

Original Research Article

Variations in fingertip dermatoglyphic pattern in congenitally deaf and mute subjects

Harsimarjit Kaur, Ruchi Goyal*, Rimple Bansal, Usha Chhabra, Gurdeep Singh

Department of Anatomy, Government Medical College and Rajindra Hospital, Patiala, Punjab, India

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*Correspondence:

Dr. Ruchi Goyal,

E-mail: dr.roochie@yahoo.com

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ABSTRACT

Background: 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. Development of dermal ridges and congenital deafness seems to be interlinked as they develop at about the same time.

Methods: The material for the study consisted of finger and palm prints of congenitally deaf and mute children of 100 subjects with congenital deafness and muteness between 5-21 years of age and 50 control of similar age group with normal hearing and speech were chosen. Digital patterns, triradii, total ridge count were noted.

Results: Overall fingertip pattern of subjects and control when right and left hands were considered together showed significant results in which there was maximum percentage of ulnar loops followed by whorls, carpal arches, composites and least were the tented arches in the subjects. Mean ridge count of all the digits comes out to be less in subjects in comparison to control but it was not statistically significant.

Conclusion: Dermatoglyphics can serve as a simple, inexpensive screening tool but further preliminary investigations are needed to come to a conclusive finding.

Keywords: Congenitally deaf and mute, Fingertip pattern, Dermatoglyphics

INTRODUCTION

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.¹⁻⁴ As palm creases are helpful in discovering anthropologic characteristics and diagnosing several diseases, this uniqueness is because of the reason that Dermatoglyphics is the reflection of DNA and hence does not change including chromosomal aberrations, palm creases have been analyzed qualitatively and quantitatively.⁵⁻⁸ Finger prints of both hands are not the same and they don't increase in size except in cases of serious injuries. Finger prints persists lifelong unless

when there is damage to dermis. During development various creases develop on the brain and are reflected on the fingerprints representing the various regions of brain. Congenital hearing loss merely means that the impairment was present at the time of birth and includes both hereditary as well as acquired cases.⁹

The membranous inner ear is of ectodermal derivation. At three weeks, an ectodermal thickening, the otic placode, appears on the lateral surface of the head. By the nine-week stage, the basis of the vestibular system, the utricle and semicircular canals, are well established, but the cochlear system lags behind.¹⁰ Development of dermal ridges and congenital deafness seems to be interlinked as they develop at about the same time.¹¹

Also, the development of the inner ear (5 weeks to 12 weeks) exactly coincides with the development of dermal patterns.¹² Hearing impairment can have a major impact on the social and emotional development as well as behavioural and academic achievement. The earlier the impairment is identified the better the prognosis. The present study is aimed at determining variations in the fingertip pattern associated congenital deaf subjects compared to normal. Most dermatoglyphics are correlated with genetic abnormalities and are useful in biomedical studies. They are used in the diagnosis of congenital malformations. The uniqueness of a person's finger prints led to the analyses of one's potential, personality and preferences by analyzing dermatoglyphics.

METHODS

The material for the cross-sectional study consisted of finger prints of congenitally deaf and mute children (as per medical records submitted to the institute at the time of admission) of Patiala School for The Deaf, Patiala. 100 subjects (50 males and 50 females) with congenital deafness and muteness between 5-21 years of age and 50 control (25 males and 25 females) of similar age group with normal hearing and speech were chosen for the study. Study period extended from February, 2012 to November, 2013. All subjects and controls were of North-West Indian population of Punjabi origin. Subjects having any other congenital abnormalities and the cases of acquired deafness were excluded from the study. "Printer's ink and paper method" was used for recording the prints. The procedure was explained to the subjects so that they could cooperate. Hands of the subject were thoroughly washed with soap and water and dried with napkin before taking prints. Then requisite amount of ink

was poured on a clean slab and ink was evenly spread on the glass slab by a cotton pad. This thin uniform film of ink was transferred on the fingers of the subject with the help of cotton pad from the end of the terminal phalanx to the flexion crease of distal interphalangeal joint. The inked finger ball was then placed on one edge of the paper which was placed on the rigid surface. The same procedure was adopted to obtain the finger prints of the controls. A magnifying hand lens was used to magnify the ridges of the prints for easy identification of the different finger print patterns.

The obtained finger prints of both hands were analysed qualitatively and quantitatively. In the present study Henry's Classification system was used for fingertip pattern study. Digital patterns, triradii (meeting point of three opposing ridge system), Total ridge count (drawing a line from the triradius to the centre of the pattern and determining the number of intersected ridges between these two points) were noted (Fig. 1). A total finger ridge count (TFRC) is the summation of the ridge counts for all the ten fingers. Arches are defined as having a ridge count of zero. The ridge count of a whorl consists of the higher of the two counts. The triradius is not included in the count, nor is the final ridge when it forms the centre of the pattern. Ridges which run close to the line without meeting it are excluded, but two ridges resulting from a bifurcation were both counted. Data analysis was done using mean, standard deviation and Chi square test (χ^2) for the data of patients as well as controls.

RESULTS

The digital prints were numbered as I, II, III, IV and V from thumb to little finger respectively for right and left hand (Table 1).

Table 1: Fingertip pattern of all the digits of the left and the right hand.

Digit	Left hand		Right hand	
	Male	Female	Male	Female
I	Subject $L^U > W > C > A^C > L^R$	$L^U > W > C > A^C > L^R$	$L^U > W > C > A^C > L^R$	$L^U > W > C > A^C > L^R$
	Control $L^U > W > C > A^C > L^R$	$L^U > W > C > A^C > L^R$	$L^U > W > C > A^C > L^R$	$L^U > W > C > A^C > L^R$
II	Subject $L^U > W > A^C > L^R > C > T^C$	$L^U > W > A^C > L^R > C > T^C$	$L^U > W > A^C > L^R > C$	$L^U > W > A^C > L^R > C$
	Control $L^U > W > A^C > L^R > C > T^C$	$L^U > W > A^C > L^R > C > T^C$	$L^U > W > A^C > L^R > C$	$L^U > W > A^C > L^R > C$
III	Subject $L^U > W > A^C > C > L^R$	$L^U > W > A^C > C > L^R$	$L^U > W > A^C > C > T^C$	$L^U > W > A^C > C > T^C$
	Control $L^U > W > A^C > C > L^R$	$L^U > W > A^C > C > L^R$	$L^U > W > A^C > C > T^C$	$L^U > W > A^C > C > T^C$
IV	Subject $W > L^U > A^C > C > L^R$	$W > L^U > A^C > C > L^R$	$W > L^U > C > A^C$	$L^U > W > A^C > C$
	Control $W > L^U > A^C > C > L^R$	$L^U > W > A^C > L^R > C$	$W > L^U > C > A^C$	$L^U > W > A^C > C$
V	Subject $L^U > W > A^C > C > T^C > L^R$	$L^U > W > A^C > C > T^C > L^R$	$L^U > W > A^C > C > T^C$	$L^U > W > A^C > C > T^C$
	Control $L^U > W > A^C > C > T^C > L^R$	$L^U > W > A^C > C > T^C > L^R$	$L^U > W > A^C > C > T^C$	$L^U > W > A^C > C > T^C$

On comparing the fingertip pattern, statistically significant results were obtained in digit I and II of male and female controls in right hand in which the frequency of ulnar loops was maximum in females in comparison to males. Overall fingertip pattern of subjects and control when right and left hands were considered together showed significant results in which there was maximum percentage of ulnar loops followed by whorls, carpal

arches, composites and least were the tented arches in the subjects as shown in (Figure 2).

Finger ridge count

While comparing the fingertip ridge count, digit I of right hand showed statistically highly significant results in subjects as compared to control in which the mean ridge

count was very less in subjects. Mean ridge count of all the digits (TFRC) comes out to be less in subjects (146.20 ± 62.890) in comparison to control

(161.76 ± 70.818) but it was not statistically significant ($p=0.17$) (Table 2).

Table 2: Finger ridge count of all the digits of the left and the right hand.

Group	Left hand	Mean	SD	P value	Right hand	Mean	SD	P value
Subject	Digit I	16.68	9.883	0.278	Digit I	17.91	9.731	0.006
Control		18.52	9.492			22.80	11.036	
Subject	Digit II	12.58	9.140	0.222	Digit II	13.80	8.785	0.232
Control		14.60	10.230			15.71	9.838	
Subject	Digit III	13.35	7.874	0.822	Digit III	11.18	6.836	0.147
Control		13.68	9.580			13.10	8.933	
Subject	Digit IV	17.98	8.581	0.950	Digit IV	17.51	8.367	0.361
Control		17.88	10.485			18.92	9.823	
Subject	Digit V	12.91	6.344	0.375	Digit V	12.21	6.071	0.562
Control		13.92	6.951			12.82	6.060	
Subject	Total	72.70	30.900	0.063	Total	73.50	33.587	0.399
Control		83.26	35.477			78.60	37.251	

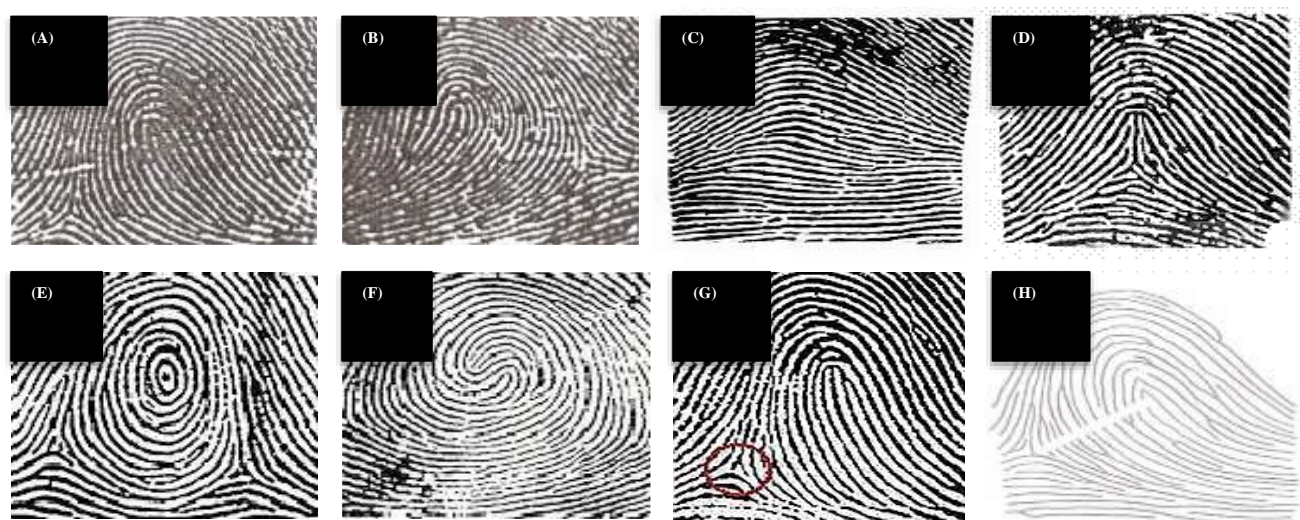


Figure 1: Diagrammatic representation of; A) Ulnar loop (L^U); B) Radial loop (L^R); C) Simple Arch (A^C); D) Tented Arch (T^C); E) True whorl (W); F) Composite whorl (C); G) Triradii; H) Technique of ridge counting, Loop having 13 ridges.

DISCUSSION

Dermal ridge differentiation takes place early in fetal development. The resulting ridge configurations are genetically determined and are influenced or modified by environmental forces. Once formed, they remain unchanged throughout life and vary between the individuals. Overall fingertip pattern of subjects and control when right and left hands were considered together showed significant results in which there was maximum percentage of ulnar loops followed by whorls, carpal arches, composites and least were the tented arches in the subjects. This finding coincides with the findings of Athanikar who reported predominance of ulnar loop over radial loop on both hands in deaf cases and arches and radial loops were less in all digits.¹² Osunwoke et al

also reported highest frequency of ulnar loops followed by whorls, arches and least were the radial loops.¹³

However, Alter in rubella-damaged individuals, Smith et al in children born with congenital rubella, Yongchun et al in deafmutes, Borate et al in congenitally deaf and Sharma et al in congenital deaf noted increased percentage of whorl pattern in deaf cases.^{5,11,14-16} This difference could be attributed to the fact that in the present study Henry's Classification system was used for fingertip pattern study whereas in previous studies Galton's/others classification might had been used in which the composites were considered under the category of whorls. Finger ridge count of digit I of right hand showed statistically highly significant results in subjects as compared to control in which the mean ridge count

was very less in subjects while other digits showed no statistically significant results in right and left hand. This finding matches with Osunwoke et al who noticed no significant difference in digital counts.¹³

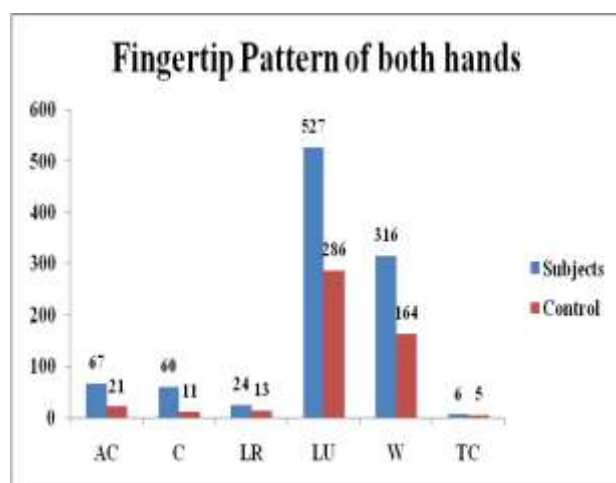


Figure 2: Bar diagram showing fingertip pattern of subjects and control; (Ulnar loop-LU, Radial loop-LR, Simple Arch-AC, Tented Arch-TC, True whorl-W, Composite whorl-C).

Mean ridge count of all the digits (TFRC) comes out to be less in subjects in comparison to control but it was not statistically significant. This finding coincides with the findings of Sharma et al who also reported less mean ridge count in deaf as compared to controls but that too was not statistically significant.¹¹ This finding contradicts Borate et al who noted increased TFRC and AFRC in congenitally deaf cases.¹⁶ The present study was conducted to strengthen the available data present on dermatoglyphic pattern in congenitally deaf and mute subjects of North-West Indian population of Punjabi origin.

Limitations

From the above study it can be concluded that dermatoglyphics can serve as a simple, inexpensive screening tool but further preliminary investigations are needed to come to a conclusive finding.

CONCLUSION

Dermatoglyphics can serve as a simple, inexpensive screening tool but further preliminary investigations are needed to come to a conclusive finding.

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