

Dermatoglyphics: A Review

H. K. Kumbhani

INTRODUCTION

The entire human body is clothed with the skin which happens to be the largest and most important organ of the body. It performs many vital functions in the life of an individual, viz. it protects and safe guards the body from the vagaries of the weather, maintains the body temperature and saves the internal organs of body from the injuries. However, the skin on the ventral sides of the hands and the plantar sides of the feet is exclusively designed and is corrugated with the ridges and configurations which are functionally useful as they help in the grasping without which the objects would easily slip away from the hands. Cummins in 1926 for the first time coined the term dermatoglyphics to this field of science. It has been accepted and adopted internationally. Etymologically this term is harmonious blend of two words *Derma*, Skin; *Glyphe*, Carve. It gives the impression that something has been carved out of the skin.

These features of dermatoglyphics are formed during the 13th/14th week of the developing embryo and once formed remain permanent and never change throughout the life except in the dimension in commensurate to the growth of an individual. This fact has been tested and confirmed in 1976 at the time when the author was awarded the Senior Fellowship by the Alexander Von Humboldt Foundation, Bonn (Germany) and was engaged in the advance research in the institute of Human Genetics, Medial College. University of Lünebeck, Lünebeck. The most ideal place to scrutinize the age of the appearance of the features of dermatoglyphics was the museum of the institute of Anatomy of the same university where the embryos are preserved in glass jars of different ages of their developments. On critically examination this age of the appearance of the said features was authenticated to be 13th week as stated earlier.

Etymologically review means to take view and inspection of retrospective, present and to some extent visualise the prospective view of the subject. It is one of the difficult exercise as it is fraught with problems and pitfalls as it is not easy accomplish and it is hard to decide what to include

an what to ignore undoubtedly it a very ambitions job. Nevertheless attempt has been made.

The importance of dermatoglyphics goes back to ancient China (1839) where it was common practice in the sale of the land. The deed of the land carried the impression of the finger prints as an acknowledgement of the deed. There was also prevailing custom of the sale of the children there, The prints of the palm and soles were recorded as the safegaurd against the impersonation. Lauter (1912) has provided the history of the finger print system. Hersched (1916) has traced the origin of the finger prints. Cummins (1927) has found the impression of a thumb print an clay. Heindl (1929) has reported the first finger print for the identification in Germany. Cummins (1930) has exhibited the first finger print carving of the Stone Age. de Forest (1930) has traced the dactyloscopy in the United States of America. Wilton (1938) published a book *Finger Prints History, Law and Romance*. Myers (1939) has provided the history of identification of finger prints. Penrose (1968) has drafted the memorandum on dermatoglyphics nomenclature.

DERMATOGLYPHICS

Once the importance of the dermatoglyphics has been established a hordes of investigators developed the fascination for the study of the finger prints. It was easy to collect the finger prints. It has many advantages. Firstly it requires the minimum of equipment and a bit of persuasion of the subjects. The data thus collected can be preserved for lifelong. It can be analysed at leisure, tabulated, evaluated followed by the logical conclusions. The frequencies of the patterns whorls, loops and arches are calculated for each fingers of both right and left hands and of both sexes. Finally totalled. This was the beginning of the scientific interest. The published work, include the frequencies of various patterns, for personal identification, Inheritance, anomalous patterns, medico-legal cases etc. Some of the authors who have made a significant contribution are given below.

Faulds (1905), Hellwig (1912), Carriere (1923), Ganther (1923), Roscher (1925), Furuhata (1927).

Heindl (1927), Bonnevie (1929), Cummins (1930, 1934, 1961), Metiner (1930), Gerke (1932), Harster (1932), Saller (1932), Abel (1933, 1935), Geipel (1935, 1937), Kirchmair (1936), Csik (1927), Henry (1937), MacArther (1937), Pol (1937), Dankmeijer (1938), de Pina (1939), Okuma (1940), Kumbnani (1959, 1968, 1972, 1978, 1984, 1990, 1991, 2005), Singh (1961), Volotzkoy (1961), Bali (1968), Sen (1968), Clercil (1969), Bhanu (1975) Mavalwala (1977), Singh and Bhasin (1979), Livshits (1987), Micle (1988), Kamali (1990), Bhasin and Walter (2001).

Middle and Proximal Phalanges

This is one of the dermatoglyphics areas of the fingers which is mostly ignored, and neglected. It is called as the middle and proximal phalanges. The charmed investigators can be counted on the fingers tips. There are only four published papers and by three authors namely, Ploetz-Radmman (1937), King (1939) and Kumbnani (1959, 1962). All the features of the Dermatoglyphics are extremely useful in apprehending the culprits and the patterns on the middle and proximal phalanges of the fingers inclusive.

PALMAR DERMATOGLYPHICS

After finger prints in the study of dermatoglyphics are study of the palm prints and it is of a great importance. Many parameters of the palm prints have attracted the attention of the investigators. The parameters include palmar main lines D.C.B.A. axial triradius, angle at d. polymorphism of main line C, configurational areas viz. hypothenar, thenar/I, II, III, and IV interdigital areas, inheritance of the patterns, main line index and transversality, palmar creases. Something which has been eluding for decades is the pattern in the parathenar area.

Parathenar Area

Parathenar Area is the part of the palm print. It is ensconced between the hypothenar and thenar/ Ist Interdigital area. For reason unknown it has been ignored, neglected and never cared. It remained a hidden till 1993 when a pattern loop miraculously surfaced after scanning the palms of 60,000 thousands subjects (120,000 palms), the pattern loop was noticed by the author in 1993. It

was indeed a landmark discovery. The pattern in the parathenar area is a historical finding in the field of dermatoglyphics in general and in the palmar formulae in particular. Now there is a compelling need to revise the existing palm formula of ten components to eleven and it stands as follows.

D.C.B.A - Axial Triradius- Hypothenar. Parathenar. Thenar/I.II.III.IV.

The image and the language of the palm formula would have been different had it been spotted during the Cumminsonian era. Some of the devoted investigators who have enriched the palm prints are Valsik (1928), Cummins (1931, 1935), Bettmann (1932), Schaeuble (1933), Beletti (1934), Biswas (1936), Steggerda (1936), Fleischhauer (1951), Kumbnani (1959, 1963, 1967, 1969, 1971, 1973, 1978, 1990, 1991, 2000, 2005), Das (1964), Bansal (1965), Bhasin (1966), Das Sharma (1966), Mukherjee (1966), Tiwari (1967), Chattopadhaya (1970), Mahapatra (1970), Plato (1970), Bhattacharaya (1971), Bhanu (1972), Bali (1974, 1983) Naffah (1974), Chaube (1977), Mukherjee (1980), Borottice (1981), Das (1981), Eshawarai (1981), Narahai (1983) Abel (1983), Raju (1983), Das (1985), Deep Kumar (1985), Rami Reddy (1985), Kamali (1986, 1990), Sharma (1986), Malhotra (1987).

PLANTAR DERMATOGLYPHICS

Soles

Although the investigation of sole prints is yet another interesting study yet not many investigators have choice, quite often the prints are incomplete and the exercise has to be repeated. There are a score of the experts who were keenly involved in the study of sole prints Fere (1900), Wilder (1903, 1904, 1922), Cummins (1923, 1926), Montgomery (1925), Montgemery (1927), Sabatin (1928), Takeya (1934), Hozyo (1936), Steffens (1953), Wichmann (1956), Datta (1958, 1963, 1966), Bhasin (1967), Bali (1968), Tiwari (1971, 1983), Pateria (1973), Singhrol (1981), Kapoor (1983).

Toes

The investigations of the toe prints is yet another component of dermatoglyphics. The collection of the toe prints is one of the toughest exercise unlike the finger and palm, the prints of the toes can only be collected on the slips of papers, it is not possible to role the toes like the

fingers. One has to be on his toes collect the prints of toes as such a investigation has been made by the braves. The published work includes of Fere (1900), Cummins (1923), Takeya (1933), Newman (1936), Steffens (1938) and Bali (1968). The investigations by these authors are patterns of toe, comparing the finger and toe prints and genetic correlation of finger and toe prints. Only four had the patience to collect the toe prints and published their findings.

DERMATOGLYPHIC TOPOLOGY

Dermatoglyphic classification based on Dermatoglyphics topology (Penrose, 1965) has been purposed by Penrose and Loesch (1969, 1970) and Loesch (1975, 1983) by which the number of possible combinations of patterns on fingers, palms and soles are reduced considerably thus facilitating the study of mode of inheritance. Topological classification is based on (1) description of all loops and enumeration of all the triradii. (2) Each whorl is rated as the equivalent of two loops and arches, vestiges, and other ridge configurations, which are not true patterns are not taken into consideration. (3) Extralimital triradii are included in counting. (4) The resulting pattern intensity as measured by the number of loops on the normal palm or sole is four less than the number of triradii. (5) All individual loops and triradii with the exception of digital triradii are recorded in a formula. Penrose and Loesch (1969, 1970) and Loesch (1975) described the dictionary of patterns to record the individual results.

INHERITANCE

All the physical traits genetically controlled and are passed on from generation to generation governed by the laws of inheritance propounded of Mendel and the features of dermatoglyphics are no exception. The literature published is replete with the same. The emphasis is given to the patterns on the configurational areas, Main Line, C, palmar creases etc. One of the most important investigations by the author titled inheritance of palmar configurations areas published in journal *Zeitschrift für Mophologie and Anthropologie* in 1969 have given a very intensive and extensive account of the mode of inheritance in all the configurational areas of the palm, some other authors who have made their presence felt in such investigations are given below.

Elderton (1920), Carriere (1923), Leven (1927), Grünenberg (1928), Saller (1932), Harresser (1934), Karl (1934), Weninger (1935), Cziki (1937), Komai (1937), Reed (1937), Von Wehren (1937) Weinand (1937), Weninger (1937), Walker (1941), Holt (1968), Kumbnani (1969), Reed (1975), Mukherjee (1980) and Loesch (1983).

PERSONAL IDENTIFICATION

The personal identification of the person is the most crucial aspect in the detection of the crime. It is here that the features of dermatoglyphics play a very vital role. The chance prints left at the scenes of crime are lifted and compared with the suspected persons and identification of the criminal established. Finger prints are regarded as an infallible evidence and some investigators are Wentworth (1932), Bugge (1938), Catellanos (1939), Cummins (1935), Inbua (1934), Hoover (1938), Mavalwala (1977), Hall (1979).

DISPUTED PATERNITY

There is an immense role that features of dermatoglyphics have to play in medico-legal cases like the dispute of paternity. The prints of the mother, the child and the putative father are taken in giving the verdict. In Germany if the paternity is proved the man has to support the child financially till it achieves the age of the 18 years. The quantum of the financial support depends upon the status and position of the man. Many such cases have been reported, some of the investigators are-

Hellwing (1912), Harster (1913), Boas (1913), Scheffer (1926), Bonnevie (1927), Boher (1930), Schrader (1934), Essen Moller (1937, 1939), Gayer (1938, 1940), Grueneberger (1929, 1935), Harrasser (1934) (1935), Komai (1937), Mueller (1928, 1930, 1931), Lauter (1930), Nurenberger (1925), Weninger (1935, 1937).

TWINS STUDIES

From the time immemorial the twins and multiplebirths have not only fascinated the common primitive man but the investigators. A number of writers, novelists, poets, dramatists, anthropologists geneticist, film producers have taken a very keen interest. The literature is replete with the mistaken identity of monozygotic twins. The author in his magnum opus has given an intensive account of MZ, DZ twins but also of

other possible rare type of twins. For the detailed account please refer to Kumbnani (2000). Several eminent anthropologists have made a detailed study of the features of dermatoglyphics of twins. They are Montgomery (1926), Siemens (1927), Von Verschuer (1928), Cummins (1930), Ennenbach (1930), Newman (1930, 1931), Rife (1933), Meyer-Heydenhagen (1934), Weninger (1935), Cummins (1936), Volotzkoy (1936), Geipel (1937, 1939), Mac Arthur (1937), Steffens (1938), Geyer (1939), Rife (1943), Pena (1979), Khatoun (1986).

DERMATOGLYPHICS CORRELATED WITH DISEASES

After having the a good grip of the basics of dermatoglyphics the icons of this field were inspired to search and investigate its correlation with various types of afflictions like psychological, physiological, neurological depression, epilepsy, schizophrenia, debilitating demensias, neuro-fibromatosis, mongolion idiocy, psoriasis, later when cytological investigations revealed the numerical and structural, aberrations correlated with dermatoglyphics. Some of the typical examples are like the high frequency of Ulnar loops in trisomy of group G chromosome, more frequency of Arches in the deletion of short arm of chromosome 5, high finger ridge count in XXX chromosomes, High value of Main Line Index in trisomy-G (for details see schaumann and Alter, 1976).

Hand with Absence of Finger Prints

One and the only case afflicted with Naggely Syndrome Dermatopathia pigmentosa rarest amongst the rare reported the absence of finger and palm prints although recorded earlier but reported by the Times of India in 2000. The author would gladly welcome, appreciate and acknowledge more such cases.

A number of investigators have reported the features of dermatoglyphics correlated with various types of diseases.

Fere (1905), Bonnevie (1927, 1933), Blumel (1928), Bettmann (1932), Blotevogel (1933), Krieger (1934), Newmann (1934), Cummins (1936, 1937, 1939, 1940), Chattopadhyaya (1937), Duis (1937), Moller (1937), Workman (1939), Brow (1940), Turpin (1953, 1974), Rodewal (1962) Uchida (1963), Holt (1964), Kumbnani (1967, 1969, 1971, 1973, 1978, 1990, 1991), Biswas (1966), Mellor

(1968) Zajazkowska (1969), Bali (1971), Chaube (1971, 1976, 1977), Vrdagh Laoureux (1975), Woolf (1976), Schaumann and Alter (1976), Ayme (1979), Balgir (1978), Esvariah Marque (1976, 1978), Suzumori (1980), Schmidt (1981), Mukherjee (1984, 1990), Simpson (1984), Hirth (1985), Sudherland (1985), Markov (1986), Chakraborty (1987), Bagga (1988), Gyenis (1988), Karmakar (1988), Milong (1988), Hauser (1989), Bhasin and Khanna (1994).

Scanning the voluminous publications on the dermatoglyphics, it has been observed that the study of the finger prints has been the most favourite by the investigators, for it has been comparatively convenient to take the prints, where as only few committed and devoted investigators have been able to report, findings on middle and proximal phalange prints and same holds good for the toe prints. Obviously it is due to the ordous and cumbersome process of collecting the toe prints.

FLEXION CREASES IN DERMATOGLYPHICS

In addition to the ridges, the ventral and the planter surfaces of the palm and soles express the creases known as the flexion creases and without any doubt they are the integral parts of the palms and soles. Cummins (1943) stated that the flexion creases are not the elements of the dermatoglyphics but the author of the present paper is at a variance with the above statement, for various logical and valid reasons. The earlier authors were either oblivious of the creases or had scanned the incomplete prints. In such situations the exact levels of the axial triradii were not clear or remained ambiguous. As such they were orbitranily taken as proximal (t), medial (t') and distal (t''), respectively. Cummins was optimist that in future more precise methods would be devised to evaluate their exact levels.

Some of the eminent flexion creases of the palm are the brecelet creases positioned proximally. Radial longitudinal crease, Proximal tranverse crease and the distal transvere crease, repectively. Contrary to the observation of Cummins the present author is of the conviction that the flexion creases are the integral part of palm and are even most important landmarks of the dermatoglyphics.

The axial triradius of the palm is the most important features of the palm print. To ascertain accurately the levels of it one requires two important creases, namely the bracelet crease and

the metacarpophalangeal crease of the fourth digit. Joining both of these creases passing through the most proximal axial triradius and the triradius of the fourth digit and extending it to the metacarpophalangeal crease of the fourth digit, the lower half of this axis provides the basis of various axial triradii, thus ascertaining the position t, t' & t'', respectively. Kumbhani (2004) has devised the model designed to ascertain metrically the various levels of this triradius of the human palm. This also helps in the formulation of the dual patterns in the hypothenar areas.

Some of the flexion creases are also associated with the afflictions of chromosomal aberrations like simian crease. This crease on the distal part of the palm starting from ulnar side continuing to radial side. As such there would be two creases in the palm rather than three as usual. Such a crease is called a simian crease for it is commonly found in simians. However, in general population it is observed to be approximately four percent. Most often in syndromes like Trisomy-G, it is often noticed and is one of the important diagnostic features (for details see Schaumann and Alter, 1976)

The palm formula would be rootless without the bracelet crease and metaphalangeal creases. Hence the flexion creases are the integral parts of the dermatoglyphics as claimed in earlier pages by this author and stand vindicated.

CONCLUSION

To sum up, having understood the basics of dermatoglyphics the prime importance has been of investigate the implication, application and the utility of this valuable knowledge. Many of the investigators have pulled up their energies in comparing the frequencies of various patterns among different communities and population to establish their relative ethnic position in the fabric of the society. The other most important parameter of dermatoglyphics is the inheritance. All the physical features of the human body including the dermatoglyphics are inherited as per the laws propounded by Mendel. It was in 1993 that the author himself after scanning the palms of 120,000 palms for the first time in the history of palm prints observed and recorded the pattern loop in the parathenar area of palm. The features of dermatoglyphics are most important in the medico-legal cases of disputes of paternity. It has a very crucial role in the diagnosis of monozygotic and

dizygotic twins. The features of dermatoglyphics also express the correlation in many somatic, physiological, neurological and cytological afflictions and syndromes. In the middle of the last century when the cytological evidences came to the fore with numerical and structural aberrations of the chromosomes. In trisomy G the typical ulnar loops, simian crease, distal displacement of axial triradius, high value of main line index have been recorded. High frequency of arches are often associated with Cat-Cry-Syndrome. High finger ridge count is commonly recorded with trisomy of X chromosome. One of the rarest syndrome reported is Naggely syndrome Dermatopathia pigmentosa reported the absence of finger and palm prints. The author would welcome, appreciate and acknowledge more such cases.

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KEYWORDS Finger, Palm and Sole Dermatoglyphics. Inheritance. Variation. Medici-legal Cases.

ABSTRACT The main purpose of this paper is to give the review of the contribution in dermatoglyphics from 1563 through 2005. The importance of it is given as observed in fingers, middle and proximal phalanges, palms, soles, toes, the inheritance of patterns, personal identification, medico – legal cases, twin diagnosis and correlation with various types of afflictions.

Author's Address: **Prof. Dr. H. K. Kumbnani**, Department of Anthropology, University of Delhi, Delhi 110 007, India

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