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Original Research Article

Dermatoglyphics pattern in children with congenital malformations

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ABSTRACT

Background: Dermatoglyphics is an indispensable tool in the field of Forensic Science and Criminology and its various unknown aspects are being explored in other fields. They are important in genetics because of their usefulness in diagnosing some dysmorphic syndromes like Down Syndrome, Turner Syndrome etc.
Methods: A hospital based descriptive study was carried out in the Institute of Child Health, Madras Medical College, Chennai from January 2015 to September 2015. Children admitted with major congenital malformation diagnosed either clinically or with imaging were included in the study.
Results: 125 children with congenital malformation were included in the study. This included 65 cases of congenital heart disease, 20 cases of congenital talipo equino varus, 15 cases of cleft lip/palate, 15 cases of genetic syndrome and 10 cases of CNS malformations. Loops (64.3%) were the most common pattern in CHD followed by whorls (31.5%). In the CTEV group, loops (57.65%) were the most common pattern followed by whorls (36.48%). Ulnar loops (50.32%) was more common in Down's Syndrome whereas arches (46.37%) were more common in Edward's Syndrome. Frequency of whorls (53.28%) was higher in children with CNS malformations.
Conclusions: Congenital malformations are associated with abnormal dermatoglyphics patterns. Patterns such as loops are common in CHD and syndromic children whereas whorls are common in children with CNS malformations. Large population study with a well-matched control may bring out definite dermatoglyphic pattern for many congenital disorders. They may serve as a simple diagnostic tool for these disorders.

Keywords: Dermatoglyphics, Congenital malformations

INTRODUCTION

Dermatoglyphics (Derma – skin and glyphi – carve) is a branch of science dealing with the study of naturally occurring ridges and their configuration on fingers, palms and soles. Investigators over years have been fascinated by dermatoglyphic patterns which have led to the development of dermatoglyphics as a science with numerous applications in various fields like biology, medicine, genetics and evolution. It is the best and most widely used method for personal identification.[1] Currently dermatoglyphics is being used as a tool in the field of biology, anthropology, genetics and medicine to explain, compare and to predict the occurrence of bio medical events.[2] Finger prints are usually categorized into three basic groups namely arches (60-65%), loops (30-35%) and whorls (5%). A person may have the same pattern on all ten fingers but various patterns often occur on different digits.[3] It describes the morphology and variations observed due to sex, race and ethnic background. They are important in genetics because of their usefulness in diagnosing some dysmorphic syndromes like Down syndrome, Turner Syndrome, Kinelfelter syndrome etc.

Development of epidermal ridge patterns occurs at 6th to 19th week of gestation. Genetic factors alone are not responsible for the development of dermatoglyphic patterns. It is also result of the interaction between individual genes and the intrauterine environment. Thus, any prenatal insult during this critical period of embryogenesis/organ system development should have an influence on the dermatoglyphic patterns.[4]

The dermatoglyphic pattern analysis mainly focuses on two 1. Total ridge count 2. atd angle

A ridge count (Figure 1) is made by drawing a line (blue line) from the triradius (green dot) to the center (red dot) of the pattern (core) and determining the number of intersected ridges between these two points. Arches score zero because they have no triradii and thus there are no ridges to count. A loop has one triradius.

In whorls, which have two triradii, counts are made from each triradii and the larger one is used. A total ridge count (TRC) is the summation of the ridge count for all 10 fingers. It was assessed for increase or decrease in mean frequencies between the groups.

A feature of the palm that captures the relative position of three triradii-a and d, usually located on distal palm just inferior to the 2 nd and 5 th fingers, respectively and t whose location can vary on the proximal palm from just distal to the wrist, up to the centre of the palm. Atd angles (Figure 5) were measured for each palm print by drawing two straight lines through the "a" and "t" triradii and the "d" and "t" triradii and measuring the resulting angle. The atd angles were compared and assessed for increase or decrease in mean frequencies between the groups.

Numerous studies have shown association of specific dermatoglyphic patterns with major congenital malformations and genetic syndromes. Establishing such a specific pattern will serve as a readily and easily accessible external marker of major malformations.

Aim of the study was to examine the finger and palmar dermatoglyphics pattern in children with congenital malformation.

METHODS

It is a Hospital based descriptive study carried out at Tertiary care setting in Institute of Child Health, Madras Medical College, Chennai, for Nine months (January 2015 – September 2015).

All children in the age group 0-12 years admitted with a diagnosis of congenital malformation or admitted with suspicion of any anomaly or syndrome in all units including speciality departments, at the Institute of Child Health and Hospital for Children, Madras Medical College, Chennai during the study period

Exclusion criteria

Children having malformation due to acquired causes like rickets, trauma, normal variants etc. were excluded from the study.

All children satisfying the inclusion criteria were enrolled in the study after obtaining proper consent. A complete demographic data was recorded in a proforma. A detailed history regarding the nature of conception, assisted reproductive techniques if any used, number of abortion and its indication if any, course of antenatal care, if any drugs taken, any chances for radiation exposure, nature of occupation if any, and medical illness were recorded.

A total of 125 children who satisfied the inclusion criteria included in the study. All investigation pertaining to the nature of abnormality or suspicion were done. Nature of evaluation included investigations like echocardiogram, ultrasonography, magnetic resonance imaging and computed tomography. Genetic analysis was carried out when indicated.

All children were treated for their illness according to the hospital protocol.

Palmar prints and finger prints were collected from all children included in the study using the ink and stamp method after cleaning the hand. The collected prints were stored after properly drying it. The palmar and finger print were taken in batches in person to the “State Crime Record Bureau” for systematic analysis. The state crime records bureau is a governmental unit under the police department.

With the help of forensic experts in the state crime department, the prints were analysed for the following variables

- Finger pattern frequency – whorls, loops, arches etc.,
- Total finger ridge count (TFRC)
- a-b ridge count
- atd angle of both hands separately
- Simian creases and Sydney lines.

The results from the state crime department were then analysed for any similarities in pattern for different malformations and syndromes.

RESULTS

A total of 125 children with congenital malformations were analysed.

The study population included 65 cases of congenital heart disease, 20 cases of congenital talipes equino varus, 15 cases of cleft lip/ cleft palate, 15 cases of genetic syndromes, and 10 cases of central nervous system malformations.

Among the 65 cases with CHD loops (64.3%) were the most common pattern observed followed by whorls (31.5%) and arches (4.27%). Arches were more common in females compared to males (Table 1).

Table 1: Distribution of Dermatoglyphic patterns in CHD.

Congenital Malformation		Finger Patterns			
		Loops	**Whorls**	**Arches**	**Total**
Congenital heart disease	**Male**				
	No. of readings (%)	222 (59.35%)	143 (38.23%)	9 (2.42%)	374
	Female				
	No. of readings, n (%)	196 (71.01%)	62 (22.46%)	18 (6.53%)	276
	Total	418 (64.3%)	205 (31.5%)	27 (4.27%)	650

Table 2: Dermatoglyphic parameters in CHD.

Congenital Malformation		'atd' Angle		TFRC		'a-b' ridge count	
		Mean	SD	Mean	SD	Mean	SD
Congenital heart disease	Male (36)	54.22	11.57	134.08	32.99	34.16	8.39
	Female (29)	55.27	9.72	137.55	25.68	38.06	8.17

On analysing various dermatoglyphic parameters like 'atd' angle, Total Finger Ridge Count (TFRC) and 'a-b' ridge count, we found that the mean 'atd' angle exhibited more widening 54.22±11.52 for males and 55.02±11.09 for females. This was in comparison to the normal ranges reported in literature (43 – 45)5. The mean a-b ridge count among children with CHD was higher 34.16±8.39 for males and 38.06±8.17 for females as compared to that of normal ranges reported in literature. (25 – 28)5. The mean total ridge count is also higher among children with CHD 134.08±32.99 for males and 137.55±25.68 for females (Table 2).

Table 3: Distribution of Dermatoglyphic patterns in CTEV.

Congenital Malformation		Finger Patterns			
		Loops	Whorls	Arches	Total
CTEV	Male				108
	No. of readings (%)	67 (62.03%)	32 (29.62%)	9 (8.35%)	
	Female				114
	No. of readings n (%)	61 (53.50%)	49 (43%)	4 (3.5%)	
	Total	128 (57.65%)	81 (36.48%)	15 (6.75%)	222

Table 4: Dermatoglyphic parameters in CTEV.

Congenital Malformation		'atd' Angle		TFRC		'a-b' ridge count	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
CTEV	Male (10)	55.30	11.43	143.20	13.67	31.50	5.93
	Female (10)	50.50	9.24	135.50	25.89	31.70	6.38

In children with CTEV, loops (57.65%) was the most common pattern followed by whorls and arches (Table 3). The mean 'atd' angle exhibited more widening 55.30±11.43 for males and 50.50±9.24 for females. This was in comparison to the normal ranges reported in literature (43-45) 5. The mean a-b ridge count among children with CHD was higher 31.50±5.93 for males and 31.70±6.38 for females as compared to that of normal ranges reported in literature. (25–28) 5. The mean total ridge count is also higher among children with CHD 143.20±13.67 for males and 135.50±25.89 for females (Table 4).

57.86% of children with cleft lip / palate had loop pattern followed by whorls (36.47%) (Table 5). The mean 'atd' angle exhibited more widening 58.00±12.75 for males

and 52.87±6.49 for females. This was in comparison to the normal ranges reported in literature (43-45).[5] The mean a-b ridge count among children with CHD was higher 35.28 8.42 for males and 32.36±7.00 for females as compared to that of normal ranges reported in literature (25-28).[5] The mean total ridge count is also higher among children with CHD 111.85±23.02 for males and 144.80±15.89 for females (Table 6).

Table 5: Distribution of dermatoglyphic patterns in CL/CP.

Congenital Malformation		Finger Patterns			
		Loops	Whorls	Arches	Total
Cleft Lip / Cleft Palate	Male No.of readings (%)	42 (55.26%)	31 (40.79%)	3 (3.94%)	76
	Female No.of readings n (%)	50 (60.24%)	27 (32.53%)	6 (7.22%)	83
	Total	92 (57.86%)	58 (36.47%)	9 (5.66%)	159

Table 6: Dermatoglyphic parameters in CL/CP.

Congenital Malformation		'atd' Angle		TFRC		'a-b' ridge count	
		Mean	SD	Mean	SD	Mean	SD
Cleft Lip / Cleft Palate	Male (7)	58.00	12.75	111.85	23.02	35.28	8.42
	Female (8)	52.87	6.49	144.80	15.89	32.36	7.00

Table 7: Dermatoglyphic patterns in Syndromic children and CNS Malformation.

Congenital Malformation		Finger Patterns			
		Loops	Whorls	Arches	Total
Syndromic Children	Male	77	31	21	129
	No.of readings (%)	(59.69%)	(24.03%)	(16.27%)	
	Female	71	26	17	114
	No. of readings n (%)	(62.28%)	(22.8%)	(14.91%)	
	Total	148 (60.9%)	57 (23.45%)	38 (15.63%)	243
CNS Malformation	Male	32	36	4	72
	No. of readings (%)	(44.44%)	(50%)	(5.55%)	
	Female	26	37	2	65
	No. of readings n (%)	(40%)	(56.92%)	(3.07%)	
	Total	58 (42.33%)	73 (53.28%)	6 (4.37%)	137

In children with Down's syndrome and Edward syndrome (syndromic conditions), loops (60.9%) were the predominant pattern. In children with CNS malformations, whorls (53.28%) were the predominant pattern followed by loops (42.33%) (Table 7).

Table 8: Comparison of occurrence of simian crease in different groups.

Simian crease	CHD	CTEV	CL/ CP	Syndromes
Present	5	1	1	11
Absent	60	19	9	4

As for the occurrence of Simian Crease and Sydney lines is concerned, 84.61% of syndromic children had Simian creases but only 13.33% of them had Sydney lines. In children with CHD, only 7.68% and 4.6% had Simian crease and Sydney lines respectively (Table 8).

DISCUSSION

The relation between congenital anomalies and dermatoglyphics has been studied by several authors.

In present study among children with CHD Loops were the most commonly observed pattern followed by whorls. Cascos AS et al also reported similar figures and Wanjari et al found that the frequency of ulnar loops were 62.5% in CHDs.[6,7] In a study done by Brijendra et al, whorls were the most common pattern.[8] In this study, the number of whorls were increased, while the number of arches were decreased in children with CHD which correlated with findings of Magotra et al and Brijendra et al.[8,9] Among children with CHD Magotra et al and Brijendra et al, showed that there is significant widening of atd angle and an increase in TFRC.[8,9] In our study we also observed increase in atd angle, increase in the TFRC count, and a-b ridge count. It is interesting to note a trend towards

increased atd angle, TFRC count and a-b ridge count in different studies. Studies with larger numbers are needed to establish this trend so that it can serve as an useful non-invasive tool.

In our study among children with cleft lip/palate there was decreased incidence of arches and increased incidence of loops and the same was observed in studies by Balgir et al and Maheswari N et al.[10,11] The increase in atd angle, increase in the TFRC count observed by us was not reported by other studies.

Among children with CTEV we found an increased frequency of loops and the same was observed in a study by Ali S et al, loops were the predominant pattern in 42 children with CTEV. Ali S et al studied that TFRC was increased in children with CTEV, we couldn't observe any specific pattern in children's with CTEV and this could be explained by the multifactorial cause of CTEV.[12]

Rajangam S et al, studied 235 Down syndrome children and stated that there was increased frequency of ulnar loops and the same was observed in our study also.[13]

In children with CNS malformation there was an increased frequency of whorls compared to loops and arches in the current study, while Igbigbi PS14 et al (2005) an increase in frequency of whorls alone in children with spina bifida.

In present study no such variation was found among the dermatoglyphic parameters in children with CTEV. Igbigbi PS et al, observed that there is lower TFRC count among the children with spina bifida and no significant changes in atd angle and a-b ridge count. Our findings also reflected the same.[13]

CONCLUSION

Congenital malformations are associated with abnormal dermatoglyphic patterns. There was higher incidence of loops in children with CHD, CTEV, cleft lip/palate and genetic syndromes. Total Finger Ridge Count (TFRC), atd angle and a-b ridge count showed an increase in number among children with congenital malformation. Large population with a well-matched control in future may bring out definite dermatoglyphic pattern for many congenital disorders and they may serve as a simple non-invasive diagnostic tool for these disorders.

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