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FORENSIC SCIENCE
PAPER NO.1: General Forensic Science
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 Accidents- II**

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1. Learning Outcomes

After studying this module, you shall be able to know about-

- The forensic investigation of road accident
- The type of physical evidences to be collected from the crime scene
- Evaluation procedures of vehicle and the victims

2. Introduction

The main purpose of whole forensic investigation of accident is to establish the 'cause' of the incident. The information obtained from it might be required for a number of following reasons;

- Investigate the case
- Either the victims or their family members want to know how accident take place and also how they were injured or killed
- Police or regulatory authorities might wish to fix responsibility and take appropriate action against the guilty
- The safety authorities might always be looking forward for improvement to prevent a re-occurrence of accident

3. Problem

In forensic investigation of road accident cases, it is necessary to establish the following:

- That an accident has actually taken place. It may not be a subterfuge to conceal some other crime.
- The identity of the location where accident took place, particularly on highways.
- The identification of the vehicle in a "hit and run" case.
- To identify the driver in a case where the owner of the vehicle alleges theft.



Fig-1: Indicating the Location of Accident Site

4. Sources of Physical Evidence in the Investigation of Road Accidents

In the investigation of road accidents involving vehicles, physical evidences play a very important role. Their nature therefore needs to be understood properly before they (Physical evidences) are collected. They should be carefully observed, located and thoroughly documented by means of making notes, sketches and photographs, and then collected. Almost every type of clue (including trace evidence) can be found at the crime scene in accordance with the Locard's principle of mutual exchange which states 'Contact leaves traces', in road accidents or "hit and run" cases.

The major sources of the evidentiary material are as follows:

4.1 The Crime Scene

The following evidentiary material can be found at the crime scene:

- The vehicle – may be one or more, its type, direction and position.
- Track marks like tyre impressions of the four wheels, which are found either at sharp turns or where the vehicle has been reversed.
- Broken or damaged parts of the vehicle.
- Greases and lubricants.
- Glass pieces of various shapes and sizes.
- Paint chips or smears.
- Skid marks.
- Dust, dirt or other debris, caked or otherwise, fallen from the suspect vehicle at the time of impact.
- Personal or vehicular articles left at the scene.
- Drag marks of the loaded material (e.g., logs of wood or any other items).

4.2 The Vehicle

In most of the hit and run or accident cases the vehicle involved may carry traces from the scene of occurrence or from the other vehicle involved, or the victim. Commonly the following clues are found on the vehicles:

- Finger and palm prints, tool-marks and fabric prints.
- Hairs, fibers, bloodstain or skin pieces from the victim.
- Small broken parts or fragments of the vehicle or the article hit.
- Broken glass, paint, greases and lubricants from the vehicle, which was hit and control samples from the suspected vehicle for similar articles to those left at the scene.
- Dust, mud and dirt from the scene of occurrence, from the victim or from the driver.

- Cigarette and 'Bidi' butts from the vehicle.
- Mechanical fault in the vehicle.
- Evidence related to changes in paint and numbers on registration plate, serial number on engine and chassis.
- Evidence related with overloading of vehicle.
- The load on a vehicle may leave characteristic smell on the way through which it has moved.

4.3 The Victim

In addition to dust, dirt, paint, glass pieces, greases and lubricants and tyre marks, which may be present on the clothes or on the body of the victim, the following important evidences can also be found at the scene:

1. Injuries.
2. Blood, fibers, hair and skin for control samples.
3. Alcohol and narcotics in the body, if the victim had taken the same.
4. Signs of disease (from post-mortem report).

5. Collection of Physical Evidences

After carefully observing the suspected vehicle, scene of occurrence and the victim, and understanding the possible cause of accident; it is required to collect the evidences at the earliest from the above sources with proper care and planning. The evidences may be lost in a very short time span. The suspect can get the vehicle repaired or repainted immediately after the commission of crime. The scene of occurrence would be tampered over by the traffic and the victim may be cremated or buried.

In the systematic collection of the evidence, one should:

- Before the collection of evidence, take photographs and make sketches of the scene at the earliest without disturbing anything from the place.
- The photographs and sketches should be taken in such a way that the location of accident scene can be fixed by including some of the prominent fixed landmarks like milestone or any hording etc. (*Fig-1*)
- The photographs should also be taken in a way to show the identity of the vehicle (kind of vehicle, its number plate etc.).
- Before taking away the vehicle, note down the reading of speedometer, record the temperature of the vehicle, of the atmosphere and of the water in the radiator.
- Ascertain the quantity of fuel in the vehicle, examine the whole area for any physical clues and collect any loose evidence, which is likely to get lost in transit.
- Examine other parts of the machinery thoroughly.
- Collect various evidences like skid marks, broken parts of machinery, bloodstains, fibers, hairs and alcohol glass, paint, soil including dust and debris, greases and lubricants, cigarette and 'bidi' butts from different sites separately and wherever necessary collect control samples also.
- Collected evidence should be documented with the help of notes and photographs and then packed properly/securely in glass containers or cellophane envelopes depending upon the nature of the evidence.

6. Evaluation of Physical Evidence

There is no single right way of evaluating any incident related to road accident, but it should always be based on

- Logic and
- Feasibility

In road accidents, proper plans, keen observations and good photographs enable the investigator to get a clear image of the scene, and are an essential first step in the analysis of the incident. Proper planning and photographs provide:

- Very important information to understand what the witnesses are saying;
- The relationship between the marks, the person involved and the environment;
- The investigator to develop his/ her own interpretation/ perception about the events;
- A source of data.

The evidence of *eye witnesses* needs to be reviewed carefully whether it can be dependable or not. The investigator needs to consider the following also:

- Whether they are consistent with their statements?
- Are there any areas of agreement?
- Are there obvious explanations for disagreements in their viewpoint?
- Is there any information which will be required for subsequent analysis? For example the state of traffic signals, the direction and speed of vehicles.

6.1 The Vehicle(s)

The condition of the vehicle(s) involved in the incident is important for two reasons:

- Is the vehicle itself a cause of the incident?
- Can anything be used to deduce the impact speed?

Besides the above, special attention is also required to be given to the following aspects in thorough investigation of road accident:

➤ **Speed**

Speed of the vehicle at the time of road accident can be one of the most important factors. It need to be determined because of two primary reasons. First, speed itself can cause the crash. An example of this is loss of control when cornering. Such accidents are usually caused by driving too fast or either one or combination of the following reasons:

- The ability of the driver
- The performance of the vehicle
- The condition of the road.

This is apparent when the car leaves curved skid marks of a vehicle cornering at the limits of adhesion. The other principal reason for estimating the speed is to use it as a factor in the analysis of the incident.

The speed can be calculated by the following methods:

- From the length of skid marks;
- From the radius of curved scuffmarks;
- From the extent of vehicle damage.

According to research conducted by Monash University Accident Research Centre (MUARC), maximum 13.5% of accidents were caused by intoxicated drivers followed by 11.8% by drivers falling asleep and 3.2 percent of accidents were results of passenger interactions. The detailed results have been shown in table -1 and 2.

It is also evident from the data given in table-2 that between the years 1997-2011, less than 0.1 per cent accident was due to hand held mobile phone use.

Table-1

Table-1: Shows the results of MURAC study conducted on 340 casualty Accidents during 2000-2011. Percentage of other reasons of accidents is also given.

13.5%	Intoxication
11.8%	Fell asleep
10.9%	Fatigued
3.2%	Failed to look
3.2%	Passenger interaction
2.6%	Felt ill

2.6%	Blacked out
1.8%	Feeling stressed
1.5%	Looked but failed to see
1.4%	Animal or insect in vehicle
0.9%	Using a mobile phone
0.9%	Changing CD/cassette/radio
0.9%	Adjusting vehicle systems
0.9%	Looking at vehicle systems
0.3%	Searching for object

Table-2

Table-2: Shows data of accidents occurs between 1997 and 2011.

Year	Crashes for "Using a hand-held telephone"	Out of Total Crashes
1997	16	50120
1998	32	52578
1999	51	52866
2000	43	52914
2001	50	51814
2002	32	50448
2003	23	49266
2004	30	47310
2005	20	45554
2006	19	45528
2007	26	45395
2008	27	42833
2009	31	42952
2010	56	60084
2011	50	42953

➤ Skid Marks

Skid marks are the marks left by wheels, which are no longer rotating (*Fig-2&3*). These marks are characteristic in appearance and caused due to the wheels sliding across the surface of the road. If all the wheels of the vehicle have locked, then it is only the friction between the tires and the road surface that slows down the vehicle. Skid marks are short-lived type of evidences, which are left at the scene and play important role in the successful reconstruction of a road traffic incident.



Fig-2: Vehicle with Skid Marks

As a consequence, the most important variables, which determine the distance a car takes to skid to a halt, are speed and the nature of the surface of road. Thus if the coefficient of friction (μ) between tires and the road surface can be measured then a reliable estimate of the speed (v) can be calculated from the length of the tire marks (l). If a car is skidded (*Photo-3&4*) to a halt from a known speed then:

$$\mu = \frac{V^2}{2gl}$$

Where g represents the acceleration due to gravity and then the speed of the car leaving the skid marks is given by:

$$V = \sqrt{2\mu gl}$$



Fig-3: Skid marks Present on the Road

➤ **Curved Scuffmarks**

These marks are formed when cornering force enables a vehicle to take a curved path. These are generated by friction between the tires and the road surface or when maximum speed exceeds, due to which the vehicle sideslips and leaves characteristic tire marks. These marks are curved and have a pattern of diagonal striations across them. As soon as vehicle starts to leave these scuffmarks, the driver in most of the cases loses control of the vehicle.

6.2 Extent of Vehicle Damage

The damage to the vehicle is mostly directly proportion to the speed i.e. the faster the vehicle is traveling (when it hits something) the greater will be the damage (*Fig-5*). The extent of the damage to the vehicles of similar size in similar impacts is comparable and is perhaps rather more unexpected.

This provides another useful tool for determining the speed of vehicles in road traffic incidents. Vehicle damage alone will not enable the exact speed of a car to be calculated as the extent of the damage depends on the change in speed brought about by the collision.



Fig-5: Extent of damage with respect to speed

6.3 Visibility

It is important that the driver of the vehicle and the pedestrian or the driver of the other vehicle must have eye contact with each other. What needs to be investigated during evaluation is why eye contact couldn't be established? It may be due to certain obstacle; the height of the vehicle; the driving position and even the height of the pedestrian. All of these factors can have a significant effect on visibility. Thus while measuring visibility, the observer should have his or her eyes at the same height as the witness and should be in the same lateral position on the road. As far as possible, the target should be as similar as possible to the actual target in the incident.

After collecting the above mentioned physical evidences like fingerprints, glass, paint, soil, physiological fluids, hairs, fibers, synthetic greases, lubricants, cigarettes and bidis etc. all of them need to be documented and evaluated individually and thoroughly.

The most significant part of any investigation is the evaluation and interpretation of the information obtained. It should be tackled in a more systematic manner and ensured that the right/relevant and complete information is obtained and nothing should be overlooked. Care must be taken not to exclude alternative believable explanations until sufficient information has been collected to justify ignoring them.

7. Conclusions

As information passes through number of overlapping stages, Information obtained from one stage may sometimes be reevaluated and corroborating one source of information with another can modify the direction of the investigation. But at the end of this process, the investigator should have a clear understanding of the incident and how it developed and be in a position to explain it in clear and simple language.

8. Summary

1. The main purpose of whole forensic investigation of accident is to establish the 'cause' of the incident.
2. In the investigation of road accidents involving vehicles, physical evidences play a very important role. Their nature therefore needs to be understood properly before they (Physical evidences) are collected.
3. In most of the hit and run or accident cases the vehicle involved may carry traces from the scene of occurrence or from the other vehicle involved, or the victim.
4. Skid marks are the marks left by wheels, which are no longer rotating. These marks are characteristic in appearance and caused due to the wheels sliding across the surface of the road.
5. Vehicle damage alone will not enable the exact speed of a car to be calculated as the extent of the damage depends on the change in speed brought about by the collision.