

Common Gait Abnormalities of the Knee in Cerebral Palsy

DAVID H. SUTHERLAND, M.D., AND JON R. DAVIDS, M.D.

Gait abnormalities in children with cerebral palsy are the consequence of contractures across joints, muscle spasticity, and phasically inappropriate muscle action. Though abnormalities involving one of the major joints of the lower extremity will usually have consequences on the function of the other joints, it is possible to recognize certain primary disorders at each joint. The most common gait abnormalities of the knee in patients with cerebral palsy occur in the sagittal plane. Based on the experience gained from performing gait analysis on more than 588 patients with cerebral palsy, four primary gait abnormalities of the knee have been identified: jump knee, crouch knee, stiff knee, and recurvatum knee. In this review, each abnormality is described by its motion analysis laboratory profile (physical examination, motion parameters, electromyography [EMG] data, and force plate data). The most common etiologies and the consequences for gait of each disorder are also considered. Appreciation of the most common pathologic patterns of gait should facilitate accurate and detailed analysis of the individual patient with gait abnormalities.

One of the most significant applications of a motion analysis laboratory is the evaluation of the pathologic gait of individuals with cerebral palsy. Despite the many etiologies of cerebral palsy, these patients have been found to exhibit several common gait abnormalities. With respect to the knee, there are four com-

mon pathologic patterns seen in ambulatory patients with spastic diplegic-type cerebral palsy. The understanding of these abnormalities begins with an appreciation of normal knee function during ambulation.

For the purpose of analysis, ambulation is best considered within the framework of a gait cycle.⁹ The gait cycle begins with foot-strike and continues until successive, ipsilateral foot-strike. This cycle is divided into two major phases: stance and swing. The components of stance phase can be further divided into three periods, based on four events, whereas those of swing are best considered in three periods based on three events.

Though there are three dimensions of motion about the knee, the common gait abnormalities in cerebral palsy occur in the sagittal plane. Coronal plane abnormalities, such as genu varum and genu valgum, occur less frequently, and are usually attributable to abnormalities at other joints that cause the body's mechanical axis to fall either medial or lateral to the physiologic axis. Excess femoral anteversion and valgus instability of the subtalar joint are common examples. The knee deformity in this plane is usually a secondary phenomena and thus will not be considered at this time. Transverse plane abnormalities at the knee, such as excess internal or external rotation, are also secondary phenomena, most often attributable to femoral or tibial torsional deformities.

The sagittal plane motion curve of the knee has two flexion waves (Fig. 1). The first

From the Department of Orthopaedic Surgery, University of California, San Diego, San Diego, California, and the Motion Analysis Laboratory, Children's Hospital, San Diego, San Diego, California.

Reprint requests to David H. Sutherland, M.D., Motion Analysis Laboratory, Children's Hospital, 8001 Frost St., San Diego, CA 92123.

Received and accepted: January 9, 1992.