



# Wrist Portals and Arthroscopic Anatomy

# 71

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## 71.1 Dorsal Radiocarpal Portals

The names of the dorsal radiocarpal portals are referred to their anatomical relationship with the extensor compartments of the wrist (Fig. 71.1).

3/4 and 6R portals are the most commonly used, as they allow complete visualization of the entire radiocarpal joint. However, the other three radiocarpal portals, 1/2, 4/5, and 6U, are also worth knowing and using as they may be useful in certain situations or for certain surgical techniques.

### 71.1.1 1/2 Portal

It is located between the abductor pollicis longus (APL) and the extensor pollicis brevis (EPB) on

the radial side and the extensor carpi radialis longus (ECRL) and the extensor carpi radialis brevis (ECRB) on the ulnar side. Since this portal is located in the anatomical snuffbox, it is important to remember that the radial artery is located in its most distal portion. Therefore, it is recommended that the entry point must be proximal. It should also be noted that in this location, the distal sensory branch of the radial nerve is at risk (Fig. 71.2).

It is a portal that is usually performed under the arthroscopic vision and not in a direct blind way (as a starting portal). Both the introduction of the needle when making the portal and the subsequent introduction of the arthroscope should be made at 20° tilt to follow the articular surface of the radius and to avoid damaging the proximal cartilage of the scaphoid.

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**Fig. 71.1** Dorsal radiocarpal portals of the wrist. Names are referred to the anatomical relationship with the extensor compartments of the wrist

### 71.1.1.1 Visualized Structures

#### At the Entry Point (Fig. 71.3)

Proximal: radial styloid and scaphoid fossa.

Distal: proximal surface of the scaphoid

Volar: Radioscaphocapitate ligament, long radiolunate (LRL) ligament, radioscapholunate ligament (Testut ligament), and volar margin of the radius.

Dorsal: dorsal capsule, dorsal radiotriquetral ligament, and dorsal margin of the radius

#### Moving the Vision Field to the Ulnar Zone (Fig. 71.4)

Proximal: lunate fossa and triangular fibrocartilage complex (TFCC).

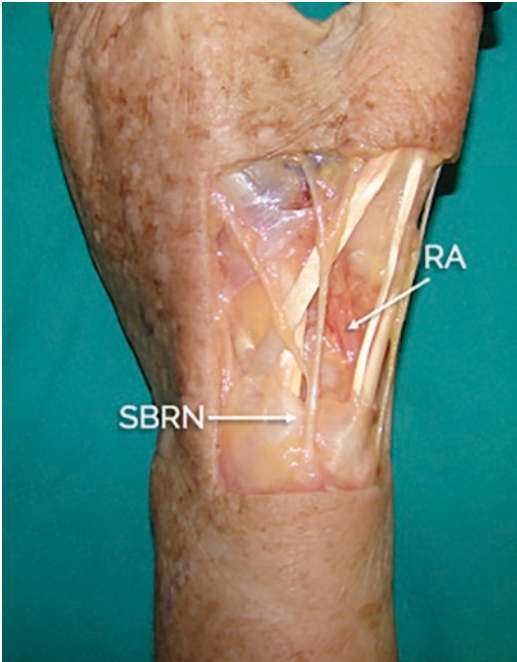
Distal: proximal pole of the lunate bone.

Volar: ulnocarpal ligaments, volar margin of the radius.

Dorsal: dorsal capsule, dorsal margin of the radius.

### 71.1.1.2 Neurovascular Structures-at-Risk

This is one of the portals considered to be of greatest risk since it is located in the anatomical snuffbox where important neurovascular structures are present. Thus, careful attention must be paid during portal placement and manipulation.

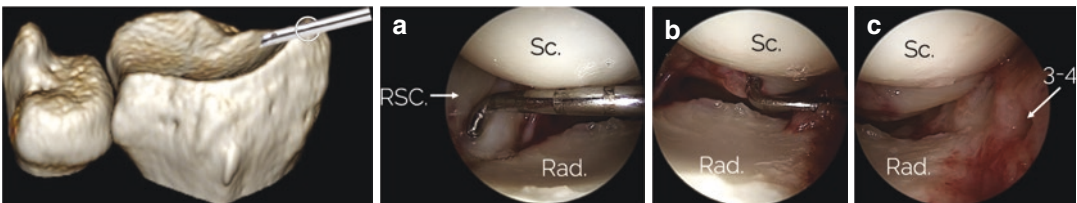


**Fig. 71.2** Structures at risk while establishing the 1/2 portal. Superficial branch of the radial nerve (SBRN). Radial artery (RA)

- *Radial artery:*
- It is located in the most distal and radial area of the anatomical snuffbox. An anatomical study has reported that it is to be found 3 mm (range 1–5 mm) radial to the 1/2 portal [1].
- *Superficial Branch of the Radial Nerve (SBRN):*
- Shyamalan et al. [2] carried out an anatomical study and a systematic review of the structures at risk with respect to arthroscopic portals. They found three more studies in which the distances at risk of the portal 1/2 with respect to the SBRN were analyzed. The study carried out by Kilic et al. [3] established a distance of 5 mm (range 2–12 mm), while those of Abrams et al. [1] and Tryfonidis et al. [4] were 3 mm (range 1–6 mm) and 3 mm (range 0–19 mm), respectively, and in that of Shyamalan et al. [2] it was 2 mm (range 0–8 mm). In the last two studies, there were several specimens with distances of 0 mm, that is, the portal was directly over the SBRN. This is why this portal puts this nerve at risk, and therefore extreme precautions must be taken during its realization, which must always be done in a blunt manner and ensuring the protection of the SBRN.

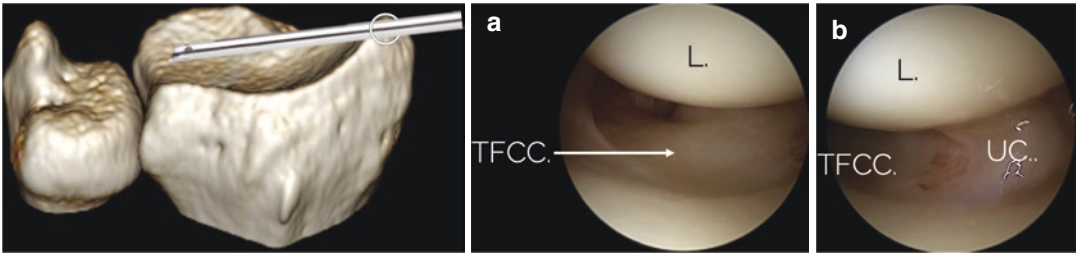
### 71.1.2 3/4 Portal

It is located in the space between the extensor pollicis longus (EPL) and the extensor digitorum

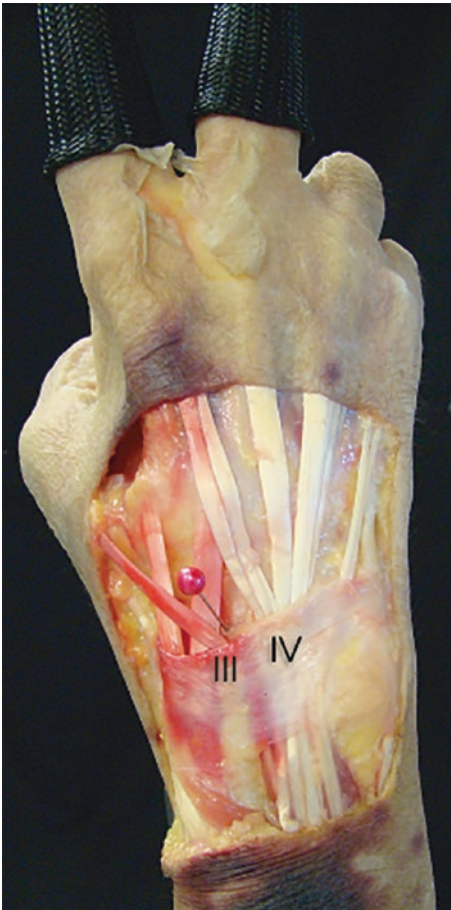


**Fig. 71.3** Arthroscopic view of the radiocarpal joint through the 1-2 portal, at the entry point. The images correspond to a left wrist (for a better understanding, all the arthroscopic images of the chapter correspond to left

wrists). Radioscaphocapitate ligament (RSC). Scaphoid (Sc). Radius (Rad). Abbreviations and symbols will be used according to the previous figures during the whole chapter (a) Volar side. (b) Central side. (c) Dorsal side



**Fig. 71.4** Arthroscopic view of the radiocarpal joint through the 1-2 portal, *moving the vision field to the ulnar side.* Lunate (L). Triangular fibrocartilage complex (TFCC) (a) Central side. (b) Volar side



**Fig. 71.5** Anatomical location of the 3-4 portal

(ED), 1 cm distal to the Lister's tubercle and in line with the radial edge of the third metacarpal bone (Fig. 71.5). Both the needle to mark the entry point and the introduction of the arthro-

scope should be volar-oriented about  $10^\circ$  to follow the volar inclination of the articular surface of the radius.

Generally, this is the first portal to be made, and being one of the safest portals, it is done "blind." It allows a panoramic view of the entire radiocarpal joint thus being useful and common in the vast majority of arthroscopic techniques.

#### 71.1.2.1 Visualized Structures

##### At the Entry Point (Fig. 71.6)

Proximal: articular surface of the radius and the ridge that separates the scaphoid and lunate fossa.

Distal: proximal pole of the scaphoid and lunate and the membranous portion of the scapholunate ligament.

Volar: the radioscapolunate ligament is in the middle of the vision field; both the long radiolunate ligament and the short radiolunate ligament are radial to it.

##### Moving the Vision Field to Radial (Fig. 71.6)

Proximal: radial styloid process and scaphoid fossa.

Distal: proximal pole of the scaphoid.

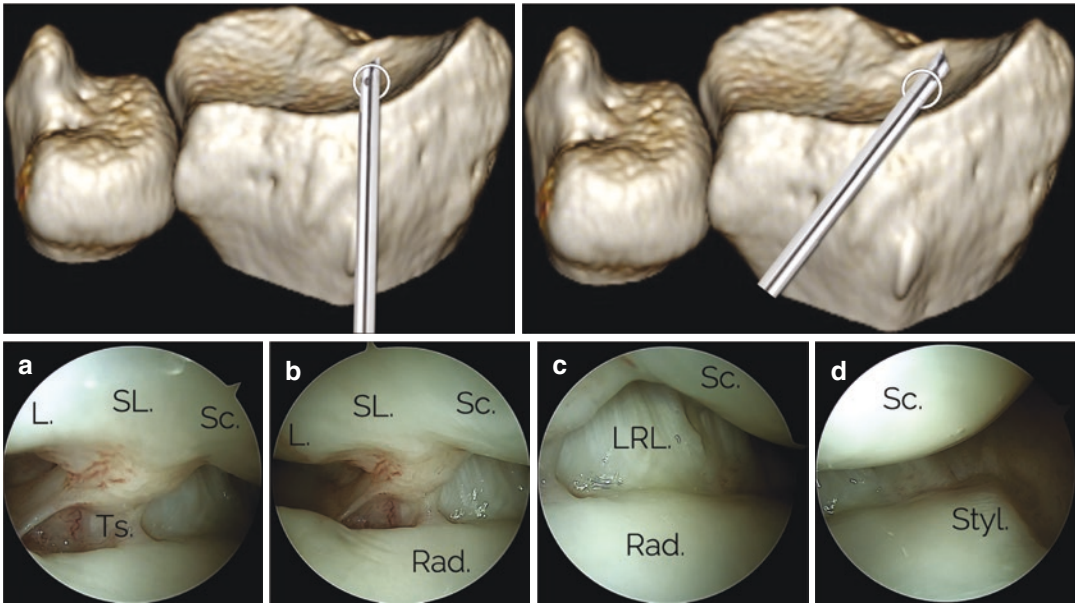
##### Moving the Vision Field to Ulnar (Fig. 71.7)

Proximal: lunate fossa, TFCC with pre-styloid recess.

Distal: proximal pole of the lunate.

Volar: Ulnocarpal ligaments.

Dorsal: Dorsal articular capsule and 6R portal.



**Fig. 71.6** Arthroscopic view of the radiocarpal joint through the 3-4 portal. (a, b) Images at the entry point. (c, d) Images moving the vision field to the radial side.

Scapholunate ligament (SL). Radioscapholunate ligament or Testut ligament (Ts). Long radiolunate ligament (LRL). Radial styloid process (Styl)

### 71.1.2.2 Neurovascular Structures at Risk

- *Superficial Branch of the Radial Nerve:*

Five anatomical studies analyzed the distances from SBRN to the 3/4 portal. The values obtained were: Kilic et al. [3] 9 mm (range 2–19 mm), Abrams et al. [1] 16 mm (range 5–22 mm) Shyamalan et al. [2] 25 mm (range 15–33 mm), Auerbach et al. [5] 4 mm (range 0–14 mm), and Tryfonidis et al. [4] 9 mm (range 0–48 mm). The last two studies include measurements of zero, indicating that the SBRN can also be found just below the portal and, despite being considered a much safer portal than 1/2, caution should also be taken during its performance.

- *Posterior interosseous nerve (PIN):*

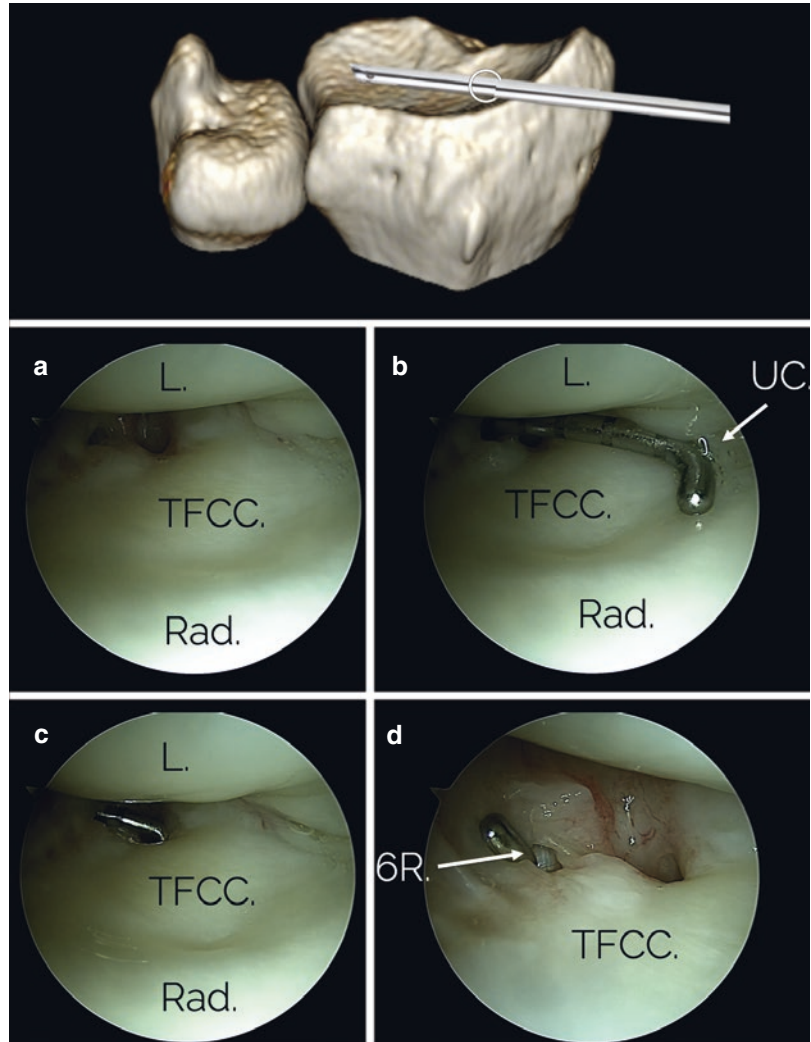
The PIN may also be at risk when performing the 3/4 portal. Three studies analyzed the distance of this nerve from the portal. The

study by Pan and Hung [6] is the one showing greater portal security with respect to the PIN, with a distance of 4.8 mm (range 1.2–12 mm). However, the study by Shyamalan et al. [2] measured a distance of 4.4 mm (range 0–10) with a 3/4 portal PIN injury. Another recent study, performed by Chea et al. [7], analyzed the histological damage of the PIN after carrying out the 3/4 portal, and they discovered axonal damage in 7 of 14 specimens. Consequently, there is also the possibility of damage to this nerve during the performance of a routine wrist arthroscopy portal.

### 71.1.3 4/5 Portal

It is located in the interval between the ED and the extensor digiti minimi (EDM), in line with the

**Fig. 71.7** (a) Arthroscopic view of the radiocarpal joint through the 3-4 portal, moving the vision field to the ulnar side. (b-d) The probe is inserted through the 6R portal. Ulnocarpal ligaments (UC)



fourth metacarpal bone. Due to the radius inclination, this portal is located slightly proximal to the 3/4 portal and approximately 1 cm radial from the 6R portal (Fig. 71.8).

Like the 3/4 portal, the insertion of the needle, arthroscope, or instruments must be performed with a 10° volar inclination. Regarding the 3/4 portal, it can improve the vision of the ulnocarpal joint and can be used for instrumentation, although its use is much less frequent than 3/4 and 6R.

### 71.1.3.1 Visualized Structures

#### At the Entry Point (Fig. 71.9)

Proximal: In the center of the view field is the radial insertion of the TFCC, which continues in

a radial direction with the lunate fossa of the radius.

Distal: proximal surface of the lunate.

Volar: ulnocarpal ligaments.

#### Moving the Vision Field to Radial

(Fig. 71.10)

Proximal: ulnar portion of the scaphoid fossa

Distal: proximal surface of the scaphoid and membranous portion of the scapholunate ligament.

Volar: long and short radiolunate ligaments and radioscapocapitate ligament.

Dorsal: dorsal capsule, 3/4 portal, and, if a dorsal displacement is performed on the lunate, the dorsal capsuloligamentous scapholunate septum (DCSS) is visualized.

### Displacement of the Field of Vision Toward Ulnar

Ulnar area of the TFCC with the pre-styloid recess.

#### 71.1.3.2 Neurovascular Structures-at-Risk

- *Dorsal sensory branch of the ulnar nerve (DBUN):*



**Fig. 71.8** Anatomical location of the 4-5 portal

In none of the three studies that analyzed its distance to the portal was found a lesion of this superficial nerve. The distances reported were: Tryfonidis et al. [4]: 18 mm (range 9–27 mm), Ehlinger et al. [8]: 4 mm (range 1–11 mm), and Shyamalan et al.: 21 mm (range 13–32 mm).

- *Posterior interosseous nerve:*

The study by Shyamalan et al. [2] observed that the mean distance to the portal was 12.6 mm (range 2–25 mm), and the study by Pan and Hung [6] measured an ulnar distance from the PIN of 9.0 mm (range 3.8–12.7 mm). In other words, with respect to the PIN, it appears as a more secure portal than the 3/4 portal.

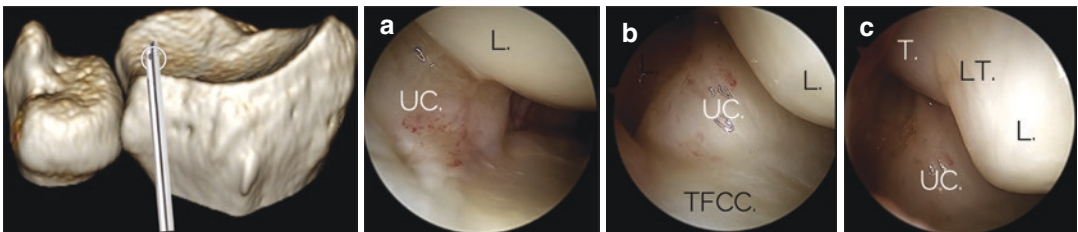
- *Extensor digiti minimi:*

Despite being a portal relatively safe for neurovascular structures, there is an increased risk than in other portals for tendon structures. Partial or complete tendinous sections have been reported after the dissection of specimens used in wrist arthroscopy training courses [9, 10].

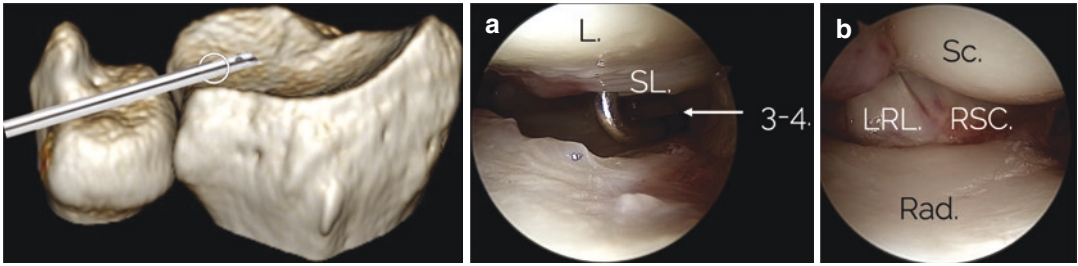
#### 71.1.4 6R Portal

It is located on the radial side of the extensor carpi ulnaris (ECU) and distal to the TFCC (Fig. 71.11). In order to avoid any damage to the TFCC, this portal, situated just distal to it, must be carried out under arthroscopic vision.

This portal is performed routinely along with the 3/4 portal in most wrist arthroscopies. It serves both for the instrumentation in techniques performed on the TFCC and ulna and for the

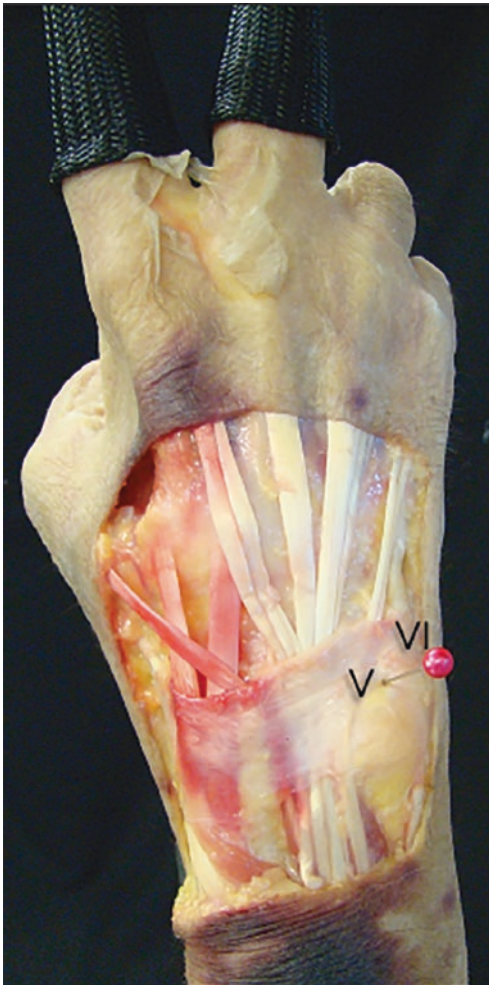


**Fig. 71.9** Arthroscopic view of the radiocarpal joint through the 4-5 portal, at the entry point (from a to c) The scope is displaced distal and ulnar



**Fig. 71.10** Arthroscopic view of the radiocarpal joint through the 4-5 portal, moving the vision field to the radial side. The probe is inserted through the 3-4 portal

(a) Moving the vision field to the dorsal side. (b) Moving the vision field to the volar side



**Fig. 71.11** Anatomical location of the 6R portal

visualization in many other arthroscopic techniques. It allows a panoramic view of the radius and proximal pole of the scaphoid (essential, e.g.,

in fractures of the radius and scaphoid), the visualization of the DCSS, the visualization of the pisotriquetral joint, the visualization of the membranous portion of the lunotriquetral ligament, and so on.

#### 71.1.4.1 Visualized Structures

##### At the Entry Point (Fig. 71.12)

Proximal: TFCC and radial sigmoid fossa

Distal: articular surface of the lunate and LT joint.

Volar: ulnocarpal ligaments.

##### Moving the Vision Field to Radial (Fig. 71.13)

Proximal: articular surface of the radius: lunate fossa and if it moves more radially, scaphoid fossa.

Distal: proximal pole of the lunate, more radial, membranous portion of the scapholunate ligament and even more radial, proximal pole of the scaphoid.

Volar: Radioscapholunate ligament and more radial, long radiolunate ligament and radioscapho-capitate ligament.

Dorsal: Dorsal capsule and if it moves over the back of the lunate, the DCSS is visualized.

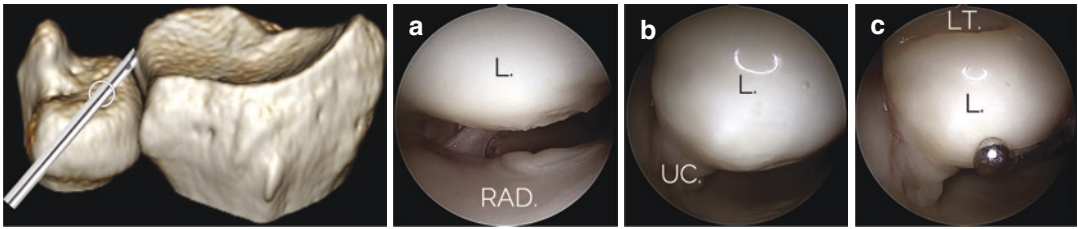
##### Moving the Vision Field to Ulnar (Fig. 71.14)

Proximal: TFCC and pre-styloid recess

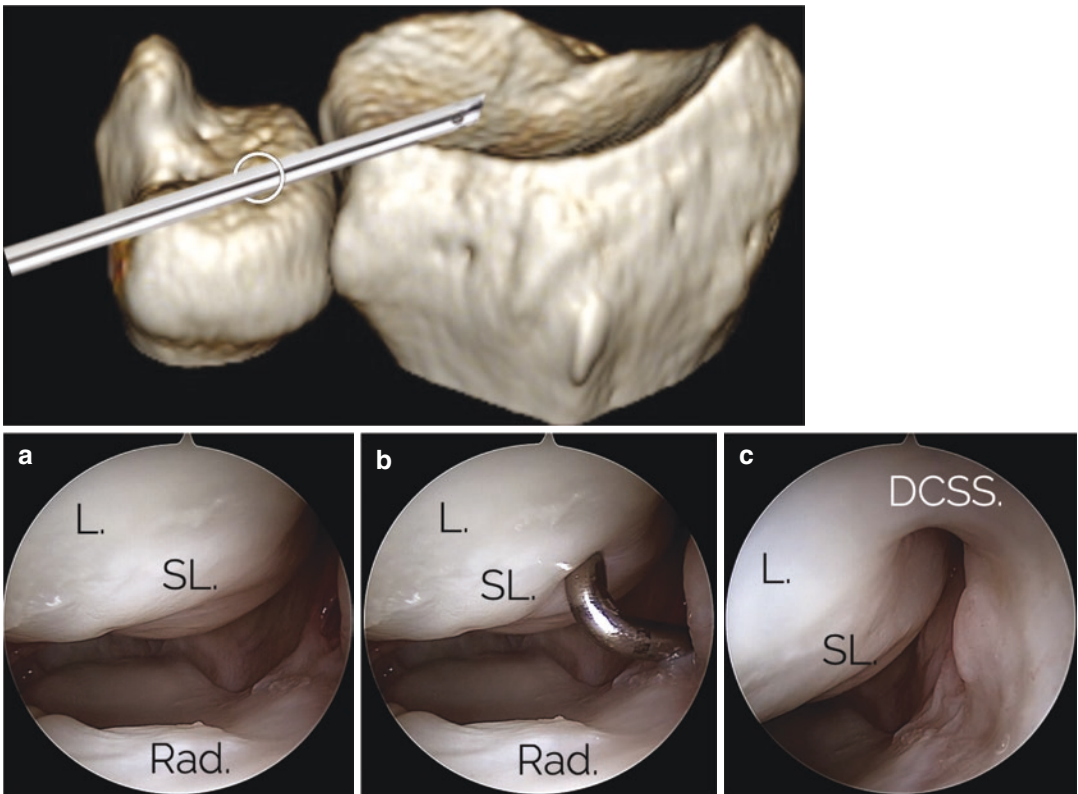
Distal: membranous portion of the lunotriquetral ligament.

Volar: Following the ulnocarpal ligaments distally, the pisotriquetral joint can be visualized.





**Fig. 71.12** Arthroscopic view of the radiocarpal joint through the 6R portal, at the entry point. Lunotriquetral ligament (LT) (from a to c) The scope is displaced distal and ulnar



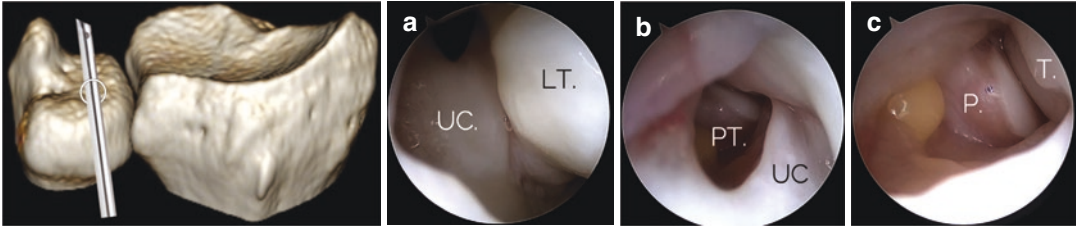
**Fig. 71.13** (a) Arthroscopic view of the radiocarpal joint through the 6R portal, moving the vision field to the radial side. (b) Probe entering through the 3/4 portal. (c) Dorsal capsuloligamentous scapholunate septum (DCSS)

**71.1.4.2 Neurovascular Structures-at-Risk**

- *Dorsal sensory branch of the ulnar nerve (DBUN):*

There are three studies that analyze its distance from the 6R portal. Ehlinger et al. [8] found an average distance of 4 mm (range 1–15 mm) and Abrams et al. [1] of 8 mm

(range 0–14 mm) with a specimen in which the branch was just below the portal, and they also studied the distance of the transverse radioulnar sensory branch of the DBUN found in 12 of 19 specimens which is only 2 mm apart (range 0–6 mm). Finally, Shyamalan et al. [2] measured a distance of 8 mm (range of 2–14 mm). That is, since the



**Fig. 71.14** Arthroscopic view of the pisotriquetral joint (PT) through the 6R portal. Pisiform (P). Triquetrum (T) (from a to c) The scope is displaced inside the PT joint

DBUN is so close to the portal, extreme care must be taken with its realization to have a reference of greater security. Tindal et al. [11] performed a study on 20 wrists to define the “safe” area of the 6R portal. They observed that the fifth most proximal part of an imaginary line that runs between the ulnar styloid to the fourth intermetacarpal space is safe, since the DBUN is not to be found in this space.

### 71.1.5 6U Portal

It is located ulnar with respect to the ECU and on the TFCC. Like the 6R portal, this portal must be performed under arthroscopic vision. The sensory branch of the ulnar nerve is very close to the portal, so precautions should be taken when performing it and when suturing the TFCC through or near this portal.

It is a portal that can be used as a working portal for the suture or reconstruction of the TFCC.

#### 71.1.5.1 Visualized Structures

The structures visible through this portal are:

##### At the Entry Point (Fig. 71.15)

Proximal: TFCC and insertion in the sigmoid fossa

Distal: Proximal pole of the lunate and lunotriquetral ligament.

Volar: Ulnocarpal Ligaments

Dorsal: Dorsal capsule (ECU floor), 6R portal.

#### Moving the Vision Field to Radial

(Fig. 71.16)

Proximal: Articular surface of the radius (lunate fossa) and if it moves more radial, scaphoid fossa. Distal: Proximal pole of the lunate; more radial, membranous portion of the scapholunate ligament and even more radial, proximal pole of the scaphoid.

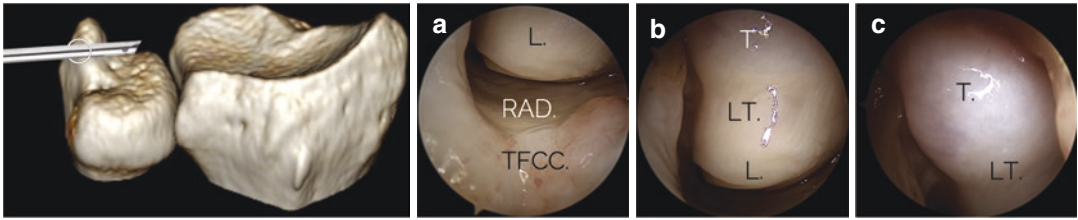
Volar: Radioscapholunate ligament and more radial, long radiolunate, and radioscapho-capitate ligament.

Dorsal: Dorsal capsule, dorsal radiotriquetral ligament, and if it moves over the dorsal side of the lunate, the DCSS is visualized.

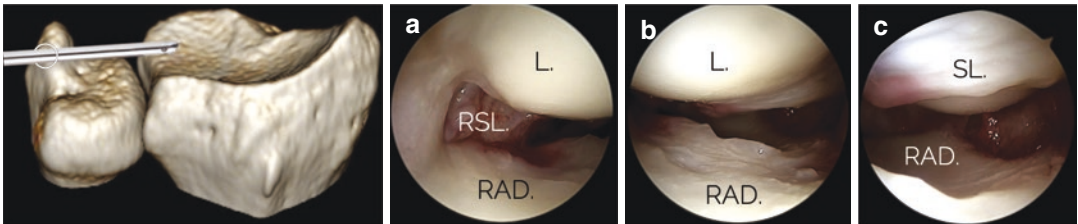
#### 71.1.5.2 Neurovascular Structures-at-Risk

- *Dorsal sensitive branch of the ulnar nerve:*

All the reviewed studies show very short distances between the portal and the nerve. Tryfonidis et al. [4] found 3 mm (range 0–11 mm), Ehlinger et al. [8] 5 mm (range 1–12 mm), Abrams et al. [1] 5 mm (range 2–12 mm), and Shyamalan et al. [2] 1 mm (range of 0–8 mm). It is one of the portals that has been classically considered more dangerous, although, as previously mentioned, if care is taken to perform a blunt dissection, neurovascular damage is minimized. Another technical recommendation to reduce the risk of injury to this nerve branch was published by Esplugas et al. [12] after performing an anatomical study on six specimens. They suggested supinating the wrist when placing the portal, since in supination the DBUN moved further away from the 6U portal.



**Fig. 71.15** Arthroscopic view of the radiocarpal joint through the 6U portal, at the entry point (from a to c) The scope is displaced distal and ulnar



**Fig. 71.16** Arthroscopic view of the radiocarpal joint through the 6U portal, moving the vision field to the radial side (a) Volar side. (b) Central side. (c) Dorsal side

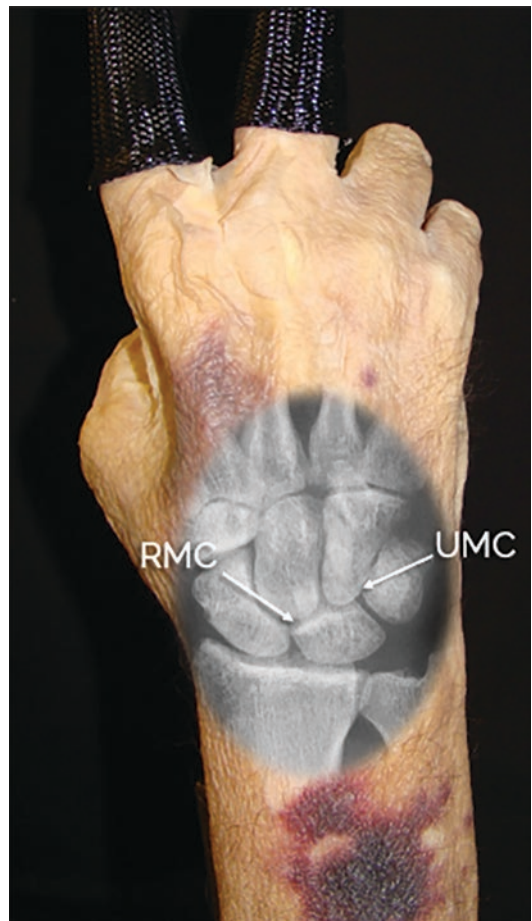
## 71.2 Midcarpal Dorsal Portals

Exploration of the midcarpal joint should be included routinely on all wrist arthroscopy procedures. Inspection of this joint is essential for the diagnosis of many pathologies that cannot be fully assessed by exploring only the radiocarpal joint.

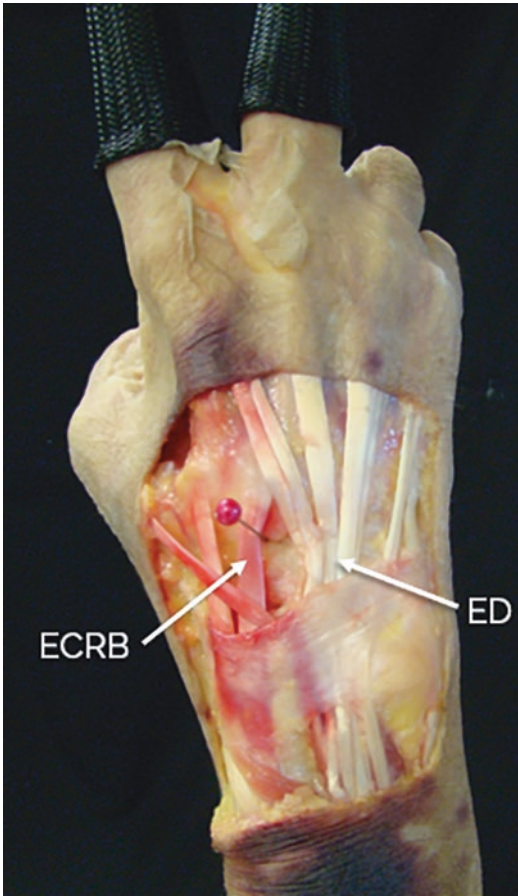
The two most used portals allowing a complete exploration of the midcarpal joint are the radial midcarpal portal (RMC) and the ulnar midcarpal portal (UMC) (Fig. 71.17). There are two others dorsal midcarpal portals that serve to assess and treat scapho-trapezio-trapezoid joint (STT) pathology; they are not used routinely but can be useful in certain situations.

### 71.2.1 Radial Midcarpal Portal (RMC)

It is located 1 cm distal to the 3/4 portal, in line with it and with the radial edge of the third metacarpal bone. The ECRB is radial to the portal while the ED is ulnar to the portal. It is located just distal to the scapholunate ligament (Fig. 71.18). Since it is just above the scapholunate ligament, it is preferable to perform it under arthroscopic control, after performing the UMC portal.



**Fig. 71.17** Dorsal midcarpal portals of the wrist. Radial midcarpal portal (RMC). Ulnar midcarpal portal (UMC)



**Fig. 71.18** Anatomical location of the Radial Midcarpal Portal. Extensor Carpi Radialis Brevis (ECRB). Extensor digitorum (ED)

It is a fundamental portal for the exploration of both the midcarpal joint and the STT joint.

#### 71.2.1.1 Visualized Structures

The structures visible through this portal are:

##### At the Entry Point (Fig. 71.19)

Proximal: The concave surface of the scaphoid and the lunate. The space between them corresponds to the scapholunate joint.

Distal: Proximal surface of the capitate bone.

Volar: The anterior portion of the scaphoid, the anterior horn of the lunate, and the radio-scapho-capitate ligament (radial portion of the arcuate ligament) are observed.

##### Moving the Vision Field to Radial (STT Joint) (Fig. 71.20)

If the surface of the scaphoid is followed radially and distally, the STT joint is reached.

Proximal: Distal portion of the scaphoid.

Distal: Proximal surface of the trapezoid and trapezium

Radial: Scapho-trapezio-trapezoid ligament

Ulnar: Capitate bone and its joint with the trapezoid.

##### Moving the Vision Field to Ulnar (Fig. 71.21)

Proximal: Articular surface of the lunate and the triquetrum as well as the lunotriquetral joint. Occasionally, a crest appears in the lunate that separates an articular fossa of the capitate bone and a smaller fossa of the hamate bone, a finding that Viegas classified in lunate type I (without a crest) and type II (with a crest) [13].

Distal: Proximal surface of the capitate and hamate bone.

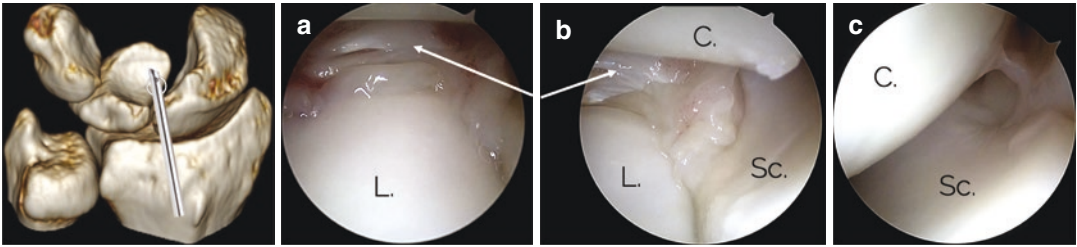
Volar: Anterior horn of the lunate, anterior portion of the triquetrum, and triquetral-hamate ligament (which is part of the distal and ulnar portion of the arcuate ligament)

Dorsal: UMC portal, dorsal portion of the lunotriquetral ligament.

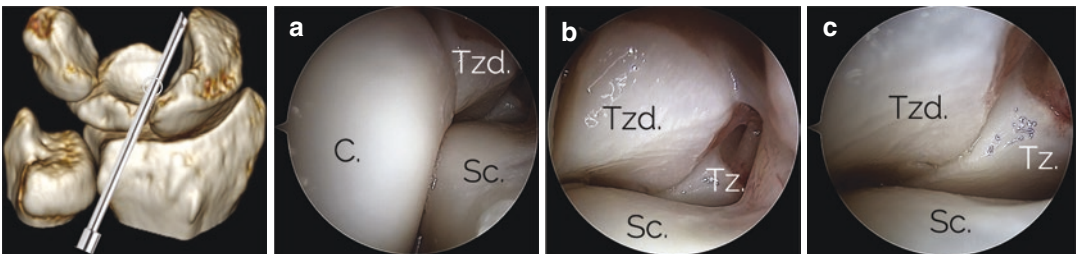
#### 71.2.1.2 Neurovascular Structures at Risk

- *Superficial branch of the radial nerve:*

Four anatomical studies have analyzed the distances from the SBRN to the RMC portal. Those made by Tryfonidis et al. [4] and Kilic et al. [3] reported smaller distances, 10 mm (range 1–20 mm) and 8 mm (range 1–16 mm),



**Fig. 71.19** Arthroscopic view of the midcarpal joint through the RMC portal, at the entry point. Capitate (C). Arcuate ligament (Arc) (from a to c) The scope is displaced to the radial side



**Fig. 71.20** Arthroscopic view of the midcarpal joint through the RMC portal, moving the vision field to the radial side. Trapezoid (Tzd). Trapezium (Tz) (from a to c) The scope is displaced distal and radial, inside the STT joint

respectively. The two other studies published somewhat greater distances, Abrams et al. [1] 16 mm (range 5–26 mm) and Shyamalan et al. [2] 24 mm (range 13–42 mm). No reports of zero distance have been published. However, despite being considered much safer, SBRN can be found very close to the RMC portal and caution should be taken during its execution.

- *Posterior interosseous nerve:*

Only two studies analyzed the distance from the PIN to the RMC portal. The one carried out by Shyamalan et al. [2] measures a distance of 13 mm (range 0–20) and the one carried out by Pan et al. [6] finds an average distance of 7.3 mm (range 0–13 mm). That is, there is also the possibility of damage to the PIN during a routine wrist arthroscopy procedure.

### 71.2.2 Ulnar Midcarpal Portal (UMC)

It is located 1 cm distal to the 4/5 portal or 1 cm ulnar and 1 cm distal to the 6R. It is in line with

the fourth metacarpal bone. It is radial to the ED and ulnar to the EDM (Fig. 71.22).

Unlike the RMC portal (which is located just distal to the scapholunate ligament), the UMC portal is not located above the lunotriquetral ligament but above the triquetrum bone. It constitutes a safer portal to penetrate the capsule, thus being used as a starting portal in the midcarpal joint.

Together with the RMC portal, it is essential for the exploration of the midcarpal joint.

#### 71.2.2.1 Visualized Structures

The visible structures through this portal are:

##### At the Entry Point (Fig. 71.23)

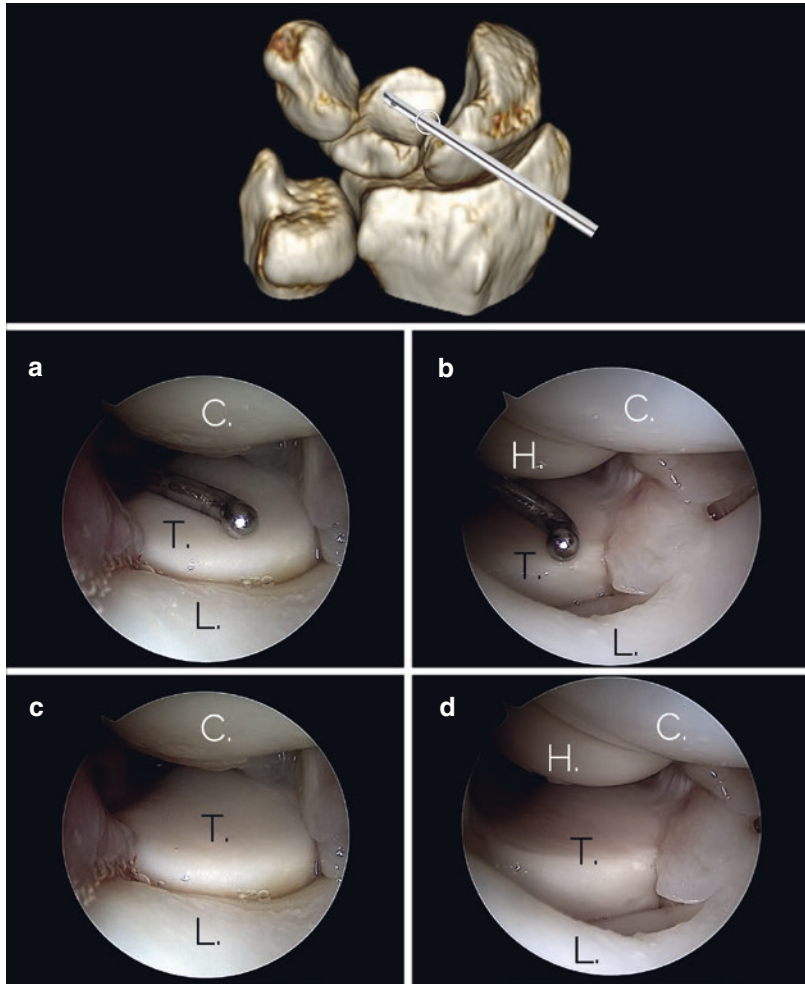
Proximal: The surface of the triquetrum and the lunate; they are separated by a space that corresponds to the lunotriquetral joint.

Distal: Proximal surface of the capitate, hamate bone, and its joint.

Volar: The anterior portion of the triquetrum, the anterior horn of the lunate, and the Triquetrum-hamate ligament (distal and ulnar portion of the arcuate ligament) are observed.

**Fig. 71.21**

Arthroscopic view of the midcarpal joint through the RMC portal, moving the vision field to the ulnar side. Hamate (H). Triquetralhamate ligament (TH) (a and c) Viegas type I. (b and d) Viegas type II



### Moving the Vision Field to Radial (Fig. 71.24)

Proximal: Articular surface of the lunate and scaphoid as well as the scapholunate joint. It is from this position that scapholunate instability is explored.

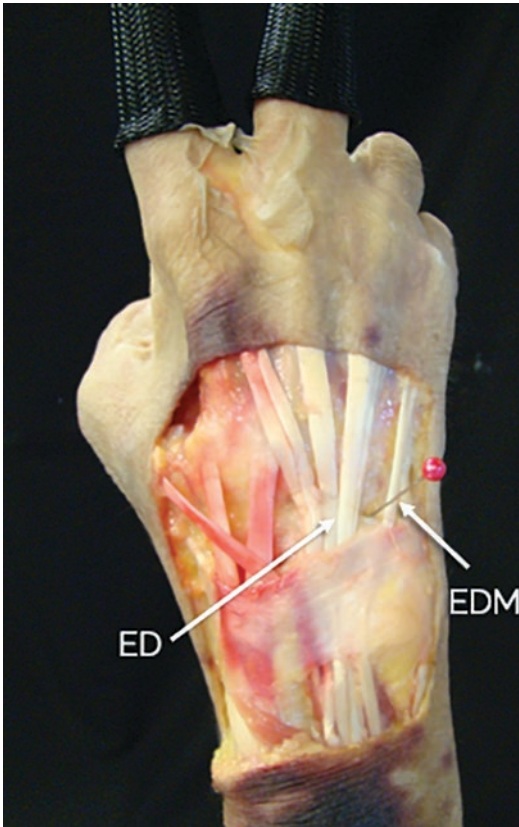
Distal: Proximal surface of the capitate bone.

Volar: Radio-scapho-capitate ligament and volar scapholunate joint.

Dorsal: RMC portal, dorsal portion of the scapholunate ligament.

### Moving the Vision Field to Ulnar

If the triquetrum surface is followed with the arthroscope toward ulnar and volar, once the most ulnar portion of the hamate is passed, the base of the hook of the hamate can be seen (Fig. 71.25).



**Fig. 71.22** Anatomical location of the ulnar midcarpal portal. Extensor digiti minimi (EDM)

### 71.2.2.2 Neurovascular Structures at Risk

- *Dorsal sensory branch of the ulnar nerve:*

Two studies analyzed the risk of DBUN with respect to the UMC portal. Both showed significant distances from the portal, which makes it a safer portal with respect to cutaneous nerve injury. Abrams et al. [1] found distances of 15 mm (range 4–25 mm) and Shyamalan et al. [2] of 25 mm (range 9–56 mm).

## 71.3 Volar Portals

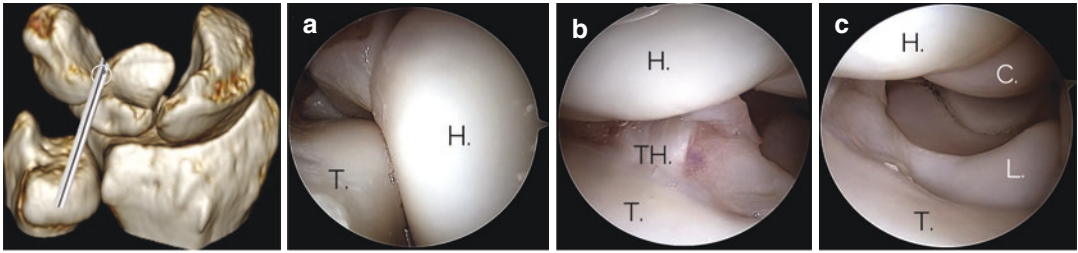
Following the description of the dorsal portals in the wrist, several authors have proposed the per-

formance of volar portals to improve dorsal visualization of the wrist [14–20]. The best known are those described by Slutsky as volar radial portal (VR) [17] and volar ulnar portal (VU) [18]. More recently, the volar central portal (VC) [20] has been published (Fig. 71.26).

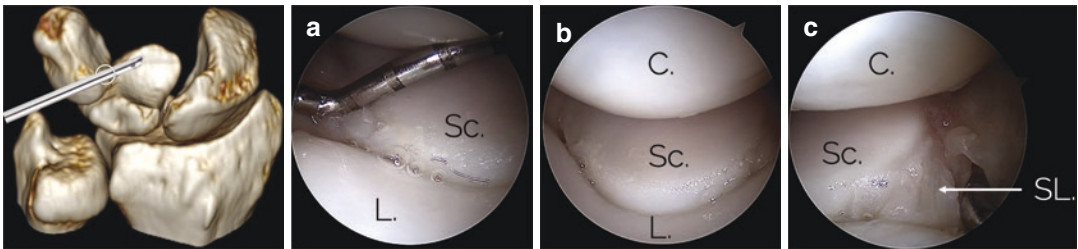
Unlike the dorsal portals, in which a direct portal is made through a 3 mm skin incision, these volar portals require a 1.5–2 cm mini-approach, which allows the structures at risk to be protected by retractors. With the possibility of carrying out the volar portals together with the dorsal portals, today the wrist is considered a “box” (a concept popularized by Bain [21]) since there is the possibility of instrumenting or viewing it from any direction in 360° (Fig. 71.27).

Two considerations have to be taken into account in view of the anatomical studies analyzing the safety of volar portals:

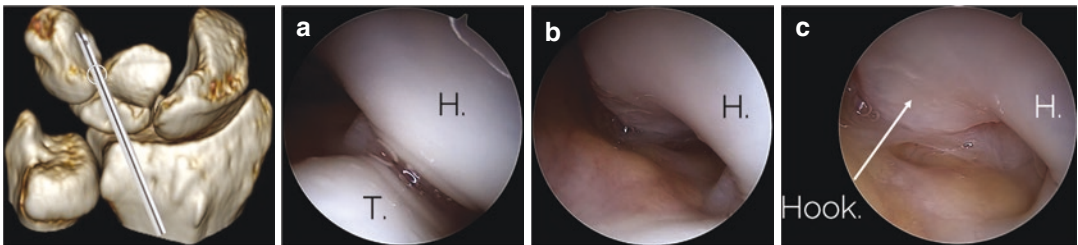
The first is that the studies can be carried out in two ways. The first way to proceed is using an inside–outside technique, that is, with the arthroscope inside the joint, a trocar is inserted through another dorsal portal. At the precise point of entry of the volar portal, pressure is applied until piercing through the volar capsule and the volar structure until the trocar is palpable, and then a skin incision is made. Then, after anatomical dissection, the distance to the structures at risk is measured and their eventual injury assessed. The second way to proceed is to follow the procedure as described by Slutsky. The portal is first made through a longitudinal incision, and once the portal is marked, the distance to the structures at risk is measured. It has to be considered that in patients, the actual distance to the structures at risk will always be greater since retractors are placed through these longitudinal incisions. Therefore, although in anatomical studies the distances to structures at risk are very small or even tendon or neurovascular injuries are reported, in clinical practice those are exceptional if a careful approach is performed, and the structures are separated



**Fig. 71.23** Arthroscopic view of the midcarpal joint through the UMC portal, at the entry point (from a to c) The scope is displaced from the ulnar side to the radial side



**Fig. 71.24** Arthroscopic view of the midcarpal joint through the UMC portal, moving the vision field to the radial side. The probe is inserted through the RMC portal. Scapholunate ligament (SL) (a) Volar side. (b) Central side. (c) Dorsal side



**Fig. 71.25** Arthroscopic view of the midcarpal joint through the UMC portal, moving the vision field to the ulnar side. Hook of the hamate (Hook) (from a to c) The scope is displaced ulnar and volar under the hook of the hamate

with the retractors using an outside–inside technique.

The descriptions of the three portals are as follows:

**71.3.1 Volar Radial (VR) Portal**

There are two methods for creating this portal.

The first, described in cadavers by Tham [16], is placed using the inside–outside technique. The optic is placed in an ulnar portal (4/5 or 6R), a blunt trocar is placed through portal 3-4 and is

inserted between the radio-scapho-capitate ligament and the long radiolunate ligament, and the flexor carpi radialis (FCR) tendon is retracted through a small incision made in the skin. Subsequently, a cannula is placed over the trocar, and the arthroscope is inserted from volar.

The second, most widespread method, is the one popularized by Slustsky [17, 18]. An incision of about 1.5–2 cm is made in the distal palmar crease of the wrist. The FCR is then retracted to the ulnar side, and the volar capsule is exposed. This portal is made in the plane between the FCR and the radial artery (Fig. 71.28).





**Fig. 71.26** Volar portals of the wrist. Volar ulnar (VU) portal. Volar central (VC) portal. Volar radial (VR) portal

The portal is performed between the long radiolunate ligament and the radioscapocapitate ligament (Fig. 71.29).

### 71.3.1.1 Visualized Structures (Fig. 71.30)

Proximal: Scaphoid and lunate fossa and dorsal edge of the radius.

Distal: Proximal and volar portions of the scaphoid and lunate bones and volar and membranous portion of the scapholunate ligament.

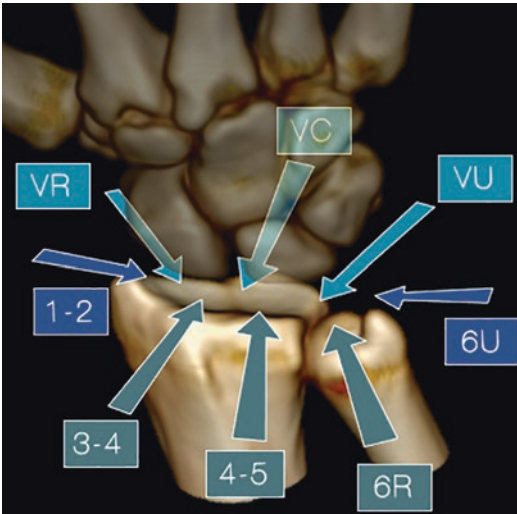
Radial: Styloid process of the radius

Dorsal: 3/4 portal and the insertion of the dorsal radiotriquetral ligament

Ulnar: Moving the arthroscope toward the ulnar side, the entire surface of the radius and even the TFCC are visible.

### 71.3.1.2 Neurovascular Structures at Risk

Five anatomical studies have assessed the risk of the neurovascular structures. The inside–outside technique was analyzed in those performed by Gillis and Kakar [22] on the volar midcarpal portals. In the study performed by Naroura et al. [23], no anatomical measurements were presented, but rather viewing angles from each portal were evaluated, and it was mentioned that no major structure was injured. Two other reports of the outside–inside technique were published by Slutsky [17] and by Antonoglou et al. [24] to evaluate the volar radial radiocarpal portal. Finally, Tham et al. [16] performed the trocar maneuver with the inside out technique, they combined a volar approach that allowed the sepa-



**Fig. 71.27** “Box concept” popularized by Bain [21]. There is the possibility of instrumenting or viewing the wrist from any direction in 360°

ration of the FCR. This study does not present a detailed anatomical analysis.

- Median nerve:

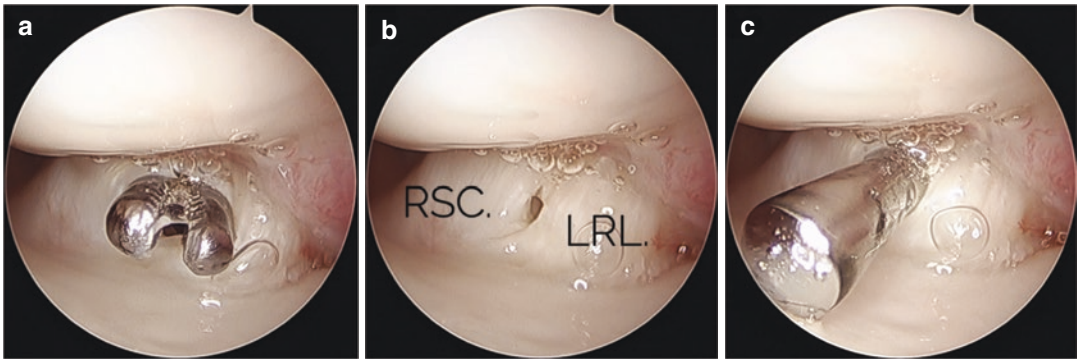
The study by Gillis and Kakar [22] reports a distance from the VR Midcarpal portal of 1 mm (range 0–35 mm); in one specimen, a direct injury occurred and in another, it entered between the median nerve and its superficial sensory branch. The study carried out by Slutsky [17] shows a distance of 8 mm (range 6–10 mm) while the one by Antonoglou et al. [24] reports a distance of 11 mm (range 9.8–13.5 mm).

- Palmar cutaneous branch of median nerve:

The distances published in the different studies are as follows: Gillis and Kakar [22] 1.9 mm (range 0–3 mm); Slutsky [17] 4 mm (range 3–5 mm), and Antonoglou et al. [24] 5.5 mm (range 4.8–6.7 mm). These are shorter



**Fig. 71.28** Anatomical location of the volar radial portal. Flexor carpi radialis (FCR)



**Fig. 71.29** Arthroscopic view of the entry point of the VR portal, from the 3-4 portal (a) A mosquito is entering between the radioscaphocapitate ligament (RSC) and the long radiolunate ligament (LRL) to establish the VR portal. (b) Dorsal vision of the VR portal. (c) A Wisinger rod is entering through the VR portal

distances than the ones from the median nerve, so there is a higher risk of injury.

- Radial artery:  
Published distances are Gillis and Kakar [22] 13.8 mm (range 9.5–17 mm); Slutsky [23] 5.8 mm (range 4–6 mm), and Antonoglou et al. [24] 6 mm (range 5.5–6.6 mm).
- Superficial branch of the radial nerve:  
The reported distances are Gillis and Kakar [22] 21 mm (range 13.5–25 mm); Slutsky [17] 15.6 mm (range 12–19 mm), and Antonoglou et al. [24] 13 mm (range 12–14.5 mm).

### 71.3.2 Volar Ulnar (VU) Portal

An incision of 1.5–2 cm is made at the ulnar side of the flexor digitorum tendons at the level of the proximal wrist crease. The flexor digitorum superficialis (FDS) and profundus (FDP) tendons are retracted radially. The portal is made in the plane between the ulnar neurovascular bundle and the flexor tendons (Fig. 71.31). Anatomically, the portal passes through the ulnocarpal ligaments adjacent to the radial insertion of the TFCC (Fig. 71.32).

#### 71.3.2.1 Visualized Structures (Fig. 71.33)

Proximal: Sigmoid fossa of the radius and TFCC.

Distal: Proximal and palmar region of the lunate and triquetrum and volar and membranous portions of the lunotriquetral ligament.

Dorsal: 6R portal, dorsoulnar capsule, and ECU floor.

Radial: By moving the arthroscope radially, the entire surface of the radius can be observed and even an oblique vision of the radial styloid is possible.

#### 71.3.2.2 Neurovascular Structures at Risk

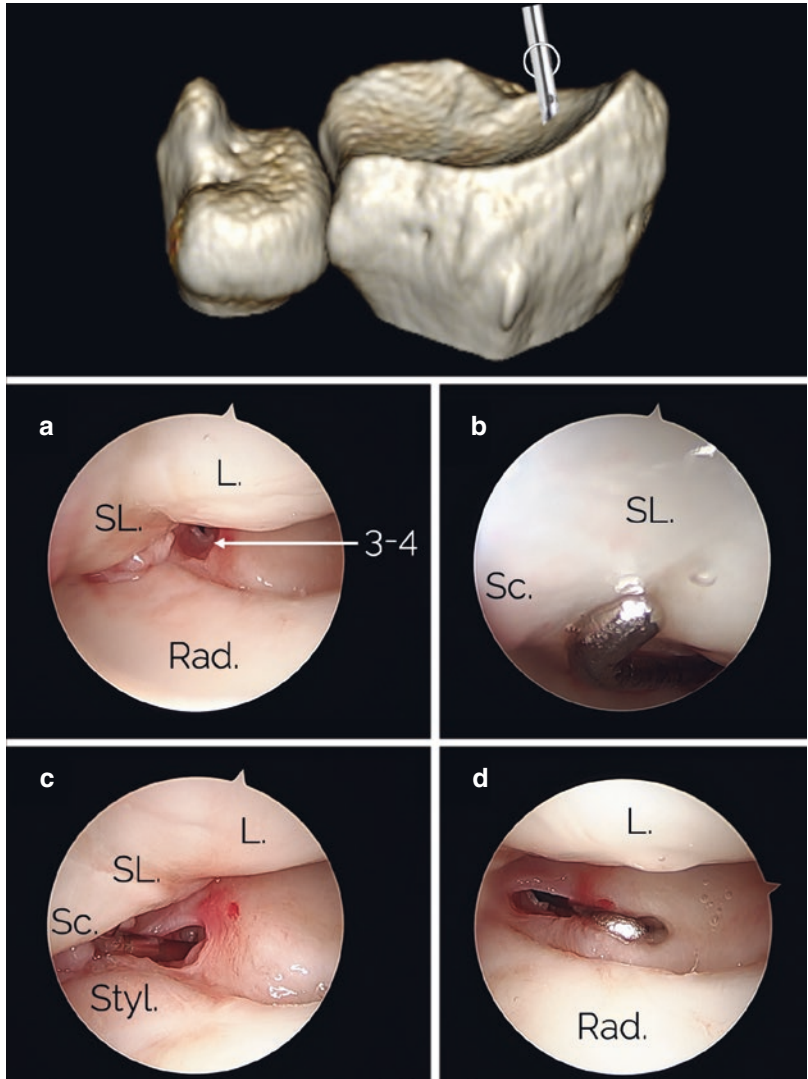
Only two articles carried out a comprehensive anatomical study of the structures at risk with the completion of this portal. The one performed by Gillis and Kakar [22] describes an inside–outside technique on the ulnar midcarpal volar portal, while Antonoglou et al. [24] performed an outside–inside technique using a volar approach and evaluated the VU radiocarpal portal. Slutsky [18] only refers that the portal is at a distance greater than 5 mm, but in this case, it does not present a detailed study or the ranges.

- *Ulnar nerve:*

The study by Gillis and Kakar [22] describes a distance from the UV midcarpal portal of 8.4 mm (range 5–13 mm), while the distance measured by Antonoglou et al. [24] is 5.8 mm (range 4.6–6.1 mm)

**Fig. 71.30**

Arthroscopic view of the radiocarpal joint through the VR portal. (a, b) At the entry point. (c) Moving the vision field to the radial side. (d) Moving the vision field to the ulnar side. The probe is inserted through the 3-4 portal



- *Ulnar artery:*

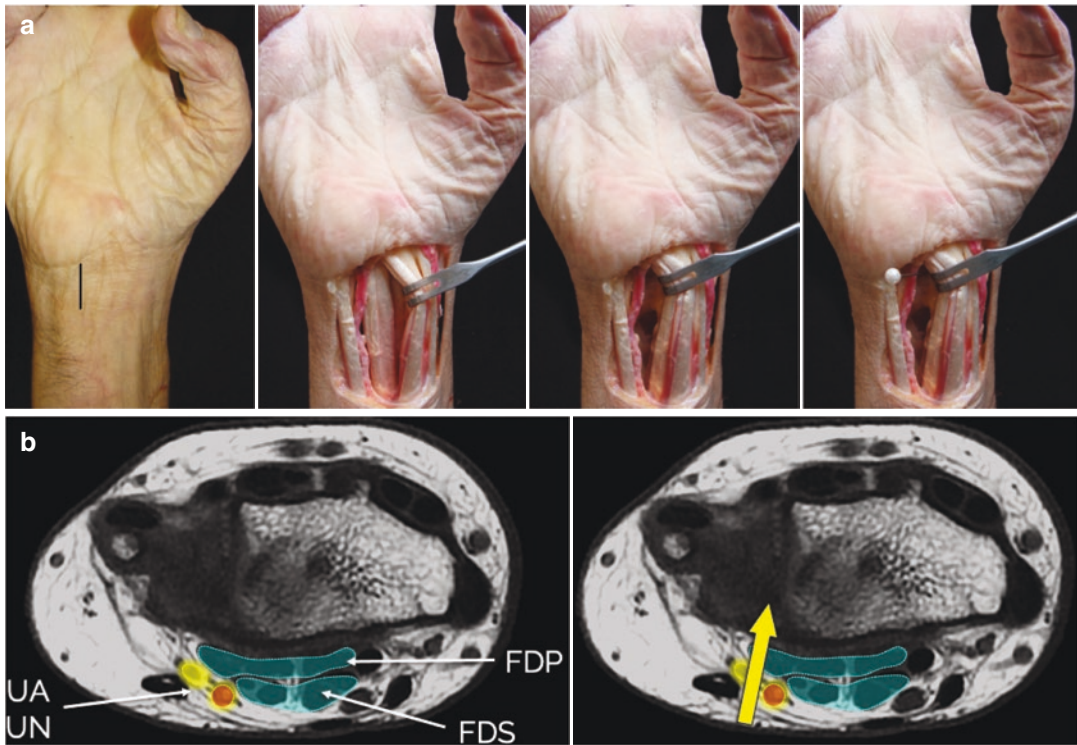
Gillis and Kakar [22] 3.7 mm (range 0–7 mm) and Antonoglou et al. [24] 4.8 mm (range 3.7–5.1 mm).

### 71.3.3 Volar Central Portal

With the arthroscope placed in the 3/4 or 6R portal, a longitudinal incision is made in the

axis of the third intermetacarpal space, the distal end of which being the distal palmar wrist crease.

The FDS tendon of the fifth finger is located by blunt dissection and pulling on it shows that the fifth finger is flexed. Once identified, the entire mass of the FDS is retracted to the radial side. In the following plane lie the FDP tendons. The interval between the third and fourth FDP tendons is identified (also pulling on them and



**Fig. 71.31** Anatomical location of the volar ulnar portal. Ulnar artery (UA). Ulnar nerve (UN). Flexor digitorum superficialis (FDS). Flexor digitorum profundus (FDP) (a) Anatomical images. (b) MRI images

observing the flexion of the fingers). The fourth and fifth FDP tendons are separate toward ulnar side and the third and second FDP tendons toward the radial side, thus exposing the volar capsule (Fig. 71.34).

### 71.3.3.1 Establishment of the Volar Central Radiocarpal Portal

With the arthroscope in the 6R portal, a 22-G needle is inserted through the volar capsule, just proximal to the lunate and in the interval between the short radiolunate ligament and the ulnocarpal ligaments. The capsule is then opened with the tip of a number 11 scalpel, and the portal is widened. From this moment on, either the instrument or the arthroscope can be inserted into the joint. To introduce the arthroscope, a 2.4-mm Kirschner

wire is inserted to be used as a Wissinger guide rod; thus, the arthroscope sheath is inserted through it (Fig. 71.35).

### 71.3.3.2 Visualized Structures in the Radiocarpal Joint

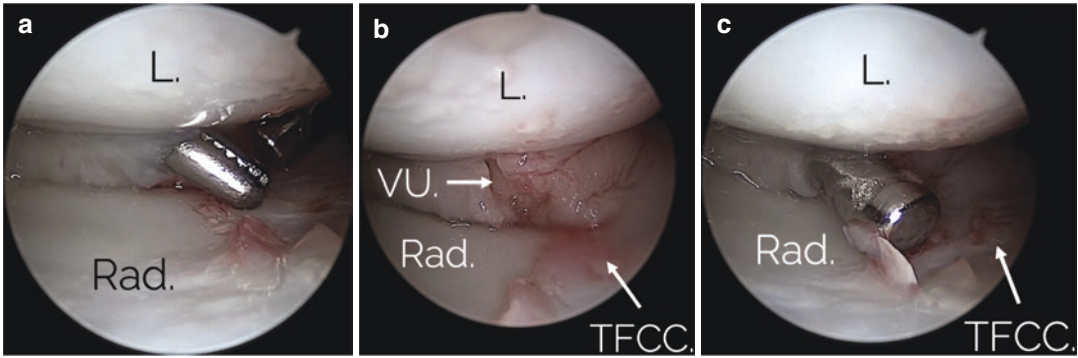
By moving the arthroscope toward the radial and ulnar side, a complete view of the entire radiocarpal and ulnocarpal joint can be obtained (Fig. 71.36).

#### At the Entry Point

Proximal: The surface of the radius is observed, with the separation of the scaphoid fossa and the lunate.

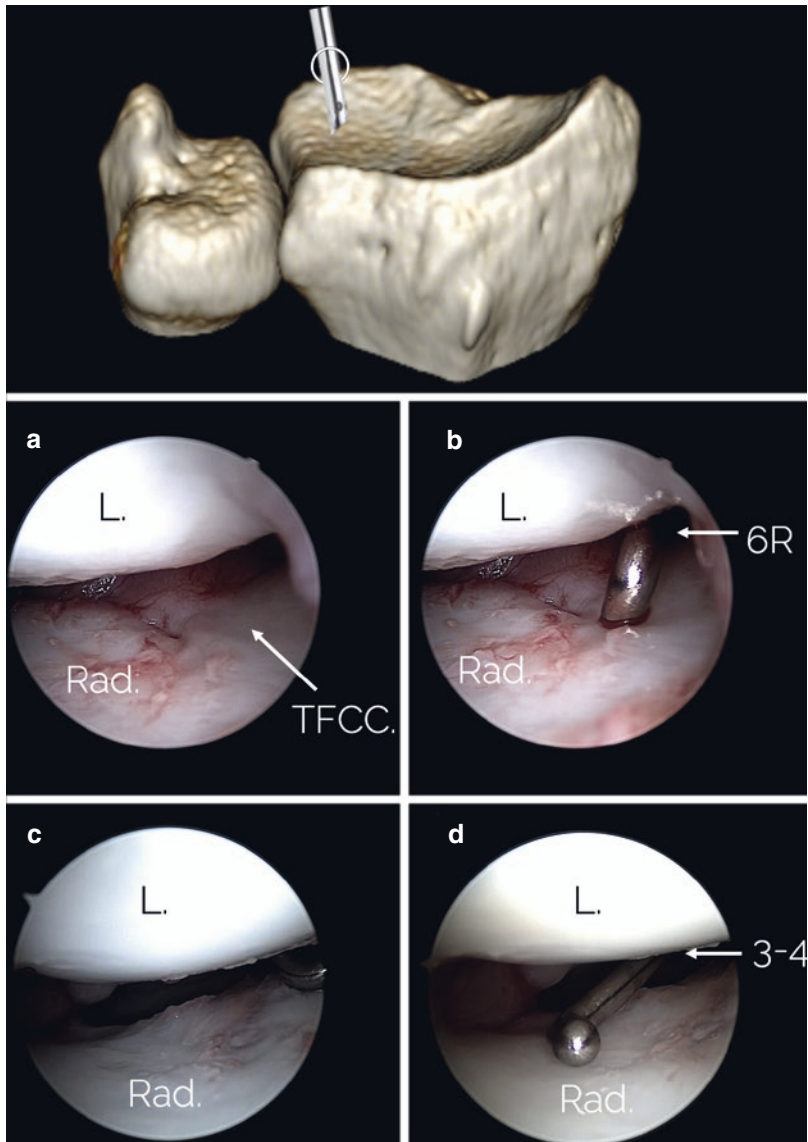
Distal: Proximal surface of the lunate.

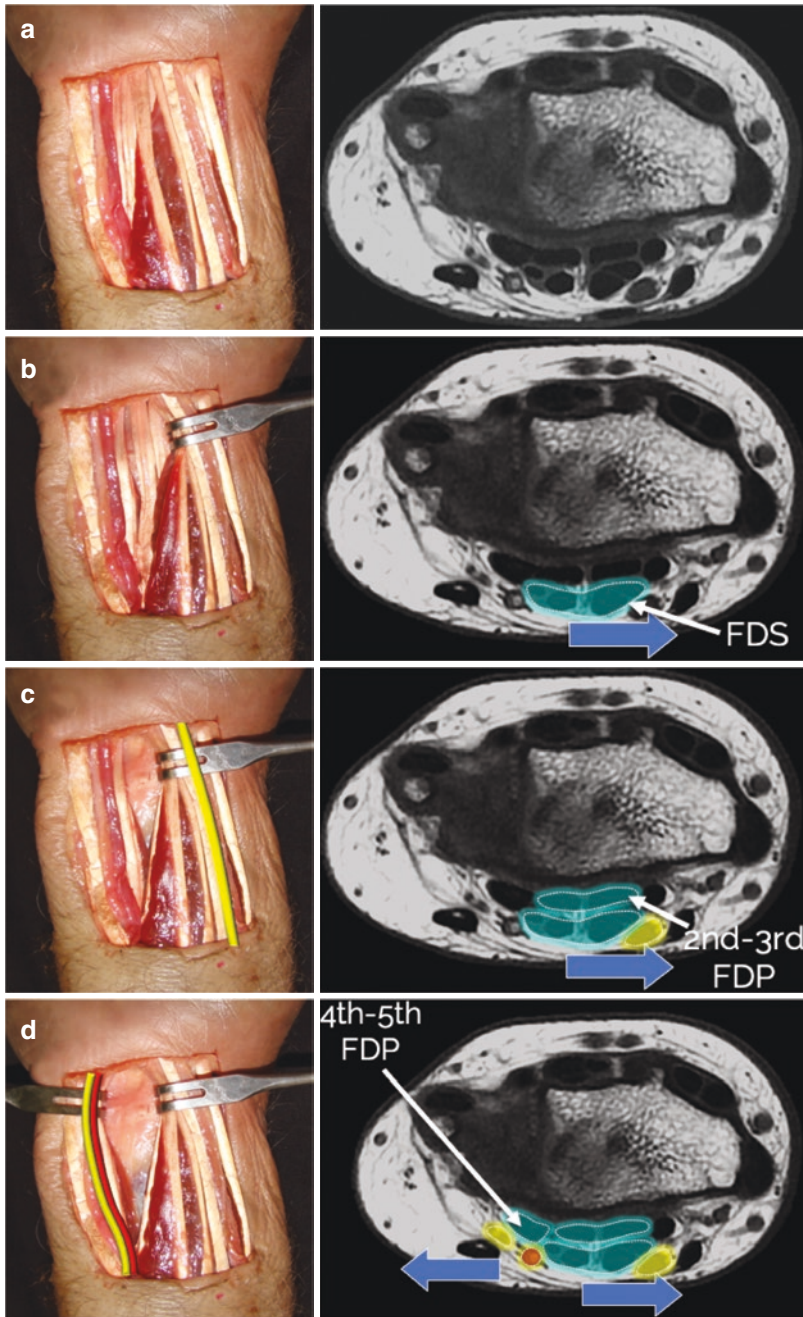
Dorsal: If a dorsal synovectomy is performed, the dorsal radiotriquetral ligament is visualized.



**Fig. 71.32** Arthroscopic view of the entry point of the VU portal, from the 6R portal (a) A mosquito is used to establish the VU portal. (b) Dorsal vision of the VU portal (c) A wisinger rod is entering through the VU portal

**Fig. 71.33** Arthroscopic view of the radiocarpal joint through the VU portal. (a, b) At the entry point. (c, d) Moving the vision field to the radial side. The probe is inserted through the 6R portal in figure b and through the 3-4 portal in figure d





**Fig. 71.34** Steps for performing the VC portal. (a, b) The FDS tendons are retracted to the radial side. (c) The interval between the third and fourth FDP tendons is identified and the second and third FDP tendons are retracted towards the radial side, this way the median nerve is pro-

TECTED. (d) The fourth and fifth FDP tendons are separate towards ulnar side, this way the ulnar neurovascular bundle is protected. (e) The volar capsule is exposed ante the midcarpal volar central portal (MVCP) and radiocarpal volar central portal (RVCP) are established

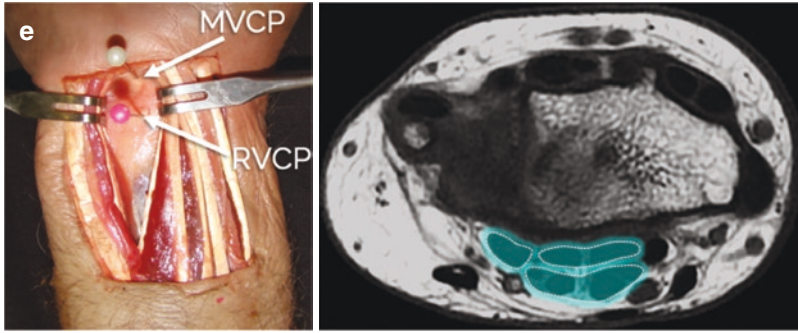


Fig. 71.34 (continued)

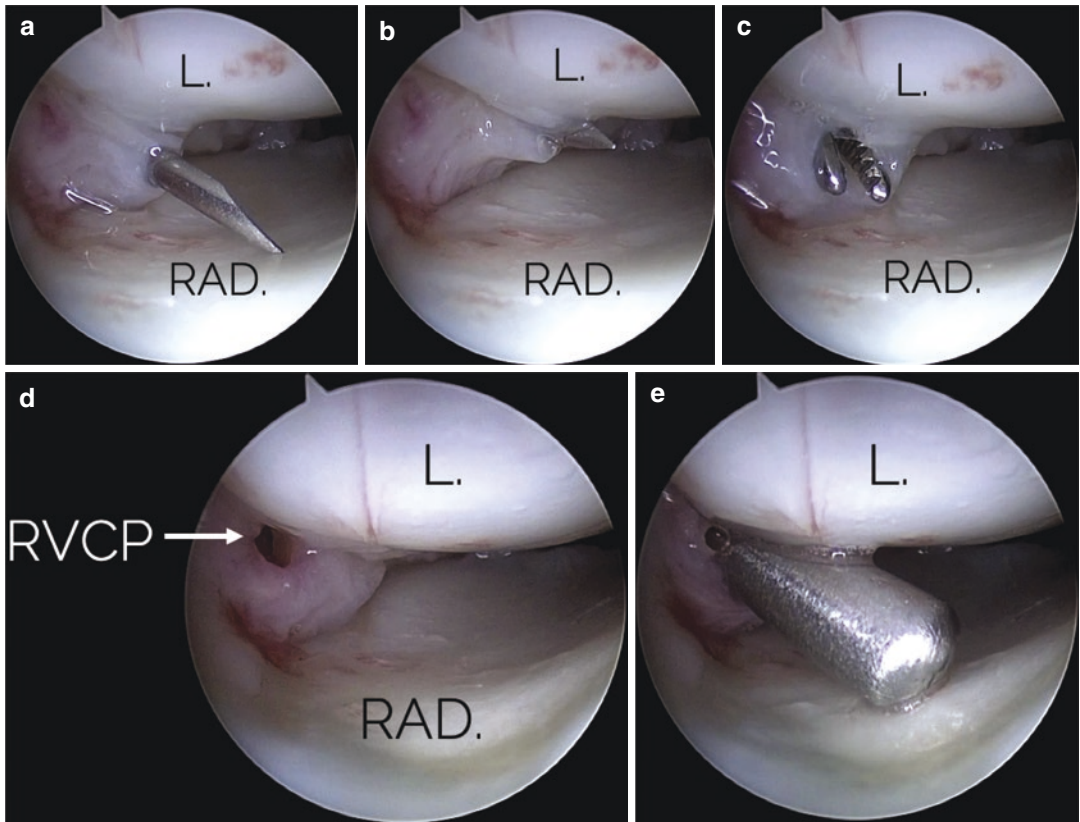
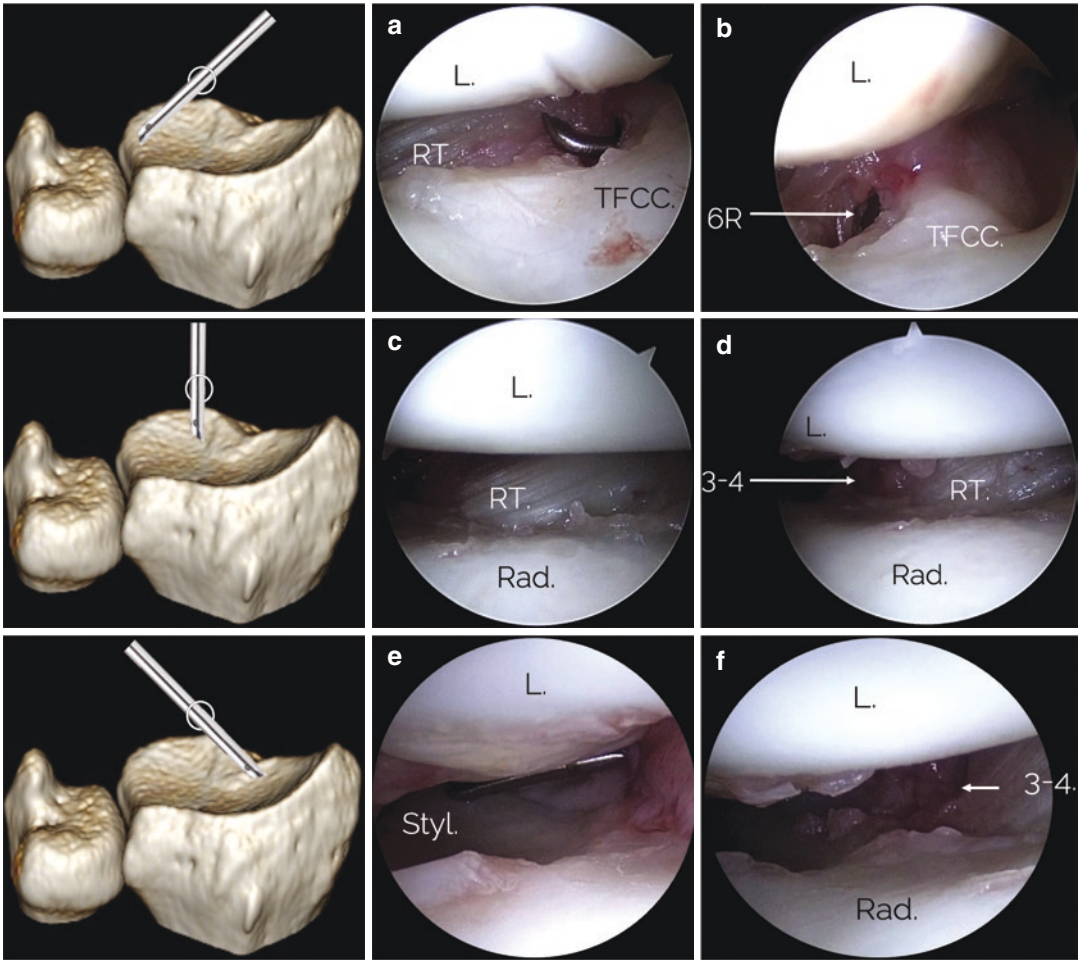


Fig. 71.35 Arthroscopic view of the entry point of the radiocarpal VC portal (a–c) Establishment of the portal. (d) Dorsal vision of the radiocarpal VC portal. (e) a Wisinger rod is entering through the radiocarpal VC portal





**Fig. 71.36** Arthroscopic view of the radiocarpal joint through the radiocarpal VC portal. (a, b) Moving the vision field to the ulnar side. Radiotriquetral ligament (RT) (c, d) At the entry point. (e, f) Moving the vision field to the radial side

### Moving the Vision Field to Radial

Proximal: Scaphoid fossa of the radius and radial styloid.

Distal: Proximal pole of the scaphoid.

Dorsal: 3/4 portal, dorsal capsule.

### Moving the Vision Field to Ulnar

Proximal: Lunate fossa and TFCC.

Distal: Proximal pole of the lunate.

Dorsal: 6R portal, dorsal capsule.

### 71.3.3.3 Establishment of the Volar Central Midcarpal Portal

With the scope located in the UMC portal, a 22-G needle is inserted into the capsule, just above the anterior horn of the lunate, at the level of Poirier's space. Next, the portal is made with an 11 scalpel and widened. Again, a Kirschner wire is used as a Wissinger rod, and the arthroscopy sheath is inserted following it (Fig. 71.37).

### 71.3.3.4 Visualized Structures in the Midcarpal Joint

From this central position, moving the arthroscope toward radial and ulnar, the entire midcarpal joint can be visualized completely (Fig. 71.38).

### At the Entry Point

Proximal: The surface of the lunate is observed.

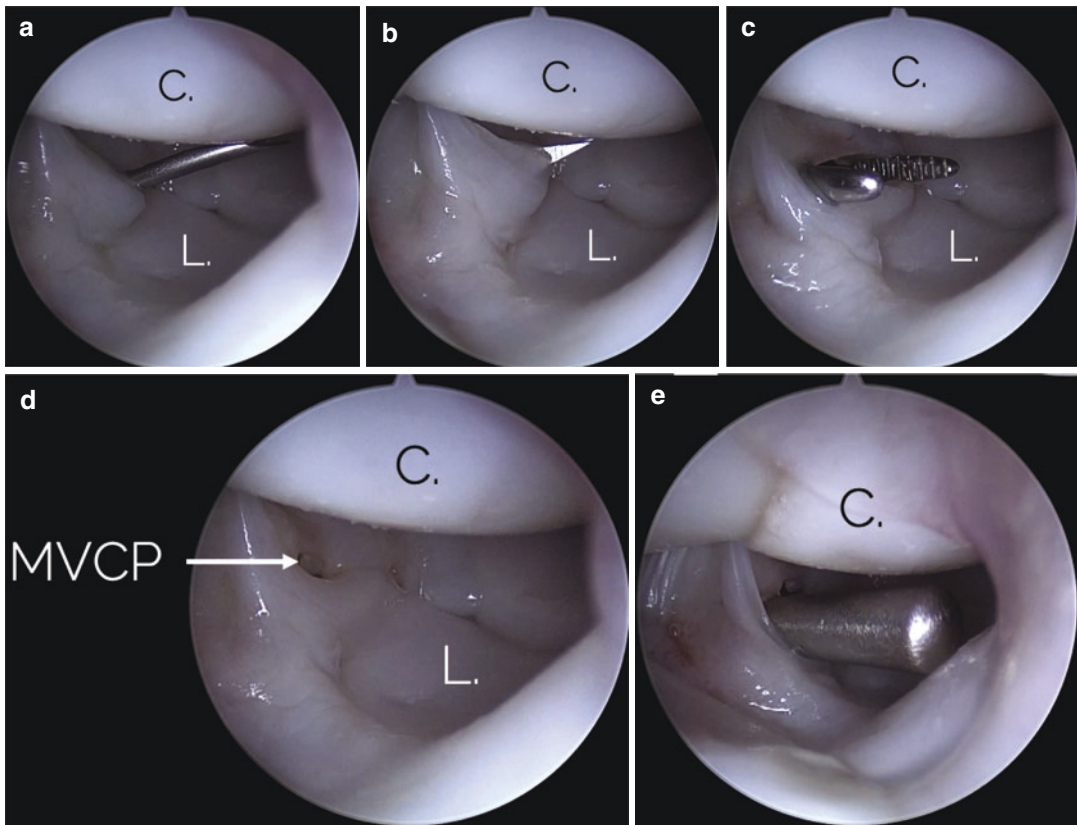
Distal: Proximal surface of the capitate bone.

Dorsal: Dorsal horn of the lunate and dorsal capsule. If a dorsal capsule synovectomy is performed, the dorsal intercarpal ligament can be seen.

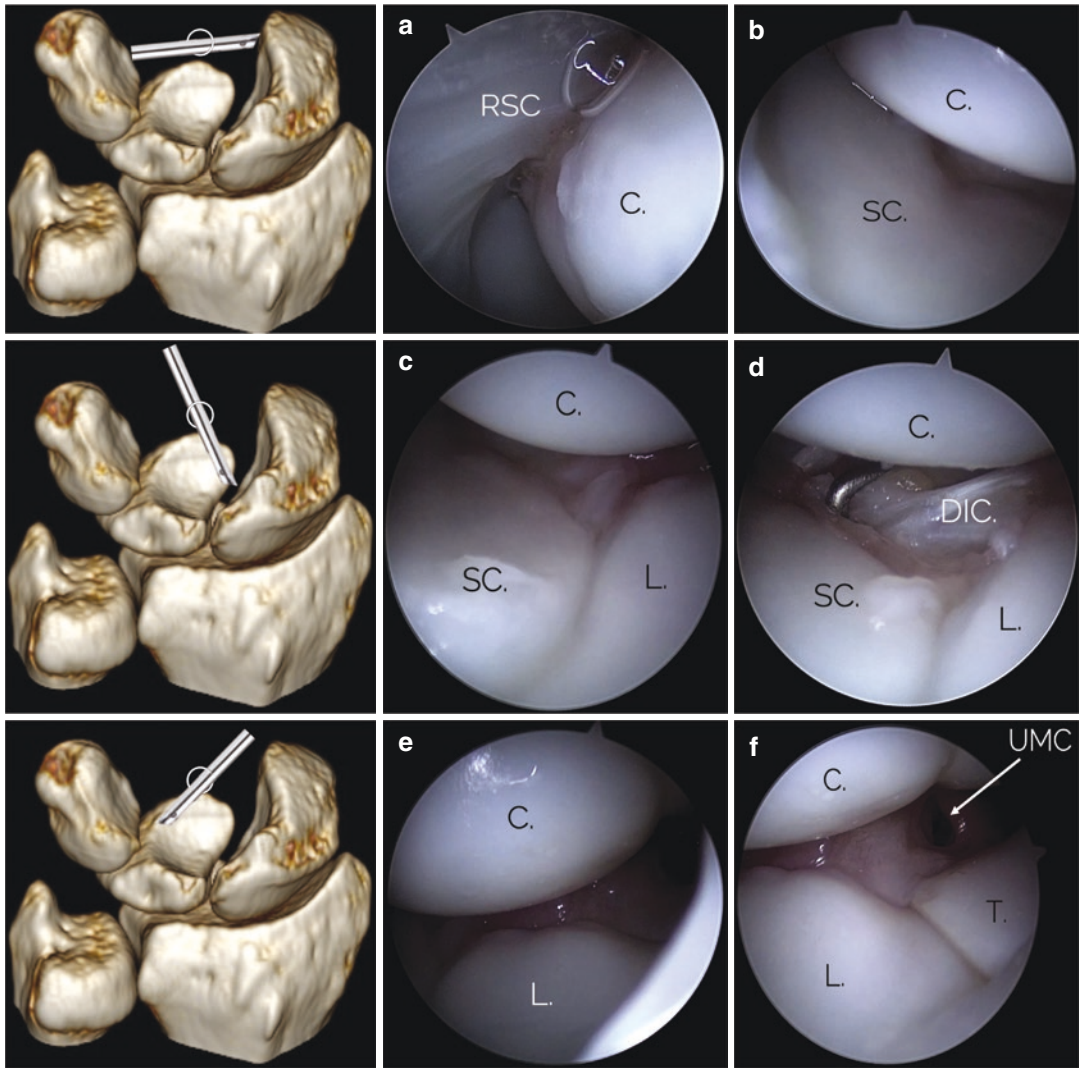
### Moving the Vision Field to Radial

Proximal: Scapholunate joint, scaphoid.

Distal: Proximal surface of capitate bone. If it is displaced by the volar part of the large one, the insertion of the radio-scapho-capitate ligament is seen.



**Fig. 71.37** Arthroscopic view of the entry point of the midcarpal VC portal. (a–c) Establishment of the portal. (d) Dorsal vision of the midcarpal VC portal. (e) A Wissinger rod is entering through the radiocarpal VC portal



**Fig. 71.38** Arthroscopic view of the midcarpal joint through the Midcarpal VC portal. (a, b) Moving the vision field to the radial side. (c, d) At the entry point. Dorsal

Intercarpal ligament (DIC) (e, f) Moving the vision field to the ulnar side

Dorsal: RMC portal, dorsal capsule. If a synovectomy is performed, the dorsal intercarpal ligament can be observed.

Dorsal: MCU portal, dorsal capsule. If a synovectomy is performed, the dorsal intercarpal ligament can be observed.

**Moving the Vision Field to the Ulnar Side**

Proximal: Lunotriquetral joint, triquetrum.  
Distal: Proximal surface of the capitate and hamate bones.

**71.3.3.5 Neurovascular Structures at Risk**

Only two articles have carried out in anatomical study of this portal. The first was published by

Corella et al. [20] and the second was recently published by Antonoglou et al. [24]

- Ulnar neurovascular bundle:

The VC radiocarpal portal distance to the ulnar nerve was 8.4 mm (range 6.7–8.5 mm) and to the ulnar artery 6.9 mm (range 5.3–7.1 mm), according to the study by Antonoglou et al. [24] According to the report by Corella et al. [20], the distance to the neurovascular structures was 7 mm (range 5–10.5 mm). Both works show shorter distances from the midcarpal portal to the ulnar neurovascular bundle. Antonoglou et al. [24] 6.8 mm (range 4.6–10.5 mm) to the nerve, 5.7 mm (range 3.8–8.7 mm) to the artery, and Corella et al. [20] 4.5 mm (range 3.8–9 mm).

- Median nerve:

It is further away than the ulnar neurovascular bundle. The measurements published are referred to the radiocarpal portal: 9.4 mm (range 6.6–10.5 mm) by Antonoglou et al. [24] and 10.5 mm (range 7.8–15 mm) by Corella et al. [20] Regarding the midcarpal portal, the distances are also smaller: 7.2 mm (range 4.8–9.8 mm) by Antonoglou et al. [24] and 7 mm (range 4.8–10.3 mm) by Corella et al. [20]

- Palmar cutaneous branch of median nerve:

It is found further away than the median nerve. Regarding the radiocarpal portal, Antonoglou et al. [24] published distances of 16.4 mm (range 13.1–20.3 mm) and Corella et al. [20] 18.5 mm (range 15.8–20.3 mm). As in previous structures, the midcarpal portal is also closer than the radiocarpal, and the published distances are 15.1 mm (range 13.5–18.9 mm) by Antonoglou et al. [24] and 16 mm (range 14.8–19 mm) by Corella et al. [20]

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