REVIEW ARTICLE

Dermatoglyphics: A Marker of Periodontal Disease

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ABSTRACT

Dermatoglyphics is the scientific study of fingerprint patterns. Fingerprints are formed in early embryonic life, during the 10th to 16th weeks of intrauterine life and remain permanent during the whole life. Dermatoglyphics can be used as a diagnostic tool of genetically and nongenetically determined diseases. Thus, it can be used not only in the field of medicine but also in dentistry for the early identification or prediction of oral lesions and diseases. Hence the present paper reviews the application of dermatoglyphics in dentistry along with the advantages, limitations, and patterns of dermatoglyphics.

Keywords: Arch, Dermatoglyphics, Fingerprints, Loop, Whorl.

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INTRODUCTION

Fingerprint analysis for personal identification, through decades of scientific research, has come to be recognized as a powerful tool in the diagnosis of psychological, medical, and genetic conditions. As the fingerprint patterns are unique to all individuals and remain unchanged over the lifetime, they now provide a firm empirical basis for the study of chirology.[1]

Dermatoglyphics is a harmonious blend of two Greek words "derma," i.e., skin, and "glyphe," i.e., carve.[1] Dermatoglyphics is defined as the study of the intricate dermal ridge configurations on the skin covering the palmar and plantar surfaces of the hand and feet.[2] This term was coined by Harold Cummins and Midlo in 1926.[3]

Dermatoglyphic patterns are determined genetically, and once they are formed completely, they remain constant throughout life. William Herschel was first to use fingerprints for identification of criminals in India.[4] In 1892, one of the most original biologists of his time, Sir Francis Galton published his work on fingerprints.[5]

Dermatoglyphic patterns develops between the 13th and 19th week of intrauterine life, which begins from early limb development stage at 4th to 6th week of intrauterine life and ridge formation (13th week) and get completed on definite pattern stage at the 19th week of intrauterine life. During pregnancy, growth disturbance in intrauterine life due to hereditary or environment factors may result in abnormal dermatoglyphic patterns.[6] It is considered as a window of congenital abnormalities and is a sensitive indicator of intrauterine anomalies and a diagnostic tool.[7]

After definite pattern stage, they are unaffected by the environment; thus, they have a unique role as an ideal marker for individual identification and study of population. Early detection can aid the clinician to anticipate health problems and initiate preventive and protective health measures at a very young age. It is still at infancy in the world of dentistry where the co-relation of dental conditions with that of dermatoglyphic patterns is done.[8]

DERMATOGLYPHIC PATTERN CONFIGURATION[9]

Dermatoglyphic Landmarks

The three basic dermatoglyphic landmarks found on the fingertip patterns are:

1. *Triradius:* It is formed by the confluence of three ridge systems that form angles of approximately 120° with one another.
2. *Core:* It is in the approximate center of the pattern.
3. *Radiant:* They emanate from the tri-radius and enclose the pattern area.

Fingertip Patterns

The ridge patterns on the distal phalanges of the fingertips are divided into the three groups:

1. *Arches:* It is simplest pattern formed by succession of more or less parallel ridges, which traverse the pattern area and form a curve that is concave proximally. Five percent of the world's total population has them.

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The arch pattern is subdivided into two types:

(a) *Simple or plain arch* – Composed of ridges that cross the fingertip from one side to the other without recurving.

(b) *Tented arch* – Composed of ridges that meet at a point so that their smooth sweep is interrupted.

2. *Loops:* A series of ridges enter the pattern area on one side of the digit, recurve abruptly, and leave the pattern area on the same side. It is the most common pattern found in 60% of the world's total population.

   The loop pattern is subdivided into two types:

   (a) *Ulnar loop*: Composed of ridges that open on the ulnar side.

   (b) *Radial loop*: Composed of ridges that open on the radial side.

   Loops may be large or small, tailor short, vertically or horizontally oriented, plain loop or double loop. Occasionally, transitional loops can be found, which resemble whorls or complex patterns.

3. *Whorls:* It is any ridge configuration with two or more triradii. One triradius is on radial and the other on the ulnar side of the pattern. A total of 35% of the world's population has them.

   Subtypes of whorl patterns include:

   (a) *Plain/simple/concentric whorl*: Composed of ridges that form ellipses.

   (b) *Spiral whorl*: A configuration in which ridges spiral around the core in either a clockwise or a counter-clockwise direction.

   (c) *Central pocket whorl*: A pattern containing a loop within which a smaller whorl is located. Central pockets are classified as ulnar or radial according to the side on which the outer loop opens.

   (d) *Lateral pocket/twinned loop pattern*: Composed of interlocking loops.

   (e) *Accidentals/complex pattern*: One in which patterns cannot be classified as one of the above patterns.

Palmar Patterns

The palm has been divided into several anatomically designed areas:

- *Thenar and first inter-digital area:* These two areas are closely related anatomically and are considered one area. Patterns, when present, are most often loops.
- *Second, third, and fourth inter-digital area:* Configurations encountered in the inter-digital regions are loops, whorls, vestiges, and open fields.
- *Hypothenar area:* Patterns commonly seen are whorls, loops, and tented arches.

Quantitative Analysis

Many dermatoglyphic characteristics can be described quantitatively, e.g., by ridge counting and measuring distances or angles between specified points.

DERMATOGLYPHICS IN DISEASE

Dermatoglyphics as a diagnostic tool is now well established in a number of diseases that have strong hereditary basis.[10] Commins was the first person to show the possible use of dermatoglyphics in clinical medicine.[11]

MEDICAL CONDITIONS[12]

- Dermatoglyphics in diseases which are purely genetic disorders:

  Down's syndrome, Klinefelter's syndrome, Patau syndrome, Edwards's syndrome, inborn blindness, Noonan syndrome, Turner's syndrome
- Dermatoglyphics in other diseases that have some genetic background:
  - *Neurological diseases*: Alzheimer's disease, schizophrenia, cerebral palsy, neurofibromatosis, epilepsy
  - *Heart diseases*: Congenital heart diseases, rheumatic heart disease, coronary heart disease

Other conditions like diabetes mellitus, cancer of the cervix, leprosy, essential hypertension, bronchial asthma, rheumatoid arthritis, tuberculosis, carcinoma of the breast, and sickle cell anemia.

DENTAL CONDITIONS

In Periodontal Diseases

Atasu et al[13] conducted a study with the aim of finding a finger-tip pattern type that would identify the patients with periodontal diseases. When the finger-tip patterns of the patients were compared with those of periodontally healthy (PH) individuals, the following were observed:

- Decreased frequencies of twinned and transversal ulnar loops on all fingers of the patients with juvenile periodontitis (JP),
- Decreased frequency of double loops on all fingers and an increased frequency of radial loops on the right second digits of the patients with rapidly progressive periodontitis (RPP),
- Increased frequencies of concentric whorls and transversal ulnar loops on all fingers of the patients with adult periodontitis (AP),
- Increased frequency of the triradii on the palms and soles of the patients with JP.

The authors concluded that in the light of these findings, dermatoglyphics could be used together with the other diagnostic methods, such as clinical and radiologic investigations and in identifying patients from distinct groups of Periodontal diseases (PDs).

Dental Caries

Sharma et al[14] studied dermatoglyphic interpretation of dental caries and its relation to *Streptococcus mutans* growth, which showed that the subject group had a decreased frequency of loops and high *S. mutans* growth as compared to control group.

Bruxism

Polat et al[15] studied 38 bruxism patients and examined dermatoglyphic patterns of fingers and palm. Bruxism patients demonstrated an increase in frequency of whorls, I loops, and t triradii. There was a decrease in the frequency of ulnar loops, atd angle, IV, H, and t″ tri-radii than the controls. This study summarized that when combined with other clinical features in bruxism, dermatoglyphics can serve to strengthen a diagnostic impression.

Malocclusion

Reddy et al[16] conducted a study using dermatoglyphics to predict and compare malocclusion groups. A total of 96 subjects were divided into three malocclusion groups: Class I (control group); class II, div. 1, div. 2; and class III (experimental group) aged 12 to 14 years. The dermatoglyphic findings revealed that the craniofacial class II, div. 1, div. 2 pattern was associated with increased frequency of arches and ulnar loops and decreased frequency of whorls, whereas in class III, there was an increased frequency of arches and radial loops with decreased frequency of ulnar loops. In predicting class III malocclusion, based on the frequency of arches, the sensitivity values were found to be higher and more reliable than the sensitivity values of class II, div. 1 and div. 2 malocclusion. From their study, the authors of the present study observed that dermatoglyphics might be an appropriate marker for malocclusion.

Malignant Disorders and Oral Carcinomas

Tamgire et al[17] carried out a study to collect the dermatoglyphic prints of 200 subjects divided into two groups. Group A consisted of 100 gutkha chewers without Oral submucous fibrosis (OSMF) and group B consisted of gutkha chewers with OSMF. The results showed a highly significant relation; i.e., dermatoglyphic pattern may have a role in identifying individuals at risk of OSMF.

Dermatoglyphics has also found its association with other dental conditions like cleft lip and palate, taurodontism, and dental fluorosis.[12]

ADVANTAGES[7]

The major advantages of the dermatoglyphics are:

- Fingerprints are fully developed at birth and thereafter remain unchanged for life.
- Scanning or recording of their permanent impressions can be accomplished rapidly, inexpensively, conveniently, and without causing any trauma to the patient or hospitalization.

LIMITATIONS

- It is difficult for the dermatoglyphics patterns to be diagnostically useful if the patient has gross malformations of the limbs.[18]
- There are several disadvantages for using atd angle as a parameter. The most important shortcoming is the size of atd angle, i.e., affected by the amount of spreading of the fingers when the patterns are recorded. The pressure exerted can also affect the atd angle.[19]
- Care must be taken while recording the prints to apply the ink material in adequate amounts. A thin or thick application results in light or dark improper prints.[20]

CONCLUSION

Fingerprints are known to be unique and unalterable and hence an excellent tool for population studies, personal identification, and morphological and genetic research. Though dermatoglyphics is considered an inexact science, it has moved from obscurity to acceptability as a diagnostic tool. Dermatoglyphics in association with other diagnostic tools, such as clinical and radiological investigation, can be used for identification of patients with distinct groups of periodontal diseases.

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