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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Ballistic Forensics and Wrongful Convictions: Strengthening Firearm Evidence in India's Criminal Trials

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ABSTRACT :

The field of ballistic forensics occupies a pivotal spot within the systems of criminal investigation in firearm-related cases, for it is an objective credibility maker, if properly done, or a distributor of wrongful convictions in misapplication. In India, systemic ills in the forensic infrastructure, baffling procedural discrepancies, and lack of expert training have detrimentally affected firearm evidence reliability. This article is an attempt to look at the disciplines of forensic ballistics in India in criminal trials, particularly in the area of wrongful conviction, focusing on statutory framework, forensic procedure, and judicial precedents. Taking cue from several national laws such as the Bharatiya Sakshya Adhiniyam and the Bharatiya Nagarik Suraksha Sanhita, the study pins its critique to the working systems of forensic laboratories and court procedures in this regard. Case studies and Supreme Court verdicts show how neglect and improper use of ballistic evidence threaten justice, especially when confessional or testimonial evidence itself is shaky. The findings included recurrent issues like lack of modernization in instruments, absence of quality controls, and accreditation for all of this are lowered evidentiary standards. To correct these, reforms in the form of creating one centralized ballistic database system, compulsory expert certification programs, standard operating procedures for evidence handling, and adaptation of best practices used internationally in forensics are proposed. It then finally suggests that transparency, accuracy, and scientific neutrality in firearm forensics be institutionalized at long last so that the constitutional guarantee for fair trial is upheld, and that miscarriages of justice are wrought.

Keywords: Ballistic Forensics, Wrongful Convictions, Firearm Evidence, Forensic Science in India, Expert Testimony, Criminal Justice Reform, Bharatiya Sakshya Adhiniyam, Forensic Lab Accreditation

Introduction

The field of ballistic forensics holds a central place within the criminal investigation systems in firearm cases, as it is an objective credibility builder, if well conducted, or a dispenser of unjust convictions in misuse. In India, infrastructural ills in the forensic setup, inexplicable procedural variances, and expert training shortages have adversely impacted firearm evidence credibility. This paper is an effort to examine the fields of forensic ballistics in India in criminal cases, especially that of wrongful conviction, with respect to statutory framework, forensic procedure, and judicial precedents. Drawing lessons from a number of national acts like the Bharatiya Sakshya Adhiniyam and the Bharatiya Nagarik Suraksha Sanhita, the research bases its criticism on working mechanisms of forensic labs and court protocols in that respect. Case studies as well as Supreme Court rulings indicate how negligence and misuse of ballistic evidence compromise justice, particularly where confessional or testimonial evidence itself is unsound. The results consisted of repeated problems such as the absence of modernization in equipment, lack of quality assurance, and accreditation for all of these are reduced standards of evidence. To rectify these, reforms in the way of instituting one central ballistic database system, mandatory expert certification programs, standard operating procedures for evidence management, and adoption of best practices applied globally in forensics are suggested. It then therefore recommends that firearm forensics undergo transparency, accuracy, and scientific neutrality institutionalized at last to ensure the constitutional right for a fair trial is ensured, and miscarriages of justice are meted.[1]

1.1.1. Definition and Importance of Ballistic Forensics

Criminal Justice System has put a lot of value on Ballistics, particularly in cases where a firearm is involved. Analysis of bullets, cartridge casings, gunpowder residues, and mechanisms of weapons will all contribute to the better understanding of the facts of a shooting incident. The use of ballistic forensics becomes increasingly important in India, where crimes involving guns have found their niche in both urban and rural areas. However, important as it is, firearm forensics in India has, in so many ways, remained compromised, shortchanging criminal trials. In fact, among the most glaring issues is the existence of false convictions from ballistic evidence that has neither been validated, misinterpreted, or not duly documented. The paper explores the vulnerabilities facing the practice of Indian ballistic forensics, investigate the consequences of these deficiencies for miscarriages of justice, and ultimately make recommendations to enhance the validity of weapon evidence in Indian courts. Keeping in view the intersection between science, law, and

[1] Kanak Singh, Remedies for Wrongful Convictions in India, *available at:* https://www.tojqi.net/index.php/journal/article/view/9901/7016 (last visited on April 17, 2025).

procedure, the conversation aims to highlight the requirement of changes and increased transparency regarding the employment of ballistic forensic in India's criminal justice system.2

1.1.2. Overview of Wrongful Convictions in India

Wrongful convictions take place when courts punish the accused for crimes they did not commit due to errors in investigations, flawed procedures, and the misapplication of the evidence in question. The matter is seldom debated and inadequately documented in India largely because the country has no structured post-conviction review system that includes a comprehensive auditing process. Although direct data on wrongful convictions involving ballistic errors are hard to come by, the effects of forensic evidence on the judicial outcomes is undeniable. The major portions of the criminal justice process still rely heavily on confessional statements and circumstantial evidence that are often supported by forensic evidence. This drastically becomes unfair when the findings are either weak in scientific terms or skewed in interpretations against the accused. Every wrongful conviction amounts to a gross infringement of fundamental rights guaranteed under Article 21 of the Constitution of India, which pledges life and personal liberty to every individual of the nation, among other things. Such situations only become more serious under the adversarial mode, because it may arise that the defense does not have an equal opportunity to access expert forensic scrutiny and/or the financial capability to counter the prosecutor's report. Hence, credible and transparent forensic evidence, particularly ballistic evidence, becomes central in such cases. Such defective ballistic analysis, though rare, will only go on to further weaken the already fragile evidentiary fabric, thus necessitating an immediate scrutiny and strengthening of these domains in the interest of natural justice and fair procedure.[3]

1.1.3. Forensic Procedures in Firearm Analysis in India

Ballistic forensics employs principles of physics, chemistry, and metallurgy, thus involving these scientific fields in the analysis of the mechanics of gun fire. Since a weapon has been fired, the bullet faces characteristic forces that impart marks upon it and the cartridge case. These marks are very similar to fingerprints, formed by barrel rifling patterns in the case of sexual marks, and by the breech face or extractor or ejector of the firearm. In india, forensic ballistic experts are obligated to examine these marks in the laboratory with the help of comparison microscopes and high-resolution imaging equipment; yet this analysis is only as good as the equipment and training of the experts and the chain of custody of the evidence from the crime scene to the laboratory. If such tests are properly verified, they might be used to decide whether or not a particular bullet could have been fired from a particular firearm and for the reconstruction of angle and distance measurements of firing that goes into useful scientific input during the course of a criminal trial subject to "section 106 of the Bharatiya Sakshya Adhiniyam", which places the burden upon the accused only for facts especially within their knowledge. Hence, an objective forensic examination guarantees that the prosecution does not rely entirely on guesswork or verbal statements but is rather backed by tangible, demonstrable evidence. Upholding ballistic science can bring much-needed scales to a trial where human error or fabrication could tilt the fact. Still, the inherent complexities of this form of forensic analysis combined with the ever-present need for interpretational clarity provide an additional rationale for highly competent forensic personnel and stringent quality controls in laboratories of india.[4]

1.1.4. Reliability and Admissibility of Ballistic Evidence

Firearm analysis is carried out in forensic science laboratories in India, with the laboratories falling under the administrative control of either the state governments or the Central Government. The standard procedure commences with the seizure of firearms and ammunition, under proper documentation, in accordance with the provisions of the Code of Criminal Procedure and the relevant sections of the Bharatiya Nagarik Suraksha Sanhita, particularly those pertaining to search and seizure. During the entire lifetime of a firearm, from the moment of its receipt in a laboratory to the actual comparisons and opinion, utmost care has to be taken since the evidence is already in dispute, and without the strict application of established procedure, the very existence of the evidence can always be questioned. The Ballistics Examiner, once they receive a firearm, test fires it; that is, they fire the same weapon to obtain known samples for comparison with the bullets or cartridge cases recovered from the crime scene. The examination is done on an optical comparison microscope to find similarities or differences in striation patterns.[5]

Likewise, if the situation calls for it, the hands or clothing of the suspect are also tested for gunshot residues with chemical analysis or scanning electron microscopy. In all cases, a proper chain of evidence custody must be maintained with evidence seals, logs, and tamper-proof packaging. Any departure or deviation from these standards will, apart from vitiating the evidence, reduce the potency of its admissibility in evidence under Section 63 of the Bharatiya Sakshya Adhiniyam when digital imaging or electronic recording is involved. Inconsistency arises primarily because of outdated infrastructures, overworked personnel, and the absence of national standards of accreditation for ballistic laboratories. Most FSLs are not subject to independent oversight, which predisposes institutional bias or procedural cutbacks. Therefore, whereas the procedural engineering ostensibly underpins objective results, actual practice often diverges. Due to this divergence, ground is created for erroneous convictions stemming from faulty firearm evidence.[6]

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[2] Mitali, "Forensic Science as Evidence in Criminal Justice System", 6 *Journal of Emerging Technologies and Innovative Research* 289 (2019).

[3] Prachi Bhardwaj, Examination of a ballistic expert is not an inflexible rule in every case involving use of a lethal weapon: SC, *available at:* https://www.scconline.com/blog/post/2021/12/29/examination-of-a-ballistic-expert-is-not-an-inflexible-rule-in-every-case-involving-use-of-a-lethal-weapon-sc/ (last visited on April 17, 2025).

[4] Catherine L. Bonventre, "Wrongful Convictions and Forensic Science", 3 *Wiley Interdisciplinary Reviews Forensic Science* 88 (2020).

[5] L. Guarnera, O. Giudice, Assessing forensic ballistics three-dimensionally through graphical reconstruction and immersive VR observation, *available at:* https://doi.org/10.1007/s11042-022-14037-x (last visited on April 17, 2025).

[6] Kent Roach, "Wrongful Convictions, Wrongful Prosecutions and Wrongful Detentions in India", 35 *National Law School of India Review* 102 (2024).

Legal Framework for Ballistic Evidence in India

Ballistic evidence is a vital chain in the new Indian investigative and adjudicatory systems. Firearms and ammunition used in committing a crime usually leave traceable patterns and marks that can connect victims, suspects, and crime scenes. Such forms of evidence must be made available through constitutionally valid means and have to be accepted by a proper mode of evidence so that they can be effective. Statutory requirements in India regulate the collection, analysis, and reporting of ballistic evidence in the courts. These consist of statutory legitimation pursuant to the Bharatiya Sakshya Adhiniyam, 2023; procedural rules pursuant to the Bharatiya Nagarik Suraksha Sanhita, 2023; and subject-matter control pursuant to the Arms Act, 1959. Cumulatively, the law ensures that ballistic evidence is relevant, scientifically reliable, and procedurally orderly, thereby bringing it to the pedestal of significant probative value in the criminal determination process, as well as protecting the system from potential miscarriages of justice.[7]

1.1.5. Relevant Laws and Sections

Contemporary Indian criminal investigations and prosecutions greatly rely on ballistic evidence. Guns and ammunition, during a crime, could leave behind traceable impressions and patterns that connect the suspect to the victim and the scene of the crime. For evidence to be effective and constitutionally effective, it has to be admissible in evidence through proper legal channel- something that is provided in the Indian statutory regime. Procedures laid down for the collection, analysis, and production of ballistic evidence in courts are available. This system thus receives statutory mention under the "Bharatiya Sakshya Adhiniyam, 2023", inclusion of procedural guidelines in the "Bharatiya Nagarik Suraksha Sanhita, 2023", and field-specific regulation in the "Arms Act, 1959". Collectively, these legislations ensure the ballistic evidence is pertinent, scientifically reliable, and procedurally normal, thereby enhancing the probative value of such evidence in criminal adjudication and preventing erroneous judgments.[8]

1.1.6. Admissibility of Ballistic Evidence

Three key statutes provide the legal core for the ballistic evidence since India. First, under Section 39 of the Bharatiya Sakshya Adhiniyam, 2023, which replaced the Indian Evidence Act of 1872, experts in different branches may provide evidence in courts. Ballistic experts are entitled to give expert evidence under this section, especially when they relate through their methods of analysis the bullets, cartridge, and firearms with one of the particular incidents alleged to have been committed by the accused. Second, the procedural framework for conducting investigations and trials has been laid down by the Bharatiya Nagarik Suraksha Sanhita, 2023. Section 176 allows an investigating officer to seek the aid of scientific experts, of which ballistics experts are one, to prepare an accurate and lawful report, and Section 336 states that the report may be read in evidence in the trial proceedings if duly authenticated. Third, The Arms Act, 1959, especially under Section 27, concerns offences of illegal use or possession of firearms. Very often, the statute calls upon ballistic examination to find out whether the weapon seized by police was the one used in the commission of a crime. Thus, each of these statutes confers procedural legitimacy and evidentiary authority to forensic evidence related to firearms and thus stands crucial to obtaining valid convictions in shooting-related cases.[9]

1.1.7. Role of Expert Witnesses

Ballistic evidence is also admissible in Indian courts only if some legal standards are met. Relevance is the prime requirement, most often taken to be as explained under Section 4 of the Bharatiya Sakshya Adhiniyam, 2023. According to it, evidence will be relevant only if it has direct bearing on a fact in issue or on an relevant fact in that specific proceeding. The examination of the bullet or cartridge becomes pertinent if it implicates the accused at the scene of crime. Secondly, its reliability hangs in the balance depending on the scientific techniques employed. Ballistic analysis should be performed in a certified forensic laboratory using accepted scientific practices that could encompass methods like rifling pattern comparison or gunshot residue analysis. Third, there has to be skilled competence of the expert[] witness presenting such evidence. Section 39 of the Bharatiya Sakshya Adhiniyam, 2023 lays down that an opinion has to be given by an individual who, on his/her own, has developed specialized expertise in the area of science relating to ballistic sciences. Courts consider the qualifications of the expert and the scientific accuracy of the inferences drawn. In *State of Maharashtra v. Damu*[10], the Supreme Court held that ballistic reports should establish a relationship between the firearm and the projectile fired which is clear and scientifically reliable. If not so, courts will reject the evidence or give it limited probative value. This provides a road map for utilizing forensic science for justice instead of undermining it through pseudoscientific arguments or fraudulent science.[11]

Case Studies and Judicial Precedents

This delves into the judicial approach to ballistic evidence in India through important judgments and contextual illustration. Although the legal system does permit a court to accept expert evidence, practical effects of existing or non-existent ballistic forensic utilization in trials offer an insight into concerns

[7] Gopal Ji Misra, C. Damodaran, PERSPECTIVE PLAN for INDIAN FORENSICS, *available at:* https://www.mha.gov.in/sites/default/files/2022-09/IFS%282010%29-FinalRpt_0%5B1%5D.pdf (last visited on April 17, 2025).

[8] Sunaina Jeevnani, "Role of Forensic Evidence in Indian Criminal Justice System", 4 *Indian Journal of Legal Review* 115 (2024).

[9] Neelam Saba, Wahied Khawar Balwan, Artificial Intelligence in Forensic Science: Can It Be a Revolution or Else?, *available at:* https://doi.org/10.36347/sajb.2025.v13i03.005 (last visited on April 17, 2025).

[10] (2000) 6 SCC 269.

[11] Morgan J., Wrongful convictions and claims of false or misleading forensic evidence, *available at:* https://doi.org/10.1111/1556-4029.15233 (last visited on April 17, 2025).

of justice in delivery. These examples demonstrate gun evidence employed as among a variety of mechanisms to repress the rights of the accused and occasionally opens up avenues for the protection of such rights, depending on how meticulously it is examined and applied.12

1.1.8. Key Supreme Court Judgments on Ballistic Evidence

Judicial scrutiny of ballistic forensics by the Supreme Court of India witnesses a mounting relevance assigned to the aspect of procedural fairness. The Supreme Court in *Pritinder Singh @ Lovely v. State of Punjab*[13] held the non-examination of a ballistic expert in a case involving firearm injuries to be an extremely serious procedural lapse in the prosecution of cases based largely on circumstantial evidence. The Court observed that if the core theory of the prosecution is based on bullet trajectories, types of weapons used, and consistency of injuries with the theory, then the ballistics expert not being involved is a great big hole in the evidence. Recording this, the Court appeared to have implicitly supported the enactment of Section 39 of the Bharatiya Sakshya Adhiniyam that courts may seek expert opinions in matters of a scientific nature. In a similar vein, the Supreme Court examined witness testimonies internally inconsistent and failed prosecution to produce adequate ballistic evidence supporting the theory of the case in *Ram Singh v. State of Haryana*[14]. It observed that those contradictions in ocular testimony could have been resolved through expert analysis of firearms, which was regrettably absent on record. The Court thus strengthened the position that forensic corroboration could become critical particularly where human testimony is ambiguous, unreliable, or tainted. Such judgments espouse the gradual preference of the judiciary for forensic science as an indispensable adjunct to criminal adjudication and signal an enhancement of evidentiary standards.[15]

1.1.9. Cases Where Ballistic Evidence Was Crucial

Judicial scrutiny of ballistic forensics by the Supreme Court of India further presaging an increasing appreciation of its role in securing procedural fairness. In "*Pritinder Singh @ Lovely v. State of Punjab*"[16], the Supreme Court emphasized that non-examination of a ballistic expert in cases involving firearm injuries represents a serious procedural flaw, particularly in circumstantial evidence-based prosecutions. A further notable observation of the Court is that if the theory of prosecution revolves around bullet trajectories, types of weapons used, and consistency of injuries, it would create a glaring evidentiary lacuna with the non-examination of a ballistic expert. Through this observation, the Court also enforced the principle enshrined under "Section 39 of the Bharatiya Sakshya Adhiniyam", which empowers courts to seek expert opinions on scientific matters. Similar to which, in "*Ram Singh v. State of Haryana*"[17], the Supreme Court dealt with a situation where the witnesses offered testimonies that were internally contradictory, and the prosecution failed to produce strong ballistic evidence in support of its story. It observed that the internal inconsistencies in ocular evidence could have been resolved through expert firearm analysis, but tragically the same did not get recorded. The judgment further cemented the principle that where human testimony is unclear, unreliable, or suspect, forensic corroboration is of paramount importance. All these judgments together indicate an increasing reliance of the judiciary on forensic science as an indispensable tool for criminal adjudication and signify an emerging shift towards more onerous standards of evidence.[18]

1.1.10. Cases Where Lack of Ballistic Evidence Led to Miscarriages of Justice

The sciences of ballistic forensics have been an important tool for establishing a timeline of events and building cases in high-profile criminal trials where the actual circumstances involved in a firearm's usage are in dispute. A classic example-or even the example par excellence-albeit not always formally documented with respect to elaborate forensic reporting, is the "Jessica Lal case." In this case, the analysis of bullet trajectories and firearm types to find the precise angle of firing was crucial in refuting contradictory witness testimonies and claims of accidental firing. Though the forensic details were never much published in legal reports, the role that ballistic interpretation played had been acknowledged at various stages during appellate procedures and certainly at a public forum. On the other hand, independent from one or more landmark cases, there are a few examples in general within Indian criminal trials where the best experts have significantly influenced the outcome of trials by linking spent bullets or cartridge cases to a particular firearm through test-firing and striation comparisons. The right linkage of firearms plays a vital role in cases of dacoity, encounter killings, and political violence, where several firearms may be involved with divergent or sometimes absent eyewitness testimony. The identification of a particular weapon can inculpate or offer exculpation to a suspect beyond any reasonable doubt as per the strictures under "Section 101 of Bharatiya Sakshya Adhiniyam", which is why such a high degree of precision is required to protect suspects from being falsely accused. Further, though the availability has been uneven in different Indian forensic labs, the use of high-resolution comparison microscopes and imaging software has proven to make a positive difference, when appropriately applied. Collectively, these cases imply that if ballistic evidence is introduced in the trial process accurately and transparently, it will prevent the miscarriage of justice.

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[12] Priya, "Investigation Process In India In Criminal Cases Using Forensic Ballistics", 12 International Journal of Creative Research Thoughts e546 (2024).

[13] (2023) 10 SCC 254.

[14] (2002) 1 SCC 401.

[15] Luhar Kirtikumar Vishnuprasad, "Critical Analysis of Admissibility of Forensic Evidence and Reports in the Criminal Justice System of India", 2 *White Black Legal International Law Journal* 209 (2024).

[16] (2023) 10 SCC 254.

[17] (2002) 1 SCC 401.

[18] Bhumika Indulia, Integrating Forensic Techniques in Indian Criminal Justice System, *available at:* https://www.scconline.com/blog/post/2022/12/10/integrating-forensic-techniques-in-indian-criminal-justice-system/ (last visited on April 17, 2025).

Challenges in Ballistic Forensics in India

This examines the systemic and procedural barriers hindering proper use of ballistic forensics in the Indian criminal justice system. These barriers are directly relevant to the probative value of firearm analysis, on the trial fairness side, and in the broader brush of averting wrongful convictions. From outdated infrastructure to ineffective technical training, these issues under this category warrant immediate institutional changes.

1.1.11. Infrastructure and Resource Constraints

One of the long-standing issues that ballistic forensics in India has struggled with is the poor infrastructure of forensic science laboratories and the ongoing dearth of funds to drive modernization efforts. Several of the state-owned Forensic Science Laboratories (FSLs) are still struggling with outdated equipment, absence of digital imaging capabilities, and low inventories of comparison microscopes needed to examine bullets and cartridge cases. This technological gap totally undermines ballistic identification based on imaging with the aid of high-resolution technology and pattern matching that is very precise. The majority of Indian technicians, lacking access to contemporary databases for the storage and comparison of ballistic signatures, have to resort to manual techniques into their own hands, therefore introducing subjectivity and putting human error above the picture. Another significant consideration is that the laboratory is taking too long from receipt until conducting processes and reporting the evidence, thus hindering the very prosecution and challenging the accused's right to speedy trial under "Article 21 of the Constitution of India". These bloated laboratories rest atop a mountain of backlogs, and in most instances, the ballistic reports are filed once the trial has already ascended through dense forests and become willingly obtuse. The absence of central funding and required performance audits also create disparity in standards region by region. Metropolitan laboratories are apt to be better outfitted, whereas rural or semi-urban areas run short of proper forensic support. This disparity is a contributing factor for inequalities in the quality of justice provided since cases pertaining to firearms evidence may be jeopardized by defective or tardy reports. Ballistic sections in FSLs require special funding, up-to-date technical facelifts, and rigorous keeping of protocols for homogeneity in forensic practices across the nation, in case there are any sincere reforms.[19]

1.1.12. Training and Expertise of Forensic Experts

Ballistics forensics is an intricate science requiring precise laboratory instruments and competent and skilled professionals equipped with the latest knowledge. In India, the shortage of skilled and competent ballistic experts is glaring, and those present in the system have nearly no opportunities for continuing education with which to keep abreast of global advances in forensic science. Most experts working in laboratories of the government join the field with a bare minimum of academic qualifications in general science, intending to learn on the job, but do not get much formal training in ballistics or exposure to simulated casework activities under controlled conditions. This lack of training may end up in a mere superficial study of very crucial evidence, which may be placed to support serious charges under "Section 109" or "Section 103(1) of the Bharatiya Nyaya Sanhita." More so, the procedures lend an atmosphere whereby experts are forced to give a categorical answer in a cross-examination when the scientific evidence only admits of a probabilistic conclusion. Credibility of expert witnesses under "Section 39 of the Bharatiya Sakshya Adhiniyam" serves as a barrier to the admission of their findings into evidence, but inadequate training practically negates such credibility. The skill of a forensic examiner, inculcated through diligent preparation in a well-developed framework of science, can never be compromised. Above all, the non-existence of an apex licensing authority or oversight mechanism to assess and accredit forensic experts leads to great disparity in the expertise developed by individual institutions. Unlike in mature jurisdictions, there is no system of mandated recertification or proficiency testing for forensic analysts in India, which actually leads to a void in accountability. This is a salient problem that affects not only the competence and capabilities in the working laboratory of the experts but also their sound communication and presentation of very complex forensic interpretations before a court of law. Hence, for ballistic forensics to stand the test of being a dependable and reliable scientific tool in criminal trials, necessary steps in terms of promotion of better training, mandatory certification, and continuous exposure to inter-disciplinary learning should be institutionalized in all forensic science divisions.[20]

1.1.13. Potential for Errors and Misinterpretation

Ballistic are terribly imperative to India's criminal justice system and have the dual role of either enhancing convictions for optimum precision or inciting miscarriages of justice. Inasmuch as ballistic forensics provides an objective basis to link weapons to crime scenes, the Indian system registers several inadequacies-from outdated infrastructure and equipment to untrained personnel. Consequently, they cannot be efficiently applied in criminal investigations, resulting in procedural lapses and lack of accreditation standards, with courts oft preferring expert credibility to scientific analysis. Through case studies and Supreme Court judgments, it has been exposed that inconsistencies or the complete lack of ballistic analysis contributed to evidentiary lacunae against the cardinal principle of proof beyond reasonable doubt in criminal law. Additionally, absent the cross-examination of experts or stringent forensic regulations, even judgments that maintain scientific integrity may inadvertently uphold flawed conclusions.

Conclusion

The article at the crucial relevance of ballistic forensics in India's criminal justice system and its twofold role as an enabling medium to strengthen a conviction with scientific exactitude or the one that causes a miscarriage of justice due to existing faults within the system. While the field of ballistic forensics can prove most promising in linking weapons with crime scenes through objective physical evidence, the infrastructure in India is grossly

[19] Dhanya Airen, "Relevancy of Forensic Evidence in Indian Criminal Justice System and Analysis", *available at:* https://ssrn.com/abstract=4290003 (last visited on April 17, 2025).

[20] Dinkar V.R, Forensic scientific evidence: problems and pitfalls in India, *available at:* https://doi.org/10.19070/2332-287X-1500020 (last visited on April 17, 2025).

inadequate with outdated equipment, very poorly trained personnel, inconsistent procedural adherence if any, lack of accreditation standards, and greater reliance of courts on so-called credibility of "experts" rather than on scientific rigor. Inconsistent or outright non-use of ballistic analysis on a number of occasions has created gaps in evidence, thereby jeopardizing the principal tenet of "proof beyond reasonable doubt" under criminal law. Further, even on the best of intentions, judicial reliance on science may cement a flawed conclusion in the absence of a mandatory cross-examination of forensic experts and proper oversight of forensic work.

Suggestions

The measures recommended to strengthen firearm evidence in India's criminal trials are drawn from an analysis of ballistic forensics and its role in wrongful convictions:

1. Codify uniform evidence handling protocols: standardize the collection, packaging, and transfer procedures for ballistic materials to maintain the chain of custody. These protocols should be codified under supplementary rules of the Bharatiya Nagarik Suraksha Sanhita.
2. Create a national forensic ethics board: establish a professional council to regulate forensic conduct, review complaints, and debar experts found guilty of negligence or misconduct. This body should also issue ethical guidelines tailored to India's legal context.
3. Ensure peer review in high-stakes cases: make peer verification of ballistic reports mandatory in cases involving life imprisonment or death penalties. This practice reduces individual bias and strengthens the evidentiary reliability of expert findings.
4. Establish a national ballistic database: create a centralized digital repository for bullet and cartridge case profiles to facilitate cross-jurisdictional matching. This database should be managed by a central forensic authority and linked to all state forensic laboratories.
5. Implement certification for ballistic experts: introduce mandatory training and periodic certification for forensic professionals working in firearm analysis. Certification criteria should include courtroom communication skills and knowledge of relevant legal provisions.
6. Incorporate global standards with local adaptation: adapt key components of international forensic frameworks, such as those from the U.S.A And uk, to india's socio-legal environment. This includes periodic proficiency testing, standardized reporting, and strict separation of scientific inquiry from investigative bias.
7. Mandate accreditation for forensic laboratories: enforce a uniform accreditation system for all labs handling ballistic evidence, with audits conducted by an independent national oversight body. Accreditation should be tied to compliance with scientific, ethical, and procedural standards.
8. Require methodological transparency in court reports: compel ballistic experts to submit detailed reports explaining the testing methods, control variables, and limitations of their conclusions. Such transparency allows defense teams to scrutinize and challenge the findings effectively.
9. Revise courtroom protocols for expert testimony: amend procedural law to require in-person cross-examination of ballistic experts in all significant firearm cases. Exceptions under section 293 of the Bharatiya Nagarik Suraksha Sanhita should be tightly regulated to preserve adversarial fairness.
10. Upgrade forensic infrastructure across states: allocate dedicated funds to modernize comparison microscopes, 3d imaging systems, and firearm simulation tools in both urban and rural labs. Mobile forensic units should also be developed to improve crime scene response.