# PALMAR DERMATOGLYPHICS IN HEART DISEASE

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The purpose of this study is to compare certain features of palmar dermatoglyphics in Japanese afflicted with congenital heart disease with those in their mothers, as well as those in patients with acquired heart disease. In addition, variations noted for Japanese are contrasted with those reported by Takashina[1] and Hale[2] in similar studies on white and Negro populations.

This study is based upon observation of a total of 1,322 pairs of palm prints of Japanese and whites. Twenty-seven of those persons had congenital heart disease and twenty-seven of their mothers, and 362 had acquired heart disease; both of these groups were Japanese. A control population consisted of 354 Japanese and 552 whites with no evidence of heart disease. The patients were from the Department of Cardiology at the Yodogawa Christian Hospital, Osaka and from the Department of Surgery at the Kobe University School of Medicine, Kobe, Japan.

An attempt was made to single out particular type of cardiac lesions which are shown in Table I. We also tried to determine differences of palmar patterns between normal Japanese and whites.

The palmar dermatoglyphics were analyzed according to the methods of Cummins and Midlo[3]. The characteristics studied were(1) the axial triradii(2) the axial main lines, and(3) the hypothenar pattern.

## RESULTS

One primary dermatoglyphic feature studied was the axial main line (line T). This originates from the axial triradius between the thenar and hypothenar eminences, then courses distally to terminate in 94% of the cases between the thumb and index finger. In about 6% of the cases this main line may terminate between the index and middle finger.

Frequency of hypothenar Configurations in Japanese Patients With Heart Disease.—Reference to Figure 1, left, illustrates the locus of the axial triradius and the course of line T in a right palm print. The axial triradius is usually located near the proximal margin. This position is designated as the t position from which the axial main line (T) begins with its distal course. In some instances, when there is a disproportion in the size of the thenar and hypothenar areas, as illustrated in Figure 1, middle, the axial triradius (t) and the axial main line (T) may be displaced ulnad from the midpalmar longitudinal axis and distally. Here its location is designated as t′ position—a quasiquantitative term used to denote distal displacement. In Fig. 1, right, a hypothenar pattern is illustrated with two axial tiradii. When two axial triradii are present, the most distal triradius usually occupies a more central position in the palm, as observed by Hale and co-workers[2]. This distal displacement of the second axial triradius varies in position depending on the patterning of the thenar and hypothenar areas and the complexity and size of the hypothenar pattern. In Fig. 1, the respective position of each is designated as t, t″, and tt′ indicating the existence of two separate axial triradii.

Since morphologic factors condition the position and number of axial triradii as well as the displacement of the main line (T) from the longitudinal axis, they also determine the distal orientation of the hypothenar and thenar pattern. Hypothenar patterns consist of four primary types in the hypothenar areas: whorls, loops, tented arches, and plain arches, illustrated in Fig. 2. Our series shows no statistical difference in hypothenar pattern alone in patients with acquired heart disease compared to patients with congenital heart disease. The results are shown in Table II.

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Percentage Frequencies (Table II, Fig. 2).—There was however a significant increase in the frequency of certain patterns with an associated distal displacement of the axial triradius in cases of congenital heart disease. In addition, there was an increased frequency of reduplication of the axial triradius (tt′) in patients with congenital heart disease compared with patients with acquired forms of heart disease or with the control group.

Higher Positions of Axial Triradii in Normal Japanese and Those With Heart Disease.—Table three shows that among Japanese with congenital heart disease the frequency of t″ and t′″ or multiple axial triradii (tt′ etc.) is 59·3% and 44·4% for their mothers, more than three times that found in the group with acquired heart disease (17%) or the controls (19%). Hale *et al*, report the frequency of these patterns in patients with congenital heart disease to 69% in whites and 45% in Negros, contrasting with frequencies for acquired heart disease of 31% for whites and 25% for Negroes.

Calculation of the statistical significance of the differences of frequency of occurrence of the t″ or multiple axial triradii in congenital versus acquired heart disease as cited above, produced probability values for Japanese in our study of $P<0{\cdot}0000000001$, compared with values reported for whites and Negro populations of $P<0{\cdot}0000634$ and $P=0{\cdot}0164$ respectively[2].

The method used to calculate the probability value in Japanese was as follows:

$$\alpha\rho\% = \sqrt{p\,q\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}$$

$$\alpha\rho\% = \sqrt{(0{\cdot}089)\ (0{\cdot}901)\left(\frac{1}{362}+\frac{1}{27}\right)}$$

$$= 0{\cdot}0854 = 8{\cdot}54\%$$

Actual difference: $59{\cdot}3 - 17{\cdot}4 = 41{\cdot}9$

$$U = \frac{41{\cdot}9}{8{\cdot}54} = 4{\cdot}90$$

The probability against the occurrence of this deviation on a chance basis alone is very great: 1,000,000,000 to 1 ($P<0{\cdot}0000000001$). Thus the t″ or multiple axial triradii occurred with significantly greater frequency in patients with congenital heart disease than in patients with acquired heart disease or normal people.

Occurrence of Higher Position of Axial Triradii in Japanese Patients With Heart Disease.—In our previous study, an interesting feature is shown in Table IV. The significance of the difference of these stigmata in either the right and left hands of Japanese patients with congenital heart disease vs acquired heart disease was equally high (right, $P=0{\cdot}000000189$ and left, $P=0{\cdot}0000532$). This contrasts with Hale's study in which only the left hands of white patients showed a significant difference (right, $P=0{\cdot}483$ and left, $P=0{\cdot}00067$; for Negro patients the values were right $P=0{\cdot}317$; left $P=0{\cdot}500$).

And particularly interesting difference noted in this analysis is the markedly lower frequency with the stigmata occurred in both hands of Japanese with congenital heart disease (22%) compared with Hale's white patients (36%). This is apparently a racial characteristic, although in our series there was no essential difference among the three groups of normal subjects, white and Japanese.

## COMPARATIVE STUDY

As a separate study, an attempt was made to demonstrate the difference of palmar patterns between normal Japanese and whites. The study consisted of data which were obtained from Osaka Police Investigation Bureau and the Nursing Service of the Yodogawa Christian Hospital (Japanese), and from the Canadian Academy in Kobe, Japan (white). The results are shown in Table V.

Position of Axial Triradii in Normal Japanese and Whites.—Five hundred and fifty two normal healthy white

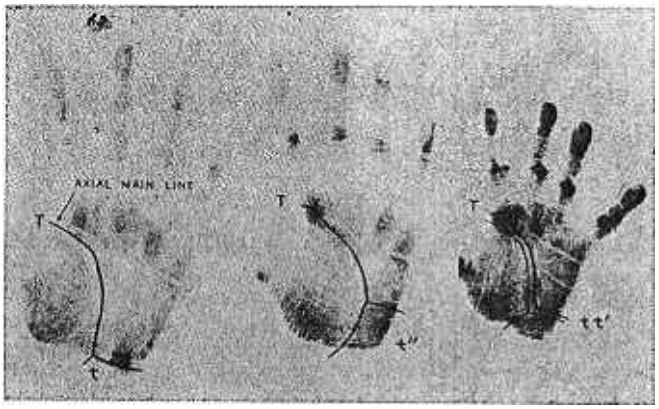



Fig. 1

TABLE I

PERCENTAGE FREQUENCIES OF PARTICULAR CARDIAC LESIONS IN PATIENTS WITH CONGENITAL HEART DISEASES

| Diagnosis | No. | Percentage (%) |
|---|---|---|
| Atrial Septal Defect | 7 | 25·9 |
| Ventricular Septal Defect | 9 | 33·3 |
| Aortic Stenosis with Pulmonary Stenosis | 1 | 3·7 |
| Aortic Insufficiency with Vent. Septal Defect | 1 | 3·7 |
| Endocardial Cushion Defect | 2 | 7·4 |
| Patent Ductus Arteriosus | 2 | 7·4 |
| Tetralogy of Fallot | 4 | 14·9 |
| Pulmonary Stenosis | 1 | 3·7 |
| TOTAL | 27 | 100·0 |

TABLE II

PERCENTAGE FREQUENCIES OF HYPOTHENAR CONFIGURATIONS IN JAPANESE PATIENTS WITH HEART DISEASES

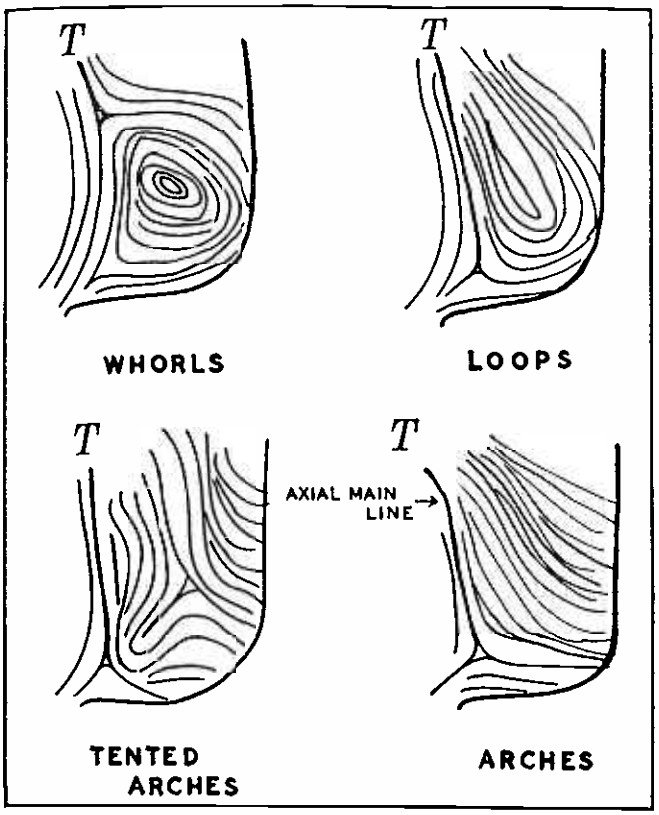
| Types | Acquired Heart Disease (362 patients) | | | | | Congenital Heart Disease (27 patients) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Right | | Left | | Mean | Right | | Left | | Mean |
| | No. | % | No. | % | | No. | % | No. | % | |
| Whorls | 3 | 1 | 8 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Loops | 114 | 32 | 125 | 35 | 33 | 8 | 30 | 11 | 41 | 36 |
| Tented arches | 3 | 1 | 7 | 2 | 1 | 1 | 7 | 3 | 7 | 7 |
| Plain arches | 242 | 67 | 222 | 61 | 64 | 18 | 63 | 13 | 52 | 57 |

TABLE III

THE HIGHER POSITIONS OF AXIAL TRIRADII IN NORMAL JAPANESE AND THOSE WITH CONGENITAL HEART DISEASES

| Sex | No. of t'' and multiple axial triradii | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Control | | AHD | | Mothers of CHD | | CHD | |
| | No. | % | No. | % | No. | % | No. | % |
| Female | 32 | 27·7 | 37 | 21·6 | 27 | 44·4 | 18 | 66·6 |
| Male | 322 | 12·1 | 325 | 14·0 | — | — | 9 | 42·0 |
| TOTAL % | 354 | (18·9) | 362 | (17·8) | 27 | (44·4) | 27 | (59·3) |

*AHD is a designation of acquired heart disease and CHD is a designation of congenital heart disease.




**2. Schematic drawing of the four primary types of hypothenar configurations, illustrating various patterns in the hypothenar area.**

Fig. 2

TABLE IV

PROBABILITY OF OCCURRENCE OF THE HIGHER POSITIONS OF AXIAL TRIRADII IN JAPANESE PATIENTS WITH HEART DISEASE

| Hand | Frequency of t'', t''' and $t^m$ % | | p Value |
|---|---|---|---|
| | Acquired | Congenital | |
| Right only | 6 | 30 | 0·000000189 |
| Left only | 7 | 25 | 0·0000532 |
| Both | 5 | 4 | 0·215 |
| TOTAL | 18 | 59 | <0·0000000001 |

TABLE V

PERCENTAGE DISTRIBUTIONS OF POSITIONS OF AXIAL TRIRADII (t', t'', AND $t^m$) IN NORMAL JAPANESE AND WHITES

| | Left Hand, % | | | | Right Hand, % | | | |
|---|---|---|---|---|---|---|---|---|
| **Japanese** | | | | | | | | |
| Sex | t | t' | t'' | $t^m$ | t | t' | t'' | $t^m$ |
| Female | 69 | 19 | 9 | 3 | 68 | 20 | 13 | 1 |
| Male | 71 | 23 | 6 | 1 | 70 | 25 | 5 | 1 |
| **White** | | | | | | | | |
| Female | 72 | 19 | 6 | 1 | 74 | 17 | 7 | 2 |
| Male | 75 | 19 | 6 | 0·4 | 75 | 18 | 5 | 0·4 |

*The expression of $t^m$ is a designation of multiple axial triradii (tt' or t' t'' or tt'').

students, 275 males and 277 females, were compared with 354 normal Japanese subjects, 322 males and 32 females. There is no significant difference between the position of the axial triradius in these Japanese and white populations. However, the fact that the incidence of distal displacement of axial triradius is much less in either group than in Hale's series is difficult to explain.

## COMMENT

It is a generally accepted fact that, except for size, once dermatoglyphic configurations are established, they never change. It has already been suggested [2,4,5] that congenital defects can be the result of a disturbance in the embryo's environment. This would seem to be borne out by the fact that anomalies occur not infrequently in distant parts of the body of patients suffering from congenital heart disease. It is generally accepted that maternal rubella during the first two or three months of pregnancy has been associated with a significant incidence of congenital heart anomalies in offspring[6,7,8]. That heredity may also play a part in the etiology of congenital heart disease is suggested by two factors: (I) the frequency with which it is associated with other anomalies which are generally considered to be hereditary. This is quite interesting observation to see the significantly greater incidence of frequency of distal displacement of the palmar axial triradii in either hand occurred in the patients with congenital heart disease (59·3%); and with their mothers (44·4%), than in the patients with acquired heart disease (17%). (II) The frequency with which these patients show a family history of congenital heart diseases.

Studies of the probability of the occurrence of these differences in palmar dermatoglyphics on a chance alone gave a value of less than 0·0000000001 for Japanese. This compares with a probability value of 0·000000858 for congenital heart disease among Japanese, 0·0000000106 for their mothers, and 0·0000634 for whites and 0·0164 for Negroes.

It appears from our series that there was no signficant difference of positions of axial triradii between normal white and Japanese subjects, whereas the present study suggests that significant departure occur primarily in patients with congenital heart disease, racial factors being ruled out.

In recent years, there are many investigators studying about a relationship between finger and palmar dermatoglyphics and some genetic diseases. The significance of abnormalities in the handprints of the patients in Forbes's series[9] strongly suggests a close relationship to genetic disorders. Her study and Hale's report indicate that patients having a pathological murmur, who exhibit either a midpalmar axial triradius 't'') or hypothemar pattern with two axial triradii, are more likely to be afflicted with congenital heart disease than heart disease of an acquired etiology.

From these considerations arise the same questions as those proposed by Hale *et al.* The authors strongly suggest that an extensive analysis of palmar dermatoglyphics in patients as well as their relatives would materially aid in the study of the genetics of congenital heart disease.

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