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Original article

A Study of Dermatoglyphic Patterns In Deaf mute Children

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ABSTRACT

One hundred and fifty established cases of congenital deafness in the age group of five to fifteen years were studied to understand their dermatoglyphic patterns and compared with a control group of hundred respective parents and siblings, with a view to observe the role of inheritance. Inkpad method described by Cummins and Midlo was used. Inverted T pad, ink slab made of plain glass, A4 size computer paper, cyclostyling ink was used to obtain the prints. Finger patterns were studied according to Galton's classification and Bhanu's classification. Various parameters like C line termination, presence of pattern in interdigital area were studied in the palm. Increased frequency of whorls in both groups and increased frequency of radial patterns in parents and siblings were observed. Significant bilateral difference in C line termination was observed in both the groups.

1. Introduction

The problem of deafness interferes with the ability of a child to acquire speech by imitating others. Uncompensated deafness therefore interferes with individuals' intellectual and emotional life. Approximately 35% to 50% cases of profound childhood deafness were classified as genetic.[1] About 40% are classified as autosomal recessive in origin [2,3] and about 10% fall under autosomal dominant.

Congenital hearing loss merely means that the impairment was present at the time of birth and includes both hereditary as well as acquired cases. Hereditary hearing loss may be defined as those cases in which the causative factor was present in the genetic makeup of fertilized ovum. Consanguineous marriages and affected parents act as risk factors. The acquired cases have Rubella acting as a main causative factor while the fetus was in utero while perinatal causes like hypoxia, preterm delivery or low birth weight may lead to deafmutisum.

Dermatoglyphics, the scientific study of the origin, development and variation on dermal ridges and patterns on the fingers, palms and soles have been employed to observe association with many congenital defects and genetic diseases. [4 - 8]

Dermatoglyphic analysis was preferred in the present study as it is a handy scientific investigating tool that is noninvasive, quick and inexpensive. The patterns can be recorded immediately after birth and these remain constant throughout the life. It requires no elaborate equipment except a magnifying lens. No specialized training and no active co-operation of the patient is required.

Since the period of development of epidermal ridges exactly coincides with the period of development of cochlea, a dermatoglyphic study in deaf mute may have an important logical bearing.[9]

2. Materials and Methods:

The study was carried out in one hundred and fifty randomly selected deaf mute children of both sexes in the age group of five to fifteen years considered as group one (Gr. 1), attending the school for hearing handicapped. After taking consent from the parents, 90 male and 60 female children were included in the study. The parents and the siblings attending the parent - teacher meetings were included for the study as control as group two (Gr. 2). As the affected children belong to the same gene pool, parents are chosen as control. The reluctance of parents and siblings to attend the parent – teacher meetings accounted for the less number of cases in this group i.e. 35 males and 65 females.

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A detailed family history including history of consanguinity if any was recorded on a Proforma. Data regarding the severity (degree) of deafness was collected from the respective audiological reports maintained by the school authorities. Palmar and finger patterns of both the hands were taken using ink & pad method described by Cummins and Midlo. [10]

The following standard materials were used, inverted T shaped pad of seven cm diameter made up of a ball of cotton covered by three layers of fine cotton cloth, Ink slab made of plain glass with smooth surface with dimension: 25cm X 15cm X 5cm, edges smoothened and rounded, black cyclostyling ink, white paper (computer paper A4 size, not a glazed paper). Firm surface used under the sheet of paper on which the fingers were pressed and rolled. The dermatoglyphic patterns were studied with the help of 3 ¼ inch diameter magnifying lens of 5X power.

The digital patterns were classified as per Galton's system as well as Bhanu's system. [11] The palm was divided into Hypothenar, Thenar and four interdigital areas. Main line termination and interdigital patterns, anatomical position of C-line termination was observed according to its direction of ending as ulnar, radial, proximal or absent. The presence or absence of the pattern in interdigital area was noted and analyzed statistically.

Bhanu's[12] Transverse crease (simian crease) classification was used to observe the presence or absence of transverse crease variation among the patients and parents and siblings.

The following parameters were included in the study. Classification by Galton's system and Bhanu's system were used for finger patterns. Pattern intensity index (PII), A/L index, L/W index, W/L index, A/W index, Radial pattern / Ulnar pattern index were studied. Presence of pattern in Hypothenar, Thenar/ Ist interdigital area, II, III, IV interdigital areas, C-line polymorphisum, types of Simian crease were studied in palm.

Tests for statistical significance (x2 and t test) were applied to the data of patients (Gr. 1) as well as controls (Gr. 2).

3. Result:

While observing digital patterns according to Galton's system of pattern classification, the variations observed in Gr. 1 in three patterns (arch, loop and whorl) were significant statistically (2 = 17.15, p = 0.00001) in comparison to Gr. 2. The variation between the frequency of patterns on total left hand fingers among the two groups was significant (2 = 12.5, p = 0.001), while on total right hand fingers it was found non significant ($\chi 2 = 5.17$, p = 0.07) (Table 1)

When all the patterns were considered together according to their anatomical orientation (Bhanu's system), the difference was statistically not significant for Rt. hand ($\chi 2 = 2.19$, p= 0.139) but for Lt. hand ($\chi 2 = 5.82$, p= 0.015) it was significant statistically. (Table 1)

Higher frequency of whorls was present in males of Gr. 1 as compared to females of same group (Males - 44.7%, Females – 37.16%) as well as in Gr. 2 (Males - 44.2%, Females – 34.76%) whereas the females of both groups showed higher frequency of loop pattern, (Gr. 1 - 55.8%, Gr. 2 – 58.3%). The differences were statistically significant when compared within the groups (Gr. 1- 2 =14.73, p=0.00, Gr. 2- 2 = 12.27, p=0.002) (Table 2)

The Pattern Intensity Index (PII) of Gr. 1 was 1.36 and for Gr. 2 was 1.27, Arch/ Loop index for Gr. 1 was 0.09 and for Gr. 2 was 0.15, Loop/Whorl index for Gr. 1 was 1.25 and for Gr. 2 it was 1.51, Arch /Whorl index for Gr. 1 was 0.12 and for Gr. 2 was 0.23, Whorl/Loop index for Gr. 1 was 0.79 and for Gr. 2 was 0.66. The Radial/Ulnar pattern index for Gr. 1 was 0.09 and for Gr. 2 was 0.14. All these indices were not significant statistically. (Table 3)

While observing the palmar patterns, the bilateral variation in incidence of III interdigital pattern was significant statistically (2 =10.33, p= 0.001) when compared within the group. Total interdigital pattern showed bilateral variation in Gr. 1 (2= 4.83, p=0.02) and in Gr. 2 (2 = 5.32, p= 0.02) which was statistically significant (Table 4)

The position of termination of C line varied bilaterally in Gr. 1 and in Gr. 2. This difference was statistically significant. Ulnar termination of C-line on left hand and radial termination on right hand was observed in both the groups. Gr.1 ($\chi 2 = 3.57$, p=0.058), Gr.2 ($\chi 2 = 6.14$, p= 0.01). (Table5)

Statistically significant bilateral difference was observed in the presence of ridge dissociation in both the groups, Gr. 1($\chi 2 = 21.38$, p= 0.00) and in Gr.2 ($\chi 2 = 10.69$, p= 0.001) also. (Table 6)

When all the palmar parameters were studied for bisexual variation in both the groups, no significant difference was found.

Table No.1: Distribution of Digital patterns among the patients (Gr. 1) and control (Gr. 2)

	Finger pattern (Galton's system) (%)				Finger pattern (Bhanu's system) (%)		
Status	Whorls	Loop	Arch	Total	Ulnar	Radial	Total
Lt.	41.84	53.07	5.08	750	90.67	9.07	748
Gr.1 Rt†	42.26	52.66	5.08	750	89.87	10.10	750
Lt.+Rt.	42.00	52.80	5.06	1498	90.27	9.60	1498
Lt	35.20	55.20	9.60	500	86.40	13.60	500
Gr.2 Rt.	37.80	54.40	7.80	500	87.00	13.00	500
Lt.+Rt.	36.50	54.00	8.70	1000	86.70	13.30	1000

Left hand, † Right hand

Table No. 2: Bisexual variation in presence of digital patterns (Galton's system)

	Gr. 1		Gr. 2	
	Male	Female	Male	Female
Whorls (%)	44.7	37.16	44.28	34.76
Loop (%)	50	55.8	50.28	58.3
Arch (%)	3.8	6.83	5.42	10.46

Table No. 3: Derived indices for Gr. 1 and Gr. 2

Index	Gr. 1	Gr. 2
Pattern Intensity Index (PII)	1.36	1.27
Arch / Loop	0.09	0.15
Loop / Whorl	1.25	1.51
Arch / Whorl	0.12	0.23
Whorl / Loop	0.79	0.66
Radial / Ulnar	0.09	0.14

Table No. 4: Frequency of presence of pattern in III interdigital area and Total interdigital areas

		Frequency of III interdigital pattern (%)			Frequency of total interdigital pattern (%)		
		Present	Absent	Total no.	Present	Absent	Total no.
Gr-1	Lt.	19.3	80.66	150	13.6	86.4	750
	Rt†	33.3	63.33	150	17.8	82.1	750
	Lt.+Rt.	28	72	300	15.7	84.2	1500
Gr-2	Lt	15	85	100	13.5	86.4	500
	Rt.	44	56	100	19.2	80.8	500
	Lt.+Rt.	29.5	70.5	200	16.4	83.6	1000

Left hand, † Right hand

Table No. 5: Frequency of hand wise distribution of C line termination

		Frequency of hand wise distribution of C line termination				
		Ulnar (%)	Radial (%)	Proximal (%)	Absent (%)	Total no.
Gr-1	Lt.	36.6	26.6	19.3	17.3	150
	Rt†	32.6	42	9.3	16	150
	Lt.+Rt.	34.66	34.33	14.33	16.66	300
Gr-2	Lt	41	27	9	23	100
	Rt.	33	52	6	9	100
	Lt.+Rt.	37	39.5	7.5	16	200

Left hand, † Right hand

Table No. 6: Frequency of Ridge dissociation

		Frequency of ridge dissociation		
		Present	Absent	Total no.
Gr-1	Lt.	74.6	25.3	150
	Rt†	48	52	150
	Lt.+Rt.	61.3	38.6	300
Gr-2	Lt	67	33	100
	Rt.	43	57	100
	Lt.+Rt.	55	45	200

Left hand, † Right hand

Higher frequency of whorls was present in males of Gr. 1 as compared to females of same group (Males - 44.7%, Females – 37.16%) as well as in Gr. 2 (Males - 44.2%, Females – 34.76%) whereas the females of both groups showed higher frequency of loop pattern, (Gr. 1 - 55.8%, Gr. 2 – 58.3%). The differences were statistically significant when compared within the groups (Gr. 1- 2 =14.73, p=0.00, Gr. 2- $\chi 2$ = 12.27, p=0.002) (Table 2)

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Statistically significant bilateral difference was observed in the presence of ridge dissociation in both the groups, Gr. 1($\chi 2$= 21.38, p= 0.00) and in Gr.2 ($\chi 2$= 10.69, p= 0.001) also. (Table 6)

When all the palmar parameters were studied for bisexual variation in both the groups, no significant difference was found.

4. Discussion:

Studies of families have shown that dermatoglyphics have a genetic basis but, the number, type and interrelationship of the genes concerned are inexplicable yet. Heredity may play a part in etiology of congenital hearing loss as it can occur in more than one sibling of the family. History of hearing loss is also often observed in the near relatives.

Although congenital hearing loss, which leads to deafmutisum, is a loose group clinically, dermatoglyphics might point towards intrauterine as well as perinatal factors, such as Rubella, low birth weight, birth asphyxia etc.[8]

As per Galton's system of classification in our study, there was a trend among the Gr.1 to have reduced frequency of loop and arch and slight increase in whorls. This was similar to what Pervis – Smith[7] found while studying the cases of congenital rubella.

In their study, on congenital deafness, Athanikar[9] and Chaturvedi and Kumar[4] observed predominance of ulnar loop over radial loop on both the hands as per Galton's classification. Gr.2 recorded a slightly higher frequency of radial patterns as compared to the Gr. 1 in the present study. The present study confirmed the earlier observations of Athanikar[9] and Chaturvedi and Kumar[4] based on loop pattern.

Increased frequency of radial loop on digit II was found in the present study. This was not similar to the observations of Arch et al.[6] and Athanikar.[9] Pervis-Smith[7] showed increased number of patients of congenital rubella with six or more whorls (28%) while in the present study 34.66% showed six or more whorls in Gr.1 and 29% in Gr.2.

The Radial / Ulnar index showed slightly higher incidence of radial patterns in Gr. 2. Increased frequency of whorls and increased incidence of ulnar pattern in Gr. 1 and increased incidence of radial pattern in Gr. 2 was observed in the present study.

Athanikar[9], Amla et al.[8] and Chaturvedi and Kumar[4] studied interdigital patterns; Amal et al.[8] and Chaturvedi and Kumar[4] did not study the bilateral variation. Athanikar[9] had merely presented the patterns. In the present study the interdigital patterns were studied and analyzed for bilateral variation as well as hand wise comparison between the groups. The frequency of Hypothenar and Thenar/ I interdigital pattern among Gr. 1 and Gr. 2 was similar in our study. This observation was in agreement with the observation made by Amla et al.[8] in patients with congenital deafness. In the present study, the presence of patterns in I3 and in total interdigital areas showed bilateral variation which was significant statistically in both the groups.

There exists significant bilateral difference among Gr. 1 and Gr. 2, for the radial/ ulnar termination of C-line, but when both hands were combined together the difference was not significant.

Able[13] pointed out the tendency of aberrant ridges (ridge dissociation) to occur in persons with deafmutism. In the present study, Gr. 1 presented higher frequency of ridge dissociation as compared to Gr. 2 and when compared bilaterally it was more in the left hand in both the groups, which was statistically significant. So it was similar to the observations by Abel. [13]

Athanikar[9] observed absence of typical transverse crease, which as per Bhanu's classification, was presumably 13TyTTc. Thus the observations of these studies match. In the present study small percentage (0.6% in Gr. 1 and 0% in Gr. 2) showed presence of transverse crease mainly the transitional type in Gr. 1. while Amla et al.[8] reported slight increase incidence of Simian crease in children with congenital hearing loss. Thus these findings were contradictory and can be overlooked in view of transverse crease being absent in majority of cases.

Presence of central pocket whorl as reported by Athanikar[9] was not found in the present study. We were in agreement with Chaturvedi and Kumar[4] as central pocket whorl cannot be taken as a definite marker for diagnosis of deafmutisum. The present study was an attempt to find out any such parameter for early diagnosis of congenitally deaf mute immediately after birth and for counseling of parents with positive history.

The foregoing salient features and trends of dermatoglyphic parameters that were analyzed and compared between the deaf mute children, their parents and siblings, indicates that, there were differences of varying degrees as observed among these parameters.

To evaluate the genetic inheritance and to get more conclusive results we need to take into account the matching parameters in deaf mute children and parents and siblings.

An attempt was made in the present study to observe the various parameters by dividing the patients into the following groups – 1.Deaf mute children with both consanguinity and family history 2. Deaf mute children with no consanguinity and no family history. Only presence of pattern in III interdigital area was seen as differentiating feature between the acquired deafmutism and the group of deaf mute children where there was positive family history and prevalence of consanguineous marriages, which could not be analyzed statistically, as the number of cases in the two groups was insufficient. However the presence of patterns in III interdigital area gives hope that in a larger group some other parameter would also surface as a definite marker for early detection of congenital deafmutism.

5. Conclusion:

After studying the dermatoglyphic patterns in one hundred and fifty deaf mute children, the significant variation was observed in incidence of arch, loop and whorl, in comparison to their parents and siblings. Similar trends like higher frequency of whorls in males, presence of patterns in III interdigital area, bilateral variation in C line termination and ridge dissociation, were observed in both the groups.

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