University of HUDDERSFIELD
University of Huddersfield Press

Crime, Security and Society
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Crime, Security and Society

The effect of insect activity on clothing damage evidence following a period of decomposition

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KEYWORDS

Forensic science,
clothing damage analysis,
textile damage,
fabric damage,
stab cuts,
insect activity

ABSTRACT

Clothing damage analysis is a field in which the examination of stab cuts to clothing can reveal information about the stabbing implement and the actions used to cause such damage. This is particularly useful where the victim of the stabbing is still alive or when the deceased is in an advanced state of decomposition. In both situations, wound examination would not be useful due to the evidence being compromised by natural processes. In cases where the body is severely decomposed, the clothing can be the only source of evidence remaining; however, it is possible that insect activity may compromise any stab cuts that may be present.

This study recreates the effect that a decomposing body might have on any fabric, by wrapping the damaged cotton fabric around meat, and allowing the meat to decompose for two weeks. The following factors were explored; the presence/absence of blood on the edges of the damage; and whether the stab cut is exposed to the air or is face-down in the soil.

It was observed that after one week, the edges of the stab cuts were worn with the effect being enhanced after two weeks. It was also observed that the presence of blood increased the amount of wear, as did the presence of meat. The visual observations were also supported by measuring the depth of fraying of the edges of the stab cuts.

Introduction

Clothing Damage Analysis is a field that becomes beneficial in cases where there is little or no evidence on the victims themselves, in which the examination of clothing for rips, tears and stab cuts by blunt and sharp objects could provide vital information (Taupin, 1998).

Textiles associated with the recovery of a body may be the only remaining evidence due the scattering or scavenging of the body. The body may also be in an advanced state of decay, which may cause the distinctive features of any wounds to be lost. Insect activity may also exacerbate the loss of any distinctive features (Lowe et al., 2013; Ueland, Nizio, Forbes, & Stuart, 2015). Lowe et al. (2013) discusses how natural textiles when buried in identical soil conditions with decomposing remains, remained intact longer than those buried without remains.

It is reasonable to assume that the clothing may be a good source of information regarding the weapon used to inflict the damage, as well as provide information about the actions that have caused such damage. However, it is also possible that any insect activity or indeed any post-mortem animal activity can affect the integrity of any clothing damage

evidence that maybe present (Komar & Beattie, 1998).

The aim of this study was to investigate whether or not insect activity can affect the appearance of any stab cuts present and if so, to what extent was this alteration. The conditions explored were the presence of meat, the effect of pre-soaking the edges of the stab cut with horse blood, and the orientation of the stab cuts within the soil-lined boxes.

Methods and materials

Three plastic containers (31 x 26 x 15 cm) were filled with 5 cm garden soil. The boxes had a one centimetre hole drilled into one side of the container approximately four centimetres from the top which would allow for access by insects.
Three repeat stab cuts were made by a single-edged kitchen knife into six pieces of 100% cotton fabric (one yarn under one yarn over) with a weave density of 20 yarns per one cm. The fabric was stabbed with the sharp edge of the blade facing to the right. Once the fabric had been stabbed, it was possible to identify which end of the stab cut was caused by the sharp edge and blunt edge of the blade. There was less damage observed on the right hand side of the fabric when compared to the damage on the left hand side of the fabric caused by the blunt edge of the blade (*Fig:1*). One of the stab cuts on each of the fabric pieces had ~0.5 ml of defibrinated horse blood deposited onto the edge of the cut. Four of the six fabric pieces were then wrapped around separate pieces of fresh chicken breast.
The four wrapped chicken breasts were placed into boxes under different conditions i.e. wrapped chicken with stab cut face up and wrapped chicken with stab cut face down. All pieces of fabric/wrapped chicken breast were placed on top of the soil not buried. The two remaining fabric pieces were also placed into a box and were labelled negative controls.
Box one contained the wrapped chicken with stab cut face up which was exposed to the air, box two contained the wrapped chicken with stab cut face down into the soil and box three contained the stabbed fabric (including the blood soaked edges) but no meat as a negative control. The boxes were placed approximately two meters apart for a period of two weeks during the summer on the roof of the Applied Science Building, University of Huddersfield, West Yorkshire, UK. All boxes were covered with a lid and then covered with a slightly larger plastic container with a one cm access hole to allow access to insects but this container also provided protection from rodents and birds.
The meat and fabric were then left for a period of two weeks during the summer in which there was a variety of weather conditions observed; including hot sunny weather and rain. No weather data was collected as this was an initial experiment to determine if any damage could be observed before planning a larger scale experiment.
After one week, one of the pieces of fabric from each box was recovered and the remainder recovered after two weeks. Upon recovery, the stab cuts were examined and certain features (described below) were recorded.
Recording of the stab cuts were carried out by using low-power stereo-microscopy Motic SMZ-140-143-N2GG Stereo Zoom fitted with a CCD digital camera (Motic Japan). Image capture and processing was performed with software supplied with the camera (Motic software 3.1).
The stab cuts were examined for visible characteristic features that show the cut end and the torn end of the damage. Such characteristics would be expected if the damage was caused by a single-edged blade.
In addition to the visual observations, the depth of the fraying was measured using the Motic software described above which is the same method also used in Bostock, Parkes and Williams (2018). The depth of the fraying was recorded by measuring the distance from the end of the fabric up to the first warp/weft of the fabric. This was measured at a number of points for each of the stab cuts and the mean and standard deviation calculated.

Results

Visual observations of damage

Blood versus no blood

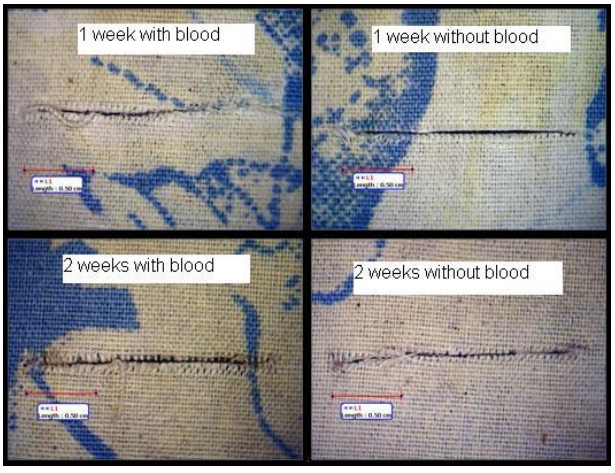

Fig 1 – Four Motic images from the pieces of fabric wrapped around a chicken breast and placed face up in a soil-filled box. The pieces of fabric on the left had 0.5 ml horse blood deposited on to the damaged area. The pieces of fabric on the right did not have any blood deposited

onto them. The pieces of fabric on the top row were recovered after one week and the pieces of fabric on the bottom row were recovered after two weeks. The scale in all cases represents 5mm with the images at 3x magnification. The cut end could be observed to the right side of the damage and the blunt end to the left.

From figure 1, it can be seen that the presence of blood alone had an effect on the integrity of the edges of the stab cut. After both 1 week and 2 weeks, the images show that the cut edges with blood present appear to have more wear present. This is more apparent after two weeks. In all images, it possible to identify which end of the stab cut was caused by the sharp edge of the blade and which was caused by the blunt edge as there is more damage observed to the left hand side of the cuts compared to the right; however, it is less clear in the lower left image (2 weeks without blood).

Meat versus no meat

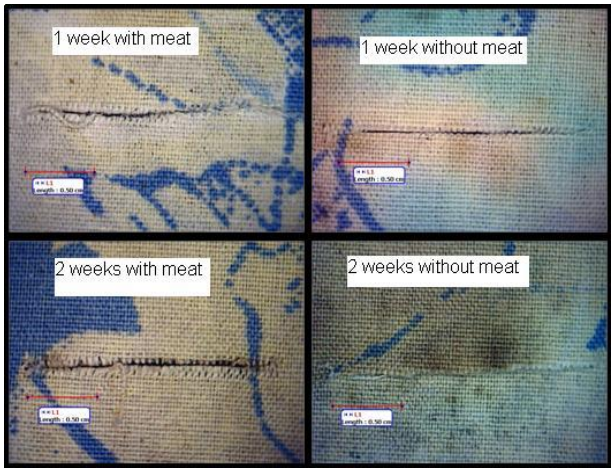

Fig 2 - Four Motic images from the pieces of fabric placed in to a soil-filled box with the cuts faced upwards. The pieces of fabric on the left are those wrapped round a piece of chicken and the pieces of fabric on the right are those not wrapped round a piece of chicken. The pieces of fabric on the top row are those recovered after 1 week and the pieces of fabric on the bottom row are those recovered after 2 weeks. The scale in all cases represents 5 mm with the images at 3x magnification. The cut end could be observed to the right side of the damage and the blunt end to the left.

From figure 2, it can be seen that there is an increase in the extent of the wear of the stab cuts on the fabrics wrapped round the meat. The piece of fabric in the upper left image shows a stab cut by the same implement and the fabric wrapped around the chicken breast. Damage can be observed, with some yarns coming loose from the fabric. It is slightly harder to identify which end was caused by the bladed edge and which end was caused by the blunt edge; but it is still possible.
The piece of fabric in the lower left image shows quite extensive wear; however, it is easier to identify which end was caused by which side of the blade in comparison with the piece of fabric in the lower right image.

Face up versus face down

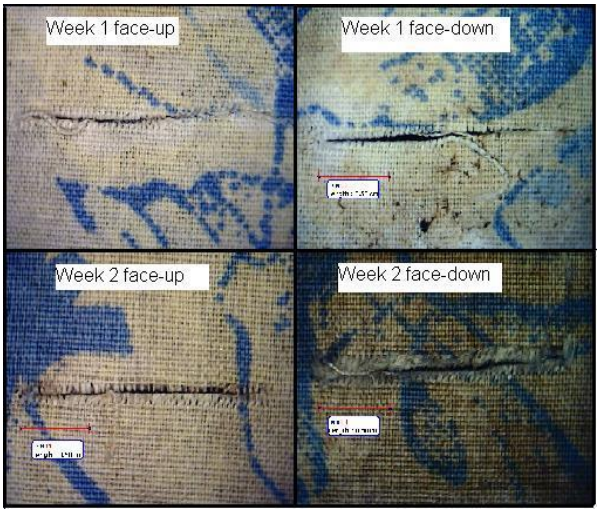

Fig 3 - Four Motic images from the pieces of fabric placed in to a soil -filled box which had 0.5 ml horse blood deposited on to the damaged areas. The pieces of fabric on the left are those placed with the stab cuts facing upwards, exposed to the atmosphere. The pieces of fabric on the right are those placed with the stab cuts facing downwards, in direct contact with the soil. The pieces of fabric on the top row are those recovered after 1 week and the pieces of fabric on the bottom row are those recovered after 2 weeks. The scale in all cases represents 5 mm with the images at 3x magnification. The cut end could be observed to the right side of the damage and the blunt end to the left.

From figure 3, it can be seen that after one week there is not much difference in the wear on the stab cut whether it is face-up or face-down. In both cases, it is clear which end is caused by the sharp edge of the blade. After two weeks the differences are clear. The stab cut facing down has worn significantly (*Table 1 & 2*), and several yarns are coming loose.

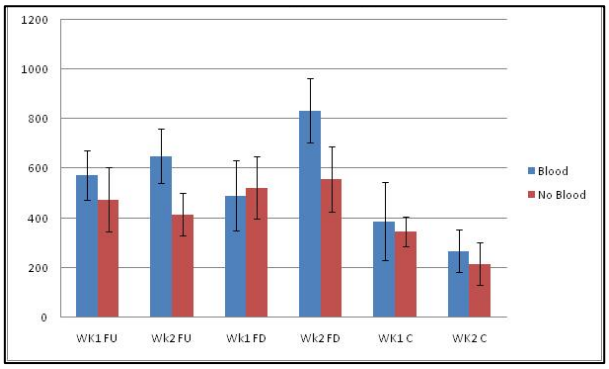

Figure 4: The effect of the presence of blood on the fraying of the edges of the damage following a stab cut with a single-edged kitchen knife. It can be seen that the absence of blood is associated with a decrease in the depth of fraying (average with Std. Errors bars). WK1 is Week 1, WK2 is Week 2, FU refers to the stab cuts being face up in the box and FD refers to face down. C refers to the control samples which are the pieces of fabric without any meat present.

Figure 4 shows that the depth of fraying has increased with the presence of blood. This supports the empirical observations from the images above. However, there are no significant differences between the some of the parameters i.e. face up experiment, with only significant differences showing after two weeks (*Table 1 & 2*). There are three further observations that can be made from the data. The first is that the presence of meat in addition to the blood allows for a more significant difference in the fraying. The second is that the difference becomes more pronounced after two weeks. Finally, blood appears to encourage fraying of the edges of the stab cut. This is despite the 'smoothing' effect that blood has on loose fabric; in the same way that wet hair can appear neater than dry hair.

Week 1 Samples	Mean (µm)	N	Std. Dev	Std. Error	Sig. (2-tailed)
FUWB - CWB	186.38	6	208.60	85.16	.080
FDWB - CWB	104.30	6	122.85	50.15	.092
FUNB - CNB	128.71	12	150.61	43.48	.013*
FDNB - CNB	174.84	12	119.47	34.49	.000*

Week 2 Samples	Mean (µm)	N	Std. Dev	Std. Error	Sig. (2-tailed)
FUWB - CWB	382.07	6	203.64	83.14	.006*
FDWB - CWB	567.67	6	145.98	59.60	.000*
FUNB - CNB	199.34	12	89.92	25.96	.000*
FDNB - CNB	341.51	12	145.35	41.96	.000*

Table 1: Paired T-tests showing comparisons between the depths of fray observed between the pieces of fabric with meat against those with no meat i.e. the controls. FU refers to the stab cuts being face up in the box and FD refers to face down. C refers to the control samples which are the pieces of fabric without any meat present, WB refers to with blood and NB refers to no blood. Those results displaying a significant difference to the 95% confidence interval have been starred.

Sample	Sig. (2-tailed)
WK1FUWB – WK2FUWB	0.068
WK1FDWB - WK2FDWB	0.007*
WK1FUNB – WK2FUNB	0.260
WK2FDNB – WK2FDNB	0.500
W1CWB - W2CWB	0.020*
W1CNB - W2CNB	0.001*

Table 2: Paired T-tests showing comparisons between the depths of fray observed between the pieces of fabric from Week 1 and Week 2. WK1 is Week 1, WK2 is Week 2, FU refers to the stab cuts being face up in the box and FD refers to face down. C refers to the control samples which are the pieces of fabric without any meat present, WB refers to with blood and NB refers to no blood. Those results displaying a significant difference to the 95% confidence interval have been starred.

With respect to whether the stab cut is exposed to the air or face-down in the soil; this does not appear to be a key factor in the appearance of the damage – although after one week there is more effect on the damage that is face up and then after two weeks, there is more effect on the damage that is face down. This leads to the hypothesis that if the damage is exposed to the air then it becomes colonised more quickly which may be due to the decomposition odour being released quicker than that of the face

down experiment however further research would be required in this area. Fly larvae were observed in the cuts of the meat however many larvae were seen hidden under the fabric away from light.

During the second week, the face down experiment was the site of the most fly larval activity. Many flies and larvae were observed during this experiment. As the flies were not able to oviposit directly onto the cuts due to them being face down in the soil, eggs were observed on both the fabric and the sides of the inside of the box with some larvae seen making their way to the chicken. Fly larvae were observed inside the cuts of which the only way to enter and exit was through the cut fabric which may explain the fray damage.

This method of quantifying the extent of fraying or wearing to the stab cuts appears to be reliable as it agrees with the visual observations reported; however, further work is required.

Discussion

The purpose of this preliminary study was to conduct a limited investigation into the parameters that affect the integrity of clothing damage evidence upon decomposed bodies. This was done in order to determine whether Clothing Damage Analysis could be just as reliable following post-mortem exposure; with a view to providing evidence that could indicate a weapon that may have contributed to the death. In all samples examined as part of this study, it was still possible to make out the 'cut' end and the 'torn' end which supports the view that a single-edged blade caused the damage, and that the action was of a stabbing nature rather than a slashing, as a slash cut would have two smooth 'V' shaped cuts where the blade has begun and ended (Causin, Marega, & Schiavone, 2005).

So this preliminary study has shown that insect activity does have a detrimental effect on the integrity of clothing damage evidence, but even after two weeks it is still possible to make out the key details. Further work is required in which the period of decomposition would be extended from 1-2 weeks to 1-2 months and beyond. An increase in the number of samples would also be required to further establish if categorising the fray damage is an acceptable method to use in the analysis of clothing damage.

One issue that needs to be addressed is a way of quantifying the amount of wear to the stab cuts, however the method of categorisation of clothing damage discussed by Bostock, Parkes, and Williams (2013) and Bostock, Parkes, and Williams (2018) may similarly work with the stab damage observed in the discussed experiments but further validation of these techniques are required.

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