

RESEARCH ARTICLE

Primary Results of Hook Plate Fixation Technique for Ulnar Collateral Ligament Fracture-Avulsion: A Case Study

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Abstract

Background: Ulnar collateral ligament (UCL) fracture-avulsion of the thumb which involves small osseous fragments is among common injuries to the thumb metacarpophalangeal (MCP) joint.

Methods: This case series was conducted on 11 patients (9 males and 2 females) with a mean age of 25.4 ± 4.8 years with acute traumatic UCL fracture-avulsion with instability and Stener Lesion. A low-profile 2-mm stainless steel hook plate with a 2-mm screw was used for the internal fixation. Immobilization was performed for 10 days. Range of motion movements (ROM), grip power, and pinch strength were measured after three months. At the end of the follow-up period, functional outcomes were determined by the visual analog scale (VAS), and Quick Disabilities of the Arm, Shoulder, and Hand (Quick DASH).

Results: The mean follow-up period was reported as 12.4 ± 2.3 months. The union of avulsed small osseous fragments occurred at the end of the three-month follow-up. A number of 10 patients were treated by one hole 2-mm plate with a screw and a mean VAS score of 22.5 ± 2.4 , while a female patient had more severe pain with a mean score of 45. This patient complained about the irritation of the plate, especially in the thumb grip. The mean Quick DASH score was 9.6 ± 1.4 . The postoperative ROM was similar to that of the other side. Grip power and pinch strength were lower in the treated thumb, as compared to that in the opposite side; nonetheless, the difference was not statistically significant.

Conclusion: As evidenced by the obtained results, it can be concluded that the hook plate technique is a strong fixation method for thumb UCL fracture-avulsion, raising the possibility of earlier joint movements and rapid recovery; nevertheless, in some cases, it can reduce efficiency and induce painful grip.

Level of evidence: I

Keywords: Fracture-avulsion, Hook plate fixation, Ulnar collateral ligament, Skier's thumb, Thumb

Introduction

Ulnar collateral ligament (UCL) injuries are among common injuries to the thumb metacarpophalangeal (MCP) joint encountered by sports physicians and orthopedic surgeons (1). These injuries are associated with acute joint trauma or abduction repeating

movements in the MCP joint and caused by a forceful abduction and radial deviation of the thumb MCP joint. The UCL rupture can lead to the weakness of hands, radial deviation of proximal phalangeal, and instability during thumb movement (2, 3). In the absence of proper

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diagnosis and treatments, this ligament injury can result in serious consequences, as well as painful instability and severe weakness in pinch and grip strength in the long term. Finally, progressive osteoarthritis is probable for the patient (1).

The breakage of UCL was firstly described by Campbell in 1955 as a laxity in thumb base in Scottish gamekeepers due to chronic repeating movements in the Valgus strain (2). Acute access valgus strain in the MCP joint can result in three types of injuries, including collateral ligament rupture alone, ulnar volar base fracture-avulsion in proximal phalangeal with or without displacement, or both of them simultaneously (2). In some rare cases, UCL might be healthy and fracture-avulsion involves volar plate (2, 3). There are various therapeutic methods for UCL fracture-avulsion repair. Surgical repair is the golden standard for UCL fracture-avulsion treatment (4).

One of the most common surgical methods is the application of anchor suture, which can make proper fixation. Different anchor methods are a single suture-to-bone anchor and micro anchor (5, 6). Regarding the small size of the fractured fragment, it is not possible to directly fix the fragment with screw and pin, and anchor suture is more proper in such cases (6). Today, the application of hook plate is popular for phalangeal fracture-avulsion fixation and buttressing of the avulsed fragment (7). Hook plate leads to stable fixation and raises the possibility of early movements (7). In this regard, primary studies used the hook plate technique for UCL fracture-avulsion for the first time.

Materials and Methods

This case series presented our primary experience of using hook plate fixation in a patient with UCL fracture-avulsion with instability and five patients with Stener Lesion. Regarding the use of this fixation method in cases of UCL fracture-avulsion, only 11 patients with UCL fracture-avulsion can be treated with this method. The inclusion criteria entailed UCL fracture-avulsion, no previous deformity in hand or thumb, congenital anomaly, instability with Stener Lesion, and consent to participate in the study.

Surgical intervention

In all cases under general anesthesia, the lesion was approached through a standard lazy S dorsoulnar approach centered at the thumb MCP joint. The radial superficial nerve was found and protected. The adductor aponeurosis was incised parallel to the extensor pollicis longus tendon [Figure 1]. The avulsed fragment was identified, and an open reduction of the avulsed fragment was performed. A low-profile 2-mm stainless steel hook plate with one 2-mm screw was used for the internal fixation. The plate was fashioned from a longer 2-mm plate, trimming one and half-hole plate with hook extensions on the proximal side of the plate to wrap around and grasp the avulsed fragment.

The fashioned plate was fixed with one 2-mm screw inserted through the single hole or two holes of the plate [figures 2; 3] (8). By fluoroscopy during the reduction



Figure 1. Intra operation clinical photo in hook plate insertion for UCL fracture-avulsion.

process, the fractured piece was placed and checked by a hook plate in which the reduction process was performed completely anatomic. At the end of the operation in all cases, the reduction was checked by an image intensifier. The rupture in the dorsal capsule was identified and repaired. At surgery, a valgus stress test of the thumb MCP joint was performed and the result demonstrated that the joint was completely stable. A spica thumb cast was applied for 10 days; thereafter, the thumb was protected by a thermoplastic thumb splint for two weeks. After three months, the Visual analog scale (VAS) was

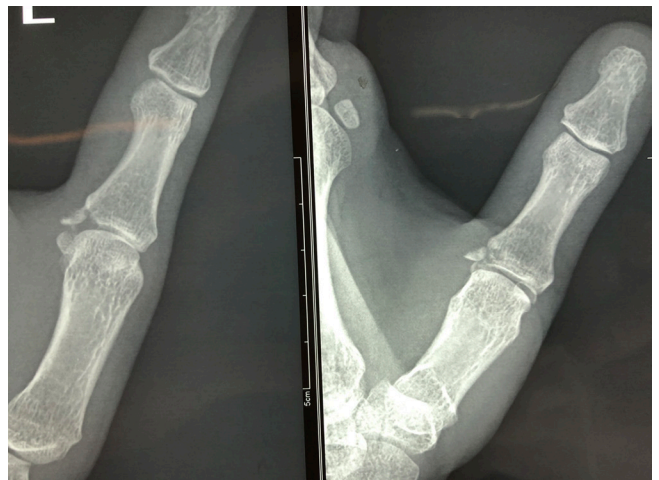


Figure 2. Plain radiography of the left thumb demonstrates the UCL fracture-avulsion lesion.



Figure 3. Radiography indicating UCL fracture-avulsion of thumb and treated by a low-profile 2-mm stainless steel hook plate with a single 2-mm screw.

used to evaluate the severity of pain and patients rated their severity of pain on a scale of 1-100.

Grip and pinch strength of the hands were measured (Sammons Preston, Warrenville, Illinois, United States) and compared for every patient. Range of motion movements (ROM) in the thumb MCP joint was determined and compared with the other side. Functional outcome was determined by Quick Disabilities of the Arm, Shoulder, and Hand (Quick DASH) at the end of the follow-up period. This study was confirmed by the Ethics Shahid Beheshti University of Medical Sciences. All patients received written consent. Statistical analysis was performed in MedCalc statistical software, and the data were presented as Mean±SD with a 95% confidence interval. The T-independent test was employed to compare the quantitative data. A *P-value* less than 0.05 was considered statistically significant.

Results

A total of 11 patients with acute UCL fracture-avulsion, including 9 males and 2 females, with a mean age of 25.4±4.8 years, were enrolled in the present study. The mean follow-up period was reported as 12.4± 2.3 months. The union of avulsed small osseous fragments occurred at the end of a three-month follow-up. There was no infection or hardware failure in the operated site. After three months, all patients had full ROM in the thumb MCP joint. A number of 10 patients were treated by a 2-mm plate with a screw in which mean VAS score was 22.5±2.4. A female patient with right-hand involvement had more severe pain with a mean score of 45. For the referred patient, we used a low-profile 2-mm stainless steel hook plate with one 2-mm screw for the internal fixation [Figure 4]. These patients complained about plate irritation, especially in the thumb grip. The grip power and pinch strength were 22.5 and 6.4 kg, respectively. As illustrated in Table 1, there was restored strength of hands grip and pinch in all patients. Grip power and pinch strength in treated thumb were lower, as compared to those on the opposite side; nonetheless, the difference was not statistically significant. The mean of Quick DASH score was obtained at 9.6±1.4.



Figure 4. Radiography indicating UCL fracture-avulsion of thumb and treated by low-profile 2-mm stainless steel two-hole hook plate with two screws.

Table 1. Clinical findings and functional outcome of patients treated with Hook plate for UCL fracture-avulsion

Variable	mean±SD	<i>P-value</i>
Involved hand		
Right	6 (54.4%)	
left	5 (45.4%)	
Period from injury to date of operation days	7.4±3.2	
Grip power(kg) in treated side	35.1±4.2	0.07
Grip power(kg) in opposite side	38.2±2.3	
Pinch strength (kg) in treated side	8.3±1.2	0.06
Pinch strength (kg) in opposite side	8.9±1.1	
Pain by VAS score	22.5±2.4	

Discussion

Phalanx fracture-avulsion is often associated with the involvement of a small osseous fragment, which is normally attached to a ligament structure and leads to the instability of joint motion (7). To reach satisfying healing in the avulsed part, proper reduction and stable fixation are needed to restore the desirable function of

the joint (7). Partial or complete ruptures of UCL in the thumb metacarpophalangeal joint, accounting for 86% of thumb proximal base, are among disabling injuries that need proper diagnosis and treatment (8, 9).

Surgical repair is the golden standard of treatment. When there is ≤ 2 mm displacement and the avulsed piece is slightly displaced, immobility treatment with a cast is recommended (10). When fracture-avulsion occurs, often the fractured part has rotation which results in the failure of cast-immobility treatment (10). In their study, Dinowitz et al. observed no successful healing in the fractured fragment in cases with a minimal displacement in UCL fracture-avulsion and cast-immobility treatment for six weeks (10). Therefore, surgical repair for fracture-avulsion cases can lead to early initiation of motions and complete stability of the thumb MCP joint (4).

Different techniques have been proposed for thumb UCL injury repairs, including the direct repair of periosteal tissue from the phalanx proximal base of the thumb, transosseous sutures tied over a bone tunnel or over a button on the radial aspect of the MCP joint, and suture anchor (6). Suture anchor which has yielded satisfying results and effective fixation is one of the most common methods of UCL fracture-avulsion (5). Single suture-to-bone anchor by Bavared et al. is another technique which results in proper and reliable fixation of the avulsed fragment (5). There is no need to externally pull out wires or buttons and this is one of the advantages of this technique in which early active movements can be started faster (5). The application of one or two 1.3-mm or 1.5-mm micro Anchors for thumb UCL fracture-avulsion was introduced by Moharram as an efficient, durable, and safe technique (6).

Direct reduction and fixation of fracture-avulsion cases of interphalangeal joints by hook plate is a proper treatment method which raises the possibility of early movements of interphalangeal joints (7). The small osseous fragment can be stabilized by this method (7). There is no experience on the application of hook plate technique in thumb UCL fracture-avulsion in humans and it was not clinically tested. This technique was first compared with the suture anchor method in thumb UCL fracture-avulsion cases in cadaver by Shin et al. in 2016 (11). According to the stated study, hook plate structure fails in significantly higher forces, in comparison with suture structure (11). The average force required for hook plate failure is 58 N, while this value is 27 N for suture anchors. From a biomechanical point of view, hook plate had higher stability for UCL fracture-avulsion,

as compared to suture anchor (11).

Regarding similar results for other cases of fracture-avulsion in interphalangeal joints of fingers, Kang et al. reported desirable clinical results regarding internal fixation by hook plate (7). In our first experience, the application of hook plate for thumb UCL fracture-avulsion resulted in proper healing and complete stability in the MCP joint of the thumb with a quick return to primary activity in a 20-year-old female (9). In this case series, patients who were treated by a low-profile 2-mm stainless steel hook plate with one 2-mm screw demonstrated similar results. Nonetheless, one case had more severe pain with plate irritation and decreased ability to function. Finally, pinch ability, as well as a complete range of motion of the joint, was completely restored. It seems that it can cause discomfort in the long term in lean people with low soft tissue. In a recent study by Lee et al., a similar mini hook plate fixation technique induced stable fixation and showed good clinical and radiologic outcomes in an avulsion fracture of thumb; however, no complication was observed (12).

As evidenced by the obtained results, it can be concluded that the hook plate technique is a strong fixation method for thumb UCL fracture-avulsion, raising the possibility of earlier joint movements and rapid recovery; nevertheless, in some cases, it can reduce efficiency and induce painful grip.

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Conflicts of Interest: The authors declare that they have no conflict of interest.

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