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# An investigation into the persistence of textile fibres on buried carcasses

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ABSTRACT

A significant amount of research has been carried out on fibres to aid the forensic scientist in determining the significance of these when found on a victim or suspect. This work has focused on open-air environments, and as such no research has been undertaken to examine the persistence of fibres on bodies in the burial environment.

Wool and cotton fibres, known to fluoresce under ultraviolet (UV) light, were transferred onto the skin of four porcine (*Sus scrofa*) carcasses (two carcasses per fibre type). The number of fibres transferred was recorded from images taken under UV light. The remains were subsequently placed in four burial sites and left interred for 14 days. After this period the carcasses were excavated and lightly brushed down to remove the soil layer that had adhered to the skin. Once again photography under UV light was used to record the number of fibres which persisted on the skin.

Results showed that after 14 days, wool and cotton fibres remain on the surface of the buried carcasses. In no circumstance was there a total loss of fibres suggesting that in such scenarios, the likelihood of finding fibres is high but the initial number of fibres transferred would be strongly diminished. This has important implications for both the excavation protocol for buried remains and the subsequent analysis for physical evidence.



## 1. Introduction

Textiles form an important part of our everyday life. Their high frequency of occurrence and the ease with which they are potentially shed upon contact form the primary reasons why they are so commonly encountered in forensic casework. For this reason fibres are a key trace evidence type as their presence at a crime scene, on a victim or on a suspect signifies contact which is potentially highly significant when presented in a courtroom.

From the late twentieth century to the present, research has looked at the transfer and persistence of fibres in various medico-legal scenarios. This has been done to aid the forensic scientist in determining how fibres are transferred from one item to another and how long these fibres are subsequently retained in a given context. Minimal research however, has been conducted on the persistence of fibres on skin. Palmer and Burch [1] investigated the transfer and persistence of fibres on the skin of living individuals with results demonstrating that there was an initial rapid loss of fibres from the transferred location followed by an exponential decay. All fibres were found to be lost after 24 h (experimentation duration) although it was noted that shorter fibre lengths were more persistent. Cotton was found to be more persistent than polyester. Krauss and Hildebrand [2] looked at the persistence of fibres on the skin of carcasses left in an open-air environment. Their study concluded that the number of retained fibres was largely dependent on weather conditions. Fibre loss increased drastically when wind and precipitation was present. However, there was never a complete loss of fibres throughout the duration of the experimentation phase (14 days). Palmer and Polwarth [3] also investigated fibre persistence on the skin of remains deposited in an open-air environment. Similar to the previous study, fibre loss was found to be dependent on weather conditions. In the absence of strong wind and precipitation, the loss of fibres was exponential, however, in stronger winds and heavier rainfall rate loss increased. The majority of the transferred fibres were lost within the first two days. Persistence of some fibres continued to be recorded until the conclusion of the experiment at day 12.

It is a common worldwide practice for criminals to bury the remains of their victims in soil so as to conceal their crime. In such an environment it would be expected that the loss of any fibre evidence would be high but this has not been investigated. Thus the aims of this research were to determine the worth of pursuing fibre evidence after a 14 day burial period, and to determine the effect of a soil environment on fibres transferred to skin by direct contact between the donor garment and skin.

## 2. Materials and methods

### 2.1. Skin source

Since the use of human remains gives rise to a number of ethical and legal issues, porcine skin was used as a human proxy. Studies such as the ones carried out by Meyer et al. [4], Lavker et al. [5], Lavker et al. [6], Ge

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et al. [7], Barbero and Frasch [8] and Liu et al. [9] have determined that there is a close similarity between porcine and human skin. In fact, these studies concluded that skin morphology [4–7,9], immunohistochemistry [6] and the permeability of porcine skin [8] bear strong similarities to human skin. Furthermore, as highlighted by Janaway et al. [10] there are also similarities in terms of body mass, weight and fat-to-muscle ratio of the animals as a whole.

Four fully grown porcine hind legs were used for this investigation having dimensions approximately 70 cm in length, 35 cm in width and 15 cm in height.

### 2.2. Fibre source

Cotton and wool were the two fibre types chosen for this investigation. These were used since fibre population studies have shown these to be two of the most commonly occurring fibre types within an environment [11–23]. Cotton fibres were obtained from a George™ white pure cotton polo-shirt and white wool fibres were obtained from a wool lined EMU Australia® display boot. These fibres fluoresced under UV light which was essential in order to facilitate the visualisation of the fibres on-site. Two porcine legs were used for each fibre type.

### 2.3. Burial phase

The grounds at the College of Policing formerly the National Policing Improvement Agency (NPIA) at Crook, north-east England were utilised. The burial sites were given clearance from the Department for Environment, Food and Rural Affairs (DEFRA). In order to assess repeatability in results, two separate burials were carried out over two periods, in June and August of 2011.

In both investigations four burial deposits were dug one metre apart from each other. This was done so that all depositions would be in a similar soil environment. The soil had a pH of 8, was non-clay based and of a medium consistency. All depositions were covered in wire netting cages reinforced by metal bars. These cages were used to reduce the potential of larger animals gaining access to the porcine legs and removing them from the burial site. However, the wire netting used had a diameter of 2 cm which allowed for smaller animals and insects to interact with the carcasses as would occur in a real scenario. The dimensions of the cages were approximately 1 m in length, 50 cm in width and 40 cm in depth. As a result, all four deposits were approximately 1 m in length, 30 cm in width and 30 cm in depth.

### 2.4. Seeding the fibres on skin

All work was conducted in a black-out tent. This created a dark environment which made it easy to visualise and photographically document the initial number of transferred fluorescent fibres on the skin prior to burial. Full personal protective equipment (PPE) was also worn by the team in order to ensure that contamination was kept to a minimum.

Initially the bottom of the cage was placed inside the deposit after which the porcine leg was rested in it (Fig. 1). Prior to seeding the leg with fibres, J-Lar® tape was used to remove any fibres already present on the skin. This was done systematically and after repeating the procedure twice, the leg was viewed under UV light to ascertain that all foreign fibres were removed. The fibre source was then rubbed vigorously over the skin surface using hand applied forceful pressure mimicking a rough contact between garment and skin. Photographic documentation using UV lighting was then carried out. Post-imaging, soil was placed on the leg and the hole was filled to three quarters of depth before the top part of the cage was placed over and secured, after which more soil was placed until the deposit was fully covered. In this way the carcass was completely inaccessible to large predators. However, as mentioned previously, there was still the possibility for smaller organisms to gain access to the porcine leg thus still allowing bioturbation to occur. Several studies have reported the movement of objects in the soil as a result of this phenomenon [24–32]. In a forensic context this activity is highly significant since it also causes the movement of any potential evidence found deposited on or in soil.

### 2.5. Excavation phase

After the 14 day period, excavation of the depositions was initiated using a stratigraphic approach. As the first porcine leg was uncovered, it was noted that the soil had adhered to the porcine skin. This did not allow the proper identification of any fibres that had persisted on skin since fluorescence could not be seen through the layer of soil that had adhered to the skin. Consequently, the porcine legs had to be carefully brushed down prior to photographic documentation. This routine would also need to be carried out at crime scenes for fibre recovery.

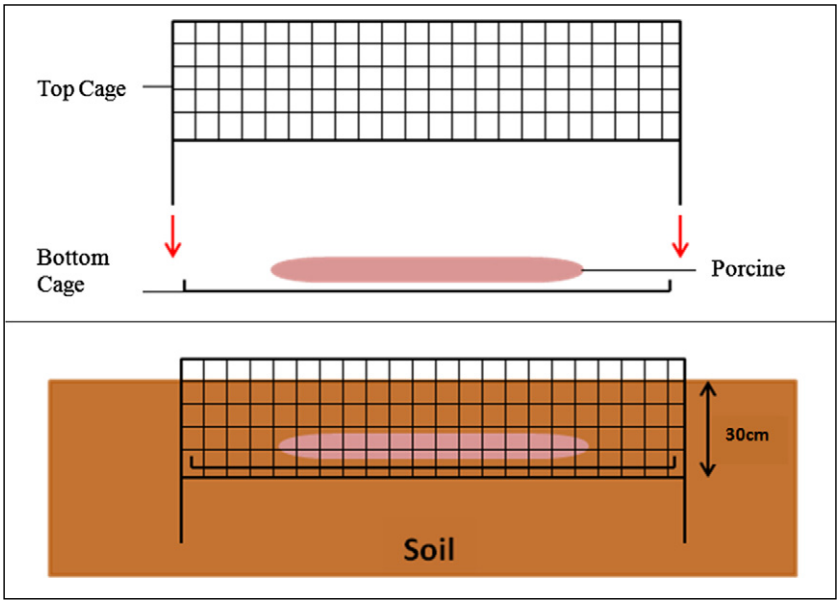


**Fig. 1.** The arrangement of the cages prior (*top*) and post burial (*bottom*).

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