Most acute injuries seen in pediatric and adolescent athletes represent pathologies that are unique compared with the adult population, which is attributable to the anatomical differences of the immature skeleton. These differences affect virtually all aspects of injury care including the initial evaluation, medical diagnosis, and management. For example, skeletal injuries are more common in pediatric and adolescent athletes than are injuries to ligaments (Schenck, American Academy of Orthopaedic Surgeons, & American Association of Orthopaedic Surgeons, 1999). This is because the attachment sites of ligaments are functionally weaker than the ligaments themselves in the immature skeleton. Injury mechanisms that result in a ligament injury in an adult can produce an avulsion fracture of the attachment site of the ligament in an athlete with an immature skeleton. Avulsion fractures can also involve the attachment sites of tendons, known as apophyses, and can mimic acute muscle strains. Apophyseal avulsion fractures are the most common sports-related injuries in the pelvic region in pediatric athletes (Auringer & Anthony, 1999). Another category of injuries unique to the pediatric and adolescent is epiphyseal, or Salter-Harris, fractures. These injuries in the lower extremity typically involve either the distal femoral or proximal and distal tibial epiphyseal plates and are commonly associated with (tackle) football, subsequent to a valgus mechanism of injury (Auringer & Anthony). A major concern with epiphyseal trauma is the long-term prognosis of an arrested growth plate or angular deformity.

**Key Points**

- Skeletal injuries are much more common in pediatric and adolescent athletes than are injuries to ligaments.
- A major concern with epiphyseal trauma is the long-term prognosis of an arrested growth plate or angular deformity.
- The physes are approximately one third as strong as their related ligaments, and the comparative strength is even more disparate during growth spurts.

**Key Words:** immature skeleton, fractures, avulsions, children and sports injuries

**Acute Injuries of the Pelvic Region**

An array of acute injuries can occur in the pelvic region, with apophyseal avulsions being perhaps the most common. This section focuses on apophyseal avulsion injuries. By definition, this injury involves attachments of tendons to a traction apophysis, and in the pelvic region there are many. The common sites for this injury in pediatric and adolescent athletes include the ischial tuberosity (hamstrings), pubis (adductors), lesser trochanter (iliopsoas), anterior superior iliac spine (tensor fascia lata), and anterior inferior iliac spine (rectus femoris).

Injuries at these sites share a common etiology: sudden or violent muscle contraction (Micheli, 1984). Such ballistic muscle activity is typically associated with sports such as gymnastics, tackle football, sprinting, soccer, and...
track-and-field events, as well as other activities involving powerful contractions of the muscles of the lower extremities.

The athlete typically reports having felt a sudden pop or “letting go” near the site of injury, followed immediately by considerable pain and loss of function. In many respects, these injuries mimic muscle strains and are often initially diagnosed as such. Initial evaluation should include a history of the activity immediately preceding the injury, along with palpation of the painful area. Functional testing should include manual muscle testing of the suspected muscle group for increase in pain or significant weakness. Apophyseal avulsions will be point tender in the area of injury and might also refer pain to the region of the hip (Auringer & Anthony, 1999). In contrast to the more common muscle strains, which are notable for tenderness at the musculotendinous junction, these injuries reveal tenderness at, or near, the bony attachment site of the muscle–tendon unit. Walking with a limp is an indication of a more severe form of the injury (Combs, 1994).

Initial treatment should include rest, ice, compression, and elevation (RICE). The athlete should be fitted with crutches to reduce weight bearing and then referred to a physician for a more complete medical evaluation. Radiographic evaluation will confirm the diagnosis. It is worth noting, however, that this injury can be difficult to visualize on the film because of its size, as well as location (Dalzell & Auringer, 1998). Standard treatment for apophyseal avulsions is conservative and includes rest, application of ice, and pain medication followed by gradual return to activity concomitant with a general strength and flexibility program. Surgical intervention is rarely required, because most of these injuries involve minimal displacement of the avulsed segment (Micheli, 1984).

Acute Injuries of the Knee

The knee in pediatric and adolescent athletes is subject to the same stresses and strains as adult knees when engaging in similar activities. Knee injuries in this young population can be complicated by the skeletal anatomy of the distal femur, proximal tibia, tibial tubercle (apophysis), and patella, especially the inferior pole. It has been reported that major ligament disruptions (intrasubstance injuries) are relatively uncommon in children under the age of 14, owing to the relative weakness of their attachments. Nonetheless, midsubstance ligamentous injuries occur (Micheli, 1984). The mechanisms of injury in pediatric and adolescent athletes are similar to those in their skeletally mature counterparts. Although epidemiologic information on the incidence of knee injury in pediatric and adolescent populations is sparse, recent research indicates that these injuries do occur in very young athletes. Shea, Wang, and Pfeiffer (2001) examined insurance-claims data from youth soccer participants and found claims filed for anterior cruciate ligament (ACL) injuries in girls as young as age 12 and boys as young as 5.

There are two general categories of ACL-injury mechanism: noncontact and contact. Noncontact injuries typically involve landing from a jump, rapid deceleration, and quick directional changes when running. In spite of extensive ongoing research, a recent consensus report on the topic concluded that the precise mechanism of injury for noncontact ACL injuries has yet to be determined (Griffin et al., 2000). Contact injuries involve a collision with an opponent or some inanimate object. These typically involve an external blow to the lateral side of a weight-bearing leg, generating injury to the ACL and the medial collateral ligament.

The specific acute knee injuries discussed in this section include ACL tears, tibial avulsion fractures, and epiphyseal-plate (Salter–Harris) fractures.

ACL Tears and Tibial Avulsion Fractures

Although epidemiologic data on injury types and rates in pediatric and adolescent athletes are rare, it is generally agreed that the incidence of knee-ligament injury is increasing because of the growth in participation in youth sports (Iobst & Stanitski, 2000). In the case of the ACL, the relative incidence of intrasubstance ligament ruptures compared with avulsions of the tibial eminence is unknown. It has been reported, however, that the latter occur most frequently in children between the ages of 8 and 12 years, as a result of the relative weakness of the tibial eminence as compared with the ACL (Iobst & Stanitski).

The mechanisms of injury for ACL tears in children (see Figure 1) are the same as for adults. Typically this injury is noncontact in nature and is often