



Latent Prints- Solving Crimes Since Centuries

¹Neeraj Taneja, ²M. K. Sunil, ³Upender Malik, ⁴Surangama Lehri

¹ABC Dentistry

^{2,3,4}Dept. Oral Medicine and Radiology, Teerthanker Mahaveer Dental College and Research Centre

Abstract:

Study of fingerprint patterns, termed as dermatoglyphics was first coined by Harold Cummins in 1926. Fingerprint is an impression made by the friction ridges that are almost parallel at constant crest to crest wavelength. The pattern is dominated by central features, such as whorls, loops, arches and triradii. Fingerprints have been used for several decades in forensic and medical sciences. The fingerprints characteristics such uniqueness, consistency and universality are the main features that are used by forensic experts in identification processes, are well developed during intra-uterine life. This elaborated review deals in depth with fingerprint pattern, scanning and how to put fingerprints in use for forensic investigations.

Keywords: Fingerprints, Dermatoglyphics

Introduction:

A Finger print is an impression of the friction ridges on all parts of the finger. A friction ridge is a raised portion of the epidermis on the palmar (palm) or digits(fingers and toes) or plantar (sole) skin consisting of one or more connected ridge units of friction ridge skin. In other words fingerprint is an impression made by the friction ridges that are almost parallel at constant crest to crest wavelength. These are termed as Epidermis ridges which are caused by the underlying interface between the dermal papillae of the dermis and interpapillary pegs of the epidermis. These ridges assist in gripping rough surfaces as well as smooth wet surfaces [1]

The Finger print normally refers to the impressions transferred from the pad on the last joint of fingers and thumbs. The uniqueness and consistency of the fingerprints throughout life, are some of the features used for personal identification. The study of configurations of these epidermal

ridges on certain body parts, namely, palms, fingers, soles, and toes is called dermatoglyphics; which is an assimilation of two Greek words: derma = skin, glyph = carving. Embryologically, these epidermal patterns begin to develop in the 10th week of gestation and completes by 24th week [2]

Since ages, fingerprints had been the gold standard for human identification. However, over the years the science behind fingerprint identification has evolved from application in business transactions to the use of biometrics in the 21st century. [1,3]

Address for Correspondence :

Prof. Dr. Neeraj Taneja
ABC Dentistry
1452, ATS Golf Meadows Prelude
Barwala Road, Dera Bassi 140507 Mohali Punjab
Email :

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Basis & Fundamental principles of Finger prints :

The basis for fingerprint identification is based on:[4]
The ridge arrangement on every finger of every person is different.

The ridge arrangement is permanent throughout in persons life. The arrangement of the ridge never changes from birth to death.

Fundamental principles:

First principle : A finger print is an individual characteristic .
No two fingers have identical ridge characteristics.

Second principle : A finger print will remain unchanged during an individuals life time.

Third principle : Finger prints have a general ridge patterns which made it possible to systematically classified into three patterns such as Arch, Loop and Whorl Scientific

Finger Print Types:

Patent prints: Such prints are visible to the naked eyes, and are therefore called as visible prints. These do not need development are left in some medium like blood, dirt, ink or grease on the finger.

Latent prints: These are formed from water, salt, amino acids and are contained in sweat and can be made visible by dusting, fuming, chemical agents and recently using nanomaterials^[6]

Plastic prints: These prints are indentations left on soft pliable surfaces such as clay, wax, paint or another surface that will take the impression. These are visible to the naked eye.

Process of fingerprint identification:

The process Finger print identification includes the following stages such as scanning , extraction, comparison and final match /non match division.

The finger print is a made of series of ridges and furrows on the surfaces of the finger. The uniqueness of a finger print can be determined the pattern of ridges and furrows as well as the minutiae points, that occur at either a ridge bifurcation or a ridge ending.

Finger print scanning :

It is the acquisition and recognition of persons finger print characteristics for the identification process. This allowed the recognition of a person through physiological characteristics that verify of an individual.[7]

Image recognition and Enhancement :

A critical step in the automatic finger print matching is to automatically and reliably extract minutiae from the input of finger print images. Regarding the image recognition these algorithms are designed in a such a way so that they can be more robust to noise in finger print images and deliver the increased accuracy in real time.

Finger print matching techniques :

It can be placed into two categories such as minutiae based and correlated based. This minutiae based techniques first find minutiae points and map their relative placement on the finger. And in correlation based techniques require the precise location of registration point and are affected by image translation and rotation. It is very difficult to achieve a very low false negative rate while keeping a lower false positive results using only one technique .Many companies investigate the methods to pullevidence from various matching techniques to increase the overall accuracy of the system.

Finger identification vs verification:

Identification and recognition are synonymous. In both process , a sample is presented to the biometric system during the access trail. This system attempts to final out the sample owner and comparing the sample also.

Verification is one to one comparison in which attempts to verify an individual identity. In this case a new biometric sample is captured and compared with previously stored template.[8]

Accuracy :

In most of the cases false negatives are more likely to occur than false positives. In a highly secure systems is preferable to have some people unidentified preferable to have some people unidentified than allowing a non authorized user to access the system.

Detectors for temperature, blood oxygen levels, pulse, blood flow, umadity could be integrated. Unfortunately no technology is perfect false positives and spoiled readings do occur from time to time.

Methods of fingerprint development:

With the use of magnifier examine the finger prints and classify each print as Loop, whorl or arch type or any other finger print patterns provided select one print to examine minutiae.

The more minutiae you can identify and it will match the finger print of a suspect. It is this minutiae that makes finger print is unique from all other parts of the world.

Various methods of developing finger prints. They are

1. Superglue method
2. Fuming with iodine
3. Ninhydrin method

Superglue method :

This method uses a foaming chamber to develop latent prints. In this procedure the materials used are microscopic slide, super glue, small jar (spice jar) , aluninium foil and magnifier.

Safety precautions :

These vapours are toxic and requires a well ventilated space and all the containers to be closed when not in use.

Procedure :

Place the finger print on a clean microscopic slide and a aluminium foil is placed in a bottom of the jar. Add few drops of glue to prevent sliding of a slide in the jar. Place the slide into the jar and leave it for 5 to 30 minutes till the finger prints are visible. Remove the slide from the jar and examine the patterns which helps in personal identification and also in cross matching of the individual .[9]

Fuming with iodine :

This is an another method. Various materials are used such as paper, gallon size (ziplock bag), iodine beads, gloves and safety goggles are also recommended.

Safety precautions : should wear goggles to protect your eyes , since iodine is toxic material. It should be worked in a proper ventilated area. And the disposable of iodine also in a safe manner.

Procedure :

Generally individuals leave fingerprints on a paper during handling or writing by hand . Usually handle the paper with edges only using gloves and place it in Ziploc bag . Add small amount of iodine crystals and close the bag . These crystals of iodine develop fumes on fingerprints during forensic examination. Later these patterns are examined which helps in investigation .

Ninhydrin method :

It is a reagent used for detection of free amino and carboxyl groups in proteins and peptides. This method is most probably used for developing latent fingerprints on porous surfaces such as paper.

Materials :

Papers, ninhydrin solution 0.5% in acetone, zinc chloride 3% solution in small bottles. 2 cloth towels, uv light, rubber gloves, goggles, newspaper to cover spraying area .

Safety precautions :

Wear safety goggles to protect your eyes from iodine vapors. Use this solution in low light conditions.

Procedure :

Usually leave on a paper during writing and holding paper in another hand. Always handle the paper holding the edges or rubber gloves. Place the paper on a sheet and spray the paper lightly with ninhydrin solutions and allow it to dry. Place the paper on a towel and cover with another towel for about 3 to 5 minutes. When you remove the upper towel, the developed latent fingerprints should be visible, which helps in cross matching.

Classification of Finger prints:

According to the Ceenadenny et al in 2013 classified the pattern into three types of arches, loops and whorls based on the degree of curvature of the ridges. There are few patterns which are nondescript and rare.

A) Arches :

These are formed when the ridges run from one side to other side of the bulb digit without making any turn.

B) Loops: It is a single backward turn. It is further subdivided according to the ridge openings as radial and ulnar.

1) Radial: It runs towards the thumb on the radial side

2) Ulnar: Away from thumb on the ulnar side.

C) Whorls: It is a turn through at least one complete circle.

It has other features such as ATD angle, H loop, IV loop and triradius.

Another classification of finger prints is based on the Henry system and the extensions and modifications were developed by federal bureau.

Types of patterns are divided into Arches such as plain and tented. And the loops are divided into ulnar and radial loops. The whorls are divided into plain, central pocket loop, double loop and accidental loop.

Loop : It is the pattern in which one or more ridges enter upon either side, recurve, touch an imaginary line between delta and core and pass out upon the same side the ridges entered.

Three basic requirements of a Loop such as:

Sufficient recurve

Delta

Ridge count - across a looping ridge

Conclusion:

The earliest forensic discipline known to man is fingerprint identification. Fingerprints have proved over time to be the most rapid, reliable, and cost-effective means by which to identify unknown deceased individuals, especially in a mass disaster setting. The recovered prints can be manually compared with known antemortem records or searched through an automated fingerprint system (AFIS) in order to verify or establish identity. The identification of remains through fingerprints accomplishes the most important and difficult mission of the forensic identification operation: the timely and accurate notification of families regarding the fate of their loved one.

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