Endoscopic Release of the Guyon Canal and Pisohamate Hiatus

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Abstract

Guyon canal syndrome referred to the ulnar nerve entrapment at the wrist and can occur at the Guyon's canal and the pisohamate hiatus. Open release requires a long incision and extensive soft tissue dissection, which may lead to wound complications. The purpose of this chapter is to describe the technical details of 2-portal endoscopic release of the Guyon's canal which can release both the volar carpal ligament and the fibrous arch of hypothenar muscles.

Keywords

Guyon canal · Ulnar nerve · Volar carpal ligament
Pisohamate hiatus · Endoscopy · Release

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13.1 Introduction

Guyon canal is a fibro-osseous tunnel with triangular-shaped cross section. It was first described by Felix Guyon in 1861 [1]. The canal is about 4 cm in length located at proximal region of the hypothenar area. It contains the ulnar nerve, ulnar artery with venae comitantes, and loose fibro-fatty tissue.

Proximally, its roof is formed by the volar carpal ligament (VCL) and the floor is formed by transverse carpal ligament (TCL). The VCL and TCL merged together laterally to form the lateral apex. Medially, the base of the triangular canal is formed by the pisiform [2].

Distally, its roof is formed by the fibrous arch of the hypothenar muscles (opponens digiti minimi, flexor digiti minimi, and abductor digiti minimi) and the floor is formed by pisohamate ligament connecting the base of pisiform proximally and hamate distally. The lateral boundary is formed by hook of hamate and the medial boundary is formed by muscles of abductor digiti minimi. Pisohamate hiatus refers to the opening at the distal end of the Guyon canal, between the fibrous arch of the hypothenar muscles and the pisohamate ligament. It is the most vulnerable compression site for the deep branch of the ulnar nerve. In some occasions, contraction of the hypothenar muscles may cause pressure at the fibrous arch, leading to compression of the deep branch of the ulnar nerve [3].

The deep branch of ulnar nerve with its vascular bundle passes through this opening around the hook of hamate to supply hypothenar muscles, the third and fourth lumbricals, all interossei, adductor pollicis, and the medial head of the flexor pollicis brevis. On the other hand, the superficial branch of ulnar nerve with its vascular bundle runs superficial to the fibrous arch in the hypothenar fat, providing sensation to the little finger and ulnar half of the ring finger [4]. It also gives rise to a small branch to supply the palmaris brevis muscles upon exiting the canal [5].

The Guyon's canal can be divided into three zones according to the bifurcation of the ulnar nerve. Zone 1 starts at the proximal edge of the volar carpal ligament and ends at the bifurcation. Zone 2 contains the deep branch, running deep to the fibrous arch of hypothenar muscles. Zone 3 contains the superficial branch, running superficial to the fibrous arch [3, 6].

With an understanding of these special anatomical features, compression of ulnar nerve inside the canal can cause pure motor, pure sensory, or mixed deficit depending on the site of pathology. It can be divided into three types according to Shea et al. [7] Type 1 lesions refer to those just proximal or within the canal causing mixed sensory and motor abnormalities. The patients may present with clawing of ring and little fingers, wasting of first dorsal interosseous, and weakness of intrinsic muscles. There will also be pain or paresthesia over ulnar one and a half digits. Type 2 lesions refer to compression along the deep branch causing pure motor deficits. Hypothenar muscles may be spared depends on the location of compression. Type 3 lesions refer to compression of the superficial branch at distal end of the canal causing pure sensory abnormalities. It is the rarest among the three types of lesions.

The ulnar nerve at the wrist can be compressed by trauma, tumors, anomalous fibrous muscles, or fibrous band. Compression of the deep branch of ulnar nerve after a long-distance bicycle riding (Handlebar palsy) has been reported in literature. Prolonged external pressure over the ulnar palm while holding the handle, especially during downhill riding when a large part of the body weight was supported by the corner of the handlebar, can lead to weakness of intrinsic muscles, sparing the hypothenar muscles and the sensation. Other less common compressive conditions at wrist can be due to endocrine, metabolic, synovial, or arthritic diseases [1, 3, 8–10].

According to a study of ulnar nerve compression syndrome, 19 different lesions could lead to compression of the ulnar nerve at and below the wrist; the most frequent cause was ganglion (28.7%) followed by occupational neuritis (23.5%), laceration (10.3%), ulnar artery disease (8.1%), and fracture of carpal bones (5.9%). Most lesions (52%) were type II, 30% were type I, and 18% were type III compression [7, 11].

With careful evaluation of symptoms, motor, and sensory findings, clinicians can arrive at a clinical diagnosis of distal ulnar neuropathy and determine the likely zone of ulnar

nerve lesion [12]. However, anatomical variations and double crush compressions inside of canal may complicate the clinical pictures. Further investigations like electrodiagnostic studies and imaging are required for accurate diagnosis [2].

Electrodiagnostic studies are helpful not only in making a diagnosis of Guyon canal syndrome, it also helps to rule out other neurological conditions like cubital tunnel syndrome, thoracic outlet syndrome, or cervical radiculopathy [12]. On the other hand, it can localize the site of the lesion. For type I lesion, there will be a normal motor conduction velocity of the ulnar nerve across-the-elbow and elbow-to-wrist segments, a prolonged distal latency to the abductor digiti minimi and first dorsal interosseous muscles, a prolonged sensory latency and diminished evoked sensory responses. For type II lesion, distal to wrist, there will be a normal sensory latency and sensory-evoked responses, a normal distal motor latency to the abductor digiti quinti minimi but a prolonged latency to the first dorsal interosseous; denervation potentials in the first dorsal interosseous but not in the abductor digiti quinti [11].

According to the consensus statement of the European HANDGUIDE study, the factors in choosing different treatment options are symptoms severity, duration, and the response to previous treatment. Conservative care involved instructions to the patient to avoid local pressure on the Guyon canal-like weight bearing or bicycling and to limit the mechanical overload caused by repetitive movement or static wrist extension. Splintage of the wrist in neutral position with or without finger support would also be helpful. Conservative treatment is generally applied to those with mild-to-moderate symptoms for less than 3 months. For moderate to very severe symptoms last more than 2 months, persistence of disturbing symptoms despite conservative care or worsening of symptoms, surgery should be offered [2, 13].

Anatomical variations of the Guyon's canal exist and surgeon should fully understand the canal anatomy and the location of entrapment before the operation. These variations include anomalous muscles inside the canal, hypoplastic hamate, multiple ulnar nerve branches, or increased amount of fat tissue inside the canal [14, 15].

Conventional surgical approach for ulnar tunnel decompression required exposures of the whole Guyon canal from the beginning to the end, not just limited to the specific site of pathology [2]. Five types of open surgical approaches are commonly employed: carpal tunnel incision with proximal extension across the wrist flexion crease, Brunner ulnar hypothenar approach (extended or not extended) or longitudinal ulnar hypothenar approach (extended or not extended) [13]. They all required a large skin incision, extensive soft tissue dissections, and mobilization of ulnar neurovascular bundles. With advancement in endoscopic technique, minimally invasive approach of decompression of ulnar nerve inside the Guyon canal and pisohamate hiatus became an attractive alternative to conventional open approach. Morbidity of long skin incisions, extensive soft tissue dissection, and risks of mobilizing neurovascular bundle can be minimized.

13.2 Indications

Endoscopic release is indicated for those with symptomatic ulnar nerve entrapment in the wrist who failed conservative treatment.

13.3 Contraindications

It is contraindicated in solid tumor or deformity of the canal, like in case of severe hamate malunion or pisiform dislocation. However, it can still be safely performed in the presence of ganglion. Endoscopic ganglionectomy can be performed together with endoscopic release of the Guyon canal and pisohamate hiatus [16–19]. Besides, 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.

13.4 Author Preferred Technique

13.4.1 Preoperative Planning

The patient's symptoms should be compatible with Guyon canal syndrome. Detailed physical examination and electrodiagnostic studies can locate the zone of compression. Radiographs and computed tomograms may be needed if malunion of the hamate is suspected. Magnetic resonance imaging is indicated if soft tissue space-occupying lesion of the Guyon canal, e.g., ganglion is suspected.

13.4.2 Patient Positioning

The patient is in supine position with the hand on the side table. A pneumatic tourniquet is put on the arm to provide a bloodless surgical field. A 2.7-mm 30° arthroscope is used and fluid inflow is driven by gravity.

13.4.3 Portal Design

The important surface landmarks are the pisiform bone, hook of hamate, and flexor carpi ulnaris (FCU) tendon. The structure connecting the distal margin of the bones is the fibrous aproneurotic arch of hypothenar muscles. Prominent tendinous structure attaching to proximal end of pisiform is the tendon of the FCU. Ulnar nerve is located on the radial side of FCU tendon running distally and branched into a deep branch running radially around hook of hamate and a superficial branch going along the direction of main bulk of hypothenar muscles. These structures should be outlined with a skin marker before the procedure.

Endoscopic Guyon canal release is performed via the proximal and distal portals. The proximal portal is located 1 cm proximal to the pisiform bone and just radial to the flexor carpi ulnaris (FCU) tendon. The distal portal is in line with the pisiform bone and FCU tendon and 1 cm distal to the hook of hamate (Fig. 13.1).

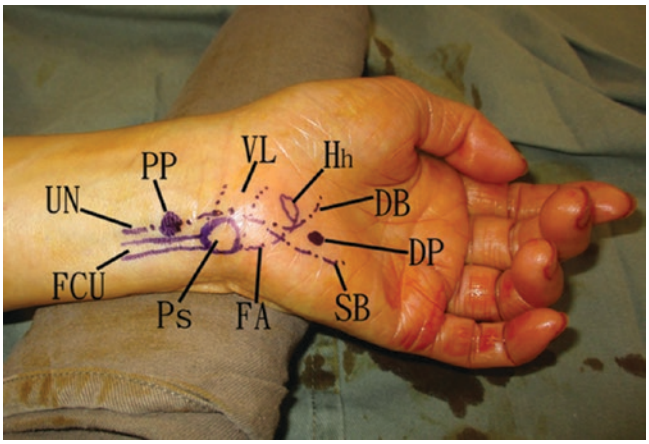


Fig. 13.1 The structures of the Guyon canal and the portals for endoscopic Guyon canal release are outlined. *FCU* flexor carpi ulnaris, *Ps* pisiform, *Hh* hook of hamate, *UN* ulnar nerve, *SB* superficial branch of ulnar nerve, *DB* deep branch of ulnar nerve, *VL* volar carpal ligament, *FA* fibrous aponeurotic arch of hypothenar muscles, *PP* proximal portal, *DP* distal portal

13.4.4 Step-by-Step Description of the Technique

- One-centimeter skin incisions are made at the portal sites. The FCU tendon is dissected out at the proximal portal (Fig. 13.2). The tendon is the landmark of the ulnar nerve as the nerve is immediately radial to the tendon. The arthroscope and arthroscopic instruments are kept radial to the tendon.
- The proximal portal incision is retracted distally and the subcutaneous tissue is bluntly dissected from the volar carpal ligament with a hemostat (Fig. 13.3). This develops the endoscopic working space of this procedure.
- The arthroscope-trocar is introduced via the proximal portal to the distal portal and the arthroscope-cannula is inserted along the trocar via the distal portal. This can ensure proper placement of the cannula into the endoscopic working space (Fig. 13.4).

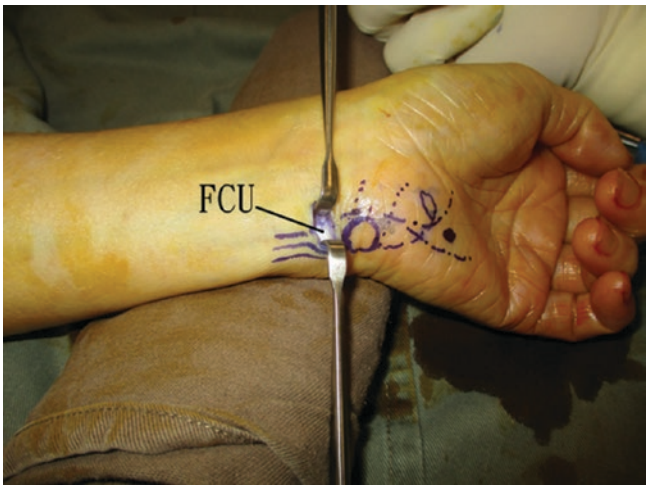


Fig. 13.2 One-centimeter skin incisions are made at the portal sites. The flexor carpi ulnaris (FCU) tendon is dissected out at the proximal portal

Fig. 13.3 The proximal portal incision is retracted distally and the subcutaneous tissue is bluntly dissected from the volar carpal ligament with a hemostat (this figure). This develops the endoscopic working space of this procedure

Fig. 13.4 The arthroscope-trocar is introduced via the proximal portal to the distal portal and the arthroscope-cannula is inserted along the trocar via the distal portal. This can ensure proper placement of the cannula into the endoscopic working space

- With the arthroscope in the distal portal, the FCU tendon is identified and traced distally till the volar carpal ligament is seen. The volar carpal ligament is then released by a SuperCut scissors via the proximal portals. The endoscopic view is frequently obscured by the subcutaneous fatty tissue. The subcutaneous tissue can be elevated with a small retractor via the proximal portal to improve the endoscopic visualization (Fig. 13.5). "Nick and spread" maneuver at the ligament surface by the scissor can also improve the endoscopic view (Fig. 13.6). Sometimes, the volar carpal ligament is so thick that repeated cut is needed to achieve full thickness release of the ligament (Fig. 13.7).
- After that, the arthroscope is switched to the proximal portal and the ulnar nerve and its bifurcation are identified (Fig. 13.8). The deep branch of the ulnar nerve is traced distally till the hypothenar muscles are seen. The fascia covering the muscles is released close to the hamate bone

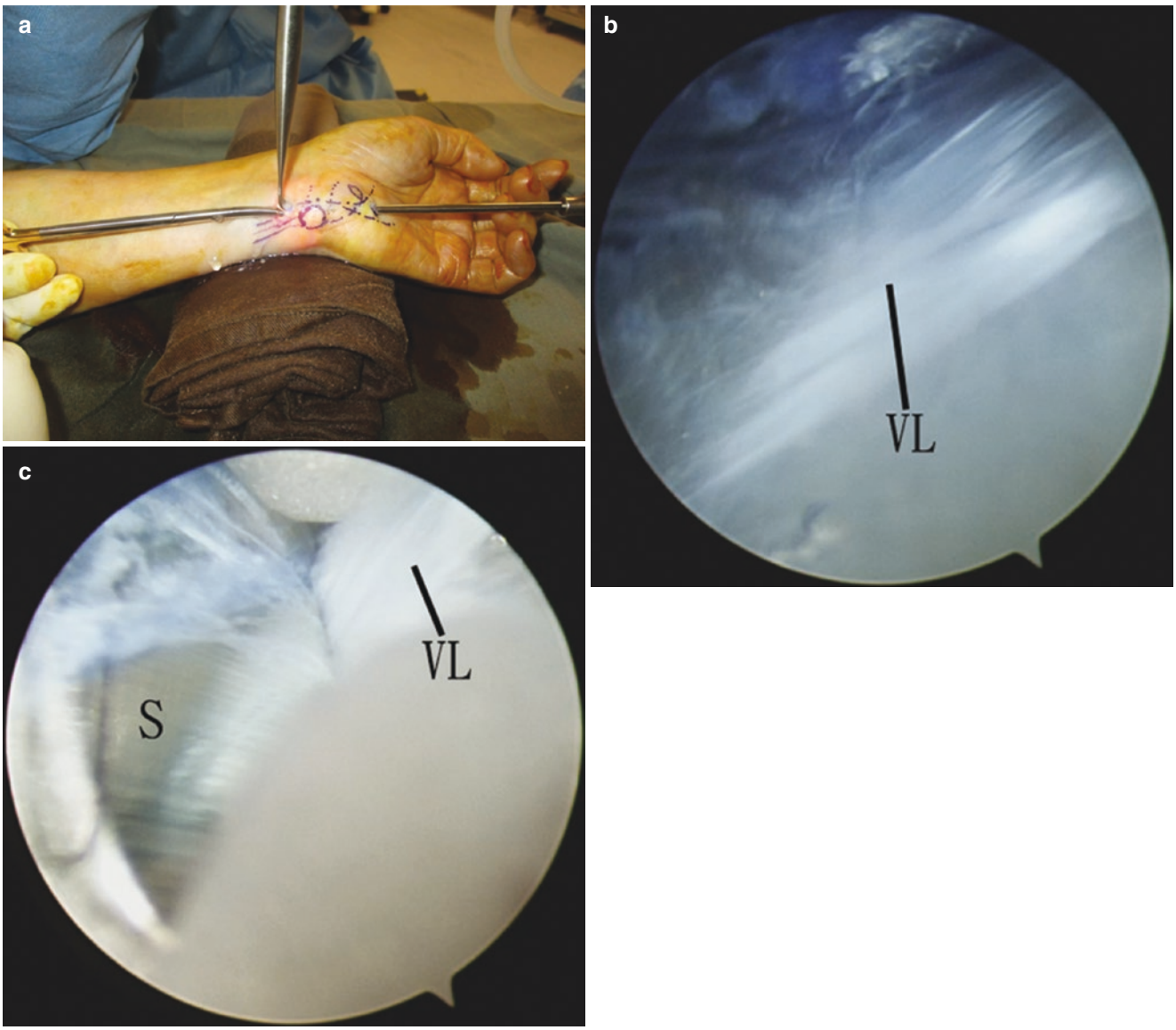


Fig. 13.5 (**a**) The distal portal is the viewing portal and the proximal portal is the working portal. The subcutaneous tissue is elevated with a small retractor via the proximal portal to improve the endoscopic visualization. (**b**) The volar carpal ligament is identified. (**c**) The volar carpal ligament is released by a SuperCut scissors via the proximal portals. The distal part of the volar carpal ligament is obscured by fatty tissue. The endoscopic view is frequently obscured by the subcutaneous fatty tissue. *VL* volar carpal ligament, *S* scissors

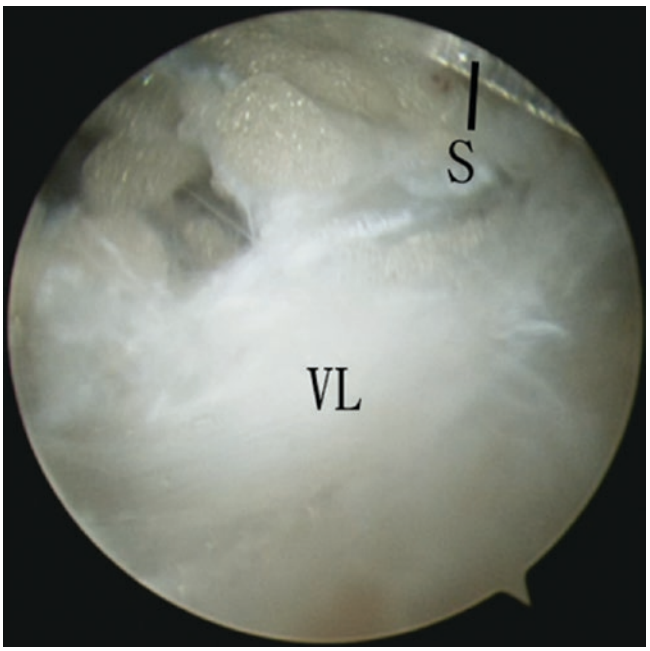


Fig. 13.6 "Nick and spread" maneuver at the ligament surface by the scissor can improve the endoscopic view. *VL* volar carpal ligament, *S* scissors

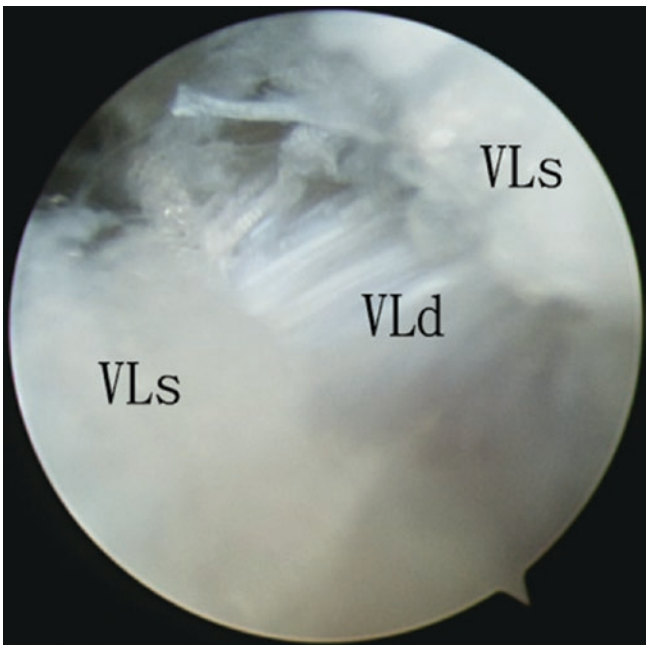
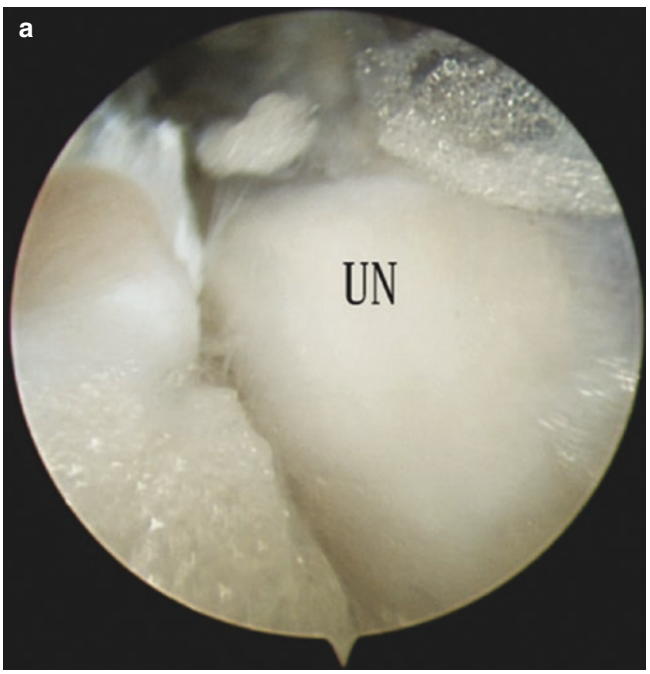


Fig. 13.7 The superficial part of the volar carpal ligament is cut but the deep part of the ligament is still intact. *VLs* superficial part of the volar carpal ligament, *VLd* deep part of the volar carpal ligament



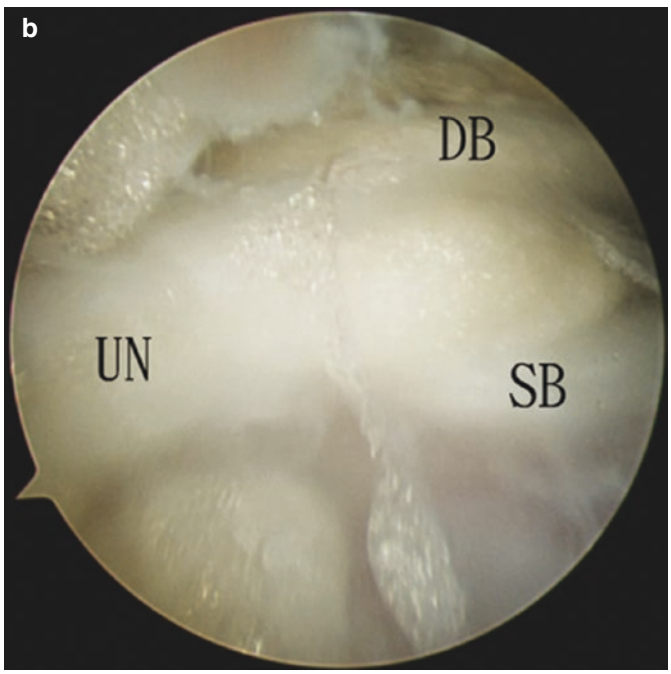


Fig. 13.8 The proximal portal is the viewing portal. (**a**) The ulnar nerve is identified. (**b**) The ulnar nerve is traced distally to its bifurcation. *UN* ulnar nerve, *SB* superficial branch of ulnar nerve, *DB* deep branch of ulnar nerve

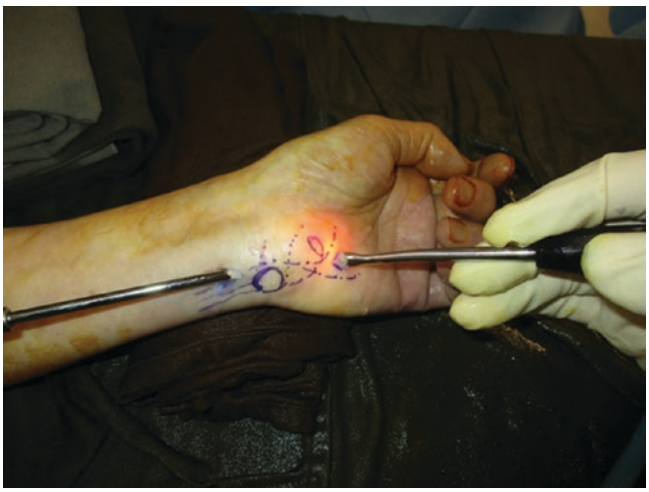


Fig. 13.9 The proximal portal is the viewing portal and the distal portal is the working portal. The hypothenar muscle is stripped from the fibrous aponeurotic arch by a small periosteal dissector

and the muscles are carefully stripped distally with a periosteal dissector to expose the fibrous arch of hypothenar muscles (Fig. 13.9). The fibrous arch is then released with a retrograde knife (Fig. 13.10). The deep branch is traced distally and any restriction to the branch is released (Fig. 13.11).

- The superficial branch of the ulnar nerve can be traced distally to look for any pathology (Fig. 13.12).
- Finally, the two portals are switched again to release the deep fascia of the distal forearm over the ulnar nerve using SuperCut scissors (Fig. 13.13).

13.4.5 Complications and Management

Endoscopic release of Guyon canal obviates the need to create a large incision and extensive soft tissue dissection. Problems of open approaches like an unsightly scar, keloid

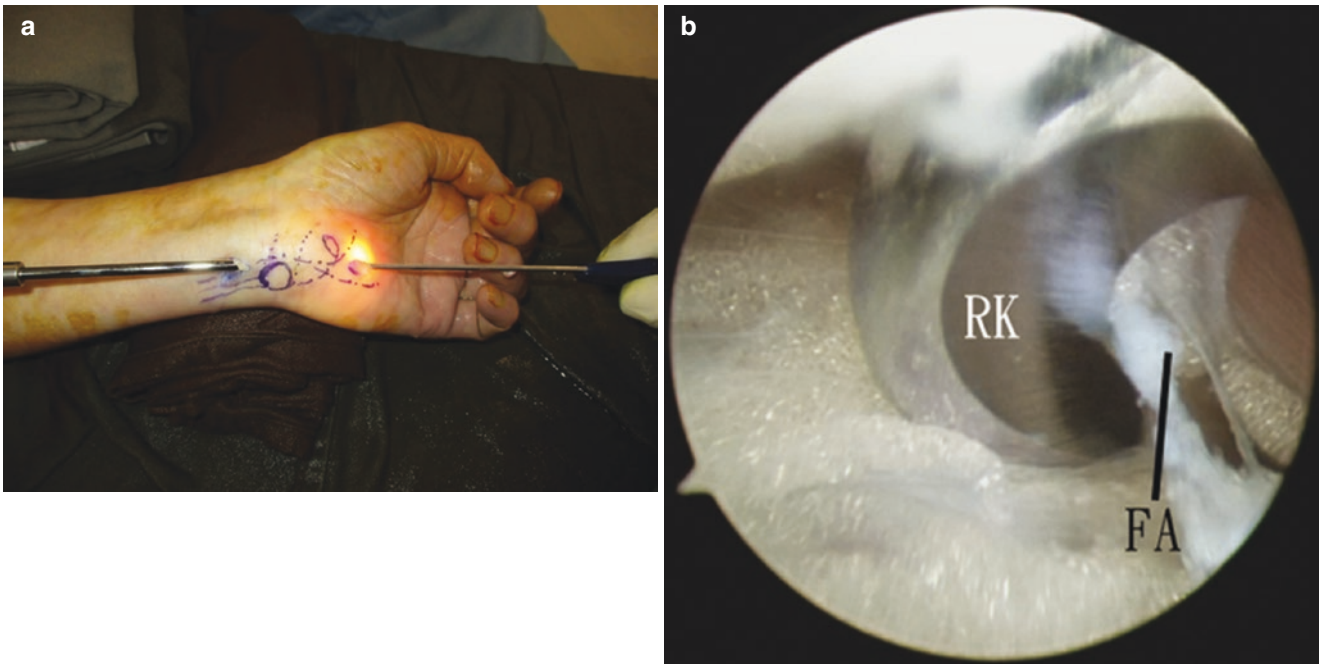


Fig. 13.10 (**a**) The proximal portal is the viewing portal and the distal portal is the working portal. (**b**, **c**, **d**) The fibrous aponeurotic arch of the hypothenar muscles is released with a retrograde knife. (**e**) The deep branch of the ulnar nerve is then exposed. *FA* fibrous aponeurotic arch of the hypothenar muscles, *RK* retrograde knife, *DB* deep branch of ulnar nerve

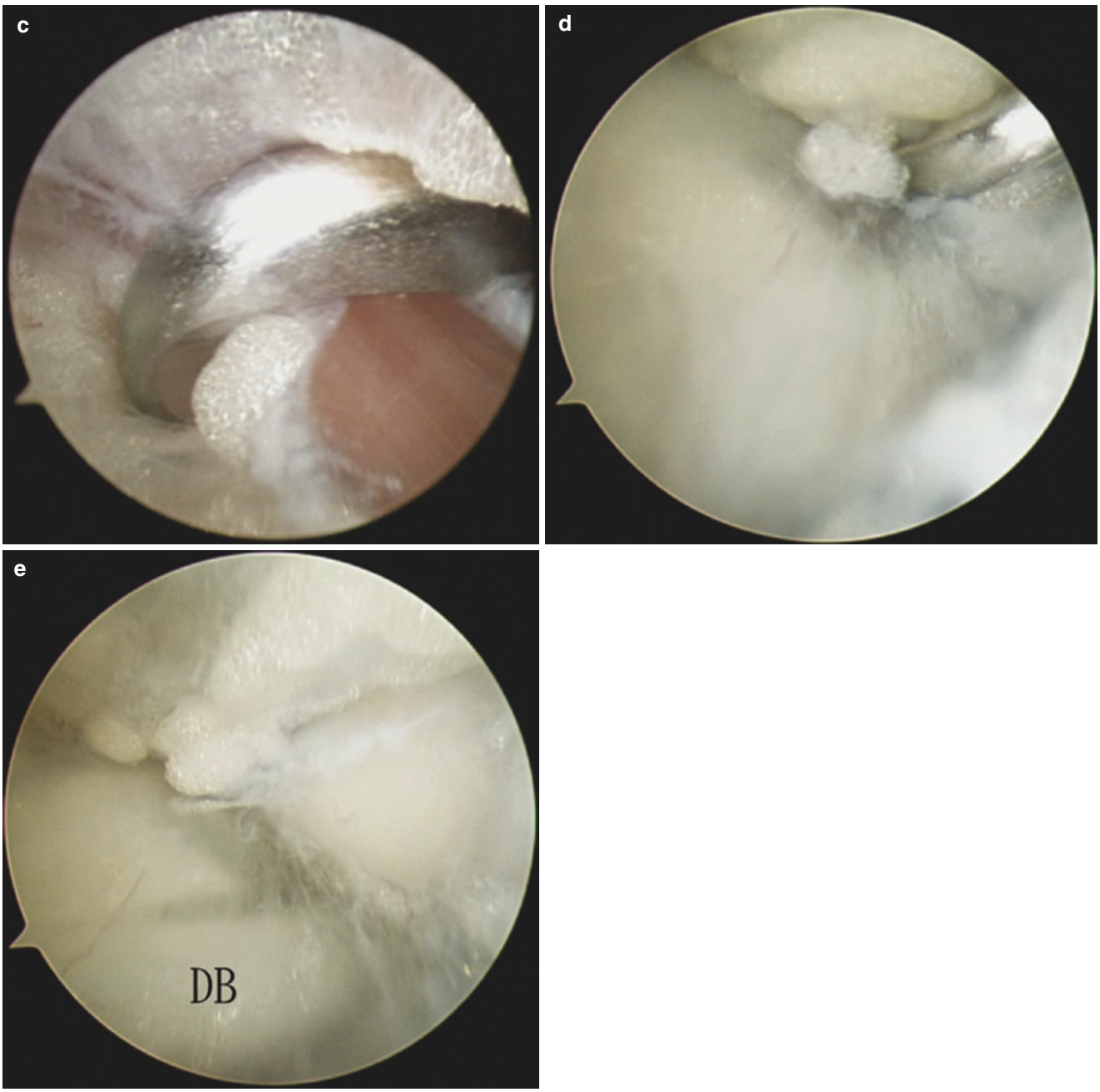


Fig. 13.10 (continued)

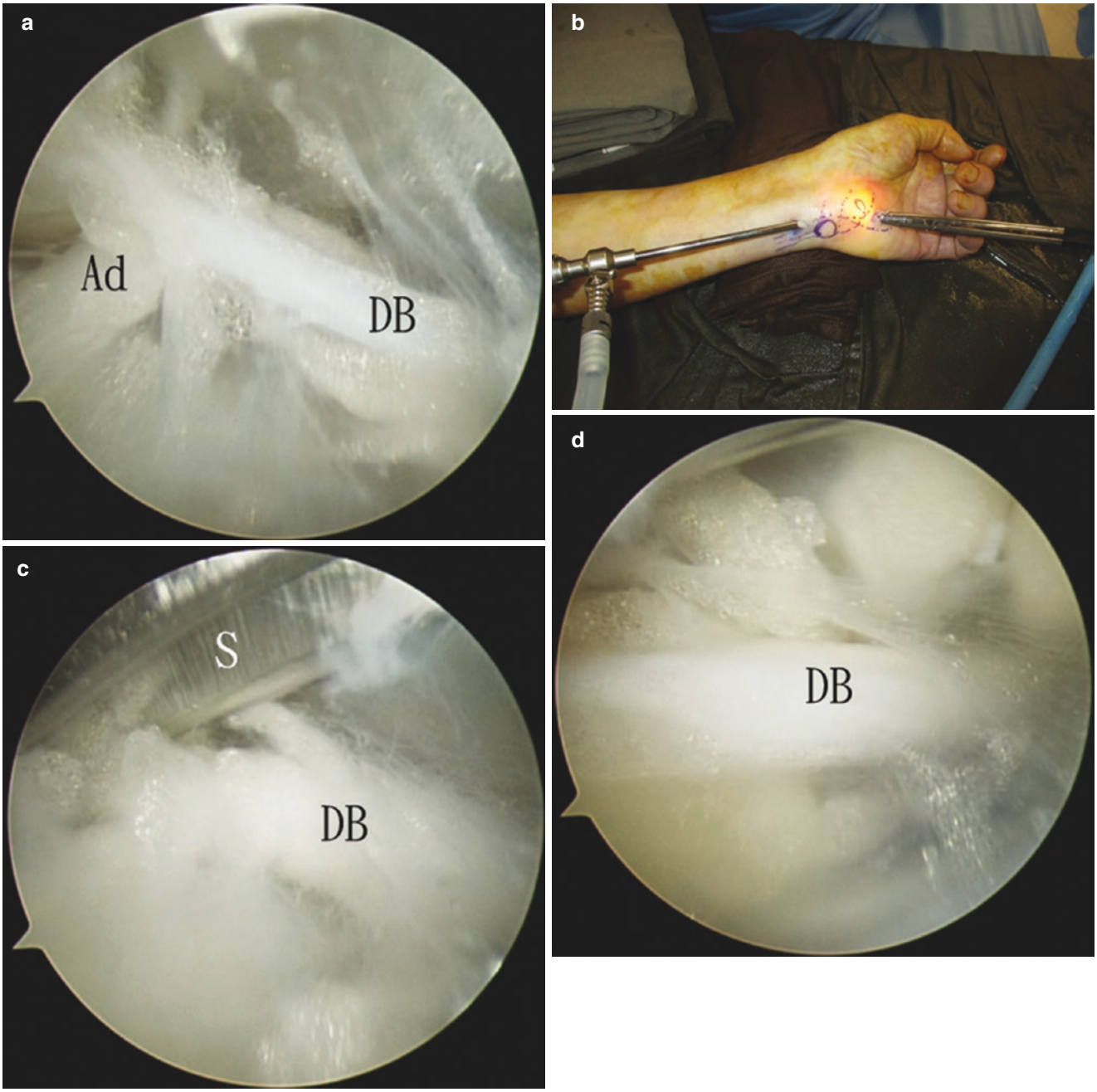


Fig. 13.11 The proximal portal is the viewing portal. (**a**) The deep branch of ulnar nerve is traced distally and fibrous adhesion is found in this illustrated case. (**b**, **c**) The adhesions are released with a scissor via the distal portal. (**d**) There are no more kinks at the deep branch of ulnar nerve after release of the adhesions. *Ad* adhesion; *DB* deep branch of ulnar nerve; *S* scissors

formation, and scarring around the neurovascular bundle can be minimized. However, this is a technically demanding procedure that required experience in handling of small endoscope, meticulous skills in the feeling of soft tissue entries to correctly guide the instruments into the right soft tissue plane, and a thorough understanding of the complex anatomy of the Guyon canal. Otherwise, iatrogenic injuries to ulnar neurovascular bundle and incomplete release of the

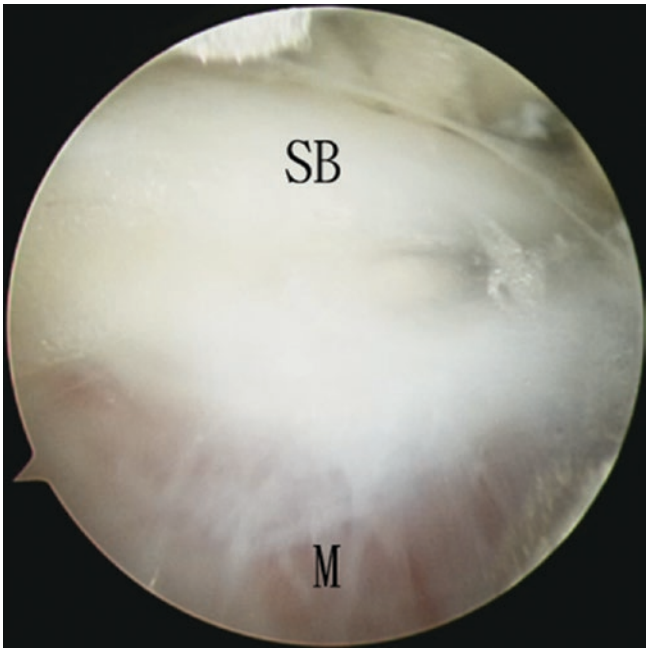


Fig. 13.12 The proximal portal is the viewing portal. The superficial branch of the ulnar nerve is traced distally to look for any pathology. *M* hypothenar muscles, *SB* superficial branch of ulnar nerve

nerve (particularly the deep motor branch) may occur. Significant morbidity from ulnar nerve injury had been reported for incidental endoscopic Guyon canal release [20].

Excessive dissection of subcutaneous tissue to create the endoscopic working space may jeopardize the blood supply to the overlying skin and causing superficial skin necrosis. Moreover, dissection into the subcutaneous tissue will make the subsequent endoscopic procedure difficult as the volar carpal ligament is then obscured by fatty tissue. Therefore, it is very important to dissect at the plane between the subcutaneous tissue layer and the volar carpal ligament in order to preserve the blood supply to overlying skin and proper exposure of the volar carpal ligament.

Fig. 13.13 The distal portal is the viewing portal and the proximal portal is the working portal. Deep fascia of the distal forearm over the ulnar nerve is released with a SuperCut scissors

13.4.6 Postoperative Care

The portal incisions are closed with simple sutures. Bulky dressing is applied for one week and then changed to simple dressing. Free mobilization of fingers and wrist is allowed after the operation.

13.5 Summary

With meticulous surgical techniques and careful anatomical evaluation, the 2-portal endoscopic Guyon canal release is far more superior than conventional open approach in selected cases. The various ligamentous structures, fibrous tissue, and the neural bundles can be better illuminated and magnified under arthroscopic view. On the other hand, as our working space is outside the boundary of the canal, more motion freedom is allowed for the arthroscope and instruments. We can assess the canal more completely and the release can be performed at multiple sites if necessary. Other advantages of this technique include small incisions, minimal soft tissue dissection, and it also avoids the need to mobilize the neurovascular structure. Less surgical trauma and wound pain allow better mobilization and postoperative recovery.

For Guyon canal release, single portal technique using a portal just radial to FCU tendon has been evaluated [21]. The arthroscopic view provided by this portal for the aponeurotic arch of the hypothenar muscles is rather suboptimal, therefore, they advised against the release of the arch because of the risk of injury to the deep branch of the ulnar nerve [21]. Our additional distal portal, on the other hand, provides a far better view of the arch and therefore, the aponeurotic arch can be released safely together with mobilization of the deep branch of ulnar nerve.

Despite various advantages of the endoscopic technique, attention in peri-operative preparation including the right indication, throughout understanding of the pathoanatomy, appropriate instrumentation, and good surgical techniques are mandatory to avoid potential complications. The risks of this technique include injury to the ulnar nerve and artery, as well as their branches and superficial skin necrosis. This technique is technically demanding and should be reserved for the experienced hand and wrist arthroscopist. Open release remained the mainstay of current surgical recommendations [13].

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