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REVIEW ARTICLE

EMBRYOLOGICAL DEVELOPMENT OF DERMATOGLYPHICS: AN AYURVEDIC PERSPECTIVE

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ABSTRACT
Dermatoglyphics is the study of the patterns of epidermal ridges of fingers, palms, toes and soles, which relates to many physical, mental health condition of an individual. Each individual has unique finger prints which are based on the genetic characteristics which are transferred from one generation to another. The ancient literature describes the figures of wheel (chakra), Conch (Shankha), Lotus (Padma) on human palms, soles, fingers and toes which indicate lifespan and health of an individual. These are studied now a day as loops, whorls and arches respectively.
The knowledge of formation of dermatoglyphics is essential in linking its features to some disease conditions. The genetic and environmental factors influence on the formation of the fingerprints. The study on formation of dermatoglyphic review is to collect information related to development, formation, pattern and factors affecting fingerprints.
Keywords: Ayurveda, Twacha , Rekha shastra , Dermatoglyphics, Genetics.

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INTRODUCTION

Dermatoglyphics is the study of the patterns of epidermal ridges of fingers, palms, toes and soles.[1] Dermatoglyphic patterns are one of the most personal things we possess. Everyone has their own characteristic patterns of ridges, differing at least in detail from those of any other person. There is an elegance in the way the ridges twist themselves into various pattern like loops, whorls etc. The epidermal ridge pattern is generally determined and is unique for each individual. Normally the ridge pattern does not change during life, except on enlarge and thus can serve as the basis for identification through fingerprints or footprints.[2]

The detail description of palms and finger ridges pattern could be found in many classical literatures on Rekhashastra, a science of prophecy and fortune telling where we get various references related to lines n signs on palm and sole indicating lifespan, wealth and health. [3]

Dermatoglyphics had a great importance in judicial and criminal researches but in the present era medical research shows that health trends can be perceived on palms which has immense application mainly in genetic disorders.

CLASSICAL REVIEW

Since long time in India, technology had been applied to detections and investigations of crime and in administration of justice and law. Although the discipline of forensic science was not in its present form, several scientific methods were applied to solve various criminal investigations. This can be noticed from the writings of Kautilya's 'Arthashastra' which was written about 2300 years ago. It is presumed that Indians knew about the individuality and persistency of fingerprints, which they used as signatures and so they studied several papillary lines.[4]

As dermatoglyphic pattern are developed in the skin, when we go through the embryogenesis of skin it is formed during the Paka of Shukra and Shonita by Agni or Pitta dosha, seven types of Twacha appear on the surface of body of Garbha just like while heating milk cream appears on its surface.[5] Acharya Vagbhata quoted that from the Paka of Raktadhatu seven types of skin appear just like cream on milk.[6] Acharya Sushruta mention that in this world every person or a creature has its own physical traits among them few are natural like falling of teeth and absence of hairs on palm and sole.

In Garuda Purana in Purvakanda or Acharakanda chapter 63 and 64 they explained predictions based on physical traits, prediction of age by palmistry etc. In Garuda purana Lord Vishnu, continuing with his narration told Lord Shiva that the age of a person could be predicted by the lines found on his palms. [7]

In kashyapa samhita in lakshana adhyaya slokha 6-7, he explained different lines and shapes like swastika, padma, chakra and other auspicious signs on the feet denoting the life span, health, wealth and the luck of individual. He explained the feet which are corpulent, well formed with upward lines are of good longevity, prosperous and administrators. The mark of swastika, plough, lotus, conch -shell, wheel, horse, elephant, chariot, weapon, and other auspicious signs of kings, coppery and smooth sole are of lucky persons. Upward bent are of persons with medium wealth and longevity, white colour denotes poor, without lines denotes servants, so many lines denotes ill health. [8]

EMBRYOGENESIS AND DERMATOGLYPHICS [9-11]

Formation of volar pads

The process of epidermal ridge formation begins with the formation of fetal volar pads. The primary volar pads formed by mesenchymal tissue are mound-shaped elevated over the end of the most distal metacarpal bone on each finger, in the interdigital areas below the fingers, and hypothenar and thenar areas of the palms and soles. Secondary pads are formed in other areas like in the center of the palm and on the proximal phalanges. The fingertip formations of volar pads are evident at about the 6th to 7th week of gestation.

Formation of epidermal ridges

The epidermal ridges initially appear as in the form of localized cell proliferations around the 10th to 11th week of intrauterine life. These form shallow corrugations that enter into the superficial layer of the dermis. The number of ridges increases rapidly which are formed either between or adjacent to existing ridges. At this period of development the epidermis composed of three layers; periderm the outer layer, the intermediate layer and the basal layer at the interface of the dermis. It is during this moment of primary ridge formation that the characteristic patterns will develop. During 10th week, embryonic volar skin consists of the layered epidermis on top of more amorphous fibrous dermis. During 11th week the basal layer of the epidermis consists of columnar cells whose axis is perpendicular to the skin surface. At about 14th week the primary ridge ceases to form and the formation of secondary ridges begin as sweat gland which develop along the apices of the primary ridges at uniform intervals. Then the constitution of primary and secondary ridges appears as a smooth ridge of tissue and thereafter spike like structures, the dermal papillae, characteristic of the definitive dermal ridges are progressively formed.

Formation of glandular folds

The sharply delineated fold like proliferations appears in the epidermis and these are later perceived as glandular folds. The glandular folds bear a close relationship with the spread of capillary-nitrite pairs. Depending on the pattern of these glandular folds, they predicted that the forces of the growth pressure of these folds. The epidermis trajectory system and the glandular ducts will determine the distinctly arranged surface pattern of the papillary ridges. The final expression of genetic information in the form of surface patterns would be redesigned by environmental influences.

Glandular folds, proliferations of cells from the epidermis that project into the dermis and form the lateral distal borders of the distal phalanx to the medial proximal part of that phalanx which forms a Horseshoe shaped border on the tips of finger. Folds continue to develop at the periphery till the pad surface is completely covered. During fifth month this process occurs on the proximal phalanges and the sweat glands set. At sixth month glandular ducts reach the surface. Glandular folds, the volar pads become increasingly less prominent while the connective tissue becomes richer in collagen and denser during the later course of development. At sixth and seventh month secondary furrow fold formation is seen but it has either slight or no effect

on the formation of the papillary ridge pattern. The papillary ridge on the surface skin moulded by the glandular fold cell proliferation after the formation of glandular folds, sweat gland secretion and keratinisation has begun, after the sixth month.

It is speculated that three factors may possibly accomplish the transfer of the deep patterns to the skin surface:

1) Proliferation pressure exerted by the increased mitotic rate of the basal cell layer.

2) The stabilization of sweat gland secreting ducts at regular intervals on the surface.

3) Some counteracting force as a result of the first two forces, exerted by the tonofilament system, the system of fine filaments in the cytoplasm of each cell that function as supportive elements within the cytoskeleton and form the main precursors of keratin in the epithelium. These conclude that after the fourth month the pattern of the papillary ridges is set after the development of the glandular folds.

Stages of spread of dermatoglyphic pattern

The formation of Primary ridge does not occur simultaneously on volar skin surface. The formation will generally starts at a certain area in the middle of volar pad and along nail furrow, a little later along the interphalangeal flexion creases. The area of the ridge will anlage and usually coincides with the center of the whorl and loops if such pattern shows up. In this way, there are three ridge systems on the fingertips starting from the ridge anlage, the nail furrow and the flexion creases, which slowly spread over the fingertip. At the location where these ridge systems finally meet, triradii arises. [12, 13,14,15] .This gives rises to complete fingerprints pattern. It's likely from empirical evidence that the primary ridge system changes until the 16th week, when it becomes permanent. It was observed that the number of minutiae significantly increases during this time. The probable reason for this observation could be an increase growth rate of the finger compared with bridge of the ridges, which will develop in to the insertion of new ridges as minutiae.[16]

These patterns begin to develop during 3rd month of intrauterine life. They are well developed by the 4th month and are complete by 6th month of IU life. They are differentiated first on hands and then on feet, on the digits and then in the palms, or soles. Skin begins to fold first on apices of fingers and toes. Short ridges fuse to form long ridges; these then are turned into arches when local pressures are equal from both ridges. The ridges are not influenced by bones, muscles or movements of hands. Thick skin bears few ridges which results into arch and small loops. Thin skin bears more number of ridges which form whorls and large loops. This particular differentiation of skin probably aid in locomotion, grip and touch. The formation of whorls, loops or arches may be expected based on symmetry or asymmetry of the pads and their development, the symmetrical pads will form whorl, asymmetrical pads forms loop and weak pad develops into arch. It indicates that the pad shape is set genetically though it is modified environmentally.

Genetics and dermatoglyphics

In the establishment of the dermal patterns the role of genetics and heredity cannot be denied. Past research has demonstrated that the epidermal ridge patterns are under genetic influence and this has been confirmed by numerous genetic studies.[17] The hereditability of fingerprints was first suggested by Sir Francis Galton in 1892, although Herschel and aGaulds probably laid the ground work for Galton`s observations.[18]

In general it is possible to determine some gross correlation between a person`s finger print and those of his parents or other members of his race and sex if large numbers of subjects are studied. The general pattern of fingerprints is nearly similar for identical twins, details may differ. A high degree of similarity of dermatoglyphic traits has been found between monozygotic twins.[17]

Individual dermatoglyphics traits were claimed to be inherited as dominant, incompletely dominant, recessive single gene or polygenic with complete or incomplete penetrance and variable expression of the

genes.at present there is a wide agreement that the heredity of most dermatoglyphic features confirms to a polygenic system with individual genes contributing a small additive effect.[19]

CONCLUSION

The major events for the formation of epidermal ridge pattern take place from 6th to 24th week of intrauterine development. During 6th-8th weeks Volar pads form (these are little ball like structures, eleven per hand, that make up the contour of the developing fetal hand) 10th-12th weeks Volar pads begin to recede, Skin ridges (fingerprints) begin to appear, taking the shape of the receding volar pad, 14th week primary ridge formation ceases and secondary ridges begin to form, 21st week dermal papillae are reported to develop in the valleys between the ridges on the deep surface of the epidermis, 24th week fingerprint patterns are completes . Dermatoglyphic patterns are determined genetically and are impacted by insults at early foetal life. Dermatoglyphic patterns make good material for genetic studies because unlike stature ,intelligence and body weight they are not influenced by age or by postnatal environment factors nor are they subject to any influences in later prenatal period. The different theories were established which are helpful for the understanding of the epidermal patterns evelopment. Although no universal accepted mechanisms for ridge formation exist, both environmental and genetic factors play vital role during the formation of ridges.

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