Castoff Spatter Analysis

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Abstract: **Blood is one of the crucial evidence encountered at a crime scene. Due to its viscous nature of blood various bloodstain patterns are created which when studied may reveal what might have happened at the crime scene. Bloodstain pattern analysis is the interpretation of bloodstains at a crime scene in order to recreate the actions that caused the bloodshed. There are different types of blood spatter i.e., high velocity spatter, medium velocity spatter low velocity spatter. Castoff pattern is a bloodstain pattern created when blood is released or thrown from a blood-bearing object in motion. An experiment was conducted to differentiate different types of castoff spatters created by fake blood by using different objects.**

Keywords: **Blood, Bloodstain pattern, Blood spatter, Crime scene, Castoff spatter, Detergent, Hammer, Knife, Lemon juice, Scissors, Turmeric.**

1. Introduction

Blood is an organic fluid circulating in your body and it ranges from 4-5 L in males and 5-6 L in females. Inside the body the blood exists in liquid form and it exits from the body due to an impact or injury. If there where blood clots in blood found at a crime scene, it suggests that the victim was exposed to an extended injury.

Blood evidence found at a crime scene can be used for DNA profiling to authenticate the suspects identity and its pattern reveals the direction of spattering in order to reconstruct the crime.

Bloodstain pattern analysis is a process to analyze the blood found at the scene of crime to reconstruct the events at a crime scene. Different types of patterns and stains that are found at the scene include transfer stains, projected stains, expiration patterns, impact patterns and others.

2. Background

A. Types of Blood Spatters

There are three types of blood spatters.

1) High velocity impact spatter

A high velocity impact spatter is the type of blood spatter created due to high velocity impact to a blood source. This type of impact spatter mainly measures 1mm or smaller. High velocity spatter mainly includes gunshot spatter.

1. Gunshot spatter-Gunshot spatters are created due to high velocity impact from the machinery mainly gun. These types of spatter mainly causes both type of spatter a forward spatter from the exit wound and a back spatter from the exit wound.

2) Medium velocity spatter

A medium velocity spatter is that type of spatter caused due to blunt force impact from hockey bat or beating. This spatter results from force anywhere between 5-100 feet per second. This type of spatter can also be a result of a stabbing.

1. Castoff spatter- This type of spatter are created when a blood bearing object flings blood onto nearby objects due to swinging of that object. This type of spatter can help a analyst determine the direction of the impacting object (tails points in the direction of motion).

3) Low velocity spatter

Low velocity impact spatter are mainly created due to dripping of blood after victim sustains an injury such as in case of swabbing. It is usually 4-8mm in size. Low velocity spatter can also result in pool of blood around the body.

1. Arterial spatter- This type of spatter are mainly created when a major artery is severed. The severe artery caused the blood to be propelled out due to the high pressure and this propelled blood causes patterns which are individual in nature.

3. Review of Literature

Prashant Singh (2022). et.al: Worked on an experiment that awlata dye was dropped from different heights that created fake blood stains. It was observed that as the height was increased, the distance of satellite stains was also increased. The author concludes that height was directly proportional to the number of satellite stains whereas in spines when the height was increased the number of spines reduced.

Patrick H. Home (2021). et.al: This review provides forensic investigators and bloodstain pattern analysts with a comprehensive overview of all available software options, knowledge of the extent of research into validating these techniques. The author comes to a conclusion that this software being applied in cases may encourage other investigators to adopt the same techniques, without the requisite validation literature having been published to ensure the evidence is later suitable for court.

Alessandro Marrone (2021). et.al: This preliminary study focuses on the age estimation of bloodstains by color variations

over time due to the oxidation of the blood. The author deduces that all five parameters of the CIELAB and CIELCh color spaces were used to predict the TSD of the bloodstains. These results improve the potential application of colorimetric analysis.

Eugene Liscio (2021). et.al: The purpose of this research was to study forward spatter misting patterns to determine if there is a relationship between bloodstain pattern size as a function of distance and orientation. The author comes to a conclusion that statistical analyses indicated a negative linear relation relationship between the bloodstain pattern size and the papers angle and distance and the vertical symmetry of the bloodstain.

Triveni K (2020): The main aim of this paper was to review detailed information on types of crime scenes and the blood patterns that can be interpreted at the different crime scenes. The technologies and developments to examine the crime scene with blood patterns are also studied with the help of research papers. The digital aid in particular is helpful in interpreting the bloodstain patterns.

Sang-Yoon Lee (2020). et.al: The motive of the author is to develop blood substitute. The blood substitute developed in the present study is more similar to human blood than other blood substitute products developed in other countries with regard to the physical properties, including viscosity and surface tension. The author draws the conclusion that blood substitute is more practical because it is available in the market and does not include and chemicals that are harmful to the human body.

Victoria Berezowski (2020). et.al: The purpose of this review paper was to highlight various geometric techniques that crime scene Reconstructionists of forensic practitioners can use to document different kinds of scenes. The main goal of this paper was not to discredit manual methods, as they are long standing and reliable, but instead to shed light on alternative methods that may produce equally or more accurate results.

Kacper Choromanski (2020): The main goal of this article was to show what is the primary indicator that will help to reduce the danger of contamination by corona virus diseases (COVID-19) during the prosecution of work. Bloodstain pattern analysis is as vast discipline. Numerous forensic fields can benefit from this information.

Rebecca Schalika (2019). et.al: The authors demonstrated the current spectroscopic techniques as a means of detecting, differentiating, and estimating the age of bloodstains. Different methods include Raman, infrared, reflectance, nuclear magnetic resonance, electron paramagnetic resonance etc. The author gathers information that methods were deemed potentially useful only for presumptive examinations.

Owen Esaias (2019). et.al: This project aimed to establish whether the FARO focus 3D scanner and FARO zone 3D software can improve the accuracy of area of origin estimates relative to the manual method. The author concludes that overall estimation of area of origin using FARO 3D scanning and associated BPA software are generally more accurate than traditional manual methods and well within accepted accuracy range.

4. Methodology

The experiment of creating castoff patterns using fake blood is performed with the help of different objects like knife, hammer, wooden log, scissors and other types of sharp and blunt objects. To carry out this experiment fake blood has to be prepared which requires water, turmeric, detergent power and lemon juice. This all ingredients are mixed in a small bowl and which at last gives a visual appearance of blood and can be used as a fake blood. After performing the experiment patterns created by different objects are to be observed and compared which can give an explanation to the experiment.

Firstly a hammer is used to create castoff spatter, for this the hammer is applied with fake blood at its head and at a distance of 1.5m from the wall the hammer is swung in a vertical direction and because of that the blood deposited on the head of the hammer is flung from it and creates a pattern on the paper been fixed on the wall. The pattern created by the hammer is mostly aligned in same plane and have nearly same diameter of blood spots. (fig. 2)

Then add the figure caption, as Fig. 1. Title of the figure with 8 pt. size. An example is given as follows,

Fig. 1. Hammer used as a tool for spatter creation

Fig. 2. Fake castoff pattern with hammer

After performing the experiment with hammer now a pointed knife is used this is dipped into the fake blood so that the blood can be equally applied on the knife. After that just like hammer the knife is also swung vertically at the same distance of 1.5m and after swinging the hammer the pattern is created on the paper pasted on the wall, the pattern created by the knife are not aligned in the same plane and the blood spots differ in the diameter. (Fig. 4)

Fig. 3. Knife used as tool for spatter creation

Fig. 4. Fake castoff pattern with knife

Again, the same experiment is performed using a scissors which is dipped into the fake blood so that it get equally spread and it is again swung from the same distance of 1.5m from the wall and as a result when it is swung with the same angle and position the blood is deposited on to the paper on the wall. The pattern created by the scissors doesn't resemble like the knife and hammer patterns instead the blood was even more weakly aligned and there were some amount of parent stains and the satellite stains where emerging from that parent stains. (Fig. 6)

Fig. 5. Scissor used as tool for spatter creation

Fig. 6. Fake castoff pattern with scissor

Now a wooden log is used to carry out the experiment. The wooden log is been applied with the fake blood and the log is swung from the same 1.5m distance and when the log is swung the blood is flung which creates the pattern and the pattern is aligned in the same plane, and the diameter of the blood spots are also similar. (Fig. 8)

Fig. 7. Wooden log used as tool for spatter creation

Fig. 8. Fake castoff pattern with wooden log

5. Result

After the fake blood was used to create castoff pattern from different objects it was seen that different objects created different patterns. Firstly, when hammer was used it created pattern which were somewhat aligned in the same plane and the diameter of that pattern was also same for all blood spots. After that when knife was used it was found that the pattern was not aligned in the same plane and the diameter of the blood spots was also not same. When scissors was used after knife it was found that the pattern was more irregular than knife pattern and the diameter of the blood spots was also more than the knife pattern as it created large parent stains. At last when a wooden log was used it was found that the pattern created by the wooden log was aligned in the same plane and the diameter of the blood spots was also similar.

6. Conclusion

From the experiment above using fake blood it was found that different objects create different types of castoff patterns. When the hammer was used the patterns where somewhat aligned in the same plane and the diameter of blood spots was also small. When knife was used it was found that the pattern was not aligned in the same plane and the diameter of the blood

was also not equal rather it was distributed. After knife when scissors was used it was found that the pattern created by it was irregular has it had large parent stains and the diameter was also larger for the blood spots. When wooden log was used it showed that the pattern was aligned in the same plane and the diameter of the blood spots was also same. From the experiment it was concluded that the size and weight of the object play a large role in the castoff pattern creation. As the size and weight of the object is large the patterns are aligned in the same plane, as seen in the case of hammer and wooden log and as the size and weight of the object is small the patterns are not aligned in the same plane, as seen in the case of knife and scissors. This existing study can help the crime scene investigators to examine the crime scene precisely.

Acknowledgement

Author's Contribution

Under this research work, all the above authors have done each and every single work whether it is related to collecting data, valuable information, contributing data or analysis tools, designing the analysis, performing the analysis. All the authors have worked hard regarding the research work with great concentration and dedication.

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