

The Foot and Ankle in Cerebral Palsy

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KEYWORDS

• Foot • Ankle • Cerebral palsy • Management

Foot and ankle problems are common in children with cerebral palsy (CP). In ambulatory children, the efficiency of gait may be compromised. Nonambulatory children may have problems with orthotic and shoe wear. Surgical interventions are frequently performed to address these issues. This article presents the current paradigm for clinical decision making for surgery about the foot and ankle in children with CP. This approach is built on a standardized assessment and classification of disruption of foot alignment and function in these children. Surgical treatment principles and options are considered, and preferred surgical techniques for the most common foot and ankle problems in children with CP are described.

CLINICAL DECISION MAKING

Clinical decision making for the management of foot deformities in children with CP can be standardized by the use of a diagnostic matrix (Table 1). This paradigm is based on the collection and integration of data from 5 sources: the clinical history, physical examination, plain radiographs, observational gait analysis, and quantitative gait analysis (which includes kinematic/kinetic analyses, dynamic electromyography [EMG], and dynamic pedobarography).¹

Clinical History

The most common complaints related to foot deformity in children with CP are pain with ambulation, shoe wear, or use of orthoses; tripping because of poor clearance in swing phase; and in-toeing or out-toeing.

Physical Examination

Foot segmental alignment is assessed in both weight-bearing and non-weight-bearing conditions. Manual examination is performed to determine intra- and intersegmental flexibility, active and passive range of motion, and individual muscle strength and selective control. The static standing alignment of the foot is best assessed from the front, behind, and both sides. The plantar and medial margins of the foot should be examined for the presence of inadequate or excessive skin callous formation, which indicates disrupted loading patterns or problems with shoe or orthotic wear.

Plain Radiographs

Standardized radiographic analysis of foot deformity in children with CP should include 3 weight-bearing views: standing anteroposterior (AP) and lateral views of the foot, and AP view of the ankle. Foot deformities are best identified and classified by dividing the foot into 3 segments and 2 columns, then determining the relative alignment of each segment and the relative length of each column (Fig. 1). A comprehensive technique of quantitative segmental analysis of the ankle and foot, with normative values, has been developed, based on qualitative techniques derived from the foot model originally developed by Inman and colleagues.^{2,3} This approach uses 10 radiographic measurements to determine the alignment of the 3 segments and the lengths of the 2 columns of the ankle and foot. Individual measures of segmental alignment that are beyond 1 standard deviation from the normal mean value are considered to be abnormal and can be used to describe malalignment patterns.

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Table 1 The diagnostic matrix	
Source	Information
Clinical history	• Pain • Tripping • In-/out-toeing
Physical examination	• Gross foot shape weight bearing/non–weight bearing • Flexible/rigid • Plantar callous pattern
Radiographic examination	• Segmental alignment weight-bearing, anteroposterior, and lateral views
Observational gait analysis	• Foot contact with floor (3 rockers) • Foot progression angle • Foot clearance in swing phase
Quantitative gait analysis	• Kinematics • Kinetics • Dynamic electromyography • Pedobarography

Observational Gait Analysis

Ambulation is best observed from multiple view-points in the coronal and sagittal planes. This observation is most effectively achieved by having the child walk toward, away from, and past the examiner. The subject should be barefoot and wearing short pants, which allows for adequate visualization of the thigh, knee, lower leg, ankle, and foot. The key events of the gait cycle related

to dynamic foot function that may be appreciated on observational gait analysis include foot position at initial contact (heel strike, flat foot, or toe strike), foot alignment in midstance (varus or valgus in the coronal plane; internal or external in the transverse plane, described as the foot progression angle), foot alignment at toe-off (varus or valgus in the coronal plane, dorsiflexed or plantarflexed in the sagittal plane), and foot clearance in swing phase.^{4,5}

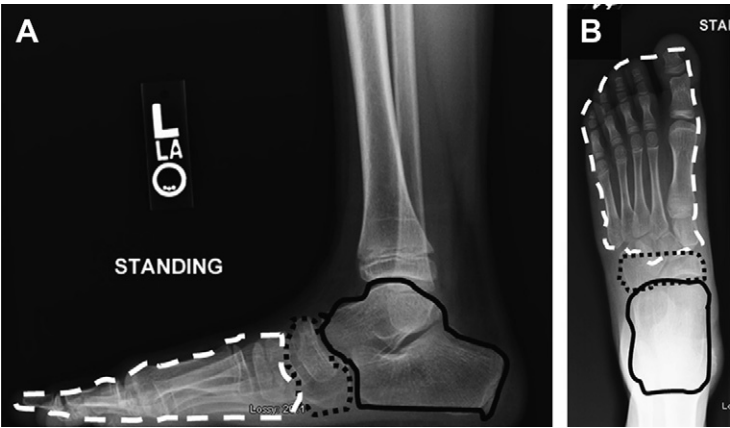


Fig. 1. Radiographic segments of the foot. (A) Lateral radiograph of a normal foot. The hindfoot (talus and calcaneus) is outlined by the solid black circle. The midfoot (navicular and cuboid) is outlined by the dotted black circle. The forefoot (cuneiforms, metatarsals, and phalanges) is outlined by the dashed white circle. (B) AP radiograph of the foot. The hindfoot (talus and calcaneus) is outlined by the solid black circle. The midfoot (navicular and cuboid) is outlined by the dotted black circle. The forefoot (cuneiforms, metatarsals, and phalanges) is outlined by the dashed white circle. The medial column (not outlined) consists of the talus, navicular, cuneiforms, and great toe metatarsal and phalanges. The lateral column (not outlined) consists of the calcaneus, cuboid, and lesser toe metatarsals and phalanges.

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