

FOOTPRINT CHARACTERISTICS WHICH MAKE THEM UNIQUE FROM THE FORENSIC PERSPECTIVE

Prasansha Singla

B.Sc. Forensic Science, Amity University, Panchgaon, Manesar, Gurugram, Haryana – 122413, India

ABSTRACT

Personal identification is preliminary concern of forensic investigation. There are many methods including fingerprints, tool marks, bite marks, lip and ear print by which personal identification can performed. Like the fingerprints, footprints are one of the valuable physical evidences that a suspect leaves unintentionally at a crime scene. Almost all the physical evidence need to be utilized to express individual characteristics. Foot can be studied by footprints and shoe prints. Analysis of footwear characteristics, impressions, and track ways can provide important evidence in a crime scene investigation. Analysis of footprints can reveal very important clues which can be used as forensic evidence. It can help to link suspect to the crime scene and also associated with other evidences like blood, soil, and any other foreign material which help in distinguishing of crime scene. After a keen analysis, footprints can provide useful information to establish personal identity. The present study is aims to analyze the unique and individual characteristics of footprints of Haryanvi's – North Indian, from a forensic perspective. The 500 sample of male and female age range 18 to 50 years were collected.

KEYWORD: *Forensic Science, Footprints, Individualizing characteristics, Personal identification, Forensic podiatrist, North Indians Haryanvi's*

INTRODUCTION

Footprints (or footmarks) are the impressions or images left behind by a person walking or running. Every person's foot has a unique set of ridges that make up a print unmatched by any other human being. As with fingerprints, the footprint's pattern is a unique characteristic that can pinpoint any one particular person. They may be caused by the bare foot, or may be left by footwear.^[1, 2, 8] Footprints evidence is found at approximately 40% of crime scenes and second to DNA as most common evidence found. Footprints are similar to fingerprints in their uniqueness. Both have the capable of providing positive identification.^[3,5] Like fingerprints, no two individual have the same palm and footprints. The use of foot related evidences in criminal investigations dated back to 1862 when Jessie Melanchlan's footprints placed her at the scene of woman's murder for which Melanchlan was subsequently convicted. In modern time, Forensic Podiatrists have assisted law enforcement in investigation since the 1970's. In 1989, the author published the journal article "Forensic Method and the Podiatric Physician" in which he suggests the need for a forensic podiatry organisation. Forensic podiatrist 'John DiMaggio' founded the American society of forensic podiatry in 2003 and for now the organisation has 55 members.^[6] Footprints obtained from the scene of crime and analysis of footprints help in the estimation of stature, weight, sex, holding weight, number of perpetrators, direction of movement and the speed at which an individual was moving.^[4,7] There is several types of footprints. One is which is seen be naked eye i.e. patent prints. It is visible to naked or bare eyes and very effective in forensic investigation. 2nd type of prints, When a person walks on a floor and both the floor and his foot are dry then they formed latent print s which are not visible by the naked eye and last type is when a impression are left over on soft or impressionable surfaces such as clay, mud etc. These impression are also visible to the naked eye and can be photographed but need some extra casting material for lifting them. This type of impression is known as the plastic prints. The main purpose of the present investigation is to find out the individual characteristics like shape, size, alignment of toes, toe shapes, ball line, heels, shape of toe line, humps, phalanges marks, creases, cuts, cracks, pits etc. of the foot.

MATERIAL AND METHODOLOGY

The aim of this study is to find the individual characteristics of the footprints. There are 500 samples of the adult person in which 250 are males and 250 females of the haryanvi's of north India. A total 1000 prints were obtained from left and right feet of 500 subjects. Information such as the names of subjects and the place of

origin was recorded. The study was carried out in the month of April to May when the temperature was about 35° to 40° C. In this month the perspiration level is also moderate due to presence of humidity in the environment. The total number of samples which was taken is 1000. All the subjects including in the present study were healthy and free apparent from any deformity of the foot. The following method was used in development of fingerprints:

The first priority is to clean the individual's foot properly. Then prepare the ink and placed on slap with the help of roller and then apply the ink on the foot with the help of the cloth on the suspected person's feet. Placed the foot on the paper and then mark the outline. After that measurement and analysis of the foot will done.

RESULT

1. Morphological features of footprints:

Footprints are the impression represents the planter position of the foot. Footprints from the different persons are never identical same as the fingerprints. Each individual have the uniqueness in their prints which help in personal identifications. The variation in the footprints is due to the variation in the shape, size; inter toe distance, pointed toe, wide heel, all line, heels, creases, pits, cuts, and any other deformities formed accidentally. A footprint may be normal, flat, curved, broken bridge or one of the infinite variations in between the main types. Missing toes, unilateral and bilateral flat foot conditions, broken bridge, abnormal heel and many intermediate variations are seen in the present population. The information on footprint morphology is especially significant because it elucidates the individuality of each person's footprints.

2. Features of Toe:

A variation in the footprints of the toe region is due to the variation in their shape, size and inters distance of the toe. Riding toes, long and short toes, missing toes, partially cut toes and damaged toes, sometimes offer useful characteristics. The shape of toe prints may be oval, round, pear-shaped or asymmetrical. The shape of the toe line may be straight, curved, staircased or irregular. Any accident marks on the toes, due to cuts, cracks and other damage, confer individuality to the toe pattern. Sometime little toe impression may be found missing. Even though all toes were found in the individuals, the missing of toes occurred because some of the toes did not make contact with the ground during the footprint development process. Sometimes riding toes also do not register their marks when there is less space between the adjoining toes.

In the present population, the footprint can be classified into four types on the basis of the relative morphological lengths of the first, second and third toes.

These types are described as follows:

- (a) When the $T1 > T2$
- (b) When the $T2 > T1$
- (c) When the $T3 > T1$ and $T2$
- (d) When the $T1 = T2 = T3$

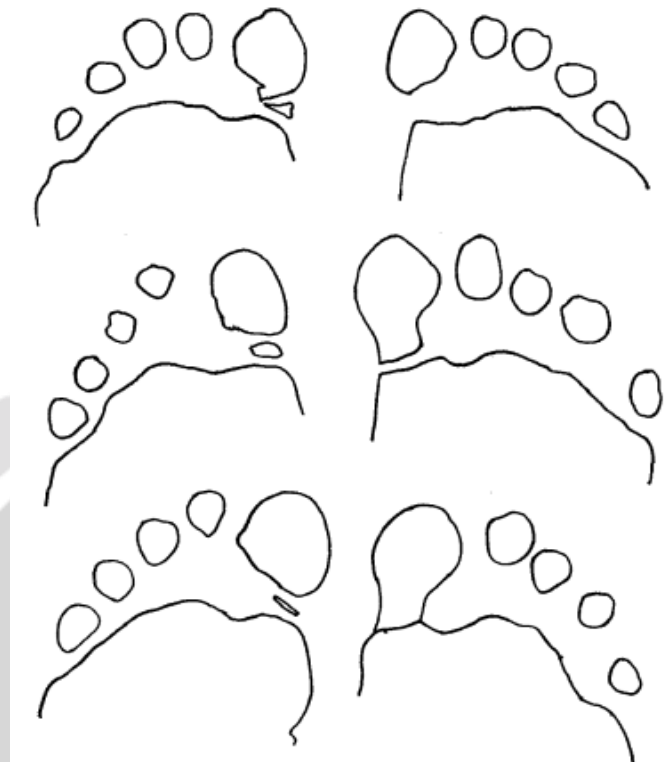
Following Philip, these four types have been denoted as T-type (the tibialis-type), F-type (the fibularis-type), M-type (the midularis-type) and O-type (the intermediate-type). The frequency distribution of the relative toe lengths of the first, second and third toe. The frequency of the F-type is the highest (50.50% on left and 51.21% on right side), followed by T-type (30.88% on left and 45.92% on right side). The O-type and the M-type is the least frequent among the population of the haryanvi's. The frequency is almost equal on both the left and right sides with a few deviations.

Spacing of the toes inter-distance gives a characteristic pattern. They may be touching one another or there may be some distance in between. The inter-distances vary. No two footprints have exactly identical toes inter-distances not even between the left and right footprints of the same individual. In the present population study, the toes inter-distance can be classified into three type's viz.:

- (a) Narrow: when the toes inter-distance is ≤ 0.47 cm.
- (b) Medium: when the toes inter-distance is between 0.47 and 1.10 cm.

(c) Wide: when the toes inter-distance is > 1.10 cm.

The percentage of medium toes narrow is found to be comparatively higher followed by inter- distance and wide toes in both sexes.



3. Features of Humps:

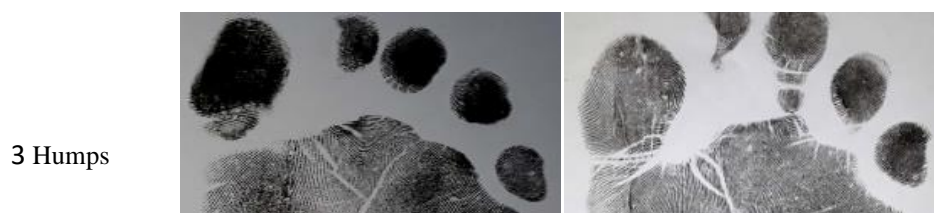
The line formed by the toes at their junction with the sole often exhibits characteristic features. It may be straight, curved, bulging or irregular. The toe line can have one, two, more or no humps. A hump may be defined as a protruding curvature in the ball line. The presence of humps is an important characteristic feature that can help in the elimination process of suspects in crimes. The toe line can have one, two, more than two or no humps (zero humps). The footprints of haryanvi's show the presence and absence of humps.



0 Humps

1 Humps

2 Humps



3 Humps

4 Humps

4. Phalanges mark:

Phalanges marks are created by the phalanges of the toe or these are imprinted in the form of the toe stems. These are also the evidentiary value in the field of the identification. Their size, shape, position and presence of the phalanges mark are highly characteristic and can help in the personal identification. The presence of phalange marks is often noticed in toe 1, whereas phalanges marks of toes 2–5 are usually absent in footprint impressions unless the footprint is made on very soft soil. The salient feature observed in the investigation is that some footprint samples show phalange marks of all toes and some samples showed no phalange marks or zero phalange marks. There are also interesting feature observed is the existence of multiple phalanges marks in the footprints.



0 Phalanges marks

1 Phalanges marks

2 Phalanges marks

5. Creases marks:

Creases marks occur on the planter surfaces of the foot with distinct features of their own. Crease marks or lines are caused by skin folds of the plantar surface of the foot. Some of these folds are long lasting but some of the temporary. These types of the creases are useful to identify the individual. Crease traits like dermatoglyphics traits are controlled by polygenic factors and stand a chance to be used in the study of ethnic and geographic distribution. The present study shows that in certain cases, there are no creases but in some cases there are one or more creases. These creases may be horizontal, vertical or crossed or may be in different directions. The present study shows that numerous crease marks are found more often in female footprints when compared to male footprints. The male footprints mostly show just one or two or almost zero crease marks in their footprints. The presence of vertical crease marks is found to be comparatively higher in females than males.



6. Flatfoot conditions:

Flat foot is also called the Pes Planus. It is the condition in which the arch of the foot collapses, with the entire sole of the foot or the complete instep region of the plantar surface of the foot on the surface. The flexed or curved area is not visible in flatfoot as in normal foot. It is one of the most important individual characteristic which help in the personal identification because it is the rare one. There are two types of pes planus i.e. unilateral and bilateral. The present study shows the existence of unilateral and but the bilateral footprints are rarer one. This study shows that unilateral flat footprints are slightly higher in males than in females. The frequency of the flatfoot condition is more on the left side than on the right side. The feature may be helpful in approaching personal identity in the exclusion and inclusion of certain suspects.



7. Pits, corns, deformity and cracks marks:

The person or the individual, who have habit of walking barefoot, have the presence of some kind of damages in their plantar region which is main cause of forming pits, corns, cracks marks, cuts or any other kind of deformities. The damage in the form of cuts and pits are individual in nature and permits the definite identification of the marks. Thus it helps in linking the mark with the foot of the suspects or of the person. These marks are lead to definite person identification in forensic investigation even though some of these marks may not be permanent sometimes



PITS

CRACK

CORNS

DISCUSSION AND CONCLUSION

The present study shows some of the new individualizing characteristics of the footprints. Detailed investigation of phalanges marks, humps, pits marks, different toe features, creases, cracks and many more features were seen in this study which help them to make them unique. The careful examinations of the morphological features of the footprints suggest that an extremely high level of individuality is expressed in the impression made by the human foot. The present investigation clearly shows that the individual characteristics of the footprints and their features can provide important clues in establishing the personal identification in the forensic science. Similar studies were conducted on Gujjars of the north India population, the north-west Indian population, and the Thai population. The presence of humps in footprints is an important characteristic feature for person identification. The present study shows that the frequency of three humps is the highest, followed by two humps and the least frequent is zero humps. But the north Indian Gujjars population showed six types of humps, viz. zero hump, one hump, two humps, three humps, four humps and five humps.^[10] The frequency of three humps was the highest followed by two humps, four humps, five humps, one hump and zero hump being the least frequent. The Thai study showed the presence of five types of humps viz. one hump, two humps, three humps, four humps and five humps. The frequency of three humps was the highest and five humps is the least frequent in the population. The comparative analysis of humps shows that people from different regions and races bear different morphological features of feet and prints. The phalanges of the toes are imprinted in the form of toe stems. The presence of phalange marks is often noticed in big toe marks. Phalange marks are also of great evidentiary value. In the present study the phalanges marks were basically seen in 1st but also seen in 3rd and 4th one. Thus, from the aspect of human footprint based recognition can be a propitious method. Therefore the researchers are encouraged to conduct similar studies for different ethnic groups living in different parts of the world so that the genetic and environmental effects can be investigated in forensic terms.

REFERENCES

1. Nabar, B. S. (n.d.). Footprints chapter 6. In *Forensic Science in Criminal Investigation & Trials*.
2. Kirk P.L.: *Crime Investigation*, 2nd Edition, John Wiley and Sons Inc. New York
3. Krishan, K., 2008. Estimation of stature from footprint and foot outline dimensions in Gujjars of North India. *Forensic Science International*, 175(2-3), pp.93-101.
4. Sharma B.R.: *Forensic Science in Criminal Investigation & Trials*
5. Naples, V. and Miller, J., 2020. *Making Tracks: The Forensic Analysis Of Footprints And Footwear Impressions*.
6. R.B. Kennedy, Uniqueness of bare feet and its use as a possible means of identification, *Forensic Sci. Int.* 82 (1996) 81–87.
7. Bandyopadhyay, S. and Basu, N., 2016. Analysis of Footprint in a Crime Scene. *Research Journal of Forensic Sciences*, Vol. 4(2).
8. Singh, H., Garg, S. and Kohli, K., 2020. Role of Foot Impressions and Boot Marks A Comparative Evaluation on Soft and Hard Materials. *J Indian Acad Forensic Med.*, Vol. 36, No. 1.
9. Moorthy, T., Mostapa, A., Boominathan, R. and Raman, N., 2013. Stature estimation from footprint measurements in Indian Tamils by regression analysis. *Egyptian Journal of Forensic Sciences*,.
10. K. Krishan Individualizing characteristics of footprints in Gujjars of North India–forensic aspects *Forensic Sci Int*, 169 (2–3) (2007), pp. 137-144