

Dermatoglyphics - A predictor of disease



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ABSTRACT

Dermatoglyphics is the scientific study of the pattern of dermal ridges on the palmar surface of digits, palm and sole. Characteristically, hair does not grow in this area. These ridges serve well to enhance contact. The development of these ridges and the development of the nervous system occur simultaneously in the intrauterine period. The pattern of dermal ridges begins to develop around the 13th week and is completed by the 19th week of intrauterine life. Once the fingerprint pattern develops, it does not change and persists throughout life. Unusual dermatoglyphic patterns often relate to genetic disorders. Dermatoglyphics may be used as an additional screening tool to identify early risk factors that may help prevent additional complications of various diseases. In this review, we will be discussing dermatoglyphics and its important role in the diagnosis of diseases which have some genetic basis.

Key words: Dermal ridges; Dermatoglyphics; Fingerprints

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INTRODUCTION

The word dermatoglyphics is derived from two Greek words (derma - skin and glyphe – curve). The term “dermatoglyphics” was coined by Cummins in 1926.¹ The importance of dermatoglyphics lies in the morphological constancy of the dermal ridge arrangements from the time of formation until death. The dermal ridges are fully formed by the 14th week of fetal development; therefore, only genetic and prenatal environmental factors can influence ridge formation.² These dermal ridges play a very crucial and important role in the personal identification of an individual, for forensic purposes, in twin diagnosis, racial variation and have applied values in various diseases and syndromes.³ Since each person's fingerprints are unique, we can understand one's innate potential, personality, and preferences by analyzing dermatoglyphics.⁴

Dermatoglyphics refers to the scientific study of the skin ridge patterns on the fingers, toes, palm, and sole. The

purpose of these ridges is to impart firmer grip and avoid slippage.⁵

Dermatoglyphic patterns have polygenic inheritance and are affected by environmental factors. There exists a relationship between epidermal ridge and fetal volar pads, because in course of development the ridge pattern is formed at the site of these pads.⁶ During development various creases develop on the brain and are reflected on the fingerprints representing the various regions of the skin and brain developing from the same ectoderm. It is probable that an insult causing damage to one of these systems would damage the other. The environmental factors such as external pressure on fetal pads and embryonic fetal finger movements could influence ridge formation.⁷

Papillary ridges are confined to the palm and soles and the flexor surface of the digits. The apertures of sweat glands open at regular intervals along the summit of each ridge. The epidermal ridges correspond to an underlying

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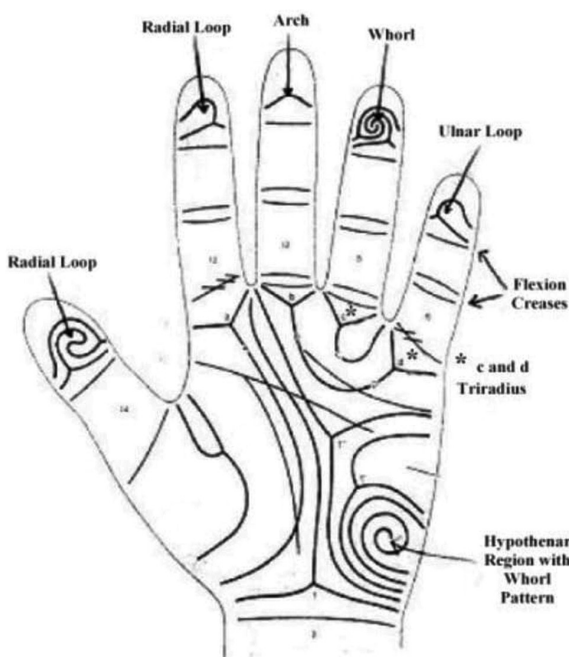
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interlocking pattern of dermal papillae, an arrangement which helps to anchor the two layers firmly together. The pattern of dermal papillae determines the early development of the epidermal ridges.⁸

The ridges once formed remain permanent and never change throughout life except in dimensions in proportion to the growth of an individual. The original ridge characteristics are not disturbed unless the skin is damaged to the depth of 1 mm. Ridges are the areas which decompose in the end after a person dies. The ridge pattern can be affected by certain abnormalities of early development, including genetic disorders such as Down syndrome, and skeletal malformations such as polydactyly. The absence of epidermal ridges is extremely rare. Functionally, epidermal ridges increase the gripping ability of hands and feet, preventing slipping.⁹ Today, considerable progression has been made in understanding the association between dermatoglyphics and various medical disorders. Dermatoglyphics analysis has been investigated as a useful diagnostic and research tool in medicine and provides valuable insight on the inheritance and/or embryological formation of many known clinical disorders.

This review deals with dermatoglyphic studies mainly based on ridge patterns of palms and fingers and the pathologies related to it. Fingerprint ridge patterns can be separated into three major types: Arches (5%), loops (70%), and whorls (25%). Although there are more than 100 ridge characteristics, called Galton's details in a single rolled fingerprint.

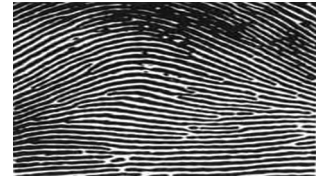
FINGERPRINTS AND CLASSIFICATION¹⁰



Arches

The arches are the simplest and least frequent pattern, which pass across the finger with a slight bow distally. They may be subclassified as plain or tented.

Plain arch - In plain arches the ridges enter on one side of the impression and flow or tend to flow out the other side with a rise or wave in the center.



Tented arch - They are similar to plain arches with exception that the ridges in the center form a definite angle; or one or more ridges in the center form an upthrust.



Loop

The loop pattern has a triradius and a core. A triradius is a point at which three groups of ridges coming from three directions meet at an angle of about 120°. The core is essentially a ridge that is surrounded by a field of ridges, which turn back on themselves at 180°. Loop can be either ulnar or radial.

Ulnar loop - these are the patterns in which the loops flow in the direction of the little fingers.



Radial loop - In this pattern the loops flow in the direction of thumbs.

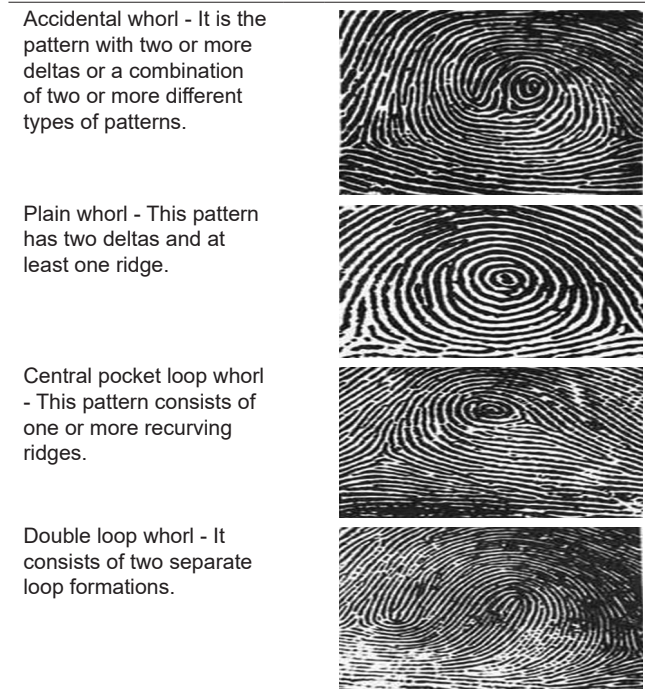


Whorl

The ridge courses follow circuits around the core in a whorl pattern

DERMATOGLYPHICS AND VARIOUS DISEASES

The development of these dermal ridges has been found to be affected by genetic and environmental factors during the developmental stages. Dermatoglyphics has, therefore, been accepted as a simple and inexpensive method for deciding whether a patient would have a particular genetic disorder or not and any chromosomal defect.¹¹ Left handedness is the dominance of the left hand over the right hand. It is developed paternally and depends on which hand of the fetus is close to the mouth. Left handers have potentially a



higher risk of developing schizophrenia. Left handers have more radial loop, modified radial loop and tented arch and decreased central pocket whorl, double loop whorl, and simple arch as compared to right handers.¹²

The left index ridge counts and fluctuating asymmetry in schizophrenic patients are different from those of the normal population.¹³ This difference may serve as a diagnostic biological marker for screening people susceptible to schizophrenia. In both sexes loops are more frequent in mentally diseased patients. Typographic diversity in fingerprint papillary patterns is more pronounced in males, and the differences between controls and cases show a tendency to significance. The bilateral comparison reveals a higher level of mismatching in fingerprint patterns on the second finger of both sexes in cases, and also on the third finger, but only in mentally diseased females.¹⁴

The chromosomal anomalies such as the trisomies 13–15 (Patau's syndrome), 18 (Edwards' syndrome), 21 (Down's syndrome), and the sex chromosomes (Turner's syndrome X0 and Klinefelter's syndrome 47, XXY), and deletion of the short arm of chromosome 5 (Cri du Chat syndrome) are recognized as having abnormal dermatoglyphic patterns.¹⁵

The subjects with Down's syndrome show single transverse palmar crease (simian crease), bilateral radial loops on digits 4 and 5 and predominance of ulnar loops.¹⁶ Dermatoglyphics and the analyses carried out have proved that they are invaluable in their clinical value, in selecting patients of Down's syndrome for cytogenetic analysis.

Predominance of ulnar loops over other patterns is also recorded in Turner patients. Mean total finger ridge count in Turner syndrome remained higher than the normal females. c-d interdigital ridge count in turners remained significantly ($P \leq 0.05$) higher than their normal female counter-parts. Occurrence of whorls and arches in the hypothenar region of 12% and 4% was, respectively, noticed in the right palms of patients.¹⁷

Type 1 diabetics show characteristic reduction in loops and notable increase in whorls and arches. Type 2 diabetics have increase in the frequency of whorls and decrease in ulnar loops. Males have a significant reduction in arches in the right hand whereas females in the left.¹⁸

In subjects with essential hypertension, there is increase in Total Finger Ridge Count and Decrease in "atd" angle.¹⁹ In bronchial asthma, there is decreased number of arches, increased number of ulnar loops,²⁰ in tuberculosis predominance of whorls, decrease in loop pattern, High Total Finger Ridge Count, Narrower "atd" angle²¹ has been noticed. In Carcinoma breast patients, reported a relatively high increase in the arches as compared to that in the controls.²² In subjects with rheumatoid arthritis there is increase in arches, decrease in whorls and loops in males and increase in whorls, decrease in loops on the 1st finger of both hands, increase in arches of 3rd digit, and whorls on 4th digit of the left hand in females.²³

Limitations of the study

Although the dermatoglyphic pattern seen in the subjects is specific for different diseases but they are seldom used as a single criteria for these pathognomic conditions.

CONCLUSION

This review brings out the importance of dermatoglyphic studies in various fields. The dermatoglyphics are important in forensic sciences due to their important feature that fingerprints are unchanged in due course even after death. By analyzing these patterns, the analyzers are able to find significant variations which represent those pathologies. Thus, we see that dermatoglyphics is a simple, inexpensive, and bedside diagnostic aid for conditions of chromosomal aberrations and various inheritable diseases. The relevance of dermatoglyphics is not to diagnose, but to prevent by predicting a disease; not by defining an existing disease, but to identify people with the genetic predisposition to develop certain diseases.

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