Elbow and Forearm Injuries

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Introduction

Elbow and forearm injuries are very common in athletes, especially those that practice overhead sports. They can be divided into acute and overuse or chronic injuries. Acute injuries typically occur in contact sports, whereas overuse injuries to the elbow and forearm are usually the result of repetitive stress at the elbow. This chapter will cover region-specific anatomy, elbow biomechanics, as well as common elbow and forearm pathologies seen in athletes.

Anatomy and Biomechanics [1]

Bones and Ligaments

The elbow is a synovial hinge joint comprised of three articulations between the humerus, ulna, and radius bones. The humeroulnar joint is formed by the trochlea of the humerus and the proximal ulna, allowing for flexion and extension at the elbow. Lateral to the trochlea is the capitellum, which articulates with the radial head to form the humeroradial or radiocapitellar joint. The articulation between the proximal radius and ulna forms the radioulnar joint. Both the radiocapitellar and radioulnar joints allow for pronation and supination at the elbow. The elbow joint is surrounded by a fibrous capsule which forms the lateral or radial collateral ligament (RCL) and the medial or ulnar collateral ligament (UCL). The RCL provides varus support, while the more injury-susceptible UCL provides valgus support.

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G. Miranda-Comas et al. (eds.), *Essential Sports Medicine*,
https://doi.org/10.1007/978-3-030-64316-4_11

Muscles

Several muscles pass through the elbow joint that allow for elbow flexion and extension and forearm pronation and supination. Anteriorly, the biceps and brachioradialis muscles function as the primary flexors of the elbow. The biceps also assists the supinator muscle in forearm supination. The short head of the biceps originates from the coracoid process, while the long head originates at the supraglenoid tubercle and both insert at the radial tuberosity and fascia of the forearm. The brachioradialis originates from the supracondylar ridge of the humerus and inserts at the lateral distal radius. Most of the anterior elbow joint is covered by the brachialis, which is another elbow flexor. It originates from the distal anterior half of the humerus and inserts at the ulnar tuberosity. Posteriorly, the triceps functions as the primary elbow extensor. The long head of the triceps originates from the scapula, while the medial and lateral heads originate from the posterior surface of the humerus. The three heads of the muscle join to insert at the olecranon process and fascia of the forearm. The anconeus muscle also aids in elbow extension, originating from the posterolateral epicondyle and inserting at the posterior-proximal ulna. The pronator teres and pronator quadratus are the primary pronators of the forearm.

The musculature of the anterior forearm is comprised of the flexor carpi radialis, flexor carpi ulnaris, flexor digitorum superficialis and profundus, pronator teres, and palmaris longus. The pronator teres has two heads which originate from the ulnar coronoid process and humeral medial epicondyle and insert in the middle one-third of the lateral radius. It also contributes to elbow flexion. Of note, the pronator quadratus aids in pronation distally. It originates from the medial distal ulna and inserts at the anterior distal radius. The common flexor tendon serves as the proximal attachment site for the anterior forearm muscles. The musculature of the posterior forearm is comprised of the extensor carpi radialis longus and brevis, extensor carpi ulnaris, extensor digitorum, and extensor digiti minimi. The common extensor tendon serves as the proximal attachment site for the posterior forearm muscles. The anterior and posterior forearm musculature are primarily responsible for flexion and extension at the level of the wrist and fingers, as well as forearm supination and pronation.

Nerves

Three nerves primarily traverse through the elbow musculature: the median, radial, and ulnar nerves. The median nerve travels anteriorly under the bicipital aponeurosis, passing through the two heads of the pronator teres and into the flexor compartment of the forearm, where it branches into the anterior interosseous nerve (AIN) and the continuation of the median nerve. The ulnar nerve travels from the posterior aspect of the medial epicondyle through the cubital tunnel, emerging anteriorly and continuing along the ulnar aspect of the forearm. The radial nerve travels laterally along the spiral groove of the humerus to the lateral epicondyle, where it crosses the elbow anteriorly between the brachialis and the brachioradialis. It then branches into the posterior interosseous nerve (PIN) and the superficial radial nerve.

Biomechanics

The primary function of the elbow is to stabilize and position the distal forearm and hand. Positioning is achieved through coordinated combinations of elbow flexion/extension and forearm pronation/supination. The average range of motion in elbow flexion and extension is 0–150 degrees; however, only approximately 30–130 degrees is required for functional use. The average range of forearm pronation and supination is nearly 180 degrees about the longitudinal axis. Forearm supination accounts for up to 85 degrees, whereas pronation accounts for 75 degrees. The previously discussed bones, joints, and ligaments work in conjunction to provide passive stabilization, while the muscles serve to actively stabilize the elbow joint.

Acute Elbow Injuries

Fractures and Dislocations [2]

Pathophysiology

Fractures and dislocations of the elbow often occur in conjunction but can be an isolated injury. Elbow fractures fall into four categories: [1] radial head fractures, [2] supracondylar fractures, [3] olecranon fractures, and [4] radioulnar fractures. Elbow dislocations can be characterized as either simple or complex, most often occurring in athletes competing in football, wrestling, or gymnastics. The joint can dislocate in multiple directions, the most common of which is posteriorly. An elbow dislocation without an associated fracture is considered simple, while an elbow dislocation with an associated fracture or nerve damage is considered complex.

Clinical Presentation

Patients often report a history of high-velocity impact or falling on an outstretched hand (FOOSH) as the primary mode of injury leading to severe pain in the elbow. Numbness (i.e., medial, radial, and ulnar nerve damage) and weakness can be seen in more severe cases.

Diagnosis

Although history (mechanism of injury) and physical exam are sufficient to diagnose dislocation, plain radiographic studies are essential to evaluate for an associated fracture. When fracture is suspected, anteroposterior (AP) view in full extension and lateral view in 90-degree flexion should be obtained. Smaller fractures may not be visible on x-ray initially but may become more evident 3 weeks post-injury. In children, oblique views may be more helpful when fractures are not evident, and the fat pad is displaced. Supracondylar fractures, which are most common in children, can often be confused with a dislocation. More complex fractures may require CT imaging to visualize bony fragments. Further classifications of fracture and dislocation types can be seen in Tables 11.1, 11.2, 11.3, and 11.4 [3]. If neurovascular injury is suspected, athletes must be evaluated for acute compartment syndrome.

Table 11.1 Classifications for radial head fractures [3]

Mason's classification for radial head fractures		Treatment
Type I	Non-displaced or minimally displaced (<2 mm)	Hinged elbow splinting with early ROM
Type II	Displaced (>2 mm) or angulated	Open reduction and internal fixation (ORIF) or surgical excision of fragments
Type III	Comminuted fracture	Excision of the radial head
Type IV	Radial head fracture with associated elbow dislocation	Reduction of dislocation Treat fracture based on type I–III classification

Table 11.2 Classifications for supracondylar fractures [3]

Classification for supracondylar fractures		Treatment
Type I	Non-displaced fracture	Long-arm cast or splinting
Type II	Displaced fracture with intact posterior cortex	Reduction and fixation
Type III	Displaced fracture with no cortical contact, unstable	Reduction and fixation

Table 11.3 Classifications for olecranon fractures [3]

Classification for olecranon fractures		Treatment
Type I	Non-displaced or minimally displaced (<2 mm), minimal comminution, elbow stable	Long-arm cast or ORIF
Type II	Displaced (>2 mm), minimal-moderate comminution, elbow stable	ORIF
Type III	Fracture with moderate-severe comminution, dislocation, elbow unstable	Open reduction and stabilization of olecranon

The increased intracompartmental pressure within the arm or forearm can lead to weakness, paresthesia, pulselessness, pallor, and pain with passive digit extension in the affected arm. Compartment pressures can be measured to confirm diagnosis.

Treatment

Any fracture or dislocation at the elbow should be monitored closely for neurovascular compromise, especially with supracondylar or midshaft radioulnar fractures. Compartment syndrome can lead to neurovascular compromise; therefore, surgical intervention with emergent fasciotomy is indicated to relieve pressure and prevent tissue necrosis. For simple dislocations, reduction can be performed on the field or in the office setting. Physical therapy emphasizing ROM is important after the immediate acute phase. Splinting for >3 weeks may lead to adverse outcomes [4]. When there is any suspicion of a dislocation, pre- and post-reduction films are essential to evaluate the fracture and ensure proper alignment. For most non-displaced elbow fractures, immobilization is the primary treatment. Displaced fractures often require surgical intervention (i.e., ORIF) (Tables 11.1, 11.2, 11.3, and 11.4) [3].

Table 11.4 Bado classification for Monteggia fracture-dislocations [3]

Bado classification for Monteggia fracture-dislocations		Treatment
Type I	Fracture of the proximal or middle third of the ulna with anterior dislocation of the radial head	Reduction and fixation
Type II	Fracture of the proximal or middle third of the ulna with posterior dislocation of the radial head	
Type III	Fracture of the ulnar metaphysis (distal to coronoid process) with lateral dislocation of the radial head	
Type IV	Fracture of the proximal or middle third of the ulna and radius with dislocation of the radial head in any direction	

Return to Sport

Athletes with neurovascular injuries or post-compartment syndrome fasciotomies can return to play when symptoms improve and the surgical site has completely healed. Such athletes should continue to be monitored regularly. If no residual instability is noted with full range of motion after a simple dislocation, most athletes can return to play after 6 weeks, with reintroduction of varus or valgus loading at 12 weeks. Prior elbow dislocation does not predispose athletes to repeat injury. Compliance with a comprehensive rehabilitation program is essential to recovery.

In complex dislocations and elbow fractures, return to sport is often not recommended until after 6 months following the injury. Athletes with such injuries require a more extensive rehabilitation program with emphasis on range of motion to avoid contractures. A valgus overload hinged elbow brace is also recommended during rigorous play to avoid valgus stress on the elbow.

Olecranon Bursopathy (Bursitis) [5]

Pathophysiology

Olecranon bursitis is an inflammation of the bursa overlying the olecranon process at the proximal aspect of the ulna. Bursal inflammation occurs by a variety of mechanisms, including acute or repetitive trauma. An acute hemorrhagic bursitis is often seen after direct trauma to the posterior elbow. Repetitive trauma to the posterior elbow will often lead to a nonhemorrhagic effusion. Less commonly, the inflammation may be due to infection.

Clinical Presentation

When the bursitis is secondary to an acute trauma, patients generally present with pain and focal swelling at the posterior elbow. Pain tends to be exacerbated with pressure on the area. However, when the bursitis develops after repetitive irritation of the bursa, the patient will present with focal swelling and minimal pain.

Diagnosis

The most classic physical finding is swelling over the olecranon process. If the area is red or warm, infection should be considered. Elbow ROM is usually normal because the bursa is extra-articular, but movement may occasionally be limited by pain. Radiographs of the elbow should be performed to assess for possible olecranon fracture if significant trauma occurred or an avulsed osteophyte is suspected. Given the risk associated with infection, bursa aspiration should be considered in most patients, as physical exam cannot alone distinguish septic from aseptic bursitis. Definitive diagnosis occurs with laboratory evaluation of cell count, gram stain, and crystal analysis.

Treatment

In the absence of infection, most patients respond very well to a series of one to two aspirations, since recurrence rate is high. This is often combined with NSAIDs, rest, ice, compression, and protection of the elbow with an elbow pad. In a subacute or chronic presentation, aspiration and corticosteroid injection into the bursa may be considered, although the effectiveness of the corticosteroids is questionable.

Return to Sport

The athlete is able to return to sport without restriction when symptoms and physical examination findings resolve. A good measure for return to play is the ability to perform sport-specific drills. If there is no recurrence of symptoms or physical exam findings, the athlete may be cleared for activity.

Triceps Rupture

Pathophysiology

Avulsion of the triceps tendon often occurs in the setting of a deceleration stress superimposed on a contracted triceps muscle. Rupture of the tendon can occur at three places: the tendon attachment to bone, the musculotendinous junction, or in the muscle body itself.

Clinical Presentation

Triceps rupture can be seen in athletes participating in competitive weight lifting and bodybuilding, associated with anabolic steroid use. They most commonly present with posterior elbow pain and weakness. The classic presentation is weakness of elbow extension and a palpable gap in the muscle body. In the setting of acute trauma, ecchymosis or localized tenderness can be appreciated.

Diagnosis

History and physical exam are the primary tools of diagnosis. Ultrasound and MRI are also excellent diagnostic tools for visualizing and differentiating between partial and complete triceps tendon tears [6, 7].

Treatment

For partial tears involving less than 50% of the tendon as well as proximal tears localized to the muscle belly, nonsurgical treatment initially consists of analgesics and splint immobilization at 30 degrees of elbow flexion for 4 weeks. This is followed by physical therapy with emphasis on ROM exercises after 4 weeks and strengthening exercises after 8 weeks.

Complete tendon ruptures are surgically repaired if the athlete presents within 3 weeks of injury [2]. Moreover, in chronic triceps tendon ruptures, surgical reconstruction should be considered. This is followed by a similar immobilization protocol for 2 weeks with progression to active-assisted range of motion in 2–6 weeks and eventual strengthening exercises with weight restrictions beginning after 6 weeks.

Return to Sports

Almost all triceps tendon ruptures require a comprehensive rehabilitation program. Once completed, return to play in nonoperative cases is recommended when athletes have regained full ROM and are no longer symptomatic. In postoperative cases, return to play is not recommended until at least 4–6 months after surgery.

Distal Biceps Tendon Rupture

Pathophysiology

Distal biceps tendon ruptures are rare and account for approximately 3–10% of all biceps ruptures. Generally, athletes are predisposed to this injury when they have already incurred progressive degeneration of the tendon. When forceful extension is applied to a flexed elbow, this already weakened structure can rupture.

Clinical Presentation

Distal biceps tendon rupture is characterized by sudden pain over the anterior aspect of the elbow after a forceful effort against resistance. Athletes often report an audible snap at the time of injury, followed by swelling and bruising. A visible or palpable mass may also develop in the upper arm.

Diagnosis

The history and physical exam findings are often suggestive of diagnosis. Swelling and ecchymosis along with gross deformity and tenderness to palpation are often noted at the antecubital fossa. Provocative maneuvers include the hook test, in which the examiner attempts to hook their finger under the distal biceps tendon at the antecubital fossa with the forearm supinated and the elbow flexed at 90 degrees. Plain radiographs may reveal hypertrophic spurring or bony irregularities that increase the likelihood of rupture and support a clinical suspicion of this diagnosis. Anteroposterior and axillary films are the most useful views for ruling out fractures in this setting. Ultrasound and MRI may also be performed to confirm the diagnosis.

Treatment

Generally accepted clinical guidelines advocate surgical reattachment in athletes within 3 weeks of injury before development of tendon contracture [8]. Cosmetic concerns may also prompt a surgical approach. ROM exercises begin 3 weeks postoperatively, followed by strength training at roughly 8 weeks after surgical intervention. Conservative management is considered appropriate for elderly individuals. This approach involves rest, followed closely by ROM and strengthening exercises for the shoulder and elbow. When conservative management is chosen, there is often a significant reduction in power of elbow flexion and supination.

Return to Sport

Return to sport is often recommended after a comprehensive rehabilitation program is completed and the athlete is 4–5-month postsurgical intervention. Athletes competing in high-impact sports may require the full 5 months to prevent re-rupture.

Overuse Elbow Injuries

Lateral Epicondylopathy [2, 9, 10]

Pathophysiology

Commonly referred to as tennis elbow, lateral epicondylitis or epicondylalgia or epicondylopathy is the most common overuse injury of the elbow. It is an injury to the extensor tendons, most commonly the extensor carpi radialis brevis, and generally arises from repetitive microtrauma and overload. The tendinous insertion is flooded with neovascularization and fibroblasts termed angiofibroblastic proliferation.

Clinical Presentation

Athletes commonly present with aching pain over the lateral elbow, which is worsened with activation of the wrist extensors and alleviated by rest. In more chronic cases, the pain may be persistent and associated with forearm weakness.

Diagnosis

Diagnosis is based primarily on physical exam and history. Pain is elicited on palpation of the lateral epicondyle and is aggravated by wrist extension and radial deviation. In Cozen's test (Fig. 11.1), the examiner palpates the lateral epicondyle while providing resistance against wrist extension. A positive exam will reproduce the painful symptoms. In more severe cases, decreased grip strength may be noted. MRI or ultrasound can be used for diagnosis but is usually reserved for patients who fail conservative therapy.

Treatment

Initial treatment includes NSAIDs, RICE, and activity modification. In tennis players, activity modification involves evaluation and adjustment of the racquet, training regimen, and technique. Inappropriate grip size, higher string tensions in the racquet, and poor stroke mechanics can all contribute.

Fig. 11.1 Cozen's test

Long-term treatment should focus on ROM exercises. Although bracing is a common treatment, continuous immobilization may be harmful as studies have suggested that tendons need stress to heal. If the above conservative management is not sufficient, injections with corticosteroids, platelet-rich plasma, or prolotherapy have also shown to provide relief of symptoms [11, 12]. Surgery is reserved for those with significant decrease in arm strength and may often only restore 90% of the tensile strength.

Return to Sport

Play can be resumed when an athlete has full strength and is able to complete all necessary movements with minimal pain. A brace may be used temporarily, but athletes must continue to participate in a therapy program while recovering.

Medial Epicondylopathy

Pathophysiology

Often referred to as golfer's elbow, medial epicondylitis or epicondylalgia or epicondylopathy is an injury to the common flexor tendons, most commonly involving the flexor carpi radialis tendon. This injury is far less common than lateral epicondylitis. Medial epicondylitis results from repetitive eccentric loading of the wrist flexors and forearm pronators causing excess valgus stress on the medial epicondyle.

Clinical Presentation

Athletes typically present with pain and tenderness over the medial elbow radiating to the proximal forearm. Symptoms are often exacerbated with activation of the wrist flexors. In more chronic cases, weakness can be reported in the forearm and wrist.

Fig. 11.2 Resisted wrist flexion with medial epicondyle palpation

Diagnosis

Diagnosis is based primarily on physical exam and history. Palpation of the medial epicondyle often elicits pain. Provocative testing with resisted wrist flexion with palpation of the medial epicondyle may reproduce symptoms (Fig. 11.2). Ulnar neuropathy may be associated with numbness, weakness, or a positive Tinel test at the elbow. Imaging studies are often unnecessary, but may show calcification adjacent to the medial epicondyle in 7% of affected patients [7, 13].

Treatment

Initial treatment includes NSAIDs, RICE, and activity modification as poor stroke biomechanics in golf and excessive topspin in racquet sports can contribute. Physical therapy emphasizing ROM and strengthening is an important strategy. Counterforce bracing and taping can be useful when return to play is a pressing priority. If the above conservative management is not sufficient, injections with corticosteroids, platelet-rich plasma, or prolotherapy have also shown to provide relief of symptoms. Surgery is reserved for cases that fail conservative treatment, but these athletes often have a longer recovery time of 4–6 months.

Return to Sport

Athletes may ideally return to sport when pain has resolved with activity. Since many athletes are unwilling to wait, bracing and activity modification may be used to reduce aggravation of symptoms.

Triceps Tendinopathy

Pathophysiology

Most commonly seen in weight lifters, triceps tendinopathy is due to repetitive overuse and subsequent degeneration of the triceps tendon insertion at the olecranon.

Clinical Presentation

Athletes present with posterior elbow pain that is worsened with resisted elbow extension. Chronic cases can present with decreased ROM and a palpable depression along the olecranon process.

Diagnosis

History and physical are the primary tools of diagnosis. Plain films may show calcification outlining the tendon. If triceps tendon rupture is suspected, imaging with ultrasound may be sufficient for detection. However, if ultrasound findings are equivocal but a high clinical suspicion remains, MRI should be considered [13].

Treatment

The primary treatment is RICE and NSAIDs. Physical therapy emphasizing triceps strengthening and activity modification to improve weight lifting technique is important in long-term treatment. Intratendinous steroid injection should be avoided due to the risk of tendon rupture. Although relatively novel, orthobiologics such as platelet-rich plasma may be considered if primary treatment methods are unsuccessful [9, 12].

Return to Sport

Return to sport is acceptable when symptoms are tolerable, activity modification is addressed, and strength is at least 90% of baseline.

Ulnar Neuropathy at the Elbow (UNE)

Pathophysiology

Also referred to as cubital tunnel syndrome, UNE is the second most common nerve compression disorder after carpal tunnel syndrome. The pathway of the ulnar nerve predisposes it to compressive, traction, and friction forces. The cubital tunnel is found deep to the arcuate ligament of Osborne, which connects the ulnar and humeral heads of the flexor carpi ulnaris (FCU) muscle. Repeat elbow flexion and repetitive throwing motions can cause irritation of the ulnar nerve through this tunnel and lead to nerve irritation and dysfunction.

Clinical Presentation

Athletes present with complaints of numbness and tingling in the elbow and lateral hand, especially the fifth digit. Muscle weakness can be noted in more chronic or severe cases.

Diagnosis

History and physical are the primary tools of diagnosis. Provocative maneuvers, such as the elbow flexion test which involves forearm supination, wrist extension, and full elbow flexion, often reproduce symptoms when the position is held over 1 minute. Tinel test at the medial elbow can also reproduce symptoms (Fig. 11.3). A

Fig. 11.3 Ulnar nerve palpation at the elbow

thorough neurological and muscular examination should assess for severity of the neuropathy and to rule out other pathologies.

Equivocal physical exam findings with continued suspicion for ulnar nerve entrapment at the elbow may warrant further evaluation with electrodiagnostics, including nerve conduction studies (NCS) and electromyography (EMG). Imaging modalities such as dynamic ultrasound can help in visualizing possible areas of structural compression through full range of motion at the elbow [7].

Treatment

Treatment varies depending on etiology. Physical therapy, including strengthening and stretching, along with NSAIDs should be considered. Nighttime splinting of the elbow in extension to avoid further injury may also be helpful. Steroid injections are often avoided as they do not effectively improve symptoms. Recent studies suggest there may be a role for hydrodissection of the cubital tunnel to decompress the ulnar nerve [14]. Surgical decompression of the ulnar nerve or submuscular transposition may be considered if there is persistent weakness or if conservative therapy fails.

Return to Sport

Recovery and return to play vary depending on therapy and response time. When athletes are asymptomatic with full ROM, they may resume play with continued therapy and movement modification. For postoperative cases, return to sport is generally recommended at 1–3 months.

Pronator Syndrome

Pathophysiology

The most common site of median nerve entrapment in the forearm is between the two heads of a hypertrophied pronator muscle teres. Other sites of median nerve entrapment in pronator syndrome include the ligament of Struthers, the lacertus fibrosus in the antecubital fossa, or under the flexor digitorum superficialis.

Clinical Presentation

Athletes often complain of pain or paresthesias in the median nerve distribution with prominent complaints in the anterior proximal forearm. A patient may note that the throwing motion or swinging a racquet aggravates the pain.

Diagnosis

Median nerve symptoms with negative Tinel and Phalen tests at the wrist should raise suspicion for pronator syndrome. Compression of bilateral pronator teres muscles at the proximal forearm with pain reproduced only on the symptomatic limb (positive Gainor test) is consistent with this diagnosis. Athletes with pronator syndrome also have difficulty making an OK sign due to weakness of the median nerve-innervated flexor pollicis longus and flexor digitorum profundus. Key features that distinguish pronator syndrome from carpal tunnel syndrome are decreased sensation over the thenar eminence and the lack of nocturnal symptoms. Decreased sensation of the thenar eminence is only seen in pronator syndrome, as this area is innervated by the palmar cutaneous sensory branch of the median nerve, which does not pass through the carpal tunnel. Electrodiagnostic testing can provide further evidence for the diagnosis of pronator syndrome.

Treatment

Treatment of pronator syndrome involves rest, activity modification, NSAIDS, and elbow splinting. After pain subsides, the athlete can begin simple hand exercises (ball squeeze). This can progress to light wrist flexion and extension, followed by pronation and supination exercises. If this treatment fails after 4–6 weeks, surgical exploration for anatomical nerve decompression can be considered. Postoperative mobilization should take place within 1 week with therapy directed at nerve gliding and strengthening.

Return to Sport

Return to play is usually appropriate when pain is resolved and the cause for compression is addressed through either biomechanical or anatomical changes. Strength should be equal to that of the unaffected side at the time of return to activity. Postoperative return to sport is typically seen at 6–8 weeks but can take up to 6 months.

Anterior Interosseous Nerve Syndrome (Kiloh-Nevin Syndrome)

Pathophysiology

Anterior interosseous nerve (AIN) syndrome involves the median nerve as it divides approximately 5 cm below the lateral epicondyle of the elbow. The AIN innervates the flexor pollicis longus, the radial half of the flexor digitorum profundus, and the pronator quadratus. Entrapment of the AIN usually occurs under the flexor digitorum profundus arch, although more commonly the cause is idiopathic.

Clinical Presentation

Athletes more prone to this injury are those who do repetitive forceful gripping or repetitive pronation. They generally experience weakness in the thumb and index finger without any associated sensory deficits. The athlete may also note a loss of coordination of the fingers.

Diagnosis

Since the AIN is purely a motor nerve, clinical weakness in its distribution is diagnostic. Patients are classically unable to form the “OK” sign with the thumb and index finger. Their “OK” sign attempt will reveal inability to flex the distal interphalangeal joint (DIP) of the index finger and hyperextension of the interphalangeal joint (IP) joint of the thumb. There may also be a compensatory increase in flexion of the proximal interphalangeal joint (PIP) joint of the finger. This pinch is characteristic of anterior interosseous syndrome. Electrodiagnostic studies (EDX) can provide further evidence to confirm the clinically suspected diagnosis, and if there is concern for a possible space-occupying lesion, an ultrasound or MRI may be warranted [6].

Treatment

Conservative treatment is the initial intervention of choice. This includes relative rest, ice, and pain control. If there is evidence of axonal loss on the EDX study or no improvement is seen in 3–6 months of conservative management, surgical exploration is indicated.

Return to Sport

Return to play is usually appropriate when the pain has resolved and the nerve compression has been addressed either through biomechanical or anatomical changes. This generally takes 6 weeks, but may often take 6–12 months for full motor recovery.

Valgus Extension Overload

Pathophysiology

Commonly a result of the valgus stress during repetitive throwing movements, valgus extension overload is an injury resulting from impingement of the tip of the posteromedial olecranon and the olecranon fossa. In the young athlete, not only synovitis and traction apophysitis can occur, but also this microtrauma may result in osteophyte formation, which can cause fractures and loose bodies. Delayed diagnosis and treatment can lead to growth plate disruption and permanent deformity.

Clinical Presentation

Although athletes most often present with medial elbow pain, lateral and posterior pain can be provoked with palpation. Pain is most commonly elicited during the cocking and/or accelerating phase of throwing, but has also been reported in the deceleration phase as well.

Diagnosis

History and physical are the primary tools of diagnosis. The posteromedial tip of the olecranon is especially painful to palpation and is often a distinguishing characteristic of valgus extension overload. There can also be concomitant injury to the medial ulnar collateral ligament as it is also stressed with valgus loading. Radiographic studies can be helpful when the diagnosis is unclear or when other pathology, such as fracture, is suspected.

Treatment

Treatment is determined by the chronicity of disease. In the acute phase, RICE and physical therapy are important. Oral NSAIDs may be used for pain control, and therapy should emphasize correction of the kinetic chain deficits and biomechanical alterations. There is no evidence to suggest that steroid injections are helpful. In more severe and chronic conditions, casting or surgery may be required in addition to physical therapy.

Return to Sport

Most athletes can return to sport within 4–6 weeks or after the completion of a rehabilitation program. Throwing should be prohibited during the rehabilitation process, and therapy should focus on shoulder girdle strengthening as well as eccentric exercises involving elbow flexion. Gradual return to throwing with proper technique should be emphasized in conjunction with a throwing program.

Ulnar Collateral Ligament Injuries

Pathophysiology

Repetitive strain during activities like throwing in baseball causes repetitive stress on the ulnar collateral ligament (UCL), resulting in eventual laxity and possible tearing of the ligament.

Clinical Presentation

Athletes most commonly present with insidious onset medial elbow pain and swelling. The onset of symptoms may correlate with a change in training regimen and possible decline in performance. Valgus stress at 25% elbow flexion can help localize the pain, which is generally located slightly posterior and distal to the olecranon at the UCL's point of insertion.

Diagnosis

History and physical along with MRI or diagnostic ultrasound can be used for a definitive diagnosis. Plain films may be obtained to rule out fracture initially. Diagnostic ultrasound can also be used for a definitive diagnosis. A neurological assessment should be done to rule out an associated ulnar nerve injury.

Treatment

Conservative management includes activity modification or rest, bracing, and physical therapy with an emphasis on strengthening, joint stability, and stretching. Orthobiologics, specifically platelet-rich plasma, have recently been shown to be effective treatment options in partial UCL tears [15]. Surgical intervention should be considered for all throwing athletes and athletes who fail conservative therapy. A brace to prevent valgus stress should be used in the postoperative period.

Return to Sport

Most athletes will require a period of 3–6 months after conservative therapy. Postoperatively, return to sport is often recommended at 9–12 months after surgical intervention and an extensive rehabilitation program.

Conclusion

From the infrequent acute fractures and dislocations to the more common repetitive stress injuries of tendons and ligaments, athletes can present with a variety of upper limb complaints. Elbow and forearm injuries are particularly common in athletes with repetitive strenuous forces through the joint (i.e., throwing, racquet sports, etc.). It is important for sports physicians to be familiar with the most common sports-related injuries involving the elbow and forearm as summarized in this chapter.

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