The Physical Examination of the Throwing Elbow

Andrew S. Bi, MD[a,*], Laith M. Jazrawi, MD[a],
Steven B. Cohen, MD[b], Brandon J. Erickson, MD[a,c]

KEYWORDS

• Physical examination • Overhead athlete • Baseball • Throwing elbow
• Ulnar collateral ligament • Valgus extension overload
• Posterolateral rotatory instability • Epicondylitis

KEY POINTS

- The examination of the elbow in throwing athletes is catered to the superficial anatomic structures and extreme forces through the joint and a proper physical examination is critical as imaging of the athlete's elbow is often abnormal.
- The major focus of the physical examination is on the medial elbow, primarily on the ulnar collateral ligament (UCL), medial epicondylitis, ulnar nerve, and posteromedial impingement in valgus extension overload syndrome.
- UCL pathology and medial epicondylitis both have a high incidence of ulnar nerve compression at the elbow, which must be examined for neurologic deficits and instability.
- The anterior and lateral elbow should not be neglected, as lateral epicondylitis and biceps tendon pathologies can also occur in throwers.
- Rare peripheral nerve compression syndromes should remain in the differential, and the examiner should understand the nuances between proximal median nerve entrapment, anterior interosseous nerve syndrome, posterior interosseous nerve syndrome, radial tunnel syndrome, and Wartenberg's syndrome.

INTRODUCTION

The throwing athlete's elbow provides a unique diagnostic dilemma that requires extensive knowledge and appreciation of elbow anatomy and kinematics, given the extreme forces seen across the elbow during the overhead throwing motion, the superficial nature of the majority of anatomic structures, and the complex interplay

[a] Department of Orthopedic Surgery, Division of Sports Medicine, NYU Center for Musculoskeletal Care, 338 East 38th Street, New York, NY 10016, USA; [b] Department of Orthopedic Surgery, Division of Sports Medicine, Rothman Orthopaedic Institute, The Sidney Kimmel Medical College at Thomas Jefferson University, 925 Chestnut Street, 5th Floor, Philadelphia, PA 19107, USA; [c] Department of Orthopedic Surgery, Division of Sports Medicine, Rothman Orthopaedic Institute, 645 Madison Avenue, 3Road and 4th Floor, New York, NY 10022, USA
* Corresponding author.
E-mail address: andrewsbi822@gmail.com

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among bony, ligamentous, musculotendinous, and neurologic structures. The physical examination (PE) of the elbow is of critical importance given the increased accuracy of some tests compared to advanced imaging, and the clinical diagnosis of several pathologies.

THE EXAMINATION OF THE THROWING ELBOW

The Basics

The examination of the throwing elbow is often less commonly seen by most orthopedists, but an understanding of anatomy and throwing mechanism can guide the examiner through the PE given the superficial nature of the majority of elbow structures. Throwing imposes extremely high valgus stresses (nearly 60–65 Nm) across the elbow, primarily during the late cocking and early acceleration phases of throwing, which generates tension through the medial elbow, compression on the lateral elbow, and shear forces on the posterior elbow structures creating predictable injury patterns that should be systematically investigated.[1] As with the shoulder, the cervical spine, joint above (shoulder–covered previously), and below (the wrist) should be examined to rule out concomitant pathologies.

Inspection and Palpation

Initial examination of the elbow begins with inspection of the resting position carrying angle, which ranges from normal values of 11° to 14° of valgus in men and from 13° to 16° in women.[2,3] In young pitchers especially, increased repetitive stresses from repetitive overhead throwing can lead to increased carrying angles, which has not been found to correlate with injury risk.[4] In addition, patients with flexion contractures can have falsely decreased carrying angles as the elbow becomes more varus with increasing elbow flexion.[5] Palpation of the elbow should be performed systematically to avoid misdiagnoses. As the patient is usually seated in an examination room, for convenience, the authors prefer to start anteriorly and work their way lateral, posterior, and then medial. Anteriorly the biceps tendon, lacertus fibrosis, and radial and median nerve courses can be palpated according to the rule-of-nine test developed by Loh and colleagues for radial tunnel syndrome (**Fig. 1**A).[5,6] Laterally, an effusion can be palpated in the triangular anconeus "soft spot" between the lateral epicondyle, radial head, and olecranon tip and is often accompanied by a resting elbow position of 70° to 80°, which maximizes capsular volume.[7] The lateral epicondyle, radial head, lateral ulnar collateral ligament (UCL), extensor carpi radialis brevis (ECRB), and posterolateral olecranon can all be easily palpated for tenderness given the superficial nature of these landmarks (**Fig. 1**B). Of particular important in throwers is tenderness over the radial head as valgus extension overload (VEO) can lead to cartilage wear in this portion of the elbow. With a slight valgus load and palpation of the radiocapitellar joint, pain, crepitus, or snapping can be felt in cases of capitellar osteochondritis dissecans (OCD) in adolescents or posterolateral plica in adults.[8,9] Posteriorly, palpation is focused on the triceps tendon and olecranon. The triceps tendon insertion for tendinitis, olecranon tip for stress fracture, superficial olecranon for bursitis, and posteromedial and posterolateral olecranon with the elbow flexed to 30° to relax the triceps should be performed. Lastly, the medial elbow is palpated. The medial epicondyle and flexor pronator mass (FPM) is palpated for pain, as well as the course of the ulnar nerve posterior to the medial epicondyle, and both the ulnar nerve and medial triceps can be palpated for subluxation or snapping, respectively, across the medial epicondyle. Elbow flexion to 50° to 70° moves the FPM anterior to the UCL, making

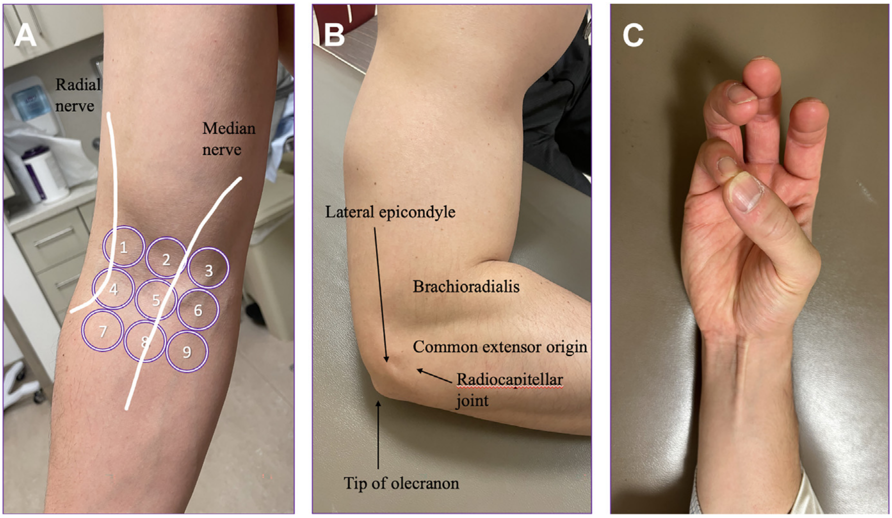

Fig. 1. The rule-of-nine test. Palpation of 1 to 2 overlies the radial tunnel, while the course of the PIN, means palpation of circle 3 should not reproduce symptoms. Circle 4 overlies the biceps tendon, and circles 5 to 6 overlie the median nerve as it enters the PT. Palpation of the medial 3 circles (7–9) should not produce any symptoms (*A*). Superficial anatomy of the lateral elbow (*B*). The Schaeffer test with the demonstration of the presence of a palmaris longus (*C*).

UCL palpation more accurate in the sulcus just distal to the medial epicondyle and anterior to the ulnar nerve.[5,10]

Range of Motion, Strength, and Neurovascular Testing

The thrower's elbow should be taken through systematic range of motion (ROM) testing and compared to the contralateral elbow. A normal extension-flexion arc is from 0° to 145°, with approximately 80° of pronation and supination.[7] Limitations in ROM should be assessed for feel, as hard end points are likely osteophyte formation in the coronoid fossa (flexion), olecranon fossa (extension), or radiocapitellar joint (pronosupination), while soft end points are due to fibrous contractures, effusion, or diffuse synovitis.[3,11] Crepitus, locking, or catching mechanical symptoms throughout ROM can be due to plicas, unstable OCD lesions, or loose bodies. Hyperextension up to 15° can be due to ligamentous laxity, while flexion contractures are particularly common in overhead throwers, with up to 20° noted to be due to physiologic changes and a mean decrease of 5.5°±7.8° compared to the contralateral elbow in professional baseball pitchers.[12] While historical studies note necessary functional ROM of 30° to 130° and pronosupination of 50° to 50°, recent studies with modern tasks such as keyboard and cellphone use have demonstrated increased need for pronation and flexion.[7,13] Baseball pitchers, in particular, require full supination for most breaking balls, and nearly all overhead throwing athletes require full pronation for follow-through.[14] Strength testing should similarly be performed for flexion, extension, supination, pronation, grip, and both wrist and finger flexion and extension. Given the proximity of the brachial artery and median, radial, and ulnar nerves to the elbow, a thorough neurovascular examination should always be performed, with further in-depth compressive neuropathy special testing if clinical concern arises. For the ulnar nerve, in particular, this entails a sensory examination to light touch in both the dorsal ulnar hand (dorsal sensory branch of the ulnar nerve that branches prior to Guyon's canal), and the volar ulnar digits (ulnar nerve superficial sensory branches through Guyon's canal), and motor testing of the fourth and fifth flexor digitorum profundus (FDP) and first dorsal interossei (pre-Guyon's canal and post-Guyon's canal, respectively). Lastly, special testing of specific pathologies that are near the top of the examining surgeons' differential diagnosis should be performed, as described in later discussion.

ULNAR COLLATERAL LIGAMENT INJURIES

The UCL is the most commonly injured structure of the elbow and cause for missed time in professional baseball pitchers given the extreme valgus stresses through the medial elbow.[14,15] It can be either simply sprained or partially or fully torn anywhere along its course from approximately 8 mm anterior and distal to the medial epicondyle apex to its insertion approximately 6 to 8 mm distal to the ulnohumeral joint line on the sublime tubercle.[16,17] A variety of special tests have been described, and the examiner should always examine the ulnar nerve for neuropathy or subluxation, and for the presence of a palmaris longus using the Schaeffer test for possible future surgical planning (**Fig. 1**C).

Milking Maneuver

The milking maneuver was first described by Veltri and colleagues in 1994 at the American Shoulder and Elbow Surgeons' 10th Specialty day.[18,19] The affected elbow is flexed to 90° and fully supinated, and either the examiner or the patient's opposite hand is used to grasp the thumb of the affected hand. The examiner's ipsilateral hand is used to palpate the UCL for both tenderness and medial joint space opening while a valgus force is applied through traction on the patient's thumb (**Fig. 2**A). A modification of the milking maneuver was proposed by Marc Safran in 2003 to eliminate the bony contributions to elbow stability that predominate at increasing elbow flexion angles and confounding motion of shoulder external rotation (ER), with the patient's affected elbow at 70° flexion and their contralateral hand held under their upper arm as counter to prevent abduction and ER of the shoulder.[19,20] To our knowledge, there have been no studies evaluating the diagnostic accuracy of the milking maneuver published.

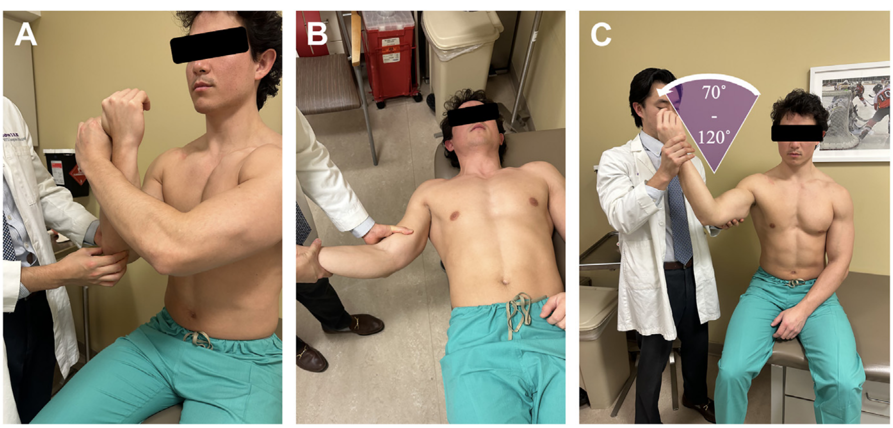

Fig. 2. The milking maneuver (*A*). The valgus stress test (*B*). The moving valgus stress test (*C*).

Valgus Stress Test

The classic valgus stress test for UCL injuries was published in 1981 by Norwood and colleagues, describing a new “elbow abduction stress test” in 4 patients.[21] They described positioning the patient supine with the shoulder abducted for the evaluation “of an injured right elbow stabilize the distal humerus with the left hand. Rest your left elbow against his side for hand support and support the patient’s hand with your right hand. Gently swing the arm and stress the medial side of the elbow, much in the same manner as when doing the abduction stress test of the knee. This is performed at 15° to 20° of flexion.”[21] Although there is some confusion with the wording, the figure demonstrates the examiner’s left hand on the patient’s lateral distal humerus without the examiner’s elbow involved, and the patient’s forearm held in full supination. The elbow flexion helps remove bony constraint by “unlocking” the olecranon tip from the olecranon fossa, and further work by O’Driscoll and colleagues has demonstrated the utility of keeping the forearm in pronation, to prevent a false positive (FP) from subtle posterolateral rotatory instability (PLRI) mimicking medial laxity (**Fig. 2**B).[22] O’Driscoll and colleagues demonstrated sensitivity (SN) of 65% and specificity (SP) of 50% for this examination when compared to intraoperative examination of the UCL.[23]

Moving Valgus Stress Test

Due to deficiencies in the prior examination maneuvers for detecting UCL injuries, particularly partial tears, O’Driscoll and colleagues developed the moving valgus stress test in 2005 to replicate actual stresses involved in the throwing motion.[23] The elbow experience maximum valgus force from 120° to 90° during late cocking and early acceleration, which was the basis for the examination, in which the patient is seated or standing and the shoulder is abducted 90°. The elbow is maximally flexed, and then a valgus torque is applied to the elbow until the shoulder reaches maximal ER, then while maintaining this constant valgus torque, the elbow is quickly extended to about 30° (as expected, patients with shoulder pathology should be treated with caution with this maneuver; see **Fig. 2**C). A positive test is both reproducible medial elbow pain *and* that the maximal pain is produced between late cocking (120° elbow flexion) and early acceleration (70° elbow flexion).[23] This angle of maximal pain was referred to by O’Driscoll as the *shear angle*, and the total arc of painful motion was deemed the *shear range*. In the same study, they reported SN of 100% and SP of 75% compared to intraoperative assessment.[23]

VALGUS EXTENSION OVERLOAD

As the thrower enters the deceleration phase of throwing, especially with medial-sided elbow laxity such as above UCL pathology, the lateral side of the elbow experiences compressive forces and the posteromedial elbow experiences high shear forces across the joint. This mechanism has been coined VEO syndrome by Wilson and colleagues in 1983.[24,25] This repetitive posteromedial impingement can lead to posteromedial olecranon or trochlear spurring/osteophyte formation, which may fracture leading to loose bodies, posteromedial olecranon stress fractures, posteromedial capsular synovitis, and loss of terminal extension.[26,27] On PE, palpation of the posteromedial elbow often elicits pain at the posteromedial olecranon tip, and loss of terminal extension is common in ROM testing. Pain with forced elbow extension is the basis of the VEO test, or extension impingement test, which is performed with the patient seated and shoulder slightly FF. A bounce test for a posteromedial osteophyte can also be performed where the elbow is repeatedly forced into full extension by the examiner while applying a valgus stress, with a positive result indicated by reproducible posteromedial elbow pain as the medial tip of the olecranon impinges on the medial wall of the olecranon fossa (**Fig. 3**).[5,24]

POSTEROLATERAL ROTATORY INSTABILITY

PLRI of the elbow had been reported previously in the literature but was formally described by O'Driscoll in 1991.[22,28] It is extremely rare in overhead throwers as a direct etiology from the throwing mechanism and in depth descriptions are beyond the scope of this review; PLRI can be present as a sequelae of elbow trauma, and the examiner should be familiar with these tests, including the PLRI test/lateral pivot shift test, posterolateral rotatory drawer test, and active push-up testing whether from the floor or chair.[5,11,22,29–32]

MEDIAL AND LATERAL EPICONDYLITIS

Although there are no specific studies investigating the incidence of lateral or medial epicondylitis in overhead throwing athletes, lateral epicondylitis, first described by Morris in the *Lancet* in 1882 as "lawn tennis arm," has been estimated to occur in 10% to 50% of tennis players.[33] Although in general lateral epicondylitis ("tennis elbow") occurs much more common than medial epicondylitis ("golfers elbow") at anywhere from a 4:1 to 7:1 ratio, medial epicondylitis has been demonstrated to occur at an increased frequency in throwers ("thrower's elbow") due to the frequent stress placed on the medial elbow.[33–35] The mainstay of the PE of lateral and medial epicondylitis is pain with palpation of the ECRB origin 2 to 5 mm distal to the lateral epicondyle and FPM origin similarly 5 to 10 mm distal to the medial epicondyle.[35] However, throwers can sustain damage to the common flexor tendon in the form of a partial or

Fig. 3. The bounce test for values extension overload syndrome.

complete tear of the flexor-pronator mass. This can accompany a UCL injury or can occur as a separate injury. These players will present with pain and weakness when testing wrist flexion strength and forearm pronation strength.

Maudsley Test

Resisted middle finger extension was first described by Roles and Maudsley in 1972 and has since become to be known as the "Maudsley test" (Fig. 4A).[36] Although popular given the ease of testing, we prefer to avoid this test, given the primary contribution of the extensor digitorum communis to isolated middle finger extension as well as the possibility of FPs with radial tunnel syndrome.[34] In Roles and Maudsley's original article, their test was performed with forearm pronation and elbow flexion to 90° and was elicited in all 36 patients in the series; however, it was thought to be due to recalcitrant tennis elbow indicating radial nerve compression by the contracting ECRB.[36] Karanasios and colleagues demonstrated in a recent systematic review inferior SN of Maudsley's test of 70%, inferior to other tests for lateral epicondylitis.[37]

Mill's Test

G. Percival Mills, FRCS, described his eponymous Mill's test in 1928, and was further described in 1937.[38,39] He described, "with full pronation combined with complete

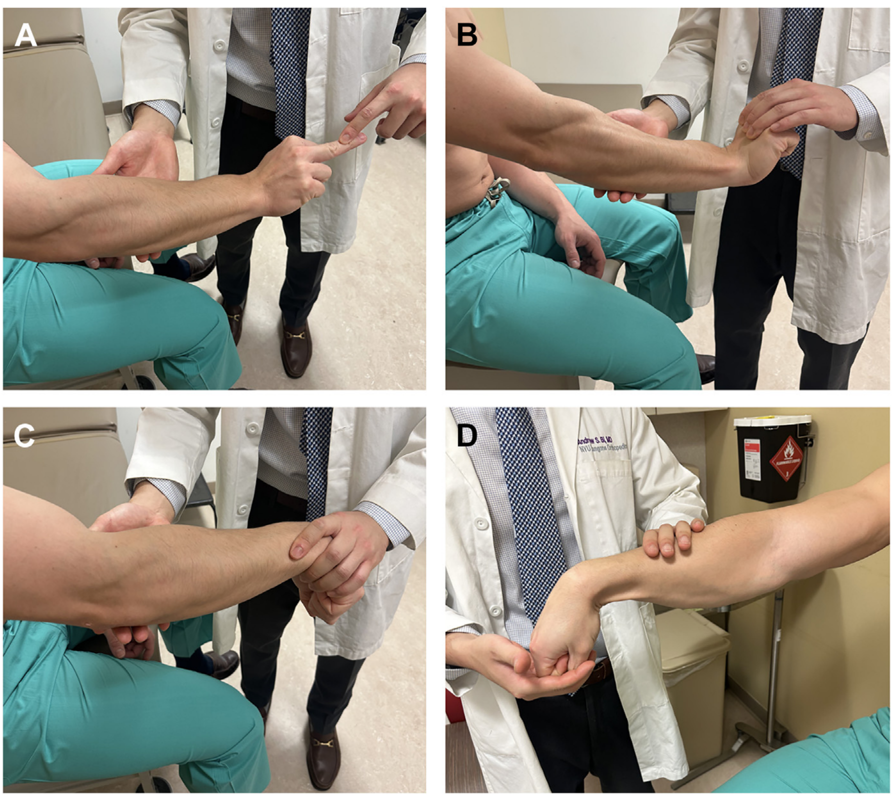

Fig. 4. PE tests for lateral epicondylitis, namely the Maudsley test (*A*), Mill's test (*B*), and Cozen's test (*C*). The medial epicondylitis test with resisted pronation and wrist flexion in elbow extension (*D*).

wrist and finger flexion, the elbow would not come perfectly straight, or if it did come straight there was a distinct feeling of resistance and the process was painful" (Fig. 4B). This maneuver places the ECRB on stretch, causing pain in diseased, angiofibroblastic tissue. Of note, Mills believed that this tennis elbow could be cured with a severe version of this maneuver and described this maneuver with forced hyperextension and feeling a "pistol shot" with a dramatic cure in symptoms and ROM.[38] Karanasios and colleagues demonstrated a slightly improved SN of 76% when compared to the Maudsley test.[37]

Cozen's Test

The authors' preferred PE maneuver for lateral epicondylitis, and the most sensitive (SN 91%) was described by Lewis Cozen of the pediatric proximal tibial valgus deformity following fracture Cozen phenomenon.[37,40] In this test, the patient is asked to perform wrist extension with a closed fist against examiner resistance, with their elbow fully extended, which places maximum stress on the ECRB proximal muscle belly (Fig. 4C).[34,35] Lastly, grip strength is commonly affected in cases of tennis elbow, and Dorf and colleagues reported excellent SN (78%, 80%, and 83%) and SP (80%, 85%, and 90%) with decreases in grip strength of 5%, 8%, and 10%, respectively, although this can be logistically difficult to quantitatively test in the office without proper equipment.[41]

Medial Epicondylitis Test

Medial epicondylitis, or "golfer's elbow," while less common than its lateral counterpart, is relatively more frequent in overhead throwing athletes given the significant stress and valgus loading during late-cocking and early acceleration phases of throwing, as well as the repetitive pronation moment of follow-through.[33,42] The FPM undergoes pathologic angiofibroblastic hyperplasia, similar to the lateral side, primarily of the flexor carpi radialis and pronator teres (PT) given their involvement during the acceleration phase of pitching.[43] Resisted pronation and wrist flexion with full elbow extension most often elicits pain, although there are no studies investigating diagnostic accuracy of this maneuver (Fig. 4D). Although grip strength is often less affected with medial than lateral epicondylitis, grip strength testing can still be performed to provide a quantitative estimate of severity of disease.[5]

NEUROPATHIES ABOUT THE ELBOW

Ulnar Nerve

Ulnar nerve compression at the elbow is the most common peripheral neuropathy seen in overhead throwing athletes due to the enormous stresses seen by the medial elbow during throwing, particularly the acceleration phase, and commonly hypertrophic and additional musculature, such as the anconeus epitrochlearis.[44,45] In addition, medial elbow pathologies in overhead throwers, such as UCL injuries or attenuation, and medial epicondylitis, have a high concomitant incidence of ulnar neuropathy, with a direct correlation between increased stress seen by the ulnar nerve and UCL insufficiency.[46]

The PE of the ulnar nerve at the elbow should first begin with the diagnosis or elimination of other contributing pathologies; UCL injuries and medial epicondylitis as aforementioned, and ulnar nerve compression at Guyon's canal or C8/T1 radiculopathy. Ulnar nerve compression at the elbow can be differentiated from Guyon's canal in 3 ways: (1) dorsal sensory branch involvement of the dorsal ulnar hand, (2) the presence of flexor carpi ulnaris (FCU) and third and fourth FDP involvement, and (3) the presence of Tinel's sign at the elbow or a positive elbow flexion test (Fig. 5A).[47] C8/T1 radiculopathy will have involvement of the proximal medial forearm from medial antebrachial cutaneous nerve involvement, which branches off the medial cord of the brachial plexus and is uninvolved with ulnar nerve compression at the elbow.[47] Next, the identification of area of maximal pain with palpation along the entire course from proximal to distal is identified; medial intermuscular septum, Arcade of Struthers, hypertrophic medial head of triceps or anconeus epitrochlearis, under Osborne's band, between the 2 heads of the FCU, or at its exit from FCU.[48] An ulnar nerve that is symptomatic in a thrower will often cause medial elbow pain when the elbow is maximally flexed and the examiner asks the player to straighten the elbow against resistance. Next, the presence of ulnar nerve instability must be examined, with the examiner's finger on the medial epicondyle as the patient's elbow is brought from extension to flexion, and differentiating it from a snapping medial head of triceps, which can be performed with resisted extension in maximal elbow flexion.[5,44,49] Players with ulnar neuritis will often have pain when the examiner maximally flexes the patient's elbow and then has the patient actively extend the elbow against resistance. This will often cause medial pain over the ulnar nerve.

Lastly, specific neurologic testing of the ulnar nerve function is performed. The Masse and Wartenberg signs can be visualized immediately upon inspection, with hypothenar atrophy and passive abduction of the small finger due to loss of innervation of the palmar interossei indicating chronic disease (Fig. 5B).[50] Pollock's test examines the integrity of the FDP to the ring and small fingers with active flexion of the distal interphalangeal (IP) joints with the proximal IP joints held in extension and is uninvolved in ulnar nerve compression at Guyon's canal (Fig. 5C). The Earle–Vlastou test investigates the second dorsal interossei and first palmar interossei in the "crossed-finger" maneuver, and is helpful as unlike the first dorsal interossei (index finger abduction), rarely receives dual or crossover innervation from the median nerve, as can occur in Martin–Gruber or Riche–Cannieu communications (Fig. 5D).[50] The last

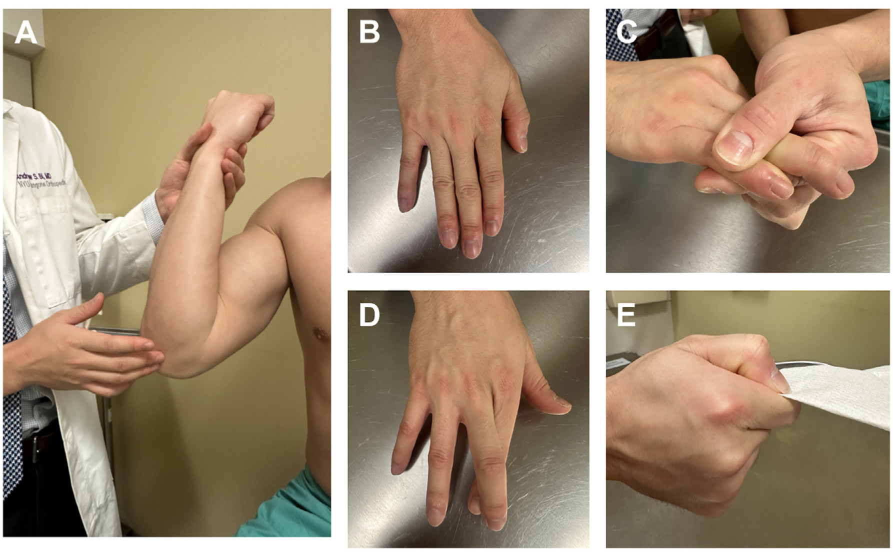

Fig. 5. Multiple tests for ulnar nerve, including the elbow flexion test (*A*), Wartenberg's sign (*B*), Pollock's test (*C*), Earle–Vlastou test (*D*), and metacarpophalangeal hyperextension of Jeanne test and IP joint flexion of Froment test during key pinch (*E*).

series of special tests are the pinch tests described in 1915, with resisted pinch leading to thumb metacarpophalangeal (MCP) hyperextension due to adductor pollicis and flexor pollicis brevis weakness and compensatory activation of the extensor pollicis longus (EPL) as an adductor in the Jeanne test, and thumb IP flexion due to the substitution of the flexor pollicis longus for weak adductor pollicis and first dorsal interossei in the Froment test (**Fig. 5**E).[50]

Median Nerve

Median nerve compression around the elbow, while less common than the ulnar nerve, should remain in the examiner's differential when examining the thrower's elbow. When the median nerve proper is compressed along its course around the elbow, it is termed pronator syndrome, although the authors prefer the term proximal median nerve entrapment (PMNE) given the misnomer of pronator syndrome for all cases of PMNE.[51,52] This course runs from a potential vestigial supracondylar process or attached Ligament of Struthers, under the lacertus fibrosus (medial to the biceps tendon and brachial artery), between the ulnar and humeral heads of the PT (specific pronator syndrome), or deep to the proximal aponeurotic arch of the flexor digitorum superficialis (FDS). Identifying the specific location of compression is essential for both conservative and possible surgical intervention and can be performed with either Tinel's testing along its course, or resisted movements designed to worsen compression at muscular sites. Resisted elbow flexion with forearm supination increases symptoms at the lacertus fibrosus, resisted forearm pronation with elbow extension worsens compression at the 2 heads of the PT, and resisted contraction of the FDS to the middle finger increases compression at the FDS proximal aponeurosis.[5,52] PMNE can be differentiated from carpal tunnel syndrome due to the involvement of the palmar cutaneous branch of the median nerve, which arises 4 to 5 cm proximal to the carpal tunnel, and an absence of compression testing at the wrist, and from anterior interosseous nerve (AIN) compression syndrome due to AIN neuropathy's involvement of the FPL or FDP to the index or middle finger, lack of sensory involvement, and its more distal location of compression after it branches from the median nerve about 4 cm distal to the medial epicondyle.[52]

Radial Nerve

Radial nerve compression is the rarest of compressive neuropathies, and it can be difficult to diagnose due to its multiple, variable branches, often-vague symptoms, and overlapping lateral-sided pain near other anatomic structures.[53] It is divided into 3 pathologies based on anatomic compression sites: Wartenberg's syndrome (not to be confused with Warternberg's sign) with compression of the superficial radial nerve, posterior interosseous nerve (PIN) syndrome with compression of the PIN within the radial tunnel, and radial tunnel syndrome (RTS), which is the pain-only compressive neuropathy of the PIN within the radial tunnel.[36,53,54] Wartenberg's syndrome presents with dorsoradial hand pain and paresthesias and primarily has a positive Tinel's sign over the brachioradialis in the forearm, while PIN syndrome and RTS are caused by compression in 5 major sites: (1) fibrous tissue anterior to the radiocapitellar joint, (2) recurrent leash of Henry vessels at the level of the radial neck, (3) ECRB leading edge, (4) Arcade of Fröhse at the proximal aponeurotic edge of supinator, and (5) supinator distal muscle edge and can be remembered with the mnemonic "FREAS."[52–54] Clinical diagnosis of RTS can be difficult to differentiate from that of lateral epicondylitis and can be present concomitantly with both having pain in the Maudsley test (see **Fig. 4**A); however, palpation within the "rule-of-nine" grid can be helpful (see **Fig. 1**A).[6,36] PIN syndrome PE focuses on the investigation of active extension at the MCP joints, EPL integrity, and wrist extension, which will deviate radially due to an intact extensor carpi radialis longus, which is innervated by the high radial nerve proper proximal to the radial tunnel.[52–54]

SUMMARY

A proper and detailed PE of the elbow is paramount when evaluating a throwing athlete with elbow pain. Given the complex interplay and dependence on the shoulder and elbow in throwing mechanics, providers for throwing athletes must be familiar with the anatomy, kinematics, and PE of both joints, and a mastery of the examination can provide both a clearer diagnostic picture for the examiner to pursue the most efficient imaging and treatments, and for the athlete's trust in the examiner.

CLINICS CARE POINTS

- The moving valgus stress test provides greater sensitivity and specificity for the diagnosis of UCL injuries compared to the valgus stress test, with the milking maneuver lacking robust evidence behind its diagnostic accuracy.
- For the diagnosis of lateral epicondylitis, the tests with the greatest sensitivity are in descending order; Cozen's test, Mill's test, and Maudsley test. Maudsley test in particular should be used with caution as there can be false positive etiologies, such as radial tunnel syndrome.
- Posterolateral rotatory instability of the elbow, medial epicondylitis, and compressive neuropathies are rarer diagnosis in overhead athletes and throwers, however should remain on the differential and evaluated as part of a thorough physical exam of the thrower's elbow.

DISCLOSURE

The authors have no relevant disclosures for this article.

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