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A comprehensive study to evaluate any significant role of Dermatoglyphic patterns of palm in tuberculosis patients and review of literature

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Abstract
Background: Dermatoglyphics is the scientific study of epidermal ridges and their configurations on the palmar region of hand and fingers and plantar region of foot and toes. In this study, we tried to determine significant palmar Dermatoglyphic parameters in pulmonary tuberculosis patients and whether the parameters can be used for screening purpose i.e. early detection of susceptible.
Method: We have studied total 100 patients (80 males and 20 females) of Tuberculosis. Similarly equal numbers of normal healthy individual were included as controls. The Palmar Prints of the patients and the controls were taken on the "Map Litho White paper" by the "INK METHOD "as described by CUMMINS and MIDLO with Black duplicating ink (Camel). Prints obtained were immediately examined with hand lens.
Result: There is significant decrease in loops (P<0.001) with corresponding increase in whorls patterns (P<0.001) in Tuberculosis patients in comparison with control group. Arches are decreased but not significant. Whorls are increased significantly in Tuberculosis (P<0.001). Mean value of TFRC and AFRC is increased in Tuberculosis but not significant. Mean value of a-b Ridge Counts decreased in females with slight increase in males but statistically not significant. Mean value of atd Angle is significantly decreased in Tuberculosis (P<0.002).
Conclusion: The present study indicates that there are some genetic factors which are involved in the causation of tuberculosis and it is possible to certain extent to predict possibility of acquiring tuberculosis from Dermatoglyphics. This study also warrants further large scale case control studies to establish the exact relation between Tuberculosis and Dermatoglyphics.

Keywords: genetics, palmar dermatoglyphics, screening, tuberculosis

Introduction
Dermatoglyphics is the scientific study of epidermal ridges and their configurations on the palmar region of hand and fingers and plantar region of foot and toes. The term Dermatoglyphics was coined by Cummins and Midlo [1] in 1926 and was derived from Greek words 'derma' means skin and 'glyphics' means carvings [2]. The ridge pattern depends upon the cornified layer of epidermis and dermal papillae. Once formed in foetal life, remain unchanged throughout the life except in the dimension in proportion to the growth of a person [3]. This is evident from the clear resemblance of Dermatoglyphics among related persons. There are many diseases known to be caused by abnormal genes. Whenever there is any abnormality in the genetic makeup of parents it is inherited to the children and is reflected in Dermatoglyphic pattern [4]. Dermatoglyphics is not diagnostic tool but is employed as a method of screening abnormal anomalies established in a number of diseases [5]. Various studies have been conducted so far for the association of Dermatoglyphics with diseases like Down's syndrome, Klienfelter's syndrome, Turner's syndrome, Congenital heart disease, Carcinoma cervix, Rheumatic disease, Essential hypertension, Asthma, Eczema, Diabetes, Schizophrenia and many more. Apart from its use in predicting the diagnosis, Dermatoglyphics is also used in Anthropology, Genetic Medicine, Forensic science and Palmistry.

Why Tuberculosis?
Tuberculosis is one of the most important causes of mortality and morbidity in developing countries. Worldwide, 9.6 million people are estimated to have fallen ill with Tuberculosis in 2014. Globally, 12% of the 9.6 million new cases in 2014 were HIV-positive. Tuberculosis now ranks alongside HIV as a leading cause of death worldwide. HIV's death toll in 2014 was estimated at 1.2 million, which included the 0.4 million Tuberculosis deaths among HIV positive people [6]. Though India is the second-most populous country in the world, one fourth of the global incident Tuberculosis cases occur in India annually. MDR (Multi Drug Resistance) Tuberculosis has made the treatment failure common and made researchers to work hard in the direction of prevention of the disease like vaccination.

Materials & Methods
The study was carried for a period of 1 year from Jan 2015 to Dec 2015, with diagnosed pulmonary tuberculosis patients in

Medicine department, PDU Medical College and Civil hospital, Rajkot, India. 100 patients [80 Males and 20 Females] between the age group of 20-70 years were taken up for the study and 100 healthy people of same age group and sex stratification as control. Informed consent was taken from individual persons and the study was approved by Institutional Ethics Committee. All the patients gave the informed consent for inclusion into study and the study was performed in accordance with the Ethical standards of the 1964 Declaration of Helsinki as revised in 2000.

Inclusion criteria

1. The patients who were diagnosed after Sputum microscopy, chest X-ray and culture method were included in the study.
2. Age group of 20-70 years

Exclusion criteria

1. Any deformity, injury, burn or scar mark of fingers and palm
2. Associated known genetic disease

Material used

Camel quick drying duplicating ink, Rubber roller, Inking Slab, Thick glass sheet fixed over Century board, White 'Map Litho' paper with a glazed surface on one side, Rubber pressure pad, Cotton puffs, Ruler scale, Pencil pen, Sharp pointed needle for ridge counting and Protractor to measure 'atd' Angle.

Procedure

After washing hands with soaps and water, requisite amount of ink was uniformly spread by the rubber roller to get a thin even ink film on the glass slab. Uniform impregnations of the palm and digits are made taking care that the hollow of the palm and the flexor creases of the wrist. If still not enough, further ink was poured into the hollow of the palm with the help of cotton puffs. Left followed by right hand of the subject was then placed on the sheet of paper over the pressure pad from proximal to distal end. The palm was gently squeezed between inter-metacarpal grooves at the root of fingers and on the dorsal side corresponding to thenar and hypothenar regions. The palm was then lifted from the paper in reverse order, from the distal to proximal. The fingers were also printed below the palmar print by rolled finger print method. The tips of the fingers were rolled from radial to ulnar side to include all the patterns. The prints were then subjected for detail Dermatoglyphic analysis with the help of magnifying hand lens and ridge counting was done with the help of a sharp needle. The details were drawn with the pencil. The data was analyzed under following headings (Figure 1) and are subjected to statistical tests to evaluate significant pattern of identifiable difference between Tuberculosis and Controls.

1. Qualitative analysis of finger Prints

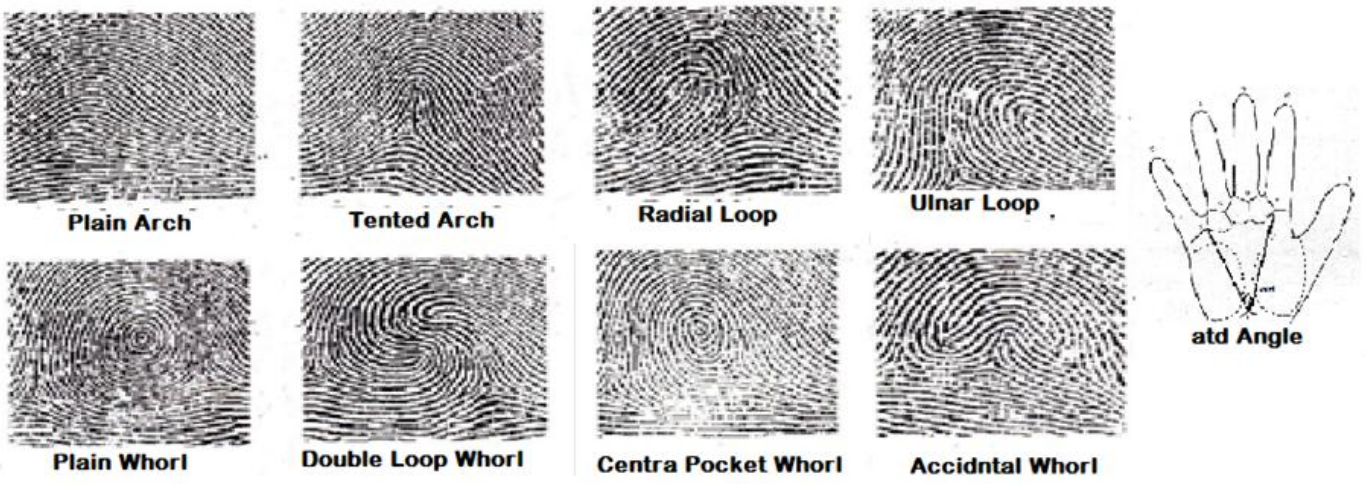
i) Loops
ii) Arches
iii) Whorls

2. Quantitative analysis of Finger Print

i) Total finger Ridge Count (TFRC)
ii) Absolute Finger Ridge Count (AFRC)

3. a b Ridge Count

4. atd Angle



Results

In the present study, mean age of male and female is 45.18 and 43.83 years respectively in Tuberculosis as compared to 41.29 and 43.12 years respectively in controls. Our observations are as below. (Table 1-9)

1. Loops are decreased in Tuberculosis in both sexes and both hands with significant decrease in Tuberculosis males ($P<0.01$) and Males + Females ($P<0.001$).
2. Arches are decreased in Tuberculosis in both sexes but not significant.
3. Whorls are increased in Tuberculosis in both sexes with significant increase in Tuberculosis males ($P<0.001$) and Males + Females ($P<0.001$).
4. Mean value of TFRC and AFRC is increased in Tuberculosis in both sexes as compared to the controls but not significant.
5. Mean value of a-b ridge count is decreased in Tuberculosis females and Males + Females with slight increase in mean value in Males.
6. Mean value of atd Angle is significantly decreased in Tuberculosis Males ($P<0.001$) and Males + Females ($P<0.002$).

Table 1: Percentage wise distribution of total fingertip patterns in Tuberculosis and Controls

Subject	Sex	Side	Total	% Loops	Total	% Arches	Total	% Whorls
Tuberculosis	M	R	197	49.3	25	6.3	177	44.3
		L	208	52.0	24	6.2	168	41.8
		R+L	405	50.7	49	6.3	344	43.1
	F	R	60	60	9	9	32	32
		L	54	54	9	9	36	36
		R+L	114	57	18	9	68	34
	M+F	R	257	51.3	34	6.8	209	41.9
		L	262	52.5	34	6.8	203	40.7
		R+L	519	51.9	68	6.8	412	41.2
Controls	M	R	216	54	34	8.3	150	37.5
		L	240	60	29	73	131	32.7
		R+L	456	57.1	63	7.8	281	35.1
	F	R	64	64	11	10.7	25	25
		L	60	60	9	9.3	31	31
		R+L	214	62	20	10	56	28.3
	M+F	R	280	56.1	45	8.8	175	35.1
		L	300	60	38	7.7	162	32.4
		R+L	580	58.0	83	8.3	337	33.7

Table 2: Statistical comparison of different fingertip pattern between Tuberculosis and Controls

Sex	Subject	Finger Tip Patterns		
		Loops	Arches	Whorl
M	Tuberculosis	405	49	344
	Control	456	63	281
	Chi Sq.	6.54	1.62	10.42
	p-Value	0.01054161	0.17010701	0.00148834
	Significance	Significant	Not Significant	Highly Significant
F	Tuberculosis	114	18	68
	Control	124	20	56
	Chi Sq.	1.03	0.11	1.68
	P-Value	0.30852022	0.73341397	0.1945263
	Significance	Not Significant	Not Significant	Not Significant
M+F	Tuberculosis	519	67	412
	Control	580	83	337
	Chi Sq.	7.51	1.84	8.71
	p-Value	0.00611533	0.17436605	0.00315776
	Significance	Highly Significant	Not Significant	Highly Significant

Table 3: Statistical calculation for TFRC in Tuberculosis and Control

Subject	Sex	Mean	Sd	Se-M	Cv (%)
Tuberculosis	M	148.12	38.51	4.30	20.80
	F	140.00	56.13	12.55	8.01
	M+F	146.10	42.40	4.21	29.15
Control	M	146.25	46.91	5.24	25.66
	F	127.5	50.26	11.23	7.88
	M+F	142.25	48.15	4.81	33.85

Table 4: Test of significance for TFRC for comparison between Tuberculosis and Controls

Comparison	t-Value	p-Value	Significance
M	0.275	0.39	Not Significant
F	0.741	0.23	Not Significant
M+F	0.600	0.27	Not Significant

Table 5: Statistical Calculation for AFRC in Tuberculosis and Control.

Subject	Sex	Mean	SD	SE-M	CV (%)
Tuberculosis	M	200.15	77.92	8.76	30.92
	F	167.05	84.00	7.90	37.54
	M+F	193.42	79.36	7.89	35.79
Control	M	192.12	88.57	9.8	36.41
	F	157.73	77.70	16.95	37.66
	M+F	185.04	87.20	8.63	36.69

Table 6: Test of significance for AFRC for comparison between Tuberculosis & Control

Comparison	t Value	P Value	Significance
M	0.846	0.19	Not Significant
F	0.301	0.38	Not Significant
M+F	2.434	0.01	Not Significant

Table 7: Statistical calculation for atd Angle in Tuberculosis and Controls

Subject	Sex	Side	Mean	SD	SE-M	CV (%)
Tuberculosis	M	R	39.31	4.19	0.41	10.65
		L	39.18	4.72	0.47	12.05
		R+L	39.25	4.45	0.44	11.34
	F	R	40.50	4.72	0.47	11.67
		L	40.25	5.25	0.52	13.04
		R+L	40.37	4.93	0.49	12.22
	M+F	R	39.55	4.30	0.43	10.88
		L	39.40	4.82	0.48	12.24
		R+L	39.47	4.56	0.45	11.55
Controls	M	R	40.75	5.33	0.53	13.08
		L	40.87	5.08	0.50	12.42
		R+L	40.81	5.19	0.51	12.71
	F	R	40.00	5.23	0.52	13.04
		L	42.75	5.49	0.54	12.85
		R+L	41.37	5.47	0.54	13.23
	M+F	R	40.6	5.29	0.52	13.03
		L	41.25	5.19	0.51	12.58
		R+L	40.92	5.23	0.52	12.80

Table 8: Test of Significance for atd angle for comparison between Tuberculosis and Controls

Comparison	t - Value	p -Value	Significance
M (Right)	1.900	0.030	Significant
M (Left)	2.180	0.015	Significant
M (Right + Left)	2.886	0.002	Significant
F (Right)	0.317	0.376	Not Significant
F (Left)	1.472	0.074	Significant
F (Right + Left)	0.137	0.446	Not Significant
M+F (Right)	1.540	0.063	Significant
M+F (Left)	2.612	0.004	Significant
M+F (Right + Left)	2.955	0.002	Significant

Table 9: Calculation for a-b Ridge Count

Subject	Sex	Side	Mean	SD	SE-M	CV (%)
Tuberculosis	M	R	39.81	4.65	0.46	11.69
		L	40.18	5.26	0.52	13.10
		R+L	39.87	5.00	0.50	12.55
	F	R	39.25	5.34	0.53	13.62
		L	40.25	6.97	0.69	17.32
		R+L	39.50	6.42	0.69	16.26
	M+F	R	39.75	5.24	0.52	13.18
		L	40.20	5.61	0.56	13.95
		R+L	39.86	5.26	0.53	13.21
Controls	M	R	39.12	5.39	0.53	13.78
		L	40.43	5.15	0.51	12.74
		R+L	39.72	5.27	0.52	13.28
	F	R	41.09	6.01	0.60	14.63
		L	41.5	4.89	0.48	11.79
		R+L	41.00	5.86	0.58	14.29
	M+F	R	39.6	5.65	0.55	14.00
		L	40.65	5.09	0.51	12.54
		R+L	40.12	5.33	0.33	13.30

Discussion

The etiology of Tuberculosis is multifactorial with genetics playing an important role. Few recent studies that aim at the identification of genes that impact on innate resistance to infection or antimicrobial immunity from South Africa, France and Canada employing the tuberculin skin test as a tool to evaluate resistance to infection found out a major locus (TST1) on chromosomal region 11p14 for T-cell independent resistance to Mycobacterium Tuberculosis. In addition, a second major locus (TST2), on chromosomal region 5p15 was identified that controls the intensity of T-cell mediated delayed type hypersensitivity (DTH) to tuberculin.[6] The finding of a strong host genetic control of anti-mycobacterial immunity justifies the purpose of this study aiming correlation between Dermatoglyphics and Tuberculosis. We have studied highest number of Dermatoglyphic parameters than any other previous study. We also compared our study with other studies which further confirms an association of Tuberculosis and Dermatoglyphic patterns. (Table 10)

Table 10: Comparison of various studies on dermatoglyphics in Tuberculosis

S. No.	Name of Study	One or more positive conclusions in Tuberculosis patients
1	Rashad and Mi *et al*(1975)[8]	1. Significant increase in whorl pattern 2. Significant decrease in loop pattern 3. No difference in arch pattern 3. Increase in TFRC and AFRC 4 No difference in a-b ridge count 5. Significant narrowing in atd angle
3	Dhall *et al* (2000)[9]	
4	S S Babu *et al* (2005)[10]	
5	K. B. Khairnar *et al* (2012)[11]	
6	Navgire Varsha *et al* (2014)[12]	
7	Our study (2015)	
8	L. S. Sidhu *et al* (1977)[13]	Non-significant
9	Jalali *et al*. (2002)[14]	

Conclusions

In the present study, it was concluded that there is significant decrease in loops with corresponding increase in whorls patterns, increase in the mean value of TFRC and AFRC and significant decrease in the mean value of atd angle in Tuberculosis. There are no significant differences in arch pattern and a-b ridge count. At present there are very few studies on palmar Dermatoglyphics in tuberculosis. The findings of previous studies are many ways similar to our present study. But still the number of studies is limited. So further large case controls are needed to establish the exact relation between Tuberculosis and Dermatoglyphics. As the specific features of Dermatoglyphic patterns are present in the Tuberculosis, it can be used for mass screening program for

early detection and the control of disease can be achieved by reducing the other risk factors.

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