REVIEW STUDY

Footprints: A direct evidence of locomotion from juridical outlook

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Abstract: Footprint is one piece of valuable physical evidence encountered at crime scenes and its identification can facilitate narrowing down the suspects and establishing the identity of the criminals. Analysis of footprints and foot length also helps in estimation of an individual’s stature because of the existence of the strong correlation between footprint and height. Foot impressions are still found at crime scenes, since offenders often tend to remove their footwear either to avoid noise or to gain a better grip in climbing walls, etc., while entering or exiting. These footprints also provide the oldest direct evidence for modern human-like weight transfer and confirm the presence of an energy-saving longitudinally arched foot in humans. Print size analyses also suggest that these individuals lived and moved in cooperative multi-male groups, offering direct evidence consistent with human-like social behaviors in individuals. Forensic barefoot morphology involves the comparison of the weight-bearing areas of the bottom of a barefoot without such ridge detail, as in a fingerprint, to establish a link between the barefoot of an individual and an impression found in mud, blood, or some other medium at the crime scene or on the insole of a shoe that may have been linked to a crime scene.

Keywords: footprints, identification, footlength, forensic

Introduction
The use of barefoot impression morphology in its current form by the RCMP had its origins in the Alan Legere case in 1989. Although extensive research into the individuality (“uniqueness”) of barefoot impressions was not performed until last decade, barefoot comparisons were presented in court for many years. Establishing a relationship between the accused and crime is of paramount importance in every crime scene investigation. There are 26 bones, 33 joints (20 of which are actively articulating) and more than 100 muscles, tendons and ligaments in each human foot along with considerable variations in its component parts. These variations are reflected in the degree of contribution of each part to the function of the foot as a whole. These variations are responsible for differences in pressure distribution and weight bearing through gait making each footprint unique. Forensic podiatry is defined as the application of knowledge regarding the anatomy and functioning of foot and also of footwear in crime scene investigations and in administration of justice. The basic theory behind footwear analysis is that, much like fingerprints, shoes and tires 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. These imprints or impressions can be compared to a suspect’s shoe or a vehicle’s tire to determine if the shoe or tire is the same one that left the impression. (5)

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 analyze the imprints and impressions: class, individual and 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 mold. For example, two tires 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 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 tread. Wear characteristics result from the natural erosion of the shoe or tread caused by use. Specific wear characteristics include the wear pattern, the basic position of tread wear; 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. (6)

As Footwear can be deposited on almost any surface, from paper to the human body. Prints are divided into three types: visible, plastic and latent. A visible print is a transfer of material from the shoe or tire to the surface. This type can be seen by the naked eye without additional aids. For example, bloody shoe prints left on flooring or tracks left by muddy tires on a driveway. A plastic print is a three-dimensional impression left on a soft surface. This includes shoe or tire tracks left in sand, mud or snow. A latent print is one that is not readily visible to the naked eye. This type is created through static charges between the sole or tread and the surface. Examiners or investigators use powders, chemicals or alternate light sources to find these prints. Examples include shoeprints detected on a tile or hardwood floor, window sill, or metal counter, or tire tracks detected on road surfaces, driveways or sidewalks. (7,8)

Various approaches have been devised to allow footprints to be objectively measured and identified for comparison purpose. The most commonly used approaches are the Gunn, Optical centre, and Overlay method. In case of Gunn method Dr. Norman Gunn produced a system to compare unknown footprints found at a scene of crime with footprint of suspected preparators of that crime and he developed an objective process to assist with that comparison. (9) Here well recognized identification points of foot are connected with one another by using a series of measured lines. (10) In Optical Center Method A distinct point on the foot is identified and concentric circles are drawn in its most suitable location. This point is then isolated and then connected to other recognized
regions of the footprint by means of lines. And in **Overlay Method** here outline of an identified footprint is drawn and positioned over an unknown footprint and compared. Features such as crease lines, shapes and positions of toes etc. are matched (11).

Examiners use several methods for collecting footwear evidence depending on the type of impression found. For impressions in soil, snow or other soft surfaces, casting is the most commonly used collection method. 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. When that is not possible, for instance, if the print is 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. With any evidence found at a crime scene, shoeprints and tire tracks must be properly documented, collected and preserved in order to maintain the integrity of the evidence. Impression evidence is easily damaged, so steps must be taken to avoid damage to the evidence. 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. 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.

Whenever possible, impression evidence is collected as is and submitted to the laboratory for examination. For shoeprints that cannot be picked up, various lifting techniques are used to recover the evidence. These include:

- **Adhesive lifter** - a heavy coating of adhesive lifts the imprint from smooth, non-delicate surfaces such as tile or hardwood floors, metal counters, etc. It is usually used in conjunction with fingerprint powders.

- **Gelatin lifter** - 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** - 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.

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Any plastic, or three-dimensional, footwear can be collected by casting. Casting uses a powdered stone material, such as dental stone, that can be mixed with water and poured into the impression. When it dries, this method creates a three-dimensional model of the impression. (12)

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 . 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. Ideally, the suspect’s shoes are submitted to the lab along with the collected evidence. Examiners will use the submitted shoes to make test standards, impressions of a known source, which can then be compared to the collected evidence. This is usually done using transparency overlays or side-by-side comparisons. (13)

Validation

In footwear impression evidence, the significance of a positive identification can be conveyed better by “quantification.” The identifying characteristics observed in the questioned impression and the corresponding characteristics observed on the outsole of the known shoe can be quantified by using the position, size, and orientation of each identifying characteristic. An association between a questioned footwear impression and a known shoe, on the other hand, relies on a combination of the outsole design and the physical size of the outsole. These areas of comparison are considered “class characteristics,” and the frequency of occurrence of these class characteristics is based on the number of shoes manufactured in a particular design and size. Often, class characteristics have been mistakenly regarded as having little or no value. However, any shoe outsole in a specific size represents a very small portion of all of the shoes manufactured in that design. Every shoe outsole manufactured from a specific mold exhibits the characteristics of that mold. Because variations exist from mold to mold, outsoles can be subdivided by molds. These variations can be observed in various stippling patterns, concentric circles, vertical bars, and the position of the logo box (Hamm 1989). Although mold characteristics are “class characteristics,” they should be examined closely during the examination process. If variations in the mold characteristics are observed, they can be used to eliminate footwear impressions that share the same general outsole design and physical size. (14)

During the examination process, the examiner also must consider the amount of wear observed on the outsole of the shoe. Wear can be defined as the erosion of the design features or design elements on the outsole of the shoe. This erosion occurs when the outsole of the shoe comes in repeated contact with a particular surface. (15) Cassidy (1980) studied the duplication of wear characteristics and concluded that the more an article of footwear is worn, the less likely general wear will be duplicated from one shoe to the next. Cassidy also found that general wear should not be used as a basis for identification but that the value of the wear becomes greater the more the footwear is worn. Just as design and physical size are, wear can be used to identify or eliminate a shoe as a potential source of an impression. For instance, if more wear is observed in a footwear impression
than on a known shoe, then that shoe should be eliminated as the source of that impression, even if the design and physical size correspond. The value of each individual and accidental characteristic on an outsole depends on an experienced evaluation of the traits and attributes of that characteristic. (16). An area of damage is examined for shape, size, relative location on the outsole, and any other distinctive characteristics. All of these traits add to or subtract from the value of an individual characteristic. For instance, a pin-sized, circular hole would be less valuable than a jagged tear in a tread element. Because damage is random and unpredictable, the value of each characteristic that may be present on an outsole is unpredictable. Also, the uncontrollable nature of the size and quality of a crime scene impression makes the reproduction of any individual characteristic random. Because all of these factors contribute to the unpredictable nature of the information provided in a crime scene impression, it is not possible to define a minimum number of characteristics needed to accurately identify an impression with the source outsole. (17)

Conclusion

Barefoot morphology has been used successfully in jurisdictions to exclude or include a suspect as having been at the scene of a crime. This evidence is based on an evaluation of the shapes and placement of various weight-bearing parts of the foot. Because footwear impressions are found at virtually every crime scene, footwear impression evidence often provides an important link between the suspect and the crime scene. As a significant form of physical evidence, impressions left behind at the crime scene may provide valuable information on where the crime occurred and the direction the suspect traveled while committing the crime. (18). Although interest in footwear evidence has increased over the years, many crime scene investigators and crime scene technicians still fail to recognize the importance and value of footwear impressions as physical evidence. Often, impressions are overlooked, improperly collected, or not collected at all. However, with the increased awareness of footwear impression evidence, accompanied by continued research and additional training now being offered on the proper detection, recovery, and collection of footwear evidence, the analysis of this valuable form of physical evidence will continue to be an integral part of criminal investigations. (19)

REFERENCES


