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Fractures of the Hamate: A Narrative Review on Diagnosis and Management Strategies

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Abstract

Hamate fractures, although rare, present significant diagnostic and management challenges, particularly when involving the hook of the hamate, commonly seen in athletes and labourers. This narrative review explores the epidemiology, clinical presentation, imaging modalities, and treatment strategies for hamate fractures. Despite accounting for only 2-4% of all carpal fractures, delayed or missed diagnoses can lead to complications such as non-union, ulnar nerve compression, and chronic pain. Clinical examination, including specific manoeuvers like the pull test, can aid in early detection, while computed tomography (CT) is the gold standard for accurate diagnosis. Non-operative treatment, including immobilization, is reserved for stable, non-displaced fractures, while displaced fractures, fractures of the hamate body, or those with complications such as non-union often require surgical intervention. Hook excision and open reduction with internal fixation (ORIF) are the most commonly performed surgical procedures. Rehabilitation plays a crucial role in functional recovery, with early mobilization recommended once the fracture heals. With advancements in diagnostic and surgical techniques, outcomes following hamate fractures are generally favourable, allowing patients to return to daily activities and athletic pursuits with minimal long-term sequelae. Further research into tailored treatment protocols and rehabilitation strategies could further enhance patient outcomes.

Keywords (MeSH): Carpal Fractures, Diagnosis, Hamate Fractures, Surgical Treatment, Rehabilitation

INTRODUCTION

Hamate fractures, though uncommon, are challenging to diagnose due to subtle symptoms and complex anatomy. They are often overlooked, leading to complications like chronic pain, impaired hand function, non-union, and ulnar nerve irritation. Despite its small size and hidden position, the hamate plays a key role in wrist and hand movement.

Its location and geometry make it prone to missed diagnoses, especially with standard X-rays, which may not clearly show the fracture due to

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overlapping bones. CT scans are often needed for accurate identification, particularly for hook fractures, which are common in athletes and labourers following repetitive or acute trauma.

While hook fractures often result from sports related trauma, hamate body fractures are typically linked to high-energy injuries, such as vehicular accidents or falls. These injuries may involve damage to surrounding ligaments, tendons, or adjacent carpal bones, complicating diagnosis and treatment.

This narrative review aims to provide a comprehensive overview of the current understanding of hamate fractures, focusing on the complexities of their diagnosis, treatment, and management. The review highlights both conservative and surgical treatment strategies and explores the potential complications that may arise from these fractures. Additionally, the rehabilitation protocols necessary to restore function and promote optimal recovery will be discussed.

METHODS

Epidemiology

Hamate fractures, though rare, account for approximately 2-4% of all carpal fractures, with hook fractures being the most commonly encountered.[1,2] Despite their infrequency, these injuries can have serious consequences if not promptly diagnosed and managed. Within this small subset of wrist fractures, hook fractures of the hamate are prevalent, particularly in individuals who participate in activities that place repetitive stress on the ulnar side of the wrist, including athletes involved in high-impact or repetitive sports such as golf, baseball, and racket sports.[1,2] The mechanism of injury in these cases typically involves either repetitive stress or acute trauma, which can result in significant ulnar-sided wrist pain and functional limitations.

Hamate hook fractures can also occur due to an acute, forceful impact to the ulnar side of the wrist, such as during a fall, collision, or direct blow.[3,4] In these situations, the hook of the hamate can fracture due to the concentrated force applied to this small structure. In contrast, fractures of the hamate body are much less common and are generally associated with more severe, high-energy trauma. These types of fractures often result from events such as motor vehicle accidents, falls from significant heights, or direct blows to the wrist.[3,4] The forces involved in these injuries are typically much greater than those that cause hook fractures, leading to more extensive damage to the wrist structures. In some cases, body fractures of the hamate may be accompanied by injuries to adjacent carpal bones, ligaments, or tendons, further complicating the clinical picture and necessitating more comprehensive treatment strategies.

Delays in treatment, whether due to a missed diagnosis or inadequate management, can lead to complications such as non-union, where the fractured bone fails to heal properly.[5] Non-union is particularly concerning as it can result in chronic pain, reduced grip strength, and functional impairment, which may be especially debilitating for high-functioning individuals such as athletes. Chronic pain and instability in the wrist can severely impact an athlete’s performance, leading to prolonged periods away from their sport and, in some cases, permanent functional deficits.

Even outside of the athletic population, individuals who sustain hamate fractures face the risk of long-term disability if their injuries are not appropriately addressed. The potential for chronic pain, limited range of motion, and difficulty with everyday tasks highlights the importance of early and accurate diagnosis.

Clinical Presentation

Patients with hamate fractures commonly present with pain localised to the ulnar side of the wrist, which is a significant hallmark of this injury. This pain often intensifies with specific wrist movements, particularly gripping or rotational motions of the hand and wrist, such as turning a door handle or using a golf club.[6] Ulnar-sided wrist pain from hamate fractures may be constant or worsen with pressure on the wrist, a key sign that warrants investigation for hamate involvement.

In hook fractures, tenderness is usually felt in the palm or hypothenar region, near the base of the little finger. This tenderness can increase with palpation or specific tests, such as the “pull test,” where resisting a pulling force on the fingers reproduces the pain, indicating stress on the fractured hook.[7] This test is considered a reliable clinical tool for identifying hook fractures in the absence of clear imaging evidence, as the pain provoked during this manoeuvre can directly localise the injury.

Patients with hamate body fractures often present with diffuse pain and swelling, making diagnosis harder. Swelling in the hand or wrist, along with limited motion, can mimic other injuries like ligament sprains or nearby bone fractures, sometimes leading to misdiagnosis. They may also report pain during wrist movement or load-bearing and a sense of instability in the wrist.[8]

Carpal instability is a concern with body fractures since the hamate supports the carpal bones. Disruption can cause abnormal wrist movements and reduced function, often presenting as a "clunking" sensation or weakness when gripping. Recognizing these subtle signs early is critical to avoid more invasive treatment later.

Diagnosing hamate fractures can be difficult due to nonspecific symptoms, often leading to misdiagnosis as sprains or strains. Without clinical suspicion, particularly in patients with trauma or repetitive wrist use, diagnosis may be delayed, increasing the risk of complications like nonunion or chronic pain.The difficulty in visualizing hamate fractures on standard X-rays can also contribute to misdiagnosis. Persistent ulnar-sided wrist pain, especially worsened by gripping or twisting, should prompt further imaging with CT or MRI to confirm the diagnosis and guide treatment.[6-8]

Imaging and Diagnosis

Imaging includes a combination of posteroanterior (PA), lateral, and oblique wrist radiographs. These standard views provide a general overview of the carpal bones but are not always sufficient for detecting fractures of the hook of the hamate. Given its anatomical location and curvature, the hook is particularly prone to being missed on these routine views. Its small size and the presence of surrounding carpal bones can create overlapping shadows, further complicating the radiographic evaluation.[9] Therefore, despite the initial use of these standard views, their limitations often require the use of more specialised imaging techniques when a hamate fracture is suspected.

One such technique is the carpal tunnel view, a specialised radiographic projection designed to improve visualisation of the hook of the hamate. By positioning the hand in a specific manner, this view provides a clearer image of the hook and can increase the likelihood of detecting fractures that might be missed on the standard PA or lateral views. While this technique is useful, it still has its limitations, particularly in cases where the fracture is non-displaced or where there is minimal disruption to the surrounding bone. As a result, even the carpal tunnel view may fail to identify subtle or early-stage fractures, necessitating further imaging to confirm the diagnosis.

When initial X-rays are inconclusive, CT is the gold standard for diagnosing hamate fractures. CT provides superior detail, revealing fracture lines, displacement, and subtle bone changes that X-rays may miss. Its cross-sectional images allow for viewing the hamate from multiple angles, making it especially useful for detecting small or hairline fractures of the hook.[10] CT is valuable when multiple carpal bones are involved, providing detailed information on alignment and integrity, essential for treatment decisions. It also assesses fracture displacement and angulation, guiding surgery if needed or confirming stability for conservative treatment in non-displaced cases.

MRI is useful for evaluating ligament or soft tissue damage, especially in high-energy trauma. It helps identify injuries like ligament tears or tendon damage and detects complications such as non-union, which can lead to chronic pain and instability.[11] Non-union is more frequent in hook fractures, especially if diagnosis is delayed or treatment is missed. MRI also assesses blood supply to the fracture, helping predict healing and identify areas at risk for non-union. In surgical cases, MRI can detect soft tissue complications like tendon entrapment or nerve involvement, guiding treatment.

MANAGEMENT STRATEGIES

Non-operative Treatment

For stable, non-displaced fractures of the hamate hook, conservative management remains the first-line treatment approach. These types of fractures are characterised by their lack of significant displacement, meaning that the bone fragments remain in close alignment despite the fracture. Conservative management typically involves immobilisation using a short-arm cast or splint, which is applied for a period of four to six weeks. The goal of immobilisation is to allow the bone to heal naturally by minimising movement at the fracture site and reducing stress on the wrist.[12] During this period, the patient is advised to refrain from activities that place undue stress on the wrist, such as gripping, lifting, or repetitive hand movements. These actions can increase the risk of aggravating the fracture or delaying the healing process. Activities that involve significant ulnar deviation or forceful wrist extension are particularly risky and should be avoided.

Clinical follow-up is essential to monitor the healing progression and prevent complications such as nonunion, where the fracture fails to heal properly. Follow-up appointments typically include clinical examinations to assess pain levels and functional improvements, as well as periodic radiographic evaluations to confirm that the fracture is healing as expected. Regular X-rays allow clinicians to check for any signs of displacement, delayed healing, or other complications. In cases where healing progresses well, patients can expect to transition out of the cast or splint after the recommended immobilisation period, gradually resuming normal activities with a focus on avoiding repetitive stress on the wrist.

Conservative treatment is particularly effective for stable fractures, where the alignment of the bone fragments remains intact, allowing for natural healing. In most cases, this approach allows patients to achieve full recovery with no long-term sequelae. Studies have shown that with appropriate management, patients typically regain normal wrist function and experience no significant complications.[13] Moreover, for individuals who engage in activities that do not require excessive wrist strain, conservative treatment provides an effective solution that minimises the need for surgical intervention. However, close monitoring is required, as even stable fractures can occasionally develop complications, particularly if the patient inadvertently places stress on the wrist during the healing period. If symptoms such as increased pain or swelling arise, a reassessment may be necessary to rule out potential issues such as non-union or displacement.[14]

Surgical Treatment

Surgical intervention becomes necessary in cases of displaced fractures, fractures involving the hamate body, or in situations where non-union or other complications have developed. Displaced fractures, where the bone fragments have shifted out of alignment, are unlikely to heal properly without surgical correction. In these cases, surgery is required to restore the normal anatomical structure of the bone and ensure proper wrist function.

For hook fractures, the most common surgical procedure is excision of the fractured hook. This technique involves removing the fractured portion of the hook to alleviate pain and prevent further complications, such as ulnar nerve irritation. Ulnar nerve compression can occur when the fractured hook impinges on the nerve, leading to sensory and motor deficits in the hand. By excising the fractured hook, the source of nerve irritation is eliminated, allowing for relief of symptoms and a faster recovery. This procedure is particularly beneficial for athletes, as it relieves pain and mitigates the risk of long-term functional impairment.[15] In sports involving repetitive wrist motions, such as golf or tennis, even minor impairments in wrist mobility can significantly impact performance. Therefore, excision of the hook is often the preferred treatment for athletes who require a quick return to activity.

Studies have shown that hook excision yields excellent functional outcomes, with most patients experiencing minimal to no impact on grip strength or wrist mobility. Following the procedure, patients typically undergo a period of rehabilitation to restore wrist strength and range of motion, after which they are able to return to their pre-injury level of activity. For athletes, this means resuming their sport without significant limitations or pain. Long-term follow-up studies indicate that patients who undergo hook excision are able to maintain full wrist function, with low rates of recurrence or further complications.[16]

In contrast, fractures of the hamate body often require a more invasive approach, such as open reduction and internal fixation (ORIF). This procedure is performed to restore the alignment of the bone and ensure the stability of the carpal arch, which is critical for maintaining wrist function. Hamate body fractures tend to be more complex than hook fractures, often involving displacement or instability that can compromise the overall integrity of the wrist. In these cases, ORIF involves surgically realigning the bone fragments and securing them in place with plates or screws to facilitate proper healing.[17]

ORIF is particularly important in cases where there is carpal instability, as the hamate plays a crucial role in maintaining the structural integrity of the carpal bones. If left untreated, hamate body fractures can lead to long-term complications, such as chronic wrist pain, reduced grip strength, and functional limitations. Surgical intervention not only restores the anatomical structure but also preserves the overall function of the wrist, allowing for a better long-term prognosis. Postoperatively, patients typically undergo a structured rehabilitation programme to regain strength and mobility, with a gradual return to full activity.

COMPLICATIONS

Complications arising from hamate fractures can be significant and, if not properly addressed, may lead to long-term dysfunction. Non-union is one of the most common complications associated with hamate fractures, particularly when there is a delay in diagnosis or inadequate immobilisation during treatment. Non-union occurs when the fractured bone fails to heal correctly, leaving the bone fragments separated or poorly fused. This condition is more likely to develop if the fracture remains undiagnosed or improperly stabilised in the early stages, allowing the bone to shift or remain mobile, which hinders the healing process. The consequences of non-union include chronic pain, often exacerbated by wrist movement, and a loss of grip strength. This can have a profound effect on daily activities, especially in individuals who rely heavily on hand function, such as athletes or manual labourers. Non-union can also lead to long-term functional limitations, as the inability of the bone to properly heal may result in a permanent reduction in the wrist's range of motion and overall strength.[18]

In addition to non-union, ulnar nerve compression is a notable complication, particularly in cases involving fractures of the hamate hook. The ulnar nerve, which passes close to the hook of the hamate, can become compressed if the fractured hook presses against it. This can result in a variety of sensory and motor deficits. Patients with ulnar nerve compression may experience numbness, tingling, or weakness in the ring and little fingers, as well as a reduced ability to perform fine motor tasks. Over time, untreated ulnar nerve compression can lead to more severe motor impairments, including muscle wasting in the hand, which can severely affect hand function. For this reason, early identification of ulnar nerve involvement is crucial to prevent permanent damage. In some cases, excision of the fractured hook is necessary to relieve the pressure on the nerve and restore normal function.[19]

Though modern surgical techniques and sterile protocols have greatly reduced the risk of postoperative infections, they remain a concern, particularly in cases where implants (such as screws or plates) are used to stabilise the fracture. Hardware irritation is another possible complication, where the metal plates or screws used in ORIF cause discomfort or pain, often necessitating a secondary procedure to remove the hardware after the fracture has healed. In some cases, the presence of hardware can also contribute to stiffness in the wrist, limiting the patient's range of motion and delaying the recovery process.[20]

Stiffness, as a postoperative complication, is particularly common when the patient does not engage in early and effective rehabilitation. The period of immobilisation following surgery, while necessary for bone healing, can lead to a loss of flexibility in the surrounding muscles and joints, which may require extended physiotherapy to overcome. Rehabilitation programmes are essential to restore full wrist function, but stiffness may persist in some cases, particularly if the patient is slow to engage in rehabilitation exercises. In these instances, more aggressive physical therapy or additional interventions, such as manipulation under anaesthesia, may be required to restore normal function.[21]

Rehabilitation and Return to Activity

Rehabilitation is a critical component of the recovery process following a hamate fracture. The successful restoration of wrist function depends on a structured rehabilitation programme, which should begin as soon as the fracture is sufficiently healed. The primary goal of rehabilitation is to gradually restore the patient's range of motion, grip strength, and fine motor control. These aspects of wrist function are essential not only for daily activities but also for more demanding tasks, particularly for athletes and manual labourers.

Early mobilization is recommended once the fracture shows healing but must be done cautiously under physiotherapist supervision. Starting too soon risks disrupting healing, while delaying can cause stiffness and muscle atrophy. Rehabilitation is tailored to each patient's needs. In conservatively managed fractures, it begins earlier, focusing on flexibility and strength. For surgical cases like ORIF, the initial phase emphasizes protecting the repair before progressing to more intensive exercises.[22]

The first phase of rehabilitation generally focuses on passive and active range of motion exercises. These exercises are aimed at gradually increasing the movement in the wrist and preventing joint stiffness. The wrist is particularly prone to becoming stiff after periods of immobilisation, so these early-stage exercises are crucial for optimising long-term outcomes. Patients are encouraged to move the wrist through its natural range of motion, starting with gentle movements and gradually increasing intensity as healing progresses. A physiotherapist plays a vital role during this phase, guiding the patient through exercises designed to safely stretch the wrist and surrounding muscles without compromising the fracture site.

Once the wrist's range of motion is sufficiently restored, the focus of rehabilitation shifts to strengthening exercises. At this stage, it is important to restore grip strength, which can be significantly diminished following a hamate fracture. Specific strengthening exercises, such as squeezing a soft ball or using resistance bands, are introduced to target the muscles of the forearm and hand. These exercises are essential for rebuilding the strength needed for functional tasks, especially those that require a strong grip, such as lifting or holding objects. In patients recovering from hamate body fractures, grip strength may take longer to return due to the involvement of the carpal arch and surrounding structures in the injury. The rehabilitation programme is therefore progressively adjusted, with the physiotherapist ensuring that the exercises remain aligned with the patient's functional needs.[23]

As the patient's strength and range of motion improve, fine motor control exercises are incorporated into the rehabilitation plan. These exercises are particularly important for individuals whose work or sport requires precise hand movements. For example, athletes involved in racket sports or manual workers who perform delicate tasks may require specific exercises that focus on dexterity and coordination. Fine motor control can be challenging to regain after a period of immobilisation, but targeted exercises, such as manipulating small objects or practising hand coordination tasks, can significantly enhance the recovery of these skills.

Patients should gradually reintroduce activities that place stress on the wrist, including sports or manual labour, once they can perform daily tasks without pain or discomfort. The progression towards more demanding activities should be based on the patient's pain tolerance and overall functional capacity. For athletes, a phased return to sport is critical, with careful monitoring of wrist function and pain levels. The reintroduction of sports-specific activities, such as swinging a racket or throwing a ball, should be gradual to avoid re-injury. During this phase, it is common for physiotherapists to introduce functional exercises that simulate the patient's sport or occupation to ensure a smooth transition back to regular activities.

Athletes, in particular, need to exercise caution when returning to their sport after a hamate fracture. Hook fractures are common in activities that place repetitive stress on the ulnar side of the wrist, such as golf, baseball, and racket sports. These athletes are at a higher risk of re-injury if they return to their sport too soon or without adequate strength and mobility in the wrist. Research suggests that most athletes can return to their pre-injury level of activity within 3-6 months following hook excision, assuming the recovery progresses as expected and there are no complications. The timing of this return is heavily dependent on the success of rehabilitation and the absence of pain or discomfort during sporting activities.[24,25] Athletes who engage in activities with high ulnar loading should be particularly vigilant, as premature return to sport can result in delayed healing or further injury.

Conversely, athletes who sustain hamate body fractures and require ORIF may face a longer and more complex recovery process. The nature of ORIF surgery means that the wrist may take longer to heal, and athletes must allow sufficient time for bone healing before resuming high-impact sports. The timeline for returning to sports that involve significant wrist loading, such as racket sports or gymnastics, may extend beyond six months, depending on the patient's progress and the treating physician's recommendations. For these athletes, the return to sport is often guided by a combination of imaging results (to confirm bone healing) and functional assessments conducted by the physiotherapist and surgeon.[26]

CONCLUSION & RECOMMENDATIONS

Though rare, hamate fractures require meticulous clinical evaluation and appropriate imaging due to their often subtle clinical presentation. Conservative management is generally sufficient for non-displaced hook fractures, while displaced or unstable fractures necessitate surgical intervention. Early diagnosis, tailored treatment, and careful monitoring are essential for preventing complications such as non-union and ulnar nerve compression. Advancements in imaging, surgical techniques, and rehabilitation protocols have significantly improved patient outcomes. With appropriate management, patients can expect to regain full wrist function and return to their daily activities or sporting endeavours with minimal long-term consequences.

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