

FOLIA MEDICA CRACOVIENSIA
Vol. LXV, 3, 2025: 51–59
PL ISSN 0015-5616 eISSN 2957-0557
DOI: 10.24425/fmc.2025.156683

Fractures of carpal bones other than scaphoid: epidemiology, methods and results of treatment

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Abstract: Fractures of the carpal bones are rare compared to fractures of the metacarpals and phalanges. The triquetrum and scaphoid are the most frequently involved, and the other bones injuries are less common. The aim of the study was to analyze the incidence of carpal fractures other than the scaphoid bone, methods and results of their treatment.

Material and Methods: Between 2021 and 2023, 35 patients, 25 men (71%) and 10 women (29%), at the mean age of 49 years, with isolated fractures of the carpal bones other than the scaphoid, were treated at the author's institution. Fractures of the triquetrum was the most commonly seen — 25 cases (71%), followed by the hamate bone — 6 cases (17%). Most fractures were treated conservatively with wrist immobilization for 5 weeks. Six patients (17%) required surgical treatment, most of them with the hamate fractures.

Results: In a telephone interview at a mean of 16 months post-treatment, 31 patients (88%) had no symptoms in an affected wrist, and 32 (91%) rated the hand as fully functional, the same as before the injury. Three patients who assessed their hands as less functional, had accompanying injuries: distal radial fracture, fracture of the base of the first metacarpal bone, and metacarpo-phalangeal joints dislocation. All of these injuries required surgical treatment.

Conclusions: Fractures of the carpal bones other than the scaphoid are moderately common, their treatment is mostly conservative, and the results of treatment, both conservative and surgical, are good.

Keywords: carpal bone fractures, diagnosis, conservative treatment, operative treatment.

Submitted: 08-Feb-2025; **Accepted in the final form:** 15-Sep-2025; **Published:** 30-Sep-2025.

Introduction

The wrist consists of two rows of carpal bones (Fig. 1). The proximal row is formed by the scaphoid, lunate and triquetrum bones; The fourth bone — the pisiform is an additional element, not playing a role in the movements of the wrist. The distal row consists with the trapezium, trapezoid, capitate and hamate bones [1]. Fractures of the carpal bones are rare compared to fractures of the



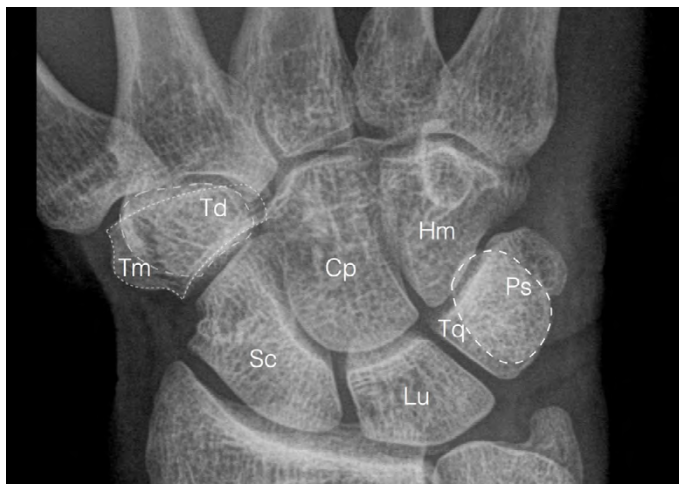


Fig. 1. X-ray of the wrist (p-a view). Marks. Distal row, from the left: Tm — trapezium bone, Td — trapezoid bone, Cp — capitate bone, Hm — hamate bone. Proximal row, from the left: Sc — scaphoid bone, Lu — lunate bone, Tq — triquetrum bone, Ps — pisiform bone.

metacarpals and phalanges. Estimated data indicate that they account for about 8% of all hand and wrist fractures [2]. Data from the literature indicate that of all carpal bones, fractures of the scaphoid and triquetrum bones account for 60%, and all the others — 40%. Fractures of the scaphoid and triquetrum bones are about the same frequency, about 30% each. Of the remaining six carpal bones, the most common fracture is the hamate bone (approx. 11%), the trapezium (10%) and the lunate (6%) [2–4]. Most publications in the literature focus on scaphoid fractures, and relatively few publications concern the epidemiology and treatment of fractures of other wrist bones.

The aim of the study was to assess the epidemiology, morphology, methods and outcomes of treatment of carpal fractures other than scaphoid in the authors' institution material.

Material and Methods

In the years 2021–2023 (a period of 3 years), 35 patients were treated at the author's center, 25 men (71%) and 10 women (29%), aged a mean of 49 years of age (range 32–73), with isolated fractures of the carpal bones other than the scaphoid. During the same period, 24 patients with isolated scaphoid bone fractures were treated. It means that a total of 59 patients with isolated carpal fractures were treated during this period, of which 41% were scaphoid fractures and 59% were fractures of other wrist bones. Data on patients and their injuries were obtained from the database of the hospital emergency department, radiology department, the department and out-patient clinic of hand surgery of the University Clinical Hospital No. 1 in Szczecin.

Treatment outcomes were assessed at an average of 16 months after the completion of treatment (range 1–3 years) based on a telephone interview. The patients were asked about the symptoms and function of the treated hand, and particularly about features of impairment. Bone union was also assessed in 17 patients (48%): in 6 who were operated on and in 11 treated conservatively. After dorsal cortical fractures of the triquetrum bone a follow-up X-ray was not routinely performed.

Results

Clinical data on fracture pattern and treatment methods are summarised in Table 1. The most common fractures were the triquetrum fractures — 25 cases (71%), of which 23 were dorsal cortical fractures, and only 2 fractures of the body of the bone. The second common were the hamate bone fractures — 6 patients (17%), of which 4 were fractures of the bone body and 2 of the hook. One patient had a concomitant fracture of the hamate and triquetrum bones in the same wrist. The third common were fractures of the trapezium bone — 3 cases.

The mechanism in which the fracture occurred was most often a fall from body height on the hand — 25 cases (71%), and in the remaining cases a fall from stairs, from a bicycle, on a skateboard, on skis and on roller skates. In one case, a patient was injured during a traffic accident when her hand was pressed by an exploding airbag. In another case, the wrist was crushed by a heavy object.

The diagnosis of the fracture was made after a mean of 4 days after the injury (range 1–15), with 24 patients (68%) diagnosed on the day of the accident. In 23 cases, an X-ray of the wrist was sufficient to make the diagnosis, while in 12 cases an additional CT scan was necessary.

Three patients had additional injuries not affecting the wrist joint: fracture of the distal radius, Rolando-type fracture of the base of the thumb metacarpal bone, and dislocations of the 4th and 5th metacarpal bones in the carpo-metacarpal joints.

Table 1. Clinical data and treatment methods of patients in the study group.

Fractured bone and site of the fracture	n	Basis of the diagnosis	Conservative treatment	Operative treatment
The triquetrum (dorsal cortical fracture)	23	X-ray — 19, CT — 4	23	—
The triquetrum (body)	2	X-ray — 1, CT — 1	2	—
The hamate (body)	4	X-ray — 1, CT — 3	2	2
The hamate (hook)	2	CT — 2	—	2
The trapezium	3	X-ray — 2, CT — 1	2	1
The capitate	1	CT	1	—
Total	35	X-ray — 23, CT — 12	30	5

Treatment

The majority of patients — 29 (83%) were treated conservatively with immobilization of the wrist in a short palmar plaster splint, in a neutral position, for 5 weeks. If the patient still felt wrist pain after removal of the splint, it was recommended to wear the orthosis for the next 4 weeks. Treatment was completed 2 months after the injury. After removal of splints, 12 patients underwent formal rehabilitation.

Six patients (17%) required surgical treatment, most of them with hamate bone fractures. Surgeries were performed under brachial plexus anaesthesia; all hamate bone fractures were operated on using the open method and fixed with lag-screws. The fracture of the trapezium bone was stabilized with a K-wire. The postoperative course was uneventful in all cases. All additional injuries found in 3 patients also required surgical treatment.

Treatment outcomes

An X-ray taken in 17 patients after the splints were removed showed the union of all wrist bone fractures. In 18 patients with dorsal cortical fractures of the triquetrum, no follow-up image was taken.

In a telephone interview after a mean of 16 months after the end of treatment, 31 patients (88%) had no complaints from the injured wrist. Three reported minor pain when the weather changed and after heavier load of the hand. One patient, after a fracture of the triquetrum and the distal radius, complained from wrist pain rated of 6 in the numerical scale (NRS, range 0–10), occurring primarily after loading the hand.

Thirty-two (91%) patients rated their hands as completely functional, the same as before the injury. Two reported a slight impairment of hand function, making it difficult to perform some activities of daily living. Both of these patients had associated injuries: one had a dislocation of the bases of the 4th and 5th metacarpal bones in the CMC joints, and the other had a fracture of the base of the thumb metacarpal bone. One patient, the same one who felt pain in the wrist, assessed her hand as disabled, which significantly reduced the performance of activities of daily living. This patient also had an additional fracture of the distal radius. After 1,5 years from the injury, she was still unable to work and on a periodic disability pension.

With the exception of this one patient, all the other persons who had been working before the accident returned to the same job.

Discussion

The analysis of carpal fractures other than the scaphoid presented in the paper indicates the triquetrum bone as the most common one to be broken, as often as the scaphoid bone. This observation is consistent with the data from the literature. However, the consequences of fractures of these bones are quite different: while the scaphoid bone relatively often does not unite, despite proper conservative treatment, the triquetrum practically always consolidates. Therefore, the literature on problems with scaphoid fractures is much greater. The vast majority of triquetrum bone injuries are dorsal cortex fractures, which, although treated as avulsion fractures, heal very well after a month of immobilization of the wrist (Fig. 2A, 2B). These fractures usually heal by creating an asymptomatic fibrous union, so there is no need to wait for the firm bone union [3, 5]. Therefore, in most cases, there is no need for a follow-up X-ray after treatment.

Hamate fractures were the second most common in the study group, accounting for 17% of all fractures (Figs. 3A, 3B). Unlike triquetrum fractures, which were treated conservatively, four of the 6 hamate fractures required surgical treatment: two fractures of the body and two fractures of the hook of the hamate (Figs. 3C–3F). The decision to undergo surgical treatment resulted from the significant displacement of these fractures, which was only revealed by a CT scan, because the displacement was not visible clearly enough on the X-ray.

In the study group there were 3 fractures of the trapezium, two of which were treated conservatively, and one was fixed with a K-wire. In one case, the fracture of this bone was accompanied by a fracture of the base of the thumb metacarpal bone (Fig. 4).

The other injuries were one fracture of the lunate (Fig. 5) and one fracture of the capitate (Figs. 6A, 6B).

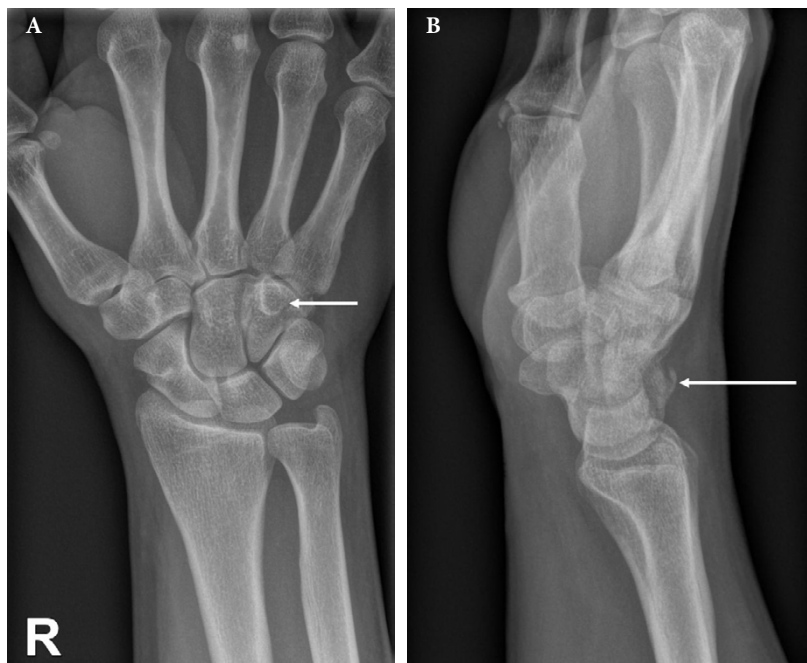


Fig. 2A. X-ray of the triquetrum bone (p-a view). A fracture of the dorsal cortex marked with an arrow.

Fig. 2B. X-ray of the triquetrum bone (lateral view). A fracture of the dorsal cortex marked with an arrow.

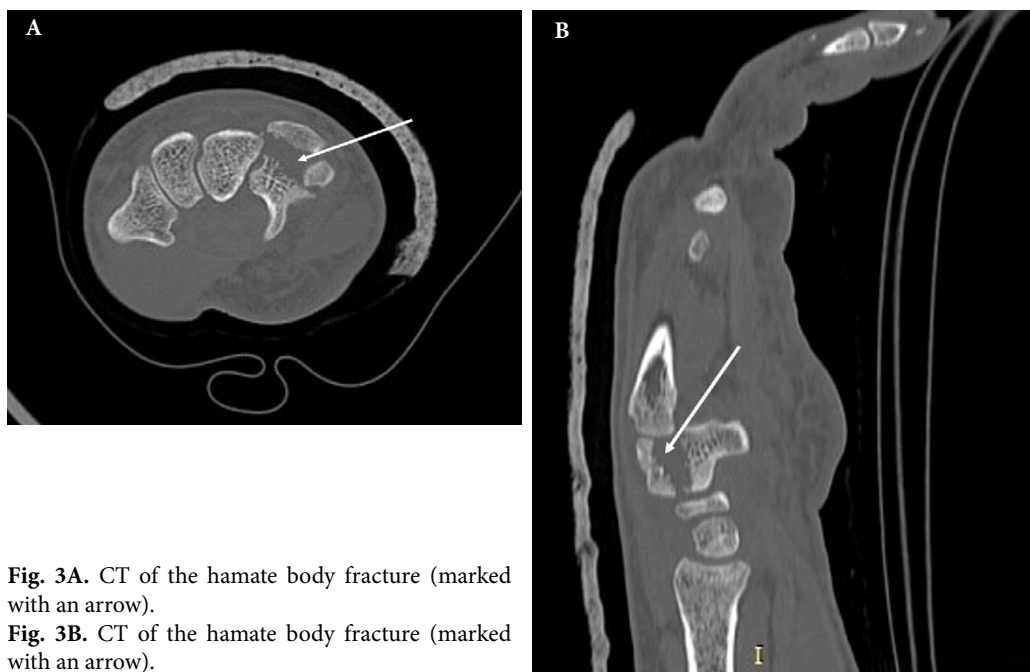


Fig. 3A. CT of the hamate body fracture (marked with an arrow).

Fig. 3B. CT of the hamate body fracture (marked with an arrow).

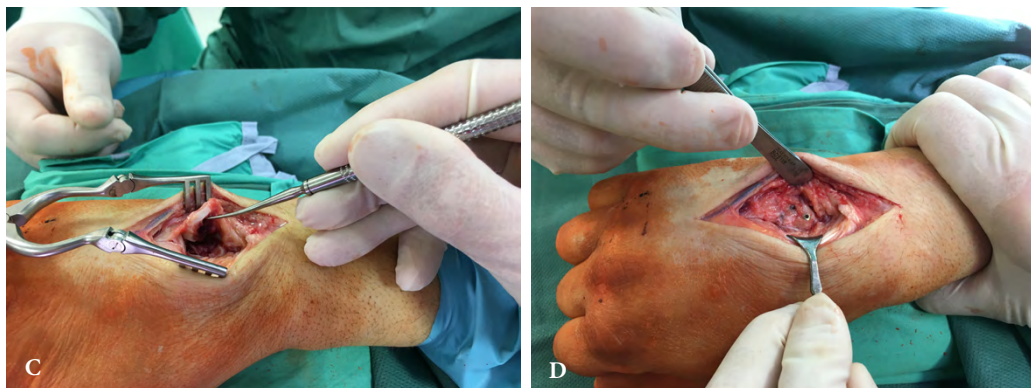


Fig. 3C. Intraoperative view of fracture of the hamate.

Fig. 3D. Intraoperative view of the hamate fixed with screws (lateral view).



Fig. 3E. Postoperative X-ray of fracture of the hamate bone body, fixed with screws (p-a view).

Fig. 3F. Postoperative X-ray of fractures of the hamate bone body, fixed with screws.

The results of treatment, assessed on average almost 1,5 years after the injury, were satisfactory in the vast majority of patients, both those treated conservatively and those who underwent surgery. One patient who suffered an injury in a traffic accident and had a fracture of the triquetrum bone accompanying the fracture of the distal radius, considered her hand disabled, but it could



Fig. 4. X-ray of the wrist with a fracture of the body of the trapezium bone (marked 1) and a simultaneous fracture of the base of the first metacarpal bone (marked 2)



Fig. 5. Sagittal view of the CT scan showing fracture of the lunate with fragmentation of the bone.



Fig. 6A. X-ray of the wrist showing a fracture of the capitate bone (marked with an arrow).

Fig. 6B. Sagittal view of the CT scan showing a fracture of the capitate bone. Note significantly displaced bone fragments, marked with arrows.

not be clearly shown whether it was due to a fracture of the wrist bone or the distal radius. In addition, the documentation of outpatient treatment showed that she was involved in a law suit against the perpetrator of the accident which may affect her worse assessment of the dexterity of her hand.

Compared to metacarpal and phalangeal fractures, carpal bone fractures are much rarer. Fractures of the scaphoid are the most common, but more recent data from the literature and the results of this study indicate that fractures of the triquetrum are equally common. The clinical picture of these fractures is non-specific, and the correct diagnosis requires imaging such as X-ray and/or CT. Most fractures of the triquetrum and trapezium bones are visible on X-rays, while fractures of the hamate and lunate bones require a CT scan. Fractures of the wrist bones can be part of complex injuries, most often perilunar wrist dislocations and ligament injuries. Most isolated and non-displaced carpal bone fractures can be treated conservatively. Surgery is necessary in the case of significantly displaced fractures and in complex injuries, e.g. accompanying perilunar dislocations or dislocations of the 4th and 5th carpo-metacarpal joints.

Literature review

Boeddrich *et al.* (2023), presented the results of an analysis of the epidemiology and treatment methods of 178 patients with carpal bone fractures who were admitted to the emergency department of a hospital in Germany, over a period of 6 years. The study group consisted of 127 men (71%) and 51 women (29%), with an average age of 44 years (range 18–89). Isolated fractures of wrist bone were significantly more common (80%) than multiply fractures (20%). The most frequently broken bone was triquetrum — 29%, followed by the scaphoid — 28%, the hamate bone — 11% and the trapezium — 10%; Fractures of the remaining wrist bones were less frequent. In 91% of patients, the diagnosis was based on CT scan of the wrist, and in 9% on X-ray. The mechanism leading to the injury was most often a fall on the hand — 42%, and the second was a fall from a bicycle — 24%. The majority of wrist bone fractures — 62% were treated conservatively with immobilization in a plaster splint. In 19% wrist bone fractures were operated on, and 13% of patients requires surgery due to concomitant trauma. More than half of scaphoid fractures and 40% of capitate fractures required surgery. The vast majority of fractures of the triquetrum (80%) and the trapezium (77%) were treated conservatively [4]. The results of this study on the epidemiology, morphology and treatment of carpal bone fractures are generally consistent with those presented in our study.

The results presented in other studies concern the treatment of fractures of individual wrist bones.

The triquetrum bone. The vast majority of triquetrum bone fractures can be treated conservatively, with immobilization of the wrist in a short palmar splint for 4–5 weeks; This applies in particular to the dorsal cortical fractures. The results of treatment, both conservative and surgical, are satisfactory, with full function restored within 2 months. Complications are rare [3–5].

The hamate bone. These fractures with no- or minimal displacement, without concomitant trauma can be treated conservatively, as well as triquetrum fractures. Surgical intervention is recommended for: displaced and unstable fractures, accompanied by dislocation of the 4th and 5th CMC joint, and displaced fractures of the hook of the hamate. The results of treatment of the hamate fractures, both conservative and surgical, are generally satisfactory, and full function is restored within 2 months [6–9].

The capitate bone. Non-displaced fractures of the capitate bone are treated in the same way as the triquetrum fractures, with 4–5 weeks of immobilization in a plaster splint; Displaced fractures require surgical treatment, usually with a headless compression screw. Treatment results are good, and non-union is rare [10].

The trapezium bone. The treatment of isolated, fresh fractures is the same as that of triquetrum bone. Due to its good vascularization, fractures of this bone heal well [11, 12]. Displaced fractures should be treated surgically, as a malunion may increase the risk of osteoarthritis in thumb CMC joint. In most cases, percutaneous fixation with a K-wire is sufficient, however, more displaced and fragmented fractures may require open reduction and internal fixation with a screw.

The results presented in the study indicate that fractures of carpal bones other than the scaphoid are moderately common. In most cases, an X-ray of the wrist is sufficient to diagnose fractures of the triangular bone, but CT of the wrist is recommended in cases of fractures of other bones and in the case of suspected concomitant injuries. Treatment of most of these fractures is conservative, and indications for surgery are fractures with significant displacement and with concomitant injuries. The results of treatment, both conservative and surgical, are good. The presented study is the first in the Polish literature to address this clinical problem, and the author believes that it may be useful for orthopaedic surgeons working in hospital emergency departments, where most of these injuries are diagnosed.

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