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Guyon Canal Syndrome

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Introduction

Guyon's canal syndrome is a relatively rare peripheral ulnar neuropathy which involves injury to the distal portion of the ulnar nerve as it travels through a narrow anatomic corridor at the wrist. The ulnar nerve originates from C8-T1 and is a terminal branch of the brachial plexus. In the upper arm, the ulnar nerve courses posterior and medial to the brachial artery, and heads for the posterior aspect of the elbow, piercing the medial intermuscular (IM) septum at the arcade of Struthers. The nerve pierces the medial IM septum approximately 8 cm proximal to the medial epicondyle.

The ulnar nerve enters the cubital tunnel posterior to the medial epicondyle, and enters the forearm by piercing between the two heads of the flexor carpi ulnaris (FCU) muscle. The ulnar nerve reaches the hand via Guyon's canal to provide motor and sensory innervation to the digits. Guyon's canal is a unique location where ulnar nerve is vulnerable to compressive injury, although the more common location of the ulnar nerve injury occurs at the elbow which is known as cubital tunnel syndrome.

The anatomic boundaries of Guyon's canal include:

- Volar carpal ligament - the "roof"
- Transverse carpal ligament - the "floor"
 - Note that the transverse carpal ligament spans Guyon's canal as the floor at the ulnar side of the hand/wrist before seamlessly transitioning to its position as the "roof" of the carpal tunnel
- Pisiform, Pisohamate ligament, abductor digiti minimi - ulnar boundary
- Hook of hamate - radial boundary

Etiology

Injury to Distal Ulnar Nerve may occur through compression, inflammation, trauma or vascular insufficiency.

Etiologies include:

- Ganglion Cyst
- Hook of Hamate Fracture/Displacement
- Tumors (e.g., lipoma)
- Repetitive trauma (e.g., Cyclist's Handlebar external compression)
- Aberrant Muscle (e.g., abductor digiti minimi) or excess fat tissue within the canal
- Ulnar Artery Thrombosis or Aneurysm (e.g., Hypothenar Hammer Syndrome)

Hypothenar Hammer Syndrome (HHS) is a unique mechanism of ulnar nerve injury secondary to ulnar artery thrombosis or an aneurysm, which results in inflammation and subsequent compression of the ulnar nerve at Guyon's canal. Etiology of hypothenar hammer syndrome is similar to that of Guyon's canal syndrome where repetitive trauma to hypothenar area eventually results in injury to the ulnar artery.

Some studies estimate that 30% to 40% of Guyon's canal syndromes result from ganglion cysts. Another study estimates 45% of cases to be idiopathic.

Epidemiology

The most commonly reported cases of Guyon's canal syndrome are due to a ganglion cyst and repetitive trauma. Unfortunately, the incidence and prevalence of Guyon's canal syndrome in the general population have not yet been accurately estimated due to lack of studies.

Pathophysiology

Guyon's canal is about 4 cm in length and housed by four borders. The roof consists of the volar carpal ligament. The floor is made of the transverse carpal ligament. The radial border has the Hook of Hamate, and the medial border is composed of pisiform bone along with pisohamate ligament. Inside this canal runs ulnar nerve and artery. The ulnar nerve enters the canal as a mixed sensory and motor nerve. As it travels through it, the nerve splits into superficial sensory and deep motor branches.

Each part of ulnar nerve which is affected within Guyon's canal region is represented by a particular zone and gives its unique constellation of symptoms.

Zone 1: proximal to the motor/sensory bifurcation

- Area of the distal portion of the ulnar nerve (main trunk) before it splits into its superficial sensory and deep motor divisions
- Etiologies include hook of hamate fracture/malunion/nonunion, ganglion cysts
- Zone 1 Guyon's canal injury to the ulnar nerve results in mixed motor and sensory symptoms

Zone 2 (most commonly affected): distal to motor/sensory bifurcation, and radial to zone 3

- Corresponds to the deep terminal motor branch of the ulnar nerve, if affected, it produces only motor symptoms (e.g. weakness)
- Etiologies include hook of hamate fracture/malunion/nonunion, ganglion cysts
- This deep branch of the ulnar nerve innervates all the interosseous muscles, fourth and fifth lumbricals, hypothenar muscles (opponens digiti minimi, abductor digiti minimi, flexor digiti minimi brevis), and adductor pollicis muscle.

Zone 3: distal to motor/sensory bifurcation, and ulnar to zone 2

- The superficial sensory terminal branch of the ulnar nerve is compromised in this zone producing sensory symptoms only (e.g., numbness and tingling, burning sensation)
- Etiologies include ulnar artery aneurysm and/or thrombosis

History and Physical

Guyon canal syndrome is usually diagnosed clinically. There may be a history of repetitive trauma (e.g., cyclists handlebar) or direct injury to the hand (e.g., fracture of Hamate). Signs and symptoms can be purely motor, purely sensory, or mixed depending on the zone of the distal ulnar nerve lesion as discussed above. Motor complaints may

include weakness/paralysis of the intrinsic muscles of the hand innervated by the ulnar nerve, which may present as a weakening of the hand grip and clawing of the fourth and fifth digits. Hypothenar atrophy may be present in more advanced cases. Differentiation between ulnar nerve compression at Guyon's canal (wrist) vs. cubital tunnel (elbow) can be done by testing the strength of intrinsic (hand) vs. extrinsic (forearm) muscles supplied by the ulnar nerve respectively. Sparing of the dorsal surface of ulnar dermatome (dorsal medial hand and two fingers) points to Guyon's canal syndrome. This occurs because this region is innervated by the dorsal ulnar cutaneous branch which comes off about 5 cm proximal to the Guyon's canal entrance. **Tinel's sign** involves reproducing symptoms by tapping at the site of suspected nerve compression and can also be used for localization.

Compromise of the deep motor branch of ulnar nerve within Guyon's canal can result in weakness of the adductor pollicis muscle. Clinically, this phenomenon can be assessed by asking the patient to simultaneously grip a sheet of paper at opposite ends. The pathologic side may exhibit a **Froment's sign**, which by definition entails thumb IP joint hyperflexion (via FPL, innervated by AIN) to compensate for an inability to adduct the thumb.

When the fifth digit is observed in an over-abducted position at rest, this is known as **Wartenberg's sign**, which can be seen in ulnar nerve palsy as a consequence of denervation of the palmar interossei muscles that are normally responsible for digit adduction. Sensory involvement will produce pain and/or paresthesias of medial palm and ulnar half of the fourth digit and entire anterior side of the fifth digit.

Allen's Test evaluates arterial supply of the hand, which is useful when Ulnar Artery Thrombosis is suspected.

The severity of symptoms can range from very mild to very severe on a spectrum of 1 to 5: very mild (1), mild (2), moderate (3), severe (4) and very severe (5).

Duration of symptoms can be acute (within one month), subacute (two to three months), or chronic (more than three months).

Evaluation

Hand x-ray or CT scan can be used to evaluate for fractures (especially hamate fracture).

MRI of the hand can show anatomical variations within Guyon's canal and evaluate for structures responsible for mechanical compression of the ulnar nerve (e.g., lipomas, ganglion cyst, aberrant muscle).

Doppler Ultrasound is used to evaluate for ulnar artery thrombosis.

Angiography can be used for evaluation of ulnar artery aneurysm or thrombosis.

EMG and nerve conduction velocity (NCV) are used to assess peripheral nerve compromise and localize the level at which nerve is affected (i.e., differentiate between ulnar nerve entrapment within Guyon's canal at the wrist vs. Cubital tunnel at the elbow vs. C8-T1 radiculopathy).

Treatment / Management

The decision to choose conservative vs. surgical management depends on the duration and severity of symptoms, as well as the exact etiology determined to be the cause of the symptoms. For example, high-performance athletes and professional baseball players can develop hook of hamate fractures that can occur from acute trauma or repetitive pathologic contact during performance. In this setting, the general consensus of hand surgeons is to perform an isolated hook of hamate incision, which has reliably demonstrated low/minimal rates of postoperative complications, return to play within 3 to 4 weeks, and high patient satisfaction scores.

General considerations

Treatment of Guyon's canal syndrome is similar to that of carpal tunnel syndrome. Its spectrum consists of conservative management and surgical decompression. Conservative management involves patient instructions and splinting. Instructions are centered around avoidance of mechanical compression and repetitive stress at Guyon's

canal. In the case of cyclists, utilization of more ergonomically favored handlebar positions can be used. Repetitive or prolonged wrist extension should be minimized as this exerts compressive forces on the ulnar nerve in the hand.

Wrist splinting must keep the wrist in neutral position but may allow fingers to move around freely. A splint is to be worn at least at night for a recommended duration of one to 12 weeks.

According to European Handguide study published in British Medical Journal, an expert panel of medical professionals had reached a consensus of utilizing conservative management for symptoms which are mild to moderate in severity and with acute to subacute duration lasting up to three months. For moderate to severe symptoms lasting three months or longer surgical decompression was favored. Surgical treatment may also include post-surgical exercises especially in those with reduced range of motion at the joint. Post-surgical splinting was not a necessity but can be used in those patients who have a habit of loading the wrist joint.

According to the same European Handguide study, NSAIDs and corticosteroid injections are not beneficial for the treatment of Guyon's canal syndrome.

Additional treatments that can be used include therapeutic ultrasound and nerve gliding exercises.

In the case of ulnar artery thrombosis or an aneurysm (hypothener hammer syndrome), asymptomatic patients do not have to be treated surgically. However, when symptomatic, treatment will range from anti-platelet medication to surgical correction (e.g., bypass).

Pearls and Other Issues

Guyon's canal syndrome is a relatively uncommon ulnar neuropathy. Diagnosis can be challenging due to the variety of presenting signs and symptoms depending on the exact location of nerve compression in addition to the individual anatomic variations within Guyon canal itself. Although there are several articles suggesting approaches to diagnosis and management of Guyon's canal syndrome, due to a lack of large-scale empirical studies comprehensive guidelines have not yet been firmly established. For instance, it is unclear when a patient suspected of Guyon's canal syndrome should receive additional, more expensive testing such as MRI, or at which level of severity and duration of symptoms these additional tests are required.

Questions

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