

# **Dermatoglyphics as a non-invasive diagnostic tool in predicting mental retardation**

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## **Abstract:**

Dermatoglyphics is an integral part of forensic odontology and this study compares and evaluates the dermatoglyphic peculiarities of mentally challenged children with those of healthy children. The purpose was to explore the possibility of a non-invasive and an early predictor of mental retardation in children so as to initiate the preventive oral health measures at an early age. The study comprised of 100 children, 50 healthy and 50 mentally challenged, selected randomly. The bilateral palmar and fingertip patterns were recorded and analyzed for their configurations. The results revealed a statistically significant correlation between dermatoglyphics and mental retardation in children. An increased frequency of loops and the transverse palmar crease line among the mentally challenged children were detected. The dermatoglyphics, a non-invasive approach can definitely

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aid the clinician in detecting mental retardation early in children and can also strengthen a diagnostic impression.

### **Introduction**

Dermatoglyphics deals with the study of the epidermal ridges and their configurations on the fingers, palms and soles. The word "Dermatoglyphics" is derived from the Greek word "Derma" meaning skin and "glyphic" meaning carvings<sup>1</sup>. Dermal ridge differentiation takes place early in foetal development. The resulting ridge configurations are genetically determined and influenced or modified by environmental forces<sup>1</sup>.

Dermatoglyphic patterns stay constant during life and may sometimes play a significant role in the diagnosis of many disorders with genetic background<sup>2</sup>. Abnormal dermatoglyphic patterns have been observed in several non – chromosomal genetic disorders and other diseases whose aetiology may be influenced directly or indirectly by genetic inheritance<sup>3</sup>. Dermatoglyphics are assumed to be genetically controlled although the exact mechanism of inheritance is still unknown. The utility of the dermatoglyphics in medicine has been demonstrated by several investigators<sup>1,4,5</sup>.

In dentistry, the significance of dermatoglyphics has been investigated by several investigators<sup>6,7,8</sup>. The study of the ridged skin called dermatoglyphics is considered as a window of congenital abnormalities and is a sensitive indicator of

intrauterine dental anomalies<sup>9</sup>. The dermal ridges develop in relation to the volar pads, which are formed by the 6th week of gestation and reach maximum size between 12th and 13th weeks. This means that the genetic message contained in the genome - normal or abnormal is deciphered during this period and is also reflected by dermatoglyphics<sup>10</sup>. The ectoderm, from which the epidermis is derived from, has a role in the formation of many specialized structures such as the teeth. When an intra uterine dermal damage occurs, naturally a tooth anomaly should be expected<sup>9</sup>.

The major advantages of the dermatoglyphics are<sup>1</sup>:

- i) The epidermal ridge of the palms fingers are fully developed at birth and thereafter remain unchanged for life.
- ii) Scanning or recording of their permanent impressions (i.e., prints) can be accomplished rapidly, inexpensively and without causing any trauma to the patient. The scanning and recording is better in children as they are fine in them.

Since there are definite dermatoglyphic patterns established very early in life and rather at birth, it will be worthwhile to study the dermatoglyphic patterns of the children with definite features of mentally challenged children with those of the healthy children. The genetic message contained in the genome - normal or abnormal is deciphered

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during the intra uterine period and is also reflected by dermatoglyphics. The purpose of this preliminary study was

- i) To compare the dermatoglyphic pattern configurations of the fingers and palms of the mentally challenged children with those of the normal children in the age group of 5-15 years.
- ii) To find out whether the method can be used as an adjunct to predict the mental retardation in children.

**Method:**

100 children, 50 healthy and 50 mentally challenged were included in the study. The 50 healthy children were selected randomly from those who visited the Department of Pedodontics and Preventive children dentistry, A.B. Shetty Memorial Institute of Dental Sciences, Mangalore, India. These 50 healthy children without any medical or congenital anomalies acted as controls. The 50 mentally challenged children were randomly selected from the St. AGNES special school, Mangalore, India. Informed consent was obtained from all the subjects participating in the study. Prior consent from the concerned authorities was also obtained before commencing the study. Bilateral palmar prints of the children were obtained on the royal executive bond papers<sup>10</sup>. The method employed to obtain the prints was the "PRUVIS – SMITH" (modified) ink method<sup>11,12</sup>.

To enhance the quality of the dermatoglyphic prints, it was essential to remove sweat, oil or dirt from the skin surface. This was done by cleaning the hands with soap and water and wiping with

ethyl alcohol. The dried palms of the children were smeared uniformly with the duplicating ink. The print was obtained on the bond paper which was fixed in place with an adhesive tape. The palmar prints included the area from the distal crease of the wrist to metacarpal phalangeal area<sup>10,11,12</sup> and the complete prints of both the radial and ulnar sides of the ridged area were assessed. Prints thus obtained were assessed for the following parameters.

For palms: Simian crease line and Sydney line

For finger tips: Presence of arches, loops and whorls.

The data gathered was subjected to statistical evaluation. Chi square test was used to determine the distribution of the parameters among the two groups. Z – Test was used to determine the comparisons between the healthy and mentally challenged children.

**Results:**

The sample consisted of a total of 100 children, 50 in each group. Among the 50 healthy children 54% were females and 46% males. The study group of the mentally challenged children comprised of 76% males and 24% females. On comparison of the finger tip patterns between the two groups, it was found that the mentally challenged children showed a decreased frequency of arches and whorls and a corresponding marked increase in the presence of loops (Tables.1 and 2). The transverse palmar crease line (Simian Line) was a prominent feature in several mentally challenged children. The mentally

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challenged children demonstrated an increased frequency of the transverse palmar crease line. Variation in the frequency of the Sydney line was not statistically significant between the normal and the mentally challenged males whereas a highly significant difference was seen in the females of the study and the control group (Tables 3 and 4).

**Discussion**

The dermal ridges and furrows are formed early during fetal life and once formed they remain unchanged throughout the life and vary between the individuals<sup>1</sup>. They are of considerable clinical interest because they not only serve as a means of identification but are also affected by certain abnormalities during early development including genetic disorders<sup>9</sup>. It is important to assess whether the dermatoglyphics can aid the clinician to predict the delayed onset or delayed expression of the features of intellectual disability.

The findings of this study reveal statistically significant differences between the dermatoglyphic patterns of the controls and the study population. As the dermatoglyphics are genetically controlled characteristics, any deviation in dermatoglyphic features indicates a genetic difference between the controls and the study population.

In the present study, among the controls, 65.2% of the males had loops on both hands while 96.3% and 85.2 of the females on the right and left hand

respectively. On the contrary, the entire 100% of the intellectually disabled population examined, had loops on both the right and left hands. A similar observation was noted by Byrant et al<sup>13</sup>. They reported 80.6% of the children with Down's syndrome of having loops on their fingertips. The elevated frequency of loops is associated with a decrease of whorls and arches which is also similar to the observation made by Holt<sup>14</sup> and Shiono<sup>15</sup> et al. A marked increase of the ulnar loops on the fingertips is virtually a constant feature of the dermatoglyphics in Down's syndrome. In this study too, a marked increase of the loops on the fingertips were found among the intellectually disabled children. Walker<sup>16</sup>, Smith<sup>17</sup> et al, Saksena<sup>18</sup> et al, Fujita<sup>19</sup> found no significant sex differences in the frequency of the fingertips patterns between males and females with Down's syndrome. But in this study, the males belonging to the study group were found to have more loops when compared to females belonging to the study group. Among the palmar crease lines, the simian crease and the Sydney line were studied. Lee and Jackson studied the physical signs in patients with Down's syndrome and listed the physical signs by their decreasing order of frequency. They found the transverse palmar crease line [Simian line] in 60.3% of the patients. In this study too, 72.4% of males and 54.2% of females of the study group had the simian crease line.

Plato et al<sup>20</sup> reported increased frequencies of the Sydney Lines in Down syndrome. However, the excess of the

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Sydney Lines in patients compared to control was not as striking as the excess of Simian lines. The present study also conforms to the above mentioned report. 19.7% of the males belonging to the study group had the Sydney Line 10.9% of their counterparts in the control group. But in the females, 41.7% had the Sydney Line in the study group to only 13% of them among the controls. Mathew. L, Hegde. A. M et al<sup>10</sup> reported a definite correlation between the dermatoglyphic patterns and cleft deformity thereby suggesting the significance of this diagnostic tool in early detection of clinical conditions with a genetic aetiology. This study also detected a definite correlation between the dermatoglyphic features and mental retardation in children.

The limitations of this study were: 1] the inability to detect whether the dermatoglyphic patterns varied considerably with the severity of the mental retardation. 2] The dermatoglyphic pattern configurations of the parents of these children were not recorded and assessed to find the presence or absence of any correlation between the parents and their children.

**Conclusion:**

There is a definite correlation between the dermatoglyphics and intellectual disability. The statistically significant correlation was found in relation to the increased frequency of the loops and the Simian crease line among the intellectually disabled children. Dermatoglyphics can prove to be an extremely useful and cost-effective tool for

preliminary investigations into conditions with a suspected genetic base. Thus, dermatoglyphics can serve to strengthen the diagnostic impression of this disability right from an early age. Early detection can aid the clinician to anticipate oral health problems in children and initiate preventive oral health measures at a very young age. The results of this study will need further large scale observations to evaluate the significance of these variations in the dermatoglyphic features among the mentally retarded children.

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