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Bloodstain Pattern Analysis on Fabric

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Abstract

Identificationof a murder weapon can be done by analyzing weapon transfer stains(if any) together with othercircumstantial evidence at a crime scene .Hand transfer stains, shoe transfer stains as also weapontransfer stains left at a crime scene play an integral role in the reconstruction of the crime scene, henceproper documentation of such stains is mandatory. The structure of textile has a profound effect on the formation of the bloodstain pattern. So in coherence with the work of Slemko and White, the authors present in this paper that fabric stain patterns should in all probability be carefully studied and analyzed.

Keywords:Blunt objects, Fabrics, Bystander, Perpetrator, Room and Victim, Foot Prints

Introduction

The authors of this work comprehend that the imprint went unnoticed largely due to the police officials being unaware of the different sorts of hammer or blunt object transfer stains or imprints that could particularly influence the sequencing of events in a crime scene. In Forensic Science evidences can particularly be classified under two heads- Associative Evidence and econstructive evidence. Bloodstain patterns obtained at/from a crime scene are used in sequencing of events in a crime scene [3-4]. Proper selection of stains in an impact spatter is particularly important for calculation of the area of origin of the impact that created the particular spatter stain. Dataset of Blood drip patterns was created using fresh pig/porcine blood that was subsequently treated with two different typesof anticoagulants (Warfarin (orally administered) and Heparin Injection (intravenous)) and the effects of different dosage of theanticoagulant medications on the stain pattern on non absorbent paper surface was accordingly recorded by varying the angle ofimpact and fall height. The day temperature and humidity shall also be recorded during the experimentation by the use of ahygrometer. A statistical analysis highlighting if there is a statistically significant difference in the stain patterns cast when thedosage of anticoagulant is varied shall be carried out[5-6]. By using the amount of anticoagulant that almost accurately mimics the stain patterns created by fresh pig blood, drip stainingshall be done on different sorts of fabrics. The fabrics can be particularly divided into 3 basic types. They are –Fabrics fromnatural 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 weaveof the cloth[7]. We take the weave of the fabric into consideration because it has been previously noticed that the fabric type, weaveof the fabric, position and volume of blood dropped influence the stain pattern formed. For each fabric type, fabrics of four shadesin particular are obtained. They are – white,

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gray, maroon, black. The shades may vary depending on the availability of the clothin a particular shade, variance due to weave of the cloth, natural color of the fiber etc. We intend to stain two light colored fabricpieces and two dark colored pieces, to record how the color of the fabric affects visibility of stains to the naked eye.

Review Works

It is often difficult to interpret bloodstains on Fabric. The texture, weave, absorption of fabric as also the volume of blood that drips onto a fabric often lead to the distortion of stain patterns formed on the concerned fabric. The structure of textile has a profound effect on the formation of the bloodstain pattern. Slemko in his work compared bloodstain patterns formed by similar physical mechanism on a collection of fabric that differ in terms of composition, texture, times worn (i.e. newness), chemical treatment on fabric[1]. He also compared the bloodstain size on various fabrics in coherence with the distance travelled by blood droplets generated from a high speed fan[1]. Based on his work he concluded that the degree of distortion of bloodstains on fabric is a function of both the ability of the fabric to absorb blood and the texture of the fabric[1]. Again higher velocity blood droplets may result in formation of satellite spatter upon impact with the cloth surface based on the absorbency, texture of the fabric[1]. The appearance of the stain is also controlled by the volume of blood in the droplet that strikes the cloth surface[1]. Washing, Scotchgard type treatments directly affect the appearance of bloodstain patterns. However, bloodstain patterns were found to remain unaffected by fabric starches[1]. The estimation of bloodstain distance from source is based upon the bloodstain sizes observed on fabric, which in its turn is directly dependent upon target surface composition and chemical fabric softening treatments[1].

In line with Slemko's work the authors conducted an experiment to check how addition of an anticoagulant might alter the formation of stain patterns as compared to the stain patterns obtained from dripping of fresh blood. Given that porcine blood is similar to human blood, the authors used pig blood for the study. Blood was allowed to drip onto a 100% cotton cloth that has been used and washed for around 25 times through a period of 6 months. Blood from a freshly slaughtered pig (i.e. blood without any anticoagulant) was allowed to drip from a height of 20, 40 and 60 cms respectively at an impact angle of 90^{o}. In order to maintain the same volume of blood in the blood droplet, a drop of blood was allowed to drip from a needle-less subcutaneous syringe full to its capacity (2.5cc.). When a patient requires anticoagulant, Heparin injection is administered as it immediately mixes with blood. When Warfarin is orally ingested, it takes some time to prevent coagulation of blood. So after Warfarin is administered, blood is tested after 2-3 days[2]. The human body contains around 5 liters of blood[3]. Based on physical condition (such as age, weight, prior medical history) an adult is administered around 2-10 mg[2]. of Warfarin in order to achieve the target INR(International Normalized Ratio) value[2]. The authors selected Warfarin as an anticoagulant for the study. 4 mg of Warfarin(2 tablets of Warf 2 in powder form) was thoroughly mixed with 500 ml. of fresh pig blood by light stirring

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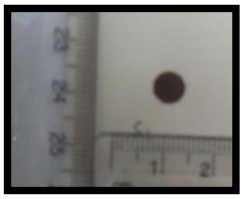
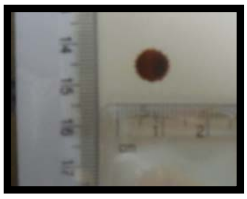
over a period of 1 day. The blood with anticoagulant was allowed to drop on a 100% cotton cloth surface from a height of 20, 40 and 60 cmsat 90^o angle of impact. The piece of cloth was divided into 2 parts to record and hence compare the stain patterns from fresh pig blood and pig blood mixed with anticoagulant.

As a control case fresh pig blood was dropped at an impact angle of 90^o from a height of 20, 40 and 60 cms. onnon absorbent paper surface to record the true dimension of the bloodstain pattern formed.

The experiment was performed at the Kolkata Municipal Pig Slaughter House in Tangra.

Experiments and Results

Table 1 represents the bloodstain patterns formed when blood was dropped on 100% cotton fabric surface from a height of 20, 40 and 60 cms at 90^o impact angle in comparison to the control sample formed on non-absorbent paper surface. In line with Slemko'swork, Table 1 represents the distortions in the stain pattern formed using similar physical mechanisms owing to difference in surface texture, composition and absorbency.

Surface Type	A single drop dripped from a needle-less subcutaneous syringe from a height of **20 cms** at an impact angle of 90^o	A single drop dripped from a needle-less subcutaneous syringe from a height of **40 cms** at an impact angle of 90^o	A single drop dripped from a needle-less subcutaneous syringe from a height of 6**0 cms** at an impact angle of 90^o
Paper	 **C1**	 **C2**	 **C3**

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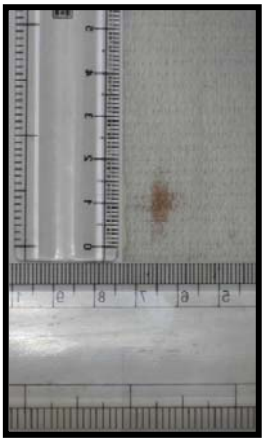
100% Cotton fabric (Worn)	 **F1**	 **F2**	 **F3**

Table 1: A comparative representation of bloodstain drops formed when same volume of blood was dropped on non-absorbent paper surface and 100% cotton cloth from a height of 20, 40 and 60 cms respectively[(Stain formed on paper surface -C1(fall height -20 cms) , C2(fall height -40 cms), C3(fall height -60 cms) ;(Stain formed on 100% cotton fabric surface -F1(fall height -20 cms) , F2(fall height -40 cms), F3(fall height -60 cms)]

Table 2 provides a comparative report of the difference in the stain patterns when the stains are formed with fresh pig blood and the case when anticoagulant was added to pig blood.

Blood Type	A single drop dripped from a needle-less subcutaneous syringe from a height of **20 cms** at an impact angle of 90^o (100% cotton cloth)	A single drop dripped from a needle-less subcutaneous syringe from a height of **40 cms** at an impact angle of 90^o (100% cotton cloth)	A single drop dripped from a needle-less subcutaneous syringe from a height of 6**0 cms** at an impact angle of 90^o (100% cotton cloth)

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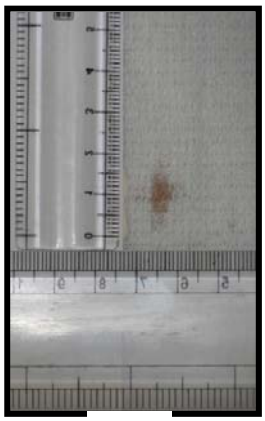
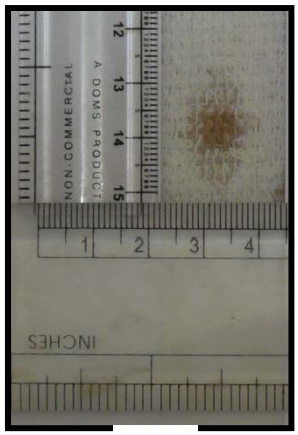
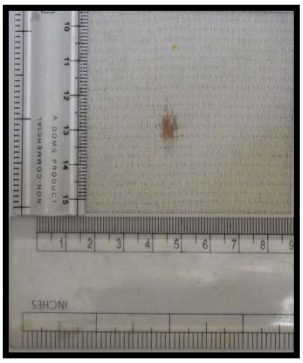
Fresh Pig Blood obtained from a freshly slaughtered pig	 F1	 F2	 F3
Fresh Pig Blood thoroughly mixed with 4mg of powdered Warfarin (commercially available as Warf 2 tablets)	 FA1	 FA2	 FA3

Table 1: A tabular representation of bloodstain drops of same volume of blood when dropped on 100% cotton cloth from a height of 20, 40 and 60 cms respectively using fresh blood and blood thoroughly mixed with Warfarin(4mg) [(Stain formed with fresh blood -F1(fall height -20 cms) , F2(fall height -40 cms), F3(fall height -60 cms) ;(Stain formed with blood containing anticoagulant -FA1(fall height -20 cms) , FA2(fall height -40 cms), FA3(fall height -60 cms)]

Figure 1 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.

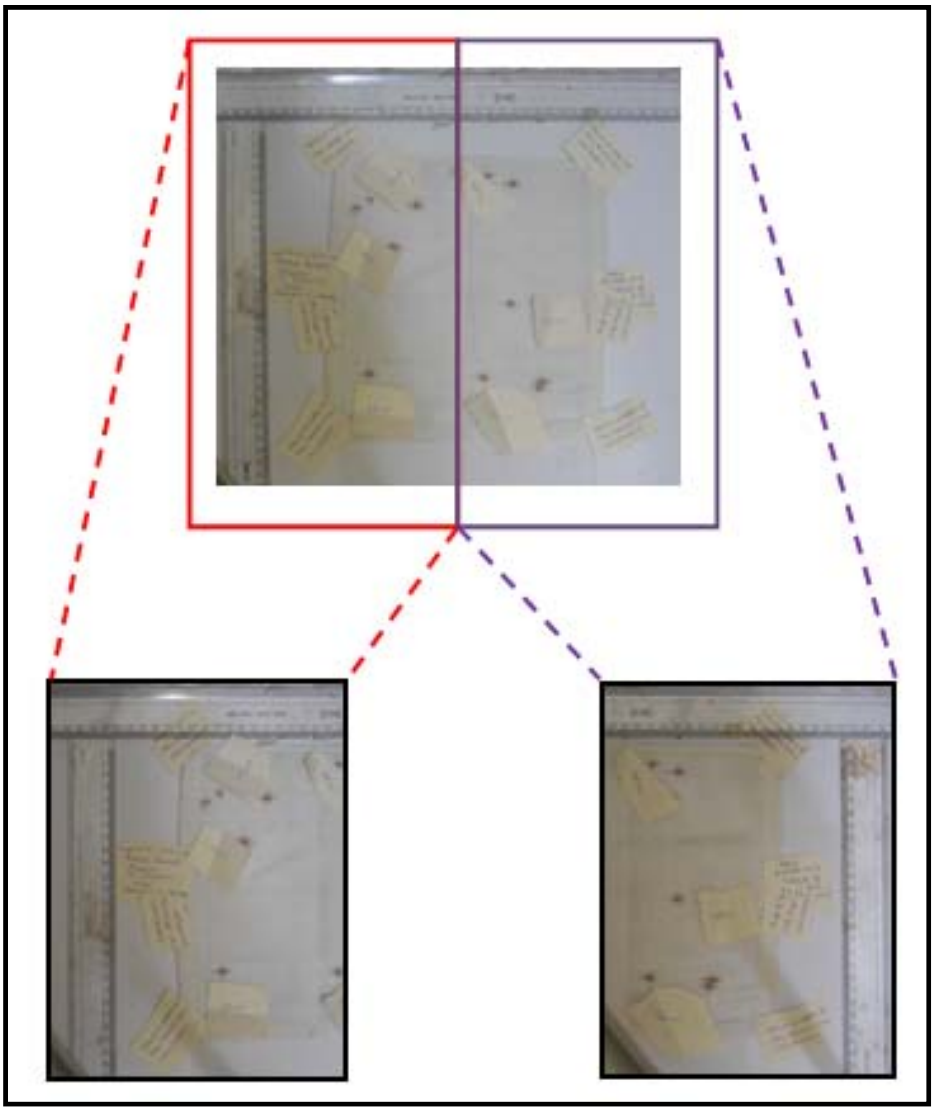


Figure 1: The overall view of the cotton cloth on which the stains were taken. The left side contains stains created with fresh pig. The right half of the cloth contains bloodstains created from pig blood thoroughly mixed with anticoagulant

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Discussion

With respect to the control sample that was recorded on non-absorbent paper, noticeable distortion was observed on the fabric surface in both cases. For example, stain dimensions were found to increase with increase in height even on fabric surface. However, no significant difference was recorded between the stain patterns formed with freshly slaughtered pig blood and pig blood thoroughly mixed with Warfarin(4mg) when they were dropped on similar fabric surface even when the stain images were magnified 50 times. Similar experiments were recorded with Heparin injection (130I.U. = 1mg) and similar results were noted. So, in line with Slemko and White's[4] work it can be safely concluded that height of fall, fabric texture, fabric composition, newness, absorption capacity of target surface , volume of blood in droplet does affect the pattern of the stain, but addition of an anticoagulant in controlled proportions does not affect the pattern characteristics .

Conclusion and Future Work

The work concludes that addition of an anticoagulant does not alter the characteristics of a stain pattern formed, when the anticoagulant is added in controlled proportions. Given that the surface texture, surface absorption capacity, fabric composition together with volume of blood, fall height, velocity at which the droplet hits the surface affect the stain pattern characteristics, the authors intend to develop a database of how absorbent surfaces(i.e. fabric surfaces) react to or rather affect stain formation.

It is difficult to develop a computer based tool that could effectively identify the absorbent surface(predominantly fabrics) on which a particular stain has been formed due to the large array of blended and textured fabrics that are available. Given the large number of factors the control the stain pattern formed on an absorbent surface and that the stain patterns on fabrics are extremely fragile , it often becomes difficult to calculate the impact angle and hence the physical mechanisms that have led to the formation of a particular stain pattern on a particular fabric surface. So in coherence with the work of Slemko and White, the authors believe that fabric stain patterns should in all probability be carefully studied and hence analyzed.

References

1. Slemko, J.A., *Bloodstains on Fabric: The Effects of Droplet Velocity and Fabric Composition.* International Association of Bloodstain Pattern Analysts News, 2003.**19**(4): p. 3-11

2. Kuruvilla, M., &Gurk-Turner, C. (2001). A review of warfarin dosing and monitoring.*Baylor University Medical Center Proceedings*, *14*(3), 305–306. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1305837/

ISSN 2348 – 7968

3. Elert, G. (2001). Volume of Blood in a Human. Retrieved December 11, 2014, from http://hypertextbook.com/facts/1998/LanNaLee.shtml

4. White, B., *Bloodstain Patterns on Fabrics: The Effect of Drop Volume, Dropping Height and Impact Angle.* Journal of the Canadian Society of Forensic Science, 1986.**19**(1): p. 3-36.

5. Welding, S. (2012, 12). Locard's Exchange Principle - Forensic HandbookForensic Handbook. Retrieved October 22, 2014, from http://www.forensichandbook.com/locards-exchange-principle/

6. Nordby, J. J. (2006). Final Analysis Forensics. Retrieved from http://www.finalanalysisforensics.com/media/pdfs/BasicBloodstainPatternAnalysisTEXT.pdf

7. Scientific Working Group On Bloodstain Pattern Analysis. (2009, April). FBI — Standards and Guidelines - Scientific Working Group on Bloodstain Pattern Analysis: Recommended Terminology - April 2009. Retrieved from http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/april2009/standards/2009_04_standards01.htm