Xournals

Academic Journal of Forensic Sciences

ISSN: 2581-4273 | Volume 02 | Issue 02 | October-2019

Dermatoglyphics Inferences in Sex Determination amongst Tribal Population – A Review

Kiruthiga U

Available online at: www.xournals.com

Received 28th May 2019 | Revised 17th June 2019 | Accepted 4th July 2019

Abstract:

Dermatoglyphics is a well-known detailed scientific study of epidermal ridges that are present on the palmer surface, fingers and sole of the feet. The epidermal ridges are known for their individuality and uniqueness that are distinguishable even between the monozygotic twins and thus their forensic significance. The present review focuses on the characteristic features of fingerprints such as ridge density, total fingerprint ridge count (TFRC) and ridge breadth amongst tribal population in India and other countries.

Keywords: *Dermatoglyphics, Fingerprints, Tribal population.*

Authors:

1. *Amity University, Noida, Uttar Pradesh, INDIA*

Introduction

The term "Dermatoglyphics" was termed by Dr. Harold Cummins, and is derived from the Greek word meaning derma as skin and glyph as carving. It is a study and interpretation of the papillary ridges that are present on the fingertips, elaborating their uniqueness and individuality for the purpose of differentiating each individual from their own kind. This study is not only limited to the fingerprint patterns but extended to the quintessential level of studying the individual characteristics that each pattern possess. There are various studies that were conducted in this field for not only the purpose of individualizing any kind but also to discriminate the gender, ethnicity and to analyse their psychological state.

As a fact of being a characteristic feature in personal identification, various researchers have conducted groundwork to enhance the dermatoglyphics from different perspectives. This review study mainly focuses on the fingerprints of the tribal population. These tribal populations are well known for their different habitat, culture, food habits and growing environment.

There are various studies that were performed on the indigenous groups such as the one that was conducted on Sub-Saharan population[1] worked specifically upon the male subjects displayed significantly lower ridge density in comparison to males subjects of the Spanish population in distal region (ulnar and radial) of all ten digits.

Secondly, the study conducted on the Hausa ethnic group of Kano state, Nigeria[2] predicted that there was not much difference found on both the sexes either on their radial, ulnar or the proximal areas of the left thumb, whereas significant changes were found on the right thumb. The ridge thickness was found more on the radial region of the female population and on ulnar area of the male population. His study prominently showed that the female ridge count can be less in number than the male population contrasting to the previous studies those of that were conducted on subjects of various geographical area denoting that female has 14 or more ridge count and male has 13 or less ridge count[3], only when the sample is taken from the proximal region.

Thirdly, in a study conducted on the Ijaw ethnic group[4] clearly stated that among the chosen population, the whorl pattern was dominant than the other types where in the ulnar loop was mostly seen among the Nigerian ethnic population. The study stated that the female subjects had significantly higher ridge density than the male subjects whereas the TFRC was seen with much less differences than $P<0.05$ between the genders.

Moreover, in a study that was conducted on the Right ring finger and Left little finger of the Igbo and Okrika people of South Nigeria[5], was depicting that there is significant distribution of the ridges amongst the Igbo population where the male subjects were found with higher distribution than the female subjects whereas in the Okrika population, the sexual dimorphism was not that prominently viewed as in the Igbo population. Hence the researchers concluded that this may be due to the differences in their tribal genetic makeup.

However, in the comparison study and scrutiny of the Kenyan and Tanzanian population[6] showed that men had higher TFRC than the female subjects among the Kenyan population whereas there were no considerable differences among the Tanzanian population

Also in the study conducted on the Dumagat-Remontado tribal population of Philippines[7] depicted that the male population has higher TFRCs than the female subjects. This study also revealed that the whorl pattern was predominantly found on the tribal population. In addition to these results, a special and unique feature was found among the subjects that were not found within the civilized population which was then named as "Club Dent".

The tribal population performs the heavy physical labour work than that of the civilized and modernized population. Considering this fact, the researchers initiated the profound groundwork to study if there are any significant factors and features that can differentiate the tribal population from the civilized subjects. On a success rate, the researchers found positive results from their studies.

Methods:

About 200 to 500 samples which include the both gender were collected between the age group of 19 and 25 among the tribal population with their concern. All the selected subjects were healthy and

physically abled; who's hereditary was from the indigenous tribes. The subjects were interviewed to confirm their social background and ethnic groups they belong to, and those who have given the positive results were chosen for the study.

The fingerprints were obtained and classified according to the method described by Cummins and Midlo's- a standard technique[8]. The clear impressions were collected for the study and classifications. The ridge characteristic studies were performed according to the method that was put forth by Acree[9]. The magnifying lens was used to count the ridge density, TFRC and to measure the ridge thickness.

To perform the ridge density study, the fingerprint patterns were divided into two regions such as the distal region (ulnar and radial) and the proximal region which was then marked into a 5mm x 5mm area of any specific region from the above mentioned. The ridge breadth study which was suggested by the previous works[11], that involves counting of ridges along the diagonal line of measure 7.07mm length in a selected region.

Results:

On a clear assessment, the study displayed that the loop and whorl pattern were the most appeared pattern among the tribal population. Ridge density was also analyzed by using the method that was put forth by Gutiérrez- Redomero et al[11], of both the sexes on three different areas of their fingerprints. This showed that the proximal region has the higher ridge density on the male subjects than that of the female subjects unlike the other regions such as the distal regions which shows that the female subjects has the maximum ridge density than that of the male subjects. It was also found that the best prediction of the sexes can be done when the sample is collected from the ulnar region of the Right thumb and the proximal region of the Left thumb. These studies also depicted that the female has the higher ridge count on the ulnar region of the Right thumb and lesser ridge count on the proximal region of the Left thumb whereas in the male population, the vice-versa. Also quoting that when the ridge thickness in measured, female subjects were having the increased thickness on the proximal region and in the radial region of their fingerprints which leads to the lesser density of the ridges on those particular regions whereas in the ulnar region, the ridge breadth was lesser in female than the male subjects that led to more ridge density in female subjects than in male subjects, only on the ulnar part of the distal region.

Additionally when studying the total fingerprint ridge count (TFRC), it was found that both sexes were not showing any range of variance between them as they were depicting significantly in the ridge density and ridge thickness. The mean TFRC value of the male and female[4] were displayed below:

Variable	Male	Female	P-value
Mean TFRC	87.73±30.09	87.73±27.88	>0.05

Hence the study shows that there are significant differences between the tribal population and the civilized population. These differences were recorded also due to the factors such as the sex, age, genetic makeup and the population origin. The considerable changes were also seen among the different tribal population.

Discussion:

Identification of any individual and gender dimorphism is still one of the most puzzled parts in the field of forensics. Yet, fingerprints are providing the major hand in decoding these difficulties. In this review study, these special characteristic features of the ridges such as the ridge density, ridge breadth and TFRC value were specifically selected in contemplation of studying their accuracy in providing clear results.

On studying the ridge density and the ridge breadth, it was found that they are indirectly proportional to each other. In detail, when the ridge breadth is more, the ridge density seems to be lower in number as the valley size increases in a marked 5mm x 5mm area. It was also depicted that the ridge breadth is higher in the male subjects than in the female population resulting in lesser density than the female subjects.

The following table shows the differences in the ridge density on different regions between the genders:

Variables	Male	Female
Ridge density (distal region)	13 or less	14 or more
Ridge density (proximal region)	13 or more	13 or less

Meanwhile ridge thickness also differs on the basis of gender on different regions of their fingerprint[2]. This will be clearly stated in the following table.

Gender	Thumb print	Region		Arches	whorls	Loops
	Right	Ulnar	Max-min	0.58-0.91	0.53-0.91	0.49-0.91
		Radial	Max-min	0.58-0.91	0.53-0.91	0.45-0.91
		Proximal	Max-min	0.64-0.91	0.53-0.91	0.53-0.91
	Left	Ulnar	Max-min	0.58-0.91	0.53-0.91	0.53-1.27
		Radial	Max-min	0.58-0.91	0.49-0.91	0.53-0.91
		Proximal	Max-min	0.64-0.91	0.58-0.91	0.58-1.06
Female	Right	Ulnar	Max-min	0.49-0.91	0.45-0.91	0.49-0.91
		Radial	Max-min	0.64-1.27	0.53-1.27	0.45-1.06
		Proximal	Max-min	0.64-0.71	0.53-0.91	0.49-1.27
	Left	Ulnar	Max-min	0.53-0.80	0.53-1.27	0.53-0.91
		Radial	Max-min	0.64-0.91	0.45-1.27	0.49-1.27
		Proximal	Max-min	0.58-1.06	0.58-1.27	0.58-1.27

From the above table, it is shown that the prediction of the gender can done with an extended accuracy when the sample is examined on the right ulnar region for the ridge count and left ulnar region for the ridge thickness. The accuracy was measured to be 82% when the samples were collected from these regions leading to the effective results whereas in the Chinese population (study conducted by Wang et al,)[12], showed the maximum of 86% of accuracy when the samples were collected from these areas.

The studies conducted on various other geographical areas such as Mataco-Mataguayo[13], Argentina[14], Sudanese[15], India[16] subjects were providing the results which showed that female population had more ridge density than that of the male population whereas in the study on tribal population, it was stated that the female population has more ridge density than that of the male population. This may be due to the factors such as the geographical area, physical condition and even may be due to the genetic makeup.

The other possible reasons may be due to the fact that the physical stature of the genders. Male subjects were known to have a taller and heavier stature than the female subjects. This factor also contributes to the differences that are seen among the gender when studying their ridge characteristics. The ridges were viewed to be coarser in male and finer in female. This attribute to increase and decrease in the number of ridges that are counted in 5mm x 5mm area[16]. In addition to it, the region from which the samples were collected, counts.

It is predicted that with the ridge characteristics specifically the ridge thickness, the estimation of age is possible as the ridge thickness changes in range according the age factor and the size of the palm. The ridge thickness is seemed to be less in the younger and older ages whereas in the adulthood, the ridge were seems to be firm and of greater thickness. It is also denoted that variance in the ridge thickness between the gender is 9%. But according to Cummins and Ohler[18], the ridges on the female population were 10.2% finer than that of the male population. Hence with the ridge features, the accuracy in identification of gender is predicted to be in a greater extend and possibility of even the age estimation.

In addition to all these factors and positive results, there is a special and unique feature that was discovered only among the Dumagat-Remontado tribal population of the Philippines[7], which was called as the "Club Dent". This feature was only between the pattern areas of the fingerprints that were collected from the subjects of this specific ethnic group.

Fig.1 Observed unique feature from the Dumagat-Remontado population's fingerprints

Conclusion:

Fingerprints and ridge characteristics were the most important features when it comes to the individualization and personal identification. However, certain features like ridge count, ridge thickness and TFRC count, even being effective and accurate, were given less consideration and importance when compared to the other characteristic features of the fingerprints. Even such features play an important role in certain areas where the other features were less found or to give more accuracy to the results. Hence in this study, these features were given the most importance to analyse the level of accuracy it can provide in the identification of the gender and in differentiating one group of population from the other of the same kind with an intention of providing a better significance in the field of forensics.

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