Review Article

International Journal of Forensic Science
Volume 5 Number 2, July–December 2022

Gender Determination Using Fingerprint Ridge Density

Akriti Singh[1], Anita Yadav[2]

How to cite this article:
Akriti Singh, Anita Yadav/Gender Determination Using Fingerprint Ridge Density/International Journal of Forensic Science. 2022;5(2):63–65.

Abstract

Fingerprints have been used to positively used to identify people for many years. A distinct pattern emerges from the furrows and ridges on people's fingers and palms. Fingerprint analysis is based on the unique pattern, which is classified into the following categories: loops (52.71%), whorls (27.38%), arches (27.38%) and composite (15.28%). These specific features in finger do not change as people get older. Several decades of research reveal that these tendencies persist throughout a person's life. As a consequence, this fingerprint based gender identification will provide a new basis of differentiation in the field of fingerprints. The examination and investigation of ridge density, ridge breath, and ridge count will also be used to determine gender. After comparing the fingerprints it is found that ridge density is higher in female followed by male and then transgender.

Keywords: Fingerprints, Transgender, Pattern.

INTRODUCTION

Fingerprints are the prints which are made by the ridges containing sweat on the surface secreted by the pores present on it. It is the most common method used in the biometrics for identification of user.[1] Individuality of a fingerprint of two different finger depends upon the probability of similarity between them.[2] These fingerprints found on crime scene can be of 3 forms among them-

I. ***Latent print***- In this, the fingerprint formed are visible to naked eyes. These fingerprints are mostly recovered using powder method or chemical method followed by their collection by tape lifting method.

II. ***Patent print***- These fingerprints are clearly visible and are generally made by fingers after touched by bloodstains, paint, mud, etc. These can be collected either by taking a photograph or cutting out that particular area.

III. ***Plastic print***- These prints are casted on a softer surface when fingers are placed on it with pressure like wax, sop, etc.

Fingerprints have widespread used in the field of biometrics and for personal identification as it have features of uniqueness and constancy. Fingerprint is unique to every individual. The identical twins

Author's Affiliation: [1]M.Sc. Student, Forensic Science, [2]Assistant Professor, Division of Forensic Science, School of Basic and Applied Science, Galgotias University, Greater Noida 201306, Uttar Pradesh, India.

Correspondence: Anita Yadav, Assistant Professor, Division of Forensic Science, School of Basic and Applied Science, Galgotias University, Greater Noida 201306, Uttar Pradesh, India.

E-mail: anita.yadav@galgotiasuniversity.edu.in

Received on: 08.06.2022

Accepted on: 12.07.2022

will not have same fingerprint. Even the fingers of same hand have different fingerprints. Fingerprints cannot be modified, changed or removed by any means.[3] Because of these anatomical references of fingerprint, they are widely used for personal identification. This personal identification is done in 3 levels.

- Level 1- With patterns
- Level 2 - With minutiae
- Level 3 - With pore formation

PATTERNS

Patterns are regarded to be the fingerprint's class characteristics. They didn't identify a specific person, but they did assist in the identification of a group of suspects.

This pattern is broadly of 4 types. They are

i. ***Arches-*** In this pattern ridges enter from one side of the finger, then goes up forming an arch and then comes down and exit from other, end of finger. They are found in about 27.38% of the population.

ii. ***Loops-*** Ridges enter from one side of the finger then form a loop and then exit from the same side of the finger. They cover the highest in population of about 52.71%.

iii. ***Whorl-*** In this the ridges form circle on the fingertip. Their frequency is lower then loop but more then, arches, covering about 27.38% of the population.

iv. ***Composite-*** These fingerprint have patterns which are composed of two or more separate pattern. They are found in about 15.38% of the population.[4]

MINUTIAE

Minutiae are the ridge discontinuities found in between the continuous ridge forming a pattern. These are considered as the individual characteristics of fingerprint which helps to individualise a person. They are of many types. Some of them are as follows

- ***Ridge ending-*** It is the sudden end of a ridge.
- ***Bifurcation-*** In this a single ridge divide into two.
- ***Trifurcation-*** In this the ridge divides into two.
- ***Short ridges-*** This are the short ridges found in between the main ridge.
- ***Dot-*** This is a small dot like structure present in between the ridge.
- ***Enclose-*** this are composed of two small ridges joined together from both the end.
- ***Eye-*** This a dot present inside a enclosure.

PORES

The study of pores present on palmar and planar surface of friction ridge for personal identification is known as poroscopy.[5] When pattern and minutiae are not enough for personal identification then these pores are used as they also have certain characteristics as – permanency, individuality and immutability. The position of pores, number and frequency of pores, distance between two continuous pores, size of pore all contributes in identification of a person.

Despite the fact that fingerprints are used for personal identification, they may also be used to determine a person's gender. This identification can be done on the basis of ridge density, ridge breadth and ridge count.

Ridge density

It is a count of fingerprint ridges of a specific fingerprint region. According to the research it has been found that females have comparatively more ridge density than male.[6,7]

Ridge breadth

The beginning of one ridge to the initiation of the next, across ridge and valley is called ridge breadth. The ridge breadth of male is comparatively higher than that of female.[8,9]

Ridge Count

Ridge count is the counting of the ridges intervening between delta and the core. It has been found that ridge count of male is higher than that of female.[10]

There are many studies done on gender identification through fingerprint for male, female and transgender. This gender identification is done by analysing and studying on ridge density, ridge breadth and ridge count.

DISCUSSION

Many studies have been done to establish a correlation between fingerprint ridge density and gender identification. On comparing the ridge

density of male, female and transgender, it has been found that ridge density is highest in female, followed by male and then transgender. According to research done by Mark Acree the ridge density of Caucasian male ranges from 9.70- 16.00 ridges\ 25mm2, here as in Caucasian female it ranges from 10.60- 16.80 ridges\ 25mm2.11 According to the research of Gagandeep Singh et al, it was found that Khatri men had a ridge density of 10.6 to 14.1 ridges/25 mm, while females had 12.8 to 15.5 ridges/25 mm.12 Another characteristic which has been used for gender identification is the ridge count. According to the research of Mark Acree ridge count of 11 ridges\25mm2 or less is of male origin, ridge count of 12 ridges\25mm2 is more likely of female.[11] Ganesh B. Dongree performed his research on 10 samples of transgender, male and female. Following the extraction and comparison of features, he discovered that fingerprint of transgender people had majority of characteristics that tends toward the fingerprint characteristics of male.[13]

In this review, the identification of gender using fingerprint ridge density has been summarized. Although gender identification using ridge density cannot be done accurately because the ridge density of male and transgender are almost same and it becomes difficult to distinguish between them. Thus, more accurate and detailed research is required to do this gender identification.

CONCLUSION

All these studies concluded that there is remarkable difference between the fingerprint ridge density of male and female and on the other side there no distinguishable difference between the fingerprint ridge density of male and transgender. Thus the result of these studies will create further need to research over gender identification of an individual with fingerprint using different characteristics of fingerprint.

REFERENCE

1. P. Gnanasivam and R. Vijayarajan (2019). Gender classification from fingerprint ridge count and fingertip size using optimal score assignment. Springer. Vol-1.
2. Y. Chen and A. K. Jain (2009). Beyond Minutiae: A fingerprint individuality model with pattern, ridge and pore features. An international conference on biometrics, Springer Berlin. Vol-1, PP-522-533.
3. S. F. Abdullah, A. F. N. A. Rahman and Z. A. Abas (2015).Classification of gender by using fingerprint ridge density in northern part of Malaysia. ARPN journal of engineering and applied science. Vol-10, PP-1.
4. I. Shrestha and B. K. Malla (2019). Study of fingerprint patterns in population of a community. Journals of Nepal medical association. Vol-1.
5. B. K. Sharma, R. Bashir, M. Hachem and H. Gupta (2019). A comparative study of characteristic features of sweat pores of finger bulbs in individuals. Egyptian journal of forensic sciences. Vol-1.
6. A. Badawi, M. Mahfouz, R. Tadross and R. Jantz (2006). Fingerprint-based gender classification. IPCV. Vol-8, PP-2-3.
7. G. Sudesh (2007). Sex determination from fingerprint ridge density. Internet journal of medical update. Vol-2, PP-1.
8. M.D. Nithin, B.M. Balaraj, B. Manjunatha and S. C. Mestri (2009). Study of fingerprint classification and their gender distribution among South Indian population. Journal of forensic and legal science. Vol-1, PP-460-463.
9. M. Kralik and V. Novotn (2003). Epidermal ridge breadth: an indicator of age and sex in paleodermatoglyphics. Variability and Evolution. Vol-11 PP-5–30.
10. J. A. Y. Hall and D. Kimura (1994). Dermatoglyphic Asymmetry and Sexual Orientation in Men.,Behavioral Neuroscience. Vol-108, PP-1203-1206.
11. M. Acree (1999). Is there a gender difference in fingerprint ridge density? Forensic Science International. Vol-102, PP 35-44.
12. S. Gagandeep (2012). Determination of gender differences from fingerprints ridge density in two northern Indian population of Chandigarh region. Journal forensic research. Vol-3, PP-2.
13. G. B. Dongree and S. M. Jagade (2019). Verification of fingerprint of transgender with male and female. IRE journals. Vol-3, PP-1.