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Overview of Physical Therapy for Children with Autism and Other Intellectual and Developmental Disabilities

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Abstract

Physical therapists are critical members of the medical home team offering expert family-centered care for children with disorders or injury that impair musculoskeletal function, resulting in poor balance, a lack of coordination, gait abnormalities, weakness, pain, or other impairments. From infancy through adulthood, the role of the pediatric physical therapist is critical to the development and quality of life of children living with developmental disability. This chapter provides an overview of the general physical therapy assessment and interventions before focusing on the care of children with autism, cerebral palsy, and developmental delay.

Keywords

Physical therapy · Autism · Cerebral palsy · Developmental delay · IDD · ASD

Introduction

Physical therapists (PTs) are critical members of the medical home team offering expert family-centered care for children with disorders or injury that impair musculoskeletal function, resulting in poor balance, a lack of coordination, gait abnormalities, weakness, pain, or other impairments. PTs are independent healthcare professionals focusing on the diagnosis of impairment resulting from disorders, disease, or injury. While diagnosing autism spectrum disorders (ASD) or intellectual disabilities would be beyond the scope of PT practice, pediatric PTs assist in restoring or enhancing functionality for children through a variety of assessment and treatment techniques tailored to individual needs. PTs may also assist in assessing for and obtaining adaptive equipment such as mobility aids and orthotics. Children are typically referred to the PT because a delay in motor milestones has been identified by parents or providers. PT therapies may be delivered in the home, school, clinic, or hospital settings.

Initiating Physical Therapy Services

Physical therapists are movement specialists assisting children to participate fully in their homes, school, and communities. While direct

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access laws in all states have empowered patients to seek PT care without a physician's referral, the scope of these laws and requirements of insurance providers vary. Additional information about direct access is available on the American Physical Therapy Association's website. State requirements are summarized at getpt.org. In the United States, about half of children with special healthcare needs receive health insurance through Medicaid or children's health insurance program (CHIP) (Musumeci & Chidambaram, 2018). Within federal guidelines, states determine how Medicaid is administered. Under Medicaid, PT is classified as a rehabilitation service, typically requiring a primary care provider's referral or a determination of eligibility for services through school-based programs.

The medical home team care coordinator can assist families in understanding access to local resources. In addition, when referring a child for PT services, the medical home should forward the shared plan of care (See Chap. 1 in this volume for more information on the SPoC) along with a prescription noting the diagnosis or condition to be addressed, therapy requested, frequency, therapy goals, and any patient-specific limitations or precautions (Houtrow et al., 2019). It is helpful to note any accommodations that will be necessary, including sensory issues, particularly sensitivity to touch or movement. In addition, the family will benefit from knowing what to expect during the appointment. It may be helpful to bring baby books to the appointment or for the parents to review family videos in order to be prepared to answer questions about motor milestones. Children should wear clothes that allow freedom of movement and bring any medical equipment they use. The American Academy of Pediatric Physical Therapy provides fact sheets and other resources for families on their website.

The Physical Therapy Assessment

When assessing the child at the first appointment, a physical therapist will complete an initial evaluation lasting 1–2 hours. This should include a thorough medical and social history, including medications the child is taking, any prior interventions the child has had, and any current services they are receiving. Documentation of major developmental milestones and any areas of current developmental concern should be reviewed. A review of systems is completed that may include gathering information on the gastrointestinal, integumentary, cardiovascular/ pulmonary, musculoskeletal, and neurologic systems, as well as sensory and communication issues to rule out any red flags as well as guide clinical decision-making. During the initial evaluation, the physical therapist may draw on a number of sources for information such as the caregiver's report, if school aged, the teacher's report, and if able to communicate, the child's report. Children's reports of motor strengths and challenges often differ from that of their parents, so understanding the child's perception is key to engaging and motivating the child in therapy (Jasmin et al., 2018).

A child's motor performance may be observed and measured through a variety of standardized assessments. See Table 18.1. Motor function is assessed in different positions such as sitting, standing, and walking. The quality of the motor function is also important such as speed, or time

Table 18.1 Sample of available standardized tests and measures used in pediatric assessments

Test	Areas assessed
Movement Assessment Battery for Children (MABC-2) (Henderson, 1992; Henderson et al., 2007)	Motor development age 3–16 years
Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) (Bruininks & Bruininks, 2005)	Fine and gross motor development age 4–21 years
6-Minute Walk Test (6MWT) (Laboratories, 2002)	Endurance level
Functional Strength Measurement (FSM) (Aertssen et al., 2019)	Strength in arms and legs
School Function Assessment (SFA) (Coster, 1997)	Functional tasks that affect school
Gross Motor Performance Measure (GMPM) (Boyce et al., 1992)	Gross motor performance in children with CP
Peabody Developmental Motor Scales Second Edition (PDMS-2) (Folio, 1983)	Gross and fine motor development birth–age 5 years

to complete the movement, range, or available movement of the joint, symmetry, or evenness of movement, and control, or smoothness, coordination, and stability of the task. Deficits in muscular endurance, strength, cardiorespiratory fitness, and balance are also identified.

After the evaluation, the physical therapists will analyze the findings to form task-oriented interventions. Task-oriented interventions focus on functional tasks that the child and parent would like to master (Das & Ganesh, 2019). Goals that are relevant, measurable, and specific will be established. Additional research is needed to establish best practices for goal-setting with children (Pritchard-Wiart et al., 2019). Often times, physical therapists will provide education and a home exercise program to be completed by the parent or caregiver between therapy visits. For a home exercise program to be effective, parents must be able to envision the outcome of program adherence for their child, master the skills to implement the program, and be armed with coping strategies for challenges that arise (Gorgon, 2018).

Infants and Toddlers

Infants and toddlers are often identified for physical therapy services if they have abnormal tone; limited joint mobility; a diagnosed genetic, brain, spine, or neuromuscular disorder; or fail to meet major developmental milestones. The American Academy of Pediatrics recommends a developmental screening at a child's 9-, 18-, and 30-month well visit (Council on Children With et al., 2006). Some insurance companies do not cover a 30-month well child visit, so the screen can occur at 24 months, which may capture a larger percentage of children who could benefit from an Early Intervention Program (EIP) (Marks, 2020). A parent or healthcare provider can also request an evaluation of the child's skills and abilities to see if they qualify for physical therapy early intervention services. The EIP for Infants and Toddlers with Disabilities is for children from birth to age 3 to provide services and support for children with disabilities and developmental delays. Some children's services may be extended until age 5. Each state has a unique Early Intervention Program, so covered services may vary. Early intervention is important as motor delays have shown that as a child grows, their school performance, ability to perform activities of daily living, and participation in recreational sports are negatively affected (Dannemiller et al., 2020).

Fig. 18.1 Services provided by the pediatric PT

- Developmental activities
- Movement and mobility training
- Strengthening
- Motor learning
- Balance and coordination
- Recreation, play, and leisure
- Daily care activities and routines
- Equipment design, fabrication, and fitting
- Tone management
- Assistive technology
- Posture, positioning, and lifting
- Orthotics and prosthetics
- Wound care
- Cardiopulmonary endurance
- Pain management
- Safety, health promotion, and prevention programs

School Age

Under the Individuals with Disabilities Education Act (IDEA), students who meet criteria for one or more of 13 disability classifications, and whose disability impacts their educational performance, can qualify for school-based physical therapy (see Chap. 12) (Individuals With Disabilities Education Act, 2004). Physical therapy provided in the school setting is established for the child to fully participate in an educational program designed to allow the child to progress in school. Observation of the child within the school day is an essential part of a physical therapist's assessment. Ideally, an evaluation occurs in the classroom or natural environment. Goals specifically related to the child's education as well as parent concern and opinions should then be established as a team within the child's IEP (Individualized Education Program). A survey of school-based physical therapists found that only 80% of parent's concerns were "always" or "usually" addressed and 83% of physical therapists "always" or "usually" participate in the IEP development (Effgen & Kaminker, 2014). Functional activities such as being able to walk the hallways, climb school stairs, write, get on or off the bus, or carry their school bag are examples of school-based tasks that a physical therapist may address in the IEP. The therapist works with the child on skills to better navigate the school day. The therapist also works with the teacher or paraprofessional to teach strategies or identify adaptive equipment to maximize the child's success during school. A study found that children receive approximately 40 minutes of school-based physical therapy per week (Jeffries et al., 2019).

Physical therapy services for children are also offered through outpatient services using a medical model, where the child's medical diagnosis has accompanied sensory, motor, or developmental delays. In the outpatient setting, functional tasks and the ability to navigate their home and community are addressed. Children may work on non-school-related activities such as riding a bike, skipping, higher level balance, and coordination. Children may only qualify for clinic-based pediatric physical therapy if their deficits do not impact their learning within the school setting. It is also possible for children to receive both school- and clinic-based physical therapy in conjunction with one another.

Transition to Adult Care

Pediatric physical therapists typically transition patients to adult care providers between 18 and 21 years of age. Programs such as Early and Periodic Screening, Diagnosis, and Treatment (EPSDT), a federally mandated program that provides comprehensive coverage for children who receive Medicaid, stops at age 21 (Early and Periodic Screening, Diagnostic, and Treatment | Medicaid). A child that receives special education services in the school system is only guaranteed these services until they finish high school or are 21 years old. Transitioning care can be challenging for families and patients. The burden of obtaining services shifts to the adult who must seek the necessary accommodations for themselves. Many providers advocate early planning to help with the transition into adult services. Many therapists argue the need for a more student-centered approach during the transition process (Chandroo et al., 2018). A transition that encompasses students, parents, and teachers as a team to identify the student's strengths, weaknesses, and goals has been shown to have more positive outcomes (Laghi & Trimarco, 2020). For a more detailed review of addressing the needs of emerging adults and transitioning care, see Chap. 25 in this volume.

The Functional Approach to Diagnosis

A PT's functional approach focuses on the diagnosis of movement system impairments (Jiandani & Mhatre, 2018). While medical professionals may have intimate knowledge of the World Health Organization's International Classification of Diseases (WHO–ICD) for diagnosing and billing purposes, its' companion, the WHO

International Classification of Functioning, Disability and Health (WHO–ICF), may be less familiar. The WHO–ICF, which includes the WHO–ICF–Children and Youth classification, is used to characterize:

> what a person with a health condition can do in a standard environment (their level of capacity), as well as what they actually do in their usual environment (their level of performance). These domains are classified from body, individual and societal perspectives by means of two lists: a list of body functions and structure, and a list of domains of activity and participation. In ICF, the term functioning refers to all body functions, activities and participation. (WHO, 2002, p. 2)

Within pediatric physical therapy, the ICF–CY model works well to incorporate a broader understanding of the whole child to include not only their disability but also their abilities through function and participation levels. The framework uses a universal language that can help pediatric physical therapists move from a novice level using deductive reasoning to a more expert clinician who uses inductive reasoning and identifies "patterns" in health conditions (Atkinson & Nixon-Cave, 2011). When using the ICF–CY, the inclusion of both the child and caregiver information is important to characterize the complete picture of the child. Children with CP were found to focus on their abilities, while caregivers tended to discuss the limitations and disabilities of the child (Schiariti et al., 2014). Among the different domains within the ICF–CY, interpersonal interactions and relationships were addressed the least by healthcare professionals (Chien et al., 2014).

A limitation in using the ICF–CY model is the lack of consensus among clinicians on which tests or measures are the most appropriate to use and which outcome should be addressed. To address this, the Children and Youth with Disability in Society (CYDiS) research unit at the University of British Columbia (Canada), and the ICF Research Branch, the Classification, Terminology and Standards Team at WHO developed 5 ICF Cores Sets for Children and Youths (CY) with CP. These include a comprehensive set covering all the developmental stages from birth up to 18 years of age, as well as brief sets for CY with CP below 6 years of age, ≥6 and < 14 years of age, ≥14 and 18 years of age, and up to 18 years of age (ICF RESEARCH BRANCH – Home (icf-research-branch.org).

Treatment Planning

After a physical therapist completes the initial evaluation of the child, they will establish a treatment plan of care. This will include the frequency of therapy visits, short-term goals, and long-term goals for the child. Short-term goals may have a target achievement of a few weeks to 3 months, while long-term goals may be up to 6 months. Physical therapy goals should be specific, objective, measurable, and meaningful to the child or caregiver. Physical therapists will monitor a child's progress through reassessments at various intervals. Goals can then be adjusted based on the child's progress. Within school-based physical therapy, goal-setting is a collaborative process that involves the IEP team and includes factors such as the educational environment, level of support available, student strengths, and therapist participation (Wynarczuk et al., 2017).

Physical Therapy for Specific Disorders

Developmental Disability

Pediatric PTs are experts in the variations in motor development associated with developmental disability (DD) and implementing therapies to improve overall functionality. The prevalence of DD has increased over the past 25 years due to improved prenatal/perinatal care, increased access to care, and greater public awareness (Callaghan et al., 2017; Zablotsky et al., 2019); however, racial disparities remain a challenge(Howell et al., 2018). The National Health Interview Survey tracks the prevalence of ten developmental disabilities (attention-deficit/hyperactivity disorder, autism spectrum disorder, blindness, cerebral palsy, moderate to profound hearing loss, learning disability, intellectual disability, seizures, stuttering or stammering, and

other developmental delays) in children 3–17 years of age. The 2015–2017 cycle of interviews found an increase in developmental delay compared to the 2009–2011 cycle, with prevalence of 17.8% and 16.2%, respectively (Zablotsky et al., 2019). Children with DD are at increased risk of functional motor impairment and developmental coordination disorder (Lachambre et al., 2021). The association between motor impairments and ADHD, ASD, epilepsy, cerebral palsy, ID, and numerous genetic disorders is well-documented (Busti Ceccarelli et al., 2020; Lee et al., 2021; van Hoorn et al., 2021). Preterm birth is also a risk factor for motor disability. The Extremely Preterm Infants in Sweden Study of children born at less than 27 weeks and without ID, cerebral palsy, hearing or visual impairment found a prevalence of developmental coordination disorder of 37.1% in those born preterm compared to 5.5% in controls at 6.5 years uncorrected age (Bolk et al., 2018). Specific learning disabilities have also been associated with motor impairments. Hussein et al. (2020) reported an association between reading disorders and balance, bilateral coordination deficits and mathematics learning disorder, and running speed and agility in children with more than one specific learning disorder. Fine motor integration and upper limb coordination impairment was also associated with learning disability.

Children with DD may be referred to a physical therapist as a newborn or when the pediatrician identifies a motor concern. The American Academy of Pediatrics offers guidance for the screening of newborns and ongoing developmental surveillance (Lipkin & Macias, 2020) as well as a clinical report on the evaluation of motor delays, which includes a review of genetic disorders with associated motor delay (Noritz & Murphy, 2013). Children with DD are best cared for in a medical home, where the coordinator can assist with specialty referrals such as PT and arrange for community supports such as Early Steps.

A Brief Review of General Movements

The science of fetal and infant movements has advanced dramatically since Prechtl first described general movements (GM) in the 1980s (Prechtl & Hopkins, 1986). Fetal movement is first detected at about 7 weeks postmenstrual age, with GM emerging in the fetus at 9–10 weeks (Lüchinger et al., 2008). GM are spontaneous and involve the whole body, providing a marker for the functionality of the developing nervous system (Prechtl et al., 1997). After delivery, between 0 and 9 weeks corrected age, normal GM are described as writhing movements and, at 6–20 weeks, as fidgety movements. After 20 weeks, GM fade as voluntary movements emerge (Prechtl, 1990). Fidgety movements are a motor reflection of the cortical and subcortical networks (Hadders-Algra, 2018). The assessment of GM considers the variation, complexity, and fluency of movements (Palisano et al., 1997; Prechtl et al., 1997). Absent or abnormal GM are associated with a poor neurological outcome (Hadders-Algra, 2018). Tools for assessing GM include the General Movement Assessment (Prechtl, 1997) and the Hammersmith Infant Neurological Examination (Haataja et al., 1999). Recently, assessment through artificial intelligence video analysis has proved promising (Silva et al., 2021). Preliminary studies have identified abnormal movement patterns which may serve as a biomarker for neurodevelopmental disorders including ASD (Caruso et al., 2020). While video analysis is becoming a useful tool, the evaluation by a pediatric PT provides the basis for therapy to improve functionality in children with DD.

PT Treatment for Children with Developmental Delay

PT treatment will vary based on the functional strengths and needs of the child. For the infant, the PT may assist with feeding strategies, environmental alterations to promote self-calming, parent education regarding expected motor

milestones, and the importance of skin-to-skin contact, known as kangaroo care. PT also addresses the positioning that is necessary to avoid tight muscles due to poor alignment, as positioning can influence developing cerebral motor pathways (Wood et al., 2015), For toddlers, PT will support the development of motor milestones. For older children, the focus will be to increase functionality to allow participation in self-care, school, and the community. When necessary, the PT will assess for orthoses or other equipment. The best treatment plan to address child-specific needs is highly individualized, but improving overall fitness is a universal goal.

The American Physical Therapy Association (APTA) has provided guidance on the role of the pediatric PT in promoting fitness, with recommendations for strength training, aerobic exercise, and adapting sports programs for children with DD (O'Neil et al., 2012). Children with developmental disability are at increased risk for poor physical fitness and obesity (Neumeier et al., 2017). Overall strength, endurance, and cardiorespiratory fitness have been noted as concerns for children with IDD (Wouters et al., 2020). In addition, pain or discomfort may limit activity (Barney et al., 2020). Because of the motivation necessary to achieve and maintain fitness, PT for fitness addresses more than functionality. Personal goals, family, environment, stressors, and readiness for change must be considered to avoid derailing the fitness plan (Bloemen et al., 2017; Rowland et al., 2015). Rowland et al. (2015) summarizes over 30 measures available for assessing the fitness level and specific interventions for persons with DD. The Gross Motor Classification System (GMCS-E&R) is a foundational measure for children ages 2–18. The GMCS-E&R assigns one of five functional levels to a child's self-initiated movement, including sitting, transfers, mobility, and use of mobility devices to inform treatment planning, progress monitoring, and communication among professionals clinically and in research (Palisano et al., 2008). The PT will select additional measures of strength, endurance, aerobic capacity, or balance based on the GMCS-E&R (Rowland et al., 2015).

Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by social interaction and communication deficits with restricted and/or repetitive behaviors (American Psychiatric Association, American Psychiatric Association, & DSM-5 Task Force, 2013). While stereotyped or repetitive motor movements are a diagnostic feature of ASD, other motor impairments are common, including delays in fine and gross motor skills, postural delays, and imitation and praxis impairments (Bhat et al., 2011). In addition, motor development plays a role in other developmental domains.

Motor delays in children with ASD are common. The Western Australian Register for Children with ASD assessed over 2000 children at the time of ASD diagnosis with 79.1% scoring low or moderately low on the Vineland Motor Skills Domain. Only 24 of the children had been diagnosed with a motor disorder prior to the Vineland (Licari et al., 2020). The SPARK (Simons Foundation Powering Autism Research for Knowledge) autism research study queried nearly 16,000 families noting that 15.1% of children carried a developmental coordination disorder diagnosis, and 31.6% were receiving physical therapy. The Developmental Coordination Disorder Questionnaire was then administered with 86.9% showing a significant motor impairment (Bhat, 2020). These studies highlight that the PT needs of many children with ASD were not being met.

The possibility of early motor phenotype as a marker for ASD has been suggested, specifically, gait biomechanics, manual dexterity, and neuromuscular tone (Esposito & Pasca, 2013; Jequier Gygax et al., 2021; Licari et al., 2020; Lidstone et al., 2020; Paquet et al., 2017; Wilson et al., 2018). Moseley and Pulvermueller (2018) have proposed an action perception integration theory as a mechanism linking motor abnormalities to social communication and conceptual deficits in ASD centering on the transfer of information between motor and sensory regions. While research regarding action perception in persons with ASD is mixed, a meta-analysis suggests that

perception and interpretation of motion lags behind TD peers with children with ASD showing a greater impairment than adolescents with ASD (Cusack et al., 2015; Todorova et al., 2019). With the increasing interest in the motor development of children with ASD, treating children with ASD is an essential competency for pediatric PTs and there has been a call for additional information on best practices for treating children with ASD (Cynthia et al., 2019; Rapport et al., 2014).

PT for children with ASD often addresses fundamental motor skills often through ECSS or in a school setting. Healy, Obusnikova, and Getchell (2019b) conducted a systematic review of fundamental motor skills (FMS) interventions targeting balance, locomotor, and object-control skills, with significant improvement noted in each category. Because PT goals can be advanced through games, physical education, and even applied behavioral analysis, PT supports cognitive and sensory development while increasing motor skills (Aniszewski et al., 2020; Bhat et al., 2015). A 10-year narrative review of motor skills intervention outcomes found improvements in fine motor, gross motor, and coordination skills with results regarding the impact of improved motor function on core social and communication features of ASD mixed (Busti Ceccarelli et al., 2020). While a more recent review suggests that interventions with a duration greater than 16 hours and greater intensity (frequency) are more effective (Case & Yun, 2019), this correlation was not noted by Colombo-Dougovito and Block (2019), who noted the need for more research to determine optimal interventions, duration, and frequency. Because gross motor delays have been associated with more problem behaviors with poorer quality of life for children with ASD, the need for assessment and treatment of motor delays should be considered in all children with ASD (Hedgecock et al., 2018).

In recognition of the contributions of physical activity to achieving developmental milestones, the U.S. Department of Health and Human Services recommends that preschool children have opportunities for physical activity throughout the day. One hour of moderate to vigorous activity is recommended for children and adolescents (Piercy et al., 2018). Children and teens with ASD are less likely than typically developing peers to meet this guideline, with adolescents lagging behind younger children (Healy, Aigner, et al., 2019a). The American Physical Therapy Association has published a clinical guideline for the *Prevention and Management of Obesity* (Orringer et al., 2020) addressing prevention, screening, diagnosis, and treatment for persons over the age of two; however, the needs of persons with ASD/IDD are not specifically addressed. There is not a general exercise program recommended for children with ASD. In addition to overall health benefits, aerobic exercise has been associated with a decrease in stereotypic and self-injurious behaviors and improved social skills and engagement (Andy, 2020; Aniszewski et al., 2020).

Cerebral Palsy

As movement specialists, physical therapists are critical to the health and development of children with cerebral palsy (CP) by assisting children to achieve greater strength, motor functionality, and independence through early intervention and ongoing targeted therapies. CP is the most prevalent motor disability in children, with the National Health Interview Survey for 2009–2016 reporting a weighted prevalence of CP as 3.2 per 1000 children ages 3–17 (McGuire et al., 2019). For children born before 32 weeks, this increases dramatically to 6.8% (Pascal et al., 2018). Cerebral palsy was defined by the International Workshop on Definition and Classification of Cerebral Palsy in 2006 as:

> a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain. (Rosenbaum et al., 2007, p. 9)

As with many descriptive diagnoses, the etiologies of CP are multifactorial and complex. Preconception, prenatal, perinatal, and postnatal risk factors for CP have been identified (Sadowska et al., 2020). In addition, an array of genetic and metabolic disorders have been identified as CP mimics (Leach et al., 2014; Pearson et al., 2019).

The American Academy of Neurology has published a practice parameter for the assessment for cerebral palsy (Ashwal et al., 2004). The American Academy of Pediatrics provides guidance to the medical home for children with CP (Liptak & Murphy, 2011), As the diagnosis of CP is beyond the scope of PT practice, here we will briefly review the assessment and treatment of CP provided by the PT.

The Evaluation of CP

The goal of the PT's evaluation is to synthesize physical, radiographic, and historical information in order to develop an individualized treatment plan detailing specific interventions and expected outcomes for a child with CP (Jewell, 2014). In addition to the general assessment procedure described above, there is careful attention to movement and postural control and tone. A Delphi study achieved a consensus definition of postural control as "control of the body's position in space for postural orientation and postural stability [balance]" (Dewar et al., 2017, p. 467). Postural control includes strength and stability within the core muscles to prepare for movement and the ability to hold oneself upright when sitting or standing. Good postural control allows the arms and legs to mover more freely. Postural tone refers to the tension of the muscles supporting the spine and is altered with spasticity and abnormal extensibility. Muscles are also assessed for shortening or overlengthening (Beaman et al., 2015). Movement of the spine, joints, and gait is assessed. As early intervention is critical to improve functionality, the assessment of the general movements of infants at risk for CP is critical. Absent fidgety movements at 3 months is strongly associated with a later diagnosis of CP, with abnormal movements also indicating risk (Ferrari et al., 2011; Øberg et al., 2015; Prechtl et al., 1997). Five classification systems are in common use by PTs for diagnosing a child's level of functionality and progress monitoring (Patel et al., 2020). See Table 18.2. The gold standard is the Gross Motor Function Classification System – Expanded and Revised categorizes self-initiated movement into five levels of functionality and is generally stable after the age of two (Palisano et al., 1997; Palisano et al., 2006; Palisano et al., 2008). The evaluation may also include assessment for orthotics, adaptive equipment, or assistive technology (Patel et al., 2020). If a PT orders durable medical equipment, the physician may receive an authorization request from the supplier in order to secure insurance payment. The evaluation of CP may be complicated by comorbid conditions including pain, epilepsy, intellectual disability, speech disorders, sleep disorders, and mental disorders, including ASD (Novak et al., 2012).

Table 18.2 Function assessment tools

Classification system	Domain
Gross motor function classification system – Expanded and Revised[1]	Classifies self-initiated movement, with emphasis on sitting, transfers, and mobility with a five-level classification system. Validated for 0–18-year-olds. Valid for use in persons with Down's syndrome.
Manual ability classification System[2]	Classifies how children 4–18 years of age use their hands to manipulate objects during activities of daily living in a five-level system.
Communication function classification System[3]	Classifies the effectiveness of daily communication using a five-level system. Validated for ages 4 and above.
Eating and drinking ability classification System[4]	Classifies functional eating and drinking ability using a five-level system. Validated for ages 3 and above.
Visual function classification System[5]	Classifies how visual ability is used in daily life in youth ages 1–19.

[1]Palisano et al. (2021), [2]Eliasson et al. (2006), [3]Hidecker et al. (2011), [4]Sellers et al. (2014); [5]Baranello et al. (2020)

The Treatment of CP

The treatment of CP is designed to maximize functional ability. The rapid development of the brain during the perinatal and first years of life offers an opportunity for early interventions to capitalize on neural plasticity. Early intervention is critical in order to promote the brain develop-

ment that is the foundation for complex motor movements throughout life (Spittle et al., 2018). The International Clinical Practice Guideline for *Early Intervention for Children Aged 0–2 Years With or at High Risk of Cerebral Palsy* (Morgan et al., 2021) includes recommended interventions to improve motor skills, promote reduction in motor tone, and support parents. The Guideline specifically recommends against passive movement, sleep positioning systems, and a wait-and-see approach. Recommended interventions to improve motor skills include targeted motor training activities, constraint-induced movement therapy, bimanual movement therapy, comprehensive hypertonia management, regular use of standing equipment for positioning, and ankle-foot orthosis.

As children age, the goal of the PT remains maximizing functionality as youth engage with their environment in more complex ways. In addition to the interventions mentioned above, action observational training, treadmill training, function chewing training, context-focused therapy, and home programs using goal-directed training have shown efficacy (Novak et al., 2020). More recently, virtual reality-based therapies for improving upper limb functionality have shown promise (Demers et al., 2021; Rathinam et al., 2019). The National Longitudinal Transition Study 2, a study that examines the experience of students as they leave secondary school, documented a dramatic decrease in PT when a student left school, with 60% of students with CP receiving PT in school, but only 35% receiving PT as emerging adults (Liljenquist et al., 2018). The authors highlight the importance of care with a medical home and the provision of well-coordinated transition services for adolescents with CP.

Future Directions in PT

The role of the pediatric PT is critical to the development and quality of life of children living with developmental disability. The PT's focus on functionality and overall wellness not only addresses impaired musculoskeletal function and pain; PT interventions can prevent dysfunction, making the PT a critical medical home team member delivering care to promote maximum independence. With the pandemic, the PTs have deftly shifted to offering virtual therapy which many families find convenient and effective. Current research into developmental trajectory of motor skills in persons with ASD may lead to the identification of a biomarker, further increasing the role of PT in the diagnosis of ASD and the development of motor interventions for children with ASD (Parma & de Marchena, 2016).

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