

## Identification of Dermatoglyphic Patterns in Parents of Children with Cystic Fibrosis

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### Abstract

#### Background

Dermatoglyphics could assist in the diagnosis of congenital abnormalities. The aim of this study was to identify the dermatoglyphic patterns (finger print pattern type, total ridge count of each finger, a-b ridge count, and articulothoracic distance [ATD angles]) in the parents of cystic fibrosis children.

#### Materials and Methods

We recruited 75 parents of children with cystic fibrosis for the study group and 341 parents for the control group. We recorded finger print pattern type, total ridge count (TRC), a-b ridge count, and ATD angles of all participants. Then we identified any asymmetry between the right and left hands of each person and characteristics of parents in two genders. Chi-square analysis, Mann-Whitney U test, and Fisher's exact test were used for data analysis.

#### Results

We observed significant differences in a-b ridge count on the right hand ( $P=0.02$ ), and mean total ridge count on the right digit I ( $P=0.05$ ), right digit IV ( $P=0.03$ ), and right digit V in the fathers of children with cystic fibrosis compared to the control group ( $P=0.02$ ).

#### Conclusion

According to the results, we suggest that the dermatoglyphic traits of parents could be used as a simple, appropriate, and supplementary screening method in the diagnosis of children with CF. Nevertheless, we need larger studies to precisely confirm that dermatoglyphics is a reliable method in the diagnosis of CF.

**Key Words:** Dermatoglyphics, Cystic Fibrosis, Palm patterns, Asymmetry a-b ridge count, ATD angle.

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## 1- INTRODUCTION

Dermatoglyphics is the science of the epidermal ridges on palms, fingers, soles, and toes (1). Epidermal ridges form during the embryonic period and are constant throughout life (2-5). Dermatoglyphic pattern inheritance is associated with several genes (4), and some genetically determined abnormalities and congenital anomalies may be related to specific dermatoglyphic patterns (2-4, 6). In fact, new research has shown that specific dermatoglyphic patterns are associated with various diseases such as cleft lip and palate, schizophrenia, Down syndrome, congenital Cutis laxa (CL), oligozoospermia, and myocardial infarction (2, 7-12). Therefore, dermatoglyphic patterns are helpful markers in the diagnosis of chromosomal disorders. Cystic fibrosis (CF) is an autosomal recessive disease in the white population, which often leads to early death if left untreated (13-15). Prenatal genetic testing and sweat testing are the best methods for CF diagnosis in early childhood, although CF is also diagnosed by manifested gastrointestinal and respiratory symptoms (16). Recent studies have shown that dermatoglyphic patterns may be used to as a supplementary diagnostic method in CF (6). The main purpose of this study was to identify specific dermatoglyphic patterns in the parents of CF children that correlate

## 2- MATERIALS AND METHODS

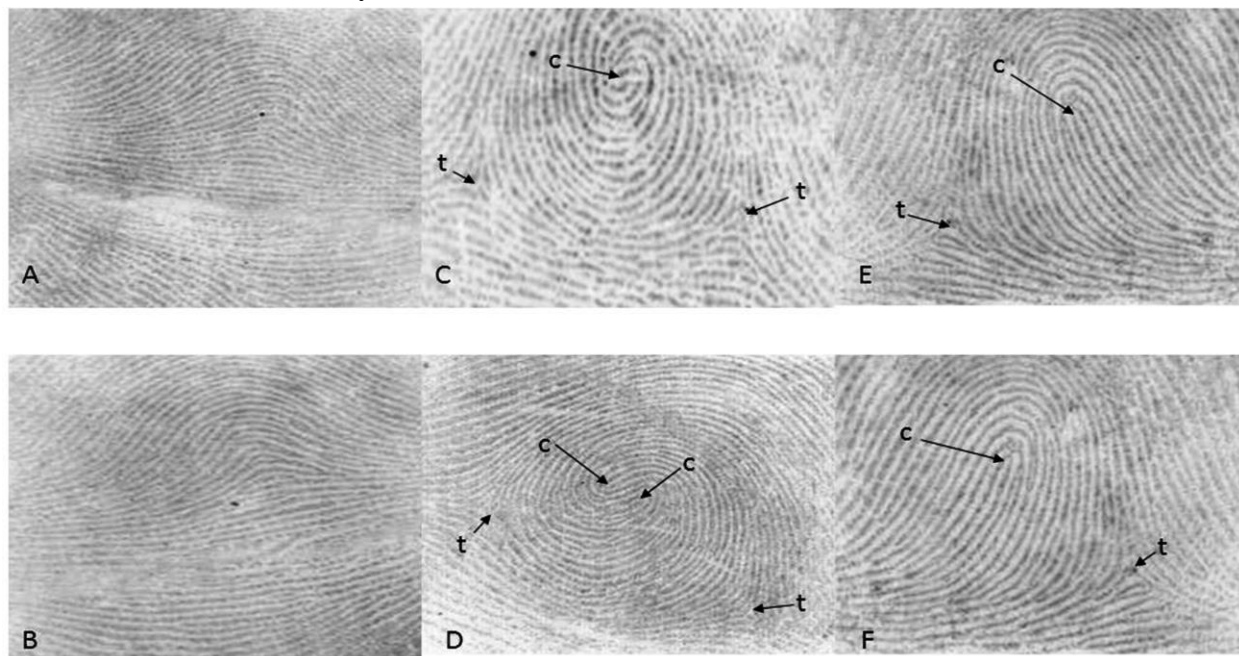
This was a case-control study performed at the Cystic fibrosis Clinic of Dr. Sheikh Hospital, Mashhad, Iran. The study group consisted of 75 parents of CF children (44 mothers and 31 fathers), and the control group consisted of 341 healthy participants (228 females and 113 males). Participants with other genetic disorders, psychological diseases, or a family history of such diseases were excluded. The study protocol was approved by the ethics

committee of the Mashhad University of Medical Sciences. Written and informed consent forms were completed by the parents in the case group and by the participants in the control group. We used a brush to rub red graphic powder on the surface of the palm and finger of both hands of all the participants in order to obtain prints. Next, the handprints were transferred onto labeled paper (right and left, respectively) and the 10 fingerprints were labeled with roman numbers from I to V (I=thumb to V=little finger). The fingerprint patterns were labeled as arch (A), loop (L) and whorl (W) (**Figure.1**). Fingerprint patterns on the homolog fingers were given a score of 0 if they were similar (i.e., fingerprint patterns on the right and left digits I were loops), and score of 1 if they were dissimilar (i.e., fingerprint patterns in the right digit I was a loop and the left digit I was an arch). Finally, we added these scores together, which ranged from 0 to 5 (5).

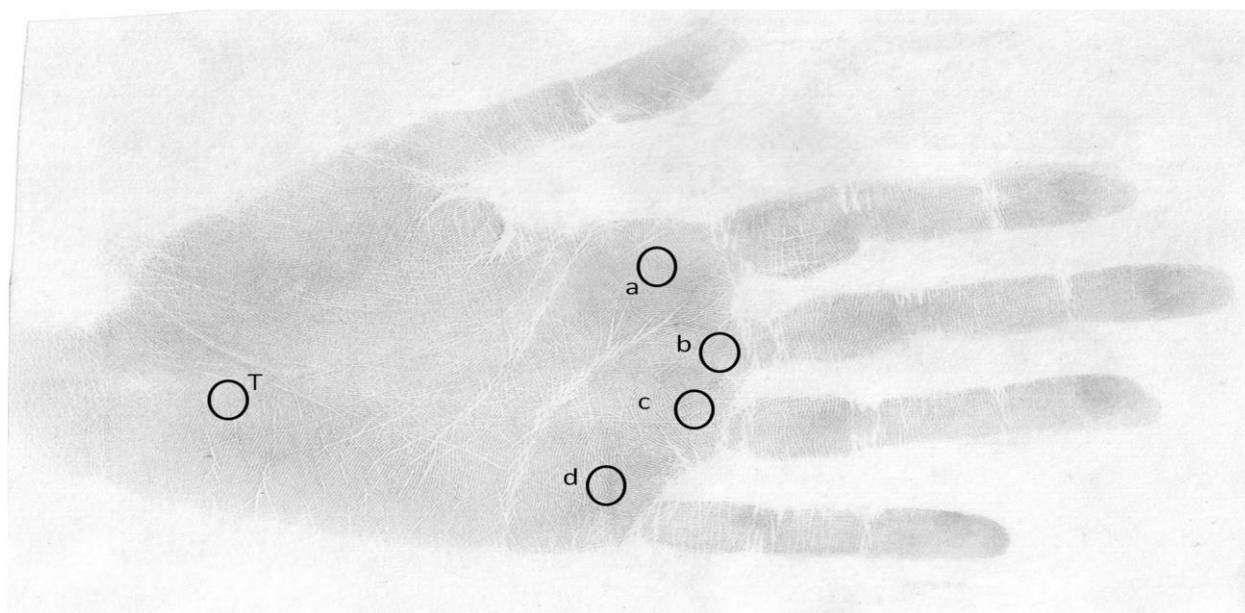
Initially, we defined the fingerprint pattern center and triradius, and then we counted the lines by means of a magnifying glass. Total ridge counts (TRC) in the arch pattern is always 0 because it does not have any triradius and the loop pattern always has one triradius, but the whorl has two. The highest number of lines was reported. We defined the triradius "a" near the distal of the palm at the base of the second finger and "b" triradius on the base of the third finger and joined them together to form the a-b line. The ridges running across the a-b line were calculated on both hands using a magnifying glass. Then, we detected the triradius "a" (at the base of the second finger on the palm), triradius "t" (on the proximal of the palm), and triradius "d" (at the base of the fifth finger on the palm). We drew the articulothoracic distance (ATD) angle, which was measured twice with a protractor by one person, and the average of these two numbers was calculated for the final report

**(Figure. 2).** Data evaluation and statistical analysis were done using SPSS software version 11.5 (SPSS Inc. Chicago, IL), the Chi-square test was used for categorical data, and the Mann-Whitney test was used

to analysis quantitative data without normal distribution. P-value less than 0.05 were considered statistically significant for all analyses.



**Fig.1:** Fingerprint pattern types are categorized into three groups: arch (A,B), whorl(C,D) and loop (E, F). c: center point of fingerprint, t: Triradius.



**Fig.2:** Palm patterns are labeled a, b, c, d and t.

### 3- RESULTS

Seventy-five parents of CF children in the case group and 341 healthy participants

in the control group were enrolled in the study. Significant difference was not found in dermatoglyphic pattern types and

gender between parents of CF child and controls (**Table.1**). In addition, significant differences were not found in the pattern dissimilarity score between mothers of CF children (P=0.624), fathers of CF children (P=0.787), and the control group (**Table.2**). Mean TRC, a-b ridge count, and ATD angle were not statistically significant between mothers of CF children and the control group.(Table 3). Mean TRC was borderline between fathers

of CF children and the control group on the right digit I (P=0.05), and was significant between right digit IV (P=0.03), right digit V (P=0.02), and the right hand a-b ridge count (P=0.03) (**Table.3**). Mean TRC, a-b ridge count, and ATD angle asymmetry revealed no significant differences between the control group and parents of CF children on both hands (**Table.4**).

**Table-1:** Number and percentage of dermatoglyphic patterns in mothers and fathers of CF children and the control group.

Digit	Control, Number (%)			CF group, Number (%)			P-value
	Loop	Arch	Whorl	Loop	Arch	Whorl	
<b>Mothers</b>							
<b>I</b>							
Right	162 (48.1%)	8 (2.4%)	167(49.6%)	24 (51.1%)	2 (4.3%)	21(44.7)	0.968
Left	173(52.0%)	17(5.1%)	143(42.9%)	25(54.3%)	1(2.2%)	20(43.5%)	0.678
<b>II</b>							
Right	162 (48.1%)	29 (8.6%)	146 (43.3%)	22(46.8%)	2 (4.3%)	23(48.9%)	0.528
Left	159(47.7%)	159(47.7%)	159(47.7%)	23(50%)	23(50%)	23(50%)	0.948
<b>III</b>							
Right	222 (65.9%)	24 (7.1%)	91 (27.0%)	36 (76.6%)	3 (6.4%)	8 (17.0%)	0.312
Left	212(63.5%)	27(8.1%)	95(28.4%)	32(69.6%)	4(8.7%)	10(21.7%)	0.634
<b>IV</b>							
Right	139 (41.6%)	9 (81.8%)	186 (55.7%)	15 (32.6%)	2 (4.3%)	29 (63%)	0.454
Left	149(45.2%)	15(4.5%)	166(50.3%)	17(37%)	2 (4.3%)	27(58.7%)	0.557
<b>V</b>							
Right	246 (74.3%)	5 (1.5%)	80 (24.2%)	35 (77.8%)	2 (4.4%)	8 (17.8%)	0.274
Left	251(77.2%)	6(1.8%)	68(20.9%)	35(76.1%)	2(4.3%)	9(19.6%)	0.545
<b>Fathers</b>							
<b>I</b>							
Right	162(48.1%)	8(2.4%)	167(49.6%)	18(46.2%)	0(0%)	21(53.8%)	0.582
Left	173(52.0%)	17(5.1%)	143(42.9%)	24(61.5%)	0(0%)	15(38.5%)	0.251
<b>II</b>							
Right	162(48.1%)	29(8.6%)	146(43.3%)	19(48.7%)	2(5.1%)	18(46.2%)	0.748
Left	159(48.1%)	28(8.4%)	146(43.8%)	20(51.3%)	5(12.8%)	14(35.9%)	0.504
<b>III</b>							
Right	222(65.9%)	24(7.1%)	91(27.0%)	28(71.8%)	3(7.7%)	8(20.5%)	0.684
Left	212(63.5%)	27(8.1%)	95(28.4%)	29(74.4%)	1(2.6%)	9(23.1%)	0.298
<b>IV</b>							
Right	139(41.6%)	9(2.7%)	186(55.7%)	17(43.6%)	0(0%)	22(56.4%)	0.581
Left	149(45.2%)	15(4.5%)	166(50.3%)	15(38.5%)	1(2.6%)	23(59%)	0.555
<b>V</b>							
Right	246(74.3%)	5(1.5%)	80(24.2%)	29(74.4%)	0(0%)	10(25.6%)	0.733
Left	251(77.2%)	6(1.8%)	68(20.9%)	30(76.9%)	0(0%)	9(23.1%)	0.671

I: thumb finger, II: Index finger, III: middle finger, IV: ring finger, V: little finger.

**Table-2:** Number and percentage of pattern dissimilarity scores between the mothers and fathers of CF children and the control group.

Number	Mothers		Fathers	
	Control	CF group	Control	CF group
	Number (%)		Number (%)	
0	89(89.9)	10(10.1)	89(92.7)	7(7.3)
I	117 (87.3)	17 (12.7)	117(88.0)	16(12.0)
II	74(84.1)	14 (15.9)	74(89.2)	9(10.8)
III	28(87.5)	4(12.5)	28(84.8)	5(15.2)
IV	13(100.0)	0(0)	13(92.9)	1(7.1)
V	1(100.0)	0(0)	1(100.0)	0(.0)
P-value	0.624		0.787	

CF: Cystic fibrosis, Fingerprint patterns in homolog fingers were given 0 score if there were similar (for example fingerprint patterns in right and left digits I was loop) and 1 score if there were dissimilar (for example fingerprint patterns in right digits I was loop and left digit I was arch). Finally, we added these scores, which ranged from 0 to 5.

**Table-3:** Mean TRC, a-b ridge count and ATD angle of the mothers and fathers of CF children and the control group

Digit	CF group		Control		P-value
	Median	IQR	Median	IQR	
I					
Right	16.5	5.0	17.0	5.5	.898
Left	15.5	7.0	15.0	7.0	.907
II					
Right	13.0	6.0	14.0	8.0	.591
Left	12.0	5.0	13.0	8.0	.314
III					
Right	12.0	5.5	13.0	7.0	.938
Left	14.5	7.88	13.0	7.5	.371
IV					
Right	16.0	7.25	15.5	6.5	.805
Left	15.0	7.0	15.0	6.5	.553
V					
Right	13.0	6.25	13.0	6.0	.952
Left	13.75	6.13	13.0	6.0	.803
a-b					
Right	30.0	9.0	30.0	9.5	.929
Left	31.5	11.5	30.5	10.5	.807
ATD					
Right	42.0	8.5	40.0	7.0	.247
Left	41.0	8.5	40.0	7.0	.336
Father					
I					
Right	18.5	17.0	5.5	5.5	.050

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Left	16.5	15.0	5.88	7.13	.074
II					
Right	14.5	13.5	8.0	8.0	.525
Left	14.75	13.0	6.63	8.0	.545
III					
Right	13.0	13.0	5.5	7.0	.742
Left	15.0	13.0	5.63	7.5	.266
IV					
Right	17.5	15.5	5.0	6.5	.030
Left	16.75	15.0	5.13	6.5	.061
V					
Right	14.0	13.0	5.0	6.0	.026
Left	13.0	13.0	5.25	6.0	.202
a-b					
Right	33.5	30.0	9.5	9.5	.030
Left	34.5	30.5	11.0	11.0	.143
ATD					
Right	42.0	40.0	8.5	7.0	.881
Left	42.0	40.0	7.0	7.0	.904

I: total ridge counts thumb finger, II: total ridge counts Index finger, III: total ridge counts middle finger, IV: total ridge counts ring finger, V: total ridge counts little finger, a-b: a-b ridge counts, ATD: atd angle, CF: Cystic fibrosis, IQR: interquartile range.

**Table-4:** TRC asymmetry in five digits, a-b ridge count and ATD angle between the mothers and fathers of CF children and the control group.

Digit	CF group		Control		P-value
	Median	IQR	Median	IQR	
Mother					
DI	3.00	3.25	2.5	3.5	0.414
D2	2.00	2.13	2.5	4.00	0.657
D3	2.00	2.75	2.00	3.25	0.258
D4	1.75	3.13	2.00	3.00	0.526
D5	2.25	2.63	2.00	2.5	0.384
Dab	4.25	5.88	3.5	4.25	0.231
Datd	2.25	3.63	2.00	4.00	0.990
Father					
DI	1.5	2.88	2.5	3.5	0.297
D2	2.25	3.25	2.5	4.00	0.965
D3	1.75	2.63	2.00	3.25	0.617
D4	2.00	3.00	2.00	3.00	0.919
D5	2.00	2.5	2.00	2.5	0.803
Dab	4.5	7.25	3.5	4.25	0.153
Datd	3.00	5.00	2.00	4.00	0.775

D1: total ridge counts asymmetry in thumb finger, D2: total ridge counts asymmetry in Index finger, D3: total ridge counts asymmetry in middle finger, D4: total ridge counts asymmetry in ring finger, D5: total ridge counts asymmetry in little finger, Dab: a-b ridge counts asymmetry, Datd: atd angle asymmetry, CF: Cystic fibrosis, IQR: interquartile range.

#### 4- DISCUSSION

In this study, we observed a significant difference in the mean total ridge counts (TRC) on the right digit I, right digit IV, right digit V, and the right hand a-b ridge count of the fathers of CF children regarding dermatoglyphic patterns. Kobylysky et al. showed that the frequency of whorl patterns were higher in males in the parental and control groups. Our results did not establish a significant difference in these patterns in either group (17). Moreover, Kobylysky et al. observed that the mean TRC values were lower in the parents of CF children in comparison to the control group (17) and their results were in line with our study.

Kobylysky et al. reported that a-b ridge count values were statistically significant on the right hand of the fathers of CF children (17) and their results supported our findings. The study limitations were confined to the small number of patients and this may negatively affect the study results. The authors recommend that further researches be done to evaluate the distribution of fingerprint minutiae and palmer sweat glands in CF children and their parents because it may provide comprehensive information about dermatoglyphic patterns in parents of CF children.

#### 5- CONCLUSION

In the present study, in most of the dermatoglyphic traits considerable asymmetry was found between the fathers of CF children and the control group. Thus, we suggest that the dermatoglyphic traits of parents could be used as a simple, appropriate, and supplementary screening method in the diagnosis of children with CF. Nevertheless, we need larger studies to precisely confirm that dermatoglyphics is a reliable method in the diagnosis of CF.

**6- CONFLICT OF INTEREST:** None.

#### 7- ACKNOWLEDGMENT

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