

Patient-Reported Outcomes and Function after Surgical Repair of the Ulnar Collateral Ligament of the Thumb

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Purpose The purpose of this study was to report prospectively collected patient-reported outcomes of patients who underwent open thumb ulnar collateral ligament (UCL) repair and to find risk factors associated with poor patient-reported outcomes.

Methods Patients undergoing open surgical repair for a complete thumb UCL rupture were included between December 2011 and February 2021. Michigan Hand Outcomes Questionnaire (MHQ) total scores at baseline were compared to MHQ total scores at three and 12 months after surgery. Associations between the 12-month MHQ total score and several variables (i.e., sex, injury to surgery time, K-wire immobilization) were analyzed.

Results Seventy-six patients were included. From baseline to three and 12 months after surgery, patients improved significantly with a mean MHQ total score of 65 (standard deviation [SD] 15) to 78 (SD 14) and 87 (SD 12), respectively. We did not find any differences in outcomes between patients who underwent surgery in the acute (<3 weeks) setting compared to a delayed setting (<6 months).

Conclusions We found that patient-reported outcomes improve significantly at three and 12 months after open surgical repair of the thumb UCL compared to baseline. We did not find an association between injury to surgery time and lower MHQ total scores. This suggests that acute repair for full-thickness UCL tears might not always be necessary. (*J Hand Surg Am.* 2023; ■(■): ■–■. Copyright © 2023 by the American Society for Surgery of the Hand. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Type of study/level of evidence Therapeutic II.

Key words Michigan hand outcomes questionnaire, PROMS, thumb UCL injury, skier's thumb, surgical repair.

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ULNAR COLLATERAL LIGAMENT (UCL) rupture of the thumb metacarpophalangeal (MP) joint is a common injury in active individuals. The mechanism causing this injury usually is forced abduction and hyperextension of the thumb.^{1,2} A thumb UCL injury can be graded into three categories. The first grade is a minor injury without loss of ligament continuity. The second grade implies a partial ligament tear, and the third grade entails total rupture of the ligament.³ A Stener lesion is characterized by entrapment of the free end of the ligament outside the adductor aponeurosis.⁴ As a result of the instability of the MP joint, the injury can lead to pain and decreased pinch strength.

The indication for thumb UCL surgery is debated. Many surgeons will consider surgery if a patient manifests clinical signs of a complete UCL rupture or if nonsurgical treatment for a partial tear fails. A total rupture is suspected if valgus testing shows $>30^\circ$ of laxity or laxity that is 15° – 20° greater than the uninjured thumb.⁵ According to Ritting et al,⁶ surgery should be considered if valgus testing of the MP joint shows no endpoint. Chuter et al⁷ argue that surgery is the best treatment option in the presence of evident instability, displaced avulsion fractures, or Stener lesions.

To make an informed choice for treatment, surgeons and patients must be aware of the outcomes of surgery. Open surgical treatment of acute UCL rupture has been reported to yield good clinical results, including low pain scores, similar strength to the unoperated thumb, and restored stability.^{8–12} However, these studies do not compare preoperative to postoperative outcome measures. Furthermore, they lack prospectively gathered data and usually report on small samples, as most articles include <35 patients.^{9,10,12} Finally, outcomes of nonsurgical treatment have been compared infrequently to surgical treatment for unstable UCL injuries, and outcomes of delayed surgery have yet to be investigated more thoroughly. Comparable outcomes of acute and delayed surgery may build a stronger foundation for deciding upon initial nonsurgical treatment for acute UCL ruptures.

The first aim of this study was to report prospectively collected patient-reported and clinical outcomes of patients who underwent open thumb UCL repair. The second aim of this study was to find risk factors, primarily injury to treatment time, that are associated with poor patient-reported outcomes among patients treated surgically.

MATERIALS AND METHODS

The ethics committee of our institution approved the study protocol. The institution where patients were treated consists of 22 clinics with 26 surgeons certified by the Federation of European Societies for the Surgery of the Hand and >150 hand therapists.

Patients undergoing open surgical repair for a complete thumb UCL rupture between December 2011 and February 2021 were included. All patients provided written consent for the use of their data.¹³ The data consisted of web-based questionnaires, including the Michigan Hand Outcomes Questionnaire (MHQ) and a questionnaire regarding patient characteristics.¹⁴ The patient-reported outcomes were collected before surgery, and three and 12 months after surgery. Patients who failed to complete the questionnaires at baseline or 12 months after surgery were excluded. Patients received three reminders for each round of questionnaires.

The indication for thumb UCL repair was MP joint valgus testing showing no endpoint as assessed by a hand surgeon. Generally, a hand radiograph was performed to look for avulsion fractures associated with thumb UCL injuries. Some surgeons preferred to perform ultrasonography, and in some instances, ultrasonography was performed at an outside facility to diagnose a ligament rupture. Patients were included if they had a full-thickness rupture, regardless of the presence of a Stener lesion. If no advanced imaging was performed, Stener lesions were diagnosed intraoperatively.

We excluded patients who underwent surgery >6 months after the date of injury. A 6-month post-traumatic time frame was chosen because it was essential to include patients who could report the exact week the trauma occurred and did not show chronic instability without recalling trauma. Another exclusion criterion was prior thumb UCL surgery. To display baseline characteristics, we divided patients into three groups based on injury to surgery time: <3 weeks, 3 weeks–6 weeks, and 6 weeks–6 months.

We adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.¹⁵

Surgical technique

All surgical interventions were performed under regional axillary or supraclavicular blocks and were performed by anesthesiologists who each administered >800 upper-extremity blocks per year. Surgeons chose the most suitable surgical method based on intraoperative findings; the surgical interventions

comprised direct repair and reinsertion with a bone anchor. First, a longitudinal incision over the thumb UCL at the MP joint level was performed. The superficial radial nerve branches were preserved. The adductor aponeurosis was incised, and the MP capsule was mobilized. Capsulotomy was performed, and the injured UCL was identified and repaired. Direct repair was performed when both ends of the UCL were visible and could be mobilized sufficiently. These were repaired by suturing the ends of the ligament together. When the UCL could not be repaired directly, the injured UCL was reattached to the site to which it inserted with a bone anchor (Mitek; JuggerKnot Soft Anchor; Zimmer Biomet). If an avulsed bone fragment was present, it was removed. After repair, the soft tissues were closed in layers.

The postoperative immobilization protocol was standardized for all patients. It consisted of 3–5 days of casting with a plaster-of-Paris cast and six weeks of splinting. Some surgeons chose to immobilize the MP joint by using Kirschner wires (K-wires). The standard time for K-wire removal was six weeks after surgery. Hand therapists started active range of motion exercises of the MP joint seven weeks after surgery. At nine weeks after surgery, patients received strengthening exercises. Postoperative hand therapy was standardized and closely monitored.

Questionnaires

The patients filled out the MHQ, which contains 37 questions based on six scales: overall hand function, activities of daily living, work performance, pain, esthetics, and patient satisfaction with hand function. A scale from 1–5 was used to answer the questions. A total score between zero and 100 was calculated. Higher scores indicate better hand performance.

Patient-reported outcomes

The primary outcome measure was the MHQ total score at three and 12 months after surgery. We also investigated the MHQ function and pain score, which are part of the MHQ total score. Our secondary outcome was the association between the 12-month MHQ total score and variables, such as age, sex, and injury to surgery time. Furthermore, we evaluated the percentage of patients who reached the minimal clinically important difference (MCID) for the MHQ pain and total score at 12 months. The MCID for the MHQ pain and total score are 14 and 21 points, respectively.¹⁶ Finally, we analyzed the return to work in weeks.¹⁷

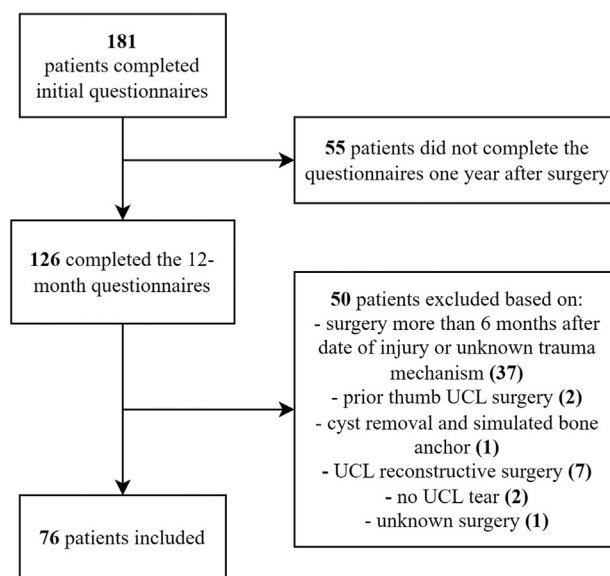


FIGURE 1: Flowchart of the study.

Clinician-reported outcomes

Postoperative MP joint stability was assessed by one of the affiliated hand surgeons using a valgus stress test as part of routine clinical care. Tip and key pinch strength and MP joint range of motion measurements were performed by a hand therapist 12 months after surgery. The MP joint range of motion was defined as the full arc of movement (MP flexion and extension), and the measurement was performed using a goniometer. Tip and key pinch strength were measured using a dynamometer.

Power analysis

An *a priori* power calculation was performed to analyze variance while adjusting for patient characteristics (analysis of covariance). A sample size of 73 patients was needed to find an effect size of 0.15 ($\alpha = 0.05$, power = 0.90) with imputation of six variables.

Statistical analysis

Continuous variables at different time points were compared using a paired *t*-test. Associations between variables and the 12-month MHQ score were analyzed using multivariable linear regression. $P < .05$ was considered significant. We examined baseline characteristics of patients included in the study to verify that these did not differ from the total number of patients who filled out the baseline questionnaires and the total number of patients who filled out the 12-month questionnaires.

TABLE 1. Demographics for Excluded and Included Patients

Demographic Variable	Patients (Baseline Questionnaire)	Patients (12-mo Questionnaire)	Included Patients
Number of patients, N	181	126	76
Treated side, right N (%)	121 (58)	71 (60)	43 (57)
Dominant side, N (%)			
Left	20 (11)	10 (8)	9 (12)
Right	165 (87)	107 (90)	65 (85)
Both	4 (2)	2 (2)	2 (3)
Age (y), mean (SD)	45 (16)	46 (14)	50 (12)
Sex, male N (%)	85 (41)	50 (42)	31 (41)
Occupational intensity, N (%)			
Unpaid labor	43 (21)	21 (18)	14 (18)
Light physical labor	78 (38)	51 (43)	38 (50)
Moderate physical labor	58 (28)	31 (26)	15 (20)
Heavy physical labor	29 (14)	16 (13)	9 (12)
Baseline MHQ Pain Score, mean (SD)	55 (21)	56 (21)	61 (21)
Baseline MHQ Function Score, mean (SD)	67 (21)	69 (20)	71 (22)
Baseline MHQ total score, mean (SD)	63 (15)	64 (14)	65 (15)

RESULTS

A total of 181 complete thumb UCL rupture patients filled out the initial questionnaires. Fifty-five patients were excluded because they did not complete the questionnaires one year after surgery (Fig. 1). We excluded 37 patients because they underwent surgery >6 months after trauma or because their trauma mechanism was unclear. Seventy-six patients who underwent open UCL repair and had not undergone prior UCL surgery completed the questionnaires before surgery and 12 months after surgery and were included in the final analysis. The baseline demographics of the excluded and included patients are shown in Table 1. The baseline demographics of the included patients did not seem to differ notably from the total number of patients who filled out the initial questionnaires and the total number of patients who filled out the 12-month questionnaires.

The average age of the included patients was 50 years (standard deviation [SD] 12). The cohort had 31 males (41%). The demographics of the included patients are shown in Table 2. Eleven patients (14%) were diagnosed with Stener lesions. Avulsion fractures were diagnosed in ten patients (13%). Seventy-three patients underwent UCL reattachment with a bone anchor, and three underwent direct repair. Immobilization with the use of K-wires was performed in 20 patients (26%). Postoperative complications included a broken K-wire,

which was partly removed prematurely, a wound infection requiring K-wire removal and antibiotic treatment, and a painful scar that was treated with a Z-plasty.

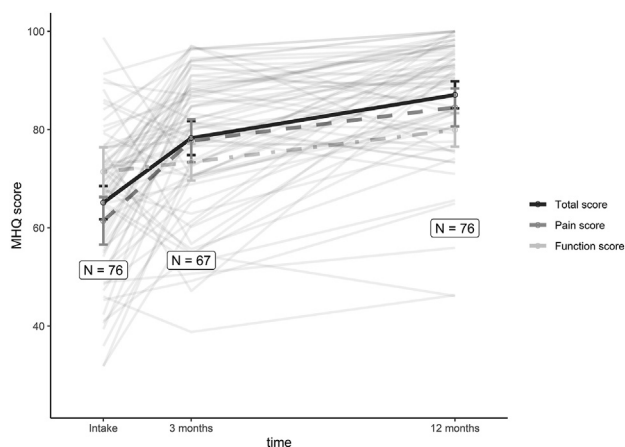
Patient-reported outcomes

From baseline to three months after surgery, patients improved significantly from a mean MHQ total score of 65 (SD 15) to 78 (SD 14; $P < .05$; Fig. 2). The mean MHQ total score from 3–12 months after surgery continued to increase to 87 (SD 12; $P < .05$). The mean MHQ function and pain scores also improved significantly from baseline to three and 12 months (Table 3). The individual MHQ scores show high between-subject variability in baseline scores and change in scores over time. A total of 54% of patients reached the MCID for the MHQ pain score after 12 months, while 68% reached the MCID for the MHQ total score after 12 months. Seventy-two percent of patients rated their satisfaction as “good” or “excellent” (Fig. 3).

Using multivariable linear regression, lower 12-month postoperative MHQ total scores were associated independently with older age (estimate -0.26 , 95% confidence interval [CI], -0.48 ; -0.04); Table 4). The 12-month MHQ total scores of patients who underwent surgery within three weeks after trauma did not differ significantly from the 12-month MHQ total scores of patients who underwent surgery

TABLE 2. Patient Characteristics of the Study Sample (n = 76)

Patient Characteristics	Overall	Surgery <3 wk	Surgery 3 wk–6 wk	Surgery 6 wk–6 mo
Number of patients, N	76	19	21	36
Age (y), mean (SD)	50 (12)	47 (14)	48 (11)	52 (13)
Sex, male N (%)	31 (41)	14 (74)	6 (29)	11 (31)
Treated side, right N (%)	43 (57)	10 (53)	10 (48)	23 (64)
Dominant side, N (%)				
Left	9 (12)	4 (21)	2 (10)	3 (8)
Right	65 (85)	15 (79)	19 (90)	31 (86)
Both	2 (3)	0 (0)	0 (0)	2 (6)
Occupational intensity, N (%)				
Unpaid labor	14 (18)	3 (16)	2 (10)	9 (25)
Light physical labor	38 (50)	13 (68)	11 (52)	14 (39)
Moderate physical labor	15 (20)	3 (16)	5 (24)	7 (19)
Heavy physical labor	9 (12)	0 (0)	3 (14)	6 (17)
Avulsion fracture, N (%)				
Yes	10 (13)	4 (21)	5 (24)	1 (3)
No	66 (87)	15 (79)	16 (76)	35 (97)
Stener lesion, N (%)				
Yes	11 (14)	7 (37)	1 (5)	3 (8)
No	65 (86)	12 (63)	20 (95)	33 (92)
Type of surgical repair, N (%)				
Bone anchor reinsertion	73 (96)	17 (89)	21 (100)	35 (97)
Direct repair	3 (4)	2 (11)	0 (0)	1 (3)
K-wire immobilization, N (%)	20 (26)	6 (32)	6 (29)	8 (22)
Days until K-wire removal, mean (SD)	39 (18)	38 (10)	36 (9)	43 (27)

**FIGURE 2:** Mean MHQ Scores at Baseline and After Thumb UCL Repair.

between three and six weeks (estimate 1.10; 95% CI, -6.51; 8.70) and from patients who underwent surgery between six weeks and six months after trauma (estimate -5.08; 95% CI, -12.05; 1.89). All

other demographics (sex, surgical technique, and K-wire immobilization) were not significantly associated with lower 12-month MHQ total scores in our cohort. The adjusted R^2 of our multivariable linear regression was 0.15. The return to work in this cohort was 4 weeks (95% CI, 2; 7).

Clinician-reported outcomes

Joint stability was assessed by a hand surgeon using a valgus stress test and was restored in all patients. In 20 patients, clinician-reported outcomes were measured as part of routine care 12 months after surgery. The mean MP joint range of motion at intake was 40° (SD 16) and did not differ significantly from the 45° (SD 15) range of motion at 12 months. Tip pinch strength increased significantly from 2.2 kg (SD 1.3) at intake to 4.1 kg (SD 1.6; $P < .05$) at 12 months. Key pinch strength also increased significantly from 3.3 kg (SD 2.0) at intake to 7.2 kg (SD 2.0; $P < .05$) at 12 months.

TABLE 3. Mean MHQ Total, Pain and Function Scores at Baseline and After Thumb UCL Repair

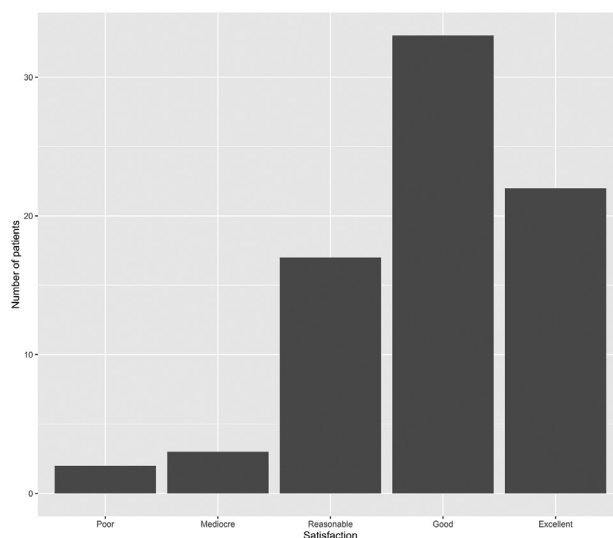
Variables	Baseline	3 mo	12 mo	P Value
Number of patients, N	76	67	76	
MHQ total score, mean (SD)	65 (15)	78 (14)	87 (12)	<.05
MHQ Pain Score, mean (SD)	61 (21)	78 (18)	85 (17)	<.05
MHQ Function Score, mean (SD)	61 (26)	84 (14)	94 (7.3)	<.05

DISCUSSION

This study aimed to report prospectively collected patient-reported and clinical outcomes of 76 patients who underwent open thumb UCL repair. The second purpose of this study was to assess risk factors for lower 12-month postoperative MHQ total scores. We found that patient-reported outcomes improve significantly at three and 12 months after UCL repair of the thumb compared to baseline. Additionally, all patients had restored MP joint stability and did not undergo revision surgery.

Furthermore, we looked at several variables that might influence patient-reported outcomes of thumb UCL repair. We did not find any differences in outcomes between patients who underwent surgery in the acute (<3 weeks after trauma) setting compared to a delayed setting (between three weeks and six months). In contrast to Smith et al,¹⁸ our results suggest that acute repair for full-thickness UCL tears might not always be necessary. This may indicate that in acute thumb UCL ruptures, surgeons may have the option to choose initial nonsurgical treatment. In cases of persistent instability or pain after the immobilization period, surgery can be considered. However, clinical and patient-reported outcomes after nonsurgical treatment for full-thickness tears that are not Stener lesions have been reported infrequently in the literature, meaning that this advice should be interpreted cautiously. We showed that higher age was associated with lower MHQ total scores. Older patients generally have more comorbidities than younger patients, such as osteoarthritis and diabetes.^{19–21} Diabetes can lead to slower soft tissue recovery and a longer duration of symptom.²² As subgroups were small, we did not analyze these comorbidities as risk factors for lower MHQ scores.

We found no significant difference in MHQ total scores of patients who underwent postoperative

**FIGURE 3:** Patient satisfaction after thumb UCL repair.

immobilization using K-wires compared to patients who underwent postoperative casting and splinting only. In this analysis, we controlled for age, sex, surgical technique, and injury to surgery time. After controlling for these factors, we assumed that the main difference between both groups was surgeon preference. This suggests that K-wire immobilization after thumb UCL repair might be unnecessary. In addition, two of the three noted complications were related to K-wires. Postoperative immobilization by casting and splinting alone could reduce treatment costs and might reduce the risk of complications. K-wire immobilization was only performed after UCL reattachment with a bone anchor. Patients who underwent direct repair did not undergo K-wire immobilization. Thumb UCL injuries are reported to be more common in men than women.²³ In contrast, our study sample consisted of more women than men. We did not find an association between lower 12-month MHQ total scores and sex.

Approximately half of the included patients reached the MCID for the MHQ pain score after 12 months. We hypothesize that reaching the MCID for pain is difficult because preoperative pain scores are low, and patients mainly complain of functional disability.

Prospectively gathered patient-reported outcomes after thumb UCL repair are reported infrequently in the current literature. Retrospective studies show that patients generally have good results after thumb UCL surgery, such as low pain scores, similar strength compared to the unoperated thumb, and restored stability. However, many studies were not able to compare these results to the preoperative state. Kozin

TABLE 4. Multivariable Linear Regression Analysis for Risk Factors

Variable	Estimate	95% CI	P Value
Age (y)	-0.26	(-0.48; -0.04)	<.05
Sex	5.64	(-0.16; 11.44)	.06
Surgical technique	6.51	(-6.82; 19.84)	.34
Surgery 3 wk-6 wk	1.10	(-6.51; 8.70)	.78
Surgery 6 wk-6 mo	-5.08	(-12.05; 1.89)	.16
K-wire immobilization	-1.45	(-7.26; 4.36)	.63

et al²⁴ showed that 4/7 patients had no pain, and 3/7 patients had mild pain after thumb UCL surgery using a bone anchor and K-wires. Also, the mean tip pinch strength was 97% (93–100) compared to the unoperated thumb, and stability was restored in all thumbs. Saetta et al²⁵ compared UCL repair with a steel wire to UCL repair with a direct suture. In the direct suture group, 8/9 patients reported no pain. The mean tip pinch strength was 94% (63–100) compared to the unoperated thumb, and stability was restored in all patients. Katolik et al¹¹ compared UCL repair with a bone anchor to UCL repair with a pull-out suture. They found that 30 patients in the bone anchor group could reach 101% (83–117) tip pinch strength compared to the unoperated thumb. They did not report on pain or stability but showed that the average overall satisfaction was 4.9 on a 5-point scale. It is challenging to compare these results to patient-reported outcomes of our study since these studies did not report preoperative outcomes and performed little or no comparative statistical analyses.

A limitation of our study is that only patients deemed eligible for primary repair and patients who filled out baseline and 12-month questionnaires were included. This might have introduced selection bias. We could not find striking differences upon reviewing the baseline demographics of the excluded and included patients. However, we did not have enough power to compare these demographics statistically. The included patients showed gross instability of the MP joint on physical examination. These patients are suspected of having a total thickness ligament tear with or without a Stener lesion. The injured ligament of the included patients was of sufficient quality that reconstruction with an autograft was unnecessary. We cannot comment on clinical outcomes after UCL reconstructive surgery in this study. Furthermore, we included six variables in our multivariable regression that we thought could influence our patient-reported outcomes. Having attained an adjusted R^2 of 0.15,

our analysis indicates the likelihood of additional measurable and immeasurable factors that could affect our patient-reported outcomes. Adding factors, such as hand dominance, occupational intensity, and type of injury (eg, Stener lesions or avulsion fractures), might benefit future multivariable analyses for primary thumb UCL repair. Because of our limited sample size, we were unable to perform a more extensive analysis. Finally, we had a substantial amount of missing data on clinician-reported outcomes at 12 months, such as MP range of motion, tip, and key pinch strength, which we could not correct for. The clinician-reported data are collected at a 12-month postoperative visit. We hypothesize that patients with suboptimal clinical progress are likelier to attend the 12-month postoperative visit than those with better postoperative outcomes. In patients with postoperative clinician-reported data, a significant increase in tip and key pinch strength was observed at 12 months compared to baseline.

The major strength is the prospective nature of data collection and the large sample size. Our results can be used when counseling patients. Patients generally obtain good results by 12 months after surgery, and delay in primary repair does not necessarily result in poor patient-reported outcomes.

Further research should investigate the difference in patient-reported outcomes between operative and nonsurgical management of thumb UCL ruptures.

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