Assessment and Treatment of Children with Cerebral Palsy

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KEYWORDS

• Orthopedics • Cerebral palsy • Hips • Spine • Spasticity • Neuromuscular • Feet

KEY POINTS

- Children with cerebral palsy are prone to development of musculoskeletal deformities.
- The underlying neurlogic insult may results in a loss of selective motor control, an increase in underlying muscle tone, and muscle imbalance, which lead to abnormal deforming forces acting on the immature skeleton.
- The severely involved child is one who is at increased risk for developing progressive musculoskeletal deformities.
- Close surveillance and evaluation are key to addressing the underlying deformity and improving and maintaining overall function.

INTRODUCTION

Orthopedic management of children with cerebral palsy is a challenging task. The presentation is highly variable, ranging from those with mild clinical manifestations to those who are severely involved. The critical part in the initial assessment of children with cerebral palsy is the identification of risk factors for development of deformities so that attempts can be made to circumvent these events. This, in turn, maintains or improves a child's overall function.

Cerebral palsy is characterized by an injury or insult to the immature brain. This may occur before, during, or up to 5 years after birth. The pathology in the brain is permanent and nonprogressive. It results in a wide variety of postural and movement disorders. Clinical manifestations are determined by the timing of the injury and whether they occur in the preterm (immature) or term (mature) infant. The underlying pathology can point to probable patterns of involvement. An immature or preterm infant with periventricular leukomalacia typically presents with spastic diplegia, whereas a child with periventricular hemorrhage is more likely to present with hemiplegia. Cerebellar involvement may present with hypotonia and ataxia. Occasionally, more than one lesion exists in the brain, resulting in a mixed presentation. A full-term child with watershed ischemia between the anterior and middle cerebral artery presents with quadriparesis whereas a focal ischemic injury in a full-term child presents with hemiparesis. Although the brain lesion is static, its manifestations are progressive. The primary manifestations of the neurologic insult include loss of selective motor control alteration in muscular balance and muscle tone abnormalities. This results in secondary manifestations of abnormal growth and development of the musculoskeletal system. It significantly affects a child's function, including

The authors have nothing to disclose.

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Orthop Clin N Am 45 (2014) 313–325

http://dx.doi.org/10.1016/j.ocl.2014.03.003

0030-5898/14/$ – see front matter

abnormalities in gait and ambulation. The compensations that children undertake to overcome or adapt to these secondary manifestations are termed, *tertiary manifestations*.[1] It is in addressing the secondary and tertiary manifestations where orthopedists take a lead role, with the goal of correcting lever arm dysfunction, preventing progression of deformity, and optimizing overall function. In a sense, the role of orthopedic surgeons is to maintain, improve, or optimize a child's function and alter the natural history of the condition.

CLASSIFICATION

Classification systems help define and quantify the underlying pathology. They help determine and guide clinicians toward the most appropriate treatment and aid in communication between clinicians. Several classification systems have been proposed, dating as far back as the 1800s. The most comprehensive of these is the classification proposed by Minear in 1956,[2] which takes into consideration every aspect of a child, including physiologic, topographic, etiologic, traumatic, neuroanatomic, functional, and therapeutic involvement. Bax and colleagues[3] proposed a simpler classification system based on motor abnormalities, associated impairments, anatomic and radiographic findings, and causation and timing. Functional classification schemes are also commonly used and these are based on a child's overall functional capability. The Gross Motor Functional Classification System (GMFCS) is the most widely used functional scheme. It divides children into 5 groups based on the overall functional capability (**Table 1**).[4] The Functional Mobility Scale (FMS) describes motor function into 6 levels in 3 domains based on typical walking distance of 5, 50, or 500 m. This system is used to monitor change in motor function over time.[5]

Table 1
Gross motor function classification system

GMFCS Level	Description
I	No functional impairment
II	Functional limitation, may need assistive device
III	Assistive device needed for ambulation
IV	Limited self-mobility, wheelchair often required
V	Wheelchair bound

ASSESSMENT

Assessment of children with cerebral palsy centers on a complete history and physical evaluation. The history must include birth history and associated underlying medical conditions. The clinical evaluation should consist of a clinical evaluation of gait, both barefoot and with the use of orthotics, if any. Rotational profile should be checked to evaluate underlying torsional malalignment. Range of motion should be checked for the presence of any contractures. The specific underlying muscle tone is evaluated and recorded. A more detailed evaluation may include strength testing and an evaluation for selective motor control. Orthotics, assistive devices, and wheelchairs are evaluated to ensure that they fit properly.

Radiographs should be taken on the first orthopedic visit to establish a baseline; this is particularly true of the hips and pelvis. The severity of involvement and amount of deformity present dictate the frequency and need for sequential imaging studies on follow-up visits. Other advanced imaging techniques may be required prior to planning of reconstructive procedures.

A comprehensive gait analysis can be performed to obtain an objective assessment of the gait pattern that could be measured and quantified. This information can be further assessed to help in preoperative planning. It also provides a permanent record to compare the outcome of surgery. Studies have shown that gait analysis may aid and improve in surgical decision making in children with cerebral palsy.

HIPS

The hips in children with cerebral palsy are normal at birth. The deformity occurs from loss of selective motor control and abnormalities in muscle tone and balance. Such deformities include coxa valga, femoral anteversion, and acetabular dysplasia. The muscular imbalance is typically due to strong hip flexors and adductors overpowering the hip extensors and abductors. The rate of hip subluxation in cerebral palsy has been reported as high as 75%.[6–15] It is related to a child's level of function. Lonstein and Beck[7] found the rate of hip subluxation 11% in ambulators and 57% in nonambulators. Root[8] reported the incidence of dislocation to be 8% and subluxation 38%. Soo and colleagues[16] found no displacement in children who were GMFCS 1% and found 90% displacement in children who were GMFCS V. Increased femoral anteversion and coxa valga were also noted to be related to children's GMFCS level; Robin and colleagues[17]