

Rock Climbing Injuries Basics

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Introduction

- Objective: This guide seeks to familiarize medical practitioners with **terminology** that is commonly used in the sport, its **biomechanical demands**, and **mechanisms of injury**. It seeks to inform and help practitioners who may encounter climbing injuries on how to best approach **evaluation**, **management** and **return to sport considerations**.
- Scope: The focus will be on **common climbing specific injuries**. Traumatic injuries, including those sustained in mountaineering, and injuries commonly encountered outside of this sport are out of the scope of this guide. This is not meant to be a comprehensive review of all material but rather a practical resource linking to studies, articles, images and videos that can be further explored or recommended to patients.

Terminology

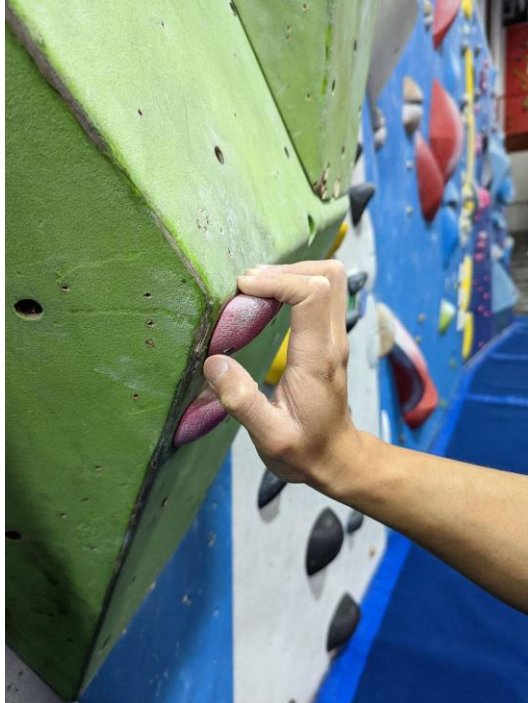
- Climbing styles
 - [Bouldering](#) - Climbing short distances (usually less than 20 feet) protected by a pad on the ground.
 - [Top rope climbing](#) - Climbing protected by a rope passed through an anchor at the top of the wall. Considered the safest with the least fall potential.
 - [Sport climbing](#) - Climbing protected by permanent bolts spaced up the wall. The climber attaches the rope to these bolts as they ascend.
 - [Trad climbing](#) - Climbing without fixed protection. The climber attaches the rope to their own removable gear placed in the wall. Considered the most dangerous and only done outdoors.
- [Climbing holds](#)
 - Jug - A large hold which is easily gripped with the whole hand.
 - Crimp - A small edge which is only large enough for the pads of the fingers.
 - Pinch - A hold which is gripped between the thumb and the rest of the fingers.
 - Sloper - A large round hold which requires an open hand grip.
 - Pocket - A hold into which only one or up to few fingers can be placed.

- Grip techniques

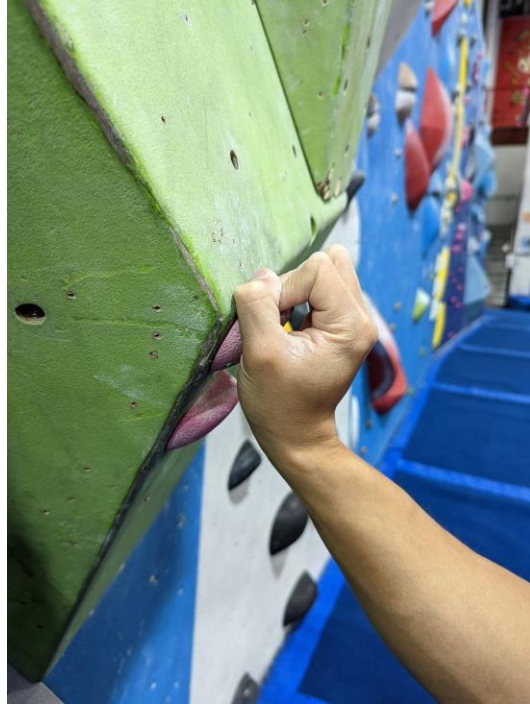
- Open hand grip - The finger joints are all in slight flexion (less than 90 degrees). Typically used for slopers but can be applied to other holds too.



- Half crimp - The PIP is flexed to 90 degrees and DIP in full extension.



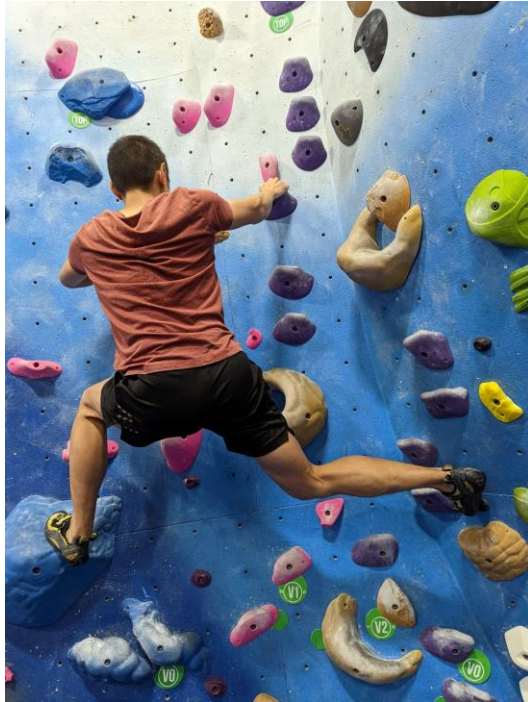
- Full crimp - Similar to a half crimp, but the DIP is hyperextended with the help of the thumb pressing down on the distal phalanx.



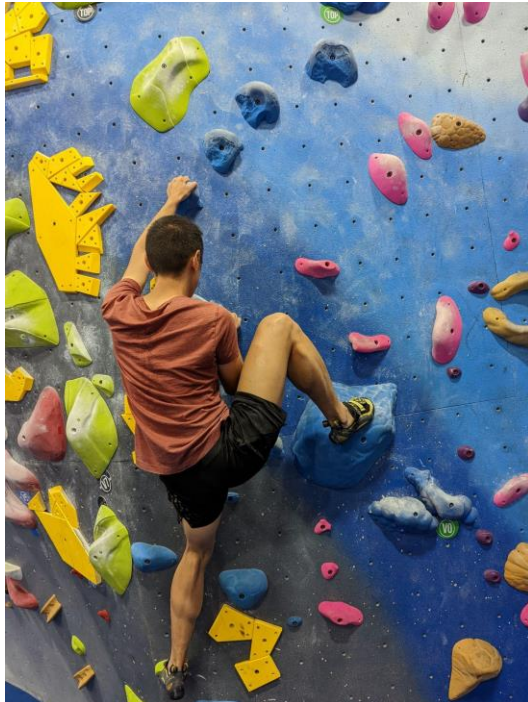
- Climbing moves
 - Heel hook - Pressing the heel of the foot onto a hold to transfer weight off the arms. This can cause a varus stress on the knee.



- Drop knee - Internally rotating one hip while maintaining the ipsilateral foot on a hold causing the knee to go into flexion. This can cause a valgus stress on the knee.

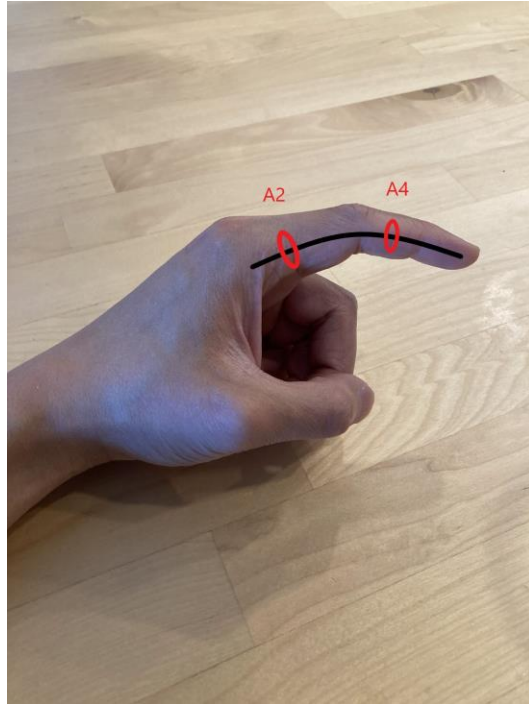


- High step - Weight is almost fully placed on one leg with the knee fully flexed (similar to a one-legged squat) but the hip abducted, externally rotated and flexed



Biomechanics

- The most common points of failure of the finger flexor system are the annular pulleys
 - Pulleys are thickened areas of the flexor tendon sheath that maintain the flexor tendons in close apposition to the phalanges. The A2 and A4 annular pulleys are the most often injured locations from climbing.



- Pulleys allow for an efficient transfer of force from the flexor tendons to the phalanges to generate finger flexion
- The full crimp position [causes more stress](#) on the pulleys than the open hand position
- [An eccentric force](#) (e.g. foot slip, sudden tiring of the muscles, dynamic move) causes more stress than a concentric force

Injury epidemiology

- Approximate distribution - Upper extremity 70% (finger highest prevalence), lower extremity 20% (ankle highest prevalence), other 10%
- Common upper extremity injuries
 - Finger
 - Pulley injury (see below)
 - Elbow
 - Medial epicondylopathy likely under described in the literature but anecdotally [very common](#)

- [Shoulder](#) - More common in older climbers and often due to chronic degeneration, increased prevalence is due to repetitive overhead movements, [muscular imbalance](#) may also play a role
 - Impingement and tendinopathy
 - Labral (SLAP) injury
 - Long head of biceps tendon injury
 - Dislocation and instability
- Common lower extremity injuries
 - [Ankle](#) - Most often due to a fall
 - Lateral sprain
 - Ankle fracture
 - Other fracture (talus, calcaneus)
 - [Knee](#) - Most often due to a fall or performing a heel hook, drop knee or high step
 - Meniscus injury
 - ACL injury
 - IT band injury

Common climbing specific injuries

Pulley injury

- Description - Most common finger injury, rupture of the annular pulley (typically A2 or A4) due to excessive force being applied by the flexor tendons causing bowstringing
- Mechanism - The highest risk of injury is in the full crimp position and after an eccentric force, common scenarios include a foot slip, dynamic move (especially while bouldering or [campus board](#) plyometric training), muscle overuse and inadequate rest, pocket holds
- Symptoms - Weakness, pain and swelling at the injured pulley, tenderness with gripping door handles or climbing holds, less commonly visible bowstringing or an audible pop
- Diagnosis - Dynamic ultrasound is preferred to assess for the change in tendon to bone distance ([multiple protocols exist](#)), MRI can be diagnostic as well
- Grading and Management - Refer to [this article](#) for details on a proposed grading scale, in general pulley injuries are managed non-surgically and involve a period of rest, followed by functional therapy and then graded return to climbing while being protected by taping
 - Functional therapy - Self-directed exercises (e.g. [putty exercises](#), [tendon glides](#), [rice bucket exercises](#)) can be recommended but refer to an occupational therapist for more severe injuries
 - Taping - The [H method](#) is recommended



- Splinting - The Pulley Protection Splint (PPS) is an [effective alternative](#) to taping
- Activity modification - Avoid sharp holds/edges that place direct pressure on the pulley, avoid pockets until the injury is resolved, use an open hand grip when possible, let go when a foot slip occurs rather than holding on

Flexor tenosynovitis

- Description - Inflammation of the flexor tendon sheath
- Mechanism - Cumulative microtrauma from overuse especially repetitive crimping, prior healed pulley ruptures may predispose towards this due to scar tissue impingement
- Symptoms - Pain and swelling of the volar fingers, sometimes extending to the forearm
- Diagnosis - Ultrasound showing fluid accumulation within the tendon sheath (compare to the opposite hand as a control)
- Management - Rest and climbing load reduction, prognosis is [usually excellent](#) with rest and load reduction, various therapies have been tried for refractory cases including [corticosteroid](#) and hyaluronic acid injections

Epiphyseal stress fracture

- Description - Fracture of the growth plate in skeletally immature climbers, typically in the 3rd or 4th fingers, much more common than pulley injuries in this population
- Symptoms - Pain or swelling at the dorsal base of the phalanx, usually the middle phalanx, the climber may not recall a specific inciting event
- [Diagnosis](#) - Usually clinical but x-ray can be helpful for prognosis and to rule out deformity, CT or MRI can be used if the diagnosis is still uncertain
- Management and prevention - Conservative management is usually successful, refer to [this article](#) for recommendations on prevention

Uncommon climbing specific injuries

Lumbrical muscle injury

- Description - Due to shear stress from the extension of one finger but flexion of the others (e.g. while using one finger pockets or “monos”), typically only occurs in the 4th/5th fingers from the bipennate origin of the lumbricals, causes pain and swelling at the base of the finger near the palm
- Diagnosis and management - Refer to [this article](#) for details

Brachialis injury

- Description - Also known as “climber’s elbow” (but has been described in other sports including gymnastics and football), strain or rupture of the brachialis muscle at the musculotendinous junction due to insufficient firing of the biceps while in the pronated position, causes pain and swelling at the cubital fossa
- Diagnosis and management - Refer to [this article](#) for details

Return to sport

- Maintain a collaborative approach when treating climbing injuries and avoid recommending complete cessation of climbing without a clear return to sport plan
- If complete cessation is needed for a period of time, advise that cross-training, such as aerobic exercise and core strengthening, has been suggested to improve climbing performance
- When appropriate, provide advice on taping methods, functional therapy exercises, and counseling to avoid the highest risk activities during recovery (e.g. full crimp grip, campus board training, mono pockets, etc)
- Consider these aspects when advising on a graduated progression of climbing
 - Volume - Start with a low duration and frequency of climbing
 - Intensity - Start several grades below the climber’s current level
 - Hold type - Start with jugs and avoid small crimps until the end
 - Volume and intensity should advance faster than hold type