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CASE REPORT

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Skin tension and cleavage lines (Langer's lines) causing distortion of ante- and postmortem wound morphology

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Abstract The assessment of individual wounds at autopsy may be complicated by the superimposition of a number of injuries or damage to tissues that occurred after death, either of which has the potential to distort the morphology of the initial injury. Additional factors that may change the shape of wounds are (1) the relationship of the wound to the so-called skin cleavage lines (Langer's lines) and (2) tension placed on the skin. Three autopsy cases are reported to demonstrate once more how wound morphology may be altered by such factors. In case 1, rectangular stab wounds to the base of the neck in a 53-year-old man, which suggested that a square or rectangular tool may have caused the injuries, were altered to more typical knife stab wounds once skin tension had been released at autopsy. The uppermost wounds, however, continued to gape due to the effects of skin cleavage lines. In case 2, slit-like wounds resembling stab wounds in the neck of a 54-year-old woman found in a river were shown to be circular once skin tension had been released. In case 3, the effects of either cleavage lines or skin tension could be demonstrated on excised wounds from a 43-year-old man whose body had also been found in a river; tensile forces easily changed circular into slit-like wounds. Tension and/or skin cleavage lines may transform round skin defects into slit-like wounds resembling knife stab wounds, round out genuine stab wounds and artefactually lengthen stab wounds. These factors must be taken into consideration carefully when wounds are assessed at the death scene prior to autopsy.

Keywords Stab wounds · Wound morphology · Postmortem injury · Skin cleavage lines · Langer's lines

Introduction

Accurate assessment of wound morphology is an essential part of medicolegal autopsies. Forensic pathological examination of wounds includes determination as to whether the wounds were inflicted during life or were caused after death and what were the most likely weapons or causative mechanisms involved in wound aetiology. However, problems may arise in the description and interpretation of wounds on a number of occasions [1, 5, 7, 14, 16–18, 20, 21].

Assessment of wounds must be made in the knowledge that distortions of initial morphology may arise from a variety of causes. In the following report, such distortion is illustrated by three autopsy cases with significant alterations to both ante- and postmortem wound morphology due to the tensile effects of intradermal bundles of collagen and elastin fibres, the so-called skin cleavage lines (Langer's lines) and tension applied to skin.

Case reports

Case 1 A 53-year-old male was found dead sitting in a chair in the cellar of his home. A variety of workshop tools were present in the cellar. The man had been stabbed seven times in the right side of his neck with death due to exsanguination from wounds to the right subclavian vein and artery, the right common carotid artery and the right jugular vein. On initial examination at the death scene, with the head of the deceased slumped to the left and the skin of the neck under tension, the stab wounds appeared rectangular in configuration with "tails" to the right (Fig. 1a). This, at first sight, suggested that the weapon that had caused the

*Dedicated to Prof. Dr. Bernd Brinkmann on the occasion of his 65th birthday

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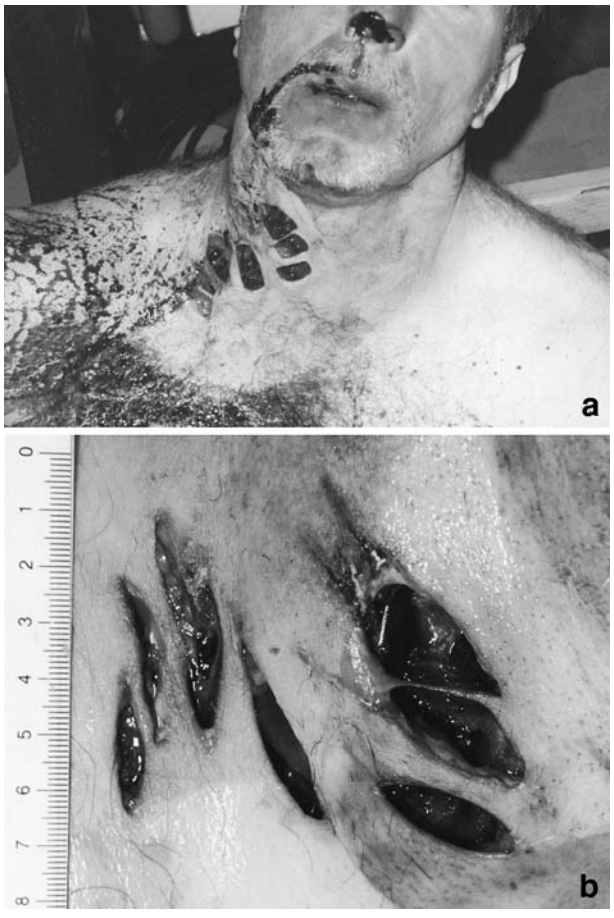

Fig. 1 Case 1. **a** Stab wounds appearing rectangular in configuration on initial examination at the death scene with tails observed on the lateral aspect. **b** Alteration in the shape of the stab wounds once skin tension had been released. The uppermost wounds continue to gape compared to the lower wounds, thus showing clearly the effects of skin cleavage lines on wounds of different orientations

injuries had either a square or a rectangular cross-section and may have been one of the adjacent workshop tools. On repositioning of the body at autopsy, however, with relaxation of the neck skin, the wounds assumed a shape much more typical of knife stab wounds including superficial slits at the superior ends of the wounds ("tailed ends") (Fig. 1b), although there was still gaping of the uppermost wounds due to the effect of skin cleavage lines. The lower wounds were slit-like and fitted a knife with a double-edged blade with a width of ~22 mm.

Case 2 The putrefied body of a 54-year-old female was found dressed floating in a river. Her bicycle with a suicide note had been found on a bridge over the river 3 weeks before. On initial examination of the body, a series of slit-like wounds were observed over the upper anterior chest which resembled stab wounds (Fig. 2a). At autopsy, on movement of the arm, however, the wounds assumed a more characteristic circular shape typical of postmortem freshwater crustacean activity (Fig. 2b). Dissection revealed that the wounds were quite superficial, only reaching the upper layer of the subcutaneous adipose tissue and did not penetrate deeper tissues or organs. At autopsy, there were no significant injuries or underlying organic diseases that could have caused or contributed to death. Apart from putrefactive changes, histology was unremarkable. Death was attributed to freshwater drowning given the circumstances and the essentially negative postmortem findings.

Case 3 The body of a 43-year-old male was found floating in a river 3 1/2 months after he was observed to leave a car on a bridge and jump into the water. The body demonstrated marked putrefactive changes with skeletonization of the head and adipocere formation. There was extensive trauma attributed to boat propeller injuries with loss of both legs.

Fig. 2 Case 2. **a** Slit-like wounds resembling stab wounds at the base of the neck in the putrefied body of a 54-year-old female retrieved from a river. **b** Alteration in the shapes of the wounds once the arm had been moved at autopsy

Fig. 3 Case 3. Circular defects of the skin corresponding to crustacean activity

At autopsy, circular defects corresponding to freshwater crustacean activity were noted in the skin (Fig. 3). The internal organs were markedly putrefied. Histology revealed no preexisting pathological conditions. It was stated that death was most probably due to drowning and possible trauma given the circumstances and autopsy findings. Excision of these defects enabled their morphology to be manipulated by applying tension across the skin segment with circular wounds (Fig. 4a) being converted to slit-like wounds (Fig. 4b).

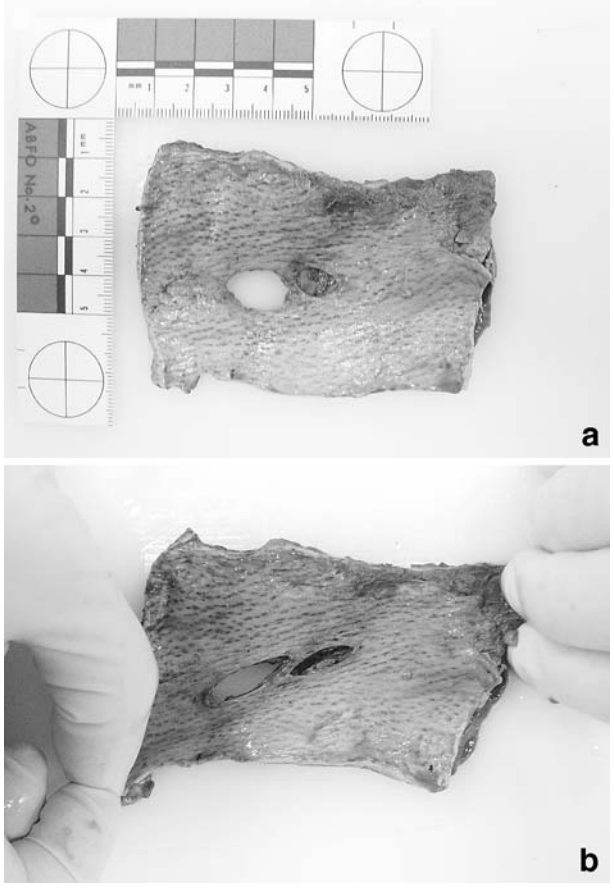

Fig. 4 Case 3. **a** Excised piece of skin in a relaxed state demonstrating circular defects. **b** The same piece of skin now under tension demonstrating significant alteration of wound shape

Discussion

The study group of Brinkmann has extensively investigated the morphology of different wounds deriving from a broad variety of underlying aetiologies [e.g., 2–7]. Unfortunately, wounds are often not found in pristine condition since destruction of wounds by subsequent trauma or modification by putrefactive changes and postmortem animal depredation may have occurred [8, 15, 19]. The initial morphology of wounds may be also significantly altered by local skin tension and the direction of Langer's lines [7, 12]. Langer's lines are caused by bundles of fibroconnective tissues within the reticular dermis that place certain tensions on skin and subcutaneous tissues. The directions of these parallel bundles tend to be horizontal in the trunk and neck and longitudinal in the skin and limbs [10, 23]. The existence of skin cleavage lines is well recognised in surgical practice, and surgeons attempt to make skin incisions along, rather than across, cleavage lines to minimise the risk of wound dehiscence and subsequent scar formation [13].

Distortion of wounds by skin cleavage lines was already documented in 1898 by Von Hofmann who showed the

Fig. 5 Skin cleavage lines clearly demonstrated in the body of a 4-month-old infant who was experimentally stabbed postmortem with a sharp conical instrument. Linear distortion of wounds resulted in slit-like defects resembling knife stab wounds (taken from Von Hofmann [22])

effects of experimentally stabbing the body of a 4-month-old infant with a sharp conical instrument (a metal thorn measuring 0.5 cm in diameter at the tip) (Fig. 5). Contrary to previous beliefs that such a weapon would cause round puncture wounds, Von Hofmann showed that the resultant wounds were slit-like, with the shapes corresponding to the arrangement of skin cleavage lines. Over a century later, Faller-Marquardt and Pollak [11] demonstrated the effects of skin cleavage lines on the formation of facial stretch-mark-like skin tears away from the original entrance wound in a series of 20 autopsy cases with contact shots to the head and intraoral shots.

Particular difficulties in interpretation of wound morphology may arise at the death scene when individual wounds may be considerably distorted by tension applied to the skin, and this may lead, at first sight, to misinterpretation of their possible nature and shape as well as dimensions of the weapon that could have inflicted the tissue damage. Tailed ends of wounds, already described in detail in 1929 by Canuto [9] and therefore often referred to as "Canuto's ends," may indicate incised wounds caused by knives or similar sharp pointed utensils (e.g., swords, razors, broken glass). They may also assist in determining the direction of a stab or a cut. However, Brinkmann and Kleiber [7] were able to demonstrate that stab wounds caused by screwdrivers may also show similar tailed ends. By carrying out stabbing experiments on human cadavers, these authors defined the morphological criteria of cutaneous stab wounds caused by screwdrivers with different tip dimensions. Tailed ends of the wounds could be produced only infrequently by screwdrivers with tip breadths less than 9 mm, but tailed ends were frequently present when wounds were caused by screwdrivers with tip breadths of ≥9 mm. In addition, Brinkmann and Kleiber [7] could produce rectangular-shaped wounds more often than slit-like wounds when stabbing was implemented with screwdrivers with tip breadths of ≥4.5 mm. In case 1, the initial suggestion from the shape of the neck wounds was that they had been caused by a sharp weapon such as a workshop tool with a square or rectangular cross-section. Flexing of the head at autopsy, however, with release of tension on skin and cleavage lines resulted in approximation of the edges of the stab wounds. This revealed their true morphology which was more closely aligned to infliction by a thin, double-edged blade, although the observed tailed ends could also have been caused by a workshop tool as mentioned above.

In the second reported case, death had most probably been caused by drowning, with postmortem damage to skin and underlying tissues inflicted by freshwater crustaceans. These creatures tend to cause circular defects of skin [19] as observed in the close-up view of the relaxed skin (Fig. 2b). In areas of tissue damage over the shoulders, however, the defects appeared in slit-like shapes (Fig. 2a) more in keeping with infliction by a weapon such as a knife blade. In case 3, excision of skin lesions with the application of tension to the skin showed how the rounded outline of the artefactual defects caused by crustaceans could be transformed into slit-like wounds resembling stab wounds. However, the interpretation of wound morphology in putrefied corpses must always be made with caution, even after relief of tension on skin cleavage lines.

Our cases show that an awareness of the possible effects of skin cleavage lines and applied tension is highly important in the assessment of possible inflicted wounds. Difficulties that may arise due to the effects of skin cleavage lines and applied tension include transforming round skin defects into slit-like wounds resembling knife stab wounds, rounding out of genuine stab wounds and artefactual lengthening of stab wounds. These factors must be taken into consideration when wounds are assessed at the death scene. Accurate assessment of stab and other skin wounds at autopsy then requires gentle apposition of wound edges in relaxed skin so that the effects of skin tension and cleavage lines can be minimised.

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