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Using Dermatoglyphics Pattern to Identify the Left Handed Unique Pattern and its Biological Significance-If Any

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Abstract: Dermatoglyphics is the scientific study of fingerprints. In humans and animals dermatoglyphics are present on fingers, palms, toes and soles. These help shed light on a critical period of embryogenesis, between four weeks and five months, when the architecture of the major organ system is developing. Left handedness is the preference for the left hand over the right for everyday activities such as writing. Studies reveal that 10% of the world population is left handed. The orientation of hand is developed in foetus and is determined by observing which hand is predominantly held close to the mouth. The gene associated with left handedness is LRRTM1 gene (leucine rich repeat transmembrane neuronal). LRRTM1 is present on chromosome 2p12 which is maternally suppressed gene that is associated paternally with handedness. It is a candidate gene for involvement in several common neurodevelopmental disorders and may have played a role in human cognitive and behavioural evolution. A study was conducted over a group of population for the identification of patterns of left handedness keeping right handed people patterns as control. In this work hundred samples were collected and were analyzed to see if any concurrent and similar patterns were present. It was observed that there were some patterns which are unique in left handed persons.

Key words: Dermatoglyphics · Left Handedness · LRRTM · 2p12

INTRODUCTION

In mammals, there are various morphological features which are unique in character, lets take an example of the stripes pattern in zebra or stripes pattern in tiger, it's never the same and its unique to each of them [1-3]. The patterns present on the palms, soles and lips are totally unique [4]. The palmar and plantar surface of the order primate are characterised by the presence of ridges. There is the intricate patterns of the epidermis and it is formed during the early foetal life, these are permanent and not affected by the age and postnatal circumstances, except when there is various injury to the stratum germinatium [5, 6, 7]. On the onset of 12th week of gestation, undulation appears on the inner surface of the epidermis which form ridges and furrow. There remains unchanged but its size keeps on growing as infant grows [6, 7, 8].

Brief Historical Background: Classical Dermatoglyphics: The science of dermatoglyphics has its own importance. It can be applied for the medical studies, for identification of the person, identification in the crime, physical anthropology [6]. The above subject had been derived from the research work of four people-Henery Faulds, William Herschel, Francis Galton and E.R. Henry. The research work of the Faulds was published in 1880 in the form of scientific identification of fingerprint whereas Herschel established fingerprint system and proved that the fingerprint do not change with age. While Henry improved system of classification was accepted and is been applied even today. It was Galton's idea to bring the fingerprint for personal identification and he realised its importance in disease identification. Galton's original classification of whorls, loops, arches, still hold good and true in the field of dermatoglyphics and he proved the hereditary basis of fingerprints [9, 10]. He had tried to develop the establishment of there fingerprint patterns with standard methods and obtaining the results from the collected data. Dr Harold Cummins and Midlo's classic work in the year 1943, "Fingerprints, Palms and Soles: An introduction to Dermayoglyphics" has been accepted as standard reference.

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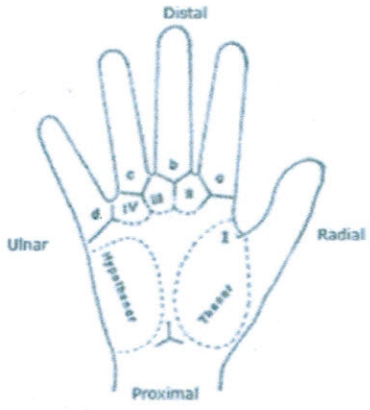
Dermatoglyphics: Dermatoglyphic traits are formed under genetic control early in development but may be affected by environmental factors [11]. These patterns may represent the genetic makeup of an individual and can therefore be marker used as to identify the predisposition for left handedness [12, 13]. Patterns of dermatoglyphics are usually studied in a population selected randomly [14, 15]. Fingerprints are extremely complex. Fingerprints are a reproduction of friction skin ridges found on the palm of the fingers and thumbs [16]. They are also found on palms, soles of feet and lips. Two types of fingerprint characteristics are used in identification of individuals: Global features and Local features. Global features are those characteristic which are seen through naked eye and Local features are tiny characteristic of fingerprint ridges [9, 10]. Their two dimensional arrangement is distinctive and is used for identification. It is possible for two or more individuals to have similar global features but still have different and distinctive fingerprints because of the local features, that is, the two dimensional arrangement is different.



The five dermatoglyphic areas of the palm and the principal palmar triradii

Global features include [17, 18]:

Pattern area, core area, type lines, delta ridge count, ridge pattern.

Pattern Area: Fingerprints are read and classified based on the information in the pattern area. Certain minutiae points that are used for final recognition might be outside the pattern area.

Core Point: The core point, located at the approximate centre of the finger impression, is used as a starting reference point for reading and classifying the print.

Type Lines: They are the two innermost ridges that start parallel, diverge and surround or tend to surround the pattern area.

Delta: In all types of ridge patterns a place occurs where two lines run side by side and then diverge significantly recurving line which passes in front of a structure which is triangular in shape called delta or triradius.

Ridge Count: It is the number of ridges between the delta and the core. To establish the ridge count, an imaginary line is drawn from the delta to the core; each ridge that touches this line is counted [19].

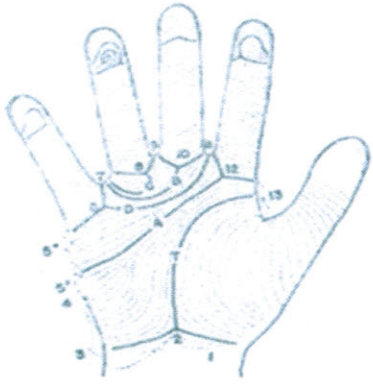
Ridge Patterns: Fingerprints have general ridge patterns for classification which are divided into three classes:

- Loops
- Whorl
- Arch
- Loops

It is the most common type of fingerprint pattern. One or more ridges entering from one side of the print, recurring and exiting from the same side is a loop. If loop opens towards little finger it is called ulnar loop. If loop opens from thumb it is called radial loop. All loops have one delta.

Whorl:
They are of four distinct types:

- Single loop whorl (simple)
- Central pocket
- Double loop



The main lines of the palm and the scheme of numbers for formulating palmar main lines

All whorl patterns have type lines and a minimum of two deltas. Simple and central pocket whorls have at least one ridge that makes a complete circuit. Ridge may be spiral, oval or any variant of a circle [20, 21].

Arches: Arches have two patterns: simple and tented. They do not have type line, deltas or cores. Of the two types of arches, the simple arch is the simplest of all fingerprint patterns. It is formed by ridges entering from one side of the print and exiting on the opposite side. These ridges tend to rise at the centre of the pattern, forming a wave like structure. The tented arch is similar, but instead of rising smoothly at the centre, there is either a sharp up thrust or spike, or the ridges meet at an angle that is less than 90 degree. The fingerprints could be thus used for screening the left handed people and our study is an effort in this regard.

Genetics and Dermatoglyphics [6, 8]: Elderton in 1920 started the scientific study of dermatoglyphics and its relation with genes. It was Bonnevie in the year 1924 found out that the dominant gene were responsible for the inheritance of some of the patterns while Mueller in 1930 and Karl in 1934 assigned it to incompletely dominant gene and recessive gene are responsible for the twisting and the whorl respectively. Counting the total number of ridge count provided the insight of genetic significance. Twins has almost the similar genotype also be proved by the total ridge counts. There the quantitative value of the total ridge counts were determine almost entirely by co-dominant gene. Penrose (1949, 1955) was able to link between the total ridge count and syndromic disorder like Klinefelter syndrome, Turner syndrome and Down syndrome.

Minutiae [22]: On carefully looking at the palms, the epidermal ridges are parallel lines. These parallel lines reveals many different types of patterns which can be collectively called as minutiae.. Minutiae are highly polymorphic and their number, type, patterns are unique to the particular person, therefore are reliable marker for personal identification. There is no internationally approved nomenclature in this produce for taking minimum number of ridge characteristics i.e. minutiae to establish the identity. It varies from one race to the other race or else it can be put as it varies from one country/ region to the other country region. In India the range of minutiae is from 6-12, while in other countries it is from 6-17. An attempt had been made to relate the minutiae to the quantitative genetics apart from the quantitative value of total ridge count. In this investigation an attempt has been made to find the different types of minutiae as well as total minutiae count in a specified area of the palm print.

Classification of the Minutiae: Although there is not yet proper nomenclature of minutiae accepted by scientist world over still many classification had been made by various scientist like Steffens (1965),Loesch (1973),Penrose(1968),Cummins and Midlo(1961).Some of the minutiae are:

Interstitial lines -it rarely contain sweat pore,it is called subsidiary ridges because it lie at a lower level than the ridges. It is also called an incipient vestigial rudimentary, secondary or nascent ridges.

Break-A joint or gap about one ridge unit in length between two ridges ends first starts.

Short ridge- A small ridge containing two to about five sebasceous gland pore.

Connecting ridge-A short ridge which is perpendicular to each other. It may have the sweat gland or may not.

Fork-Bifurcation of the ridges or else also called 'y' shaped ridge.

Island-It is small ridge approximately a dot size having a circular outline,and has only a sweat gland. Also called as a point.

End- An abrupt termination of ridges.

Comb-A formation of five or more parallel ridges joined to another ridge almost at right angle to direction.

Enclosure- A continuous ridge which surrounds a furrow, usually made by the two minutiae –fork facing each other.

Fig. 1:

Fig. 2:

Brief Historical Background of Dermatoglyphics Research in India: There is a deep relation between the disease and the patterns of dermatoglyphics and in India too it had been studied by many scholar like Kumbnani (1994), Patoria (1994), Bansal *et al*., (1994), Bagga (1994), Bajangam *et al*., (1991), Dasgupta *et al*., (1973), Chandra (1968). Study of the patterns on the palm was studied by Biswas (1936) for anthropological studies whereas the finger patterns was also studied by various scholar like Verma (1952), Tiwari (1955), Schlaginhaufen (1906) and Collins (1913) are the scholars who had studied the samples from the population of India.

Left Handedness: Purpose of Study: Left handedness is due to the gene name LRRTMI. It was discovered by the Centre of Human Genetics at the University of Oxford. It is consider that it modifies the development of asymmetry in the human brain. Asymmetry is important, as, left side usually controls the speech and language and the right side controls the emotions [11]. In left handed people it is vice versa. There is also evidence that asymmetry of the brain is important for the evolution of human: the brains of our closest relative, the apes are more symmetrical compared to *Homo sapiens* and they do not show a strong handedness. LRRTM1 is a gene involved in many neurodevelopmental disorders and plays the role in human cognitive and behaviour evolution. It may also increase the risk for the development of schizophrenia. Schizophrenia is a disorder of the brain which results in impaired perception and thought. It affects 2% of the adults. There is the report that, among the left handed females, the chances of the breast cancer is more likely to be doubled and likely to develop premenopausal breast cancer. Dutch scientist believes that the exposure to high levels of sex hormones before birth may be the reason for the left handedness, which may be responsible for the breast cancer. Fingerprints could be used for screening left handed people and the present study is an effort in this regard. The study can be particularly important and useful in forensic studies for the identification of criminals or victims.

MATERIALS AND METHODS

The study was conducted on 100 numbers sample randomly selected left handed persons after taking their informed consent and permission. The finger and palmar prints were taken on a100GSM bond sheet by rolling finger technique using kajal. Kajal was used because of its antiseptic property attributed by its constituent camphor. Simultaneously 100 numbers sample of controls were also selected which were recorded. The difference of qualitative (dermatoglyphics pattern) data was tested for its significance using the chi square test and for quantitative (ridge counts) data using the t-test [22, 23].

RESULT AND DISCUSSION

The mean ridge count in the right hand of the cases was 17.12, whereas it was 21.64 in controls. When the t test was applied, the difference in the mean ridge count of cases and controls was insignificant in the right hand. The result was the same in the left hand. In left hand, the cases gave a mean ridge count of 16.62 and control mean ridge count was 20.72 and t-test showed that the difference was not significant (Table 1).

In the hypothenar and thenar regions of the left handed people, certain variations were found which was not observed in the right handed people. Many of them had patterns such as comb (Minutae), t', loop and CPW in the hypothenar and thenar region in variable number which is represented (Table 2).

Besides the variation in the thenar and hypothenar regions, some variations were observed in the creases in the palm of the left handed people. Variation in Distal crease, Proximal crease and triradii which are usually not present in a healthy man were observed in the left handed people in a considerable number (Table 3).

The comparison of the finger print pattern of left handed people with the right handed ones (Table 4) revealed that, the pattern peacock was found more in left handed people while it was very rare in the control. Ulnar loop and single loop whorl were the other common fingerprint pattern observed in case, but, it was not significantly different from the control as these patterns were commonly found in them too. Compared to the control, left handed samples had less number of central pocket whorl, double loop whorl and simple arch.

Table 1: Quantitative Analysis of Total Ridge Count in Left Handed (Case) and Right Handed (Control) People

		Right Hand		Left Hand	
		Case	Control	Case	Control
Ridge Count in Digits	Thumb	21.9	24.6	19.16	22.4
	Index	13.76	25.31	14.84	18.3
	Middle	14.42	19.2	14.6	17.9
	Ring	22.52	22.4	20.54	26.7
	Little	13	16.7	14	18.3
Statistics	Mean Rc	17.12	21.64	16.62	20.72
	SD	4.52	2.73	3.59	2.76

T-test Result t= 1.70 which is < the table value, 2.306 at a significance level of 5% and df of 8, t= 1.88 which is < the table value, 2.306 at a significance level of 5% and df of 8

Table 2: Different Types of Minutaes Found in the Hypothenar and Thenar region of Left Handed People

	Hypothenar Region of Left Hand	Hypothenar Region of Right Hand	Thenar Region of Left Hand	Thenar Region of Right Hand
COMB*	05	04	06	00
t'	11	10	06	00
LOOP	25	17	07	01
CPW	01	01	02	00

*COMB is the minutae

Table 3: Variations Observed in the DC, PC and TC (Crease) of the Left Handed People

	Left Hand	Right Hand
DC_V	52	50
PC_V	80	78
TC_V	32	29

Table 4: Comparison of the Fingerprint Pattern in the Left and Right Hand of the Case and Control

	Right Hand		Left Hand	
	Case	Control	Case	Control
Single Loop Whorl	102	94	110	87
Central Pocket Whorl	24	52	36	65
Double Loop Whorl	20	82	32	93
Ulnar Loop	198	196	174	152
Peacock	110	1	110	2
Radial Loop	12	2	12	2
Radial Loop Modified	6	1	4	1
Simple Arch	16	68	16	92
Tented Arch	12	4	6	6

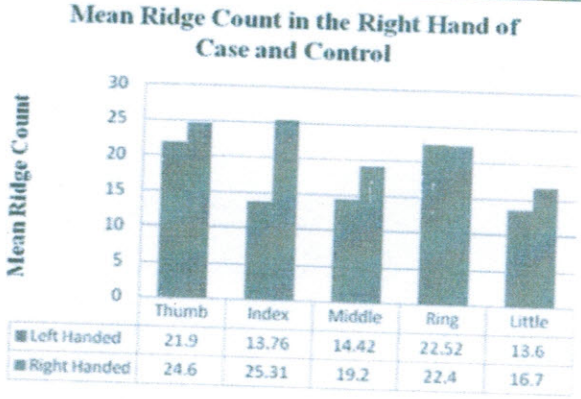


Fig. 3:

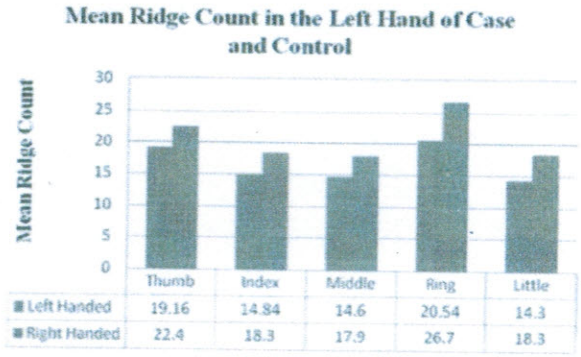


Fig. 4:

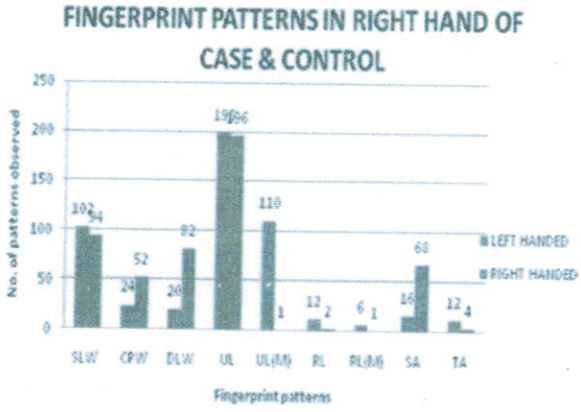


Fig. 5:

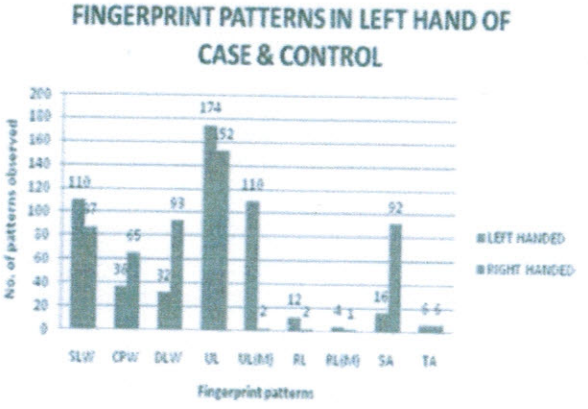


Fig. 6:

On the other hand, even though less in number left handed samples had more radial loop, modified radial loop and tented arch as compared to the control. All the variations found in the fingerprint pattern of the cases except for ulnar loop and single loop whorl were found to be significantly different from control when the chi square test was performed.

It could be concluded from the study that the left handed people shows particular fingerprint patterns as compared to the right handed people. The major variation was the peacock and the radial loop modified as it is very rarely observed in right handed people. Besides, particular patterns were observed on the thenar and hypothenar regions of the left handed people along with variations in

the crease patterns. All these variations can be used for the identification of a left handed person from a right handed person. The minutae- comb is the significant patter identified in the left handed sample collected. This finding can be particularly important and useful in forensic studies.

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