Peripheral Nerve Entrapments in Sports Medicine

Part I: Upper Extremity

By David BenEliyahu

A small but significant amount of sports injuries include peripheral nerve trauma. It has been estimated that almost six percent of peripheral nerve injuries are due to sports with common causes including football, gymnastics and baseball.

There are two methods of peripheral nerve injury and they include direct/acute trauma and microtrauma. Microtrauma is due to repetitive stress of the local soft tissue from overuse with collagenous remodeling. Enlargement or change in shape of the nerve is often seen and can result in entrapment.

Pain is typically the predominant feature of entrapment neuropathies. In sensory nerve dysfunction the pain may be sharp, burning, with associated parasthesias. Altered sensation will be present such as hyperesthesia, or hypoesthesia. Motor involvement may present as sharp or dull pain, often poorly localized, with or without atrophy. Mixed nerves have a combination of sensory and motor findings and include nerves like the median n., ulnar n., and the peroneal n.

Entrapment neuropathies have common features:

1. Pain is usually ever-present, and activity increases the pain.

2. Discomfort after activity and relief after rest is not usually seen as in tendinitis or bursitis.

3. There is retrograde pain distribution.

4. Nerve trunks are tender both proximal and distal to the point of involvement.
Nerve injuries may be classified as follows:

a. neuropraxia-conduction block is observed;

b. axontmesis-loss of continuity of axons with intact endoneurium and connective tissue sheath;

c. neurotmesis-loss of continuity of axons and the connective tissue is destroyed or there is transection.

**Median Nerve**

The median n. may be entrapped at the wrist (carpal tunnel syndrome), distal to the elbow at the pronator teres muscle (pronator syn.), and proximal to the elbow at the ligament of struthers. In carpal tunnel syndrome (CTS), the well known discriminating clinical/orthopedic tests include phalens test, tinels tap, two point discrimination for sensory loss, muscle testing for thumb adduction, and opponens weakness, as well as thenar atrophy. Electrophysiologic evaluation typically consists of EMG/NCV studies.

The median nerve sensory NCV at the wrist is a very sensitive and reliable tool for establishing the diagnosis. Slowing of the sensory nerve action potential (SNAP), is the most sensitive sign of abnormality. In addition, a prolonged median nerve distal motor latency from the wrist to the APB is helpful. Some experts advocate comparing right to left differences in sensory conduction velocity of the median n. to the ulnar n. or the radial nerve. Stress testing may be helpful by having the patient hyperflex the wrist for 2-5 minutes followed by repeat NCV testing. An increase of 0.2 ms is abnormal and suggests that ischemia may be involved in the pathophysiology of CTS. Some authors suggest stimulation both proximal and distal to the wrist to help differentiate axonal and demyelinating impairment. Motor conduction is often abnormal as well albeit it is not as sensitive as the sensory component. EMG studies are often positive in advanced cases when axontmesis is present.

The median nerve may be compressed distal to the elbow at three distinct sites. The first is at the thickened lacertus fibrosis (a thick band of fascia extending from the biceps tendon), the second site is at an hypertrophied pronator teres constricting the nerve, and the third site is at a tight fibrous arch of the flexor digitorum superficialis. The patient typically complains of an aching pain in the proximal forearm often described as a "heaviness," there is exercise induced arm pain, hypesthesia, palpable tenderness over the pronator muscle, and a positive tinels sign. There are three clinical tests that can be helpful in establishing the level of compression.
1. The patient’s forearm is placed in full pronation with wrist flexion, the examiner attempts to supinate and extend the wrist against resistance. Increased pain in the proximal forearm is suggestive of a "pronator syndrome."

2. The patient fully supinates and flexes the elbow while resisting pronation of the forearm. This contacts the biceps and tightens the lacertus fibrosis.

3. The patient is asked to flex the long digit against resistance. This contracts the flexor digitorum superficialis, and forearm pain is suggestive of entrapment of the superficialis arch.

EMG and NCV studies are not always reliable for pronator syndrome although they can sometimes be helpful. Denervation patterns on EMG can be helpful, for example a spared and normal pronator teres muscle indicates the lesion is below the elbow. In a study by Mysiew et al., NCV studies with dynamic testing maneuvers as described earlier for pronator syndrome did not significantly alter amplitude, latency, or velocity. The differential diagnosis of CTS from pronator syndrome includes, area of tenderness and tinels sign, elbow and wrist provocative clinical tests, and nocturnal symptoms.

The pronator syndrome can be seen in baseball players and pitchers since the pronator teres may hypertrophy and cause a Median nerve entrapment from repetitive throwing.

**Ulnar Nerve**

Ulnar nerve lesions are the most common nerve injury in baseball pitching. Due to the mechanism of throwing and the action of the flexor carpi ulnaris on the medial epicondyle at or near the cubital tunnel, the ulnar nerve may get entrapped. This often called the cubital tunnel syndrome. Another type of ulnar nerve injury that is common to cyclists occurs at the canal of Guyon, often called the ulnar tunnel syndrome. This occurs due to the grip on the handlebars putting excessive pressure on the ulnar nerve. Most times these types of entrapment respond favorably to conservative management. Ulnar nerve conduction studies may be used to help localize the level of injury and entrapment.
The technique of inching may be utilized which monitors the action potential while stimulating different regions of the nerve. The examiner looks for a change in amplitude or conduction velocity. In a study by Bhala et al., electrodiagnostic criteria for EMG/NCV of ulnar nerve injuries revealed as follows:

1. absent or abnormal evoked SNAP at the fifth digit; 2. motor nerve conduction less than 45 ms across the elbow; 3. abnormal EMG findings including fibrillation potentials, at the first dorsal interosseous, flexor carpi ulnaris, and the abductor digiti minimi.

**Suprascapular Nerve**

The suprascapular nerve may get entrapped in sports such as baseball, volleyball, weight training and fencing in the area of the suprascapular notch or spinoglenoid notch. There will typically be a deep aching pain in the area of the lateral and posterior shoulder. Pain is increased with scapular motion, as is pressure over the notch. Arm adduction increases the pain as well, due to stretching of the nerve as the scapula moves on the thorax. Actions contributing to suprascapular nerve injury include throwing or serving, reaching across the body, and shoulder abduction against resistance. Typically upon physical exam the infraspinatus will be weak with sensation essentially normal. EMG/NCV studies can be helpful in isolating the lesion and needle testing the supraspinatus and infraspinatus muscle can help differentiate suprascapular notch from spinoglenoid notch entrapment. Signs of denervation typically manifest themselves 3-4 weeks postinjury with EMG findings of fibrillation potentials, and positive sharp waves suggestive of axontmesis. These types of injuries can take up to a year to recover.

**Radial Nerve**

Lateral elbow pain may be present due to a radial tunnel syndrome which is entrapment of the radial nerve at its bifurcation point at the elbow at the arcade of Frohse, or at the fibrous margin of the supinator muscle. This topic was discussed in a previous issue of "DC." This pain may be confused with the more common lateral epicondylitis, and should be in the differential diagnosis of patients with chronic unrelenting lateral elbow pain or tennis elbow.

**Plexus Injuries**

A more proximal injury sometimes seen in a sports practice plexus injuries. Injuries to the plexus may be seen in sports such as football, soccer, wrestling, hockey and lacrosse. They are often referred to as burners or stingers. A burner is a temporary dysfunction of the neural structures in the plexus after a blow to the
head, neck, or shoulder. In a study by Vereschagin et al., 446 football players were evaluated in the 1989 season. Burners were more frequent in defensive players and at higher levels of competition. In another study by Sallis et al., 201 NCAA Division III football players were surveyed. They found that 65 percent had burners in their football careers, and 57 percent had recurrent plexus injuries. Signs and symptoms include sharp burning pain in the shoulder with paraesthesia radiating to the arm and hand with or without neurologic deficit. The most prominent physical finding is weakness of either the deltoids, biceps, supraspinatus, or the infraspinatus. The burner syndrome is a traction injury to the plexus, more specifically to the upper trunk. Burners have been classified into three grades.

Grade I: a neuropraxic type injury with transient sensory and motor loss

Grade II: an axonotmesis type injury with motor deficits and sensory loss

Grade III: a neurotmesis injury

When pain persists longer than 3-4 weeks an EMG study is helpful to identify the level and locale of the lesion. Some authors have published work on the utility of somatosensory evoked potentials (SSEP) with regards to plexus injuries. Jones et al., compared right to left median n. SSEP studies in assessing plexus injuries, while Synek used radial, median, and ulnar nerves to discriminate the type and level of injury. SSEP has also been shown to be helpful in assessing patients with thoracic outlet syndrome (TOS). Machleder et al., published work on the utility of ulnar amplitude ratios and interpeak latencies in SSEPs of patients with TOS. SSEP results were found to be abnormal 75 percent of the cases he studied. Excellent clinical correlation was seen in 92 percent of the cases.

In summary, entrapment neuropathies in the athlete may involve the median nerve, ulnar nerve, radial nerve, the plexus, as well as other nerves of the upper extremity. This brief synopsis is not an exhaustive treatise on this topic and for further information the reader is encouraged to refer to neurology textbooks or to subscribe to on-line computer searches such as Chirolars, or PaperChase. It should be noted that most times conservative management of these conditions is quite helpful and include the various techniques of rest, bracing, splinting, physiotherapy, exercise rehabilitation/strengthening, and soft tissue technic like transverse friction massage, active release, and postisometric relaxation technic.

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