Hand Injuries in Rock Climbing

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Rock climbing has gained tremendous popularity in recent decades, causing more people to be exposed to injuries associated with the unique biomechanical forces of rock climbing. In a recent survey of 205 active British rock climbers, 50% had sustained at least one injury in the past 12 months. Wrist and hand injuries make up as much as 73% of all rock climbing injuries, with tendon and pulley injuries being the most common. This often results from the crimp grip position with the distal interphalangeal joints hyperextended, the proximal interphalangeal (PIP) joints flexed at 90°, and the metacarpophalangeal joints extended.

Pulley injuries of the flexor tendons often result from performing a difficult move or slipping off a foothold. In normal climbing conditions, the forces acting on the pulley system are near the biological tear strength. Any slip can exceed this limit, causing strain or rupture. The injuries are most commonly closed; involve rupture of the A2, A3, or A4 pulley; and are termed climber fingers. There is an increased prevalence of these injuries with higher levels of climbing, with 26% of elite climbers having clinical evidence of pulley injuries. An excellent review of these injuries was published by Schoffl and Schoffl in 2006.

Acute finger pulley ruptures are often accompanied by a popping noise and pain over the injured pulley. However, the diagnosis of strain versus partial and complete rupture can be difficult. The middle and ring fingers are most commonly injured. Clinical examination is not reliable. Occasionally, A2 pulley ruptures can result in an increased distance between the tendon and the bone that can be palpated. True bowstringing does not occur unless multiple pulleys are injured. If clinical examination warrants, magnetic resonance imaging (MRI) and dynamic ultrasound are useful, with most advocating for ultrasound first and then MRI in cases of doubt. The ultrasound is performed dynamically first with an extended finger and then with resisted flexion and evaluated for bowstringing. The MRI should be performed with full extension of the metacarpophalangeal joint and 60° flexion of the PIP against resistance. The pulley cannot reliably be visualized, so diagnosis of a pulley rupture is made by identifying separation of the tendon from the bone (Fig. 1).

Treatment varies depending on the extent of the injury. Schoffl and Schoffl reviewed the literature and reported good functional outcomes with conservative management of single tendon pulley injuries. Nonsurgical therapy includes initial immobilization, then functional therapy and slow return to sports, followed by taping of the digits while climbing. Ruptures of the A2 pulley progress more slowly than A3 and A4 pulley injuries. The initial loss of strength after rupture resolves in about 6 months.

The indications for surgical treatment include failed conservative management with clinical deficits as well as ruptures of multiple pulleys with clinical bowstringing. The bowstringing results in reduced distal interphalangeal joint flexion and sometimes an extension deficit of the PIP joint. Various surgical techniques have been described for pulley reconstruction using extensor retinaculum as well as multiple loops with tendon grafts. The intricacies are beyond the scope of this article. In a retrospective comparison of 2 pulley reconstruction techniques, all climbers returned to previous levels of activities. Regardless of the reconstruction technique, postoperative management requires initial immobilization, protective splinting and taping, slow return to resisted flexion and sports, and prolonged (6 or more months) taping after return to sports.

Tendon and Ligament Injuries

Although pulley ruptures dominate the literature, flexor tendon injuries can also be a source of disability in rock climbing. In fact, in the self-reported questionnaire on rock-climbing, tendon injuries were the most common,
making up 25% of the injuries. Tendonitis is the most common, and it generally responds to activity modification. Acute ruptures of both the flexor tendons and lumbricals have been reported. Repair of ruptured flexor tendons are performed acutely, and a variety of techniques are reported. Collateral ligament injuries are also reported in the adult literature; they present after abnormal loading of the joint. Activity modification and functional therapy have been advocated for treatment.

**EPiphyseAL Fractures**

Epiphyseal fractures have been increasingly discovered in young, competitive climbers with chronic pain around their PIP joints. In the largest case series, 24 patients were presented with an average age of 14.5 years. These fractures are not acute injuries; instead, they develop from repetitive stress and present as chronic finger pain around the PIP joint. Radiographic studies must be carefully evaluated with attention to the dorsal aspect of the middle phalanx epiphysis. The injuries are usually minimally displaced Salter-Harris III fractures, but MRI can be used to identify Salter-Harris II fractures in cases of clinical suspicion. Treatment consists of a combination of splinting and functional therapy with cessation of climbing until complete healing has occurred (4 to 6 months). Noncompliance, with return to high-level climbing too early, can lead to finger deformities and partial necrosis of the epiphysis. Surgical management is not reported for rock climbing–related epiphyseal injuries, as they are stress fractures that are minimally displaced and respond to conservative management.

**DUPuyTREN CONTRACTURE**

Repetitive microtrauma of the palmar fascia has been thought to contribute to the development of Dupuytren contracture. A recent questionnaire completed by a climber’s club showed an increased prevalence of Dupuytren contracture, with 19.5% of men having disease involvement. Although there is geographic variability, this is higher than in the general population. In addition, climbers had earlier onset and greater severity of the contracture. The ring finger was most commonly involved, followed by the small finger, and then the middle finger. Increased climbing intensity was correlated with a greater likelihood of contracture.

Rock climbing is increasing in popularity, and it imparts abnormal loading and repetitive forces on the hand that can cause injury to the bones and soft tissue. The diagnosis is not straightforward because multiple structures can be the source of pain, but injuries to the flexor pulleys, flexor tendons, and epiphyseal plates appear to be the most common. In addition, late disability includes earlier and more severe development of Dupuytren contracture.

**REFERENCES**


![FIGURE 1: Magnetic resonance images (T1 fat-saturated) of an A2 and A3 pulley rupture, with substantial bowstringing of the flexor tendons away from the proximal phalanx.](image-url)

JOURNAL CME QUESTIONS

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What pulley(s) can be injured during rock climbing?

a. A2
b. A3
c. A4
d. All of the above

What pulley(s) rupture leads to true bowstringing?

a. A1
b. A2
c. A3
d. A4
e. Multiple pulleys

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