The Painful Wrist in the Pediatric Athlete

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Abstract: Wrist pain is common among pediatric and adolescent athletes, either as a result of acute injury or chronic stress. Referring and treating physicians must be aware of occult bony and ligamentous injuries about the wrist in order to properly evaluate and treat acute injuries. The clinician must also be aware of the consequences of repetitive loading of the wrist during upper extremity weight-bearing, especially with regard to distal radius physeal injury in skeletally immature gymnasts. The present review provides current strategies for evaluation and treatment of several less commonly discussed sources of wrist pain in the pediatric athlete, including scaphoid fractures, scapholunate ligament injuries, triangular fibrocartilage injuries, dorsal carpal impingement, and gymnast wrist.

Key Words: wrist pain, pediatric sports, pediatric athlete

BACKGROUND

Sports are a major cause of hand and wrist injury in children and adolescents.1,2 The wrist and hand are the leading sites of injuries in many sports,3 including sports that do not use the hands, such as soccer,4 skateboarding,5 and snowboarding.6 Sports activities can produce a wide variety of injuries about the growing wrist, but because most epidemiologic studies have focused on fractures, the true incidence of ligamentous and cartilaginous injuries in this population is not known. Chronic and overuse injuries can also cause wrist pain and dysfunction in growing athletes.

The following sections will discuss acute and chronic injuries to the pediatric athlete’s wrist with special attention to diagnoses that may be unfamiliar to the general pediatric orthopedist.

ACUTE INJURIES

Scaphoid Fractures

The scaphoid is most commonly fractured carpal bone in children.7 The peak age for scaphoid fractures is 13 to 15 years, and scaphoid fractures are rare under 10 years. Most fractures occur in the waist or distal pole. Scaphoid fractures can occur with ipsilateral distal radius fractures.

Snuffbox tenderness and tenderness at the distal pole of the scaphoid with volar palpation and pain with radial deviation of the wrist or axial loading of the thumb are physical examination findings suggestive of scaphoid fractures and should be assessed in any injured wrist. Radiographs should include not only standard PA and lateral views but also a posteroanterior view in ulnar deviation. However, nondisplaced fractures may be undetectable on plain radiographs. Magnetic resonance imaging (MRI) is both sensitive and specific for scaphoid fractures in children and can be used after injury, if a scaphoid fracture is suspected clinically but radiographs are normal. If MRI is not readily available, follow-up radiographs 2 weeks after the injury can aid in the diagnosis with presumptive immobilization treatment until final diagnosis, although occult scaphoid fractures in adolescents can take up to 7 weeks to become evident on plain radiographs.8 If a fracture is readily apparent on plain radiographs, but displacement is unclear, computed tomography (CT) is helpful for assessing the degree of displacement in the sagittal plane.

Most scaphoid fractures are nondisplaced and can be treated nonoperatively with high rates of union after immobilization in a thumb spica cast.7 Displaced scaphoid fractures are best treated with open reduction and internal fixation with wires or, more commonly, osseous screws. On rare occasions, structural bone graft is required to anatomically align the scaphoid in acute cases. CT scans are used to determine the degree of displacement and operative indications. In adults now, percutaneous fixation is commonplace for nondisplaced or minimally displaced acute fractures. The indications in adolescents are unclear but are also becoming more commonplace practice in the elite athlete. Under fluoroscopy, at times with arthroscopic assistance, volar distal to proximal or dorsal proximal to distal screws are placed. This is particularly useful in proximal pole fractures that have such a high rate of avascular necrosis and nonunion.

As many as two thirds of scaphoid fractures in adolescents present as nonunions9 (Fig. 1). Scaphoid nonunions can be treated with open reduction, internal fixation, and bone grafting with vascularized bone graft reserved for cases with established avascular necrosis of the proximal pole or failure of conventional bone grafting.10,11 Results are excellent for healing, return of function, and motion.
Distal Radius Fractures

The incidence of distal radius fractures does not necessarily correlate with sports activity likely owing to the extremely common nature of this injury. Nonetheless, sports activities are a major cause of distal radius fractures, and some of these injuries may be preventable. For instance, wrist guards lower the risk of distal radius fracture in high-risk sports, such as inline skating and snowboarding.

The evaluation and treatment of distal radius fractures is covered in detail in subsequent sections of this symposium, but it is worth noting in this context potential concomitant injuries more distally in the wrist, such as scaphoid fracture and triangular fibrocartilage complex (TFCC) tear. Scaphoid fractures should be routinely ruled out by physical examination (and further imaging, if needed) in any distal radius fracture in adolescents (Fig. 2). Tears of the TFCC are likely to be quite common in the setting of a displaced distal radius fracture, especially, when accompanied by a displaced ulnar styloid fracture. However, the majority of these tears likely heal uneventfully in the time that it takes the distal radius fracture to heal and are thus not a cause of ongoing pain. Nonetheless, persistent ulnar-sided wrist pain after successful treatment of a distal radius fracture should prompt investigation for unresolved TFCC tear. Artho-MRI scans are the most useful diagnostic test and arthroscopy is the gold standard for diagnosis and treatment.

Scapholunate Ligament Injury

Ligamentous and cartilaginous injuries may go unrecognized in children and adolescents owing to difficulty in evaluating the incompletely ossified carpus and a propensity to assume that wrist injuries with normal radiographs are physeal fractures. Scapholunate distance
on pediatric wrist radiographs does not reach the normal adult value of 2 mm until at least age 12. Persistent wrist pain and appropriate clinical examination findings should raise suspicion for scapholunate injury even with normal radiographs. Stress radiographs, MRI, and arthroscopy can aid in diagnosis of scapholunate ligament injuries. Acute, complete tears are generally easier to diagnose with imaging, whereas partial tears are typically diagnosed by arthroscopy in the setting of chronic posttraumatic pain unresolved with conservative treatment.

Partial ligament injuries can be debrided arthroscopically with excellent symptomatic relief as long as carpal instability does not exist. Complete tears can be diagnosed arthroscopically and treated with open repair and pinning. Perilunate dislocation should be treated with reduction, ligament repair, and pinning.

**TFCC Injuries**

Injuries to the TFCC are commonly diagnosed in adults but not often considered in children. TFCC injuries can coexist with distal radius fractures in children or can occur as isolated injuries. Ulnar-sided wrist pain and swelling after a twisting injury to the wrist (such as in color-guard, stick sports, falls) should raise suspicion for acute TFCC tear. Tenderness palmar to the ulnar styloid and pain with full passive supination are indicative of a TFCC tear. Splinting or casting can be used as initial treatment depending on the degree of symptoms. Persistence of symptoms prompts MRI with or without intraarticular contrast, although some tears may be missed with even the most advanced imaging. Arthroscopy can confirm diagnosis and allow repair of large tears with satisfactory results in children (Fig. 3).

**CHRONIC PAIN**

**Gymnast Wrist**

Wrist pain is common among growing gymnasts, including elite and nonelite competitors, which can be associated with growth disturbance in the distal radius. Repetitive axial loading of the wrist causes cumulative injury to the distal radius physis. The distal ulna is unaffected or less affected. Growth of the distal radius may slow or cease and lead to distal radius deformity or distal ulna overgrowth. Wrist pain and physeal tenderness in a competitive gymnast should prompt radiographic evaluation. Radiographic physeal widening or irregularity indicates physeal damage/dysfunction and should prompt a discussion about ceasing gymnastics.

**FIGURE 3.** Arthroscopic visualization of a large peripheral triangular fibrocartilage complex tear after an acute twisting injury to the forearm.

**FIGURE 4.** A, Distal radius physeal widening in a highly competitive female gymnast with chronic wrist pain. Cessation of gymnastics was advised but not heeded. B, Same wrist 9 months later with distal radius growth arrest and ulnar overgrowth.
participation temporarily or permanently. Acute worsening of physeal wrist pain in a gymnast, with or without specific incident, should be treated as an acute physeal fracture. Complete distal radius growth arrest may require distal ulna epiphysiodesis or ulnar shortening osteotomy to prevent or treat distal ulna overgrowth (Fig. 4).

Dorsal Carpal Impingement

Weightbearing on a hyperextended wrist can produce dorsal wrist pain from dorsal radiocarpal/synovial impingement. Push-ups and bench-pressing are common offending activities. Elimination or modification of activities to prevent wrist hyperextension can relieve symptoms. For instance, push-ups can be done on handles or fists to keep the wrist in more neutral alignment. If symptoms persist despite conservative treatment, arthroscopic debridement of the dorsal synovitis along with excision of the articular branch of the posterior interosseous nerve may be necessary.

Generalized Chronic Wrist Pain

Vague, chronic, activity-related wrist pain is common among adolescents, often girls between the ages of 13 and 16. There is typically no history of specific trauma but sometimes a history of heavy participation in grip-intensive sports, such as racquet sports or fencing. Ligamentous laxity is a common finding, but other physical findings are nonspecific. Radiographs and MRI are typically normal. Formal hand therapy focusing on grip strengthening (isometric wrist flexor/extensor strengthening) without wrist isokinetic or range-of-motion exercises is effective at reducing or eliminating the pain in most patients. Failure of conservative management should prompt further evaluation with advanced imaging or arthroscopy. Depression or simply a lack of desire to participate in the offending activity or sport may be causative or exacerbating factors and should also be addressed in the evaluation and treatment. Most chronic wrist pain in adolescents is a nonoperative situation.

REFERENCES