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Bloodstains Analysis on Fabric from Contact in a Crime Scene

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Abstract

Bloodstain pattern analysis (BPA) is the interpretation of bloodstains at a crime scene in order to recreate the actions that caused the bloodshed. Analysts exam-ine the size, shape, distribution and location of the bloodstains to form opinions about what did or did not happen We intend to study primary (i.e. Location of the original criminal activity) crime scene and the different sort of blood stains and we could see particularly on different sorts of fabrics, floor, ceiling walls, ground, both indoors and outdoors in a violent crime scene by use of a range of murder weapons (eg. Axe, Knife, Screw-driver, stick etc.).

Keywords: *Fabrics, Bystander, Perpetrator, Room and Victim.*

I. INTRODUCTION

Dataset of Blood drip patterns was created using fresh pig/porcine blood that was subsequently treated with two different types of anticoagulants (Warfarin (orally administered) and Heparin Injection (intravenous)) and the effects of different dosage of the anticoagulant medications on the stain pattern on non-absorbent paper surface was accordingly recorded by varying the angle of \impact and fall height. The day temperature and humidity shall also be recorded during the experimentation by the use of a hygrometer. A statistical analysis highlighting if there is a statistically significant difference in the stain patterns cast when the dosage of anticoagulant is varied shall be carried out [1-3].

BPA provides information not only about what happened, but just as importantly, what could not have happened. This information can assist the investigator in reconstructing the crime, corroborating statements from witnesses, and including or excluding potential perpetrators from the investigation. By using the amount of anticoagulant that almost accurately mimics the stain patterns created by fresh pig blood, drip staining shall be done on different sorts of fabrics. The fabrics can be particularly divided into 3 basic types. They are –Fabrics from natural fibers, Fabrics from man-made fibers, Again each particular type of fabric can further be divided predominantly into two types – woven and knitted based on the weave of the cloth[4-7].

We take the weave of the fabric into consideration because it has been previously noticed that the fabric type, weave of the fabric, position and volume of blood dropped influence the stain pattern formed. For each fabric type, fabrics of four shades in particular are obtained. They are – white, gray, maroon, black.

The shades may vary depending on the availability of the cloth in a particular shade, variance due to weave of the cloth, natural color of the fiber etc[8-12]. We intend to stain two light colored fabric pieces and two dark colored pieces, to record how the color of the fabric affects visibility of stains to the naked eye. Also we plan to use 3 different types of the same cloth – new, worn out (washed 8 times), sweat stained cloth washed 2 times, to record the same type of stains.

From previous research we expect these different types of clothes to have very different stains although the stains might have been dropped using the same mechanism, under similar temperature , humidity and wind condition keeping the volume of liquid dropped , blood column , fall height, angle of impact constant .

A dataset of wipe and swipe bloodstain patterns formed on non-absorbent surfaces (such as non- absorbent paper surface, non- absorbent floor surface, non- absorbent wood surface etc.) shall be developed and an attempt shall be made to understand if there are any marked stain characteristics that can help analysts to distinguish swipe patterns from wipe patterns. Whether the difference (if any) between the two sets of stains statistically significant shall then be analyzed using t-test, correlation significance values.

Bloodstains are classified into three basic types: passive stains, transfer stains and projected or impact stains. Passive stains include drops, flows and pools, and typically result from gravity acting on an injured body.

II. RELATED WORKS

The successful use of textiles in such a broad range of applications is due in part to the great variety of fibres and fabric constructions that are available. Most textile items are compound structures composed of up to four levels - fibre, yarn, fabric and the final article—and within each level, there are many choices available.

There are more than fifty types of textile fibre in commercial use of various lengths and diameters; for example, cotton, wool, flax, jute, nylon, polyester, acrylic and polypropylene. Normally, these fibres are formed into yarns of various types (for example, monofilament or

multifilament; ring, rotor or air-jet spun; single, plied or cabled), and then the yarns are interlaced into fabrics, either by weaving, knitting, braiding or even knotting (in the case of nets).

Slemko in his work particularly looked at the effect of droplet velocity and fabric composition on bloodstain patterns. In his work he experimentally compared bloodstain patterns created on a collection of various fabrics based upon fabric composition, fabric texture, new vs. used/worn out fabrics, and chemically treated fabrics[12].

Within the experimental design, a collection of various fabrics placed at different distances were exposed to blood droplets generated by a high speed fan[13-14]. The droplets were hence compared on the basis of bloodstain size versus distance travelled in relation to fabric composition and chemical treatment of fabric[13].

Based on the experimental results, Slemko concluded that the degree of distortion of bloodstain observed on the fabric is a function of both, the ability of the fabric to absorb blood and the texture of the fabric[14].

However owing to the distorted nature of the bloodstain on fabric, interpretation of the impact angle often becomes difficult[8]. F. Adolf put in place the guidelines that should be abided by when examining textile fiber/s within the Forensic context[13]. B. Karger et al. developed an experimental setting to evidentially highlight the differences between contact/transfer stains and projected droplet patterns on fabric surface[8]. It was found that even on similar surfaces contact stain patterns lack the characteristic features of dynamic stains (i.e. projected droplet stains)[8].

However mode of formation of micro-stains on rough surface structure when the blood volume is small (< 1 microlitre) is difficult to predict as the characteristic features of dynamic stains in case of such micro-stains are reduced[11]. Tronnberg et al worked on and thereby provided essential guidelines for recognition of expirated bloodstain pattern on cotton fabrics[4].

There have also been other works done documenting the recognition of expirated stain patterns on different fabrics [5]. White summed up the effect of droplet volume, dropping height and impact volume on the bloodstain formed on a fabric[5]. It might surprise the readers to know that one could for a matter of fact come across a regular stain being formed on an apparently porous fabric surface depending on the volume of blood in the droplet and the location at which the droplet falls (refer Figure 2)[5].

III. RESULTS

Transfer stains result from objects coming into contact with existing bloodstains and leaving wipes, swipes or pattern transfers behind such as a bloody shoe print or a smear from a body being dragged. Stains result from blood projecting through the air and are usually seen as spatter, but may also include gushes, splashes and arterial[2-4].

In the very beginning, we intend to document the stain type we can see or might expect to see on the clothes of an individual when he is a victim, perpetrator or a simple bystander in the event of a head hit of a victim using a stick, rod, axe etc. (The instruments of head hit shall be decided in discussion and study of court proceedings of several violent cases that have so far been solved) in an indoor setting.

Based on the velocity of hit, stain type on cloth of an individual, number of hits, distance between the victim , perpetrator and bystander, relative position of the three at the time of hit, movement of any party before probable subsequent hits, direction of movement of weapons and people, room temperature, humidity, room dimensions, person height , weight ,using Bayesian networks, correlation and regression we would try to probabilistically infer the position of an individual (victim, perpetrator, bystander(if any)).

Some bloodstains on fabrics are latent, meaning they cannot be seen with the naked eye. Investigators can use chemical reagents such as Luminol to find and photograph latent bloodstains. When sprayed on blood, Luminol creates a bright blue luminescent glow by reacting with iron in the blood's hemoglobin.

Of the different types of bloodstains patterns such as drip trails, impact patterns, expiration stains, blood flow pattern,saturation stains etc., the authors were particularly interested in the review of work done with particular focus on the impact patterns, expiratory bloodstain patterns and transfer stain patterns on fabrics. The images are shown below.

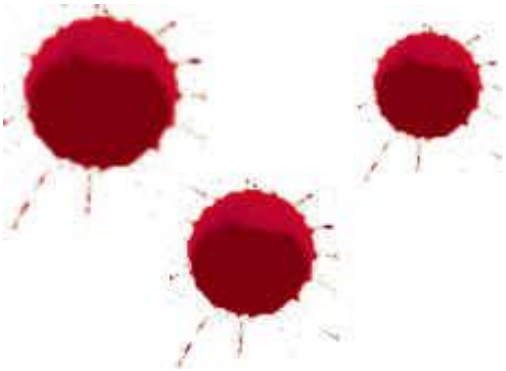

Figure 1: DripStains/Patterns (caused by the force of gravity only)

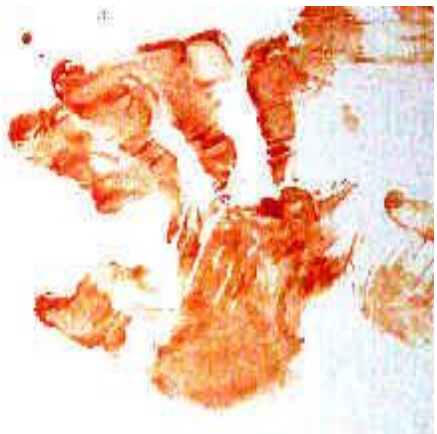

Figure 2 Transfer stain/patterns in Fabrics

The following general features are examined at the fabric level

a. Distortion of fabric surrounding the severance, such as buckling or folds out of the fabric plane or tight threads.

b. Changes to the normal thread spacing, including runs in knitted fabrics.

c. Direction of the severance line relative to the thread directions in the fabric; for example, tears usually propagate parallel to one of the thread directions.

d. The relative positions of the severed yarn ends. In cuts, the yarn ends usually line up quite well, whereas a puncturing action may rupture neighbouring yarns at different positions.

Figure 3 represents the overall view of the 100 % cotton cloth that was used for the study. The left half of the cloth was used to record the stains formed using the blood from a freshly slaughtered pig and the right half was used to record stains from blood mixed with an anticoagulant.

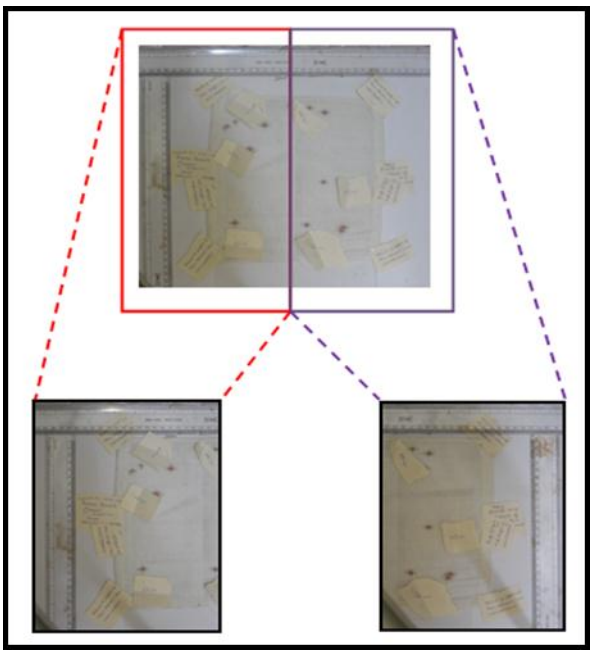

Figure 3: The overall view of the cotton cloth on which the stains were taken. The left side contains stains created with fresh pig. The right half of the cloth contains bloodstains created from pig blood thoroughly mixed with anticoagulant.

IV. CONCLUSIONS

From literature review it can be safely concluded that various surfaces, concrete, fabric react differently to bloodstain dropped by similar physical mechanisms. There also exist intra- surface differences that impact or rather influence the formation of bloodstain pattern formation. For example, fabrics based on texture, porosity, absorbing power impact the formation of the bloodstain pattern. Again, study shows volume of blood , impact force as also fall height have significant effect on bloodstain pattern formation

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