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INTEGRATING LAW, SCIENCE AND JUSTICE: EVALUATING THE ROLE OF FORENSIC EVIDENCE IN SEXUAL OFFENCES

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ABSTRACT

Forensic science plays a significant role in the investigation, prosecution, and adjudication of sexual offences, acting as a link between law and science in the quest for justice. Advancement in Science and technology around the world have had a significant impact on crime scene investigation and solving. Sex crimes are a significant category of criminal conduct. Forensic science plays an important part in identifying victims' bodies using advanced forensic techniques such as DNA Profiling, Fingerprint analysis, Forensic anthropology etc. In such circumstances, forensic science is used to examine physical injuries as well as collect and analyse biological materials such as semen, saliva, blood, and skin cells, which may include DNA profiling that link the suspect to the crime scene or the victim. Beyond biological evidence, forensic science investigates clothing fibres, trace evidence, type of wounds, skeleton remains and the collection of evidence that gives conclusive scientific proof that confirms or contradicts the accused's guilt. These pieces of evidence are useful for investigating and concluding the trial. However, forensic science has several limits in sexual crime identification. Delayed reporting can degrade evidence and incorrect collection or storage might jeopardise its trustworthiness. There is also a lack of specialists and standardised processes, technical infrastructure particularly in distant locations.

Furthermore, forensic evidence cannot indicate consent, which is often crucial in such circumstances. As a result, forensic professionals must follow the Standard Operating Procedure (SOP) standards to ensure accurate results throughout sample collection, preservation, and storage. Failure to follow these rules by forensic specialists may result in incorrect or erroneous results. Such incorrect results can occur as a result of insufficient amount, faulty collection procedures, testing delays, and so on. Forensic experts and other frontline responders must closely adhere to Standard Operating Procedure (SOP) rules, otherwise, courts may acquit the guilty due to the inadmissibility of such evidence. This article discusses the role of forensic science in sexual offences, as well as the importance of adhering to suitable norms and processes in order to provide viable results.

INTRODUCTION

The pursuit of justice in sexual offences needs requires scientific supports and not just mere legal reasoning. These types of offences happen in secret cases which lack eyewitnesses and are based on inconsistent testimony. Forensic science offers essential tools for discovery of evidence and interpretation in such cases. Forensic science is a cornerstone in the search of fairness and truth. It acts as a crime-solving instrument. The character of forensic science ensures that innocents are exonerated and guilty should be held accountable and the will of truth, regardless of societal injustices or prejudices. Furthermore, forensic science has the ability to eliminate systemic prejudices and help to create a more just society for all.

Sexual offences are something that is a violation of bodily integrity and liberty of human. It lasts physical, psychological, and social traumas and consequences. Rule of law, justice for survivors is dependent not on mere effective legal structures, but on the capacity to establish crimes precisely, and objectively. In such cases, forensic science plays an important and major role.

Even in historical law and science have distinct intellectual grounds. Law seeks justice via normative reasoning guided by the concept of fairness, obligation, and rights. Whereas if we talk about science, it seeks truth through empirical evidence, predictability, and objectivity. Even after these basic disparities, the modern justice system and especially in criminal law, there is increasing need and reliance on science to assess legal reasoning in many matters and especially in complicated matters like sexual offences. Forensic science provides various methods that can convert psychological trauma into legally admissible evidence that can transform survivors into objective groups. From the time immemorial, many forensic procedures have evolved, especially DNA profiling, trace evidence detection, which can empower both investigators and courts, to frequently happening sexual assaults. Forensic science serves as a silent testimony who can speak with scientific certainty.

TRUTH AND JUSTICE: A PHILOSOPHICAL EXPLORATION OF LAW AND SCIENCE

The principles of truth and justice have historically served as the essential cornerstone of a civilized community. Though they are frequently perceived as interrelated ideals, their connection becomes intricate when examined through the perspective of law and scientific inquiry. The law- aims to uphold order, settle disputes/conflicts, administer justice through legal frameworks and policies. Science, on the other hand, aims to discover objective truths about the natural world using

systematic methods of observation, experimentation and reasoning. We will understand how these two realms- law and science- interact with each other in the pursuit of truth and justice, scrutinizing their methodologies, boundaries and the ethical considerations.

In the realm of legal philosophy, justice is perceived not merely as the equitable enforcement of regulations but also as a moral principle that upholds fairness, safeguards rights and fosters societal cohesion. Generally, science focuses on the observable realities- objective, verifiable knowledge about the universe. Nevertheless, in practice, especially within the judicial arena, these domains intersect. Forensic analysis, genetic evidence, digital tools, psychological evaluations and health assessments are all vital components in legal cases. Courts frequently rely on scientific knowledge to reach conclusions that strive to be both accurate and equitable. However, this relationship is not devoid of the philosophical conflict.

One major concern arises in the adjudication of evidence and the standard of proof. In science, theories must withstand rigorous testing and can be adjusted in response to emerging evidences. Truth is viewed as tentative, open to disproof. In the judicial system, especially in criminal cases, the burden of proof lies on the prosecution and that must be 'beyond a reasonable doubt'. The decisiveness of legal verdicts often clashes with the progressive character of scientific understanding. The philosophical disparity raises a important questions. Does the scientific discoveries jeopardize the reliability of legal decision? Is it possible to achieve the justice when truth itself is ambiguous or subject to change?

Furthermore, it is essential to scrutinize the function of expert witnesses and the acceptance of scientific evidence. Philosophical analysis must be utilised regarding how such evidence is showcased, interpreted and assessed by judges and juries, who may not possess the technical knowledge to fully comprehend it. The potential for scientific prejudice or excessive dependence on seemingly impartial data can result in miscarriage of justice. Ethical dilemmas also emerge when scientific procedures- such as predictive algorithms, lie detection challenge and conflict with established legal principles like the presumption of innocence or the right to privacy.

Ideas of thinkers like Aristotle, Kant and Rawls will be analysed alongside with philosophers of science like Thomas Kuhn and Karl Popper to understand how truth and justice can be intricately aligned.

The core objective of this research is to connect the truth- seeking approaches of science with the ethical, justice -oriented framework of law. By philosophically examining their interplay, this paper

aspires to enhance the comprehension of how contemporary legal systems can assimilate scientific progress without sacrificing justice, equity or human dignity.

RECONCILING SCIENTIFIC RIGOR WITH NORMATIVE JUSTICE

The adjudication of sexual offenses exists in a complicated space where the scientific methods meet the actual demands of justice. Science relies on methodological methods, certainty, consistency, yet unbelievers cannot balance the scientific information with values like justice, fairness, respect for human dignity, human rights. So when science gives assertions, the court must interpret it carefully within a broad legal context.

At the core of this reconciliation of science and law together, there is a basic conflict in between objective truth asserted by science and normative truth by law. Science seeks objective truth that which can be proven through test and error, while the law seeks normative truth that what is fair or what is just according to law and legal rules. Forensic science offers neutral evidence that is reliable and based on science. However, these are tenable, which are normally dependent, and there are stone-cold limitations, and systematic flaws, such as contamination of personal bias or flaws in the institutional meaning of the evidence.

In contrary to the science, which focuses on facts, normative justices are not just focused on facts, but are also concerned with the moral validity of the process and the consequences. It ensures to safeguard the rights of the people, which includes the prevention of innocence, the right to get tried, and the prohibition of self-incrimination. A trauma-informed reality is required in the sexual offensive cases that reduces the secondary victimization and respects the dignity of the survivor.

The key challenge is to maintain balance between science and law by interpretative moderation and strong procedural protections, rather than subordinating normative justice to scientific positivism or rejecting empirical discoveries ideologically. This demands a legal epistemology that acknowledges the fallibility of scientific evidence and the contingent character of knowledge generation, while also including frameworks like epistemic humility and procedural pluralism. Moreover, to reconcilethese spheres, there is need of institutional reforms that foster interdisciplinary dialogue, continuous training, and the establishment of independent forensic oversight bodies to guard against bias and malpractice. A justice system that wants to balance scientific rigor with normative justice must self aware and must acknowledge the provisionality of knowledge, the vulnerability of human subjects, and the cases of bodily autonomy that carries serious ethical gravity.Ultimately, the

reconciliation is a dynamic, ongoing process—a dialectic that resists easy synthesis but demands constant vigilance to ensure that science serves justice without undermining its foundational values.

EVIDENTIARY JUSTICE: INTERROGATING THE ROLE OF SCIENCE IN SEXUAL OFFENCE CASES

In the context of sexual offences, evidentiary justice demands a critical review of how forensic science is used or overlooked in achieving legal results. While forensic evidence, particularly biological elements like blood or semen, has the potential to help identify perpetrators and corroborate victims statements, in many case its actual use remains inconsistent and underutilized. Forensic science can help to process and gather evidence in sexual offence cases such as blood stains, fingerprints, footprints, and sperm. It includes various forensic techniques such as facial reconstruction, magnetic fingerprinting, blood splatter analysis, DNA profiling, Automated Fingerprint Identification System (AFIS), and ballistics. The methods strengthens the justice process by bringing scientific clarity and objectivity and also help to identify the perpetrator.

DNA profiling is critical for properly tying suspects to crime scenes. This procedure is only used after identifying the victim or obtaining comparable DNA samples from parents or offspring. Two main strategies are used:

- Restriction fragment length polymorphisms (RFLP)
- Polymerase Chain Reaction, or PCR

However, the effectiveness of these tests is strongly dependent on the careful handling and preservation of biological specimens. Improper collection or contamination—such as the transmission of the expert's own DNA by touch—can jeopardise the results.

According to interviews with sex crimes detectives, the existence of forensic evidence such as DNA is frequently overlooked in favour of other investigation factors such as victim and suspect credibility, witness testimony, and crime scene images. The usefulness of forensic evidence is reduced, particularly in situations involving known criminals, when the fundamental issue is permission rather than identify. This weakens science's greater capacity to provide justice by injecting objective material evidence into a system that is frequently based on subjective tales.

Statistical assessments show that there are problems with the system. According to studies, in over half of reported sexual assault instances, Sexual Assault Kits (SAKs) are not collected, and a large number of those obtained are never submitted for investigation. Even when submitted, many kits

are not checked by laboratory professionals, and only a small percentage—approximately 7% in some studies—of viable DNA is recovered. Case closure through plea bargains, expiring statutes of limitations, delayed sample collection, and administrative mistakes such as missing kits all contribute to these gaps.

Furthermore, even improvements like the CODIS database have had a limited transformational influence. In backlogged cases where SAKs were subsequently analysed, just a fifth resulted in CODIS hits, and even fewer resulted in legal action. This calls into doubt the previously assumed linear link between scientific evidence and legal resolution, implying that institutional reforms, rather than merely scientific advancements, are required. The use of forensic science in sexual crime cases exposes a justice gap: while objective, scientific truth exists, its unequal application raises concerns about fairness, access, and institutional will. Closing this gap is critical for a more equal and evidence-based criminal justice system.

In recent times, the RG Kar medical college rape and murder case(2024) has highlighted the groundbreaking capacity of forensic science alongside its inherent challenges in resolving sexual offences cases. The victim, a 31 year old postgraduate medical student, was found lifeless in the hospital under questionable conditions. A forensic examination uncovered at least five different DNA profiles on the victims body, including one from a female, raising both public and legal concerns. Among these profiles, the DNA of the main suspect, Sanjay Roy, matched unmistakably, leading to his conviction and life imprisonment. Nevertheless, the presence of numerous unidentified DNA samples triggered considerable backlash and cast doubts on the investigation's reliability. The Central Bureau of Investigation (CBI), which took over the investigation, stated that the extra DNA traces were caused by cross-contamination during the autopsy, notably owing to non-sterile surgical instruments and inadequate evidence-handling practices at the hospital mortuary.

Despite the CBI's response, the victim's family and legal experts expressed their worries about the lack of openness and the inability to undertake a more thorough investigation, notably into the other DNA donors. This case highlighted the need of procedural integrity in forensic investigations, particularly when dealing with biological evidence in sexual offences. It also demonstrated how, while scientifically significant, forensic evidence can lose its evidential value if standards are not strictly followed, raising concerns about chain of custody, contamination hazards, and institutional responsibility. The lack of numerous critical forensic reports, which officials eventually confessed to, intensified claims of manipulation and probable cover-up. Finally, the RG Kar case highlights the delicate balance that forensic science must strike between being an instrument of truth and being a source of contention. It urges immediate revisions to autopsy processes, forensic laboratory

standards, and judicial monitoring to ensure that scientific evidence supports—rather than undermines—the pursuit of justice in sexual crime cases.

In **Nirbhaya Rape Case,** the role of forensic science was crucial in securing the conviction of the assailants. Nirbhaya and her male companion boarded a private bus in South Delhi. The perpetrators masqueraded the vehicle as a public transport unit. Once inside, they assaulted the male friend and brutally gang-raped Nirbhaya. They introduced a metal rod into her intimate areas, causing severe internal injuries. Both victims were undressed and subsequently thrown off the moving bus. Tragically, Nirbhaya succumbed to her injuries on December 29, 2012, at a hospital in Singapore. Following the horrific attack, forensic specialists gathered vital biological and physical evidence from the victim, the crime scene (the bus), and the suspects. Vaginal swabs, clothing and the iron rod employed in the assault were sent to the Central Forensic Science Laboratory for DNA analysis. The DNA profiles obtained from the defendants matched the sperm and blood stains located on the victim's garments and the bus seats, strongly linking them to the crime. Moreover, forensic odontology was utilised to correlate bite marks found on the victims body with dental impressions of one of the assailants. Fingerprint and footprint evidence collected from the bus was analyzed and connected to the suspects, confirming their presence at the scene of the crime. Blood type analysis corroborated the findings, as the defendants blood types matched those listed on the retrieved documents. Additionally, forensic experts assisted in reconstructing the entire event timeline inside the bus, delineating the chronology of the assault and attributing specific actions to each perpetrator. This scientific evidence not only substantiated the victim's final statements but also provided the court with compelling, impartial proof, culminating in the conviction of the accused and their subsequent capital punishment.

In **Priya Darshini Mattoo rape and murder case,** a 25 year old law student faced harassment from Santosh Kumar Singh, the son of the then Assistant Commissioner of Police, who was a former LLB student at the same institution. Despite her clear disinterest, the accused continued to torment and intimidate her. She lodged complaints at several police stations and the perpetrator was cautioned to behave appropriately. On January 23, 1996, the accused visited the victims home, an event witnessed by neighbours, after which she was found deceased inside. Medical professionals from Safdarjung Hospital in Delhi collected biological evidence form the crime scene and performed an autopsy on the remains. The autopsy revealed no evidence of sexual assault. Additionally, the Trial court referred the case to the Central Bureau of Investigation for a thorough investigation.

RML Hospital in Delhi subsequently collected the blood samples of accused for analysis. Furthermore, the CBI submitted the samples to the Centre for Cellular and Molecular Biology (CCMB) in Hyderabad for DNA profiling, which proved the victim's rape and murder. However, because CCMB only does DNA profiles, one of the samples (the victim's knickers clothing) was returned. Furthermore, these semen samples were sent to the Central Forensic Science Laboratory in Delhi, which filed a report claiming that there was no proof of rape. During the trial, the Defence Counsel made substantial concerns, claiming that the results of the DNA test and the victim's autopsy report were incompatible. Furthermore, the trial court determined that the CBI did not follow judicial procedure when conducting the DNA profile test. As a result, the DNA Profile test result was deemed inadmissible evidence, and the accused was acquitted by the court. Furthermore, the government appealed to the High Court, which imposed the death penalty on the defendants. The accused filed an appeal with the Supreme Court of India, contesting the legitimacy of the DNA profile test, which resulted in his death sentence being reduced to life imprisonment and giving him the benefit of the doubt.

CONCLUSION

Incorporating forensic science into the prosecution of sexual crimes makes a notable advancement towards justice grounded in evidence. Previously, the legal system often relied on verbal testimonies. However, new technologies such as DNA analysis, forensic odontology, digital forensic have greatly improved the precision of criminal investigations and legal proceedings. Nevertheless, for these innovations to lead to consistent judicial outcomes, structural reform is essential. Establishing specialized courts equipped with scientific experts, streamlining procedures and requiring forensic training of legal professionals can ensure a harmonious collaboration between science and law. Only in this way the criminal justice framework safeguard the rights of victims, avert wrongful convictions and deliver swift justice in instances of sexual assault.

Some of the required reforms are provided below-

1. To enhance the judicial procedure, dedicated expedited courts for cases of sexual crimes ought to be established, staffed with forensic experts and scientific authorities. These courts/tribunals need to emphasize cases related to sexual assault and ensure that professionals insights on forensic evidence are given significant considerations during trials.

2. Designated courts ought to utilize either permanent or designated forensic experts to assist judges in decoding intricate scientific evidence in cases. Their involvement would connect the bridge

between legal and scientific realms, guaranteeing that technical findings are neither misconstrued nor overlooked.

3. These courts should establish a technological or digital framework that facilitated the instantaneous sharing and presentation of forensic documents, trace evidence and expert testimony through video conferencing. This modernization would streamline procedures and enhance the evidential significance of scientific contributions.

4. Judges, prosecutors and law enforcement officers should be required tot get forensic science collection and analysis training, particularly in the interpretation of DNA results, biological evidence and digital footprints. This would assist to minimise misunderstanding and enhance informed decision- making during sexual crime trials.

5. The authorities need to commit resources to building centralised and regionally established forensic labs equipped with cutting-edge equipment and manned by well-trained professionals. This expansion will reduce the existing backlog and facilitate the analysis of vital evidence such as DNA samples, body fluids and cloth fibres.

6. Forensic evidences and all the investigative proof including sexual assault forensic examination kits, DNA profiling and trace material analysis, should be mandated in every reported case of sexual assault. This would enhance the reliability of evidence and avert wrongful acquittals due to insufficient corroborative proof.

7. Every forensic samples must be treated, preserved and conveyed following a stringent and legally binding chain-of-custody protocol. It is essential that each specimen be digitally recorded and monitored to prevent contamination, alteration, or loss during the investigation.

8. In significant sexual offence cases, forensic medical experts must be the part of the primary investigative teams. Their expertise in evaluating physiological and biological signs of assault can help in record- keeping and corroborative testimonies.

9. There should be a uniform and binding set of Standard Operating Procedures (SOPs) for forensic examination in sexual assault cases across all states. These SOPs should include clear instructions for medical professionals, police, and forensic scientists to avoid procedural errors and ensure consistency in the process.

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