


<b>SUBJECT</b>	<b>FORENSIC SCIENCE</b>
<b>Paper No. and Title</b>	<b>PAPER No.3: Fingerprints and Other Impressions</b>
<b>Module No. and Title</b>	<b>MODULE No.33: Shoeprints and its importance</b>
<b>Module Tag</b>	<b>FSC_P3_M33</b>

<b>Principal Investigator</b>	<b>Co-Principal Investigator</b>	<b>Co- Principal Investigator (Technical)</b>
<b>Dr. A.K. Gupta</b> Professor and Head, Department of Forensic Science Sam Higginbottom Institute of Agriculture, Technology & Sciences SHIATS, Allahabad	<b>Dr. G.S. Sodhi</b> Associate Professor Forensic Science Unit Department of Chemistry SGTB Khalsa College University of Delhi	<b>Dr. (Mrs.) Vimal Rarh</b> Deputy Director, Centre for e-Learning and Assistant Professor, Department of Chemistry, SGTB Khalsa College, University of Delhi  <i>Specialised in : e-Learning and Educational            Technologies</i>
<b>Paper Coordinator</b>	<b>Author</b>	<b>Reviewer</b>
<b>Dr. G.S. Sodhi</b> Associate Professor Forensic Science Unit Department of Chemistry SGTB Khalsa College University of Delhi	<b>Dr. G.S. Sodhi</b> Associate Professor Forensic Science Unit Department of Chemistry SGTB Khalsa College University of Delhi  <b>Ms. Tulika Banerjee</b> Assistant Professor, Forensic Science Unit, SGTB Khalsa College University of Delhi	<b>Mr. V.N. Sehgal</b> Ex-Director CBI, CFSL, HOD & Ex-officio Chemical Examiner to GOI
<b>Anchor Institute : SGTB Khalsa College, University of Delhi</b>		

## TABLE OF CONTENTS

1. Learning Outcomes
2. Introduction
3. Types of prints
4. Principles of Footwear Examination
5. Analysis of Shoeprints
6. Methods of Recording of Footwear Impressions
7. Summary

 **Pathshala**  
**पाठशाला**  
A Gateway to All Post Graduate Courses

## 1. Learning Outcomes

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

- How shoeprints are useful in forensic investigations
- The various types of shoeprints and about the principles of footwear examination
- How the shoeprints can be analyzed and the various methods of recording footwear impressions

## 2. Introduction

Footwear or shoeprint evidence is considered as the best type for linking a suspect or a victim to the crime scene. These shoeprint evidences are also referred to as the pattern evidences as these form an exclusive pattern. Shoes and boots leave prints and impressions specific to their particular brand, style and size.

Footwear evidence can be found at many crime scenes including breaking and entering, assault, hit and run, armed robbery, rape and homicide. For instance, shoeprints may be found on the tile in the entryway of a residential break in. At some point in time, the perpetrator arrived at the scene, committed the crime, and then left the scene on foot or in a vehicle. This type of evidence can provide valuable information to investigators including:

- Where the crime occurred
- The number of parties or vehicles present
- The direction a person may have traveled before, during or after the crime
- Whether a person was on foot
- Other crime scenes connected to a perpetrator

This evidence can then be used to help determine if a suspect was present at a crime scene or exclude a person of interest from the investigation.

### 3. Types of prints

Footwear can be deposited on almost any surface, from paper to the human body. Prints are divided into three types:

- visible,
- plastic and
- latent prints

A visible print is a transfer of material from the shoe to the surface and hence this type is clearly visible by the naked eyes and where no additional techniques are required for visualization. An example of this type is the bloody shoeprints left on the floors.

A plastic print can be defined as the 3-D impression left on the soft surface. For example, shoe prints left on snow, mud or sand.

A latent print is one that is not readily visible to the naked eye. This type is created through static charges between the sole and the surface. Crime scene investigators use various powders, chemical reagents or alternate light sources to detect and visualize these prints. For example, footwear impressions found on tiles or flooring, metal counters, etc.

### 4. Principles of Footwear Examination

The basic theory behind footwear analysis is that, much like fingerprints, shoes may leave behind either prints (referred to as “imprints”) or impressions that can be examined by investigators. The type of evidence left behind depends largely on the type of surface traveled.

For example, a shoe will leave an impression in loose sand, but on a hard surface like concrete or linoleum, it will leave an imprint. The footwear impressions can be compared with the suspect’s footwear so as to determine whether the impressions obtained are from the same individual or not.

As shoes are used, their physical features change over time. This is called wear, and is often reflected in the imprint or pattern left behind.

During the examination of a crime scene or other location, if footwear evidence is found and collected, examiners can compare these unknown impressions to known impressions, impressions connected to other crimes and impression evidence stored in Law enforcement databases.

To do this, examiners use three main characteristics to analyse the imprints and impressions:

- class,
- individual
- wear

**Class characteristics** result from the manufacturing process and are divided into general and limited. General class characteristics include those that are standard for every item of that make and model. Limited characteristics refer to variations that are unique to a certain molds. For example, two shoes of the same brand, model and size will have identical tread design and dimensions, but may have slight differences due to imperfections in the molds used during manufacturing.

**Individual characteristics** are unique aspects of a particular shoe or tire that result from use, not the manufacturing process. These could be from damage such as a cut, gouge or crack, or a temporary alteration like a stone or twig stuck in the shoes.

**Wear characteristics** result from the natural erosion of the shoe caused by use. Specific wear characteristics include the wear pattern; the wear condition, the amount Or depth of the wear; and where extreme, the damage to or destruction of the tread. For instance, the location and amount of tread loss on a particular brand and style of shoe will be different for each person wearing the shoe based on how and where they walk, and the length of time they have owned the shoe.

## 5. Analysis of Shoeprints

Two types of markings are present on the shoes-primary and secondary. The primary markings give the information about the maker of shoe or it's sole while the secondary markings are due to wear and tear of the sole associated with use. If there is an incidental finding it will be useful because of its uniqueness and it is desirable to find its corresponding shoe before that feature gets lost with time or damage.

The information from shoes can be obtained in three different ways- (a) outer impressions, (b) inner impressions and (c) Other evidence from shoes.

### (a) Outer impressions

They are the impressions left on an object that was caused by contact with footwear. They can be found on the floor, doormats, carpet, doors or even the body of victim (eg: due to kicking). Sometimes latent impressions are also encountered; they are usually difficult to see with the naked eye. When properly collected and preserved, shoeprints can provide the type, make, description, approximate size, number of suspects, path through and away from the crime scene, the involvement of evidence and the events that occurred during the crime. Consequently, the importance of shoe impression evidence should not be underestimated. Their detection may require the use of additional specialized light sources such as portable ultraviolet lighting. Recovery typically includes photography as well as lifting with "gel" or "electrostatic" dust lifters.

### (b) Inner impressions/imprints

They are imprints left in the inside of shoe by contact from the person's foot. Analysis of the insole impressions can be used to link a person(s) to a piece of footwear.

### (c) Other evidence from shoes

It is in the form of body hair, body fluids, skin tags, dust particles, glass fragments that may be found on the shoes. The study of this trace evidence could be used to link the footwear to a location or owner. DNA can be one of the contributing factors in forensic evidence from shoes.

The above knowledge helps a podiatrist to address certain questions like if a particular person is the usual wearer of a certain shoe, whether certain shoes have the same usual wearer, whether there have been multiple wearers of particular shoes, whether a foot could be fitted in a particular shoe, with a shorter marked size than that of the foot and whether differences between the prints, impressions or wear marks between shoes or between feet and shoes can be justified in terms of common ownership.

It is extremely unlikely to have a subject all of whose individual measures coincide with the corresponding population mean in all dimensions. With sufficient available data, a podiatrist may be able to help in identification in a fairly large number of cases.

## 6. Methods of Recording of Footwear Impressions

There are four basic methods of recording footwear impressions at the crime scene.

1. Photography
2. Documentation/Sketching
3. Casting
4. Lifting

### 1. Crime Scene Photographs

Shoeprint evidence can be easily located in and outside the scene of crime keeping in mind the fact that the suspect who arrives at the scene of crime will depart also. The location containing the footwear impressions should be photographed accordingly wherein each and every minute detail should be photographed. While photographing the crime scene close up shots, medium range and overall shots should be done because these photographs will help in future for the comparison purposes. An easy way to do this is to place a numbered marker next to the evidence print and photograph.

Also, the main point that should be taken into consideration is that the photographs of the scene of crime should be taken before documentation is carried out. In order for a footwear examiner to perform a quality examination, high-quality, close-up photographs are required.

Properly photographing impressions is crucial. Since there is only a slight difference between different shoe sizes, if the photographs are not taken at a 90° angle to the impression, then the true size cannot be produced in order to compare to the actual shoe. In the case of impression evidence, general photographs of the evidence location in relation to the rest of the scene are taken, along with high-resolution images of the individual imprints or impressions. Examiners may use alternate light sources or chemical enhancers to capture as much detail as possible, especially with latent imprints.

In tracking, which is the process of following the footprints of an individual, photograph the scene as you found it and then lace numbers next to each impression. Photograph the scene showing the impressions' numbers, this way you can come back later and relate where each impression was found. Then the quality examination photographs can be taken.

## **2. Documentation/Sketching**

In order to maintain the integrity of the shoeprint evidence, the prints obtained from the scene of crime must be properly documented, collected and preserved.

A point to be noted is that as these impression evidences can be easily damaged, so care must be taken so as to avoid damage to the evidence otherwise which will result in the ultimate loss of its evidentiary value.

This includes securing and documenting the scene prior to collecting any evidence. In the case of impression evidence, general photographs of the evidence location in relation to the rest of the scene are taken, along with high-resolution images of the individual imprints or impressions. Examiners may use alternate light sources or chemical enhancers to capture as much detail as possible, especially with latent imprints. Properly photographing impressions is crucial.



The crime scene investigators employ various techniques for the collection of footwear and evidence depending on the type of impressions found at the scene of crime. For the impressions found in snow, soil or other soft surfaces, the very commonly employed method for the collections of these imprint evidences is the casting technique.

For imprints, examiners generally try to collect the entire object containing the imprint, such as a whole sheet of paper or cardboard with a shoe print. In certain circumstances, the collection of whole of the evidence is not possible such as in cases where the print is found on a bank counter, the examiner would use a lifting technique to transfer the imprint to a medium that can be sent to the laboratory.

### **3. Casting**

Irrespective of the fact that the impressions obtained from footwear have been found indoors or outdoors, they must be photographed properly, documented, cast and lifted. All three dimensional impressions should be cast with the help of dental stone. Dental stone like plaster is a gypsum product. But dental stone unlike softer plasters set much harder and have a higher compressive strength and provide a quicker and easier way to recover impressions.

Dental stones having a compressive strength of around 8000 pounds per square inch or greater are sufficiently hard to be cleaner without loss of detail. Although Dental stone can be mixed in a bucket, it has become more popular to prepare and have on hand several Ziplock bags of Dental Stone in 2-pound portions. The proper amount of water for the 2-pound portion can then be added to the bag at the crime scene. A dental stone having a consistency of 30 and a compressive strength of 8000 pounds per square inch requires approximately 9.5 ounces of water. The exact amount of water will depend on the powder to water ratio. The casting material can be carefully poured next to the impression and allowed to flow quickly into the impression. The dental stone material will harden in approximately 20 minutes, after which it can be lifted and placed where it can dry further. Impressions in snow can also be cast with special methods and materials such as snow print wax.

#### **4. Lifting**

For the lifting purposes contact or adhesive paper can be placed over the impression present in dust or very light dirt. Thus, this allows the dust or dirt to get transferred to the contact paper or adhesive side of the paper. Once this procedure is completed, it is then peeled off and photographed for future references. This sheet can then also be treated with a mixture of 0.05g of crystal violet and 500mL of distilled water so that the obtained impression gets stained and hence produces a reversed image on collection.

Once this is completed a piece of clear acetate is placed over the print in order to preserve it for impounding and later examination purposes.

Latent fingerprint powders and lifting tapes can be used on various surfaces for contrast and recovery.

#### **Gelatin-lifter**

It is a sheet of rubber with a low-adhesive gelatin layer on one side that can lift prints from almost any surface, including porous, rough, curved and textured surfaces. It is less tacky and more flexible than an adhesive lifter, allowing it to pick up a dusty shoeprint on a cardboard box, for example, but not tear the surface of the box.

#### **Electrostatic dust-print lifting device**

It is a tool that electrostatically charges particles within dust or light soil, which are then attracted and bonded to a lifting film. This method is best for collecting dry or dusty residue impressions on almost any surface, even the skin of a cadaver.

Imprints and impressions may be further processed to enhance or bring out additional minute details. For example, a digital enhancement program such as Adobe Photoshop® can be used to improve the quality of a photographed impression. Fingerprint powders and chemical stains or dyes can enhance image color or increase the contrast against the background. This enables lifted or casted evidence to be photographed or scanned.

## 7. Summary

- Footwear or shoeprint evidence is considered as the best type for linking a suspect or a victim to the crime scene.
- This evidence can then be used to help determine if a suspect was present at a crime scene or exclude a person of interest from the investigation.
- Footwear can be deposited on almost any surface, from paper to the human body. Prints are divided into three types- visible, plastic and latent prints.
- The basic theory behind footwear analysis is that, much like fingerprints, shoes may leave behind either prints (referred to as “imprints”) or impressions that can be examined by investigators.
- Three main characteristics are used to analyse the imprints and impressions-class, individual and wear.
- There are four basic methods of recording footwear impressions at the crime scene.
  - 1) Photography
  - 2) Documentation/Sketching
  - 3) Casting
  - 4) Lifting