

Complications of Wrist Arthroscopy: A Multicenter Study Based on 10,107 Arthroscopies

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Abstract

Background Wrist arthroscopy is now a routine procedure, regarded as safe. Complications are reported in the literature as being rare and mostly minor.

Purpose The two goals of this study were to evaluate the incidence and nature of complications based on a very large multicenter retrospective study, and to investigate about a potential learning curve.

Methods The authors sent a detailed questionnaire to all members of the European Wrist Arthroscopy Society (EWAS), inquiring about the number and types of complications encountered during their practice of wrist arthroscopy, and about their experience with the technique.

Results A total of 36 series comprising 10,107 wrist arthroscopies were included in the study. There were 605 complications (5.98% of the cases), of which 5.07% were listed as serious and 0.91% as minor. The most frequent ones were failure to achieve the procedure (1.16%), and nerve lesions (1.17%). Cartilage lesions and complex regional pain syndrome each occurred in 0.50% cases. Other complications (wrist stiffness, loose bodies, hematomas, tendon lacerations) were less frequent. Breaking down of the data according to each surgeon's experience of the technique showed a significant relationship with the rate of complications, the threshold for a lower complication rate being approximately 25 arthroscopies a year and/or greater than 5 years of experience.

Conclusion Although the global incidence of complications was in keeping with the literature, the incidence of serious complications was much higher than previously reported. There is a significant learning curve with the technique of wrist arthroscopy, both in terms of volume and experience.

Keywords

- ▶ wrist arthroscopy
- ▶ complications
- ▶ large multicenter review
- ▶ learning curve

Since its initial description,¹ wrist arthroscopy (WA) has been increasingly performed, and is now a routine procedure for surgeons dealing with the wrist, not only for diagnosis but mainly for the treatment of pathologies of the wrist.

It is usually regarded as a safe procedure. Complications have been reported in the literature as rare (1.2–7.9%) and are mostly minor.^{2–9} Only 0.9 to 1.1% of the cases are reported as “serious” complications.^{7,9} Reports from the literature involve mostly personal series^{3–9} with numbers of WA ranging from

84 to 463. There is only one systematic review of the literature, including 895 WA procedures, with a 4.7% complication rate.² There is currently no large-scale multicenter study of complications published in the literature.

The primary purpose of this study was to evaluate the incidence and nature of complications, based on a very large number of patients recruited via a retrospective multicenter study. The second purpose was to investigate about a potential learning curve, as this study includes both experienced and

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beginner arthroscopist surgeons. The authors hypothesize that there is a threshold for both experience and volume at which the risk of complication decreases. This would define a learning curve for WA, which has not yet been reported in the literature.

Material and Methods

For the purpose of the study, and following Dubos' definition,¹⁰ a complication has been defined as an unfavorable event directly or indirectly linked to the technique of WA, excluding secondary failures linked to the application of the technique, or to the initial pathology.

The European Wrist Arthroscopy Society (EWAS) is an interest group with no criteria of admission. A questionnaire in English was sent via email to all members of EWAS and the results were collected over a period of 1.5 years.

The first part of the questionnaire inquired about the members' experience in WA: number of years of practice in WA, number of cases per year, total number of cases performed, and indications for the WA procedures (either diagnostic or therapeutic).

The second part listed all complications of WA previously reported in the literature,^{11,12} and responders were required to report precisely the number of each complication they had experienced in their practice, based on their patients' data. For each reported complication, secondary descriptive questions were added for details, requiring either multiple choice or open answers, according to need. Contributors were specifically required to base their answers solely on data retrieved from their patients' files.

A third part was an open questionnaire about other possible unlisted complications.

Results

Of the 39 questionnaires that were returned, 3 were excluded because they were either incomplete or unclear. There remained 36 series, of which 35 were personal series, and 1 a hand surgery department series. Overall, 14 countries were represented, including 9 European countries (29 series/36) (► **Table 1**).

There are 10,107 cases of WA included in this study. For the purpose of this study, we distinguished between larger series: more than 600 cases, middle-size series: 50 to 600 cases, and small series: less than 50 cases. Eight of the series (22%) were large, with an average of 860 cases per series, 19 (53%) were middle size with an average of 167 cases per series, and 9 (25%) were small with an average of 22.5 cases per series.

The surgeon's experience with WA was calculated excluding the 1 series from a hand surgery department, leaving 35 series. Ten surgeons (29%) had more than 15 years of experience of WA, and nine (26%) had less than 5 years. Seven surgeons (20%) performed more than 75 WA/year, and 18 surgeons (51%) less than 25/year (► **Table 2**). All these figures indicate the large diversity of experiences among series in the survey.

The purpose of WA in the whole group was diagnostic in 28% cases, and therapeutic in 72%. But when correlated to the size of the series, the figures show less therapeutic WA (60.5%) in small series, as opposed to 87% in large series.

Table 1 Participating countries to the survey

	Country	NB of series
Europe	France	12
	Italy	6
	Belgium	3
	Spain	2
	Germany	2
	Switzerland	2
	UK	1
	Portugal	1
Total Europe	8 countries	29 series
ROW	USA	2
	Australia	1
	Lebanon	1
	Brazil	1
	Turkey	1
	Malaysia	1
Total ROW	6 countries	7 series

Abbreviations: NB, number; ROW, rest of the world.

As a whole, 605 complications were reported, accounting for 5.98% of cases in the whole survey.

Results according to the size of the series indicate that in the large series (> 600 cases), the average complication rate was 3.73%, whereas it was 9.77% in the middle-size series (50–600 cases), and 22.58% in the small series (< 50 cases).

Of the 35 personal series, 17 surgeons performed less than 25 WA/year at the time of the survey; their complication rate was 12.06%, whereas among the 7 surgeons who performed more than 75 WA/year, the complication rate was 3.95%. Nine surgeons had less than 5 years of practice of WA and their complication rate was 13.6%, whereas it was 2.3% among the nine surgeons who had more than 15 years of practice (► **Table 2**).

Following Beredjiklian et al³ and Luchetti et al,⁷ complications were broken down into serious or benign (► **Table 3**). Of the 5.98% complications, 5.07% were listed as "serious" and 0.91% as "benign." They are detailed hereunder by frequency.

Failure to Achieve the Procedure

Failure to achieve the procedure occurred in 118 cases (1.17%), and dorsal ganglia were the causative pathology in more than half of these (► **Table 4**). It was necessary to proceed to an arthrotomy in 26 cases.

Complications of the Surgical Setup

There were 78 complications (0.77%) related to the setup itself, of which 57 (0.56%) were due to finger traction, 18 to arm counter traction, and 3 to burns by a hot traction tower. Of these, 27 were transient neurapraxies, mostly at the finger level. The details of each complication are listed in ► **Table 5**.

Table 2 Complication rate according to experience

	Number of surgeons <i>n</i> = 35	Complication rate (%)
Total number of WA		
> 600	8	3.73
50–600	19	9.77
< 50	8	22.58
NB of WA/y		
Less than 25	17	12.06
25–75	11	3.49
More than 75	7	3.95
Years of experience in WA		
Less than 5 y	9	13.6
5–15 y	17	5.35
More than 15 y	9	2.30
Less than 5 y AND less than 25 WA/y	5	35.63

Abbreviations: NB, number; WA, wrist arthroscopy.

Note: These figures are based on the 35 personal series.

Nerve Lesions

There were 59 nerve lesions at the wrist related to the portals (0.58%), the majority of which involved either the sensory branches of the ulnar nerve (30 cases) or of the radial nerve (23 cases) (► **Table 6**). The two median nerve lesions occurred during the course of volar ganglia removal. Out of these, 15 lesions required revision surgery.

Cartilage Lesions

In the questionnaire, cartilage lesions were divided into: (1) Minimal, that is, “neither large nor deep, and unlikely to create future problems,” and (2) large, that is, “more than 5 mm², and/or likely to create future problems.”

Table 3 Serious/benign complications

Serious	Benign
Laceration of tendon, nerve, artery	Transient nerve lesion (neurapraxia)
Large cartilage lesion	Small cartilage lesion
Loose body requiring arthrotomy	Loose body not requiring arthrotomy
Hematoma	Synovial fistula
Compartment syndrome	Local swelling
Pyogenic arthritis	Superficial sepsis
Wrist stiffness	Problems at portal site: ganglia, adhesion, pain
Failure to achieve the procedure	All spontaneously resolvable problems
CRPS	Miscellaneous

Abbreviation: CRPS, complex regional pain syndrome.

Table 4 Failure to achieve the procedure

Procedure	Number	Percentage of all failure (<i>n</i> = 118)	Percentage total cases (<i>n</i> = 10,107)
Ganglion removal	69	58.5	0.68
Ligament repair	24	20.3	0.24
Distal radius fracture	11	9.3	0.11
Wafer procedure	10	8.5	0.1
Other (arthrolysis, lunarectomy)	4	3.4	0.04
Total	118		1.17

Minimal cartilage lesions occurred in most series (33/36). They were reported as frequent in 11/36 series, rare in 22/36, absent in 1/36, and unknown in 2/36 (► **Table 7**).

There were 51 large lesions reported (0.5%) located mostly at the radiocarpal joint (32), less frequently at the midcarpal joint (19, involving the head of the capitate most of the time) (► **Table 8**).

In answer to the question: “Which type of procedure created most cartilage lesions?” (open question), “tight wrist, regardless of the procedure” ranked first (► **Table 9**).

Complex Regional Pain Syndrome

Complex regional pain syndrome (CRPS) was reported in 50 cases (0.49%) in the survey.

Stiffness

There were 30 cases (0.30%) of stiffness of the wrist which were reported as directly related to the procedure.

Table 5 Complications related to the surgical setup

Complication type	Number	Percentage total cases (<i>n</i> = 10,107)
Finger traction	57	0.56
Edema	27	
Transient collateral nerve neurapraxia	21	
Finger stiffness	6	
Finger sprain	2	
Blister	1	
Arm countertraction	18	0.18
Neurapraxia: median nerve	4	
Neurapraxia: ulnar nerve	1	
Neurapraxia: brachial plexus	1	
Skin lesions	3	
Pain at tourniquet site	9	
Skin burn	3	0.03

Table 6 Nerve lesions at the wrist

Nerve	Number	Percentage total cases (n = 10,107)
Sensory branch ulnar nerve	30	0.3
Sensory branch radial nerve	23	0.23
Post. Interosseous nerve	3	0.01
Median nerve	2	0.02
Ulnar nerve	1	0.01
Total	59	0.58

Table 7 Minimal cartilage lesions

Frequency	Number of series/36
Frequent	11
Rare	22
None	1
Unknown	2

Table 8 Large cartilage lesions

Location	Number of cases	Percentage total cases (n = 10,107)
Distal radius	15	0.15
Proximal carpal row	17	0.17
Midcarpal joint	19	0.19
Total	51 cases	0.5

Table 9 Which procedure created most cartilage lesions?

N°1	Tight wrist, regardless of the procedure
N°2	Wrist arthrolysis
N°3	Degenerative arthritis
N°4	Radius fracture
N°5	Incorrect portals

Table 10 Tendon injury

Tendon	Number	Percentage total cases (n = 10,107)
EDC index finger	4	0.04
EDC 5th finger	3	0.03
EPL	2	0.02
EIP	2	0.02
TOTAL	11	0.11

Abbreviations: EDC, extensor digitorum communis; EPL, extensor pollicis longus; EIP, extensor indicis proprius.

Table 11 Types of loose bodies

Loose bodies	Number	Percentage total cases (n = 10,107)
Instruments	11	0.11
Sutures	8	0.08
Hair	4	0.04
Other (part of screw, staple, needle, metal particles)	5	0.05
Total	28	0.28

Tendon Injury

Tendon lacerations at the entry point accounted for 11 cases (0.11%). They involved mainly the extensor digitorum communis (EDC) to the index finger (four cases), and to the fifth finger (three cases) (► **Table 10**). Also, there were two cases of tenosynovitis, one of the extensor carpi radialis longus, and one of the EDC. Only three of these lesions underwent revision surgery (two extensor pollicis longus ruptures, and one extensor tenosynovitis).

Loose Bodies

Aside from osteochondral loose fragments, there were 28 reported iatrogenic loose bodies (0.28%). They are listed in ► **Table 11**. Only one of them required an arthrotomy.

Hematoma and Fluid Extravasation

Hematoma was reported in 19 cases (0.19%), necessitating revision in 2 patients.

Fluid extravasation occurred only in wet procedures. It was reported as "frequent" by 17 responders, and spontaneously resolute.

Infection

Among septic complications, superficial infections were either not recorded, or reported as "infrequent." There were four pyogenic arthritis, one of which occurred on a scaphoid screw, one on a Kirschner wire, and one in a WA converted to an open procedure (one unknown).

Miscellaneous

Other complications included skin burns with a thermovap (two cases). At the portal sites, synovial fistulae (nine cases), pain, ganglia ("several"), and adhesions (four cases) were reported. There was a single case of compartment syndrome.

Two series mention complications related with the knot used for TFCC repair: pain, irritation of the sensory branch of the ulnar nerve, skin ulcers, and superficial sepsis.

► **Table 12** lists the most frequent complications. Failure to achieve the planned procedure ranked first (118 cases, 19.5% of all complications). The next most frequent problems were related to the setup (78 cases), including 27 transient neurapraxias: 21 at the finger level and 6 at the arm (tourniquet). These 27 neurapraxias, combined with the 59 nerve lesions at the wrist portals, actually make nerve lesions the

Table 12 Most frequent complications

	Number	Percentage of complications (n = 607)	Percentage total cases (n = 10,107)
Failure to achieve procedure	118	19.5	1.16
Finger traction	60	8.2	0.59
Nerve lesions	59	9.7	0.58
Cartilage lesions	51	8.4	0.50
CPRS	50	8.48	0.49
Wrist stiffness	30	4.9	0.29
Loose bodies	28	4.6	0.27
Hematoma	19	3.1	0.18
Tendon lacerations	13	2.1	0.12

Abbreviation: CPRS, complex regional pain syndrome.

second most frequent complication (86 cases, 14.1% of all complications).

Discussion

The two purposes of this study were to evaluate the incidence and nature of complications of WA based on a very large multicenter retrospective study, and to investigate about a potential learning curve.

In our review, based on 10,107 wrist arthroscopies, the overall incidence of complications (5.98%) is similar to other series. However, the rate of those listed as serious in our series (5.07%, accounting for 82% of complications), is much higher than previously reported. It is also noteworthy that some of the most frequent complications in our survey (i.e., “failure to perform the procedure”) are not even mentioned in most other series.

We studied the relationship between the surgeon's experience in WA and the number of complications in each series. Results according to the size of the series indicate that the average complication rate is six times higher in the small series (< 50 cases: 22.58% complications) than in the large series (> 600 cases: 3.73% complications). We then investigated which of the following factor was correlated with a higher incidence of complications: less than 25 WA performed each year, or less than 5 years of practice of WA. There was no significant difference, with 12.06 and 13.6% complications, respectively. The highest rate of complications (35.63%) was observed for those cumulating these two factors, that is, less volume and less experience.

Interestingly, the rate of complications decreases abruptly above 25 WA/year, and then remains stable: 3.49% for 25 to 75 WA/year (11 series), and 3.95% for more than 75 WA/year (7 series). Similarly the rate decreases significantly after more than 5 years of experience in WA, then remains quite stable (→ **Table 2**).

A learning curve can be defined as an improvement in performance over time or with increasing experience or training.¹³ The existence of a learning curve in acquiring technical skills in orthopedic surgery has been studied in

several fields,¹³⁻¹⁷ but to the best of our knowledge, not in arthroscopic surgery.

The present study demonstrates that there is a learning curve with WA, and that both a regular practice of the technique (more than 25 WA/year) and the number of years of experience (more than 5 years) decrease the risk of complications significantly. This is the first study exploring the influence of both volume and years of experience on the rate of complications in arthroscopy of the wrist.

In a survey from members of the Arthroscopy Association of North America¹⁸ of 395,566 arthroscopies, including all joints, the overall rate of complications was 0.56%, but this included mostly knee procedures, and only 121 wrist procedures for which the incidence of complications was not specified.

The reported rate of complications for the wrist is higher, varying from 1.2 to 7.9%, but most of them are minor.²⁻⁹ Beredjikian et al³ reported 5.2% complications of which only 0.9% were serious, and Luchetti et al⁷ reported 2.9% complications of which 1.1% were serious. In his initial description of the technique, Roth et al¹ reported 7.94% complications in 214 diagnostic WA, among which 3.7% were CRPS. Further series including 84 to 463 patients reported smaller rates, ranging from 1.2 to 5%.^{5,6,8,19} One systematic review of the literature from 1994 to 2010 found 11 multiple-patient studies, with 4.7% complications in 895 WA.²

Most available series, by publication bias, are likely to be from experienced surgeons. In this series, the complication rate is actually similar to the literature for that group. However, it is the less experienced surgeons who skew the figures to give a more realistic interpretation of complications of WA for more junior and less experienced surgeons.

The incidence of complications in other sites of upper limb arthroscopies has been reported as higher than in the wrist,³ with the elbow bearing the highest incidence of complications, comprised between 11.8²⁰ and 13.7%.²¹ Although shoulder arthroscopy was initially reported to be associated with a high morbidity,²² recent multicenter data collected by the American College of Surgeons showed a rate of 0.99%.²³

The relative frequency of each complication for WA also varies greatly from series to series.

In our series, nerve lesions were the second most frequent complications (0.8%) with 27 transient neurapraxias (21 at the finger level and 6 at the arm due to the installation), and 59 nerve lacerations at the wrist portals. Similarly, Rodeo et al noticed 0.1% of neurological complications due to WA.²⁴ There have been several isolated reports of nerve lacerations, including injuries of the dorsal sensory branch of the ulnar nerve,^{25,26} the ulnar nerve itself,²⁷ and the distal posterior interosseous nerve.²⁸ Many anatomical studies have demonstrated the close anatomic relationship between the dorsal branch of the ulnar nerve and the ulnar wrist portals (4–5, 6R, 6U), and how to avoid lacerations.^{25,27,29–31} Recommendations to protect the collateral nerves during finger traction have also been described.⁴

Most reports of tendon lacerations during WA are single case reports.^{32,33} But they have been reported to occur in up to 7% cases,³⁴ involving mainly the extensor tendons. They seem to be more frequent when the procedure involves thermal ablation (6.4%).³⁵ Their incidence was much lower in our study (0.11%). Recommendations from the literature to avoid tendon lacerations during WA involve marking the landmarks and the portals, making superficial skin incisions and spreading soft tissues with a hemostat before entering the joint, using a blunt trocar, and avoiding forceful insertion of instruments.⁴

Compartment syndrome has been reported to occur mostly after arthroscopic treatment of articular fractures of the distal radius. It has been recommended that the procedure be performed more than 3 days after the injury,³⁶ or to use a “dry” technique.³⁷

There have been isolated reports of other complications, among which pyogenic arthritis after using the Ho:YAG laser in an diabetic patient,³⁸ extensor tendon sheath fistula,^{39,40} and a case of pseudoaneurysm of the radial artery in a hemophilic patient after an arthroscopic treatment of a volar wrist ganglion.⁴¹

This study has several limitations. It is retrospective, and based on a questionnaire. Responders were specifically asked to base their answers exclusively on a retrospective study of their patients' files, but the data themselves were obviously not reviewed by the authors of this article. However, any imprecise or nonpertinent data were returned to the responder until satisfactory, or the series was rejected (three series). Another apparent weakness of the study could be the low response rate as 36 of the then 180 members of EWAS participated. However, EWAS is an open interest group without any admission criteria, as attested by the limited experience of some of the members, and this could actually be one of its strength, as the result is probably closer to the “real life” of WA in our countries.

Another limitation concerns comparison between studies, which is difficult for several reasons. The definition of complications differs among authors. For instance the most frequent of our complications (20%), that is, “failure to perform the procedure,” is not even mentioned in most other series. Some of the complications are difficult to assess, such as cartilage lesions especially when small, and may go unreported in some series. Other complications, such as wrist edema/local swelling, regarded as “a normal postoperative

event,” are not reported in most series. It was listed in our questionnaire, but the answers were so vague and partial that no analysis could be drawn, and we did not take it into account in the final results.

Conclusion

Although the global incidence of complications was similar to previous reports in the literature, the incidence of serious complications in this large multicenter study was much higher than previously reported.

This study shows a significant relationship between the rate of complications and the individual surgeon's experience, the threshold for a lower complication rate being approximately 25 arthroscopies a year and/or greater than 5 years of experience.

Conflict of Interest

None.

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References

- Roth JH, Poehling GG, Whipple TL. Arthroscopic surgery of the wrist. *Instr Course Lect* 1988;37:183–194
- Ahsan ZS, Yao J. Complications of wrist arthroscopy. *Arthroscopy* 2012;28(6):855–859
- Beredjikian PK, Bozentka DJ, Leung YL, Monaghan BA. Complications of wrist arthroscopy. *J Hand Surg Am* 2004;29(3):406–411
- Culp RW. Complications of wrist arthroscopy. *Hand Clin* 1999; 15(3):529–535, x
- De Smet L, Dauwe D, Fortems Y, Zachee B, Fabry G. The value of wrist arthroscopy. An evaluation of 129 cases. *J Hand Surg [Br]* 1996;21(2):210–212
- Hofmeister EP, Dao KD, Glowacki KA, Shin AY. The role of midcarpal arthroscopy in the diagnosis of disorders of the wrist. *J Hand Surg Am* 2001;26(3):407–414
- Luchetti R, Atzei A, Rocchi L. Incidence and causes of failures in wrist arthroscopic techniques[in French]. *Chir Main* 2006;25(1): 48–53
- Nagle DJ, Benson LS. Wrist arthroscopy: indications and results. *Arthroscopy* 1992;8(2):198–203
- Slutsky DJ, Nagle DJ. Wrist arthroscopy: current concepts. *J Hand Surg Am* 2008;33(7):1228–1244
- Dubos JP, Franck A. Complications de l'arthroscopie. In: SFA. *Arthroscopie*. Paris: Elsevier; 1999:32–35
- Warhold LG, Ruth RM. Complications of wrist arthroscopy and how to prevent them. *Hand Clin* 1995;11(1):81–89

- 12 Roure P, Fontes D. Complication and prevention of upper limb joints arthroscopy [in French]. *Chir Main* 2006;25(Suppl):(1):274–279
- 13 Bjorgul K, Novicoff WM, Saleh KJ. Learning curves in hip fracture surgery. *Int Orthop* 2011;35(1):113–119
- 14 Delaunay C, Kapandji AI. 10-year survival of Zweymüller total prostheses in primary uncemented arthroplasty of the hip [in French]. *Rev Chir Orthop Reparatrice Appar Mot* 1998;84(5):421–432
- 15 Pardiwala D, Prabhu V, Dudhniwala G, Katre R. The AO distal locking aiming device: an evaluation of efficacy and learning curve. *Injury* 2001;32(9):713–718
- 16 De Vos J, Vandenberghe D. Acute percutaneous scaphoid fixation using a non-cannulated Herbert screw. *Chir Main* 2003;22(2):78–83
- 17 Paillard P. Hip replacement by a minimal anterior approach. *Int Orthop* 2007;31(Suppl 1):S13–S15
- 18 Committee on Complications of the Arthroscopy Association of North America. Complications in arthroscopy: the knee and other joints. *Arthroscopy* 1986;2(4):253–258
- 19 Culp RW. Wrist arthroscopy: Operative procedures. In: Green DP, Hotchkiss RN, Pederson WC, Wolfe SW, eds. *Green's Operative Hand Surgery*. 5th ed. New York, NY: Elsevier Churchill Livingstone; 2005:781–820
- 20 Kelly EW, Morrey BF, O'Driscoll SW. Complications of elbow arthroscopy. *J Bone Joint Surg Am* 2001;83-A(1):25–34
- 21 Nelson GN, Wu T, Galatz LM, Yamaguchi K, Keener JD. Elbow arthroscopy: early complications and associated risk factors. *J Shoulder Elbow Surg* 2014;23(2):273–278
- 22 Berjano P, González BG, Olmedo JF, Perez-España LA, Munilla MG. Complications in arthroscopic shoulder surgery. *Arthroscopy* 1998;14(8):785–788
- 23 Martin CT, Gao Y, Pugely AJ, Wolf BR. 30-day morbidity and mortality after elective shoulder arthroscopy: a review of 9410 cases. *J Shoulder Elbow Surg* 2013;22(12):1667–1675.e1
- 24 Rodeo SA, Forster RA, Weiland AJ. Neurological complications due to arthroscopy. *J Bone Joint Surg Am* 1993;75(6):917–926
- 25 McAdams TR, Hentz VR. Injury to the dorsal sensory branch of the ulnar nerve in the arthroscopic repair of ulnar-sided triangular fibrocartilage tears using an inside-out technique: a cadaver study. *J Hand Surg Am* 2002;27(5):840–844
- 26 Tsu-Hsin Chen E, Wei JD, Huang VW. Injury of the dorsal sensory branch of the ulnar nerve as a complication of arthroscopic repair of the triangular fibrocartilage. *J Hand Surg [Br]* 2006;31(5):530–532
- 27 Nguyen MK, Bourgooin S, Gaillard C, et al. Accidental section of the ulnar nerve in the wrist during arthroscopy. *Arthroscopy* 2011;27(9):1308–1311
- 28 del Piñal F, Herrero F, Cruz-Camara A, San Jose J. Complete avulsion of the distal posterior interosseous nerve during wrist arthroscopy: a possible cause of persistent pain after arthroscopy. *J Hand Surg Am* 1999;24(2):240–242
- 29 Ehlinger M, Rapp E, Cognet JM, et al. Transverse radioulnar branch of the dorsal ulnar nerve: anatomic description and arthroscopic implications from 45 cadaveric dissections [in French]. *Rev Chir Orthop Reparatrice Appar Mot* 2005;91(3):208–214
- 30 Esplugas M, Lluch A, Garcia-Elias M, Llusà-Pérez M. How to avoid ulnar nerve injury when setting the 6U wrist arthroscopy portal. *J Wrist Surg* 2014;3(2):128–131
- 31 Tryfonidis M, Charalambous CP, Jass GK, Jacob S, Hayton MJ, Stanley JK. Anatomic relation of dorsal wrist arthroscopy portals and superficial nerves: a cadaveric study. *Arthroscopy* 2009;25(12):1387–1390
- 32 Dumontier C, Chassat R, Nourissat G. Complications des arthroscopies du poignet. In: Rodineau J, Saillant G, eds. *Arthroscopie thérapeutique en traumatologie du sport*. Paris: Masson; 2005:133–136
- 33 Cooper AR, Elfar JC. Extensor tendon lacerations from arthroscopic excision of dorsal wrist ganglion: case report. *J Hand Surg Am* 2013;38(10):1957–1959
- 34 Fortems Y, Mawhinney I, Lawrence T, Trial IA, Stanley JK. Late rupture of extensor pollicis longus after wrist arthroscopy. *Arthroscopy* 1995;11(3):322–323
- 35 Pell RFT IV, Uhl RL. Complications of thermal ablation in wrist arthroscopy. *Arthroscopy* 2004;20(Suppl 2):84–86
- 36 Geissler WB. Intra-articular distal radius fractures: the role of arthroscopy? *Hand Clin* 2005;21(3):407–416
- 37 Del Piñal F. Technical tips for (dry) arthroscopic reduction and internal fixation of distal radius fractures. *J Hand Surg Am* 2011;36(10):1694–1705
- 38 Blackwell RE, Jemison DM, Foy BD. The holmium:yttrium-aluminum-garnet laser in wrist arthroscopy: a five-year experience in the treatment of central triangular fibrocartilage complex tears by partial excision. *J Hand Surg Am* 2001;26(1):77–84
- 39 Shirley DS, Mullet H, Stanley JK. Extensor tendon sheath fistula formation as a complication of wrist arthroscopy. *Arthroscopy* 2008;24(11):1311–1312
- 40 Naam NH. Synovial fistula as a complication of recurrent dorsal wrist ganglion excision: case report. *J Hand Surg Am* 2012;37(6):1225–1228
- 41 Clerico C, Benatar M, Dumontier C. Radial artery pseudoaneurysm: a rare complication after arthroscopic treatment of a volar wrist ganglion in a hemophilia patient. *Chir Main* 2014;33(5):361–363