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Original article

Hand injury without any deficit: Is systematic surgical exploration justified?

Plaies de main sans déficit : l'exploration chirurgicale systématique est-elle justifiée ?

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ABSTRACT

Out of 100,000 inhabitants, 700 to 4000 suffer a hand wound each year. Numerous hand wounds that may not have a clinically evaluated deficit, actually have damage to a major structure after surgical exploration in the operating room (OR). The aim of our study was to evaluate the incidence of major structure damage within a population of patients presenting a hand wound with no deficit on the clinical examination. Every patient older than 12 years, consulting for a wound deeper than the dermis with no clinical signs of major structure damage underwent surgical treatment and exploration of the wound under regional anesthesia in the OR. After each surgery, the surgeon filled out an anonymous study form describing the wound characteristics and the potential findings of major structure damage. Of the 145 wounds with normal clinical examination, we found that 58.6% had a major structure damaged. Given that damage to any major structure in the hand can lead to functional sequela, and the fact that a well-conducted clinical examination by a qualified hand surgeon is not sufficient to eliminate major structure damage, we recommend systematic surgical exploration of hand wounds, even when no clinical deficit is evident.

Level of evidence III.: Type of study: diagnostic study.

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RÉSUMÉ

Entre 700 et 4000 personnes sur 100 000 habitants sont victimes chaque année d'une plaie de main. De nombreuses plaies de main, pourtant cliniquement évaluées comme non déficitaires, s'avèrent présenter des lésions d'éléments nobles après exploration chirurgicale. L'objectif de notre étude était d'évaluer l'incidence des lésions de structures nobles sur un panel de plaies de main jugées comme cliniquement rassurantes. Nous avons inclus tous les patients âgés de plus de 12 ans présentant une plaie dont la profondeur dépassait le derme et dont l'examen clinique initial était jugé rassurant. Les patients inclus dans l'étude ont alors bénéficié d'une exploration de leur plaie au bloc opératoire, en chirurgie ambulatoire, sous anesthésie locorégionale. En fin d'intervention, il était demandé à l'opérateur de renseigner au moyen d'un formulaire spécifique et anonyme les caractéristiques de la plaie et s'il existait une lésion d'un élément noble. Sur les 145 plaies explorées qui présentaient un examen clinique normal, 58,6 % comportaient une lésion d'un élément noble. Sachant qu'une atteinte non diagnostiquée d'un élément noble à la main peut être responsable de séquelles majeures et qu'un examen clinique normal réalisé par un praticien expérimenté est insuffisant pour affirmer l'absence de lésion d'un élément noble, nous recommandons l'exploration chirurgicale systématique de toutes plaies de main.

Niveau de preuve C.. – Étude : Diagnostique.

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1. Introduction

Acute hand injuries account for about 10% of the visits in the emergency department (ED) and represent more than 20% of the injuries treated in the ED [1]. Their incidence varies from 700 to 4000 per 100,000 inhabitants [2,3]. The decision to manage the wound surgically is taken in the ED based on the initial clinical examination. When the patient presents with a motor or a sensory deficit or with signs of devascularization, the diagnosis of tendon, nerve or artery injury is easy and surgical management is warranted. However, in cases of partial tendon or nerve injury, or in cases of joint capsule or flexor sheath injury, the clinical examination may be normal. Many of these injuries are managed non-surgically in the ED with skin sutures without any formal surgical exploration. In our daily practice, we have noticed that surgical exploration of hand injuries that appear normal based on clinical examination allowed us to diagnose unseen injuries.

The aim of our study was to determine the incidence of undiagnosed injuries of the flexor/extensor tendons, nerves, arteries, joint capsules, and flexor sheaths in a population of patients presenting with a hand injury and a normal clinical examination.

2. Patients and methods

In a prospective study, all consecutive patients aged 12 years or older who presented at the ED of our hospital between November 2015 and November 2016 and underwent surgical exploration of a hand injury with normal clinical examination were included. During this time period, 135 patients (93 males and 42 females) of a mean age of 36.2 years (range; 12–78) met the inclusion criteria (Table 1).

2.1. Clinical examination

All patients had a thorough initial clinical examination by a fellowship-trained hand surgeon. Sensory deficits were assessed with a Weber test and compared to the other digits. The vascular condition was evaluated by the color of the skin at the fingertip and the capillary pulse. Tendon lesions were ruled out by looking for a loss of tenodesis. All the flexor tendons (flexor pollicis longus, flexor digitorum superficialis, flexor digitorum profundus) and extensor tendons (extensor digitorum communis, extensor digiti minimi, extensor indicis and extensor pollicis longus) were tested individually. A quick exploration of the wound under local anesthesia (lidocaine 1%) was performed in the ED. If a lesion was suspected after the clinical examination or after the quick superficial exploration, the patient was excluded from the study.

2.2. Surgical exploration

All the included patients underwent surgical exploration by a fellowship-trained hand surgeon under regional anesthesia with tourniquet inflation. After each procedure, the surgeon was asked to fill out a form documenting the lesion(s) that had been diagnosed during the surgical exploration and the type of repair that had been performed. All patients were informed of the

Table 1
Population characteristics.

Number of wounds	145
Number of patients	135
Males, (n)	93 (68.9%)
Age, (years)	36.2 (12–78)
Smoker, (n)	55 (40.7%)
Right handed, (n)	116 (85.9%)

possibility of using data from their medical records and gave their agreement. Our hospital does not require IRB approval for observational studies.

2.3. Statistical analysis

Descriptive statistics are provided as mean values (standard deviation) for continuous variables and counts (percentage) for discrete variables.

3. Results

Between November 2015 and November 2016, there were 145 hand injuries in 135 patients; 47.6% of these injuries were dorsal, 37.2% were volar, and 15.2% were lateral or web space injuries. The injury characteristics are listed in Table 2. Injuries occurred at the work place in 21.5% of the cases and involved the non-dominant hand in 62.2% of the cases. The most frequent cause of injury was broken glass (31.7%), followed by knives (26.9%).

Undiagnosed injuries were found in 85 cases (58.6%) after surgical exploration: 56.5% of dorsal hand injuries, 61.1% of volar injuries, 69.2% of lateral injuries and 44.4% of web space injuries. Among these injuries that had not been diagnosed during clinical examination, 56.5% required surgical repair. These injuries are detailed in Tables 3 and 4. In dorsal hand injuries, 52.2% were tendon injuries, 1.4% were nerve injuries, 1.4% were arterial injuries and 18.8% were joint capsule injuries. In volar hand injuries, 29.7% were tendon injuries, 14.8% were nerve injuries, 13.0% were arterial injuries and 25.9% were flexor sheath injuries. In our study, the risk of undiagnosed injury was 69.2% after a knife cut (27/39) and 50% (23/46) after a broken glass cut (Table 5).

4. Discussion

Undiagnosed damage to a major structure in the hand after an apparently harmless wound or cut can lead to severely impaired hand function or infection, or both [4]. Even though meticulous clinical examination in the ED provides valuable information [5] on

Table 2
Wound characteristics.

	n	(%)
<i>Injury mechanism</i>		
Glass	46	31.7
Knife	39	26.9
Ceramic	7	4.8
Cutter	9	6.2
Saw	7	4.8
Screwdriver	1	0.7
Other	36	24.8
<i>Wound size</i>		
Less than 1 cm	50	34.5
1–2 cm	70	48.3
2–4 cm	23	15.9
More than 4 cm	2	1.4
<i>Injury location (dorsal wounds)</i>		
Fingers (Zones 1–4)	50	72.5
Metacarpals (Zones 5–6)	16	23.2
Wrist (Zone 7)	2	2.9
Forearm (Zone 8)	1	1.4
Total	69	
<i>Injury location (volar wounds)</i>		
Fingers (Zone 1–2)	32	59.3
Metacarpals (Zone 3)	13	24.1
Wrist (Zone 4)	3	5.6
Forearm (Zone 5)	6	11.1
Total	54	
<i>Context</i>		
Work accident	29	21.5
Injury of the dominant hand	52	38.5

Table 3
Assessment of damage.

	n	(%)
<i>Dorsal wounds</i>	69	47.6 ^a
Number of major structure damaged	30	43.5
Damage of at least one element	39	56.5
Sheath	0	
Joint	13	0.0
Tendon (partial)	32	18.8
Tendon (full laceration)	4	46.4
Nerve (partial)	1	5.8
Nerve (full laceration)	0	1.4
Artery	1	0.0
Bone	1	1.4
Muscle fibers	0	1.4
Total	52	0.0
<i>Volar wounds</i>	54	37.2 ^a
Number of major structure damaged	21	38.9
Damage of at least one element	33	61.1
Sheath	14	25.9
Joint	2	3.7
Tendon (partial)	13	24.1
Tendon (full laceration)	3	5.6
Nerve (partial)	2	3.7
Nerve (full laceration)	6	11.1
Artery	7	13.0
Bone	0	0.0
Muscle fibers	6	11.1
Total	53	
<i>Web space wounds</i>	9	6.2 ^a
Number of major structure damaged	5	55.6
Damage of at least one element	4	44.4
<i>Lateral wounds</i>	13	9.0 ^a
Number of major structure damaged	4	30.8
Damage of at least one element	9	69.2
<i>All wounds</i>		
Number of major structure damaged	60	41.4
Damage of at least one element	85	58.6

^a Percentage of all wounds.

the potential damage to functional structures of the hand, some lesions remain undiagnosed, and can be underestimated during this first physical examination (e.g. partial tendon tears, sheath breaches, joint capsule breaches, partial nerve cuts, partial artery wounds with secondary thrombosis). A literature review found the incidence of partial tendon tears after a hand wound reaching 30% [6,7]. Miranda et al. [8] found an 87% agreement rate between the intraoperative findings and the preoperative clinical suspicion for extensor tendon lesions in a population of 1500 hand injuries; this rate was 56.3% for flexor tendons. In our study, despite a normal clinical examination, 58.6% of patients were found to have an undiagnosed injury.

These lesions, when misdiagnosed, can lead to infectious complications such as septic flexor tenosynovitis in case of flexor sheath injury, or septic arthritis in case of joint capsule injury. They can also lead to functional impairment in case of tendon or nerve

Table 4
Major structure damage by location.

	n	Major damage
<i>Dorsal wounds</i>		
Fingers (zones 1–4)	50	30 (60.0%)
Metacarpals (Zones 5–6)	16	7 (43.8%)
Wrist (Zone 7)	2	2 (100.0%)
Forearm (Zone 8)	1	0 (0.0%)
Total	69	39 (56.5%)
<i>Volar wounds</i>		
Fingers (Zone 1–2)	32	16 (50.0%)
Metacarpal (Zone 3)	13	9 (69.2%)
Wrist (Zone 4)	3	3 (100.0%)
Forearm (Zone 5)	6	5 (83.3%)
Total	54	33 (61.1%)

Table 5
Major structure damage by injury mechanism.

	Dorsal wounds		Volar wounds ^a		All wounds	
Glass	13	(18.8%)	10	(18.5%)	23	(15.9%)
Knife	10	(14.5%)	17	(31.5%)	27	(18.6%)
Ceramic	3	(4.3%)	1	(1.9%)	4	(2.8%)
Cutter	5	(7.2%)	2	(3.7%)	7	(4.8%)
Saw	2	(2.9%)	1	(1.9%)	3	(2.1%)
Screwdriver	0	(0.0%)	1	(1.9%)	1	(0.7%)
Other	6	(8.7%)	14	(25.9%)	20	(13.8%)
Total	39	(56.5%)	46	(85.2%)	85	(58.6%)

^a Lateral and web wounds were grouped into volar wounds.

injury. From a technical and cost perspective, treatment of a chronic non-diagnosed damage to a major structure increases the surgical technical difficulty and triples the duration of work disability [2].

Our study is consistent with the existing literature [1,9–12], particularly with the cause of the injury being broken glass in many cases, and the fact that men are more often injured than women.

A well-conducted clinical examination seems insufficient to detect every injury. Therefore, some authors have proposed systematic ultrasonographic screening to improve the diagnosis of soft tissue lesions [13–16]. This has been shown to diagnose 100% of tendon lesions and 75% of nerve lesions [15,16]. Even though partial sheath cuts were not described, it seems highly improbable that even a trained operator would be able to detect such lesions, which still has a risk of infection. Moreover, ultrasonography requires training, and it is not sufficiently available to allow its systematic use in the clinical and paraclinical evaluation of every hand laceration. It is not yet enough to prevent systematic surgical exploration of every hand wound in the OR.

5. Conclusion

We recommend systematic surgical exploration of every hand laceration. A normal clinical and physical examination in the ED does not appear sufficient to rule out every soft tissue lesion.

Disclosure of interest

The authors declare that they have no competing interest.

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