DERMATOGLYPHIC PATTERN ON FINGERTIPS OF THALASSEMIA PATIENTS: A CASE CONTROL STUDY IN NORTH INDIAN POPULATION

Gultaj Paul ¹, Gurdeep Singh Kalyan ², Harsimarjit Kaur ^{*3}, Usha Chhabra ⁴.

¹ Senior Resident, Department of Anatomy, Government Medical College, Patiala, Punjab, India.

² Professor(Anatomy) currently posted as Joint Director, DRME, Punjab, India.

^{*3} Associate Professor, Department of Anatomy, Government Medical College, Patiala, Punjab, India.

⁴ Associate Professor, Department of Anatomy, Government Medical College, Patiala, Punjab, India.

ABSTRACT

Background: Dermatoglyphics is the scientific study of fingerprints. Fingerprint is a multifactorial trait. Large number of genes play their role along with environmental influence. Chromosomal aberration affect these genes and produce variation in dermatoglyphic pattern in various chromosomal syndromes.

Materials and methods: The present study was conducted in the Department of Anatomy, Government Medical College and Rajindra Hospital, Patiala and is based on digital dermatoglyphics of 100 Thalassemic patients from Thalassemia Ward of Rajindra Hospital, Patiala hailing from Northern region of India. The control group comprises of 50 individuals of similar origin. Fingertip dermatoglyphic patterns of both hands of Thalassemia patients and control group were recorded by INK method. The fingertip pattern type was recorded by using Henry's classification method. The data so obtained was compiled and analysed statistically.

Results: It was found that whorls were most frequent pattern on digit IV in patients and controls, with statistical significance in both hands, right hand (p value .042) and left hand (p value .010). Ulnar loops had preponderance over other patterns on digit V in both the groups but the difference was statistically significant in left hand (p value .033).

Conclusion: From our study it can be concluded that dermatoglyphics can prove to be an extremely useful tool for the preliminary investigations into conditions with a suspected genetic base and dermatoglyphic abnormalities should prove of considerable value in preliminary mass screening.

KEY WORDS: Dermatoglyphics, Thalassemia, Fingertip Pattern.

Address for Correspondence: Dr. Harsimarjit Kaur, Associate Professor, Department Of Anatomy, Government Medical College, Patiala, Punjab, India. **E-Mail:** dr.harsimarjit@gmail.com

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INTRODUCTION

Dermatoglyphics (from ancient Greek derma = "skin", glyphe = "carve") is the scientific study of fingerprints. The term was coined by Cummins and Midlo in 1926. The word is literally descriptive of the delicately sculptured skin surface,

inclusive of single ridges and their configurational arrangements [1]. Fingerprints are dermal ridge configurations between them [2]. They are formed between the seventh and twenty-first week of foetus life and is individually unique and immutable during life [3].

Fingerprint is a genetic trait. There are a large number of genes determining the ridge pattern. Chromosomal aberrations affect these genes and produce a variation in dermatoglyphic pattern in various chromosomal syndromes [4]. Abnormalities in the epidermal ridges may result from the genetic alteration occurring around the first trimester of pregnancy during organogenetic period. Such epidermal ridge alterations in individuals may have distinctive dermatoglyphic feature which may remain unchanged throughout life [5].

Thalassemia is the world's most common hereditary hemoglobinopathy [6]. The hereditary prevalence rate of this disease varies between 2.5% and 15% in the Mediterranean regions, the Arabian Peninsula, Turkey, Iran, India and South-eastern Asia [7].

Dermatoglyphics is used since they are convenient and easily accessible tool in the study of genetically influenced diseases. Since there is scanty data from north-indian region, we have made an attempt to study dermatoglyphic features of Thalassemia patients from northern india region in order to find out any variation which could be highlighted with a view to assess its value as a diagnostic marker.

MATERIALS AND METHODS

The proposed study was conducted on 100 thalassemia patients residing in Northern India. These patients were diagnosed cases and were enrolled in the Thalassemia ward of Rajindra Hospital, Patiala. The control group included 50 normal healthy individuals selected randomly, residing in similar surroundings in northern parts of India.

Inclusion criteria: The thalassemia patient has to be a diagnosed case enrolled in Thalassemia ward, Rajindra Hospital, Patiala, Intact fingertips and palms.

Exclusion criteria: Any injury on any of the finger or palm, Those having less developed papillary creases. Burnt or amputated fingers.

Subjects were informed about the procedure in detail and consent was taken. "Printer's ink and paper method" was used [1]. From each subject, inked impression of both hands using printers ink was taken on a thick white paper sheet.

The following materials were used:

Printer's ink-to obtain clear and quick drying prints. Cotton pad wrapped in muslin cloth-for spreading the ink. Glass slab-on which the ink is rolled into thin film. Sunlit bond paper-for taking prints of both hands. A rigid surface-on which bond paper will be laid during the process of taking prints. Magnifying glass-for analysis of the finger prints. Soap, water and napkin for cleaning the dermatoglyphics area.

Fig. 1: Showing the materials used for taking fingerprints.

1-Kore's duplicating ink 2- cotton 3-muslin cloth 4- soap and towel 5&6- sunlit bond paper 7A- magnifying glass 7B- glass slab.

Fig. 2: Magnifying glass with LED which was used to study the fingertip pattern types.

Hands of the subject was thoroughly washed with soap and water and dried with napkin before taking prints. Inking slab was also cleaned to avoid any interference of accumulated dust etc. in taking good prints. Then requisite amount of ink was poured on a clean slab and ink was evenly spread on the glass plate by a cotton pad. This thin uniform film of ink was transferred on the fingers of the subject with the help of the

cotton pad from the end of the terminal phalanx to the flexion crease of distal interphalangeal joint. The inked finger ball will then be placed on one edge of the paper which will be placed on the rigid surface i.e. top of the table and rolled into its opposite edge, so that a clear pattern will be obtained on paper. Rolled prints of all the fingers will be taken to ensure imprinting of triradii present on lateral side of each digit. The Fingertip pattern type was evaluated as per the standardized methods described by Cummins and Midlo 1961.

According to Henry's classification there are four main types of fingertip pattern :

1. Arches
2. Loops- radial or ulnar
3. True whorls
4. Composites

The obtained fingertip pattern of both the hands was analysed qualitatively and quantitatively. The results so obtained were analysed statistically.

For the present study the digits have been numbered as Digit I, II, III, IV and V in the radio-ulnar sequence.

The following landmarks have been given due consideration for identifying the pattern types :

A) Triradius- is located at the meeting point of three opposing ridge systems.

B) Delta- in a strict sense is a triangular plot and triradius is represented by ridges forming its boundary.

Fig. 3: Showing the Triradius (green dot) and core (red dot) in a radial loop.

Fig. 4: Showing the diagrams of different types of ridge arrangement in the area of a triradius. The triradial point is the center of the dotted circle.

Fig. 5: Showing that an arch can either be plain or tented and has no triradius.

Fig. 6: Showing that loop has one triradius.

Fig. 7: Showing that a true whorl has two triradii.

Fig. 8(a): Showing that the central pocket loop type of composite pattern may have two or more triradii.

Fig. 8(b): Showing Accidental type of composite pattern having two or more triradii.

OBSERVATIONS

Table 1: Gender distribution of patients and controls in the present study.

sex	Patients	Control	Total
Females	30 (30%)	22(44%)	52 (34.7%)
Males	70(70%)	28(56%)	98 (65.3%)
Total	100 (100%)	50 (100%)	150(100%)

Observations have been tabulated and presented from table 2 to 11 along with the count and percentage within the group.

Table 2: Frequency counts of different types of digital pattern on Digit I in Thalassemia patients and controls.

Pattern	Left Hand			Right Hand		
	Patients	Controls	Total	Patients	Controls	Total
A	3(3%)	1(2%)	4(2.7%)	3(3%)	1(2%)	4(2.7%)
C	8(8%)	5(10%)	13(8.7%)	16(16%)	6(12%)	22(14.7%)
L ^r	0(0%)	1(2%)	1(0.7%)	0(0%)	1(2%)	1(0.7%)
L ^u	47(47%)	23(46%)	70(46.7%)	34(34%)	23(46%)	57(38%)
W	42(42%)	20(40%)	62(41.3%)	47(47%)	19(38%)	66(44%)
P Value	.677 (not significant)			.359 (not significant)		

Table 2 shows the absence of radial loops in patients and few radial loops in controls. Predominant pattern in left hand is ulnar loop in both the groups while in the right hand patients showed more frequency of whorls and controls had more number of ulnar loops.

Table 3: Frequency counts of different types of digital pattern on Digit I in females and males.

Pattern	Left Hand						Right Hand					
	Patients			Controls			Patients			Controls		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
A	1(3.3%)	2(2.9%)	3(3%)	0(0%)	1(3.6%)	1(2%)	1(3.3%)	2(2.9%)	3(3%)	0(0%)	1(3.6%)	1(2%)
C	4(13.3%)	4(5.7%)	8(8%)	1(4.5%)	4(14.3%)	5(10%)	2(6.7%)	14(20%)	16(16%)	2(9.1%)	4(14.3%)	6(12%)
L ^r	0(0%)	0(0%)	0(0%)	0(0%)	1(3.6%)	1(2%)	0(0%)	0(0%)	0(0%)	0(0%)	1(3.6%)	1(2%)
L ^u	13(43.3%)	34(48.6%)	47(47%)	13(59.1%)	10(35.7%)	23(46%)	13(43.3%)	21(30%)	34(34%)	13(59.1%)	10(35.7%)	23(46%)
W	12(40%)	30(42.9%)	42(42%)	8(36.4%)	12(42.9%)	20(40%)	14(46.7%)	33(47.1%)	47(47%)	7(31.8%)	12(42.9%)	19(38%)
P value	.636 (not significant)			.363 (not significant)			.328 (not significant)			.447 (not significant)		

Table 3 shows that most frequent pattern on digit I in left hand of both male and female patients is ulnar loop whereas in the right hand patients of both the genders had predominance of whorls.

Table 4: Frequency counts of different types of digital pattern on Digit II in Thalassemia patients and controls.

Pattern	Left Hand			Right Hand		
	Patients	Controls	Total	Patients	Controls	Total
A	17(17%)	5(10%)	22(14.7%)	11(11%)	4(8%)	15(10%)
C	4(4%)	6(12%)	10(6.7%)	5(5%)	3(6%)	8(5.3%)
L ^r	10(10%)	5(10%)	15(10%)	10(10%)	4(8%)	14(9.3%)
L ^u	33(33%)	16(32%)	49(32.7%)	32(32%)	24(48%)	56(37.3%)
W	36(36%)	18(36%)	54(36%)	42(42%)	15(30%)	57(38%)
P Value	.364 (not significant)			.399 (not significant)		

Table 4 shows that whorls are predominant in the patients and controls in the left hand. Where as in the right hand, patients have predominance of whorls while controls have more ulnar loops.

Table 5: Frequency counts of different types of digital pattern on Digit II in females and males.

Pattern	Left Hand						Right Hand					
	Patients			Controls			Patients			Controls		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
A	7(23.3%)	10(14.3%)	17(17%)	3(13.6%)	2(7.1%)	5(10%)	4(13.3%)	7(10%)	11(11%)	1(4.5%)	3(10.7%)	4(8%)
C	1(3.3%)	3(4.3%)	4(4%)	3(13.6%)	3(10.7%)	6(12%)	2(6.7%)	3(4.3%)	5(5%)	1(4.5%)	2(7.1%)	3(6%)
L^r	4(13.3%)	6(8.6%)	10(10%)	2(9.1%)	3(10.7%)	5(10%)	2(6.7%)	8(11.4%)	10(10%)	0(0%)	4(14.3%)	4(8%)
L^u	9(30%)	24(34.3%)	33(33%)	6(27.3%)	10(35.7%)	16(32%)	9(30%)	23(32.9%)	32(32%)	13(59.1%)	11(39.3%)	24(48%)
W	9(30%)	27(38.6%)	36(36%)	8(36.4%)	10(35.7%)	18(36%)	13(43.3%)	29(41.4%)	42(42%)	7(31.8%)	8(28.6%)	15(30%)
P value	.721 (not significant)			.922 (not significant)			.910 (not significant)			.296 (not significant)		

Table 5 shows that female patients have equal distribution of ulnar loops and whorls in left hand but in right hand patients of both genders have whorls predominantly. Whereas in the left hand the control group females have more of whorls and males have equal percentage of ulnar loops and whorls. In the right hand of control group ulnar loop is the pattern with maximum frequency.

Table 6: Frequency counts of different types of digital pattern on Digit III in Thalassemia patients and controls

Pattern	Left Hand			Right Hand		
	Patients	Control	Total	Patients	Control	Total
A	7(7%)	3(6%)	10(6.7%)	6(6%)	3(6%)	9(6%)
C	2(2%)	1(2%)	3(2%)	1(1%)	1(2%)	2(1.3%)
L^r	1(1%)	0(0%)	1(0.7%)	1(1%)	0(0%)	1(0.7%)
L^u	58(58%)	35(70%)	93(62%)	79(79%)	34(68%)	113(75.3%)
W	32(32%)	11(22%)	43(28.7%)	13(13%)	12(24%)	25(16.7%)
P Value	.647 (not significant)			.447 (not significant)		

Table 6 shows that both the groups have maximum frequency of ulnar loop pattern. Radial loop pattern is present in only 1 % patients in both hands and is absent in controls.

Table 7: Frequency counts of different types of digital pattern on Digit III in females and males.

Pattern	Left Hand						Right Hand					
	Patients			Controls			Patients			Controls		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
A	4(13.3%)	3(4.3%)	7(7%)	1(4.5%)	2(7.1%)	3(6%)	1(3.3%)	5(7.1%)	6(6.0%)	2(9.1%)	1(3.6%)	3(6%)
C	0(0%)	2(2.9%)	2(2%)	0(0%)	1(3.6%)	1(2%)	0(0%)	1(1.4%)	1(1%)	1(4.5%)	0(0%)	1(2%)
L^r	0(0%)	1(1.4%)	1(1%)	0(0%)	0(0%)	0(0%)	0(0%)	1(1.4%)	1(1%)	0(0%)	0(0%)	0(0%)
L^u	17(56.7%)	41(58.6%)	58(58%)	17(77.3%)	18(64.3%)	35(70%)	24(80%)	55(78.6%)	79(79%)	16(72.7%)	18(64.3%)	34(68%)
W	9(30%)	23(32.9%)	32(32%)	4(18.2%)	7(25%)	11(22%)	5(16.7%)	8(11.4%)	13(13%)	3(13.6%)	9(32.1%)	12(24%)
P value	.433 (not significant)			.687 (not significant)			.770 (not significant)			.286 (not significant)		

Table 7 shows the absence of composites and radial loops in female patients in both the hands. 1.4% male patients have radial loop on both hands. Radial loop pattern is absent in both genders in the control group. In both genders, in both the hands the pattern with maximum frequency is ulnar loop.

Table 8: Frequency counts of different types of digital pattern on Digit IV in Thalassemia patients and controls.

Pattern	Left Hand			Right Hand		
	Patients	Controls	Total	Patients	Controls	Total
A	1(1%)	2(4%)	3(2%)	4(4%)	0(0%)	4(2.7%)
C	0(0%)	4(8%)	4(2.7%)	0(0%)	3(6%)	3(2%)
Lu	47(47%)	16(32%)	63(42%)	32(32%)	14(28%)	46(30.7%)
W	52(52%)	28(56%)	80(53.3%)	64(64%)	33(66%)	97(64.7%)
P Value	.010 (significant)			.042 (significant)		

Table 8 shows whorls to be the most frequent pattern in both patients and controls. Composites are absent in both hands of patients. Radial loops are absent in both groups on digit IV. The difference in frequency distribution is found statistically significant in both the hands.

Table 9: Frequency counts of different types of digital pattern on Digit IV in females and males.

Pattern	Left Hand						Right Hand					
	Patients			Controls			Patients			Controls		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
A	0(0%)	1(1.4%)	1(1%)	1(4.5%)	1(3.6%)	2(4%)	2(6.7%)	2(2.9%)	4(4%)	0(0%)	0(0%)	0(0%)
C	0(0%)	0(0%)	0(0%)	1(4.5%)	3(10.7%)	4(8%)	0(0%)	0(0%)	0(0%)	1(4.5%)	2(7.1%)	3(6%)
L ^r	14(46.7%)	33(47.1%)	47(47%)	8(36.4%)	8(28.6%)	16(32%)	13(43.3%)	19(27.1%)	32(32%)	10(45.5%)	4(14.3%)	14(28%)
W	16(53.3%)	36(51.4%)	52(52%)	12(54.5%)	16(57.1%)	28(56%)	15(50%)	49(70%)	64(64%)	11(50%)	22(78.6%)	33(66%)
P value	.801 (not significant)			.834 (not significant)			.150 (not significant)			.051 (not significant)		

Table 9 depicts that whorls are the predominant pattern in both genders in patients and controls in both the hands. There is no statistical significance when evaluated genderwise.

Table 10: Frequency counts of different types of digital pattern on Digit V in Thalassemia patients and controls.

Pattern	Left Hand			Right Hand		
	Patients	Controls	Total	Patients	Controls	Total
A	1(1%)	0(0%)	1(0.7%)	5(5%)	0(0%)	5(3.3%)
C	0(0%)	4(8%)	4(2.7%)	3(3%)	3(6%)	6(4%)
L ^r	0(0%)	0(0%)	0(0%)	1(1%)	0(0%)	1(0.7%)
L ^u	76(76%)	36(72%)	112(74.7%)	73(73%)	31(62%)	104(69.3%)
W	23(23%)	10(20%)	33(22%)	18(18%)	16(32%)	34(22.7%)
P Value	.033 (significant)			.125 (not significant)		

Table 10 is showing the preponderance of ulnar loops over other patterns in both the groups but the difference is statistically significant in left hand (P value .033). Radial loop pattern is present in 1% patients in right hand, in addition to that in the left hand composites are absent in patients and arches are absent in controls.

Table 11: Frequency counts of different types of digital pattern on Digit V in females and males.

Pattern	Left Hand						Right Hand					
	Patients			Controls			Patients			Controls		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
A	0(0%)	1(1.4%)	1(1%)	0(0%)	0(0%)	0(0%)	3(10%)	2(2.9%)	5(5%)	0(0%)	0(0%)	0(0%)
C	0(0%)	0(0%)	0(0%)	3(13.6%)	1(3.6%)	4(8%)	0(0%)	3(4.3%)	3(3%)	0(0%)	3(10.7%)	3(6%)
L ^r	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	1(1.4%)	1(1%)	0(0%)	0(0%)	0(0%)
L ^u	22(73.3%)	54(77.1%)	76(76%)	16(72.7%)	20(71.4%)	36(72%)	21(70%)	52(74.3%)	73(73%)	18(81.8%)	13(46.4%)	31(62%)
W	8(26.7%)	15(21.4%)	23(23%)	3(13.6%)	7(25%)	10(20%)	6(20%)	12(17.1%)	18(18%)	4(18.2%)	12(42.9%)	16(32%)
P value	.698 (not significant)			.308 (not significant)			.405 (not significant)			.027 (significant)		

Table 11 makes it clear that ulnar loop pattern is dominant over other patterns in both the groups and in both genders but statistical significant difference is found in the sex distribution of control group (P value .027).

DISCUSSION

The percentage frequency for fingertip patterns recorded over different digits of the Thalassemia patients and controls of both genders is presented from Table 2 to 11. In the present study the predominance of ulnar loops over other patterns was noted in both Thalassemia patients and controls and statistically significant difference was found over left digit V (P value .033) [Table 10]. Similar finding was reported by study of dermatoglyphics of Thalassemics of north-western population by Bhalla et al⁸ and in Iranian Thalassemics by Solhi et al [9].

Dallapiccola et al [10] reported a significant increase of loops on fingers of Italian patients with Cooley's anemia/ trait but they also found a corresponding decrease of whorls in their study. However, in the present study it was found that the frequency of whorls was increased in Thalassemia patients in comparison to controls [Table 8] but the difference was found statistically significant for digit IV of left hand (P value .010) and right hand (P value .042) only. Solhi et al [9] also reported increased whorls in all fingers in Thalassemic patients than normal individuals and the number of loop fingerprints was smaller

(P value 0.05). Russian researchers, Mutalimova and Kurdimova [11] also reported the prevalence of whorls over other patterns in Thalassemics. Dehankar and Ksheersagar [12] have also reported increase of whorls, loops and arches in Thalassemia patients of Maharashtrian origin.

In the present study it was found that arches were more common on the fingertips of Thalassemia patients than controls just like Bhalla et al [8] who reported statistical significance (P value 0.001) for the same. Maharashtrian counterparts also reported increased arches in Thalassemics as already mentioned above. Whereas Mahato et al [13] have reported decreased frequency of arches in patients of Vidharba region of Maharashtra.

In the current study sex differences in the pattern type were not found statistically significant except for right digit V of controls where 81.8% females had ulnar loops and 46.4% males had ulnar loops (P value .027) [Table 11].

Gualdi Russo E [14] observed that the digital patterns have been the most efficient dermatoglyphic characters that differentiate between the Thalassemia patients and controls.

CONCLUSION

As the dermatoglyphics are genetically controlled characteristics, any deviation in the dermatoglyphic features indicate a genetic difference between the patients and control population. In developing countries like India it might prove to be an anatomical, non-invasive, inexpensive and effective tool for screening of patients.

ABBREVIATIONS

A- arch

C- composite

L^r - Radial loop

L^u - Ulnar Loop

W - whorl.

Conflicts of Interests: None

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