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The relationship between embryogenesis and fingerprint use: A review

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ABSTRACT

A fingerprint is an imprint left by friction ridges that are nearly parallel and have a consistent wavelength from crest to crest. Whorls, loops, arches, and triradii are some of the pattern's most prominent centre elements. Forensic and medical fields have employed fingerprints for many years. The primary features that forensic investigators use are those of originality, consistency, and universality. During intrauterine development, individuals become skilled in identification procedures. knowing embryogenesis of fingerprints is crucial in connecting its characteristics to some medical situations. This review's goal was to Emphasize details about fingerprint establishment, formation, theories, and influences. Applications of the fingerprints in forensic and medical disciplines were also addressed. both environmental The development of fingerprints is influenced by environmental (in utero) and genetic variables. The main responsibility of Personal identification is done by fingerprints, which can be obtained by disclosing sex, race, nutrition, and lifestyle of a person. In a different light, the fingerprints can be utilised as diagnostic and verification tools. Disease conditions are present, but this varies depending on the population.

Keywords: fingerprints, embryogenesis, forensic anatomy, and medical sciences

INTRODUCTION

A fingerprint is an imprint created by friction ridges that are nearly parallel and have a consistent wavelength from crest to crest. Central elements including whorls, loops, arches, and triradii dominate the pattern. [1] A thorough investigation shows dozens of additional

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flaws, including island ridges, ridge bifurcations, and ridge ends. The basis for the fingerprints' individuality is the type and relative geometry of these dislocations. [1, 2] One of the characteristics utilised for personal identification is the distinctiveness and consistency of each fingerprint throughout the course of a lifetime. [2, 3] The relationship between fingerprints and disease conditions is necessary due to the genetic factor's function in fingerprint embryogenesis. [4]

This review's main goal was to draw attention to data on embryogenesis and the use of fingerprint patterns in forensic and medical fields. This analysis might assist in disclosing details that are helpful to the forensic community in establishing identity. Additionally, it might shed more light on the potential of fingerprint features as screening and diagnostic tools for various disorders.

Materials and Methods

Data from PubMed and ScienceDirect were used, while other information was found directly using the Google search engine. We searched the identified articles' reference lists for related articles. In the headings and subheading of the articles, certain keywords were utilised singly or in combination. Original research and reviewed publications were incorporated to keep the review's emphasis. Editorial, case reports, and abstracts were not included.

Fingerprint Embryology

The dermal pattern and cornified layer of the epidermis both influence the epidermal ridge pattern.The dermis thickened in regular intervals as a result of cell proliferation in the lower zone of the epidermis. Dermal papillae are epidermal hollows into which the dermis also protrudes. The result was the development of elevations on the skin's surface known as epidermal ridges. [5]

the creation of fingerprints

The 10th to 16th weeks of development are critical for the creation of the epidermal ridge pattern. Embryonal volar skin at the tenth week is composed of a layered epidermis on top of a more amorphous fibrous dermis. The periderm on the outside, the intermediate layer, and the basal layer at the dermis-epidermis contact make up the three layers of the epidermis at that time. [6,7]

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During the eleventh week, columnar cells with an axis perpendicular to the skin surface make up the basal layer of the epidermis. It has been noticed that the basal layer begins to undulate, which quickly stands out and creates creases in the epidermis and dermis.

The future surface patterns, which are well pronounced by the 16th week, are established by these folds, which are referred to as main ridges. Fingerprint patterns cannot be altered by superficial skin lesions because they are encoded at the dermis-interface. [8,9]

Epidermal ridges are spreading

On the surface of the volar skin, the primary ridge does not form synchronously. The formation typically begins at a certain location along the interphalangeal flexion creases and along the ridge anlage, which is located in the middle of the volar pad.If such a pattern appears, the ridge anlage area typically coincides with the whorl and loop centres.

The nail furrow, the flexion creases, and the ridge anlage are the three ridge systems on the fingertips that gradually extend over the fingertip. Triradii appear at the point where these ridge systems ultimately come together. [10-12] Due to this, a complete fingerprint pattern is produced.

The major ridge system is probably dynamic until the 16th week, at which point it becomes stable. For instance, it has been noted that at such time, the number of minutiae significantly increases. This observation might be the result of the finger growing more quickly than the ridges' bridge, which would cause the insertion of additional ridges as minute details. [13]

Ridge Formation Theory Hypotheses

The various hypotheses, which are crucial to comprehending the embryology of fingerprints, were established. The following assumptions are crucial in understanding how fingerprints are formed, despite the fact that there is still no widespread agreement on the mechanism for ridge creation.

Influences on fingerprint features

Fingerprints have a number of characteristics.Several factors in utero have an impact on how fingerprints form.

Usage of fingerprints

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Forensic sciences

The distinctiveness and consistency of fingerprints, once generated, are the primary factors in their use. [14] Additionally, it has been demonstrated that even when subjected to temperatures as high as 600°C, non-volatile inorganic components of eccrine secretion from fingerprints maintain their integrity. [15] The use of the novel scanning Kelvin probe fingerprinting method, which avoids physical contact with the fingerprint and does not call for the use of chemicals, has the ability to record fingerprints while preserving data that might later be subjected to DNA analysis. [16,17] Establishing identity is the only goal of utilising a fingerprint. Sex, race, and lifestyle predictions are all possible for the identity.

Sex determination

The characteristics of fingerprints can be used to identify an individual's sex. It has been discovered that using fingerprint patterns, males have more whorls and females have more arches. Urea levels in male prints are often higher than those in female prints. [18]

Additionally, males were said to have 10% coarser ridges than females. [19] In the right thumb of the Hausa population of Kano state, females have a considerably higher ulnar ridge density. [32] According to MatacoMataguayo [20], Sudanese [21], and Argentinian [22] populations, females showed higher ridge counts in all the ulnar, radial, and proximal zones. Compared to their male counterparts, women typically have finer ridge.

Ethnic Difference

A population-based comparison showed that Africans (Sudanese and Nigerians) recorded higher ridge densities. [23] were less than those Argentinians reported. Spanish people [24] and Central Indians [25], employing the same approach. This may shed light on the likelihood that people of African heritage have lower ridge counts. [26]

When comparing the sexes of the research populations, confounding factors like age must be taken into account. This is due to the fact that, at all ages, ridge density is higher on the distal (radial and ulnar) area, followed by the proximal sides. Ridge density is permanent after development but declines with age. In the Mataco-Mataguayo population, it was discovered that females had higher ridge densities than males when they were older than 12 years old, but not when they were younger. [23] This is in line with variations in body composition and

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proportions, which vary between groups and are more strongly influenced by sex at a given age. [27]

Prediction of personal style

The chemical and metabolic composition of a fingerprint is revealed by using gelatine-based tape and sophisticated chemical analysis under a spectroscopic microscope.According to the study, particular amino acids might tell if a "suspect" consumed meat or not.[28] The examination of chemicals and metabolic features with a fingerprint using a spectroscopic microscope can also disclose the usage of substances like cigarettes, narcotics, grooming products, etc. [25]

Risk of Illness

Cummins was the first researcher to examine the possibility of fingerprints in clinical medicine. [29] Many disorders that have a high genetic component can be diagnosed using fingerprints. [30] Two various strategies are used. a) A quantitative technique, which is based on fingerprint patterns, primarily loops, arches, and whorls For instance, in patients with cervix cancer, there is a drop in the frequency of ulnar loops and an increase in arches. [31] b) The qualitative approach, which makes use of total or absolute ridge counts. [32] For instance, in Klinefelter's syndrome, a complete decrease in the number of finger ridges was documented (Schaumann and Alter, 1976; Chimne and Ksheersagar, 2012). [44] In contrast, patients with essential hypertension showed an increase in the overall number of finger ridges. [33] The idea of linking some particular illnesses with fingerprints has generally seen a significant improvement. [34]

The results, it should be stressed, are population-specific. In a healthy population, one may see a specific trait that is present in a group with a sickness. For instance, both the right and left hands of the female and male patients with multiple sclerosis showed significantly greater overall ridge counts than the control group (MS). In contrast, ridge counts in the fingertips of MS patients in a different population were lower than those of the control group. These case patients had more arches and loops and fewer whorls than those with schizophrenia, according to research [35]. Contrarily, it was shown that male schizophrenia patients had a large rise in whorls and a decrease in loops. [36]

Conclusion

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The 10th to 16th weeks of development are critical for the creation of the epidermal ridge patterns. These formed the upcoming surface patterns, which start to stand out during the sixteenth week. On the volar skin surface, primary ridge development does not take place simultaneously. The various hypotheses, which are crucial to comprehending the embryology of fingerprints, were established.

Despite the lack of widely acknowledged processes for ridge formation, environmental and genetic variables both contribute to the development of fingerprints.The main goal of using fingerprints is personal identification, which can be accomplished by disclosing a person's sex, food, and lifestyle. The risk of contracting certain diseases can also be determined using fingerprints.This potential should, however, be interpreted differently depending on the population because it is population-specific.

References

1. Cummins, H. and Midlo, C. (1976): Fingerprints,Palms and Soles. Research Publishing Company, Inc. Galton F (1892) Fingerprints. London: Macmillan &Co.
2. Babler WJ. Embryological development of epidermal ridges and their configuration. In: C.C Plato, RM Garuto and BA Shaumann, Eds. Dermatoglyphics: Science in transition. 2nd ed. New York: Wiley liss; 1991; 27: PP95-PP112.
3. Bhat GM, Mukhdoomi MA, Shah BA, Ittoo MS. Molecular dermatoglyphics: in health and disease – a review. Int J Res Med Sci 2014;2:31-7
4. Bonnevie, K. (1927): Die crstenentwicklungstadiender papillarmuster der menschlichenfingerballen. Nyt. Mag. Naturvidensicaaberne. 65. 19-56.
5. Gould, E. J. (1948): A topographic study of the differentiation of the dermatoglyphic in the human embryo. PhD thesis. Tulane University
6. Hale, A. (1951). Morphogenesis of volar skin in thehumanfetus. American journal of Anatomy. 91. 147-180.
7. Hirsch, W. (1973): Morphological evidence concerning the problem of skin ridge formation. Journal of Ment. Defic. Res. 17. 58-72.
8. Okajima, M. (1975): Development of dermal ridges in the fetus. Journal of medical Genetic. 12. 234-250.
9. Penrose, L. and O'Hara, P. (1973): The development of epidermal ridge. Journal of medical Genetic. 10. 201-208.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,Iss 7, Oct 2022

10. Schaeuble, J. (1932): Die Entstenhung der palmarenTriradien. Z. Morphol. Anthropol. 31. 403-438.
11. Kucken, M. and Newell, A.C. (2004): A model of fingerprints formation. Euro physics latter. 68(1). 141-146
12. Hale, A. (1949): Breadth of epidermal ridges in the fetus and its relation to the growth of hand and foot. Anat. Rec. 105. 763-776.
13. Kollmann, A. (1883): Der Tastapparat der Menchlichenrassen und der affen in seiner
14. Kucken, M. and Newell, A.C. (2005): Fingerprintsformation. Journal of theoretical Biology. 235. 71-83.
15. Dell, D. and Munger, B. (1986): The early embryogenesis of t papillary (sweat gland) ridges in primate glabrous skin: The dermatotopic map of cuteneous mechanoreceptors and dermatoglyphics.Journal of Compul. Neurol. 244. 511-532.
16. Moore, S. and Munger, B. (1989): The early ontologeny of the afferent nerves and papillaryridges in human digital glabrous skin. Developmental Brain Research. 48. 119-141.
17. Morohunfola, K., Jones, T. and Munger, B. (1992): The differentiation of the skin and its appendages II. Altered development of papillary ridges following nueralectomy. Anat. Rec. 232. 599-611
18. Bentil, D. and Murray, J. (1993): On the mechanical theory for Biological pattern formation. Physica. 63.161-190.
19. Diego, A. G. and Angelica, M. R. M. (2011): A biochemical hypothesis on the formation of fingerprints using a turning patterns approach. Theoretical Biology and Medical Modeling. 8. 24.
20. Bonnevie, K. (1929): Was lehrt die embryologie der papillar must eruberihrebe deutungalsrassen-und familiencharakter. Part I and II. Z inducts. Abstammver. 50. 219-274.
21. Adra, C. N., Donato, J. L., Badovinac, R., Syed, F.,Kheraj, R., Cai, H., Moran, C., Kolker, M. T., Turner, H., Weremowicz, S., Shirakawa, T., Morton, C. C., Schnipper, L. E. and Drews, R. (2001): SMARCAD1, a novel human helicase family-defining member associated with genetic instability: cloning, expression, and mapping to 4q22-q23, a band rich in breakpoints and deletion mutants involved in several human diseases. Genomics69 (2): 162–73.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11,Iss 7, Oct 2022

22. Cummins H, Midlo C. Finger, palm and sole prints. An introduction to dermatoglyphics, Second ed. NewYork: Dova; 1943.
23. McMurray, N. and Williams, G. (2010): Materials Research Centre. Swansea University.
24. Ward, M. (2006). Fingerprints hide lifestyle clues. BBC. http://news.bbc.co.uk/1/hi/
25. Shiono H. Dermatoglyphics in Medicine. Am J Forensic Medicine Med Pathol. 1986;7(2):120-6.
26. Pal GP, Roufal RV,Bhagvat SS. Dermatoglyphics in carcinoma cervix..J Ant Soc India. 1985;34(3):157-61
27. Schaumann B and Alter M. Dermatoglyphics in medical disorders. New York: Springer Verlog; 1976:187-189.
28. Chimne HD, Ksheersagar DD. Dermatoglyphics in Angiographically proven coronary artery disease. J AnatSoc India. 2012;61(2):262-8.
29. Komotz Y, Yoshida O. Finger patterns and ridge counts of patients with Klinefelter's syndrome (47xxy) among the Japanese, Hum Hered. 1976;26(4):290-7.
30. Pursani MZ, Elhence GP, Tibrewala L. Palmer dermatoglyphics in essential hypertension. Indian heart J. 1989;41:119-22.
31. Holt SB. Dermatoglyphic pattern, eds. Genitical Variations in human populations. Pregarnon: oxford; 1961: PP791.
32. ShamsuddinS, Masomi M, Magad - Hossini M. Relations between the lines on the fingers of hands and the incidence of disease in the human. Journal of Kermin Medical Science University. 1997;4(3):136-42.
33. Sabanciogullari V,Cevik S, Karacan K, BolayirE,CimenM,Dermatoglyphic features in patients with multiple sclerosis Neurosciences 2014; Vol. 19 (4)
34. Supe S, Milicić J, Pavićević R. Analysis of the quantitative dermatoglyphics of the digito-palmar complex in patients with multiple sclerosis. CollAntropol 1997; 21: 319-325.
35. Jhingan HP, Munjal GC, Dermatoglyphics In Male Catatonic Schizophrenics, Indian J. Psychiat.(1990), 32(2), 188-192
36. Pahuja K, Agarwal SK. Analysis of quantitative and qualitative dermatoglyphic traits in Schizopherinicpatients. J AnatSoc of India. 2012;61(2):269-72.