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Radionuclide Evaluation of Legg-Calvé-Perthes Disease

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The etiology of Legg-Calvé-Perthes disease (LCP) remains an enigma despite being one of the most frequently studied pediatric orthopedic disorders. The reasons for the uncertainty surrounding the etiology of LCP are multiple. LCP is a clinically silent disorder during its initial stages, and only with complications such as collapse of the epiphysis or the onset of synovitis do symptoms and signs such as pain and limitation of motion appear. This sequence occurs weeks to months after the onset of the avascular necrosis (AVN) incident. In my experience, the mean duration of symptoms before the appearance of radiographic changes of AVN averages 5 months.20 Importantly, the plain radiographic examination is insensitive and nonspecific for the vascular changes of AVN in bone. To further confound the issue, changes in other disorders, such as steroid osteopathy20 and epiphyseal dysplasia,63 mimic the radiographic changes of LCP in its later stages.

Bone scintigraphy is recognized as a sensitive, specific method for studying LCP. Bone pharmacueticals in bone are based on the perfusion and metabolism of bone. There are no other radiologic modalities whose images are derived or are based on the principles of the perfusion of bone; thus bone scintigraphy depicts the vascular integrity of bone and provides a means for the early recognition of ischemia or avascularity.

The radiographic appearance in the later stages of LCP has been postulated as being related to the extent of the avascularity within the epiphysis. The Salter classification relates the extent of the rim fracture to prognosis.81,82 A fracture line greater than 50% of the epiphysis indicates a poor prognosis. Unfortunately, the rim fracture sign appears late in the second stage of LCP and is seen in fewer than 30% of cases.82,88

The Catterall classification estimates the extent of dead bone in the epiphysis based on its radiographic appearance.12,13 The Catterall classification is not applicable during the first or even the second stages of LCP, and there is a poor interobserver correlation when using this classification.51,55,78,87

Historical Considerations

Legg-Calvé-Perthes disease was initially described during the early part of the twentieth century.9,61,73 The clinical entity of a limping child, usually a white boy between the ages of 5 and 10 years, must have puzzled practitioners because of the paucity of clinical history, clinical signs, and laboratory findings of trauma, tumor, or infection.

The early use of radiography to identify skeletal abnormalities provided a definitive means for the
diagnosis and classification of the various stages of LCP. One of the early roentgenographic staging classifications by Waldenström remains the basis for most such classifications. His classification allowed insight into the evolution of the disease process, and it has frequently been correlated with the eventual outcome of the disease. The original Waldenström classification can be further modified to reflect early and late phases of stage 2. For the purposes of this chapter, the roentgenographic appearance is related to the original Waldenström staging classification. Other radiographic criteria have been proposed as prognostic indicators of the final outcome but because there is no morbidity associated with LCP pathologic specimens to correlate with the radiographic appearance are rare. The paucity of pathologic findings, especially in the earliest stages of the disease, has hindered our understanding of the underlying pathologic mechanisms and the evolution of the healing process.

Vascular Anatomy of the Pediatric Hip

To interpret the appearance of the scintigraphic patterns in LCP, it is important that one understand the characteristic vascular anatomy of the proximal femoral epiphysis in the child. There are two primary arterial branches arising from the deep femoral artery that supply the femoral head and neck (Fig. 14.1). The medial circumflex artery passes posterior to the femoral neck and enters the hip joint laterally. The artery then passes through the hip joint intracapsularly to enter the femoral head in a posterolateral sector of the epiphysis. A rete of branching arterioles extends medially and anteriorly within the epiphysis.

The lateral circumflex artery traverses the hip capsule medially and enters directly into the femoral metaphysis. A rete of arterioles ramifies throughout the femoral neck. Importantly, the lateral circumflex artery does not normally traverse the physis (epiphyseal growth plate) of the femoral head. To recapitulate, the medial circumflex artery passes laterally and traverses the intracapsular portion of the hip joint to enter the femoral head in the posterolateral sector of the epiphysis. The lateral circumflex artery enters the femoral metaphysis directly from the medial side of the hip. In the normal situation, neither the artery nor its branching rete of vessels crosses the epiphyseal growth plate.