

Original article

Sexual dimorphism by plantar dermatoglyphics

¹Rohini M. Pawar , ²Mohan N. Pawar

¹Associate Professor , Department of Anatomy , Rural Medical College, Loni. Taluk Rahata, District Ahmednagar. (Maharashtra) India. PIN – 413736.

²Professor and Head – Department of Forensic Medicine , Rural Medical College, Loni. Taluk Rahata, District Ahmednagar. (Maharashtra) India. PIN – 413736.

Corresponding Author: Dr Rohini M. Pawar

Abstract:

Background: Plantar dermatoglyphic is the study of various epidermal ridge patterns on toes and soles. Foot prints are distinctive for every individual. The foot prints and palm prints are used mainly for dermatoglyphic study, personal identification, in cases of accidents and claimants for inheritances. The foot impressions are useful in recognition of species.

Material and Method: Dermatoglyphic footprints of 100 male and 100 female Medical student was obtained. All the subjects were free from metabolic and genetic diseases or inborn and acquired deformity of one or either foot. Footprints were obtained by Standard ink method. All the footprints were tabulated and analyzed by applying statistical tests.

Objectives: 1.To study and to correlate the footprint patterns in either of the gender. 2. To know the implications of plantar dermatoglyphics in personal identification.

Result: The percentage frequency of simple and tented arch on the left foot were significantly higher in female than male. The percentage frequency of loop distal were significantly higher in right foot of male than female. Open field on either foot was also significantly higher in female as compared to males. All the variations were found statistically significant.

Conclusion: Plantar dermatoglyphics is helpful in sexual dimorphism. It can also be a valuable tool in personal identification, medico-legal practices and anthropological studies.

Keywords: Dermatoglyphics, Plantar Dermatoglyphics, Foot Prints, Sexual Dimorphism.

Introduction:

The study of epidermal ridge, patterns formed by them and flexion creases is known as dermatoglyphics. [1] It has been studied extensively in chromosomal disorders, single gene disorders and medical disorders whose genetic basis is not clear. [2] Gender wise ‘palmar’ dermatoglyphics patterns were extensively studied in various medical disorders. [3] But the study of plantar dermatoglyphics was seemed to be neglected by most of the researchers. Like fingerprints, foot prints are also very distinctive for every individual. So, it is used in personal

identification in criminal as well as in mass disaster cases. [4] The foot prints and palm prints are used mainly for dermatoglyphic study, personal identification, in cases of accidents and claimants for inheritances. [5]

Material and methods

In the present study dermatoglyphic footprints of 100 male and 100 female Medical Student were obtained from undergraduate students of Krishna Institute of medical Sciences, Deemed university; Karad (Maharashtra) India. The age group was of 19 to 23 years. All the subjects were free from

metabolic, genetic diseases, inborn or acquired deformity of one or either foot; which would have affected the observations. After written and voluntary consent, study participants were asked to wash soles with soap and water to remove sweat, oil and dirt from the sole. (Fig. 1, 2) The ridged area was printed completely, including the complete hallucal, thenar, hypothenar and calcar area. The various methods [6] that can be employed are: i) Ink method, ii) Inkless method, iii) Transparent adhesive tape method, and iv) Photographic method. Dermatoglyphics prints were taken by using standard Ink Method by Cummins and Midlo and was too followed in present study. (Fig. 3, 4) [7]

There are also some special methods like, Hygrography, Radiodermatography, Plastic mould. These methods are also widely used with some advantages over standard methods. [8] Footprints were studied with the help of hand lens and patterns were recorded as follows.

A. Toe tip patterns:

1. Arches - [simple (A^s) and tented (A^t)]
2. Loops - [Tibial (L^t), Fibular (L^f), Proximal (L^p), Dista (L^d)]

3. Whorls
4. Vestiges
5. Open fields

B. Patterns in interdigital area

1. Hallucal area, Interdigital area II, Interdigital area III,

Interdigital area IV, Hypothenar area V and Calcar area.

The footprints were studied with the help of these magnifying lens. Observations were then tabulated (Fig. 5, 6, 7, 8, 9 10) and analysed for statistical significance by applying Chi-square test. Weighing machine, Soap and water, Plane glossy white paper, Butter paper, Porcelain tile, Hand gloves, Stamp pad ink, Cotton gauzes, Spirit, Acetone and magnifying hand lens were used for obtaining & studying the footprints. (Fig.1)

Observations and results:

Dermatoglyphic foot prints of 100 males and 100 females study participants were obtained, studied, tabulated and analysed by applying statistical tests. For qualitative analysis Chi-square test was applied. The results are stated in following Table No. 1, 2, 3 and 4.

Table No 1 Percentage frequency of all patterns on both feet in male and female.

Pattern	Male (n = 100)			Female (n = 100)		
	Right	Left	Total (%)	Right	Left	Total (%)
A ^s	175	187	181	187	194	190.5
A ^t	1	0	0.5	7	5	6
L ^d	118	43	80.5	43	87	65

L ^t	158	116	137	116	160	138
L ^t	14	21	17.5	21	20	20.5
O	351	452	401.5	452	465	458.5
V	104	103	103.5	103	105	104
W	79	70	74.5	70	63	66.5

Total Chi square value for pattern on right foot $\sum X^2 = 64.264$. $P < 0.05$

Total Chi square value for pattern on left foot $\sum X^2 = 56.485$. $P < 0.05$

The different in the pattern in male and female is statistically significant.

Table 2 Percentage frequency of patterns on great toe of both feet in male and female.

Pattern	Source	Male (n=100)			Female (n=100)		
		Right	Left	Total (%)	Right	Left	Total (%)
A ^s	Present study	5	0	2.5	0	0	0
	Study by Blanka	7	0	3.5	8	0	4
L ^d	Present study	68	59	63.5	62	56	59
	Study by Blanka	54	47	50.5	60	52	56
L ^t	Present study	12	11	11.5	8	15	11.5
	Study by Blanka	9.5	13.5	11.5	21	8	14.5
V	Present study	5	3	4	3	2	2.5
	Study by Blanka	0	0	0	0	0	0
W	Present study	15	27	21	21	19	20
	Study by Blanka	30	32.5	31.25	22	31	26.5

Table 3 Percentage frequency of patterns on hallucal area of both feet in male and female.

Pattern	Source	Male (n=100)			Female (n=100)		
		Right	Left	Total (%)	Right	Left	Total (%)
A ^s	Present study	0	0	0	0	0	0
	Study by Blanka	6.5	7	6.75	10	8.5	9.25
L ^d	Present study	68	59	63.5	62	56	59
	Study by Blanka	54	47	50.5	60	52	56
L ^t	Present study	12	11	11.5	14	15	14.5
	Study by Blanka	9.5	13.5	11.5	8	8	8
V	Present study	5	3	4	3	2	2.5
	Study by Blanka	0	0	0	0	0	0
W	Present study	15	27	21	21	19	20
	Study by Blanka	30	32.5	31.25	22	31	26.5



Fig.1. Instruments, equipments and Material used for the study



Fig.2. Cleaning of sole for footprint.



Fig.3. Ink application to sole for footprint.



Fig.4. Position of subject for footprint.



Fig.5. Footprint of Right foot of male

Discussion

Dermal palmer and plantar ridges are highly useful in biological studies.[9] Penrose and Ohara have studied the stages in normal development of ridges formation by series of light microscopic sections.[10] The embryogenesis of epidermal ridge patterns on feet identical to that on hands except that each step occurs two or three weeks later.[11] Galton and Wilder were first to study the hereditary basis of the establishment of dermal patterns.[12] In 1968 Penrose published a memorandum on dermatoglyphics reclassifying Galton's basic patterns.[13] Previously very few authors had tried to attempt study on plantar dermatoglyphics. Penrose L. S and Blanka Schaumann studied differentiation of sex by plantar dermatoglyphic. [14] They observed more loop fibular on great toe in female than in male and more whorls on great toe in male. There were more arches

in hallucal area of male and more loop distal on hallucal area of female. These findings are similar to that of present study in respect to the findings about great toe. But the findings noted on hallucal area are varying. B. Schaumann and Alter. M quoted differences in the pattern type frequencies between the fingers and toes, the toes showing considerably more arches and fewer whorls than the fingertips in the same group of individuals. [15] In present study also, arches are more common as compared to whorls.

Table 3 shows the comparison of great toe patterns of Blanka's study with that of presents study. In which, the frequency of simple arches in the present study was 2.5% in male and was absent totally in females. According to study by Blanka the frequency of arches in male were 3.5% and 4% in female. It also shows frequency of loop distal in present study was

63.5% in male as compared with 59% in female, on great toe of both sides in male and female. While according to study of Blanka the percentage frequency of loop distal in male were 50.5% and in female 56%. The frequency of loop tibial in present study were 11.5% in male and female were same while according to study of Blanka the frequency of loop tibial in male and female were different i.e., in male 11.5% and in female 14.5%. The frequency of vestiges in present study was 4% in male and 2.5% in female as compared with the study of Blanka in which they were absent in both male and female. The frequency of whorls in the present study was 21% in male and 20% in female as compared with the study of Blanka in which the same were 31.25% and 26.5% respectively. The differences in some dermatoglyphic patterns in study of Blanka and present study could reflect the differences in the genetic background of different population and different geographic distribution. This difference in the patterns is statistically significant.

According to present study Table No.4 shows, that simple arches were absent in male and female on hallucal area. While, according to study of Blanka showed the frequency of simple arches were 6.75% in male and 9.25% in female on hallucal area. The frequency of loop distal was 63.5% in male while in female 59%, according to present study. But, according to Blanka, frequency of loop distal was 50.5% in male and 56% in female. The frequency of loop tibial in present study was 11.5% in male and 14.5% in female. While according to study of Blanka the percentage frequency of loop tibial were 11.5% in male and 8% in female. The frequency of vestiges in male, according to present study was 4% and 2.5% in female. According to study of Blanka, they were absent in both. The frequency of whorls in present

study was 21% in male 20% in female. While, according to study of Blanka the percentage frequency of whorls in male was 31.25% and 26.5 % in female. This difference in the patterns was statistically significant.

Summary and conclusion

The present dermatoglyphic study made following conclusions:

1. Simple arches on the left foot of females were significantly higher in males as compared to males. (chi-square value=3.1888. $p < 0.05$)
2. Tented arches were observed more in females as compared to males. (chi-square value = 0.776. $p < 0.05$)
3. Loop distal were significantly higher on the right foot of males as compared to females. (chi-square value =3.126. $p < 0.05$)
4. Loop tibial were significantly higher in females as compared to males. (chi-square value =3.18. $p < 0.05$)
5. Open fields were significantly higher in females as compared to males. (Chi-square value = 7.168. $p < 0.05$)

The dermatoglyphic study is a valuable tool in medico-legal, anthropological and various medical genetic disorders. This science is also being correlated with a variety of chromosomal, developmental defects and certain clinical disorders. The present study of plantar dermatoglyphics also helps us in sexual dimorphism with their foot prints. It can also become a valuable contrivance in medico-legal practices.

Acknowledgement:

Authors are thankful to the Dr. B. N. Umarji, Dean, Prakash Institute of Medical Sciences, Islampur. Distt. Satara and participant students of KIMS Deemed University, Karad Maharashtra, India.

References:

1. M Kamboj Dermatoglyphics. British Dental Journal 204, 51 (2008); Published online: 26 January 2008.doi:10.1038/bdj.2008.14.
2. Sangita s.Bahu, B.P. Powar, O.N. Khare. Palmer dermatoglyphics in pulmonary tuberculosis. J.Anat.Soc.India 54(2)2005; 64-66.
3. Alter M. "Dermatoglyphic analysis as a diagnostic tool. J. Medicine 1967. Vol. 46; 35-36.
4. H.K. Kumbhani. Dermatoglyphics: A Review.A historical review of dermatoglyphic research; May 2008.
5. Barkar S.L, Scheuer J.L.Predictive Value of human footprints in Forensic context.Med.Sci.Law (1998), Vol.38,No.4;341-346.
6. Roopam K Gupta, Aruna K Gupta. New, easy and effective method to take dermatoglyphic prints. National Journal of Medical Research 2013; 3: 45-47.
7. Cummins H. Palmar and Plantar Epidermal Ridge Configuration in Europeans and Americans. Am J Phy Anthropol.1926; 179: 741-802
8. Bansal P and Rifa D C. The inheritance of accessory triradii on palmer interdigital area II and IVth. Acta. Genet. Gemellol. (Rome). 1982, Vol. 2; 29.
9. Mullhill J J, Smith D.W. The genesis of dermatoglyphics. J of Paediatrics.1969; vol.75, 579-589.
10. Penrose L S .Medical significance of fingerprints and related phenomenon.B.Med.J.1978. Vol.2; 321-325
11. Bonnevie K.Studies of papillary patterns on human finger.J.Genetics, 1924,15;1-11.
12. Wilder H H. Palms and soles. Am.J.Anatomy 1904, 1:423.
13. Penrose L.S.Loesch D. Comparative study of sole patterns in chromosomal abnormalities.J.Ment.Def.Res. 1970. Vol 14;129
14. Penrose L., Loesch D. Dermatoglyphics in sole patterns: A new attempt at classification. Human Biology.1969.vol.41;427
15. Blanka Schaumann and Milton Alter. Dermatoglyphics patterns configuration. 27-87. Springer-Verlag New York Inc 1976.