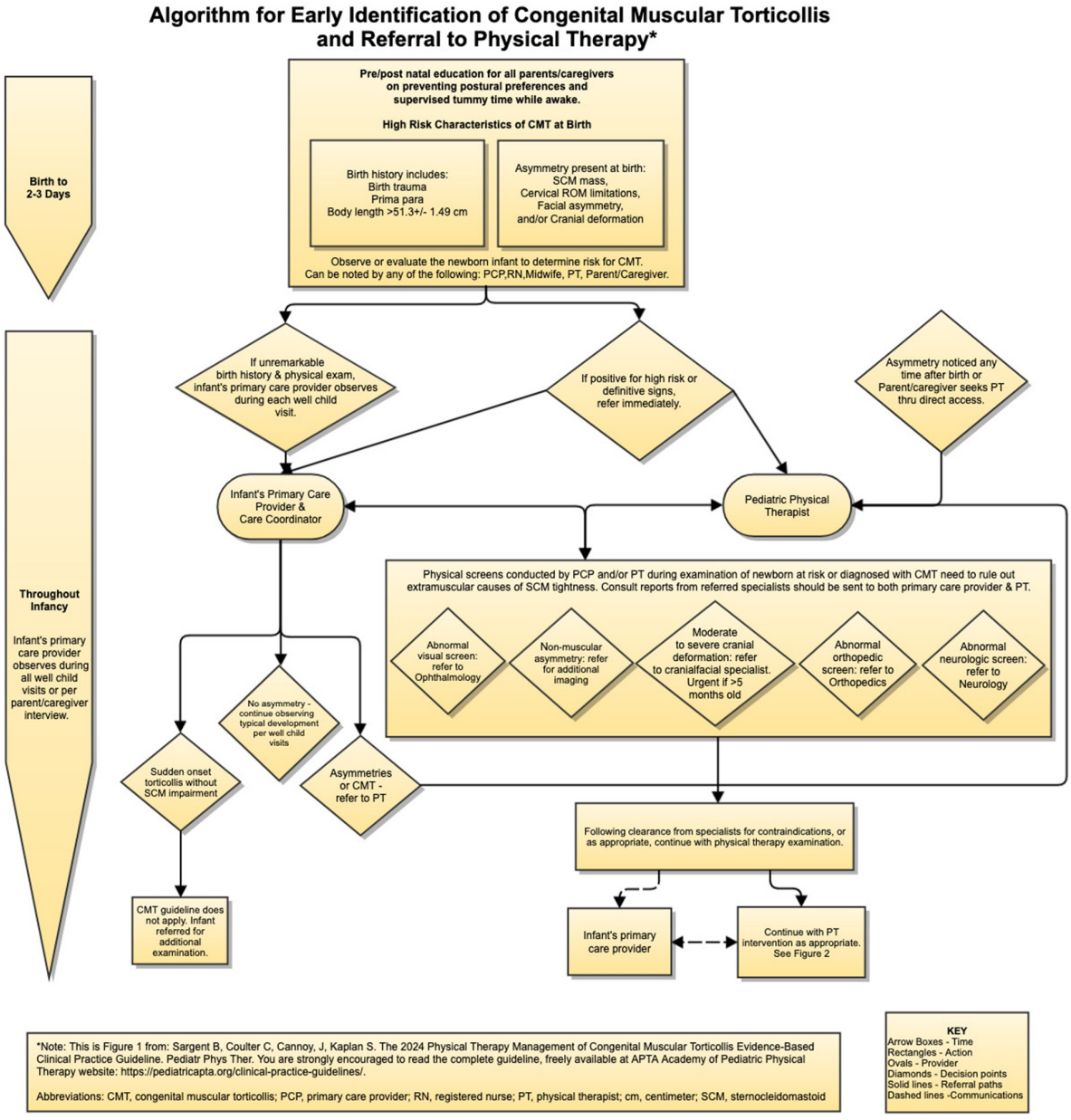

Fig. 1. Referral flow diagram.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: A preponderance of evidence supports that early identification of postural preference and CMT results in shorter episodes of care and more complete resolution of asymmetries. The GDG feels that if parents/caregivers know how to monitor their newborn during the first months of life, how to encourage tummy time during awake periods, and are empowered to report their concerns to their primary care provider, that asymmetries could be reduced more quickly or even prevented.

Intentional Vagueness: Prone positioning for supervised play up to 2 to 3 times a day is the recommendation for newborns because the amount of time awake is limited, though the need to start prone positioning right away for short periods should be reinforced. As time awake increases, infants should be placed for supervised prone play as often as tolerated and practical.

Role of Child/Parent/Caregiver Preferences: Due to the amount of information that parents/caregivers of infants receive during the first days of parenthood, they may benefit from multiple educational opportunities before and after the infant's arrival. Parents/caregivers may prefer receiving instruction using different modes of delivery (by video or brochure), by different health care providers (with those they already have a relationship with or as part of prenatal care), or at different phases in their pre- to post-natal experience.

Exclusions: None.

Quality Improvement:

- Pre- and post-natal education for parents/caregivers on postural preference and the benefits of early intervention may shorten the episode of care or improve outcomes if an infant is diagnosed and referred to physical therapy early. This is especially true for parents/caregivers of multiples, whose infants may be at greater risk than singletons for CD, which may lead to postural preference.[34]

Implementation and Audit:

- PTs need to engage in knowledge-translation outreach, including distributing the CMT CPG implementation resources,[3] to ensure that expectant parents/caregivers, parents/caregivers of newborns, and health professionals, including but not limited to primary care providers, prenatal educators, physicians, midwives, obstetrical or other nurses, lactation specialists, nurse practitioners, physician assistants, doulas, and early intervention providers, have an accurate understanding of: (a) screening for postural preference in all infants, (b) ways to prevent or minimize postural preference through positioning and handling, (c) the importance of early referral to a primary care provider and pediatric PT if postural preference is noted or CMT is suspected, (d) the role of physical therapy in the comprehensive management of postural preference and optimizing motor development, and (e) ways to access the CMT CPG implementation resources.[7]
- PTs should collaborate with policymakers, administrators, and health care providers in their clinical settings to develop pathways for parent/caregiver education on CMT to ensure that education is provided both before and within the first 2 to 3 days of life.
- Audits of education provided to expectant parents/caregivers and parents/caregivers of newborns may indicate if patterns of education are changing.

Supporting Evidence and Clinical Interpretation

Early and frequent parent/caregiver education to monitor for asymmetry, the importance of "prone for play" or "tummy time", and the recommendation for "supine or back to sleep" may help to reduce or prevent asymmetries from developing, particularly when postural preferences are apparent. Daily supervised awake prone time is widely recommended starting at birth for 2 to 3 times daily for 3 to 5 minutes, gradually working toward 15 to 30 minutes daily by 7 weeks of age, and at least 30 minutes daily by 6 months of age.[35,36] Supervised awake prone time has been positively associated with gross motor and global development, prevention of brachycephaly, and the ability to move while prone, supine, crawling, and walking.[37,38]

The American Academy of Pediatrics' policy on surveillance for developmental disorders is to "elicit and attend to parents' concerns about their child's development"[39] although this does not universally happen.[40] Thus, parents/caregivers should be educated on early surveillance of symmetry and positioning. A mixed methods study determined that 90% of mothers are educated about infant supine sleeping positions, but instruction on awake prone play or rotating prone and supine was only received by 27% of mothers postpartum, and 2 months later, only 8% of mothers used prone positioning during awake time, with 70% positioning only 1-2 times per day.[41] The success of the *Back to Sleep/Safe Sleep* campaign[42] has demonstrably reduced cases of sudden and unexpected infant death, including sudden infant death syndrome; however, many ascribe parent/caregiver adherence to supine positioning, and concomitant avoidance of prone positioning for infant play, as a contributing factor to an increase in CMT.

Research Recommendation: Studies are needed on the impact of education on:

- Health care providers and their knowledge of pediatric PTs' roles in managing postural preference.
- Parents/caregivers about the experience of receiving this education.

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 PTs) 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 ROM and/or visual observation as their respective training or experience supports.

(Evidence Quality: I, Recommendation Strength: Strong)

Action Statement Profile

Aggregate Evidence Quality: Level I based on the odds ratio (OR) for prediction of CMT from facial asymmetry (OR 21.75; 95% confidence interval [CI], 6.60-71.70) and plagiocephaly (OR 23.30; 95% CI, 7.01-70.95)[43] and cohort studies that consistently support that starting intervention before 4-6 weeks of age yields greater reductions in SCM thickness, improved outcomes, shorter episodes of care, and reduced need for surgical intervention, compared to starting after 4-6 weeks.[12-14]

Benefits:

- Early identification of infants at risk for CMT or other conditions that may cause asymmetries.
- Early onset of intervention for infants with CMT if referred.
- Reduced episode of care to resolve CMT, with consequent reduction in costs.
- Reduced risk of needing more invasive interventions (botulinum neurotoxin therapy or surgery) in the future.

Risk, Harm, and Cost:

- Potential of overidentification of infants may increase costs.
- Potential of increasing parent/caregiver anxiety.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: None.

Intentional Vagueness: Assessment of neck and/or facial or cranial asymmetry is recommended within the first 2 to 3 days of life to allow for variations in birth settings, eg, hospitals, out-of-hospital birth centers, or homes.

Role of Child/Parent/Caregiver Preferences: While parents/caregivers may not be skilled in formal infant assessment, they are keen observers of their own child. Parents/caregivers may notice that their infant has greater difficulty eating on one side, or they may notice asymmetry in photographs. These observations should trigger ROM screening by a health care professional.

Exclusions: None.

Quality Improvement:

- Documentation of an assessment for postural symmetry and cervical ROM, including baseline measurements, provides uniform data for more effective communication among clinicians and settings, for monitoring progress, and for uniform data entry in child registries.
- Early examination can detect asymmetries and support earlier referral to PTs who can provide comprehensive intervention and follow-up.

Implementation and Audit:

- PTs should share the CMT CPG and the APTA Pediatrics CMT CPG implementation resources[7] with other health care providers in their geographic area, highlighting this recommendation and the importance of early cervical ROM screening.
- Develop clinical pathways for health professionals who see infants at birth ensure that cervical ROM assessment occurs within the first 2 to 3 days of life.
- Documentation forms or electronic records may need revision to include the documentation of cervical ROM and postural symmetry screens.
- Audits of newborn charts may indicate if patterns of examination are changing.

Supporting Evidence and Clinical Interpretation

This action statement intends to increase the early identification of infants with CMT for early referral to physical therapy. The American Academy of Pediatrics policy on surveillance states that primary care providers should provide developmental surveillance for all infants at every well-child preventative care visit from birth and throughout the first 6 months[39]; thus, infants with identified postural asymmetries are referred immediately for physical therapy intervention.[8] During the first neonatal exam,[44] infants can be easily screened by assessing for full neck rotation (chin turns past shoulder to 100°)[27] and lateral cervical flexion (ear approximates shoulder)[27] while stabilized in supine.[45]

Newborns are at higher risk for CMT if their birth history includes a combination of longer body length, primiparity, maternal perineal trauma during delivery, facial asymmetry, and plagiocephaly.[43] Infants with cranial and/or facial asymmetries have a 22-fold increase in abnormal sonogram for CMT; primiparity a 6-fold increase; maternal perineal trauma during delivery a 4-fold increase; and body length a 2-fold increase.[43] Additionally, infants with a history of neonatal abstinence syndrome (NAS) who require medication have a higher incidence of CMT than infants without NAS.[46] No single characteristic predicts CMT alone but the presence of 2 or more of the above risk factors warrants referral for preventative care and parent/caregiver education.

The diagram shown in Figure 1 (Supplemental Digital Content 1, available at: http://links.lww.com/PPT/A546) outlines the possible screening, referral, and communication pathways based on time of observation, identification of nonmuscular causes of asymmetry, prior models, and current literature.[30,31,47-49]

The referral flow diagram has 2 distinct time frames: Birth to 2 to 3 days, representing the newborn period, and

throughout infancy, representing the typical time after discharge to home. During the newborn period, many different health care providers may observe the infant because they are involved in the birth and/or postnatal care. These health care providers are in the ideal position to observe the symmetry of the head on the shoulders and screen for passive and active movement limitations. After the infant is at home, the most likely observers will be the primary care provider and parents/caregivers, who may document persistent asymmetries with photos. Regardless of who performs the initial screen, infants with asymmetry should undergo an evaluation by their primary care provider to rule out nonmuscular causes of CMT. If CMT or a persistent postural preference is diagnosed, the infant should be immediately referred to a pediatric PT.

Research Recommendation: Studies are needed to determine:

- whether routine screening during the first 2 to 3 days of life increases the rate of CMT identification and/or increases false positives.
- the barriers to early referral of infants with CMT to physical therapy.

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 PTs) and parents/caregivers should refer infants identified as having postural preference, reduced cervical ROM, an SCM mass, and/or craniofacial asymmetry to their primary care provider, and a PT with expertise in infants as soon as the asymmetry is noted. (**Evidence Quality: I, Recommendation Strength: Strong**)

Action Statement Profile

Aggregate Evidence Quality: Recommendation upgraded to Strong based on consistency of results: (1) reevaluation of a cohort study that demonstrated a dose-response relationship of physical therapy intervention with earlier intervention resulting in improved outcomes and decreased treatment duration[12]; and (2) several cohort studies that consistently support that earlier intervention results in better outcomes,[12-14] shorter episodes of care,[12,14,15] reduced need for surgical interventions,[14,16,17] and reduced risk of secondary complications, such as cervical spine dysmorphism[18] and mandibular asymmetry.[19] Demonstration of a dose-response relationship is considered strong evidence for a causal relationship between the exposure and the outcome[20] because increasing levels of exposure, in this case, earlier physical therapy intervention, is associated with an increasing chance of improved outcome. In addition, stretching interventions are easier for parents/caregivers to administer when infants are younger and more tolerant of stretching.[12,50]

Benefits:

- Early differential diagnosis to determine that the postural asymmetry is due to CMT vs another medical condition, such as a visual impairment or reflux.
- Earlier intervention to resolve limited ROM and asymmetries more quickly.
- Early parent/caregiver education to facilitate symmetrical development and self-efficacy with home programs.
- Greater infant tolerance with intervention in the first few months of life.

Risk, Harm, and Cost:

- Increased cost of treating asymmetries at later ages when CMT is assumed to spontaneously resolve without intervention.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: Early referral to physical therapy ensures early onset of intervention, which strongly correlates with improved outcomes, shorter episodes of care, and, as a result, can lower overall costs of care. A pediatric PT also screens and monitors the infant for developmental delays, eating issues, and environmental factors that may be associated with or contribute to postural preference or CMT.

Intentional Vagueness: For infants suspected of other causes of asymmetries, eg, bony anomalies, fractures, neurological conditions, or extra-muscular masses, PTs should collaborate with the infant's primary care provider and appropriate specialists to determine when to initiate physical therapy intervention. The focus and prioritization of interventions may change depending on the type of limitations the infant presents with (eg, neurological, musculoskeletal, cardiopulmonary, integumentary, and/or gastrointestinal).

Role of Child/Parent/Caregiver Preferences: Infant tolerance with stretching is easier in the first 2 months than when started after the infant develops greater head control[50,51]; thus, infant cooperation is greater, and parent/caregiver adherence to home programs may be optimized. Later referrals put additional stress on parents/caregivers to adhere to stretching recommendations.

Exclusions: Infants suspected of having nonmuscular conditions that might cause asymmetrical or torticollis posturing should be fully examined by the appropriate specialists to rule out confounding medical conditions prior to initiating physical therapy.

Quality Improvement:

- This recommendation will reduce delays in referrals to PTs who can provide a comprehensive plan of intervention and follow-up to ensure that the primary caregivers can adhere to the recommended interventions.

Implementation and Audit:

- Training for health professionals and early intervention providers who see infants in early infancy may be needed

to ensure that infants are appropriately and quickly referred to physical therapy. Health professionals may be reluctant to refer right away if they perceive parents/caregivers as being overburdened during those early weeks; however, earlier referral translates to better outcomes.

- Audits of the age at which parents/caregivers first notice the CMT, the date of referral, and the age of the first physical therapy examination will provide objective measures of delays between identification and referral to physical therapy and delays between referrals and the first scheduled physical therapy examination.
- PTs should share the 2024 CMT CPG and/or the APTA Pediatrics CMT CPG implementation resources[7] with primary care providers, early intervention providers, and other referral sources in their geographic area, highlighting this recommendation and the supporting evidence for early referral.
- Clinical pathways for examination and referral processes may reduce delays in the onset of physical therapy services by prioritizing infants with asymmetry/CMT for physical therapy examinations. PTs may need to collaborate with administrators and nonmedical professionals to ensure that these infants receive immediate referrals, either internally or through external referrals.

Supporting Evidence and Clinical Interpretation

Clinicians involved with the delivery and care of infants are in the ideal position to assess the presence of CMT. If screening for CMT occurs routinely within the first 2 to 3 days of life, newborns who are at high risk for CMT, or who have identified SCM tightness or masses, can have physical therapy initiated when the infant is most tolerant of interventions. CMT may not appear until several weeks after birth; thus, the 1-month well-child visit with the primary care provider may be the first point of identification. Using multivariate analysis with stepwise logistic regression, Cheng et al found that infants with CMT older than 1 month of age at presentation to the clinic demonstrated longer treatment durations, worse overall outcome scores, and increased need for surgical management.[14]

Early intervention for infants with CMT, initiated before 3 to 4 months of age, results in excellent outcomes with 92% to 100% achieving full neck rotation PROM and 0 to 1% requiring surgical intervention,[12,16,52,53] compared to only 75% achieving full resolution after 3 to 4 months of age. Yet, 3 retrospective studies[54-56] of infants with CMT managed from 2014 to 2018 found that the average age at initial physical therapy examination ranged from 3.2 (SD 1.6)[55] to 3.5 (SD 2.1)[54] months of age.

Earlier intervention results in better outcomes,[12-14] shorter duration of intervention,[12,14,15] reduced need for surgical intervention,[14,16,17] and reduced risk of secondary complications, such as cervical spine dysmorphism[18] and mandibular asymmetry.[19] Petronic et al found that when intervention was initiated before 1 month of age, 99% of infants with CMT achieved good clinical outcomes (no head tilt, full passive cervical rotation, and lateral flexion ROM) with an average treatment duration of 1.5 months, but if initiated between 1 and 3 months of age, only 89% of infants achieved good outcomes with an average treatment duration of 6 months.[12] When initiated between 3 and 6 months of age, 62% of infants achieved good outcomes with an average treatment duration of 7 months.[12] When initiated between 6 and 12 months of age, 19% of infants achieved good outcomes with an average treatment duration of 9 months.[12] This research supports a dose-response relationship[20] of physical therapy intervention with earlier intervention resulting in improved outcomes and decreased treatment duration.[12]

In contrast to recommendations to provide stretching instruction to the parents/caregivers when CMT is identified at birth, and only refer to physical therapy at 2 months of age if the condition does not resolve,[52] early physical therapy reduces the time to resolution compared to parent-only stretching,[57] infants become more difficult to stretch as they age and develop neck control,[50] and earlier intervention can negate the need for later surgery.[14,16,17]

PTs address a broad range of developmental and environmental factors that influence outcomes, such as parent/caregiver ability to perform or adapt the home exercise programs, transportation distance from the clinical setting,[58] eating positions,[59] and the infant's motor and developmental progression.[58,60] Since developmental delays are detectable at 2 months in infants with CMT,[61] and the delays may be inversely related to time spent in the prone position,[61] instruction to parents/caregivers and early modeling of prone play time may help negate potential developmental delays that can occur with CMT.[37,62]

Research Recommendations:

- Studies are needed to clarify the predictive baseline measures and characteristics of infants who benefit from immediate follow-up and to compare the cost-benefit of early physical therapy intervention and education as compared to parent/caregiver instruction and monitoring by primary care providers.
- Longitudinal studies of infants with CMT would clarify how referral timing and intervention initiation impact body structures and functional outcomes, and overall care costs.

II. PHYSICAL THERAPY EXAMINATION AND EVALUATION OF INFANTS WITH ASYMMETRIES/CMT

B **Action Statement 4: DOCUMENT INFANT HISTORY.** Prior to initial screening, PTs 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.
(**Evidence Quality: II-IV, Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II-IV based on cohort and outcome studies.

Benefits:

- A complete history of the pregnancy, birth, known medical conditions, developmental milestones, and daily management of the infant can provide information important to the physical therapy diagnosis, prognosis, and intervention.

Risk, Harm, and Cost: None.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: None.

Intentional Vagueness: None.

Role of Child/Parent/Caregiver Preferences: Parents/caregivers can provide the history through interview and preadmission information packets. Medical records may also be used.

Exclusions: None.

Quality Improvement:

- Documentation of the 6 specific health history factors provides uniform data for more effective communication among clinicians and settings and for uniform data entry in child registries.

Implementation and Audit:

- Create parent/caregiver intake forms that are completed prior to the initial examination to assist with collecting the 6 items.
- Documentation forms or electronic records may need revision to include documentation of the 6 specific health history factors.
- Audit the completeness of history documentation.

Supporting Evidence and Clinical Interpretation

In addition to documenting the standard intake information (eg, date of birth, date of examination, sex, birth rank or order, reason for referral, parent/caregiver concerns, general health of the infant, and the infant's other health care providers), the PT should specifically document the following 6 birth and health history factors.

- Chronological age (and corrected age if the infant was born preterm) at the initial visit.[13,60]
- Age of onset of symptoms,[29,60] which may be aided by early photographs.
- Pregnancy and birth history, including obstetric and neonatal complications.[43,45,63] These may include:
  - maternal sense of whether the infant was "stuck" in one position during the final 6 weeks of pregnancy,[45]
  - breech presentation,[63]
  - operative delivery (ie, forceps or vacuum-assisted delivery),[43]
  - low birth weight.[63]
- Head posture/preference[27,64-66] and asymmetries of the head or face.[27,29]
- Other known or suspected congenital, developmental, or medical conditions.[30,31,66-68]
- Developmental milestones.[61,69,70]

Research Recommendation: Studies are needed to clarify how the health history screening influences CMT identification, physical therapy diagnosis, prognosis, and intervention.

B **Action Statement 5: SCREEN INFANTS FOR NONMUSCULAR CAUSES OF ASYMMETRY AND CONDITIONS ASSOCIATED WITH CMT.** When infants present with or without primary care provider referral, and a professional or parent/caregiver indicates concern about head or neck posture and/or developmental progression, PTs 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, upper and lower extremities, consistent with state practice acts.
(**Evidence Quality: II-IV, Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II-IV based on cohort and outcome studies and expert clinical consensus.

Benefits:

- Comprehensive screening can identify asymmetries and determine their consistency with CMT.
- Screening for other causes of asymmetry (eg, cerebral palsy, craniofacial asymmetries, visual impairments, scoliosis, GERD, acute respiratory distress) facilitates referral to specialists.
- For infants treated for other conditions associated with higher risks for developing CMT (ie, brachial plexus injuries, developmental dysplasia of the hip [DDH], and GERD), parents/caregivers can receive preventative instruction for CMT.
- In states where PTs may screen and/or treat without primary care provider referral, infants may receive services more quickly.

Risk, Harm, and Cost:

- The cost of a physical therapy screening if the infant is not already being treated for other conditions.
- The risk that PTs without infant experience may miss or misidentify nonmuscular causes of asymmetry.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: In some geographic locations or practice settings, particularly where direct access to physical therapy is permitted, PTs may be the first to screen an infant for postural asymmetries. Infants may present for reasons other than head or neck postures, but observing overall symmetry is an element of a thorough physical therapy systems review.

Intentional Vagueness: None.

Role of Child/Parent/Caregiver Preferences: None.

Exclusions: None.

Quality Improvement:

- Documentation of the neurological, musculoskeletal, integumentary, cardiopulmonary, and gastrointestinal system reviews provides uniform data for more effective communication among clinicians and settings and for uniform data entry in child registries.
- Systematic screening ensures that nonmuscular causes of asymmetry or associated conditions are ruled out or that timely referral for additional testing occurs.

Implementation and Audit:

- Documentation forms or electronic records may need revision to reflect the data collected from the screens.
- Clinicians may require training to enhance consistency and reliability of system reviews.
- Audit the incidences in which system reviews are positive for nonmuscular causes of CMT or potential associated conditions.

Supporting Evidence and Clinical Interpretation

It is within the scope of physical therapy practice to perform a systems review for nonmuscular causes of CMT in the neuromuscular, musculoskeletal, cardiopulmonary, and integumentary systems, including screening for visual impairments, GERD, and developmental delay.[71] The systems review is performed to rule out nonmuscular causes of asymmetrical posturing[30,31,66] and to determine whether the PT should refer to or consult with the infant's primary care provider immediately or continue with a detailed examination for CMT. The systems review is conducted through parent's/caregiver's report and observation of the infant in different positions. Elements of the systems review to document include the following:

- **History**: per parent/caregiver report as described in Action Statement 4.
- **Systems Review**: Per the APTA Guide to Physical Therapist Practice 4.0,[71] a systems review traditionally examines the following 6 domains and for infants with CMT, a gastrointestinal history should be added as the seventh.
- **Musculoskeletal System**: Screen for the symmetrical shape of the face, skull, and spine[72,73]; symmetrical alignment of the shoulder and hip girdles[74] with particular attention to cervical vertebral anomalies, rib cage symmetry,[47] and DDH[74]; symmetrical PROM and AROM of the neck; and palpation for an SCM mass or tight cervical musculature.[75]
- **Neurological System**: Screen for abnormal or asymmetrical tone or spasticity; cranial nerve integrity; brachial plexus injury; temperament (irritability, alertness); symmetrical movement; and achievement of age-appropriate developmental milestones.[30,31,47,66,69,75] Perform a visual screen composed of symmetrical eye position in midline and symmetrical eye tracking in all directions, noting visual field defects and nystagmus as potential ocular causes of asymmetrical postures.[76]
- **Integumentary System**: Screen for skin fold symmetry of the hips[45,66] and cervical regions[77]; color and condition of the skin, with special attention to signs of pressure and trauma that might cause asymmetrical posturing.[66]
- **Cardiopulmonary System**: Screen for symmetrical coloration, rib cage expansion, and clavicle movement to rule out conditions that might cause asymmetrical posturing (eg, brachial plexus injuries and Grisel's syndrome)[66,68]; screen for acute respiratory distress.[78,79] The infant should be alert and appropriately vocal, without wheezing.
- **Communication**: Screen for facial expressions when vocalizing or crying, general alertness and behavioral responses, and receptivity to caregiver or clinician vocalizations.[71]
- **Movement**: Observe for symmetrical and full AROM or preferential patterns in supine, prone, and while held by the caregiver.[71]
- **Gastrointestinal System**: Interview the parents/caregivers for an infant history of GERD[80,81] or difficult or preferential eating from one side[64]; both can contribute to asymmetrical posturing.

Research Recommendation: Studies are needed to identify the precision of screening procedures specific to CMT.

B **Action Statement 6: REFER INFANTS FROM PHYSICAL THERAPIST TO PRIMARY CARE PROVIDER IF INDICATED BY SYSTEMS REVIEW.** PTs 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 GERD); 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 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° to 15° of difference exists in passive or active cervical rotation or lateral flexion ROM.

(Evidence Quality: II, Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II based on cohort and outcome studies.

Benefits:

- Infants with positive results from the systems review are identified and can be co-managed with the infant's primary care provider and other specialists, eg, orthotists, neurologists, or orthopedic surgeons.
- Early coordination of care may resolve CMT more quickly and with less cost, as well as initiate appropriate intervention for conditions other than CMT.
- Parent/caregiver support starts earlier for effective home programming, parent/caregiver education, and the balance of intervention with parent/caregiver needs to enjoy and bond with their infant.

Risk, Harm, and Cost:

- Cost of care is increased in the cases when there is a false positive from the review of systems.
- Additional family stress due to concerns about the infant having more serious health conditions.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: Evidence demonstrates that earlier diagnosis of CMT is better, but there is no literature that documents the risks and consequences of a lack of immediate follow-up for the 18% of infants who have conditions other than CMT.[30,31] While the recommendation strength is categorized as Moderate based on level II evidence, the GDG believes that consultation with or referral to the infant's primary care provider should be categorized as a MUST when any nonmuscular causes of asymmetry or other parental concerns are identified. This promotes collaboration in the co-management of care of the infant who may have both CMT and other medical conditions.

Intentional Vagueness: An infant with postural asymmetry may present to the physical therapy evaluation with or without a primary care provider referral. The PT should use their professional judgment to determine if they should refer to or consult with the infant's primary care provider immediately if any of the aforementioned conditions are present or continue with a detailed examination for CMT. If the PT continues with the evaluation, the PT should consult with the infant's primary care provider when any of the conditions are present to assure that the primary care provider is aware of them and refer the infant to the primary care provider for further diagnostic testing when indicated.

Role of Child/Parent/Caregiver Preferences: None.

Exclusions: None.

Quality Improvement:

- Documentation of consultation with or referral to the infant's primary care provider when the PT suspects a nonmuscular cause of the asymmetry or associated medical conditions provides uniform data for communication across clinicians and settings and ensures an accurate record of care.

Implementation and Audit:

- Consultations with or referrals to the primary care provider should include the results of the review of systems and a rationale for concerns underlying the consult or referral.
- Documentation forms or electronic records may need revision with indicators and rationales for consults and referrals.
- Audit the incidences in which consults and referrals helped to identify nonmuscular causes of CMT and associated conditions.

Supporting Evidence and Clinical Interpretation

Up to 18% of cases with asymmetrical head posturing may be due to nonmuscular causes.[30,31] The following are the basis for consultation with or referral to the infant's primary care provider or other specialists:

- Signs and symptoms consistent with nonmuscular causes of head preference, such as neurological conditions including cerebral palsy, visual impairments and visual field deficits, spinal conditions including scoliosis, and GERD.[30,31,76,80,81]
- Signs and symptoms consistent with conditions associated with CMT, such as CD and/or facial asymmetry, brachial plexus injury, and DDH.[66,82]
- Presentations atypical of CMT, such as head lateral flexion and rotation to the same side, plagiocephaly and head lateral flexion to the same side, or torticollis that alternates sides.[31,55]
- Signs and symptoms consistent with medical conditions in which neck stretching may be contraindicated or require precautions, such as skeletal dysplasia,

osteogenesis imperfecta, or conditions associated with atlantoaxial instability, eg, Trisomy 21.[83]
- Changes in the infant's color during screening of neck PROM.
- History of acute onset torticollis, which is usually associated with trauma or acute illness.[30,84]
- Late onset torticollis at 6 months or older, which can be the result of neurological conditions, tissue mass, inflammation, or acquired asymmetry.[66,78]
- The presence of an SCM mass at 6 months or older, or an SCM mass that changes shape and location or increases in size at any age.[85]
- The infant is older than 12 months on initial screening, and either facial asymmetry and/or 10° to 15° of difference exists in active or passive cervical rotation or lateral flexion ROM.[1]

Research Recommendations: Studies are needed to clarify the incidence of nonmuscular causes of CMT and associated conditions and how early referral impacts ultimate outcome.

B **Action Statement 7. REQUEST IMAGES AND REPORTS.** PTs 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.
(Evidence Quality: II, Recommendation Strength: Moderate).

Action Statement Profile

Aggregate Evidence Quality: Level II based on cohort and outcome studies.

Benefits:
- Imaging may prevent injury to the spine in infants diagnosed with skeletal dysplasia, osteogenesis imperfecta, or Trisomy 21.[83]
- Available images and imaging reports provide a comprehensive picture of the infant's medical status, including comorbidities.
- Images provide visualization of the SCM muscle fiber organization, and the location and size of fibrotic tissue.
- Parents/caregivers appreciate care that is coordinated and shared across disciplines.

Risk, Harm, and Cost:
- Requesting reports may require additional time for the parents/caregivers and/or the PTs.
- Imaging may incur additional costs.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: Per the APTA Guide to Physical Therapist Practice 4.0,[71] requesting relevant clinical reports on an infant's suspected or diagnosed condition is appropriate medical history gathering.

Intentional Vagueness: None.

Role of Child/Parent/Caregiver Preferences: Parents/caregivers need to formally request release of reports to the PT or bring copies to their first physical therapy appointment.

Exclusions: None.

Quality Improvement:
- Document the request for and receipt of reports and images.

Implementation and Audit:
- Documentation forms or electronic records may need revision with indicators of requests for and receipt of images and reports.
- Audits the incidences in which a report or image helped to inform the prognosis or intervention choices.

Supporting Evidence and Clinical Interpretation

The current standard of care does not include routine imaging of infants with suspected or diagnosed CMT younger than 1 year of age.[86] Rather, infants are typically referred for imaging when there is a specific sign or symptom that raises concern, eg, skeletal dysplasia or atlantoaxial instability for Trisomy 21, or there is a lack of progress despite close adherence to the intervention program.[83] Reports and images from specialized exams or laboratory tests can rule out ocular, neurological, skeletal, and oncological reasons for asymmetrical posturing.[30,84] A growing body of research uses sonoelastography or ultrasound imaging to quantify the size, shape, organization, and location of fibrous bands or SCM masses, to inform treatment duration and quantify change with intervention.[21,29,33,87-93] Evidence suggests that infants with masses or abnormal fiber organization of the SCM are typically identified earlier but require longer episodes of care.[32,33]

Research Recommendations: Studies are needed to determine infants who would benefit from imaging, at what time in the management of CMT images are useful, and how images affect the plan of care.

B **Action Statement 8: EXAMINE BODY STRUCTURES.** PTs 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. **(Evidence Quality: II; Recommendation Strength: Moderate)**
- Bilateral PROM into cervical rotation and lateral flexion using an arthrodial protractor or goniometry. **(Evidence Quality: II; Recommendation Strength: Moderate)**

- Bilateral AROM into cervical rotation using an arthrodial protractor or goniometry and cervical lateral flexion functional strength using the Muscle Function Scale. **(Evidence Quality: II; Recommendation Strength: Moderate**)
- PROM and AROM of the trunk and upper and lower extremities, inclusive of screening for DDH. **(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 (FLACC) Scale. **(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. **(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. **(Evidence Quality: II; Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II-III based on cohort studies, reviewed by Seager et al[94] (refer to Supplemental Digital Content 4, Psychometric Properties of Assessment Tools Commonly Used in the Management of Congenital Muscular Torticollis, available at: http://links.lww.com/PPT/A545).

Benefits:

- Confirms the diagnosis of CMT and identifies other medical conditions such as craniosynostosis, DDH, plagiocephaly, brachycephaly, or scoliosis.
- Standardizes baseline measurement and documentation of body structure and function to inform prognosis, evaluate individual progress and outcomes, and evaluate group outcomes within or across clinical settings.

Risk, Harm, and Cost:

- Examination of passive cervical rotation PROM may result in SCM snapping or a sense of "giving way" in approximately 8% of young infants with CMT and an SCM mass.[95]
- During the physical therapy examination, infants may feel some discomfort or pain, and/or may cry[79] due to restricted movement, discomfort with PROM tests, or intolerance of general handling.
- In infants with undiagnosed orthopedic conditions (eg, osteogenesis imperfecta, hemivertebrae, or cervical instability), there is a risk that overly aggressive testing of PROM could cause secondary injury, although this has not been reported.

Value Judgments: The evidence for selected measurement approaches varies in strength; however, measures of passive and active ROM, strength, and posture *must* be documented as part of any physical therapy exam and are consistent with current standards of practice.[71] For ROM measurement, the GDG recognizes that clinical practicality has to be weighed against the desire for the most reliable measures. Use of photography, head markers, and other devices to increase measurement reliability may create undue burdens for the infant, the family, and the PT in clinical practice even while they are necessary for research protocols. While there is only moderate to weak evidence to justify the measurement of cervical spine AROM, AROM of the upper and lower extremities, pain or discomfort, condition of the skin folds, condition of the SCM and cervical muscles, and head shape, a lack of evidence is not equated with a lack of clinical relevance. Documenting these initial examination results sets the baseline for regularly scheduled objective reassessment and outcome measurement.

Intentional Vagueness: There is no vagueness as to *what* should be documented. There is variability as to *how* selected body structures should be measured, due to the limited number of valid tools or methods.

Role of Child/Parent/Caregiver Preferences: During testing, parents/caregivers may perceive that the infant experiences discomfort or that testing positions could potentially harm the infant, resulting in requests to stop testing if the infant is crying. The clinician must be aware and responsive to the parent/caregivers' perceptions; it is incumbent on the clinician to fully explain the importance of the measures and the safety precautions used, so that parents/caregivers and infants can comfortably and accurately complete the testing procedures. Clinicians may need to provide the infant breaks during testing to obtain the infant's best performance and most reliable measures. Including the parent/caregiver in the test procedures may help elicit the infant's best performance, calm the infant if under stress, and generally assist with building trust between the PT and the infant.

Exclusions: None.

Quality Improvement:

- Documentation of the 7 body structures and functions provides uniform data for more effective communication among clinicians and settings, as well as uniform data entry in child registries.

Implementation and Audit:

- Documentation forms or electronic records may need revision to reflect the 7 body structure elements.

- Additional equipment may be needed, such as an arthrodial protractor or goniometer.
- Clinicians may require training to enhance examination consistency and reliability, specifically for cervical PROM and AROM using an arthrodial protractor or goniometer, cervical lateral flexion functional strength using the Muscle Function Scale, pain assessment using the FLACC scale, and craniofacial asymmetries using a quantitative measurement method or a standard classification, such as the Argenta Classification Scales.
- Use of photos may require consent and storage procedures for Health Insurance Portability and Accountability Act of 1996 compliance.
- Audit the incidences in which body structure elements informed intervention.

Supporting Evidence and Clinical Interpretation

Following a thorough history and screening to rule out asymmetries inconsistent with CMT, the PT conducts a more detailed examination of the infant. The following items appear as a checklist, but in practice, the PT simultaneously observes for asymmetries throughout all exam positions to reduce infant repositioning and increase infant cooperation.

- **General Posture**: Document infant's posture and tolerance to positioning in supine, prone, sitting, and standing for body symmetry, with or without support, as appropriate for age. (**Evidence Quality: II, Recommendation Strength: Moderate**)

Observe the infant in all positions, documenting symmetrical alignment and preferred positioning or posturing.[27,60,64,70] In supine, document the side of torticollis,[27,45,64,70] asymmetrical hip positions,[45,64,96] facial and skull asymmetries, restricted AROM, and asymmetrical use of the trunk and extremities,[27,45,64,70,97] as these are all typical of CMT.

In prone, document asymmetry of the head relative to the trunk, the spine and/or the presence of scoliosis, asymmetrical use of the extremities, and the infant's tolerance to the position and ability to clear the face from side to side and lift their head upright against gravity. In infants with typical development, greater time spent in prone while awake is positively correlated with higher Alberta Infant Motor Scale (AIMS) scores and fewer delays in achieving prone extension, rolling, unsupported sitting, and fine motor control.[98,99] In infants with CMT, positioning in prone at least 3 times per day is correlated with higher AIMS scores.[61]

In sitting, supported sitting, and supported upright positions (eg, holding the infant vertically in the air or supported standing as age appropriate), document asymmetrical preferential postures and compensations in the shoulders, trunk, and hips.[47,60,61]

Still photography for measuring preferred head tilt in supine has sufficient reliability (intraclass correlation coefficient [ICC] ≥ 0.7) for clinical use[100,101]; however, setting up for photo consistency and adding photos to the medical record may not be feasible in some clinical settings. To quantify the head tilt on the photo, a line is drawn through the acromial processes and another is drawn through the midpoints of both eyes. The intersection angle of the eye line with the shoulder line provides an objective measure of preferred head tilt. Care needs to be taken not to record artifacts of the placement of the infant on the surface; photos should represent the typical posture that the infant repeatedly reverts to during the examination session.

The Functional Symmetry Observation Scale, version 2 (FSOS-2) is a standardized method for assessing spontaneous movement and posture in infants with CMT.[102] The FSOS-2 has evidence of content validity,[102] but further research on reliability and other psychometric properties are needed before recommending it for clinical use.

- **PROM**: Document the infant's bilateral PROM into cervical rotation and lateral flexion using an arthrodial protractor or goniometry. (**Evidence Quality: II, Recommendation Strength: Moderate**)

The arthrodial protractor has sufficient intra-rater reliability (ICC ≥ 0.7) to measure cervical lateral flexion PROM, and a standard goniometer has sufficient intra-rater reliability to measure cervical rotation PROM.[101,103] An accurate measurement of cervical rotation PROM establishes a baseline and informs the CMT severity grade. For all PROM measures, cervical neutral[104] needs to be maintained but is easily compromised when the infant compensates with cervical rotation or extension movements at the end ranges. The PT should visually check the cervical neutral position, assuring that the infant's nose, chin, and visual gaze are directed forward (neutral rotation), with the nose, mouth, and chin vertically aligned (neutral lateral flexion) and the ear lobes and base of the nares are horizontally level (neutral flexion-extension).[104]

Normal infant passive cervical rotation PROM is 110 ± 6.2° and should be measured with the infant in supine, head in cervical neutral, and the nose aligned with the 90° vertical reference using an arthrodial protractor or a goniometer.[101,105,106]

It is important to remove the table surface as a possible barrier to full PROM by either elevating the infant's body above the table with a supporting mat or supporting the infant's head beyond the edge of the supporting table.

Normal infant passive cervical lateral flexion is 70 ± 2.4° with the limiting factor being cheek size[106] and should be measured in supine with the infant's shoulders stabilized, using an arthrodial protractor or a goniometer.[101,103] The PT can either place their hands on the side of the head if the parent/caregiver stabilizes the trunk and shoulders, or place one hand under the occiput and another diagonally across the

infant's chest to palpate for trunk movement and to stabilize the shoulder on the side of the stretch. The head should start in cervical neutral, avoiding neck extension or flexion. The head is laterally flexed until the ear approaches or contacts the stabilized shoulder[103] while the opposite shoulder is stabilized.

When testing cervical PROM, infants with orthopedic conditions associated with cervical instability may require modification or avoidance of tests, eg, osteogenesis imperfecta, congenital hemivertebrae, or infants with Trisomy 21. In these cases, the GDG recommends that testing PROM can be avoided or the PT may modify testing cervical PROM by using very gentle guidance through the range, ending at the first palpable sign of resistance.

The clinical challenge of using either an arthrodial protractor or goniometer is that they minimally require 2 adults: one to stabilize the infant's trunk on the support surface (and this can be the parent/caregiver) and another to rotate the head/neck while measuring PROM. A third person may be needed to hold the arthrodial protractor or goniometer in place unless it can be attached to the support surface or stabilized in a stand and calibrated to be level. Practice surveys in New Zealand and Canada suggest that PTs often visually estimate, rather than measure ROM with an instrument; the greatest barrier being the absence of a time efficient and reliable tool.[58,60] The GDG strongly values the objective measurement of cervical rotation and lateral flexion PROM as a means of establishing a baseline

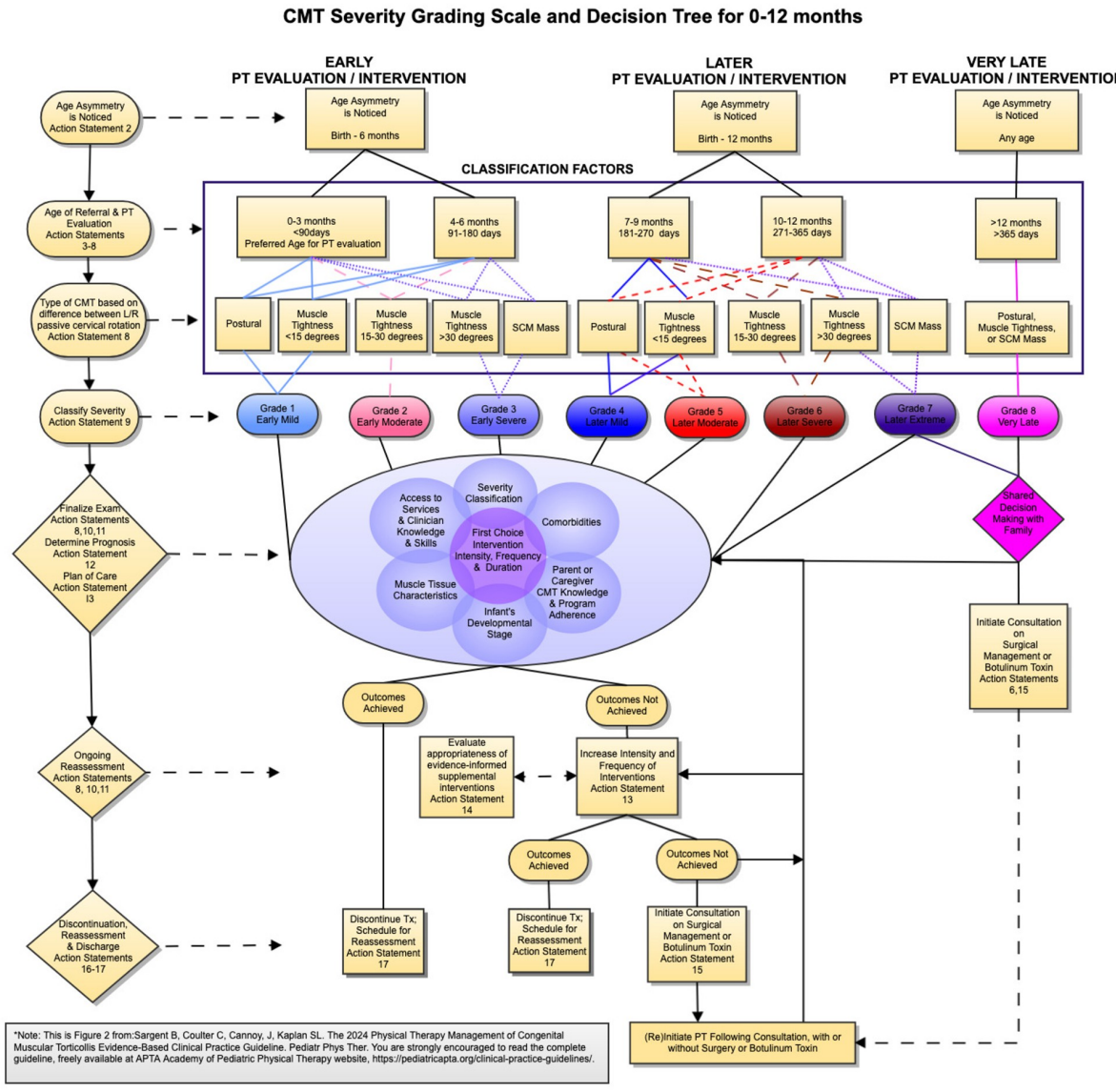

Fig. 2. 2024 Classification of Severity and Management of CMT

for future comparison and determining the CMT severity grade.

Research Recommendation: Develop reliable, valid, and time-efficient methods of measuring infant cervical PROM, including lateral flexion, and large-scale normative data of PROM established by age in months.

- **AROM**: Document the infant's bilateral AROM into cervical rotation using an arthrodial protractor or goniometry and cervical lateral flexion functional strength using the Muscle Function Scale. (**Evidence Quality: II, Recommendation Strength: Moderate**).

Cervical AROM is considered an important indicator of symmetrical development and neck strength[51,106,107] and the infant's integration of PROM for functional activities. Intervention to improve AROM is consistent with the goals of early intervention.[108] Asymmetrical movements and movement compensations can indicate muscle tightness, restrictions, or weakness.[50,109]

Active range is challenging to measure in infants due to behavior and movement variability, difficulty with isolating cervical movements, and a paucity of practical measurement tools that capture infant movements in the clinical setting in a timely manner.[58,60,101] Studies may list "active movement" as an outcome but do not describe how it is measured, and many PTs rely on visual estimation.[60]

PTs should measure active cervical movement, looking for active and full range in all planes, including diagonals, while the infant is enticed to follow toys, sounds, or other forms of stimulation to elicit full range.

- For infants <3 to 4 months old, it is recommended for active cervical rotation to be tested in supine using an arthrodial protractor or goniometer, similar to passive cervical rotation, but with visual tracking of a toy to obtain available AROM.[101,110] Although the ROM Limitation Scale that classifies active cervical rotation as full, moderate limitation, or severe limitation has sufficient intra- and inter-rater reliability for infants with positional plagiocephaly to screen for CMT,[110] it does not have the precision needed to measure active cervical rotation for infants with CMT.[101] Therefore, quantification of active cervical rotation using an arthrodial protractor or goniometry is recommended by the GDG.
- For infants ≥3 to 4 months old who can hold their head upright, it is recommended for active cervical rotation to be tested using an arthrodial protractor or goniometer with the parent/caregiver holding the infant in the supported sitting position with visual tracking of a toy to obtain available AROM.[94] Although visual estimation of cervical rotation AROM has good average intra-rater (ICC = 0.85; 95% CI, 0.23-0.97) and inter-rater reliability (ICC = 0.79; 95% CI, 0.15-0.99), the 95% CIs extend into the poor range.[94] Therefore, quantification of active cervical rotation using an arthrodial protractor or goniometry is recommended by the GDG.
- For infants 2 months and older, the Muscle Function Scale provides an objective categorization of active lateral flexion functional strength in developmentally appropriate positions.[106,111] By holding the infant vertically in front of a mirror and tipping the infant horizontally for 5 seconds, the PT classifies the head righting position according to a 6-point scale.[111] Infants with typical development do not differ between sides by more than 1 point, and infants with CMT frequently have a difference of 2 to 3 points.[111] Clinicians should refer to the study by Öhman et al[111] for specific reference values and procedures.

Research Recommendations:

- Determine the sensitivity and specificity of the Muscle Function Scale to differentiate infants with clinically significant limitations from infants with typical development.
- Establish a clinically practical, objective method of measuring cervical rotation AROM in infants 0 to 3 months and infants ≥3 months to assess baselines and changes over time.
- Determine what, if any, correlation between active and passive ROM should be used for discontinuation and/or discharge criteria.

- **Trunk and Extremity ROM**: Document the infant's PROM and AROM of the trunk and upper and lower extremities, inclusive of screening for DDH. (**Evidence Quality: II; Recommendation Strength: Moderate**)

The PT should examine passive and active ROM of the spine, shoulder and hip girdle, and arms and legs by observing the natural straight plane and rotational movements of the infant and by passively moving the arms and legs through all available range at each joint to rule out concern for brachial plexus injuries, clavicle fractures, neurological impairments, hypermobility, or central nervous system lesions.[30,31,47]

DDH has been associated with CMT, so screening for DDH is recommended with referral to primary care provider if indicated.[112,113] For infants with CMT under 3 months of age, the Ortolani maneuver, in which a subluxed or dislocated femoral head is reduced into the acetabulum with gentle hip abduction by the examiner, is considered the most important clinical test for detecting newborn hip dysplasia.[112] For the infant with CMT over 3 months of age, observations of asymmetric limited hip abduction, thigh-fold asymmetry, and unequal knee heights also known as the Galeazzi sign, can be performed, but the most sensitive examination for unilateral hip dislocation is asymmetric limited hip abduction.[113]

- **Pain**: Document the infant's pain or discomfort at rest and during passive and active movement using a standard scale, such as the FLACC scale. (**Evidence Quality: III, Recommendation Strength: Weak**)

PTs should document any behaviors that may indicate discomfort or pain.[77,114] Pain is not typically associated with the initial presentation of CMT[48] but may be associated with passive stretching.[115] The infant may cry in response to stretching[115] or in response to handling from the therapist, anxiety, or the stress of an unusual environment. One method to differentiate pain from behavioral distress is to hand the inconsolable infant back to their parent/caregiver, observing how quickly the infant quiets. Another option is to have the parent/caregiver do the handling with the PT instructing and observing the infant's reactions to differentiate pain from behavioral reactions.

The Therapy Behavior Scale, version 2.2 (TBS-2), is currently under development as a tool to assess infant and toddler behavior during the physical therapy management of infants with CMT.[116] The TBS-2 had sufficient reliability to measure behavior of infants with CMT, but the scale contains 11 items that are rated on a 4-point ordinal scale taking approximately 5 minutes, which may not be feasible in some clinical settings.[116]

The FLACC is a clinically practical means to document the infant's pain or discomfort for several reasons: (1) it was originally developed for children from 2 months to 7 years of age,[117,118] but its reliability and validity have been investigated for children from 0 to 10 years[119,120]; (2) the scale ranges from 0 to 10, similar to the Numeric Pain Rating Scale that is common in PT practice with lower scores indicating fewer pain-related behaviors and higher scores indicating more behaviors; (3) the 5 behaviors that are assessed using the 3-point scale of "0" = no expression or a quiet state, "1" = occasional expression or movements, and "2" = inconsolable relate to the FLACC acronym (Face, Legs, Activity, Crying, Consolability) making it easy to remember. FLACC training is required to achieve adequate reliability.[121]

Research Recommendation: Studies are needed to:

- Describe and differentiate signs of discomfort and pain observed in infants with CMT during examination and intervention.
- Determine the validity of the FLACC in rating pain in infants with CMT.
- Determine whether pain tools need to be specific to CMT.

- **Skin and Muscle**: Document the infant's 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. (**Evidence Quality: II, Recommendation Strength: Moderate**)

Skin: PTs should observe the symmetry and condition of the skin folds around the neck and hips. Typically, the neck skin folds on the anterior affected side are deeper and reddened.[75] Infants with brachycephaly and limited cervical ROM in all directions may have deeper posterior folds.[77] Observe for symmetry of the hip skin folds in the inguinal and upper thigh area as an indicator of DDH.[66,96]

Muscle: PTs should visually inspect and palpate both SCM muscles and document the side of tightness, the presence or absence of a fibrous band and/or mass, and if a mass is present, note its size and location along the SCM muscle (inferior, middle, superior, or entire length).[90] The presence of a fibrous band and/or mass, particularly a mass that involves more than the distal 1/3 of the muscle, is correlated with greater severity of the condition and is used to determine the CMT severity grade.[56,90]

PTs should document the presence of secondary asymmetries, compensations, or atypical tone in the shoulders, trunk, hips, and distal extremities while the infant moves through positions during the examination. Typical compensations include tightness of the upper trapezius muscle, imbalance of neck muscle strength,[106] shoulder hiking on the same side of the involved muscle, asymmetrical preference for limb use,[122] asymmetrical and delayed protective and righting reactions of the head, neck, and trunk,[69] Trendelenburg's sign in children who are walking,[96] and scoliosis.[85] Secondary compensations and asymmetries of movement need to be continually monitored across the episode of care as they can develop and/or worsen over time.[73]

- **Craniofacial**: Document the infant's craniofacial asymmetries and head/skull shape using a quantitative measurement method or standard classification, such as the Argenta Classification Scales. (**Evidence Quality: II, Recommendation Strength: Moderate**)

Facial asymmetries involve the relative alignment of each side of the jaw, the cheekbones, eye orbits, and ear positions.[19,123] Cranial asymmetries or CD refers to asymmetries of the skull, including the frontal, temporal, parietal, and occipital bones, presenting with posterior unilateral flatness (plagiocephaly), bilateral posterior flattening (brachycephaly), asymmetrical brachycephaly, or flattening on both sides of the skull (scaphocephaly).[47,124]

The incidence of localized cranial flattening is 13% in typical singleton infants and 55.6% in twins.[34] Cheng et al reported a 90.1% prevalence of craniofacial asymmetry in children with CMT at initial evaluation.[29] Untreated CMT may result in craniofacial asymmetries on the side of the CMT, including: reduced jaw or ramal height, a smaller and elevated eye with changes in the orbit (recession of the ipsilateral zygoma), recession of the ear on the affected side, a flat appearance of the jaw, malocclusion, and possible gum line asymmetry.[27,73,125]

Although CMT is associated with CD, it is unclear how or whether they are causally related. Limited AROM from CMT may cause CD as asymmetrical muscle tensions lead to an asymmetrical postural head preference and subsequent CD.[34,48,64,65,72,126,127] Conversely, for infants with CD, an asymmetrical resting position of the skull may cause persistent neck rotation that may lead to SCM tightness.[25,48,65,126-128]

PTs should document asymmetries of the skull and face. One of the most clinically feasible tools is the Argenta Classification Scales.[124] The method is clinically practical, does not require equipment other than a copy of the scale, includes pictures to assist with rating, and has moderate inter-rater (mean weighted κ score = 0.54) and substantial intra-rater reliability (weighted κ scores ranged from 0.6 to 0.85).[129] Other methods to quantify head shape asymmetries exist, and when more reliable or accurate methods for quantifying head shape are available and feasible, PTs should use them. Examples include: anthropometric measurements using a caliper,[130] plagiocephalometry,[131,132] the modified Severity Scale for Assessment of Plagiocephaly,[133] a craniometer with a headband,[134] molding a flexible ruler to the infant's head shape and tracing the shape,[135] 3-dimensional computerized scanning,[136] and the Children's Healthcare of Atlanta Plagiocephaly Severity Scale.[137] These alternative methods may not be available in physical therapy clinics or tolerated well by the infant.

PTs should consult with the infant's primary care provider regarding assessment for craniosynostosis when craniofacial asymmetry is inconsistent with deformational plagiocephaly or brachycephaly[138] or to assess if a cranial molding orthosis (ie, helmet or band) is indicated when cranial asymmetry is moderate or severe or when facial asymmetry is noted.[139]

B **Action Statement 9: CLASSIFY CMT USING THE CMT SEVERITY GRADING SCALE.** PTs should classify and document CMT severity using the CMT Severity Grading Scale, choosing 1 of 8 grades (Figure 2, Supplemental Digital Content 2, available at: http://links.lww.com/PPT/A547) 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. **(Evidence Quality: II, Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II based on cohort studies of the psychometric properties of the CMT Severity Grading Scale.[56,140]

Benefits:

- Classifying levels of severity may assist with prognosis and parent/caregiver education.
- The 8 grades integrate 3 of the strongest factors related to outcome: the infant's age at initiation of physical therapy intervention, the presence of an SCM mass, and the difference in cervical rotation PROM between sides.
- Use of the CMT Severity Grading Scale may more fully describe research samples; however, an even more precise classification system may be needed to compare outcomes across research samples, eg, classifying infants by age in 1-month increments and more precise severity, such as separating infants with PROM restrictions from infants with an SCM mass.

Risk, Harm, and Cost:

- Minimal costs to update electronic health records to add the CMT Severity Grading Scale.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: The GDG recommends the use of the CMT Severity Grading Scale as it may inform episode of care.[56]

Intentional Vagueness: There is no evidence as to whether the chronological or corrected age should be used for infants born preterm to determine the severity grade. Clinicians should document both ages in their practice setting. The GDG recommends using corrected age when determining the severity grade.

Role of Child/Parent/Caregiver Preferences: None.

Exclusions: None.

Quality Improvement:

- Documentation of a severity grade provides a common taxonomy for clinical and research communication and for uniform data entry in child registries.
- The severity grades are a tool for communicating with parents/caregivers about the estimated episode of care.

Implementation and Audit:

- Documentation forms or electronic records may need revision to reflect the CMT Severity Grading Scale.
- Clinicians may require training to enhance CMT Severity Grading Scale consistency and reliability.
- Audit the documentation frequency of the CMT Severity Grading Scale and the accuracy of prognoses with respect to episode of care and functional outcomes.
- While there are no studies that correlate the severity of cervical lateral flexion to the severity of CMT or the episode of care, PTs should document objective measures of lateral flexion as a type of asymmetry.
- For infants who change service providers to treat CMT, CMT severity should be classified based on the infant's current age and initial examination findings by the new provider.

Supporting Evidence and Clinical Interpretation

The 2013 CMT CPG proposed a 7-grade CMT Severity Grading Scale that combined 3 factors (ie, age at initial physical therapy evaluation, cervical rotation PROM difference between sides, and presence of an SCM mass) to add clarity to research, aid communication among health providers, and inform prognosis. Prior to the 2013 CMT CPG, only 3% of PTs classified CMT severity, but this increased to 57% once the 7-grade CMT Severity Grading Scale was introduced.[6] Reliability of the 7-grade CMT Severity Grading Scale was strong (ICC ≥ 0.81 for inter- and intra-rater reliability).[140] The 2018 CMT CPG updated the original 7 grades to 8, based on clinician confusion as to how to grade toddlers >12 months old,[140] because the majority of evidence is based on infants younger than 12 months of age. The CMT Severity Grading Scale can inform prognosis because units billed, episode of care duration, and total visits increase across CMT Severity Grades 1 to 3.[56]

Figure 2 graphs the CMT Severity Grading Scale and Decision Tree for 0 to 12 months. The diagram is best viewed in color; however, to aid clarity with noncolor copies, the lines from conditions to grades are patterned. The left edge, vertically aligned ovals of the diagram, list factors that are most relevant to the classification process, ie, age asymmetry noted, age of referral, physical therapy evaluation, and type of CMT. The combinations of characteristics in the box to the right are linked to the 8 CMT Severity Grades with recommended actions explained in the following section.

CONGENITAL MUSCULAR TORTICOLLIS SEVERITY GRADING SCALE DEFINITIONS

Grade 1—Early Mild: Infants between 0 and 6 months of age with only postural preference or a difference between sides in passive cervical rotation of <15°.

Grade 2—Early Moderate: Infants between 0 and 6 months of age, with a difference between sides in passive cervical rotation of 15° to 30°.

Grade 3—Early Severe: Infants between 0 and 6 months of age, with a difference between sides in passive cervical rotation of >30° or an SCM mass.

Grade 4—Later Mild: Infants between 7 and 9 months of age with only postural preference or a difference between sides in passive cervical rotation of <15°.

Grade 5—Later Moderate: Infants between 10 and 12 months of age with only postural preference or a difference between sides in passive cervical rotation of <15°.

Grade 6—Later Severe: Infants between 7 and 9 months of age with a difference between sides in passive cervical rotation of >15°, or between 10 and 12 months with a difference of 15° to 30°.

Grade 7—Later Extreme: Infants between 7 and 12 months with an SCM mass, or between 10 and -12 months of age with a difference between sides in passive cervical rotation of >30°.

Grade 8—Very Late: Infants and children older than 12 months of age with any asymmetry, including postural preference, any difference between sides in passive cervical rotation, or an SCM mass.

The classification process begins at the top of the diagram. Document the age that asymmetry is first noted by a parent/caregiver or health professional; this may be informed by early infant photos. This age provides a history of the condition and may impact the prognosis for the episode of care; however, it does not directly factor into the choice of severity grades. The age of referral for a physical therapy evaluation is documented to understand the timeliness between referral and the initial evaluation. The age of initial physical therapy evaluation is documented and used in combination with the difference in cervical rotation PROM and/or presence of an SCM mass to determine the CMT Severity Grade. Classifications are first grouped as "early," "later," or "very late." "Early" and "later" have a range of severity within the categories. For example, CMT Severity Grade 2, Early Moderate, is assigned to an infant between 0 and 3 months or between 4 and 6 months of age, with a difference between sides in cervical rotation PROM of 15° to 30°. van Vlimmeren et al[141] illustrate how the grades can describe study samples more accurately.

Research Recommendation: Studies are needed to determine a reliable, valid, and clinically practical method of measuring cervical lateral flexion and then to determine if lateral flexion measures relate to the CMT Severity Grading Scale.

B Action Statement 10: EXAMINE ACTIVITY AND DEVELOPMENTAL STATUS. During the initial and subsequent examinations of infants with suspected or diagnosed CMT, PTs 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 (TIMP), AIMS, or gross motor subtests of the Peabody Developmental Motor Scales, third edition (PDMS-3). **(Evidence Quality: II; Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II based on cohort and outcome studies.

Benefits:

- Early detection of developmental delays, neurological impairments, movement capabilities, muscle function/strength in developmental positions, and infant preferences helps to direct the plan of care.
- Provides opportunities for parent/caregiver education on typical development, the importance of prone playtime, alternative positioning, and reinforcement of parent/caregiver adherence to home programs.

- Standardizes measurement and documentation of motor activity to evaluate group outcomes across clinical settings for infants with CMT.

Risk, Harm, and Cost:
- No risks or harms.
- Norm-referenced developmental standardized tests are proprietary and thus have associated costs for the forms, test manuals, and test items. Proficiency in administering the tests may require training.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: Measures of the infant's activity, symmetry of movements, and developmental progression *must* be documented as part of any physical therapy exam. These are consistent with professional standards of practice[71] and clinical practice specific to CMT.[58,60]

Intentional Vagueness: None.

Role of Child/Parent/Caregiver Preferences: Parents/caregivers may perceive that the infant experiences discomfort from the testing positions or that the prone position is harmful and may request that testing not continue if the infant is crying. The clinician should fully explain the importance of varying the infant's positions, including the use of prone positioning, which may be avoided by parents/caregivers due to misinterpretation of Safe Sleep Recommendations.[61]

Exclusions: None.

Quality Improvement:
- Routine assessment of development ensures that infants with CMT are achieving age-appropriate milestones and, if not, that delays are addressed as they are identified.

Implementation and Audit:
- Documentation forms and electronic records may need revision to include the recommended standardized developmental tests and documentation of asymmetries during developmental activities.
- Clinicians may require training to enhance consistency and reliability to administer standardized developmental tests.
- Audit the incidences in which the standardized developmental tests are completed and inform intervention.

Supporting Evidence and Clinical Interpretation

Infants with CMT have a higher prevalence of gross motor delay at 2 and 6 months of age.[61,70] The motor delay of most infants undergoing physical therapy for CMT resolves by 8 to 15 months,[61,70] but similar to the general population, some will continue to demonstrate a gross motor delay.[70] PTs should use a standardized norm-referenced developmental assessment to monitor infants with CMT for potential developmental delays and, if identified, should address remediation of those delays in their plans of care. The GDG recommends using age-appropriate, reliable, and valid standardized tests, such as the TIMP through 4 months corrected age,[107] the AIMS from 1 to 18 months corrected age or until walking,[142] or the gross motor subtests of the PDMS-3 from 0 to 5 years corrected age,[143] during the initial evaluation and reassessments. While certification is not required to administer these tests, the validity of the scores and test-retest reliability may be improved following formal training. Additionally, the PT should observe and document asymmetries of age-appropriate developmental activity, movement, and upper and lower limb use throughout all exam positions.

Research Recommendation: Studies are needed to identify the best developmental tests to use for infants with CMT, from birth through 12 months, so that the same measures can be documented on all infants, enabling comparison of outcomes across studies.

B Action Statement 11: EXAMINE PARTICIPATION STATUS.

The PT should obtain and document the parent/caregiver responses regarding:
- Positioning when awake and asleep. **(Evidence Quality: II; Recommendation Strength: Moderate)**
- Infant time spent in prone while awake, consistent with Safe Sleep Recommendations. **(Evidence Quality: II; Recommendation Strength: Moderate**)
- Whether the parent/caregiver alternates sides when holding the infant for breast or bottle feeding. **(Evidence Quality: II; Recommendation Strength: Moderate)**
- Infant time spent in equipment/positioning devices, such as strollers, car seats, or swings. **(Evidence Quality: II; Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II based on cohort and outcome studies.

Benefits:
- Identifies routine passive positioning that facilitates asymmetrical positions of the head, neck, and trunk.
- Provides information about the general developmental activities and position preferences of the infant.
- Provides opportunities for parent/caregiver education and counseling about positioning and activities that facilitate symmetrical development, including eating.

Risk, Harm, and Cost: None.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: None.

Intentional Vagueness: None.

Role of Parent/Caregiver or Child Preferences: Parents/caregivers must accurately describe the infant's daily care routines so positioning and home exercise programs can be tailored to maximize implementation opportunities and enhance the success of early parent/caregiver roles. Fear of blame for the infant's condition may lead parents/caregivers to provide inaccurate descriptions. Clinicians should be sensitive to this and may need to build a level of trust with the parents/caregivers before an accurate description can be obtained.

Exclusions: None

Quality Improvement:

- Routine examination of participation ensures that parent/caregiver-infant dyads are appropriately and successfully interacting during daily routines to optimize motor development.

Implementation and Audit:

- Documentation forms and electronic records may need revision to document the 4 participation elements.
- Clinicians may require training to enhance consistency and reliability in assessing participation.
- Audit the incidences in which the participation elements are documented and inform intervention.

Supporting Evidence and Clinical Interpretation

There is consensus about the need to assess across all the domains of the ICF, including infant participation in daily routines, to develop a comprehensive plan of care.[58,60,69] Moderately strong evidence suggests that specific activities are either preludes for possible asymmetrical development or are the consequences of existing asymmetries.

Positioning When Awake and Asleep, Including Time Spent in Prone: Documentation should address positioning when awake and asleep, while eating, and while using positioning devices (eg, car seats, changing tables, and cribs). The purpose of asking parents/caregivers about positioning is to *prevent* deformational plagiocephaly that may be associated with CMT,[49] to *correct* postural preference that can lead to CMT and plagiocephaly,[27,47,65,144] and to *manage* CMT and CD if present. Three aspects of positioning support an interaction effect with CMT resolution: use of prone positioning when awake, asymmetrical handling to activate weak neck musculature and AROM toward the limited side, and eating from alternate sides.

The American Academy of Pediatrics Safe Sleep Recommendations include consistently placing infants on their back to sleep and encouraging prone positioning while awake and supervised for short periods of time beginning soon after birth, increasing incrementally to at least 15 to 30 minutes daily by 7 weeks of age.[42] Prone positioning while awake for greater than 1 cumulative hour per day, with no minimum amount of time per opportunity, appears to offset the transient effects of supine sleep positions on motor skill acquisition.[145,146] Supine positioning is associated with postural preference and consequently may facilitate asymmetrical neck ROM and secondary development of plagiocephaly.[64,128] Infants who spend more time in prone and side lying positions reduce the impact of preferred positioning[64] and achieve motor milestones sooner.[61,147]

The conscientious use of positioning during wakeful activities (eg, play, eating, and dressing) facilitates symmetrical development of head shape,[49,148] active and passive neck motion,[49] tolerance of prone positioning,[146] and achievement of motor milestones.[51,149] Conscientious positioning means that parents/caregivers actively place infants in positions during play, on changing tables, in cribs, or carry their infant in ways that require head righting, rotation toward the restricted side, neck and upper body extension,[51] or visual attraction toward the affected side. Active movement toward the affected side[52] and alternation of trunk and limb movements[150] help to counteract asymmetries and prevent potential ones. For the infant with postural preference, these activities may reduce the preference and avoid consequential tightness.

Parents/caregivers are reported to avoid prone positioning with typically developing infants if the infant does not tolerate the position or if the infant has achieved independent sitting.[146] Education about the importance of prone playtime is critical for infants with CMT, as they have multiple risks for asymmetrical development and delayed motor milestones. PTs should assess each parent's/caregiver's ability to implement exercises and home program positioning.

Eating: PTs should document the infant's eating positions and difficulties as reported by the parent/caregiver during the initial and periodic evaluations. Eating issues have been identified in infants with CMT and/or plagiocephaly as asymmetrical jaw positioning,[151] preference for side of breastfeeding,[65,128] and/or side of bottle feeding.[128,152] As many as 44% of infants with CMT may have an eating preference to one side,[152] and as many as 2.4% are described as having additional eating issues.[153] In conjunction with infant preference, the parent/caregiver's preferred side or hand dominance may also bias positioning to bottle feed from the same side.[64] Conversely, infants who breastfeed from both sides have a lower incidence of CD and CMT, possibly due to frequent position changes as compared to infants who are consistently bottle-fed on the same side.[154] Alternating sides and alternative positions[59] for eating can effectively increase symmetrical positioning, reduce preferred positioning by the infant, and improve parent/caregiver self-efficacy. Interviewing parents/caregivers about their comfort with alternating eating positions is common practice,[58,60] is consistent with family-centered care,[108] and provides an opportunity to suggest positioning strategies.

Equipment/Positioning Devices: PTs should document the amount of time the infant spends in positioning equipment as reported by the parents/caregivers (eg, positioning/seating devices, strollers, car seats, cribs, or swings).[126] Persistent use

of supportive equipment, in lieu of time spent playing in prone or side lying, may facilitate the deformation of the developing skull due to gravitational forces, which increases the risk of CMT and other asymmetrical developmental movement patterns. The PT should discuss practical strategies with the parents/caregivers regarding positioning and movement facilitation, including alternating positioning of toys and placement in cribs,[154] and ensuring frequent opportunities to play in prone from an early age.[37,38] Parent/caregiver avoidance of prone placement when the infant does not tolerate it well offers an opportunity to assess parent/caregiver comfort and provide graded strategies for prone positioning that build on the infant's tolerance.

Research Recommendations: Studies are needed to quantify changes in participation and clarify how the participation elements inform the plan of care.

B **Action Statement 12: DETERMINE PROGNOSIS.** PTs 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 physical therapy intervention, CMT Severity Grade (Figure 2, Supplemental Digital Content 2, available at: http://links.lww.com/PPT/A547), intensity of intervention, presence of comorbidities, rate of change, and adherence with home programming. **(Evidence Quality: II, Recommendation Strength: Moderate)**

Action Statement Profile

Aggregate Evidence Quality: Level II based on cohort and outcome studies.

Benefits:

- Links the exam results and CMT Severity Grade to interventions and/or referrals.
- Allows parents/caregivers to prepare for what to expect from physical therapy and the range of possible outcomes for their infant.
- Assists parents/caregivers with understanding and implementing the plan of care.
- Articulates the relationship of exam results to expected outcomes for documentation, including letters of medical necessity.

Risk, Harm, and Cost:

- Lack of a prognosis by either the primary care provider or the PT may lead to underestimation of the CMT severity, resulting in inadequate or untimely delivery of care and/or parent/caregiver confusion about what to expect.
- Parents/caregivers of infants with SCM masses can better prepare for a longer episode of care and slower resolution.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: The GDG supports the need to document the potential for improvement of CMT prior to initiating intervention. The physical therapy prognosis is the bridge between the evaluation of initial examination results and the classification of severity with the associated interventions within an expected time frame. It should include both objective outcomes to achieve and time frames in which to achieve them. Articulating the prognosis for physical therapy management ensures clear communication of expectations for the parents/caregivers and sets objective milestones as a basis for referral back to the primary care provider if outcomes are not met. Prognosis is a continual process that occurs throughout the episode of care.

Intentional Vagueness: None.

Role of Child/Parent/Caregiver Preferences: The prognosis for improvement, or the time to achieve change, may need to be modified based on the parent's/caregiver's ability to perform the exercises and adhere to the home program. Parents/caregivers and the PT should participate in shared decision-making to design a home program that addresses both the infant's limitations and other parent's/caregiver's responsibilities.

Exclusions: None.

Quality Improvement:

- Determining a prognosis provides the family and caregivers, health care providers, and payors an estimate of the episode of care and expected outcomes.

Implementation and Audit:

- Educate parents/caregivers about the estimated episode of care and the importance of consistently implementing the home program to maximize outcomes.
- Update documentation forms or electronic records to include prognosis based on a uniform collection of age at initiation of intervention, CMT Severity Grade, intervention intensity, presence of comorbidities, change rate, and home program adherence.
- Include the prognosis and episode of care estimate on the initial evaluation document and in all professional communications.
- Audit the documentation frequency of prognoses and their accuracy with respect to episode of care and functional outcomes.

Supporting Evidence and Clinical Interpretation

Figure 2 graphs the CMT Severity Grading Scale and Decision Tree for 0 to 12 months. The vertically aligned diamonds at the left most edge of the diagram describe the cycle of physical therapy examination, intervention, and reassessment. Following the evaluation, the PT determines a prognosis that includes the expected outcomes in objective measurable terms, the content, frequency, and duration of

intervention to achieve the outcomes, and appropriate referrals to other health care providers. Decisions regarding expected outcomes and intervention frequency and duration take into consideration each of the factors within the large central oval: CMT Severity Grade, Access to Services & Clinician Knowledge and Skill, Child/Caregiver CMT Knowledge and Program Adherence, Muscle Tissue Characteristics, Infant's Developmental Stage, and Comorbidities. The GDG recommends performing the first-choice intervention described in Action Statement 13 frequently throughout each day with responses to intervention regularly reassessed for effectiveness.

Evidence supports that for infants with CMT, the earlier and more intense the intervention, the shorter the episode of care[12,14,15] and the more complete the resolution of symptoms.[12-14] If an infant diagnosed with CMT begins physical therapy intervention before 1 month of age, the prognosis for good clinical outcomes (no head tilt, full passive cervical rotation) is 99% with 1.5 months of physical therapy.[12,13] Beginning between 1 and 3 months of age, the prognosis for good outcomes declines to 89% with 6 months of physical therapy.[12] Beginning between 3 and 6 months of age, the prognosis for good outcomes declines to 63% with 7 months of physical therapy, and beginning between 6 and 12 months of age, the prognosis for good outcomes declines to 19% with 9 months of physical therapy.[12]

Factors associated with full resolution. These 5 factors include: (1) participation in physical therapy intervention,[155] (2) younger age at initiation of intervention,[12-14] (3) CMT severity including less difference between sides of cervical rotation PROM[156] or SCM muscle thickness,[157] (4) the caregiver's ability to frequently implement a home program of active positioning and passive stretching,[57] and (5) infants insured by private insurance vs Medicaid (91.3% vs 65.2% had no residual head tilt at discharge).[56]

Factors associated with treatment duration. Treatment duration has been associated with age, CMT severity, and birth history. Although strong evidence supports that younger age at initiation of physical therapy intervention results in shorter treatment durations,[12,14,15] some studies support the opposite.[63,93] Severity may be a confounding factor since infants with more severe CMT, including the presence of an SCM mass, may be referred for physical therapy evaluations at a younger age than infants with less severe CMT.[14,32,33] Measures of CMT severity associated with longer treatment duration include: (1) decreased cervical rotation PROM,[50] (2) increased severity of head tilt,[93,158] (3) motor asymmetry,[97] (4) increased thickness[63,93] or stiffness[159] of the involved SCM or higher thickness ratio between the involved and uninvolved SCM,[63,158] and (5) the presence of an SCM mass or lesion.[14,32,33,160] Knudsen et al found that treatment duration increased across CMT Severity Grades 1 to 3, with average treatment durations of 3 months for Grade 1, 5 months for Grade 2, and 6 months for Grade 3.[56] However, the average number of visits was just over once a month in each severity group; therefore, a different frequency may affect the intervention duration.[56] In addition, longer treatment durations have been associated with birth history, including lower birth weight[63] and breech, compared to cephalic, presentation.[63]

Intervention frequency. There is no consensus on intervention frequency. An algorithm based on infant age and CMT severity was developed to guide therapists on therapy frequency with weekly to biweekly therapy recommended for infants ≤3 months with CMT Grade 1 severity and 1 to 3 times per week for older infants or those with more severe CMT.[161]

Intervention delivery. There is no consensus on who should deliver intervention. Ohman et al[57] provided preliminary evidence of better outcomes when infants were treated by a PT vs parents/caregivers, but the combination of physical therapy and parent/caregiver home program is the more frequent intervention plan.[14,92] Individual intervention is the most common model, but a single observational pilot study of 6 infant-parent dyads and 2 PTs suggests that a group model may be an effective alternative to individual intervention.[162]

Research Recommendations: Studies are needed to:

- Clarify the interaction between the factors associated with full symptom resolution and episode of care.
- Clarify the prognostic accuracy for full symptom resolution and the episode of care.
- Compare the efficacy of different delivery models, eg, individual vs group or clinic vs home vs telerehabilitation.

III. PHYSICAL THERAPY INTERVENTION FOR INFANTS WITH CMT

The literature continues to support the following 5 components as the first-choice intervention for CMT: neck PROM, neck and trunk AROM, development of symmetrical movement, environmental adaptations, and parent/caregiver education. The provision of interventions allows for continuous evaluation of progress along all ICF domains, including body structure and function, activity, and participation. Repeated objective progress measurements can focus intervention choices to achieve goals more quickly.[3] The PT must educate parents/caregivers on the importance of the home program[163] and partner with them to incorporate a reasonable and effective program into the home and family schedule. Care should be taken to balance the full scope of the family demands and resources on a case-by-case basis.

Look beyond the infant's body structure limitations to include perceptual-motor experiences within the context of the infant's

social environment and gross and fine motor exploration as contributing to cognitive development.[108] Infants with limited or asymmetrical exploration, as seen in CMT and CD,[69,70,149] have demonstrated delays in early motor development that may affect the development of early perceptual-motor skills and, by inference, cognition.[108] Thus, PTs should treat beyond the body structure level to design and provide interventions that incorporate the infant's available functional range into activities that promote age-appropriate participation for current and future development and learning across domains.[108]

Although craniofacial asymmetry is a common condition associated with CMT, the management of positional plagiocephaly is beyond the scope of the 2024 CMT CPG. Please refer to the Congress of Neurological Surgeons systematic review and evidence-based guidelines for the management of children with positional plagiocephaly.[139,144,164-166]

B Action Statement 13: PROVIDE 5 COMPONENTS AS THE FIRST-CHOICE INTERVENTION. PTs should provide and document these 5 components as the first-choice intervention for infants with CMT:

- Neck PROM when PROM is limited. **(Evidence Quality: I; Recommendation Strength: Strong**)
- Neck and trunk AROM. **(Evidence Quality: II; Recommendation Strength: Moderate**)
- Symmetrical movement. **(Evidence Quality: II; Recommendation Strength: Moderate)**
- Environmental adaptations. **(Evidence Quality: II; Recommendation Strength: Moderate**)
- Parent/caregiver education. **(Evidence Quality: II; Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level I for Neck PROM when PROM is limited based on 2 RCTs.[21,22] Level II for other components of the first-choice intervention based on cohort and outcome studies. (Refer to Supplemental Digital Content 5, Randomized Controlled Trials of the First-Choice Physical Therapy Intervention for Infants with Congenital Muscular Torticollis, available at: http://links.lww.com/PPT/A545.)

Benefits to the Infant

- Providing evidence-based interventions for CMT improves infant outcomes (ie, resolves or minimizes CMT) with shorter durations of care, minimizes or prevents secondary complications (eg, craniofacial asymmetry and movement asymmetry), promotes age-appropriate skills in all areas of development, and reduces the need for more invasive procedures.
- Balances the use of supine as a frequent infant position with activities in prone, side lying, and sitting during supervised, wakeful activities.
- Reduces use of environmental supports/equipment that may increase asymmetry.

Benefits to the Parents/Caregivers

- Education empowers parents/caregivers to be active and effective caregivers, assures them that they did not cause the CMT, and supports them in implementing interventions between physical therapy appointments.
- Education provides parents/caregivers with information about typical developmental milestones and the factors that contribute to asymmetry.
- Reduces potential overall cost of care for CMT with early, intense intervention.

Risk, Harm, and Cost:

- Stretching of the SCM of younger infants with CMT and an SCM mass can result in manual myotomy, defined as partial or complete rupture of the SCM. Manual myotomy may or may not cause momentary infant discomfort, bruising, and an increase in cervical ROM; documented long-term outcomes are similar in infants with CMT with and without manual myotomy.[95,167]
- Cost of care may be a burden for families.
- Parents/caregivers may apply interventions incorrectly.
- Parents/caregivers may decrease the intensity of home exercises if they perceive that the PT is implementing the intervention.[51]

Value Judgments: None.

Intentional Vagueness: The GDG supports that stretching should be frequent through the day, every day; however, there is no dosage standard linking technique and duration of stretches, repetitions within each intervention session, frequency of intervention sessions per day, overall duration of care, and frequency of clinic visits, including tapering schedules, to specific CMT severity grades.

Role of Parent/caregiver or Child Preferences: Parent/caregiver perceptions of the impact of CMT on their infant's function and the importance of the intervention program on their infant's future function are strong factors related to adherence to appointments and home exercises.[163] Parent/caregiver adherence to the plan of care under a PT's guidance[22,57] is optimal for achieving early intense intervention dosages.

Exclusions: None.

Quality Improvement:

- This recommendation may reduce unwarranted variation in practice and provides consumers with guidance for evidence-based interventions.

Implementation and Audit:

- Develop home exercise program materials, including videos that parents/caregivers can access online, of the 5 components of the first-choice intervention.

- Update documentation forms and electronic records to include the education provided to parents/caregivers and their understanding and adherence to the exercises.
- PTs should consider the corrected age of infants born preterm when designing a plan of care.
- Audit PTs' adherence to providing the 5 components of the first-choice intervention or reasons for deviating from the recommendation.

Supporting Evidence and Clinical Interpretation

Neck PROM when PROM is limited: Manual stretching remains the most commonly reported form of intervention for CMT.[16,52,92] It is best supported by 2 randomized control trials (RCT) of infants with CMT. Song et al found that passive stretching was more effective than thermotherapy or AROM for improving passive cervical rotation.[21] He et al documented a stretching dose-response relationship with higher doses of daily stretching by parents/caregivers leading to greater changes in passive cervical lateral flexion and rotation ROM.[22] There is no consensus on the techniques to perform the stretches, the number of repetitions, the duration of stretches and rest periods, and the number of individuals required for the stretches.

Stretching interventions should not be painful; stretches should be stopped if the infant resists[48] or there are perceived changes in breathing or circulation.[22] Low-intensity, sustained, pain-free stretches are recommended to promote acceptance of stretching by the infant and avoid micro trauma of the muscle tissue.[48] Manual myotomy, defined as a partial or complete rupture of the SCM during manual stretching, has a reported incidence of 9.2% in infants with CMT and an SCM mass.[95] In one study, the only risk factor for the occurrence of manual myotomy during physical therapy was a young age at the initial physical therapy session, with manual myotomy occurring at approximately 31 days and 90% of events occurring during the first physical therapy session.[167] Infants with and without manual myotomy have similar outcomes and prognoses.[167]

Stretching can be done in many different positions such as in supine, side lying, sitting, lying prone on the parent/caregiver's chest with the infant's face turned toward the shortened SCM,[52,168] with the child held laterally against the adult's body known as the *football hold*,[48,52] and during eating by encouraging turning toward the shortened SCM while bottle feeding or breastfeeding.[59,128,154] The most important features are that the child's head and shoulders are stabilized to prevent compensations and the cervical spine is gently guided through the available PROM into the cervical rotation, lateral flexion, or the combination of rotation with lateral flexion that is restricted.[45,52] The choice of a 1-person or 2-person technique may depend on parent/caregiver preference and the size and age of the infant when stretching is initiated. Younger, smaller infants may be more easily managed by a single person, while larger or more active infants may require 2 people: 1 to stabilize the infant and 1 to guide the head to obtain an adequate stretch of the restricted cervical musculature.

Neck and Trunk AROM: Active ROM continues to be the standard of care in combination with other interventions.[168,169] Strengthening cervical and trunk muscles can be achieved through AROM during positioning, handling,[51,79] carrying the infant,[51,79,128] while eating,[59,128,154] and through exercises isolating the weaker muscles.[51] Incorporating righting reactions in upright postures, rolling, side lying, or sitting has been used effectively during intervention and daily care routines to strengthen muscles opposite of the affected muscles. The affected side of CMT is placed downward, elongating the tighter muscles and encouraging activity of the weaker, non-affected side.[51] Positioning the infant in prone encourages bilateral neck flexor elongation and strengthens neck and spine extensors.[75] Visual and auditory tracking can elicit head turning toward the affected SCM[52] to strengthen cervical rotation musculature.

Development of Symmetrical Movement: Observational data (n = 173) suggest that up to 25% (n = 44) of infants with postural CMT may have transient motor asymmetry; 2/3 of the 33 infants with follow-up data had no asymmetries by age 2 years.[97] Developmental exercises should be incorporated into physical therapy interventions and home programs to promote symmetrical movement in weight-bearing postures and to prevent the development of asymmetrical movement patterns in prone, sitting, crawling, and walking.[97,128]

Environmental Adaptations: Adaptations to the infant's environment can be incorporated into the home management program. Alternating the infant's position in the crib and on changing tables encourages head turning in the desired direction.[34,45,128] Strategic placement of the car seat and toys in the car can also encourage head turning in the desired direction; however, placing towel rolls or other positioning devices in the car seat is not recommended since they can become a suffocation hazard or decrease the safety of the car seat.[147,154] Minimizing the amount of time in infant equipment that places the child's head against a surface, such as infant swings and strollers, has been recommended as part of a home program,[126,127] but not studied.

Parent/Caregiver Education: Qualitative data on parents' experiences with infants with mild or severe CMT informs the content of parent/caregiver education on physical therapy management of CMT.[170] Eight themes were identified among all parents: unfamiliarity with CMT diagnosis, varying approaches of pediatricians, worrying about diagnoses of CMT and

plagiocephaly, needing the PT's support and reassurance, managing the home program, appreciating family member's support, dealing with more than CMT, and experiencing additional benefits.[170] Two themes were unique to the parents of infants with severe CMT: reflecting on pregnancy to look for cause and experiencing anxiety after finding an SCM mass.[170] This study highlights the importance of parent/caregiver education to build a strong parent/caregiver-PT relationship over the episode of care, educating the family on CMT, tailoring the home program intensity to meet infant needs and family capacities, and providing strong support and reassurance to parents/caregivers, especially to those with infants with severe CMT who may be experiencing additional guilt and anxiety associated with the SCM mass.

Parents/caregivers should be educated on the importance of "tummy time" or prone play while awake consistent with Safe Sleep Recommendations,[41,61,171] positioning and handling to encourage symmetry,[97,128] minimizing the time spent in car seats and carriers to avoid CD,[64,126] and alternating eating to each side.[59,154] These strategies should be integrated into daily routines and home programs to enhance adherence.

Parents/caregivers may be inclined to seek advice from social media, internet sites, and support groups. These sources can provide an array of information, but the information veracity varies, and the sites cannot tailor interventions to an individual child's body structures and activity limitations. Information on prone positioning for play varies widely on when to start, how often, and for how long a session.[41] Parents/caregivers should be encouraged to review internet information with their infant's primary care provider and/or PT regarding exercises or interventions they are considering. Identification of evidence-based, reputable internet resources would assist both clinicians and families in keeping up with current and valid management approaches. The APTA Pediatrics has developed several free CMT CPG implementation resources[7] specifically for parents/caregivers.

Research Recommendation: Studies are needed to:

- Identify intervention techniques and dosages, including accurate descriptions of active exercises, with links to the CMT Severity Grades.
- Identify the components of optimal home programs.
- Evaluate the benefits of individual vs group therapy conditions.

C Action Statement 14. EVALUATE EVIDENCE-INFORMED SUPPLEMENTAL INTERVENTION(S) FOR APPROPRIATENESS TO AUGMENT THE FIRST-CHOICE INTERVENTION. PTs 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 PT has the appropriate training to administer the intervention. **(Evidence Quality: I-V, Recommendation Strength: Weak)**

Action Statement Profile

Aggregate Evidence Quality: Level I-V studies, with a preponderance of studies with high risk of bias (refer to Supplemental Digital Content 6, Randomized Controlled Trials of Evidence-informed Supplemental Interventions for Infants with Congenital Muscular Torticollis, available at: http://links.lww.com/PPT/A545).

Benefits: On an individual basis, combining evidence-informed supplemental interventions with the first-choice intervention may:

- be effective in improving outcomes or shortening episode of care.
- accommodate an infant's temperament or tolerance to intervention.
- avoid or minimize the need for future, more invasive procedures.
- increase parent/caregiver ability to implement home program.

Risk, Harm, and Cost:

- Evidence-informed supplemental interventions should only be applied by clinicians skilled in that specific technique or modality, and who understand the potential risks or side effects.
- There may be added parent/caregiver burdens to learn additional intervention techniques.
- Some interventions may not be covered by insurance.
- Some approaches may increase the cost of care.

Benefit-Harm Assessment: Preponderance of benefit for microcurrent (MC), soft tissue mobilization (STMo), and traditional Chinese medicine (TCM) massage if the clinician has received specialized training. Undetermined benefits and harms/costs for other evidence-informed supplemental interventions.

Value Judgments: Clinicians who are seeking to augment their first-choice interventions should choose evidence-informed supplemental interventions with the strongest evidence first and for which they have appropriate training.

Intentional Vagueness: While the evidence supporting MC and TCM massage is consistent across studies, it is not

known when it is best to add it to a plan of care or which approach is most effective.

Role of Parent/Caregiver or Child Preferences: Parents/caregivers may inquire about different interventions for the management of CMT.

Exclusions: None.

Quality Improvement:

- Providing evidence-informed supplemental interventions may accelerate the resolution of CMT in infants whose progress has slowed.

Implementation and Audit:

- Document the application and dosage of supplemental interventions to accurately measure their impact on infants with CMT.
- Audit the types and documentation of supplemental interventions to determine their overall benefit to children.

Supporting Evidence and Clinical Interpretation

A retrospective study of supplemental intervention use in infants with CMT[54] found that infants who received first-choice plus supplemental interventions were older with more severe CMT at the initiation of physical therapy compared to those who received only the first-choice intervention. The CMT resolution was similar in both groups of infants; however, the treatment duration of infants who received supplemental interventions was substantially longer.[54] An anecdotal finding supported that manual techniques, defined as myofascial release and massage, were added to the first-choice intervention early in the episode of care, in contrast to other supplemental interventions that were used later when the first-choice intervention did not result in the expected outcome.[54]

The following interventions are described as supplements to the first-choice intervention described in Action Statement 13 and are presented in descending order of evidence strength. Some interventions in the common press, social media, or the internet have no peer-reviewed publications to describe their approach or effect on CMT, including some interventions currently taught in physical therapy continuing education courses. Departures from this guideline should be documented in the child's record at the time the relevant clinical decisions are made; clinicians are strongly encouraged to publish the clinical reasoning and results of these alternative approaches.

Level I and II Evidence from Small Controlled Clinical Trials

Microcurrent (MC) is a low-intensity single-channel alternating current applied superficially at a level that is not perceived by the child. Two studies demonstrate reduced treatment duration and improved ROM with the addition of MC to physical therapy intervention. In a 2014 RCT,[168] all 20 infants received a home program, 20 minutes of exercises, 5 minutes of ultrasound, and 30 minutes with the MC unit set up, but only 10 infants received active MC. Treatment sessions were 3 times per week until PROM resolved or there were no improvements after 6 months of ongoing care. Those receiving the active MC had significantly shorter treatment durations (2.6 months) than those who did not (6.3 months). The results are consistent with a prior clinical trial[115] when 30 minutes of MC was applied to the involved SCM of infants with CMT, 3 times per week for 2 weeks, resulting in improved head tilt angle, neck rotation toward the affected side, and less crying during therapy when compared to a control group of infants with CMT who received traditional stretching and exercises. The sample size was small (n = 7 experimental vs 8 control), and there was no long-term follow-up. The average infant age was 7 months, and many had already been managed with stretching programs. A case study of a 19-month-old child with CMT and fibrotic nodules reported full passive cervical rotation and lateral flexion, improved lateral cervical flexion strength, and improved head tilt after 10 weeks of stretching, strengthening, massage, and parent/caregiver education, including 7 weeks of MC.[172]

Soft tissue mobilization (STMo) as described by Keklicek and Uygur[173] was applied in 3 phases: a passive mobilization phase, mobilization with stretching, and mobilization with active cervical rotation. For infants with CMT, a home program with STMo 3 days a week for 12 weeks, compared to only a home program, resulted in improved cervical rotation PROM and head tilt after 6 weeks of intervention, but not after 12 weeks of intervention or 18 weeks after the start of the study.[173] Between groups, there was no difference in lateral flexion PROM or AROM throughout the study.[173] It is not clear if the improvements at 6 weeks are due to the treatment technique or intensity of treatment since the intervention for the control group was not dose equivalent and parents/caregivers performed an unspecified home program of stretching and handling.

Traditional Chinese Medicine Massage. A systematic review with meta-analysis, an RCT, and a retrospective comparative study support the efficacy of TCM massage.[23,174,175] The SR included 6 RCTs and 1 quasi-RCT. Pooled analysis of 2 RCTs supported that TCM massage had similar effects to stretching based on effective rate, the percentage of infants with CMT that improved (risk ratio 1.00; 95% CI, 0.94-1.06); however, both RCTs in the meta-analysis had a high risk of bias.[174] Cui et al's 2019 RCT compared 2 types of TCM massage and found that infants in the modified tuina group had a greater effective rate than infants in the textbook tuina group; the study had a high risk of bias.[175] A retrospective study comparing stretching alone to stretching preceded by 6 minutes of TCM massage to the SCM found an effective rate of 87.5% for both groups with improved passive cervical rotation and lateral flexion in the TCM massage group, but no difference in the surgical rate or the Muscle Function Scale (MFS) between groups; the study had a high

risk of bias.[23] These studies support the feasibility of TCM massage, but further high-quality research is needed to support its efficacy.

Level II Evidence From Cohort Studies

The following interventions for CMT documented improvements in cohorts of infants with CMT before and after intervention, but intervention efficacies have not been established through controlled clinical trials: myokinetic stretching[92] and neural and visceral manipulation.[176] Refer to the 2018 CMT CPG, Castilla et al[11] or direct references for greater details.

Level IV Evidence From Case Studies and Case Reports

The following interventions for CMT are described in case studies and case reports but efficacy has not been established through controlled clinical trials: Tscharnuter Akademie for Motor Organization,[79] the Tubular Orthosis for Torticollis (TOT collar),[177] soft foam collars, and custom fabricated cervical orthosis.[178,179] Refer to the 2018 CMT CPG or direct references for greater details.

Indeterminant Evidence

Kinesiological taping (KT) refers to the use of stretchable tape to support muscles and to provide sensory feedback. In contrast to the 2013 CMT CPG recommendation that KT could be a supplemental intervention, current evidence is indeterminant. Öhman reported an immediate effect of KT on MFS scores while the tape is on[180]; however, a 2016 RCT suggests that there is no added value to KT when provided for 3 weeks in conjunction with other conservative methods.[169] This small RCT had 3 infant groups who had KT applied 6 days/week for 3 weeks; all groups received a home exercise program and physical therapy intervention. Group 1 had exercise only, group 2 had KT applied to the involved SCM for inhibition and the uninvolved SCM for facilitation, and group 3 had KT applied only to the involved SCM for inhibition. While there were within-group changes in neck PROM, MFS scores, and head shape symmetry from their baselines, there were no significant differences among intervention groups immediately after intervention, at 1 month or 3 months postintervention. This suggests that there is no added value of KT beyond exercise even over a 3-week intervention period. Since there is conflicting evidence of an immediate effect of KT, but not a sustained effect, additional studies of KT are needed to clarify when and if this approach is useful with CMT.

Not Recommended

Cervical manipulation and physical therapy focused on the encouragement of symmetrical motor performance has been compared to physical therapy alone in a small RCT of infants with CMT.[181] Results indicated no differences between the groups, and the technique used for cervical manipulation was not well described.[181] The use of cervical manipulation in infants has no sufficient evidence of benefits and may be associated with higher risks of apnea and possible death.[182-184] In weighing the potential risks against the benefits of other approaches, the GDG does not recommend cervical manipulation as an intervention for infants with CMT.

Interventions without Published Evidence of Efficacy

The following approaches have either not been studied systematically or shown not to provide any additional benefit. Additional approaches were found on social media and the internet, as well as in the common press for which no peer-reviewed literature was found.

Some interventions appear in print, online, on social media, in continuing education brochures, and at parent/caregiver support groups for infants with CMT and plagiocephaly, but no peer-reviewed studies have been found that describe the approaches or their effectiveness for resolving CMT, including craniosacral therapy, Total Motion Release, and Feldenkrais. Clinicians and parents/caregivers should be aware that these approaches have no peer-reviewed studies that describe their clinical application, efficacy, risks, and anticipated outcomes. Without studies, per guideline development criteria, the GDG cannot review these approaches for their efficacy. Clinicians who choose to use these approaches should document departures from the recommended approaches in children's records at the time the relevant clinical decisions are made, obtain consent to treat from parents/caregivers that acknowledges the lack of published evidence, carefully document objective measures of change, and publish their outcomes.

Research Recommendation: Studies are needed to describe and clarify the efficacy of all supplementary interventions, including determinants for their choice, principles of application, dosages, and outcome measures.

B **Action Statement 15: INITIATE CONSULTATION WHEN THE INFANT IS NOT PROGRESSING AS ANTICIPATED.** PTs 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 may include when asymmetries of the head, neck, and trunk are not starting to resolve after 4 to 6 weeks of comprehensive intervention, or after 6 months of intervention with a plateau in resolution. (**Evidence Quality: II, Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II based on cohort and outcome studies.

Benefits:

- Other interventions (eg, botulinum neurotoxin therapy or surgery) can be considered to resolve the current asymmetries and prevent further progression of deformities and compensations.
- Provides the family/caregivers with alternative management strategies to help resolve asymmetries.
- Rules out an underlying condition that has not been identified during initial examination or follow-up physical therapy sessions.

Risk, Harm, and Cost:

- The consultations and possible subsequent interventions may require additional time of the parents/caregivers and add to the cost of care.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: Collaborative and coordinated care is in the best interest of the infant and family-centered care.

Intentional Vagueness: The GDG is intentionally vague about the range of 4 to 6 weeks as the amount of time that a PT should treat an infant who is not responding to intervention. Since younger infants typically change more quickly than older infants, the GDG recommends that infants younger than 2 months who are not responding to intervention should be referred to their primary care provider sooner than infants older than 2 months, who may require more time to respond to intervention.

Role of Child/Parent/Caregiver Preferences: The infant's age, CMT severity, change rate, family needs, infant cooperation and developmental needs, and available family/caregiver resources should help to determine the episode of care before an infant is referred to the infant's primary care provider for consideration of alternative interventions.

Exclusions: None.

Quality Improvement:

- Referral to the primary care provider when the infant is not progressing as anticipated enhances coordinated communication about the infant, enables the infant to receive additional or specialized interventions, and promotes stronger professional relationships.

Implementation and Audit:

- Documentation should include information supporting the reason for referral, the PT's hypotheses about other factors that might need attention, and the intervention content, frequency, intensity, and duration.
- Survey referral sources for how they would like to receive communication about the children they referred (ie, digital vs hard copy reports or letters).
- Audit the number of infants that are fully resolved as compared to those who require referral for interventions other than physical therapy.

Supporting Evidence and Clinical Interpretation

The literature supports a wide range of intervention durations for conservative care, so the question of when to refer an infant who is not progressing as anticipated has no clear answer. The duration of intervention will vary depending on the age of initiation of physical therapy intervention and the CMT severity grade. Infants younger than 3 months with a CMT severity grade of 1 to 3 (Figure 2) will most likely NOT require 6 months of conservative intervention if the interventions appropriately address the impairments and there is adherence with home programming. Older infants who present with severity grades of 4 to 7 will more likely require the full 6 months of care, or more, depending on the number of comorbidities. Per Action Statement 12, factors associated with longer treatment durations include older age at the initiation of physical therapy intervention, increased CMT severity, and birth history. Other factors that may increase treatment duration include insufficient frequency, intensity, and content of direct physical therapy intervention, inconsistent home program adherence by parents/caregivers, and infant tolerance or medical conditions that may interfere with CMT interventions. Throughout the episode of care, the PT should collaborate with the infant's primary care provider and the parents/caregivers to make a judgment on when to increase the frequency and intensity of direct physical therapy intervention or consider alternative approaches. This decision should be based on the rate of change, the persisting impairments, the age of the infant, and the needs and values of the family. The literature supports that if intervention is initiated before 3 months of age, 98% to 100% of infants will respond to physical therapy intervention within a 6-month period of time,[16,17,50,52] though full resolution may require longer durations. The determining factors should be documented measures of progressive improvement, with referral triggered by plateaus at or after 6 months of consistent and intensive intervention.

Invasive Interventions: There are 2 conditions for which a child may be referred for consideration of more invasive interventions: (1) if after 6 months of physical therapy intervention, there is a lack of progress, or (2) if the child first begins intervention after 1 year of age and presents with significant restrictions and/or an SCM mass. Under these conditions, the PT should consult with the infant's primary care provider or referring provider about other approaches; the 2 most reported are botulinum toxin (BTX) injections and surgical management. The following brief descriptions are provided for information but are not exhaustive reviews of these approaches. Clinicians and families should discuss these options with their infants'

primary care providers when physical therapy intervention has not been successful.

BTX is a neurotoxin that is postulated to act on the tight SCM in 2 ways: as a neuromuscular block that inhibits acetylcholine release, thus reducing stimulation of an already tight muscle, and as a neurotoxin causing muscle atrophy and weakening that allows for easier stretching.[185] The use of BTX is considered off-label for infants; however, there is a growing body of support for its use with recalcitrant CMT to reduce the need for surgical management for infants who have not responded to at least 3 months of physical therapy.[186-188] A meta-analysis of BTX for CMT found an effective rate of 84% when BTX was used in combination with physical therapy intervention.[186] After BTX, the conversion rate to surgical management was 9%, and the adverse reaction rate was 1%.[186] The most common adverse reactions included bruising, neck pain, transient dysphagia, neck weakness, and fever of unknown origin.[186] Other more severe reactions, including death, have not been reported in the CMT literature.[186,189]

Surgical management of the SCM is the more traditional alternative for managing recalcitrant CMT.[190-192] Surgical approaches generally fall into 3 categories: unipolar release of the distal SCM attachment, bipolar release of both SCM muscle attachments, or tendon lengthening.[193,194] Criteria that have been used to determine the timing for surgery include: persistent limitations in cervical ROM >15°,[14,195] progressing limitations,[48] persistent residual tight band or SCM mass,[14] persistent visible head tilt,[14,29,195] not responding to physical therapy intervention after 6 months,[14,29] and reaching the age of 1 year without resolution[195]; surgery before 8 years of age appears to yield better outcomes than after age 8.[196] The postoperative management of CMT is similar to preoperative management and can range from 4 to 6 weeks[197] up to 11 months[198] to work on scar management, muscle strength, and ROM.

Research Recommendations: Studies are needed to describe the incidence of infants that require invasive care, their history of interventions, the best time for referral, and any associated physical therapy outcomes.

IV. PHYSICAL THERAPY DISCONTINUATION, REASSESSMENT, AND DISCHARGE OF INFANTS WITH CMT

B **Action Statement 16: DISCONTINUE DIRECT SERVICES WHEN THESE 5 CRITERIA ARE ACHIEVED.** PTs 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. **(Evidence Quality: II-III, Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II-III based on cohort and outcome studies.

Benefits:

Use of these criteria for discontinuation from direct PT reasonably ensures that:

- The CMT has resolved within accepted ranges of measurement error.
- There are no lingering secondary compensations or developmental delays.
- The parents/caregivers know how to assess for regression as the infant grows and when to contact their infant's primary care provider and/or the PT for reassessment.
- Discontinuation documentation reflects the expected outcomes for the episode of care, relative to the baseline measures taken at the initial examination.

Risk, Harm, and Cost:

There is an unknown amount of risk that discontinuation from physical therapy services with 5° residual asymmetry will progress to other anatomical areas (cervical scoliosis, craniofacial) or return as the infant grows.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: The GDG defines cervical rotation and cervical lateral flexion motions as included in PROM. Further, it includes full active cervical rotation and lateral flexion in the phrase symmetrical active movement.

Intentional Vagueness: None.

Role of Child/Parent/Caregiver Preferences: Parents/caregivers need to be educated about the importance of screening for asymmetries as the child grows and becomes more active against gravity, eg, when the infant is first learning to walk. They should also be advised that preferential positioning is often observed during times of fatigue or illness. Reevaluation is only warranted if the head tilt or asymmetry persists.

Exclusions: None.

Quality Improvement:

- Complete documentation of baseline and discontinuation measures will support more accurate physical therapy outcomes.
- Measurements taken at each intervention session provide feedback to parents/caregivers about the child's progress and support fine-tuning of the interventions, which can shorten the duration of care.[3]

Implementation and Audit:

- PTs should follow up with families that discontinue direct physical therapy services prior to achieving resolution of asymmetries or formal discharge, to determine the reason for discontinuation.
- PTs should educate parents/caregivers on signs of recurring CMT when changing from direct physical therapy to

monitoring with a reassessment at 3 to 12 months of age or when the infant starts walking.
- PTs should send discontinuation and discharge reports to the infant's primary care provider to inform them about the infant's progress.
- PTs should educate the infant's primary care provider on signs of recurring CMT when changing from direct physical therapy to monitoring with a reassessment at 3 to 12 months of age or when the infant starts walking and to refer to physical therapy with any concerns.

Supporting Evidence and Clinical Interpretation

An implementation study of the 2013 CMT CPG attributed taking cervical ROM measurements at each visit to reducing the episode of care for infants with CMT.[3] Frequent, routine measurements may reduce treatment duration by enhancing progress tracking and intervention adjustments, such as working more closely with parents/caregivers to improve their skills and confidence in administering interventions at home.

Discontinuation of direct services occurs when the infant has achieved the 5 criteria and direct intervention is no longer warranted. *Discharge* is defined as occurring 3 to 12 months after the discontinuation of direct services when physical therapy reassessment for residual CMT or other developmental concerns are negative.

While the duration of intervention for the individual infant will vary depending on the constellation of factors identified in Figure 2, the criteria for discontinuing direct physical therapy services are based on norms for infant growth and development,[106] known risks of early delays,[61,70,199] and evidence of possible long-term sequelae.[200] Functionally, it is critical that the infant who has achieved full PROM can actively use the available range, so physical therapy criteria for discontinuation should address developmental activity rather than focus solely on biomechanical measures of change.[69] Persistent functional limitations or developmental delays, after achievement of full PROM, are reasons to extend or initiate a new episode of care. Finally, these criteria are common across the literature and thus are in keeping with current practice norms.

Research Recommendation: Longitudinal studies are needed to understand the best criteria and/or timing for discontinuing infants from direct physical therapy intervention and the final discharge from the episode of care.

B Action Statement 17: REASSESS INFANTS 3 TO 12 MONTHS AFTER DISCONTINUATION OF DIRECT SERVICES, THEN DISCHARGE IF APPROPRIATE. PTs 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 to 12 months following discontinuation from direct physical therapy intervention OR when the child initiates walking. **(Evidence Quality: II-III, Recommendation Strength: Moderate**)

Action Statement Profile

Aggregate Evidence Quality: Level II-III based on cohort and outcome studies (refer to Supplemental Digital Content 7, Studies of Long-Term Outcomes, available at: http://links.lww.com/PPT/A545).

Benefits:
- Detection of postures and movement consistent with relapsing CMT, particularly as infants initiate walking and move against gravity.
- Detection of developmental delays.
- Ability to restart home exercise programs if asymmetry is identified.
- Screening identifies other causes of asymmetry, other than CMT, if asymmetries reappear.

Risk, Harm, and Cost:
- A single follow-up reassessment will require additional time of the parents/caregivers and minimally add to the cost of care.
- A single follow-up reassessment will require monitoring when to schedule an infant for reassessment and may be easily missed.

Benefit-Harm Assessment: Preponderance of benefit.

Value Judgments: A single follow-up physical therapy reassessment for infants with a history of CMT is consistent with the APTA Guide to Physical Therapist Practice 4.0, which describes the roles of a PT as including prevention of recidivism and preservation of optimal function.[71]

Intentional Vagueness: The time at which the follow-up reassessment is scheduled (3-12 months) is varied because an infant's age at discontinuation from direct physical therapy intervention will vary. Reassessment of younger infants, discontinued from direct intervention between 4 and 6 months, may need to occur sooner when the infants are initiating standing and walking. It is not known how far out into early childhood that reassessment should occur. Literature suggests that by 8 to 15 months, infants with delays at 2 to 6 months catch up with their peers,[70,201] and they continue to demonstrate age-appropriate motor development at preschool age.[199] However, a single follow-up study suggests that some infants are at greater risk for persistent neurodevelopmental conditions, such as developmental coordination disorder and attention deficit hyperactivity, which may not become evident until the early school years.[200]

Role of Child/Parent/Caregiver Preferences: Parents/caregivers may choose to forego a physical therapy reassessment if it places undue burden on the family for travel, time, or finances. Parents/caregivers should be advised at discontinuation

of direct physical therapy intervention of the small chance that developmental conditions may evidence themselves when the child enters school. Parents/caregivers should be counseled to express concerns to their infant's primary care provider and seek a physical therapy reevaluation if they observe persistent asymmetry or developmental delays.

Exclusions: None.

Quality Improvement:

- Long-term follow-up reassessments will provide data to understand the incidence of residual asymmetries or functional deficits, as well as parent/caregiver satisfaction.

Implementation and Audit:

- Provide education to clinicians and families about this recommendation to improve adherence to reassessment.
- Determine a method, based on location and health care coverage processes, to facilitate a cost-effective physical therapy reassessment. This may require PTs to educate administrators, service coordinators, and non-medical professionals about the importance of a comprehensive reassessment for infants with CMT. PTs should collaborate with their administrative and health care providers to develop pathways for parents/caregivers to obtain this reassessment, either internally or by referral to other services.
- Provide clear instructions to parents/caregivers and the infant's primary care provider about the signs of unresolved or returning CMT.
- After reassessment, document on a report sent to the infant's primary care provider:
  - That parents/caregivers were instructed to notify the PT if there is a persistent return of head tilt or asymmetry in active rotation or lateral flexion ROM.
  - The physical therapy recommendation to the primary care provider to check the infant's cervical ROM and presence of head tilt in well-child visits.
  - The physical therapy recommendation for a physical therapy reassessment to check the condition of the infant's CMT and general development at 12 months or when walking begins.
- Send reminder texts, emails, and/or postcards to the parents/caregivers for the physical therapy reassessment.
- Audit the number of reassessments completed vs the reasons for no reassessment, or premature discontinuation of services.

Supporting Evidence and Clinical Interpretation

The long-term consequences of CMT are implied from studies of older children and adults who require surgeries for correction of unresolved asymmetry[193,202] and from long-term outcome studies.[52,199] While the short-term outcomes of physical therapy management are well documented, there is little direct evidence of the long-term effectiveness of early physical therapy intervention, nor the rate of recidivism following early intervention. Studies report an "excellent" resolution of CMT as having less than 5° of passive cervical rotation asymmetry with the opposite side,[29,160,203] and a "good" resolution with as much as 10° residual.[203] It is not known whether the last 5° to 10° spontaneously resolves or in whom a mild limitation will remain, whether achieving cervical rotation PROM equates to full active use of the available range, or whether residual asymmetry influences normal development.

Öhman and Beckung[199] found that infants with a history of CMT did not exhibit motor delays at preschool age, but 7% exhibited a head tilt and 26% had some degree of PROM asymmetry. The clinical significance of asymmetric neck PROM is uncertain because only children with CMT were followed. All had ≥85° of rotation PROM to each side, and 7 children had a cervical lateral flexion PROM difference between sides of only 5° to 10°; it is not clear if age-matched children without CMT would present with similar results. In this study, asymmetric cervical PROM at preschool age was associated with the degree of asymmetric cervical rotation PROM as an infant.[204]

The documented potential for increasing muscle fibrosis,[91] developmental delays,[200] and hemi-syndrome support that a single physical therapy reassessment is prudent to determine if the resolution of CMT achieved at an earlier age is maintained as the infant continues to develop and to assess for potential developmental delays or biased limb use. Primary care providers should be cognizant of the risk for asymmetries and/or motor delays during routine physical exams as infants with a history of CMT are followed through to their teen years.

The length of time after discontinuation that a physical therapy reassessment should be conducted is supported by level IV evidence. Wei et al[153] proposed following infants until complete resolution or a minimum of 12 months. Ultrasound images suggest that while clinical indicators of ROM may improve, they are not correlated with SCM fibrous changes, and these fibrous changes can continue until at least age 3 years.[91] Finally, the potential for developmental delays may not become evident until early school age,[200] so a reassessment when the child enters elementary school may be warranted if a parent/caregiver or teacher reports, or the child presents with, residual asymmetries, developmental delays, or preferential positioning. Regional differences as to when a child is seen for their final direct service appointment may differ from the criteria for discharge, when the episode of care for CMT is considered closed.

Research Recommendations: Studies are needed to:

- Determine the most reasonable physical therapy reassessment times after discontinuation of direct physical therapy intervention based on initial presentations.
- Establish the level of risk of developing asymmetries following an episode of intervention.

- Determine the validity and reliability of using telemedicine or virtual meetings as compared to in-person physical therapy reassessment for the 3- to 12-month reassessment.

SUMMARY

A review of the literature, including a focused systematic review, reaffirms and updates 17 graded action statements that address education, referral, screening, examination and evaluation, classification, prognosis, first-choice and evidence-informed supplemental physical therapy interventions, interprofessional consultations, discontinuation, reassessment, and discharge, with recommendations for quality improvement, implementation, and audits. Flow sheets for referral paths and classification of CMT severity have been reaffirmed and updated. Evidence tables are available as supplemental digital content. Research recommendations made for 17 practice issues are summarized at the end of the document.

Suggestions are provided as general strategies for clinicians to implement the action statements of this CPG but are not an exhaustive review. Clinicians will need to assess their own practice structures, cultures, and clinical skills to determine how to best implement the action statements.

The GDG recommends that:

- Education about the 2024 CMT CPG be included in physical therapy curricula.
- Continuing education programs are provided to PTs on the updates in the 2024 CMT CPG.
- PTs distribute implementation resources developed by APTA Pediatrics[7] to parents/caregivers, primary care providers, and other health care providers who summarize the applicable key points of the 2024 CMT CPG.

Strategies for Individual Implementation

- Seek training in the use of the recommended standardized measures and/or intervention approaches.[205]
- Build relationships with referral sources to encourage early referral of infants.
- Measure individual service outcomes of care (eg, child impact across the ICF domains, costs, and parent/caregiver satisfaction).[206,207]

Strategies for Facilitating Clinical Practice Guideline Implementation in Other Clinicians

- Recognize that adoption of the recommendations by others may require time for learning about the 2024 CMT CPG content, developing a positive attitude toward adopting the action statements, comparing what is already done with the recommended actions, trialing selected changes in practice to determine their efficacy, and finally, routine integration of the tested changes.[206]
- Identify early adopting clinicians as opinion leaders to introduce the guideline via journal clubs or staff presentations.[206]
- Identify gaps in knowledge and skills following content presentations to determine staff needs to implement recommendations.[208]
- Use documentation templates to facilitate standardized collection and implementation of the recommended measures and actions.[4,209,210]
- Institute quality assurance processes to monitor the routine collection of recommended data and implementation of recommendations and to identify barriers to complete collection.[206,211]
- Measure structural outcomes (eg, dates of referral and equipment availability), process outcomes (eg, use of tests and measures, as well as breadth of plan of care), and service outcomes (eg, child impact across the ICF domains, costs, and parent/caregiver satisfaction)[206,207] to describe service delivery patterns and publish results.

SUMMARY OF RESEARCH RECOMMENDATIONS PER ACTION STATEMENT

Action Statement 1: Educate Expectant or New Parents/Caregivers of Newborn Infants to Prevent Asymmetries/CMT. Studies are needed on the impact of education of:

- Health care providers and their knowledge of pediatric PTs' roles in managing postural preference.
- Parents/caregivers about their experience of receiving this education.

Action Statement 2: Assess Newborn Infants for Asymmetries/CMT.

Studies are needed to determine:

- Whether routine screening within the first 2 to 3 days of life increases the rate of CMT identification and/or increases false positives.
- The barriers to early referral of infants with CMT to physical therapy.

Action Statement 3: Refer Infants with Asymmetries/CMT to their Primary Care Provider and a Physical Therapist.

- Studies are needed to clarify the predictive baseline measures and characteristics of infants who benefit from immediate follow-up and to compare the cost-benefit of early physical therapy intervention and education as compared to parent/caregiver instruction and monitoring by primary care providers.
- Longitudinal studies of infants with CMT would clarify how referral timing and intervention initiation impact body structure and functional outcomes and overall care costs.

Action Statement 4: Document Infant History.

- Studies are needed to clarify how the health history screening influences CMT identification, physical therapy diagnosis, prognosis, and intervention.

Action Statement 5: Screen Infants for Nonmuscular Causes of Asymmetry and Conditions Associated with CMT.

- Studies are needed to identify the precision of screening procedures specific to CMT.

Action Statement 6: Refer Infants from Physical Therapist to Primary Care Provider if Indicated by Systems Review.

- Studies are needed to clarify the incidence of nonmuscular causes of CMT and associated conditions, and how early referral impacts ultimate outcome.

Action Statement 7: Request Images and Reports.

- Studies are needed to determine who would benefit from imaging, at what time in the management of CMT images are useful, and how images affect the plan of care.

Action Statement 8: Examine Body Structures.

Studies are needed to:

- Develop reliable, valid, and time-efficient methods of measuring infant cervical PROM, including lateral flexion, and large-scale normative data of PROM established by age in months.
- Determine the sensitivity and specificity of the Muscle Function Scale to differentiate infants with clinically significant limitations from infants with typical development.
- Establish a clinically practical, objective method of measuring cervical rotation AROM in infants 0 to 3 months and infants ≥3 months to assess baseline and change over time.
- Determine what, if any, correlation between active and passive ROM should be used for discontinuation and/or discharge criteria.
- Describe and differentiate signs of discomfort and pain observed in infants with CMT during examinations and intervention.
- Determine the validity of the FLACC in rating pain in infants with CMT.
- Determine whether pain tools need to be specific to CMT.

Action Statement 9: Classify CMT using the CMT Severity Grading Scale.

- Studies are needed to determine a reliable, valid, and clinically practical method of measuring cervical lateral flexion and then to determine if lateral flexion measures relate to the CMT Severity Grading Scale.

Action Statement 10: Examine Activity and Developmental Status.

- Studies are needed to identify the best developmental tests to use for infants with CMT, from birth through 12 months, so that the same measures can be documented on all infants, enabling comparison of outcomes across studies.

Action Statement 11: Examine Participation Status.

- Studies are needed to quantify changes in participation and clarify how the participation elements inform the plan of care.

Action Statement 12: Determine Prognosis.

Studies are needed to:

- Clarify the interaction between the factors associated with full symptom resolution and episode of care.
- Clarify the prognostic accuracy for full symptom resolution and the episode of care.
- Compare the efficacy of different delivery models, eg, individual versus group or clinic vs home vs telerehabilitation.

Action Statement 13: Provide 5 Components as the First-Choice Intervention.

Studies are needed to:

- Identify intervention techniques and dosages, including accurate descriptions of active exercises, with links to the CMT Severity Grades.
- Identify the components of optimal home programs.
- Evaluate the benefits of individual vs group therapy conditions.

Action Statement 14: Evaluate Evidence-Informed Supplemental Intervention(s) for Appropriateness to Augment the First-Choice Intervention.

- Studies are needed to describe and clarify the efficacy of all supplemental interventions, including determinants for their choice, principles of application, dosages, and outcome measures.

Action Statement 15: Initiate Consultation When the Infant Is Not Progressing as Anticipated.

- Studies are needed to describe the incidence of infants that require invasive care, their history of interventions, the best time for referral, and any associated physical therapy outcomes.

Action Statement 16: Discontinue Direct Services When These 5 Criteria Are Achieved.

- Longitudinal studies are needed to understand the best criteria and/or timing for discontinuing infants from direct physical therapy intervention and the final discharge from the episode of care.

Action Statement 17: Reassess Infants 3-12 Months After Discontinuation of Direct Services, Then Discharge if Appropriate.

- Determine the most reasonable reassessment times after discontinuation of direct physical therapy intervention based on initial presentations.
- Establish the level of risk of developing asymmetries following an episode of intervention.
- Determine the validity and reliability of using telemedicine or virtual meetings as compared to in-person physical therapy reassessment for the 3- to 12-month reassessment.

Development of the guideline details are shown in Supplemental Digital Content 10, available at: http://links.lww.com/PPT/A545.

REFERENCES

1. Kaplan SL, Coulter C, Fetters L. Physical therapy management of congenital muscular torticollis: an evidence-based clinical practice guideline: from the Section on Pediatrics of the American Physical Therapy Association. *Pediatr Phys Ther*. 2013;25(4):348-394. doi:10.1097/PEP.0b013e3182a778d2.
2. Kaplan SL, Coulter C, Sargent B. Physical therapy management of congenital muscular torticollis: a 2018 evidence-based clinical practice guideline from the APTA Academy of Pediatric Physical Therapy. *Pediatr Phys Ther*. 2018;30(4):240-290. doi:10.1097/PEP.0000000000000544.
3. Strenk ML, Kiger M, Hawke JL, Mischnick A, Quatman-Yates C. Implementation of a quality improvement initiative: improved congenital muscular torticollis outcomes in a large hospital setting. *Phys Ther*. 2017;97(6):649-658. doi:10.1093/ptj/pzx029.
4. Gutierrez D, Kaplan SL. Aligning documentation with congenital muscular torticollis clinical practice guidelines: administrative case report. *Phys Ther*. 2016;96(1):111-120. doi:10.2522/ptj.20150012.
5. Nichter S. A clinical algorithm for early identification and intervention of cervical muscular torticollis. *Clin Pediatr (Phila)*. 2016;55(6):532-536. doi:10.1177/0009922815600396.
6. Kaplan SL, Dole RL, Schreiber J. Uptake of the congenital muscular torticollis clinical practice guideline into pediatric practice. *Pediatr Phys Ther*. 2017;29(4):307-313. doi:10.1097/PEP.0000000000000444.
7. APTA Pediatrics Congenital Muscular Torticollis Clinical Practice Guideline Implementation Resources. Accessed 12 29, 2023. https://pediatricapta.org/clinical-practice-guidelines/
8. Sargent B, Kaplan SL, Coulter C, Baker C. Congenital muscular torticollis: bridging the gap between research and clinical practice. *Pediatrics*. 2019;144(2):e20190582. doi:10.1542/peds.2019-0582.
9. Institute of Medicine (US). *Committee on Standards for Developing Trustworthy Clinical Practice Guidelines. Clinical Practice Guidelines We Can Trust*. National Academies Press; 2011.
10. Shiffman RN, Michel G, Rosenfeld RM, Davidson C. Building better guidelines with BRIDGE-Wiz: development and evaluation of a software assistant to promote clarity, transparency, and implementability. *J Am Med Inform Assoc*. 2011;19:94-101. doi:10.1136/amiajnl-2011-000172.
11. Castilla A, Gonzalez M, Kysh 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. doi:10.1097/pep.0000000000000993.
12. Petronic I, Brdar R, Cirovic D, et al. Congenital muscular torticollis in children: distribution, treatment duration and outcome. *Eur J Phys Rehabil Med*. 2010;45(2):153-158.
13. Lee K, Chung E, Lee B-H. A comparison of outcomes of asymmetry in infants with congenital muscular torticollis according to age upon starting treatment. *J Phys Ther Sci*. 2017;29:543-547.
14. Cheng JC, Wong MW, Tang SP, Chen TM, Shum SL, Wong EM. Clinical determinants of the outcome of manual stretching in the treatment of congenital muscular torticollis in infants. A prospective study of eight hundred and twenty-one cases. *J Bone Joint Surg Am*. 2001;83(5):679-687. doi:10.2106/00004623-200105000-00006.

15. Lee JY, Koh SE, Lee IS, et al. The cervical range of motion as a factor affecting outcome in patients with congenital muscular torticollis. *Ann Rehabil Med*. 2013;37(2):183-190. doi:10.5535/arm.2013.37.2.183.
16. Demirbilek S, Atayurt HF. Congenital muscular torticollis and sternomastoid tumor: results of nonoperative treatment. *J Pediatr Surg*. 1999;34:549-551.
17. Cameron BH, Langer JC, Cameron GS. Success of nonoperative treatment for congenital muscular torticollis is dependent on early therapy. *J Pediatr Surg*. 1994;9:391-393.
18. Hussein MA, Yun IS, Lee DW, Park H, Oock KY. Cervical spine dysmorphism in congenital muscular torticollis. *J Craniofac Surg*. 2018 Jun;29(4):925-929. doi:10.1097/scs.0000000000004357.
19. Fenton R, Gaetani S, MacIsaac Z, Ludwick E, Grunwaldt L. Description of mandibular improvements in a series of infants with congenital muscular torticollis and deformational plagiocephaly treated with physical therapy. *Cleft Palate Craniofac J*. 2018;55(9):1282-1288. doi:10.1177/1055665618763374.
20. Guyatt GH, Oxman AD, Sultan S, et al. GRADE guidelines: 9. Rating up the quality of evidence. *J Clin Epidemiol*. 12 01, 2011;64 (12):1311-1316. doi:10.1016/j.jclinepi.2011.06.004.
21. Song S, Hwang W, Lee S. Effect of physical therapy intervention on thickness and ratio of the sternocleidomastoid muscle and head rotation angle in infants with congenital muscular torticollis: a randomized clinical trial (CONSORT). *Medicine (Baltimore)*. 2021;100(33):e26998. doi:10.1097/md.0000000000026998.
22. He L, Yan X, Li J, et al. Comparison of 2 dosages of stretching treatment in infants with congenital muscular torticollis: a randomized trial. *Am J Phys Med Rehabil*. 2017;96(5):333-340. doi:10.1097/PHM.0000000000000623.
23. Tang W, Li Z, Xu W, et al. Effect of massage therapy on infants with congenital muscular torticollis: a retrospective comparative study. *Front Pediatr*. 2022;10:984675. doi:10.3389/fped.2022.984675.
24. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. *BMJ*. 2016;355:i4919. doi:10.1136/bmj.i4919.
25. AGREE Next Steps Consortium. The AGREE II Instrument [Electronic version] 2009. www.agreetrust.org. Accessed December 29, 2023.
26. Aarnivala HE, Valkama AM, Pirttiniemi PM. Cranial shape, size and cervical motion in normal newborns. *Early Hum Dev*. 2014;90 (8):425-430. doi:10.1016/j.earlhumdev.2014.05.007.
27. Stellwagen L, Hubbard E, Chambers C, Jones KL. Torticollis, facial asymmetry and plagiocephaly in normal newborns. *Arch Dis Child*. 2008;93(10):827-831. doi:10.1136/adc.2007.124123.
28. Brown RE, Harave S. Diagnostic imaging of benign and malignant neck masses in children—a pictorial review. *Quant Imaging Med Surg*. 2016;6(5):591-604. doi:10.21037/qims.2016.10.10.
29. Cheng JC, Tang SP, Chen TM, Wong MW, Wong EM. The clinical presentation and outcome of treatment of congenital muscular torticollis in infants—a study of 1,086 cases. *J Pediatr Surg*. 2000;35(7):1091-1096. doi:10.1053/jpsu.2000.7833.
30. Ballock RT, Song KM. The prevalence of nonmuscular causes of torticollis in children. *J Pediatr Orthop*. 1996;16(4):500-504. doi:10.1097/00004694-199607000-00016.
31. Nucci P, Kushner BJ, Serafino M, Orzalesi N. A multi-disciplinary study of the ocular, orthopedic, and neurologic causes of abnormal head postures in children. *Am J Ophthalmol*. 2005;140:65-68.
32. Han MH, Kang JY, Do HJ, et al. Comparison of clinical findings of congenital muscular torticollis between patients with and without sternocleidomastoid lesions as determined by ultrasonography. *J Pediatr Orthop*. 2019;39(5):226-231. doi:10.1097/BPO.0000000000001039.
33. Lee YT, Park JW, Lim M, et al. A clinical comparative study of ultrasound-normal versus ultrasound-abnormal congenital muscular torticollis. *PM R*. 2016;8(3):214-220. doi:10.1016/j.pmrj.2015.07.014.
34. Peitsch WK, KC H, LR A, MJ B. Incidence of cranial asymmetry in healthy newborns. *Pediatrics*. 2002;110:e72.
35. Australian Government Department of Health. *Australian 24-hour Movement Guidelines for the Early Years (Birth to 5 Years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep*. Australia: Australian Government Department of Health Canberra; 2017.
36. American Academy of Pediatrics. Back to sleep, tummy to play. 2023. http://www.healthychildren.org/English/ages-stages/baby/sleep/Pages/Back-to-Sleep-Tummy-to-Play.aspx. Accessed November 23, 2023.
37. Hewitt L, Stanley R, Okely A. Correlates of tummy time in infants aged 0–12 months old: a systematic review. *Infant Behav Dev*. 2017;49:310-321. doi:10.1016/j.infbeh.2017.10.001.
38. Carson V, Lee E-Y, Hewitt L, et al. Systematic review of the relationships between physical activity and health indicators in the early years (0-4 years). *BMC Public Health*. 2017;17(1):985. doi:10.1186/s12889-017-4981-5.
39. Hagan JF, Shaw JS, Duncan PM. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. American Academy of Pediatrics; 2017.
40. Porter S, Qureshi R, Caldwell BA, Echevarria M, Dubbs WB, Sullivan MW. Developmental surveillance and screening practices by pediatric primary care providers. *Infants Young Child*. 2016;29 (2):91-101. doi:10.1097/iyc.0000000000000057.
41. Koren A, Reece SM, Kahn-D'angelo L, Medeiros D. Parental information and behaviors and provider practices related to tummy time and back to sleep. *J Pediatr Health Care*. 2010;24(4):222-230. doi:10.1016/j.pedhc.2009.05.002.
42. Moon RY, Carlin RF. Task force on sudden infant death syndrome and the committee on fetus and newborn. sleep-related infant deaths: updated 2022 recommendations for reducing infant deaths in the sleep environment. *Pediatrics*. 2022;150(1):e2022057990. doi:10.1542/peds.2022-057990.
43. Chen MM, Chang HC, Hsieh CF, Yen MF, Chen TH. Predictive model for congenital muscular torticollis: analysis of 1021 infants with sonography. *Arch Phys Med Rehabil*. 2005;86(11):2199-2203. doi:10.1016/j.apmr.2005.05.010.
44. Xiong Z, Zhao Z, Deng H, et al. Screening for musculoskeletal system malformations and birth injuries in newborns: results of a screening program in 2 hospitals in Shenzen, China. *Pediatr Investig*. 2022;6(3):156-162. doi:10.1002/ped4.12334.
45. Stellwagen LM, Hubbard E, Vaux K. Look for the "stuck baby" to identify congenital torticollis. *Contemp Pediatr*. 2004;21:55-65.
46. McAllister JM, Hall ES, Hertenstein GER, Merhar SL, Uebel PL, Wexelblatt SL. Torticollis in infants with a history of neonatal abstinence syndrome. *J Pediatr*. 2018;196:305-308. doi:10.1016/j.jpeds.2017.12.009.
47. van Vlimmeren LA, Helders PJ, van Adrichem LN, Engelbert RH. Diagnostic strategies for the evaluation of asymmetry in infancy—a review. *Eur J Pediatr*. 2004;163:185-191.
48. van Vlimmeren LA, Helders PJM, van Adrichem LNA, Engelbert RHH. Torticollis and plagiocephaly in infancy: therapeutic strategies. *Pediatr Rehabil*. 2006;9:40-46.
49. de Chalain TMB, Park S. Torticollis associated with positional plagiocephaly: a growing epidemic. *J Craniofac Surg*. 2010;16:411-418.
50. Emery C. The determinants of treatment duration for congenital muscular torticollis. *Phys Ther*. 1994;74:921-929.
51. Ohman A, Mardbrink EL, Stensby J, Beckung E. Evaluation of treatment strategies for muscle function in infants with congenital muscular torticollis. *Physiother Theory Pract*. 2011;27(7):463-470. doi:10.3109/09593985.2010.536305.

52. Celayir AC. Congenital muscular torticollis: early and intensive treatment is critical. A prospective study. *Pediatr Int*. 2000;42:504-507.
53. Amaral DM, Cadilha R, Rocha J, Silva AIG, Parada F. Congenital muscular torticollis: where are we today? A retrospective analysis at a tertiary hospital. *Porto Biomed J*. 2019;4(3):e36. doi:10.1097/j.pbj.0000000000000036.
54. Greve KR, Goldsbury CM, Simmons EA. Infants with congenital muscular torticollis requiring supplemental physical therapy interventions. *Pediatr Phys Ther*. 2022;34(3):335-341. doi:10.1097/pep.0000000000000906.
55. Greve KR, Sweeney JK, Bailes AF, Van Sant AF. Infants with congenital muscular torticollis: demographic factors, clinical characteristics, and physical therapy episode of care. *Pediatr Phys Ther*. 2022;34(3):343-351. doi:10.1097/pep.0000000000000907.
56. Knudsen KCR, Jacobson RP, Kaplan SL. Associations between congenital muscular torticollis severity and physical therapy episode. *Pediatr Phys Ther*. 2020;32(4):314-320. doi:10.1097/PEP.0000000000000739.
57. Ohman A, Nilsson S, Beckung E. Stretching treatment for infants with congenital muscular torticollis: physiotherapist or parents? A randomized pilot study. *PM R*. 2010;2(12):1073-1079. doi:10.1016/j.pmrj.2010.08.008.
58. Fradette J, Gagnon I, Kennedy E, Snider L, Majnemer A. Clinical decision making regarding intervention needs of infants with torticollis. *Pediatr Phys Ther*. 2011;23(3):249-256. doi:10.1097/PEP.0b013e318227cb2a.
59. Genna CW. Breastfeeding infants with congenital torticollis. *J Hum Lact*. 2015 May;31(2):216-220. doi:10.1177/0890334414568315.
60. Luxford BK. The physiotherapy management of infants with congenital muscular torticollis: a survey of current practice in New Zealand. *NZ J Physiother*. 2009;37:127-135.
61. Öhman A, Nilsson S, Lagerkvist A, Beckung ERE. Are infants with torticollis at risk of a delay in early motor milestones compared with a control group of healthy infants? *Dev Med Child Neurol*. 2009;51:545-550.
62. Kuzik N, Poitras V, Tremblay M, Lee E-Y, Hunter S, Carson V. Systematic review of the relationships between combinations of movement behaviours and health indicators in the early years (0-4 years). *BMC Public Health*. 2017;17(S5):849–undefined. doi:10.1186/s12889-017-4851-1.
63. Jung AY, Kang EY, Lee SH, Nam DH, Cheon JH, Kim HJ. Factors that affect the rehabilitation duration in patients with congenital muscular torticollis. *Ann Rehabil Med*. 2015;39(1):18-24. doi:10.5535/arm.2015.39.1.18.
64. Boere-Boonekamp MM, van der Linden-kuiper LT. Positional preference: prevalence in infants and follow-up after 2 years. *Pediatrics*. 2001;107:339-343.
65. van Vlimmeren LA, van der Graaf Y, Boere-Boonekamp MM, L'Hoir MP, Helders PJM, Engelbert RHH. Risk factors for deformational plagiocephaly at birth and at 7 weeks of age: a prospective cohort study. *Pediatrics*. 2007;119:e408-e418.
66. Nuysink J, van Haastert IC, Takken T, Helders PJ. Symptomatic asymmetry in the first six months of life: differential diagnosis. *Eur J Pediatr*. 2008;167(6):613-619. doi:10.1007/s00431-008-0686-1.
67. Thompson F, McManus S, Colville J. Familial congenital muscular torticollis: case report and review of the literature. *Clin Orthop Relat Res*. 1986;202:193-196.
68. Sönmez K, Turkyilmaz Z, Demirogullari B, et al. Congenital muscular torticollis in children. *J Oto-Rhino-Laryngology*. 2005;67(6):344-347.
69. Tessmer A, Mooney P, Pelland L. A developmental perspective on congenital muscular torticollis: a critical appraisal of the evidence. *Pediatr Phys Ther*. 2010;22(4):378-383. doi:10.1097/PEP.0b013e3181f940f3.
70. Schertz M, Zuk L, Zin S, Nadam L, Schwartz D, Bienkowski RS. Motor and cognitive development at one-year follow-up in infants with torticollis. *Early Hum Dev*. 2008;84:9-14.
71. APTA. APTA Guide to Physical Therapist Practice 4.0. *American Physical Therapy Association*. Accessed 8 26, 2023. https://guide.apta.org/
72. Hollier L, Kim J, Grayson BH, McCarthy JG. Congenital muscular torticollis and the associated craniofacial changes. *Plast Reconstr Surg*. 2000;105:827-835.
73. Yu -C-C, Wong F-H, Lo L-J, Chen Y-R. Craniofacial deformity in patients with uncorrected congenital muscular torticollis: an assessment from 3-dimensional computed tomography imaging. *Plast Reconstr Surg*. 2004;113:24-33.
74. Gou P, Li J, Li X, et al. Clinical features and management of the developmental dysplasia of the hip in congenital muscular torticollis. *Int Orthop*. 2022;46(4):883-887. doi:10.1007/s00264-021-05279-9.
75. Gray GM, Tasso KH. Differential diagnosis of torticollis: a case report. *Pediatr Phys Ther*. 2009;21(4):369-374. doi:10.1097/PEP.0b013e3181beca44.
76. Nucci P, Curiel B. Abnormal head posture due to ocular problems: a review. *Curr Pediatr Rev*. 2009;5:105-111.
77. Freed SS, Coulter-O'Berry C. Identification and treatment of congenital muscular torticollis in infants. *J Prosthet Orthot*. 2004;16:S18-S23.
78. Tomczak KK, Rosman NP. Torticollis. *J Child Neurol*. 2013;28(3):365-378. doi:10.1177/0883073812469294.
79. Rahlin M. TAMO therapy as a major component of physical therapy intervention for an infant with congenital muscular torticollis: a case report. *Pediatr Phys Ther*. 2005;17:209-218.
80. Bercik D, Diemer S, Westrick S, Worley S, Suder R. Relationship between torticollis and gastroesophageal reflux disorder in infants. *Pediatr Phys Ther*. 2019;31(2):142-147. doi:10.1097/pep.0000000000000592.
81. Bess LK, Costa J, Nguygen ATH, Amankwah E, Wilsey MJ. Prevalence of gastroesophageal reflux disease in infants with congenital muscular torticollis: a prospective cohort study. *Pediatr Phys Ther*. 2022;34(2):180-183. doi:10.1097/pep.0000000000000883.
82. Minihane KP, Grayhack JJ, Simmons TD, Seshadri R, Wysocki RW, Sarwark JF. Developmental dysplasia of the hip in infants with congenital muscular torticollis. *Am J Orthop*. 2008;37(9):E155-158.
83. White KK, Bober MB, Cho T-J, et al. Best practice guidelines for management of spinal disorders in skeletal dysplasia. *Orphanet J Rare Dis*. 2020;15(1):161. doi:10.1186/s13023-020-01415-7.
84. Haque S, Bilal Shafi BB, Kaleem M. Imaging of torticollis in children. *Radiographics*. 2012;32(2):557-571. doi:10.1148/rg.322105143.
85. Ben Zvi I, Thompson DNP. Torticollis in childhood-a practical guide for initial assessment. *Eur J Pediatr*. 2022;181(3):865-873. doi:10.1007/s00431-021-04316-4.
86. Boyko N, Eppinger MA, Straka-demarco D, Mazzola CA. Imaging of congenital torticollis in infants: a retrospective study of an institutional protocol. *J Neurosurg Pediatr*. 2017;20(2):191-195. doi:10.3171/2017.3.PEDS16277.
87. Dudkiewicz I, Ganel A, Blankstein A. Congenital muscular torticollis in infants: ultrasound-assisted diagnosis and evaluation. *J Pediatr Orthop*. 2005;25:812-814.
88. Kwon DR, Park GY. Diagnostic value of real-time sonoelastography in congenital muscular torticollis. *J Ultrasound Med*. 2012;31(5):721-727. doi:10.7863/jum.2012.31.5.721.

89. Hu CF, Fu TC, Chen CY, Chen CP, Lin YJ, Hsu CC. Longitudinal follow-up of muscle echotexture in infants with congenital muscular torticollis. *Medicine (Baltimore)*. 2017;96(6):e6068. doi:10.1097/MD.0000000000006068.
90. Cheng JC, Metreweli C, Chen TM, Tang S. Correlation of ultrasonographic imaging of congenital muscular torticollis with clinical assessment in infants. *Ultrasound Med Biol*. 2000;26(8):1237-1241. doi:10.1016/s0301-5629(00)00301-x.
91. Tang SF, Hsu KH, Wong AM, Hsu CC, Chang CH. Longitudinal followup study of ultrasonography in congenital muscular torticollis. *Clin Orthop Relat Res*. 2002;403:179-185. doi:10.1097/00003086-200210000-00026.
92. Chon SC, Yoon SI, You JH. Use of the novel myokinetic stretching technique to ameliorate fibrotic mass in congenital muscular torticollis: an experimenter-blinded study with 1-year follow-up. *J Back Musculoskelet Rehabil*. 2010;23(2):63-68. doi:10.3233/BMR-2010-0251.
93. Song S, Hwant W, Lee S. Factors related to the treatment duration of infants with congenital muscular torticollis. *Phys Ther Rehabil Sci*. 2020;9:191-196.
94. Seager A, Meldrum D, Conroy R, French HP. Congenital muscular torticollis: the reliability of visual estimation in the assessment of cervical spine active rotation and head tilt by physiotherapists and the impact of clinical experience. *Eur J Pediatr*. 2020;179(11):1823-1832. doi:10.1007/s00431-020-03691-8.
95. Cheng JC, Chen TM, Tang SP, Shum SL, Wong MW, Metreweli C. Snapping during manual stretching in congenital muscular torticollis. *Clin Orthop Relat Res*. 2001;384:237-244.
96. Storer SK, Skaggs DL. Developmental dysplasia of the hip. *Am Fam Physician*. 2006;74:1310-1316.
97. Watemberg N, Ben-Sasson A, Goldfarb R. Transient motor asymmetry among infants with congenital torticollis-description, characterization, and results of follow-up. *Pediatr Neurol*. 2016;59:36-40. doi:10.1016/j.pediatrneurol.2016.02.005.
98. Majnemer A, Barr RG. Association between sleep position and early motor development. *J Pediatr*. 2006;149(5):623-629. doi:10.1016/j.jpeds.2006.05.009.
99. Majnemer A, Barr RG. Influence of supine sleep positioning on early motor milestone acquisition. *Dev Med Child Neurol*. 2005;47(6):370-376. doi:10.1017/s0012162205000733.
100. Rahlin M, Sarmiento B. Reliability of still photography measuring habitual head deviation from midline in infants with congenital muscular torticollis. *Pediatr Phys Ther*. 2010;22(4):399-406. doi:10.1097/PEP.0b013e3181f9d72d.
101. Seager A, French H, Meldrum D. Measurement properties of instruments for assessment of cervical spine function in infants with torticollis: a systematic review. *Eur J Pediatr*. 2019;178(5):657-671. doi:10.1007/s00431-019-03338-3.
102. Rahlin M, Barnett J, Sarmiento B. Functional Symmetry Observation Scale, Version 2: development and content validation using a modified Delphi method. *Pediatr Phys Ther*. 2022;34(1):37-44. doi:10.1097/pep.0000000000000847.
103. Klackenberg EP, Elfving B, Haglund-Åkerlind Y, Carlberg EB. Intra-rater reliability in measuring range of motion in infants with congenital muscular torticollis. *Adv Physiother*. 2005;7:84-91.
104. Fletcher JP, Bandy WD. Intrarater reliability of CROM measurement of cervical spine active range of motion in persons with and without neck pain. *Jospt*. 2008;38:640-645.
105. Cheng JC, Tang SP, Chen TM. Sternocleidomastoid pseudotumor and congenital muscular torticollis in infants: a prospective study of 510 cases. *J Pediatr*. 1999;134:712-716.
106. Öhman AM, Beckung ERE. Reference values for range of motion and muscle function of the neck in infants. *Pediatr Phys Ther*. 2008;20:53-58.
107. Campbell SK, Kolobe TH, Osten ET, Lenke M, Girolami GL. Construct validity of the Test of Infant Motor Performance. *Phys Ther*. 1995;75:585-596.
108. Lobo MA, Harbourne RT, Dusing SC, McCoy SW. Grounding early intervention: physical therapy cannot just be about motor skills anymore. *Phys Ther*. 2013;93(1):94-103. doi:10.2522/ptj.20120158.
109. Öhman A, Beckung E. Functional and cosmetic status in children treated for congenital muscular torticollis as infants. *Adv Physiother*. 2009;7(3):135-140. doi:10.1080/14038190500213836.
110. Murgia M, Venditto T, Paoloni M, et al. Assessing the cervical range of motion in infants with positional plagiocephaly. *J Craniofac Surg*. 2016;27(4):1060-1064.
111. Öhman AM, Nilsson S, Beckung ER. Validity and reliability of the muscle function scale, aimed to assess the lateral flexors of the neck in infants. *Physiother Theory Pract*. 2009;25:129-137.
112. Shaw BA, Seg Al LS. Section on Orthopaedics. Evaluation and referral for developmental dysplasia of the hip in infants. *Pediatrics*. 2016;138(6):e20163107. doi:10.1542/peds.2016-3107.
113. Yang S, Zusman N, Lieberman E, Goldstein RY. Developmental dysplasia of the hip. *Pediatrics*. 2019;143(1):e20181147. doi:10.1542/peds.2018-1147.
114. Herr K, Coyne PJ, Key T, et al. Pain assessment in the nonverbal child: position statement with clinical practice recommendations. *Pain Manag Nurs*. 2006;7(2):44-52. doi:10.1016/j.pmn.2006.02.003.
115. Kim MY, Kwon DR, Lee HI. Therapeutic effect of microcurrent therapy in infants with congenital muscular torticollis. *Phys Med Rehabil*. 2009;1:736-739.
116. Rahlin M, Haney N, Barnett J. Reliability of the Therapy Behavior Scale version 2.2 in infants with congenital muscular torticollis: a pilot study. *Physiother Theory Pract*. 2022;38(5):717-728. doi:10.1080/09593985.2020.1786870.
117. Merkel S, Voepel-Lewis T, Malviya S. Pain assessment in infants and young children: the FLACC scale. *Am J Nurs*. 2002;102(10):55-58. doi:10.1097/00000446-200210000-00024.
118. Merkel SI, Voepel-Lewis T, Shayevitz JR, Malviya S. The FLACC: a behavioral scale for scoring postoperative pain in young children. *Pediatr Nurs*. 1997;23:293-297.
119. Peng T, Qu S, Du Z, Chen Z, Xiao T, Chen R. A systematic review of the measurement properties of Face, Legs, Activity, Cry and Consolability Scale for pediatric pain assessment. *J Pain Res*. 2023;16:1185-1196. doi:10.2147/jpr.S397064.
120. Crellin DJ, Harrison D, Santamaria N, Babl FE. Systematic review of the Face, Legs, Activity, Cry and Consolability scale for assessing pain in infants and children: is it reliable, valid, and feasible for use? *Pain*. 2015;156(11):2132-2151. doi:10.1097/j.pain.0000000000000305.
121. Manworren RC, Hynan LS. Clinical validation of FLACC: preverbal child pain scale. *Pediatr Nurs*. 2003;29:140-146.
122. Parikh SN, Crawford AH, Choudhury S. Magnetic resonance imaging in the evaluation of infantile torticollis. *Orthop*. 2004;27:509-515.
123. Baratta VM, Linden OE, Byrne ME, Sullivan SR, Taylor HO. A quantitative analysis of facial asymmetry in torticollis using 3-dimensional photogrammetry. *Cleft Palate Craniofac J*. 2022;59(1):40-46. doi:10.1177/1055665621993284.
124. Argenta L, David L, Thompson J. Clinical classification of positional plagiocephaly. *J Craniofac Surg*. 2004;15(3):368-372. doi:10.1097/00001665-200405000-00004.
125. Chate RA. Facial scoliosis from sternocleidomastoid torticollis: long-term postoperative evaluation. *Br J Oral Maxillofac Surg*. 2005;43:428-434.

126. Laughlin J, Luerssen TG, Dias MS. Prevention and management of positional skull deformities in infants. *Pediatrics*. 2011;128 (6):1236-1241. doi:10.1542/peds.2011-2220.
127. Persing J, James H, Swanson J, Kattwinkel J, Medicine A. Prevention and management of positional skull deformities in infants. *Pediatrics*. 2003;112:199-202.
128. van Vlimmeren L, van der Graaf Y, Boere-Boonekamp MM, L'Hoir MP, Helders PJM, Engelbert RHH. Effect of pediatric physical therapy on deformational plagiocephaly in children with positional preference: a randomized controlled trial. *Arch Pediatr Adolesc Med*. 2008;162:712-718.
129. Spermon J, Spermon-Marijnen R, Scholten-Peeters W. Clinical classification of deformational plagiocephaly according to Argenta: a reliability study. *J Craniofac Surg*. 2008;19:664-668.
130. Pastor-Pons I, Lucha-López MO, Barrau-Lalmolda M, et al. Inter-rater and intrarater reliability of cranial anthropometric measurements in infants with positional plagiocephaly. *Children*. 2020;7 (12):306.
131. van Vlimmeren LA, Takken T, van Adrichem LN, van der Graaf Y, Helders PJ, Engelbert RH. Plagiocephalometry: a non-invasive method to quantify asymmetry of the skull; a reliability study. *Eur J Pediatr*. 2006;165(3):149-157. doi:10.1007/s00431-005-0011-1.
132. van Adrichem LN, van Vlimmeren LA, Cadanova D, et al. Validation of a simple method for measuring cranial deformities (plagiocephalometry). *J Craniofac Surg*. 2008;19(1):15-21. doi:10.1097/scs0b013e31815c93cb.
133. Ohman A. The inter-rater and intra-rater reliability of a modified "severity scale for assessment of plagiocephaly" among physical therapists. *Physiother Theory Pract*. 2012;28(5):402-406. doi:10.3109/09593985.2011.639850.
134. Öhman A. A craniometer with a headband can be a reliable tool to measure plagiocephaly and brachycephaly in clinical practice. *Health*. 2016;08(12):1258-1265. doi:10.4236/health.2016.812128.
135. Loveday BP, de Chalain TB. Active counterpositioning or orthotic device to treat positional plagiocephaly? *J Craniofac Surg*. 2001;12:308-313.
136. Plank LH, Giavedoni B, Lombardo JR, Geil MD, Reisner A. Comparison of infant head shape changes in deformational plagiocephaly following treatment with a cranial remolding orthosis using a noninvasive laser shape digitizer. *J Craniofac Surg*. 2006;17 (6):1084-1091. doi:10.1097/01.scs.0000244920.07383.85.
137. Holowka MA, Reisner A, Giavedoni B, Lombardo JR, Coulter C. Plagiocephaly Severity Scale to aid in clinical treatment recommendations. *J Craniofac Surg*. 2017;28(3):717-722. doi:10.1097/SCS.0000000000003520.
138. Cunningham ML, Heike CL. Evaluation of the infant with an abnormal skull shape. *Curr Opin Pediatr*. 2007;19(6):645-651. doi:10.1097/MOP.0b013e3282f1581a.
139. Tamber MS, Nikas D, Beier A, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline on the role of cranial molding orthosis (helmet) therapy for patients with positional plagiocephaly. *Neurosurgery*. 2016 Nov;79(5):E632-E633. doi:10.1227/neu.0000000000001430.
140. Oledzka M, Kaplan SL, Sweeney JK, Coulter C, Evans-Rogers DL. Interrater and intrarater reliability of the Congenital Muscular Torticollis Severity Classification System. *Pediatr Phys Ther*. 2018;30:176-182.
141. van Vlimmeren LA, Engelbert RH, Pelsma M, Groenewoud HM, Boere-Boonekamp MM, Nijhuis-van der Sanden MW. The course of skull deformation from birth to 5 years of age: a prospective cohort study. *Eur J Pediatr*. 2017;176(1):11-21. doi:10.1007/s00431-016-2800-0.
142. Piper M, Darrah J. *Motor Assessment of the Developing Infant*. Sauders; 1994.
143. Folio MR, Fewell RR. *Peabody Developmental Motor Scales*. 3rd ed. Pearson; 2023.
144. Flannery AM, Tamber MS, Mazzola C, et al. Congress of neurological surgeons systematic review and evidence-based guidelines for the management of children with positional plagiocephaly: executive summary. *Neurosurgery*. 2016;79(5):623-624.
145. Dudek-Shriber L, Zelazny S. The effects of prone positioning on the quality and acquisition of developmental milestones in 4-month-old infants. *Pediatr Phys Ther*. 2007;19(1):48-55. doi:10.1097/01.pep.0000234963.72945.b1.
146. Monson RM, Deitz J, Kartin D. The relationship between awake positioning and motor performance among infants who slept supine. *Pediatr Phys Ther*. 2003;15(4):196-203. doi:10.1097/01.PEP.0000096380.15342.51.
147. Pin T, Eldridge B, Galea MP. A review of the effects of sleep position, play position, and equipment use on motor development in infants. *Dev Med Child Neurol*. 2007;49(11):858-867. doi:10.1111/j.1469-8749.2007.00858.x.
148. Fetters L, Huang HH. Motor development and sleep, play, and feeding positions in very-low-birthweight infants with and without white matter disease. *Dev Med Child Neurol*. 2007;49(11):807-813. doi:10.1111/j.1469-8749.2007.00807.x.
149. Kennedy E, Majnemer A, Farmer JP, Barr RG, Platt RW. Motor development of infants with positional plagiocephaly. *Phys Occup Ther Pediatr*. 2009;29(3):222-235. doi:10.1080/01942630903011016.
150. Philippi H, Faldum A, Jung T, et al. Patterns of postural asymmetry in infants: a standardized video-based analysis. *Eur J Pediatr*. 2006;165(3):158-164.doi:10.1007/s00431-005-0027-6.
151. Wall V, Glass R. Mandibular asymmetry and breastfeeding problems: experience from 11 cases. *J Hum Lact*. 2006;22:328-334.
152. Lal S, Abbasi AS, Jamro S. Response of primary torticollis to physiotherapy. *J Surg Pakistan*. 2011;16:153-156.
153. Wei JL, Schwartz KM, Weaver AL, Orvidas LJ. Pseudotumor of infancy and congenital muscular torticollis: 170 cases. *Laryngoscope*. 2001;111:688-695.
154. Losee JE, Mason AC, Dudas J, Hua LB, Mooney MP. Nonsynostotic occipital plagiocephaly: factors impacting onset, treatment, and outcomes. *Plast Reconstr Surg*. 2007;119(6):1866-1873. doi:10.1097/01.prs.0000259190.56177.ca.
155. Ryu JH, Kim DW, Kim SH, et al. Factors correlating outcome in young infants with congenital muscular torticollis. *Can Assoc Radiol J*. 2016;67(1):82-87. doi:10.1016/j.carj.2015.09.001.
156. Lee K, Chung E, Lee B-H. A study on asymmetry in infants with congenital muscular torticollis according to head rotation. *J Phys Ther Sci*. 2017;29:48-52.
157. Park HJ, Kim SS, Lee SY, et al. Assessment of follow-up sonography and clinical improvement among infants with congenital muscular torticollis. *Am J Neuroradiology*. 2013;34:890-894.
158. Lee K, Chung E, Koh S-E, Lee B-H. Outcomes of asymmetry in infants with congenital muscular torticollis. *J Phys Ther Sci*. 2015;27:461-464.
159. Hong SK, Song JW, Woo SB, Kim JM, Kim TE, Lee ZI. Clinical usefulness of sonoelastography in infants with congenital muscular torticollis. *Ann Rehabil Med*. 2016;40(1):28-33. doi:10.5535/arm.2016.40.1.28.
160. Lee YT, Yoon K, Kim YB, et al. Clinical features and outcome of physiotherapy in early presenting congenital muscular torticollis with severe fibrosis on ultrasonography: a prospective study. *J Pediatr Surg*. 2011;46(8):1526-1531. doi:10.1016/j.jpedsurg.2011.02.040.

161. Christensen C, Landsettle A, Antoszewski S, Ballard BB, Carey H, Pax Lowes L. Conservative management of congenital muscular torticollis: an evidence-based algorithm and preliminary treatment parameter recommendations. *Phys Occup Ther Pediatr*. 2013;33 (4):453-466. doi:10.3109/01942638.2013.764959.
162. Surprenant D, Milne S, Moreau K, Robert ND. Adapting to higher demands: using innovative methods to treat infants presenting with torticollis and plagiocephaly. *Pediatr Phys Ther*. 2014;26(3):339-345. doi:10.1097/PEP.0000000000000048.
163. Rabino SR, Peretz SR, Kastel-Deutch T, Tirosh E. Factors affecting parental adherence to an intervention program for congenital torticollis. *Pediatr Phys Ther*. 2013;25(3):298-303. doi:10.1097/PEP.0b013e318298eb92.
164. Baird LC, Klimo P, Jr, Flannery AM, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline for the management of patients with positional plagiocephaly: the role of physical therapy. *Neurosurgery*. 2016 Nov;79(5):E630-E631. doi:10.1227/neu.0000000000001429.
165. Klimo P, Jr, Lingo PR, Baird LC, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline on the management of patients with positional plagiocephaly: the role of repositioning. *Neurosurgery*. 2016;79(5):E627-E629. doi:10.1227/neu.0000000000001428.
166. Mazzola C, Baird LC, Bauer DF, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline for the diagnosis of patients with positional plagiocephaly: the role of imaging. *Neurosurgery*. 2016 Nov;79(5):E625-E626. doi:10.1227/neu.0000000000001427.
167. Zhao Z, Deng H, Qiu X, et al. Factors influencing and long-term effects of manual myotomy phenomenon during physiotherapy for congenital muscular torticollis. *BMC Musculoskelet Disord*. 2022;23 (1):892. doi:10.1186/s12891-022-05788-7.
168. Kwon DR, Park GY. Efficacy of microcurrent therapy in infants with congenital muscular torticollis involving the entire sternocleidomastoid muscle: a randomized placebo-controlled trial. *Clin Rehabil*. 2014;28 (10):983-991. doi:10.1177/0269215513511341.
169. Giray E, Karadag-Saygi E, Mansiz-Kaplan B, Tokgoz D, Bayindir O, Kayhan O. A randomized, single-blinded pilot study evaluating the effects of kinesiology taping and the tape application techniques in addition to therapeutic exercises in the treatment of congenital muscular torticollis. *Clin Rehabil*. 2017;31(8):1098-1106. doi:10.1177/0269215516673885.
170. Oledzka MM, Sweeney JK, Evans-Rogers DL, Coulter C, Kaplan SL. Experiences of parents of infants diagnosed with mild or severe grades of congenital muscular torticollis. *Pediatr Phys Ther*. 2020;32 (4):322-329. doi:10.1097/PEP.0000000000000738.
171. Moon R. Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: expansion of recommendations for a safe infant sleeping environment. Review. *Pediatrics*. 2011 Nov;128(5):1030-1039. doi:10.1542/peds.2011-2284.
172. Thompson R, Kaplan SL. Frequency-specific microcurrent for treatment of longstanding congenital muscular torticollis. *Pediatr Phys Ther*. 2019;31(2):E8-E15. doi:10.1097/PEP.0000000000000576.
173. Keklicek H, Uygur F. A randomized controlled study on the efficiency of soft tissue mobilization in babies with congenital muscular torticollis. *J Back Musculoskelet Rehabil*. 2018;31(2):315-321. doi:10.3233/BMR-169746.
174. Chen SC, Ho YS, Kwai-Ping Suen L, et al. Traditional Chinese medicine (TCM) massage for the treatment of congenital muscular torticollis (CMT) in infants and children: a systematic review and meta-analysis. *Complement Ther Clin Pract*. 2020;39:101112. doi:10.1016/j.ctcp.2020.101112.
175. Cui L-N, Zhang X-Y, Li Z-T. Tuina for infant congenital muscular torticollis: a randomized controlled trial. *World J Acupunct Moxibustion*. 2019;29(3):186-189. doi:doi:10.1016/j.wjam.2019.08.002.
176. Zollars JA, Burtner PA, Stockman G, Werbelow P, Swartzentruber J, Lowe JR. Neural and visceral manipulation in infants with congenital muscular torticollis: a feasibility study. *J Phys Ther Sci*. 2020;32 (1):7-15. doi:10.1589/jpts.32.7.
177. Tillinghast AB, Greve KR, Le Cras SP. TOT collar use in complex case of congenital muscular torticollis with persistent head tilt. *Pediatr Phys Ther*. 2024;36(1):113-118. doi:10.1097/pep.0000000000001070.
178. Itoi E, Funayama K, Suzuki T, Kamio K, Sakurai M. Tenotomy and postoperative brace treatment for muscular torticollis. *Contemp Orthop*. 1990;20:515-523.
179. Amemiya M, Kikkawa I, Watanabe H, Hoshino Y. Outcome of treatment for congenital muscular torticollis: a study on ages for treatment, treatment methods, and postoperative therapy. *Eur J Orthop Surg Traumatol*. 2009;19:303-307.
180. Öhman A. The immediate effect of kinesiology taping on muscular imbalance in the lateral flexors of the neck in infants: a randomized masked study. *PM R*. 2015;7(5):494-498. doi:10.1016/j.pmrj.2014.11.010.
181. Haugen EB, Benth J, Nakstad B. Manual therapy in infantile torticollis: a randomized, controlled pilot study. *Acta Paediatr*. 2011;100(5):687-690. doi:10.1111/j.1651-2227.2011.02145.x.
182. Brand PL, Engelbert RH, Helders PJ, Offringa M. Systematic review of the effects of therapy in infants with the KISS-syndrome (kinetic imbalance due to suboccipital strain). *Ned Tijdschr Geneeskd*. 2005;149:703-707.
183. Gotlib A, Rupert R. Chiropractic manipulation in pediatric health conditions–an updated systematic review. *Chiropr Osteopat*. 2008;16:11. doi:10.1186/1746-1340-16-11.
184. Milne N, Longeri L, Patel A, et al. Spinal manipulation and mobilisation in the treatment of infants, children, and adolescents: a systematic scoping review. *BMC Pediatr*. 2022;22(1):721. doi:10.1186/s12887-022-03781-6.
185. Allergan. Botox. 2013.
186. Qiu X, Cui Z, Tang G, et al. The effectiveness and safety of botulinum toxin injections for the treatment of congenital muscular torticollis. *J Craniofac Surg*. 2020;31(8):2160-2166. doi:10.1097/scs.0000000000006652.
187. Vova JA, Green MM, Brandenburg JE, et al. A consensus statement on the use of botulinum toxin in pediatric patients. *PM R*. 2022;14 (9):1116-1142. doi:10.1002/pmrj.12713.
188. Sinn CN, Rinaldi RJ, McLaughlin MJ. Botulinum toxin type A outcomes in infants with refractory congenital muscular torticollis. *J Pediatr Rehabil Med*. 2023;16(3):539-552. doi:10.3233/prm-210088.
189. Kuehn BM. FDA requires black box warnings on labeling for botulinum toxin products. *JAMA*. 2009;301(22):2316-2316. doi:10.1001/jama.2009.780.
190. Kozlov Y, Yakovlev A, Novogilov V, et al. SETT–subcutaneous endoscopic transaxillary tenotomy for congenital muscular torticollis. *J Laparoendosc Adv Surg Tech A*. 2009;19(Suppl 1):S179-S181. doi:10.1089/lap.2008.0177.supp.
191. Lee IJ, Lim SY, Song HS, Park MC. Complete tight fibrous band release and resection in congenital muscular torticollis. *J Plast Reconstr Aesthet Surg*. 2010;63:947-953.
192. Lee TG, Rah DK, Kim YO. Endoscopic-assisted surgical correction for congenital muscular torticollis. *J Craniofac Surg*. 2012;23 (6):1832-1834. doi:10.1097/SCS.0b013e318260e931.

193. Patwardhan S, Shyam AK, Sancheti P, Arora P, Nagda T, Naik P. Adult presentation of congenital muscular torticollis: a series of 12 patients treated with a bipolar release of sternocleidomastoid and Z-lengthening. *J Bone Joint Surg Br*. 2011;93(6):828-832. doi:10.1302/0301-620X.93B6.26232.
194. Shim JS, Jang HP. Operative treatment of congenital torticollis. *J Bone Joint Surg Br*. 2008;90:934-939.
195. Burstein FD. Long-term experience with endoscopic surgical treatment for congenital muscular torticollis in infants and children: a review of 85 cases. *Plast Reconstr Surg*. 2004;114:491-493.
196. Hung NN, Anh LT. A comparison of outcome of age at time surgery between younger and older than 8 years old in children with congenital muscular torticollis. *OALibJ*. 2017;04(11):1-12. doi:10.4236/oalib.1104105.
197. Burstein FD, Cohen SR. Endoscopic surgical treatment for congenital muscular torticollis. *Plast Reconstr Surg*. 1998;101:20-24.
198. Oledzka M, Suhr M. Postsurgical physical therapy management of congenital muscular torticollis. *Pediatr Phys Ther*. 2017;29(2):159-165. doi:10.1097/PEP.0000000000000375.
199. Öhman A, Beckung E. Children who had congenital torticollis as infants are not at higher risk for a delay in motor development at preschool age. *PM R*. 2013;5(10):850-855. doi:10.1016/j.pmrj.2013.05.008.
200. Schertz M, Zuk L, Green D. Long-term neurodevelopmental follow-up of children with congenital muscular torticollis. *J Child Neurol*. 2013;28(10):1215-1221. doi:10.1177/0883073812455693.
201. Öhman A, Nilsson S, Lagerkvist AL, Beckung E. Are infants with torticollis at risk of a delay in early motor milestones compared with a control group of healthy infants? *Dev Med Child Neurol*. 2009;51:545-550.
202. Chen CE, Ko JY. Surgical treatment of muscular torticollis for patients above 6 years of age. *Arch Orthop Trauma Surg*. 2000;120:149-151.
203. Shim JS, Noh KC, Park SJ. Treatment of congenital muscular torticollis in patients older than 8 years. *J Pediatr Orthop*. 2004;24:683-688.
204. Öhman AM. The status of the cervical spine in preschool children with a history of congenital muscular torticollis. *Open J Ther Rehabil*. 2013;01(02):31-35. doi:10.4236/ojtr.2013.12006.
205. Brusamento S, Legido-Quigley H, Panteli D, et al. Assessing the effectiveness of strategies to implement clinical guidelines for the management of chronic diseases at primary care level in EU member states: a systematic review. *Health Policy*. 2012;107(2-3):168-183. doi:10.1016/j.healthpol.2012.08.005.
206. RNAO. *Toolkit: Implementation of Best Practice Guidelines*. 2nd ed; 2012.
207. Hoenig H, Duncan PW, Horner RD, et al. Structure, process, and outcomes in stroke rehabilitation. *Med Care*. 2002;40(11):1036-1047. doi:10.1097/00005650-200211000-00005.
208. Moulding NT, Silagy CA, Weller DP. A framework for effective management of change in clinical practice: dissemination and implementation of clinical practice guidelines. *Qual Health Care*. 1999;8(3):177-183. doi:10.1136/qshc.8.3.177.
209. Whited K, Aiyagari V, Calderon-Arnulphi M, et al. Standardized admission and discharge templates to improve documentation of the Joint Commission on Accreditation of Healthcare Organization performance markers. *J Neurosci Nurs*. 2010;42(4):225-228. doi:10.1097/jnn.0b013e3181e26aff.
210. Davies BL. Evidence into clinical practice. *Jognn*. 2002;31:558-562. doi:10.1177/088421702237739.
211. Kinsman L, James EL. Evidence-based practice needs evidence-based implementation. *Lippincotts Case Manag*. 2001;6:208-216.