Although the knee is the largest joint in the lower extremity, it creates fewer problems in children with cerebral palsy (CP) than the hip, foot, or ankle. It is not clear exactly why the knee joint is relatively immune to the pathomechanics that affect the hip and foot; however, because the muscles primarily control motion in a single plane, there is less opportunity to create severely maldirected force vectors. Most of the stability of the knee is due to its inherent ligamentous stability, the strength of which is usually able to overcome the weak abnormal muscle forces in varus, valgus, or torsional malalignment planes. The high stress on the extensor side of the joint may lead to patella alta and stress reactions in the patella. Stiff knee and crouch gait patterns are most defined by the position of the knee; however, most of the etiology of these problems emanates from the foot.

Ankle equinus was the first CP deformity that received significant attention. In Germany in the early 1800s, Louis Stromeyer developed the Achilles tenotomy. An English physician, William John Little, who himself had hemiplegic pattern CP, had Dr. Stromeyer do an Achilles tenotomy for him.1 He was so impressed with the result that he became a great proponent of tenotomy for CP. He also studied the causes of CP and wrote so extensively that even today in England CP is still referred to as Little’s disease. By the early 1900s, Achilles tenotomy was well established and attention was directed at the varus component, which sometimes accompanies the equinus. A whole series of tenotomies, lengthenings, and tendon transfers were devised for the tibialis anterior and posterior. By the mid-1900s, many operations were developed for polio patients, such as subtalar fusions, triple arthrodesis, and multiple foot osteotomies. These operations were applied to the spastic feet of children with CP as well.

The role of the foot in gait function was much better defined in the 1980s, changing the focus from isolated foot deformities to a more global evaluation of the lower extremity. Because of the history focused on correcting clearly recognizable problems, there is almost no literature or data available to discern the natural history of various foot deformities. Almost all procedures devised to correct foot deformities have some positive results based on review of the literature. Poor results are reported only on rare occasions. This tendency to prefer reporting good results over bad combined with no defined natural history against which to compare published results makes an objective assessment of many reported foot procedures difficult. In spite of this problem, a better understanding of the role of the foot in gait has led to current recommendations that are based in part on the reported literature and in part on theory still needing clinical validation. The problems of the
foot and ankle include tibial torsion, ankle valgus, and subtalar varus and valgus deformities, as well as forefoot and toe deformities.

Knee Flexon Flexion Contracture

By far the most common problem occurring in the knee is contracture of the hamstring muscles, which, if left untreated, leads to fixed knee flexion contracture. The fixed knee flexion contracture can become severe, with deformity of the femoral condyles (Figure 11.1). These contractures can occur in children with all types of CP, and usually occur during the most rapid growth period.

Etiology

The cause of hamstring contracture is directly related to spasticity and relative decreased growth rate of the length of the muscle fibers. Knee flexion is the only major joint in the lower extremity that has only one relatively small single joint muscle. Most of the function is by multiple joint hamstring muscles. The short head of the biceps is small in comparison to other hamstring muscles. This muscle is also active predominantly in early swing phase to assist knee flexion if it is needed.2 The popliteal muscle is too small to have significant mechanical impact on knee flexion. There are six multiple joint muscles that are major flexors of the knee. In CP with decreased motor control, managing these complex motor units is difficult. The sartorius, which assists hip flexion and knee flexion in swing phase, seldom develops pathologic contracture causing impairment. The reason for this is unclear, but the antagonist of the sartorius probably overpower the sartorius and does not allow a contracture to develop. The gracilis, which is active primarily in swing phase,2 is more often identified as a hip adductor causing limited hip abduction because a contracture limits hip abduction more than knee flex-

Figure 11.1. This 13-year-old girl has a fixed knee flexion contracture of 35°. The lateral knee radiograph shows flattening and some indentation of the lateral femoral condyle. These changes in the femur suggest that correction of the knee joint contracture will be difficult with a capsular release because there is a tendency for the joint to hinge at the point of this flattened area. If correction of the knee contracture is indicated, correction with a distal femoral extension osteotomy is a better choice.