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Fracture of the Hook of the Hamate in Athletes*

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ABSTRACT: During an eight-year period, four tennis players, seven golfers, and nine baseball players were seen with a fracture of the hook of the hamate. Eighteen of these twenty patients were disabled by pain and after the fracture fragment was removed, all eighteen were relieved so that they returned to their athletic pursuits. Two patients were asymptomatic, their old fracture being discovered accidentally when they were treated for other injuries. Nineteen of the twenty patients had been examined before coming under our care, but the correct diagnosis had been made in only two. Conservative treatment, including rest, physical therapy, and injections of steroids into the wrist and hand, had not been beneficial. From the history and findings, we believe that these fractures were caused by a direct blow against the hook of the hamate caused by the handle of the tennis racket, golf club, or bat during a swing, and not by indirect force produced by the ligaments and muscles attached to the hook. The fracture was demonstrated in all twenty patients by a roentgenogram (profile view) of the carpal tunnel.

During the past eight years (1969 through 1976), we have seen twenty male athletes who fractured the hook of the hamate by swinging a baseball bat, golf club, or tennis racket. None of these patients had fallen, and we believe that these twenty fractures were caused by the handle of the bat, racket, or club impinging forcibly against the hook of the hamate during a swing. The fracture was demonstrated in all twenty patients by a roentgenogram of the

carpal tunnel (profile view), and the eighteen who had disabling symptoms were cured by removal of the fractured hook of the hamate.

We also saw patients with fractures of the hook of the hamate caused by either a fall on the open palm or a crushing injury. Of the nineteen previously reported fractures of the hook of the hamate, seven were caused by a crushing injury or a fall^{1,3-5,8,14}, nine by a mechanism of injury that was not described^{2,4-6,12,13}, and three by playing golf^{13,15}. Of these three, one had experienced sudden pain in the hand when the club struck the ground, another had had acute pain when he swung the club, and the third had noted the onset of pain in the hand while playing golf.

Functional Anatomy and Mechanism of Injury

The body of the hamate is on the dorsal and ulnar aspect of the wrist (Fig. 1). Its hook, or hamulus, which is rather long and thin, protrudes volarly into the base of the hypothenar eminence. The hook may be likened to the mast of a ship, for the pisohamate ligament, short flexor, and opponens muscles of the little finger, and the transverse carpal ligament, are all attached to it like stays. Although they afford considerable stability to the hook even after it is fractured, they also interfere with bone healing by exerting intermittent forces on it⁹. The hook of the hamate is more difficult to palpate than the pisiform, for its volar tip is covered by thick skin, subcutaneous tissue, fibrofatty tissue, and parts of both the palmaris brevis muscle and the transverse carpal ligament. Although firm pressure over a fractured hook will cause pain because of the thick soft-tissue protective coverings, light or moderate pressure over the hook may cause little, if any, discomfort. However, direct pressure over the dorso-ulnar aspect of the wrist is often painful, especially if the fracture is at the base of the hamulus.

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The motor branch of the ulnar nerve passes around the ulnar and distal sides of the hook, while the sensory branches of the ulnar nerve lie superficial but very close to its tip.

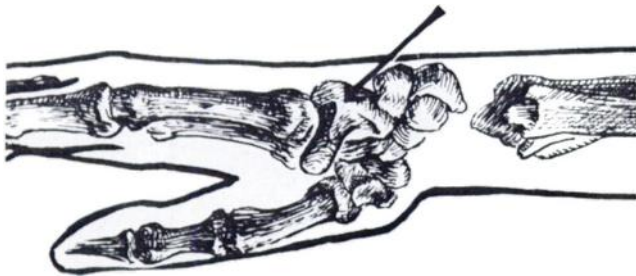


FIG. 1

Drawing of the ulnar side of the wrist, showing that the body of the hamate is situated dorsally while its curved hook-like process, the hamulus, projects volarly into the hypothenar eminence. When the hook is fractured at or near its base, the dorso-ulnar aspect of the wrist is tender to pressure.

When a racket, club, or bat is grasped, the end of the handle is located over the distal and ulnar surfaces of the hook (Fig. 2). If the grip is relaxed, or if the centrifugal force of the swinging bat or club overcomes the grasping power, the butt end of the handle can strike and fracture the hook.

Although the fracture may be located in any part of the hook, it frequently occurs at or near the base. In baseball players, the fracture occurs at the end of a forceful or checked swing, and not when the ball is hit. In tennis, fracture occurs when the player loses control of the racket while trying to make a difficult shot. In golf, the lesion can be caused by the end of the club striking the hamate at the end of a swing, but we suspect that it can also be the result of force transmitted to the bone through the club shaft when the club head accidentally strikes the ground, as in a dubbed shot.

Clinical Material

Of the twenty male athletes seen with this fracture, eight were professional baseball players and one played baseball on a college team; three were professional and four, amateur golfers; and four were Class A or B amateur tennis players. Without exception, the fracture occurred in the hand that grasped the end of the club, bat, or racket. All seven golfers played right-handed, and the fracture occurred in the left hamate; all of the tennis players played right-handed, and the fracture occurred in the right hamate; and in the baseball players, the four who batted right-handed had a fracture of the hook of the left hamate while the five who batted left-handed had a fracture of the hook of the right hamate (Table I).

Nineteen of the twenty patients had been examined before coming under our care, but the correct diagnosis had been made only in the two whose roentgenographic studies had included a carpal-tunnel view. The many conventional roentgenograms of the other patients had failed to show the fracture. Eleven patients had been treated for

“a sprained wrist” or “tendinitis”, and seven had been injected with steroids on one or more occasions. Of the twenty patients, we first examined five one month or less after injury, ten at between one and seven months, and five at between one and four years. Eighteen of the twenty were symptomatic and unable to play their sport. In two patients (Cases 8 and 18), both professional baseball players, an old ununited fracture of the hook of the hamate was discovered when they came for treatment of another injury. Both recalled having had a painful hand three years previously which had caused them to “have a bad year”. Symptoms had subsided after twelve to eighteen months.

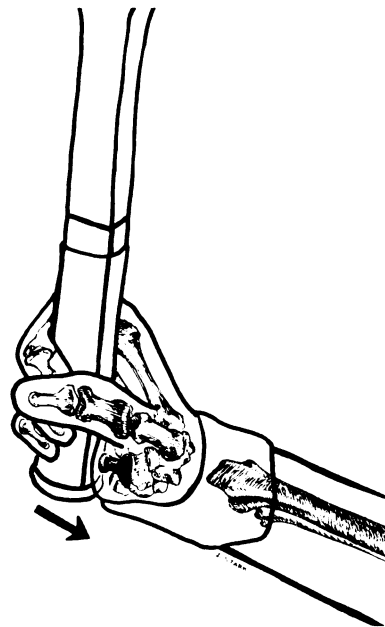


FIG. 2

Drawing of a hand grasping a tennis racket, showing the relationship of the handle to the hamate. In athletes, the hook is fractured by the butt end of a racket, club, or bat striking it during a swing.

Selected Case Reports

CASE 5. A fifty-year-old right-handed male architect who played tennis six times a week was examined in July 1972. Five months previously his right hand had become painful while he was playing tennis. A physician injected “cortisone” into the wrist; when the pain continued, he saw another physician who also injected “cortisone” into the wrist and palm on two occasions. In April 1972, both flexor tendons of the little finger ruptured while he was playing tennis. He taped the little finger to the ring finger and continued to play regularly, but both flexor tendons of the ring finger ruptured a few weeks later. When he was examined after this episode, firm pressure on the palm over the tip of the hook of the hamate caused moderate discomfort, and a carpal-tunnel roentgenogram showed an old fracture of the hook (Fig. 3).

At operation in August 1972, large deposits of what appeared to be the injected steroid were found embedded in the ruptured tendons and in the few remaining intact fibers of the profundus tendon of the long finger. Deposits of the steroid also surrounded the fracture site. The fractured hook was removed, and the rough base of the hamate was smoothed with a rongeur and covered with a flap of local soft tissue. After removing the steroid, the profundus tendon of the long finger was repaired with Dexon sutures, and the profundus tendons of the ring and little fingers were reconstructed with segmental tendon grafts. The patient resumed playing tennis four months after operation. Four years later he had no pain and

TABLE I

Case	Age (Yrs.)	Dominant Hand	Fractured Side	Sport	Occupation	Date of Injury	History	Time from Injury to Diagnosis (Mos.)	Therapy before Diagnosis*	Other Information	Date of Operation	Results
1	52	R	L	Golf	Executive	10/68	Struck ground w. 4-iron; pain	4	Rest, PT	Could not play golf	2/69	Playing golf at 6 wks.
2	64	R	L	Golf	Dentist	3/69	Struck ground w. 5-iron; pain	5	Rest, PT	Could not play golf	8/69	Playing golf at 8 wks.
3	25	R	L	Baseball	Prof.	8/70	Swung, missed a pitch; pain (bats w. right)	6	"Cortisone", PT	Could not play regularly because of pain	2/71	Playing baseball at 8 wks.
4	22	R	L	Baseball	Prof.	6/71	Swung, missed a pitch; pain (bats w. right)	½	Rest		6/71	Playing baseball at 9 wks.
5†	50	R	R	Tennis	Architect	3/72	Became sore during tennis	5	"Cortisone" X3	Flexor tendons of ring and little finger rupt. preop.	8/72	Playing tennis at 5 mos.
6	53	R	L	Golf	Attorney	6/72	Struck ball; sudden pain	4	Rest, heat	Could not play golf	10/72	Playing golf at 10 wks.
7†	28	R	R	Baseball	Prof.	6/72	Swung, missed a pitch; sudden pain (bats w. left)	1½	Rest, PT, cast, diathermy, steroids	Struck on back of wrist by ball 10 days before	7/72 (elsewhere)	Playing baseball at 10 wks.
8	30	R	L	Baseball	Prof.	69	Became sore while batting (bats w. right)	36	Rest, PT	Sore for 1½ yrs., then painless	Not done	
9	21	R	R	Baseball	Prof.	1/73	Checked swing (bats w. left)	1	"Cortisone" X2	Could not swing a bat	2/73	Playing baseball at 9 wks.
10	24	R	L	Golf	Prof.	12/72	No known injury; soreness	6	PT, injections	Could not play golf	6/73	Playing golf at 7 wks.
11	29	R	L	Golf	Prof.	70	No known injury	48	Diathermy, PT, rest	Could not play golf	4/74	Playing golf at 10 wks.
12	25	L	R	Baseball	Prof.	7/74	Sudden pain while batting (bats w. left)	1	"Cortisone" X2	Could not play baseball	8/74	Played baseball the next season
13	20	L	R	Baseball	Prof.	10/74	Sudden pain while swinging bat (bats w. left)	2	Rest, PT	Disabled for baseball	12/74	Playing baseball at 10 wks.
14	19	R	R	Baseball	Student	1/75	Pain while swinging at a pitch (bats w. left)	¾	None	Too sore to play baseball	2/75	Playing baseball at 8 wks.
15	44	R	L	Golf	Executive	73	Pain while playing golf	24	Rest, PT	Could not play golf	9/75	Playing golf at 7 wks.
16†	20	R	R	Tennis	Student	9/75	Pain while playing tennis; no fall	6	Butazolidin, rest, PT	Played but with great pain	3/76	Playing competition tennis at 6 wks.
17	17	R	R	Tennis	Student	9/75	Pain during forehand stroke	7	Rest, PT	Could not play tennis	4/76	Playing tennis at 7 wks.
18†	30	R	L	Baseball	Prof.	73	Pain while swinging at ball (bats w. right)	36	Rest, PT; no pain after 1 yr.	No further discomfort	Not done	
19†	29	R	L	Golf	Prof.	3/76	Sudden pain while swinging club	1	Rest, PT, "cortisone"	Could not play golf	4/76	Playing golf at 7 wks.
20	43	R	R	Tennis	Restaurant manager	10/75	Pain while serving	12	"Cortisone" X3	Could play but with pain	10/76	Playing tennis at 9 wks.

* PT = physical therapy.

† See text for case report.

was playing tennis five times a week. The tip of the long finger lacked 1.25 centimeters of flexion to the mid-palm; the ring finger, 3.2 centimeters; and the little finger, 2.8 centimeters. His grip was 70 on the right compared with 90 on the left, as measured with a Jamar dynamometer set in the third position.

It has been suggested that flexor tendons rupture because of chronic irritation caused by the irregular surface of an ununited fracture of the hook of the hamate. Clayton

reported two patients with ruptured flexor tendons who also had old fractures of the hook. In one of these, steroid had been injected into the palm several weeks earlier. Crosby and Linscheid also reported two patients with ruptured flexor tendons who had old fractures of the hamate, and one of those patients had also received injections of "cortisone".

At surgery, we found the flexor tendons to be normal

in sixteen patients, and in seven of them the fracture fragment was removed at between six months and four years after injury. Therefore, we suspect that some of the reported ruptures may have been caused by injection of steroids rather than by the ununited fracture. However, there is a *possibility* that flexor tendons may rupture because of chronic chafing against rough bone edges, and for this reason we think that the fracture fragment should be removed even if the patient is asymptomatic; reconstruction of a ruptured tendon is a much more difficult procedure than excision of the hook of the hamate.



FIG. 3

Case 5. Carpal-tunnel roentgenogram of a five-month-old fracture of the hook of the hamate. The area of fracture and the adjacent flexor tendons had been injected repeatedly with "cortisone", and the flexor tendons of the ring and little fingers had subsequently ruptured.

CASE 7. A twenty-eight-year-old major-league professional baseball player who batted left-handed was first examined on July 19, 1972. On June 3, 1972, seven weeks previously, while at bat, the dorso-ulnar aspect of his right wrist had been struck by a thrown baseball. The wrist was tender after this episode, but he continued to play regularly and effectively, without significant discomfort, for the next two weeks. At that time, the right wrist and hand became acutely painful when he hit a foul ball, and severely painful when he fouled off the next pitch. During the next four weeks he was examined by three physicians, who prescribed rest, diathermy, and temporary plaster immobilization. The wrist and hand were injected with steroids on several occasions, but the pain continued and he had played in only one game since the *second* injury.

Although many roentgenograms had been made, the fracture was not discovered until a carpal-tunnel view was obtained on July 19 (Figs. 4-A and 4-B). On that date, the dorso-ulnar aspect of the wrist was much more tender to pressure than the volar aspect of the palm, and strong pinch between the little finger and thumb was moderately painful. Removal of the fractured hook was recommended, and this was done on July 21, 1972, by Dr. Richard Eaton. The patient returned to professional play in September 1972, and he was still playing for a major-league team at the time of writing.

Case 7 illustrates the importance of a careful history. We believe that the first injury was probably insignificant, no more than a bruise, and that the fracture occurred when the patient hit the foul ball two weeks later. Since the fracture was near the base of the hook, there was more tenderness on the dorso-ulnar aspect of the wrist than over the



FIG. 4-A

Figs. 4-A and 4-B: Case 7.

Fig. 4-A: Carpal-tunnel roentgenogram of the right wrist, showing a seven-week-old fracture at the base of the hook of the hamate in a professional baseball player.



FIG. 4-B

Carpal-tunnel roentgenogram of the normal left wrist.

proximal part of the palm — a finding that caused the patient to relate his problem to the first injury.

CASE 16. A twenty-year-old right-handed male college student and varsity tennis player was examined on March 20, 1976. He could not recall a specific injury, but he had first noticed pain and tenderness in the right hand six months previously while playing tennis. Roentgenograms had been reported to show no abnormality. However, despite treatment for "tendinitis" with Butazolidin Alka (phenylbutazone), rest, and physiotherapy, the patient's pain continued and he could not play tennis. Five months after the onset of symptoms he was examined by another physician, who made a carpal-tunnel roentgenogram of the wrist, diagnosed the fracture, and referred him to our service (Figs. 5-A, 5-B, and 5-C). The fracture fragment was removed on March 22, 1976, and in six weeks he resumed playing competitive tennis.

CASE 18. A thirty-year-old right-handed major-league baseball player was examined on August 17, 1976, for an acute injury of the *left* wrist. Three days previously, while starting and checking a swing of the bat, he had noticed discomfort on the *radial* aspect of the wrist. Routine roentgenograms and a carpal-tunnel view showed an old fracture of the hook of the hamate (Figs. 6-A and 6-B). There was no pain or tenderness about the ulnar aspect of the wrist, and the only positive finding was slight tenderness on the radial side of the wrist. On questioning, he



FIG. 5-A

Figs. 5-A, 5-B, and 5-C: Case 16.
Fig. 5-A: Carpal-tunnel roentgenogram of a six-month-old fracture in a tennis player.



FIG. 5-B

An oblique roentgenogram made with the forearm partially supinated also shows the fracture. See Fig. 9 for technique to obtain this view.



FIG. 5-C

The oblique roentgenogram of the left wrist shows a normal hamate.

remembered that he had felt acute pain in the left wrist and hand while swinging a bat three years before. The wrist and hand had remained painful for several months, and although he had continued to play profes-

sional baseball, he "had a bad year". After one year the pain disappeared, and he had no further difficulty until the new injury. He was re-examined at frequent intervals until September 13, 1976. The tenderness on the radial side of the wrist cleared in one week, and he played regularly from September 1 until the end of the 1976 season. Surgical excision of the fracture fragment as an elective procedure was recommended, but the patient was reluctant to have an operation.

CASE 19. A twenty-nine-year-old right-handed male professional golfer was examined on April 5, 1976. On March 8, 1976, four weeks previously, he had had severe pain in the left hand when he struck a golf ball. Shortly afterward, the painful area was injected with "cortisone", but the pain continued in spite of his resting the hand. Examination showed tenderness over the hook of the hamate and less severe tenderness over the dorso-ulnar aspect of the wrist. A carpal-tunnel roentgenogram showed the fracture, and the fragment was removed (Figs. 7-A and 7-B). The patient resumed playing professional golf seven weeks after operation.

Diagnosis

Clinical Findings

It is important to take a careful history, because many of these patients, if questioned, will recall having first ex-



FIG. 6-A

Figs. 6-A and 6-B: Case 18.
Fig. 6-A: Carpal-tunnel roentgenogram of the left wrist, showing a three-year-old *asymptomatic* fracture of the hook of the hamate in a professional baseball player.

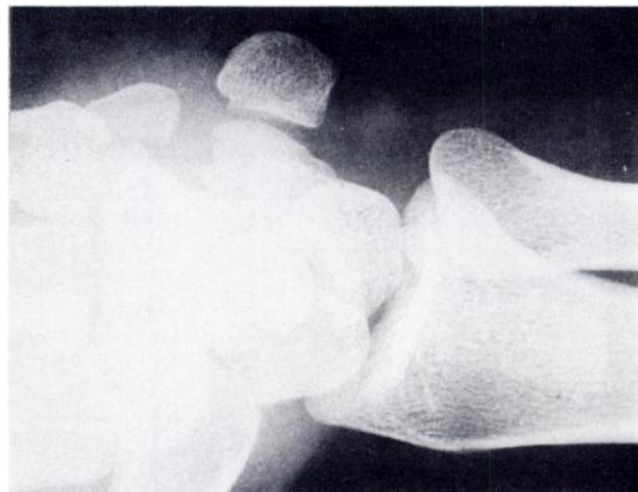


FIG. 6-B

An oblique roentgenogram of the same wrist shows some displacement of the fracture fragment.

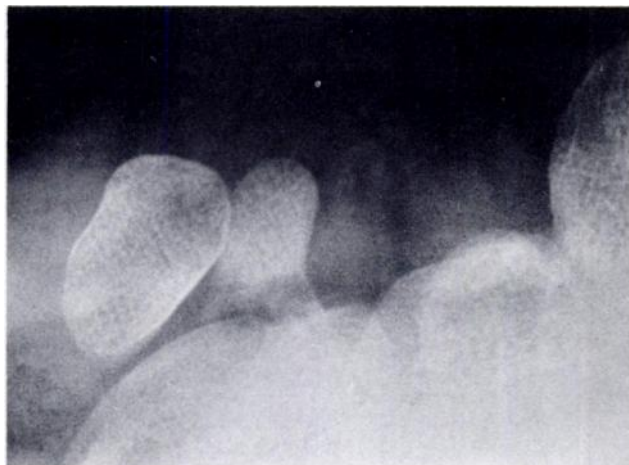


FIG. 7-A

Figs. 7-A and 7-B: Case 19.

Fig. 7-A: One-month-old fracture of the hook of the left hamate in a professional golfer.



FIG. 7-B

Carpal-tunnel roentgenogram of the wrist after removal of the fractured hook.

perceived pain in the wrist and hand while swinging a bat, club, or racket (Case 7). If the fracture occurred several months before, the patient will give a history of having had soreness in the wrist and hand, but *without* swelling, for several weeks or months. Voluntary wrist and finger mo-

tions are painless and normal, but abduction and adduction of the little finger against resistance are usually uncomfortable. Ordinary gripping is not painful, but the patient cannot grip and swing a cylindrical object such as a bat, club, or racket because of pain in the wrist and hand. Firm pressure over the hook of the hamate causes some discomfort in all patients, but when the hook is fractured at or near its base, tenderness is more marked over the dorso-ulnar aspect of the wrist. Although none of our patients had dysfunction of the ulnar nerve, this has been reported^{5,6,8,13,14}.

Roentgenographic Findings

Routine roentgenographic views of the wrist do not show the fracture, but it is clearly visible on a carpal-tunnel roentgenogram. Hart and Gaynor described this view in 1941, and in 1954 Wilson emphasized its importance for demonstrating certain fractures and congenital variations of the carpal bones. When one suspects a fracture of the hook of the hamate, appropriate roentgenographic views should be obtained, including carpal-tunnel views. The projections should be varied so that an oblique fracture will not be missed (Fig. 8). In addition, comparative roentgenograms should be made of both wrists, since the hook often forms from a separate ossification center which sometimes fails to unite with the body^{1,10}. When this happens, a developmental variation of the hook can be mistaken for a fracture^{1,16}.

To obtain a Hart and Gaynor profile roentgenogram of the carpal canal¹¹ (a carpal-tunnel view), seat the patient at the end of a table so that the pronated forearm lies on the film holder. Place a two-centimeter-thick radiolucent pad between the wrist and the cassette and have the patient hold the wrist in *maximum* dorsiflexion by pulling the finger tips dorsally with the opposite hand. Direct the central ray at a point approximately 2.5 centimeters distal to the base of the fourth metacarpal, and angle the tube 25 degrees toward the horizontal from the long axis of the hand (Figs. 10-A and 10-B). Passive dorsiflexion of the wrist is not painful in these patients, but since the amount of dorsiflexion differs from patient to patient the angle of the x-ray tube must be varied according to the amount of



FIG. 8

Three carpal-tunnel views of the same wrist, showing the effect of rotation. By rotating the hand and forearm a few degrees in the plane of the cassette, the hook of the hamate can be separated from the pisiform. Once a fracture of the hamulus is suspected, several carpal-tunnel roentgenograms should be made in different positions to ensure visualization of all of the hamulus.

dorsiflexion possible at the wrist. Obtain several exposures with the forearm and hand rotated in the plane of the cassette a few degrees in the radial or ulnar direction until the roentgenograms provide a clear view of the entire hook, well separated from the pisiform.



FIG. 9

Technique of obtaining an oblique roentgenogram of the wrist, with the forearm in mid-supination and the wrist dorsiflexed. The arrow indicates the proper trajectory of the central ray of the roentgenogram.

The fracture can also be demonstrated on a special oblique roentgenogram of the wrist^{1,13,15} made using the technique shown in Figure 9. It is more difficult to get a clear picture of the hook with this technique than with a carpal-tunnel view. We have not found it necessary to use tomograms to diagnose this fracture, but it is conceivable that they could be helpful in perplexing situations.

Treatment

We removed the ununited fracture fragment in seventeen patients and also repaired ruptured flexor tendons in one of them. In one patient the fragment was removed by another surgeon. The professional athletes all returned to competitive play within seven to ten weeks, and all eighteen patients who had the hook removed returned to their previous athletic pursuits. Although these fractures might unite if the hand and wrist were immobilized in a plaster cast for several weeks, we think that the fracture fragment should be excised.

The operation was performed under general anesthesia, with a pneumatic tourniquet on the arm. The ulnar nerve and its branches were identified and protected, for they are in close proximity to the hook. The fracture frag-

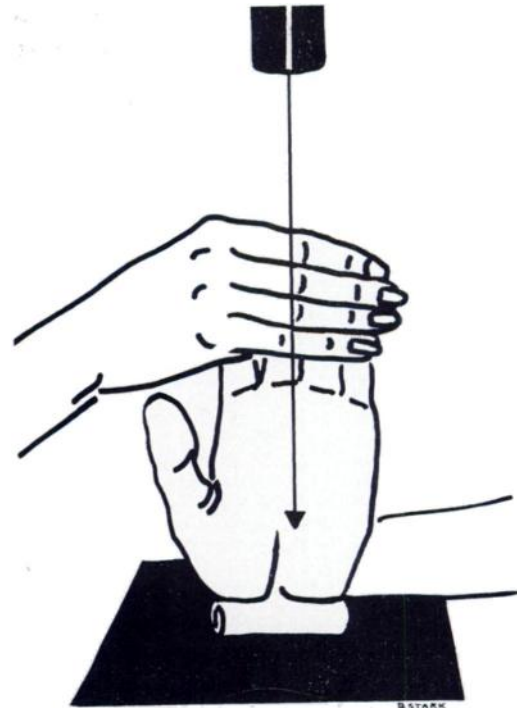


FIG. 10-A

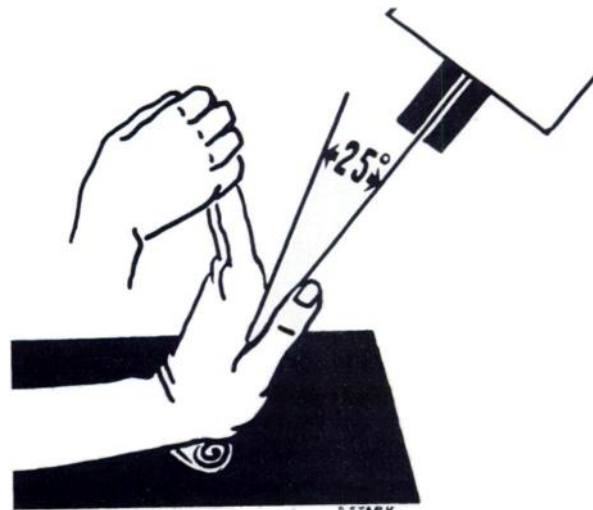


FIG. 10-B

Figs. 10-A and 10-B: Technique of obtaining a carpal-tunnel roentgenogram of the wrist.

ment was usually quite stable until its periosteum had been stripped to its base. Once this had been accomplished, the hook separated easily from the body of the bone. The base of the hamate was smoothed with a rongeur. The wrist was immobilized for two or three weeks in a plaster cast and then the patient was allowed to use the hand for all activities as soon as the tenderness in the scar had subsided.

Conclusion

Although the hook of the hamate can be fractured in other ways, we believe that this fracture usually occurs when the butt end of a tennis racket, golf club, or baseball bat strikes the ulnar side of the hook during a swing. This

fracture should be suspected in baseball players, tennis players, and golfers who complain of persistent pain about the ulnar aspect of the wrist or hand. Although the lesion is difficult to demonstrate on conventional roentgenograms,

it can be seen clearly on a carpal-tunnel view. Once the diagnosis is established, the fractured hook should be removed, for this eliminates symptoms and lessens the likelihood of subsequent rupture of the flexor tendons.

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