DOI: 10.7860/IJARS/2022/51807.2753

Original Article

Anatomy Section

Palmar Dermatoglyphics in Essential Hypertensive Patients: An Analytical Cross-sectional Study

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ABSTRACT

Introduction: Dermatoglyphics deal with the study of papillary ridge patterns on the skin of fingers, palms, toes and soles. Each pattern is a unique anatomical marker, and their development is strongly affected by genetic and environmental factors.

Aim: To determine whether essential hypertensive patients have significant dermatoglyphic pattern association as compared to non hypertensive participants in the study population.

Materials and Methods: An analytical cross-sectional study was carried out in 228 patients (114 diagnosed essential hypertensive patients and 114 non hypertensive patients) attending the Department of Medicine at Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu, India, of both the sexes and belonging to different age groups. Informed consent was obtained from each individual. Palmar and fingertip prints of the patients and the controls were taken on the white crystal bond paper by modified Purvis-Smith method and the following parameters were analysed: i) Fingertip pattern frequency; ii) Total and Absolute Finger Ridge Count (AFRC); iii) a-b ridge count; and iv) 'atd' angle. The statistical contents like arithmetic mean and standard deviation were calculated and the t-test and Chi-square test were applied wherever necessary.

Results: There were more loop pattern in digit 2 of left hand of female hypertensives than controls. There was increased Total Finger Ridge Counts (TFRC) in both males (134.14±19.560; p-value=0.038) and females (131.42±27.777; p-value=0.001) hypertensives and significantly higher AFRC (187.65±67.806; p-value=0.001) in female hypertensives, There was decreased 'a-b' ridge count in both hands of male (right: 24.19±4.36; p-value=0.001 left: 24.54±3.586; p-value=0.001) and female (right: 23.65±3.43; p-value=0.001 left: 24.16±3.321; p-value=0.001) patients and decreased 'atd' angle in both hands of male (right: 38.86±4.001; p=0.003 left: 38.51±4.428; p-value=0.001) and right hand of female (40.70±4.476; p-value=0.009) hypertensive patients, as compared to that of controls.

Conclusion: As the parameters showed significant association, they can be used as dermatoglyphic markers for early detection of essential hypertension.

Keywords: Atd angle, Finger ridge count, Loop, Raised blood pressure

INTRODUCTION

Dermatoglyphics is the science and art of study of papillary ridge patterns on the skin of fingers, palms, toes and soles. All primates have ridged skin and dermatoglyphic patterns are seen on the paws of certain mammals and tails of some monkey species [1]. The term dermatoglyphics was coined by the anatomists Cummins H and Midlo C in 1926. Since the last 150 years, besides being the leading and most extensively used method for personal identification, dermatoglyphics has been utilised as a useful tool in understanding the fundamental questions in evolution, biology, medicine and genetics [2].

Embryogenesis of epidermal ridge pattern takes place early in foetal life and is genetically determined [2]. These patterns remain constant throughout the life of an individual except in dimension, which corresponds to their growth. Multiple genes govern the dermatoglyphic configuration, and their study provides vital genetic and medical information about an individual. Hence, dermatoglyphics has a central role in the identification of most of the gene-linked medical disorders like hypertension, diabetes mellitus, congenital heart diseases, systemic lupus erythematosis [3].

At present, hypertension is a dominant health problem in India. Over the last 50 years, there has been a constant rise in the prevalence of hypertension across the world, which is independent of the income status of the country [4]. About 95% of hypertension cases are categorised as essential, primary or idiopathic hypertension, which by definition has no detectable cause [5]. Essential hypertension tends to be familial and is currently recognised as a multi-factorial disease arising from the combination of many genetic, environmental and behavioural factors. As most of the affected individuals remain asymptomatic, early diagnosis is a problem. If left untreated it increases the likelihood of developing complications which are the major cause of morbidity and mortality [6].

Dermatoglyphics serves as a device to describe, differentiate, and at times to foretell the occurrence of most gene-linked disorders. The present study was aimed to study the dermatoglyphic pattern in patients with essential hypertension, analyse various quantitative and qualitative parameters, compare these statistically with the dermatoglyphic pattern in individuals who are not suffering from it, look for significant markers if any.

MATERIALS AND METHODS

An analytical cross-sectional study was carried out in 228 subjects {114 essential hypertensive (57 males and 57 females) and 114 non hypertensive (57 males and 57 females)} attending the Department of Medicine, Sree Mookambika Institute Of Medical Sciences, Kulasekharam, Tamil Nadu, India, between the age group of 30-70 years. After getting approval from Institutional Human Ethical Committee, (Ref.No. SMIMS/IHEC/2013/A/04) the study was carried out. Informed consent was obtained from each individual and the palmar prints of the patients and the controls were taken on the white crystal bond paper by ink method [Table/Fig-1].

Inclusion criteria: Patients of either sex (57 male, 57 female) with sustained high blood pressure (≥140/90 mmHg) without any specific underlying cause [5] were included.

Exclusion criteria: Patients who were unwilling, suffering from diseases that cause secondary hypertension, suffering from any

[Table/Fig-1]: Methodology of finger and palm printing.

chronic skin disease such as eczema, leprosy, chronic dermatitis, or those having congenital or acquired anomalies of fingers were excluded from the study.

Qualitative Analysis

Fingertip pattern: Using a magnifying lens, the fingertip patterns were studied carefully. To analyse the pattern frequency, the configurations were classified as Arches (A), Loops (L) and Whorls (W) based on the presence or absence of triradii [7].

Quantitative Analysis

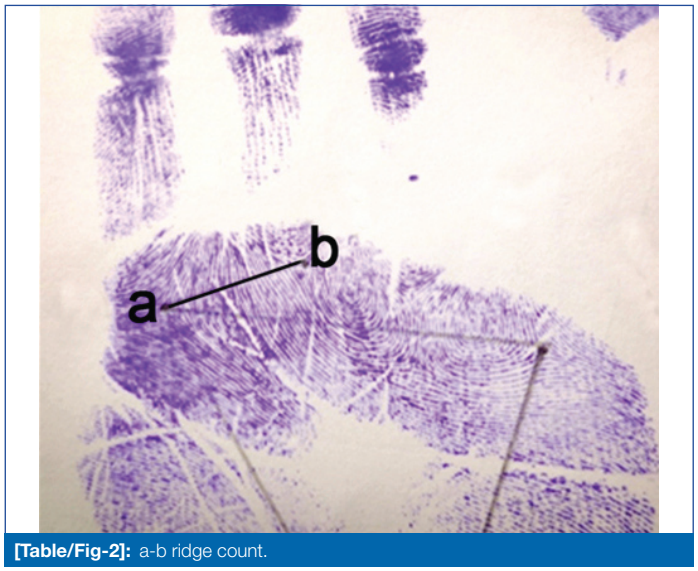
Ridge counting was done along the straight line connecting the core and the triradius. In the case of a whorl with two triradii and one point of core, two different counts were made, one from each triradii.

a. Total Finger Ridge Count (TFRC): Sum of ridge counts of all the ten digits. In digits with more than one ridge count (whorls) only the larger count was used [8].

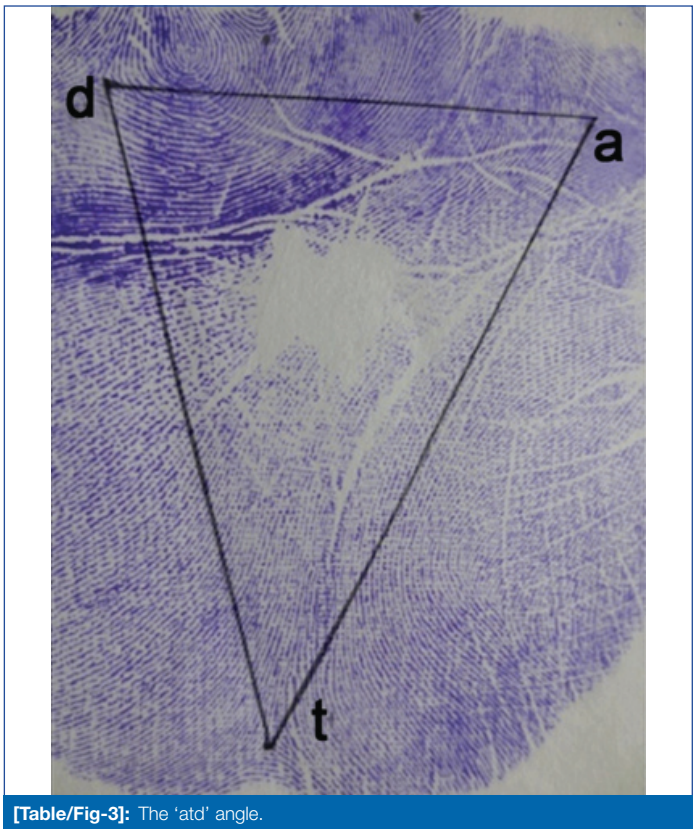
b. Absolute Finger Ridge Count (AFRC): It is the sum of the ridge counts of all the separate triradii on the 10 digits. i.e, in the presence of whorl on the digit, count from both the triradii was included [8].

c. 'a-b' Ridge count: It is the number of ridges intersected by the line drawn between the triradii 'a' and 'b' present at the bases of the index and the middle fingers of each hand, respectively [Table/Fig-2].

d. 'atd' angle: It was recorded by drawing lines from the triradius 'a' present in the first inter-digital area to the axial triradius 't' and from this to the triradius 'd' of the fourth inter-digital area [Table/Fig-3]. The numeric value of the 'atd' angle was measured in both hands using protractor.



[Table/Fig-2]: a-b ridge count.



[Table/Fig-3]: The 'atd' angle.

STATISTICAL ANALYSIS

In order to see whether the dermatoglyphic patterns in essential hypertensive patients were different from those of control groups, results were presented in terms of mean±SD for quantitative data and simple percentage calculation for frequency distribution. For determining the statistical significance of different variables, quantitative data was analysed by student's independent t-test and qualitative data by Chi-square test. The p-value ≤0.05 was considered significant. All analysis was done by using Statistical Package for the Social Sciences (SPSS) version-20.

RESULTS

Fingertip pattern in digit 2 of left hand of female patients showed more loops and less number of arches than controls [Table/Fig-4]. Increased TFRC in male (134.14±19.560; p-value=0.038) and female (131.42±27.777; p-value=0.001) patients than the controls (male: 124.49±28.585 and female: 100.56±27.177) [Table/Fig-5].

Significantly higher AFRC count was seen in female patients (187.65±67.806; p-value=0.001) than in the controls (131.82±47.046) [Table/Fig-5]. Decreased 'a-b' ridge count in both hands of male (right: 24.19±4.36; p-value=0.001, left: 24.54±3.586; p-value=0.001) and female (right: 23.65±3.43; p-value=0.001, left: 24.16±3.321; p-value=0.001) hypertensive patients than, male (right: 28.86±5.88, left: 28.49±5.632) and female (right: 31.53±4.43, left: 32.72±4.992) controls [Table/Fig-6].

Decreased 'atd' angles in both hands of hypertensive males (right: 38.86±4.001; p-value=0.003, left: 38.51±4.428; p-value=0.001) and right hand of hypertensive females (40.70±4.476; p-value=0.009) than the controls (male: right- 41.49±5.172, left- 41.84±5.561 female: right- 43.33±6.001) [Table/Fig-7].

DISCUSSION

As dermatoglyphic patterns are genetically regulated characteristics, any deflection in this pattern, specifies significant genetic difference

Variables		Right hand digits					Left hand digits				
		1	2	3	4	5	1	2	3	4	5
Male (patients)	Whorl	30	29	13	38	18	29	26	23	34	16
	Loop	27	23	44	19	39	28	28	32	23	41
	Arch	0	5	0	0	0	0	3	2	0	0
Male (control)	Whorl	26	24	13	37	16	26	23	23	34	17
	Loop	31	26	43	19	39	31	27	32	23	37
	Arch	0	7	1	1	2	0	7	2	0	3
Chi-square value		0.562	0.989	1.011	1.013	2.118	0.316	1.802	0.001	0.001	3.235
Significance (p-value)		0.454	0.610	0.603	0.603	0.347	0.574	0.406	1.000	1.000	0.198
Female (patients)	Whorl	30	32	15	32	17	27	31	27	31	21
	Loop	27	22	38	25	40	30	24	24	26	36
	Arch	0	3	4	0	0	0	2	6	0	0
Female (control)	Whorl	25	23	13	32	11	27	28	16	32	14
	Loop	30	28	42	24	44	26	19	35	23	42
	Arch	2	6	2	1	2	4	10	6	2	1
Chi-square value		2.612	3.193	1.010	1.020	3.476	4.286	6.067	4.865	2.200	2.862
Significance (p-value)		0.271	0.203	0.600	0.600	0.176	0.117	0.048	0.088	0.333	0.239

[Table/Fig-4]: Fingertip pattern frequency of both hands in 114 hypertensive patients and 114 controls.

Variables	Male			Female		
	Patient	Control	Total	Patient	Control	Total
TFRC (μ±σ)	134.14±19.560	124.49±28.585	129.32±24.860	131.42±27.777	100.56±27.177	115.99±1.442
F-value	4.424			35.945		
Significance (p-value)	0.038			0.001		
AFRC (μ±σ)	181.00±47.363	165.18±54.667	173.09±51.535	187.65±67.806	131.82±47.046	159.74±64.509
F-value	2.728			26.080		
Significance (p-value)	0.101			0.001		

[Table/Fig-5]: TFRC and AFRC in 114 hypertensive patients and 114 controls-hands combined.

Variables	Male			Female		
	Patient	Control	Total	Patient	Control	Total
Right hand a-b ridge count (μ±σ)	24.19±4.36	28.86±5.88	26.53±5.67	23.65±3.43	31.53±4.43	27.59±5.58
F-value	23.081			112.845		
Significance (p-value)	0.001			0.001		
Left hand a-b ridge count (μ±σ)	24.54±3.586	28.49±5.632	26.52±5.101	24.16±3.321	32.72±4.992	28.44±6.025
F-value	19.924			116.222		
Significance (p-value)	0.001			0.001		

[Table/Fig-6]: 'a-b' ridge count in 114 hypertensive patients and 114 controls- right and left hands.

Variables	Male			Female		
	Patient	Control	Total	Patient	Control	Total
Right hand 'atd' angle (μ±σ)	38.86±4.001	41.49±5.172	40.18±4.794	40.70±4.476	43.33±6.001	42.02±5.433
F-value	9.214			7.045		
Significance (p-value)	0.003			0.009		
Left hand 'atd 'angle (μ±σ)	38.51±4.428	41.84±5.561	40.18±5.277	42.11±4.526	42.81±5.826	42.46±5.206
F-value	12.533			0.516		
Significance (p-value)	0.001			0.474		

[Table/Fig-7]: 'atd' angle in 114 hypertensive patients and 114 controls- right and left hands.

between the study groups. Though dermatoglyphics are considered to have limited role as a diagnostic tool, it has moved from uncertainty to acceptability. Essential hypertension is a disease with polygenic inheritance [5]. In the present study, some of the important parameters of dermatoglyphic patterns were compared in inherited essential hypertensive patients and non hypertensives to discover significant difference between test and control groups.

Fingertip pattern frequency: In general, the most frequently seen ridge pattern is loop (60%-70%), followed by whorl (25%-30%) and the least common and simple pattern is the arch (5%) [9]. In the study done by Chakravarthy PG et al., whorls were the most frequent distribution in all the fingers of hypertensive, and normotensive showed significant association with ulnar loop [10]. This was in accordance with the previous works done by Jain PK et al., Oladipo GS et al., Godfrey KM et al., [11-13].

In the present observation, study groups of either sex showed the conventional ridge pattern, dominated by loops followed by whorls and then arches. A significant association was noticed in the digit 2 of the left hand of female patients, with more loops and less number of arches than the controls (p-value=0.048). Fingertip pattern of male subjects did not show any association with hypertension. It is in concordance with Umana UE et al., who noticed high frequency of loop pattern in both cases and controls, with females showing significant association [14].

The TFRC and AFRC: Reflects the pattern size and its intensity. In the absence of whorls in fingertip pattern, total and absolute ridge count remains the same. Oladipo GS et al., found that the digital ridge count is a good marker for essential hypertension, since the individuals with hypertension had TFRC more than or equal to 100 [12]. In the present study, TFRC was noticed to be significantly higher in males (134.14±19.560) and female hypertensive patients (131.42±27.777) when compared to that of the control groups (male: 124.49±28.585; female:100.56±27.177), which was in line with the findings of Kulkarni SKG et al., and Palyzova D et al., [15,16]. AFRC in the present study also showed higher values in male and female patients compared to that of controls, with only females (patient: 187.65±67.806, control: 131.82±47.046) showing statistically significant association. But Rudragouda SB et al., noticed that the AFRC in male patients were less compared to that of controls, wherein female patients had higher counts as compared to that of control group [17].

a-b ridge count: Tafazoli M et al., found no significant difference between test and control groups, but she noticed that female patients showed increased frequency of higher a-b ridge counts than the controls and in male patients mean a-b ridge count was less when compared to that of controls [18]. In the present study, significant difference was noticed between the patient and control groups in both hands of males and females, with the patients having significantly lower a-b ridge count (male:right-24.19±4.36, left 24.54±3.586; female:right-23.65±3.43, left- 24.16±3.321) than the controls (male:right-28.86±5.88, left- 28.49±5.632; female:right-31.53±4.43, left-32.72±4.992). This was in agreement with Palyzova D et al., Deepa G and Sumangala KD et al., [16,19,20].

'atd' angle: 'atd' angle is marked for being age and sex related. It is broader in male and tends to reduce with increasing age, as palm grows more in length than width. It is also used for interpreting the position of axial triradius. i.e., angle value less than 45° is designated as t, values between 45° and 56° as t' and values greater than 56° as t". Hence, more distal the axial triradii, broader is the 'atd' angle [21].

Jain PK et al., reported decreased 'atd' angle in hypertensive cases of both sexes as compared to that of the controls [11]. Kulkarni DU, Pursnani ML et al., and Kwami AO et al., also revealed the same result [22-24]. Oladipo GS et al., found no significant difference between the 'atd' angles of patient and control groups [12]. In another study conducted by Godfrey KM et al., he noticed that people with long hand relative to their breadth and a narrow palmar 'atd' angle had higher systolic pressure and this association was stronger for the right hand [13]. In the present study, both hands of male and right hand of female patients showed significant association, wherein the patients had lower 'atd' value (male:right: 38.86±4.001, left: 38.51±4.428 and female:right-40.70±4.476) than the controls (male:right-41.49±5.172, left-41.84±5.561, female:right-43.33±6.001) [Table/Fig-8] [10,12,14,15,17-20,24,25].

Whereas, Zeenat A et al., noticed higher mean 'atd' angle in both hands of hypertensive subjects than normotensives, with significant association in left hand [25]. Similar finding was reported by Chakravarthy PG et al., [10]. This disagreement in observations could be connected to variable methods employed in the computation of 'atd' angle depending on the position of triradii. Additionally variations can occur due to altered position of fingers (approximated or spread-out) and amount of pressure applied while obtaining the print [Table/Fig-8].

Author and year of study	Country	Study group	Dermatoglyphic parameters				
			Fingertip pattern	TFRC	AFRC	a-b RIDGE count	'atd' angle
Oladipo GS et al., (2010) [12]	Nigeria	Cases: 50 (M-26, F-24) Controls:50 (M-26, F-24)	High frequency of whorls in both hands of hypertensive	More than or equal to 100 in EHP	NR	NR	Left hand of hypertensive males had significantly higher 'atd' value than controls
Deepa G, [19] (2013)	India	Cases:100 (M-50, F-50) Controls:100 (M-50, F-50)	Digit-2 of female hypertensive had more whorls &loops , and least arches than controls	Digit 1 &5 of both hands & Digit 2 of right hand of hypertensive had higher value	NR	Decreased in EHP	Decreased in EHP
Tafozoli M et al., (2013) [18]	Iran	Cases: 40 Controls: 20	High frequency of whorls and arches in EHP	NR	NR	Less in male and more in female hypertensive than controls, (insignificant)	Higher in patients than controls with significance only in left hand of female patients
Rudragouda SB et al., (2013) [17]	India	Cases:100 Controls:100	Both hands of male and female EHP showed more arches & radial loops.	Less in male patients (significant). More in female patients (insignificant)	Less in male and more in female patients (both insignificant)	NR	Mean value in both hands of female and left hand of male patients was less than controls (insignificant)
Kulkarni SKG et al., (2014) [15]	India	Cases:200 (M-104, F-96) Controls:200 (M-104, F-96)	Both hands of EHP had high frequency of whorls and low ulnar loops	High in both hands of hypertensive	NR	NR	Low 'atd' value in both hands of EHP
Umana UE et al., [14] (2014)	Nigeria	Cases: 118 Controls:126	Both groups had high frequency of loops followed by whorls and arches. Females showed significant association with patients having higher value than controls	NR	NR	NR	NR
Sumangala KD et al., (2016) [20]	India	Cases:100 (M-50, F-50) Controls:100 (M-50, F-50)	NR	No difference noticed between groups	No difference noticed between groups	Lower in cases than controls (Significant)	Significantly lower in cases than controls

Chakravarthy PG et al., (2018) [10]	India	Cases: 250 (M:120, F:130 Controls:250 (M:137, F:113	In both sexes, hypertensive showed high frequency of whorls in all fingers	NR			Both hands of cases had higher value with significant association only in right hand
Zeenat A et al., (2020) [25]	India	Groups: NR Participants: M-200, F-200	NR	NR	NR	NR	Mean value was higher in both hands of hypertensive with significant association in left hand
Kwami AO et al., (2021) [24]	Ghana	Cases: 200 (M: 100, F: 100) Controls: 200 (M: 100, F: 100)	Both groups showed high frequency of loops followed by whorls and arches	NR	NR	NR	Both hands of EHP showed significantly lower value than controls
Present study (2021)	India	Cases:114 (M-57, F-57) Controls:114 (M-57, F-57)	High frequency of loops followed by whorls and arches in both groups. Significance in digit 2 of left hand of females , with patients having more loops and less arches than controls	Significantly higher in male and female patients	Significantly higher in female patients	Decreased count in both hands of male and female patients (significant)	Significantly decreased in both hands of male and right hand of female patients

[Table/Fig-8]: Synopsis of studies that determined the association of dermatoglyphics with essential hypertension [10,12,14,15,17-20,24,25].

Limitation(s)

In the present study, the sample size was small (114 hypertensive patients and 114 non hypertensive participants) and only few variables were analysed. The conventional method used in recording the finger print also has drawbacks, compared to the advanced software programmes available.

CONCLUSION(S)

In dermatoglyphics, any deviation from normal pattern will not establish a diagnosis by itself, but they would remind the physician to do an in-depth examination than usual to find out any hidden or latent diseases. In the present study we tried to determine significant palmar dermatoglyphic parameters in case of essential hypertension between the age group of 30-70 years and noticed increased TFRCs and AFRCs and decreased a-b ridge count and 'atd' angle in hypertensive than controls. It is believed that, like clinical history, examination and investigations, the positive dermatoglyphic parameters will also have a crucial role in screening cases of essential hypertension.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Aug 12, 2021
- Manual Googling: Dec 03, 2021
- iThenticate Software: Dec 21, 2021 (7%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Aug 07, 2021**
Date of Peer Review: **Sep 07, 2021**
Date of Acceptance: **Dec 04, 2021**
Date of Publishing: **Jan 01, 2022**