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DERMATOGLYPHICS - An Indicator for Assessing the Intelligence Quotient (IQ) and Anxiety Levels in Children? – A Cross-Sectional Study

Sapna Konde[1], Sharvani M[2], Nandan N[3], Anitha Anand[4]

[1]Professor and Head, Department of Pediatric and Preventive Dentistry, Bangalore Institute of Dental Sciences & Hospital, Bangalore, Karnataka, India
[2]Post graduate, Department of Pediatric and Preventive Dentistry, Bangalore Institute of Dental Sciences & Hospital, Bangalore, Karnataka, India
[3,4]Reader, Department of Pediatric and Preventive Dentistry, Bangalore Institute of Dental Sciences & Hospital, Bangalore, Karnataka, India

ABSTRACT

AIM AND BACKGROUND: To assess the correlation of dermatoglyphics with intelligence quotient (IQ) and anxiety levels in children.

MATERIALS AND METHODS: A cross-sectional study was conducted among 160 children aged 8-11 years selected by simple random sampling after institutional ethical clearance. Dermatoglyphic finger and palmar prints were recorded using the Cummins and Mildo ink method and analyzed for pattern types and the atd angle. IQ was assessed using Raven's Colored Progressive Matrices (CPM), and children were categorized into five IQ grades based on Indian normative percentiles. Anxiety levels were evaluated using Venham's Picture Test.

RESULTS: Children with high IQ significantly showed whorl patterns whereas loop patterns were significantly higher among children with average IQ and arch patterns were also significantly higher among the lower IQ children. Lower atd angles were seen in high IQ children. Higher IQ children also showed lower anxiety levels.

CONCLUSION: Dermatoglyphics can serve as a predictor for both IQ and anxiety levels in children.

CLINICAL SIGNIFICANCE: Dermatoglyphics may serve as a simple, non-invasive, economical, and early screening tool for predicting a child's intellectual ability and anxiety levels enabling better behavior management and improved dental treatment cooperation.

KEYWORDS: Anxiety levels, atd angle, cross sectional study, dermatoglyphics, fingerprint patterns, Intelligence Quotient(IQ)

INTRODUCTION

Dental fear and anxiety (DFA) is one of the daunting challenges in pediatric dentistry. The prevalence of dental anxiety in children and adolescents ranges from 5.7 to 20.2%.[1] The etiology of dental anxiety is multifactorial, hence there is no monotherapy for management of pediatric patients in a dental office.

Intelligence Quotient (IQ) serves as an indicator of a child's cognitive ability influencing their understanding, perception and coping response to dental procedures. Children with higher IQ levels are often found to exhibit better comprehension, coping skills, and cooperation whereas children with lower IQ levels may show increased anxiety, fear, or uncooperative behavior.[2]

Could a simple look at a child's palm offer insight into their cognitive ability? Fingerprints constitute a unique phenotypic trait, distinguishing one individual from another. Dermatoglyphics is the study of these finger prints and can be traced back to Sir Francis Galton who was a cousin of Charles Darwin, published his work on finger prints in 1892.[3] Once formed, the dermal patterns do not change over a lifetime. In addition, no two individuals, including identical twins, share the same fingerprints. Fingerprints are widely utilized today across diverse fields, including criminology, early detection of certain diseases particularly congenital diseases, brain fingerprinting, and dermatoglyphic multiple intelligence testing.

IQ and dermatoglyphics share the same origin, as both neural tissue and epidermis are embryonic ectodermal derivatives, and their respective embryological fetal development takes place during the second trimester of intrauterine life.[4] As they take the same origin in the intrauterine life, dermatoglyphic variables could estimate IQ range.

So, the aim of the study is to associate the dermatoglyphic patterns with IQ and anxiety levels of children, aiming to understand how fingerprint analysis can serve as a predictive tool of behavior management in pediatric dentistry. And we hypothesize that dermatoglyphic patterns can be used as a predictive marker for determining the intelligence quotient (IQ) and anxiety levels in children.

MATERIALS AND METHODS

A cross-sectional study was conducted in Quest India school among 160 children aged 8-11 years, who were selected using simple random sampling after obtaining institutional ethical clearance. (BIDS/24/02/01) The study was prepared in accordance with STROBE guidelines.

Inclusion criteria

- Individuals with informed parental consent
- Children of age 8-11 years

Exclusion criteria

- Children having skin lesions, scars or deformities on the palmar surface of their hands.
- Medically compromised and intellectually disabled children.

SAMPLE SIZE ESTIMATION

The sample size for the present study was estimated using GPower software (latest ver. 3.1.9.7; Heinrich-Heine-Universi-tat Du'3seldorf, Du 3seldorf, Germany). Based on 95% Confidence Interval, the present study comprises of 160 children in the age group of 8-11 years.

Prior to the study, the examiner was calibrated in recording and interpreting dermatoglyphic patterns to ensure consistency and reliability of observations. Efforts were made to minimize potential sources of bias. All dermatoglyphic recordings and analyses were performed by a single calibrated examiner using a standardized recording protocol to ensure consistency. Participants were selected by simple random sampling, thereby minimizing selection bias.

DERMATOGLYPHIC FINGER AND PALM PATTERN RECORDING

Cummins and Mildo's ink method was used to record the finger and palm prints.[5] The hands of the children included in the study were cleansed with soap and water to remove dirt and oil from the ridged skin and were blot-dried to enhance the quality of the prints. Fingerprints of both hands were recorded using the black duplicating ink applied with a cotton swab. Each digit was guided and pressed firmly onto the white bond paper clipped to a board.

Palmar prints of both hands were recorded using the black duplicating ink evenly applied to the palms and pressed onto a firm recording sheet. A sponge pad placed beneath the paper facilitated accurate recording of palmar hollows and minimized errors in ridge pattern interpretation. The prints were assessed for clarity using a hand magnifying glass (×2) and coded. Only prints with clearly identifiable cores and triradii were included in the study. A total of 1,600 digital prints and 320 palmar prints were obtained.

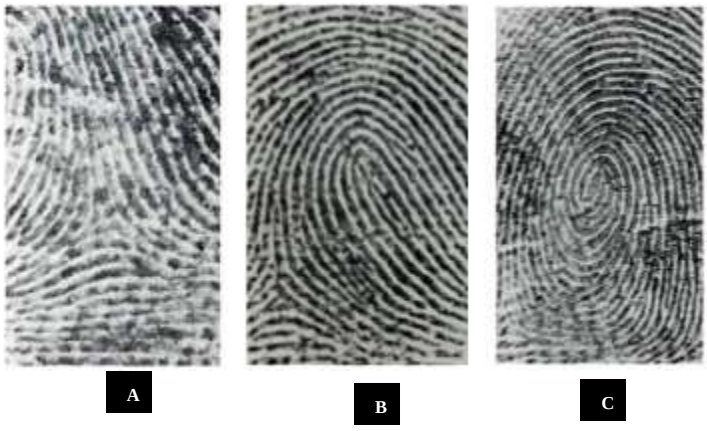
METHOD OF READING HANDPRINTS

The handprints were examined sequentially under a magnifying glass (×2), beginning with the 4th digit of the left hand and proceeding to the thumb, followed by examination of the thumb of the right hand through to the 4th digit.

Type of Dermatoglyphic Pattern: Dermatoglyphic patterns were classified according to the Galton-Henry system as arches, loops and whorls. (as shown in figure 1) The frequency of these true patterns was recorded for all ten digits of each child.

'atd' Angle: The atd angle (as shown in figure 2) is a palmar measurement based on the relative positions of three triradii: 'a' and 'd', located below the index and little fingers, respectively, and 't', which lies on the proximal palm. The atd angle was measured by drawing lines from triradius 't' to triradii 'a' and 'd' and calculating the angle formed at 't'.

FIGURE 1. Dermatoglyphic patterns: (A) ARCH (B) LOOP (C) WHORL



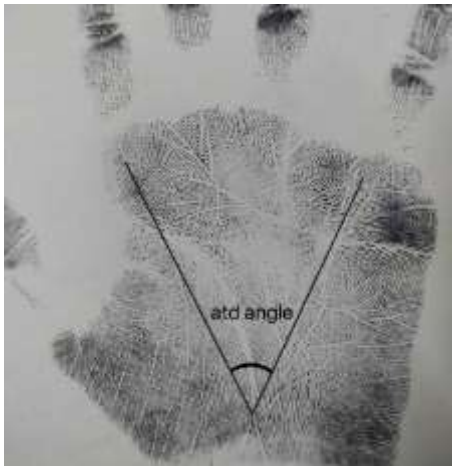


FIGURE 2. atd angle

ESTIMATION OF INTELLIGENCE QUOTIENT (IQ) LEVELS

IQ of the children were assessed using Raven's Colored Progressive Matrices (CPM), a nonverbal intelligence test consisting of 36 items arranged into three sets, A, B and Ab with 12 items in each set. The level of difficulty increased progressively within each set. The children were instructed to select the missing part of each item from the six options provided. No time limit was imposed for completing the test.

Each correct response was given 1 point, with a maximum possible score of 36. The total raw score was converted into an age-appropriate IQ score using Indian normative data. These standardized IQ scores were then used to determine the percentile ranks and assign the following intelligence grades.

- Grade I: Intellectually superior - ≥95th percentile,
- Grade II: "Definitely above the average in intellectual capacity" - ≥75th percentile, (Grade II + at 90th percentile and Grade II at 75th percentile)
- Grade III: Intellectually average - over 25th and below 75th percentiles
- Grade IV: "Definitely below average in intellectual capacity" - ≤25th percentile, (Grade IV + at 25th percentile, Grade IV at 10th percentile)
- Grade V: Intellectually defective - ≤5th percentile

ESTIMATION OF ANXIETY LEVELS

Anxiety was assessed by using the Venham's Picture Test (VPT), which consists of eight cards, each showing an anxious and a non-anxious cartoon figure. The child selected the figure reflecting their current feeling, with anxious responses scored from 0 to 8.

STATISTICAL ANALYSIS

Data were tabulated in an Excel sheet and the analysis was done using the Statistical Package For Social Sciences (SPSS) software version 23.0 (IBM Corp. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp; 2015.). Chi-square test was applied for the qualitative variables to find the association.

RESULTS

Table 1 presents the association of IQ grades with dermatoglyphic patterns across different fingers; thumb,

index, middle, ring, and little using the Chi-square test. A statistically significant association between fingerprint patterns and IQ was observed for the thumb, index, middle, and ring fingers ($p = 0.001$), with whorl patterns predominating in higher IQ grades, loops in average IQ grades, and arches in lower IQ grades. No significant association was found between the fingerprint patterns and IQ grades in the little finger.

TABLE 1: ASSOCIATION OF IQ GRADES WITH DERMATOGLYPHICS PATTERNS

(Right + Left)			IQ					Total	Chi-square value	p value
			I	II	III	IV	V			
Thumb	Arch	Count	5	9	25	18	22	79	38.41	0.001*
		%	50.0%	20.5%	25.5%	20.5%	27.5%	24.7%		
	Loop	Count	1	5	48	40	39	133		
		%	10.0%	11.4%	49.0%	45.5%	48.8%	41.6%		
	Whorl	Count	4	30	25	30	19	108		
		%	40.0%	68.2%	25.5%	34.1%	23.8%	33.8%		
Index	Arch	Count	1	4	4	6	5	20	31.65	0.001*
		%	10.0%	9.1%	4.1%	6.8%	6.3%	6.3%		
	Loop	Count	2	10	59	47	55	173		
		%	20.0%	22.7%	60.2%	53.4%	68.8%	54.1%		
	Whorl	Count	7	30	35	35	20	127		
		%	70.0%	68.2%	35.7%	39.8%	25.0%	39.7%		
Middle	Arch	Count	0	1	0	1	0	2	58.6	0.001*
		%	0.0%	2.3%	0.0%	1.1%	0.0%	.6%		
	Loop	Count	5	13	84	71	62	235		
		%	50.0%	29.5%	85.7%	80.7%	77.5%	73.4%		
	Whorl	Count	5	30	14	16	18	83		

		%	50.0 %	68.2 %	14.3 %	18.2 %	22.5 %	25.9 %		
Ring	Arch	Count	0	0	0	2	0	2	36.86	0.001 *
		%	0.0%	0.0%	0.0%	2.3%	0.0%	.6%		
	Loop	Count	3	4	55	45	41	148		
		%	30.0 %	9.1%	56.1 %	51.1 %	51.3 %	46.3 %		
	Whorl	Count	7	40	43	41	39	170		
		%	70.0 %	90.9 %	43.9 %	46.6 %	48.8 %	53.1 %		
Little	Loop	Count	9	43	90	82	71	295	3.39	0.495
		%	90.0 %	97.7 %	91.8 %	93.2 %	88.8 %	92.2 %		
	Whorl	Count	1	1	8	6	9	25		
		%	10.0 %	2.3%	8.2%	6.8%	11.3 %	7.8%		

Table 2 shows the association of mean atd angle of the right and left palm across different IQ levels. The mean atd angle increased with decreasing IQ levels. In the right palm, atd angle values increased from IQ level I to IV whereas in the left palm, the lowest mean atd angle was seen in IQ level I, while levels II–V showed similar values. However, there was no statistical significance.

TABLE 2: ASSOCIATION OF MEAN atd ANGLE WITH IQ LEVELS

IQ	N	Right Palm Minimum	Maximum	Mean +/- S.D	Left Palm Minimum	Maximum	Mean +/- S.D
I	5	37	52	43.60 +/- 6.19	35	50	43.60 +/- 5.94
II	22	40	54	46.86 +/- 3.85	40	60	47.68 +/- 5.21
III	49	37	63.5	47.77 +/- 6.47	37	64	47.81 +/- 6.40
IV	44	38	61	48.65 +/- 6.50	35	63	47.90 +/- 6.63
V	40	38	63	47.80 +/- 6.23	38	64	47.98 +/- 6.90

Table 3 shows the association between IQ and anxiety levels. Lower anxiety scores were seen among children with higher IQ, whereas higher anxiety scores were seen in children with lower IQ (p value - 0.153).

TABLE 3: ASSOCIATION OF ANXIETY WITH IQ

			IQ					Total	Chi-square value	p value
			I	II	III	IV	V			
Anxiety	High	Count	2	12	4	6	0	24	11.96	0.153
		%	4.5%	13.6%	4.1%	7.5%	0.0%	7.5%		
	Low	Count	24	46	58	38	8	174		
		%	54.5%	52.3%	59.2%	47.5%	80.0%	54.4%		
	Moderate	Count	18	30	36	36	2	122		
		%	40.9%	34.1%	36.7%	45.0%	20.0%	38.1%		

DISCUSSION

Hodges and Plow reported that children with anxiety disorders tend to have significantly lower IQ scores. Anxiety in high-IQ children was found to be dimension-specific, with some children showing increased cognitive worry but not heightened somatic or generalized anxiety. This suggests that advanced cognitive abilities may allow better understanding and verbalization of concerns.[6,7]

Priya PRG et al and Khosrozadeh et al found lower anxiety among intellectually superior children and higher anxiety in children with lower intellectual capacity which is similar to this study.[8,2]

IQ and fingerprint patterns have an association as in the intrauterine period, brain formation and fingerprint patterns are formed almost at the same time and genetic messages, normal or abnormal will affect both brain and fingerprints. The central nervous system is connected to the parts of the brain which is the centre of all the physical and mental activities. Each part of the brain has different powers and functions, and the pattern of a person's fingerprints is a manifestation of early neurodevelopmental processes.[9]

The ridge growth takes place in synchronisation with Neocortex which is primarily brain's centre of intelligence. The unique levels of intelligence displayed by different individuals depends upon the unique pattern of sulci or grooves developed in the prenatal stage. Anencephaly (neural tube defect) is the absence of the prime brain portions, skull as well as scalp. It occurs due to failure in the development of cephalic end of neural tube. A foetus born with such deformity usually has no forebrain. Forebrain which is the largest portion of a mammalian brain governs all thinking abilities and organ coordination functions. It has been witnessed that such babies are devoid of any fingerprint ridges too. Numerous medical conditions have also been correlated to fingerprints and their pattern occurrence. They are Klinefelter's Syndrome, Down's Syndrome, Schizophrenia, Cerebral Palsy, Congenital diabetes and Cardiac diseases etc. People with more complex fingerprint patterns tend to have better cognitive abilities, such as numerical and verbal skills.[10,9]

In the present study, the most common fingerprint pattern in children with Grade II IQ were whorl followed by loop, whereas in participants with IQ level of Grade III and IV, loop were the most common pattern followed by whorl. In contrast, arch patterns appeared more commonly in the lower IQ grades (Grade V).

The distribution of fingertip patterns reported by various studies is almost similar to the present study. Singh A et al. reported the most common fingerprint pattern in medical students with Grade I and II IQ were whorl followed by loop, whereas in participants with IQ level of Grade III onward, loop was the most common pattern followed by whorl. Sathvika et al. reported whorl as the most common pattern in

class A IQ level and arch as a common pattern in class B IQ level. Nayak et al. reported that the whorl pattern was the most common fingerprint pattern, followed by radial loop and ulnar loop among the students.[11,12,13]

Higher IQ children have lower atd angles as reported by Cesarik et al. and Singh A et al. which is similar to the present study.[14,11]

Within the limitations of the study, including the relatively small sample size, a non-clinical setting, limited age groups, results reflect one specific institution not a broader demographic.

CONCLUSION

By analyzing the fingerprints, the IQ levels of children can be determined. Children with higher IQ levels predominantly exhibited whorl fingerprint patterns, lower atd angles, and lower anxiety levels, whereas children with average and below-average IQs exhibited more loop patterns. Children with lower IQ levels demonstrated increased arch patterns, higher atd angles, and higher anxiety levels. These findings help us tailor behaviour guidance techniques according to a child's IQ using dermatoglyphics, leading to better understanding, acceptance, and cooperation during dental treatments.

CLINICAL SIGNIFICANCE

Dermatoglyphics may serve as a simple, economical, non-invasive and early screening tool for identifying children who are more likely to have lower intellectual ability or higher levels of dental anxiety. Early recognition of these children enables the pediatric dentist to anticipate the potential behavioral challenges and plan appropriate behavior management strategies before initiating any treatments. This individualized approach can improve patient cooperation, reduce treatment-related stress, and enhance the overall quality and success of dental care.

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