Embryology

The human knee dates back 320 million years in the evolutionary scale to Eryops, the common ancestor of reptiles, birds, and mammals (Figure 2.1). The Eryops knee was bicondylar, with a femorofibular articulation, cruciate ligaments, and asymmetric collateral ligaments. The patella was not yet present. As evolution continued, the fibula migrated distally, away from the joint line; and the bicondylar femur rotated internally and developed a medial offset, bringing the joint progression closer to the midline. The osseous patella developed separately in birds, some reptiles, and in mammals about 70 million years ago. This was a late development compared with the cruciates or the condylar surfaces. The anterior femoral articular surface extended proximally beneath the patella to form the sulcus and completed the development of the patellofemoral joint (Figure 2.2).1,2

Sreeter outlined a staging system for embryologic development that depended upon the external appearance of the embryo and not upon the length or the age of the embryo.3 He proposed 23 stages or horizons from the single cell through the end of the embryonic period, when the nutrient vessel enters the humerus. The leg bud appears during horizon 13 (28 days). In horizon 18 (37 days), the chondrification of the femur, tibia, and fibula begins, along with early differentiation of the patella and the patellar ligament. At horizon 22 (45 days), chondrification of the patella begins along with the differentiation of the cruciate ligaments and the menisci. Thus, at the end of the embryonic period, the knee resembles the adult structure (Table 2.1).4

There are three primary synovial plicae of the knee: (1) the suprapatellar, (2) the medial, and (3) the infrapatellar (Figure 2.3). The knee joint at 12 weeks of gestation is a single synovial cavity. Between 11 and 20 weeks of gestation a suprapatellar plica forms in approximately one third of the fetuses and goes on to separate the suprapatellar pouch from the primary knee joint by the fourth month of gestation. This plica then develops into four variants in the adult knee: (1) a full septum, (2) a fenestrated septum, (3) a medial shelf, or (4) a fully involuted structure.5 The medial synovial plica develops during the same gestational period in approximately one third of the fetuses, and the infrapatellar plica develops in 50% of the fetuses.6 The pathologic conditions of the plicae of the knee can mimic many of the symptoms related to the patellofemoral articulation and should be included in any thorough differential diagnosis. The epiphyses of the distal femur and the proximal tibia are both present at birth. The proximal fibular epiphysis and the patellar ossification center are not present until age 3 years for the female and age 4 or 5 years for the male (Table 2.2).7

Patellar Dysplasias

There are several types of patellar dysplasias, including aplasia, hypoplasia, partial hypopla-
Figure 2.1. The relationship of Eryops to mammals as depicted by Mossman and Sarjeant (Adapted from the footprints of extinct animals, Mossman DJ, and Sarjeant WAS. *Sci Am* 250:78-79, 1983 with permission. Copyright © 1983 by Scientific American, Inc. All rights reserved.)