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Dematoglyphic analysis in Jatyaandh: A case-control study

Research Article

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Abstract

Introduction: Dermatoglyphics stands as one of humanity's oldest and most enduringly useful techniques. Dermatoglyphics has historically been employed for identification since ancient times, its application in diagnosing various diseases gained attention as early as the 17th century. In recent decades, there has been a growing global interest in epidermal ridges, especially as it became apparent that individuals with chromosomal abnormalities often exhibit unusual ridge formations. Significant advancements have been achieved in researching and comprehending the connections between dermatoglyphics and various medical conditions. Consequently, dermatoglyphic analysis has gained acceptance as a valuable diagnostic tool in numerous diseases, particularly in disorders arising from chromosomal abnormalities. These conditions often coincide with alterations in patterns, highlighting the diagnostic utility of dermatoglyphic analysis. Materials and Methods: The objective of this study is to investigate the correlation between dermatoglyphics and *Jatyaandh.* In this study, 250 children diagnosed with *Jatyaandh* underwent examination, comparing their dermatoglyphic patterns with those of age and sex-matched controls. Dermatoglyphics prints were taken by 'Ink method' described by Cummins and Mildo. Results: Significant variances were noted in several dermatoglyphic traits among the cases. Specifically, the case group displayed differences in Finger Ridge Count, Total Finger Ridge Count, Absolute Finger Ridge Count, as well as an elevated atd angle, and a greater prevalence of whorl patterns on their digits.

Keywords: *Jatyaandh, Chakshurindriya, Twak, Jnanendriya, Dauhrudaya-apchar, Janmabala-pravruta vyadhi.*

Introduction

The skin is not smooth on the fingertips of Palmer and Plantar surface; rather, it's characterised by grooved ridges forming various configurations. These ridge patterns have intrigued both laymen and scientists for over three centuries. Dermatoglyphics, a scientific field, focuses on studying these ridge patterns found on fingertips, palms, soles, and toes. Forensic officials particularly find these unique ridge configurations reliable for personal identification, as they remain unchanged throughout an individual's life, barring proportional adjustments due to growth (1). Consequently, clinicians can utilise knowledge of these dermatoglyphic patterns associated with various medical conditions as a diagnostic tool, particularly for diseases with a clear genetic basis (2). Till now, many similar studies have been carried out in genetically inherited conditions such as Down's syndrome (3), schizophrenia (4), cerebral palsy (5), leprosy (6), congenital heart diseases (7) and others. This study seeks to explore and highlight whether individuals with *Jatyaandh* exhibit distinct dermatoglyphic patterns.

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According to the *Acharya Kashyapa*, analysing various shapes such as *Chakra* (wheel), *Padma* (lotus), *Shankha* (conch), and the lines on our palms and soles can reveal insights into an individual's lifespan, well-being, prosperity, abilities, talents, and weaknesses (8). In modern times, these skin ridge patterns found on the palms and soles are studied as dermatoglyphic patterns. Dermatoglyphics, encompassing Digital and Palmer patterns, have been explored for their potential in predicting a range of genetic and acquired disorders due to their stable characteristics throughout life.

There are three basic Digital patterns a) Arches b) Loops c) Whorls (9). The Arch patterns are characterised by ridges entering from one side and flowing to the other, creating a simple, tented appearance. Arches have no ridge count, meaning there's no delta (triangular area) within the pattern. Loops feature a triradius (where three ridges converge), at least one recurving ridge, and a minimum ridge count of one across the recurving ridge. Ridges enter from one side, curve back, and exit on the same side. Depending on whether the ridges exit from the ulnar or radial side, loops are classified as ulnar or radial loops, respectively. A loop pattern contains only one triradius. Whorls are the most complex type, forming continuous circular shapes bounded by type lines extending from two triradii. The area enclosed by these lines is the pattern area. Whorls have subtypes like simple, symmetrical, double loop, and accidental, each with its own unique characteristics within the overall whorl pattern. The palmer area comprises various zones, each potentially

exhibiting distinct pattern. These zones include the four interdigital areas (I1, I2, I3, and I4 from the radial to the ulnar side), the axial triradius (t, t', t'' located based on triradius position), as well as the hypothenar eminence and the thenar eminence.

The *'Netra'* holds immense importance within the *'sharira'*, as their absence would plunge the world into darkness, stripping life of its meaning. These vital organs primarily contain the element of *'Agni mahabhuta'*, pivotal in the process of '*Roopagrahana*' (10). Failure of *'Agni mahabhuta'* to enter '*drishti*' during *garbhakala* (pregnancy) could result in *'jatyaandh*', a condition akin to congenital blindness in modern science (11). The word *'Jatyaandh'* originates from *'jata'* meaning 'born' or 'become' and *'andh'* signifying 'blindness', collectively referring to someone born blind or become blind after birth (12). Genetic factors contribute significantly to various eye diseases, comprising a significant portion of blindness cases among infants, children, and adults. Inherited eye diseases, such as congenital glaucoma, congenital cataracts, optic atrophy, retinal degeneration, and various ocular malformations like anophthalmia, microphthalmia, microcornea, coloboma, and leukocoria, account for approximately 60% of cases of blindness in infants. (13).

Chakshu and *twak* are two of the *panch-jnanendriyas* that develop during the third month of *Garbhavakranti* (14). According to modern science, both these sensory organs form from the ectoderm during the period of 3rd to 8th week of intrauterine development (15). Given their shared ectodermal origin, any developmental anomaly in the ectoderm should reflect in both *chakshu* and *twak*. To explore this concept, researchers are studying dermatoglyphics, which involves evaluating the unique patterns on the skin's surface. The objective of this research is to identify dermatoglyphic features and specific variations that can be used as an affordable screening tool in populations at risk. Early detection of such variations can aid in anticipating and preventing diseases or complications associated with them.

Materials and Methods

The present study is an observational case control study; participants for this study were selected based on a sample size of 500, comprising 250 cases and 250 controls, determined according to the prevalence rate. Patients, aged between 0-16 years, diagnosed with *jatyaandh*, were recruited from blind schools, regardless of their gender. An ophthalmologist evaluated their visual acuity and central visual field, confirming impairment (visual acuity <6/60 or central visual field <20 degrees in the better eye). Controls of the same age group and region, without a family history of ocular malformation, were also recruited. Ethical clearance was obtained from the institutional ethics committee, and the study was registered with the Clinical Trials Registry of India (CTRI/2021/10/037152) before collecting dermatoglyphic imprints. Informed consent was obtained from both patients and their relatives, with verbal consent from the patient and signed consent from the first-degree relative.

Procedure

- Dermatoglyphic prints were obtained using the 'Ink Method' as outlined by Cummins and Mildo (1961). For this purpose, duplicating ink, white paper, ink pad, paper towel, washing bowl, cleansing fluid, magnifying hand lens, needle with a sharp point for ridge counting, cotton puffs, scale, pencil pen, protractor are needed.
- Before the procedure, patients received detailed information and were directed to cleanse their hands using soap and water, followed by drying with a soft cotton cloth to eliminate any oil or dirt. Subsequently, blue duplicating ink was evenly spread on their hands, ensuring thorough coverage including the palm hollow and wrist flexor creases.
- Following that, the participants hands were positioned on bond paper, beginning at the hand's proximal end and moving toward the distal end. Delicate pressure was exerted to create an impression of the palm, focusing on the intermetacarpal grooves near the finger bases and the top side, aligning with the thenar and hypothenar areas. Subsequently, the fingerprint patterns of each finger were documented in a sequential order from the thumb to the little finger.
- The palm was then lifted from the paper in the reverse order, starting from the distal end and moving to the proximal end. Subsequently, the palm was cleaned, washed, and dried with a hand towel. This standardized procedure was also followed for the control group.
- The printed sheets were labelled with essential information, including the name, age, and sex of both the case and control groups. Dermatoglyphic analysis was performed using a magnifying hand lens, and ridge counting was conducted with the help of a sharp needle.

The data obtained was analysed statistically using SPSS (statistical programme for social sciences, version 18.0) computer software package. The dermatoglyphic prints of 500 subjects were taken on special assessment proforma and various quantitative and qualitative parameters were observed. The descriptive statistics of all the quantitative and qualitative dermatoglyphic parameters are studied and assessed. To study the correlation between palmer dermatoglyphic pattern in jatyaandh and healthy individual, Mann-Whitney U test, Paired sample Wilcoxon signed-rank test, z-Test and Chi – Square Test of Proportion are used.

Parameters observed

- Finger ridge patterns
- Finger ridge count
- a-b ridge count
- Total finger ridge count (T.F.R.C)
- Absolute finger ridge count (A.F.R.C)
- Axial triradius angles (atd, adt and dat angles)

Method of Calculating Dermatoglyphic Parameters

- Finger Ridge Patterns: The distal phalanx of each finger is inspected to determine the ridge pattern, which is categorized as an arch, loop, or whorl.
- Finger Ridge Count: The ridge count is determined by counting the total number of ridges intersected by a line drawn from the central point of a pattern to its nearest triradius. For a loop, the count begins at the core and extends to the triradius, tallying the ridges crossed by the line. In a whorl, which has two triradii, a line is drawn from the core to each triradius, and the ridges intersecting each line are counted. In an arch, where the core itself serves as the triradius, the ridge count is zero.
- a-b Ridge Count: This count involves the ridges between two digital triradii, specifically between triradii 'a' and 'b.' The count is performed along a straight line connecting both triradial points, excluding the ridges forming the triradii.
- Total Finger Ridge Count (T.F.R.C): The T.F.R.C is the sum of the ridge counts for all ten fingers, with only the higher count used for digits with more than one ridge count.
- Absolute Finger Ridge Count (A.F.R.C): The A.F.R.C is obtained by summing the ridge counts of the whorls on both sides and the loops of all ten fingers. Since a whorl has two triradii, two counts are taken—one from each triradius. The values for all ten fingers are then summed to get the AFRC.
- atd, adt, and dat Angles: Lines are drawn from the axial triradius 't' to the digital triradii 'a' and 'd,' and the three angles within this triangle are measured using a protractor.

Image 1: Google image showing Finger Ridge patterns

Image 2: Google image showing Palmer patterns

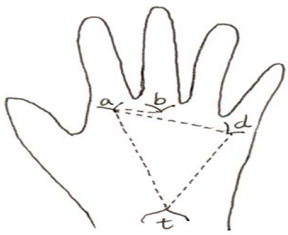
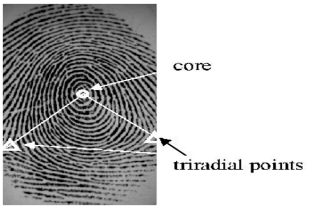


Image 3: Google image showing method of counting Ridges



Observations and Results

Data was collected by recording both quantitative and qualitative dermatoglyphic features from the handprints of 250 children having *jatyaandh* and 250 controls.

- Finger Ridge Patterns: Here the distal phalanx of each finger of both the hands of samplesare inspected for the ridge pattern and it is named as Simple arch (SA), Tented arch (TA), Whorl (W), Radial loop (RL) and Ulnar loop (UL). In *jatyaandh* cases, the whorl, radial-ulnar loop and simple-tented arch frequency were 58%, 17%, 16%, 4% and 5% in comparison to the controls in which they were 21.52%, 33.10%, 35.04%, 6% and 4.32% respectively. A significant increase in the Whorls is noted in cases as compared to controls in combined count of both hands while loop pattern (radial and ulnar) is found most commonly in controls.

Table 1: Showing Frequency and %age of Finger ridge patterns in Cases and Controls

Finger Ridge Patterns	Frequency		%age	
	Case	Control	Case	Control
S. Arch	107	150	4%	6%
T. Arch	124	108	5%	4.32%
Whorl	1460	538	58%	21.52%
R. Loop	424	828	17%	33.10%
U. Loop	385	876	16%	35.04%

Table 2: Mann-Whitney U test to compare Finger RidgePatterns of Case and Control Group

Finger Ridge Patterns		Mean	Std. Deviation	Std. Error	Median	Min	Max	Z - value	p - value
SA	Case	0.43	0.496	0.031	0.000	0	1	-2.77833	0.005(HS)
	Control	0.60	0.634	0.040	1.000	0	2		
TA	Case	0.50	0.540	0.034	0.000	0	2	-1.5784	0.114(NS)
	Control	0.43	0.564	0.036	0.000	0	2		
W	Case	5.84	0.835	0.053	6.000	4	7	-19.7235	<0.0001(HS)
	Control	2.11	0.679	0.043	2.000	1	3		
RL	Case	1.70	0.701	0.044	2.000	1	3	-17.4367	<0.0001(HS)
	Control	3.37	0.666	0.042	3.000	2	5		
UL	Case	1.54	0.531	0.034	2.000	0	2	-19.3281	<0.0001(HS)
	Control	3.48	0.746	0.047	3.000	2	5		

- Finger Ridge Counts: Case group exhibited a noteworthy rise in the finger ridge count (FRC) when individual fingers were compared. In case group, FRC varies from17.68 to 20.67 while in controls, it varies from 13.65 to 16.34 and there is a significance difference found between case group and control group with p –value < 0.001 (Significance level) except FRC LH 1. (Table 3).

Table 3: Mann-Whitney U test to compare Finger Ridge Count of Case and Control Group

Finger Ridge Count (FRC) of Right Hand (RH) & Left Hand (LH)		Mean	Std. Deviation	Std. Error	Median	Min	Max	Z - value	p - value
FRC RH I	Case	17.68	10.101	0.639	21.000	0	32	-3.41331	0.001(S)
	Control	15.47	6.422	0.406	14.000	0	28		
FRC RH II	Case	18.49	8.567	0.542	20.000	0	34	-6.14032	<0.0001(HS)
	Control	14.20	8.151	0.515	13.000	0	30		
FRC RH III	Case	19.96	9.835	0.622	23.000	0	32	-7.81624	<0.0001(HS)
	Control	14.08	7.225	0.457	13.000	0	31		
FRC RH IV	Case	19.67	9.483	0.600	23.000	0	33	-7.14826	<0.0001(HS)
	Control	14.22	6.867	0.434	14.000	0	28		
FRC RH V	Case	18.35	10.523	0.666	21.000	0	35	-5.10164	<0.0001(HS)
	Control	13.78	7.437	0.470	14.000	0	33		
FRC LH I	Case	18.56	8.713	0.551	17.000	0	34	-1.80944	0.07(NS)
	Control	16.34	7.189	0.455	16.000	0	29		
FRC LH II	Case	19.07	8.367	0.529	21.000	0	33	-6.37896	<0.0001(HS)
	Control	13.92	8.674	0.549	13.000	0	33		
FRC LH III	Case	19.79	8.599	0.544	22.000	0	35	-6.06753	<0.0001(HS)
	Control	15.00	7.819	0.495	14.000	0	31		
FRC LH IV	Case	20.67	7.845	0.496	23.000	0	35	-7.53123	<0.0001(HS)
	Control	15.04	7.137	0.451	14.000	0	30		
FRC LH V	Case	18.84	8.410	0.532	21.000	0	32	-7.19895	<0.0001(HS)
	Control	13.65	6.319	0.400	12.000	0	29		

- The mean of Total finger ridge count (T.F.R.C) and Absolute finger ridge count (A.F.R.C) is found out to be more in cases i.e. 142.88 and 191.07 respectively when compared to controls i.e. 120.64 and 145.51 and significance difference found between case group and control group with p –value < 0.001. (Table 4).
- The mean values of a-b Ridge Count is more in controls as compared to cases i.e. 43.52 and 30.73 respectively and shows a statistically significant difference. The 'atd' angle mean values of the cases (50.11) and the controls (42.78) differed significantly (p –value < 0.001) but no statistically significant difference found between the mean values of adt angle and left dat angle. (Table 4).

Table 4: Mann-Whitney U test to compare parameters of Case Group and Control Group

Parameters Observed		Mean	Std. Deviation	Std. Error	Median	Min	Max	Z - value	p - value
T.F.R.C	Case	142.88	10.653	0.674	145.000	112	160	-17.7572	<0.0001(HS)
	Control	120.64	6.102	0.386	121.000	101	133		
A.F.R.C	Case	191.07	16.816	1.064	193.000	143	221	-18.56	<0.0001(HS)
	Control	145.51	11.722	0.741	143.000	126	178		
Rt a-b ridge	Case	30.76	4.627	0.293	31.000	21	39	-18.3917	<0.0001(HS)
	Control	43.52	5.060	0.320	44.000	33	53		
Lt. a-b ridge	Case	30.73	4.615	0.292	31.000	21	39	-18.4148	<0.0001(HS)
	Control	43.59	5.116	0.324	44.000	33	53		
Rt atd angle	Case	50.11	4.437	0.281	50.000	42	59	-16.957	<0.0001(HS)
	Control	42.78	1.947	0.123	43.000	39	46		
Lt atd angle	Case	50.02	4.396	0.278	50.000	42	59	-17.0385	<0.0001(HS)
	Control	42.76	1.965	0.124	43.000	39	46		
Rt adt angle	Case	76.72	4.246	0.269	77.000	70	85	-1.48919	0.136(NS)
	Control	76.12	3.329	0.211	76.000	71	83		
Lt adt angle	Case	76.70	4.246	0.269	77.000	70	85	-1.41495	0.157(NS)
	Control	76.12	3.329	0.211	76.000	71	83		
Rt. dat angle	Case	58.69	4.144	0.262	59.000	50	68	-1.97627	0.048(S)
	Control	57.99	4.363	0.276	58.000	50	69		
Lt. dat angle	Case	58.52	4.109	0.260	58.500	50	68	-1.50731	0.132(NS)
	Control	58.04	4.404	0.279	58.000	50	69		

Discussion

Dermatoglyphics as a diagnostic aid is now well established in number of diseases which have strong hereditary basis and is employed as a method for screening of different diseases like Cerebral Palsy, Down Syndrome, Schizophrenia, Leprosy, Congenital heart diseases, Bronchial asthma and many more has been well documented in recent years. Cummins reported that in mongloids dermatoglyphics of fingertip and palm present number of characters which are different from those of racially comparable normal controls (16). The dermal ridges are said to remain unchanged unlike other body traits except in dimensions. They are not only age but also environmentally stable. Dermatoglyphics reflects phylogenetic history of individual and show variability; therefore it can be used as diagnostic criteria.

The genetic association of the blindness is well known fact and it is universally accepted. Approximately 60% of cases of infant blindness stem from inherited eye conditions like congenital cataracts, congenital glaucoma, retinal degeneration, optic atrophy, and eye malformations. Additionally, about 40% of individuals with specific types of strabismus have a familial connection to the ailment (17). Recognizing the significance of lessening childhood vision impairment, World Health Organization (WHO) selected childhood blindness as one of five preventable eye conditions targeted in the VISION 2020-Right to Sight campaign (18).

In the present study, it was observed that the eye and skin, both the sensory organs have common origin from surface ectoderm, and their differentiation occurs during a similar period of intrauterine development. The researchers hypothesized that any insult causing *jatyaandh* (congenital blindness) during the critical stage of development in the first trimester might also influence the dermal ridge pattern. To explore this concept, the palmer dermatoglyphic patterns of 250 individuals with *jatyaandh* and 250 control subjects were examined. The results showed a significant difference between the dermatoglyphic palmer patterns of both the groups. The frequency of finger ridge patterns of case group i.e. congenitally blind children shows maximum number of Whorls pattern as compared to controls in combined count of both hands. The whorl pattern in atleast six fingers out of ten fingers are found out in case group with 72% in 4th finger of Left hand followed by 3rd finger of Right hand (68%) and 3rd finger of Left hand (62%) whereas in Control group Radial and Ulnar loops are found out to be more common pattern.

There was a significant increase in the finger ridge count in both right and left hands of cases when compared with controls. All the ridge counts are found out to be highly significant except first finger of Left hand. The Total finger ridge count (T.F.R.C) and Absolute finger ridge count (A.F.R.C.) is found out to be more in cases when compared to controls and there is a significant difference found between two groups. Also the coefficient of variation of T.F.R.C and A.F.R.C is found to be less than 10 % so it is recommended to prioritise it for further study and evaluation. The a-b Ridge Count is found out to be more in controls when compared with cases and significant difference found between them in z-test at 0.0001% significance level. This discrepancy between ridge count of cases and control may indicate an earlier developmental insult that affects dermatoglyphic pad size and the subsequent number of ridges during the early prenatal period between 6.5 and 10.5 weeks post-fertilization, when volar pads exhibit rapid growth. There was a significant increase in the atd angle in both right and left hands of cases when compared to controls. The atd angle is found to be highly significant with p –value < 0.001 also the coefficient of variation of atd angle is found to be less than 10 %.

There was no previous literature found on the *jatyaandh* and dermatoglyphics, hence our present findings could not be compared. Thus, with the available data and statistical analysis, dermatoglyphic patterns may be used as a reliable indicator for scientific screening of children.

Conclusion

Dermatoglyphic analysis is a cost-effective method that doesn't necessitate hospitalisation. In the field of clinical medicine, dermatoglyphics play a crucial role in predicting the potential phenotype of future illnesses. Identifying individuals at risk early on through user-friendly and economically feasible screening tools like dermatoglyphics could significantly aid in the prevention of post-natal blindness. This proactive approach allows for early treatment to prevent and mitigate the occurrence of blindness.

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