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Original article

Dermatoglyphics: An Economical Tool for Prediction of Diabetes Mellitus

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ABSTRACT

Diabetes Mellitus being one of the curse of human civilization is said to be genetically linked. Dermatoglyphics of the individual are also genetically determined and remains constant throughout the life. In the present study an attempt has been made to find an association of the dermatoglyphics pattern of the individual and Diabetes Mellitus. A total of 200 subjects were participated in the present study of which 100 were diabetic (50 males and 50 females) and 100 healthy individuals as control (50 males and 50 females). Dermatoglyphics patterns i.e. 'atd', 'tda' and 'dat' angles of the right and left hands of diabetic and control group were measured. The mean 'atd' angle in both the hands (right and left) of both the sexes (male and female) of diabetics was found to be significantly wider as compared to that of the controls. The mean 'tda' angle in both the hands (right and left) of both the sexes (male and female) of diabetics was found to be narrow as compare to that of control. The mean 'dat' angle was found to be significantly narrow only in the left hand of diabetic females as compare to left hand of control females. Thus, dermatoglyphics may be considered as an economical tool for the prediction of the diabetes mellitus in developing country, particularly diabetic capital of the world *i.e.*, India.

KEYWORDS: Diabetes mellitus, Dermatoglyphics, Finger print

INTRODUCTION

Dermatoglyphics is the study of patterns of the epidermal ridges of the palms, fingers, soles and toes. Abnormalities in the ridge patterns may occur due to genetic alteration during organogenesis period i.e. between 13^{th}-60^{th} day after fertilization of the ovum. During development, once the epidermal ridges are formed they are age and environment stable becoming a reliable indicator of genetic composition of the individual. The knowledge of dermatoglyphics has been applied to the field of medical and genetic diagnosis. The role of dermatoglyphics is very important in the diagnosis of chromosomal disorders such as Turner's syndrome, trisomy 18 and Down syndrome [1-3].

The dermatoglyphic patterns commonly studied are the flexion creases of the palm and dermal patterns such as fingerprint and palmer patterns. According to Henry's System of Fingerprint Classification, a triradius is a point from which ridge system courses in three different directions at an angle of about 120^0. The four digital triradii near the distal border of the palm one proximal to each finger except the thumb, named a, b, c, d from index to little finger respectively and an axial triradius 't' commonly placed over the fourth metacarpal near the base of the palm provide the

landmarks for palmer patterns. The 'atd' angle is measured by joining the digital triradius 'a' to axial triradius 't' and to the digital triradius 'd' [4].

Diabetes mellitus is a metabolic disorder characterized by common feature of hyperglycemia with disturbance of carbohydrate, fat and protein metabolism. Diabetes mellitus is the leading cause of morbidity and mortality across the world. India leads the world with largest number of diabetic subjects (40.9 million prevalence) and is expected to rise to 69.9 million by 2025 [5]. It is estimated that approximately 1% of population suffer from diabetes mellitus (DM). Diabetes mellitus is classified as Type I and Type II. Type I DM is juvenile onset, insulin dependent while type II DM is maturity onset and noninsuline dependent. Increased incidence of obesity and lack of physical activity is raising the incidence of DM especially of type 2 (NIDDM). The peculiar patterns of the epidermal ridges serve as a diagnostic tool in number of diseases that have a strong hereditary background. Diabetes mellitus is one of such disease with a strong genetic basis.

There appears to be little agreement between the findings of various authors on dermatoglyphic parameters studied in the diabetes mellitus such as Sherke *et al*, Mandasescu *et al*, Ravindranath *et al* and Vaddgaonkar *et al* gave the opinion concerning efficacy of dermatiglyphics in the prediction of diabetes mellitus [6-9]. On this foundation, it has been presumed that any alteration in epidermal ridges of an individual prone to diabetes may have a distinct dermatoglyphics pattern, which remains unchanged throughout life. In the present study an attempt has been made to identify whether patients with diabetes mellitus express any specific dermatoglyphics pattern/patterns or not. If so then patients prone to diabetes are informed and warned to avoid certain trigger factors, in this way it would be an added advantage for clinician to check diabetes mellitus.

MATERIALS AND METHODS

In the present study, one hundred diabetics patients (50 Males, 50 Females) and one hundred healthy individuals as control group (50 Males, 50 Females) were included. All the selected individuals were above 40 years of age and were the resident of Malwa region of Madhyapradesh. The patients with raised blood sugar level attending the Department of Medicine and the Department of Surgery of Tertiary care hospital of Malwa region in the year of 2007 were taken as the study group.

The control group was sex and age matched population without personal or family history of diabetes mellitus and was selected from attendants accompanying the patients or their neighbors. Inclusion Criteria for the present study was adult patients > 40 years of age, diagnosis of type 2 diabetes mellitus for at least 3 months, treated with a stable dose of oral hypoglycemics, body mass index $\geq$ 27 kg/m^2 and $\leq$ 42 kg/m2 at screening. Exclusion criteria included history of significant liver or kidney disease, uncontrolled hypertension, significant cardiovascular disease, significant gastrointestinal conditions, history of chronic or acute pancreatitis.

After obtaining informed consent, height (using stadometer) and weight of each individual were noted. Fingerprints of all digits and print of the palm of the right and left hand of each individual were taken after obtaining their written consent. A small quantity of ink was applied over the palmer aspect of hand and fingers by placing the same over the duplicating ink pad. Ink was applied thoroughly and uniformly with the help of gauge piece. A sheet of paper was kept at the edge of the table.

The palm was rolled on card-board roller with paper, taking care that the cupped region of the palm were printed properly. Fingerprints were then taken by keeping the sheet of paper clipped with writing board on the edge of the table and rolling each finger subsequently over it, taking care not to apply pressure on finger and avoiding overlapping of the impressions. With the help of magnifying glass, finger print pattern were noted and triradii points on the palm were marked. Using protractor, 'atd', 'dat' and 'tda' angles were measured. Data was analyzed statistically using unpaired 't' test.

RESULTS

The 'atd' angle in control and diabetic group on right were 39.43^0 and 41.13^0 respectively while on left were 39.3^0 and 41.47^0 respectively. The 'tda' angle in control and diabetic group on right were 81.18^0 and 80.35^0 respectively while on left were 81.26^0 and 80.17^0 respectively [Table 1].

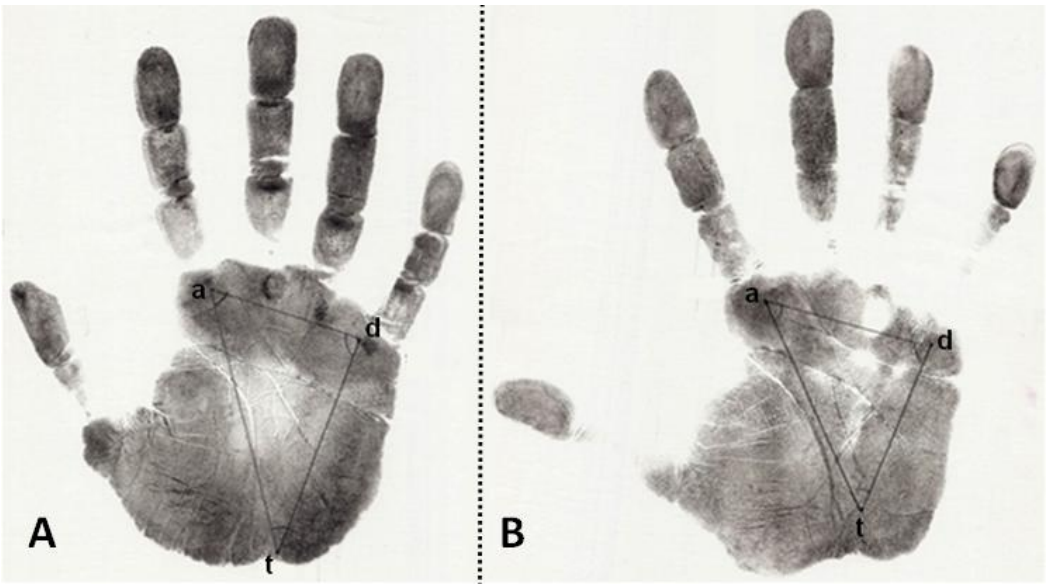
There was statistically significant difference in 'atd' angle and 'tda' angle of diabetic and control group (p value < 0.05) [Table 1, Fig-1].The 'dat' angle in control and diabetic group on right were 59.39^0 and 58.52^0 respectively while on left were 59.44^0 and 58.36^0 respectively. There was no statistically significant difference in 'dat' angle of diabetic and control group (p value > 0.05) [Table 1, Fig-1].

Table 1: Comparison of Dermatoglyphics angles in Control group (C) and Diabetic patients (D)

Parameter	Groups	Right hand (Mean ±SD)	Left hand (Mean ± SD)
'atd' angle	C	39.43±1.81	39.30±1.92
	D	41.13±3.73	41.47±4.20
	p-value	< 0.001	< 0.001
'tda' angle	C	81.18±1.93	81.26±2.03
	D	80.35±2.61	80.17±2.51
	p-value	0.0113	0.0009
'dat' angle	C	59.39±3.13	59.44±4.51
	D	58.52±3.26	58.36±3.88
	p-value	0.0630	0.0710

SD: Standard deviation, D: Diabetic patients, C: Control group

Figure 1 A: Dermatoglyphic pattern of an individual from control group with 38^0 'atd' angle, 58^0 'tad' angle and 84^0 'tda' angle. **B:** Dermatoglyphic pattern of an individual from Diabetic group with 46^0 'atd' angle, 54^0 'tad' angle and 80^0 'tda' angle.



Average values of 'atd' angle, 'tda' angle and 'dat' angle of right and left hand in male and female individuals of diabetic and control group are given in table 2. There was statistically significant difference in 'atd' angle and 'tda' angle of diabetic and control group in both male and female (p value < 0.05). There was statistically significant difference in 'dat angle of diabetic and control group only in female (p value < 0.05) [Table 2].

Table 2: Comparison of dermatoglyphic angles of male and female individuals in Control and Diabetic groups

Parameter	Group	Male		Female	
		Right hand (Mean ±SD)	Left hand (Mean ±SD)	Right hand (Mean ±SD)	Left hand (Mean ±SD)
'atd' Angle	C	39.34±2.15	39.30±2.25	39.52±1.42	39.30±1.54
	D	41.10±3.40	42.02±4.56	41.16±4.07	40.92±3.78
	p-value	0.0026	0.0003	0.0084	0.0060
'tda' Angle	C	81.16±2.08	81.52±2.29	81.20±1.78	81.00±1.74
	D	79.70±2.91	79.36±2.72	80.00±2.11	80.08±1.99
	p-value	0.0048	< 0.0001	0.0027	0.0156
'dat' Angle	C	59.50±2.64	59.18±2.13	59.28±1.50	59.70±2.01
	D	59.20±2.52	58.62±2.85	57.84±3.77	58.10±3.52
	p-value	0.5624	0.2400	0.0137	0.0063

D: Diabetic patients, C: Control group

DISCUSSION

The genetic association of the diabetes mellitus is well known fact and it is universally accepted. India is referred as the 'diabetes capital of the world' as it leads the world with largest number of diabetic subjects. According to the Diabetes Atlas published by the International Diabetes Federation, around 40.9 million people in India are diabetic and urgent preventive steps need to be taken with immediate effect. Increased insulin resistance and greater abdominal adiposity i.e., higher waist circumference despite lower body mass index indicates the Asian Indian Phenotype more prone to diabetes and premature coronary artery disease. At least a part of this phenotype is due to genetic factors [5].

The present study revealed that the mean 'atd' angle was significantly wider in both the hands of diabetics as compared to control population in male and female. Similar findings were reported in the study conducted by Ravindranath *et al* and Vadgaonkar *et al* [Table 3] [8-9]. The values of the 'atd' angle in the present study are very close to the findings of Ravindranath *et al* as compared to that of Vadgaonkar *et al*. These differences in the values might be due to the different population groups in the different geographical areas or the population belonging to different gene pools.

In the present study and study of Ravindranath *et al*, 'tda' and 'dat' angle were also included as dematoglyphic parameters for analysis of the diabetic patients. The present study showed that the 'tda' angle was significantly narrower in both the hands of diabetic compared to control population in both sexes while Ravindranath *et al*

showed that in both the hands 'tda' angle was wider of diabetic male while narrower in diabetic female. Ravindranath *et al* concluded that there was no significant difference in 'dat' angle in diabetics while in the present study 'dat' angle was found significantly narrow only in left hand of diabetic female [Table 3] [8]. Thus, with the available data and the statistical analysis, dermatoglyphic patterns may be used as a reliable indicator for scientific screening of population prone to diabetes mellitus.

Table 3: Comparison of findings of the present study with the findings of earlier researchers

Parameter	Study	Group	Right Hand		Left hand	
			Male	Female	Male	Female
'atd' angle	**Present study**	C	39.34	39.52	39.30	39.30
		D	41.10	41.16	42.02	40.92
	Vadgaonkar *et al* [9]	C	44.26	45.12	43.60	45.64
		D	52.51	55.57	52.13	58.08
	Ravindranath *et al* [8]	C	44.00	43.37	43.22	43.57
		D	42.63	43.73	42.35	44.79
'tda' angle	**Present study**	C	81.16	81.20	81.52	81.00
		D	79.70	80.00	79.36	80.08
	Ravindranath *et al* [8]	C	78.43	77.93	78.68	76.97
		D	79.39	76.50	79.28	76.50
'dat' angle	**Present study**	C	59.50	59.28	59.68	59.7
		D	59.20	57.84	58.62	58.10
	Ravindranath *et al* [8]	C	58.05	57.93	59.34	57.63
		D	58.24	58.64	58.20	58.94

D: Diabetic patients, C: Control group

The most disturbing trend is the shift in age of onset of diabetes to a younger age in the recent years. This could have long lasting adverse effects on nation's health and economy. Early identification of at-risk individuals using simple screening tools like dermatoglyphics which is user friendly; economically viable would greatly help in preventing or postponing the onset of diabetes and thus reducing the burden on the community and the nation as a whole.

CONCLUSION

Dermatoglyphic patterns which remain constant throughout life serve as a diagnostic tool in number of diseases that have a strong hereditary background, Diabetic mellitus is one such disease with a strong genetic basis. Dermatoglyphic investigation is very cost effective and requires no hospitalization. In clinical medicine the importance of dermatoglyphics is that it can help in predicting the phenotype of a possible future illness.

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