

# Upper Extremity Injuries in Gymnasts



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## KEYWORDS

- Gymnast • Wrist pain • Carpal instability • Ulnar positive • Ulnar abutment
- Triangular fibrocartilage complex • Scaphoid stress fracture • Grip lock injury

## KEY POINTS

- Gymnasts' wrist is a complex entity with multiple potential diagnoses caused by load bearing on the upper extremity.
- Distal radial physeal injury can occur with load in the immature wrist and lead to later ulnar positive variance and ulnar abutment.
- Ulnar abutment and TFCC tears are common causes of ulnar-sided wrist pain in gymnasts.
- Scaphoid stress fractures can occur because of stress with loading at the scaphoid waist.
- Grip lock injuries are unique to gymnastics and are caused when the leather or dowel grip worn on the wrist/hand locks onto a bar and prevents the wrist from rotating.

## INTRODUCTION

Gymnastics is a unique sport with varied activity requirements that cause the upper extremity to be used as a weight-bearing extremity. The load demands on the wrist can lead to musculoskeletal issues with chronic use and overuse. In 1989, Mandelbaum and colleagues<sup>1</sup> reported that 87.5% of male gymnasts and 55% of female gymnasts complained of wrist pain with activities requiring compression and impaction of the joint. Of this cohort, 75% of male gymnasts and 33% of female gymnasts noted wrist pain for longer than 3 months. The authors termed these findings "wrist pain syndrome," incorporating ligamentous tears, triangular fibrocartilage complex (TFCC) tears, and secondary chondromalacia of the carpus. Gymnastics as a sport has become more demanding with complex stunts requiring the athletes to begin at a younger age and to train more hours during the week to advance. The abnormal amount of weight bearing on the wrist at a young

age has shown changes in the development of the wrist in addition to the more typical overuse complaints in this population of athletes.

## DISTAL RADIUS PHYSEAL INJURY

### *Background*

Physeal injuries to the immature distal radius present in a range from mild dorsal wrist pain without radiographic changes to physeal arrest. Because most gymnasts participate in the sport at an early age, the physis is a common site of injury especially with wrist compressive forces reported to be 16 times body weight.<sup>2,3</sup> The immature wrist typically exhibits negative ulnar variance,<sup>4</sup> which naturally distributes a higher load to the distal radius compared with the 80% load seen in neutral variance.<sup>5</sup> Stress injury to the distal radius physis was originally described by Read<sup>6</sup> in three gymnasts with radiographic changes. It is postulated that physeal injury may be the result of compromised blood supply to the metaphyseal and

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epiphyseal area leading to uncalcified chondrocytes.<sup>7</sup> Chronic compression can lead to full arrest manifested as a shift to ulnar positivity<sup>8,9</sup> or a partial closure appearing similar to a Madelung deformity.<sup>9-11</sup>

### **Diagnosis**

Clinical evaluation should include a thorough history to define the chronicity and the elements that most exacerbate symptoms. Pain, noted as generally dull and aching at the dorsal wrist, is typically experienced with loading in elements, such as floor routines, vaulting, or pommel horse, and relieved with rest. Although pain at rest may be from other causes, it can also be a sign of a more severe injury. On examination, tenderness to palpation at the distal radial physis is noted. Radiographs often show characteristic changes as described by Roy and colleagues<sup>12</sup>: widening of the radial physis, cystic changes of the metaphysis, beaking of the distal aspect of the epiphysis, and haziness within the physis. When radiographs are negative, MRI is recommended to further evaluate the physis and to rule out other causes.

### **Conservative Modalities**

Conservative treatment, as in other overuse-type injuries, centers on avoidance of compressive loading, splinting for immobilization, and often complete rest with no gymnastics participation. There are no known pharmacologic treatments to support an injured physis, and unless pain is experienced at rest, analgesics are not recommended. Reassessment after 6 weeks should be performed to consider the athlete suitable for gradual return. Physical therapy should be prescribed to address the entire upper extremity and contralateral side when improved ability to dissipate forces may prevent recurrence. Return to gymnastic elements should begin gradually, with slowly increasing wrist loading if the athlete remains pain free.

### **Surgical Treatment**

Surgery is reserved for treating the consequences of compressive load on the distal radius physis with injury or arrest, specifically focused on the treatment of resulting positive ulnar variance.<sup>13</sup> Long-term observational studies of gymnasts are scant in literature. Although Claessens and colleagues<sup>14</sup> showed progressive ulnar negativity in gymnasts in 4- to 5-year follow-up, DiFiori and co-workers<sup>15</sup> showed significantly greater ulnar variance compared with normative values at 3-year follow-up. If ulnar-positive variance is noted in association with radial physeal arrest, this should be treated to avoid progressive degeneration with

ulnar abutment and articular surface changes and TFCC degeneration (discussed later). Partial closure of the radial physis should be treated only if symptomatic, or if progressive deformity creates unacceptable clinical malalignment. Radial physiolysis and ulnar shortening with or without distal ulna epiphyodesis is corrective if growth potential remains.<sup>16</sup>

### **Outcomes**

Longitudinal studies for distal radius physeal injuries are minimal. Bak and Boeckstyns<sup>17</sup> described the use of epiphyodesis of the distal radius and ulna in a 14-year-old gymnast with a 1-year history of wrist pain that interfered with gymnastics, and radiographs showing widening of the radial physis and premature closure of the ulnar aspect. They reported good results with a gymnast who was asymptomatic at 16 months postoperatively and qualified for the national team. Injuries typically present late when premature closure of the physis leads to consequences of ulnar abutment from positive ulnar variance; thus, it is difficult to ascertain how many gymnasts go on to have issues requiring surgical treatment. Treatment of resultant ulnar abutment and/or TFCC tears is described in the following sections.

## **ULNAR ABUTMENT OF THE WRIST**

### **Background**

Excessive transmission of load to the ulnar side of the wrist is called ulnar abutment or ulnar impaction syndrome. With neutral ulnar variance, the distal ulna experiences about 20% of the load of the wrist. With 2 mm of positive ulnar variance, this load can almost double.<sup>5</sup> This is a dynamic change as seen in gymnasts with wrist extension and forearm pronation, such as a handstand, or it is seen at maturity with associated premature radial physeal closure.<sup>8,18</sup> This leads to degeneration of the TFCC and articular surfaces of the distal ulna and lunate.

### **Diagnosis**

Ulna abutment is one of several causes of ulnar-sided wrist pain in the athlete. This entity typically presents with insidious onset of progressive ulnar-sided wrist pain that eventually affects athletic performance. Tenderness to palpation is typically isolated dorsally at the prestyloid recess of the ulna.<sup>19</sup> Loss of wrist and forearm motion may inhibit such elements as the floor exercises, whereas pain with compressive forces affects the vault or pommel horse. Reproduction of pain with the wrist in ulnar deviation as the forearm is

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