ORIGINAL ARTICLE

SEXUAL DIMORPHISM IN PLANTAR DERMATOGLYPHICS

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ABSTRACT: Dermatoglyphic study of fingertip and palmar patterns had been done extensively in various genetic and metabolic diseases. It appears that plantar dermatoglyphics has been neglected. So the present study is undertaken to know the sexual difference in plantar dermatoglyphics. Dermatoglyphic foot prints of 100 males and 100 females of age between 17 to 50 years from Government Medical College, Aurangabad were taken. Foot prints were taken by usual methods. Various patterns like Arches, Loops (tibial, fibular, proximal, distal), Whorls, Vestiges & open fields were studied. Triradial count, a-b ridge count & total toe ridge count were analyzed in male and female. Qualitative and quantitative analysis of sole prints was done. Complex patterns like Loops and whorls were significantly higher in males than females. Simple patterns like open fields were significantly higher in females than males. Total toe ridge count, triradial count and a-b ridge count were significantly higher in males than females. From this it appears that male shows more complex pattern than females which can give and additional information regarding the identity of and individual.
KEYWORDS: Plantar dermatoglyphics, sexual dimorphism, arches, loops, whorls.

INTRODUCTION: The term Dermatoglyphics pertains to the scientific study of epidermal ridges on palms, soles, fingertips and toes. Since long, these ridge patterns were used by fortune tellers for predicting the future. It was studied first time scientifically in seventieth century by an anatomist Midolw.(1) The term dermatoglyphics was coined by Herald Cummins in 1926. Later on large amount of information had been added to this science by anthropologists and genetists from time to time.(2) Thus the dermatoglyphics had been recognized as a valuable tool for medico-legal, anthropological and genetic studies.

Early in the fetal life in the 12th week of gestation, the differentiation of epidermal ridges starts. It continues till 19th week of gestation. The ridges on palms proceed on soles. These configurations are thus genetically determined but they are greatly influenced by physical, topographical and environmental factors. These patterns once formed do not change throughout the life of an individual. No two patterns are alike even in monozygotic (uniovular) twins. This characteristic feature is used by scientists for questioned paternity and other hereditary and genetic disorders.(3, 4, and 5)

Most of the workers had studied fingertip and palm patterns in various genetic and metabolic diseases in male and female. The studies of plantar dermatoglyphics are seemed to be neglected by the workers. So the present study is undertaken to know the sexual differences in plantar dermatoglyphics.

MATERIAL AND METHODS: Dermatoglyphic foot prints of 100 males and females were taken. These individuals were selected from staff and undergraduate students of government medical

college Aurangabad. The age group of these persons was in the range of 17 to 50 years. Plain white glossy drawing paper and Kores Duplicating ink was used for taking foot prints. After applying Kores Duplicating ink at the sole by a special ball prepared from cotton and gauze, toes were pressed and rolled over drawing paper. Then hallucal area was pressed firmly. After that Hypothenar area and lateral border of foot was pressed and finally Calcar area was pressed.

The foot prints obtained so was then numbered and filed together noting the information about the name, age and sex. The method which was used is the commonest and easiest advised by Strong (1929).[6] Dermatoglyphic configurations encountered in the sole are basically like those on the palms. They include whorls, loops, arches, open fields and vestiges. Superscripts d, p, f & t were used to identify the distal, proximal, fibular and tibial directions respectively of the patterns. The same rules for designating the patterns openings apply in both the palms and soles.

Patterns studied:

1. Arches: Simple arch and tented arch.
2. Loop: Tibial and fibular loop depending on the opening of the loop.
3. Whorls:
4. Vestiges: These do not represent true patterns but consists usually of a series of straight parallel converging ridges having a direction different from the neighboring ridged area. Vestiges give an impression of ridge disarrangement.
5. Open fields: These are the most common ridges configuration encountered in the distal palm and sole. These are truly pattern less areas formed by almost parallel ridges.

The areas studied on the soles are as follows.

1. **Hallucal area:** This is the combination of distal thenar and the first interdigital area. It covers the tibial area of the ball of the foot. Pattern identification is usually not difficult. The only discrepancy encountered is in the terminology used for simple arches, which are sometimes termed open fields with the symbol 'O' (Cummins and Midlow 1961).[1] The term open field should be reserved for situations where a series of ridges do not curve but follows a more or less straight line.

2. **Interdigital areas:** These are homologous to those found on the palms. Because, the first interdigital area belongs morphologically to the hallucal area, there are usually only three interdigital areas identified on the distal sole, labeled usually II, III & IV. Areas II-IV is bordered laterally by plantar digital triradii a & b, b & c, and c & d respectively.

3. Hypothenar area covers the fibular side of the sole between the interdigital areas and the heel.

4. Calcar area occupying the heel of the foot is usually patternless. Here open field is present. True patterns rarely occur. When found, they are described by symbols already explained.

Plantar Landmarks studied on the sole.

Typically there are five digital triradii in the distal region of the sole. Four of them are comparable to those found in the palms. They are labeled a, b, c & d in the tibiofobular direction, each of them located proximal to each of the digits II-V. The fifth triradius labeled e, located in the vicinity of the base of the digit I (great toe) does not have an analogue in the palm. Depending on the type of configuration, additional triradius may be present in the hallucal area. It is labeled 'f'. Frequently, one or more triradii labeled g, g1 & h are observed proximal to the hallucal and interdigital regions. The triradius near the fibular edge of the sole is labeled as h & centrally placed proximal triradii are named g & g1. Sole prints were studied with the help of hand lens and patterns were recorded as follows.

1) Qualitative Analysis:

A) Toe Tip Patterns

1) Arches
2) Loops a) Tibial b) Fibular c) Proximal d) Distal
3) Whorls
4) Vestiges
5) Open fields

B) Patterns in interdigital area

1) Hallucal area I
2) Interdigital area II
3) Interdigital area III
4) Interdigital area IV
5) Hypothenar area
6) Calcar area

C) Type of triradii on sole

2) Quantitative Analysis-

1) Triradial count
2) a-b ridge count
3) Total toe ridge count

The foot prints were studied with the help of above parameters.

OBSERVATION AND RESULTS: The foot prints were studied with the help of above parameters Observations were then Tabulated and analysed for statistical significance by applying 1) Chi square test for Qualitative parameters & 2) 't' test for quantitative analysis. The sole prints

of right side of male were compared with right side of female & left side of male with & left side of female. In these observations, statistically significant.

Differences were observed in following areas of sole & in the following parameters.

Sr. no	Areas	patterns	Male right	Male left	Female right	Female left
1	Interdigital area II	Ld	7	11	8	7
		Lp	30	24	11	18
		O	59	61	73	72
		W	3	3	8	3
		At	1	1	0	0
2	Interdigital area III	Ld	41	44	29	29
		Lp	8	6	13	12
		O	39	39	47	52
		W	12	11	11	7
3	Interdigital area IV	Ld	21	13	5	6
		Lp	0	2	3	4
		W	4	-	0	-
		O	73	84	92	90
		V	2	-	0	-
4	Hypothenar area	Lt	18	8	8	1
		A	1	0	0	2
		V	0	91	2	97
		O	81	1	90	0
5	Great toe pattern	A	18	22	21	29
		Lf	48	39	54	44
		Lt	2	4	2	2
		Lp	32	29	17	12
		W	0	4	1	5
		At	0	2	5	8
6	Type of Triradi	f	68	-	33	-
		g	38	-	42	-
		g 1	1	-	2	-
		h	10	-	2	-

Table-1: Qualitative Parameters on different areas of sole

f-Triradi present in the hallucal area g and g 1-Triradi present in the central areas of sole h-Triradi present near the fibular edge of sole Ld-Loop distal, Lp-Loop proximal Lf –Loop fibular, Lt Loop tibial, A-Arches, W-whorls, V-Vestiges, O-Open fields, At-Tented Arch.

1) Interdigital area II of Right side showed statistically significant difference in patterns. It showed increased frequency of proximal loops in males &increased frequency of open fields and whorls in females. P<0.05 & X2=12.73 (Table-1).

2) Interdigital area III of Left side showed statistically significant difference in patterns. It showed raised frequency of distal loop in Interdigital area III of Left side of male as compared with Left side of females. There was also raised frequency of whorls on left side of male & raised frequency of open fields and loop proximal in females. P<0.05 & X2=7.8 (Table-1)

3) Interdigital area IV on Right side showed increased frequency of loop distal in males (21) as compared with females (5) & also of whorls (4) & vestiges (2) in males than females with whorls (0) & vestiges (0). This variation was statistically significant with X2=20.02 & P<0.05. (Table-1)

4) Hypothenar area Von Left side showed raised frequency of loop tibial in hypothenar area V of Left side of males (8) as compared with females.[1] There was raised frequency of open fields (97) & vestiges[2] in females as compared with males with open fields (91) & vestiges (0) respectively. This was statistically significant with P<0.05 & X2=8.62. (Table-1).

5) Great toe patterns on Right side showed raised frequency of Loops proximal in males 32% as compared with females 17%.It showed raised frequency of Arches, Loop fibular whorls in females than males. This variation was statistically significant with X2=11.11 & P<0.05. (Table-1).

6) Great toe pattern on left side showed raised frequency of proximal oops (29%) in males than with females (12%). It also showed raised frequency of arches (29%) Loops fibular (44%) in females with similar patterns 22% &39% respectively in males. This was statistically significant with X2==12.66 & P<0.05. Statistically significant differences were also found in following parameters in foot prints of male and female. (Table-1).

Sr. no	Patterns	Male Right	Male Left	Female Right	Female Left
1	Triradi	Mean=6.1	Mean=6.12	Mean=5.76	Mean=5.76
		SD=0.81	SD=0.794	SD=0.668	SD=0.712
2	a-b ridge count	Mean=26.3	Mean=25.28	Mean=24.65	Mean=22.99
		SD=7.474	SD=7.098	SD=6.374	SD=6.404
3	Total Toe Ridge count	Mean=47.26		Mean=25.09	
		SD=27.865		SD=16.961	

Table-2: Quantitative parameters of Sole

7) Mean of Triradii present on Right side of males & females showed more number of triradii in males (6.1) as compared with females. Unpaired 't' test was applied and it was statistically significant. (Table-2)

8) Mean of Triradii on Left side of males were more than females showing SD=0.754 & Unpaired T test 3.372 which is statistically significant. (Table-2).

9) Type of triradii on Right side; It showed more f triradii on Right side of male (68%) as compared with females (33%). It also showed more h triradii in males (10%) as compared with (2%) in females. (Table-2).

10) a-b ridge count; It was raised on Left side in males as compared with females which was statistically significant with SD=6.759& unpaired T test=2.39. (Table-2).

11) Total toe ridge count: Its mean was higher in males (47.26%) than females (25.09%) SD=23.06 & T test=6.639 which was statistically significant. (Table-2).

DISCUSSION: Plantar dermatoglyphics has been studied very less. Blanka Schauman and Milton Alter (1976) & F Z Hassan et al (2000) have studied Plantar dermatoglyphics.[2, 7] The study was compared with the study by Blanka & it showed similar differences in male & female in hallucal area of Right side& Left side, Great toe pattern of Right side& Left side. The Total Toe Ridge Count was higher in males than females & it was in accordance with the study conducted by F.Z. Hassan et al. So, according to this study, males are having a complex pattern of plantar dermatoglyphics. It showed raised frequency of Whorls, Loops than in females. In females simple patterns like Open fields, Loops & Arches were more.

Dermatoglyphic patterns are determined genetically. The significant differences found in this study in between males and females are probably due to gene differences found in X &Y chromosomes.

CONCLUSION: From this study, it appears that male shows more complex patterns than females. Thus plantar dermatoglyaphics gives supplementary evidence regarding discrimination of sex.

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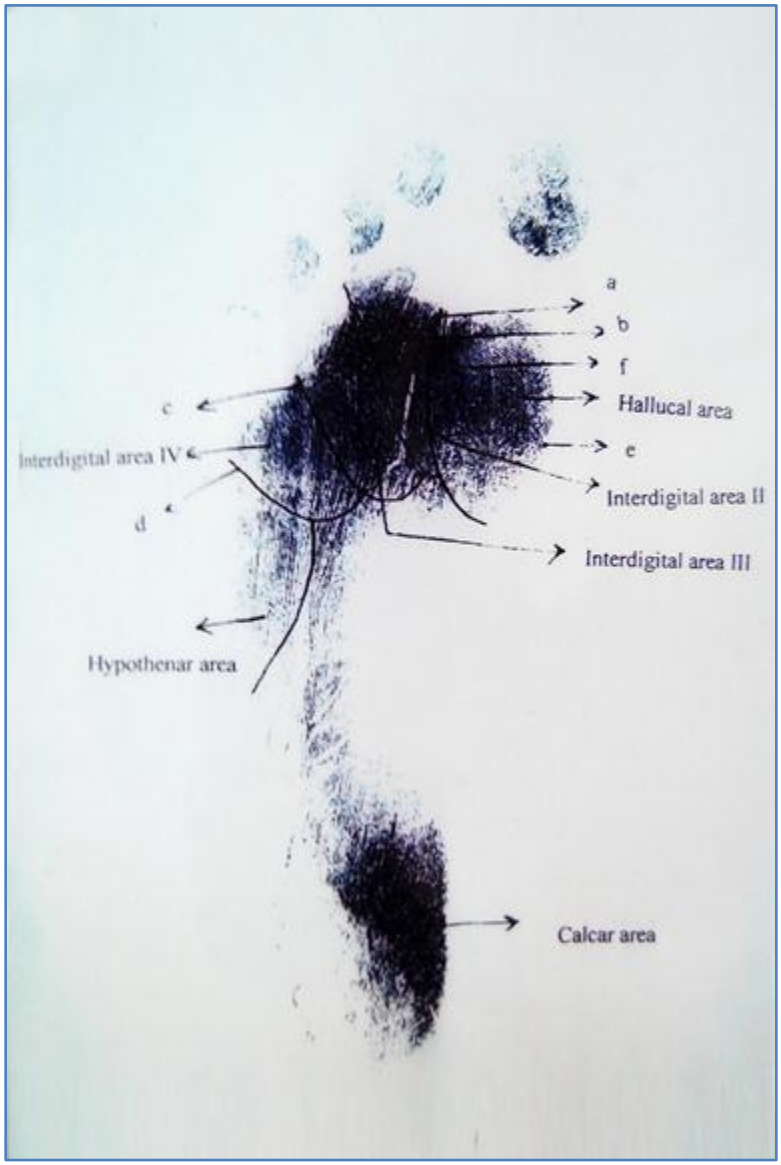

Fig. 1: Showing plantar landmarks

a, b, c, d, e, f – Digital triradii in tibiofibular direction.

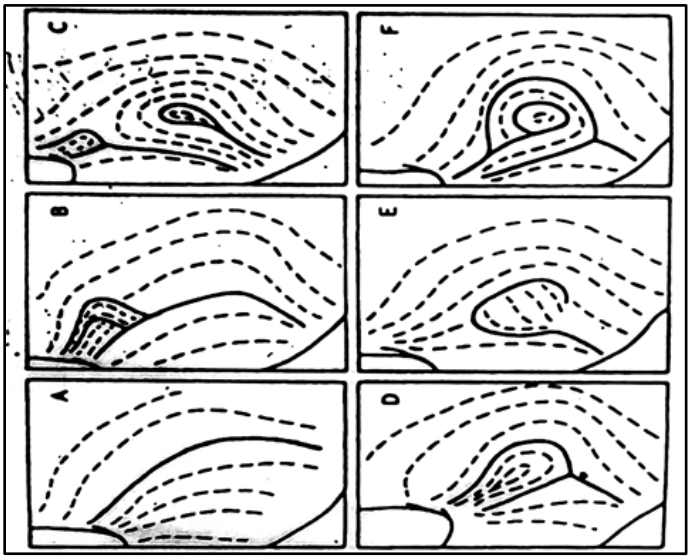

Fig. 2: showing types of hallucal/ interdigital areas patterns

(A - Open field, B – Open field/vestige, C – Loop, D – Loop, E – Vestige, F – Whorl)

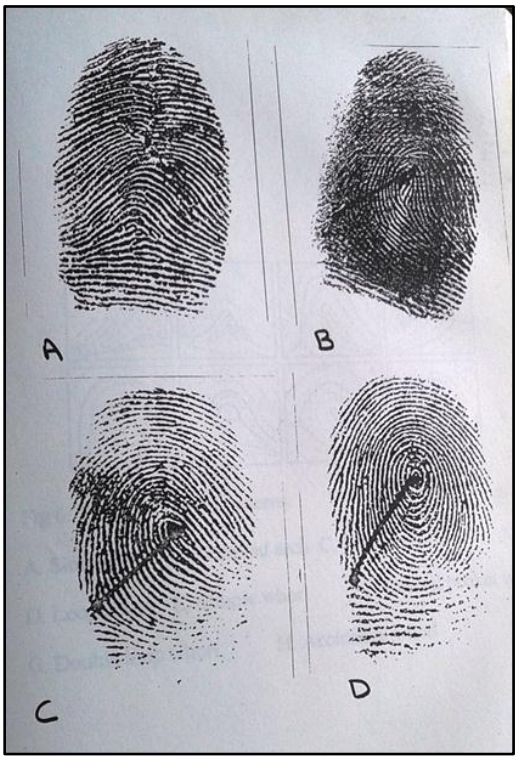

Fig. 3: Showing different dermatoglyphic patterns of toes

(A - Arch, B – Tibial Loop, C – Fibular Loop, D – Whorl)

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