

THE DETECTION AND IDENTIFICATION OF FOOTPRINT IMPRESSIONS AT THE SCENE OF CRIME – A MINI REVIEW

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ABSTRACT

In order to identify the offender and solve a mystery crime like Footprint, forensic investigators hunt for physical evidence at crime scenes or the place of the crime. Forensic science is based on physical evidence. Even in the early stages of the inquiry, the footprint is simply overlooked since it is thought to be unimportant, even though it is essential physical evidence found at many crime scenes, including those of homicide, burglary, and sexual assault. The most similar kind of pattern-based evidence to fingerprint and gait analysis are blood pattern analysis. The most crucial aspect of forensic science is the analysis and comparison of the footprint impressions. The investigation officer or forensic science specialist usually follows the parameters, such as the design, size, or shape of a footprint, when taking footprint impressions. In a criminal investigation, a footprint impression can be helpful evidence that steers the case in the wrong way. In comparison to the footprints left by walking, those left by standing are smaller. In this review paper, we demonstrate how to quickly analyze the footprint imprint found at the crime scene using the scientific method.

Keywords: Footprint impressions, Crime Scene, Expert scientific method, Heel creases, Forensic podiatrists.

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INTRODUCTION

The practice of using forensic science and skill to unravel civil, legal, and criminal disputes is known as forensics. The term "footprint" refers to both the bare footprint and the shoe print and impression. The footprint may be seen at every actual crime site. In the crime scene, footprints are either known or unknowing pieces of evidence. A thorough forensic study of the produced prints may produce data that can easily assist in connecting a suspicious to the crime act. Based on distinctive shoe sizes or patterns, footprint imprints function as imprint evidence that can be expose a suspect at a malfeasance scene. Aristotle (382–322 BCE) is credited with the study of human gait, but it wasn't until the Renaissance that Giovanni Borelli (1608–1679) undertook the first solely scientific investigations of gait analysis. In Scotland during the 1700s, shoe print evidence had been utilized in a

court case for the first time [1, 2]. Since 1862, when Jessie McLachlan's footprint proved she was present at the site of the woman's murder and was found guilt-ridden for it, good evidence has been employed in criminal investigations. Since the 1990s, when contemporary tools were used for forensic enforcement surveys along with the support of podiatrists, Sergeant Robert Kennedy of the Royal Canadian Mounted police (RCMP) has been in command of the investigation, which has entailed collecting and scrutinizing 24,000 footprints.

BASIC GROUPS OF FOOTPRINT IMPRESSION

Two-Dimensional Footprint Impression

The impressions that are generated when the shoe underside contacts a hard, flat, or plane surface, like a linoleum floor or countertop. Intermittently, the substance is deposited on the substrate after being

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transmitted from shoe sole. They are referred to as "positive impressions," and they include blood and wet mud prints. Positive impressions are typically clear to see. At the beginning, before the substance that adheres to the sole wears. Less frequently, a negative footprint impression is left by scraping away residual material from the flat surface, making the prints latent (invisible to the naked sight). They are produced in the sand or on a surface that has received a mild wax finish [3, 4].

Three-Dimensional Footprint Impression

These shoe imitations are discovered when they are made in soft plastic materials like snow or sand. As this is the first round of photographs at the crime site, a record will be preserved. Afterwards, if possible, they are preserved by using dental stone for making three-dimensional footprint impressions and cast plaster of Paris [5].

FOOTPRINT AT THE CRIME SCENE

Footprint Location

At every incident setting, experts should look for track marks. The investigating officer should therefore be very careful during their search. Every surface where the accused might have arrived or left the area, had the foot impression. The impressions can be revealed in the countryside, rooms floors, courtyards, walls, stairs, tables, drainpipes, chairs, paper boxes, etc. If the offender entered a service department, there may be prints on the floor or its surface. The perpetrator is probably going to live Prince in blood if he leaves his footprint and shoes covered with blood [6].

Examination of Footprint

Foot impressions can be assembled from a variety of crime scenes and are regarded as a sort of evidence [7]. A person's gait pattern, body weight range, height, foot's interrelated movements, length of legs, ankle and body that are specific to that person can all be inferred indirectly from the location of each footprint. stride dimension, size, shape, depth and angulations, outer margins/interspaces, and heel creases (Fig. 1). So, a footprint impression can serve as evidence and may reveal information on the body type and skeleton of the person who left it, whether it is whole, partial, or even just a little bit. The gathering of footprints is a crucial part of the crime scene investigation process. Depending on the type of imprint observed, investigation officers are accurately trained in numerous gathering maneuvers for footprint testimony [8, 9].

Tracing of Footprint

The investigator's capacity for observation determines how valuable a traced mark is, and it is very individualized. Because the technique is unreliable, it should never be employed. Attempting

to go as close as possible without touching the footprint. It is important to draw the lines as thinly as possible. The area of the foot that needs to be traced is the point of discomfort, thus need to stand in a straight line to prevent destruction. The various components of the footprints should be noticeably delineated in thin, continuous lines. Dotted lines could be used to depict the hazy, uncertain outline [10].

Photography

Before using any other technique, all Prince and imprints should be photographed. Thus, both surface prints and sunken imprints are initially photographed. It is advised to avoid taking images of the identical mark twice by illumination coming from dual sides at 45-degree angles and twice with a single oblique light coming from a different side because the first details of marks are crucial. Because of its easy handling and accessibility to high-quality film, SLR (single-lens reflex) 35mm cameras have become quite popular. The examination of the walking pattern should benefit from the record that photogrammetry will provide [11].



Figure 1: Footprint impressions can be used to estimate a person's height and manufacturer's pattern.

Lifting

Following photography, any crime where the same surface prints are lifted usually ruins the original mark. Secondary prints can be lifted, although the quality of the pattern is normally very minimal. The lifting methods vary depending on the surfaces and

materials, but the following methods are frequently employed:

1. Sheet of bromide paper is used and fixed to sterilize it. It is applied over the impression once the extra water has been drained, so spread evenly. The print's outline is created on the paper by the print's particles adhering to the gelatin surface.
2. A bromide paper that is exposed is developed and fixed if the print is identified in white (or a light shade of) powder. The resultant junk will be black in hue. It gives lifted print the essential contrast.
3. Whether there is enough adhesive tape to lift food to check for shoe prints. It is used to remove marks made by powdered fingerprints.
4. Greasy and sticky stains left behind by shoes that have been covered in blood or other liquids can be removed from any surface by first dusting the stain with powder and then removing the excess powder by blowing as usual [11, 12].

Casting

In forensic science, casting refers to the process of creating a three-dimensional (3D) impression of a shoeprint or tire track found at a crime scene. This technique is used to preserve and study the impression for further analysis. To create a cast, a forensic scientist first prepares the impression by cleaning it of any debris or loose material. They then make a mold of the impression by pouring a liquid casting material, such as dental stone or plaster of Paris, over the impression. Once the casting material sets, the forensic scientist can remove the cast and study it for further analysis. The analysis of shoeprint or tire track casts can provide valuable information to investigators, such as the size and shape of the footwear or tire, the weight and direction of the object, and even the type of surface on which the impression was made. This information can help in identifying suspects and reconstructing the events of a crime [4].

It is vital to photograph the imprint before preparing a cast for it because the casting procedure almost destroys it. To fix the prices, a variety of items like wax, plaster of paris, plaster powder, resins, modifying clay, sulphur, woods, plasticizers, lead, and metal have been utilized. The material that is most usually employed is plaster of Paris [13].

HOLOGRAPHY

Holography is a technique used in forensic science to create three-dimensional images of an object or scene for analysis and investigation. It involves the use of laser technology to record the interference patterns created by two light waves that are reflected off an object or scene. The holographic image that

is produced can be examined from various angles, providing a complete view of the object or scene. In forensic science, holography is remarkably useful in the assessment of crime scenes, as it sanctions investigators to recreate the scene and examine it in detail without physically disturbing any evidence. Holography can also be used to analyze and compare tool marks and other types of impressions remaining at a crime scene, such as shoe prints or tire tracks. By creating a holographic image of the impression, investigators can examine it from different angles and make comparisons to other impressions found at the scene or in a suspect's possession [14].

Dr. Bradford, a British scientist, has developed laser methods for capturing food and shoe impressions. The fibers that have been squeezed often return to their initial locations. Although the fibers do not appear to take this long to return to their initial places when viewed visually, they do. The compression of laser beam can be recorded on a photographic plate, the shape of the foot or pair of shoes and the tread's external features, such as patterns, nails, wear and tear, etc [15].

Electrostatic Technique

Electrostatic techniques are a set of methods used in forensic science to analyze and identify various types of physical evidence, such as fingerprints, shoe prints, and other trace materials that are left behind at crime scenes. These techniques rely on the principles of electrostatics, which is the study of electrical charges at rest.

Some of the electrostatic techniques used in forensic science include:

Electrostatic Dust Print Lifter (EDPL)

This technique involves using an adhesive film to lift shoeprints or other types of impressions from surfaces. The film is charged electrostatically, which helps it to adhere to the impression and lift it off the surface [16].

Electrostatic Detection Apparatus (ESDA)

This practice is used to spot indented writing on paper. The paper is positioned on a charged plate, and the electric field created by the charge allows the indented writing to be visualized [17].

Electrophoresis

Based on their size and charge, DNA fragments are separated using this method. An electric field is applied to DNA fragments that are positioned in a gel matrix, causing the fragments to migrate through the gel. The separated fragments can then be visualized using various staining techniques.

Electrostatic Imaging

This technique is used to enhance fingerprints on non-porous surfaces. The surface is charged with an electrostatic charge, and then a conductive powder

is applied. The powder adheres to the charged surface, highlighting the fingerprint pattern [18]. A novel method for removing invisible shoe and footprints from flooring and floor covering is based on the idea that high voltage can lift dust particles on vinyl sheet, where they can be imprisoned on camera or set in gelatin paper. Cover the area where you think there may be evidence of barefoot footwear with a black vinyl sheet. Aluminum foil on a cabinet sheet. To the foil, apply high voltage of around 15,000 volts. Take a photo of the vinyl sheet where the mark was made. The indoor crime scene is where this technique is employed the most.

Latent Prints

Latent prints refer to the impressions left by the friction ridge skin on a surface, such as fingers, palms, and soles of the feet. These prints are typically not visible to the naked eye and can only be detected through specialized techniques such as fingerprint powder, cyanoacrylate fuming, or ninhydrin staining. Latent prints are often used in criminal investigations as a means of identifying suspects and linking them to a crime scene. The uniqueness and permanence of friction ridge skin make it a valuable tool for forensic analysis, as no two individuals have the same fingerprints.

The most recent food for shoe prints behaves like latent fingerprints. The grey powder is employed for dark-colored surfaces where there are numerous color powders extant to produce a latent footprint. Moreover, send powder is employed for multicolored surfaces or the magma brush technique is preferred when using black powder on a light background. If the developed print is located on a topic that cannot be taken to the lab, it may also be lifted because it is a photograph [19].

EVALUATION OF PRINT

A competent trend footwear and tyre markings expert should evaluate and compare the impression evidence. Laboratory and photography equipment and techniques for evidence recovery, handling, and examination. Every single footmark has a unique object that cannot be replicated, even with the best human effort and scientific methods, as is widely known, and this individual liberty is granted.

The size of real monks shoes and the cost of the materials, the type and quality of the surface, the way the mark is applied, the nature of the production process, and other factors all affect the cost in different ways, but these differences and dimensions are all within permissible limits. Examination of a footprint can disclose a lot about a person's activities at a crime scene. Impression that their number may be tallied can leave a second imprint, and prints that show scuffs or dragging feet can signal danger.

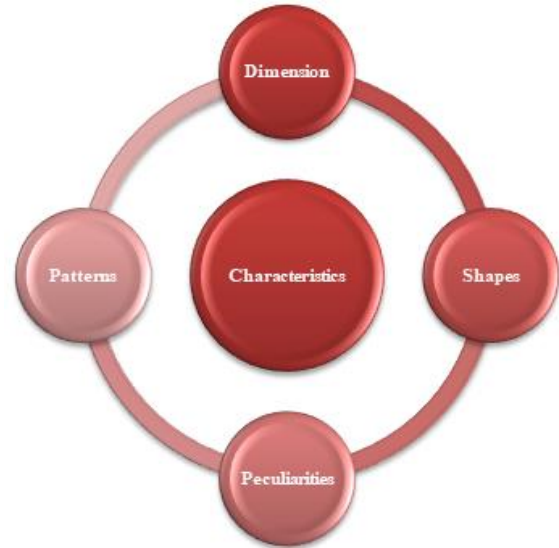


Figure 2: The characteristics of marks.

Inquire of the investigator about what others were doing at the crime scene. The footprints or shoe impressions of those who can be linked to the crime are allowed to overlap with their own. Naked-eye footprints are regularly discovered during crime scene investigations in India, and they may offer useful information. The marriage in encompasses of the heel's border and the food's inner and outer border lines, which can be either oval or round. Some foot with deformities may have distinct slopes and soles. In these situations, the inner and outer edges are continuous. The toes have a wide range in size and form. There are numerous identifying traits, Certain toe traits, such as riding toes, short and long toes, partially sliced toes, missing toes, and injured toes can be adequate for identification on their own. Phalange marks are finished by the toes phalanges, and their existence, position, forms, and sizes are typically used as distinguishing characteristics. They frequently turn up in the foot impressions. Because a footwear mark has plentiful distinguishing characteristics, it can be identified even when the mark is incomplete. Sometimes the shoe can be identified by its hill marks alone. Like the cracks of the chipped area of sole, damage to a shoe gives the sole personality. The bookmark is tough to customize. Frequently, the animal's nature can be determined by itself. In rare cases, hoof damage caused by the shod animal's iron shoes wearing out allows for the individual identification of the animal. The direction line, food line, walk line, food angle, step length, step angle, steps with step, and other unique feature of the foot or footwear are regarded as the most crucial evaluation of a footprint.

Control Samples for Preparation

Any type of forensic sample that are utilized to certify that the investigation so carried is accurate and results are dependable is termed as control samples. They are also known as control know samples to control, and they are a crucial component of the quality procedures that forensic scientists practice to stamp out laboratory inaccuracy. The examiner examines each component of the footprint pattern and each imprint's length before comparing those measurements to those of a crime scene impression or print. Low magnification and specific lighting techniques are occasionally employed to ascertain which of many different traits are unintentional or the result of manufacturing processes [20].

FORENSIC SIGNIFICANCE OF FOOTPRINT

Footprints are images or imprints that a person leave behind when they walk or run. The print left at a crime scene might provide the criminal with crucial evidence.

1. Rest on the sole design, the shoe at the crime scene has variety of prints that can be utilized to recognize the suspect.
2. Footprints that are present at a crime scene should be photographed so that the finding and examination of the footprints, a specialized area of forensic science, can be preserved.
3. Footprints and shoe prints can be used to determine an approximate height. The foot typically measures about the average height of the individual.
4. Unless distinct footwear or print impressions permitted their number to be recorded, it is frequently difficult to ascertain how many people were present at the crime scene.
5. A shoe print can be distinctive due to a variety of factors. The wear pattern of a pair of shoes can reveal how long they have been used as well as occasionally the owner's walking style.
6. Examination of footprints can disclose a lot about an individual's timing of actions at the crime site.
7. We have discovered more two-dimensional patterns for three-dimensional impressions thanks to footprints. The process of creating Prince involves either adding (blood, dirt), or removing (dust, blood).

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8. Footprints can provide valuable forensic evidence in criminal investigations. The point form of footprints refers to the individual characteristics of a print, such as the size and shape of the foot, the pressure applied, and any unique identifying features, such as scars or tattoos.
9. Footprints can be used to connect suspect to a crime scene or to except a person from suspicion. Forensic experts can analyze the characteristics of a footprint, including the size and shape of the foot, the pattern of the shoe sole, and any unique identifying features, to determine whether it was made by a particular individual.
10. Footprints can also provide information about the movements of a suspicious or target at a crime scene. By analyzing the depth and direction of the footprints, investigators can gain insight into the speed and gait of the person who made them [21, 22].

CONCLUSION

Track evidence includes tire tracks, skid marks, tire prints, tire tread impressions, and animal tracks such as pug or stick prints. Although some collection approaches differ for print and impression, both individual spots and their combined pattern are helpful in identifying persons. The ideas and methodologies for the evaluation of markings are similar. newest methods for collecting footprints that seem like holograms, electrostatics methods, and silicon prices. It is occasionally necessary to ascertain if a person is standing, running, or both. Identification of a science by its track mark and whether it is recovered under Section 45 of the Indian Evidence Act. The lawful dispute centered on whether the police or the magistrate might order the gathering of footprints in accordance with the Prisoners Act's identifying requirements.

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