

## DERMATOGLYPHICS STUDY OF PARAMETERS LIKE TOTAL RIDGE COUNT AND A-D DISTANCE IN DIABETES MELLITUS

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### ABSTRACT

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#### BACKGROUND

It is widely accepted that the dermal ridges develop during early foetal life and are constant (stable) throughout life, unique to the individual and therefore significant as a means of identification. It is proved that dermatoglyphics is of polygenic inheritance and like many other hereditary characters show racial and social variations. An attempt has been made to create a database of the dermatoglyphic pattern among the diabetics of Southern Orissa, which may become helpful for the early prediction of the disease and thus prevents its complications.

#### MATERIALS AND METHODS

Fifty male diabetic patients diagnosed as cases of insulin-dependent diabetes mellitus (type 1) of age ranging from 25 to 40 years and fifty cases of normal controls of similar age group were included in this study. Similarly, fifty patients diagnosed as cases of non-insulin-dependent type of diabetes mellitus (type 2) of age more than 40 years and fifty cases of normal controls of similar age group without family history of diabetes of either type 1 or type 2 up to two previous generations were studied and analysed in this study. Fifty female diabetic patients diagnosed as IDDM cases of age ranging from 25 to 40 years and fifty cases of normal controls of similar age group and fifty female diabetic patients of type 2 variety (NIDDM) and fifty female controls of age group more than 40 years were included in this study. The finger prints and palm prints of the control and patients were taken and studied for different parameters like total ridge count, a-d distance. In type 1 diabetes, the total finger ridge count in male diabetics is more than that in the male controls of similar age group with a level of significant difference being 0.001%. The female diabetics of type 1 variety showed a higher ridge count value in comparison to type 2 male diabetics while the type 1 female diabetics and type 2 female diabetics did not have any significant difference between them in regards to TRC.

#### RESULTS

There was increase in the a-d distance measured in case of the diabetics in comparison to the controls. The male diabetics possessed a higher mean than the female diabetics when measured in the left palms. Similarly, the right palms of the male diabetics possessed a higher mean than the female diabetics. The diabetics of the type 1 variety as a whole have a higher mean than their counterpart controls. The type 1 male diabetics also possessed a higher value than the type 2 male counterparts regarding the observations obtained from their left palms. The female diabetics of the type 1 variety also possess a higher value than the female diabetics of type 2 variety regarding their right palms.

In type 2 diabetes, the male diabetics possessed a higher TRC value in comparison to the normal controls. Similarly, the female diabetics also possessed a higher TRC value with a level of significant difference being 0.001% in comparison between the male and female diabetics of type 2 variety. The female diabetics possessed a higher TRC value than their male counterparts, but not that significantly. In comparison to type 1 variety of diabetics, the non-insulin-dependent diabetics possessed a lower TRC value than their insulin-dependent counterparts.

#### CONCLUSION

Increase in the distance between the axial triradius 'a' and 'd' was a constant feature among the diabetics both males and females in comparison to their controls of age group more than 40 years. The left palms of female type 2 diabetics showed a lower value of a-d distance in comparison to that of the right palms of the female diabetics of type 2 variety. The type 2 diabetics especially the males possessed a lower value of a-d distance than their counterpart type 1 male diabetics irrespective of their hands.

#### KEYWORDS

Dermatoglyphics, Total Ridge Count (TRC), A-D Distance.

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## BACKGROUND

It is widely accepted that the dermal ridges develop during early foetal life and are constant (stable) throughout life, unique to the individual and therefore significant as a means of identification. It is proved that dermatoglyphics is of polygenic inheritance and like many other hereditary characters show racial and social variations. The dermal ridges develop during 2<sup>nd</sup> to 4<sup>th</sup> week of foetal life and fully formed by the 14<sup>th</sup> week of foetal development. Therefore, any environmental factor influencing the development of finger ridges during the process of foetal growth amount to an increase familial prevalence of dermatoglyphic variations in the individual. It is clinically significant as certain specific dermatoglyphic pattern indicates some serious developmental anomalies due to chromosomal and environmental factors.

Holt and Lindstern (1964)<sup>1</sup> mentioned the significance of fingerprint in the diseases like Turner syndrome by trisomy 17 and 18 by Uchida et al (1962)<sup>2</sup> and Pen Rose 1963.<sup>3</sup>

On the basis of following conditions exhibiting unusual pattern frequencies, we sought to determine whether dermatoglyphics could be employed as a prediction index for diabetes mellitus.

## Selection of Cases:

Sl. No	Type of Cases	No. of Cases	Age	Source of Selection
1	Type 1 Diabetics	100	25 to 40 years	Outdoor and indoor diabetic patients attending Department of Medicine, M.K.C.G. Medical College, Berhampur, and diagnosed patients of diabetes mellitus among people of district Ganjam
	• Males	50		
• Females	50			
2	Type 2 Diabetics	100	More than 40 years	
	• Males	50		
• Females	50			
3	Controls	100	25 to 40 years	
	• Males	50		
• Females	50			
4	Controls	100	More than 40 years	
	• Males	50		
• Females	50			

The cases were selected from the patients diagnosed as cases of diabetes mellitus of the same geographic region attending outdoor and indoors of the Department of Medicine of M.K.C.G. Medical College, Berhampur during the period from June 2009 to June 2011. Each patient and control was subjected to through history taking, treatment history and family history.

Presence or absence of family history of the patient was ascertained by detailed interview with family members and cross checking of clinical records. Patients from Ganjam

According to Harrison's principle of internal medicine (2011),<sup>4</sup> diabetes mellitus is classified broadly into four types:

1. Type 1-DM (IDDM).
2. Type 2-DM (NIDDM).
3. Type 3-DM (Gestational diabetes mellitus).
4. Type 4-DM (Other specific types).

Out of the four types, we have taken type 1 and type II diabetes mellitus into consideration in our elaborate research work on diabetes. An attempt has been made to create a database of the dermatoglyphic pattern among the diabetics of southern Orissa, which may become helpful for the early prediction of the disease and thus prevents its complications.

## MATERIALS AND METHODS

Fifty male diabetic patients diagnosed as cases of insulin-dependent diabetes mellitus (type 1) of age ranging from 25 to 40 years and fifty cases of normal controls of similar age group were included in this study. Similarly, fifty patients diagnosed as cases of non-insulin-dependent type of diabetes mellitus (type 2) of age more than 40 years and fifty cases of normal controls of similar age group without family history of diabetes of either type 1 or type 2 up to two previous generations were studied and analysed in this study. Fifty female diabetic patients diagnosed as IDDM cases of age ranging from 25 to 40 years and fifty cases of normal controls of similar age group and fifty female diabetic patients of type 2 variety (NIDDM) and fifty female controls of age group more than 40 years were included in this study.

district of Southern Orissa were selected for the present study. Care has been taken to include one patient from one family and it was ensured that the patients did not have relation with each other.

Only those patients with definite clinical features of diabetes mellitus of either type 1 or type 2 and investigated accurately with their glucose tolerance tests well analysed and diagnosed and established according to the criteria of the National Diabetes Data Group were selected for the study. Cases of doubtful or dubious diagnosis were kept out

of purview of the study. For the patients, associated diseases and congenital abnormalities and as far as possible diseases producing dermatoglyphic changes other than diabetes were ruled out. The finger and palmar prints of the diagnosed groups of either type 1 or type 2 diabetics with regard to sex and family history of diabetes of either type were compared with the control group. Normal controls (100 in number) of both sex (50 males and 50 females) belonging to Ganjam district of age between 25 years to 40 years without any known family history of diabetes mellitus of either type 1 or type 2 or any other congenital or hereditary illness were selected as control group. Similarly, 100 normal controls of both sex (50 males and 50 females) of the same geographic region of Southern Orissa aged more than 40 years were chosen for the study.

### Procedure for the Fingerprints

Finger and palm prints were obtained by using the "Ink and Pad" technique.

- a) **Positioning of the Mounting Sunmica Glass and Paper:** The inking plate, i.e. the glass slab and paper was mounted at an elevation on a table in a horizontal position to get the total print of the finger tips to prevent any strain or pressure to the hand of the subject. As the quality of the paper affect the standard of the impression, white J. K. bond paper has been utilised in the present study.
- b) **Cleaning:** Cleaning of the finger tips and palm of the hand was done by means of rough cloth soaked in denatured alcohol and wiped dry. Thus, the palm was freed from lint and flakes of loose skin, etc. In cases in which the patient's skin was cold and dry, it was warmed and moistened slightly by holding the subject's hand for a few second.
- c) **Position of the Subject:** The subject was positioned in front of the elevated platform at forearm length from the inking plate mounted on the table earlier.
- d) **Inking of Finger and Rolling:** Some amount of ink was squeezed and rolled on the glass slab. With the help of a cotton ball, a thin smear of the printer's ink was obtained on the glass slab. The cotton ball was lightly applied over the finger tips so that the ink was applied evenly from the distal interphalangeal joint up to the tip of each finger in the following sequence, i.e. thumb, index, middle, ring and little finger and the rolled impressions were taken. While taking the rolled impressions, emphasis was given so that the bulb of the finger was placed at the right angle to the surface of the paper, then the finger was turned/rolled until the bulb faced in the opposite direction and the finger was pressed lightly while rolling. A rolled finger impression is always larger in area than a normal one as the rolling motion will cover a larger area than the plain one and rolling should be done once only in horizontal manner to avoid double or overlapping impressions. Such fingers were labelled as of right or left hand and the name of

the cases noted against such parts along with the type of diabetes. The analysis of the quantitative parameters of the fingerprints was undertaken with the aid of special magnifying lens. In this present study of the finger patterns are classified into three types and the other subtypes are excluded. They are (i). Arches (ii). Loops (iii). Whorls.

### Total Ridge Count

In the present study, the total ridge count has been taken as a parameter calculated as the total of the ridges of all the ten fingers. Ridge counts for each fingertip were calculated from the number of primary dermal ridges that intersected or touched a straight line drawn from the central core of the fingerprint pattern to one or two adjacent triradial points consistent with standard methods. Fingertips with an arc pattern were assigned a ridge count zero because the arc has no triradius. Fingertips with a loop pattern received a ridge count equal to the number of ridges crossing the single straight line. For fingertip patterns with two radial points (e.g. Whorls, double loops, etc.), the following protocol was chosen (ridges crossing the longer line) + (1/2 ridges crossing the shorter line).

### Procedure for the Palmar Prints

#### RESULTS

The palmar prints were obtained by using the same ink and pad technique. The palm of the hand was smeared with the printer's ink by the help of a cotton ball soaked with the ink as mentioned before, which is just dusted on the palm so that the ink is just sufficient to give a print. The palm was inked from distal wrist crease to the base of the fingers. Heavy inking was avoided as it produces loss of detail in the prints. The roller was covered and fixed with the bond paper on it with the glazed surface facing the palmar surface. The print was taken by starting at a position just proximal to the bracelet creased and drawing the roller steadily and with moderate pressure towards the base of the fingers. It must be held out of the way while the palm is being printed either voluntarily by the patient or by an assistant. The number on the roller allows the paper to conform to the shape of the palmar surface ensuring that all parts of the surface are recorded. The completed print was removed from the roller. The second hand was printed in a similar fashion using the other half of the quarto sheet. The remaining ink on the palms and fingers was removed by means of ether and then soap and water.

The parameters evaluated was distance a-d in mm.

The distance in mm of the interdigital area between the digital triradii 'a' and 'd'.

#### OBSERVATION

Parameters like the Total Finger Ridge Count (TRC), distance (a-d) were studied in 50 male diabetics and 50 female diabetics diagnosed as cases of insulin-dependent type of diabetes mellitus of age between 25 to 40 years and from same geographical region and of similar race in comparison to 50 normal male controls and 50 normal female controls.

The same parameters were also studied in 50 male diabetics and 50 female diabetics diagnosed as cases of type 2 diabetes mellitus of age more than 40 years and of similar racial and geographical variation. They were compared with 50 male controls and 50 female normal controls. The parameters were studied under the following headings:

**1. Total Finger Ridge Count:**

- a) Distribution of mean of total finger ridge count of type 1 (IDDM) diabetics both males and females and normal control subjects.
- b) Distribution of mean of total finger ridge count of type 2 (NIDDM) diabetics both males and females and normal control subjects.

**2. II Distance "a-d":**

- a) Distribution of mean of distance a-d of the palms of left hands of type 1 diabetics (males and females) and normal control subjects.
- b) Distribution of mean of distance a-d of the palms of right hands of type 1 diabetics (males and females) and normal control subjects.
- c) Distribution of mean of distance a-d of the palms of left hands of type 2 diabetics (males and females) and normal control subjects.
- d) Distribution of mean of distance a-d of the palms of right hands of type 2 diabetics (males and females) and normal control subjects.

**Total Finger Ridge Count (TRC)**

**Table-I A:** Distribution of mean of total finger ridge count in type 1 diabetics and normal controls.

Parameters	Males		Females	
	Diabetic	Control	Diabetic	Control
Mean	143.32	133.80	144.68	136.73
± S.D	10.52	11.18	13.46	14.46
Sample	50	50	50	50
	P<0.001		P<0.01	

**Table IA**

\*S.D. = Standard Deviation.

The above table depicts the mean of the total finger ridge count in 50 cases of type 1 (IDDM) diabetic males and 50 cases of type 1 (IDDM) diabetic females. They have been compared with the mean of 50 normal male controls and 50 normal female controls respectively. Their standard deviation have been deduced to determine the level of significance, which is calculated with the help of unpaired 'T' test.

In this study, it is thus depicted that the total finger ridge count is higher in the diabetics both males and females in comparison to controls. The mean of the total finger ridge count in the type 1 diabetic male cases being 143.32 is higher than the mean of TRC of the male controls of same age group (25 to 40 years), which is 133.80. Similarly, the

mean of the TRC of the female normal controls of age 25 to 40 years, which is 136.73. The level of significance being 0.1% in the male diabetics in comparison to male controls while the level of significance is 10% in the female diabetics in comparison to female controls.

**Distribution of Mean of Total Finger Ridge Count in Type 2 (NIDDM) Diabetics and Normal Controls:**

Parameters	Males		Females	
	Diabetic	Control	Diabetic	Control
Mean	136.45	127.94	138.44	124.77
± S.D	18.21	10.59	8.72	15.32
Sample	50	50	50	50
	P<0.001		P<0.001	

**Table IB**

\*S.D. = Standard Deviation.

This table shows the mean of the total finger ridge count obtained from the TRC of a total of 50 type II (NIDDM) diabetic males and the mean of TRC of 50 type II (NIDDM) diabetic females. They have been compared with 50 normal and 50 normal female controls respectively of similar age group, i.e. more than 40 years and from same geographical region. Their respective standard deviations have been indicated and the P-value has been determined by the unpaired T-test method. Thus, it has been indicated that the type 2 male diabetics as well as the type 2 variety of female diabetics show a higher total finger ridge count value than their counterpart normal controls. The mean of the TRC value in 50 type 2 male diabetics being 136.45 with a standard deviation of 18.21 is significantly higher at a level 0.1% than that of the normal male controls. Similarly, the mean of the TRC value of 50 type 2 diabetic females being 138.44 with a standard deviation of 8.72 is higher than that of the normal female controls at a level of significance being 0.1%.

**Distance "a-d":** Table IIA and Table IIB:

**Distribution of Mean of Left Hand Distance a-d of Type 1 Diabetics and Normal Controls:**

Parameters	Males		Females	
	Diabetic	Control	Diabetic	Control
Left hand a-d Distance				
Mean	62.57	52.7	57.7	55.2
± S.D	3.73	8.11	3.6	3.81
Sample	50	50	50	50
	P<0.001		P<0.001	

**Table IIA**

\*S.D = Standard Deviation

**Distribution of Mean of Right Hand Distance a-d of Type 1 Diabetics and Normal Controls:**

Parameters	Males		Females	
	Diabetic	Control	Diabetic	Control
Right Hand a-d Distance				
Mean ± S.D	64.3 6.34	51.6 3.82	60.8 3.61	52.4 3.60
Sample	50	50	50	50
	P<0.001		P<0.001	

**Table IIB**

\*S.D = Standard Deviation

This table shows the mean value of distance a-d determined from the right palms of 50 type 1 male diabetics of age 25-40 years being 64.3 to be higher than that of 50 normal male controls, i.e. 51.6 of similar age group. The level of significance being 0.1%. Similarly, the mean value of distance a-d, i.e. 60.8 determined from the right palms of 50 diabetic females has been shown to be higher in comparison to the female controls with a level of significance being 0.1%, the standard deviation has been calculated. The P-value then determined by the help of unpaired T-test and then the level of significance was obtained. The level of significant difference being 0.1% in the male group indicating that the observations are highly significant.

**Distribution of Mean of Left Hand Distance a-d of Type 2 Diabetics and Normal Controls:**

Parameters	Males		Females	
	Diabetic	Control	Diabetic	Control
Left Hand a-d Distance				
Mean ± S.D	59.8 3.50	51.9 3.79	60.7 3.24	54.7 3.62
Sample	50	50	50	50
	P<0.001		P<0.001	

**Table IIC**

\*S.D. = Standard Deviation

This table depicts the mean value determined from measuring distance a-d of left palms of 50 type 2 male diabetics, which is shown to be higher than that of male controls 50 in number of same age groups and from same geographical region. The level of significance obtained by statistical analysis is 0.1% in case of the males. Similarly, the mean value of distance a-d, i.e. 60.7 of female diabetics is higher than that of female controls, i.e. 54.7 of same age group, i.e. more than 40 years with a level of significance being 0.1%. The standard deviation has been determined

for each group of subject and control to facilitate the determination of the p-value, which is <0.001 in both the comparisons and the level of significant difference was obtained from the p-value chart.

**Distribution of Mean of Right Hand Distance a-d of Type 2 Diabetics and Normal Controls:**

Parameters	Males		Females	
	Diabetic	Control	Diabetic	Control
Right Hand a-d Distance				
Mean ± S.D	59.18 4.04	52.07 3.20	55.6 3.52	49.7 3.96
Sample	50	50	50	50
	P<0.001		P<0.001	

**Table IID**

\*S.D, = Standard Deviation

This table indicated that the mean value obtained from the measurement of distance a-d of right palms of 50 type 2 diabetics, i.e. 59.18 is higher than that of male controls, i.e. 52.07 of similar age group, which is more than 40 years and with a level of significance being 0.1%. The mean value obtained from the distance a-d of right palms of 50 type 2 female diabetics, i.e. 55.6 is higher than that of corresponding female's controls, i.e. 49.7 and with a high level of significance being 0.1%. Here, also the standard deviation has been calculated to determine the p-value by the unpaired Student's 'T' test method and then the level of significant difference was obtained.



**Fig. 1: Taking Fingerprinting**



**Fig. 2: Taking Palm Print**

## DISCUSSION

Several authors have studied the dermatoglyphics in diabetes mellitus, but have not mentioned the type of diabetes mellitus in accordance with the age of onset of the disease and very few literatures are available regarding the study of dermal ridges in non-insulin-dependent diabetics.

### Total Ridge Count

A.G. Ziegler, R. Mathies and G. Zieglmayer<sup>5,6</sup> stated that type 2 diabetic patients showed the characteristics abnormalities of qualitative and quantitative dermatoglyphic markers, which differed from the normal population. Diabetic patients showed a decreased third finger ridge count (Right  $10.2 \pm 0.4$  versus  $11.6 \pm 0.4$ ,  $P=0.02$ , Left  $10.3 \pm 0.4$  versus  $11.6 \pm 0.4$ ,  $P=0.04$ ). They have not indicated any significant difference of total finger ridge count among the diabetics and controls. L. Barta, Andrea Regoly-Merei and L. Kammeren<sup>7,8,9</sup> carried out their studies in 290 diabetic children and 180 adults and stated an increase in TRC value in the diabetics in comparison to the controls, but they reported that differences were not found in the adult diabetics as shown below.

Control		Type	
		Juvenile	Adult
Female	124.3±44.1	129.8±47.4	124±45.5
Male	137.5±44.0	144.2±48.6	137.4±47.2

This is corroborative with the findings of Table 1A shown as before, but the age factor is specially mentioned as between 25 to 40 years in our observations.

R. Ravindranath and I.M. Thomas<sup>10</sup> studied 150 type 2 diabetics and published their findings that the difference in the mean total finger ridge counts were not significant at the 5% level. The mean TFRC being  $134.95 \pm 39.03$  (Standard Deviation) in case of type 2 diabetics (75M, 75F) in comparison to mean  $141.97 \pm 37.64$  (S.D) 60M and 60FM controls. M = Male, F = Female, S.D = Standard Deviation. Their findings are not corroborative with that in Table-IB.

Iqbal et al<sup>11</sup> reported increased TFRC in male diabetics, which is corroborative with the observation recorded in Table-1(A). Ahuja et al<sup>12</sup> found increase in fingerprint pattern whereas Banerjee et al<sup>13</sup> reports decrease in fingerprint pattern, which is not taken into consideration in this study. Vera et al<sup>14</sup> in a study of 158 diabetic children found a decrease in TRC and an increase in the number of t' axial triradii. Barta et al<sup>7,8,9</sup> in a study with 290 children and 180 adults found that a high TRC value was more frequent in both the sexes with diabetics than in the controls, which is corroborative with the observations in Table-I(A). The studies carried out by various authors are not corroborative with the findings stated in the Table nos. IA and B. The reason maybe because of the different geographical distributions and also may be due to the difference in age of onset of the disease.

### Distance a-d

The distance in 'mm' between the axial triradii 'a' and 'd' have significant difference between the diabetics of type 1 variety and controls.

## CONCLUSION

In type 1 diabetes, the total finger ridge count in male diabetics is more than that in the male controls of similar age group with a level of significant difference being 0.001%. The female diabetics of type 1 variety showed a higher ridge count value in comparison to type 2 male diabetics while the type 1 female diabetics and type 2 female diabetics did not have any significant difference between them in regards to TRC. This finding is corroborative with Iqbal et al<sup>11</sup> and Barta.<sup>7,8,9</sup>

There was increase in the a-d distance measured in mm in case of the diabetics in comparison to the controls. The male diabetics possessed a higher mean than the female diabetics when measured in the left palms. Similarly, the right palms of the male diabetics possessed a higher mean than the female diabetics. The diabetics of the type 1 variety as a whole have a higher mean than their counterpart controls.

The type 1 male diabetics also possessed a higher value than the type 2 male counterparts regarding the observations obtained from their left palms. The female diabetics of the type 1 variety also possess a higher value than the female diabetics of type 2 variety regarding their right palms. In type 2 diabetes, the male diabetics possessed a higher TRC value in comparison to the normal controls. Similarly, the female diabetics also possessed a higher TRC value with a level of significant difference being 0.001% in comparison between the male and female diabetics of type 2 variety. The female diabetics possessed a higher TRC value than their male counterparts, but not that significantly. In comparison to type 1 variety of diabetics, the non-insulin-dependent diabetics possessed a lower TRC value than their insulin-dependent counterparts.

### Distance a-d

Increase in the distance between the axial triradius 'a' and 'd' was a constant feature among the diabetics both males and females in comparison to their controls of age group more than 40 years. The left palms of female type 2 diabetics showed a lower value of a-d distance in comparison to that of the right palms of the female diabetics of type 2 variety. The type 2 diabetics, especially the males possessed a lower value of a-d distance than their counterpart type 1 male diabetics irrespective of their hands.

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