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Evaluation of Finger Print Ridge Density for Gender Identification among Dental Students of Gujarati Origin: - A Forensic Study

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Abstract: Ridge density means the number of ridges present in a specified area of a fingerprint and several researches have been carried out on this aspect of fingerprints. This study was conducted with an aim to establish a relationship between sex and fingerprint ridge density. The fingerprints were taken from 100 subjects (50 males and 50 females) in the age group of 18-25 years. After taking fingerprints, the ridges were counted in the upper portion of the radial border of each print for all ten fingers and mean value was calculated. The results have shown that a the ridge density ranges from 7-16 ridges/25mm^2 in male and 11-17 ridges/25mm^2 in females. It has been successful to support the hypothesis that women tend to have a statistically significant greater ridge density than men.

Keywords: Fingerprint, Ridge density, Sex, Personal identification.

INTRODUCTION

Gender determination becomes the first priority in the process of identification of a person by a forensic investigator in the case of mishaps. Numerous studies have been done on features of human body to estimate gender. Some of recent examples include foot print ratio, metatarsals, humerus, foot shape, femoral head, foot and shoe dimensions, teeth, canine to canine width etc. These studies have been carried out in different populations to ascertain any racial or geographic differences.

Out of these above mentioned parameteres, dermatoglyphics because of its uniqueness and immutability are one of the most commonly employed features in determining the identification of an individual. Dermatoglyphics is also considered as a window of congenital abnormalities and is a sensitive indicator of intrauterine abnormalities, also known to be one of the best available diagnostic tools in genetic disorders. Several studies have associated altered dermatoglyphic patterns with congenital defects, syndromes, developmental disorders, dental caries, leukaemia, schizophrenia, and other pschycological disorders. Fingerprints of an individual have been used as one of the vital parts of identification in both civil and criminal cases because of their unique properties of absolute identity. They have considerable value in morphological, biological, anthropological and forensic studies [1]. Fingerprints collected from the crime scene and from the items of evidence of crime have been successfully used to identify suspects, victims or any other person who had touched the surface in question. Numerous researches have been carried out on the human population in the field of dermatoglyphics, which is one of the most precise activities within forensic science. There are many features of fingerprints such as ridge count, ridge orientation etc, which have been correlated to various aspects of human population. Gender is one such aspect. Ridge width influences the number of ridges present in a specified area of fingerprints i.e. the epidermal ridge density [2].

Need for the study

The present study will be carried out to evaluate whether, there is any difference in the finger ridge density in males and females in Gujarati population and equate it with the results in the studies conducted in other regional areas. As per literature search done by using search engines such as MEDLINE, Pubmed and EBSCO HOST till august 2016, no studies were found on the differences in ridge density in the Gujarati population. Also, despite many well developed finger matching techniques, and a wide

range of biometric applications, a reliable finger print based gender determination method does not seem to be available. Hence the goal of this study is to determine if women have significantly higher ridge density than men by counting ridges that occur within a well defined specific area of finger print. If significant gender differences do exist then the likelihood of inferring gender from given ridge densities can be explored and then this will add information to the already existing forensic database for assessing the sexual dimphorphism in solving cases where only partial finger prints are available in the crime scene.

This study has been planned with a research hypothesis stating there is a difference in the ridge density between males and females in Gujarati population and females possess greater ridge density as compared to males.

MATERIALS AND METHODS

This study was included Gujrati participants (minimum 2 generations of both mother and father should be Gujarati origin). The samples for the present study were consist of fingerprints from 50 males and 50 females Gujarati population aged between 18–25 years. The written consent was obtained from the subjects participating, and the objective of the study was explained to them. Before taking fingerprints, the subjects were asked to clean their hands. With the help of stamp pad all five fingers of right hand and left hand were stained. The subjects were asked to roll their finger from the radial side (thumb) to the ulnar side (little finger) on the stamp pad and then transfered their finger prints in the same manner onto the specified space on the bond paper. In this manner, fingerprints of all the five fingers of right hand and left hand were obtained for each individual.

After taking fingerprints, the upper portion of the radial border of each print was chosen as an area for the data collection because all fingerprint pattern types showed a similar ridge flow in this region. In this region, the ridges conform to the finger outline flowing in an arch from one side of the finger to the other. The cores of loops and whorls pattern are away from this region. In this selected area of the prints, epidermal ridges of both males and females were counted carefully within a square of 5mm x 5mm drawn on a transparent film fixed to the lens. Counting started from one corner of the square to the diagonally opposite corner. Some specific criteria were observed during the counting procedure such as the dots, which were not counted, and the handle of the fork and a lake was counted as two ridges (though lakes were hardly seen). Hence this value represented the number of ridges/25 mm square and would reflect the ridge density value. The ridge thickness and the furrows are two important factors which determine the density of ridges. After the ridge counts were done for all the ten fingers, the mean value is calculated. This new value represented the approximate number of ridges for the particular individual. The significance of this value was determined.

Specific comparisons of means were made and calculations were performed using STATISTIX software on IBM computer. The likelihood ration (LR) was calculated to obtain the probability inferences of gender, based on ridge density values. The likelihood ratio is based on Baye's theorem.

LR = Probability of given fingerprint originating from male contributor (C) / Probability of given fingerprint originating from female contributor (C^1)

RESULTS

The ridge density ranges from 7-16 ridges/25mm^2 in male and 11-17 ridges/25mm^2 in females. The analysis by T Test results show that males have significantly lesser density than females ($P<0.001$). The results show that there is a significant difference between the ridge density of males and females in Gujarati population with females having significantly higher ridge density than males. The mean value of ridge count for male was 11.11 and female was 13.89.

Table-1: T Test Comparing ridge difference between Male and Female subjects

	t	df	P Value
Thumb print ridge density – Male Vs Female	6.680	49	.000
Index fingerprint ridge density - Male Vs Female	9.271	49	.000
Middle fingerprint ridge density - Male Vs Female	7.600	49	.000
Ring fingerprint ridge density - Male Vs Female	10.441	49	.000
little fingerprint ridge density - Male Vs Female	8.002	49	.000

DISCUSSION

All over India many regional differences exists, and these regional differences affect the dermatoglyphics of that particular region. Racial differences can also be present, which may affect this parameter for sexual dimorphism. In the past it has been assumed that the fingerprints of women tend to have "fine" epidermal ridge detail while men have "coarse" ridge detail. Past studies have examined this hypothesis, but have not clearly demonstrated if observed differences are statistically significant [3].

Recently, a few researches have been carried out on this aspect of fingerprint [2].

All of these studies have reported higher epidermal ridge density in females as compared to males [4]. The thickness of epidermal ridges varies between individuals. Females are supposed to have finer ridges than males and therefore found to have a greater ridge density [5].

This study demonstrates that there is a significant difference in the epidermal ridge density between males and females in Gujarati population, with females possessing a higher ridge density as compared to males. The magnitude the means of Gujarati males is 11.11ridges/25 mm and females is 13.89 ridges/25 mm. This observed trend of a difference between males and females of various populations may be similar. Studies have been carried out in the past on this very aspect of finger prints. Cummins *et al.*, established that males have coarser epidermal ridges than females. Ohler and Cummins reported that males have a ridge breadth of 0.48 mm, whereas females have 0.43 mm, but none of them have included the furrow breadth. This was taken into consideration by Nayak [6] who reported a higher value of ridge to ridge distance in males and thus a lesser ridge density as compared to females. Thus, the present study supports the observation made by, Nayak [6] and Rastogi. On the basis of the obtained results it can be concluded that there are differences in epidermal ridge density between women and men and they can be used to determine the sex of the donor.

CONCLUSION

This study shows that women of the Gujarati population of India have a significantly higher finger print ridge density than men, that differences in the finger print ridge density can be used as an important tool for the determination of gender in cases where partial fingerprints are encountered as evidence either at the crime scene or on any document(s) of forensic significance.

REFERENCES

1. Ahmed, I., & Yasin, I. (2010). Dermatoglyphic pattern study. *AMPC*, *4*(2), 107-10.
2. Cummins, H. (1939). Dermatoglyphic stigmata in mongoloid imbeciles. *The Anatomical Record*, *73*(4), 407-415.
3. Nandy A. Identification. Principles of Forensic Medicine 2nd Edition. New Central Book Agency (P) LTD. Calcutta. 2001: 47- 109.
4. Singh, G. (2012). Determination of Gender Differences from Fingerprints Ridge Density in Two Northern Indian Population of Chandigarh Region. *J Forensic Res*, *3*(145), 2.
5. Acree, M. A. (1999). Is there a gender difference in fingerprint ridge density?. *Forensic science international*, *102*(1), 35-44.
6. Nayak, V. C., Rastogi, P., Kanchan, T., Yoganarasimha, K., Kumar, G. P., & Menezes, R. G. (2010). Sex differences from fingerprint ridge density in Chinese and Malaysian population. *Forensic science international*, *197*(1-3), 67-69.