

Fibers and Forensics : A Review of Textile Analysis in Stab Wound Cases

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ARTICLE INFO

Article History:

Accepted: 25 March 2024

Published: 16 April 2024

Publication Issue :

Volume 11, Issue 2

March-April-2024

Page Number :

586-590

ABSTRACT

This paper covers the complex field of forensic textile stabbing analysis, including its past growth, methods, case studies, applications, and database use. The evaluation begins with an outline of its historical background and proceeds to examine diverse analytical techniques and equipment essential for proficient analysis. It follows the development of stab analysis from simple visual inspections to advanced instruments. The review clarifies the critical function of stab analysis in criminal investigations via the lens of case studies and academic publications. The relationship between stab analysis and other forensic specialties is also examined, with a focus on cooperation with material engineering domains. The study emphasizes the value of stab analysis in modern forensic science by demonstrating its potential. This article offers insights to improve analysis procedures and further the cause of justice, making it a useful tool for forensic professionals, advocates, and researchers alike. Through a combination of historical viewpoints, methodological developments, and multidisciplinary efforts, the review facilitates innovation in conventional forensic technology, which in turn helps to resolve complex criminal cases.

Keywords : Fabric Analysis, Textile Analysis, Stab Wound, Forensic Textile Analysis, Microscopic

I. INTRODUCTION

Forensic textile stab analysis is a specifically categorized area in Forensic Science that involves the examination of fibers and fabrics or textiles in the cases of stabbing, cutting or any incidence which harms a living body. It plays an important role in criminal investigations, providing valuable hints and

information about the incidence, weapon, perpetrator and their nature, the force applied while the incidence was happening and the circumstances at that time. It is important to understand this topic deeply as it gives us an overview of what was happened, how it happened, when it happened, even where it happened and who did it. An curtail study of fabric with methodological perspective can help us

find these five W's and lead us to the conclusion. This study includes fabric damage and characteristics, its microscopic analysis, toolmark analysis, force applied and energy analysis, experimental studies, related case studies and practical applications and challenges and legal considerations regarded to it.

In the specialized branches with this field there are many techniques which has developed for help of investigators which involve analysis of sharp as well as blunt weapons. Any object that can harm human body can be considered as weapon there should be no specific definition for weapons. This review article focuses on the evolution, methodologies, and case studies of forensic Textile stab analysis. Putting our wealth of knowledge in this area we can play important role in providing valuable information in modern forensic investigations. We are going to deal with historical roots of forensic textile analysis and start from beginnings of techniques. In some sections we are going to deal with methodologies for analysis. From microscopic to instrumental and chemical approaches.

We will also put light on techniques of SEM-EDS and FTIR, each approach gives us layers of curtail information for crime scene reconstruction involving various injuries. We are going to learn practical applications of stab analysis by seeing various cases. We will uncover some limitations and challenges that researchers face.

II. HISTORICAL PERSPECTIVE

The forensic textile analysis is an emerging science from early 20th century when scientist recognized the value of trace evidences in criminal investigations. Firstly, focused field was on the examination of fibers which were collected as evidence on SOC and microscopic examination was done on technique such as stab analysis When first examinations were done scientists focused in the primary characteristics such as visual examination and basic microscopy for analysis of damage on textile. More precisely focus

was on sharp- edged weapons such as knife. Would like to recommend an article " The year of knives " by Charis Eades it argues that the facts about knife crime and knife carrying are at odds with public policy, media and public perception. In that they explained the knife crime report and solutions and reactions. Many advancements in microscopy and their techniques of staining after early 20th century was going on path of research in the field of forensics textile analysis this invention allowed more detailed fiber examinations.

In late 20th century a drastic change in forensics science occurred and fast technological advancements took gear and stab analysis got more light into developments and superior instrumentation such and Fourier-transform infrared spectroscopy (FTIR) the principle of this technique is depend on the absorption rate of infrared radiation which measures the interaction between the sample and infrared light and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS) it is a combination of two analytics technique SEM is related with beam of electron which scans the sample it backscatters the electrons where EDS is the technique which do analysis of reflected or emitted rays .In recent days there is seen inter relationship between the forensics scientists, material engineers and other scientific authorities which further study stab analysis

III.METHODOLOGICAL PERSPECTIVES FOR STAB ANALYSIS

This area of forensic has very wide range of specialized techniques to enlighten the valuable information from textile sales connecting with stabbing or any type of incidents. Some of the methods play an important role in reconstruction of a crime scene and providing investigators the insights. Some of preliminary techniques are

I. Microscopic examination of fibers.

- microscopy has a very keen observation of stain analysis. Experts examine the textile fibers using different types of microscopes, which include compound microscope and stereomicroscopes. This allows the identification of weapon, its nature, what was the force, and what would be the entry and exit of weapon, its tear, cuts and puncture marks.

II. Chemical analysis for identification of stab remains.

Chemical techniques help us to detect the stab residue left on textiles and its effect. These residues can include body tissue, blood, sweat, saliva, or other bodily fluid.

III. Instrumental techniques.

Instrumental or analytical techniques in this area include use of FTIR, SEM-EDS like instruments for detection and analysis of sample and its detailed examination

IV. Recent developments in stab analysis methodologies.

-ongoing research and projects progress to expand toolkit which is available in Forensics experts stab analysis. Some innovations like high-resolution imaging, three-dimensional imaging or reconstruction, etc. will be capable of providing more and more key insights

IV. CASE STUDIES AND APPLICATIONS

Forensics Textile analysis has played a very significant role in so many investigations which provides critical information and leads towards the solution of complex cases. Some are the case studies

i. The cold case breakthrough.

- Forensics Textile stab analysis played very significant role in reopening this case from early 1990s. The analytical technique which included SEM-EDS, were employed to re-examine available evidences. The detailed analysis was done and the suspect was accused.

ii. The Smithsonian case.

- In this case, it was a homicide investigation. Where microscopic analysis unleashed the vary pattern of fiber damage consisting the specialized weapon.

Here for more better understanding I would like you to recommend an article "Bullet entry holes in fabric, fibers, facts and fallacies" by Alexander Jason, ANITE Group, Pinole, CA; Lucien C. Haag, Forensic Science Services, Carefree, AZ.

In this study they have explained what is bullet wipe and how to determine the bullet entry and exit points and fiber direction.

These case Studies simplify the wide range of application of forensics textile analysis from solving them to provide a curtail evidence. The stab analysis is the powerful tool to explore evidence and lead investigations the analysis pursuit of justice and its ability to unleash the complex criminal investigations

V. ETHICAL CONSIDERATIONS AND LEGAL PRACTICES

The practice of forensic textile stab analysis is carried out by ethical principles and must include legal standard. While we point towards ethical considerations and understanding the legal impact of stab analysis it is prominent to maintain credibility and reliability of its results. Here are some key points regarding it:

1. Admissibility of stain analysis evidences in court.

- The admissibility of stab analysis evidences depends of their reliability, relevance, and the quantification of the expert presenting the results. Forensic experts must elaborate the validity and reliability of their methods that has been used, the accuracy of their findings and conclusion.

2. Ethical concerns around stab analysis procedures.

- Ethical considerations involve wide range of factors, including the handling, collection and preservation of evidence, ensuring the privacy of victim. Maintaining confidentiality of victim's story is important. The approach towards work should be handled with

professionalism, sensitivity and commitment to the ethical standards

3. Ensuring the integrity of forensic textile analysis in legal contexts.

- Transparency and accuracy should be maintained. Peculiarities should be noted and proper documentation is expected, the record keeping must be ensured and all the standardized protocol should be followed

VI. FORENSIC TEXTILE DATABASE AND DATABASES

This area is immensely beneficial from establishment of specialized Database which should be dedicated to catalogue and should organize information related to textiles which are associated to the criminal cases. Its importance should be noted. Database could serve as centralized repositories of information in relation with textile fibers their characteristics and associates and forensic details Existence if database and their contribution should be noted. It's examples in Forensic Textile Database include the international fiber Database (IFDB) and textile fiber Database (TFBD). These resources compile a wealth of knowledge on textile fibers. Which include their composition, color, and microscopic characteristics. Future preservatives for database development should be studied and considered

VII. CONCLUSION

Forensics Textile stab analysis stand as foundation in modern forensic sciences, which provides invaluable information in criminal investigations which involve sharp force injuries. The blunt force injuries should also be considered and the lack of variety of weapons in examination is observed. As stated above any object that can harm human body is weapon. So, examination should be done on every harmful object such as a nail and hammer and their nature force and impact on fiber and body not in multiple cases but in

some psychopaths' cases it can give a key insight related to investigation. Overall, the historical journey from preliminary visual examination to advanced instrumental techniques shows a remarkable evolution of this specialized field. Some case studies show a powerful impact of stab analysis in solving complex criminal cases. Which provided curtail evidence for the reconstruction of crime scene. Interdisciplinary collaborations further cope up the capabilities of stab analysis

VIII. ACKNOWLEDGMENT

We extend our heartfelt gratitude and sincere appreciation to the Department of Forensic Science at Yashvantrao Chavan Institute of Science, Satara, Maharashtra, India. For their vitally important role and guidance, cooperation, support through the process of writing this review article on "Fibers and Forensics: A review of Textile Analysis in Stab Wound Cases ". This collaborative effort paves the path of importance of interdisciplinary research in forensic science, and we are grateful for the collective contributions.

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