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1. Learning Outcomes

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

- Casting Procedure for Track Marks
- Preservation of Two Dimensional Footprints
- Forensic Investigation of Track Marks

2. Introduction

A capable crime scene investigator on reaching the crime scene try to recognise, collect various types of evidences to solve the crime by identifying the person who have committed the crime. These evidences in the form of foot/footwear and tyre impressions have to be preserved properly to be used in the court of law as follows:

Preservation of Footwear Evidence

Footwear evidence could be preserved either by taking *photographs* or by preparing *casts (three dimensional)* depending upon the surface on which they are present or, by lifting, in case of two *dimensional dust prints*.

Fig-1: Footwear Impression

Photographing Track Impressions

In all the cases, before attempting to collect the track marks, it is mandatory to record them first with the help of notes, sketches and then with photography. Photographs need to be taken both at a distance from the track marks and close to it.

In a photograph taken from distance, the location of the number of track marks should be fixed with respect to some fixed objects or landmarks. Then to record every detail of the track marks, close-up photographs should be taken by putting either one or preferably two scales (one horizontal and other vertical) along with the track marks. Close-up photos should indicate size, shape, and any irregularities (in the form of wear marks). While taking photographs or to avoid distortion, the following precautions should be taken:

- The lens of the camera should be kept parallel to the track marks.
- Proper arrangement should be made to get greater depth of field and all the important points should be in sharp focus.
- Identification marks should be put along with the track marks.
- Proper lighting arrangement should be made.
- A tripod is suggested for most close-up photography.

Although large format cameras, e.g., 4 x 5 or 2-inch formats, allow for larger negatives, but 35 mm cameras are more widely used for crime scene work and produce good acceptable results. The quality of photographic films should be very good. Footwear and tyre impressions require film that can capture finer details; therefore, fine-grained films are best suited for this purpose. Prints can be clicked either with Black-and-white or color films. High-resolution digital cameras can provide good results for track mark impression examination.

Before taking photographs, any extraneous matter that may have fallen into the impression after it was formed should be cleaned away with the help of tweezers. If it is not possible to carry out this cleaning without disturbing the details of the impression, it should be omitted.

Materials trampled into the impression, such as leaves or grass, should not be removed because they form part of the impression and no details will be found under them. Careless removal of a trampled blade of grass can destroy parts of the impression. If a foot impression has been found in snow, it may be difficult to get a clear picture of it. Hard snow may be dusted with aluminum powder, which gives a clearer picture.

Cast of footwear impressions is generally made with dental stone powder. Other materials include paraffin, sulfur, and silicone rubber, can be utilized, but are less frequently used.

3. Casting Procedure for Track Marks

When three dimensional track marks such as a footprint or tyre track is encountered, a positive cast of it should be made. Several types of casting materials are commercially available like plaster of paris and dental stone (which are a type of gypsum or calcium sulfate) etc. But plaster of paris is one of the most commonly preferred casting materials at the crime scene because it is inexpensive; easy to use and best to record the details of the marks exactly the way they were in reality. Another advantage of plaster of paris is that it solidifies very quickly.

Detailed steps involved in the procedure for making cast with the most common casting material plaster of paris (Fig. 2-6) are as follows:

- After photography of the track marks with and without a scale, examine the area containing track marks carefully. Any precautions thought necessary to protect the integrity of the track marks must be taken.
- Foreign matters or loose pieces or leaves (if any) should be vigilantly removed without disturbing the surface of the mark. Any accumulated water or liquid if available should be removed with a pipette or plastic syringe.
- The impression is prepared for casting, if necessary. Particularly, when three-dimensional impression is in loose, dry sand or soil, the surface must be prepared by spraying *shellac or lacquer* solution onto a cardboard deflector held above the mark at a 45^0 angle so the sprayed liquid falls onto the pattern surface by gravity, rather than being propelled by a potentially disruptive jet of gas.

The shellac or lacquer will harden the surface of the mark by binding the loose particles of soil, once dried, make it suitable for casting. If the pattern is in very dry, firm dirt, it should be sprayed with light oil.

- A physical barrier to restrict the flow of the plaster must be set up around the impression i.e. with aluminum frame as shown in fig-4, 5&6. Commercially manufactured metal frames are available for this purpose, but any material (cardboard, wood strips, metal frame) that will retain plaster and confine it to the immediate area of the mark will suffice. A little ingenuity with commonly available materials will solve most containment problems (Fig-2).

Figure-2: Showing Containers and Frame Used for Preparation of Cast

Fig-3: Showing Sunken Foot Print

Fig-4: Showing Frame Placed around the Foot Print

Fig-5: Showing Casting Procedure

Fig-6: Showing Completion of Foot Print Cast

Fig-7

Fig. 2-7: Showing various stages in the preparation of caste of foot or footwear impression

- The recent methods for lifting wet footprint impressions by making use of *dental stone* or *gypsum* and *liquid silicone* commonly known as 'microsil'.

4. Preservation of Two Dimensional Footprints

Photography is always one of the best means to preserve the footprints particularly the two dimensional dust prints. After this, one of the following methods should be applied to preserve it by making caste (Fig 2):

- **Recovering and preserving the object on which the footprint is made.**

Footprints are often found on objects stepped on by the criminal while entering in the dark through a window. If the window is broken, then all fragments of glass should be examined. This type of print is usually best detected by allowing illumination from one side at low-angle. Rubber heels and soles leave good prints on glass. Detailed prints are also found on paper or cardboard that may be scattered about the room during a safe burglary. All such loose objects bearing prints should be carefully preserved and sent to the laboratory for examination.

- **Electro-static lifting**

Readymade kits are available to lift dust print with electrostatic lifters, which pick up dust prints onto Mylar-coated foil by means of static electricity. This procedure has applications in certain situations in which suspects had walked on tile/hard floors.

- A special lifter is preferred whenever dust or a dust-like substance holds the print from the shoe (smeared foot/footwear marks). The lifter is a sheet of black rubber with a slightly sticky surface that is pressed against the print, picking up a replica of the whole print. Oblique light photography under laboratory conditions brings out this dust print to a contrast often better than that observed in the original print. If a sufficiently large *fingerprint lifter* is available, it may be used instead of the special lifter. Care must be taken not to stretch the rubber lifter because the dust image may become distorted.

- **Lifting with photographic paper**

This technique may be employed when special lifters are not available. Black (exposed, developed, fixed, and washed) or white (fixed and washed) photography paper can be used, as determined by the color of the material in the print. The paper is dampened with water or dilute ammonia, laid emulsion side down over the print, and beaten against the print with a stiff brush or clapped with the palm. When the whole surface has been thoroughly beaten, the paper is removed and laid out to dry.

- **Enhancement of prints present on any transparent or colored substrate**

Various types of enhancers may often be employed to develop the prints if present on different substrates or any type of intervening medium or if they are almost latent. For e.g. conventional and fluorescent fingerprint developers can also be used as a Mechanical Enhancers when the footmarks or footwear marks or tyre marks are found on transparent substrates like glass doors or windows and white colored background materials like tiles, floors, etc. Similarly there is another set of enhancers called Chemical Enhancers, which include the *blood enhancement chemicals* and *residue material enhancers.* The former class of enhancers comprises of patent blue, fushcin acid, luminal, amido black and leuco crystal violet that can be used to improve the quality of prints stained with blood; and the later one consists of chemicals like bromophenol blue, safranin, potassium thiocyanate, diazoflouren and 8-hydroxyquinalone. All these can be employed for enhancing the prints which been generated by any extraneous material.

5. Obtaining Standards Footprints for comparison from a Suspect

When the original prints are from footwear, the examiner has to obtain the shoe print. Subject is requested to carefully step onto a sheet of tracing paper or acetate sheet after inking. While, taking prints of bare foot, the foot is blackened by pressing it against a thin layer of printing ink. In order to get a true picture of the sole, the foot prints can be taken in the following four positions:

- Normal standing position,
- Standing position with pressure outside of the foot
- With pressure inside, and
- Finally when walking.

This can also be applied to stocking feet.

Another method for obtaining known foot/footwear exemplars can be obtained by using talcum powder and black carbon paper. A thin coating of talc is spread on a sheet of newspaper placed with talc side up on top of about 10 sheets of newspaper that act as a cushion. Then the suspect is made to walk over the newspaper containing talc with shoes. The talc-covered shoe is then impressed onto the carbon paper. The carbon paper is similarly cushioned with about 10 sheets of newspaper. The resulting print is photographed using high-contrast copy film. The developed negative will show a positive reproduction of the impression that can be superimposed over a negative from the crime scene.

6. Forensic Investigation of Track Marks

The whole investigation of track marks follows two major laws which the forensic science relies upon i.e. Law of Individuality and Principle of Exchange or Locard's exchange Principle

Whenever an item of footwear or a tyre touches a substrate, it results in direct transfer of both class and individual characteristics. The suspected footwear or tyre can be compared with them in order to substantiate any linkage to or elimination from an alleged crime.

Class Characteristics

Those characteristics which are common to a particular group and which differentiate the members of that particular group from those of another group are termed as Class Characteristics. These comprise of type of footwear like sneaker, loafer, fleet, chappal, etc., physical size and shape, design or model of the footwear and the brand name tag or logo of manufacturer.

In case of tyre marks tread width or *Tyre stance*, depth of pattern when present deep-set in mud, design and logo of manufacturing company are considered as class characters.

In case of bare or naked footmarks length of feet, width of feet and curvature of heel constitute the class characters.

Individual characteristics

The characteristics that specifically belong to one particular type and are not present in any other are termed as Individual characteristics. These include wear and tear marks present on insole as well as outsole of footwear, various features like scratches, cuts, holes, etc. retained by the shoe's outsole, any materials adhered to the outsole for a long time that includes gum, nails, pins, threads used while stitching/repairing a torn sole and most importantly the maker's art like any patchwork if the footwear is handmade.

Individual characters in case of tyre marks are almost similar to those found in case of footwear marks. Wear and tear marks, random cuts, holes made by sharp embedded pebbles or nails, etc. are the important individual marks.

In both the cases, any extraneous material like sand, hair, fiber, paint chip, etc found embedded over the pattern should never be overlooked as they may act as important corroboratory evidence.

Ridge pattern present either on the tarsals of feet or on the tali, shape of the bulf line or Zanziri and arch of feet are considerable individual features in case of naked or bare footmark.

- A *side by side match* (also called point-by-point analysis) of the questioned and standard track marks is performed by making use of either the photographs or tracings of the plaster of Paris casts of the same. *Composite matching* by using a comparison microscope is another way of comparing the questioned and standard samples.

Presence of sufficient identifying characteristics ends up with a positive identification. As such there is no fixed number as per the characteristics that should be looked for. Comparison is based upon the class and individual characteristics as discussed earlier.

Fig- 8 & 9: Showing a Footwear Impression and the Stud Alleged to have made the Print

- Analysis of walking pattern or *Gait Pattern* is an important aspect of track mark, which has great application in crime investigation. It consists of a series of footprints or footwear impressions made by a person while walking or running and is highly individualistic and results obtained are reproducible, thereby qualify as one of the important forensic evidence.

It includes the direction line, the walking line, the foot line, the foot angle, the principal angle, the step length and the step width etc.

- Direction line: an imaginary straight line indicating the direction of walk or run.
- Walking line: A straight or zig- zag line produced as a result of placing one's feet or footwear along the direction line.
- Foot line: A tangent indicating the inclination of foot with respect to the direction line.
- Foot angle: An angle between the direction line and the foot line.
- Principal angle: It is the sum of two feet angles i.e. angle between foot lines of two feet.
- Step length: A straight line joining the heels of two successive feet.
- Step width: The distance between parallels drawn to inner sides of both feet.

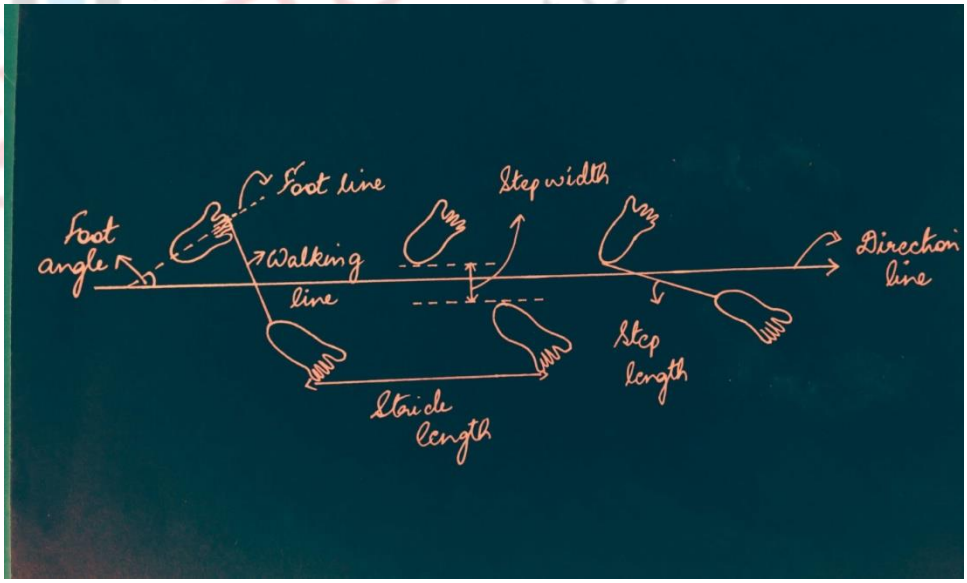

Fig-10: Showing Outline of Gait Pattern

Determination of height, age and sex of the depositor can be very well performed by analyzing gait pattern of the same.

7. Summary

1. A capable crime scene investigator on reaching the crime scene try to recognise, collects various types of evidences to solve the crime by identifying the person who have committed the crime. These evidences in the form of foot/footwear and tyre impressions have to be preserved properly to be used in the court of law.
2. In all the cases, before attempting to collect the track marks, it is mandatory to record them first with the help of notes, sketches and then with photography. Photographs need to be taken both at a distance from the track marks and close to it.
3. When three dimensional track marks such as a footprint or tyre track is encountered, a positive cast of it should be made. Several types of casting materials are commercially available like plaster of paris and dental stone (which are a type of gypsum or calcium sulfate) etc.
4. Individual characters in case of tyre marks are almost similar to those found in case of footwear marks. Wear and tear marks, random cuts, holes made by sharp embedded pebbles or nails, etc. are the important individual marks.
5. Analysis of walking pattern or Gait Pattern is an important aspect of track mark, which has great application in crime investigation. It consists of a series of footprints or footwear impressions made by a person while walking or running and is highly individualistic and results obtained are reproducible, thereby qualify as one of the important forensic evidence.