The elbow is a complex joint that is designed to withstand a variety of dynamic forces. Its main role in the upper limb is to help position the hand in the appropriate location, in order for the hand to perform its function. Elbow pain may be due to disorders involving the joint itself or the surrounding structures. In addition, referred pain may arise from regions above or below the joint. As is key with other musculoskeletal diagnoses, history is a crucial tool that should be utilized to find out about the mechanism of injury in order to diagnose elbow pain. Also, a focused physical exam in conjunction with imaging studies, when necessary, will provide valuable information needed to arrive at the correct diagnosis.

Last month, part one of this two-part series reviewed causes of and diagnoses associated with elbow pain. This month, we review diagnostic and treatment challenges.

**DIAGNOSTIC TESTING IN ELBOW PAIN**

Knowledge of radiographic features, anatomy, and bony development are essential in recognition of elbow injuries. There are multiple modalities for diagnostic imaging and testing such as magnetic resonance imaging (MRI), computed tomographic (CT) imaging, ultrasound and EMG. Sonography has gained popularity in the evaluation of soft tissues and articular surfaces however, in most cases, plain conventional radiography remains an adequate and most appropriate initial choice of imaging technique of the elbow. When pain remains unresponsive to conservative management, most physicians will order imaging, blood work, or other diagnostics to evaluate.

X-rays can be helpful in evaluating bony structures’ pathology, such as osteophyte formation secondary to arthritis, as well as calcifications that may be present in tendon or muscle tissues as a result of injury. When X-ray is inconclusive, further studies such as MRI, ultrasound, or CAT scan may be ordered. In many cases MRI can be useful in evaluating the soft tissues for tears, fluid, inflammation, or other changes within the joint or surrounding tissues.

“Pain that is referred from other anatomical sites, such as cervical radiculopathy, thoracic outlet syndrome and remote arthritis can be sent to the appropriate specialty for treatment.”

This two-part series reviews the causes, diagnosis, and treatment of elbow pain.
Ultrasound is another modality that can be helpful in evaluating the superficial soft tissues, muscles, tendons, and ligaments. This is especially useful when pain is present with specific movement. Unlike the other imaging modalities, ultrasound offers dynamic clinical evaluation. It looks at the tissues in motion, as well as watching in live time the movement of the joints in the elbow. An initial radiographic evaluation should be obtained in three views: anterior-posterior (AP), lateral, and lateral oblique view. The anterior-posterior view should be performed with the elbow fully extended and forearm supinated to display medial and lateral epicondyles as well as radiocapitellar and ulnotrochlear articular surfaces. The lateral view should be obtained with the elbow in 90 degrees of flexion and forearm in neutral position. Ultrasound is helpful for classification of fractures and alignment prior to surgery. The higher quality of images from a CT scan may help diagnose elbow fractures that may not be obvious on conventional radiographs. CT imaging is helpful for classification of fractures and alignment prior to surgery. The higher quality of images from a CT scan may help diagnose elbow fractures that may not be obvious on conventional radiographs.

Magnetic resonance imaging is a great tool to evaluate soft tissue damage due to chronic overuse injuries of the elbow. Assessment begins with proper patient positioning in supine position with the arm held at the side in anatomical position (supinated). The field of view should include the distal humerus metaphysis and the bicipital tuberosity of the radius in 3 planes. Evaluation should begin with the assessment of the 3 joints of the elbow: the radiocapitellar, ulnohumeral and radioulnar articulations. The next step in evaluation examines tendons and muscles of the 4 major muscle groups (medial, lateral, anterior and posterior), followed by the ligaments, the three major nerves of the elbow (ulnar, radial and median) and synovium. Aside from imaging, many elbow pain cases will require an electromyography/nerve conduction study. This test consists of two parts, and utilizes needle EMG to test the muscles in the extremity. It is helpful when looking for a radicular or nerve compressive processes that may be ongoing in the nerves of the arm/elbow. The needle EMG is helpful in differentiating between denervation versus nerve injury or compression. Nerve conduction studies are done to evaluate the nerve’s electrical pathway by providing a stimulus to the nerve, causing an action potential to propagate along its length, where it is recorded. These studies provide information about nerve conduction velocity, amplitudes, and myelin insulation.

In many cases, clinical evaluation and differential diagnosis will help determine which test to order. In cases were significant swelling is present or a systemic process is thought to be occurring, blood work would be indicated. This would help direct the evaluation toward a systemic, rheumatologic, or infectious etiology.

MANAGEMENT OF ELBOW PAIN FROM LATERAL AND MEDIAL EPICONDYLITIS

Once the diagnosis is made, treatment can be directed at the exact cause of the pain. Pain that is referred from other anatomical sites, such as cervical radiculopathy, thoracic outlet syndrome and remote arthritis can be sent to the appropriate specialty for treatment. Conditions that are localized to the elbow can be treated by the physician effectively without the need for surgical intervention once the etiology is recognized. Lateral epicondylitis has a good track record of improvement with conservative care. Relief of pain and inflammation is the primary goal of the first phase of treatment. Cessation of the offending activity is recommended initially. Modification of lifting and sporting activities is important. Nonsteroidal anti-inflammatory medication is begun if the patient can tolerate it. Labelle and Guibert compared 28 days of oral NSAID with placebo in 129 patients. The treatment group reported less subjective pain although the grip strength did not improve. Topical NSAIDs have been successful in one study by Burnham, R. Ice is recommended to decrease local swelling and for its vasoconstrictive and analgesic effects.

Physical therapy has been shown to be effective in the treatment of lateral epicondylitis by reducing pain and maintaining range of motion. Bisset, L. found that eccentric strengthening of the extensor muscles of the forearm.
relieved the stress on the lateral elbow.\textsuperscript{24} Theoretically, eccentric strengthening efficiently induces hypertrophy of the musculotendinous unit and increases its tensile strength, thereby reducing strain of the tendon. Therapy was more effective than rest and restriction of activities. Extracorporeal shock wave therapy has produced relief of pain by blocking nociceptors. One study, by Pettrone, F.A. demonstrated pain relief after 12 weeks of therapy. Modalities of ultrasound and galvanic stimulation are commonly used but there are no prospective studies to demonstrate their efficacy.\textsuperscript{25}

Counterforce bracing (forearm bands) inhibits full muscular expansion and decreases the force on the muscular tissue proximal to the brace. Groppel and Nirschl demonstrated that lower extensor muscle activity was produced by the use of counterforce bracing during the tennis serve and one handed backhand. Decreasing the strain on the extensor muscles of the forearm allows the patient to be functional without excessive strain on the tendon, thereby, promoting healing to take place.\textsuperscript{26}

For those patients who do not respond to these treatment modalities, injections have been used to treat lateral epicondylitis. Currently a mixture of corticosteroid and local anesthetic is the most common, but recent studies have shown a new group of injectable substances being utilized. These include botulinum toxin, autologous blood, platelet-rich plasma, hyaluronic acid and prolotherapy. Most studies have shown that in the acute follow up time period, patients receiving steroid injections have improved Visual Analog Scale (VAS) pain scores and functional scores during the first 2 to 6 weeks after the injection.\textsuperscript{27} The choice and dose of the steroid preparation has remained arbitrary since prospective studies comparing various preparations have not been done. Care should be taken to instill the mixture deep to the extensor carpi radialis brevis, anterior and distal to the lateral epicondyle, into the fatty subaponeurotic recess. Corticosteroids have been associated with local skin atrophy, depigmentation and muscle wasting, resulting in an increase in the bony prominence of the lateral epicondyle.\textsuperscript{28}

Botulinum toxin A has the ability to cause a palsy of skeletal muscle. This allows healing of the lateral epicondylitis by causing a partial paralysis of the wrist extensors. It allows the pathologic tissue to heal while avoiding micro trauma to the tendon. Wong evaluated 60 patients who received a blinded injection of botulinum toxin or placebo. Patients in the botulinum toxin group had significantly lower VAS pain scores at 4 and 12 weeks. The major adverse effect seen with botulinum toxin injection is finger and wrist extensor weakness. Wong found a 13 percent incidence of mild paresis in the fingers at 4 weeks after injection.\textsuperscript{29}

Autologous blood injection has been described by Edwards and Calandruccio. They proposed that an injection of 2 to 3 ml of autologous blood combined with lidocaine would deliver cellular and humoral mediators to the elbow to encourage healing. In their series of 28 patients, the overall improvement was 79 percent after receiving 1-3 injections of autologous blood. Autologous platelet-rich plasma (PRP) is a concentrated source of platelets and platelet derived growth factor that has been used for injection for lateral epicondylitis.\textsuperscript{30} Mishra and Pavelko treated 20 patients with chronic lateral epicondylitis in an un-blinded prospective study.\textsuperscript{31} They found that the patients who received PRP injections had significantly better VAS scores at 8 weeks than the placebo. In conclusion, PRP and autologous whole blood injections are both effective methods to treat chronic lateral epicondylitis and their efficacy persisted during long term follow up.\textsuperscript{32} Hyaluronic acid and Prolotherapy injections have also been studied for lateral epicondylitis have been found to be effective in studies but the mechanism of action is not well known.\textsuperscript{31,32}

Medial epicondylitis is an inflammation of the flexor pronator musculature on the anterior portion of the elbow. The principles of non-surgical treatment of lateral epicondylitis apply to medial epicondylitis as well. Initial treatment consists of anti-inflammatory medication and modalities of physical therapy. Cortisone injections are also recommended, being careful not to injure the ulnar nerve which is located near the medial epicondyle. Wrist flexor and forearm pronator stretching and progressive isometric exercises usually result in resolution of symptoms.\textsuperscript{32}

Surgical indications for medial and lateral epicondylitis include persistent pain and weakness of the forearm that persists after a period of at least six months of conservative care. These surgeries involve release of the muscular insertion at the epicondyle with epicondylectomy. This is followed by debridement of the degenerated tissue with reattachment of the muscle. The prognosis for recovery is very good with relief of pain, but often results in weakness of the forearm musculature.\textsuperscript{33} Nirschl and Pettrone reported prospectively on 88 operations where they excised the tendinotic tissue with drilling the epicondyle and anatomical repair of the muscle. They found that 97.7 percent of the patients improved.\textsuperscript{34}

**DISABILITY AND IMPAIRMENT**

Functional assessment: when assessing the elbow, it is important to remember that the elbow is the middle portion of an integral kinetic chain. It allows the hand to be positioned in space; it helps stabilize the upper extremity for power and detailed work activities; and it provides...
power to the arm for lifting activities. Therefore, a few functional testing techniques should be performed to assess for disability rating, ranging from functional to non-functional as shown in the table below.3,35

Impairment Calculation: Performed at MMI (Maximum Medical Improvement), impairments in the upper extremities are based on the Diagnosis-based Impairments (DBI), where the impairment class is determined by the diagnosis and/or specific criteria; this is then adjusted by “non-key” factors (grade modifiers) that may include Functional History, Physical Examination, and Clinical Studies (AMA 6th edition).36

The elbow region is very complex, with multiple motions and components that allow for mobility and function. Injury to the region can vary from being mechanical, neurologic, infectious, or systemic in nature. As was emphasized in this article, proper history and physical exam are crucial for diagnosis and treatment. In the acute presentations, treatment may be more straightforward and responsive, whereas in the more chronic cases, treatment and management will depend on the appropriate diagnosis. It can be painful and debilitating for patients with elbow pain to perform their ADLs as well as be able to return back to work. However, with a comprehensive understanding of the joint anatomy and probable differential diagnosis in patients with elbow pain, an effective treatment plan can be formulated to help the patient return to an optimal functional level. ■

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