

Determination of Hand by Analysing Fingerprint Characteristics

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Abstract

Fingerprints are unique and permanent to each and every individual. At a crime scene if a single fingerprint is found it could be used to determine the hand from which it originated by analysing the characteristics of the print. The rotation of angle, position of bisector, ridge tracing, ridge counting and the relative position of the delta were used in whorl patterns. A presumptive study was carried out for archs, in which the visual characteristics were analysed and a conclusion was drawn. The study can help the Investigating Officer to determine the hand of origin of the print.

Keywords: Fingerprint Direction, Whorls, Archs, Fingerprint Identification, individualisation

INTRODUCTION

Fingerprints are unique patterns that are made by friction ridges (raised) and furrows (recessed), which appear on the pads of the fingers and thumbs. A fingerprint is an impression left by the friction ridges which are the raised portion of the epidermis of a human finger. Impressions of fingerprints are left behind on the surface due to the natural secretion of sweat from eccrine glands that are present on the friction ridge skin. Although many people appear to have similar looking

patterns, that is Class Characteristics are the same; the minutiae details owe to the individuality of the pattern amongst individuals.

The patterns formed by the friction ridges on the skin are: (Class Characteristics)

1. Loop (60-65%)
2. Whorl (30-35%)
3. Arch (5-10%)

Loops are the most common pattern of fingerprints found (60-65%). It is described as ridges that enter from one side of the print, recurve and exits from the same side. Loops have one delta, and a core. There are two types of loops;

1. Radial Loop (slope towards the thumb)
2. Ulnar Loop (slope towards the little finger)

Whorl patterns occur 30-35% of the time. Whorls are characterized by a circular type of ridge flow (spiral) pattern. Whorls have two deltas (right and left) and a core. There are four types of whorls;

1. Plain Whorls
2. Central Pocket Whorls

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3. Double loop or Twinned loop
4. Accidental

Arches are the least common type of fingerprint occurring about 5-10% of the time. It is characterized by ridges that enters from one side of the print, rises up in the centre and then exits on the opposite side. Arches do not have deltas or a core. It has the following types:

1. Plain Arch
2. Tented Arch

Individual Characteristics or Minutiae

These are the point interests in a fingerprint that are solely responsible for the uniqueness of a fingerprint. These unique characteristics establish the identification of an individual. They may be accidental, or unintentional, characteristics also. This is what the Forensic scientists look for when comparing prints.

Some Minutiae Marks Include:

1. Bifurcations
2. Trifurcations
3. Ridge Endings
4. Short Ridge
5. Island/Dot
6. Enclosure
7. Eye
8. Spur/Hook
9. Crossover/ Bridge
10. Ridge Crossing

Fingerprints also contain a core, delta and typelines. The core is the most approximate centre of the pattern; it is placed on or inside the innermost sufficient recurve. The delta is that point on a ridge, at the point of divergence or nearest to the point of diverges, of the type lines. It is located at a triangular area where the ridges radiate outwards in three directions. Typelines are the two innermost ridges, which start parallel, diverge and surround or tend to surround the pattern area. When there is a definite break in the typelines, the ridges immediately outside it is counted in continuation.

There are three types of fingerprints:

1. Latent
2. Patent
3. Plastic

Patent prints are those prints which are simply visible to the unaided eye. They are wholly visible to the naked eye and some amount of visualization and preservation is needed. Latent Prints are undetectable until they have been enhanced by either physical or chemical processes. Latent means hidden or secret. Most prints left at a crime scene are latent prints. These prints require the most enhancement and development processes. A plastic print is a print that was left in a substrate when it was pliable enough to record the print. These impressions are formed when the raised portions of the friction ridge skin is physically pushed into the substrate and forms an impression into the pliable substrate. The impression so formed is a negative impression of the friction ridge pattern.

There are many methods in which fingerprints can be enhanced. They include physical methods; powders and are mostly used to give a contrast to the surface background on which the print is suspected to be present on and chemical methods which include Iodine fuming, silver nitrate, ninhydrin, etc.

Fingerprint can be taken from the suspect, victim or witness, in two ways. Normally both ways of taking prints are used. Rolled print are taken for each independent finger separately, the thumbs are rolled from outside to towards the body, and the fingers are taken from the inside to away from the body.

Plain prints are taken together for the four fingers and separately for the thumbs. The purpose of taking plain prints too, to know the finger from which the pattern originated from in case some problems arise in that aspect.

MATERIALS AND METHODS:

The study population consisted of 100 females belonging to a random population of different age groups. Whorl patterns were collected from them, and a total of 50 whorls from the right hand and 50 whorls from the left hand were collected and analysed. **The objectives were:**

1. To determine the hand of origin of a fingerprint based on analyzing the characteristics of fingerprints in whorl patterns.
2. To analyze arch prints to determine if the hand of origin can be estimated from the print.

Sample: 100 whorl samples were collected from a random female population, 50 whorls from the right hand and 50 whorls from the left hand. The rolled prints of whorls were taken using ink method.

The following parameters were considered:

Rotation of Ridge: the central ridge was considered for determining the Rotation of the ridges. If the central ridge is concentric or elliptical then the rotation of ridge is absent.

Position of bisector of the line joining the two deltas: arcs were drawn from the top and bottom of the print from both deltas. A line was drawn joining the two points that were formed the meeting of the arc on both sides. The position of bisector was used as a parameter to determine the hand.

Ridge Tracing: By tracing the lower type line from the left delta towards right delta, the ending of the segment of the type line is noted as to whether it ends inside or outside the right delta. Then according to the number of ridges in-between between the tracing line and the right delta it is classified as inner, outer, and meeting. 'Inner' means the ridges being traced; starting at the left delta, passes inside of the right delta and three or more ridges intervene between the tracing line and the right delta. 'Outer' means the ridges being traced, after starting at the left delta, passes outside of the right delta, and three or more ridges intervene between the tracing line and right delta. 'Meeting' means the ridges being traced, after starting at the left delta, meets the right delta without intervening ridges or with not more than two such ridges inside or outside the right delta.

Ridge Counting: On drawing a straight line simultaneously from the left and right deltas to a core, the number of ridges intersected by it on both sides is counted. 'Left counting' is the count of intervening ridges between the left delta and core is greater. 'Right counting' is the count of intervening ridges between the right delta and core is greater.

Relative position of the delta: The relative position of the deltas to each other was visually examined. Either the right delta was superior to the left delta or the left delta was superior to the right delta.

Materials used:

1. Printers ink
2. Ink Roller
3. Ink Slab
4. Personal Information sheet
5. Stationary

Procedure:

1. The subject was asked to fill the Personal Information sheet

2. Printers ink was rolled onto the slab with the help of the roller.
3. The thumb was roller inwards, that is toward the body on the slab and then the print was deposited in the slot allotted for it on the sheet.
4. The same was repeated for the other four fingers, except the in this case the fingers were rolled outwards, that is away from the body.

Analysis:

1. Only the whorl prints were taken into consideration for analysis.
2. The angle of rotation was traced using a pointed needle to determine if it was clockwise or anticlockwise.
3. The two deltas were identified and they were joined together with a line using a pencil.
4. Using a compass arcs were marked both at the bottom and the top of the print from both deltas.
5. The bisector was then drawn.
6. Ridge tracing and ridge counting was down and the relative position of the deltas to each other was noted down.

RESULTS AND DISCUSSION

Parameters for the right hand

The following parameters were observed when analysis of prints originating from the right hand was taken into consideration. The rotation of the ridge was in anticlockwise direction, the position of the bisector was to the left of the core, the ridge tracing was mostly outer trace, although there were cases of meeting, the left count of ridge counting was more and the relative position of the right delta was superior to the left delta. In cases of meeting, there were instances where the position of the bisector was at the centre of the print and the right delta was relatively slightly superior to the left delta.

Parameters for the Left hand

The following parameters were observed when analysis of prints originating from the left hand was taken into consideration. The rotation of the ridge was in clockwise direction, the position of the bisector was to the right of the core, the ridge trace

was inner trace, the right count of ridge counting was more and the relative position of the left delta was superior to the right delta.

CONCLUSION

The hand of origin can be determined from the direction of the print using the above mentioned parameters. There is also a significant relation between the ridge tracing, ridge counting and the relative position of the deltas. If one of the parameters were true, the other two parameters can also be assumed to stand true. That is, in cases of the print originating from the right hand if the ridge trace is Outer or Meeting it can be assumed that the ridge count of the left side was more and that the relative position of the right delta was superior to the left delta. In cases of the print originating from the left hand if the ridge trace is inner it can be assumed that the ridge count of the right side was more and that the relative position of the left delta was superior to the right delta.

For the right hand, the relative position of the delta (98%) showed the highest significance followed by Ridge Counting (96%) and Rotation of Angle (96%). The left hand showed the same level of significance for all the parameters i.e. 100%.

After thorough analysis we have concluded that the Rotation of Angle, Ridge Counting and Relative position of the delta are excellent parameters to determine the hand of origin and the Position of the Bisector and Ridge Tracing were also good parameters and can be used. Although the right hand showed slight variation the significance of each parameter, the left hand showed all parameters to have the same strong degree of significance.

LIMITATIONS

1. The study was conducted only on female subjects.
2. Some of the parameters used in previous studies were not fully understood and were thus excluded from the study.
3. Only simple whorl patterns were used.

Arch Fingerprints-Proposed Parameters

Arch type fingerprints, although found in

minority of the population also deserves a chance in determine if it is possible to determine the hand of origin. Since arch type of fingerprints have no delta and no core it is difficult to place points of reference to accurately analyse the print.

Therefore the overall visual description of the arch was taken into consideration. The study was conducted on 16 archs, 7 from right hand and 9 from lefthand.

For the purpose of this study, we used two visual parameters for archs, the apparent centre of the print and the overall sloping of the arch print. For the sake of simplification, the apparent centre will be called minor arch, and the overall slope will be called major arch.

In arches originating from the left hand the minor arch ridges appear to be arching (sloping) towards the left side and the major arch appears to be sloping towards the right.

In arches originating from the right hand the minor arch ridges appear to be arching (sloping) towards the right side and the major arch appears to be sloping towards the left.

The population size is the main limitation of the study, due to which it cannot be estimated with accuracy as to whether the direction of the print can be analysed from analysis of the visual characteristics of the arch print.

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