The Indian Journal for Research in Law and Management

Open Access Law Journal – Copyright © 2026

Editor-in-Chief – Dr. Muktai Deb Chavan; Publisher – Alden Vas; ISSN: 2583-9896

THE ROLE OF FORENSIC SCIENCE IN CRIMINAL JUSTICE SYSTEM IN INDIA; EVALUATING THE INVESTIGATION AND PROSECUTION OF CRIMINALS IN INDIA

Sam S. Siryon

ABSTRACT

The Indian criminal justice system has faced huge challenges including massive case backlogs and judicial delays revolving around under-resourced police force, poor forensic infrastructure, low conviction rates, witness intimidation, custodial torture, political interference, lack of police reform, ineffective prosecution, outdated laws and systemic bias against marginalized groups wherein many undertrials are languishing in jail due to slow bail processes. To address these challenges, particularly the criminal justice in India, there is a need for imploring forensic science in criminal justice by providing objective scientific evidence like DNA, fingerprints and digital data to identify perpetrators, establish facts, link suspects to crimes and verify timelines, this offers an unbiased foundation for justice and ensures that convictions are based on proof rather than mere speculations. This process helps to exonerate the innocent, bridge law enforcement and judiciary for accurate case resolution. It has been proven that the criminal justice system in India has shown progress since the inclusion of forensic science and has aided criminal investigations although there are some challenges like underutilization, resource gap, and training of law enforcement officials and criminal investigators which has hindered its full potential for accuracy in convictions and exonerations. The increasing use of DNA, digital forensics and fingerprints in high-profile cases shows the growing importance and impact on securing convictions. By addressing these systemic gaps, forensic science can move from a useful tool to a foundational element that can significantly improve the precision and fairness of India's criminal justice system. When it is introduced as a fundamental element of the justice system, not only accessible to the high-profile cases but also to all cases invoking its essence for fairness and justice to all people.

KEYWORDS

Criminal Justice, Forensic Investigation, Fair Trial, Human Rights and Judicial Effectiveness in Justice Delivery.

INTRODUCTION

Prior to the introduction of modern forensics, the Indian justice system had relied heavily on eyewitness testimony, confessions which are often coerced through the use of third-degree methods, and physical evidence interpretations which were done by traditional experts with little or no scientific backing, these lead to unreliable outcomes. The system evolved from relying on brute force and witness accounts to incorporating early identification techniques like fingerprints and anthropometry which eventually formalized through institutions like the Kolkata FSL inn the 1950s to meet demands of a rapidly changing society. The introduction of forensic investigation in India has been rooted in ancient practices like fingerprints use in old texts but it was formalized under the British rule with the *Indian Penal Code of 1860*[1] and the *Indian Evidence Act of 1872*[2] leading to the world's first fingerprint Bureau in Kolkata in 1897 under Sir Edward Henry.

The application of science and technology to the detection and investigation of crime and the administration of justice has not been a new idea to India, although pre-independent India did not know forensic science in its present form, scientific methods in one way or the other seem to have been followed in the investigation of crimes as was detailed in Kautilya's Arthashatra which was written about 2300 years ago. Indians studied various patterns of the papillary lines thousand years ago[3]. The Kautilya's Arthashastra is an ancient Indian treatise on statecraft which contains surprisingly modern forensic concepts which details procedures for medico-legal autopsies, poison detection (toxicology) and evidence assessment. It emphasizes physical signs like swelling and ligature marks to determine cause of death, especially for sudden or unnatural deaths, foreshadowing forensic pathology and toxicology within a comprehensive judicial framework of evidence like witnesses, documents and possession, as well as punishment. It serves as an early guide for criminal investigation with focus on empirical observation and systematic inquiry rather than pure superstition. In medico-legal examinations,

[1] Indian Penal Code, 1860 (Act No. 45 of 1860)
[2] Indian Evidence Act, 1872 (Act No. 1 of 1872) Indian Legislative Assembly
[3] History and Development of Forensic Science in India: Legal Service India, Law Articles, Legal Resources, Last Visited December 27, 2025 https://www.legalserviceindia.com/legal/article-2975-history-and-development-of-forensic-science-in-india.html

the Arthashastra mandated soil smearing of corpses in sudden deaths to reveal hidden bruises or injuries. Identified specific signs of asphyxiation (suffocation) like swollen abdomen or limbs, inflated navel, sunken eyes, and ligature marks on the neck. In the context of toxicology and poison detection, it discussed poisonous substances and their detection and lay down the groundwork for forensic toxicology. For evidence and investigation, Arthashastra based on witness testimony (Sakshi) which requires multiple witnesses often three ad detailed rule for assessing their credibility, punishing false testimony. While on documentary evidence (Lekhya), it requires valued contracts and documents which often instructs judges to detect forgery. In this light, forensic investigation is a multi-stage scientific process used to identify, document and collect evidence for court presentation.

In criminal investigation and prosecution, it is important that the facts are proven beyond reasonable doubts to either exonerate or punish criminals. Forensic investigation has significantly impacted Indian criminal trials by providing objective, scientific evidence like DNA, fingerprints and ballistics to identify perpetrators, reconstruct events and collaborate or challenge witness testimony to boost conviction rates and ensure fairer justice, especially with new laws making forensics mandatory for serious crimes. Forensic investigations are kin to rescuing the innocent and strengthening legal proceedings.

RESEARCH QUESTIONS

Where did the concept of Forensic Science and Investigation originates from?

How is Forensic Science important in exonerating falsely accused persons?

What are the Challenges faced by the Indian Criminal Justice System and how can forensic investigation be used to address these challenges?

What is the role of Crime Scene Investigators in investigating crimes and ensuring that forensic evidences are processed and untainted?

How were crimes investigated and criminals prosecuted in India prior to the introduction of Forensics in the Criminal Justice System in India?

RESEARCH HYPOTHESIS

The scope of this paper is limited to the Indian Criminal Justice System as it evaluates the role of forensic science in criminal investigation in India, by assessing the evolution of evidentiary investigation, witness testimonies from early India to the modern use of Forensics. By focusing

on the role of crime scene investigators in securing forensic evidences as well as the role of judges in ascertaining facts from forensic evidence beyond reasonable doubts for a fairer justice delivery and criminal prosecution. Ancient practices and principles like the Arthashastra are assessed to understand the pattern of investigation, before proving facts during ancient Indian justice system.

RESEARCH METHODOLOGIES

This paper implores both primary and secondary sources to expand on the subject matter for a clear, genuine and concise discourse. This paper is exploratory in nature as it explains and investigates the concept from multiple viewpoints rather than taking a firm stance, although at the conclusion of the discourse, the paper might have a stance on the subject matter wherein recommendations and suggestions will be implored to address the discovered challenges in the Criminal Justice System. Primary sources like landmark case Laws and constitutional provisions are used for in depth explanation and references whereas, secondary sources from reputable articles, journals, blogs and websites are used for simpler explanation on the subject matter.

LITERATURE REVIEW

Forensic science may be understood as the scientific application of principles to analyze evidence for legal matters, it may also be understood as the application of scientific techniques and methods like biology, chemistry and physics to examine evidence for legal proceedings both in civil and criminal matters. The application of scientific knowledge and methodology for the resolution of legal questions and problems for individuals and society, involving the observation, documentation, collection, analysis, assessment and scientific interpretation of evidence during the course of an investigation required for the different fields of law[4]. The actual word “forensics” originated over 2000 years ago in relation to the death of 56-year old Julius Caesar, where Antistius, a Roman physician in 44 BC who performed the first recorded forensic autopsy on Julius Caesar to determine the fatal stab wound which established a precedent for using expert medical opinion in legal matters. Antistius linked his work to the origin of forensics which in Latin means “forum” making it an early milestone in the history of using science to solve crimes, alongside other ancient techniques like Chinese fingerprints

[4] Forensic Science: Defending Justice, Shen and Vieira; National Library of Medicine, National Centre for Biotechnology Information, December 12, 2016
https://pmc.ncbi.nlm.nih.gov/articles/PMC6197096/

use and Indian lie-detection methods. After Caesar's assignation by the senators, Antistius examined his body and found 23 stab wounds but identified the single fatal blow to the chest which was the cause of death. This was a pivotal moment as Antistius delivered his medical opinion in the public forum, making it the first recorded instance of pathologist providing expert opinion and testimony thereby giving rise to the term "forensics" (from Latin "forensic" meaning forum).

EDMOND LOCARD'S[5] EXCHANGE PRINCIPLES IN FORENSICS

This is a fundamental concept in forensics which states that "every contact leaves a trace" meaning that a perpetrator will always leave something behind at a crime scene and take something away, linking them to the scene through exchanged materials like fingerprints, hair, fibers blood, DNA, or tool marks. Locard's exchange principle is a foundational concept in Forensic science which states that whenever two objects come into contact, each object leaves behind some trace or residue on the other. It was formulated in the 20th century and underscores the importance of physical evidence in criminal investigations. Inspired by literary and scientific figures, Locard established the first modern forensic laboratory in Lyon, France, where he conducted pioneering research on trace evidence.[6]

ELEMENTS OF FORENSIC SCIENCE IN CRIMINAL INVESTIGATION

Forensic components in criminal investigation revolves around several elements including DNA analysis, Fingerprints, toxicology, ballistics, digital forensics and trace evidence which are used to scientifically collect, analyze and interpret physical evidence from crimes scenes to identify suspects, exonerate the innocent, reconstruct events, and provide objective facts for legal proceedings. These methods link people to crimes (the DNA, fingerprints), identify weapons (ballistics), detect substances (toxicology), an uncover digital clues are all crucial for building cases and ensuring justice. It is crucial for investigators to effectively understand the various components of forensic science and how to effectively use them for building strong cases particularly in a systematic framework. Investigators must be able to identify and preserve evidence; by having the knowledge of different evidence types, investigators are guided to conduct proper search, collection, and thus prevents contamination or degradation

[5] Dr. Edmond Locard; A Pioneering French criminologist also called the Sherlock Holmes of France" who established modern forensic science with his famous Locard's Exchange Principle" Every contact leaves a trace", his Exchange Principles forms the basis for trace evidence analysis, that allows investigators to connect people, objects, and locations by analysing these microscopic clues.

[6] Locard's Exchange Principle: Research Starters: EBSCO Research, Johnson and Edwards; 2024 https://www.ebsco.com/research-starters/science/locards-exchange-principle

which are crucial for evidence admissibility in a court of law. It also enables investigators to analyze evidence accurately where the understanding of forensic techniques would allow them to interpret laboratory results correctly and recognizes the potential and limitations of different analyses like DNA, ballistics and toxicology.

CRIME SCENE INVESTIGATION AND EVIDENCE PACKAGING

In India, crime scene investigation involves securing the crime scene, documenting it through photos, sketching and videos, systematically searching for, collecting, packaging, and persevering evidence like fingerprints, DNA, fibers, and weapons while maintain the chain of custody, and sending it to the Forensic Science Laboratory FSL for analysis. All these processes are guided by strict protocols under laws like the new BNSS with the aim of reconstructing the crime and bolstering court evidence, emphasizing the prevention of contamination. In conducting crime scene investigations, during the initial response at the crime scene, the first responders establish a perimeter (police tape) to prevent unauthorized entry and contamination. The officers must wear protective gears like gloves and shoe covers to avoid leaving their own traces. During the preliminary survey which is also known as the planning stage, the lead investigator surveys the scene, identifies entry and exit points, and plans the search method, and afterwards initial investigations and fragile evidence are noted. Follow by the documentation stage where detailed photographs, videography and sketching of the entire crime scene and evidence are done using scale markers, and details like date, time, case number, and locations are captured and noted. A systematic search pattern is used to find latent prints, DNA, fibers, weapons and digital evidence. The evidence is then collected with specialized tools, packaged in appropriate containers, labeled meticulously, and sealed to maintain the chain of custody. The packaged, sealed and labeled evidence is then transported to the Forensic Science Laboratory for scientific analysis like profiling and chemical tests, and the findings from the FSL help investigators reconstruct the crime, and detailed reports are prepared for legal proceedings. This systematic procedure is required to adequately investigate a crime and link perpetrators directly with the crime. Forensic science in criminal investigation provides reliable forensic evidence that can clear wrongly accused individuals and protects the innocent. It provides scientific data for courts and help determine guilt or innocence thereby ensuring fair adjudication and efficiently resolving the vast number of pending cases. Crime scene investigation is essential as it ensures accurate identification of suspects by protecting innocent individuals from false accusations, help in strengthening legal cases with scientific evidence that can help reconstruct the sequence of events, this process provides closure to

victims and families and supports the justice system with reliable investigative methods. An effective crime scene investigation bridges the gap between the police force, forensic experts, and the judicial system.[7]

Forensic aid is mandatory under *section 176(3) of the Bharatiya Nagarik Suraksha Sanhita*[8] as it requires forensic experts to visit the crime scene and collect evidence for offenses that are punishable by 7 years or more, and the state is required to build such capacity in case a forensic facility is not available. Coupled with this, there are several provisions of the BNSS which governs the procedures and forensic evidence and crime scene investigations in India.

THE IMPACT OF DNA ANALYSIS ON CRIMINAL INVESTIGATION

DNA profiling in criminal investigation seeks to identify individuals by analyzing the unique DNA patterns rom biological evidence like blood, hair etc., that are found at crime scenes, this process links suspects directly to crimes or exonerates them when proven innocent. It primarily uses *Short Tandem Repeat* STR analysis with *Polymerase Chain Reaction* PCR to amplify variable DNA sections, creating genetic fingerprints for comparison against databases like CODIS and suspects. This has been a cornerstone of modern criminal justice. Although facing legal questions on admissibility, DNA analysis offers highly accurate identification in serious crimes like murder and rape, they are essential for identifying victims and strengthening evidence as well as exonerating the innocent. It enhances investigations by linking suspects to crimes with certainty, it increases accuracy and lowers wrongful convictions by reducing reliance on unreliable methods. It is an essential component for corroboration as it provides strong scientific support, corroborating other evidence in sexual assault, murder and theft cases. DNA evidences are regulated to balance law enforcement needs with individual rights under the Indian *Criminal Procedure Code (CrPC)* for collection form the suspects and victims and the *Indian Evidences Act. Article 20(3) and 21 of the Indian Constitution*[9] influence DNA collection, although they are deemed admissible as physical evidence but are not testimonial and does not however violates self-incrimination.

---

[7] Crime Scene Investigation: A Comprehensive guide, Simplyforensic
Crime scene investigation applies scientific methods to uncover the truth behind criminal acts. From evidence collection to digital forensics, CSI plays a vital role in solving crimes and supporting justice through precision, technology etc. Last visited December 28, 2025
https://simplyforensic.com/crime-scene-investigation-a-comprehensive-guide/

[8] Bharatiya Nagarik Suraksha Sanhita, 2023 (Act No. 46 of 2023)

[9] No Person accused of any offense shall be compelled to be a witness against himself; Indian Const. Art. 20(3) No person shall be deprived of his right to life or personal liberty except according to procedures established by law; Indian Const. Art. 21

While Indian courts accepts DNA evidence as admissible, it is dependent on its weight and contexts as well as statistical ratios rather than absolute proof. Essentially, DNA analysis requires legal and infrastructural maturation for its complete, and ethical implementation.

FINGERPRINT ANALYSIS AND CRIMINAL JUSTICE

Fingerprints analysis is a foundational forensic technique that uses the unique and permanent patterns of friction ridges on fingertips to identify individuals and it plays a critical role in tracking criminals and exonerating the innocent. These analyses are invaluable in criminal investigation due to their uniqueness to each individual even identical twin, and their permanence throughout life. The primary use is matching unknown prints like latent prints that are collected from crime scene to known prints of suspects or victims. Typically prints on murder weapons, doorknob, or ransom note can be place a suspect at the scene of the crime. Law enforcement uses Automated Fingerprint Identification System (AFIS) to rapidly search large databases containing millions of print records. This technology significantly speeds up investigations by generating a list of potential matches, which are then verified by a human examiner. Unlike the argument surrounding DNA violating right to privacy, personal liberty or self-incrimination, fingerprints have been consistently compelled by courts although governed that it should be used for corroboration and not conclusion. In the 1961 case of *State of Bombay v. Kathi Kalu Oghad*[10], the Hon'ble Supreme Court held that compelling an accused person to provide fingerprints does not violate his right against self-incrimination, thereby confirming the constitutionality of collecting such physical evidence. Furthermore, in the 1997 case of *Mohammed Aman & Anr v. State of Rajasthan*[11], the Hon'ble Supreme Court highlighted the importance of reliability in fingerprint evidence, suggesting that it is desirable for specimen fingerprints to be taken under the order of a magistrate.

Fingerprints can link a perpetrator to other unsolved crimes if there is a reason to compare them, or if prints from an unsolved crime turn up as a match during a database search. Sometimes these unknown prints linking multiple crimes can help investigators piece together enough information to zero in on the culprit. Fingerprints are typically used in the absence of DNA and are used by the criminal justice system to verify a convicted offender's identity and

[10] State of Bombay vs. Kathi Kalu Oghad And Others, 1961 AIR SC 1808
[11] Mohammed Aman, Babu Khan And Another vs. State of Rajasthan AIR 1997 SC 2960

track their previous arrests and convictions, criminal tendencies, known associates and other useful information regarding a criminal's sentence, probation, parole or pardon.[12]

APPLICATION AND JUDICIAL CRITICISMS OF LIE-DETECTION IN CRIMINAL INVESTIGATION IN INDIA

Lie-detection help criminal investigators to monitor physiological changes like heart rate, breathing and sweat, linked by stress, guiding them by identifying deceptive suspects or clearing the innocent and confirming evidence. Using detection techniques like polygraphs to measure blood pressure, pulse, respiration and skin conductivity, assuming that lying causes unique physiological stress responses like increased heart rate and sweat. Techniques like Narcoanalysis that involves administering drugs like sodium pentothal to lower inhibitions, it supposedly makes truthful answers more likely although it is highly controversial. Brain Mapping monitors brain activity like blood flow and oxygen use to see which areas activates during specific questions, this technique is used to look for patterns that indicates deception. Similar to DNA analysis, lie-detection is criticized for unreliability, inaccuracy, lack of scientific consensus and major human rights violations, especially concerning the right against self-incrimination under *Article 20(3)* and the right to personal liberty as provided under *Article 21* of the Indian constitution. This lead the Hon'ble Supreme court, in the case of *Selvi v State of Karnataka*[13] to rule that involuntary tests are unconstitutional even though the results might sometimes aid investigations with consent. It can only be used as an aid in the investigation but not a standalone proof of guilt. The Hon'ble Supreme court in the right to privacy judgement as in the case of *K.S. Puttaswamy v. Union of India*[14], found that lie detection tests were substantially intrusive into one's mind and body, and hence involuntary conduct of such tests would violate *Article 20(3) and Article 21 of the Constitution*. Thus, it is clear that lie-detection cannot be conducted on a respondent or an accused without their voluntary consent.

RECOMMENDATIONS AND CONCLUSION

DNA analysis forms the backbone for forensic criminal investigation globally thus a challenge on grounds of human right violation must no hinder its effectiveness in the criminal justice system, a robust legal framework like the DNA Bill when fully enacted can create clear rules

[12] Fingerprint Analysis; A Simplified Guide, Last Visited December 28, 2025 https://www.forensicsciencesimplified.org/prints/why.html#:~:text=In%20addition%2C%20fingerprints%20can%20link,%2C%20probation%2C%20parole%20or%20pardon.
[13] Selvi & Ors vs. State of Karnataka & Anr 2010 (7) SCC 263
[14] Justice K.S. Puttaswamy v. Union of India (2017) 10 SCC 1

for DNA collection, storage, usage and database management like entry and removal criteria which could minimize the increasing violation on human rights. Such legal frameworks must address privacy and self-incrimination by clarifying how DNA profiles of accused/convicts are stored, this ensures it does not violate privacy or compel self-incrimination by offering legal recourse for misuse. At the State level, government must mandate strict Quality Control/Assurance protocols in all labs to guarantee accuracy. The government should develop and enforce protocols for proper collection, preservation and storage of biological evidence. At the Judicial level, judges should be educated on DNA science, its limitations, statistical interpretation and challenges to ensure informed decisions or rulings. Police and investigators should be trained on correct collection, chain of custody and handling of DNA evidence to prevent contamination. To address the criticisms regarding fingerprints in criminal investigation, the State must invest in rigorous training for examiners, adopting advanced technologies like AI/AFIS that ensures strict chain of custody and promotes scientific integrity while upholding constitutional rights via judicial precedents like the Kathi Kalu Oghad case. This can foster better accuracy, faster and effective investigation results and fewer wrongful convictions. In conclusion, by implementing these strategies, India can build a much stronger and more reliable evidence-based analysis in their criminal justice system to reduce the miscarriages of justice and streamline investigations.

REFERENCES

History and Development of Forensic Science in India: Legal Service India, Law Articles, Legal Resources, Last Visited December 27, 2025
https://www.legalserviceindia.com/legal/article-2975-history-and-development-of-forensic-science-in-india.html

Forensic Science: Defending Justice, Shen and Vieira; National Library of Medicine, national center for Biotechnology Information, December 12, 2016

https://pmc.ncbi.nlm.nih.gov/articles/PMC6197096/

Locard's Exchange Principle: Research Starters: EBSCO Research, Johnson and Edwards; 2024
https://www.ebsco.com/research-starters/science/locards-exchange-principle

Crime Scene Investigation: A Comprehensive guide, Simply forensic

Crime scene investigation applies scientific methods to uncover the truth behind criminal acts. From evidence collection to digital forensics, CSI plays a vital role in solving crimes and supporting justice through precision, technology etc. Last visited December 28, 2025 https://simplyforensic.com/crime-scene-investigation-a-comprehensive-guide/

No Person accused of any offense shall be compelled to be a witness against himself; Indian Const. Art. 20(3)

No person shall be deprived of his right to life or personal liberty except according to procedures established by law; Indian Const. Art. 21

Fingerprint Analysis; A Simplified Guide, Last Visited December 28, 2025 https://www.forensicsciencesimplified.org/prints/why.html#:~:text=In%20addition%2C%20fingerprints%20can%20link,%2C%20probation%2C%20parole%20or%20pardon.

Mohammed Aman, Babu Khan And Another vs. State of Rajasthan AIR 1997 SC 2960

Justice K.S. Puttaswamy v. Union of India (2017) 10 SCC 1

Selvi & Ors vs. State of Karnataka & Anr 2010 (7) SCC 263

State of Bombay vs. Kathi Kalu Oghad And Others, 1961 AIR SC 1808

Bharatiya Nagarik Suraksha Sanhita, 2023 (Act No. 46 of 2023)

Indian Evidence Act, 1872 (Act No. 1 of 1872) Indian Legislative Assembly