



Flexor Tendoscopy, Endoscopy of the Ulnar Bursa, Radial Bursa, MidPalmar Space, and Thenar Space

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Abstract

The hand has a complex anatomy consisting of deep spaces, bursae, and tendon sheaths, which are potential spaces for infectious spread. These spaces can be accessed via different pairs of longitudinally aligned and transversely aligned coaxial portals. Endoscopic technique in the management of pathology involving

deep spaces of the hand is feasible and confers many advantages over traditional open techniques in suitable cases.

Keywords

Tendon sheath · Midpalmar space · Thenar space · Ulnar bursa · Radial bursa · Endoscopy

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10.1 Introduction

The hand has a complex anatomy consisting of deep spaces, bursae, and tendon sheaths, which are potential spaces for infectious spread. These deep spaces of the hand include the midpalmar space, the hypothenar space, the thenar space, space of Parona, and the interdigital web spaces [1–4]. There are various patterns of communication between the finger flexor tendon sheaths and the deep spaces of the hand.

The midpalmar space of the hand communicates with the space of Parona in the forearm via the carpal tunnel [5]. In 50–80% of cases, the first flexor digitorum tendon sheath communicates with the radial bursa, while the fifth flexor digitorum tendon sheath communicates with the ulnar bursa [2]. The flexor digitorum tendon sheaths of the other fingers usually do not communicate with the radial nor ulnar bursa [2]. It is important to know the variations in the anatomy of the deep spaces of the hand, to better understand the spread of inflammatory, infectious, and neoplastic processes involving this region.

Hand infections may range from simple cellulitis to suppurative flexor tenosynovitis or severe deep space abscesses, which sometimes present as limb-threatening compartment syndrome of the hand and forearm. Ultrasonographic study is a useful diagnostic tool to differentiate between the clinical entities. Deep space infection of the hand can result from direct inoculation into the tendon sheath or bursa, hematoge-

neous spread, via the lymphatic system or through direct spread from infected adjacent structures [6–8].

Suppurative deep space infection is usually treated with surgical drainage together with rest, elevation, and systemic antibiotic therapy [6, 8]. Wide surgical incision and drainage allows excellent exposure and extensive debridement, but with risks of wound complications, flap necrosis, and exposed tendons or neurovascular structures [6]. In cases of flexor tenosynovitis, a less extensive technique involving limited incisions at the proximal and distal ends of flexor sheaths has been described [6, 8]. A catheter is threaded from one end of the tendon sheath to the other end, and it is then used for either continuous or intermittent irrigation of the sheath. This technique has been shown to achieve good final range of motion of the involved finger, though many surgeons believe that it should only be used in less severe cases of tenosynovitis [2]. Fluid extravasation is also not uncommon due to tendon sheath erosions or inaccurate placement of the catheter. Regardless of the technique used for drainage, vigorous hand therapy is crucial in the post-operative period to avoid hand stiffness and functional impairment [6–8].

Endoscopic approaches to these deep spaces are rarely described in current existing literature [9–11]. Endoscopic techniques are beneficial in reducing the risk of wound complications and the risk of exposed tendons or nerves associated with open approaches. It also allows immediate post-operative vigorous hand therapy.

10.2 Indications

- (a) Suppurative or chronic infections of the fifth flexor digitorum tendon sheath, ulnar bursa, midpalmar space, flexor pollicis longus (FPL) tendon sheath, radial bursa, or thenar space.
- (b) Hematoma collection of the midpalmar and thenar space.
- (c) Chronic tenosynovitis or bursitis of these spaces associated with inflammatory diseases that are resistant to conservative management.

10.3 Contra-Indications

- (a) Compartment syndrome of the myofascial spaces.
- (b) Pigmented villous synovitis that extends into the carpal tunnel.

10.4 Author Preferred Techniques

10.4.1 Pre-operative Planning

An ultrasound, CT, or MRI are recommended to delineate the extent of involvement especially the spread out of disease via communication between the potential spaces.

10.4.2 Patient Positioning

The patient is placed in supine position with an arm tourniquet to provide a bloodless operative field. Fluid inflow is driven by gravity, and no arthropump is required. A 2.7 mm 30° arthroscope is used.

10.4.3 Portal Design

1. For conditions involving the FPL tendon sheath, radial bursa, and thenar space

(a) Phalangeal portal of the thumb

This portal is located close to the phalangeal insertion of the FPL tendon and just proximal to the volar interphalangeal crease of the thumb. A 5 mm longitudinal incision is made at this point. The subcutaneous tissue is bluntly dissected down to the flexor tendon sheath using a hemostat. The tendon sheath is incised to expose the FPL tendon. This por-

tal can be used interchangeably as a viewing and working portal for FPL tendoscopy (Fig. 10.1).

(b) Thenar portal

This portal is created using an inside-out technique. After creating the phalangeal portal of the thumb, the endoscope is advanced within the FPL tendon sheath. When the endoscope reaches the turn of the FPL tendon sheath at the proximal palm, the endoscope is removed, leaving the cannula in situ. The Wissinger rod is inserted into the cannula and the cannula is removed. The rod is passed through the thenar muscle and the skin over the tip of the rod is incised to create the thenar portal. This portal and the phalangeal portal of the thumb can be used interchangeably as a viewing and working portal (Fig. 10.1).

(c) Radial wrist portal

This portal is placed at the ulnar side of the flexor carpi radialis (FCR) tendon and 1 cm proximal to the proximal edge of the flexor retinaculum. The FPL tendon and radial bursa are deep and ulnar to the FCR tendon. Using a 1 cm longitudinal skin incision, the subcutaneous tissue is bluntly dissected down to the deep fascia using a hemostat. The deep fascia is incised to expose the FCR tendon, which is then retracted radially to expose the FPL tendon and radial bursa. Excessive ulnar traction of the wound should be avoided, as the median nerve lies at the ulnar side of the incision (Fig. 10.1).

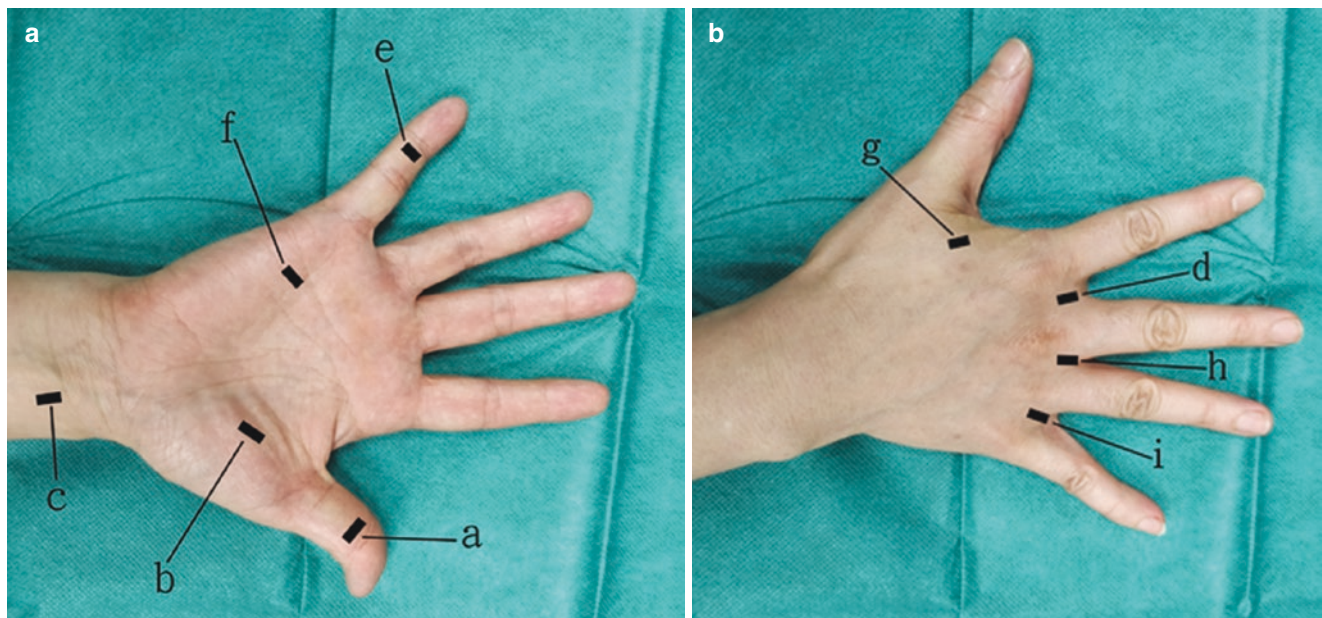


Fig. 10.1 (A, B) Portals for flexor tendoscopy, endoscopy of the ulnar bursa, radial bursa, midpalmar space, and thenar space. a: phalangeal portal of the thumb; b: thenar portal; c: radial wrist portal; d: second

finger web portal; e: phalangeal portal of the little finger; f: ulnar palmar portal; g: first web portal; h: third finger web portal; i: fourth finger web portal

(d) *Second finger web portal*

This portal is created using an inside-out technique. After creating the radial wrist portal, the endoscope is advanced along the wrist portion of the FPL tendon sheath toward the dorsum of the second finger web. The endoscope is then removed, leaving the cannula in situ. The Wissinger rod is inserted into the cannula and the cannula is removed. The rod is advanced into the second finger web and a 5 mm skin incision is made at the tip of the rod to create the second finger web portal. This portal serves as the working portal for the thenar space and radial bursa of the wrist. The radial wrist portal and the second finger web portal are co-axial to one another (Fig. 10.1).

2. *For conditions involving the fifth flexor digitorum tendon sheath, ulnar bursa, and midpalmar space*

(a) *Phalangeal portal of the little finger*

This portal is located just proximal to the distal volar skin crease of the little finger. A 3–4 mm transverse skin incision is made at the portal site. The subcutaneous tissue is bluntly dissected down to the flexor tendon sheath using a hemostat. The tendon sheath is then penetrated by the hemostat to create the portal. This portal can be used interchangeably as a viewing and working portal for flexor tendoscopy of the little finger (Fig. 10.1).

(b) *Ulnar palmar portal*

This portal is located over the flexor tendons to the little finger at the level of the neck of the fifth metacarpal. It is created using the inside-out technique, after establishing the phalangeal portal of the little finger. A trocar is advanced proximally through the established phalangeal portal of the little finger. Some resistance may be encountered when the trocar passes through

the pulleys. Excessive force should be avoided and the trocar should not be directed toward the phalangeal bones to avoid injury to the flexor tendons. When the tip of the trocar is felt at the planned ulnar palmar portal site, a 3–4 mm transverse incision is made at the tip. This portal can be used interchangeably as a viewing and working portal for flexor tendoscopy of the little finger as well as endoscopy of the ulnar bursa and midpalmar space (Fig. 10.1).

(c) *First web portal*

The first web portal is located at the dorsum of the first web space of the hand. It is created using an inside-out technique. The trocar cannula is introduced through the ulnar palmar portal and advanced transversely along the palmar surface of the flexor tendons toward the first web space of the hand, with the thumb held in abduction. The skin is incised at the tip of the trocar to create the first web portal. To decrease the risk of injury to the superficial palmar arch, the trocar should be passed as distal as possible and excessive force should be avoided. The distally placed first web portal also avoids injury to the branches of the superficial radial nerve and allows access to the most proximal part of the subfascial space. This portal can be used interchangeably as a viewing and working portal for endoscopy of the ulnar bursa and midpalmar space (Fig. 10.1).

(d) *Third and fourth finger web portals*

These portals can be used as alternatives to the first web portal for midpalmar space endoscopy. They should be used with caution because of the risk of injury to the interdigital neurovascular bundles. Adjacent web portals must not be used simultaneously due to the risk of complete numbness or ischemia of the central digit (Fig. 10.1).

10.4.4 Step-by-Step Description of the Techniques

1. Endoscopy of the Distal Portion of the FPL Tendon

The phalangeal portal of the thumb is used as the viewing portal. After advancing the endoscope proximally, the first structures that are viewed through the endoscope are usually the thenar muscles. When the endoscope is pulled backward, it will slide back into the tendon sheath and the FPL tendon can be examined (Fig. 10.2). It is extremely difficult, if not impossible, to advance the endoscope proximally along the tendon sheath beyond the turn of the FPL tendon at the proximal palm. The thenar portal and the phalangeal portal of the thumb are coaxial and can be used interchangeably as the working portal for the distal portion of the FPL tendon sheath.

2. Endoscopy of the Proximal Portion of the FPL Tendon, Radial Bursa, and Thenar Space

The radial wrist portal is used to access the radial bursa. The trocar-cannula is inserted via the radial wrist portal, advanced distally along the FPL tendon and penetrated the tendon sheath reaching the thenar space. The trocar is removed and the arthroscope is incorporated into the cannula. Hence, the first structure which comes into view is usually the thenar space. As the endoscope is pulled backward, it will eventually slide into the tendon sheath and the proximal portion of the FPL tendon can be visualized (Fig. 10.3). It is difficult, if not impossible, to advance the endoscope distally along the tendon sheath due to the turn of the FPL tendon at the proximal palm.

The second finger web portal and the radial wrist portal are coaxial and can be used interchangeably as the viewing and working portals for the thenar space and the radial bursa at the wrist.

3. Endoscopy of the Flexor Tendon of the Little Finger

The phalangeal portal of the little finger is used as the viewing portal and the flexor tendon sheath and

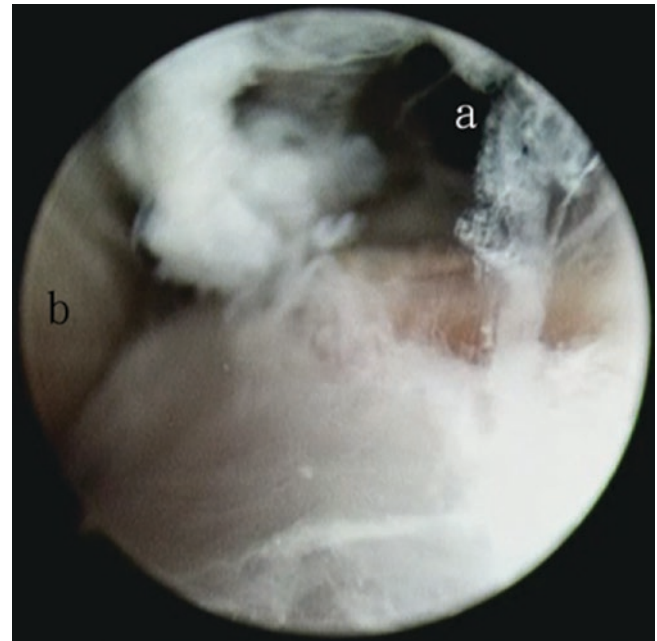


Fig. 10.3 The radial wrist portal is the viewing portal. At the turning point of the flexor pollicis longus tendon, the thenar space can be seen. a: thenar space; b: flexor pollicis longus tendon

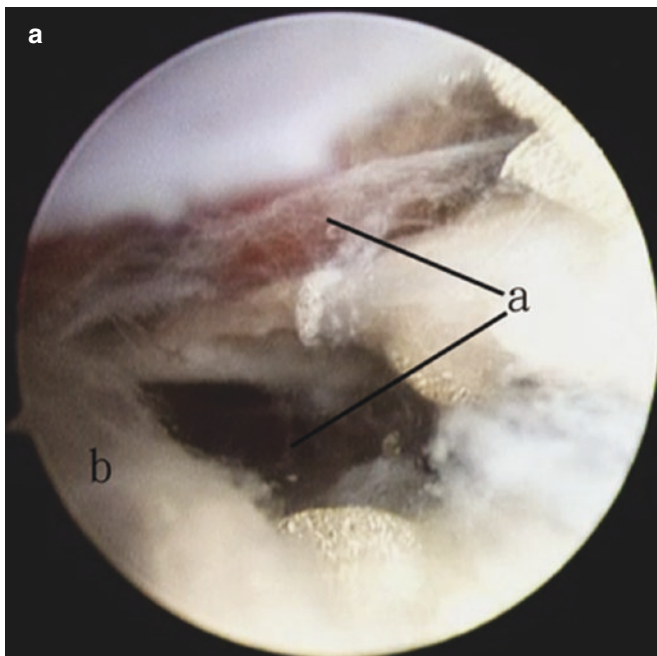
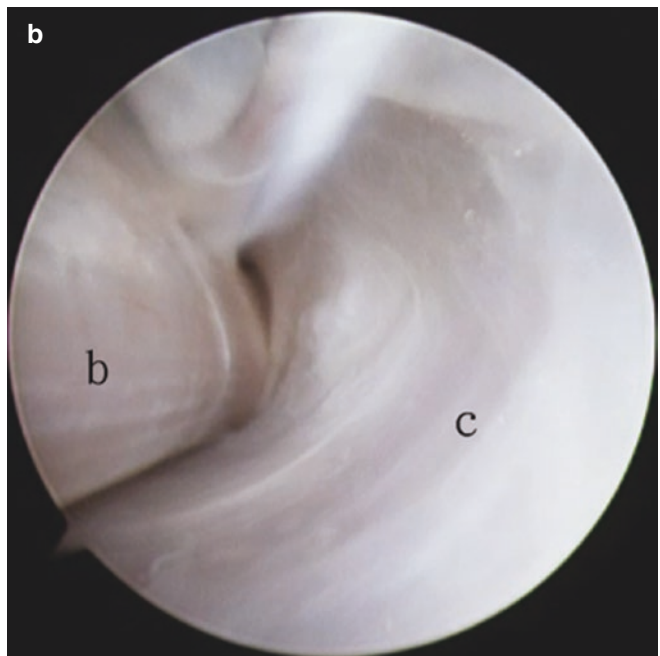


Fig. 10.2 (A) The phalangeal portal of the thumb is the viewing portal. After advancing the endoscope proximally, the thenar muscles are in view. (B) When the endoscope is pulled backward, it will slide back



into the tendon sheath and the flexor pollicis longus tendon can be examined. a: thenar muscles; b: flexor pollicis longus; c: tendon sheath

the flexor tendons can be examined for any pathology. As the endoscope is withdrawn distally, the flexor digitorum superficialis and the flexor digitorum profundus tendon can be seen in sequence (Fig. 10.4). Debridement of any inflamed synovium can be done with the phalangeal portal of the little finger and the ulnar palmar portal interchangeably as the viewing and working portals.

4. Endoscopy of the Ulnar Bursa

The ulnar palmar portal and the first web portal are interchangeable as viewing and working portals. The endoscope is advanced through the ulnar palmar portal, along the superficial surface of the flexor tendons to the first web portal. When the arthroscope is withdrawn gradually, the thenar muscles, the flexor pollicis longus tendon, and the thenar bursa (if distended) can be seen (Fig. 10.5).

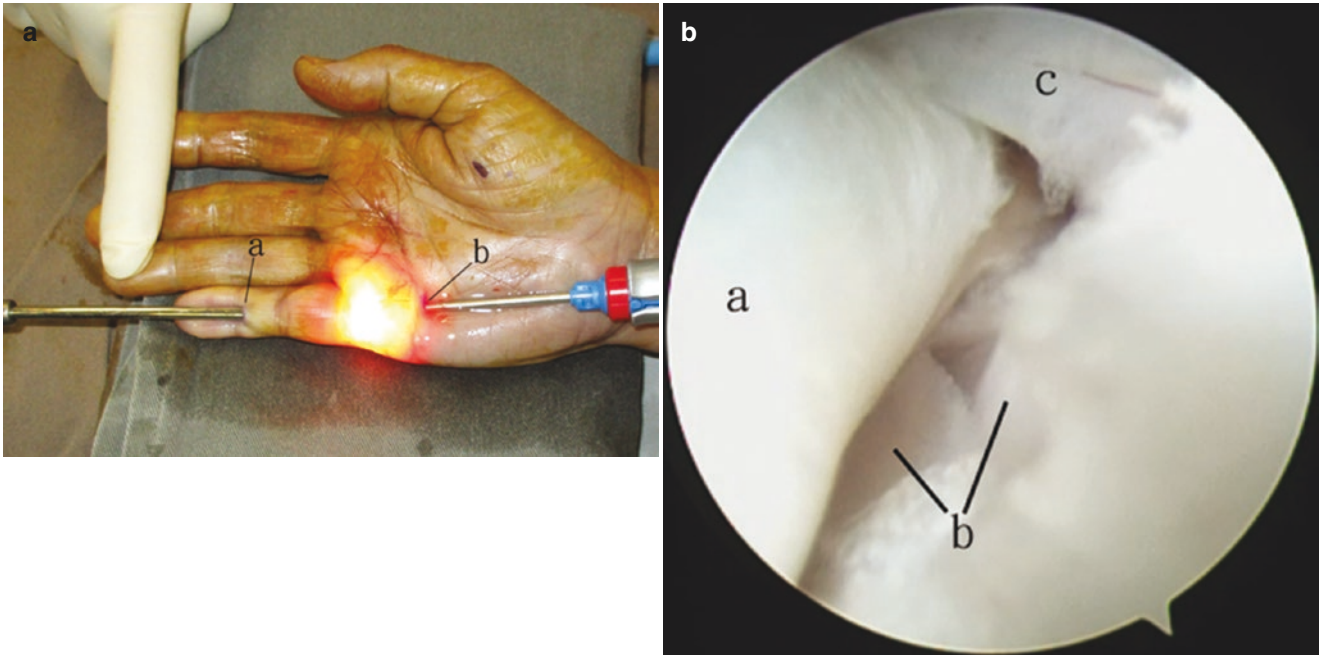


Fig. 10.4 (A) Endoscopy of the flexor tendon of the little finger via the phalangeal portal of the little finger and the ulnar palmar portal. (B) The phalangeal portal is the viewing portal. The flexor digitorum profundus

tendon can be seen passing through Camper's Chiasm of the flexor digitorum superficialis tendon. a: flexor digitorum profundus tendon; b: flexor digitorum superficialis tendon; c: tendon sheath

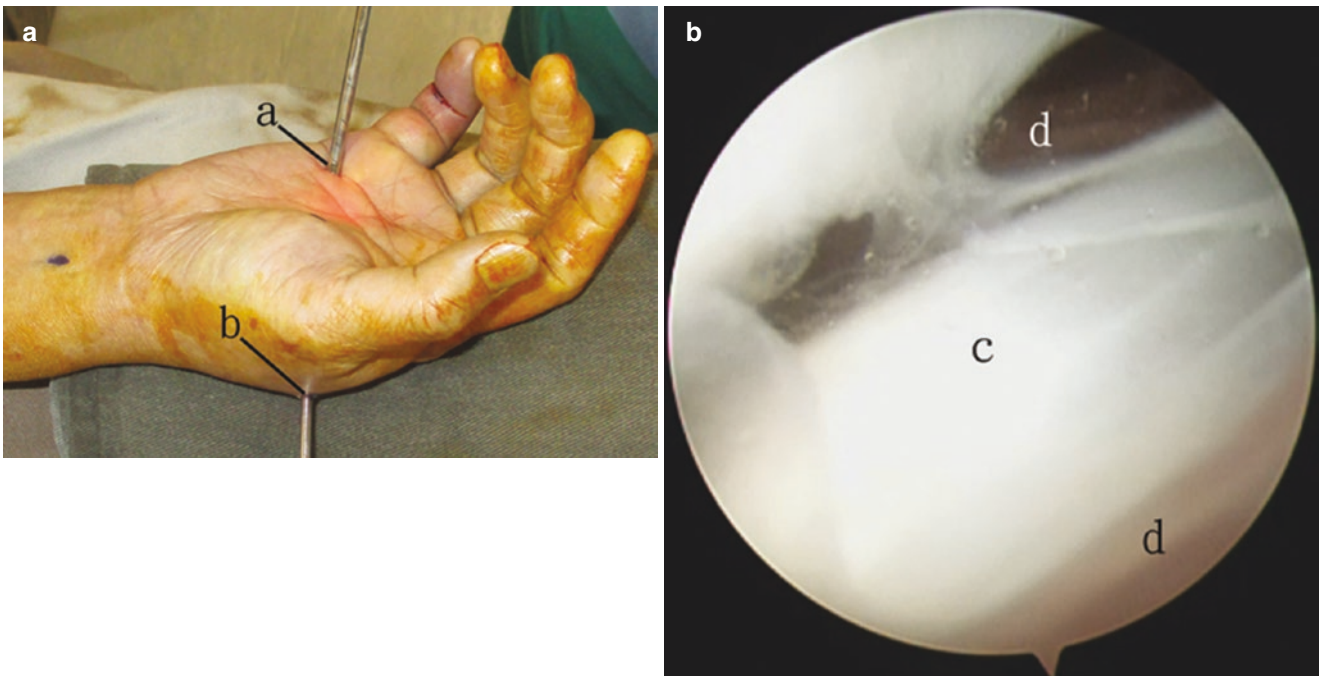


Fig. 10.5 (A) Endoscopy of the ulnar bursa is performed via the ulnar palmar portal (a) and the first web portal (b). (B) The ulnar palmar portal is the viewing portal. The flexor pollicis longus tendon (c) can be seen within the thenar muscles (d)

Upon withdrawing the endoscope further, the flexor tendons and the ulnar bursa can be assessed. At this level, the flexor tendon to the index finger is usually outside the ulnar bursa and can be seen at the radial side of the bursa because bursa invaginates the flexor tendons from ulnar

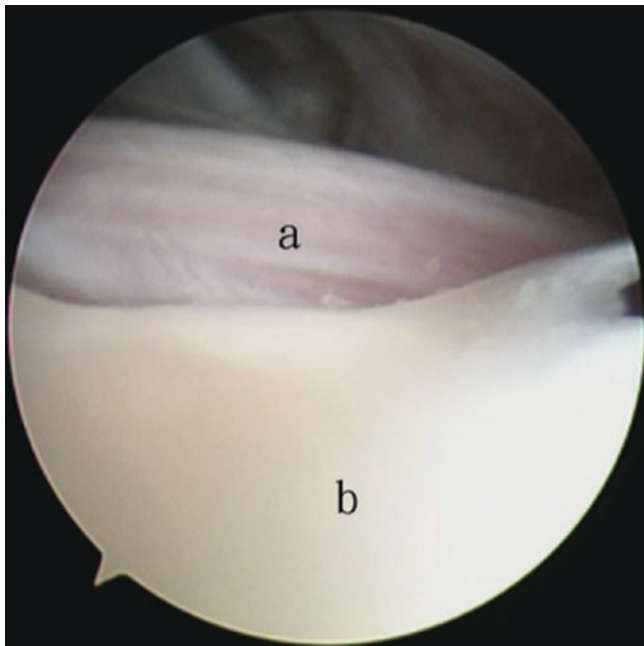


Fig. 10.6 The ulnar palmar portal is the viewing portal. The flexor tendon to the index finger (a) is usually outside the ulnar bursa (b) and can be seen at the radial side of the bursa because bursa invaginates the flexor tendons from ulnar side

side (Fig. 10.6). The flexor tendons to the middle and ring fingers can also be seen through the ulnar bursa. Passive mobilization of the individual fingers can help with identification of the tendons. The first web portal can be used as the working portal for synovectomy and bursectomy. Synovectomy is started in transverse direction to clear up the inflamed synovium of the flexor tendons at the level of the metacarpal necks (Fig. 10.7). After that, each flexor tendon can be traced proximally and synovectomy can be performed in the longitudinal direction (Fig. 10.8). The surgeon should take caution not to debride toward the palmar aponeurosis to avoid injuring the superficial palmar arch and the digital nerves. Further withdrawal of the endoscope via the ulnar palmar portal will cause it to enter the flexor tendon sheath of the little finger.

5. Endoscopy of the Midpalmar Space

This can be performed using the ulnar palmar portal and the first web portal, which can be used interchangeably as viewing and working portals. The third and fourth finger web portals may substitute the first web portal but use of adjacent finger web portals is not recommended due to risk of complete numbness or ischemia of the central digit. The trocar and cannula are first advanced through the ulnar palmar portal, along volar surface of the metacarpal bones and deep to the flexor tendons, toward the first web portal. The trocar is then removed, and the endoscope is inserted through the cannula. While withdrawing the endoscope, the thenar muscles and thenar space (if distended) will come into view before the midpalmar space is visualized. The midpalmar space can be

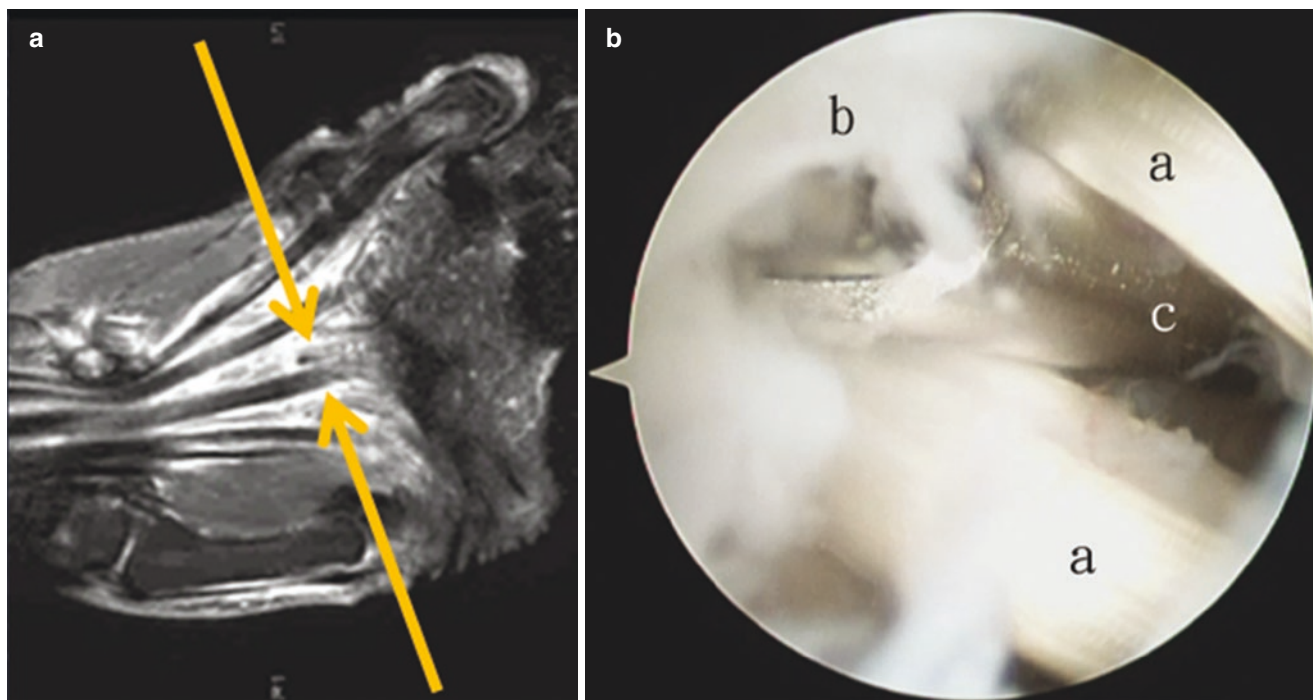


Fig. 10.7 (A) Synovectomy in transverse direction (arrows) to clear up the inflamed synovium of the flexor tendons at the level of the metacarpal necks. (B) endoscopic view shows synovectomy between the flexor

tendons. a: flexor tendons; b: chronically inflamed synovium; c: arthroscopic shaver

drained and debrided with an arthroscopic shaver through the first web portal (Fig. 10.9).

The surgeon should be cautious not to breach the fascia overlying the metacarpals and interossei as this may risk injuring the deep palmar arch and deep branch of the ulnar nerve. Again, further withdrawal of the endoscope with result in entering the flexor tendon sheath of the little finger.

10.4.5 Risks and Complications

The potential risks of this procedure include injury to the superficial and deep palmar arches, deep branch of the ulnar nerve, digital nerves and branches of the superficial radial nerve and flexor tendons. There is also a risk of spreading the infection among different compartments.

10.4.6 Post-operative Care

Immediate mobilization of the hand is encouraged.

10.4.7 Outcome

The advantages of this endoscopic procedure include better cosmesis, less soft tissue dissection, less post-operative pain,

complete assessment of the subfascial spaces, avoidance of exposed tendons or nerves, and allowance of immediate post-operative vigorous hand therapy [9–11].

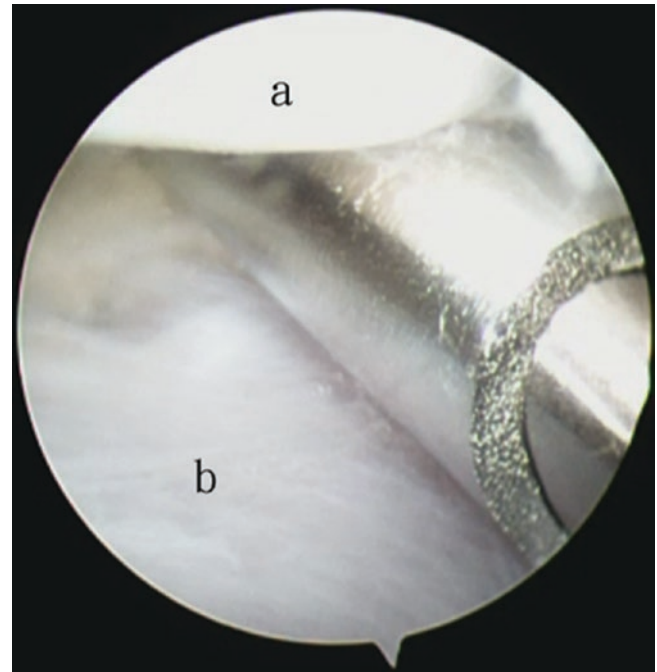


Fig. 10.9 Endoscopy of the midpalmar space. a: ulnar bursa; b: fascia overlying the metacarpals and interossei

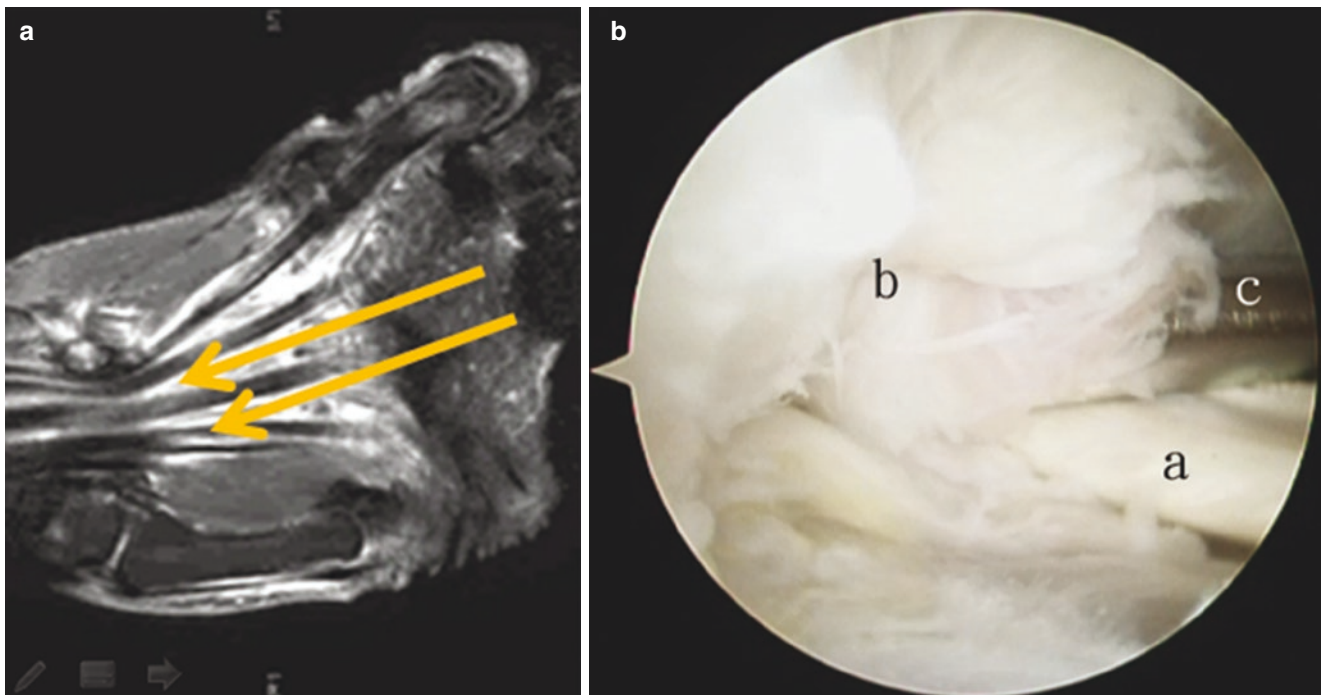


Fig. 10.8 (A) Synovectomy in longitudinal direction (arrows) along the flexor tendons. (B) endoscopic view shows synovectomy along the flexor tendon. a: flexor tendons; b: chronically inflamed synovium; c: arthroscopic shaver

10.5 Summary

The flexor tendon sheaths and deep spaces of the palms can be accessed via different pairs of longitudinally aligned and transversely aligned coaxial portals. Endoscopic technique in the management of pathology involving deep spaces of the hand is feasible and confers many advantages over traditional open techniques in suitable cases. Nevertheless, this is a technically demanding procedure and should be attempted only by surgeons experienced in hand and wrist arthroscopies.

References

1. Fussey JM, Chin KF, Gogi N, Gella S, Deshmukh SC. An anatomic study of flexor tendon sheaths: A cadaveric study. *J Hand Surg Eur*. 2009;34:762–5.
2. Aguiar RO, Gasparetto EL, Escuissato DL, Marchiori E, Trudell DJ, Haghghi P, Resnick D. Radial and ulnar bursae of the wrist: Cadaveric investigation of regional anatomy with ultrasonographic-guided tenography and MR imaging. *Skelet Radiol*. 2006;35:828–32.
3. Ahlawat S, Corl FM, LaPorte DM, Fishman EK, Fayad LM. MDCT of hand and wrist infections: Emphasis on compartmental anatomy. *Clin Radiol*. 2017;72:338.e1–9.
4. DiFelice A Jr, Seiler JG III, Whitesides TE Jr. The compartments of the hand: an anatomic study. *J Hand Surg Am*. 1998;23:682–6.
5. Jamil W, Khan I, Robinson P, Thalava R. Acute compartment syndrome of the forearm secondary to infection within the space of Parona. *Orthopedics*. 2011;34:e584–7.
6. Franko OI, Abrams RA. Hand infections. *Orthop Clin N Am*. 2013;44:625–34.
7. Jebson PJ. Deep subfascial space infections. *Hand Clin*. 1998;14:557–66. Viii
8. Rigopoulos N, Dailiana ZH, Varitimidis S, Malizos KN. Closed-space hand infections: diagnostic and treatment considerations. *Orthop Rev (Pavia)*. 2012;4:e19.
9. Lui TH. Flexor pollicis longus tendoscopy. *Arthrosc Tech*. 2017;6:e249–54.
10. Lui TH, Lee CH. Little finger flexor tendoscopy, endoscopy of the ulnar bursa and midpalmar space. *Arthrosc Tech*. 2018;7:e817–22.
11. Lui TH, Lee JCY. Endoscopic synovectomy of the ulnar bursa of the palm of the hand. *Arthrosc Tech*. 2018;7(12):e1257–61.