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Research Paper

Gait Pattern Significance in Forensics: A Review

Forensic Science

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Ms. Manashree Mane

ABSTRACT

Tracking through gait pattern is an art. It is practiced in various parts of India by certain families. The trackers are known as Khojis. Police forces have utilized them for tracking criminals. Some of them have joined police forces. They follow track of individuals, animals or drag marks or even stick marks. They know the peculiarities of foot, distances, angles and pressures in foot, footwear and allied marks. Gait pattern has been studied scientifically. Individual foot or footwear marks are seldom clear in sandy places, but gait pattern is usually distinct. Hence it is more useful for study.

Introduction:

Individuality of the Feet:

The human foot is highly individual in its form, size, and shape. These features originate from and are initially influenced by an individual's genetic code. However, environmental and physiological influences, as well as other acquired characteristics, injuries, and pathologies that occur throughout an individual's life, contribute to considerable and significant changes in the foot and result in the adult foot's uniqueness.

Podiatrists' involvement in barefoot identification is both descriptive and interpretative. The particular emphasis is on the recognition and utilization of foot-related conditions and foot dimensions in this process. As podiatrists recognize a condition, state or pathology in an unknown barefoot print, this would then be described and compared with the recognized presence or absence of such a condition, state or pathology in a known barefoot print.(Nabar,2001)

Nature of Footprints:

Footprints are produced under the following circumstances:

- The impressions of the foot may be cause in mud, dust, sand, and snow or like substances. Such impressions will be depressed or three-dimensional type and referred to as sunken foot impressions.
- If the footprint is produced by deposition of material like dirt, oil, blood, coloured powdery substance, etc on smooth and hard surfaces, giving rise to two-dimensional print, it is known as surface footprint. They are generally found indoors.
- Footprint may also be produced by lifting dust or liquid material in which case a negative print will be left on the surface.

Location of Footprints:

Following places should be carefully searched:

- At the crime scene
- Around the place of occurrence
- Along the route taken by the culprit, both at the time of ingress and egress,
- At the places where the culprits gathered together for planning before action and for sharing the booty,
- Besides the above, footprints may be found in the fields, courtyards, floors of rooms, walls, staircase, roofs, tables and chairs, papers, boxes, drain pipes etc,
- If the culprit has visited a garage, he is likely to leave prints on the greasy surface of the garage floor,
- If the culprit gets his foot or footwear smeared in blood he is likely to leave prints in blood.

Identification characteristics:

It is well established that every footprint has an individuality which cannot be duplicated. The individuality in a given print is established by studying the following characteristics:

(a) Dimension: It should be noted. If the dimensions vary to a considerable extent then it can be concluded that the suspect could not have left the questioned print.

(b) General Shape: The shape of the foot may have remarkable variations. It may be normal, flat, club shaped, bow shaped, broken bridge or abnormal.

(c) Pattern: Sometimes ridge patterns may be noticed on the prints and impressions. Their study may reveal identifying characteristics.

(d) Margins: Sometimes margin of the bare footprints are highly characteristic. The margins consist of outline of the heel and the inner and the outer boundary line of the foot. The heel may be oval of round; the outer margin may be straight, bulging outward or inward.

(e) Toe marks: The shapes and sizes of the toes, their inter spaces and alignment vary greatly. Long and short toes, missing toes, an extra toe etc. may be highly characteristic.

(f) Crease, phalanges, cut marks etc: The shape, size, position of the phalanges of the toes, crease marks or cuts may be highly characteristic.

Forensic Gait Analysis is defined as the identification of a person or persons by their gait or features of their gait, usually from CCTV footage and in comparison to footage of a known individual. Where the perpetrators of crime have been captured on CCTV, the persons gait and/or features of gait can assist in the subsequent identification process. Such gaits and features are identified on CCTV footage and compared to video or other recorded footage of a known person. This work is currently the exclusive domain of forensic podiatrists. Although electronic/computing engineers are working on biometric systems in this same area, these are still under development and are not in practical use to date. The work is usually carried out at the request of police agencies or lawyers. (Bodziak)

A single sequence of functions of one limb is called a gait cycle. It is essentially the functional unit of gait. The gait cycle has two basic components, the swing phase and the stance phase

- **Stance:** phase in which the limb is in contact with the ground
- **Swing:** phase in which the foot is in the air for limb advancement.

A gait cycle is also referred to as a stride.

Stride (Stride length): Linear distance between corresponding successive points of contact of the same foot (e.g., distance measured from heel strike to heel strike of the same foot)

Step (Step Length): Linear distance in the plane of progression between corresponding successive contact points of opposite feet (e.g., distance measured from heel strike of one foot to heel strike of the other foot). Normally, the step length is approximately 15–20 inches.

Each stride comprises two steps.

Stance phase can be subdivided into:
1. Initial contact
2. Loading response
3. Midstance
4. Terminal stance
5. Preswing

Swing phase subdivisions:
1. Initial swing
2. Midswing
3. Terminal swing

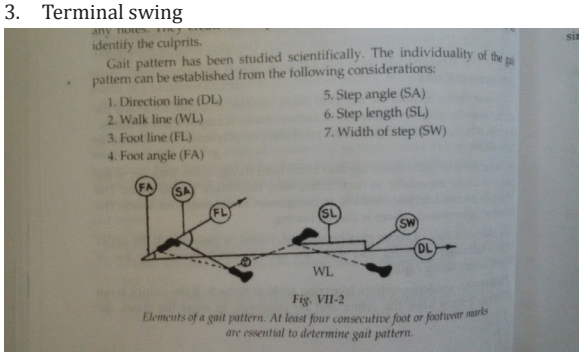


Fig. Gait pattern Analysis

Atleast four consecutive foot or footwear marks are essential to determine gait pattern

Discussion:
When a person while walking or running makes a series of footprints or impressions, it is called a gait pattern or walking picture or walking ensemble. It is possible to deduce some of the characteristics of the owner's manner of walking. Walking pattern is found to be highly individualistic. It may therefore be of great value to study an indiviudal. The gait pattern is analyzed as follows:

(i) The direction line: It is an imaginary line which indicates direction in which the person is walking or moving. It is a straight line.

(ii) The gait line: In normal persons walk the gait line coincides with direction line and runs along the inner sides of both heel prints. It is more broken in stout persons and in pregnant women because they walk with their feet wide apart to maintain equilibrium. Broken walking line is suggestive of sluggish persons, drunkards and a person carrying heavy load on their backs.

(iii) The foot line: This is a straight line running through the longitudinal axis of the footprint. It is a line which passes through the second toe to the center of the heel.

(iv) The foot angle: The angle between the foot line and the direction line is known as the foot angle. It can be highly characteristic and does not change much. The normal foot angle is 30-32 degrees.

(v) The principal angle: This is the angle between the foot lines of the two feet and is thus sum of the two foot angles.

(vi) The step length or stride: This is the distance between the centers of two successive heel prints. It depends on the size of the walker, his habits and his speed.

(vii) The step width: This is the distance between the parallel drawn in the direction of direction line touching the inner side of right and left foot.

Other deductions from Gait pattern:
- Age of the person: It may be possible to know whether the track marks left are of a young or old person. A young person may show twisting action of the toes and the ball of the foot. Old persons during their walking drag earth by their toes. Their step length will be comparatively shorter. Marks of stick may also be found by the side of the foot impressions.
- The gender: Step length of an adult woman is between 25-28 inches. The ball of the foot is comparatively narrower than that of a man. The unimpressed part in a woman's foot is more pronounced. Women press their feet without an inclination towards the outside and the first two toes kick the earth forward, whereas the other three leave stationary marks. Some Indian women wear rings on the toes, and if they walk barefooted are likely to leave their marks.
- The Height of the person: The length of a footprint is not always suggestive of the person's height, but generally a longer footprint say, 10-12 inches and a step length exceeding 30 inches may suggest it to be that of a tall person (near about 5'- 10" to 6 feet in height). A short person will not only have a smaller foot (say, 6 to 8 inches in length), but would also register a shorter step length. Thus, a step length of about 20 or 24 inches with a foot whose length is about 6 to 8 inches suggest a person who is not more than 5'- 3" or 5'- 4 " in height. Footprint is 15% a person's height. Analysis indicates quick estimate of height may be made by presuming foot length to be 15.346% in men, 14.926% in women. The height of a man with a foot length of 28 cm would be estimated as 28 divided by .15346 = 182.5 cm. Likewise, a woman's foot length of 9 inches would be calculated in similar manner, 9 divided by .14926 = 60.29 inch.

Conclusion:
Walking pattern is highly individualistic. . It may therefore be of great value to study an individual. It may be possible to know whether the track marks left are of a young or old person. Step length of an adult woman is between 25-28 inches. The length of a footprint is not always suggestive of the person's height, but generally a longer footprint say, 10-12 inches and a step length exceeding 30 inches may suggest it to be that of a tall person (near about 5'- 10" to 6 feet in height). A short person will not only have a smaller foot (say, 6 to 8 inches in length), but would also register a shorter step length.

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