

Endoscopic Release of the Guyon Canal and Pisohamate Hiatus



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Abstract: The ulnar nerve runs in more than 1 tunnel in the wrist. Ulnar nerve entrapment in the wrist can occur at the Guyon canal and the pisohamate hiatus. Open release of these 2 tunnels requires a lengthy incision and extensive soft-tissue dissection. The purpose of this technical note was to describe the details of endoscopic release of the Guyon canal and the pisohamate hiatus. This minimally invasive approach allows release of the ulnar nerve and its motor branch at the wrist level.

The ulnar nerve runs in more than 1 tunnel in the wrist. It runs first within the Guyon canal (ulnar tunnel), and the deep motor branch enters a second tunnel called the “pisohamate hiatus.” The Guyon canal is approximately 4 cm long. It begins at the proximal extent of the transverse carpal ligament and ends at the aponeurotic arch of the hypothenar muscles. It is triangular in cross section with the base on the medial side of the canal and is bounded ulnarly by the pisiform bone, volarly by the volar carpal ligament, and dorsally by the transverse carpal ligament.¹ The volar carpal ligament attaches to the flexor retinaculum (transverse carpal ligament) and does not directly connect to the hamate bone.² At around the level of the pisiform bone, the ulnar nerve divides into a deep motor branch and a superficial sensory branch. The deep branch of the ulnar nerve provides motor innervation to the muscles of the hypothenar eminence, the interossei, the third

and fourth lumbricals, the adductor pollicis, and the medial head of the flexor pollicis brevis. The superficial sensory branch of the ulnar nerve lies superficial to the hypothenar fascia and provides sensory supply to the little finger and the ulnar side of the ring finger.³ The deep branch is bounded by the aponeurotic arch of the hypothenar muscle fascia, which connects the pisiform to the hook of hamate.⁴ Pressure from this fibrous arch during hypothenar muscle contraction may compress the deep branch of the ulnar nerve.⁴

The ulnar tunnel can be classified into 3 zones according to the level of branching of the ulnar nerve.^{4,5} Zone 1 begins at the proximal edge of the volar carpal ligament and ends distally at the bifurcation of the ulnar nerve. Zone 2 runs from just distal to the bifurcation of the ulnar nerve to the aponeurotic arch of the hypothenar muscles and contains the deep branch of the ulnar nerve. Zone 3 begins just distal to the bifurcation of the ulnar nerve and contains the superficial branch of the ulnar nerve.^{4,5} This 3-zone anatomic classification perfectly matches the clinical classification of ulnar nerve compression at the Guyon canal.^{4,5} In type 1 nerve compression, the common ulnar nerve bundle is compressed, causing sensory loss and motor weakness. In type 2 nerve compression, the deep branch of the ulnar nerve is compressed, leading to motor weakness of muscles innervated by this branch. In type 3 nerve compression, the superficial branch of the ulnar nerve is compressed, leading to sensory deficits.⁶ This classification allows surgeons to localize the site of compression within the ulnar tunnel based on a patient’s symptomatology and clinical findings.⁷ However, anatomic variations and the possibility of multiple sites of compression may result in variation in the

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Table 1. Indication and Contraindications of Endoscopic Release of Guyon Canal and Pisohamate Hiatus

Indication
Symptomatic ulnar nerve entrapment of wrist
Contraindications
Nerve compressed by solid tumor, severe hamate malunion, or pisiform dislocation
Isolated sensory deficits in which superficial sensory branch of ulnar nerve is compressed by abnormal musculature or ulnar artery thrombosis in zone 3

presentation of ulnar nerve entrapment in the wrist.¹ Electrodiagnostic studies can be performed to help support a diagnosis of ulnar tunnel syndrome and to differentiate the clinical findings of ulnar tunnel syndrome from other diagnoses, such as cubital tunnel, thoracic outlet, and cervical radiculopathy syndromes.⁷

The causes of ulnar nerve compression in the wrist include soft-tissue tumors; repetitive or acute trauma; the presence of anomalous muscles and fibrous bands; arthritic, synovial, endocrine, and metabolic conditions; and iatrogenic injury.^{1,3,8-10} Nonsurgical management is appropriate for a distal compression lesion caused by repetitive activity, but surgical decompression is indicated if symptoms persist or worsen over a period of 2 to 4 months.¹ During surgical decompression, the ulnar nerve should be exposed from the distal forearm through the entire Guyon canal, regardless of the site of compression.¹ This implies a long incision and extensive soft-tissue dissection.

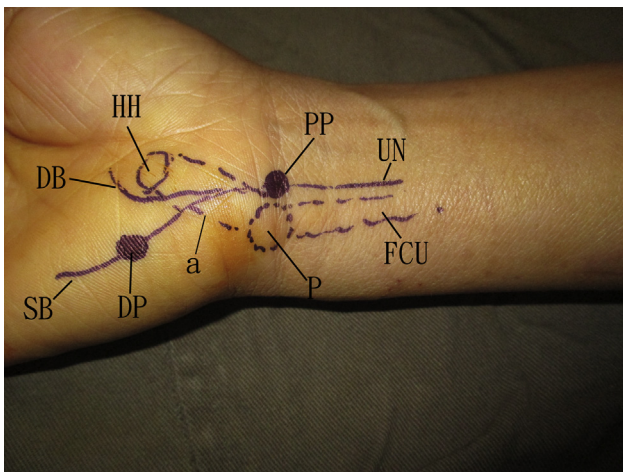


Fig 1. Endoscopic release of Guyon canal and pisohamate hiatus in right wrist. The patient is in the supine position with the hand on the side table. The procedure is performed via the proximal portal (PP) and distal portal (DP). The PP is at the proximal end of the pisiform bone (P) and just radial to the bone and flexor carpi ulnaris (FCU) tendon. The DP is along the line projected from the pisiform bone and FCU tendon and just distal to the hook of hamate (HH). (a, aponeurotic arch of hypothenar muscles; DB, deep branch of ulnar nerve; SB, superficial branch of ulnar nerve; UN, ulnar nerve.)

This report describes the technical details of endoscopic release of the Guyon canal and pisohamate hiatus. It is indicated for symptomatic ulnar nerve entrapment in the wrist. This procedure is contraindicated if the nerve is compressed by a solid tumor, severe hamate malunion, or pisiform dislocation. The presence of a ganglion is not a contraindication because endoscopic ganglionectomy can be performed during endoscopic release of the Guyon canal and pisohamate hiatus.¹¹⁻¹⁴ The procedure is contraindicated in cases of isolated sensory deficits in which the superficial sensory branch of the ulnar nerve is compressed by abnormal musculature or ulnar artery thrombosis in zone 3 (Table 1).

Technique

Preoperative Planning and Patient Positioning

The patient's symptomatology should be analyzed together with clinical findings and electrodiagnostic studies. Radiographs, computed tomography scans, and magnetic resonance images may be needed to study the bony or soft-tissue causes of nerve compression.

The patient is placed in the supine position with the hand on the side table. An arm tourniquet is applied to provide a bloodless operative field. A 2.7-mm, 30° arthroscope (Henke Sass Wolf, Tuttlingen, Germany) is used for this procedure. Fluid inflow is by gravity, and no arthro-pump is used.

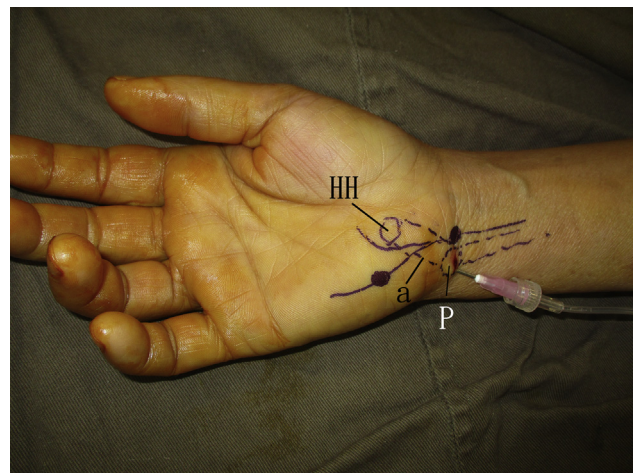


Fig 2. Endoscopic release of Guyon canal and pisohamate hiatus in right wrist. The patient is in the supine position with the hand on the side table. A needle is inserted from the pisiform bone (P) toward the hook of hamate (HH) and lies just superficial to both bones. The needle is then withdrawn halfway, and normal saline solution is injected. This hydrodissection creates a space just superficial to the ligamentous roof of the Guyon canal. (a, aponeurotic arch of hypothenar muscles.)

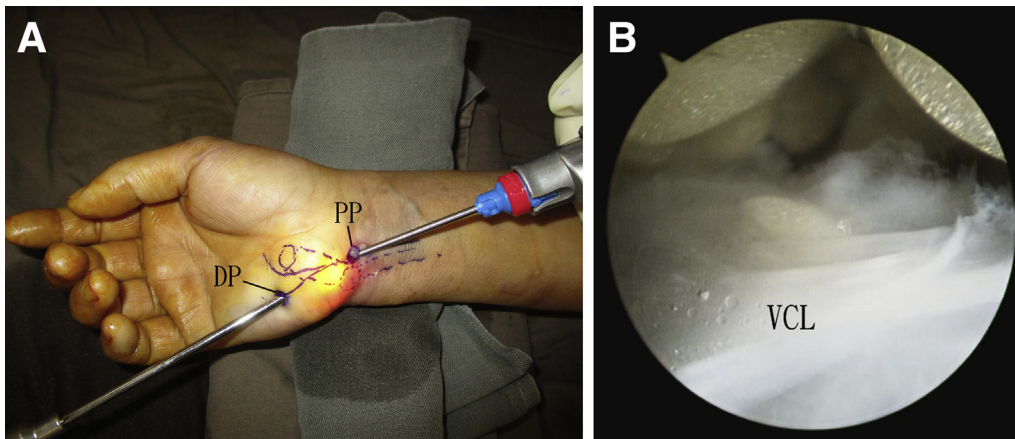


Fig 3. Endoscopic release of Guyon canal and pisohamate hiatus in right wrist. The patient is in the supine position with the hand on the side table. (A) The distal portal (DP) is the viewing portal, and the proximal portal (PP) is the working portal. (B) The working space of the endoscopic procedure is created just superficial to the ligamentous roof of the Guyon canal. (VCL, volar carpal ligament.)

Portal Placement

The procedure is performed via the proximal and distal portals. The reliable surface landmarks include the pisiform bone and hook of hamate. The proximal portal is at the proximal end of the pisiform bone and just radial to the bone and the flexor carpi ulnaris (FCU) tendon. The distal portal is along the line projected from the pisiform bone and FCU tendon and just distal to the hook of hamate (Fig 1).

Hydrodissection

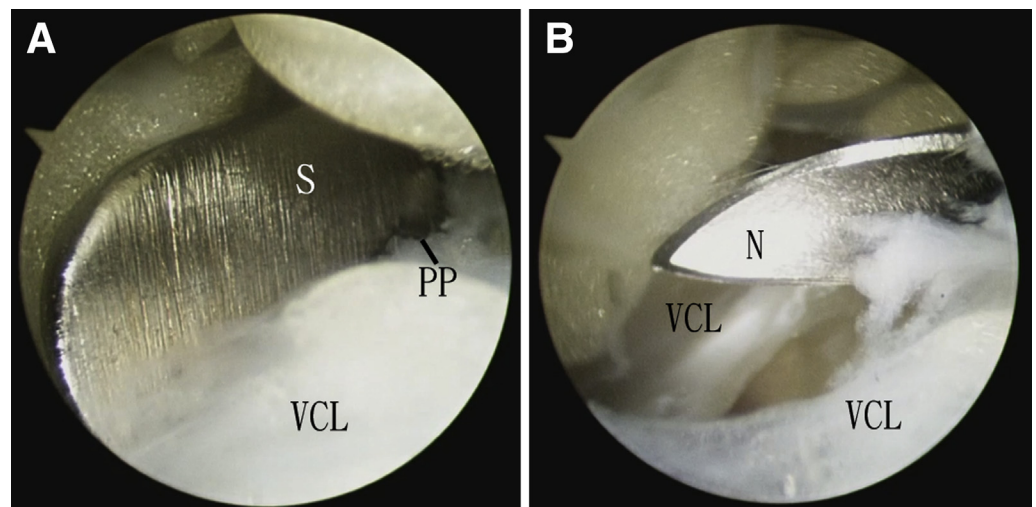
A needle is inserted from the pisiform bone toward the hook of hamate. The needle lies just superficial to both bones so that it is seated approximately at the plane between the subcutaneous tissue and the ligamentous roof of the Guyon canal. The needle is then withdrawn halfway, and normal saline solution is injected. This hydrodissection creates a space just

superficial to the ligamentous roof of the Guyon canal.¹⁵ Blanching of the overlying skin can be observed (Fig 2).

Creation of Working Space

Three-millimeter skin incisions are made at the portal sites. The subcutaneous tissue is bluntly dissected toward the space developed by hydrodissection, and normal saline solution is then drained. The distal portal is the viewing portal, and the proximal portal is the working portal. The remaining subcutaneous tissue adhered to the underlying ligamentous roof of the Guyon canal is released by an arthroscopic shaver (Dyonics; Smith & Nephew, Andover, MA) to create the working space for the endoscopic procedure (Fig 3). The shaver blade should face away from the ligamentous roof so that iatrogenic injury to the neurovascular

Fig 4. Endoscopic release of Guyon canal and pisohamate hiatus in right wrist. The patient is in the supine position with the hand on the side table. The distal portal is the viewing portal, and the proximal portal (PP) is the working portal. (A) The volar carpal ligament (VCL) is released along its ulnar border with SuperCut scissors (S). (B) Saline solution injection via a needle (N) distends the working space, and the cut VCL is visualized.



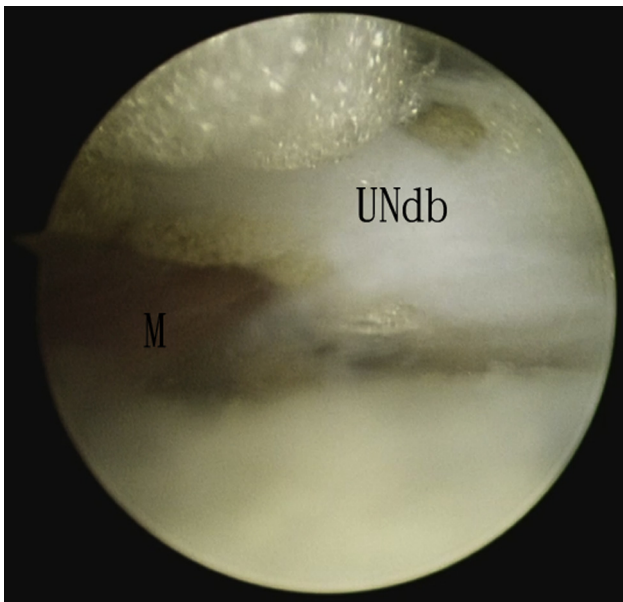


Fig 5. Endoscopic release of Guyon canal and pisohamate hiatus in right wrist. The patient is in the supine position with the hand on the side table. The distal portal is the viewing portal. An endoscopic view shows the deep branch of the ulnar nerve (UNdb) and the hypothenar muscles (M).

structures of the canal can be avoided. The working space can be periodically distended by injection of normal saline solution via the needle to improve endoscopic visualization.

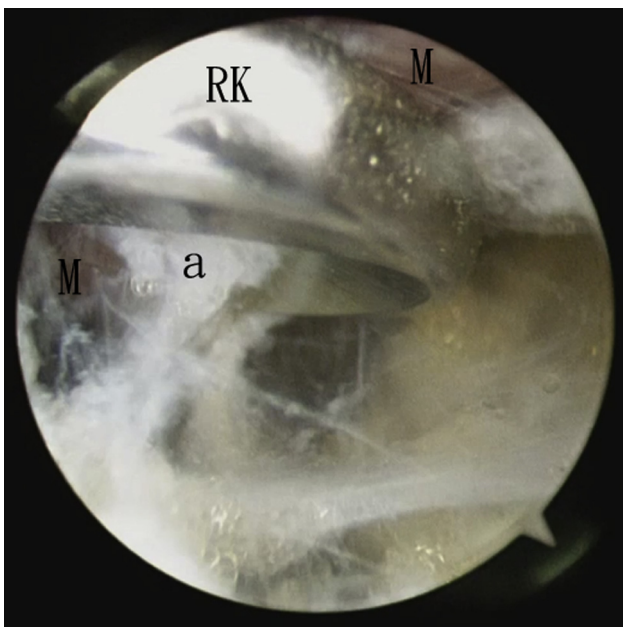


Fig 6. Endoscopic release of Guyon canal and pisohamate hiatus in right wrist. The patient is in the supine position with the hand on the side table. The proximal portal is the viewing portal, and the distal portal is the working portal. The aponeurotic arch (a) of the hypothenar muscles (M) is released by a retrograde knife (RK).

Table 2. Pearls and Pitfalls of Endoscopic Release of Guyon Canal and Pisohamate Hiatus

Pearls

Hydrodissection facilitates the creation of the endoscopic working space.

The cutting blade of the shaver should face away from the ligamentous structure during release of the subcutaneous tissue from the ligamentous structure. This avoids accidental injury to the neurovascular structures of the Guyon canal.

Release of the volar carpal ligament should be performed along its ulnar edge because the Guyon canal is more spacious ulnarly.

Periodic distension of the working space by saline solution injection improves endoscopic visualization.

Pitfalls

Hydrodissection that is too superficial or extensive may cause skin necrosis.

Release of the volar carpal ligament should be performed bit by bit to avoid injury to the ulnar nerve and artery because the neurovascular structures are obscured by the ligament initially.

Release of Volar Carpal Ligament

The distal portal is the viewing portal, and the proximal portal is the working portal. The arthroscope in the working space provides a bird-eye's view of the volar carpal ligament and the ulnar nerve. The Guyon canal is triangular in cross section with a radial apex and is more spacious on its ulnar side. Therefore, the volar carpal ligament is released along its ulnar border with SuperCut scissors (Stille, Lombard, IL) (Fig 4).

Oblique Release of Aponeurotic Arch of Hypothenar Muscles

The distal portal is the viewing portal, and the proximal portal is the working portal. The fascia over the hypothenar muscles is released with SuperCut scissors, and the muscles are exposed. The muscles are traced proximally to their origin. The aponeurotic arch attached to the hook of hamate is carefully released with scissors to expose the deep branch of the ulnar nerve (Fig 5). Any fibrous adhesions around the nerve are gently released with an arthroscopic probe (Acufex; Smith & Nephew).

Longitudinal Release of Aponeurotic Arch of Hypothenar Muscles

The proximal portal is the viewing portal, and the distal portal is the working portal. The fascia of the hypothenar muscles is released with scissors. The muscles are retracted to expose the portion of the aponeurotic arch between the

Table 3. Advantages and Risks of Endoscopic Release of Guyon Canal and Pisohamate Hiatus

Advantages

Better cosmetic results

Less pain

Less surgical trauma

Risks

Injury to ulnar nerve and its branches

Injury to ulnar artery and its branches

Skin necrosis

pisiform and hook of hamate. The fibrous arch is then released with a retrograde knife (Smith & Nephew) (Fig 6, Table 2, Video 1). Thereafter, the arthroscope can be switched to the distal portal, and the deep fascia of the distal forearm over the ulnar nerve can be released with scissors via the proximal portal.

After the procedure, the wounds are closed with simple sutures. Postoperatively, free mobilization of the wrist and fingers is encouraged.

Discussion

A single-portal endoscopically assisted approach to Guyon canal release has been proposed.¹⁶ However, the authors concluded that this single-portal approach should not be used to release the aponeurotic arch of the hypothenar muscles.¹⁶ Otherwise, the endoscopically assisted dissection can jeopardize the motor branch of the ulnar nerve.¹⁶ The portal used in this endoscopically assisted approach is just radial to the FCU tendon and is not a good viewing portal for the obliquely oriented pisohamate hiatus. Instead, the distal portal in our technique provides better endoscopic visualization of the pisohamate hiatus and the deep branch of the ulnar nerve. However, release of the aponeurotic arch at the hook of hamate may not be sufficient to completely relieve its compression effect on the ulnar nerve. Therefore, besides oblique release of the aponeurotic arch, longitudinal release of the arch is performed to ensure complete release of the pisohamate hiatus. The endoscopic working space in our technique is essential outside the boundary of the Guyon canal and the pisohamate hiatus. This facilitates the freedom of manipulation of the arthroscope and arthroscopic instruments and allows multiple-site release of the canal and hiatus via 2 portals.

Endoscopic Guyon canal release has the advantages of better cosmetic results, less pain, and less surgical trauma. The potential risks of this technique include injury to the ulnar nerve and artery, as well as their branches. Moreover, skin necrosis may develop owing to hydrodissection too superficially (Table 3). This technique is technically demanding and should be reserved for the experienced hand and wrist arthroscopist.

References

1. Earp BE, Floyd WE, Louie D, Koris M, Protomastro P. Ulnar nerve entrapment at the wrist. *J Am Acad Orthop Surg* 2014;22:699-706.
2. Cobb TK, Carmichael SW, Cooney WP. Guyon's canal revisited: An anatomic study of the carpal ulnar neurovascular space. *J Hand Surg Am* 1996;21:861-869.
3. Sierakowski A, Zweifel CJ, Payne S. Compression of the ulnar nerve in Guyon's canal caused by a large hypothener cyst. *Eplasty* 2010;10:e4.
4. Maroukis BL, Ogawa T, Rehim SA, Chung KC. Guyon canal: The evolution of clinical anatomy. *J Hand Surg Am* 2015;40:560-565.
5. Gross MS, Gelberman RH. The anatomy of the distal ulnar tunnel. *Clin Orthop Relat Res* 1985:238-247.
6. Shea JD, McClain EJ. Ulnar-nerve compression syndromes at and below the wrist. *J Bone Joint Surg Am* 1969;51:1095-1103.
7. Strohl AB, Zelouf DS. Ulnar tunnel syndrome, radial tunnel syndrome, anterior interosseous nerve syndrome, and pronator syndrome. *J Am Acad Orthop Surg* 2017;25:e1-e10.
8. Francisco BS, Agarwal JP. Giant cell tumor of tendon sheath in Guyon's canal causing ulnar tunnel syndrome. A case report and review of the literature. *Eplasty* 2009;9:e8.
9. Afshar A. Ulnar tunnel syndrome due to an aberrant muscle. *Arch Iran Med* 2015;18:58-59.
10. Fadel ZT, Samargandi OA, Tang DT. Variations in the anatomical structures of the Guyon canal. *Plast Surg* 2017;25:84-92.
11. Lui TH. Arthroscopic ganglionectomy of the foot and ankle. *Knee Surg Sports Traumatol Arthrosc* 2014;22:1693-1700.
12. Lui TH. Endoscopic ganglionectomy of palmar ganglion via flexor carpi radialis tendoscopy. *Arthrosc Tech* 2017;6:e1459-e1463.
13. Lui TH. Endoscopic ganglionectomy of the volar radial wrist ganglion. *Arthrosc Tech* 2017;6:e1477-e1480.
14. Lui TH, Lau AYC. Endoscopic ganglionectomy and release of the sixth extensor compartment. *Arthrosc Tech* 2019;8:e111-e115.
15. Wanner M, Jakob S, Schwarzl F, Honigmann K, Oberholzer M, Pierer G. Water jet dissection in fatty tissue. *Swiss Surg* 2001;7:173-179 [in German].
16. Noszczyk BH, Zdybek P. Feasibility and limitations of endoscopy in Guyon's canal. *Wideochir Inne Tech Maloinwazyjne* 2014;9:387-392.