FINGERPRINT PATTERN: MINUTIAE OF DISTAL PHALANGES FROM THE TWO LOCALITIES OF TURA, MEGHALAYA

Ricky Mirth R. Marak

Masters in Anthropology, (Discipline of Anthropology), School of Social Science, Indira Gandhi National Open University, New Delhi

Email: rickymirthrangsha@gmail.com

ABSTRACT

Fingerprint pattern is a part of dermatoglyphics which subsumed the palmar and plantar and also a very imperative constituent in the sphere of forensic anthropology and forensic science. The friction ridges are gradually formed while developing inside the mother's intrauterine and in this pattern it has three basic parts like arch, loop and whorl; and besides, different types of fingerprints which formed are also present on the stratum corneum (outermost layer part of epidermis from the human skin) and provides unique information from various populations. Some ridge portions of the epidermis which present on our fingers are almost resemble to other fingerprints but all the fingerprint patterns are not provide precise similar information because of very distinct to each other and even though from the twins never alike between them. In fingerprint, there is an another essential facet that is minutiae and encompassed as crossover, pore, double bifurcation, fork, hook, bifurcation, dot, ridge ending, eye, delta etc., all are very imperative component in the study of fingerprint because it is needed in criminal investigation etc. In such case like victimized, crimes etc., it is very important to carry out the causes which it helps through employing of multifarious tools for the concerned department of criminals or investigators. Minutiae provides detail information on about the ridge patterns which present on the fingers and help us to investigate and to examine of each and every distal phalanges. It also provides information to detect through biometrics with the help of various ridges or minutiae which it is the corridor to access and operate that provided fingerprint sensored in some application of tools or gadgets etc. Some fingerprints are very complicated while analysing to examine from the different individuals because of occurred major traumatic accident, cicatrix, desquamation and study of this provides tremendous information through the biological variation of populations. Simple Random Sampling (SRS) is employed while studying through minutiae from the fingerprint and found the highest percentage which is Bifurcation or Fork (105) and the least part is Tribifurcation (11) but the cicatrix and desquamation also found from the distal phalange then made subtle analysed, that encompassed from male and female where those who have been inhabited in the two localities of Tura, Meghalaya.

Keywords: *Fingerprint pattern, Minutiae, Genetic trait, Forensic science, Distal phalange, Dissimilarity, Friction ridge, Stratum corneum, Dermatoglyphics, Palmars and plantars, Forensic Anthropology*

Introduction

Each and every human has an own identity with physical aspect of stature, face, skin colour, hair etc., all these are exhibited through its disparity and uniqueness of identity which is either contingent on geographical areas where selected to live in order to suit their body, genetic traits etc.,[1] [2]. Fingerprint pattern also is one of the most dissimilarity which on the *stratum corneum* and unique identity which presents on our fingers with friction ridges and the pattern of this from the fingertips (the part of distal phalange) are not coequal and even the palms too. In fingerprint patterns which usually the three basic parts as *arch, loop* and *whorl* [3] [4] [5]. In fingerprint, minutiae is an essential component in the field of forensic anthropology as well as forensic science which provides tremendous information and in minutiae which subsumed the *crossover, eye, ridge ending, dot, bifurcation, double bifurcation, island, hook, delta,* etc.,[6] [7]. The study of fingerprints from the people which it is the part of dermatoglyphics and

it provides huge information through the biological variation of populations [8]. Each and every fingerprint is a very unique which are formed themselves and it gradually starts to develop inside the mother's intrauterine [9] [10] (Singh., *et al*) [11]. The fingerprints displayed through its dissimilarity in the human's fingertips which it very formidable to examine for some people but it might not be quite easier to examine and analyse without any tools even for the experts. It is a very important to study under this dermatoglyphics which it encompassed as one of the part of forensic sciences. Some friction ridges are very tricky and subtle analyse to understand regarding the study or examining of fingerprints from the different people of different geographical areas due its some contingent on either scars which present on the fingers because of traumatic accident, cicatrix, desquamation, suffered or genetic traits which presented and inherited from their parents, families etc., these are all subsequently made to recast their tissue by the environmental influence within their physical body or appearance. Friction ridges are part of our body which it present on the outermost layer part of the skin and attached to palmars and plantars which it is very important to study in the area of field sciences or forensic science [12]. In such case like victimized, crimes etc., it is very important to carry out the causes which it helps through employing of multifarious tools for the concerned department of criminals or investigators [13]. To study, examine and collection that related to the sub-field of forensic about it from the people is no doubt but rather it helps and supports them to understand about their fingerprints which those who have not known or understand regarding their own fingerprints because it is a crucial part to assimilate of our own body. To understand practically of our own body parts in comprehensive is very much needed in our day to day life and by doing so, it helps to sensitise about their own fingerprints. To study or examine scientifically reagarding the fingerprint patterns is help to lore of knowledge from the human's fingertip requires set of multifarious tools so that it makes pave the way to understand in the field of this area. To extract the fingerprint patterns required employing of various tools and techniques that made facilitate while finding the different and unique ridge of pattern designs which present on the fingers. Our fingers is also one of the indispensable role and help with the other parts of our body and it constituted or made up naturally through cells, tissues and organs which the outermost layer of *stratum corneum* (outermost layer part of epidermis from the human skin) covers the unique thin layer of skin on the fingers that it attached to our beautiful palms (Baswaraj, *et al*) [14]. Epidermis have ridges with pattern on our palmars and plantars but some presented ridge patterns are very indistinguishable to examine and made difficulty while studying in details regarding on this area and the lore of information on about this provides translucent. Some ridge portions of the epidermis which present on our fingers are almost resemble to other fingerprints but all the fingerprint patterns are not provide precise similar information because of very distinct to each others. Collected data of fingerprints delineate through bring the light from two localities of Tura town by employing of simple random sampling methods. By doing this method so, it made easier to conduct this fingerprint patterns from those who are living in these areas. From these areas displayed their unique of fingerprint patterns that exhibited with three general categorised pattern types as arches, loops, whorls which shown through their fingers impression in the white sheet of papers [15]. These all are shown by different people through their uniqueness of fingerprint patterns and it never same as other fingers due to all ridge patterns of fingertips are made up by different factors of environment as associated with tissues etc. Without employing of tools it is very tricky to examine this dissimilarity of fingerprint patterns and it could not provide clear information about it. Knowing of own fingerprint is very essential and indispensable in our life.

Materials and Methods

The distinct fingerprint patterns highlighted through different ages by employing of multifarious tools and techniques from their distal phalanges' part. In order to acquire various fingerprints required tissue papers or wet wipers to be wipe off if the distal phalange parts are sweat or greasy substances which present on it. If the fingerprints are dry then taken of fingerprints are studied which left by the impression on the white sheet of papers. Especially employed from the youths, men and women which have selected to obtain the fingerprints by utilising the black moulded ink pad to smear on the distal phalanges in order to impression on the white papers and white papers used to record the various fingerprints and minutiae too. The magnifier glass (optical grade lenses with 5x & 10x magnifying capacity) has utilised to get their minutiae through exploration from the white papers. Fingerprint brings to light from the both hands which collected from the two localities of Tura where chosen from Niram A·ding and Rengmal Gittim. It is done through the Simple Random Sampling Methods (SRS) which taken from male and female which used purposefully to sensitise the people and again out of 32 number of selected people from these two area of localities which it is taken from the selected age of 20 to 40 years.

Results and Discussion

The study of this method in the field of sciences is very essential in the area of dermatoglyphics and is a crucial aspect which subsumed in the subfield of forensic anthropology and forensic sciences, in this field required practically to understand and to acquire some knowledge to conduct about this part of various ridges which present on the fingers. Though some of us have not been garnered of knowledge in their mind and unaware about this important of fingerprints because have not ruminated on about its important and though it is biologically variation but an indispensable part of our own body. In this study, the clear description has been listed in Table - 1 which including the list of basic fingerprint patterns, male and female's age, and total; in Table - 2 encompassing the minutiae from the distal phalanges and the total.

Table 1: Basic fingerprint patterns from the two localities of Tura, West Garo Hills, Meghalaya

List of Fingerprint Patterns	Male (Age: 20 to 40)	Female (Age: 20 to 40)	Total
1. Arch	8	1	9
2. Loop	94	108	202
3. Whorl	41	59	100

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1). Arch (in the fingerprint patterns, the ridges presented on the distal phalanges which ridges form like a hill shape or tent shape and it is not only on the fingertips but it also appears on the middle and proximal phalanges mostly formed with plain arch). The total number of Arches in male is 8 (Three) which found from the distal phalanges and only 1 (one) has found from the female's fingertip. Both hands have taken and employed through the fingers impression on the sheet of white paper by using of ink pad from the male and female's fingertips which selected from the age of 20 to 40 years. It is a rare friction ridges which present on the distal phalanges. According to the data collection revealed that comparing with male and females' bears male's distal phalanges having more Arches (this is the part of ridges which present on the skin of fingers) than females.

2). Loop (the formed or structured of ridges are more recurved bending which is either towards the radial or ulnar parts which present on the distal phalanges) The total number of Loops has 94 (Ninety four) which present on the fingers and revealed through the male's distal phalanges which collected from the age of 20 to 40 years, and 108 (Ninety eight) number of loops has found from the female's distal phalanges which encompassed from the both hands and occupied with this peak in number than male.

3). Whorl (the ridges is like a concentric circle or spiral which present on the distal phalanges) In male's fingertips presented with 41 (Forty one) number of Whorls and 59 (Fifty four) number of Whorls exhibited in female's distal phalanges which according to exhibited through data collected by employing of tools whorl is more commonly present on their fingers than male. These are the three which present on the distal phalanges as Arch, Loop and Whorl are the basic parts of fingerprint patterns and also subsumed in the part of dermatoglyphics. It has not forgot to bring the light which highlights through their unique friction ridges as Arch is the least one among these three basic part of fingerprint patterns and according to collected data reveal from these two localities that whorl is commonly seen on the female's distal phalanges than male.

The study of this method in the field of sciences is very essential in the area of dermatoglyphics and is a crucial aspect which subsumed in the subfield of forensic anthropology and forensic sciences, in this field required practically to understand and to acquire some knowledge to conduct about this part of various ridges which present

on the fingers. Though some of us have not been garnered of knowledge in their mind and unaware about this important of fingerprints because have not ruminated on about its important and though it is a part of our own body.

Table 2: THE COMPARISON OF MALE AND FEMALE'S MINUTIAE IN THE TABULAR

Sl. No.	**DIFFERENT TYPES OF RIDGE CHARACTERISTICS / MINUTIAE**	**MALE**	**FEMALE**	**TOTAL**	**HIGHEST NO. OF MINITIAE**
1.	Bifurcation (Fork)	51	54	105	*Fork* in female
2.	Bridge	46	45	91	*Bridge* in male
3.	Core	18	12	30	*Core* in male
4.	Crossover	3	8	11	*Crossover* in female
5.	Delta	13	1	14	*Delta* in male
6.	Dot (Fragment)	28	25	53	*Fragment* in male
7.	Double Bifurcation	7	9	16	*Double Bifurcation* in female
8.	Eye (Enclosure)	26	28	54	*Enclosure* in female
9.	Island (Short Ridge)	9	14	23	*Island* in female
10.	Pore	25	26	51	*Pore* in female
11.	Hook (Spur)	18	11	29	*Spur* in male
12.	Ridge Ending	28	35	63	*Ridge Ending* in male
13.	Tribifurcation	4	7	11	*Tribifurcation* in female
14.	Desquamation		1	1	*Desquamation* found only in one female
15.	Scar	1	1	2	*Scar*, found from both sexes.

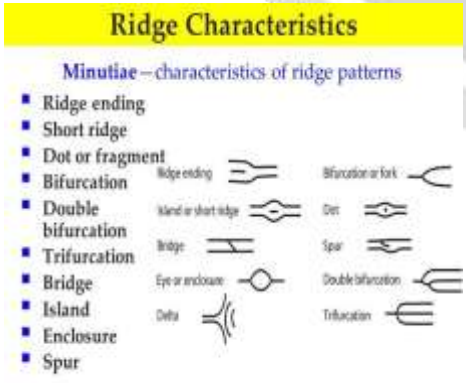

Figure 1

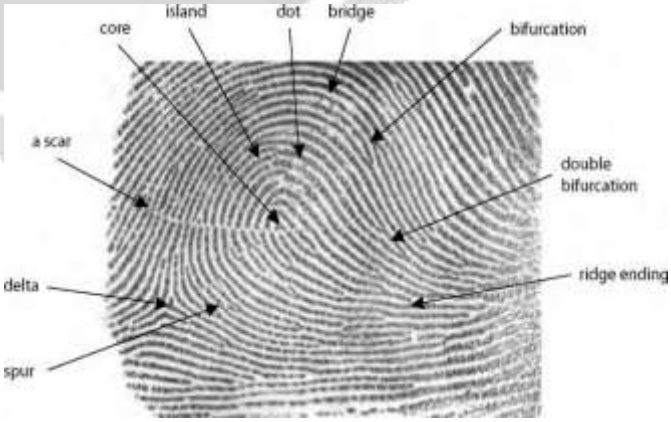

Figure 2

Figure 3

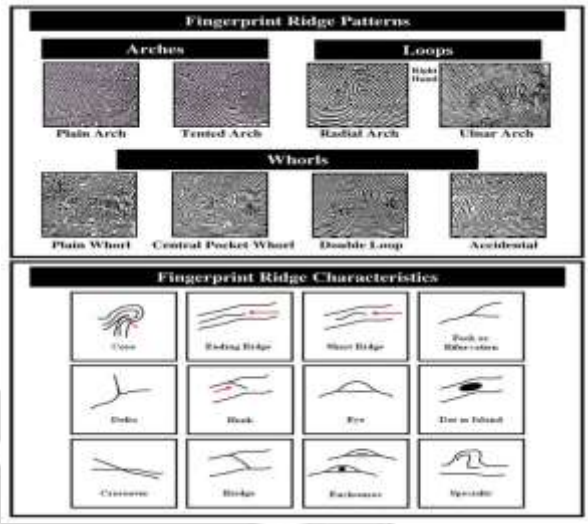

Figure 4

Minutiae is the study and exploration of minor details from the friction ridges which present on the distal phalanges of the human body part and it is formed or structured on the outermost layer part of the skin of fingers with miniature pattern of ridges which is already formed in the intrauterine. In this minutiae subsumed the small ridges as *Bifurcation or Fork, Bridge, Crossover, Core, Dot or Fragment, Delta, Double Bifurcation, Eye or Enclosure, Ridge Ending, Short Ridge or Island, Spur or Hook, Tribifurcation* etc., these are the common ridge characteristics or minutiae. Minutiae provides detail information on about the ridge patterns which present on the fingers and help us to investigate and to examine of each and every distal phalanges. It also provides information to detect through biometrics with the help of various ridges or minutiae which it is the corridor to access and operate that provided fingerprint sensored in some application of tools or gadgets etc. In this study and investigation regarding this requires enough multifarious tools in order to extract the small ridges which formed on the skin of fingers. It is a very essential and valuable to study in details regarding in this area of dermatoglyphics which it is much needed in the field of forensic anthropology. To study the minutiae or characteristics of ridge patterns in details requires either ink pad, white sheet of papers to take the finger impression from each persons or biometrics equipments or in simple method requires magnifier glass in order to extract the various minutiae for various purposes in the field of forensic science or forensic anthropology which to study and investigation is very important because it provides to garner the knowledge and through this method or finding helps the trainer in this modern day of field sciences.

Fingerprint minutiae is formed or structured with different pattern of ridges on the outermost layer of the distal phalange's skin which is very distinct and not homogeneous with the other fingerprints; it is as shown in the below along with the vivid description of pictures from the human fingers.

In ridge characteristics or minutiae, reveals that most of the distinct ridges are display the *Bifurcation or Fork, Bridge, Pore, Ridge Ending, Hook or Spur, Dot or Fragment, Enclosure or Eye, Pore,* these are the most common special ridges which found from the males' distal phalanges where those who are living in these two localities and it is done through simple random sampling. *bifurcation* Scar is also found from one person within these two localities and it also occupied the least one among them. In minutiae, *Bifurcation* or *Fork* and *Bridge*, these two special ridges are occupied the highest number among those ridge patterns which present on the distal phalanges in the males' fingers and these are most commonly seen in every person within these two localities of Tura. Both these special ridges are found in the pattern ridges as in the Arches, Loops and Whorls but mostly seen in the *Loops* and *Whorls* which those distal phalanges are formed with these two ridge patterns and the *Bridge* ridges are connected or joined with the other ridges on the fingers and it exhibited with other patterns naturally; and also commonly displays the *Dot* or *Fragment* and *Ridge Ending* in every fingertips of male which along with the other special ridge patterns. These distinct unique ridges are very benefitted which provides information through this study under this dermatoglyphics and it is very essential in the field of this area which it is the another component of anthropology. Through their unique of friction ridges, it revealed the different fingerprint patterns which from the each people.

Most of the females' distal phalanges are revealed through unique minutiae which according to the collected data from the two localities, *Bifurcation* and *Bridge* ridges occupied the highest number which present on their fingers and the least number is Delta among the special different ridges. *Desquamation* (skin peeling) also present on the fingertips which is occurred in one person that it also made difficulty to investigate regarding the fingerprint patterns and while extracting it can renders the good quality of this to imbibe knowledge to the researchers; and even the scar which it is either by wounded or by others circumstances, this occurred also not provide clear information about this study of minutiae. In minutiae of females' fingertips, most of the ridge patterns are commonly seen which present of the distal phalanges are *Bifurcation, Bridge, Ridge Ending, Dot, Eye, Pore* and lastly even the *Hook* or *Spur* is also commonly seen on the some fingertips of the females. *Double Bifurcation* and *Tribifurcation* ridge also form on the some fingers which it is only found in few females who have been inhabited within these two localities of Tura, but how many people having with these unique fingerprint patterns no one could not bring to light without any equipments or tools within the jurisdiction or area of Tura. To study about the different fingerprint patterns and special ridge characteristics or minutiae is very much essential for us and also a very documented for the future which associated with the other institutions or some organisational works those who are involved mostly in the field of sciences as forensic or criminal departments etc. Studying of fingerprint patterns, some special and unique minutiae from the distal phalanges under the dermtoglyphics is no doubt for the people but rather acquires more knowledge on regarding this study and also provides enormous information through various methods. It is the one from the part of anthropology which it is regarded as the holistic aspects among the various field of studies in the concept of academia.

Conclusion

In conclusion, it can be said that the study of fingerprint patterns and minutiae in dermatoglyphics is an important component in the area of biological anthropology and this study unmasked through different unique fingerprints which has done from these two localities of Tura. It is very much needed in this present generation to garner and to impart knowledge on about this study of fingerprint which gaining of knowledge is no doubt but rather it helps to shape up through this study and also essential in the field of academia. In the basic fingerprint patterns which brought to light that Arch ridges are more commonly present on the males' distal phalanges than female which comparing with the both sexes; and Loop ridges present with more numbers on females' fingertips than male and Whorls are also commonly seen than male where found within these two localities of Tura through data collection. It is detailed enough to provide information regarding the examining on this study in the area of dermatoglyphics. In minutiae or ridge characteristics displayed through the distal phalanges which according to the recorded fingerprint the unique ridges are not similar. Through the examined employ of multifarious tools help to provide the various information to acquire knowledge. The unique ridges in minutiae are very important to study and examine in the area of dermatoglyphics and it is very document in the field of study. Most of the special ridges like *Bifurcation* (Fork shape) and Bridge are present on the both hands which encompassed from male and females' distal phalanges, but the highest number of occupied is Bifurcation with 54 numbers which present on the females' fingers than male and Bridge ridges also commonly appears on the both fingertips which means on the male and female's hands. In minutiae, most of the ridges like *Crossover, Double Bifurcation, Eye* (Enclosure), *Island* (Short Ridge), *Pore, Ridge Ending, Tribifurcation* are the highest occupied in female's distal phalanges than male and *Core, Delta, Dot* (Fragment), *Hook* (Spur) are more commonly seen which present on the fingertips of male than female. The study and examining on this is not enough and it continues to exist because in the panorama of field sciences it is very broad which because of biological variation of populations. Basic fingerprints and other special ridges, minutiae etc., are very essential in our life to garner and to assimilate about our own fingerprint patterns from the distal phalanges. In the advancement of modern technology which has been employed of multifarious tools to provide huge enough information and it also helps to strengthen the document in detail which collected data through various methods and techniques. It is a very valuable to sensitise regarding the fingerprints for the people who have been inhabited within these two localities and it is very indispensable in our modern days which connecting with this present era of sciences, and has encompassed and dominated with advancement in new technologies. It also a very document through this study which it a physical part from our body and subsumed in the part of dermatoglyphics.

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References

[1]. Galton, F. 1892. “Finger Prints”. MacMillan: London.

[2]. Cynthia D’Souza N, Rodrigues, L J and Nausheeda, B.S. “A SURVEY ON FINGERPRINT RECOGNITION TECHNIQUES”. International Journal of Latest Trends in Engineering and Technology Special Issue SACAIM 2016, pp. 441-447

[3]. Kawagoe, M., Tojo, A. “Fingerprint Pattern Classification”. Pattern Recognition, vol. 17, (1984) 295−303.

[4]. Jiang, X., Yau, W.Y. “Fingerprint Minutiae Matching Based on the Local and Global Structures”. Proc. Int. Conf. on Pattern Recognition (15th), vol. 2 (2000) 1042-1045.

[5]. Biswas, S. 2011. Finger and palmar dermatoglyphic study among the Dhimals of North Bengal, India. Anthropologist, 13(3): 235-238.

[6]. D. Maltoni, D. Maio, A.K. Jain and S. Prabhakar, “Handbook of Fingerprint Recognition,” Springer, 2003. 2003 Springer

[7]. Christophe Champod, 2004 “Fingerprints and Other Ridge Skin Impressions” INTERNATIONAL FORENSIC SCIENCE AND INVESTIGATION SERIES by CRC Press LLC

[8]. Cummins, H. and C. Midlo 1943. Finger Prints, Palms and Soles: An Introduction to Dermatoglyphics. Dover: New York.

[9]. Narahari, S., K. S. K Malati and R.S.S Dev 2008. “The Khond: A dermatoglyphic study.” *The Anthropologist*. 10 (3): 207-210.

[10]. Dorjee. B, Mondal. N & Sen. J. Applications of Dermatoglyphics in Anthropological Research: A Review. *South Asian Anthropologist*, 2014, 14(2): 171-180

[11]. Singh. A, Gupta. R, SHH Zaidi, Arun Singh. “Dermatoglyphics: A Brief Review”. *International Journal of Advanced & Integrated Medical Sciences*. July-September 2016;1(3):111-115

[12]. Jim Fraser (2009) “Fingerprint”. Handbook of Forensic Science

[13]. Rohrig B. 2016. “Guilty or Inocent”. CHEMMATTERS

[14]. S. Baswaraj, Lalakiya. H, Mashru. K, Modi. H, Patel. U, Ramani. A. 2016. “Dermatoglyphics and Malocclusion”. *Journal of International Oral Health*. 8(8):865-869

[15]. Maltoni, D., Maio, D., Jain, A.K. and Prabhakar, S. (2003) Handbook of Fingerprint Recognition. New York