Discussion on Discovery and Identification of the on-Scene Footprint

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ABSTRACT The on-scene footprint is a high-value evidence that can often be collected on the crime scene. Since criminals have to enter the scene before committing criminal activities, the criminals are generally not likely to vacate from the scene. The on-scene footprint inspection is the use of scientific means and methods to detect, protect and extract the criminals' on-scene footprints, and the discovery and identification of the on-scene footprint for the detection, which is a very important and key part of the entire case. The investigation plays a vital role. In this paper, we mainly analyze the role of on-scene footprint verification in detection, and the importance of the discovery, protection and extraction of scene footprints by referring to relevant documents, cases and materials.

KEY WORDS scene footprint, identification, extract, analysis, detection, forensic science

Footprint traces, along with fingerprints, tool marks, and other bullets, compared to the track, have a significant feature.

With the development of the times, due to the anti-reconnaissance ability is getting higher and higher, lawless elements in the crime scene to leave less and less fingerprint traces, making fingerprint extraction more and more difficult. The national average rate of fingerprint extraction data in the last few years was 14% [1]. With the maturing of the global DNA identification technology, the on-scene awareness of DNA extraction is growing, but the legacy of the suspect is limited. Footprint inspection does not have the huge database support function of fingerprint or DNA, but does not affect its great role in the investigation. From the point of view of the relevant data, the footprint extraction rate is up to 35%. People have reached a consensus on that the footprint inspection technology has become the forensic technical staff, which is to say that the footprint verification technology is a major advantage, and therefore more attention must be paid to footprint search, discovery and extraction in criminal cases.

Scene footprint refers to the footprints or shoe prints left by the suspect in the conduct of a criminal activity. Each criminal would leave some marks on the scene as long as he or she committed a crime. In the process of committing the crime, the criminal will move around and will leave many trails, so the footsteps of the criminals are not only the reflection of the crime process, the reconstruction of the scene, but also the accurate analysis of its basic characteristics, such as age, gender, height, weight, which to some extent, can help the broad masses of investigators to narrow the scope of investigation and to determine the focus of investigation.

1. THE ROLE OF ON-SCENE FOOTPRINT INSPECTION IN THE DETECTION OF CASES INTRODUCTION

1.1. Narrow the scope of investigation to determine the focus of investigation

On-scene footprint verification can reduce the scope of detection to a certain extent, and meanwhile determine the focus of investigation. In general, the main purpose of the field of is to use the advanced technologies and methods to determine the case and the case-related physical evidence, which means through scientific testing methods to provide the review body with evidence of litigation [2].

1.2. Determine the crime situation

It is necessary to analyze the process and scope of the crime through the footsteps of the suspects. Such analysis can help to determine the time of the crime, the the entrance and exit of the crime, and also the number of the suspects. Therefore, the field of footprint test can help to determine the crime situation indirectly, and can help the further investigation of the case.

1.3. Analyze the characteristics of the suspect

In the process of committing the criminal will leave a lot of footprints due to moving around, so through the criminal's footsteps on the crime scene the specific characteristics of prisoners

Second is the plane dust footprint of photographic extraction. Bearing a smooth surface, contrast clear case can use wide footprint light footprint, plus a direct photographic scale. Bearing mark surface is not smooth, contrast small case, can be found with wide footsteps of the footsteps of the electrostatic adsorption method will be attached to the film on the film plus the scale of the photo, the photo processing software can be reversed.

On May 7, 2012, in Z City, the computer and multimedia equipment was stolen from Classroom D in a primary school. It was almost impossible to find the footprint on the rough cement floor by using the direct photographic extraction method, with a wide footprint lights. Electrostatic adsorption law can be the ground of making the shoe print clear before photographic extraction. In addition, suspicious footsteps were found on desks and chairs near one of the windows of the classroom, and were visually observable by natural light, but photographic extraction was difficult due to the unevenness of the surface of the table and chairs. At this point, the difficulty with the electrostatic adsorption method is greatly reduced. Further, in order to obtain a large contrast, it is necessary to adopt a method of displaying color according to the color and the alike of the surface of the mark, and to extract the footprint after obtaining the optimum contrast [6].

3. THE IDENTIFICATION OF THE ON-SCENE FOOTPRINT

3.1. In time to the scene, accurate identification of footprints

The identification of the scene footprint plays an important role in solving the whole case. During the on-scene investigation, the relevant technicians not only need to rush to the scene in time, but also need to accurately identify the suspect's footprints. As we can see that the footprints may not belong to the suspect’s only, and they may be the ones mixed with some other unrelated personnel or police footsteps. At this time, we must conduct a comprehensive and thorough research according to the actual situation of the case.

The first thing to do is to look into the situation after the incident. had entered the scene of all unrelated information on the situation, collecting these unrelated people’s sample footprints. Make sure that the on-scene footprint extraction is complete. Make a comparison to exclude the irrelevant footprint. However, people who had entered the scene may have already left the scene, so it is impossible to collect their sample footprints. At this point, we should follow the law of the footstep characteristics. analysis and judgment to identify the case has nothing to do with the footprint.

3.2. According to the on-scene footprint to analyzed the basic situation of the criminals

Footprint analysis is the basis for detection, for the scene will certainly have the suspect's footprint. Only after careful and comprehensive analysis can the investigators reduce the scope of investigation and detection to find out the suspect. Only through the specific analysis of the track on the scene can they get the basic information of the suspect, such as the height, age, gender and so on.

As we all know, the general size of the footprints is proportional to the personal height, that is, the greater the footprint, the higher the height of the criminal. In addition, men and women can be traced according to the specific analysis on their different characteristics, because men and women are different in body. and so is the edge severity, foot uneven uneven footprints are generally young and middle-aged. Women usually wear smaller shoes, and the shoe patterns are finer.

Therefore, the specific analysis of the basic situation on the crime scene requires the relevant personnel in the investigation to conduct a comprehensive and careful scene investigation, in which even very small area should not be missed under the specific circumstances of the scene to analyze the basic information of the suspects.

On-scene footprints can provide clues to the investigation and detection, can improve the efficiency of investigation, and can also become a Criminal Procedure in the sentencing evidence. At present, the crime rate is getting higher and higher, and especially the burglary has a very serious impact on people's sense of security. I believe that the public security organs should increase the number of the technical staff who know the use of the on-scene footprint to provide more and more effectively available clues to the investigation department. and more broken "small case" to improve the sense of security, service overall situation. In addition, the government should build unified inter-provincial, municipal and county resources to share the footprint system, and to improve the utilization rate of the footprint, making it play the largest possible role in footprint investigation and detection.

4. TRAINING OF FOOTPRINT RECOGNITION

The first step is the training of the three support points of the standing footprint, which is the basis of the follow-up training; the second and third step are to carry out walking footprints Dengzhe Step identification training; the fourth step is to carry out comprehensive identification of walking trains training.

4.1. support point recognition training

Support point recognition training belongs to basic training, which is the basis for follow-up training. For standing footprints, the first is barefoot training, and then the shoe footprint training. Barefoot footprint training can also be carried out by wearing socks.

When standing, in order to maintain stability, one has to let each foot have three parts at the same time interact. Calcaneal tubercle (calcaneal face),the first metatarsal head and the fifth metatarsal

head are called the three "support points". The purpose of support point recognition training is to accurately identify the location and extent of the three support points in the footprint made by shoes.

4.1.1. Barefoot training.

Footprint recognition training order can be like this: fist is the Indian footprint, second is the three-dimensional footprint, and finally is the plane footprint.

4.1.1.1. barefoot print training

First of all, position the three support points of the restrained Indian footprints through their own barefoot. The method is as follows: feel the location of the three bones of the barefoot, find the corresponding parts in the footsteps, observe these parts and compare the intensity difference between them and the rest of the ink shade reflected. Repeated observation and comparison will be conducted until the location of the footprints and the scope of support points and be successfully determined by visual analysis. Secondly, determine the location and scope of the three support points of the Indian footprints through observation and analysis, and then measure their own barefoot positioning accuracy. The purpose of the training is to locate the footsteps through the traces of reflection.

Finally, identify the rest standing points of the barefoot footprints. After confirming the position and range of the supporting points, the position of the skeleton corresponding to the barefoot was compared and the calibration was observed repeatedly.

Barefoot print training is relatively simple. In the identification process, pay attention to excluding such factors as the foot of the ridge, peeling or scars which have an impact on the ink, and you will find a trace of the support points where there is a "force" reflecting the body's own gravity on the feet and or the pressure generated by the object.

4.1.1.2. three-dimensional barefoot footprint training

Stereo footprints training requires lighting and measurement tools. If the eyesight is a bit poor, you need to use a magnifying glass, and you need to have the correct identification method.

(1) Identification tools. Lighting tools is mainly used to enhance the contrast and highlight the details of the features through ordinary flashlight, small angle or even horizontal light distribution. Measuring tools are mainly used to measure the distance between the feature points and to judge the accuracy of the identification features by using the tape, ruler, etc. The main role of the magnifying glass is to make up for the visual deficiencies, for poor vision cannot have a close observation over the details of the feature, so you need to use magnifying glass to enhance the reliability of observation and identification.

(2) Observation method. Observing the footprint features requires a combination of distance and near-concept, repeated comparison of distance and close-up view of the features found, and ultimately determine the positioning accuracy of the feature.

A distant view refers to observing a locating feature at a greater distance. The method is as follows: squat next to the footprint, with eyes 10 cm or more from the footprint, generally not more than 50 cm. The purpose of the distant view is to determine where the footprint is located and its general extent.

Near-sightedness refers to observing the locating feature at a closer distance. The method is as follows: lie on the side of the footprint on one knee, with eyes less than 10 cm from the footprint. The purpose of the near-concept is to determine the boundaries of the footprint features and other traces, and to specify the extent and size of the feature.

(3) Identification method. Stereo footprint training methods are not only similar to the Indian footprints, but also in accordance with the following three steps:

First of all, determine the three support points of the three-dimensional footprint through their own barefoot positioning. And then find the corresponding parts in the three-dimensional footprint through light observation to distinguish between parts of the bone and other parts of the pressure, elastic, reflective and also the degree of difference. Distant view will find the bone pressure heavier, the object itself loose, the weight of the place tight, reflective strong, whereas the object itself is tight, the pressure will be heavy parts of the loose, reflective weak even diffuse reflection. Close to the main observation of the performance of the edge of the bone, there will be obvious in the connection line-like traces. In barefoot, the bones and muscles of the pressure will be expressed in two levels, that is, the weight of the skeletal parts is heavier, while the muscle pressure is slightly lighter.

Secondly, determine the location and scope of the three supporting points of the three-dimensional footprint, and then measure their positioning barefoot accuracy through observation and analysis.

Finally, identify the support points for other standing three-dimensional footprints. After confirming the position and range of the supporting points, the bone position is compared with its barefoot position, and the calibration is observed repeatedly.

Barefoot three-dimensional footprint training is relatively simple, we need to pay attention to the traces of a clear distinction between the strength of bone weight and the muscle weight.

4.1.1.3. Bare Foot Footprint Training.

In the plane footprint training on the formation of the ground, the object such as floor tiles, wood floors, terrazzo or other smooth and delicate surface can be the first choice, skilled and then choose the cement ground, mud and other surface roughness surface training. The medium such as mud, sand, dust and other plasticity and delicate material can be selected, the thickness of the grasp can be thicker, after the gradual thinning, the equivalent of a gradual

transition from the semi-stereo to the pure plane. The recognition method is the same as the stereo footprint training.

4.1.2. Footwear Training

Footwear training methods, steps and barefoot footprint training the same. Training, should first select the soft soles, thin shoes, skilled gradually increase the thickness and hardness of soles. Usually sole shoes wear serious shoes, in the wear process will make the focus of the parts become soft and thin, the initial training can wear a similar shoe.

Footwear training to note that the barefoot in the footsteps of gravity will be expressed in three levels, the most important part of the force is the formation of bones, the edge of the heavier parts of the muscle formation, the most peripheral parts of the foot is led to the formation of barefoot, To identify the three parts of the dividing line.

4.2. pedal mark recognition training

Pedal marks in the process of walking, foot pedal from the foot to form the traces, so pedal mark recognition training for walking footsteps. People in the process of walking, in addition to the three support points of force, the toe also forced to pedal, usually the three support points and toes together known as the foot of the four "focus." When the toe pedal to the ground, the first metatarsal head will be pedal to the front, so Deng Deng marks including the toe pedal and the first metatarsal pedal marks. Of course, people walking, or older people walking, enough to have a number of toes will be forced, accordingly, there are a number of metatarsal head force, but the criminal case on the scene most of the footwear footprints , The soles have a certain thickness, feet on the strength of the other toes smaller, usually can not break through the soles of the thickness of the footprint in the formation of their own exclusive traces, and the greater the power of the metatarsal head, can form their own exclusive traces, so often found The toe pedal and metatarsal head pedal marks are inconsistent.

Pedal mark recognition training to solve the position and scope of the toe, plantar pedal marks the location of two issues, but also in accordance with the first barefoot footprint shoes, the first footprint footprints and then three-dimensional footprint of the final plane footprint in the order. In the control of the toe and metatarsal head position calibration process, should also be in accordance with the way the formation of footprint comparison and calibration.

Pedal mark recognition training methods and steps with reference to support the point recognition training, it should be noted that:

4.2.1. Toe mark

There are two levels of traces in the barefoot traces. The center of the traces (not necessarily the center) is the formation of the pedal force. The external traces are the formation of the muscular pedaling force. However, due to the toe muscularity, Even without a dividing line, must be carefully distinguished by near-concept. At the same time, walking faster, the toe traces will be a slight forward displacement, that is, toe to toe root distance will be widened, the error of up to 0.1-0.2 cm; such as by cold, hard, And other effects, the thumb may shrink, the toe mark will be a greater backward displacement, with the normal error of up to 1 cm or so, the practice encountered such cases can no longer consider the length of the toe.

Toe footprints in the footwear trail is generally expressed in two levels, the strength of the region is the toe and muscle pedal force common form, its periphery is the toe to drive the formation of soles, two levels of traces have more obvious dividing line. It should be noted that the toe mark is mainly toe toe and toe belly muscle pedal force formation, did not reach the toe toe, can be seen as the toe plane barefoot traces. At the same time, by the toe, insole and upper bound, the toe generally do not shrink, the toe length is not easy to change.

4.2.2. metatarsal pedal marks.

In the barefoot, the metatarsal pedal (not limited to the first metatarsal pedal, may also be the first and second metatarsal or first, second and third metatarsal joint formation of pedal marks) and the subsequent metatarsal indentation (indentation can be expressed Out of the different metatarsal head) there is a clear dividing line, manifested as two separate and connected parts. In the dividing line will appear obvious signs of fracture, the performance of the boundary line incoherent, or forward and backward protrusions, is the plantar area medial pedal mark strength changes in the node, the teaching of the dividing line is called the pedal change line , Fracture marks known as the pedal force point. Pedal force point is to accurately determine the basis of one of the remaining traces of human age.

In the shoe footprint, the metatarsal pedal marks are not complete, generally attached to the metatarsal indentation (indentation can not show different metatarsal head, usually only to find the first metatarsal head) front, in most cases only pedal change line. Through the distribution of light, near view, pedal change line and pedal force point is relatively easy to find.

4.3. Tread mark identification training

Tread mark is the normal walking heel when the natural footprint of the formation of the foot, the shape of a crescent-shaped, its front and rear edges are curved. The leading edge of the tread mark is the trailing edge of the barefoot plane. The trailing edge, in the barefoot trail, is the upper edge of the object that is obliquely in contact with the rear, and in the shoe footprint is the heel edge.

Tread mark recognition training for walking footsteps, in the positioning of the front edge will be involved when the foot drop. Footfall refers to the barefoot in the normal walking of the initial contact with the ground and other objects in the scene, in the

footwear footsteps refers to the thickness of barefoot breakthrough soles of the initial force of the scene, so whether it is barefoot footprint or footwear footprints, Is the original object of barefoot formation marks, it is accurate to determine the age of one of the locating marks.

The method and steps of the identification of tread marks are the same as those of the support point recognition training. The aim is to accurately locate the leading edge of the tread mark. The leading edge of the tread marks is an incomplete arc line, which can be easily recognized by combining the distance view and the near view.

Foothold in the tread mark on the front edge, its identification need to pay attention to is:

4.3.1. Falls are located on the leading edge of the tread mark, so determine the location of the foot position need to find the leading edge of the tread mark. The front edge of the barefoot footprint is easier to locate. In the shoe footprint in the front edge of the tread marks about 1 cm from the trailing edge, by light distribution, combined with the distance and near view, can be found in clear curved forefront of the mark.

4.3.2. Most of the foot position is in the tread mark and the intersection of the centerline of the footprint at the intersection of the location, then because the normal walking footsteps of the footsteps are outreach, foot position leads To the outside. Of course, there is a drop-off point is located in the intersection or partial, such as long-term model walking training is usually at the intersection point, "within the character" of the human foot position is located within the intersection point.

4.3.3. Find the footer near the intersection of the leading edge of the score and the center line of the footstep. The leading edge of the tread mark is not complete, and there is always a discontinuity, rupture, or backward protrusion in the vicinity of the intersection point.

4.4. Integrated Training of Footprint

Through the first three stages of training, to determine the footsteps of the barefoot force on the part of a "force" reflection. "Force" reflected in the footsteps in addition to the four focus points, foot drop and other five parts, there are the first metatarsal medial edge, the fifth metatarsal lateral edge, and even running footprints in the second to the first Five toe marks and the second to fourth metatarsal head traces, the body is thin and the fifth metatarsal tuberosity traces, body fat than there are traces of the outer edge of the arch, and so on. In short, integrated training in the foot trains to grasp the following details:

4.4.1. For the positional relationship between the stable footprint features, it needs to measure the distance between each other. These features are:

4.4.1.1. The central point of the calcaneal tuberosity. The traces of calcaneal tubercle is a relatively large area, accounting for the entire heel traces of 3/4 or more, in its positioning, the general selection of the geometric center.

4.4.1.2, the first and fifth metatarsal head center. The first and fifth metatarsal head traces were round, about 1 cm in diameter, positioning the geometric center of its selection.

4.4.1.3. The toe mark center point. The toe-toe-to-toe and the toe-to-toe muscle traces are often indistinguishable in the footwear footprint, and can therefore be treated as a whole toe mark. The toe mark is round or oval-like, and its geometric center is selected.

4.4.1.4. The intersection of the centerline of the footprint and the leading edge of the tread mark. The designated point is to select the barefoot plane standing trail midpoint, easy to grasp the length of barefoot.

The five scenes in the footwear footprint almost no change, even if there are running, jumping and other special circumstances, the position change is also small. Therefore, after the calibration feature points, through geometric mapping analysis of the way, its distance, location of the footprint test is important.

4.4.2. for the location of a slight change in the characteristics of the need to determine the characteristics of the before and after, internal and external relations. These characteristics typically include:

4.4.2.1. Inner edge of plantar. That is, the inner edge of the plantar area traces inward the most bump. The inner edge of the plantar area was curved, angular and other linear structure, in the shoe footprint in the performance significantly. As the inner edge of the sole shape, thickness and hardness of the medial side of the soles of the palm and the pattern, traces of people walking posture and other effects, the inner edge of the plantar area of the extent of inward expansion will change, the plantar margin and the first metatarsal head center Distance is not much reference value. However, the inner edge of the plantar area traces the extent of inward expansion with regularity, it and the toe traces of the internal and external relations will not be affected, so the inner edge of plantar and the toe mark the inner edge of the point (the toe inward) Of the internal and external location is an important basis for footprint testing.

4.4.2.2 pedal force point. That is, the inner edge of the plantar pressure traces on the front edge of the line of change in the force change node. The pedaling force point will change with the internal and external offset of the bare palm force, and will also change with the increase or decrease of the height of the foot, but its internal and external relations with the various metatarsal heads will not change, The relationship between the internal and external position of the metatarsal head is an important reference factor in foot tracing test.

4.4.2.3. Plantar edge points. That is, the outer edge of the plantar

area traces out of the most bump. And the inner edge of the plantar changes in the same token, the plantar margin and the fifth metatarsal head center distance is not much reference value, but with small toe traces of the internal and external relations will not be affected. If the traces can be judged small toe marks, the outer edge of the plantar and small toe traces outside the point (small toe marks out of the most convex point) of the internal and external position is an important basis for the footprint test. At the same time, the distance between the outer edge of the plantar and the inner edge of the plantar is relatively stable, which is the basis for judging the oblique width of the plantar and the relative position of the first and fifth metatarsal heads.

4.4.2.4. drop foot. But the long-term development of walking habits, foot-down point relative to the footprint center line and the front edge of the tread mark the relationship between the location of the internal and external position will not change, but the footsteps of the foot- The positional relationship is also an important basis for footprint testing.

In short, the footprint recognition training is the basis for footprint testing, and only the right footprint of the scene for analysis and use be protected can the footprint features be accurately identified.

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