

Excision of Hook of Hamate Fractures in Elite Baseball Players

Surgical Technique and Return to Play

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Background: Hook of hamate fractures are relatively common in baseball players, but the proper diagnosis and surgical technique can be challenging. Outcomes after surgical excision, as well as optimal surgical technique, in elite baseball players have not been clearly established.

Hypothesis: Excision of hook of hamate fractures with a technique tailored to elite professional and collegiate baseball players will lead to high rates of return to play within a short time.

Study Design: Case series; Level of evidence, 4.

Methods: We reviewed the cases of 42 elite athletes who underwent surgical excision of 42 hook of hamate fractures at a single academic hand surgery practice from 2006 to 2020. The athletes competed at the professional (n = 20) or varsity collegiate (n = 22) baseball levels and were treated using the same surgical technique tailored toward the elite athlete. The clinical history, timing of surgery, complications, and time to return to play were recorded for each patient.

Results: All 42 patients underwent an excision of their hook of hamate fracture at a mean of 7.2 weeks (range, 0.5-52 weeks) from the onset of symptoms. All but one patient were able to return to full preinjury level of baseball participation within 6 weeks from the date of surgery, with a mean return to sport of 5.4 weeks (range, 3-8 weeks). Two patients returned to the operating room—1 for scar tissue formation causing ulnar nerve compression and 1 for residual bone fragment causing pain and ulnar nerve compression.

Conclusion: Surgical excision of hook of hamate fractures in elite baseball players showed a very high rate of return to play within 6 weeks. Meticulous adherence to the described surgical technique tailored to athletes optimizes clinical outcomes and avoids complications.

Keywords: hook of hamate; fracture; excision; baseball, batter

Hook of hamate fractures are relatively rare wrist injuries in the general population, comprising an estimated 2% to 4% of carpal bone fractures.^{3,15,19} However, hook of hamate fractures are seen more commonly in elite athletes, particularly those participating in sports that utilize a bat, stick, club, or racket, such as baseball, hockey, golf, or tennis.¹⁹ These fractures are caused by compressive and/or shear forces applied to the hypothenar eminence of the hand overlying the hamate hook. These injuries can lead to significant morbidity and greatly affect athletic performance. Delay in diagnosis and treatment is common² and can lead to chronic ulnar hand pain, attritional rupture of the ulnar digital flexor tendons,^{14,16,26} or terminal ulnar nerve motor

or sensory deficits because of the proximity of the ulnar nerve and flexor tendons to the fracture site.¹¹

Given the inconsistent results seen with nonoperative measures and that high-level athletes typically desire a rapid return to play, techniques for surgical interventions have been developed in this population; namely, open reduction and internal fixation (ORIF)^{18,20,21} or excision of the fracture fragment. Surgeons who care for elite athletes have come to favor early excision of hook of hamate fractures.^{1,6,8,12} However, published series have generally been modest in size and report mixed cohorts of recreational and higher-level athletes who participate in a variety of sports. Published techniques of hook of hamate excision have not focused on athletes and may be more extensible than is desired in this population.^{5,24}

The current study represents a large uniform cohort of elite baseball players competing at professional or varsity collegiate levels treated with the same specialized surgical

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Figure 1. Skin incision for hook of hamate excision. Characteristic location of the callus over the hook of hamate, marked by dots.

technique and similar rehabilitation protocol. The purpose of this study was to outline steps to the surgical technique that are critical to successful excision of a hook of hamate fracture in an elite athlete and to report the rate of return to play after the procedure. Our hypothesis was that excision of hook of hamate fractures in elite professional and collegiate baseball players with a tailored technique would lead to high rates of return to play within a short time.

METHODS

After obtaining institutional review board approval, a retrospective review was performed at a single academic hand surgical practice of patients treated for a hook of hamate fracture. All patients underwent hook of hamate excision by fellowship-trained orthopaedic hand surgeons (M.D.L., D.E.R., M.R.B.) between June 2006 and August 2020 using the same surgical technique that was tailored toward the elite athlete. Patients were included if they satisfied the following criteria: (1) elite baseball player, defined as

professional or varsity collegiate; (2) hook of hamate fracture diagnosis confirmed by computed tomography (CT) or magnetic resonance imaging (MRI) scan; (3) hook of hamate fracture sustained while playing baseball; and (4) patient underwent surgical excision. Their medical records were queried for the following information: patient characteristics, hand dominance, clinical presentation, injury mechanism, time from injury to surgical treatment, time from surgery to return to play, and complications.

Surgical Technique

The operative upper extremity was prepared and draped in standard sterile fashion. The arm was exsanguinated, and a tourniquet was inflated. A gentle curvilinear incision was made over Guyon's canal and through any hypothenar callosity (Figure 1). It should not be made around the callus, which may compromise the approach.

The subcutaneous tissue was carefully mobilized, obtaining hemostasis. Dissection was carried down to identify the palmaris brevis muscle. The muscle was divided at the

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Ethical approval for this study was obtained from Partners Healthcare Human Research Committee (protocol No. 2017P002767/PHS).

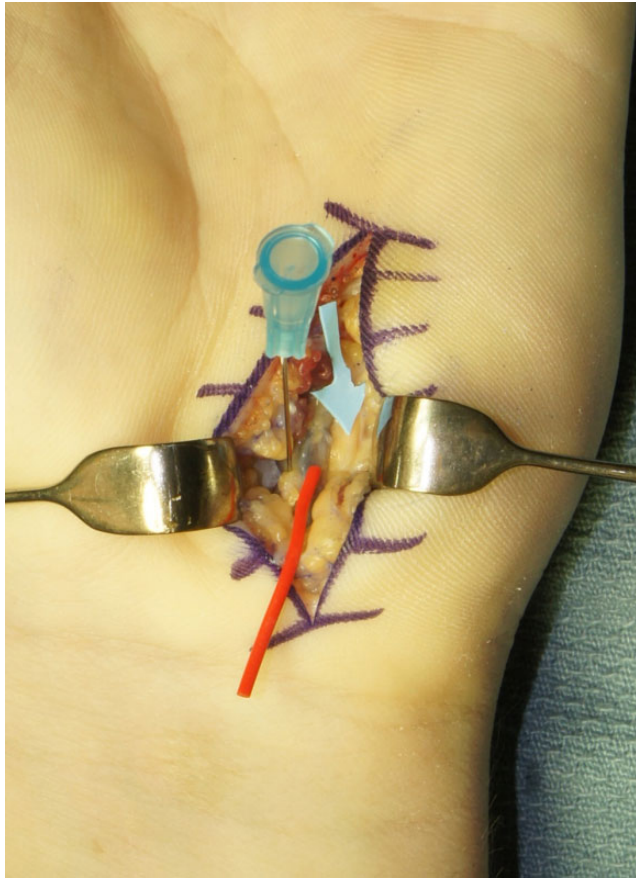


Figure 2. Ulnar artery (red vessel loop) and superficial sensory branch of the ulnar nerve (blue arrow) coursing over, and slightly ulnar to, the apex of the hook of hamate (needle).

fascial junction along its most radial edge and carefully elevated off Guyon's canal.

The ulnar artery and superficial sensory branch of the ulnar nerve were identified passing through Guyon's canal and coursing toward and over the apex of the hook of hamate (Figure 2). The artery was carefully separated from the nerve. A common misconception is that Guyon's canal and the neurovascular bundle are beneath the hook; in reality they sit atop and slightly ulnar to the hook. The artery is typically more superficial than the nerve. The palmar cutaneous branch of the ulnar nerve at the distal aspect of the incision was identified and protected throughout.

Of note, patients with terminal ulnar nerve symptoms can undergo decompression of the ulnar nerve at the wrist: once the ulnar neurovascular bundle is visualized, the volar carpal ligament is released proximally. The antebrachial fascia at the distal wrist flexion crease is incised, protecting the ulnar neurovascular bundle beneath it to complete the proximal release.

Crucially, the surgeon must recognize that the superficial sensory branch of the ulnar nerve (which includes the common digital sensory nerve to the fourth webspace and the ulnar digital nerve proper to the small finger) is the

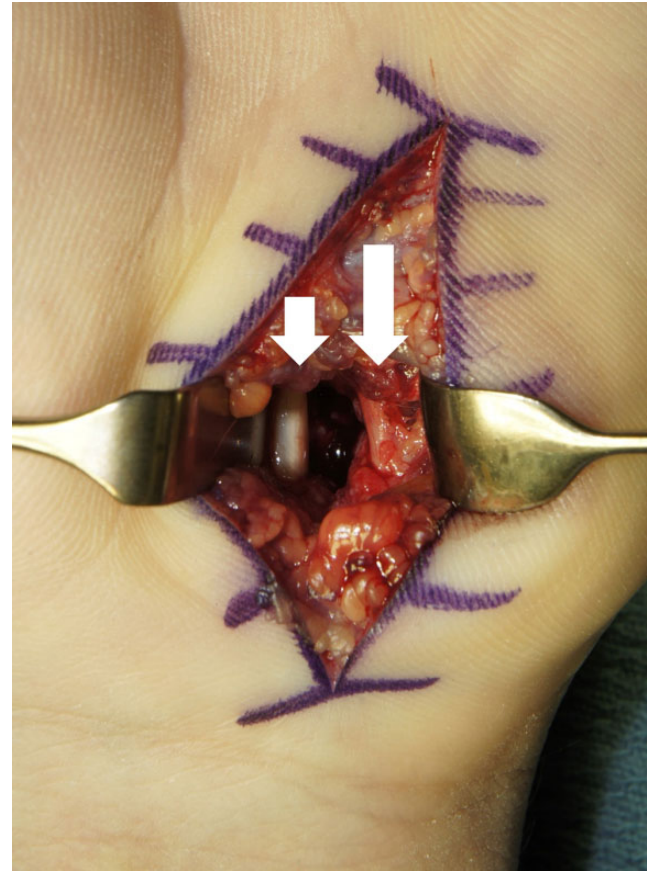


Figure 3. The deep motor branch (long arrow) is seen once the superficial sensory branch and ulnar artery (held in the right retractor) are moved ulnarward. The hook of hamate has been excised. The ulnar-most flexor tendons (short arrow) are seen.

branch visible superficially at the apex of the hook of hamate. The deep motor branch splits off before the hook, diving deep along the ulnar aspect of the hook (Figure 3). Therefore, protecting the sensory branch is not sufficient; the surgeon must identify the deep branch as well.

The sensory branch of the ulnar nerve was identified and carefully mobilized ulnarward. The fibrous arch at the proximal portion of the origin of the hypothenar musculature was identified, with the proximal takeoff of the deep motor branch of the ulnar nerve passing just beneath (Figure 3). The fibrous arch of the hypothenar musculature was carefully released along the proximal ulnar border of the hook of hamate. This decompression allows the deep ulnar motor branch to be gently retracted ulnarward, away from the distal edge of the hook of hamate. Retractors were used meticulously to gently protect the sensory and motor branches of the ulnar nerve as well as the ulnar artery throughout the case, making sure to allow the nerves and the artery to rest periodically.

The soft tissue and periosteum were carefully elevated subperiosteally off the hook of hamate using a beaver blade. Critically, great care must be taken at the distal ulnar



Figure 4. Excised hook of hamate.

aspect of the base of the hamate, where the deep motor branch is closest to the hamate. This must not be injured during exposure of the hook. On the radial side of the hook are the flexor tendons in the carpal tunnel, which should be protected. The fracture can then be visualized, usually at the base of the hook of hamate.

A fine rongeur may remove the hook of hamate in acute injuries (Figure 4). In chronic settings, a hand osteotome may be needed to carefully osteotomize the hook of hamate at its base. A rongeur and rasp are used to smooth out the base of the hook of hamate. Bone wax can be applied to the cancellous surface to minimize bleeding. The wound is irrigated with normal saline.

The ulnar nerve motor and sensory branches as well as the ulnar artery were carefully inspected to verify that no injury has occurred. The periosteum and palmaris brevis were then closed with a No. 4-0 buried, undyed, polydioxanone suture. The skin was closed with a No. 5-0 nylon suture. The tourniquet was let down, and the fingers were checked to ensure they became pink in color. A dry sterile dressing was applied with a neutral volar resting wrist splint.

Postoperatively, all patients followed a progressive rehabilitation protocol tailored to their individual improvement. The generalized protocol template was as follows:

- Week 1: Plaster splint. Rest, ice, shoulder/elbow passive range of motion (ROM), and lower body stretching program. Incision check at the end of the week.
- Week 2: Discontinue splint. Begin light wrist/fingers ROM, shoulder ROM, shoulder strengthening program, conditioning program (keep incision dry), and lower body workout (no gripping). Remove sutures at end of week 2 if incision is well-healed.

- Week 3: Initiate throwing program with someone else catching in nonthrowing hand, full wrist/finger ROM, begin light wrist/forearm strengthening program, massage scar, initiate light dry swings, begin light upper body workout, heat (whirlpool if incision is closed), modalities as needed, continue lower body workout (no gripping), ice after workouts, and conditioning.
- Week 4: Begin light catch (extra padding in glove as needed), continue dry swing program, initiate the Tee Program (if no pain with dry swings), progress light upper body workout, continue hand/wrist strengthening and ROM, modalities as needed, continue lower body workout (gripping exercises as tolerated), and conditioning.
- Week 5: Continue the Tee Program, initiate the soft toss program if no pain with tee work, progress throwing/catching program (use padding as needed), progress hand/wrist strengthening/ROM, upper body workout, modalities as needed, progress upper/lower body workouts, and conditioning.
- Week 6: Continue the Tee Program, continue the soft toss program, initiate batting practice if no pain with tee or soft toss, initiate fielding drills, modalities as needed, maintain full ROM, full upper and lower body workouts, and full conditioning program. Initiate game activities by the end of the week if/when appropriate (no pain with palpation or workouts or sport activities).
- Week 7 and beyond: Return to sport program, continue conditioning/strengthening, and modalities as needed.³²

RESULTS

A cohort of 42 patients with 42 hook of hamate fractures was identified. There were 20 professional players and 22 collegiate players. All of the patients were men, with a mean age of 20.2 years at the time of surgery (range, 17-25 years). Thirty-two of the players batted right-handed and 10 batted left-handed; 6 of the left-handed batters were right-hand dominant. All patients sustained a hook of hamate fracture on the bottom-positioned hand when gripping a bat.

A total of 17 patients had acute pain in their wrist while batting, whether from a hit, a foul ball, or from a swing and a miss. Seven patients had acute-on-chronic pain, with up to a year of pain before the inciting event. The remaining 18 players reported an insidious onset of pain with batting but could not recall a specific swing or event that caused the injury. None of the patients presented with significant terminal ulnar nerve signs or symptoms.

All patients underwent an excision of their hook of hamate fracture using the aforementioned surgical technique at a mean of 7.2 weeks (range 0.5-52 weeks) from the onset of symptoms. The median time from symptoms to surgery was 2 weeks; there were 5 patients who had surgery at 20 weeks or more.

All patients were able to return to full preinjury level of participation in their sport. For those patients whose timing data were available, all patients except 1 returned to

play with live batting within 6 weeks from the date of surgery at a mean of 5.4 weeks (range 3-8 weeks). The 1 patient returning at 3 weeks did so ahead of the rehabilitation protocol and by his surgeon's recommendation, although he was throwing, catching, and batting without later complication.

Two patients in the series had undergone an ipsilateral hook of hamate excision previously at an outside hospital. One patient was 1 year out from the prior excision, and MRI could not differentiate whether this was regrowth of the hook or a new fracture of the remaining hook. The other patient was 4 years out from the prior procedure, and CT showed reformation of the entirety of the hook of hamate with a discrete acute-on-chronic fracture line. Both did well after their revision procedures.

Two different patients in the series returned to the operating room after the index procedure. One patient was found to have scar tissue formation causing pain and ulnar nerve compression symptoms and underwent revision surgery 5 months from the index procedure. The second patient had complete symptom relief and returned to play after the index procedure; however, 5 months later, he had pain and ulnar nerve compression symptoms. A 3 × 3-mm residual bony fragment was removed. Neither of the patients had further complications and returned to full play after their second surgical procedure.

DISCUSSION

Our primary finding was that surgical excision of hook of hamate fractures in elite baseball players with a surgical technique tailored to athletes showed a very high rate of return to play within 6 weeks, with a mean return to sport of 5.4 weeks. There were low reoperation and complication rates.

Hook of hamate fractures have been well-described in the literature. However, the anatomy can make it a challenging injury to diagnose and treat, particularly in the elite athlete with associated high demands and pressures to return to a high level of play quickly. Mastery of the anatomy is essential to a successful surgical approach to the hook of hamate. Although lateral¹⁷ and variations of volar^{5,24} surgical approaches have been recommended, we find the volar approach as we describe, with painstaking care to identify and protect the deep motor branch of the ulnar nerve and mindfulness of the size of the incision, to be the most appropriate and reliable.

Numerous management strategies have been developed for hook of hamate fractures. Older small studies of immobilization alone showed mixed results, with 17% to 88% of patients healing without symptoms, otherwise resulting in a symptomatic nonunion.^{22,25} Fujioka et al¹⁰ reported complete clinical and radiographic healing of 2 hook of hamate fracture nonunions treated with ultrasonography 20 minutes a day for 4 months.

Authors advocating fixation emphasize the benefit of the pulley effect of the retained hook of hamate on the small-finger flexor tendons. A cadaveric study showed biomechanical advantages of the hamulus for flexor tendon

function,⁷ and a clinical review suggested that ORIF of the hook of hamate fracture provides superior grip strength to excision.²³ Other studies, however, show no limitations in grip strength or athletic activity after excision.^{8,20} Multiple authors have reported favorable results of ORIF for hook of hamate fractures or nonunions^{18,20,21}; however, a definitive advantage over excision has not been borne out in the literature. The risks of nonunion, hardware failure, or persistent irritation by the hook of hamate, alongside the need to delay return to sport for bony healing, turn many surgeons toward excision.^{1,8}

The outcomes for hook of hamate fracture excision in elite baseball players reported in the present study are consistent with the literature, which supports strong clinical results and fast return to play. A recent database review of 261 Major League Baseball players showed that 81% of players return to the same or higher level of play at a mean of 48 days.⁹ Usage increased postoperatively, but batting statistics slightly declined. A similar study found that the wins-above-replacement statistic was unchanged in athletes from pre- to postoperatively.¹³ Prior smaller studies of baseball players, including high school athletes, found fast return to play of median 5 to 6 weeks, with most all athletes returning.^{1,4,8} Complication rates in hook of hamate excision have varied from 0% to 25%, with by far the most common complication being transient ulnar nerve paresthesias.^{2,24} We found no complications in our cohort, although patients may underreport transient paresthesias.

Regarding the surgical technique, we believe that the technique we have described is optimal in elite athletes, striking the balance between adequate visualization of vital neurovascular structures alongside a limited incision and dissection to allow for the fastest possible return to play. While a minimally invasive approach is not appropriate given the risk of neurovascular or tendon injury, we believe that an approach that consistently spans the wrist crease, widely dissects through the carpal tunnel, or decompresses the ulnar nerve is not necessary.^{1,5,24} These techniques previously described in the literature have not focused on the athlete and their associated high demand on the hand and desired rapid return to play. In the elite athlete, minimizing the size of the incision and dissection is beneficial to the length of recovery.

Our study population is similar to prior populations in the prevalence of nondominant hand injuries and the mix of acute, acute-on-chronic, and chronic presentations. Although the presence of an associated preoperative ulnar neuropathy is commonly reported in prior studies,^{1,11} none of the patients in the current series had overt ulnar nerve symptoms or signs identified during their preoperative evaluation.

The current study adds to the literature as a relatively large series of 42 elite baseball players—a focused population. Limitations include the inherent imprecision of a retrospective review, including occasional incomplete data in follow-up documentation. This can be exacerbated by the nature of working with elite athletes, as follow-up may be more informal on the sidelines or through their team facilities. Because of their time commitment to their sport, they often avoid formal follow-up unless there are any

complications. Other limitations are the lack of patient-reported outcomes measures or quantitative physical examination findings, which could not be obtained.

CONCLUSION

Surgical excision of hook of hamate fractures is a reliable option in elite baseball players with acute or chronic pain who have either failed nonoperative treatment or have a need for rapid return to play. Although the potential risks of the procedure are not trivial, meticulous adherence to the described surgical technique tailored to athletes optimizes clinical outcomes and avoids complications.

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