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An Evaluation of Dermatoglyphics in Leprosy

A Pilot Study[1]

Carl D. Enna, John P. Elliott, and Frederick E. Stockwell[2]

The science of dermatoglyphics has progressed from the study of dermal patterns for the purpose of identification of individuals to the classification and quantitative assessment of the patterns to ascertain their significance in disease of hereditary origin. It is established that dermal patterns are determined on a genetic basis (11). The ridges begin to differentiate during the third fetal month and are completely developed by the seventh month, thereafter remaining unchanged for life (15). Whereas traits are genetically determined, studies indicate that certain mechanisms cause chromosomal aberrations which result in a modification of these traits (1, 20, 21, 30). Certain viruses and drugs, particularly the rubella virus (1, 3, 20, 30) and thalidomide (12), respectively, are reported capable of producing chromosomal changes in the mother during gestation.

Dermatoglyphics have been studied in various diseases including mongolism (10, 24, 25, 27, 34, 36), the rubella syndrome (1, 3, 20, 21), congenital heart disease (16, 27), selected neurologic diseases (18, 23, 26, 28) and other disorders (7, 14). However, reports of dermatoglyphic studies in patients with leprosy have not been encountered.

Although leprosy is an infectious disease due to the *Mycobacterium leprae*, the hereditary susceptibility of the host to the organism is proposed as an additional predisposing factor. This concept has been proposed to reconcile the low incidence of disease among large numbers of contacts. Most reports delving into the role of heredity in leprosy have been related to epidemiologic studies (4, 5, 6, 8, 9, 22, 29, 31, 32, 33). An irregularly dominant factor P which neutralizes the natural resistance of the host is suggested by Saul and Diaz (29) as an explanation for susceptibility to the infection. Prasad and Mohamed (22) suggest, on the basis of data related to multiple patient families, that the acquisition of leprosy may be determined genetically on the assumption of incomplete dominance of genes; on the other hand, Spickett (33) suggested that if there is any genetic effect, it is but a component of the familial effect.

This study of dermatoglyphics in leprosy was undertaken to determine if there might be significance in the analysis of dermal patterns of the hand as related to the hereditary susceptibility of individuals to the disease. The dermal markings that were studied were the ridges of the fingers and the creases of the palm of the hand. The arch, loop and whorl were the basic patterns used for classifying the fingerprints (19) and for computing the ridge count (17). Only the ridges between the point in the center and the triradius of the pattern are counted. Since the arch does not possess a triradius, its ridge count is always zero, whereas ridges are encountered between the center and one triradius of the loop and two triradii in the double loop and the whorl (Fig. 1). Ridge counting (Fig. 2) provides additional information on the basis of the total number of ridges in one digit, or a hand, and also both hands (2).

The significant dermal markings in the palm are the flexion creases and the axial triradius. There are usually three flexion creases in the palm. The proximal crease is curvilinear and borders the base of the thenar eminence. This crease appears constant. The middle and distal creases lie

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2 C. D. Enna, M.D., Chief, Clinical Branch, U.S. Public Health Service Hospital, Carville, Louisiana 70721; J. P. Elliott, B.S., Formerly Associate, Department of Electrical Engineering, Louisiana State University, Baton Rouge, Louisiana; F. E. Stockwell, Medical Statistician, Research Associate, U.S. Public Health Service Hospital, Carville, Louisiana 70721.

FIG. 1. The whorl presents a pattern in which the ridges recurve in a circular manner, to form a circle around the central core. It has two or more triradii, with a recurring ridge in front of each triradius.

transversely in the mid-palm and are usually parallel; however, variations in the pattern of these two creases are occasionally encountered. They may form a single horizontal line, referred to as the "Simian crease." This sign is a well-known characteristic of congenital disorders and is particularly seen in the mongoloid hand ([27, 34, 36]). A partial simian crease is produced when the two creases converge on the ulnar side of the palm.

The axial triradius is a point resulting from three radiant markings which meet to form three angles. It is usually located in the midpart of the proximal part of the palm. Occasionally two axial triradii are encountered. In such case the more distal joint is used for analyzing patterns. Two methods of analysis employing the axial triradius are recommended for studying palmar prints. In one method proposed by Walker ([34, 36]) the proportion between the distance from the distal flexion crease of the wrist to the axial triradius and the distance from the flexion crease to the base (proximal flexion crease) of the middle finger is estimated. In another method proposed by Penrose ([23, 25]), the angle resulting by drawing lines from the axial triradius to triradii patterns located near the base of the index and little fingers is measured (Fig. 3).

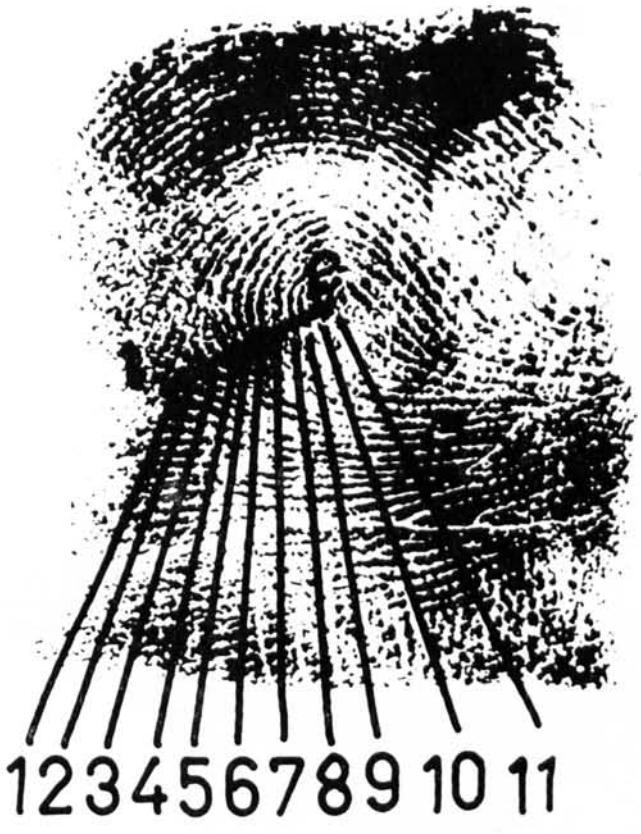

FIG. 2. Ridge counting is used in the subclassification of fingerprint patterns. It provides a value for quantitative assessment of the digital patterns. Only the ridges between the center and the triradii of patterns are counted.

METHODS OF STUDY

A group of 50 patients with leprosy and 50 persons without leprosy were selected at random for this pilot study without regard to the type of leprosy, sex, or age. Random selection of individuals in each group was decided upon due to the limited number of available subjects and because in such a situation it would tend to equalize the two groups with respect to age, sex, and race. There were 39 patients with the lepromatous type, 11 with the dimorphous type, and one with the tuberculoid type of leprosy. (Total 51. ED.)

The conventional method for recording dermal patterns employs printer's ink which is applied to the palmar surface of the fingers and the hand after which an impression is made on glossy paper. An "inkless" method described by Walker ([35]) has the advantage of eliminating staining the hand. These methods proved time-consuming due to technical difficulties. It was noted that the ridges were worn smooth in many hands of patients possessing loss of sensation for several years. Whereas a clear, well-defined pattern of the fingerprint was either difficult or impossible to obtain in many instances due to smearing, accurate ridge counting could be made by use of the operating microscope. The magnification obtained through this instrument facilitated the examination of

FIG. 3. Triradii of the palm: There are two palmar triradii, the proximal (**t.p.**) and the distal (**t.d.**) The distance from the flexion crease of the wrist to the distal triradius is 36%, and the angle formed by the distal triradius with the triradii of the index (**t.i.**) and little (**t.l.**) fingers is 48°.

the fingerprints, thereby expediting completion of this study. Permanent records were not made of the fingerprints studied in this series.

RESULTS

The data obtained from the dermatoglyphic studies of both the leprosy and the control group were statistically analyzed by computer. The following determinations were made.

An analysis was made of the whorl patterns as recommended by the Henry system of classification ([13]). A different value is assigned to whorls depending upon their respective digits, and these values were summarized for the odd and even numbered fingers individually. These totals were used to form combinations expressed as even/odd, of which there are 1,024 possibilities. This was done for both groups of examinees. The averages for the odd and

TABLE 1. *Analysis of whorl patterns by group.*

	Averages	
	Odd	Even
Leprosy patients	15.8	14.2
Control group	9.0	12.6

even totals were different as indicated in Table 1. However, when the primary combinations were formed, no significant modal differences were noted between the two groups, and they appeared to show equal variability. Thus, no one combination or group of combinations appeared to be more probable in either group.

The distribution of the fingerprint patterns and their ridge counts were individu-

TABLE 2. *Distribution of pattern types by digit, hand, and group (leprosy group).*

Pattern type	Thumb		Index		Long		Ring		Little		Total		Per cent
	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	
Simple arch	3	2	7	8	3	6	2	2	2	3	17	21	7.6
	5		15		9		4		5		38		
Tented arch	1	1	4	1	2	3	2	1	1	2	10	8	3.6
	2		5		5		3		3		18		
Ulnar loop[a]	0	0	9	9	0	1	0	1	0	0	9	11	4.0
	0		18		1		1		0		20		
Radial loop	23	23	12	16	33	30	26	26	43	37	137	132	53.8
	46		28		63		52		80		269		
Double loop[b]	7	3	2	3	1	1	0	1	0	0	10	8	3.6
	10		5		2		1		0		18		
Whorl	16	21	16	13	11	9	20	19	4	8	66	70	27.4
	37		29		20		39		12		137		
Totals	100		100		100		100		100		100		100.0%

[a] The ulnar loop pattern was not encountered in the thumb and little finger of the leprosy group, whereas they occurred in the corresponding digits of the control group.
[b] The double loop pattern was not encountered in the little finger of either group.

TABLE 3. *Distribution of pattern types by digit, hand, and group (control group).*

Pattern type	Thumb		Index		Long		Ring		Little		Total		Per cent
	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH	
Simple arch	2	2	4	6	3	3	1	1	1	1	11	13	4.8
	4		10		6		2		2		24		
Tented arch[a]	0	0	3	1	1	0	0	0	0	0	4	1	1.0
	0		4		1		0		0		5		
Ulnar loop	1	0	9	10	3	1	0	3	0	1	13	15	5.6
	1		19		4		3		1		28		
Radial loop	33	27	20	20	42	44	40	33	46	45	181	169	70.0
	60		40		86		73		91		350		
Double loop[b]	6	11	2	3	1	0	0	0	0	0	9	14	4.6
	17		5		1		0		0		23		
Whorl	8	10	12	10	0	2	9	13	3	3	32	38	14.0
	18		22		2		22		6		70		
Totals	100		100		100		100		100		500		100.0

[a] The tented arch was not encountered in the thumb, ring, and little fingers.
[b] The double loop was not encountered in the ring and little fingers of the control group, whereas it was encountered in the ring fingers of the leprosy group.

ally recorded and analyzed by chi-square. A highly significant difference between the leprosy and nonleprosy groups ($p = < .001$) was noted with respect to the type of pattern (Table 4). A difference was not noted to occur between the right and left hand ($p = > .05$) (Table 2), but a difference was observed involving the whorls and radial loops of specific digits (Table 3). A significantly greater number of radial loops on all fingers and a fewer number of whorls on the thumb, middle and ring fingers were noted in the control group (Table 5). Also, the tented arch was not observed in the thumb and long and little fingers of the nonleprosy group.

In the analysis of the ridges, there was no significant difference ($p = > .05$) between the leprosy and nonleprosy groups with respect to the mean number. The average number of ridges is summarized in Table 6.

A significant statistical difference between the leprosy and control groups exists

with respect to the distance (mm.) from the distal flexion crease of the wrist to the base of the middle finger, and the distance (mm.) from the flexion crease of the wrist to the axial triradius. Both are significantly less in the leprosy group. These statistics are summarized in Table 7.

There was no significant statistical difference in the incidence of the simian and partial simian lines between the two groups.

CONCLUSION

This preliminary study was done on a small number of patients. It suggests that certain factors are correlated to the problem of hereditary susceptibility to leprosy; however, the nature of these findings being considered, they do not appear to be of direct clinical value. It is felt that this study should not be considered as conclusive since the genetic composition of the sample

TABLE 4. *Distribution of pattern types by groups (leprosy group).*

Pattern type	Leprosy group		Control group	
	No. of fingers	Per cent	No. of fingers	Per cent
Simple arch	38	7.6	24	4.8
Tented arch	18	3.6	5	1.0
Ulnar loop	20	4.0	28	5.6
Radial loop[a]	269	53.8	350	70.0
Double loop	18	3.6	23	4.6
Whorl[a]	137	27.4	70	14.0
	500	100.0	500	100.0

[a] The whorl and radial loop patterns possessed a significant statistical difference by group. There were approximately twice as many whorls and a fewer number of radial loops in the leprosy group.

TABLE 5. *Distribution of whorls and radial loops by groups and digit.*

Finger	Whorls				Radial Loops			
	Per cent of fingers				Per cent of fingers			
	Leprosy		Control		Leprosy		Control	
	No.	%	No.	%	No.	%	No.	%
Thumb[a]	37	7.4	18	3.6	46	9.2	60	12.0
Index	29	5.8	22	4.4	28	5.6	40	8.0
Long[a]	20	4.0	2	0.4	63	12.6	86	17.2
Ring[a]	39	7.8	22	4.4	52	10.4	73	14.6
Little	12	2.4	6	1.2	80	16.0	91	18.2
TOTAL	137	27.4	70	14.0	269[a]	53.8	350	70.0

[a] Significant difference between leprosy and control groups. $p = < .05$. There is a significant difference in the number of whorls in the digits of the thumb, long, and ring fingers arch also for the group, being greater for the leprosy group as compared with the control group. There was no significant difference in radial loops noted between individual digits, but a significant difference is apparent between the two groups. A smaller number is present in the leprosy group.

group may have obscured other relationships, or a more complex dependency may in fact exist.

SUMMARY

A statistical computer analysis was made of dermatoglyphic palmar patterns obtained from 50 patients with leprosy and a control group of 50 persons without leprosy.

This pilot study reveals that there are significant statistical differences between the two groups with respect to the following: (a) There were a significantly smaller

TABLE 6. *Mean number of fingerprint ridges by digit, hand, and group.*

Digit	Leprosy group			Control group		
	Left	Right	Total	Left	Right	Total
Thumb	20	24	44	18	22	40
Index	14	14	28	13	13	26
Long	13	12	25	11	11	22
Ring	19	19	38	16	18	34
Little	11	12	23	13	14	27
Total	77	81	158	71	78	149

There is no significant difference in the number of ridges between the leprosy and the control groups ($p = >.05$).

TABLE 7. *Measurements based on axial triradii and A.T.D. angle.*

Axial triradii and A.T.D. angle variables	Left hand (1)				Right hand (1)			
	Means		Mean diff.	t-ratio	Means		Mean diff.	t-ratio
	Leprosy	Control			Leprosy	Control		
1. Distance (mm.) distal crease wrist to base of long finger.	101.3	114.2	12.9	7.13[a]	100.8	113.5	12.7	7.09[a]
2. Distance (mm.) distal crease wrist to axial triradius.	16.0	18.7	2.7	1.85[b]	15.9	19.4	3.5	2.17[c]
3. (2 ÷ 1) in %	15.8	16.2	0.4	0.30	15.8	17.0	1.2	0.83
4. A.T.D. angle	41.1	41.2	0.1	0.10	41.6	41.2	0.4	0.37
5. Distance (mm.) triradius to thenar fold.	8.9	9.0	0.1	0.13	9.1	9.1	0.0	0.10

(1) Hypotheses were tested at 0.05 level of confidence.
[a] $p = <.005$ on a one tail t-test.
[b] $p = <.05$ on a one tail t-test.
[c] $p = <.025$ on a one tail t-test.

number of radial loops of all fingers and a larger number of whorls of the thumb, long, and ring fingers in the leprosy group. (b) The tented arch was not observed in the thumb, long or little fingers of the nonleprosy group. The statistical value of this finding is questioned in view of the small number of similar prints encountered in the leprosy group. (c) A significantly shorter distance (mm.) exists in the measurement between the distal crease of the wrist to the axial triradius and also to the base of the middle finger in the leprosy group.

RESUMEN

Se hace un análisis estadístico por medio de computadora de los patrones dermatoglíficos palmares obtenidos de 50 pacientes con lepra y de un grupo control de 50 personas sin lepra.

Este estudio piloto revela que hay diferencias estadísticamente significativas entre los dos grupos con respecto a lo siguiente: (a) Había un número significativamente menor de surcos radiales de todos los dedos y un número mayor de verticilos del dedo pulgar, índice y anular en el grupo con lepra. (b) No se observaba arco entoldado en el pulgar, dedo índice o meñique del grupo no leproso. El valor estadístico de este hallazgo es dudoso en vista del pequeño número de huellas similares que se encontraron en el grupo leproso. (c) Se encuentra una distancia significativamente menor (mm.) en la medida entre el pliegue distal de la muñeca al triradio axial y también a la base del dedo medio en el grupo con lepra.

RÉSUMÉ

On a procédé à une analyse statistique sur ordinateur des profils dermatoglyphiques palmaires obtenus chez 50 malades atteints de lèpre et dans un groupe témoin de 50 personnes ne souffrant pas de lèpre.

Cette étude pilote a montré qu'il existait des différences statistiquement significatives entre les deux groupes en ce qui concerne les points suivants: (a) il y a un nombre significativement plus petit de boucles radiales à tous les doigts et un nombre plus élevé de tourbillons au niveau du pouce, du median et de l'annulaire, dans le groupe atteint de lèpre; (b) l'arc (tented arch) n'a pas été observé au niveau du pouce, du médian et de l'auriculaire dans le groupe ne souffrant pas de lèpre. La valeur statistique de cette observation est mise en doute du fait du petit nombre d'empreintes digitales similaires relevées dans le groupe malade; (c) une distance significativement plus courte, en millimètres, a été notée dans les mesures effectuées entre la crête distale du poignet et le triradius axial ainsi qu'entre la crête distale et la base du median, dans le groupe malade.

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