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Effect of decomposition on clothing damage evidence: A preliminary study

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KEYWORDS

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Integrity of evidence

ABSTRACT

Textiles are generally present when a crime takes place and, in some cases, may be directly linked to a crime. Due to changes that occur to fabric over time, there is a risk of clothing damage being misinterpreted, and vital evidence being missed. This study is the first of a number of studies exploring the effect of decomposition upon clothing damage evidence following a stabbing. Sections of porcine tissue were wrapped in fabric in which stab cuts had been created, and left exposed to the environment alongside negative controls. Images of the damage were taken before and after a period of decomposition over two weeks. When compared to the negative controls, these images clearly demonstrated that there was a significant amount of alteration to the clothing damage evidence e.g. loose and fraying yarns, following a period of decomposition. Quantification of the fraying to the damage showed a statistically significant increase of the amount of fraying ($p=<0.05$).

Introduction

Clothing damage analysis is a field in which the examination of stab cuts, rips and tears can provide information about any weapons used or the actions used to assault someone (Boland, McDermott, & Ryan, 2007; Daéid, Cassidy, & McHugh, 2008; Taupin, 1998).

This analysis becomes particularly useful in cases where there is little or no evidence on the victims themselves such as assault cases where the examination of clothing for cuts and tears may help the investigator to corroborate or refute a scenario (Boland et al., 2007). Such cases may also include individuals who have survived a violent attack following rapid medical intervention in which the clothing may have been cut to allow the medical team access to the victim. Medical treatment by its very nature compromises any evidence (such as wound examination) that can provide information about the implement used e.g. treatment is required immediately due to a wound that does not stop bleeding which may affect the appearance of the initial wound (Riviello, 2009).

In addition, clothing damage analysis is particularly useful in examining clothed bodies that are in an advanced state of decay. Any wounds, fatal or otherwise, present on the body would decompose over time and as such any distinguishing features may be lost (Lowe et al., 2013; Viero, Montisci, Pelletti, & Vanin, 2018).
Damage analysis can then be carried out on the clothing of the deceased, which can provide information about the actions and the implement that may have caused visible injury. However, decomposition is a dynamic process with many mechanisms (Campobasso, Di Vella, & Introna, 2001) leading to the breakdown of the tissues, such as microbes (Vass, 2001), insects and soil fauna (Petersen & Luxton, 1982). This leads to the question: can the same mechanisms that affect the break-down of the wound and tissues influence the integrity of any clothing damage evidence?
The aim of this study was to establish whether decomposition has a significant effect on the integrity of clothing damage evidence, focusing on 100% cotton fabric.

Material and Methods

Two boxes were prepared using lidded plastic containers (31x26x15 cm) which were filled to a depth of five cm with garden soil. Four centimetres from the top a one cm diameter hole was drilled in one of the sides of each container to allow access for flying insects. A slightly larger outer container, also with a one cm access hole, was placed over the inner container to provide additional protection when experiments were underway. This configuration was used to exclude light and to ensure that animals, such as rodents and birds, could not gain access to the boxes and make off with the fabric. It is recognised that this may affect the verisimilitude of the study, but ultimately it was deemed necessary given the health and safety concerns.

Four pieces of 36 by 40 cm fabric cloth were cut from a single 100% cotton single weave (one under and over) sheet with a weave density of 20 yarns per one cm. Two pieces of cloth were then each wrapped around a section of porcine tissue (*Sus scrofa*) (~750 g). Three repeat stab cuts were then made with a single edged kitchen knife using a gravity-based device capable of accurate repetition of stab cuts. The stab cuts were approximately one and a half to two cm in length and three cm apart.

One section of wrapped porcine tissue was placed in each box alongside another piece of fabric, as a negative control (15 x 15 cm). The stab cuts were facing upwards. This gave enough sample data for robust statistical analysis.

The two boxes were placed approximately two metres apart on the roof of the Science Building at the University of Huddersfield (West Yorkshire, United Kingdom) for a total period of two weeks during the summer. The boxes were checked daily and larval activity was observed in both Box 1 and Box 2 after three to four days. After one week, one box was recovered, and the remainder recovered after two weeks.

The cloths were viewed using a 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 characteristics that indicate the cut end and the torn end typical of damage caused by a single-edged blade.

In addition to visual observations, 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.

This experimental design was repeated twice, with an additional experiment replacing the porcine tissue with avian tissue (*Gallus gallus domesticus*).

Results

Visual comparison of the damage showed no apparent difference in the stab cuts between the fabric prior to decomposition and the fabric that was not wrapped around the porcine tissue; suggesting that the appearance of stab cuts is not affected by time in a stable environment and particularly in the absence of a decomposing medium.

Visual comparison of the stab cuts in the fabric wrapped round the porcine tissue after decomposition with the stab cuts prior to decomposition showed a marked increase of 0.24 mm in the fraying of the stab cut.

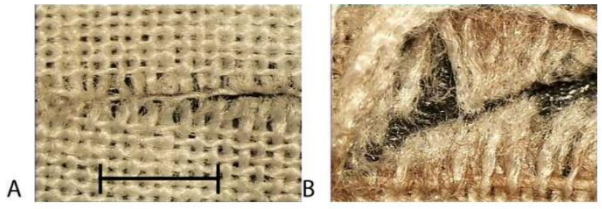


Figure 1.
Effect of decomposition on clothing damage evidence.
The image to the left (A) is from fabric that was not wrapped around a section of porcine tissue.
The image to the right (B) is from fabric that was wrapped around a section of porcine tissue. The scale in Image A represents 5mm and applies to both images.

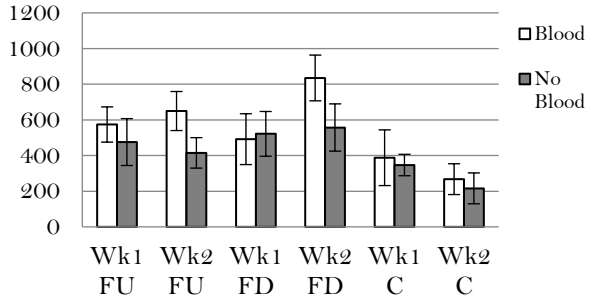
Statistical analysis was carried out by measuring the depth of the fraying from the edge of the stab cut to the next intact yarn. Paired sample T-tests were conducted on the multiple sets of data (n=18 per set) showing a significant difference between the appearance of the stab cut before and after a period of decomposition (p-value <0.05) (*Table 1*).

Title	Mean	Std Dev	Std Error Mean	Sig (2 tailed)
Fray before - Fray After	0.18	0.33	0.06	0.002

Table 1:
Paired sample T-test showing the effect before and after decomposition on the fraying of the edges of stab cuts in fabric created with a single edged kitchen knife

A similar study was also carried out using avian tissue. This showed similar results in that a significant difference *(Graph 1)* was observed between the integrity of the clothing damage

evidence before and after decomposition in which 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.



Graph 1.
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. 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. The depth of fraying is measured in μm (Y-axis). (Bostock, Parkes, & Williams, 2018)

Discussion

The aim of this study was to determine whether or not the decomposition of organic tissue had a detrimental effect on the integrity of clothing damage evidence. This was achieved by exposing a set of fabrics to a decomposing environment and comparing with fabric from the same swathe and same damage in a non-decomposition environment.

The comparison between the appearance of the stab cut before and after a period of decomposition clearly demonstrated that when doing clothing damage analysis upon 100% cotton garments recovered from decomposed bodies, caution needs to be taken.

Regular observations also showed that there were fly larval activity during the decomposition phase and it was noted on several occasions that the larvae were actively crawling in and out of the stab cuts as this was there only entry/exit point which may have helped to increase the textile damage observed and therefore caused disruption to the edges of the stab cuts which is supported by Komar and Beattie (1998) as they discuss studies conducted on clothed pig carrion which revealed that post-mortem insect activity, particularly maggot masses could produce changes to clothing.

Given that *Sus scrofa* is considered to be more physiologically similar to humans (Sullivan, Eaglstein, Davis, & Mertz, 2001) than *Gallus gallus domesticus* and that the similar effects were observed whether porcine or avian tissue was used; it is reasonable to assume that a similar effect would be observed if the source of decomposition was human.

Further studies are required to establish whether the fabric type has an effect by using man-made fabrics such as polyester as well as other natural fabrics such as wool. In addition, insect exclusion studies will also be carried out in order to determine the extent to which insects compromises the integrity of clothing damage evidence.

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