Ulnar Nerve Entrapment in the Upper Limb

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Ulnar Nerve Entrapment in the upper limb is a common disorder, characterized mainly by signs and symptoms of Cubital tunnel compression with rare exceptions of Guyon's canal involvement. It is second only to Carpal tunnel syndrome in occurrence. Patient factors such as late presentation and diagnostic inaccuracy of nerve conduction studies as well as subtle early clinical symptoms and signs result in delayed diagnosis. Early presentation and treatment results in better outcomes whilst delayed diagnosis with profound motor and sensory deficits often portends less satisfactory outcomes despite adequate surgical release.

Diagnosis:

A thorough clinical history elucidating numbness/paresthesia of the ring and little finger, night symptoms; weakness in activities such as opening jars and gripping and pinching; location of pain (isolated elbow or ill-defined) and fatigue should be documented.

The onset of symptoms, together with loss of strength and the location of the pain (dorsal vs volar) are important details in the history that will allow localization of the compression and severity of pathology. Exacerbating and alleviating factors and co-morbidities (diabetes, haemophilia, neuropathies) will impact on what type of therapy will be instituted for the patient and the relative benefit of surgical release. Occupational history (use of vibrational tools) may point to an Ulnar Hammer Syndrome. Chronic postural history will determine symptoms brought on by overhead working (thoracic outlet obstruction); persistent elbow flexion or wrist flexion positions (especially in office workers) may point to cubital tunnel or Guyon's canal compression respectively. It is important to ask about neck and upper back pain as a number of patients with poor ergonomics in a work

environment will often have cervical muscle spasms, myofascial pain and attendant headaches, poor sleep and a history of chronic analgesic use.

Examination:

A proximal to distal workup of the patient is prudent as cervical pathology may result in a double crush phenomenon or a peripheral neuropathy may obscure the diagnosis. A bilateral examination with comparison of sensory and motor testing is equally important for the same reason. Manual muscle testing of selected muscle groups looking for subtle weakness may point to an early diagnosis as the overt claw hand and wasted intrinsic musculature is a rather obvious but late sign.

How does one distinguish proximal from distal compression?

In any patient complaining of pain/numbness/tingling/loss of dexterity or strength in an upper limb, an composite examination involving eliciting a Tinel's sign, looking for decreased muscle strength in selected ulnar nerve supplied groups distal to the site of suspected compression, beginning in a proximal to distal fashion from the neck down. For example, the pectoral weakness can isolate for cervical root pathology (radiculopathy) whilst for the ulnar nerve particularly, cubital tunnel compression may lead to flexor profundus weakness to the little finger and ring finger; a weak abductor digiti minimi may be present in an isolated Guyon's canal compression.

In late stages of chronic compression the loss of these muscles is obvious but in the early stages the importance of contralateral comparative strength testing; "working" the patient assists in bringing out subtle muscle weakness (M4 Medical Research Council Grading Scale), which is often not detectable on electromyogram testing. (E Hagert – Diagnosing the M4 weakness, ASSH 2016 presentation)

Tinel's sign should be looked for in the neck and from the axilla medially on the upper arm proceeding distal to the cubital tunnel along the course of the ulnar nerve.

A detailed exam of the elbow, including carrying angle, inspection for a mass or

deformity may unmask a structural cause for the nerve compression. Checking for ulnar nerve subluxation through the entire range of motion at the elbow is necessary to differentiate cubital tunnel symptoms from snapping triceps syndrome.

Sensory testing in addition to gross clinical exam may include two point discrimination, Semmes-Weinstein monofilament testing and tuning fork vibration at 256 cps. Proximal sensory signs may indicate radiculopathy and bilateral symptoms could add a neuropathy to the differential. Volar vs dorsal sensory testing will aid determining the level of the compression; a more proximal compression at the cubital tunnel will involve the dorsal sensory branch of the ulnar nerve whereas a Guyon's canal compression will present with isolated sensory loss in the ulnar volar palm and ring and little fingers {Figure 1}. Sensory testing (vibrational hypersensitivity) is particularly useful to detect progressive changes in nerve function; whereas moving two point discrimination is better at monitoring improvement in function post release.

Figure 1: The dorsal branch of ulnar nerve originates in the distal third of the forearm. So, in a lesion distal to this level the sensations over the dorsum of the hand will be normal.

Provocative test:

The intra neural pressure in the ulnar nerve at cubital tunnel increases by seven times on elbow flexion. A patient with cubital tunnel syndrome may have onset of pain and numbness when asked to keep his elbow flexed. This also may mimic the symptoms they have during night.

Claw hand is a late clinical presentation in cubital tunnel syndrome but could be as early feature in a Guyons canal compression cases.

Figure 2: Claw hand in a patient with ulnar nerve compressive neuropathy

What is the Role of Adjunctive Testing?

Radiography, ultrasound of the cubital tunnel, computed tomography or magnetic resonance imaging and laboratory tests should be undertaken prudently on the basis of suspicion in clinical examination. Electrodiagnostic testing has a sensitivity and specificity for diagnosis no greater than clinical testing. (Bridgeman, Electro Clin Neurophys, 2007) These investigations are useful to exclude or confirm lesions or deformities that point to an alternate diagnosis for ulnar nerve symptoms and should serve to confirm a clinical assessment. Alternatively, these adjunct tests can be used for follow up and post operative monitoring if clinical recovery is not as expected.

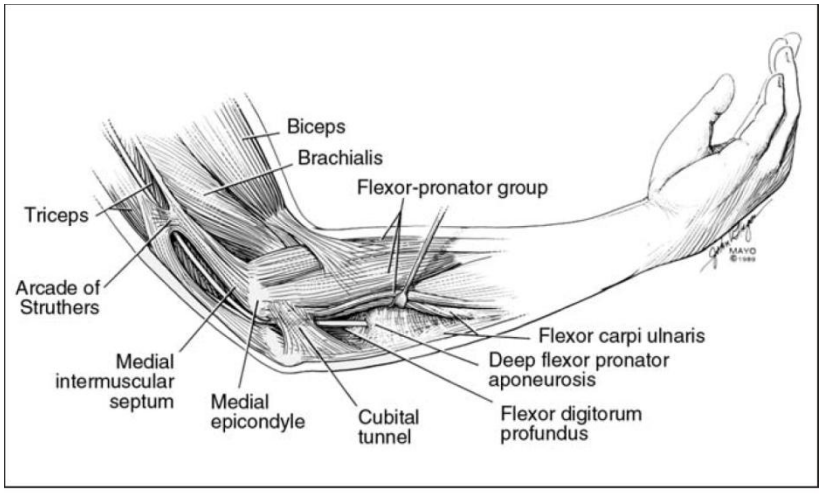
Treatment:

Conservative therapy for mild-moderate disease consists of splinting the elbow in 45 degrees flexion and neutral rotation, cushioning of the nerve and daily use of protective splints for wrist or elbow. This can be combined with oral non-steroidal anti-inflammatories and occasional steroid injections. Postural correction therapy in addition will aid overall recovery of the patient as these patients often have overall chronic postural and ergonomic bad habits. A pre-op consultation and assessment with the physiotherapist/hand therapist is useful in educating the patient regarding the holistic nature of their nerve symptoms and in pointing out reasons for apparent failure of surgical procedures.

When to operate on the Ulnar Nerve Compression:

Surgical treatment is indicated with failure of conservative treatment and in patients who present initially with moderate to severe disease and significant muscle weakness. A period of 3-6 months is adequate to assess the outcome of conservative measures with regular follow up during this time vital to encouraging compliance. Post operatively the exercises and habits emphasized will assist with surgical recovery. Good communication between therapist, surgeon and patient is mandatory.

The surgical principal is to release all the areas of compression and the effect of nerve compression created by elbow movement. The cubital nerve can be compressed at 5 different sites, beginning proximal to the elbow at the Ligament of Struthers, then at medial intermuscular septum, the medial epicondyle, the cubital tunnel (Osborne's ligament) and the common flexor aponeurosis reaching distally to the FCU (Figure 3).



The five sites of potential ulnar nerve entrapment around the elbow: arcade of Struthers, medial intermuscular septum, medial epicondyle, cubital tunnel, and deep flexor pronator aponeurosis. (Copyright Mayo Foundation.)

Figure 3: Levels of compression of the ulnar nerve at the elbow.

In Situ Decompression:

In-situ decompression is approached through a 4-5cm curvilinear incision centred over the medial epicondyle. During skin undermining, it is important to note and protect the posterior sensory branches of the medial and antebrachial cutaneous nerves of the forearm. Decompression of the fibrous tunnels should extend from proximal fibres of the Arcade of Struthers to the FCU aponeurosis without excising or releasing tissue deep to the nerve as this may cause subluxation. Ensure that no tethering points remain post releasing the nerve and take the elbow through flexion and extension to note any subluxation of the nerve. Post operatively mobilization is commenced as soon as possible to allow nerve glide.

Transposition:

Either subcutaneous, intramuscular or submuscular transposition have been advocated. Key points to note are that mobilization of the nerve may result in further scarring and tethering resulting in new points of possible compression. The proposed benefit of transposition being that the nerve is no longer strained by the movement at the elbow and that it is provided good soft tissue cover.
Disadvantages are a longer healing time and possible scar formation with longer immobilization. In submuscular transposition, recurrence rates have been found to be the lowest with good resolution of symptoms. Elevating the flexor pronator mass off the medial epicondyle and reflecting it posteriorly, transferring the ulnar nerve anteriorly from proximal to distal so that it lies adjacent and parallel to the median nerve and sometimes adding a Z lengthening to the reattached muscle mass onto the medial epicondyle are the principles followed in the Learmonth technique.

Figure 4: If anterior transposition of the ulnar nerve is planned the release has to be complete- from the medial inter-muscular septum proximally and the two heads of the flexor carpi ulnaris distally, to prevent any acute angulations / kinking after transposition which may act as a potential site of repeat compression.

Evidence for treatment:

Dellon (J Hand Surg (Am), 1989) concluded with a review of 50 articles over 90 years that 50% of patients with minimal compression could obtain relief from conservative measures whilst all surgical treatments all universally provided excellent results for early disease.

Bartels (Neurosurg 2005), recently showed no difference in results between anterior subcutaneous transposition and in situ release; however a marked increase in complications (9,6% vs 31.1% in transposition cases). Biggs and Curtis (Neurosurg 2006) concluded that in situ decompression also showed equally good results as compared with submuscular transposition but with fewer complications.

What can be expected after surgery?

Prolonged immobilization (> 2 weeks) has been associated with greater chance of scar adherence therefore early movement is of benefit in the rehabilitation. Nevertheless a large proportion of patients will experience relief of some symptoms but continuation of others. A useful approach is to note whether the patient is

complaining of ongoing symptoms; mostly related to incomplete release, a recurrence of symptoms after a period of no symptoms; related to perineural scar adhesion, or completely new symptoms, which may point to another diagnosis and therefore further adjunctive testing may be required. In Dellon's paper he found that up to 75% of patients had ongoing symptoms of on sort or another. Symptoms may take many months to resolve particularly in patients with postural, and more proximal neck pathology.

Failed Cubital Tunnel Surgery:

Failure of surgery is due to inadequate release of all components of the cubital nerve passage; perineural scarring with the development of secondary tethering sites, subluxation of the ulnar nerve, damage to the posterior branch of the medial antebrachial cutaneous nerve or medial epicondylar ligament injury. A large proportion of secondary symptoms can be attributed to iatrogenic neuromas of the medial cutaneous nerves. (Mackinnon and Novack, Hand 2007). Submuscular transpositions have been found in meta-analyses to provide the best results for moderate to severe disease and in cases of recurrence.

Guyon's canal Compression:

Guyon's canal compression almost always is because of a space occupying lesion at this level which results in compression of the ulnar nerve. Ultrasound and MRI scan are the investigation of choice. Surgical removal of the lesion would relieve the symptoms.

Figure 5: Release of Guyon's canal- this patient presented with an ulnar claw hand with no sensory deficit. MRI scan showed a ganglion at the Guyon's canal level compressing the ulnar nerve. Excision of the ganglion decompressed the nerve and resulted in full motor recovery.

Conclusion:

Ulnar nerve compression, of which cubital tunnel syndrome is the commonest disorder can be treated with in-situ release in the majority of patients especially those presenting with persistent symptoms, no objective motor deficit and mild sensory signs. In those patients in whom nerve subluxation is a problem, career sportsman who have throwing actions, a submuscular transposition is advised. Those that have recurrent symptoms after surgical release or demonstrate multiple areas of compression a submuscular transposition is also recommended. It is worthy to note that a thorough clinical examination will form the basis of diagnosis and that adjunctive tests will confirm suspicion and not dictate diagnosis.

Recommended Reading:

Elhassan, Steinmann: Entrapment Neuropathy of Ulnar Nerve. J Am Acad Orthop Surg 2007; 15 : 672-681