

Down's Syndrome and Dermatoglyphics*

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Dermatoglyphics are the special curling designs and shapes on the fingertips, palms, soles and the epidermal ridges. For the first time in 1936, after Cummins observed that there had been different dermatoglyphics from control individuals in Down's Syndrome dermatoglyphic cases, the dermal patterns in these cases were studied by many researchers.

Cummins' first observations were that Down's Syndromes and their control in hypothenar areas were more frequent than true dermal patterns. Parallel to this, in distally positions, axial triradius examples were mostly met and bimanual asymmetry had decreased.¹

In addition to this, in 1939, Cummins discovered that whorl type patterns on the fingertips had decreased and radial loop types on the fourth and fifth fingers had increased. Also he observed that ulnar loop type patterns increased while whorl type patterns decreased and true patterns in the third interdigital areas on the palm, generally distal loop type dermal patterns and tibial arch or small distal loop types in the hallucal areas increased.¹ Cummins' observations were confirmed by researchers after him.²⁻¹⁰

Material and Method

At the Hacettepe University Medical Faculty, Clinical Genetics Department 72 (35 male, 37 female) Down's Syndrome cases were studied, particular attention being paid to dermal patterns. In most of these cases chromosomal studies and analysis were performed and in 21 cases trisomy was observed.

* These are some of the studies of Clinical Genetics in Hacettepe University Medical Faculty which have been communicated by the Turkish Scientific and Technical Investigation Society.

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However, in cases when maternal age was advanced chromosomal studies were not deemed necessary. The age range of the Down's Syndrome cases was from one day to seven years. In one single case acute Lymphocytic Leukaemia was established.

A comparison of Down's Syndrome cases was made on 473 (282 male, 191 female) children in Ankara Atatürk Orphanage. The age range of these children was between one and eight years. In all cases finger prints of the right and left hands and prints of palmar and plantar parts of the right and left sides were taken and studied.

The impressions reported here were made by spreading printer's ink with a roller on a glass slide and then pressing the region where the sample was to be taken; first, to the inked slide and then to a thin cardboard which had been placed on a sponge. In some cases the prints were obtained with scotch tape. Features studied were frequencies in the third interdigital area of the palm, a-b ridge count, maximal atd angle, position of axial triradius t, and pattern types of the hallucal area.

Results

Dermatoglyphic patterns on the fingertips of Down's Syndrome and control cases are shown according to type and percentage in Table 1. From these results, a statistically significant difference between Down's Syndrome and control groups can be seen. In the first group, the radial loop pattern on the fourth and fifth fingers of the left and right hands and ulnar patterns on the other fingers is the most frequent type. This is proved by their highest Chi square values.

In male Down's Syndrome cases the mean of the total ridge count of the fingertips was $\bar{x} = 136.093 \pm 8.217$, normal male $\bar{x} = 147 \pm 7.89$ and between two groups the difference was negligible. In female cases the set-count $\bar{x} = 128.222 \pm 8.946$, and in normal females was $\bar{x} = 141.34 \pm 8.72$, also in these groups the difference was significant (Table II).

a-b ridge counts mean value with respect to Down's Syndrome patterns was in the left hand palm $\bar{x} = 34.161 \pm 1.707$. Those were in the control cases $\bar{x} = 40.188 \pm 0.486$. In these two groups a significant difference at the level of 0.001 was established. In the case of the right hand palm Down's Syndrome average count was $\bar{x} = 39.956 \pm 0.608$ and the difference in this case was also significant at the level of 0.001

TABLE II
STATISTICS CONNECTED WITH TOTAL RIDGE COUNTS AT
FINGERTIPS OF DOWN'S SYNDROME AND CONTROL CASES

	Female		Male	
	D.S.	C.	D.S.	C.
n :	27	47	32	52
$\bar{x}$:	128.222	141.34	136.093	147.67
S :	± 46.48	± 59.85	± 46.488	± 56.99
$S\bar{x}$:	± 8.945	± 8.72	± 8.217	± 7.89
D :	13.118 $\pm$ 28.323		11.182 $\pm$ 8.465	
t :	± 0.463		± 1.321	
p :	> 0.05		> 0.05	

(Table III). It is evident that in Down's Syndrome cases in the right and left palms there are fewer a-b ridge counts than those in the control group.

TABLE III
STATISTICS CONNECTED WITH a-b RIDGE COUNTS ON THE PALMS
OF DOWN'S SYNDROME AND CONTROL CASES

	Female		Male	
	D.S.	C.	D.S.	C.
n :	31	160	31	160
$\bar{x}$:	34.161	40.188	34.355	39.956
S :	± 9.507	± 6.146	± 7.155	± 7.695
$S\bar{x}$:	± 1.707	± 0.486	± 1.285	± 0.608
D :	6.027 $\pm$ 1.333		5.601 $\pm$ 1.493	
t :	± 4.521		± 3.751	
P :	< 0.001		< 0.001	

The true pattern frequencies of Down's Syndrome cases in the third interdigital areas of the palms were 63.2 percent on the left hand and 89.8 percent on the right hand. In the control cases these percentages were 51 percent on the left hand and 32 percent on the right hand and between these groups important differences exist (on the left palms $P < 0.005$, on the right $P < 0.001$). In other words in the third interdigital areas of Down's Syndrome cases more dermal patterns (Loop type) exists.

In Down's Syndrome cases maximal atd mean angle in the left hand palm is $\bar{x} = 87.412 \mp 2.082$, that in the control group $\bar{x} = 49.942 \mp 0.799$ and the important difference of 0.001 is established between these two groups. The mean angle in the palm of the hand in Down's Syndrome cases is $\bar{x} = 86.676 \pm 2.356$, and the control cases is $\bar{x} = 48.673 \pm 0.858$. Between these a significant difference at the level of 0.001 is established (Table IV). These results encountered in Down's Syndrome cases indicate bigger atd angles than those found in control cases.

TABLE IV

STATISTICS CONNECTED WITH ATD ANGLES AT THE PALMS OF DOWN'S SYNDROME AND CONTROL CASES

	Female		Male	
	D.S.	C.	D.S.	C.
n :	32	155	32	153
$\bar{x}$:	87.412	49.942	86.676	48.673
S :	± 12.144	± 9.945	± 13.739	± 10.616
$S_{\bar{x}}$:	± 2.082	± 0.799	± 2.356	± 0.858
D :	37.47 ± 1.347		38.003 ± 2.231	
t :	± 27.817		± 17.034	
p :	< 0.001		< 0.001	

In Down's Syndrome cases the mean value of the position of the axial triradius, t patterns are $\bar{x} = 48.333 \pm 1.052$ on the left hand palm and in the control group $\bar{x} = 18.857 \pm 1.2$ and also between these a significant difference at the level of 0.001 is established. In Down's Syndrome cases this value on the right palms is $\bar{x} = 47.744 \pm 1.219$ and also an important difference at the level of 0.001 is established (Table V). In other words in Down's Syndrome cases the axial triradius pattern takes place more distally compared with control cases (Figure 1). Otherwise, the two sided simian line is 14.7 percent in Down's Syndrome and 0.25 percent in control cases. An important difference at the level of 0.001 exists between these percentages. In Down's Syndrome cases simian lines exist frequently. Whereas the percentage of a single digital flexion crease on the fifth fingers is 4.4 percent in Down's Syndrome cases, it does not exist in the control group.

Table VI shows the results of the percentages of the patterns in the hallual areas in Down's Syndrome and control cases and also a comparison between the two groups. From these results it is seen that

TABLE V
STATISTICS CONNECTED WITH AXIAL TRIRADIUS (t) POSITION OF
DOWN'S SYNDROME AND CONTROL CASES

	Female		Male	
	D.S.	C.	D.S.	C.
n :	43	84	43	84
$\bar{x}$:	48.333	18.857	47.744	18.714
S :	± 6.736	± 11.05	± 7.996	± 10.0
Sx :	± 1.052	± 1.2	± 1.219	± 1.09
D :	28.352 $\pm$ 1.992		29.030 $\pm$ 1.764	
t :	± 14.232		± 16.456	
P :	< 0.001		< 0.001	

there is a statistically significant difference between the two groups on the right and left soles. On the other hand, there are more arch tibials (Figure 2) and small distal loops and less whorls in Down's Syndrome cases (Table VI).

Discussion

H. Cummins in 60 American cases¹, N. F. Walker in 150 old Toronto cases,¹⁰ and P. N. Saksena et al in 35 Indian cases⁸ have analysed Down's Syndrome cases on fingertips, palms and soles and compared these with those in the control groups. These researchers have indicated that, on the fingertips, in Down's Syndrome cases radial loop on the fourth and fifth fingers, ulnar loop type dermal patterns on all the fingers, on the palms in the third interdigital regions, true patterns and distal triradius pattern frequencies at hallucal regions, small distal loop or tibial arch type patterns increase. S. B. Holt, in 310³ and F. Rosner et al in 267 Caucasian mongoloid cases⁶, have studied the patterns on the fingertips and established similar results. Also our studies showed similar results and statistical evaluations. S. B. Holt found on the fingertips total ridge count $\bar{x} = 133.02$ in males, $\bar{x} = 124.38$ in females in one hundred Down's Syndrome cases. This is $\bar{x} = 142.5$ in males and $\bar{x} = 130.36$ in females in the normal cases. S. B. Holt tried to differentiate Down's Syndrome cases from the control group by the help of the ridge variation on the fingertips. Although according to Holt's mean findings fewer ridge count exists in Down's Syndrome cases, in my cases statistical difference is not found from those in the control cases.

TABLE VI

THE PERCENTAGES, CHI SQUARE AND P RESULTS OF DERMATOGLYPHICS IN THE HALLUCAL AREAS OF DOWN'S SYNDROME AND CONTROL CASES

		W	dL(0-20)	dL(21-<)	L ^t	A ^r	A ^r	TA	A ^t	L ^r	x ²	P
Left	D.S.	2.9	33.8	8.8	—	—	—	—	54.5	—	228.590	<0.001
	C.	26.6	17.5	35.3	8.7	3.8	4.0	1.9	1.3	0.8		
Right	D.S.	7.3	29.4	7.3	1.5	—	—	—	54.5	—	142.260	<0.001
	C.	24.1	16.4	38.6	11.4	3.6	3.6	0.8	0.2	1.3		



Figure 1

T. C. Fang compared the pattern frequencies in the third interdigital area of the palms of British individuals, in 205 Down's Syndrome cases. Although no morphological difference exists, percentages vary. According to this writer more distal patterns exist in the third interdigital area in Down's Syndrome cases.² Although my results do not give the same percentages, they are similar in nature.

L. S. Penrose compared maximal atd angles in palms in 126 Down's Syndrome cases and 403 control cases. In this connection the angles found in both hands were compared and studied and an index showing



Figure 2

variations indicated differences between the groups.⁵ Although my method was different, I also observed larger atd angles in Down's Syndrome cases than those in the control groups.

I. A. Uchida and H. C. Soltan,⁹ R. D. Rowe and I. A. Uchida⁷ have indicated that in Down's Syndrome simian line and single digital flexion creases on the fifth digit frequencies increase. Although not in the magnitude found by said writers, I observed more simian lines in Down's syndrome cases than those in the control cases. Not a single flexion line is observed on the fifth finger in the control cases.

Summary

1 – 35 male and 37 female and a total of 72 Down's Syndrome cases dermal patterns were studied. These were compared with those of 212 male and 191 female children.

2 – In Down's Syndrome cases ulnar loop patterns on all fingertips and loop type dermal patterns on the fourth and fifth fingers increased.

3 – No important statistical difference was established in the fingertip ridge count between Down's Syndrome and control cases.

4 – Fewer a-b ridges exist on the palms in Down's Syndrome cases than those in control cases.

5 – In the third interdigital area more distal loops exist in Down's Syndrome cases than those in control cases.

6 – Atd angles and t percentages are greater in Down's Syndrome cases.

7 – Simian line and single flexion line on the fifth finger are frequently observed in Down's Syndrome cases.

8 – In hallual areas of Down's Syndrome cases tibial arch or narrow distal loop patterns are frequent.

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