Why Wrist Pain Is Common in Gymnasts

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GYMNASTS DIFFER FROM many athletes in that they spend a large amount of time on their hands. Gymnasts, particularly at higher competitive levels, might practice 20–40 hr/week. The wrists of a gymnast are repeatedly exposed to various combinations of compressive, torsional, and tensile stresses, frequently with the wrist in the extremes of extension, pronation, and supination. Although normal wrist extension is about 60–75°, many gymnastics activities require wrist extension of 90° or greater. This essentially changes the upper extremities into weight-bearing joints. It has been shown that when 11- to 13-year-old gymnasts perform back handsprings, the compressive forces transmitted to their upper extremities are on average 2.37 times their body weight.[1] The combination of high-volume repetition with upper extremity weight-bearing positions can lead to chronic wrist problems.

Wrist pain is a common complaint in gymnasts. A study of UCLA gymnasts revealed that 33% of female gymnasts and 75% of male gymnasts had chronic wrist pain of greater than 4 months duration.[2] A study of young, nonelite female and male gymnasts revealed that 45% reported chronic wrist pain of at least 6 months duration, suggesting that wrist pain is common across all levels of competitive gymnastics.[3] Although a gymnast might suffer from any one of multiple chronic wrist diagnoses, it appears that certain diagnoses are more commonly reported in gymnasts. This column will focus on two diagnoses: scaphoid stress fractures and distal radial physeal stress injury.

Scaphoid Stress Fractures

Stress fractures of the scaphoid have been reported in gymnasts. Although this is generally regarded as an unusual wrist injury, most scaphoid stress fractures reported in the medical literature are in gymnasts. It is important to consider this condition in the differential diagnosis when examining a gymnast with chronic wrist pain.

The blood supply to the scaphoid is less than ideal. The best blood supply, and thus the most readily healed area, is found in the distal portion of the scaphoid. The blood supply to the middle third of the scaphoid (scaphoid waist) is intermediate, and the worst blood supply is to the proximal third of the bone. For acute scaphoid fractures, proximal pole fractures have the highest rate of nonunion.

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It is thought that stress fractures of the scaphoid can be attributed to the combination of factors described in the introduction. These factors are repetitive, compressive, and rotational loads applied to the scaphoid while the wrist is hyperextended. The dorsal joint surfaces are compressed when the wrist is extended, and if radial deviation is added to the equation, the scaphoid and radius come into direct contact with one another.

Gymnasts with this injury will likely have experienced chronic pain for months in the area of the scaphoid. Their pain will be worse in upper extremity weight-bearing positions. They will be tender to palpation in the anatomic "snuffbox," and their pain might be reproduced with passive wrist hyperextension and axial loading by the clinician. Radiographs might reveal sclerosis of the scaphoid but might also be negative. If the clinician's suspicion is high, a bone scan or MRI will help determine the diagnosis (Figure 1).

Treatment of scaphoid stress fractures generally involves cast immobilization for 2–4 months. The long healing period is necessary because of the limited blood supply.[4,5]

Distal Radial Physeal Stress Injury (Gymnast's Wrist)

There is evidence in gymnasts to support the hypothesis that the growth plates around the wrist, particularly the distal radial physis, are susceptible to chronic stress injury from repeated microtrauma. Stress injury to the distal radial physis, as diagnosed with radiographic and MRI findings, has been reported in elite and nonelite gymnasts of both sexes.[2,6-8] This injury is sometimes referred to as gymnast's wrist. A distal radial growth-plate injury rate of 2.7 injuries per 100 participants per year in gymnasts has been reported.[6] Studies have shown that 25–51 % of nonelite gymnasts have radiographic findings consistent with distal radial growth-plate stress injury.[3,9]

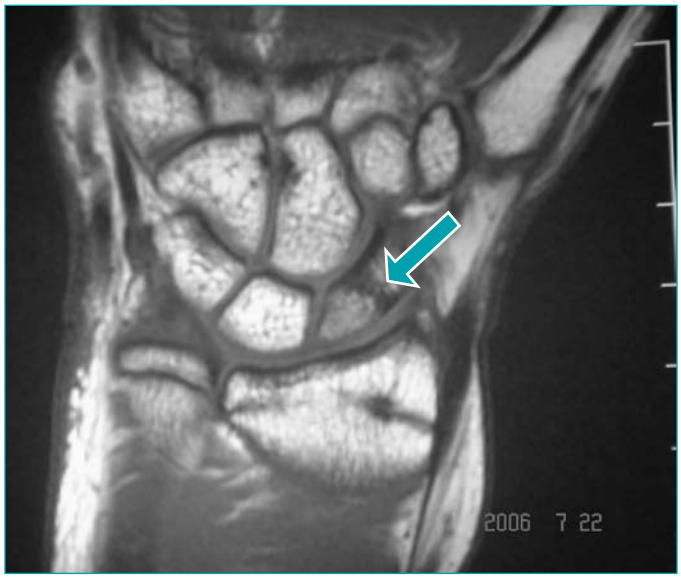

Figure 1 MRI of a scaphoid stress fracture in a gymnast. Initial X-rays were negative after 6 months of wrist pain.

The presenting symptoms of distal radial physeal stress injury generally include the gradual development of dorsal, radial wrist pain that occurs with wrist hyperextension activities. On examination the wrist might be entirely normal or might reveal tenderness over the distal radial physis and reproduction of pain with wrist hyperextension and axial loading.[4,10,11]

Bilateral wrist radiographs should be obtained in order to compare the injured with the uninjured growth plate, although both wrists might be symptomatic. Further complicating matters are the reports of radiographic findings consistent with distal radial growth-plate stress injury in asymptomatic gymnasts.[9,11] An MRI might be helpful to further define the extent of the physeal injury or to further evaluate the physis, if the radiographs are normal.[9,13]

Distinguishing radiographic features of physeal stress injury from normal anatomic variation can be difficult. Roy et al.[8] described radiographic findings thought to be consistent with a stress injury to the distal radial physis in elite gymnasts (see the sidebar below). MRI findings consistent with stress injury to the distal radial physis in gymnasts have also been reported (sidebar on the next page and Figures 2 and 3).[13]

Distal radial physeal stress injury generally responds well to avoidance of upper extremity weight-bearing positions for 4–12 weeks, although up to 24 weeks has been reported in some cases.[4,8,11] Complete

Radiographic Findings of Distal Radial Physeal Stress Injury[8]

- Widening of the physis
- Haziness within the physis
- Cystic changes on the metaphyseal portion of the physis
- Beaking of the epiphysis

MRI Findings of Distal Radial Physeal Stress Injury[13]

- Widening of the physis
- Lack of physeal homogeneity
- Physeal cartilage extension
- Metaphyseal "bone bruise"
- Linear striations

Figure 2 MRI of a gymnast's wrist demonstrating positive ulnar variance, widening of the radial side of the distal radial physis, and physeal cartilage extension into the metaphysis.

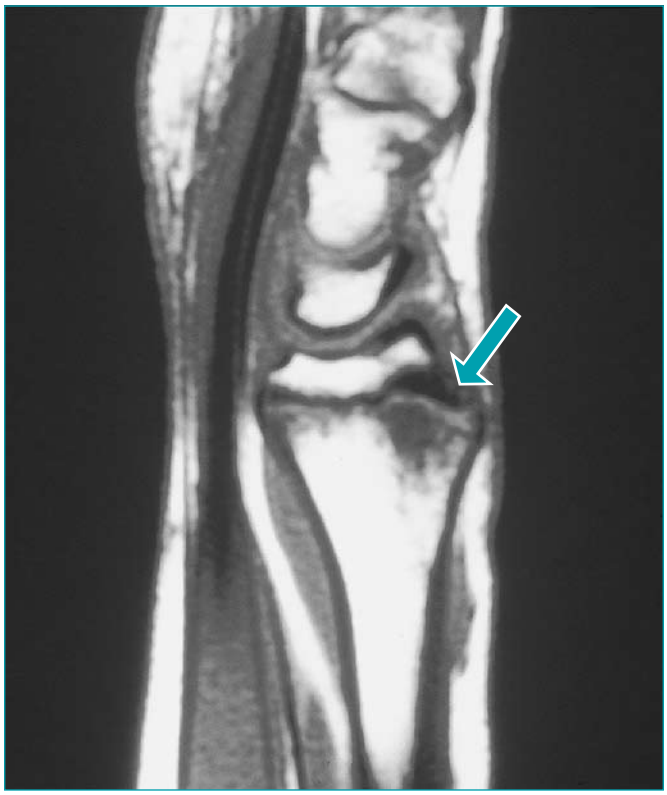

Figure 3 Sagittal-view MRI of a gymnast's wrist demonstrating widening of the distal radial physis and a metaphyseal "bone bruise.

resolution of pain has been reported with or without splint or cast immobilization. Strengthening the wrist extensors and flexors is also recommended. After complete resolution of signs and symptoms, upper extremity weight-bearing activities should be gradually reintroduced and poor technique corrected. The use of a special wrist brace (Ezy ProBrace, Gibson, Englewood, CO; Lion Paws, RBJ Athletics, Spanish Fork, UT) for injury prevention or on return to gymnastics after this injury might be warranted. These specially designed braces are thought to block excessive wrist hyperextension and also provide extra padding on the palmar side of the hand to help reduce the forces on the distal radial growth plate.[4,6,10,11,14]

There is growing concern that chronic distal radial physeal stress injury might lead to long-term complications. Some of this concern is based on the high prevalence of positive ulnar variance (length of ulna greater than the radius) found in the elite gymnasts and less negative ulnar variance seen in nonelite gymnasts than in nongymnast controls and norms.[2,3,9-11] Various authors have speculated that chronic stress injury to the distal radial physis can lead to premature closure of that growth plate and secondary growth inhibition of the radius. Growth inhibition of the radius or growth stimulation of the ulna could potentially result in a radius that is shorter than the ulna.[2,6,9,10,12] A change in the length relationship of the ulna and radius can alter load-distribution properties, thus placing more stress on the ulna. Positive ulnar variance in gymnasts has been associated with tears of the triangular fibrocartilaginous complex, degenerative changes of the carpal bones and ulna, and alterations of the radioulnar articulation.[2,4]

It is important to realize that not all gymnasts with positive ulnar variance experience wrist pain. Data from one study revealed that approximately 50% of gymnasts with positive ulnar variance were asymptomatic, and another reported no correlations between mean ulnar variance and wrist pain or X-ray finding.[3,12] Further research into the relationship of distal radial

growth-plate injury, positive ulnar variance, and chronic wrist pain should be pursued, because these relationships have yet to be fully defined.

Summary

Gymnasts represent a unique population of athletes because they spend an unusually large amount of time using their wrists as weight-bearing joints. Although wrist pain is common in gymnasts, it is not normal. Using the wrists as weight-bearing joints can lead to overuse injuries of the wrist, such as scaphoid stress fracture and distal radial physeal stress injury. These problems can be successfully treated if considered in the differential diagnosis of a gymnast presenting with wrist pain. Failure to recognize these problems early and manage them appropriately, particularly injury to the distal radial physis, could lead to long-term complications.

References

1. Koh T, Grabiner M, Weikler G. Technique and ground reaction forces in the back handspring. *Am J Sports Med*. 1992:20(1):61-66.
2. Mandelbaum B, Bartolozzi A, Davis C, Teurlings L, Bragonier B. Wrist pain syndrome in the gymnast: pathogenetic, diagnostic, and therapeutic considerations. *Am J Sports Med*. 1989:17(3):305-317.
3. DiFiori J, Puffer J, Aish B, Dorey F. Wrist pain, distal radial physeal injury, and ulnar variance in young gymnasts: does a relationship exist? *Am J Sports Med*. 2002:30(6):879-885.
4. Gabel G. Gymnastic wrist injuries. *Clin Sports Med*. 1998:17(3):611-620.
5. Werner S, Plancher K: Biomechanics of wrist injuries in sports. *Clin Sports Med*. 1998:17(3):407-420.
6. Caine D, Roy S, Singer K, Broekhoff J. Stress changes of the distal radial growth plate: a radiographic survey and review of the literature. *Am J Sports Med*. 1992:20(3)290-298.
7. DiFiori J, Puffer J, Mandelbaum B. Factors associated with wrist pain in the young gymnast. *Am J Sports Med*. 1996:24(1):9-14.
8. Roy S, Caine D, Singer K. Stress changes of the distal radial epiphysis in young gymnasts: a report of twenty-one cases and a review of the literature. *Am J Sports Med*. 1985:13(5):301-308.
9. DiFiori J, Puffer J, Mandelbaum B. Distal radial growth plate injury and positive ulnar variance in nonelite gymnasts. *Am J Sports Med*. 1997:25(6):763-768.
10. Dobyns J, Gabel G. Gymnast's wrist. *Hand Clin*. 1990:6(3):493-505.
11. Wyzykowski RJ, Lovallo JL, Simmons BP. Wrist injuries in the child. In: DeLee JC, Drez D, Miller MD, eds. *Orthopedic Sports Medicine: Principles and Practice*. Philadelphia, Pa: Saunders; 2003:1364-1381.
12. Chang C, Shih C, Penn I, Tiu C, Chang T, Wu J. Wrist injuries in adolescent gymnasts of a Chinese opera school: radiographic survey. *Radiology*. 1995:195(3):861-864.
13. Shih C, Chang CY, Penn I, Tiu C, Chang T, Wu J. Chronically stressed wrists in adolescent gymnasts: MR imaging appearance. *Radiology*. 1995:195:855-859.
14. Hecht SS, Gymnastics. In: Mellion MB, Walsh WM, Madden C, Putukian M, Shelton GL, eds. *Team Physician's Handbook*. 3rd ed. Philadelphia, Pa: Hanley & Belfus; 2001:668-677.

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