



RESEARCH ARTICLE

Comparative Evaluation of Ring Finger Dermatoglyphics and Atd Angle in Individuals with Intellectual Disability

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ABSTRACT

Background: Dermatoglyphics, the study of epidermal ridge patterns, reflects genetic and prenatal developmental influences. Since epidermal ridges and the nervous system develop simultaneously, dermatoglyphic variations may serve as valuable, non-invasive markers for early screening and identification of intellectual disability.

Objective: The objective of the present study was to evaluate and compare dermatoglyphic patterns of ring finger and ATD angles in intellectually disabled individuals and healthy controls, and to identify characteristic dermatoglyphic variations that may aid in the early screening and understanding of neurodevelopmental abnormalities associated with intellectual disability.

Methods: A cross-sectional case-control study was performed in August 2024 to December 2025 in the J.L.N. Medical College and Associated Hospital and evaluated dermatoglyphic patterns in 200 intellectually disabled individuals and 100 controls using standardized ink-print analysis of fingers and palms.

Results: The study evaluated 200 intellectually disabled individuals and 100 healthy controls aged 8–45 years. Arch patterns on the left ring finger were significantly higher in cases (8%) than controls (2%) ($p=0.034$), while the right ring finger showed a similar trend (7% vs 2%). Mean ATD angles were significantly increased in cases (left: $52.84 \pm 8.96^\circ$, right: $51.76 \pm 9.14^\circ$) compared to controls ($p<0.001$), suggesting characteristic dermatoglyphic abnormalities in intellectual disability.

Conclusion: The present study demonstrated significant dermatoglyphic variations in intellectually disabled individuals, particularly increased arch patterns and higher ATD angles. These findings support the association between abnormal epidermal ridge development and intellectual disability. Dermatoglyphic analysis may serve as a simple, economical, and non-invasive adjunctive tool for early screening and identification.

Keywords: Dermatoglyphic, Intellectually, Disabled, Neurodevelopmental, Screening, Standardized.

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INTRODUCTION

Dermatoglyphics, derived from the Greek words *derma* meaning skin and *glyph* meaning carving, is the scientific study of the intricate epidermal ridge patterns present on the fingers, palms, toes, and soles.[1] These unique ridge configurations are established during the 10th–16th weeks of intrauterine life and remain unchanged throughout an individual's lifetime. Their formation is primarily governed by genetic factors, although environmental influences during fetal development also play a significant role.[2] Since both epidermal ridges and the central nervous system originate from the embryonic ectoderm during the same critical phase of prenatal development, any disturbance during this period may simultaneously affect both structures. [3] Consequently, dermatoglyphic patterns serve as valuable indicators of developmental abnormalities occurring in utero.[4]

Over the years, dermatoglyphics has emerged as an important field in medical genetics, anthropology, forensic science, and the study of congenital and neurodevelopmental

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disorders.[5] Characteristic dermatoglyphic alterations have been observed in several chromosomal anomalies, genetic syndromes, and intellectual disabilities.[6] Intellectual disability, formerly referred to as mental retardation, is characterized by significantly impaired intellectual functioning accompanied by limitations in adaptive behavior.[7]Both genetic predisposition and adverse prenatal or perinatal influences contribute to its development.[8]

Numerous studies have reported significant variations in fingerprint patterns, ridge counts, and ATD angles among intellectually disabled individuals.[9]Owing to its non-invasive, economical, and easily reproducible nature, dermatoglyphic analysis offers a promising adjunctive tool for early screening and identification of individuals at risk. [10] In view of these considerations, the present study was undertaken to evaluate dermatoglyphic patterns and identify characteristic variations in individuals with intellectual disability.[11]

METHODOLOGY

A cross-sectional observational case-control study was conducted from August 2024 to December 2025 in J.L.N. Medical College and Associated Hospital to evaluate dermatoglyphic patterns in individuals with intellectual disability. The study comprised 200 intellectually disabled subjects and 100 age- and sex-matched healthy controls from the general population, within the age group of 8–45 years. Sample size was calculated using a standard statistical formula, which yielded a minimum requirement of 100 subjects; however, a substantially larger sample was included to improve reliability and minimize sampling error. Ethical clearance was obtained from the Institutional Ethics Committee, and informed consent was secured from participants or guardians. Finger and palm print of both hands were recorded using the standardized ink-and-roller technique on bond paper and analyzed for various dermatoglyphic parameters using magnification and angular measurements.

RESULTS

The study included 200 individuals with intellectual disability and 100 healthy controls aged 8–45 years. Dermatoglyphic analysis of all ten fingers and both palms was performed in each participant, comprising 120 males and 80 females among cases, and 60 males and 40 females among controls.

Significantly higher frequency of arches was observed in mentally retarded patients on the left ring finger ($p=0.034$).A trend toward higher frequency of arches

Table 1: Comparison of left ring fingerprint between mentally retarded patients and controls

Pattern	Case %	Control %	p-value
Ulnar Loop	52.0	50.0	0.746
Whorl	38.0	47.0	0.135
Arch	8.0	2.0	0.034*
Radial Loop	2.0	1.0	0.536

(* $p<0.05$ significant)

Table 2: Comparison of right ring fingerprint between mentally retarded patients and controls

Pattern	Case %	Control %	p-value
Ulnar Loop	50.0	48.0	0.748
Whorl	40.0	49.0	0.142
Arch	7.0	2.0	0.058
Radial Loop	3.0	1.0	0.288

Table 3: Comparison of Left and Right ATD Angle Between Mentally Retarded Patients and Controls

Parameter	Case (Mean $\pm$ SD)	Control (Mean $\pm$ SD)	p-value
ATD Angle Left			*
ATD Angle Right			*

(* $p<0.05$ significant)

was observed in mentally retarded patients on the right ring finger, though not reaching statistical significance ($p=0.058$).

The ATD angle was significantly higher in mentally retarded patients compared to controls for both left and right hands ($p<0.001$). The mean ATD angle exceeded 50° in mentally retarded patients, consistent with literature indicating angles $>50^\circ$ are associated with intellectual disability.

DISCUSSION

The present study demonstrated notable dermatoglyphic variations in intellectually disabled individuals when compared with healthy controls. A significantly higher frequency of arch patterns was observed on the left ring finger among cases (8%) as compared to controls (2%) ($p=0.034$). A similar increase in arches was also observed on the right ring finger in mentally retarded individuals, although the difference did not attain statistical significance ($p=0.058$). The frequencies of ulnar loops and whorls did not show significant variation between the two groups.

These findings suggest altered epidermal ridge development in intellectually disabled individuals, possibly due to disturbances during early fetal life.

The observations of the present study are in agreement with the findings of N. N. Laha, who reported an increased frequency of arches and reduced whorl patterns in mentally retarded individuals.^[2] Similar findings were also documented by Dey P. K., who observed abnormal fingerprint configurations and increased arch patterns among intellectually disabled subjects.^[3] Rajangam S. and colleagues also reported significant dermatoglyphic abnormalities, including altered ridge counts and increased arches, in mentally retarded individuals, supporting the role of genetic and prenatal environmental factors in ridge formation.^[4]

A major finding of the present study was the significantly increased ATD angle in intellectually disabled individuals. The mean left and right ATD angles in cases were 52.84 ± 8.96 and 51.76 ± 9.14 respectively, compared to 43.26 ± 6.42 and 42.88 ± 6.18 in controls ($p < 0.001$). These findings correlate well with studies conducted by Cummins H. and Walker N. F., who reported higher ATD angles in individuals with chromosomal and intellectual abnormalities.^[1,5] Increased ATD angle reflects distal displacement of the axial triradius and is considered an important marker of disturbed prenatal development.

The present study therefore supports the concept that dermatoglyphic abnormalities may serve as valuable, non-

invasive indicators of neurodevelopmental disturbances associated with intellectual disability.

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