

# The Role of the Scientific Method in Forensic Crime Scene Investigation: A Vehicular Homicide Case Study

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## Abstract

Forensic science has a very important role in the crime scene. During the inspection of the crime scene, the concerned scientific officer carefully inspects various types of cases and collects evidence which is prima facie related to the crime scene. All the evidence obtained during the inspection is sent to the forensic laboratory in a sealed condition for physical, chemical, biological and electronic testing. After the test, it is assessed as per the report received that how the incident sent to the lab is related to the crime scene, how the evidence is related to the deceased or the victim, it helps in understanding and solving it in a systematic way. The presented research paper is related to such a case in which a girl dies in a road accident in District Balrampur, State Chhattisgarh, which prima facie appeared to be a normal road accident after seeing the crime scene, but when the investigation was done as per the instructions given by the senior scientific officer to the investigating officer, it emerged as a murder committed under a well-planned conspiracy. In this case, the doctor who conducted the postmortem also It was recommended to give the cause of death only after the forensic report came in. During the investigation of this case, the concerned person was traced and after collecting the evidence, the scene of crime was inspected again by the senior scientific officer and scientific officer of forensics and the evidence found during the inspection was sealed and sent to the forensic laboratory; the test report of which came as expected, so the case was resolved and the accused was punished. In the said case, the scene of crime inspection and the forensic test report of the evidence found at the scene of crime played a major role.

**Keywords:** Forensic Science, Crime Scene Investigation, Fiber Evidence, Digital Forensics, Vehicular Homicide, Postmortem Report, Locard's Exchange Principle, Evidence Analysis.

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## 1. INTRODUCTION

The scientific method is the cornerstone of modern forensic science, providing a structured framework for investigating and interpreting evidence in criminal cases. In forensic crime scene investigations, the scientific method is critical for ensuring objectivity, minimizing bias, and drawing conclusions that can withstand legal scrutiny (Saks & Koehler, 2005). Vehicular homicide cases, in particular, present unique challenges due to the interplay of human behavior, environmental conditions, and mechanical factors. The application of the scientific method enables investigators

to systematically collect, analyze, and interpret physical evidence—such as skid marks, vehicle damage, and biological samples—while integrating findings from disciplines such as physics, biology, and toxicology (Houck & Siegel, 2015).

In addition, the scientific method offers protection against cognitive biases that may arise during high-stakes investigations. By adopting a hypothesis-based approach and subjecting findings to peer review and reproducibility, forensic experts increase both the reliability of their findings and their acceptability in court (Dror, 2020). In the context of vehicular homicide, this

methodology not only helps reconstruct the sequence of events, but also contributes to establishing causation and intent, which are crucial elements in legal proceedings. This paper explores the role of the scientific method in forensic investigations, focusing on a vehicular homicide case study to demonstrate its practical significance in building a bridge between science and law.

## 2. AIMS OF OBJECTIVE

Two objectives have been set for this study-

1. The present research paper aims to present a precise example of how justice can be provided to the victim by investigating a planned murder through a normal road accident by organizing the technical facts obtained from the site inspection, observation and guidance of forensic scientists, police investigation, evidence found from the site of the incident, forensic laboratory test reports.
2. To make the investigating officers aware that there can be a conspiracy of murder in normal road accidents.

## 3. RESEARCH METHODS

The presented paper is a case study in which the analysis has been done by inductive method which is descriptive and conclusive methods have been used, the collection of data is completely primary which was collected by measuring during scientific observation at the scene and using scientific methods. The evidence obtained from the scene was completed by physical, chemical, biological tests such as serological, me tetra mythel benjidene and phephthelene and Flame atomic emission spectroscopy (FAES), photometry Illuminance and microscopic tests, and footage recorded by closed-circuit television camera was used for evidence collection and research journals, books and research articles were analyzed for the collection of secondary data (Campbell, 2000; Houck & Siegel, 2015; Inman & Norah, 2000; Kosariya, Mishra, Chandra, & Chakraborty, 2024; Saferstein & Roy, 2020; Nagwanshi, Kosariya, Mishra, Chandra, & Chakraborty, 2024).

## 4. CRIME SCENE INVESTIGATION RESULT

On receiving information from Ambikapur Range Police Headquarters for site inspection through telephone from Balrampur Police Station, District Balrampur Ramanujanj (95km approx) to Regional Forensic Science Laboratory on 20/11/2023, the team of Forensic Senior Scientific Officer and Scientific Officer left for Balrampur Police Station, District Balrampur Ramanujanj for Pratappur Road crime scene investigation. On reaching the police station, a detailed microscopic inspection was done by appearing at the site of the incident near Aurajharia. Blood stains were visible on the ground near the site of the incident for about 2 meters above the marks of dragging. Since the site of the incident was on the main road, the tire marks which were

visible going to the left of the main road due to the incident taking place a day before were not clear, but it was definitely found out that the accident was caused by a four-wheeler like a car or a jeep. Plain soil and blood-soaked soil were seized from the site of the incident. After that he went to the post mortem house to inspect the dead body of the deceased.

### 4.1 Dead Body Inspection

Dead body inspection was done by the senior scientific officer in the presence of the panch and the investigating officer. The body of the deceased was lying on the post-mortem table. The head was in the east direction and the feet were in the west direction. The head was tilted towards the left. The hair on the head was black, long and brown eyes were half open, the eyelid of the left eye was swollen, blood due to injury was stuck on the eyebrow, blood was flowing from the left nostril towards the eye, a mark of injury was visible on the left cheek due to abrasion, the skin had turned black due to abrasion, a pink sweater was worn on the body, the skin around the right hand was visible peeled due to injury, the fist was half open and there was yellowness in the nails, the left hand was bent from the elbow and kept on the stomach, the upper skin had peeled off, there was a mark of injury on the palm behind the index finger. She was wearing a green coloured kurti under the sweater. There were marks of abrasion on the entire stomach due to dragging. The upper skin had come off below the waist. She was wearing blue-coloured jeans. There was a button on the jeans. There was a 6.5-inch-long tear near the right thigh. Abrasion marks were visible on the inner skin. There were pieces of grass stuck in the lower part. After removing the clothes, a black mark due to abrasion was visible on the left side of the knee. There was a half tear of 2 inches below the left knee as well. A mark of injury was visible below due to the tear. Both the legs were straight, the heel was touching the surface of the table and the toes were side by side. She was wearing a sock on the left leg and the sock of the right leg was half removed. There was blood on the sock. On removing the sock, there were injury marks at two places inside the left ankle on the lower side of the toe. After removing the sock of the right leg and examining it, the nail of the thumb was uprooted. A 4-inch-long abrasion mark was visible on the skin behind the thumb. Slight yellowness was visible on the sole. When examined upside down, blood was coming out from an injury near the left eye, behind the neck it was normal, there was a mark of abrasion on the left side of the waist over the jeans pant, there was blackness towards the calf at the back as well, the sweater was torn by 2 inches at the back also, grass was stuck in the sweater near the left hand and near the waist, there was stiffness in the body, the private parts were inspected by female Panchas and were found to be clean. The doctor who conducted the postmortem and the investigating officer were instructed to write an article for preserving the clothes worn by the deceased, vaginal slide and swab.

#### 4.2 Important facts and evidence of the first day of crime scene inspection:

On the first day, blood stains with dragging marks were found at the crime scene. The primary blood test of the crime scene came out positive. The investigation officer was directed to collect a series of evidences from the crime scene. 1. Blood stained and 2. Plain soil were seized. The vaginal slide and swab from the deceased were secured from the postmortem doctor. The clothes worn by the deceased were 3. Black inner 4. Green kurti 5. Pink sweater 6. Black jeans 7. Cream white panty 8. 2 socks of grey color. 9. The evidences secured from the crime scene and by the doctor were sent to regional forensic science laboratory Ambikapur Surguja CG for testing. Question –

Dragging marks were found at the crime scene for some distance and blood stains were also found. Tyre marks were also found which were seen coming from the footpath and then going towards the main road.

Is this an accident or a murder under a well-planned conspiracy?

#### 4.3 Postmortem report of the deceased

Doctor in his report gave details of injuries sustained by the deceased in which abrasion present over cheek (4.5X 4cm) lacerated wound over Left orbital area 4.5X1.5x1cm) Right thigh 4X 1cm

Left thigh 4x10cm, and contusion and blood stain were found. Chest cavity near heart, lungs filled with blood about 500ml, skin torn with abrasion marks near abdomen, liver ruptured, right kidney ruptured & contusion and blood stain, 10,11 and 12 Rib fractured, peeling of nail from right toe.

In opinion "After postmortem examination it seems to be death occurs primarily due to massive internal bleed, final report will be submitted after forensic scientists have given reports of various cases related to this case" was written. The investigation officer questioned the people related to the deceased, a brief description of which is as follows

#### 4.4 Statement of the deceased's father:

The deceased's father said in his statement that my daughter was living in the room of her friend Ishwari and her husband Dipesh in Dhara Colony in Hunza, Ambikapur since 2020. She came to village Sapna on 17/11/2023, after that on 19/11/23, she took rice, pulses, flour and went to Ambikapur at 8:30 in the morning and said that Ishwari and her husband Dipesh are going to Bastar and will not return for 2-4 months, so I will stay there and look for another room.

Then I called at 1:27 in the afternoon to ask if she got the room or not, she said that she will take rest after reaching the room, I said okay daughter take rest and hung up the phone, then at 4:00 my cousin Rakesh

came home and told that your daughter Hunza has met with an accident, I recognized him by looking at my daughter's Aadhar card and photo. But he did not tell me that my daughter has gone to Balrampur, but my daughter used to talk to a boy working in a bank in Ramanujganj, his name I came to know after the incident that he was Abhijit Pathak. 2. Statement of the owner of the room –

#### 4.5 Statement of the rented room owner:

I Dipesh Kumar Netam am working as a Forest Ranger. The deceased was living with me and my future wife's friend on rent since 2020. We were going to our home in Kanker on 11/11/2023 to celebrate Diwali holidays and left at 6-7 pm. Then saying okay, Hunza also left for her office at 9:00 am. Then on 12/11/23 I sent a WhatsApp message to the deceased that you find another room for a month or two, till then I will get the room putty painted and after that you come again to live together. Hunza said okay. After that on 16/11/23 Hunza messaged that I am going to vote and will keep the key of the rented room in my shoes at the back. After this my future wife called Hunza on 19/11/23 at 6:00 pm, she did not pick up. Then when the room When we reached there at 6:56 in the evening, Shubham Gupta informed that Hunza had met with an accident. When he called his sister-in-law, she told him that we have left for Balrampur. When Hunza used to stay with us, she used to talk a lot with a boy. When we refused, she said that she would not talk to him anymore. She told us that the boy is from Jharkhand and works in a rural bank. On the third day of Karva Chauth, Hunza came back to her room in a black car with that boy. She said that the boy is unwell and is asking for medicine. When we asked him to come inside, the boy refused to come inside. She used to be very upset about something. Later, it was found out that the boy's name is Abhijit Pathak and it was he who had called Hunza to Balrampur. 3. Culling's statement –

#### 4.6 Statement of the deceased's room partner:

I, Mita Dewangan, used to work with Hunja in Ambikapur in 2022. I worked together for about 15 days, then left the job due to the care of my child and husband, but I used to talk to Hunja. Hunja always used to talk to a boy. When asked, she said that she has a boyfriend who works in Ramanuj Ganj Balrampur. Hunja said that I am very sad right now because my boyfriend is getting married somewhere else. I got the news of Hunja's death on 20/11/23 and the office boss Vivek Kumar Singh told that Hunja's body was found near Balrampur Forest and the name of her boyfriend was found to be Abhijit Pathak.

#### 4.7 The details from mobile data of the deceased:

The details of the mobile data of the deceased, the chat with Abhijit in the WhatsApp message of the deceased Hunja Devangan's mobile number, the screen shots of the chat and the soft copy of the video photo etc. revealed that there was a love affair between the two. On

the day of the deceased's death, the deceased had talked with the accused Abhijit for a long time for the last time.

#### 4.8 Statement of the person who helped the deceased to reach the hospital from the spot of incident:

The statement of the person who called the ambulance and took the deceased to the hospital from the scene revealed that Abhijeet was present at the scene and he had a Tata Nexon car and he was trying to open the screen lock of the deceased's mobile at the scene, as if he was hiding something. According to the statement of the traffic police present on the road near the hospital and the statement of the hospital staff who traced Abhijeet, the suspect Abhijeet did not take the deceased to the hospital. These evidences were further strengthening the suspicion towards Abhijeet. The police got a CCTV footage of Abhijeet in which he was seen passing by in his Tata Nexon car on the same day.

#### 4.9 Statement of the person who repaired the vehicle used in the incident:

The police took the statement of the mechanic who repaired the Tata Nexon car of the suspect Abhijeet. He told the whole story of repairing the vehicle and talked about the damaged parts of the car that the right-side headlight of the car was broken and I still have it, the bonnet of the car was dented and the fender was also dented. There is denting of the fender and bonnet. After this, for colour matching, I asked the car owner for the registration card and he sent it to my mobile through which I matched the colour and applied the same colour paint on the car and got the colour matched by rubbing. He did not want to get insurance and said that he would pay 21500/- from his own expense and told him to pay 6000/- in advance. He showed his signature on the bill and got the broken right headlight and the copy of the receipt confiscated by the police.

#### 4.10 Forensic report of deceased's clothes:

Forensic team was called for scientific investigation of the suspect Abhijeet's Tata Nexon car. Pieces of clothes matching with the deceased's clothes were found from the suspect's Tata Nexon car, which were sent to the forensic laboratory for examination and matching with the deceased's clothes. The forensic report revealed that the pieces of clothes found in the suspect's car are similar to the deceased's clothes.

## 5. DISCUSSION

### 5.1 Multidisciplinary crime scene investigation

This case demonstrates the fundamental importance of a multidisciplinary forensic approach—integrating crime scene investigation, circumstantial data, forensic laboratory work, and forensic pathology to reconstruct events and ensure forensic accuracy. De Simone *et al.*, (2019) emphasize that a critical, multidisciplinary crime scene investigation can help distinguish between staged accidents and actual murders (De Simone, *et al.*, 2019).

### 5.2 The role of fiber trace evidence

The forensic team in this case collected fibers from the suspect's vehicle that matched the victim's clothing—strong associative evidence consistent with Locard's exchange principle, which claims that criminals bring something to a crime scene and take something away. Mane *et al.*, (2022) reviews how fiber evidence aids in the reconstruction of crime events, and states that although fiber transfer and permanence can be challenging, fiber matching is still important as evidence (Mane & Devika, 2022). When biological evidence may be absent, trace evidence, including fibers, plays a crucial role and aids in crime reconstruction (Lepot, Vanhouche, Vanden Driessche, & Lunstroo, 2022). Tracing evidence to a suspect is further reinforced by Hauck (2003), who outlined a comparative analysis of fiber evidence in unrelated crimes to uncover uniqueness in fiber characteristics (Houck, Inter-comparison of unrelated fiber evidence, 2003).

### 5.3 Chain of Custody and Evidence Integrity

Effective collection, proper packaging, and maintenance of chain of custody of trace evidence are crucial to maintaining credibility in court. Pollock (2020) emphasizes that mistakes made here can jeopardize the entire evidentiary value—even high-tech results can be discarded if handled incorrectly (POLLOCK, 2020).

### 5.4 Forensic Pathology and Postmortem Evidence

This case is also based on forensic reports; the autopsy confirmed that the victim died due to motor vehicle injuries. Gehl *et al.*, (2017) emphasizes that forensic pathologists often work closely with investigators at crime scenes and during autopsies, analyzing injuries to determine the cause and mechanism of death (Gehl & Plecas, 2016).

### 5.5 Corroborating Physical Evidence with Digital and Witness Data:

In addition to physical evidence, your case is built into a coherent narrative by integrating circumstantial digital data (WhatsApp chats and CCTV footage) and eyewitness evidence—reflecting the scientific method in forensics, where hypotheses (e.g., accident vs. murder) are tested based on multiple lines of evidence.

### 5.6 Similar Case Study

A similar example in the research paper published by Kosariya *et al* (2025) where an attempt was made to portray a murder as a mishap and on the basis of the crime scene report of the forensic expert, data recovered from the mobile phone and the forensic report, it was proved that it was a murder and not an accident (Kosariya, Nagwanshi & Chakraborty, 2025).

## 6. CONCLUSION

This case highlights the important role of the scientific method in modern criminal investigation, where multiple aspects of evidence are systematically



analyzed to establish the truth. Starting from circumstantial findings such as WhatsApp messages, CCTV footage and witness statements, the investigation gradually built a strong case against the accused. The suspect's attempt to tamper with the crime scene and erase mobile phone data demonstrates the importance of digital forensics in corroborating physical evidence. Further, the careful recovery of fibres from the suspect's Tata Nexon car, which matched the victim's clothing, demonstrates the practical application of Locard's exchange principle and the evidentiary value of trace materials, when they are properly collected and examined.

The forensic logic report further corroborated the investigation, confirming that the cause of death was consistent with motor vehicle injuries. This integration of forensic science, forensic medicine, postmortem reports, witness testimony and digital evidence demonstrates how a holistic approach strengthens the credibility of findings in court. Ultimately, the accused's confession and subsequent conviction underline the effectiveness of a systematic, evidence-based investigation. This case confirms that the convergence of forensic science and scientific reasoning not only uncovers the truth, but also ensures that justice is served.

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