SIXTH SEMESTER (HONS)

PAPER: C13T/ UNIT-3

DERMATOGLYPHICS

Sir Francis Galton, a cousin of Charles Darwin was the first to study dermatoglyphics. Dermatoglyphics is derived from a Greek terminology where derma denotes skin and glyph denotes carving. Dermal ridges appear around 3rd month of intrauterine life (IUL) and are fully developed by the 6 months of IUL. The dermal configurations remain the same till adulthood except for the change in size. The impression of papillary ridges of fingertips is used for analysis in dermatoglyphics. Papillary ridges are mostly located in the palms, soles, and flexure surfaces of the digits. They form fine parallel or coiled arrays divided by thin furrow with the opening of sweat ducts at the summit of each ridge.

Dermatoglyphics includes genetics, anthropology, and egyptology. Finger, palm, and sole impressions are said to be products of both environment and heredity. No two individuals, even monozygotic twins, have the same fingerprints. Thus, fingerprints are unique to each person and not altered during lifetime.

Currently, medical dermatoglyphics is associated with various conditions such as diabetes mellitus, hypertension, psychosis, breast cancer, alcohol embryopathy, epilepsy, congenital heart diseases. Previous literature suggests the presence of asymmetrical fingerprints amid patients with periodontitis, dental caries, and birth defects such as cleft lip and palate.

In common parlance, the study of the skin patterning on the finger palms, soles, and toes, are termed as Dermatoglyphics. It is derived from an ancient Greek term (derma= skin; glyphe = a carving). In Human as well as in many other organism the palmer and planter surfaces are covered by skin different from others parts of the body. The surface is continuously corrugated with narrow minute (friction ridges) ridges and there are neither hairs nor sebaceous (oil) gland. However, sweat glands are abundant and relatively large in size. Similarly palms and soles of all primates' bear ridges. The tails of certain monkeys and paws in some mammals other than primates also possess such kind of ridges.

In human it starts appearing for the first time from the twelfth to sixteenth week of embryonic development. Their formation get completed by the twenty fourth week i.e. about six foetal months. Thus once formed becomes permanent and do not change or alter throughout the course of life until intentionally destroyed or decomposed after death.

Brief Historical Development

The study of finger print started since long back showing an archaeological evidence of ancient Chinese and Babylonian civilizations to sign legal documents in 1000 BC. In AD 650, nearly 600 years before Marco Polo visited "Cathay", Chinese historian Kia Kung-Yen wrote of fingerprints used in an older method of preparing contracts. The law book of Yung-Hwui of the same period listed that the husband in a divorce decree had to sign the document with his fingerprint.

In the late 1700's, a German doctor, J.C.A. Mayer, A very astute observation were made. He reported that fingerprints are never duplicated by nature. However he did not continue to work. Most historians credit Sir William Herschel with being the first person to categorically use fingerprints for identification purposes. In 1858, when he began the practice, the idea was probably based on superstition; but Herschel quickly saw the value of fingerprints as a positive form of identification. The first person given credit for using fingerprints to solve a crime is

Henry Faulds. He wrote in Nature magazine that when bloody finger marks or impressions on clay, glass, etc. exist, they may lead to the scientific identification of criminals. However the only scientific method of study started recently at the end of the 19th century.

Today due to the advances in the state-of-the-art have led to computerization of fingerprint record files. Automated Fingerprint Identification Systems (A.F.I.S.) is in operation in many parts of the country. For example A. F. I. S. not only stores record cards in computer memory, it will match latent fingerprints from crime scenes to its data bank. A well-known example of the speed of an A.F.I.S. at work was in California. A latent fingerprint was entered into the system, and in less than four minutes later the print was matched, and a killer who had eluded police for six years was identified and apprehended.

Working Principles of Dermatoglyphics

Importance of Dermatoglyphics lies due to the following distinct characters-

1. It is not modified by environmental factors
2. It is Non- adaptive in characters
3. Not subjected to high rate of mutation
4. It can be identifiable without any subjective biasness etc.

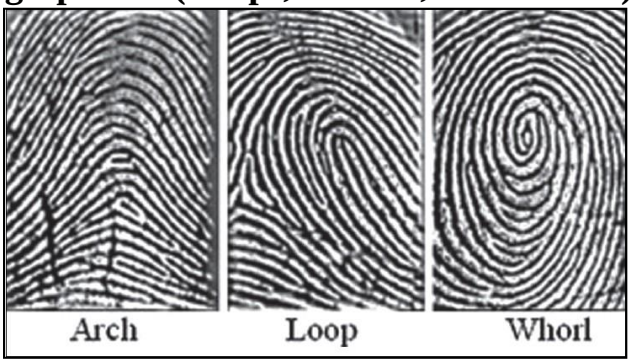
In the case of particular finger print it has three important principles:

- **First Principle:** A fingerprint is an individual characteristic. No two fingers have identical ridge characteristics (we have no specific proof of this, so we go on the scientific principle of inductive reasoning: it helps to explain why the term "fingerprint have been shown to be identical, therefore no finger prints are identical. This is used throughout science, and will hold up until one contradictory example is found. As it is impossible to test every fingerprint on every person living, not to mention those in the past & those yet to be born, in the absence of contradictory evidence this will continue to be accepted as a fundamental principle.)
- **Second Principle:** A fingerprint will remain unchanged during an individual's lifetime.
- **Third Principle**: Fingerprints have general ridge patterns which make it possible to systematically classify.

Importance

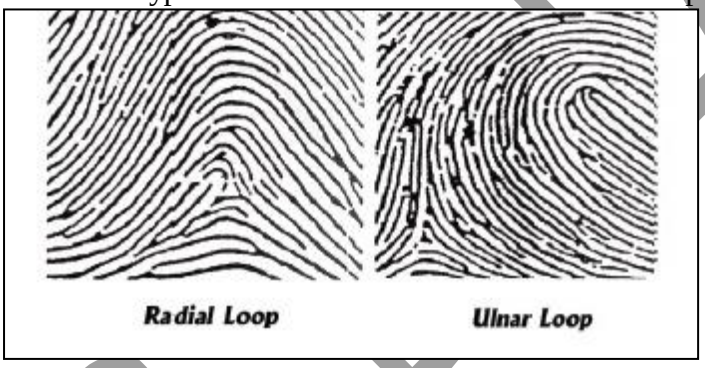
Because of all this important traits, in the present society it becomes one of the tremendous tools for human biologist. It is used for the personal identification as pointed out by Henry Fauld (1880) and Francis Galton (1892). It becomes one of the greatest contributions to the law enforcing departments on the principle that 'anything can lie but not finger print'. It becomes one of the cheapest means to prove the identity of the criminals. It is also very much applicable in the prevention of impersonation and applied in the biometrics based electronic gadgets. Its value increases in clinical investigations with the rapid growth in human genetics and along with the discovery of chromosomal aberration in man. Because of its unchangeable characteristics, it has got very importance place in criminal investigation by storage, search, retrieval and matching of prints using computers with different methods (automated fingerprint identification systems; AFIS) etc. The anthropologists are very much concerned not only in the context of twin diagnosis (monozygotic and dizygotic), disputed paternity diagnosis, primatology and biological variation among different populations etc. but it try to understand in all the perspectives considering even the cultural and social background of the populations.

Main Classes of Fingerprints: (Loops, Whorls, and Arches)



Loops: 60-65% of the population has loops. It is characterize by having one or more ridges entering from one side of the print, curving and exiting from the same side. It has classified mainly two types:

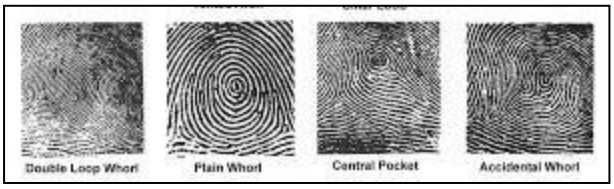
1. *Loop opening toward little finger:* Ulnar loop (As the ulna is the medial bone).
2. *Loop opening toward thumb:* Radial loop (As the radius is the lateral bone). All loops must have one delta and type lines. The core is the center of the loop.



Whorls: 30-35% of the population has whorls. All whorl patterns must have type lines and two deltas. It has four major types:

1. *Plain,*
2. *Central pocket,*
3. *Double loop* and
4. *Accidental*

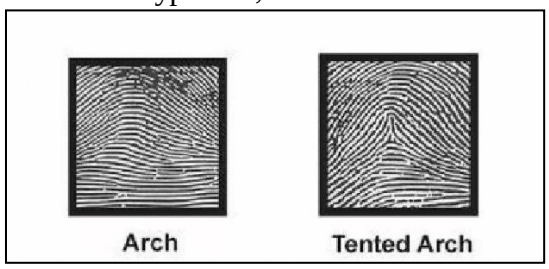
Plain whorls must have at least one ridge that makes a complete circuit and an imaginary line from one delta to the other must touch a whorl ridge. Central pocket whorls must have at least one ridge that makes a complete circuit and an imaginary line from one delta to the other cannot touch a whorl ridge. Double loop is two loops combined to make one whorl. Any other types not in the three categories are called accidentals (generally, they have a whorl type pattern).



Arches: Only 5 percent of the population has arches. Arch ridges tend to enter from one side of the print and leave out on the other side. It has two distinct types:

1. *Plain arches* and
2. *Tented arches.*

Plain arches tend to show a wave like pattern. Tented arches show a sharp spike at the center of the arch. Arches do not have type line, deltas or cores.



Finger Patterns:

Sir Edward Henry solved the fingerprint-indexing problem with an ingenious solution in 1897.Scotland Yard adopted the Henry-System in 1901. Since then, the system has been adopted by virtually every country in the world (with minor regional variations). Henry has classified the various finger patterns into four main types: Arches, Loops, True, Whorls and Composites. The compo sites form a heterogeneous assemblage of patterns. Again, three types have been identified by Galton. His three types are: Arches, Loops, and Whorls. A loop may be open to the ulnar side or to the radial side and accordingly it is termed as ulnar or radial loop.

The classic and widely used notation is **A= arches; Lr = radial loops; Lu= ulnar loops**; and W= whorls.

Another Englishman living in India, Sir William Herschel, had already solved the authentication problem by using fingerprints (again, the motivation was fraud prevention). But it was the Henry Classification system which solved the identification problem.

Dermatoglyphic Landmark:

The three basic dermatoglyphics landmarks found on the fingertip patterns are the triradii, cores and radiant.

- **Triradii:** A triraduis is formed by the confluence of three ridge systems.
- **Core:** It is the approximate center of the pattern. It is useful for ridge counting.
- **Radiants (Type lines**): Radiants are that emanate from triradius and they enclose the pattern

The whorls possess two triradii, while only one triradius is present in loops. On the other hand triradius is absent in arches. Thus, generally speaking, the patterns may be identified from the occurrence of triradius.

The classification dermatoglyphics specially the fingerprints, according to Henry's system is based on the availabi lit y o f triradius.

Apart from classification of each finger pattern types as qualitative variables, different indices are also taken into account for quantitative assessment for any individual or population. Usually three indicates are calculated on the basis of the frequency distribution of the different finger patterns. These are as follow:

- Furuhata's Index=Whorls x 100/loops
- Dankmeijer's Index=Arches x 100/Whorls
- Pattern Intensity Index=2 x Whorls + Loops/n

Pattern Intensity Index:

Pattern Intensity Index: 2 x W + L / n (Number of subject / No. of fingers).

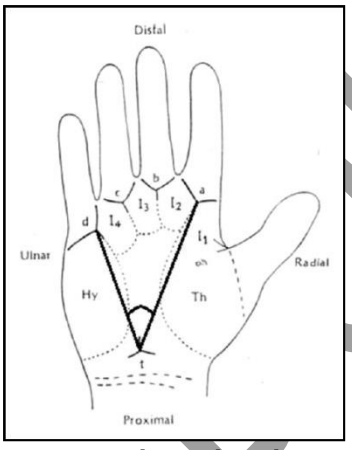
Therefore Pattern intensity index (PII) represent how many triradii are there in that population. Arch is not taken into consideration in case of PII because arch does not possess any triradius. Therefore increased value of PII envisaged higher prevalence whorl while contrary to

that decrease of PII indicates lower prevalence of whorl however if PII tends towards very minimum value then the prevalence of arch is higher than the other types. Dermatoglyphics can be taken as a tool for population variation.

It is evident from table that whorls are most frequent among the Mongoloid population and least among the Caucasoid population. On the other hand, loops appear most frequently among the Caucasoid groups, while among the Mongoloid and Negroid groups loops are found in equal frequencies. Again arches appear in very small number in the Mongoloid. It is most frequent in the Negroid. The position of the Caucasoid is intermediate.

Palmar Dermatoglyphics:

In order to carry out Dermatoglyphics analyses that can be compared in different individuals, the palm has been divided into several anatomical defined areas. The areas approximate the sites of embryonic volar pads and include the thenar area, four interdigital areas and the hypothenar area.

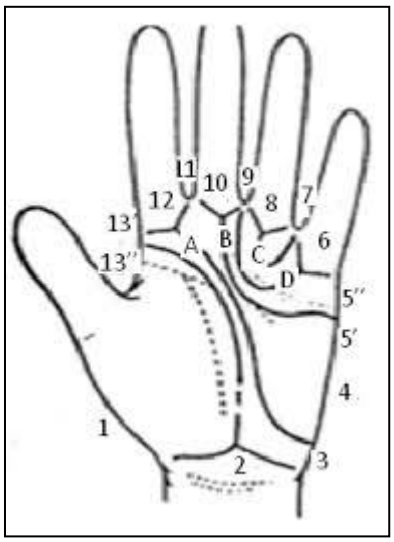


Hy = HypothenarTh = Thenar

The digital and axial triradii and the main line traced from each constitute important landmarks for dermatoglyphics analysis. Typically, there are four digital triradii in the distal potion of the pa lm. They are found in the metacarpal region at the base of the digits II, III, IV & V. Each triradius is normally associated with one digit. By convention, they are termed a, b, c & d proceeding in radioulnar direction.

Main Line Formula:

The radiants of the digital triradius traced is along its whole course within the palmer area, it constitute palmer main line, one of the dermatoglyphics characteristics usually noted in dermatoglyphics analysis. There are four main lines, each emanating from one of the digital triradii and labeled by capital letter A, B, C & D corresponding to the triradii having the same lower case letter. The termination of the main lines, recorded in the order D, C, B, A are used to express the main line formula. Periods are used to separate the numerical symbols. The main-line formula serves as an indication of the general direction of palmar ridge flow. For achieving the main line formula the palmis designated as follows:



Main Line Index

Main line formula as mentioned earlier serves as an indication of the general direction of palmer ridge flow. Cummins (1936) observed that the termini of two main lines A and D alone can adequetly reflect the ridge direct ion. From this observation proposal of mail Line Index based on the sum of the two numbers corresponding to the exits of main line A and D. If the resulting value is low then it indicates vertical alignment, whereas, high value reflects a tendency for the palmer ridge direction to be horizontal.

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