PEDIATRICS Official Document

Physical Therapy Management of Congenital Muscular Torticollis: An Evidence-Based Clinical Practice Guideline

FROM THE SECTION ON PEDIATRICS OF THE AMERICAN PHYSICAL THERAPY ASSOCIATION

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The American Physical Therapy Association Section on Pediatrics welcomes comments on this guideline. Comments may be sent to the corresponding author or 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 an idiopathic postural deformity evident shortly after birth, typically characterized by lateral flexion of the head to one side and cervical rotation to the opposite side due to unilateral shortening of the sternocleidomastoid muscle. CMT may be accompanied by other neurological or musculoskeletal conditions. **Key Points:** Infants with CMT are frequently referred to physical therapists (PTs) to treat their asymmetries. This evidence-based clinical practice guideline (CPG) provides guidance on which infants should be monitored, treated, and/or referred, and when and what PTs should treat. Based upon critical appraisal of literature and expert opinion, 16 action statements for screening, examination, intervention, and follow-up are linked with explicit levels of evidence. The CPG addresses referral, screening, examination and evaluation, prognosis, first-choice and supplemental interventions, consultation, discharge, follow-up, suggestions for implementation and compliance audits, flow sheets for referral paths and classification of CMT severity, and research recommendations. ***(Pediatr Phys Ther 2013;25:348–394)*** *Key words: congenital muscular torticollis, evidence-based practice, infant, physical therapy, practice guideline*

INTRODUCTION AND METHODS

CONGENITAL MUSCULAR TORTICOLLIS RECOMMENDATIONS

ACKNOWLEDGMENTS, REFERENCES, AND APPENDICES

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LEVELS OF EVIDENCE AND GRADES OF RECOMMENDATIONS

This clinical practice guideline for physical therapy management of infants with congenital muscular torticollis (CMT) is intended as a reference document to guide physical therapy practice and to inform the need for continued research related to physical therapy management of CMT. The methods of critical appraisal, assigning levels of evidence to the literature, and summating the evidence to assign grades to the recommended action statements follow accepted international methodologies of evidence-based practice. The document is organized to present the definitions of the levels of evidence and grades for action statements (Tables 1 and 2), the list of 16 action statements, followed by the descriptions of the aims, methods, and each action statement with a standardized profile of information that meets the Institute of Medicine's criteria for transparent clinical practice guidelines. The 16 action statements are organized under 4 major headings: Identification and Referral of Infants with CMT; Physical Therapy Examination of Infants With CMT; Physical Therapy Intervention for Infants With CMT; and Physical Therapy Discharge and Follow-Up of Infants With CMT. Thirteen recommendations for research are placed within the text where the topics arise, and are collated at the end of the document.

Table 1 presents the criteria used to determine the evidence level of diagnostic, intervention studies and prognostic studies that support each of the recommended action statements. Levels 1 and 2 differentiate stronger from weaker studies by integrating the research design and the quality of the execution and/or reporting of the study.

Table 2 presents the criteria for the grades assigned to each action statement. The grade reflects the overall and highest levels of evidence available to support the action statement. Throughout the guideline, each action statement is preceded by a letter grade, followed by the statement, and a summary of the quality of the supporting literature.

TABLE 1: LEVEL 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 >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, <80% follow-up) (critical appraisal score <50% of criteria)
III	Case-controlled studies or retrospective studies
IV	Case studies and case series
V	Expert opinion

TABLE 2: GRADES OF RECOMMENDATION 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 the topic supports the recommendation.
C	Weak	A single level II study at <25% critical appraisal scores 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, from conceptual/theoretical models/principles, or from 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	An absence of research on the topic, or conclusions from higher-quality studies on the topic are in disagreement. The recommendation is based on these conflicting conclusions or absent studies.

SUMMARY OF ACTION STATEMENTS

IDENTIFICATION AND REFERRAL OF INFANTS WITH CONGENITAL MUSCULAR TORTICOLLIS (CMT)

A. Action Statement 1: IDENTIFY NEWBORNS AT RISK FOR CMT. Physicians, nurse midwives, obstetrical nurses, nurse practitioners, lactation specialists, physical therapists (PTs), or any clinician or family member must assess the presence of neck and/or facial or cranial asymmetry within the first 2 days of birth, using passive cervical rotation, passive lateral flexion, and/or visual observation as their respective training supports, when in the newborn nursery or at time of delivery. (Evidence Quality: I; Recommendation Strength: Strong)

B. Action Statement 2: REFER INFANTS WITH ASYMMETRIES TO PHYSICIAN AND PHYSICAL THERAPIST. Physicians, nurse midwives, obstetrical nurses, nurse practitioners, lactation specialists, PTs, or any clinician or family member should refer infants identified as having positional preference, reduced cervical range of motion, sternocleidomastoid masses, facial asymmetry and/or plagiocephaly to the primary pediatrician, and a PT as soon as the asymmetry is noted (Figure 1). (Evidence Quality: II; Recommendation Strength: Moderate)

B. Action Statement 3: DOCUMENT INFANT HISTORY. Physical therapists should obtain a general medical and developmental history of the infant prior to an initial screening, including 9 specific health history factors: age at initial visit, age of symptom onset, pregnancy history, delivery history including birth presentation and use of assistance, head posture/preference, family history of CMT, other known or suspected medical conditions, and developmental milestones. (Evidence Quality: II; Recommendation Strength: Moderate)

B. Action Statement 4: SCREEN INFANTS. When a clinician, parent, or caretaker indicates concern about head or neck posture and/or developmental progression, PTs should perform a screen of the neurological, musculoskeletal, integumentary, and cardiopulmonary systems, including screens of vision, gastrointestinal functions, positional preference and the structural and movement symmetry of the neck, face, and head, spine and trunk, hips, upper and lower extremities, consistent with state practice acts. (Evidence Quality: 22-15; Recommendation Strength: Moderate)

B. Action Statement 5: REFER INFANTS FROM PHYSICAL THERAPIST TO PHYSICIAN IF RED FLAGS ARE IDENTIFIED. Physical therapists should refer infants to the primary pediatrician for additional diagnostic testing when a screen or evaluation identifies red flags (eg, poor visual tracking, abnormal muscle tone, extramuscular masses, or other asymmetries inconsistent with CMT), or when, after 4 to 6 weeks of initial intense intervention, in the absence of red flags, little or no progress in neck asymmetry is noted. (Evidence Quality: II; Recommendation Strength: Moderate)

B. Action Statement 6: REQUEST IMAGES AND REPORTS. Physical therapists should obtain copies of all images and interpretive reports, completed for the diagnostic workup of an infant suspected of having or diagnosed with CMT, to inform prognosis. (Evidence Quality: II; Recommendation Strength: Moderate)

PHYSICAL THERAPY EXAMINATION OF INFANTS WITH CMT

B. Action Statement 7: EXAMINE BODY STRUCTURES. Physical therapists should document the initial examination and evaluation of infants with suspected or diagnosed CMT for the following 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 passive cervical rotation and lateral flexion. (Evidence Quality: II; Recommendation Strength: Moderate)
- Bilateral active cervical rotation and lateral flexion. (Evidence Quality: II; Recommendation Strength: Moderate)
- Passive range of motion (PROM) and active range of motion (AROM) of the upper and lower extremities, inclusive of screening for possible hip dysplasia or spine/vertebral asymmetry. (Evidence Quality: II; Recommendation Strength: Moderate)
- Pain or discomfort at rest, and during passive and active movement. (Evidence Quality: IV; 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 secondary muscles. (Evidence Quality: II; Recommendation Strength: Moderate)
- Craniofacial asymmetries and head/skull shape. (Evidence Quality: II; Recommendation Strength: Moderate)

P. Action Statement 8: CLASSIFY THE LEVEL OF SEVERITY. Physical therapists and other health care providers should classify the level of CMT severity choosing 1 of 7 proposed grades (Figure 2). (Evidence Quality: V; Recommendation Strength: Best Practice)

B. Action Statement 9: EXAMINE ACTIVITY AND DEVELOPMENTAL STATUS. During the initial and subsequent examinations of infants with suspected or

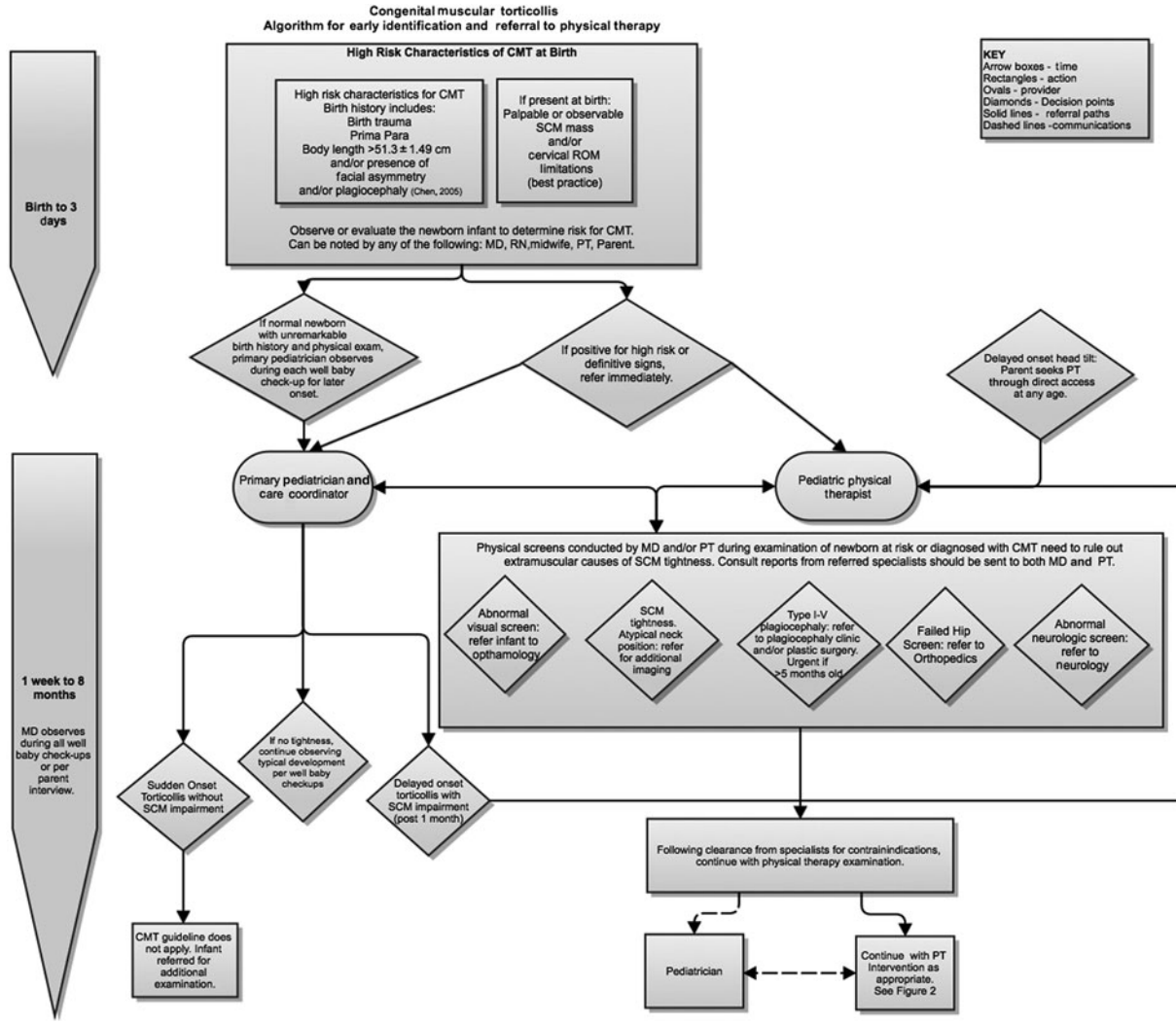

Fig. 1. Referral flow diagram. Solid lines represent initial communication pathway; dashed lines indicate ongoing communication.

diagnosed CMT, PTs should document the types of and tolerance of position changes, and examine motor development for movement symmetry and milestones, using an age-appropriate, valid, and reliable standardized tool. (Evidence Quality: II; Recommendation Strength: Moderate)

B. Action Statement 10: EXAMINE PARTICIPATION STATUS. The PT should document the parent/caregiver responses regarding:

- Whether the parent is alternating sides when breast or bottle-feeding the infant. (Evidence Quality: II; Recommendation Strength: Moderate)
- Sleep positions. (Evidence Quality: II; Recommendation Strength: Moderate)
- Infant time spent in prone. (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)

B. Action Statement 11: DETERMINE PROGNOSIS. Physical therapists should determine 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, classification of severity (Figure 2), intensity of intervention, presence of comorbidities, rate of change, and adherence with home programming. (Evidence Quality: II; Recommendation Strength: Moderate)

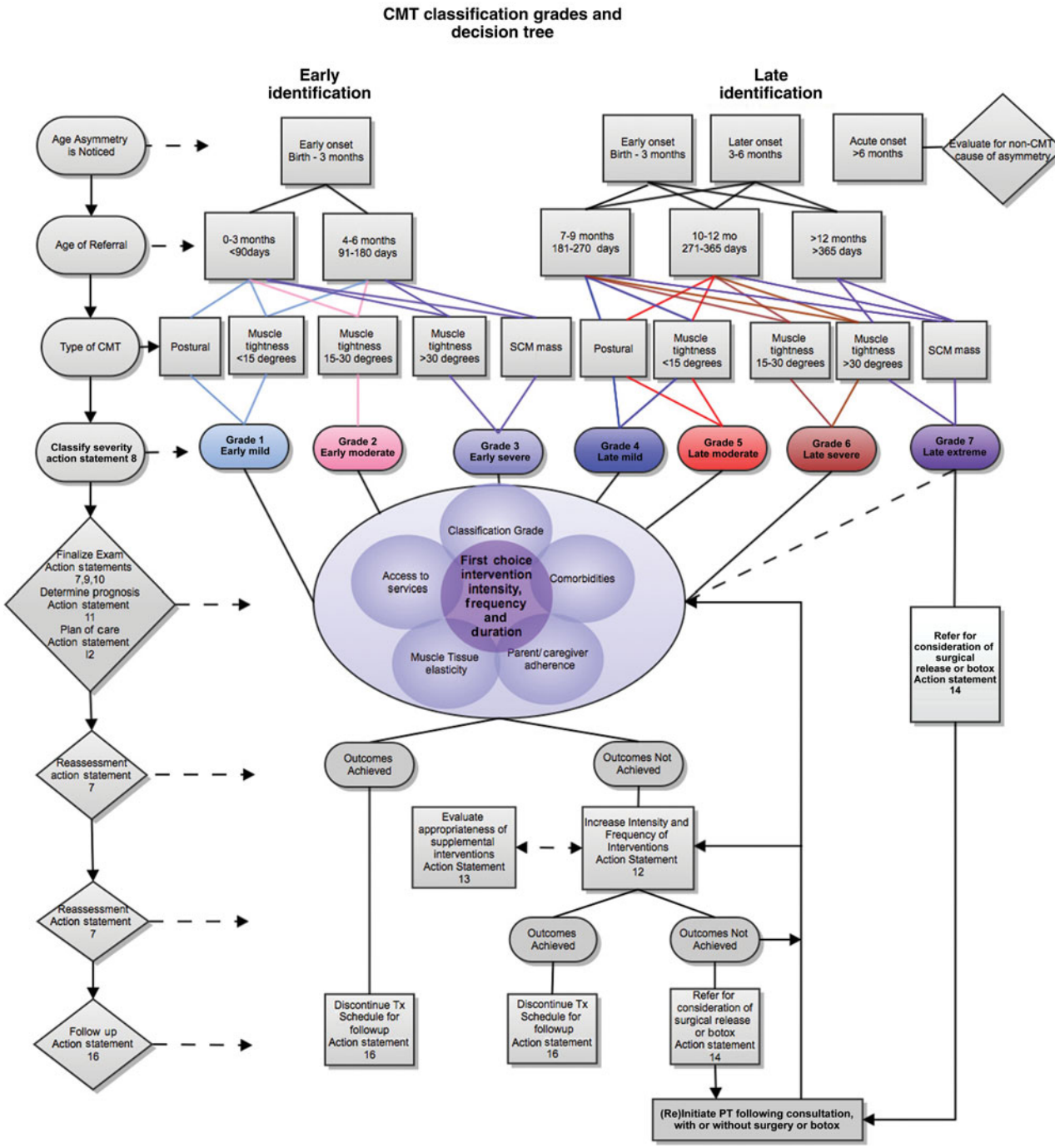

Fig. 2. Congenital muscular torticollis classification grades and decision tree. Solid lines represent clinical reasoning paths; dashed lines portray the less supported option of trying "first choice interventions," for a limited time, prior to referral for more invasive interventions.

PHYSICAL THERAPY INTERVENTION FOR INFANTS WITH CMT

B. Action Statement 12: PROVIDE THE FOLLOWING 5 COMPONENTS AS THE FIRST-CHOICE INTERVENTION. The physical therapy plan of care for the infant with CMT or postural asymmetry should minimally address these 5 components:

- Neck PROM. (Evidence Quality: II; Recommendation Strength: Moderate)
- Neck and trunk AROM. (Evidence Quality: II; Recommendation Strength: Moderate)
- Development of 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)

C. Action Statement 13: PROVIDE SUPPLEMENTAL INTERVENTION(S), AFTER APPRAISING APPROPRIATENESS FOR THE INFANT, TO AUGMENT THE FIRST-CHOICE INTERVENTION. Physical therapists may add supplemental interventions, after evaluating their appropriateness for treating 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: III; Recommendation Strength: Weak)

B. Action Statement 14: REFER FOR CONSULTATION WHEN OUTCOMES ARE NOT FULLY ACHIEVED. Physical therapists who are treating infants with CMT or postural asymmetries should initiate consultation with the primary pediatrician and/or specialists about alternative interventions when the infant is not progressing. These conditions might include when asymmetries of the head, neck, and trunk are not resolving after 4 to 6 weeks of initial intense treatment; after 6 months of treatment with only moderate resolution; or if the infant is older than 12 months on initial examination and either facial asymmetry and/or 10 to 15° of difference persist between the left and right sides for any motion; or the infant is older than 7 months on initial examination and a tight band or SCM mass is present; or if the side of torticollis changes. (Evidence Quality: II; Recommendation Strength: Moderate)

PHYSICAL THERAPY DISCHARGE AND FOLLOW-UP OF INFANTS WITH CMT

B. Action Statement 15: DOCUMENT OUTCOMES AND DISCHARGE INFANTS FROM PHYSICAL THERAPY WHEN CRITERIA ARE MET. Physical therapists should document outcome measures and discharge the infant diagnosed with CMT or asymmetrical posture from physical therapy services when the infant has full passive ROM within 5° of the nonaffected side, symmetrical active movement patterns throughout the passive range, 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)

B. Action Statement 16: PROVIDE FOLLOW-UP SCREENING OF INFANTS 3 to 12 MONTHS POST-DISCHARGE. Physical therapists who treat infants with CMT should examine positional preference, the structural and movement symmetry of the neck, face and head, trunk, hips, upper and lower extremities, and developmental milestones, 3 to 12 months following discharge from physical therapy intervention, or when the child initiates walking. (Evidence Quality: II; Recommendation Strength: Moderate)

INTRODUCTION

Purpose of CPGs

The Section on Pediatrics (SoP) of the American Physical Therapy Association (APTA) supports the development of clinical practice guidelines (CPGs) to assist pediatric physical therapists (PTs) with the identification and management of infants and children with participation restrictions, activity limitations and body function and structure impairments, related to developmental, neuromuscular, cardiorespiratory, and musculoskeletal conditions, as defined by the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF) (www.who.int/classification/icf/en/).

In general, the purpose of a CPG is to help PTs know who, what, how, and when to treat, and who and when to refer, and to whom. Specifically, the purposes of this CPG for congenital muscular torticollis (CMT) are to:

- Describe the evidence supporting physical therapy management of CMT, including screening, examination, evaluation, diagnosis, reasons to refer, prognosis, intervention, discharge, and long-term assessment of outcomes.
  - Define and classify common CMT impairments of body functions and structures, activity limitations and participation restrictions and, where possible, align descriptions with ICF terminology (Appendix 1-ICF/ICD 9/10 Codes).
  - Identify appropriate outcome measures for CMT to establish baseline measures and assess changes resulting from physical therapy interventions.
  - Identify interventions supported by current best evidence to address impairments of body functions and structures, activity limitations, and participation restrictions associated with CMT.
- Create a reference publication for PTs, physicians, families and caretakers, other early childhood or health care service providers, academic instructors, clinical instructors, students, policy makers, and payers, that describes, using internationally accepted terminology, best current practice of pediatric PT management of CMT.
- Identify areas of research that are needed to improve the evidence base for physical therapy management of CMT.

Background and Need for a CPG on Congenital Muscular Torticollis

Physical therapy and conservative interventions are well documented in the literature for the treatment of infants with torticollis.[1,2] Earlier studies were primarily written by physicians regarding the diagnostic process, incidence and presentation, and surgical management of CMT from an orthopedic or biomechanical perspective.[3-7] Subsequent studies of conservative care typically focused on passive stretching applied in a standardized manner for a specific period of time,[8-11] similar to experimental interventions as opposed to individualized clinical care plans. More recent literature on the incidence of developmental delays in children treated for CMT,[12-14] and the apparent increase in incidence of CMT[15] and plagiocephaly[16] associated with the *Back to Sleep* campaign, and its related reduction in time spent in prone[12] suggest that a broader developmental approach is needed for the management of CMT.

A pivotal study on physical therapy interventions for CMT by Emery[2] has been considered by many as the standard for conservative intervention.[17,18] While her outcomes focus on neck range of motion (ROM), the study clearly establishes that conservative management of stretching and parent education on handling and home exercises can effectively reduce CMT, thus avoiding surgery for the vast majority of infants. Karmel-Ross[19] compiled a comprehensive collection of articles in a special edition of *Physical & Occupational Therapy in Pediatrics*, providing foundational and clinical guidance for rehabilitation management of infants with CMT. Since that publication, many studies have addressed selected aspects of CMT identification and rehabilitation. The Cincinnati Children's Hospital guideline on CMT[20] is the first to use evidence-based processes to support recommendations on CMT management; though it was updated in 2009,[20] its levels of evidence are unique to the institution, the literature is appraised by consensus and expert opinion rather than by applying a systematic appraisal rubric, and the guideline recommendations are hierarchically categorized but not graded. Since that publication, there have been numerous studies published on the diagnosis, imaging, and care of infants with CMT, as well as advances in evidence-based practice methods. The roles of PTs in the treatment of CMT are clearly documented in survey results from Canada[21] and New Zealand[22]; though no studies describe these roles in the United States. Given the number of newer publications, the SoP initiated the development of this CPG to build on these earlier foundational documents and to create a document that would be more consistent with evolving international evidence-based practice methodologies and ICF terminology. This guideline addresses CMT from a broader developmental perspective consistent with pediatric physical therapy, but does not address plagiocephaly, nor is it applicable to cases of sudden onset, acquired CMT evidenced later in infancy or childhood.

The Scope of the Guideline

This CPG uses literature available through May 2013 to address the following aspects of PTs' management of CMT in infants and young children. It is assumed throughout the document that the PT has newborn and early childhood experience. The CPG addresses these aspects of CMT management:

- Diagnostic and referral processes.
- Reliable, valid, and clinically useful screening and examination procedures that should be documented.
- Determination of prognosis for intensity of intervention and duration of care.
- Effective first-choice physical therapy interventions, dosage guidance, and supplemental interventions.
- Conditions under which a child should be referred for consideration of more invasive interventions.
- The prognosis if CMT is left untreated, treated with conservative interventions, or treated with invasive interventions.
- The important outcomes of intervention and patient characteristics affecting outcomes.

Statement of Intent

This guideline is intended for clinicians, family members, educators, researchers, policy makers, and payers. It is not intended to be construed or 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 on the basis of all clinical data available for an individual patient/client and are subject to change as knowledge and technology advance, patterns of care evolve, and patient/family values are integrated. This CPG is a summary of practice recommendations that are supported with current published literature that has been reviewed by expert practitioners and other stakeholders. These parameters of practice should be considered guidelines only, not mandates. Adherence to them will not ensure a successful outcome in every patient, 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 treatment plan must be made using the clinical data presented by the patient/client/family, the diagnostic and treatment options available, the patient's values, expectations, and preferences, and the clinician's scope of practice and expertise. The guideline development group suggests that significant departures from accepted guidelines should be documented in patient records at the time the relevant clinical decisions are made.

METHODS

The guideline development group (GDG) was appointed by the SoP to develop a guideline to address PT roles in the management of CMT. The procedures are documented in *Pediatric Physical Therapy*[23] and were derived from the review of selected guideline development manuals[24-28] in order to meet the goals of the SoP and to produce guidelines that parallel international processes.

Determining Purpose, Scope, and Outline of Content

In 2011, the GDG solicited topics from the SoP leadership and members of its Knowledge Translation Task Group to identify what clinicians expected a CPG on CMT to cover. Fifty topics were organized into an online survey. Fourteen members of the SoP Knowledge Translation Task Group and clinicians who expressed interest in the CMT guidelines completed the survey, ranking the importance of each topic. These rankings influenced the scope and outline of the CPG content; 45 of the 50 topics are addressed in this document. (Survey results are available from the authors.)

Literature Review

The GDG, volunteers from the SoP Knowledge Translation Task Group, and clinicians from the SoP were invited to conduct literature searches on CMT and submit the search histories and results to a dedicated e-mail account. This provided a range of search strategies and access to a wider range of databases. The combined comprehensive literature search used these key words separately and in combination: congenital muscular torticollis, torticollis, plagiocephaly, infant asymmetry, cervical ROM, physical therapy, physiotherapy, and exercise. The databases include: MEDLINE(R), CINAHL, EBM Reviews–Cochrane Database of Systematic Reviews 2005 to June 2010, EBM Reviews–ACP Journal Club 1991 to June 2010, EBM Reviews–Database of Abstracts of Reviews of Effects 2nd Quarter 2010, EBM Reviews–Cochrane Central Register of Controlled Trials 2nd Quarter 2010, EBM Reviews–Cochrane Methodology Register 3rd Quarter 2010, EBM Reviews–Health Technology Assessment 3rd Quarter 2010, EBM Reviews–NHS Economic Evaluation Database 3rd Quarter 2010, EMBASE 1980 to 2010 Week 32, ERIC 1965 to July 2010, Health and Psychosocial Instruments 1985 to July 2010, PsycINFO 1806 to August Week 2 2010, PubMed Clinical Queries, PEDro, Google Scholar, and the Web of Science. Additional sources were identified using the same key words by searching specific journals, manual searching of article and textbook reference lists, and through Google and Google Scholar. Studies

published through May 2013 were included in the CPG; a reference librarian from the University of Southern California validated the search for the years 1990 to 2012. Operational definitions were adopted for clarity of writing (Appendix 2).

Articles were included if they were written in English and if they informed the diagnosis, examination, intervention, or prognosis of CMT as related to physical therapy. Research designs included RCTs, cohort, case-control, case series, and case studies. Study outcomes included range of cervical motion, cervical muscle strength, ROM and strength measures, posture, motor development, treatment durations, need for surgical intervention, and parent satisfaction with physical therapy. Articles were excluded if they focused only on plagiocephaly, did not report data directly related to physical therapy diagnosis, intervention or prognosis for CMT, or were poster or presentation abstracts. A total of 193 articles were reviewed, and a total of 167 articles informed this document.

Critical Appraisal Process

The critical appraisal forms used for diagnostic and intervention literature are based on adaptations from Fetters and Tilson[29] and have been described previously.[23] Selected diagnosis and intervention articles were critically appraised by the GDG to establish the test standards. Volunteers completed critical appraisals of the test articles to establish interrater reliability. Volunteers qualified to be appraisers with agreement of 90% or more. Appraisers were randomly paired to read each of the remaining diagnostic or intervention articles. Each dyad compared scores for agreement and submitted a single critical appraisal form when complete. Discrepancies in scoring were negotiated by the readers. In the event that a score could not be agreed on, a member of the GDG made the final determination.

Levels of Evidence

The levels of evidence evolved from the APTA Section on Orthopedics[30] to incorporate critical appraisal scores.[29] Recommendation grades are derived to be consistent with the BRIDGE-Wiz software deontics.[31] BRIDGE-Wiz is designed to generate clear and implementable recommendations consistent with the Institute of Medicine recommendations for transparency.[28] The GDG believes it is important to consider all controlled research designs (randomized controlled trials, meta-analyses, systematic reviews, diagnostic, prognostic, prospective, and cohort studies) to equalize their importance in rehabilitation decision making. While it is recognized that experimental studies are the only designs that suggest causality, the difference between level I and II evidence is based on methodological rigor within each design, rather than solely on the study design. Thus, the score from the critical appraisal process determines whether an intervention or diagnosis study is a level I or II.

Theoretical/foundational (designated by D) and practice recommendations (designated by P) are not generated with BRIDGE-Wiz. The former are based on basic science or theory, and the latter are determined by the GDG to be representative of current physical therapy practice or exceptional situations that exist for which studies cannot be performed.

Research recommendations (designated by R) are provided by the GDG to identify missing or conflicting evidence, for which studies might improve measurement and intervention efficacy, or minimize unwarranted variation.

AGREE II Review

This CPG was evaluated by the third author and 2 external reviewers using AGREE II.[32] AGREE II is an established instrument designed to assess the quality of clinical practice guidelines using 23 items in 6 domains (see Table, Supplemental Digital Content 1, available at http://links.lww.com/PPT/A48). Each item is rated using a 7-point scale, with 7 representing the highest score. Each item includes specific criteria, although reviewer judgment is necessary in applying the criteria. The AGREE II appraisal process supported an iterative process to improve the quality of the guideline. Domain scores for the CMT CPG ranged from 98% to 67%. The 3 reviewers unanimously agreed to recommend the Guideline for use. Scores were discussed by the GDG; where possible, items were addressed in the CPG following the AGREE II reviews. Thus, the percentages are likely higher in the final version of the CPG.

External Review Process by Stakeholders

This CPG underwent 3 formal reviews. First draft reviewers were invited stakeholders representing medicine, surgery, nursing, midwifery, PT clinicians and researchers, and a parent representative. The second draft was posted for public comment on the APTA SoP website; notices were sent via email and an electronic newsletter to SoP members, literature appraisers, and clinicians who inquired about the CPG during its development. Two *Pediatric Physical Therapy* journal reviewers read the third draft. Comments from each round of reviews were considered for successive revisions.

Document Structure

The guideline action statements are organized according to the APTA Patient Management Model,[33] beginning with recommendations for referral and screening, physical therapy examination, evaluation, intervention, outcome measurement, and concluding with follow-up and collaboration. References, acknowledgments, and appendices are included at the end.

Each action statement is introduced with its assigned recommendation grade, followed by a standardized content outline generated by the BRIDGE-Wiz software. It has a content title, a recommendation in the form of an observable action statement, indicators of the evidence quality, and the strength of the recommendation. The action statement profile describes the benefits, harms, and costs associated with the recommendation, a delineation of the assumptions or judgments made by the GDG in formatting the recommendation, reasons for intentional vagueness in the recommendation, and a summary and clinical interpretation of the evidence supporting the recommendation. An iterative process was used for discussion, literature review, and external review to develop the content of action statements and profiles.

Incidence and Progression of Congenital Muscular Torticollis

Congenital muscular torticollis is a common pediatric musculoskeletal condition, described as a postural deformity of the neck evident at birth or shortly thereafter. Synonyms include fibromatosis colli for the mass type,[34] wry neck,[35] or twisted neck.[36] It is typically characterized by a head tilt to one side or lateral neck flexion, with the neck rotated to the opposite side due to unilateral shortening or fibrosis of the sternocleidomastoid (SCM) muscle. It may be accompanied by cranial deformation[37] or hip dysplasia,[38] brachial plexus injury,[39-41] distal extremity deformities, and less frequently, presents as a head tilt and neck rotation to the same side. The incidence of CMT ranges from 0.3 to 2%[42] of newborns, but has been reported as high as 16% (n = 102),[37] and may occur slightly more frequently in males.[17,43] Congenital muscular torticollis may be present at birth when selected morphologic and birth history variables converge, such as in larger babies, breech presentation, and/or the use of forceps during delivery,[44] or it may evidence during the first few months,[18,37] particularly in those with milder forms.

Congenital muscular torticollis is typically categorized as one of 3 types: postural CMT presents as the infant's postural preference[15,45] but without muscle or passive ROM restrictions and is the mildest presentation; muscular CMT presents with SCM tightness and passive ROM limitations; and SCM mass CMT, the most severe form, presents with a fibrotic thickening of the SCM and passive ROM limitations.[46] These presentations, in combination with the age of initial diagnosis, are highly predictive of the time required to resolve ROM limitations. In general, infants identified early with postural CMT have shorter treatment episodes, and those who are identified later, after 3 to 6 months of age and who have SCM mass CMT, typically have the longest episodes of conservative treatment, and may ultimately undergo more invasive interventions.[10,46]

Pediatricians or parents may be the first to notice an asymmetry, and pediatricians may provide the initial instructions about positioning and stretching to the parents.[21] The American Academy of Pediatrics, in its *Bright Futures Guidelines For Health Supervision of Infants, Children, and Adolescents* publication, recommends checking the newborn for head dysmorphia at 1 week and skull deformities at 1 month, but does not specify checking the neck for symmetry until 2 months, when the term *torticollis* is first mentioned.[47] If the asymmetry does not resolve after initial exercise instructions by pediatricians, infants are typically then referred to physical therapy.[21] While this pattern of identification and eventual referral to physical therapy is described in the literature, the GDG is in strong agreement that pediatricians should be screening for CMT throughout the first 3 to 4 months, such that infants with any persistent postural asymmetries are referred as early as possible for physical therapy intervention.

Typical physical therapy management of CMT is a conservative approach that includes passive stretching, positioning for active movement away from the tightness, and parent education for home programs.[22,48] Earlier intervention is more quickly effective than intervention started later. If started before 1 month of age, 98% achieve near normal range within 1.5 months, but waiting until after 1 month of age prolongs intervention to about 6 months, and waiting until after 6 months can require 9 to 10 months of intervention, with progressively fewer infants achieving near normal range[49]; current CMT guidelines do not address the time of referral.

Reports of untreated CMT are rare,[3,5] but there are descriptions of unresolved or reoccurring CMT in older children or adults, who later undergo Botox injections[42,50,51] or surgery for correction of movement limitations and consequent facial asymmetries.[5,52,53] The incidence of spontaneous resolution is unknown, and there are no foolproof methods for predicting who will resolve and who will progress to more severe or persistent forms.

Finally, CMT has been associated with hip dysplasia,[4] brachial plexus injury,[39-41] distal extremity deformities, early developmental delay,[14,39] persistent developmental delays,[13] facial asymmetry, which may affect function and cosmesis,[6] and temporal–mandibular joint dysfunction.[54] Thus, early identification and treatment is critical for early correction, early identification of secondary or concomitant impairments, and prevention of future complications.

Early Referral

The evidence is strong that earlier intervention results in the best outcomes[11,49]; thus, early referral is the ideal. A referral flow diagram is provided (Figure 1) that outlines the possible referral and communication pathways based on time of observation, identification of "red flags," prior models, and current literature.[1,39,42,55-57]

The referral flow diagram is divided into 2 distinct time frames: birth to 3 days, representing the newborn period; and 3 days and older, 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, though screening for CMT at this point in development is not considered the norm. After the infant is at home, the most likely observers will be the primary pediatrician and the parents or other caregivers. Regardless of who performs the initial screen, infants with asymmetry should undergo

an evaluation to rule out nonmuscular causes of CMT. If CMT or a persistent postural preference is diagnosed, the infant should be referred to the PT.

Early referral to physical therapy translates to earlier intervention and prevention of secondary sequelae,[2,8,18,58] and, by reducing treatment duration and avoiding additional or more invasive interventions, is cost-effective. Preliminary evidence suggests that treatment by a PT may be more efficient in achieving symmetrical movements than when parents are the sole providers of home exercise programs,[59] thus referral to the PT should not be delayed.

IDENTIFICATION AND REFERRAL OF INFANTS WITH CONGENITAL MUSCULAR TORTICOLLIS (CMT)

A. Action Statement 1: IDENTIFY NEWBORN INFANTS AT RISK FOR CMT. Physicians, nurse midwives, obstetrical nurses, nurse practitioners, lactation specialists, PTs or any clinician or family member must assess the presence of neck and/or facial or cranial asymmetry within the first 2 days of birth, using passive cervical rotation, passive lateral flexion, and/or visual observation as their respective training supports, when in the newborn nursery or at site of delivery. (Evidence Quality: I; Recommendation Strength: Strong)

Action Statement Profile

Aggregate Evidence Quality: Level I. Based on the odds ratios (OR) and confidence intervals (CI) for prediction of CMT from facial asymmetry (OR: 21.75; CI: 6.60-71.70) and plagiocephaly (OR: 23.30; CI: 7.01-70.95).[60]

Benefits:

- Early identification of infants at risk for CMT or other conditions that might 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 aggressive interventions (Botox or surgery) in the future.

Risk, Harm, and Cost:

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

Benefit–Harm Assessment: Preponderance of Benefit
Value Judgments: None
Intentional Vagueness: None
Role of Patient/Parent Preferences: Although parents may not be skilled in infant assessment, mothers who are breastfeeding may notice that the infant has greater difficulty feeding on one side, or may notice asymmetry in photographs, and these observations should trigger ROM screening by an attending clinician.
Exclusions: None

Supporting Evidence and Clinical Interpretation

The intent of this action statement is to increase early identification of infants with CMT for early referral to physical therapy. Newborns (up to the first 3 days of life) can be easily screened by checking for full neck rotation (chin turns past shoulder to 100°)[37] and lateral flexion (ear approximates shoulder)[37] while stabilized in supine[61] during the first postnatal examination. Newborns are at higher risk for CMT if their birth history includes a combination of longer birth body length, primiparity and birth trauma (including use of instruments for delivery), facial asymmetry, and plagiocephaly. Odds ratios from multiple logistic regression for these 5 factors are, from highest to lowest: plagiocephaly 23.30 (CI: 7.01-70.95), facial asymmetry 21.75 (CI: 6.60-71.70), primiparity 6.32 (CI: 2.34-17.04), birth trauma 4.26 (CI: 1.25-14.52), and birth body length 1.88 (CI: 1.49-2.38). This indicates that infants with asymmetrical heads or faces have as much a 22-fold increase in abnormal sonogram for CMT; primiparity a 6-fold increase; birth trauma a 4-fold increase; and birth body length an almost 2-fold increase.[44] No one item predicts CMT alone, but the presence of 2 or more of the above risk factors warrants referral for preventative care and parent education.

The importance of early identification of CMT is well supported. Pediatricians and PTs in Canada agree that infants identified with CMT should receive formal intervention.[21] When intervention is started at earlier ages, it results in shorter episodes of care[11] that anecdotally have financial, psychological, and quality-of-life implications for the family.

R. Research Recommendation 1. Researchers should conduct studies to determine whether routine screening at birth increases the rate of CMT identification and/or increases false positives.

B. Action Statement 2: REFER INFANTS WITH ASYMMETRIES TO PHYSICIAN AND PHYSICAL THERAPIST. Physicians, nurse midwives, obstetrical nurses, nurse practitioners, lactation specialists, PTs, or any clinician or family member should refer infants identified as having positional preference, reduced cervical ROM, sternocleidomastoid masses, facial asymmetry, and/or plagiocephaly to their primary pediatrician and a PT as soon as the asymmetry is noted. (Evidence Quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II evidence supports that when intervention is started earlier, it takes less time to resolve the ROM limitations ($P < .001$),[46,49] and there is less need for subsequent surgical intervention ($P < .005$).[8,49] Authors suggest that stretching interventions are easier for parents to administer when infants are younger, before the neck musculature strengthens and cooperation declines.[2,49]

Benefits:

- Early differential diagnosis to confirm CMT.
- Early onset of intervention to resolve reduced ROM and asymmetries.
- Early parental education to facilitate symmetrical development.
- Greater infant cooperation with intervention in the first few months of life.

Risk, Harm, and Cost:

- Increased cost for treatment of asymmetries that some suggest may spontaneously resolve.

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: Early referral to physical therapy ensures early onset of intervention, which strongly correlates with shorter episodes of care, greater success of conservative measures, and thus can lower overall costs of care. A pediatric PT will also screen and follow the infant for developmental delays, feeding challenges, and environmental factors that may be associated with or contribute to positional preference or CMT.

Intentional Vagueness: For infants suspected of other causes of asymmetries (ie, bony anomalies, fractures, neurological damage, or extramuscular masses), the PT should collaborate with the primary pediatrician to make a definitive diagnosis of CMT prior to onset of physical therapy interventions. 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 Patient/Parent Preferences: Infant cooperation with stretching is easier in the first 2 months than when started after the infant develops greater head control,[2,62] thus infant compliance is greater and parent adherence to home programs may be optimized.

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 diagnoses prior to initiating physical therapy.

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 at birth, infants 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 pliable. CMT may not appear until several weeks postdelivery; thus, the 1-month well baby check-up by the pediatrician may be the first point of identification. Early treatment for infants with positional preference or confirmed diagnoses of CMT has excellent outcomes, with more than 95% to 100% only needing stretching[10,11] or techniques that facilitate functional activation of weak neck muscles.[62] The earlier intervention is started, the shorter the duration of intervention[10,46,49] and the need for later surgical intervention is significantly reduced.[7,8,11] In contrast to recommendations to provide stretching instruction to the parents when CMT is identified at birth, and only refer to physical therapy at 2 months of age if the condition does not resolve,[10] recent studies suggest that early physical therapy reduces the time to resolution by approximately 1 month versus 3 months for parent-only stretching,[59] that infants become more difficult to stretch as they age and develop neck control,[2] and that earlier intervention can negate the need for later surgery.[8]

Physical therapists typically address a broad range of developmental and environmental factors that influence outcomes, such as parental ability to comply with the home exercise programs, distance from the clinical setting,[21] feeding positions, and the infant's motor and developmental progression.[21,22] Since developmental delays are detectable at 2 months in infants with CMT,[63] and the delays may be more related to time spent in the prone position,[63] instruction to parents and early modeling of prone play time may help to negate potential developmental lags that can occur with CMT.

R. Research Recommendation 2. Researchers should conduct studies 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 to parental instruction and monitoring by physicians. Longitudinal studies of infants with CMT should clarify how the timing of referral and initiation of intervention impact body structure and functional outcomes, and overall costs of care.

B. Action Statement 3: DOCUMENT INFANT HISTORY. Physical therapists should obtain a general medical and developmental history of the infant, including 9 specific health history factors, prior to an initial screening. (Evidence Quality: II; Recommendation Strength: B-Moderate)

Action Statement Profile

Aggregate Evidence Quality: II

Benefits: A complete history of the pregnancy, delivery, known medical conditions, developmental milestones, and daily management of the infant can provide information important to the diagnosis by the PT, prognosis, and intervention.

Risk, Harm, and Cost: None

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: None

Intentional Vagueness: None

Role of Patient/Parent Preferences: Parents/caregivers can provide much of the history through interview and preadmission information packets; however, obtaining medical records may provide specifics that oral histories may not.

Exclusions: None

Supporting Evidence and Clinical Interpretation

In addition to documenting the standard intake information (eg, date of birth, date of examination, gender, birth rank, and reason for referral or parental concerns, general health of the infant, and other health care providers that are seeing the infant), the PT should specifically document the following birth and health history factors:

- Age at initial visit.[8,22]
- Age of onset of symptoms.[18,22]
- Pregnancy history including maternal sense of whether the baby was "stuck" in one position during the final 6 weeks of pregnancy.[61]
- Delivery history including birth presentation (cephalic or breech).[18]
- Use of assistance during delivery such as forceps or vacuum suction.[11,17,37,40]
- Head posture/preference[15,37,64,65] and changes in the head/face.[7,17,18,37,66]
- Family history of torticollis or any other congenital or developmental conditions.[67,68]
- Other known or suspected medical conditions.[39,65]
- Developmental milestones appropriate for age.[13,14,69]

B. Action Statement 4: SCREEN INFANTS. When a clinician, parent, or caretaker indicates concern about head or neck posture and/or developmental progression, PTs should perform a screen of the neurological, musculoskeletal, integumentary, and cardiopulmonary systems, including screens of vision, gastrointestinal functions, positional preference and the structural and movement symmetry of the neck, face, and head, spine and trunk, hips, upper and lower extremities, consistent with state practice acts. (Evidence Quality: 22-15; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: The benefits of screening infants with suspected CMT are based on a combination of level II-IV evidence and expert clinical consensus,[15,42,65,70] within which selected procedures used by PTs to identify red flags have varying levels of evidence.

Benefits:

- Thorough screening can identify asymmetries and determine if they are consistent with CMT or not.
- Screening for other causes of asymmetry (ie, hip dysplasia, scoliosis, clavicle fracture, brachial plexus injury, congenital, and/or genetic conditions) facilitates referral to specialists.
- For infants being treated for other conditions (ie, brachial plexus injuries, reflux, and hip dysplasia) that are associated with higher risks for developing CMT, parents can receive preventative instruction for CMT.

Risk, Harm, and Cost: The cost of a PT screening if the infant is not already being treated for other conditions.

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: In some geographic locations or practice settings, particularly where autonomous practice 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 screen.

Intentional Vagueness: None

Role of Patient/Parent Preferences: None

Exclusions: None

Supporting Evidence and Clinical Interpretation

In situations where infants present without physician referral for CMT (eg, locations with direct access to physical therapy or infants who are being treated by a PT for other conditions), the PT should conduct a systems screen to rule out red flags and other potential causes of observed asymmetrical posturing.[33,39,64,65] The screen is conducted through parent report and observation of the infant in different positions. The purpose of the screen is to determine whether the PT should continue with a detailed examination for CMT, or refer for consultations when red flags are suspected. Elements of the screen include:

History: per parent report as described in Action Statement 3.

Systems Screen: Per the APTA Guide to Physical Therapist Practice,[33] a systems screen traditionally includes examinations of the following 4 domains. For infants with CMT, a gastrointestinal history should be added.

Musculoskeletal Screen: Screen for symmetrical shape of the face, skull, and spine[36,54]; symmetrical alignment of the shoulder and hip girdles with particular attention to cervical vertebral anomalies, rib cage symmetry,[56] and hip dysplasia[66]; symmetrical passive ROM of the neck; and palpation for SCM masses or restricted movement.[71]

Neurological Screen: Screen for abnormal or asymmetrical tone, retention of primitive reflexes, resistance to movement, cranial nerve integrity, brachial plexus injury; temperament (irritability, alertness); achievement of age-appropriate developmental milestones,[39,42,56,65,69,71] inclusive of cognitive and social integration within the family setting.[72] Perform a **visual screen** comprised of symmetrical eye tracking in all directions, noting visual field defects and nystagmus as potential ocular causes of asymmetrical postures.[42,71,73]

Integumentary Screen: Screen for skin fold symmetry of the hips[61,65] and cervical regions[19,70]; color and condition of the skin, with special attention to signs of trauma that might cause asymmetrical posturing.[65]

Cardiorespiratory Screen: 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 syndrome)[65,68]; check for acute upper respiratory tract distress.[41,74] The infant should be alert and appropriately vocal, without wheezing.

Gastrointestinal History: Interview the parents for an infant history of reflux or constipation,[41] or preferential feeding from one side,[15] both of which can contribute to asymmetrical posturing.

Red Flags: The following are the basis for consultation with the primary pediatrician, referring physician, or other specialists:

- Suspected hip dysplasia.[4,38,65,75,76]
- Skull and/or facial asymmetry, including plagiocephaly and brachycephaly.[36,37,44]
- Atypical presentations, such as tilt and turn to the same side, or plagiocephaly and tilt to the same side.
- Abnormal tone.[41,65,71]
- Late-onset torticollis at 6 months or older, which can be associated with neurological conditions, tissue mass, inflammation, or acquired asymmetry.[41,65]
- Visual abnormalities including nystagmus, strabismus, limited or inconsistent visual tracking, and gaze aversion.[65,71]
- History of acute onset, which is usually associated with trauma or acute illness.[39,77]

R. Research Recommendation 3. Researchers should conduct studies to identify the precision of screening procedures specific to CMT.

B. Action Statement 5: REFER INFANTS FROM PHYSICAL THERAPIST TO PHYSICIAN IF RED FLAGS ARE IDENTIFIED. Physical therapists should refer infants to the primary pediatrician for additional diagnostic testing when a screen or evaluation identifies red flags (eg, poor visual tracking, abnormal muscle tone, extramuscular masses, or other asymmetries inconsistent with CMT) or when, after 4 to 6 weeks of initial intense intervention, in the absence of red flags, little or no reduction in neck asymmetry is noted. (Evidence Quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II evidence based on cohort follow-up studies of moderate size.

Benefits:

- Infants with red flags are identified and can be comanaged by the primary pediatrician and other specialists.
- 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 support starts earlier for effective home programming, parent education, and the balance of intervention with parental needs to enjoy and bond with their infant.

Risk, Harm, and Cost:

- Cost of care is increased in the cases where red flags are ruled out or the PT has misidentified red flags.
- Additional family stress due to concerns about the infant having more serious health conditions.

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: Level II 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 20% of infants who have conditions other than CMT.[39] While the recommendation strength is categorized as moderate based on level II evidence, the GDG believes that referral to the primary pediatrician should be categorized as a *must*, when any red flags are identified to collaborate in the comanagement of care of the infant who may have both CMT and other medical conditions.

Intentional Vagueness: In settings with direct access to physical therapy services, parents may seek evaluation services for an infant with postural asymmetry without referral from the primary pediatrician. 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 pediatrician sooner than infants older than 2 months, who may require more time to respond to treatment. In either case, a PT should initiate communication with the primary pediatrician when there are red flags or when a child does not respond after 4 to 6 weeks of treatment.

Role of Patient/Parent Preferences: None

Exclusions: None

Supporting Evidence and Clinical Interpretation

Up to 18% of cases with asymmetrical head posturing may be due to nonmuscular causes,[39] including Klippel–Feil,[39] neurologic disorders,[39,45] ocular disorders,[39,73,78,79] brachial plexus injuries including clavicle fractures,[39] paroxysmal torticollis that alternates sides,[41] spinal abnormalities,[77] and SCM masses.[45,70] It is within the scope of physical therapy practice to screen for neuromuscular and musculoskeletal disorders, including testing for ocular cranial nerve integrity and coordination, abnormal tone, orthopedic alignment, and developmental delay,[33] and to screen for potential nonmuscular causes of CMT. Any red flags that are identified should be documented, and the primary pediatrician should be consulted.

B. Action Statement 6: REQUEST IMAGES AND REPORTS. Physical therapists should obtain copies of all images and interpretive reports, completed for the diagnostic workup of an infant suspected of having or diagnosed with CMT, to inform prognosis. (Evidence Quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II evidence based on cohort and outcome studies of moderate size.

Benefits:

- 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 appreciate care that is coordinated and shared across disciplines.

Risk, Harm, and Cost: None

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: Per the APTA Guide to Physical Therapist Practice,[33] requesting relevant clinical reports on an infant's suspected or diagnosed condition is considered appropriate gathering of medical history.

Intentional Vagueness: None

Role of Patient/Parent Preferences: Parents need to formally release information for reports to be forwarded to the PT; parents may arrive with reports and images in their possession.

Exclusions: None

Supporting Evidence and Clinical Interpretation

Reports and images from specialized examinations or laboratory tests can rule out ocular, neurological, skeletal, and oncological reasons for asymmetrical posturing.[39,77] In particular, ultrasound images and/or reports may assist with describing the degree of fibrosis,[80] visualizing the size and location of muscle masses, and determining an appropriate plan of care and treatment duration.[18,81,82]

R. Research Recommendation 4. Researchers should conduct studies 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.

PHYSICAL THERAPY EXAMINATION OF INFANTS WITH CMT

B. Action Statement 7: EXAMINE BODY STRUCTURES. Physical therapists should document the initial examination and evaluation of infants with suspected or diagnosed CMT for the following 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 passive cervical rotation and lateral flexion. (Evidence Quality: II; Recommendation Strength: Moderate)**
- **Bilateral active cervical rotation and lateral flexion. (Evidence Quality: II; Recommendation Strength: Moderate)**
- **Passive and active ROM of the upper and lower extremities, inclusive of screening for possible hip dysplasia or spine/vertebral asymmetry. (Evidence Quality: II; Recommendation Strength: Moderate)**
- **Pain or discomfort at rest, and during passive and active movement. (Evidence Quality: IV; 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**

secondary muscles. (Evidence Quality: II; Recommendation Strength: Moderate)

- **Craniofacial asymmetries and head/skull shape. (Evidence Quality: II; Recommendation Strength: Moderate)**

Action Statement Profile

Aggregate Evidence Quality: Preponderance of level II studies based on well-conducted prospective and retrospective cohort follow-up studies of small to moderate sample sizes.

Benefits:

- Confirms the diagnosis of CMT and identifies other problems such as hip dysplasia, plagiocephaly, brachycephaly, scoliosis, brachial plexus injury, or other orthopedic and medical conditions.
- Determines the extent of primary and secondary muscle involvement, to estimate prognosis.
- Establishes baselines to measure progress of ROM, strength and alignment, and infant's ability to incorporate movement through available ranges.
- Facilitates systematic linking of interventions to identified impairments.
- Standardizes measurement and documentation of body structure limitations from CMT to evaluate group outcomes across clinical settings.

Risk, Harm, and Cost:

- Examination of passive cervical rotation may result in SCM snapping or a sense of "giving way" in approximately 8% of infants.[46]
- The infant may feel some discomfort or pain, and/or may cry[48,74] due to restricted movement, discomfort with ROM 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 passive ROM could cause secondary injury, though 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 examination and are consistent with current standards of practice.[33] 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 daily clinical practice. While there is only moderate to weak evidence to justify the measurement of active cervical ROM, active ROM 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. Further, documentation of these initial examination findings 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 Patient/Parent Preferences: During testing, parents may perceive that the baby experiences discomfort or that testing positions could potentially harm the baby, resulting in requests to stop testing if the baby is crying. The clinician must be aware and responsive to the parents' perceptions; it is incumbent on the clinician to fully explain the importance of the measures and the safety precautions used, so that parents and infants can comfortably and accurately complete the testing procedures. Clinicians may need to provide the infant with breaks during testing to obtain the baby's best performance and most reliable measures. Including the parent 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

Note: Table 3 provides a summary of the evidence on measurement.

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 examination positions to reduce infant repositioning and increase infant cooperation:

- **General Posture:** Document the infant's posture and tolerance to positioning in supine, prone, sitting, and standing when CMT is suspected or diagnosed (dependent and independent) (Evidence Quality: **II**; Recommendation Strength: **Moderate**)

Observe the infant in all positions, documenting symmetrical alignment and preferred positioning or posturing.[14,15,22,37,89] In supine, document the side of torticollis,[14,15,37,61] asymmetrical hip positions,[7,15,61,90] facial and skull asymmetries, restricted active ROM, and asymmetrical use of the trunk and extremities,[14,15,37,61] as these are all typical of CMT.

In prone, document asymmetry of the spine or presence of scoliosis,[5] the head on trunk, asymmetrical use of the extremities, and the infant's tolerance to the

TABLE 3: MEASUREMENT EVIDENCE TABLE

MEASUREMENT OF INTEREST	TYPE OF MEASUREMENT TOOL	CITATIONS	LEVEL OF EVIDENCE, VALIDITY, AND RELIABILITY	POSITION FOR MEASUREMENT (INFANT AND EXAMINERS)	STRENGTHS AND LIMITATIONS	WHAT NORMS ARE USED
Passive side bending (S)/ lateral flexion (L)	Arthrodial protractor	Cheng et al, 1999,[17] 2000,[18] 2001[9]	NA for lateral flexion	Supine: 2 examiners; 1 measures and 1 stabilizes the shoulders	S—reproducible; used in many studies L—no established reliability for lateral flexion	Comparison of values to right and left
		Öhman and Beckung, 2008[83]	Referenced Klackenberg's intrarater reliability values, 0.94-0.98	Supine: 2 examiners; 1 measures and 1 stabilizes the shoulders	S—assigned PROM values L—infants did not have torticollis	70° mean PROM
		Klackenberg et al, 2005[84]	Intrarater reliability 0.94-0.98	Supine with head and body supported. The PT measures; the second examiner stabilizes the shoulders	S—reproducible with high intrarater reliability L—no ICC for interrater reliability	ICC higher when measuring the affected side than unaffected; 60°, the infant's ear reached the shoulder
	Goniometer with the level adaptation	Karmel-Ross, 1997[19]	NA	Supine and sitting according to the infant's development. In supine the head is supported off the edge of the surface	S—assigning ROM values L—orienting the goniometer accurately	NA
	Photography	Klackenberg et al, 2005[84]	ICC (0.74-0.90) fair to good	Supine: the PT measures and the second examiner stabilizes the shoulders. The photograph is taken and the examiner draws on the photograph	S—comparison values to measurement with protractor L—too many variables to control. Extra steps. Author reports unfeasible	NA
	Photography	Rahlin and Sarmiento, 2010[85]	Intrarater reliability 0.80-0.85, ICC (3.1) interrater reliability 0.72-0.99, ICC (2.1)	Supine: 1 examiner places the child and provides visual stimulus in midline	S—measures the infants resting posture L—time-consuming with several steps to measure the photograph	
	Palpation of extensibility	Emery, 1994[2]	NA	2 examiners: the PT measures and the second examiner stabilizes the shoulders	Subjective data, no definition of resistance	NA, symmetry of movement by feel

(*continued*)

TABLE 3: MEASUREMENT EVIDENCE TABLE (*continued*)

MEASUREMENT OF INTEREST	TYPE OF MEASUREMENT TOOL	CITATIONS	LEVEL OF EVIDENCE, VALIDITY, AND RELIABILITY	POSITION FOR MEASUREMENT (INFANT AND EXAMINERS)	STRENGTHS AND LIMITATIONS	WHAT NORMS ARE USED
Passive cervical rotation	Arthrodial protractor	Cheng et al, 1999,[17] 2000,[18] 2001[9]	Interrater reliability ICC 0.71 Unpublished data	Supine with the head supported off the edge of the surface; 2 examiners, 1 measures and 1 stabilizes the shoulders	S—reproducible and used in many studies L—unpublished data	110° cervical rotation
		Öhman and Beckung, 2008[83]	Interrater reliability ICC 0.71 per Cheng's unpublished data	Cheng's method	S—assigned PROM values L—infants did not have torticollis	110° mean PROM
	Goniometer	Klackenberg et al, 2005[84]	Right CMT ICC 0.82-0.95 for rotation and side for rotation and lateral flexion. ICC 0.58-0.65 for rotation and side for rotation and lateral flexion to the nonaffected side	Supine with head and body on the surface. The PT measures and the second examiner stabilizes the shoulders	S—establishing intrarater reliability L—cervical rotation is limited by supporting surface	ICC higher when measuring the affected side than unaffected; 70-80° when the infant's chin touches the supporting surface
	Goniometer with the level adaptation	Karmel-Ross, 1997[19]	NA	Supported sitting according to the infant's development. The second examiner stabilizes shoulders	S—values can be assigned L—accounting for compensations of trunk and shoulders	100-120° of cervical rotation per Emery values 1994
	Visual inspection	Boere-Boonekamp and van Der Linden-Kuiper, 2001[15]	NA	Supine	S—easy to administer	NA
	Palpation of extensibility	Cameron and Cameron, 1994[8]	NA	Supine: 2 examiners, 1 measures and the second examiner stabilizes the shoulders	S—easy to administer; subjective	Symmetry of movement by feel; grades assigned by mild, moderate, severe

(*continued*)

TABLE 3: MEASUREMENT EVIDENCE TABLE (*continued*)

MEASUREMENT OF INTEREST	TYPE OF MEASUREMENT TOOL	CITATIONS	LEVEL OF EVIDENCE, VALIDITY, AND RELIABILITY	POSITION FOR MEASUREMENT (INFANT AND EXAMINERS)	STRENGTHS AND LIMITATIONS	WHAT NORMS ARE USED
Active lateral flexion/side bending	Muscle Function Scale	Öhman et al, 2009[12]	Inter- and Intrarater reliability kappa >0.9; ICC 0.9	The infant is held in a vertical position and lowered to horizontal	S—valid and reliable measure of lateral flexion strength L—lateral flexion only	0-5 scores; validated on infants >4 mo; 5/5 is normal strength of lateral flexion
	CROM—inclinometers mounted on glass head and magnet yolk on trunk	Karmel-Ross, 1997[19]	NA	Supported sitting in an adapted car seat mounted on hinge	S—measures for lateral flexion L—stabilizing of the body. Child needs head and trunk control	NA
Active cervical rotation	Visual tracking	Persing, 2003[16]; Laughlin, 2011[86]	NA	Supine: infants <4 mo, and supported sitting in examiners' lap for infants >4 mo	Easy to administer but no values	−0-Comparison between right and left ranges
		Boere-Boonkamp and van Der Linden-Kuiper, 2001[15]	NA	Supine: 1 examiner to encourage the infant to track	S—easy to administer but no values L—subjective	−0-Comparison between right and left ranges
	CROM—inclinometers mounted on glass head and magnet yolk on trunk	Fletcher, 2008[87]	Intrarater reliability ICC 0.92 for lateral flexion, ICC 0.94 for rotation	1 examiner with subject independent sitting	S—reproducible if the child is older and cooperative L—adults only, head array needs to be worn	No values for infants
		Youdas, 1992[88]	Interrater ICC 0.80; intrarater ICC 0.67-0.90 (median = 0.86) for left lateral flexion, ICC 0.60-0.94 (median = 0.85) for right lateral flexion, 0.81-0.95 (median = 0.84) for left rotation, and 0.58-0.99 (median = 0.80) for right rotation	1 examiner with subject independent sitting	S—reproducible if the child is older and cooperative L—adults only, head array needs to be worn	No values for infants

Abbreviations: CMT, congenital muscular torticollis; CROM, cervical range of motion; ICC, intraclass correlation coefficient; NA, not available; PROM, passive range of motion; PT, physical therapist.

position. In typically developing infants, 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.[91,92] In infants with CMT, positioning in prone at least 3 times per day is correlated with higher AIMS scores.[12]

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 hip.[7,12,22,56]

If feasible, digital photography may be a fast, reliable method of measuring preferred positioning in supine.[85] A baseline is drawn through the acromial processes, and another line is drawn through the midpoints of both eyes. The intersection angle of the eye line with the shoulder baseline provides an objective measure of preferred head tilt. Care needs to be taken not to record artifacts of the placement of the baby on the surface; photos should represent the typical posture to which the baby repeatedly reverts during the examination session.

- **PROM**: Document the infant's passive cervical rotation and lateral flexion when CMT is suspected or diagnosed (Evidence Quality: **II**; Recommendation Strength: **Moderate**)

Both passive cervical rotation and lateral flexion or side bending should be measured bilaterally with an arthrodial protractor as described by Öhman and Beckung.[83] The severity of CMT is determined by the differences between the left and right measures of ROM. Cervical neutral[87] needs to be maintained for all measures, but is easily compromised when the infant compensates with rotation or extension movements at the end ranges. The PT visually checks the cervical neutral position, assuring that the infant's nose, chin, and visual gaze are directed forwards (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).[87]

Passive cervical rotation should be measured with the infant in supine, the head in neutral, and the nose aligned with the 90° vertical reference.[17,83] This approach with an arthrodial protractor is the most commonly referenced standard for measuring passive cervical rotation,[13,17,18,37,43,61,62,83] despite a lack of published data to support a reported interrater ICC of 0.71.[17] The benefit of an arthrodial protractor is that the infant's head is supported beyond the edge of the supporting table, allowing fuller neck rotation and removing the table surface as a possible barrier to full range. Cervical rotation can be measured reliably by the same rater (ICC = 0.87-0.97) using a goniometer aligned along the support surface with the infant lying supine, or in the horizontal plane with children more than 2 years old if they can independently sit and cooperate[84]; however, values from the method used by Klackenberg et al[84] of 49 to 67 ± 4 to 9° are distinctly lower than the 110 ± 6° found by others.[18,83]

The clinical challenge of using either a goniometer or an arthrodial protractor 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 the other to rotate the head/neck while measuring range. A third person may be needed to hold the arthrodial protractor in place unless it can be attached to the support surface and calibrated to be level. The GDG strongly values the objective measurement of cervical rotation as a means of establishing a baseline for future comparison. Current practice surveys in New Zealand and Canada suggest that PTs often visually estimate, rather than measure rotation range with an instrument; the greatest barrier being the absence of a time-efficient and reliable tool.[21,22]

Lateral flexion should be measured in supine with the shoulders stabilized, using an oversized or arthrodial protractor. PTs can either place their hands on the side of the head, or place one hand under the head and the other hand on the baby's chest to palpate for trunk movement. The head should be in cervical neutral, avoiding neck extension or flexion. The head is laterally flexed until the ear contacts the stabilized shoulder[84] while the opposite shoulder is stabilized; ROM typically reaches 70 ± 2.4° with cheek size being the limiting factor.[83] This method is reliable (ICC = 0.94-0.98) when the measures are taken by the same person, using the same setup and procedure, and may be more accurate by 2 to 3° than photographs taken of the same end-range positions.[84]

When testing passive ROM, known orthopedic conditions may require modification or avoidance of tests (eg, children with osteogenesis imperfecta, congenital hemivertebrae, or Down syndrome who have not been cleared for cervical instability). In these cases, the GDG recommends that testing for passive range use only very gentle guidance through the range, ending at the first palpable sign of resistance.

R. Research Recommendation 5. Researchers should conduct studies to develop a reliable, valid, and time-efficient method of measuring infant cervical ROM and determine normative data of cervical passive ROM.

- **AROM**: Document the infant's active cervical ROM. (Evidence Quality: **II**; Recommendation Strength: **Moderate**).

Active range is considered an important indicator of symmetrical development and neck strength[7,62,83,93] and

the baby's integration of PROM for functional activities. Treatment to improve active range is consistent with the goals of early intervention.[72] Asymmetrical movements and movement compensations can indicate muscle tightness, restrictions, or weakness.[2,94]

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.[21,22] Studies may list "active movement" as an outcome but do not describe how it is measured, and most PTs rely on visual estimation.[22]

Physical therapists should measure active cervical movement by using one of these techniques, looking for active and full range in all planes, including diagonals, while the baby is enticed to follow toys, sounds, or other forms of stimulation to elicit full range.

For the infant who is younger than 3 months, head rotation is tested in supine.[86]

For the infant who is older than 3 months, test neck rotation while the infant sits in the clinician's lap who is sitting on a rotating stool. The parent entices the infant to maintain eye contact while the PT rotates the baby away from the parent. The PT observes neck rotation from above using the baby's nose as a midline indicator as it approaches the shoulder.[86] Additionally, neck flexion and extension can be screened in this sitting position.

For infants older than 2 months, the Muscle Function Scale provides an objective categorization of active lateral flexion in developmentally appropriate positions.[83,95] By holding the infant vertically in front of a mirror and tipping the baby horizontally, the PT classifies the head righting position according to a 6-point scale.[95] Typically developing infants rarely show a difference between sides, and infants with CMT frequently have a difference of 2 to 3 points.[95] Clinicians should refer to Öhman et al[95] for specific reference values and procedures.

R. Research recommendation 6. Researchers should conduct studies to determine the sensitivity and specificity of the Muscle Function Scale to (1) differentiate infants with clinically significant limitations from typically developing infants; (2) establish a clinically practical, objective method of measuring active ROM in infants 0 to 3 months and infants older than 3 months to assess baselines and change over time; and (3) determine what, if any, correlation between active and passive ROM should be used for discharge criteria.

- **Extremity ROM:** Document the infant's passive and active ROM of the spine, upper and lower extremities, and screen for developmental dysplasia of the hip (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 movements of the infant and by passively moving the arms and legs through all available range at each joint to rule out brachial plexus injuries, clavicle fractures, neurological impairments, hypermobility, or CNS lesions.[13,39,42,56,57,66] Physical therapists should observe for symmetry and stability of the hip, and symmetry of the leg lengths and gluteal skin folds.[90]

The incidence of DDH with CMT ranges from 2.5%[14] to 17%[38] depending on inclusion criteria, and it increases with the severity of neck rotation restriction.[17] While guidelines do not recommend routine screening of all infants for DDH,[96] infants at risk for or those diagnosed with CMT have a slightly higher incidence.[38,76] Factors such as a history of breech position (OR: 4.68 [1.66, 13.03]) or cesarean delivery (OR: 5.19 [2.06, 12.04]),[75] family history, maternal age less than 20 years, Apgar scores less than 8 at 1 minute,[97] and being female[96] have been associated with greater risk of DDH. No single test or observation is sufficient to diagnose the presence of DDH, nor does the presence of DDH in young infants necessitate immediate treatment, as more than 90% of newborns with DDH confirmed by ultrasound may resolve on their own.[98] Conversely, a missed diagnosis of DDH may cause the infant more difficulty if treated later with bracing or surgery; thus, the Ortolani and Barlow maneuvers and skin fold assessment are traditionally included in the evaluation of the infant younger than 3 months with CMT.[90] Although the sensitivity of the tests varies among studies,[96,99] the specificity for ruling out DDH is stronger.[96,100] After 3 months of age, the Ortolani and Barlow maneuvers may not be sensitive enough to pick up DDH as the joint capsules tighten.[100] For infants older than 3 months, the Galeazzi sign (asymmetrical shortening of the affected leg), asymmetrical posture of the legs and skin folds, and restrictions of hip adductors may be stronger red flags for DDH, especially since it would be expected to resolve by that time.[100]

- **Pain**: Document the infant's pain or discomfort (Evidence Quality: **IV**; Recommendation Strength: **Weak**)

The PT should observe for behaviors reflective of discomfort or pain reactions in the infant and child during the examination process.[70,89,101] Pain is not typically associated with the initial presentation of CMT[1] but may be associated with passive stretching.[5,102] The infant may cry in response to stretching,[102] or in response to handling by the therapist, and children older than 2 years may be able to provide self-reports of pain.[101] The PT should differentiate actual pain responses from discomfort or behavioral reactions to stretching, anxiety, or the stress of an unusual environment. Despite acknowledging the possibility

of pain, no assessment tools for identifying or rating pain are reported in the CMT literature.

There are 3 clinician-rated pediatric pain scales that quantify infant pain-related behaviors and that do not rely on physiological monitoring (eg, heart rate, blood pressure, O_2 saturation, and body temperature). The Children and Infants' Postoperative Pain Scale (ChIPPS)[103] has been validated for newborns through 5 years of age for postsurgical pain, and is available in English and Portuguese.[104] The Face, Legs, Activity, Crying and Consolability (FLACC) is valid for children from 2 months to 7 years of age[105,106] and in children younger than 3 years before and after anesthesia.[107] The revised FLACC (rFLACC)[108] is valid for children 4 to 19 years old including those with cognitive impairments. Parent descriptions of their children's specific pain reactions are part of the rFLACC, and the clinician can observe for those specifically.

Since the FLACC is valid for the typical age range of infants and children treated for CMT, the GDG is recommending its use over the ChIPPS or rFLACC. The FLACC is administered by having the clinician rate facial expressions, movement, and behavior state with a 3-point scale of "0" = no expression or a quiet state, "1" = occasional expression or movements, and "2" = inconsolable and large, frequent movements" for a maximum of 10 points; lower scores indicate fewer pain-related behaviors and higher scores indicate more behaviors. Training in the use of the FLACC is required to achieve adequate reliability.[107] Care must be taken to interpret the infant's behavioral reactions when the PT is handling the infant to differentiate crying and behavioral distress due to pain versus discomfort, separation anxiety, or other infant fears. One method to differentiate pain from behavioral distress is to hand the inconsolable baby back to its parent/caregiver, observing how quickly the infant quiets. Another option is to have the caregiver do the handling with PT instruction and observe the infant's reactions to differentiate true pain from discomfort or behavioral reactions.

R. Research Recommendation 7. Researchers should conduct studies to describe and differentiate signs of discomfort from the types of pain reactions typically observed in infants with CMT during specific testing or interventions, as well as to determine the validity of the FLACC in rating true pain reactions during CMT examinations or interventions.

- **Skin**: Document the condition of the infant's cervical skin and hip folds. (Evidence Quality: **V**; Recommendation Strength: **Theoretical/Foundational**)

Physical therapists 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.[71] Infants with brachycephaly and limited cervical ROM in all directions may have deeper posterior folds.[70] Observe for symmetry of the hip skin folds in the inguinal and upper thigh area as an indicator of DDH.[65,90]

- **Muscle**: Document the condition of the infant's musculature, and particularly the SCMs and secondary cervical muscles. (Evidence Quality: **II**; Recommendation Strength: **Moderate**)

Physical therapists 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).[109] The presence of a fibrous band and/or mass, particularly a mass that involves more than the distal one third of the muscle is correlated with greater severity of the condition.[9,109] Thus, these qualities are useful for determining the CMT severity and estimating the episode of care.[2,9,17,18,46,66,109] Ultrasound imaging is useful for quantifying the size, shape, and organization of the fibrous bands or masses[66,109-111] and for indicating the amount of muscle fiber realignment that occurs over time.[109,111,112]

Physical therapists should document the presence of secondary asymmetries or compensations 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,[113] imbalance of neck muscle strength,[83] hiking of the shoulder on the side of the involved muscle,[114] asymmetrical preference for limb use,[7,115] asymmetrical and delayed protective and righting reactions of the head, neck, and trunk,[69] Trendelenburg's sign in children who are walking,[90] and scoliosis.[7] 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.[7,35,54,114]

- **Craniofacial characteristics**: Document the condition of the infant's craniofacial characteristics to include head shape and facial features. (Evidence Quality: **II**; Recommendation Strength: **Moderate**)

Facial asymmetries involve the relative alignment of the each side of the jaw, the cheekbones, eye orbits, and ear positions.[10,36,37,44,54,61,116] Plagiocephaly refers to asymmetries of the skull, including the frontal, temporal, parietal, and occipital bones, presenting with posterior unilateral flatness, bilateral flattening (brachycephaly), asymmetrical brachycephaly, or flattening on both sides of the skull (scaphocephaly).[56,117,118]

The incidence of cranial asymmetries in typical singleton infants is about 13%,[118] 55.6% in twins,[118] and 67%[119]

to 90%[18] of children with CMT have plagiocephaly. The reported incidence of combined craniofacial asymmetry varies among studies from 10% in typical newborns[37] to 100% of infants with CMT.[36]

Untreated CMT can cause craniofacial asymmetries on the side of the torticollis, 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.[36,37,54,116]

Plagiocephaly can either cause or be a result of CMT. Limited active ROM from CMT may cause skull deformation as asymmetrical muscle tensions lead to development of positional plagiocephaly.[1,15,16,36,64,86,118] Conversely, positional preference of the infant with CMT can lead to asymmetrical muscle activity and persistent positioning of the skull on one side with subsequent deformation. Finally, for infants with plagiocephaly and no initial CMT, an asymmetrical resting position of the skull may cause persistent neck rotation that can lead to SCM tightness.[1,15,16,64,86,120]

Physical therapists should document asymmetries of the skull and face using Argenta's classifications.[117] The method is clinically practical, does not require equipment other than a copy of the scale, and has established inter rater (0.51-0.66) and intrarater reliability (0.6-0.85).[121] Other methods to quantify head shape asymmetries exist, such as the modified "severity scale for assessment of plagiocephaly,"[122] molding a flexible ruler to the infant's head shape and tracing the shape,[123] 3-dimensional computerized scanning,[124] and plaster of Paris molds of the infant's head,[119] but these alternatives are sometimes not tolerated well by the infant or are not clinically practical for many physical therapy settings.

P. Action Statement 8: CLASSIFY THE LEVEL OF SEVERITY. Physical therapists and other health care providers should classify the level of CMT severity choosing 1 of 7 proposed grades (Figure 2). (Evidence Quality: V; Recommendation Strength: Best Practice)

Action Statement Profile

Aggregate Evidence Quality: Clinical and research experience of the GDG.

Benefits:

- Classifying levels of severity may assist with prognosis and parent education.
- The 7 grade levels integrate 2 of the strongest factors related to outcome: the infant's age at which treatment is initiated and the type of CMT the infant presents with.
- More precise classification grades are needed to compare outcomes across research samples.

Risk, Harm, and Cost: None

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: The GDG recommends the use of its Classification of CMT Severity, recognizing that it has only been minimally piloted, and that further research is needed to validate the 7 levels.

Intentional Vagueness: None

Role of Patient/Parent Preferences: None

Exclusions: None

Supporting Evidence and Clinical Interpretation

Five taxonomies of CMT classification recur in the literature: age of treatment initiation,[11,49] type of CMT,[9,11,13,18] severity of ROM limitations,[17,18] presence of plagiocephaly,[56,57] and muscle fiber appearance by ultrasound.[40,109,125] In most studies, these taxonomies are detailed enough to answer the research questions about incidence of various types, incidence of surgical outcomes, and usefulness of ultrasound as a diagnostic tool or classification process. At this writing, the use of ultrasound by PTs to determine a classification of CMT would require advanced training, and is beyond the scope of typical pediatric physical therapy practice.

When looking for guidance on intervention effectiveness for CMT, study samples typically analyze outcomes according to the type of CMT, the age of presentation, or the ROM limitations,[9,58] but no studies have combined the factors to determine the interaction effects of age of initiation and type of CMT. Both factors are considered strongly correlated with outcomes, such that the earlier the infant is treated and the milder the form of CMT, the shorter the episode of care and the higher the probability of complete resolution.[49]

The GDG proposes a more detailed classification method to add clarity to research and aid communication among clinicians. Figure 2 is a flow diagram that can be used to guide practice and inform prognosis. The vertically aligned ovals, at the left most edge of the diagram, list the factors that are most relevant to the classification process (age asymmetry noted, age of referral, type of CMT), followed by diamonds that describe the cycle of PT examination, intervention, and reassessment. To the right are the range of conditions and actions that link the classification with PT management.

The 7 grades of severity are defined as follows:

Grade 1—Early Mild: These infants present between 0 and 6 months of age, with only postural preference or muscle tightness of less than 15° of cervical rotation.

Grade 2-—Early Moderate: These infants present between 0 and 6 months of age, with muscle tightness of 15 to 30° of cervical rotation.

Grade 3-–Early Severe: These infants present between 0 and 6 months of age, with muscle tightness of more than 30° of cervical rotation or an SCM mass.

Grade 4-–Late Mild: These infants present between 7 and 9 months of age, with only postural preference or muscle tightness of less than 15° of cervical rotation.

Grade 5-–Late Moderate: These infants present between 10 and 12 months of age, with only postural or muscle tightness of less than 15° of cervical rotation.

Grade 6—Late Severe: These infants present between 7 and 12 months of age, with muscle tightness of more than 15° of cervical rotation.

Grade 7—Late Extreme: These infants present after 7 months of age with an SCM mass or after 12 months of age with muscle tightness of more than 30° of cervical rotation.

Clinicians should begin the classification process at the top of the diagram. The age that asymmetry is first noted should be documented followed by the age of referral for treatment. Classifications are first dichotomized as either "early" or "late" and have a range of severity within these 2 categories. The age of referral in combination with the type of CMT determines the classification grade. For example, Classification Grade 2, Early Moderate, is assigned to an infant referred to the PT either prior to 90 days of age (3 months) or between 4 and 6 months with SCM muscle tightness and a limitation in cervical rotation of 15 to 30°. A Classification Grade 7, Late Extreme, is assigned to an infant referred to the PT after 1 year of age with muscle tightness and limitation in cervical rotation ROM greater than 30° and or an SCM mass. The GDG recommends that these grades also be used to describe patient study samples in order to better understand the impact of selected interventions on more clearly defined subsets of infants.

Decisions regarding treatment intensity and duration take into consideration each of the factors within the large, center oval: Classification Grade, Access to Services, Patient/Caregiver Adherence (with interventions), Muscle Tissue Elasticity, and Comorbidities. Action Statement 11 regarding prognosis supports the idea that the earlier and more intense the intervention, the shorter the episode of care and the more complete the resolution of symptoms. No specific recommendation of intensity of treatment is appropriate for all cases. Regardless of severity, if PT treatment is initiated, passive stretching and active positioning should be frequently performed throughout each day and specific to the limitations, with responses to treatment regularly evaluated for effectiveness. While a minimum of 1.5 months[49] and a maximum of 36 months[2] of conservative treatment is reported, the majority of studies cite a range of 4 to 6 months in duration for intervention.

R. Research Recommendation 8. Researchers should conduct studies to determine a reliable, valid, and clinically practical method of measuring lateral flexion, and to determine how the severity of lateral flexion may affect the Classification of CMT Severity grades.

B. Action Statement 9: EXAMINE ACTIVITY AND DEVELOPMENTAL STATUS. During the initial and subsequent examinations of infants with suspected or diagnosed CMT, PTs should document the types of and tolerance to position changes, and examine motor development for movement symmetry and milestones, using an age-appropriate, valid, and reliable standardized tool. (Evidence Quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II evidence from cohort and outcome studies.

Benefits:

- Early detection of developmental delays, neurological impairments, movement capabilities, muscle function in developmental positions, and infant preferences help to direct the plan of care.
- Provides opportunities for parent education on typical development, importance of prone playtime, alternative positioning, and reinforcement of parent 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.
- Some standardized tests are proprietary and thus have associated costs for the forms and test manuals. 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 examination. These are consistent with professional standards of practice[33] and clinical practice specific to CMT.[21,22]

Intentional Vagueness: None

Role of Patient/Parent Preferences: Parents may perceive that the baby experiences discomfort from the testing positions or that the prone position is harmful, and may request that testing not continue if the baby is crying. The clinician should fully explain the importance of varying

the infant's positions, including use of prone positioning, which may be avoided by parents due to misinterpretation of *Back to Sleep* instructions.[12]

Exclusions: None

Supporting Evidence and Clinical Interpretation

Infants with CMT are shown to have a higher incidence of persisting developmental delay in early childhood in comparison to the typical population,[13] and may demonstrate those delays as early as 2 months.[12] Many may resolve by 10 months[12] but approximately 10% may not.[14] Physical therapists should use a standardized tool with established predictive validity 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 tools, such as the Test of Infant Motor Performance through 4 months of corrected age (http://thetimp.com/) and the AIMS from 4 to 18 months of corrected age,[126] during the initial and periodic reexaminations. While neither requires certification to administer the tools, 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 examination positions.[7]

R. Research Recommendation 9. Researchers should conduct studies to identify the best developmental screening tests to use for infants with suspected or diagnosed CMT, from birth through 12 months. This research would enable standardization of measures to document outcomes across studies.

B. Action Statement 10: EXAMINE PARTICIPATION STATUS. The physical therapist should document the parent/caregiver responses regarding:

- **Whether the parent is alternating sides when breast or bottle-feeding the infant. (Evidence Quality: II; Recommendation Strength: Moderate)**
- **Sleep positions. (Evidence Quality: II; Recommendation Strength: Moderate)**
- **Infant time spent in prone. (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: A predominance of level II prospective cohort follow-up studies with small sample sizes.

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.

Risk, Harm, and Cost: None

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: None

Intentional Vagueness: None

Role of Parent or Patient Preferences: Parents and caregivers must accurately describe the infant's daily care routines, so positioning and home exercise programs can be tailored to maximize implementation opportunities. 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

Supporting Evidence and Clinical Interpretation

Consensus exists 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.[21,22,69] Moderately strong evidence suggests that specific activities either are red flags for possible asymmetrical development or are the consequences of existing asymmetries.

Positioning: Documentation should address positioning when awake and asleep, while feeding, 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 can lead to CMT,[57] to *correct* positional preference that can lead to CMT and plagiocephaly,[37,56,64] and to *treat* CMT if present. Three aspects of positioning support an interaction effect with CMT resolution: use of prone positioning; asymmetrical handling to activate weak neck musculature and active ROM toward the limited side; and feeding from alternate sides.

Prone positioning while awake for greater than 1 cumulative hour per day, with no minimum amounts of time per opportunity, appears to offset the transient effects of supine sleep positions on motor skill acquisition.[127,128] Supine positioning is associated with positional preference and consequently may facilitate asymmetrical neck ROM and secondary development of plagiocephaly.[15,120] Infants who spend more time in prone and side lying positions reduce the effect of preferred positioning[15] and keep better

pace with motor milestones.[12,129] Although prone sleeping is counter to the *Back to Sleep* recommendations,[130] it has been associated with faster achievement of developmental milestones.[131]

The conscientious use of positioning during wakeful activities (eg, play, feeding, and dressing) facilitates symmetrical development of head shape,[57,132] active and passive neck motion,[48,57] midline hand play,[15] tolerance of prone positioning,[128] and achievement of motor milestones.[62,133] Conscientious positioning means that the parent actively places the infant in positions during play, on changing tables, in cribs or carries the infant in ways that require head righting, rotation toward the restricted side, neck and upper body extension,[62] or visual attraction toward the tight side. Active movement toward the affected side[10] and alternation of trunk and limb movements[134] help to counteract asymmetries and prevent potential ones. For the infant with positional preference, these activities may reduce the preference and avoid consequential tightness.

Parents are reported to avoid prone positioning with infants who are typically developing because the infant does not tolerate the position or because the infant has already achieved independent sitting.[128] Education about the importance of prone playtime is critical for infants with suspected or diagnosed CMT, as they have multiple risks of asymmetrical development and delayed motor milestones. Physical therapists should assess each parent's ability to carry out exercises and home program positioning.

Feeding: Physical therapists should document the infant's feeding positions and difficulties as reported by the parent/caregiver during the initial and periodic evaluations. Feeding problems have been identified in infants with CMT and/or plagiocephaly as asymmetrical jaw positioning,[135] preference for side of nursing,[64,120] and /or side of bottle-feeding.[58,120] As many as 44% of infants with CMT may demonstrate a feeding preference to one side,[58] and as many as 2.4% are described as having additional feeding problems.[66] In conjunction with infant preference, the parent's preferred side or hand dominance may also bias positioning to bottle-feed from the same side.[15] Conversely, infants who breastfeed from both sides have a lower incidence of skull deformation and torticollis, possibly due to the frequency of position changes as compared to infants who are bottle-fed on the same side of the caregiver at each feeding.[136] Intervention that addresses alternating sides for feeding can effectively increase symmetrical positioning and reduce preferred positioning by the infant. Interviewing parents/caregivers about their comfort with alternating feeding positions is a common practice,[21,22] is consistent with family-centered care,[72] and provides an opportunity to suggest positioning strategies.

Equipment/Positioning Devices: Physical therapists should document the amount of time the infant spends in positioning equipment as reported by the parents (eg, positioning/seating devices, strollers, car seats, cribs, or swings).[86] 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,[7,136] and ensuring frequent opportunities to play in prone from an early age.[12,70,133] Avoidance of prone placement by parents can occur if the infant does not tolerate prone well; the discussion offers an opportunity to assess parent/caregiver comfort and provide graded strategies for prone positioning that build on the infant's tolerance.

B. Action Statement 11: DETERMINE PROGNOSIS. Physical therapists should determine 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, classification of severity (Figure 2), intensity of intervention, presence of comorbidities, rate of change, and adherence to home programming. (Evidence Quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II-IV cohort studies and case reports with long-term follow-up.

Benefits:

- Classifies the severity of CMT in the infant for communication purposes.
- Links the examination results and severity level to classification and associated interventions and/or referrals.
- Provides guidance on the frequency and dosage of intervention(s) across episodes of care.
- Allows parents/caregivers to psychologically prepare for what to expect from the PT and the range of possible outcomes for their infants.
- Assists parents with understanding and implementing the plan of care.
- Articulates the relationship of examination results to expected outcomes for documentation, including letters of medical necessity.

Risk, Harm, and Cost: Lack of determining a prognosis by either the referring pediatrician or the PT may lead to

underestimation of the severity of CMT, resulting in inadequate or untimely delivery of care and/or parent/caregiver confusion about what to expect.

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 PT's prognosis is the bridge between the evaluation of initial examination results and classification of severity with the associated interventions within an expected timeframe; thus, the prognosis 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 health care provider if outcomes are not met.

Intentional Vagueness: None

Role of Patient/Parent Preferences: The prognosis for improvement, or the time to achieve change, may need to be adjusted based on the parent/caregiver ability to comply with a home program designed by the PT.

Exclusions: None

Supporting Evidence and Clinical Interpretation

A PT is responsible for determining a prognosis following the patient evaluation.[33] A prognostic statement should include the expected outcome in objective measurable terms, the time frame for intervention to achieve the outcomes, and a description of the potential courses of the condition if treated or not. The prognosis for full resolution of CMT that is treated conservatively prior to 3 months of age is 100% and lower (75%) when treated after 3 months of age.[11] The later the onset of treatment after identification of the condition, the lower the chance of full resolution[2,5,49,58,59] and the greater the need for surgery.[49] Tatli et al[40] report 94% resolution of CMT symptoms for infants if treated by a PT before 24 weeks with a home program of positioning, including infants with masses. The ability of the caregivers to frequently implement a home program of active positioning and passive stretching also correlates with a high level (94%) of full resolution.[59]

The challenge is to identify the appropriate level of intervention intensity to remediate the limitations that are present and to prevent secondary impairments. Essentially, the earlier and more intense the intervention, the shorter the episode of care and the more complete the resolution of symptoms.[5,10,17,49,112,137] No specific recommendation of intensity of treatment is appropriate for all cases. Operational definitions of treatment intensity vary across studies with frequencies of home exercises ranging from 8 times a day[10] to 2 times a day,[8] or as unspecified frequencies per day but specific repetitions and durations of holds (eg, 4 sets of 15 repetitions).[112] Öhman et al[59] provide preliminary evidence of better outcomes when infants are treated by a PT versus parents, but the combination of physical therapy and a home program is the more frequent intervention plan.[2,9,43,112]

The time frame for change is estimated based on the age at CMT identification and the age at treatment initiation. Infants younger than 3 months may only need 1.5 to 3 months of care, whereas infants older than 3 months, or who initiate treatment several months or more after diagnosis, will require 3 to 6 months of intervention. Prognosis is also related to the extent of fibrous mass at initial diagnosis[80] with longer treatment durations with more fibrosis; however, if treatment is initiated before 3 months of age, then 99% have resolution of symptoms. The severity of ROM restrictions is noted by Emery[2] to be the best predictor of treatment duration. Within the estimated episode of care, the PT should be documenting changes in all objective measures to demonstrate the effectiveness of the chosen interventions.

Some infants will not gain sufficient active or passive ROM without more invasive interventions.[138] The 2 most commonly reported are surgical lengthening or release of the SCM muscle and, more recently, injections of botulinum toxin (Botox).

The prognosis for needing surgery is based on extent and severity of symptoms,[1,8,11,49,137] including the tissue condition,[125] with an incidence as low as 5% when stretching is initiated in the first few months after birth.[46] The severity of limitation in cervical ROM, presence of a mass, and an older age at initiation of treatment all affect prognosis. Limitations in cervical ROM of more than 15° or having an SCM mass, and presenting after 1 month, combined with older age at diagnosis are strongly correlated with the need for surgery at a later age.[9] Recommendations for surgery are typically made after a period of conservative treatment, ranging from a minimum of 3 months, but more typically, between 6 and 12 months of treatment.[1,7,8,11,66,137,139]

Botox injections have been used after conservative physical therapy treatment has failed to eliminate symptoms and to prevent surgery,[50,113] although only Oleszek et al[113] objectively measured cervical ROM and head tilt, but not in all participants. Although initial studies are promising, this represents an off-label use of Botox. Long-term studies on its effectiveness, side effects, and/or adverse effects are warranted.

PHYSICAL THERAPY INTERVENTION FOR INFANTS WITH CMT

Manual stretching is the most common form of treatment for CMT. Active and passive ROM exercises are chosen specific to the child's body structure limitations of tight neck, trunk, and/or upper extremity muscles. Stretching

should elongate the shortened muscles by moving in the direction opposite to the atypical posture.

It is well supported that the earlier intervention begins, the more successful the outcomes and the shorter the duration of intervention. Outcomes of intervention have typically focused on the incidence of achieving full cervical passive ROM and symmetrical head positioning, whether through care, surgery, or botulinum toxin. Cohort studies provide rich descriptions of these same outcomes following typical conservative care, relative to selected variables of age, ROM limitations, and type of CMT. Passive ROM and symmetrical head posture are important body structure characteristics, but they are only one part of the ICF disablement model.

Early on, Binder et al[7] recognized the importance of looking at overall development, in addition to neck mobility. Newer concepts of early intervention encourage looking beyond the infant's body structure limitations. They stress the importance of perceptual–motor experiences within the context of the infant's social environment, and the contribution of gross and fine motor exploration to the development of cognition.[72] The domains of impairment, perceptual–motor development, and social and environmental factors parallel the ICF terminology of body structures, activity, and participation, respectively, and should not be viewed as separate identities; rather they develop together to form the infant's cognition. Infants with limited or asymmetrical exploration, as seen in CMT and deformational plagiocephaly,[13,14,69,133] have demonstrated delays in early motor development that may have an effect on the development of early perceptual–motor skills and, therefore, cognition.[72]

Therefore, pediatric 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, and that promote current and future development and learning across domains.[72]

B. Action Statement 12: PROVIDE THE FOLLOWING 5 COMPONENTS AS THE FIRST-CHOICE INTERVENTION. The physical therapy plan of care for the infant with CMT or postural asymmetry should minimally address these 5 components:

- **Neck PROM. (Evidence Quality: II; Recommendation Strength: Moderate)**
- **Neck and trunk active ROM. (Evidence Quality: II; Recommendation Strength: Moderate)**
- **Development of 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 II cohort and outcome studies.

Benefits to the Infant:

- Increases infant's active and passive ROM.
- Facilitates normal and prevents, reduces, or eliminates asymmetrical postural, gross motor, skeletal, cognitive, sensory, and visual development.
- Reduces use of environmental supports/equipment that may increase asymmetry.
- Avoids or minimizes need for future, more invasive procedures.

Benefits to the Parent:

- Enables parents to be active and effective caregivers.
- Education empowers parents to implement interventions between physical therapy appointments.
- Education helps parents to understand the factors that contribute to asymmetry.
- Balances use of supine as the preferred infant position by parents, overemphasized by the *Back to Sleep* campaign, with activities in prone, side lying, and sitting during supervised, wakeful activities.
- Provides parents with information about typical developmental milestones.
- Reduces potential overall cost of care for CMT with early intense treatment.

Risk, Harm, and Cost:

- Stretching of the SCM can result in muscle snapping, which may or may not cause momentary infant discomfort; however, the documented long-term outcomes are positive.[46]
- Cost of care may be a burden for families.
- Parents/caregivers may apply interventions incorrectly.
- Parents might ease up on home exercises if they perceive that the PT is implementing the treatment.[62]

Value Judgments: None

Intentional Vagueness: The duration of treatment is dependent on the classification of severity of the CMT, with mildest forms requiring an average of 2 to 3 months of treatment, and more severe forms requiring up to 5 to 6 months of treatment.[17] Infants who receive surgical interventions may require an additional 4[18] to 6[35] months of treatment. There are no dosage formulae to link technique and duration of stretches, repetitions within each treatment session, frequency of treatment sessions per day, overall duration of care, and frequency of clinic visits, including tapering schedules, to CMT severity classifications; thus, the GDG cannot define "intense treatment" except that stretching should be frequent through the day, every day.

Role of Parent/Caregiver or Patient Preferences: Parent/caregiver adherence to the plan of care is essential for achieving early intense treatment dosages.

Exclusions: None

Note: Table 4 provides a summary of evidence on passive stretching.

Supporting Evidence and Clinical Interpretation

Neck PROM: Manual stretching is the most commonly reported form of treatment for CMT[10,11,89,112]; however, there are no consistent formulae reported to determine the intensity of stretching to improve passive range, nor consensus on the techniques to perform the stretches. The frequency of stretching sessions per day, the number of repetitions and the duration of stretches and rest periods, and the number of individuals required for the stretches vary across studies. While the specific intensity of many approaches is not clearly defined, there is a trend that more frequent intervention throughout the day, every day, results in more rapid resolution of symptoms.

Stretching as an intervention should not be painful, and stretches should be stopped if the infant resists.[1,48] Low-intensity, sustained, pain-free stretches are recommended to avoid microtrauma to the muscle tissue.[1] The optimal time of the sustained stretch has not been studied, and protocol recommendations range from 1[80] to 30 seconds,[140] with one report[71] describing progressive tolerance developing for up to 2 to 3 minutes.

The 2-person technique for stretching has the first person stabilizing the infant in supine with the head held beyond the support surface and the second person holding the head to guide it through the available range of cervical rotation and lateral flexion.[2,10,141] Alternatively, the single-person technique has the infant positioned in supine on the caregiver's lap with 1 hand stabilizing the chest and shoulders and the other guiding the head through the range.[61] Hand placement is important when using either the 1- or 2-person stretch to properly stabilize the infant, to minimize compensatory movements and to guide the infant's head through the available range.[2,61,141] The choice of technique may depend on the size and age of the infant when stretching is initiated, with younger, smaller infants more easily managed by 1 person, whereas larger or more active infants may require 2 people to provide adequate positioning support.

Neck PROM can also be achieved through positioning and handling,[7,48,62,142] including carrying the infant in side lying with the tighter side down, having the infant sleep or lie on the affected side to obtain a gentle stretch on the contracted muscle[1,7,10,48,142] and while lying prone with the neck turned to the affected side.[10,43,48] Passive cervical stretching can also be achieved during feeding[120,136] by encouraging turning away from the shortened side to pursue a bottle or breast, and when necessary, through positioning in car seats and infant carriers.[16,48,61,86]

Neck and Trunk Active ROM: Strengthening cervical and trunk muscles can be achieved through active ROM during positioning, handling, carrying the infant,[7,48,62,74,142] while feeding,[120,136] and through exercises isolating the weaker muscles.[7,48,62,142] Incorporating righting reactions in upright postures, rolling, side lying, or sitting has been used effectively during treatment and daily care routines to strengthen muscles opposite of the affected muscles.[43,48,142] The affected side of CMT is placed downward, elongating the tighter muscles and encouraging activity of the weaker, nonaffected side.[7,48,62] Positioning the infant in prone encourages bilateral neck flexor elongation and strengthens neck and spine extensors.[2,71] Using visual and auditory tracking to elicit head turning in supported sitting toward the affected muscle can strengthen cervical rotation.[7,10]

Development of Symmetrical Movement: Developmental exercises should be incorporated into PT interventions and home programs to promote symmetrical movement in weight-bearing postures and to prevent the development of impaired movement patterns in prone, sitting, crawling, and walking.[7,74,120]

Environmental Adaptations: Adaptations to the infant's environment can be incorporated into the home exercise program. Alternating the infant's position in the crib and changing table encourages head turning in the desired direction.[61,118,120] Adapting the car seat to promote symmetry,[48,129,136] minimizing the amount of time in a car seat and infant carrier,[16,86] and placing toys on the affected side for the infant to turn the head toward the tighter side[48] have been recommended as part of home programming, but not studied.

Parent/Caregiver Education: Parents and caregivers should be educated about the importance of "tummy time" or prone play,[1,12,128,131,133] positioning and handling to encourage symmetry,[1,61,62,71,120] minimizing the time spent in car seats and carriers to avoid plagiocephaly as a precursor to CMT,[15,61,86] and alternating feedings to each side.[136] These strategies should be integrated into the daily routines and home programs to enhance adherence.

Parents and caregivers may be inclined to seek advice from internet sites and support groups. These sources can provide an array of information, but the veracity of information can vary, and the sites cannot tailor interventions to an individual child's body structures and activity limitations. Parents should be encouraged to review information with their primary pediatrician and/or PT regarding exercises or interventions they are considering. Identification of evidence-based, reputable internet resources would

TABLE 4: PASSIVE STRETCHING EVIDENCE TABLE

CITATION	LEVEL	WHO PERFORMS	WHO INSTRUCTS	FREQUENCY PER DAY OR WEEK	REPETITION	DURATION OF HOLDS	HOME PROGRAM	OUTCOMES
Celayir, 2000[10]	II	2 persons	MD	8×/d, every 3 hrs	10	10 s	Positioning, handling, promoting active cervical ROM	No surgery needed: 100% success for infants <4 mo Asymmetry: 80% achieved full rotation with no asymmetry; 20% achieved full rotation with mild asymmetry or mild rotation limitation and no asymmetry
Chon et al, 2010[112]	II	2 persons, a parent and a PT	PT	5×/wk in rehabilitation department; home exercise	4 sets of 15 repetitions	3 min rests	Gentle stretching and massage, positioning and handling. Home program was monitored daily	Muscle thickness: significant reduction in SCM ($P < .00$) in those with sternomastoid mass and muscular torticollis. Infants were <3 mo at start of treatment
Emery, 1994[2]	II	2 persons	PT	2×	5	10 s	Positioning and handling for neck rotation to the affected side and tilt away from the affected side. Sleep positions and prone exercises were instructed. Righting reactions were used to strengthen the opposite weaker side	PROM: 99% (100/101) achieved full range and complete CMT resolution; 1 required surgery. Duration of care: $x =$ 4.7 mo. Infants with SCM mass were correlated with severity and longer duration of care. 36% received a TOT collar.
Cameron and Cameron, 1994[8]	III	2 persons	NA	2×/d	10	NA	NA	PROM: 100% of infants who started treatment <3 mo resolved without surgery; 45% infants who started treatment >3 mo required surgery. 65% of infants had excellent results (full ROM and no asymmetry), 27% good results (full rotation and mild asymmetry or mild rotation limitation and no asymmetry), and 8% poor results (no improvement)
Demirbilek and Atayurt, 1999[11]	III	2 persons	NA	4-5×/d	40/set	NA	Parents were instructed in PROM, and AROM exercises were undefined	Surgery: 0% <3 mo old required surgery; 25% between 3 and 6 mo old; 71% between 6 and 18 mo, and 100% >2 to 7 yr of age. Overall, 26% subjects (15/57) required surgery.
Cheng et al, 2001[9]; Cheng and Au, 1994[43]	II	1 person	PT	3×/wk	3 repetitions × 15 stretches	1 s hold; 10 s rest	Sleep positioning to stretch out tighter side, righting to strengthen muscles on the opposite side	Duration of care: 3.7 mo with SCM mass, 2.5 mo for muscular torticollis, 1.4 mo for postural torticollis. Surgery: 7.5% for SCM mass; 3.1% for muscular; 0% for postural.

(*continued*)

TABLE 4: PASSIVE STRETCHING EVIDENCE TABLE (*Continued*)

CITATION	LEVEL	WHO PERFORMS	WHO INSTRUCTS	FREQUENCY PER DAY OR WEEK	REPETITION	DURATION OF HOLDS	HOME PROGRAM	OUTCOMES
Schertz et al, 2008[14]	II	PT	PT	Weekly sessions	NA	NA	Home stretching program and developmental exercises	Infants with CMT are at an increased risk for gross motor delay.
Öhman et al, 2010[59]	II	PT	PT	3×/wk with PT performing the exercises	15-min session with unlimited repetitions	10-30 s	Prone positioning, handling and carrying with the affected side down and gentle stretch to the affected neck muscles	Infants in the group where the PT did the stretching demonstrated increased symmetry of movements on average 2 mo sooner than infants in the parent only, no PT, intervention group.

Abbreviations: CMT, congenital muscular torticollis; MD, medical doctor; NA; not applicable; PROM, passive range of motion; PT, physical therapists; ROM, range of motion; SCM, sternocleidomastoid; TOT, tubular orthosis for torticollis.

assist both clinicians and families in keeping up with current and valid management approaches.

R. Research Recommendation 10. Researchers should conduct studies to identify intervention techniques and dosages, and link them to classifications of severity. Dosage should address the technique and duration of stretches or active movements, the repetitions within each treatment session, the frequency of treatment sessions per day, the overall duration of care, and the frequency of clinic visits, including tapering schedules.

C. Action Statement 13: PROVIDE SUPPLEMENTAL INTERVENTION(S), AFTER APPRAISING APPROPRIATENESS FOR THE INFANT, TO AUGMENT THE FIRST-CHOICE INTERVENTION.

Physical therapists may add supplemental interventions, after evaluating their appropriateness for treating 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: III; Recommendation Strength: Weak)

Action Statement Profile

Aggregate Evidence Quality: Level II-IV studies with small sample sizes, and case reports.

Benefits: On an individual basis, combining supplemental interventions supported by weaker evidence with first-choice interventions:

- May be effective in addressing asymmetrical postures.
- May accommodate an infant's temperament or tolerance to treatment.
- May improve ROM.
- May avoid or minimize the need for future, more invasive procedures.
- May increase parent/caregiver ability to implement home program.

Risk, Harm, and Cost:

- Selected supplemental interventions (ie, microcurrent, kinesio tape, myokinetic stretching, or Tscharnuter Akademie for Motor Organization [TAMO]) should only be applied by clinicians skilled in that specific technique or modality.
- There may be an added burden to the parent(s)/caregivers 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

Value Judgments: The GDG recommends these approaches as supplements to more established interventions due to the limited number of studies and the small sample sizes in the available studies.

Intentional Vagueness: Whereas selected interventions are presented, there is no evidence as to when it is best to add them to a plan of care.

Role of Parent/Caregiver or Patient Preferences: Parents may inquire about different interventions for the treatment of CMT.

Exclusions: None

Supporting Evidence and Clinical Interpretation

The following interventions are recommended as supplements to the first-choice interventions described in Action Statement 12. They are presented in descending order of evidence strength. Finally, there are some interventions described in the common press for which there are no studies to support their effectiveness. Departures from the guideline should be documented in patient records at the time the relevant clinical decisions are made.

Interventions With Limited Level II Evidence

Microcurrent is a low-intensity alternating current applied superficially at a level that is not perceived by the patient. Thirty minutes of microcurrent applied directly to the SCM of infants with CMT, 3 times per week for 2 weeks, improved tilt angle ($P < .01$), neck rotation on the affected side ($P < .05$), and yielded less crying during therapy ($P < .05$) when compared to a control group of infants with CMT who received traditional stretching and exercises.[102] The sample groups were small (7 experimental vs 8 control) and there was no long-term follow-up, but the average infant age was 7 months, and many had already been treated with stretching programs. This approach should be further tested for reproducibility, but may be appropriate to try after 2 to 3 months of intervention if changes are slowing.

Myokinetic stretching as applied by Chon et al[112] consists of sustained 2-finger overpressure on the taut SCM muscle; 60 repetitions were delivered over 30 minutes, 5 times per week for an average of 1.7 months. Pre- and posttreatment measures of the SCM thickness in infants with either the muscular torticollis or SCM mass types were made by ultrasound. Results describe significant reductions in SCM thickness ($P < .05$), improved cervical rotation and head symmetry ($P < .05$), with retention at 1-year follow-up by parent reports. The study had no control group, and the average age of the sample was 50 days (range of 30-70). Additionally, the parents performed an unspecified home program of stretching and handling, so it is not clear if the improvements are due to the treatment technique, or the intensity of treatment, and/or the age of the study subjects. Most studies demonstrate that infants less than 2 months of age will resolve with traditional stretching approaches delivered at frequencies of less than 5 days per week. Physical therapists may want to try this approach if an infant is not progressing or is resisting passive stretching.

Interventions With Level III Evidence

Kinesiological taping (KT) refers to the use of stretchable tape to support muscles, to provide sensory feedback, and, although suggested as an approach to assist with the treatment of CMT,[19,89] only 1 retrospective study could be found. Öhman[143] reports the effect of KT on 28 infants diagnosed with CMT. The KT was applied with 3 different techniques, either muscle relaxation on the affected side, muscle facilitation on the unaffected side, or a combination of both approaches. Muscle Function Scale scores were significantly higher ($P < .001$) when KT was applied to the affected side for the purpose of muscle relaxation; however, these are preliminary results. Prospective controlled trials are needed to determine the true contribution of KT to the speed of CMT resolution.

Interventions With Level IV Evidence

The TAMO approach promotes problem solving and movement exploration during treatment, emphasizing light touch and the infant's responses to gravity and support surfaces. A single case study of TAMO therapy describes the treatment plan for an infant with CMT.[74] The subject was a twin born prematurely, hospitalized in the NICU for 5.5 weeks, and who had additional hospitalizations for other medical conditions during which he appeared to develop asymmetrical posturing. Despite home programming of position changes, encouragement of active ROM, and use of prone positioning, SCM tightness developed and the infant was referred for treatment at 6.5 months of age (4.5 months corrected age). The application of TAMO therapy was mixed with active ROM activities, soft tissue mobilization, parent instruction for use of home positioning to facilitate muscle lengthening and carrying techniques that facilitate head righting opposite of the tightness. While the changes across time are well documented, it is not clear what contribution the TAMO approach provides separate from the positioning and handling approaches that others have shown to be effective[7,62] except for the noticeable absence of passive stretching. This approach may be a useful addition for PTs who have received postgraduate training in the TAMO approach, particularly for infants who are resistant to stretching. Prospective comparison studies are needed to determine its true benefit.

Interventions With Level V Evidence

The **Tubular Orthosis for Torticollis** (TOT) collar has been described by Jacques in Karmel-Ross,[19] by Emery[2] and online (www.symmetric-designs.com) as a neck orthotic designed to prevent movement toward and stimulate active movement away from the tilted head position. The collars are used as an adjunct to conservative treatment of infants with CMT aged 4 to 4.5 months who demonstrate adequate head control in supported sitting, and who demonstrate more than 5 to 6° of head tilt.[19,142] Although noted as part of routine intervention in the treatment of infants with CMT who meet criteria for their use,[2,71,89,142] there are no studies that isolate the outcomes of the TOT collar compared to other interventions. Pilot data reported in Karmel-Ross[19] suggest that infants treated with the TOT collar achieve 89.5/90° vertical head position as compared to 84.8/90° for those who did not.

Soft foam collars have been described by Jacques[19] and have been used postsurgery,[68] postsurgery in conjunction with physical therapy,[138,139,144-146] and postbotulinum toxin[50] without specific rationales provided. They may be useful as passive support for the lengthened muscle, to protect incisions from curious hands, or to facilitate active movement away from the previously shortened side. Binder et al[7] describe the use of a soft felt and stockinet collar for infants presenting with less than 45° passive cervical rotation and a constant tilt. In all cases, no studies have been found that isolate the effect of foam or soft collars on the outcomes of conservative care.

Custom-fabricated cervical orthoses have been described for postsurgical management of CMT in children[145,147] and young adults.[148] They reportedly provide greater stabilization of the spine and less mobility than the softer foam collars or semirigid cervical orthoses[149,150]; however, their use with infants has not been reported in the literature.

Interventions Without Evidence of Efficacy

The following approaches are reported in the literature, but either have been shown not to provide any additional benefit or have not been studied systematically. Additional approaches have been found on websites and in the lay press for which no peer-reviewed literature was found.

Manual therapy, when defined as cervical manipulation of the infant in supine, has been compared to standard stretching alone in a small double-blind randomized trial ($n = 32$).[151] Results indicate no differences between the groups, with many confounding variables. The study was underpowered; both groups received stretching and home programs; the infants were young, ranging from 3 to 6 months of age when stretching alone is known to be effective; and selected measures were reported as unreliable due to infant cooperation. The actual technique used for cervical manipulation was not well described in the study. Others have concluded that 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.[152,153] 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.

The following interventions appear in print, online, in continuing education brochures and parent support groups for infants with torticollis and deformational plagiocephaly, but no peer-reviewed studies have been found that describe the specific approaches or their effectiveness for resolving CMT: soft tissue massage,[19,71,74,112] craniosacral therapy,[19] Total Motion Release, and Feldenkrais.[19] Referring physicians, therapists, and parents should be aware that these approaches have not been systematically described or studied for CMT, and their clinical application, risks, and anticipated outcomes are not known. Due to a lack of studies, the GDG cannot recommend these approaches for management of CMT at this time. Clinicians who choose to use these approaches should document departures from the guideline in patient records at the time the relevant clinical decisions are made, obtain consent to treat from parents that acknowledges the lack of published evidence, and carefully document objective measures of change.

R. Research Recommendation 11. Researchers should conduct studies to describe and clarify the efficacy of all supplementary interventions, including determinants for their choice, principles of application, dosage, and outcomes measures.

B. Action Statement 14: REFER FOR CONSULTATION WHEN OUTCOMES ARE NOT FULLY ACHIEVED. Physical therapists who are treating infants with CMT or postural asymmetries should initiate consultation with the primary pediatrician and/or specialists about alternative interventions when the infant is not progressing. These conditions might include when asymmetries of the head, neck, and trunk are not resolving after 4 to 6 weeks of initial intense treatment; after 6 months of treatment with only moderate resolution; or if the infant is older than 12 months on initial examination and either facial asymmetry and/or a 10 to 15° difference persists between the left and right sides; or the infant is older than 7 months on initial examination and a tight band or SCM mass is present; or if the side of torticollis changes. (Evidence Quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II evidence based on cohort follow-up studies.

Benefits:

- Alternative invasive interventions (eg, Botox 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.

Risk, Harm, and Cost: The consultations and possible subsequent interventions may 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: None

Role of Patient/Parent Preferences: The age of the infant, the severity of the CMT, the rate of changes, the needs of the family, the cooperation and developmental needs of the infant, and the available resources of the family/caregivers should help to determine the episode of care before an infant is referred back to the primary pediatrician for consideration of alternative interventions.

Exclusions: None

Supporting Evidence and Clinical Interpretation

The literature supports a wide range of treatment durations for conservative care; the question of when to refer an infant who is not progressing has no clear answer. The duration of care will vary depending on the age of diagnosis and referral of the infant for services and the severity grade. Infants who are referred within the first 3 months with a 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. 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. Factors that might extend treatment duration include slow but progressive improvement in asymmetries, the initial age of treatment,[49] the presence or absence of a mass in the SCM, the amount of head tilt,[2,9,18,49] the presence of facial asymmetry or plagiocephaly,[49] parental preference for conservative care, inconsistent adherence by parents/caregivers, and infant health conditions that may interfere with CMT interventions. Throughout the episode of care, the PT should be collaborating with the primary pediatrician and the family, to make a judgment about when to consider alternative approaches. This decision should be based on the rate of changes, the persisting impairments, the age of the infant, and the needs and values of the family. The literature supports that if infants have treatment initiated before 3 months of age, 98% to 100% will respond to conservative treatment within a 6-month period of time,[2,8,10,11] although full resolution may require a longer duration. 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 Procedures: There are 2 conditions for which a child may be referred for consideration of more invasive interventions. If after 6 months of conservative treatment there is a lack of progress, or if the child first begins intervention after 1 year of age and presents with significant restrictions and/or an SCM mass, the PT should consult with the primary pediatrician or referring physician about alternative approaches; the 2 most common being botulinum toxin injections and surgery. The following brief descriptions are provided for information, but are not exhaustive reviews of these approaches. Clinicians and families should discuss these options separately as alternatives when conservative care has not been successful.

Botulinum toxin 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.[113,154] Although it is not formally approved for use with infants, it is approved for adults with cervical dystonia.[154] Three relatively recent retrospective studies[50,113,114] describe botulinum toxin as varying from 25%[114] to 74%[113] to 93%[50] effective for increasing ROM in infants with CMT. Adverse effects include pain and bruising,[50] temporary dysphagia,[113] and neck weakness,[113] all of which are reported to resolve.

Surgery is the more traditional alternative for treating recalcitrant CMT.[138,139,155] It is beyond the scope of this CPG to describe the variety of surgical approaches, which generally fall into 3 categories: tendon lengthening, unipolar release of the distal SCM attachment, or bipolar release of both muscle attachments.[156,157] Criteria that have been used to determine the timing for surgery include persisting limitations in cervical ROM more than 15°,[9,137] progressing limitations,[1] having an SCM mass and being older than 12 months combined with late age diagnosis,[9] persistent visual head tilt,[9,18,137] not responding to treatment after 6 months,[9,18] and reaching the age of 1 year without resolution.[137] The postoperative management of CMT is similar to preoperative management, and can range from 4 to 6 weeks[158] up to 4 months[159] to work on scar management, muscle strength, and ROM.

PHYSICAL THERAPY DISCHARGE AND FOLLOW-UP OF INFANTS WITH CMT

B. Action Statement 15: DOCUMENT OUTCOMES AND DISCHARGE INFANTS FROM PHYSICAL THERAPY WHEN CRITERIA ARE MET. Physical therapists should document outcome measures and discharge the infant diagnosed with CMT or asymmetrical posture from physical therapy services when the infant has full passive ROM within 5° of the nonaffected side, symmetrical active movement patterns throughout the passive range, 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: Levels II-III with evidence from long-term follow-up studies and cohort and case reports of unresolved CMT in infancy that later require surgical intervention.

Benefits: Use of these criteria for discharge 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 primary pediatrician and/or the PT for reexamination.
- Discharge documentation reflects the expected outcomes of care, relative to the baseline measures taken at the initial examination.

Risk, Harm, and Cost: There is an unknown amount of risk that discharge from physical therapy services with 5° residual asymmetry will progress to other anatomical areas (cervical scoliosis, craniofacial) or return as the infant grows. There appears to be a slightly higher risk than general prevalence of developmental coordination disorder and attention-deficit hyperactivity disorder that is not associated with the type or severity of the CMT,[13] although more studies are needed.

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: None

Intentional Vagueness: None

Role of Patient/Parent Preferences: Parents/caregivers need to be educated about the importance of screening for asymmetries as the child grows and becomes more active against gravity. They should be advised that preferential positioning is often observed during times of fatigue or illness, and that reevaluation is warranted if it persists.

Exclusions: None

Supporting Evidence and Clinical Interpretation

Although the duration of intervention for the individual infant will vary depending on the constellation of factors identified in Figure 2, the criteria for discharging an infant from physical therapy services are based on norms for infant growth and development,[83] known risk of early delays,[12-14] and the emerging evidence of possible long-term sequelae.[5,13] Functionally, it is critical that the infant who has achieved full PROM can actively use the available range; consequently, physical therapy criteria for discharge 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 the episode of care. Finally, these discharge criteria are common across the literature and thus are in keeping with current practice norms.[140]

B. Action Statement 16: PROVIDE A FOLLOW-UP SCREENING OF THE INFANT 3 to 12 MONTHS POSTDISCHARGE. Physical therapists who treat infants with CMT should examine positional preference, the structural and movement symmetry of the neck, face and head, trunk, hips, upper and lower extremities, and developmental milestones, 3 to 12 months following discharge from physical therapy intervention *or* when the child initiates walking. (Evidence Quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate Evidence Quality: Level II evidence based on longitudinal follow-up studies with moderately large samples, reasonable follow-up periods, and reliable outcome measures.

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 causes of asymmetry, other than CMT, if asymmetries reappear.

Risk, Harm, and Cost: A single follow-up visit will minimally add to the cost of care.

Benefit–Harm Assessment: Preponderance of Benefit

Value Judgments: A single follow-up physical therapy visit for infants with a history of CMT is consistent with the APTA Guide to Physical Therapist Practice that describes the roles of a PT to include prevention of recidivism and preservation of optimal function.[33]

Intentional Vagueness: The recommended time at which follow-up is scheduled (3-12 months) is wide

because the age of the infant at discharge will vary. For younger infants, discharged between 4 to 6 months of age, follow-up may need to occur sooner after discharge when the infants are initiating standing and walking. It is not known how far out into early childhood that screening should occur. Literature suggests that by 18 months, infants with delays at 10 months catch up with their peers[14,63]; however, longer follow-up 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.[13]

Role of Patient/Parent Preferences: Parents/caregivers may choose to forego a follow-up visit if it places undue burden on the family for travel, time, or finances. Parents should be advised at discharge of the small chance that developmental conditions may become evident when the child enters school, and parents should be educated to observe for persistent asymmetry.

Exclusions: None

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[5,53,156] and from a few long-term follow-up studies.[10,13,14] Although the short-term outcomes of conservative 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 rotation asymmetry with the opposite side,[17,18,52,80] and a "good" resolution with as much as 10°[17,52] residual. It is not known whether the last 5 to 10° will resolve on its own, in whom it remains as a mild limitation, whether achieving passive ROM equates to full active use of the available ROM, and whether mild residual asymmetry influences normal development. The documented potential for increasing muscle fibrosis,[111] developmental delays,[13,14] and hemisyndrome[7] supports that a single physical therapy follow-up visit 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. Pediatricians should be cognizant of the risk for asymmetries and/or motor delays during routine physical examinations as infants with a history of CMT are followed through to their teen years.

The length of time after discharge that a physical therapy follow-up should be conducted is supported by level IV evidence. Wei et al[66] propose 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.[111] Finally, the potential for developmental delays may not become evident clearly until early school age[13]; a reexamination when the child enters elementary school may be warranted if a parent or teacher reports, or the child presents with residual asymmetries, developmental delays, or preferential positioning.

R. Research Recommendation 12. Researchers should conduct studies to determine the most reasonable follow-up times after discharge from physical therapy based on initial presentations, to establish the level of risk of developing asymmetries following an episode of intervention.

R. Research Recommendation 13. Researchers should conduct studies to document parent/caregiver concerns and/or satisfaction with physical therapy intervention.

Summary

A scoping review of the literature resulted in 16 graded action statements with varying levels of obligation that address referral, screening, examination and evaluation, prognosis, first-choice and supplementary physical therapy interventions, interprofessional consultations, discharge, and follow-up, with suggestions for implementation and compliance audits. Flow sheets for referral paths and classification of CMT severity are proposed. Research recommendations are made for 13 practice issues.

GUIDELINE IMPLEMENTATION RECOMMENDATIONS

A growing body of literature exists on the uptake of evidence into practice. The following suggestions are provided as possible strategies for clinicians to implement the action statements of this CPG, but are not an exhaustive review. Many variables affect the successful translation of evidence into practice; clinicians will need to assess their own practice structures, cultures, and clinical skills to determine how to best implement the action statements as individuals and how to facilitate implementation by others.

Strategies for Individual Implementation

- Keep a copy of the CMT CPG in a location that is easy to reference.
- Compare items in the recommended examination list to determine what should be added to an examination to increase adherence.
- Adapt examination forms to include a place to document each of the recommended measures.
- Seek training in the use of the recommended standardized measures and/or intervention approaches.[160]
- Build relationships with referral sources to encourage early referral of infants.
- Measure individual service outcomes of care (eg, patient effect across the ICF domains, costs, and parent/caregiver satisfaction).[161,162]

Strategies for Facilitating CPG Implementation in Other Clinicians

- Recognize that adoption of the recommendations by others may require time for learning about the CMT CPG content, developing a positive attitude toward adopting the action statements, comparing what is already done with the recommended actions, trying selected changes in practice to determine their efficacy, and finally, routine integration of the tested changes.[161,163]
- Identify early adopting clinicians as opinion leaders to introduce the guideline via journal clubs or staff presentations.[161,163]
- Identify gaps in knowledge and skills following presentation of content to determine needs of staff for adopting recommendations.[163]
- Use documentation templates to facilitate standardized collection and implementation of the recommended measures and actions.[164,165]
- Institute quality assurance processes to monitor the routine collection of recommended data and implementation of recommendations, and to identify barriers to complete collection.[161,166]
- Measure structural outcomes (eg, dates of referral, equipment availability), process outcomes (eg, use of tests and measures, breadth of plan of care), and service outcomes (eg, patient effect across the ICF domains, costs, and parent/caregiver satisfaction).[161,162]

Plan for Revision: The GDG recommends that the CPG be updated in 5 years, as the body of evidence expands.[23]

SUMMARY OF RESEARCH RECOMMENDATIONS

R. Research Recommendation 1: Researchers should conduct studies to determine whether routine screening at birth increases the rate of CMT identification and/or increases false positives.

R. Research Recommendation 2: Researchers should conduct studies to clarify the predictive baseline measures and characteristics of infants who benefit from immediate follow-up, and compare the cost–benefit of early physical therapy intervention and education to parental instruction and monitoring by physicians. Longitudinal studies of infants with CMT should clarify how the timing of referral and initiation of intervention affect changes in body structure, function, and overall costs of care.

R. Research Recommendation 3: Researchers should conduct studies to identify the precision of screening procedures specific to CMT.

R. Research Recommendation 4: Researchers should conduct studies 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.

R. Research Recommendation 5: Researchers should conduct studies to develop a reliable, valid, and time-efficient method of measuring infant cervical ROM and determine normative data for cervical passive ROM.

R. Research Recommendation 6: Researchers should conduct studies to:

a. Determine the sensitivity and specificity of the Muscle Function Scale to differentiate infants with clinically significant limitations from infants who are typically developing.
b. Establish a clinically practical, objective method of measuring active ROM in infants 0 to 3 months and infants older than 3 months to assess baselines and change over time.
c. Determine what, if any, correlation between active and passive ROM should be used for discharge criteria.

R. Research Recommendation 7: Researchers should conduct studies to describe and differentiate signs of discomfort from the types of pain reactions typically observed in infants with CMT during specific testing or interventions, as well as determine the validity of the FLACC in rating true pain reactions during CMT examinations or interventions.

R. Research Recommendation 8: Researchers should conduct studies to determine a reliable, valid, and clinically practical method of measuring lateral flexion, and determine the relationship between the severity of lateral flexion and the severity grades.

R. Research Recommendation 9: Researchers should conduct studies to identify the best developmental screening tests to use for infants with suspected or diagnosed CMT, from birth through 12 months. This research would enable standardization of measures to document outcomes across studies.

R. Research Recommendation 10: Researchers should conduct studies to define home exercise program intervention dosages and link them to classifications of severity. Dosage should address the type and duration of stretches or active movements, the repetitions within each treatment session, the frequency of treatment sessions per day, the overall duration of care, and the frequency of clinic visits, including tapering schedules.

R. Research Recommendation 11: Researchers should conduct studies to describe and clarify the efficacy of all supplementary interventions, including determinants for their choice, principles of application, dosage, and outcomes measures.

R. Research Recommendation 12: Researchers should conduct studies to determine the most reasonable follow-up times after discharge from physical therapy services based on initial presentations, to establish the level of risk of developing asymmetries following an episode of physical therapy.

R. Research Recommendation 13: Researchers should conduct studies to document parent/caregiver concerns or satisfaction with physical therapy intervention.

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Appendix 1: ICF AND ICD 10 CODES

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

ICD 10/9 Codes

These codes are offered for reference and are not intended to be directional for billing purposes.

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

Abbreviations: AIMS, Alberta Infant Motor Scale; AROM, active range of motion; CMT, Congenital Muscular Torticollis; ICD, International Classification of Diseases; ICF, International Classification of Functioning, Disability and Health; LEs, lower extremities; PROM, passive range of motion; SCM, sternocleidomastoid; TIMP, Test of Infant Motor Performance; UE, upper extremity.

Appendix 2: Operational Definitions

Brachycephaly: Flattening of the entire posterior surface of the head.

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

Congenital muscular torticollis: Congenital muscular torticollis (CMT) is a common pediatric orthopedic condition, described as an idiopathic postural deformity of the neck evident at birth or shortly thereafter. CMT is typically characterized by a head tilt to 1 side and the neck rotated to the opposite side, due to unilateral shortening or fibrosis of the sternocleidomastoid muscle. CMT may be accompanied by cranial deformation or hip dysplasia, and less frequently, atypically present as a head tilt and neck twisting to the same side.[9,44,167] CMT has been associated with hip dysplasia,[4] brachial plexus injury,[39-41] distal extremity deformities, early developmental delay,[14,39] persistent developmental delays,[13] facial asymmetry, which may affect function and cosmesis,[6] and temporal–mandibular joint dysfunction.[54]

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

Plagiocephaly: Cranial asymmetry with flattening of 1 side of the head.[121]

Sternocleidomastoid mass (synonymous with fibromatosis colli, tumor, pseudotumor, or node): A condition in which the sternocleidomastoid muscle is enlarged due to fibrosing of muscle cells with identifiable histological changes.[110] This condition is referred to as a "mass" throughout this document.