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## Cuts to the offender's own hand—unintentional self-infliction in the course of knife attacks

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**Abstract** In a knife attack the perpetrator can unintentionally injure his own hand, if the knife does not have an adequate handguard and the tip of the blade hits a solid, mostly bony structure while being violently thrust into the victim's body. The injuries occurring under these conditions are localized on the flexor side of the knife-holding hand and may include the index, middle, ring and little fingers. They are seen particularly often on the little finger at the level of the proximal phalanx and in the skin fold of the proximal interphalangeal joint. The majority of these cuts run transversely to the longitudinal axis of the fingers and can show a step-like arrangement with different distances to the metacarpophalangeal joints, often from ulnar-proximal to radial-distal. In the six cases presented the injuries were most pronounced on the ulnar side of the hand. When the flexor tendons of the fingers are also severed and the tendon stumps are strongly retracted this indicates that the fist was firmly closed at the time of the injury.

**Keywords** Sharp force · Hand injury · Knife attack · Flexor tendon injury · Self-infliction of cuts

Dedicated to Prof. Dr. Dr. h. c. B. Brinkmann on the occasion of his 65th birthday.

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### Introduction

One of the main tasks of clinical forensic medicine is the evaluation of injuries and symptoms as to their origin, i.e., self-infliction vs. infliction by another person [7, 19], causation by external force vs. psychological stress [10, 21, 29] and intentional harm vs. damage by accident [3]. In many cases of sharp force injuries the total wound pattern (e.g., severity, localization, distribution and morphology of the individual lesions) allows a differentiation between accidental [14], artificial [13, 25], suicidal [17, 18] or homicidal [2, 6, 15, 20] infliction and conclusions to be drawn on the course of events and the weapon used [2, 23].

After knife attacks by another person, victims who are primarily able to act often show stab or cut wounds on their hands sustained in the attempt to ward off the attack. Such defense injuries provide highly specific evidence that the victim was assaulted [15]. Moreover, they show that the attacked individual was—at least initially—conscious and able to move. On the other hand, the absence of defense injuries does not necessarily suggest self-infliction [15, 22, 24].

Cut injuries on the flexor side of the hand usually occur when the victim grasps the blade of the knife or raises his hands towards the assailant to protect himself [22]. However, the perpetrators themselves may also suffer injuries to their hands. The following cases from our own investigation material are presented to illustrate special features of cut injuries on the flexor side of the offender's hand.

### Case reports

#### Case 1

An elderly woman was found dead in her apartment with numerous stab and cut wounds. The autopsy revealed that several stabs ended in the bony skullcap. The suspect, who was arrested shortly afterwards, showed transverse cut

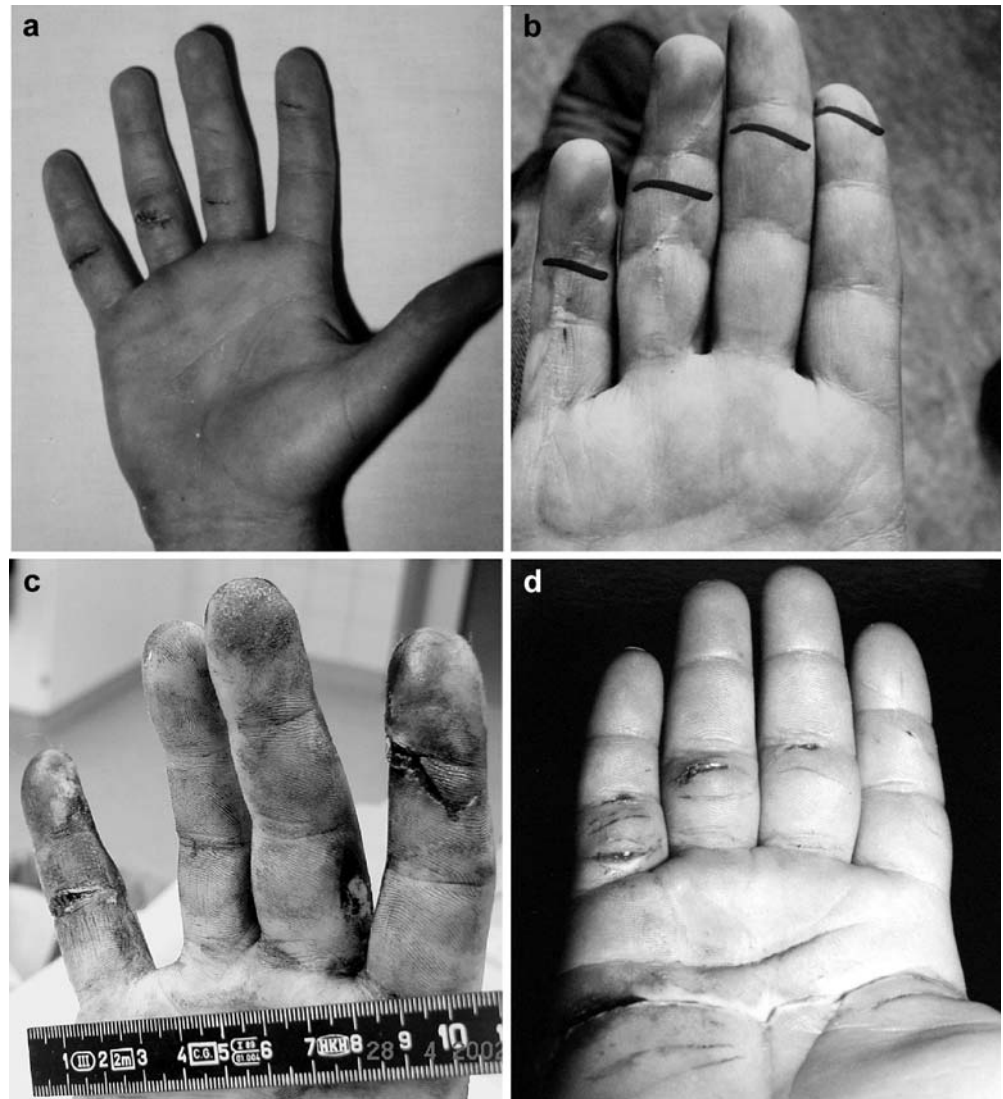
wounds on the flexor side of his right little, ring and middle fingers. The injury on the little finger was localized in the skin fold of the proximal interphalangeal joint, those of the ring and middle fingers on the proximal phalanges. The cuts showed a step-like arrangement with different distances from the respective metacarpophalangeal joints (Fig. 1a). Distally, further superficial lesions were discernible on the middle phalanges of the ring and middle fingers as well as on the distal phalanx of the index finger. The flexor tendons of the fingers were intact. Upon confrontation with these findings, the suspect admitted that his blood-soiled hand had slipped down onto the blade of the kitchen knife while stabbing at the victim's head.

## Case 2

The body of a 25-year-old man who had been reported missing 2 months before was recovered from a river. At autopsy 17 stab wounds were found with one ending in the greater trochanter of the left femur. On the day when the

man had been reported missing, the victim's 25-year-old business partner had sought treatment in a hospital for several cut wounds of his right hand. The following injuries were recorded and surgically treated: on the middle phalanges of the little, ring and middle fingers transverse cut wounds with a step-like arrangement were localized proximal to the distal joints of the fingers. The deep flexor tendons of the right little and ring fingers were severed. The proximal tendon stumps had retracted as far as the carpal tunnel. Moreover the tip of the index finger was partially amputated. Figure 1b shows the right hand of the suspect about 11 weeks later; the location and orientation of the primary injuries have been marked according to the surgeon's report. The additional, partly zigzag-shaped scars are due to the surgery. The suspect at first claimed to have slipped and fallen while carrying a meat knife in his left hand, thereby cutting his right hand. The reconstruction at the scene proved that this version was not plausible.

**Fig. 1a-d** Cuts on perpetrator's hand. **a** Case 1, **b** case 2: state of wound healing 76 days after hand surgery, primary injuries marked according to the surgeon's report, **c** case 3, **d** case 4



## Case 3

A 59-year-old man was killed during an argument in the course of which he suffered 10 stab injuries mostly located on the head and along the cervical spine. On the palmar side of his right hand the perpetrator showed a cut wound of the middle phalanx of the index finger with severance of the deep flexor tendon. The right little finger showed an approximately transverse cut wound in the flexor skin fold of the proximal interphalangeal joint with severance of both the deep and the superficial flexor tendons (Fig. 1c). The offender stated that he had suffered the injury during the knife attack when his hand slipped from the hilt onto the blade.

## Case 4

In the basement of a private house the body of a 32-year-old man was found rolled into a carpet. The deceased showed more than 60 stab wounds, 18 stabs were localized on the anterior thorax and were largely consistent with partial cuts and stabs to the ribs and the sternum. Further stab injuries were found in the region of the mid-face and the forehead. On the offender's right palm there was a 9 cm long and up to 1 cm deep, transverse cut wound with a shelved distal wound edge; the deepest part of the wound was found on the hypothenar. Proximal to this wound, three other superficial cuts were localized, one on the thenar and two on the hypothenar. On the flexor side of the right little, ring and middle fingers the proximal phalanges showed 2–5 mostly superficial, transverse cut wounds partially localized in the skin folds of the proximal interphalangeal joints (Fig. 1d). On the flexor side of the right index finger three further short, superficial cuts were discernible on the middle and distal phalanges. No surgical treatment had been given. The perpetrator (right handed) had claimed at first to have injured himself when his hand slipped down from the handle of a scraper-like tool used to remove floor covering. After being told that the injuries could not have been caused as described, he changed his story and stated that these were defense injuries suffered when the victim (also right handed) attacked him with a knife. No further stab or cut wounds were detected on the perpetrator's body.

## Case 5

A 17-year-old girl was killed by 16 stab and cut injuries. Some of the stab wounds caused lesions of the sternum and the skullcap (frontal and occipital bone). On the flexor side of the offender's right hand there was a 2 cm long, gaping cut wound on the middle phalanx of the little finger and a 1 cm long, transverse cut on the metacarpophalangeal joint of the ring finger. The blade and the hilt of the kitchen knife showed traces of blood with the DNA characteristics of both persons involved. During the interrogation the offender admitted that he had had "wet

hands" and that the hand holding the knife had slipped from the hilt onto the blade during the attack.

## Case 6

A 31-year-old woman was found dead with 32 stab and cut wounds; one of them ended in the lumbar spine and another one in the fourth thoracic vertebral body. On the perpetrator's right little finger there was a transverse, 3 mm long, superficial incision in the skin fold of the proximal interphalangeal joint. Proximally, the upper skin layers were detached over a length of 3 mm.

## Synopsis

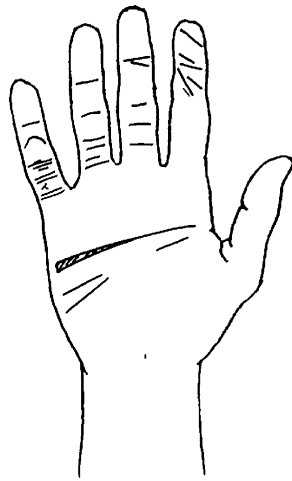
- All the victims had suffered multiple stab wounds with at least one involving a bone.
- The identified inflicting weapons were knives with a single-edged, fixed blade. The blades were at least 10 cm long and at least 1.5 mm thick. In cases 5 and 6 the blades were bent, in case 3 the blade had broken at the tip (Fig. 2a), in case 4 near the hilt (Fig. 2b). Blood traces were found on blades and handles except for case 4 (blood traces only on the blade). Except for case 1, the handles were anatomically shaped but did not have a hand guard.
- In all the perpetrators / suspects the injuries were on the dominant (right) hand. There were no other sharp force injuries on hands and body.

Altogether, there were 31 cut injuries on the offenders' hands, all localized on the flexor side, which usually declined in depth from ulnar to radial. An especially characteristic feature was that on the open palm the individual lesions of the fingers showed a step-like



**Fig. 2a** Knife used in case 3 with anatomically shaped handle and blade wider than the grip. Blade tip broken during attack. **b** Knife used in case 4 with anatomically shaped handle, so-called clip point blade. Total blade broken off during offence

**Fig. 3** Cumulative diagram of the localization of all the 31 cut injuries to the right hand (palmar surface) found in the 6 perpetrators of the study material



formation (cases 1, 2, and 4, Fig. 1a, b, d, respectively); in cases 2 and 4 the cuts were arranged from ulnar-proximal to radial-distal. Cut injuries were particularly frequent on the proximal phalanx of the little finger. Flexor tendons were severed on the little finger in two cases (no. 2 and 3), on the ring finger in one case (no. 2) and on the index finger also in one case (no. 3). When cut wounds were localized on the palm (case 4), the hypothenar was a preferred site and the depth of the cut declined from the ulnar edge towards the middle of the hand. A cumulative diagram of the local distribution of all 31 lesions is given in Fig. 3.

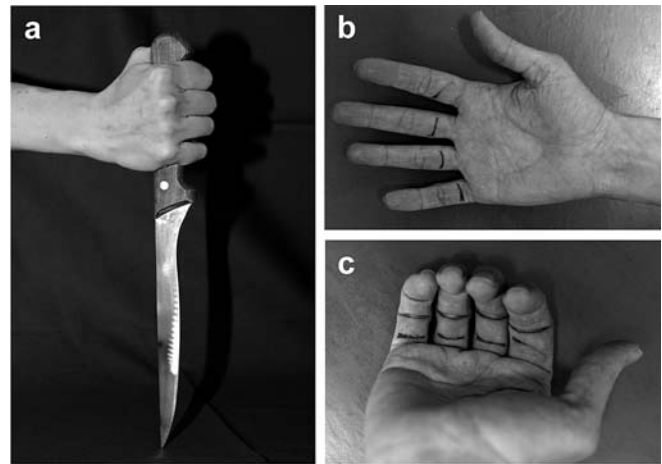
## Materials and methods

### Experimental stabs

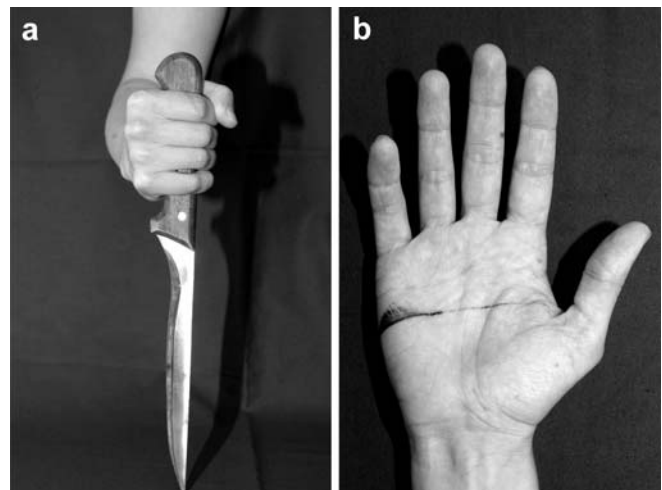
In order to illustrate the mechanism of injury, a conventional kitchen knife (slicer or utility knife) similar to those used by the offenders in the demonstrated cases was mechanically blunted. The former cutting edge of the blade was then dyed with an ink pad to visualize the contact sites on the hand. In each stab, the tip of the knife was placed on a solid object and the firmly closed hand was quickly moved along the blade towards the tip imitating a stab to a solid resistance. The knife was held in the following ways:

1. The blade projected on the ulnar side of the fist, the cutting edge pointing towards the proximal interphalangeal joints (Fig. 4a). Figure 4b shows the resulting ink markings running transversely across the proximal phalanges of the little, ring and middle fingers. When the fingers are held in a flexed position, the individual ink markings form a straight line (Fig. 4c).
2. The blade projected on the ulnar side of the fist, the cutting edge pointing towards the palm (Fig. 5a). The resulting ink markings are found on the palm and are accentuated in the hypothenar region (Fig. 5b).

For each of the above settings 3 experimental stabs were performed with corresponding results.



**Fig. 4a-c** Simulation of the mechanism wounding the active knife-holding hand during the stab. **a** Position of the knife in the right hand with blade projecting on the ulnar side, cutting edge pointing towards the interphalangeal joints of the fingers. **b** Linear ink marks on the flexor sides of the fingers after slipping along the cutting edge blunted and dyed before the test. **c** When fingers are flexed the individual contact sites form a nearly straight line



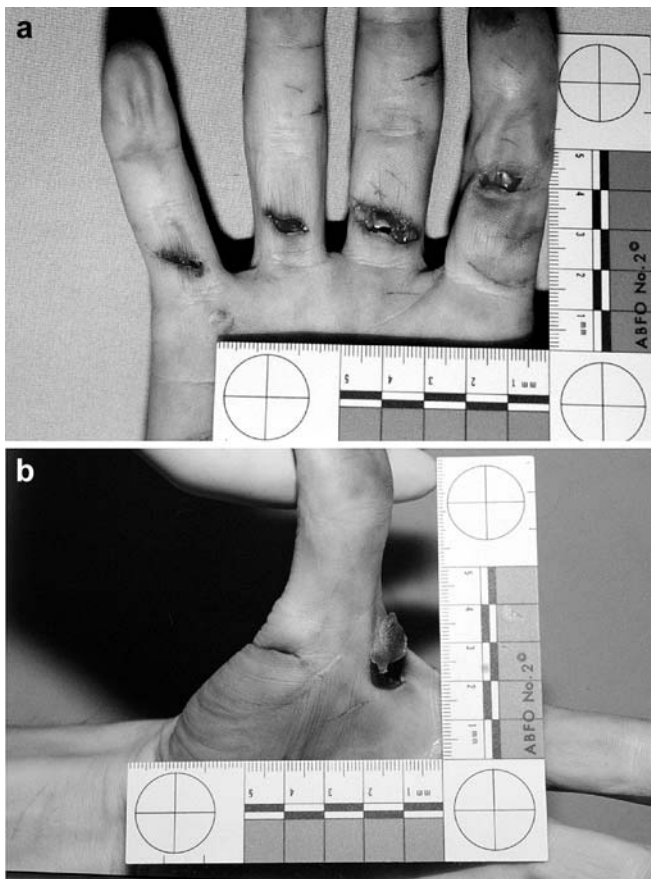
**Fig. 5a** Blade projecting on the ulnar side of the fist, cutting edge pointing towards palm, **b** resulting ink marking on the palm with accentuation of the hypothenar region

### Findings in victims of knife attacks

#### *Clinical study material assessed by the authors*

For the purpose of comparison, 150 subsequent forensic examinations of victims having survived a knife attack were evaluated. 72 of these individuals showed sharp force injuries on their hands and/or forearms. Only in one victim was a comparable pattern of injuries found: transverse cuts to the right ring and little fingers with severance of the flexor tendons. However, in addition there were several cuts on the victim's left hand involving particularly the web between thumb and index finger.





**Fig. 6a-b** Differential diagnosis: “active” defense injuries on the hands of a young man who seized the blade to defend himself. **a** Transverse cut injuries of the right index, middle, ring and little fingers, **b** cut injuries of the left thumb and of the web between thumb and index finger

### *Autopsy material*

Among 82 victims of fatal knife attacks consecutively investigated at the Freiburg Institute of Legal Medicine, there was only one case with an injury pattern similar to that found on the offenders’ stabbing hands: transverse cuts to the index, middle, ring and little fingers of the right hand (Fig. 6a). But contrary to the findings in the perpetrators the victim showed additional cuts on his left hand (Fig. 6b).

## **Discussion**

The six presented cases have some characteristic features in common:

- The perpetrator’s affected hand was the dominant hand.
- The injuries were localized on the palmar side, transversely to the longitudinal axis of the hand and the fingers, respectively.
- When the hand was extended the individual injuries on the flexor side of the fingers DII to DV usually

showed a step-like arrangement running from ulnar-proximal to radial-distal.

- The wound depth declined in an ulnar to radial direction.
- In several cases the flexor tendons of the fingers were severed, with a very pronounced retraction of the proximal tendon stumps in case 2.
- The thumb was never injured.
- There were no other sharp force injuries found aside from the hand holding the knife.
- The knives used did not have a handguard and the blades were at least 10 cm long.
- The victims had suffered multiple knife stabs with at least one involving a bony structure, mostly the skull but also the spine, sternum, ribs and femur.

The injury pattern in the offenders which was basically corresponding in the six cases, and the experimental stabs which produced analogous results, show that the described type of hand injury allows reconstructive conclusions as to the position of the hand and the knife. When the knife is held with the blade projecting on the ulnar side, the stab is usually effected by moving the raised arm in a downward direction. With this common method of attack [26] the victim’s most exposed sites are the head, the shoulders and the thorax [5]. Accordingly, bone injuries are frequently observed in victims of knife attacks [4]. The six victims of our study all showed at least one bone hit.

As biomechanical studies on the impact of stabs have demonstrated, submaximal impulses are sufficient to produce lesions on bony structures [11, 16, 30]. If the frictional forces between the offender’s hand and the handle of the knife are additionally reduced by sweat or blood, even stabs against a minor resistance, e.g. a strong fabric, may cause sliding of the hand. Obviously an anatomically shaped knife handle (case 4) or a blade which is wider than the grip (case 3, Fig. 2) are not always sufficient to prevent the hand from sliding onto the blade. As a consequence of a strong impact on a solid resistance, the knife blade may bend or even break (cases 3, 4).

There are two essential conditions for injuries to the hand holding the knife: The tip of the knife is decelerated abruptly by hitting a solid object, and the knife used does not have an effective handguard. The offender’s hand is injured when the knife is vigorously thrust and hits a solid resistance so that the hand slides from the hilt onto the blade. Three of the perpetrators attributed their own injuries to this mechanism.

For a differential diagnosis, the distinction of the described type of wounds from defense injuries caused by grasping the knife is of particular importance. The perpetrator may claim that he was attacked himself and seized the blade to ward off the stab (cf. case 4). As stated in the relevant forensic literature [e.g., 12, 25], most defense injuries occur on the left upper extremity, especially the middle hand, thumb and index finger, the interdigital spaces, the back of the hand and the forearm. In a study conducted by Metter and Benz on 118 defense injuries of the hands, almost 62% were localized on the

left side, about 50% in the metacarpal areas I and II as well as the thumb and the index finger. In their study material of 101 autopsy cases, a cut injury was found only 3 times on the right (2.5%) and once on the left (0.8%) little finger. These injuries were localized on the ulnar edge of the middle and distal phalanx of the little finger [22].

Herbst et al. reported self-inflicted cuts involving the flexor sides of the left thumb, index, middle and ring fingers in a suicide by stabs to the neck where the knife was held with both hands [15].

In our study material mentioned above (150 surviving victims of knife attacks) a comparable pattern of transverse cut injuries on the dominant hand was seen only once, but the respective victim showed several cuts on the other (left) hand as well involving particularly the web between the left thumb and index finger; these latter cuts could be clearly identified as defense injuries from grasping the blade. The same applies to the autopsy case demonstrated in Fig. 6 as the cut injuries affected both the right and left hand.

Cuts to the offender's hand caused by slipping off the hilt are expected to be most severe on the primarily exposed part of the fist, that is the ulnar side from where the blade usually projects (Figs. 4, 5). Accordingly, the little finger, especially its proximal phalanx and the skin fold of the proximal interphalangeal joint, is often affected (Fig. 3). If the cuts on the knife-holding hand are deep enough, the flexor tendons of the fingers can be severed. In our study material a deep flexor tendon was severed 3 times (cases 2 and 3) and a superficial flexor tendon was additionally severed once (case 3). That the deep flexor tendons are injured more often is due to their anatomical position [28].

According to the experience of hand surgeons, the position of the fingers at the time when the flexor tendons are severed is essential for the localization of the tendon stumps [9]. If a tendon is severed while the finger is flexed, the proximal tendon stump retracts, as the finger is extended again and is often found quite far away from the skin wound [8, 9]. The retraction of the proximal tendon stump within the tendon sheath is limited by laterally attached ligament structures (vincula tendineum) [1, 8]. This check-rein mechanism can even preserve a residual function of the finger flexors after complete severance of the tendons [8, 27]. On the other hand, if the flexor tendon is severed while being under tension, e.g. when closing the hand into a tight fist, the vincula may rupture, so that the retraction of the proximal tendon stump is particularly pronounced (cf. case 2: retraction of the proximal tendon stump as far as the carpal tunnel). In practical hand surgery, tendon injuries with extreme retraction of the proximal tendon stumps are known in connection with so-called de-boning injuries seen in butchers who hit a bone while cutting up meat, so that their hand slides onto the blade of the knife. This is an analogous mechanism of injury, as butchers also hold the knife with the blade projecting from the ulnar side of the fist when de-boning meat.

The localization of the tendon stumps after severance of the flexor tendons by a sharp instrument thus allows certain conclusions as to the state of action of the hand when suffering the injury. Systematic investigation of this biomechanical relationship might considerably extend the possibilities of reconstruction in relevant injuries. Generally, it has to be stressed once more that the forensic evaluation should always consider the total wound pattern and the circumstances of the individual case.

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