Early detection and treatment of complications in the fingers and hand after arthroscopic rotator cuff repair

Mikio Harada, MD, PhD a,*, Nariyuki Mura, MD, PhD b, Masatoshi Takahara, MD, PhD a, Daisaku Tsuruta, MD, PhD c, Michiaki Takagi, MD, PhD c

a Department of Orthopedic Surgery, Izumi Orthopedic Hospital, Sendai, Miyagi, Japan
b Department of Orthopedic Surgery, Yoshioka Hospital, Tendo, Yamagata, Japan
c Department of Orthopedic Surgery, Yamagata University Faculty of Medicine, Yamagata, Japan

ARTICLE INFO

Keywords:
Shoulder
arthroscopic rotator cuff repair
finger
hand
complex regional pain syndrome
carpal tunnel syndrome
flexor tenosynovitis
trigger finger

Level of evidence: Level IV; Case Series;
Treatment Study

Background: Complications in the fingers and hand after arthroscopic rotator cuff repair (ARCR) have been reported to include carpal tunnel syndrome (CTS), flexor tenosynovitis (TS), and complex regional pain syndrome. These studies were conducted retrospectively; however, the reported complications have not been examined prospectively. The aim of this study was to evaluate the outcomes of early detection and treatment of the complications after ARCR.

Methods: Forty-six patients (48 shoulders) who underwent ARCR were prospectively examined to investigate complications in the fingers and hand after ARCR. We attempted to immediately detect and proactively treat these complications. We evaluated the outcomes of the early detection and treatment of the complications.

Results: Complications were observed in 17 hands (35%) and occurred an average of 1.5 months after ARCR. The symptoms in 3 hands resolved spontaneously, 2 hands were diagnosed with CTS, and 12 hands were diagnosed with TS. Of the 12 hands with TS, 11 exhibited no triggering of the fingers. Among the 14 hands diagnosed with CTS or TS, 13 hands (CTS: 2 hands, TS: 11 hands) were treated with corticosteroid injections; the mean interval between treatment initiation and symptom resolution was 1.0 months (0.5-3.0 months). None exhibited complex regional pain syndrome.

Conclusions: When symptoms occur in the fingers and hand after ARCR, CTS or TS should be primarily suspected. The diagnosis of TS must be made carefully because most patients with TS have no triggering. For patients with CTS or TS after ARCR, rapid corticosteroid injection administration can lead to improvement in these symptoms.

© 2020 The Author(s). Published by Elsevier Inc. on behalf of American Shoulder and Elbow Surgeons. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Arthroscopic rotator cuff repair (ARCR) is a safe and effective option for the treatment of rotator cuff tears. The short-term and midterm outcomes after ARCR have been good to excellent. Nevertheless, ARCR is a complex procedure with associated specific and clinically relevant complications. The complications associated with ARCR have been reported to include rerupture, infection, stiffness, direct nerve injury, brachial plexus stretch neurapraxia, hardware failure, fluid extravasation, deep venous thrombosis, and complications related to anesthesia.

Regarding complications of the fingers and hand after ARCR, complex regional pain syndrome (CRPS) type I has been reported. CRPS type I from trauma or surgical intervention is a clinical entity characterized by severe spontaneous pain that is disproportionate to the inciting event and by motor symptoms, such as movement limitations of the fingers and hand. CRPS has been known by many names, but most commonly as reflex sympathetic dystrophy. The prevalence of CRPS ranges from 0% to 14.8% after ARCR. It is of great importance to evaluate clinical outcomes in patients with CRPS. In terms of these clinical outcomes in patients with CRPS, Kobayashi et al. reported that there is no significant difference in the University of California, Los Angeles score at the 2-year postoperative time point between the patients with or without CRPS, and they concluded that the coexistence of CRPS does not affect shoulder function after surgery. However, the outcomes of hand lesions associated with CRPS remain unclear.
Regarding complications in the fingers and hand after ARCR with the exception of CRPS, we found that 12 patients (29%) experienced numbness, pain, edema, and movement limitations in the fingers and hand after ARCR and that these symptoms occurred an average of 1.1 months (range, 0.1-2.5 months) after ARCR, and we reported that the diagnoses were cubital tunnel syndrome in 2 hands, carpal tunnel syndrome (CTS) in 3 hands, and flexor tenosynovitis (TS) in 10 hands and that none of the hands exhibited CRPS. However, these reports on complication in the fingers and hand occurring after ARCR were retrospective, and these complications have not been examined prospectively. Therefore, we sought to prospectively detect and proactively treat these complications. We aimed to evaluate the outcomes of the early detection and treatment of complications in the fingers and hand after ARCR.

Materials and methods

From 2012 to 2017, 48 patients underwent the arthroscopic repair of rotator cuff tears. We excluded 2 patients complicated with distal radius fracture and osteochondroma of the hand, carpal tunnel syndrome (CTS) in 3 hands, and flexor tenosynovitis (TS) in 10 hands and that none of the hands exhibited CRPS. However, these reports on complication in the fingers and hand occurring after ARCR were retrospective, and these complications have not been examined prospectively. Therefore, we sought to prospectively detect and proactively treat these complications. We aimed to evaluate the outcomes of the early detection and treatment of complications in the fingers and hand after ARCR.

All ARCR surgeries were performed by 2 of the authors (NM and MH), who are orthopedic shoulder surgeons. After general anesthesia was induced, all the patients were placed in the beach chair position (T-MAX Beach Chair; Smith & Nephew, Andover, MA, USA). A Spider Arm Holder (Spider; Smith & Nephew) was used during surgery on 10 shoulders and not used on 38 shoulders.

ARCR using suture anchors was performed on all patients. Among the 48 shoulders included, primary repair was performed on 46, and partial repair was performed on the other 2 shoulders. According to the Cofield classification, the tear size was small (less than 1 cm) in 9 shoulders (19%), medium (between 1 and 3 cm) in 27 (56%), large (from 3 to 5 cm) in 10 (21%), and massive (more than 5 cm) in 2 (4%). After surgery, the arms were immobilized using an UltraSling (UltraSling; DONJOY, Ontario, CA, USA) for a period of 4-6 weeks. On postoperative day 1, all patients in this consecutive series began an organized exercise program including active range of motion (ROM) of the fingers and elbow under the supervision of a physical therapist. The patients began performing passive ROM of the fingers and hand after ARCR until 1-3 weeks (mean, 1.2 weeks) after surgery and active ROM exercises at 8 weeks after surgery. The mean observation period after surgery was 19.1 months (range, 12-48 months).

Regarding the history of the fingers and hand for disease before ARCR as well as complications in the fingers and hand, including numbness, pain, edema, and movement limitations, on the operated side that occurred within 1 year after ARCR. We attempted to detect and diagnose the complications as soon as they occurred and to treat them proactively. We evaluated the outcomes of the early detection and treatment of complications in the fingers and hand after ARCR. Until 1 month after surgery, the patients were examined almost daily because they had been hospitalized for 1 month. From 1 to 3 months after surgery, the patients were examined at 1- to 2-week intervals. From 3 months after surgery to the final follow-up, the patients were examined at 1- to 3-month intervals.

One of the authors (MH), who is an orthopedic shoulder surgeon, diagnosed complications in the fingers and hand according to previous diagnosis criteria of CTS, TS, or CRPS. The diagnosis of CTS was based on clinical findings such as finger numbness (thumb, index, middle, or ring finger) or pinch disorder, abnormal findings for Tinel’s sign, Phalen’s test, and the carpal compression test, atrophy and muscle weakness of the abductor pollicis brevis, abnormal Perfect 0 sign, and a delay in distal motor latency of the median nerve beyond 4.2 milliseconds. According to the modification reported by Quinnett, a diagnosis of TS was based on clinical findings such as motion pain or movement limitations of the fingers and abnormal findings regarding more than 1 of the following: triggering, tenderness around the metacarpophalangeal (MP) joints, and swelling of the flexor tendon. Swelling of the flexor tendon was considered present when an orthopedic clinician noted thickening of the flexor tendon distal or proximal to the A1 pulley while pulling the volar MP joint as the patient actively flexed the fingers. According to the Budapest clinical diagnostic criteria for CRPS, CRPS was diagnosed when the following 4 items were met: (1) continuing pain disproportionate to any inciting event; (2) at least 1 symptom in 3 of the following 4 categories: (a) sensory: reports of hyperesthesia and/or allodynia, (b) vasomotor: reports of temperature asymmetry and/or skin color changes and/or skin color asymmetry, (c) sudomotor/edema: reports of edema and/or sweating changes and/or sweating asymmetry, (d) motor/trophic: reports of decreased ROM and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin); (3) at least 1 sign at the time of evaluation in 2 or more of the following categories: (a) sensory: evidence of hypesthesia (to pinprick) and/or allodynia (to light touch and/or deep somatic pressure and/or joint movement), (b) vasomotor: evidence of temperature asymmetry and/or skin color changes and/or asymmetry, (c) sudomotor/edema: evidence of edema and/or sweating changes and/or sweating asymmetry, (d) motor/trophic: evidence of decreased ROM and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin); and (4) no other diagnosis better explains the signs and symptoms.

As for treatment, for CTS, according to the modified protocol of a previous report, the injections were placed using a 27-gauge needle at the wrist between the proximal and distal wrist crease to infiltrate the carpal tunnel using 1.0 mL of 1% mepivacaine hydrochloride (Aspen Japan, Inc., Tokyo, Japan) and 0.5 mL of triamcinolone acetonide (40 mg/mL; Bristol-Myers Squibb, New York, NY, USA) with a total injection volume of 1.5 mL. In TS, according to the modified protocol of a previous report, the injections were placed into and around the flexor sheath using a 27-gauge needle at the level of the A1 pulley using 0.5 mL of 1% mepivacaine hydrochloride (Aspen Japan, Inc.,) and 0.25 mL of triamcinolone acetonide (40 mg/mL; Bristol-Myers Squibb) with a total injection volume of 0.75 mL.

Results

A past history of disease in the fingers and hand before ARCR was present in 5 patients, including TS in 2 (1: surgical history in the middle finger, 1: injection history in the thumb) and CTS in 3 (2: surgery history, 1: injection history). No patients, including these 5 patients, had symptoms of disease in the fingers or hand before ARCR.

In all, 17 patients (17 hands) (35%) experienced numbness, pain, edema, and movement limitations of the fingers and hand on the operated side after ARCR, and these symptoms occurred an average of 1.5 months (range, 0.1-7 months) after ARCR (Tables I and II). In detail, finger numbness was present in 6 patients (6 hands) (12%), and the numbness occurred an average of 0.3 months (range, 0.1-1 months) after ARCR (Tables I and II). Edema in the fingers and hand was observed in 14 patients (14 hands) (29%) an average of 0.9 months (range, 0.1-6 months) after ARCR (Tables I and II). Movement limitations of the fingers and hand were present in 6 patients...
ARCR, arthroscopic rotator cuff repair.

1. In both hands with thumb movement limitations, the range of motion (ROM) of the interphalangeal joint was as follows: extension: 0°, flexion: 60°. In the remaining 4 hands with movement limitations in the fingers, the mean ROM was as follows: extension of the proximal interphalangeal joint: –0.5° (–5° to 0°), flexion (pulp-palm distance): 0.3 cm (0-1 cm).

(6 hands) (12%), and the movement limitations occurred an average of 2.1 months (range, 0.8-3 months) after ARCR (Tables I and II). Pain was present in the fingers and hand in 12 patients (12 hands) (29%), and the pain occurred an average of 2.8 months (range, 0.8-7 months) after ARCR (Tables I and II).

Among 17 patients (17 hands) (35%) with numbness, pain, edema, and movement limitations in the fingers and hand after ARCR, the symptoms in 3 hands resolved spontaneously an average of 0.3 months after ARCR, edema in the fingers and hand occurred an average of 0.9 months after ARCR, and the movement limitations occurred an average of 2.6 months (range, 1-6 months) after ARCR (Table III). In the remaining 14 hands, the diagnosis was CTS in 2 hands and TS in 12 hands (61%), and the movement limitations occurred an average of 2.1 months (range, 0.8-3 months) after ARCR (Tables I and II).

Among 17 patients (17 hands) (35%) with numbness, pain, edema, and movement limitations in the fingers and hand after ARCR, the symptoms in 3 hands resolved spontaneously an average of 0.3 months after ARCR, edema in the fingers and hand occurred an average of 0.9 months after ARCR, and the movement limitations occurred an average of 2.6 months (range, 1-6 months) after ARCR (Table III). In the remaining 14 hands, the diagnosis was CTS in 2 hands and TS in 12 hands (61%), and the movement limitations occurred an average of 2.1 months (range, 0.8-3 months) after ARCR (Tables I and II).

Among 17 patients (17 hands) (35%) with numbness, pain, edema, and movement limitations in the fingers and hand after ARCR, the symptoms in 3 hands resolved spontaneously an average of 0.3 months after ARCR, edema in the fingers and hand occurred an average of 0.9 months after ARCR, and the movement limitations occurred an average of 2.6 months (range, 1-6 months) after ARCR (Table III). In the remaining 14 hands, the diagnosis was CTS in 2 hands and TS in 12 hands (61%), and the movement limitations occurred an average of 2.1 months (range, 0.8-3 months) after ARCR (Tables I and II).

Among 17 patients (17 hands) (35%) with numbness, pain, edema, and movement limitations in the fingers and hand after ARCR, the symptoms in 3 hands resolved spontaneously an average of 0.3 months after ARCR, edema in the fingers and hand occurred an average of 0.9 months after ARCR, and the movement limitations occurred an average of 2.6 months (range, 1-6 months) after ARCR (Table III). In the remaining 14 hands, the diagnosis was CTS in 2 hands and TS in 12 hands (61%), and the movement limitations occurred an average of 2.1 months (range, 0.8-3 months) after ARCR (Tables I and II).

Among 17 patients (17 hands) (35%) with numbness, pain, edema, and movement limitations in the fingers and hand after ARCR, the symptoms in 3 hands resolved spontaneously an average of 0.3 months after ARCR, edema in the fingers and hand occurred an average of 0.9 months after ARCR, and the movement limitations occurred an average of 2.6 months (range, 1-6 months) after ARCR (Table III). In the remaining 14 hands, the diagnosis was CTS in 2 hands and TS in 12 hands (61%), and the movement limitations occurred an average of 2.1 months (range, 0.8-3 months) after ARCR (Tables I and II).

Among 17 patients (17 hands) (35%) with numbness, pain, edema, and movement limitations in the fingers and hand after ARCR, the symptoms in 3 hands resolved spontaneously an average of 0.3 months after ARCR, edema in the fingers and hand occurred an average of 0.9 months after ARCR, and the movement limitations occurred an average of 2.6 months (range, 1-6 months) after ARCR (Table III). In the remaining 14 hands, the diagnosis was CTS in 2 hands and TS in 12 hands (61%), and the movement limitations occurred an average of 2.1 months (range, 0.8-3 months) after ARCR (Tables I and II).

In both hands with thumb movement limitations, the range of motion (ROM) of the interphalangeal joint was as follows: extension: 0°, flexion: 60°. In the remaining 4 hands with movement limitations in the fingers, the mean ROM was as follows: extension of the proximal interphalangeal joint: –0.5° (–5° to 0°), flexion (pulp-palm distance): 0.3 cm (0-1 cm).

The patient was a 52-year-old man. TS in the index finger on the operated side (right side) was diagnosed after ARCR (Fig. 2). The patient experienced motion-induced finger pain, movement limitation, and slight edema in the index finger at 2 months after ARCR. Tenderness around the MP joint of the index finger was also found, and we diagnosed the index finger with TS and administered corticosteroids. At 2 weeks after injection, the motion-induced pain and edema in the fingers and hand had resolved, and the movement limitation in the index finger had improved. Furthermore, at 1 month after injection, the movement limitation in the index finger had almost completely resolved.

**Discussion**

In this study, we evaluated complications in the fingers and hand after ARCR prospectively; 17 patients (17 hands) (35%) experienced numbness, pain, edema, and movement limitations in the fingers and hand within 1 year after ARCR. Finger numbness occurred an average of 0.3 months after ARCR, edema in the fingers and hand occurred an average of 0.9 months after ARCR,
movement limitations in the fingers and hand occurred an average of 2.1 months after ARCR, and pain in the fingers and hand occurred an average of 2.8 months after ARCR. Among 17 hands with complications in the fingers and hand after ARCR, the symptoms in 3 hands resolved spontaneously, 2 hands were diagnosed with CTS, and 12 hands were diagnosed with TS. Because the patients were restrained at the shoulder to within 20° of abduction for a period of 4-6 weeks after ARCR, their finger and hand use was extremely limited; consequently, many of them experienced edema of the fingers and hand. We speculate that immobilization of the shoulder to within 20° of abduction after ARCR causes perfusion injury in the upper extremity, resulting in edema in the upper extremity and promoting the development of common conditions in the fingers and hand, such as CTS or TS. However, we could not confirm whether the presence or duration of shoulder immobilization was statistically related to the onset of the complications, so we need to investigate this immobilization phenomenon in future studies.

Previous studies have shown that risk factors of CTS and TS included injuries such as wrist fracture,25 diabetes mellitus,22,23 rheumatoid arthritis,22,23 and dialysis.25 However, in our study, no patients had these injuries or diseases. Therefore, we could not investigate the risk factors of CTS and TS. The potential mechanisms of the development of common conditions such as CTS or TS are speculated as follows: (1) symptom exacerbation due to a disease that existed before surgery; (2) symptom occurrence due to subclinical disease that existed before surgery; and (3) acute symptom occurrence due to a new disease that developed after surgery. In our study, among the 14 hands diagnosed with CTS or TS, 1 hand diagnosed with CTS had a past history of CTS (injection history) before surgery, and although the fingers diagnosed with TS were different from those with a past history of TS, 2 hands diagnosed with TS had a past history of TS (1 hand: surgical history, 1 hand: injection history) before surgery. In these 3 hands, the symptoms were suspected to occur due to subclinical disease that existed before surgery. In the remaining 11 hands, the symptoms may have occurred acutely due

---

**Table III**

| Patient | Past history | Diagnosis | Triggering | Occurrence time (mo) | Treatment | Symptom resolution | Resolution interval (mo) | Observational period after surgery (mo) |
|---------|--------------|-----------|-----------|----------------------|-----------|-------------------|-------------------------|----------------------------------------|
| 1       | Yes (inj)    | No        | No        | 6                    | inj       | Yes               | 1                       | 12                                     |
| 2       | No           | No        | Yes No    | 2                    | inj       | Yes               | 3                       | 14                                     |
| 3       | Yes (op)     | Yes 1 (inj) | No Yes 3  | 2.5                  | inj       | Yes               | 0.5                     | 12                                     |
| 4       | No           | Yes 3 (op) | No Yes 4  | 1                    | inj       | Yes               | 1                       | 25                                     |
| 5       | No           | No        | No Yes 1  | 7                    | inj       | Yes               | 1                       | 36                                     |
| 6       | No           | No        | No Yes 4  | 1.5                  | inj       | Yes               | 1                       | 48                                     |
| 7       | No           | No        | No Yes 3  | 6                    | inj       | Yes               | 0.5                     | 36                                     |
| 8       | No           | No        | No Yes 1,2,3,4| 1.6                | inj       | Yes               | 1                       | 36                                     |
| 9       | No           | No        | No Yes 2  | 2                    | inj       | Yes               | 1                       | 32                                     |
| 10      | No           | No        | No Yes 1  | 3                    | inj       | Yes               | 1                       | 29                                     |
| 11      | No           | No        | No Yes 3  | 3                    | inj       | Yes               | 1                       | 24                                     |
| 12      | No           | No        | No Yes 3,4| 4                    | inj       | Yes               | 1                       | 12                                     |
| 13      | No           | No        | No Yes 1  | 7                    | inj       | Yes               | 1.5                     | 12                                     |
| 14      | No           | No        | No Yes 3  | 3                    | No        | No                | –                       | 25                                     |
| 15      | No           | No        | No No     | 0.1                  | No        | Yes               | 1                       | 20                                     |
| 16      | No           | No        | No No     | 0.1                  | No        | Yes               | 1                       | 12                                     |
| 17      | No           | No        | No No     | 0.1                  | No        | Yes               | 6                       | 12                                     |

ARCR, arthroscopic rotator cuff repair; CTS, carpal tunnel syndrome; inj, injection; op, operation; TS, tenosynovitis.

Yes 1, 2, 3, 4, 5: thumb, index finger, middle finger, ring finger, little finger.

Resolution interval: resolution interval between treatment initiation and symptom resolution (mo).

---

**Figure 1** Diagnosis, treatment, and treatment outcomes of complications in the fingers and hand after arthroscopic rotator cuff repair. CTS, carpal tunnel syndrome; TS, flexor tenosynovitis.
A 52-year-old male patient was treated with corticosteroid injections due to flexor tenosynovitis (TS) in the index finger on the operated side (right side) occurring at 2 months after arthroscopic rotator cuff repair. Before receiving the injection, on the operated side (right side), the patient experienced motion-induced finger pain, slight edema in the dorsal fingers and hand (before injection: A, nonoperated side, left side; B, operated side, right side), and movement limitation in the index finger (operated right side when fingers flexed before injection: C, front view; D, side view). We diagnosed these symptoms as TS in the index finger and administered corticosteroid injections. At 2 weeks after injection, the motion-induced pain and edema in the fingers and hand had disappeared, and the movement limitation in the index finger had improved (operated right side when fingers flexed at 2 weeks after injection: E, front view; F, side view). Furthermore, at 1 month after injection, the movement limitation in the index finger had completely resolved (operated right side when fingers flexed at 1 month after injection: G, front view; H, side view).
to a new disease that developed after surgery, but the mechanisms involved are still unclear and need to be further investigated. CTS and TS have been reported to occur after trauma or surgical intervention, resulting in the presentation of CRPS-like symptoms, including numbness, pain, edema, and movement limitations in the fingers and hand.15,16 Our study also demonstrates the development of CTS and TS with CRPS-like symptoms after ARCR. Among 12 patients with TS, only 1 hand exhibited triggering of the fingers, whereas the remaining 11 exhibited no triggering. These results suggest that when numbness, pain, edema, and movement limitations in the fingers and hand occur after ARCR, common conditions, such as CTS or TS, should be primarily suspected; the diagnosis of TS must be made carefully because most patients with TS have no triggering.

Regarding treatment and outcomes, previous studies have reported that when CTS and TS occurred after trauma or surgical intervention in the finger, hand, or shoulder, these patients should be treated proactively with corticosteroid injections or surgery.17,18 In our study, except for 1 hand that was not injected, 13 hands (CTS: 2 hands, TS: 11 hands) were treated with corticosteroid injections, and the symptoms in all 13 hands resolved completely. The mean interval between treatment initiation and symptom resolution was 1.0 months (0.5–3.0 months). These results suggest the utility of the early diagnosis of complications in the fingers and hand after ARCR and rapid corticosteroid injection administration to treat the complications. We speculate that rapid corticosteroid injection administration can lead to rapid improvement in these symptoms, thereby effectively preventing the development of CRPS. However, we need to investigate whether the cortisone injection actually leads to rapid improvement of the symptoms using a control group in future studies.

The incidence of CRPS is largely influenced by the criteria employed.21 Three criteria of CRPS diagnosis were mainly used, including the International Association for the Study of Pain (IASP) criteria,12,26 the Ministry of Health, Labor, and Welfare study team for CRPS in Japan (MHLWJ) criteria,27 and the Budapest criteria.4,8,11,12 In 1994, the IASP introduced the term “CRPS” and advocated the criteria for its diagnosis,26 and the IASP criteria were re-established in 2005.13 However, the IASP criteria for CRPS have low specificity, potentially leading to overdiagnosis. To improve the low specificity of the IASP criteria, the MHLWJ criteria and Budapest criteria were established. Consequently, the MHLWJ and Budapest clinical diagnostic criteria provide an incremental improvement in diagnostic accuracy compared with the IASP criteria. On the other hand, there is a great difference between the MHLWJ and Budapest criteria, namely, the presence or absence of 1 item: “no other diagnosis better explains the signs and symptoms.” The Budapest criteria include the presence of this 1 item, whereas the MHLWJ criteria do not include it. In our study, we have chosen the Budapest criteria for CRPS, and the results have shown that none of the hands exhibited CRPS among the patients with complications in the fingers and hand after ARCR. We speculate that this is because we could make a diagnosis of CTS or TS before we had diagnosed CRPS, according to the 1 item “no other diagnosis better explains the signs and symptoms,” which was included in the Budapest criteria.

In our study, the reason why the patients were hospitalized for 1 month is that the Japanese medical system recognizes 1-month hospitalization as a medical service that under health insurance does not incur a large amount of expense, and consequently, all patients in our study wanted to be hospitalized for 1 month. Another reason why these patients were hospitalized is that all the patients lived in distant areas from our hospital, and because traveling from this distance would have posed difficulties for frequent hospital visits and thus required the availability of their family or relatives to bring the patients to our hospital, the patients’ hospitalization stay accounted for the entirety of these considerations. This study had several limitations. The first limitation is that, despite the prospective design, we did not have a control group because we had injected most of patients who developed complications in the fingers and hand to avoid making the complications worse, resulting in CRPS. Because we focused on improving the complications, we could not have a control group without injections. Therefore, the causal relationships between the complications and injections or between CRPS and injections were not analyzed. Second, our study had a very small sample size. Further investigations with large study populations and comparisons of 2 groups will be needed. Third, we have not yet investigated whether certain factors, including shape and size of tear, immobilization period, 1-month hospitalization, and so on, are related to the complications. Fourth, the diagnosis may be biased because one of the authors who diagnosed these complications is an orthopedic shoulder surgeon (the investigator). However, we do not consider this limitation to be of high bias because the investigator did not diagnose these patients based on observing the results but diagnosed according to previous diagnosis criteria of CTS, TS, or CRPS.

Conclusions

We evaluated the outcomes of early detection and treatment of the complications in the fingers and hand after ARCR. Complications were observed in 17 hands (35%), and the complications occurred an average of 1.5 months (range, 0.1–7 months) after ARCR. When complications in the fingers and hand occur after ARCR, CTS or TS should be primarily suspected. Rapid corticosteroid injection administration can lead to improvement in these symptoms.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

References

1. Boileau P, Brassart N, Watkinson D, Carles M, Hatzidakis AM, Krishnan SG. Arthroscopic repair of full-thickness tears of the supraspinatus: does the tendon really heal? J Bone Joint Surg Am 2005;87:1229–40. https://doi.org/10.2106/jbjs.d.02035.
2. Bonnici AV, Spencer JD. A survey of ‘trigger finger’ in adults. J Hand Surg Br 1988;13:202–3.
3. Brislin KJ, Field LD, Savioe FH. Complications after arthroscopic rotator cuff repair. Arthroscopy 2007;23:124–8. https://doi.org/10.1016/j.arthro.2006.09.001.
4. Bruehl S, Harden RN, Galer BS, Saltz S, Bertram M, Backonja M, et al. External validation of IASP diagnostic criteria for complex regional pain syndrome and proposed research diagnostic criteria. International Association for the Study of Pain. Pain 1999;81:147–54.
5. Carmona I, Gonzalez-Alvaro I, Balsa A, Angel Belmonte M, Tena X, Sannotti R. Rheumatoid arthritis in Spain: occurrence of extra-articular manifestations and estimates of disease severity. Ann Rheum Dis 2003;62:897–900. https://doi.org/10.1136/ard.62.9.8397.
6. Chesterton LS, Blagojevic-Bucknall M, Burton C, Dziedzic KS, Davenport G, Jowett SM, et al. The clinical and cost-effectiveness of corticosteroid injection versus night splints for carpal tunnel syndrome (INSTINCTS trial): an open-label, parallel group, randomised controlled trial. Lancet 2018;392:1423–33. https://doi.org/10.1016/s0140-6736(18)31572-1.
7. Curtis AS, Snyder SJ, Delpizzo W, Ferkel RD, Karzel RP. Complications of shoulder arthroscopy. Arthroscopy 1992;8:395.
8. Galer BS, Bruehl S, Harden RN. IASP diagnostic criteria for complex regional pain syndrome: a preliminary empirical validation study. International Association for the Study of Pain. Clin J Pain 1998;14:48–54.
9. Geoghegan JM, Clark DJ, Bainbridge LC, Smith C, Hubbard R. Risk factors in carpal tunnel syndrome. J Hand Surg Br 2004;29:315–20. https://doi.org/10.1016/j.jhsb.2004.02.009.
10. Harada M, Mura N, Takahara M, Takagi M. Complications of the fingers and hand after arthroscopic rotator cuff repair. Open Orthop J 2018;12:134–40. https://doi.org/10.2174/1874325001812010134.

11. Harden RN, Bruehl S, Galer BS, Salz T, Bertram M, Backonja M, et al. Complex regional pain syndrome: are the IASP diagnostic criteria valid and sufficiently comprehensive? Pain 1999;83:211–9.

12. Harden RN, Bruehl S, Perez RS, Birklein F, Marinus J, Maihofner C, et al. Validation of proposed diagnostic criteria (the “Budapest Criteria”) for complex regional pain syndrome. Pain 2010;150:268–74. https://doi.org/10.1016/j.pain.2010.04.030.

13. Harden RN, Bruehl S, Stanton-Hicks M, Wilson PR. Proposed new diagnostic criteria for complex regional pain syndrome. Pain Med 2007;8:326–31. https://doi.org/10.1111/j.1526-4637.2006.00169.x.

14. Kobayashi H, Hata Y, Ishigaki N, Nakamura K, Murakami N, Itsubo T, et al. CRPS type I after operation with rotator cuff tears. Katakansetsu 2010;34:463–6. https://doi.org/10.11296/katakansetsu.34.463.

15. Koh SM, Moate F, Grinsell D. Co-existing carpal tunnel syndrome in complex regional pain syndrome after hand trauma. J Hand Surg Eur Vol 2010;35:228–31. https://doi.org/10.1177/1753193409354015.

16. Levy O, Venkateswaran B, Even T, Ravenscroft M, Copeland S. Mid-term clinical and sonographic outcome of arthroscopic repair of the rotator cuff. J Bone Joint Surg Br 2008;90:189–90. https://doi.org/10.1302/0301-620x.90b10.19989.

17. Marecek CS, Saltzman MD. Complications in shoulder arthroscopy. Orthopedics 2010;33:492–7. https://doi.org/10.3928/01477447-20100526-15.

18. Mbariki H, Akrichi A, Lazrak A, Maaronfi C, El Midaoui A, Tachfouti N, et al. CRPS type I after operation with rotator cuff tears. Katakansetsu 2010;34:463–6. https://doi.org/10.11296/katakansetsu.34.463.

19. Koh SM, Moate F, Grinsell D. Co-existing carpal tunnel syndrome in complex regional pain syndrome after hand trauma. J Hand Surg Eur Vol 2010;35:228–31. https://doi.org/10.1177/1753193409354015.

20. Levy O, Venkateswaran B, Even T, Ravenscroft M, Copeland S. Mid-term clinical and sonographic outcome of arthroscopic repair of the rotator cuff. J Bone Joint Surg Br 2008;90:189–90. https://doi.org/10.1302/0301-620x.90b10.19989.

21. Randelli P, Spenacchio P, Ragone V, Arrigoni P, Casella A, Cabitza P. Complications associated with arthroscopic rotator cuff repair: a literature review. Musculoskelet Surg 2012;96:9–16. https://doi.org/10.1007/s12306-011-0175-y.

22. Rodeo SA, Forster RA, Weiland AJ. Neurological complications due to arthroscopy. J Bone Joint Surg Am 1993;75:917–26.

23. Saldana MJ. Trigger digits: diagnosis and treatment. J Am Acad Orthop Surg 2001;9:246–52.

24. Small NC. Complications in arthroscopic surgery performed by experienced arthroscopists. Arthroscopy 1988;4:215–21.

25. Spahn H, Wollny J, Hartmann B, Schiele R, Hofmann GO. Metaanalysis for the evaluation of risk factors for carpal tunnel syndrome (CTS) part I. General factors. Z Orthop Unfall 2012;150:503–15. https://doi.org/10.1055/j-0032-1315345.

26. Stanton-Hicks M, Janig W, Hassenbusch S, Haddox JD, Boas R, Wilson P. Reflex sympathetic dystrophy: changing concepts and taxonomy. Pain 1995;63:127–33.

27. Sumitani M, Shibata M, Sakae G, Mashimo T. Development of comprehensive diagnostic criteria for complex regional pain syndrome in the Japanese population. Pain 2010;150:243–9. https://doi.org/10.1016/j.pain.2010.03.032.

28. Takahara M, Ogino T, Kikuchi N, Ito K, Watanabe T. Various disorders with symptoms and signs similar to complex regional pain syndrome (CRPS) type I. Nihon Tenogeka Zassi. J Jpn Soc Surg Hand 2006;23:581–6.

29. Tanesue R, Gotoh M, Mitsui Y, Nakamura H, Honda H, Ohzono H, et al. Hand lesion after arthroscopic rotator cuff repair: association with complex regional pain syndrome. J Orthop Sci 2018;23:70–4. https://doi.org/10.1016/j.jos.2017.09.007.

30. Weber SC, Abrams JS, Nottage WM. Complications associated with arthroscopic shoulder surgery. Arthroscopy 2002;18:88–95. https://doi.org/10.1053/jars.2002.31801.

31. Wojahn RD, Foege NC, Gelberman RH, Calfee RP. Long-term outcomes following a single corticosteroid injection for trigger finger. J Bone Joint Surg Am 2014;96:1849–54. https://doi.org/10.2106/jbjs.n.00004.