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Injury, Fatal and Nonfatal: Sharp and Cutting-Edge Wounds

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Abstract

Sharp-force and cutting-edge injuries represent a large group of inflicted injury. Any sharp or bladed object can cause a range of injuries, in which stab- or slash-type injuries are predominant. The nature of injury is dependent on a wide variety of factors, including nature of implement, sharpness of blade, and sight of contact. This chapter explores these and other factors, giving examples of the types of injuries.

Introduction

Classification of injury types is crucial to proper forensic interpretation (Payne-James and Hinchliffe, 2011). Sharp-force injuries are those injuries caused by any object, weapon, or implement with cutting edges or points (e.g., knives, scissors, and broken glass). Sharp bladed implements can create different types of cuts including incised, stab, and slash wounds. An incised wound describes a clean-edged wound that divides tissue. Stab wounds and slash wounds are types of incised wounds, having been caused by a sharp edge. Certain bladed implements – for example, axes, machetes, and meat cleavers – can create deep wide wounds due to their sharpness, shape, and weight. The term ‘chop’ wounds may be used. Some such implements are blunt and although theoretically are cutting instruments, may only inflict blunt impact-type injuries. This may also apply where the impact is made, not by the cutting part but another, for example, the back of an axe or the side of the blade. The term laceration is wrongly used in the setting where bladed instruments are under discussion as lacerations are caused by the splitting of skin following blunt impact. The degree of force required to penetrate skin and underlying structures (which may include fat muscle and fibrous tissue) and bone with sharp implements such as knives or scissors or other sharp-edged implements is predominantly dependent on the characteristics of the implement, including sharpness, numbers of cutting edges, pointedness, and length of blade. Two types of injuries predominate – stabbing and slashing. With stabbing – the wound tends to be deeper than it is wide. With slashing – a blade is drawn across a surface and the wound may be wider than it is deep. As slash cuts may run across different surfaces or curvatures of the body, they may be of varying depth throughout their length. Many wounds are a combination of both.

For all wounds the depth of penetration will be dependent on the anatomical site of any injury, the characteristics of the implement (as described above), and any additional factors. Such a factor that may

require an increased penetrative force include the type or nature of overlying clothes. Clearly this may also affect the depth of penetration as will other factors including, for example, whether an individual is obese or fat and whether there are underlying bones. It is not possible in such settings to quantify the degree of force required to cause a stab injury – but qualitative interpretation can be undertaken by using the following scale. The degree of force required to inflict an injury may be described as any of – weak, weak/moderate, moderate, moderate/severe, and severe. Studies have been undertaken to more accurately quantify force (Annaihd *et al.*, 2013) but at present such techniques are not practical. It is not possible and is inappropriate to comment on the degree of force without having some information about the circumstances of the alleged injury and the characteristics of the implement.

For example a blunt, nonpointed pair of scissors may require severe force in contrast to a very sharp, pointed knife which may only require a weak/moderate force to penetrate to the same extent. A clear description of the wound can also sometime assist in determining the kind of force required as there may be adjacent evidence of where attempts of penetration have already been made.

A sharp blade or point drawn across the skin may be able to create a substantial slash-type injury with only weak or moderate force. Some injuries are not capable of being divided clearly into the stab, slash, chop, or incised category, but may exhibit features of some or all.

Incidence

Generally injuries most frequently seen in those survivors and fatalities of sharp-force injuries are caused by implements such as knives and less commonly broken glass, although any type of agent with a sharp edge or point can cause such wounds. In the United Kingdom to the year ending March 2014, the police recorded 25 972 offenses involving a knife or sharp instrument, a 2% decrease compared with the previous year. Analysis of

Table 1 Distribution of wounds by body region

| Body region | Percentage of all wounds |
|-----------------------|--------------------------|
| Head (face and scalp) | 22.3 |
| Neck | 6.5 |
| Shoulders | 2.7 |
| Chest | 22.3 |
| Abdomen | 12.4 |
| Groin | 1 |
| Thighs | 7.9 |
| Buttocks | 4.9 |
| Arms | 19.9 |

Source: Modified from Bleetman, A., Watson, C.H., Horsfall, I., Champion, S.M., 2003. Wounding patterns and human performance in knife attacks: Optimising the protection provided by knife resistant body armour. *Journal of Clinical Forensic Medicine* 10, 243–248.

selected individual offense groups shows that the fall in knife or sharp instrument offenses is largely due to a reduction in robbery offenses involving a knife or sharp instrument. In 2013–2014 in the United Kingdom there were 200 homicides involving a knife or sharp instrument (Office of National Statistics, 2014). The type of implement varies between countries and cultures and in certain settings other implements such as axes or machetes or Samurai swords (which may combine a sharp or sharpish edge with a heavy weight and blunt surfaces) are more available and may be used more frequently. These may produce injuries that have both sharp-force and blunt-force elements – the term ‘chop’ wounds is appropriate (Misliwetz and Denk, 1994; Ong, 1999). The sites of injury in a study of wounds from penetrating injuries in the 1990s from Glasgow (Bleetman *et al.*, 2003) showed a range of sites of wounding, with head, chest, and arms predominating (Table 1).

Wound Characteristics

Stab and slash wounds are generally differentiated by the fact that stab wounds are deeper rather than wider because of the mode of contact with the body, namely thrusting the knife by one means or another into the body. Incised slash injuries are caused by the sharp edge or blade moving tangentially across the skin surface. This definition is of use when the dimensions of a wound can be properly assessed, for example, at autopsy. This, however, itself is not always ideal when measuring wound depth and comparing it with sizes of potential causative weapons as tissues compress and expand. The length of the wound can be quantified, but caution needs to be exercised in overinterpreting what it means, for example, in relation to the size of the blade or weapon. In the living victim, treatment within hospital may not properly document the size of wound prior to exploration or closure, or the depth of wound following exploration such as laparotomy or thoracotomy. Bolliger



Figure 1 Scar following a stab wound to the neck (white line indicates site of original stab wound, remainder of scar is caused by planned surgical exposure).

et al. (2014) have compared radiological and probe methods of determining wound depth and characteristics and found that neither are completely satisfactory. Interpretation of such injury can become difficult. Figure 1 shows a scar following a stab wound to the neck. The operation notes did not detail the depth of penetration, no major structures were damaged, and persistent bleeding was shown to originate from a small unnamed artery. The line indicates the original stab wound. The operation scar which extended the initial stab wound obscured detail, and no documentation had been made of the preoperative wound characteristics. Such issues become very relevant in court cases where a charge of attempted murder may be argued on the perceived depth of penetration of a knife (and by inference the force used to create the wound). It is in situations such as this that proper documentation of injury, pre-treatment, within the nonforensic primary care and trauma settings, can be extremely helpful.

It should also be appreciated that a knife, glass, or other object or fragment with a sharp edge is capable of producing a cleanly cut wound resulting in a stab or an

incision. Perhaps the most common error that non-forensic personnel make is using the term laceration (skin splitting or tearing after blunt-force injury) for an incised or stab wound when describing a ‘cut’ which they have treated (Milroy and Ruddy, 1997). This can be misleading in the absence of a proper forensic assessment. ‘Cut’ is a term that may be appropriate to use in the absence of a forensic assessment, which at a later stage and with proper documentation and records can better determine whether, for example, a cut on the head has been caused by a knife, or the impact of a baseball bat.

Cuts may be divided into those caused by blunt impact injury – lacerations – and those caused by sharp implements or edges – ‘incisions’ or incised-type and stabs. The distinction between incised wounds, stabs, and lacerations is of the greatest importance medicolegally as causation (blunt impact or sharp implement) is often the key to the outcome of a case. Although in terms of clinical treatment this is a minor issue, it can be extremely relevant in the medicolegal and forensic setting. Lack of understanding of the difference and its significance between lacerations and sharp-force wounds is probably the most common mistake made by nonforensic doctors at all levels when providing statement or reports for courts.

Heavy implements with a sharp surface such as an axe or machete can cause a combination of cutting injuries associated with crushing of underlying tissue and frequently fractures if there is an underlying bone. Sometimes, however, a lacerated wound is the predominant component rather than a clean-cut wound.

Lacerations versus Sharp-Force Cuts

Lacerations are caused by blunt-force impacts compressing and splitting the skin, or occasionally by shearing force. Lacerations most commonly occur where underlying bone is prominent – classically at the orbital margin. After treatment, that is, suture or gluing, it is often impossible to distinguish between a laceration and an incised wound, which is why adequate documentation before treatment is essential. The most significant difference that can distinguish between lacerations and incised wounds is that incised wounds have clean distinct edges. Lacerations may have macroscopically clean and distinct edges, but not under magnification. Generally lacerations have irregular or macerated edges – residual skin bridging (particularly at the ends) – and may have other features of blunt impact injury associated, for example, swelling, reddening, and bruising. **Figure 2** shows a laceration with local swelling and irregular, macerated wound edges.

Incised Wounds

Incised-type wounds may be caused by anything with a sharp edge, including knives and broken glass. If glass



Figure 2 Laceration. A laceration of the forehead extending through the full thickness of the scalp, with irregular macerated edges. Impact from a length of wood.

breaks at the time of impact, multiple cuts from sharp glass shards may be seen. **Figure 3(a)** shows the fingers of a male arrested for breaking into a house, having broken a window by punching with his hand. The illustration shows multiple small incised wounds. In contrast, another example of a hand punching through glass shows a single incised wound with no additional satellite lesions, at the thumb base (**Figure 3(b)**).

Incised wounds crossing irregular surfaces may be irregular in depth, but their linearity will assist in confirming causation. **Figure 4** shows the dorsum of a hand across which a sharp knife had been drawn.

Assaults with broken glasses or bottles are commonly seen in emergency medicine, maxillofacial, and plastic surgery clinics. The characteristics of such injury are multiple irregular incised-type wounds of variable depth and severity. **Figure 5** shows a male who had a pre-broken bottle thrust in his face. The wound edges are all clean with no skin bridging, confirming that sharp edges caused these injuries.

Figure 6(a) shows another typical ‘glassing’ injury after treatment and suture: the wounds were much more superficial and irregular. This particular injury was caused when an intact glass was thrust to the side of the face, breaking on impact. **Figure 6(b)** shows a further example of the nature of injury, in this case when a glass was impacted upon and broke on the head.

Figure 7 is another example of the type of injury seen when an intact glass object is impacted on the face, breaking on impact. The periorbital hematoma and the cut indicated by the arrow which is more likely to represent a laceration is caused by the (blunt) impact of glass striking, and the multiple incised-type wounds are caused by the pieces of broken glass after breakage.

With glassing injuries it is extremely important to try and identify from witness accounts and examination of the scene whether the glass or bottle was broken prior to impact, or on impact. Issues such as these become



Figure 3 (a) Fingers of a male after having broken a window with a punch with his hand. (b) Isolated incised wound also caused by punching (accidentally) through glass.



Figure 4 Dorsum of a hand and fingers across which a sharp knife had been drawn.



Figure 5 Male who had a pre-broken bottle thrust in his face.

extremely important in court cases where intent (to maximize injury) may be determined on the interpretation of the injury patterns.

Sharp blades may have features of their own which give rise to a patterned appearance. **Figure 8** illustrates the sutured incised wound of a male who alleged he had been assaulted with a serrated bread knife. This was confirmed by review of the injury where a repeated regular pattern could be observed along the length of the scar, which matched exactly with the serration pattern on the bread knife used in the attack.

Heavy weapons with sharp blades (e.g., meat cleavers, machetes, and swords) are capable of causing major injury with damage to soft tissues and bone.

A mixture of blunt and sharp injury may be present, and lacerations and incised wounds may be evident. Slash wounds ('slicing' or 'stripping') may be caused by the above implements with the intention of killing or simply disfiguring. Often the face is the target. Stanley knives, craft knives, razor blades, and other very sharp instruments may be used, creating clean cuts that can be repaired surgically but leave clean scars. Hand-fashioned weapons are often used in secure establishments such as prisons. **Figure 9(a)** shows a scar that was repaired surgically from a wound in which a sharp blade was used. The continuity across irregular surfaces indicates that pressure must have been applied throughout the length of the injury. **Figures 9(b)** and **(c)** show the

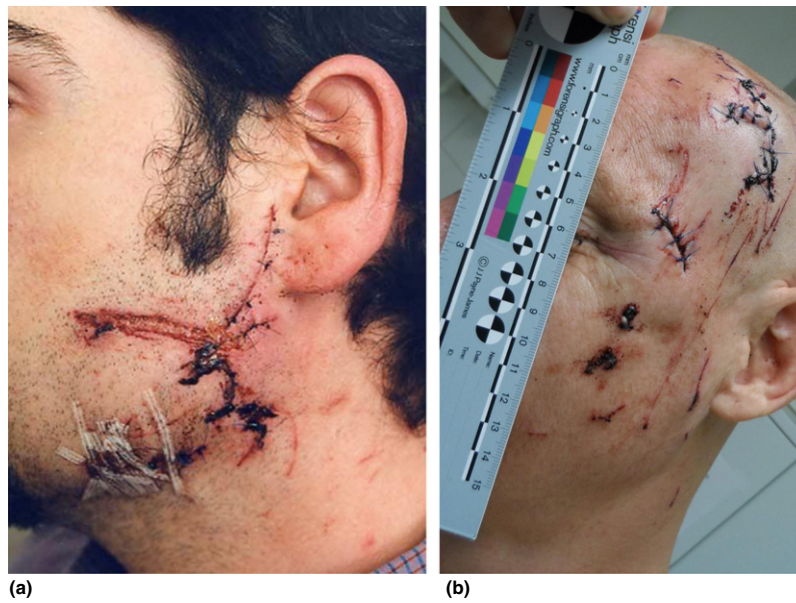


Figure 6 (a) Typical 'glassing' injury after treatment and suture. (b) A further example of the nature of injury when a glass impacts and breaks on contact with the head.

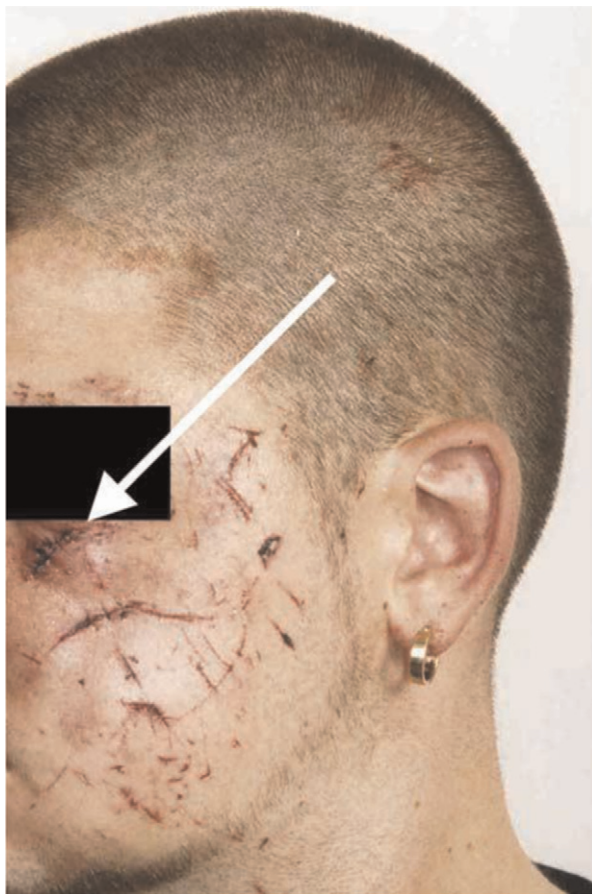


Figure 7 Face of a male after an intact glass object broke on impact on the face (arrow indicates site of impact over zygoma).



Figure 8 Sutured incised wound after assault with a serrated bread knife (arrows show site of measurable, repeat serration patterns).

initial appearance of a wound caused by a single blade slash cut across the face and the subsequent appearance after suture. Clearly there is a difference in emotive value between the two injuries and it is for the forensic examiner to make clear to the court the seriousness or otherwise of injuries that are sustained during assaults.

Figure 10 shows scarring following a serious assault with a machete about 1 year ago. The victim did not attend hospital and simply dressed the wounds until healed.

Death and loss of body parts may be the result of chop wounds. Compound fractures have been described

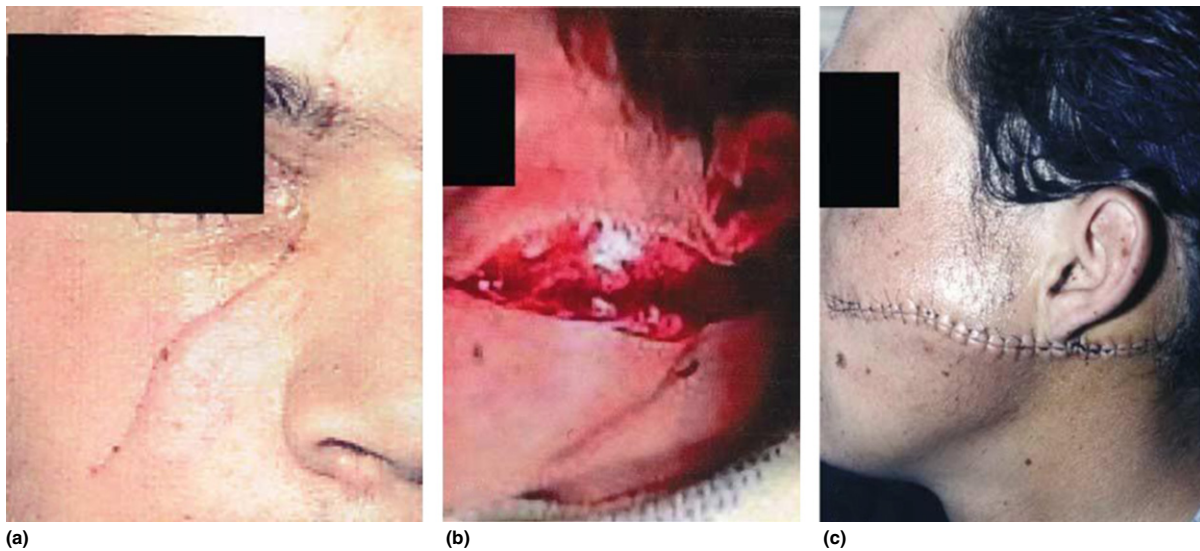


Figure 9 (a) Scar caused by a sharp blade that was surgically repaired. (b) The initial appearance of a wound caused by a single blade slash cut across the face and (c) the subsequent appearance after suture.



Figure 10 Scarring following an assault with a machete about 1 year previously.

– the term ‘bony laceration’ has been used, although ‘bony incision’ may be a better term.

Certain incised wounds have particular medicolegal relevance. These are incised wounds to the neck, wrist, and specific wounds to other parts of the body.

Incised Wounds in Specific Sites

Neck

Incised wounds to the neck are generally either homicidal or suicidal and only occasionally accidental. This is because the neck is generally not exposed, but is protected by the bony skeleton of mandible and upper chest. Accidental wounds are seen particularly in traffic accidents where such injuries are caused by fragments of glass.

The distinction between homicidal and suicidal wounds can be difficult and sometimes unascertainable at autopsy alone. It is essential before an opinion is given that account is taken of the circumstances surrounding the deceased’s movements shortly before death, his/her personal history, and a thorough examination of the scene of discovery of the body.

There are a number of characteristic features in terms of appearance and distribution of self-inflicted injury which apply to all sites of wounds including the neck (Gall *et al.*, 2011) that may be of assistance to the forensic practitioner in making the distinction between self-infliction or attack by an assailant, although it is advisable to be cautious and not over-interpret findings. When made by right-handed individuals, self-inflicted injuries may begin high on the left side of the neck and pass downward across the front to end on the right side. They may be deeper at their origin and then tail off on the right. Such wounds may also be horizontal, lying across the front of the neck. They are usually linear and clean-cut, since the skin is likely to be put under tension. Separate shallow wounds, ‘tentative’ or ‘hesitation’ wounds, are strongly indicative of self-infliction. There may be associated incised wounds to the wrist or

occasionally elsewhere. There may be evidence of healed self-harm scars indicating previous attempts at self-harm. Some self-inflicted incised wounds may be extremely deep, extending as far as and leaving score marks on the cervical vertebrae.

As a rule, homicidal wounds do not have the more organized 'planned' appearance of self-inflicted wounds and are unaccompanied by tentative injuries, but may be frequently accompanied by incised wounds that are difficult to interpret without accompanying obvious self-inflicted injuries. Generally, homicidal wounds are more randomly placed on the neck and, in some cases, have more irregular edges. In addition such wounds tend to be deeper, although this is by no means invariably so. Accompanying stab wounds may also be present on the neck and other parts of the body, as well as defense cuts to the backs of the arms and hands. There may also be noncutting injuries to the body which may have contributed to the cause of death.

Accidental incised wounds may be caused by glass in road traffic accidents. Such wounds are frequently accompanied by numerous small abrasions from glass fragments and particles of glass may be found in wounds if carefully searched for.

Wrists

Multiple and commonly parallel incised wounds to the ventral aspect of the wrist and lower forearm are typical of self-inflicted injury as a means of deliberate self-harm. They frequently accompany other self-inflicted cutting wounds to other parts of the body and often old healed wounds may be evident. Although the victim may be aiming to sever a major artery in the wrist, usually the resulting wounds are more superficial. [Figure 11](#) shows an extreme acute, nonfatal example, with a number of lesser tentative injuries ([Vanezis and West, 1983](#)). Incised wounds to the dorsal surface of the wrists are occasionally seen in cases of self-inflicted injury but, depending on their number and distribution, they may well be defensive injuries.

Other Sites

Planned incised wounds to various parts of the body, including the face and trunk, may well form part of torture, or of cultural rituals. It is important to distinguish these in those still living by inquiring of the individual, and in fatalities asking friends, family, or cultural experts to determine whether they are relevant to the death.

Stab Wounds

Forensic pathologists and physicians are frequently asked to determine the degree of force used in homicidal and nonfatal stabbing. It is almost impossible to



Figure 11 Multiple self-inflicted nonfatal wounds to wrist and forearm.

quantify in a precise way and therefore a more qualitative approach may be used. Generally, an impact with greater force is more likely to produce severe injury than an impact of lesser force.

There are a large number of factors or conditions that need to be taken into account when assessing injury severity. These factors range from and influence the movement of the knife up to the point of impact with the skin and from the skin to the point of termination and withdrawal from the body. These phases must be considered in conjunction with: (1) the properties of the knife; (2) the way the assailant delivers the blow, in terms of speed and direction; and (3) the movement or reaction of the victim to the assault. It is important to convey to the nonforensic investigator that this is a dynamic process that changes moment by moment. [Table 2](#) summarizes the main factors to consider when assessing force required.

It was previously believed that, once the skin had been pierced, unless the knife impacted against bone, virtually no resistance was offered by the internal soft tissues, including the major organs. More recent work has suggested that the scenario is more complex than previously appreciated ([O'Callaghan et al., 1999](#)). It appears that once the skin has been pierced, significant resistance may be offered by the internal organs and other soft tissues. Once the knife has impacted on the skin and even after piercing it, there still needs to be a firm hand on the knife to push the weapon further into the body, because it has been slowed down by the

resistance offered by the skin. In an accidental stabbing or where a knife has been thrown, less penetration into the body is to be expected. In the case of accidental stabbing, it is much more likely that, once resistance is offered by the skin, then there would not be a follow-through thrust, as in a deliberate movement. To produce such a further deliberate movement, the weapon would need to be anchored or held firmly. To produce impalement on to a knife there would need to be enough momentum by the victim moving toward the knife and it would need to be fixed firmly in some way. When a knife is thrown at a person, the main resistance will be by the skin, causing significant loss of its kinetic energy. Because there would be no follow-through, penetration into the body may not be deep because of the further resistance of the internal tissue.

Generally the best approach to assist those investigating such wounds is to advise that the force required is

in the following range – weak, weak/moderate, moderate, moderate/severe, or severe.

Wound Assessment

In a case involving sharp-force trauma, assessment of the injuries should take into account the following:

- the number of wounds
- their location and relationship to each other
- their character.

Characteristics of Surface Wounds

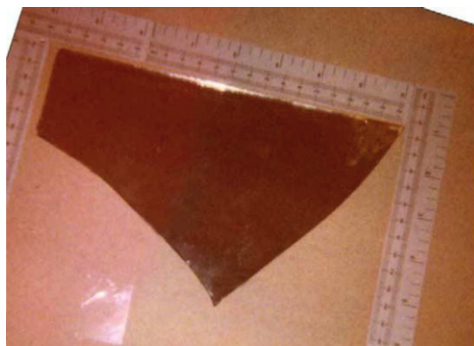
Assessment of stab wound characteristics may assist the forensic practitioner in identifying the type of implement involved, its shape, size, and any possible individual features such as a broken or bent blade tip or anomalous serrations on the blade. Additionally review of possible implements will allow a determination of whether an implement was capable of causing the injury described.

Figure 12(a) shows a piece of glass alleged to have created the wound seen on the thigh in Figure 12(b). The depth of the wound was measured at operation and, even allowing for compression, the piece of glass was too wide at all relevant points to have been responsible for creating the wound seen in Figure 12(b). The crime-scene investigators were asked to look for and were able to identify the weapon that had caused the injury.

Stab wounds on the surface of the body may show a wide variety of morphological characteristics, depending on the type of implement used, cutting surface, sharpness, width, and shape of the blade. Most stab wounds seen in the United Kingdom result from knives with a single sharp-edged blade. Occasionally, broken glass, screwdrivers, and other pointed objects are used. Most stab wounds caused by knives tend to have clean-cut edges with one or both ends appearing pointed. If the blade is single-edged the nonpointed end may be either squared off or split (fishtail) in appearance. Figure 13 shows an example of a ‘fishtail’ caused by a single-sided

Table 2 Examples of the many factors influencing outcome of stabbing

| Factor | Additional comment |
|--|---|
| <i>Intrinsic properties of knife</i> | |
| Shape of knife | Including length, extent of blade, single blade/double blade/serrated blade, sharp tip, round tip, and hilt |
| Sharpness of knife | Razors harp? Degree of sharpness? |
| Weight of knife | |
| <i>Delivery of blow by assailant</i> | |
| Velocity of thrust | Is force kept up throughout thrust? |
| Type/direction of thrust | Overarm, underarm? |
| <i>Movement of knife up to point of impact over which victim has influence</i> | |
| Clothing | Amount of clothing, body protector? |
| Movement of victim | Toward, away from, deflecting? |
| <i>Movement of knife through skin into body</i> | |
| Skin resistance | |
| Underlying organs | Fat, muscle, body cavity, bone, and solid organs, for example, liver? |
| Movement of organs | On respiration? |



(a)



(b)

Figure 12 (a) A piece of glass alleged to have created the wound (b) seen on the thigh.

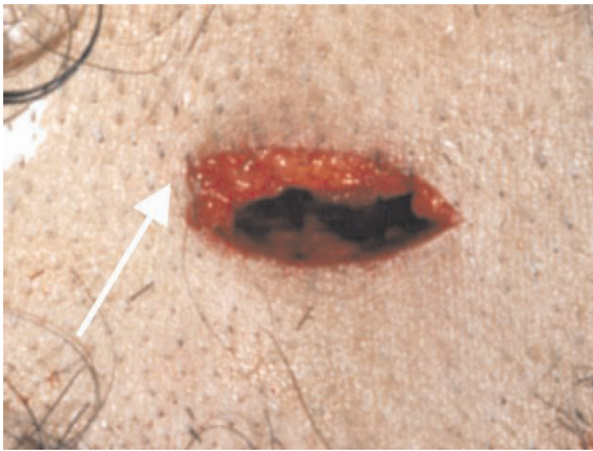


Figure 13 A 'fishtail' caused by a single-sided blade.

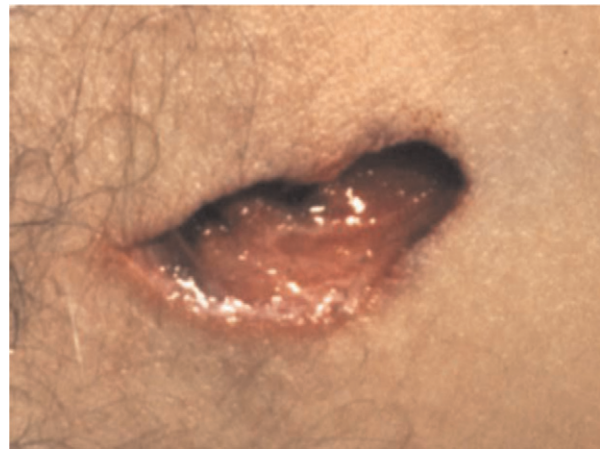


Figure 15 A stab wound showing a slight central notch on its upper margin.

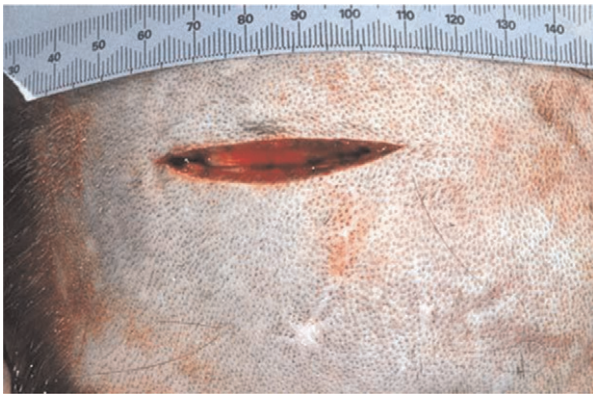


Figure 14 A tangential stab wound to the crown of the head with underlying scoring of the cranium.

blade, although there is evidence to suggest that a double-edged blade moving with rotational force in the wound may have created a similar appearance.

Figure 13 shows a stab wound caused by a knife with a single cutting edge. The right side of the wound is caused by the cutting side of the blade and the more ragged square/fishtail end, indicated by the arrow, is from the noncutting side.

A wound overlying bone, especially over the skull, requires care in its interpretation. It is not unusual to find a laceration of the skin resulting from a blunt impact having clean edges and a very similar superficial appearance to an incised or stab injury. The reason for this is that the skin, being close to a bony surface, becomes easily stretched during impact, thus tending to split cleanly. A thorough exploration of the wound to detect bridging tissue as one would observe within a laceration is essential. With sharp-force trauma one may see scoring by the weapon on the outer table of the skull. **Figure 14** shows a tangential stab wound (although this could be termed a slash wound – however, it was seen to be caused by stabbing motion) to the crown of the head

with underlying scoring of the cranium. This can be confirmed at autopsy but may not be able to be confirmed in a living victim, and the differentiation between a laceration and an incised wound depends on accurate assessment of the cut itself and absence of associated blunt injury. However, with a 'chop' wound it may be almost impossible to determine in the living, although computed tomography (CT) and magnetic resonance imaging (MRI) may assist.

Patterned bruising may also surround the wound as a result of impaction by the hilt of the knife. Sometimes the wound may show abraded edges or a clear hilt pattern (Murray and Green, 1987). Often wounds show a notch or change of direction along the margin on the skin. This is caused by relative movement of the knife and the body during the stabbing action, thus causing the exit track of the wound to be slightly modified. **Figure 15** shows a stab wound showing a slight central notch on its upper margin. The lower margin shows 'shelving,' with underlying tissue visible. Such wounds give the investigator an indication of the direction of the track of the wound.

Figure 16 shows a stab wound with a central notch giving the appearance of a V-shape, again caused by the dynamic movement of assailant, victim, and knife.

Other Information

There are a number of factors to assess in determining the mechanism of injury. Assessment of clothes has been referred to in relation to injuries caused by deliberate self-harm. In assault cases, careful examination of the defects of the items of clothing by a sharp weapon such as a knife and matching these up with the wounds on the victim can help in assessing the number of times the victim has been stabbed and the direction of the stab (**Figure 13**). Where possible – this is generally easier in

the deceased victim than the living where clothes may have been cut off or discarded during first aid or resuscitation – the forensic examiner should take the opportunity to examine the clothing and the various tears produced by a knife, in conjunction with the wounds found on the body and the implement supposedly used. The number of cuts in clothes may not correspond to the number of wounds on the body. This may be for a number of reasons, including that the weapon may impact on an outer garment but not reach the skin, clothing may be folded, the knife may cause more than one cut from the same thrust, and clothing at the point of impact may not be present, for example, it may have been pulled away from its normal position for various reasons.

Assessment of Wound Tracks

As with assessment of many injuries, detailed and accurate assessment is done better in the deceased victim than the living victim because treatment and repair may obscure information, and nonforensic personnel have

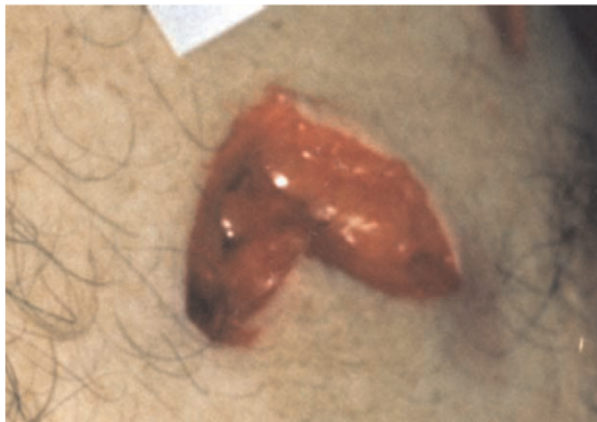


Figure 16 A stab wound with a central notch.

different agendas when documenting the type of injury. Although the characteristics of a stab wound on the surface of the body give a great deal of information, as discussed above, it is desirable to examine the track of a particular wound, which can be done at autopsy, or to attempt to describe it anatomically in the living survivor.

Ideally the following factors should be determined or commented upon:

1. the direction of impact on to the body
2. the depth of an injury resulting from stabbing
3. the force used to inflict the injury, taking into account the various structures injured
4. injured structures and their bearing on morbidity and mortality
5. in cases of multiple stabbing, to assess which surface wounds are responsible for which internal injuries.

The depth, or more accurately, the length of the track of the wound may give some guidance as to the depth to which the blade of the knife has penetrated. Nevertheless, it should be appreciated that a number of factors affect the estimation of the length of the track, which first, is only an approximation and second, depending on the site, may be valueless in correlating with the length of blade that has penetrated the body. This is particularly the case with abdominal and neck wounds. In chest wounds one must allow for the elasticity of the ribs, especially in younger subjects.

Figure 17(a) shows external injuries following multiple stab wounds on the left side of the chest. The probe indicates the initial entry through the arm then to the chest wall. **Figure 17(b)** shows the track of the wound continued into the upper lobe of the left lung.

Outcome of Injury

The forensic practitioner needs to be able to interpret first, the injuries seen and second, the potential for injury

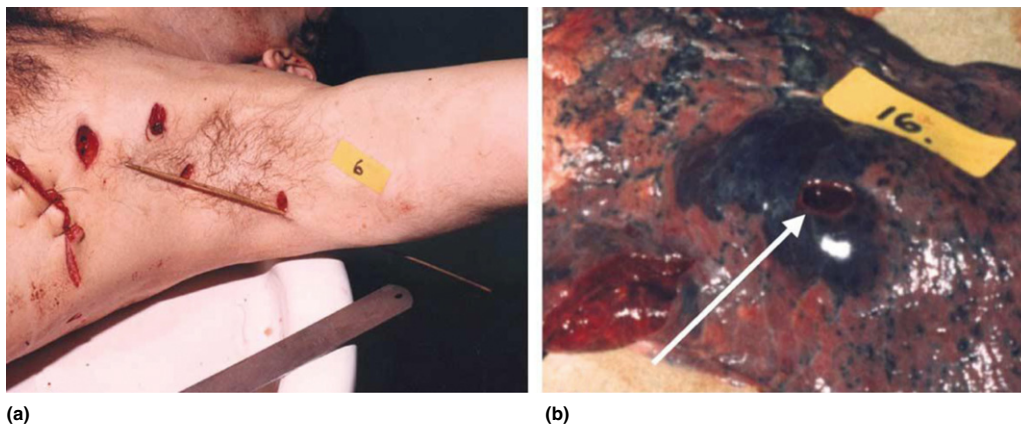


Figure 17 (a) External injuries following multiple stab wounds on the left side of the chest; (b) the track of the wound continued into the upper lobe of the left lung.

Table 3 Some of the potential effects of sharp-force trauma

Acute effects include:

- Hypovolemic shock from blood loss
- Tamponade
- Direct effect of injury to organ function, for example, heart and spinal cord
- Air embolism
- Asphyxia from airway obstruction from hematoma
- Aspiration of blood
- Pneumothorax
- Hemothorax

Subacute and chronic complications include:

- Infection
- Loss of or diminished function
- Aneurysm
- Dissection
- Ischemia
- Fistula
- Diaphragmatic hernia
- Adhesions
- Chronic inflammation

that could have or might have been the outcome in both living and deceased. **Table 3** identifies some of the potential outcomes of even single sharp-force or stab traumas required to take into account the various possible effects of sharp-force trauma, including the impact of medical intervention on the overall outcome and possible contribution to morbidity and mortality. The list below includes the more recognized effects of sharp-force trauma – acute, subacute, and chronic. There are many others.

Subacute and chronic complications include:

- infection
- loss of or diminished function
- aneurysm
- dissection
- ischemia
- fistula
- diaphragmatic hernia
- adhesions
- chronic inflammation.

Defense Wounds

Certain types of injuries may be described as ‘defense’ injuries. These are injuries that are typically seen when an individual has tried to defend him/herself against an attack, and are the results of instinctive reactions to assault. When attacked with blunt objects most individuals will attempt to protect their eyes, head, and neck by raising their arms, flexing their elbows, and covering the head and neck. As a result the exposed surfaces of the arms become the impact point for blows. Thus the extensor surface of the forearms (the ulnar side) may receive

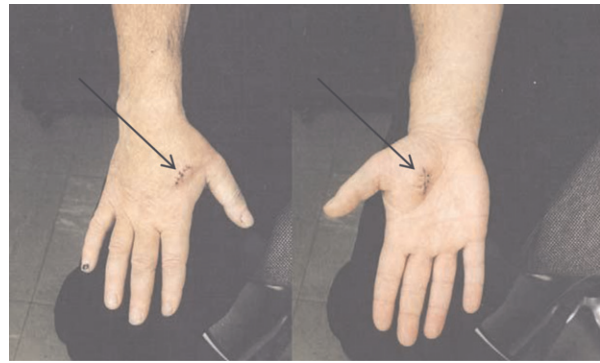


Figure 18 The palmar and dorsal surface of a hand after a knife attack. The palmar wound is the entrance wound – through the thenar eminence, exiting through the first dorsal interosseous space.



Figure 19 Injuries to the palms and ventral surfaces of the fingers.

blows, as may the lateral/posterior aspects of the upper arm, and the dorsum of the hands. Similarly the outer and posterior aspects of lower limbs and back may be injured as an individual curls into a ball, with flexion of spine, knees, and hips to protect the anterior part of the body.

In addition to the above, in sharp-force attacks another natural reaction is to try and disarm the attacker, often by grabbing the knife blade. This results in cuts to the palm and ulnar aspect of the hand. On some occasions the hands or arms may be raised to protect the body against the stabbing motion, resulting in stab wounds to the defense areas, which in some cases may be through and through because of the sharpness of the blade. **Figure 18** shows the palmar and dorsal surface of a hand and the sutured through and through cut where the victim had put his hand palmar surface out to ward off a knife attack. Note that the alignment is the same, confirming that this was from a single stab.

Figure 19 shows injuries to the palms and ventral surfaces of the fingers. Such wounds indicate that the

Table 4 Factors to assist in the differentiation between homicidal and suicidal stabbing

| Factor | Homicide | Suicide |
|--|--|---|
| <i>Scene</i> | | |
| Signs of disturbance | Likely | Very unlikely |
| Knife near body | Unlikely | Almost always |
| <i>Body</i> | | |
| Clothing pulled above wound | Unusual | Very common |
| Stab through clothing | Very common | Unusual |
| Single or very few deep wounds seen | Can be any number from one upwards | Common |
| Multiple deep wounds | Common | Uncommon |
| Body laid out neatly | Uncommon (unless restrained) | Common |
| Irregularly placed multiple wounds | Very common | Uncommon, tend to be in single region |
| Tentative wounds | Not seen (unless torture involved) | Common |
| Defense wounds | Common (almost half of cases) | No |
| Additional fresh marks of self-harm | No | Sometimes |
| Old marks of self-harm | Sometimes | Common |
| Location of injury in site accessible to reach | Possible | Commonly, chest, abdomen, neck, and wrist |
| Other types of injury (e.g., blunt impact) | Possible, particularly if there was a struggle | Unusual unless unrelated |

victim tried to grab hold of the weapon between all the fingers with the thumb in apposition, or predominantly between the forefinger and the thumb. In the latter situation care should be taken to differentiate between injuries caused by the knife slipping through the hand of the assailant holding a knife thus injuring his/her own hand, or from a genuine defense injury suffered by the victim.

The number of defense wounds tends to increase as the number of stab wounds to the victim increases and defense wounds in stab wound cases may be present in approximately 40% of the victims (Katkici *et al.*, 1994).

Homicidal versus Suicidal Stabbing

The assessment of any stabbing case requires great attention to detail, particularly where there is a possibility that the injuries may be self-inflicted. There are a number of reports which highlight these problems of determination (Pentone *et al.*, 2013; Kaliszan *et al.*, 2013; Saint-Martin *et al.*, 2008). In the living victim it is easier to determine a relevant history but in fatalities there may be times when the two categories are difficult to distinguish on pathological grounds (Karlsson, 1998). The circumstances, appearance of the scene, and any background information play an important role in resolving the problem and the autopsy findings should all be examined, taking into consideration all these factors. **Table 4** summarizes some of the factors that may differentiate between the two categories.

Summary

Sharp-force trauma may present in many different ways, with both living and deceased victims. Living victims are

able to provide accounts of what happened, but the characteristics of the injury may be poorly documented. For deceased victims the characteristics of the injury can be documented clearly, although the account of what happened may be lacking. In each case of sharp-force trauma, from the most minor to the most serious, accurate documentation, detailed review of available history, and interpretation of the findings with an understanding of the mechanism of injury will enable the investigators and courts to come to the most appropriate determination of outcome.

See also: Deaths: Trauma, Abdominal Cavity – Pathology. Deaths: Trauma, Head and Spine – Pathology. Deaths: Trauma, Musculoskeletal System – Pathology. Deaths: Trauma, Thorax – Pathology. Deliberate Self-Harm Patterns: Patterns of Injury. Injury, Fatal and Nonfatal: Injury Documentation. Injury, Fatal and Nonfatal: Legal Classifications. Suicide: Etiology, Methods, and Statistics

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