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Review article

RELEVANCE OF DERMATOGLYPHICS IN DENTISTRY

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A B S T R A C T

Fingerprints are known to be unique and unalterable, and hence an excellent tool for population studies, personal identification, morphological and genetic research. Dermatoglyphics, the study of surface markings of the skin, especially feet and hands, has been the subject of interest in medical genetics. Different diseases have different fingerprint patterns associated with them. This has been verified in thousands of independent studies. Dermatoglyphics has a significant relationship with oral diseases. Dermatoglyphics has moved from obscurity to acceptability as a diagnostic tool.

INTRODUCTION

Fingerprints are found in humans and some animals. They are unique to all individuals and remain unchanged over the lifetime. Multiple genes determine fingerprint configurations. The scientific investigation of the hand is beginning to prove without doubt, that the hand is indeed worth a study of the finest minds and can reveal, not only vital genetic and medical information about an individual, but also something of the psychological uniqueness of each person.[1]

Over the past 150 years, dermatoglyphics has been a useful tool in understanding basic questions in biology, medicine, genetics and evolution, in addition to being the best and most widely used method for personal identification. Some may not rightfully view dermatoglyphics as an independent field of study, even though it has a body of theory, methods and applications. In many respects, it has been used as an adjunct to other disciplines, serving as a vehicle to resolve broader biomedical problems. Thus in biology, anthropology, genetics and medicine, dermatoglyphics serves as a tool to describe, compare and contrast, and at times predict occurrences and risks for biomedical events studied by these major disciplinary areas.[2]

Dermatoglyphics can be used not only in the field of medicine but also in dentistry for the early identification or prediction of oral lesions & diseases using various available methods. The oral structures and dermal ridges embryonically develop at the same time.

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There are quite number of studies conducted in dentistry to establish relationship between finger patterns and the disease process.

Dermatoglyphic Pattern Configurations
Fingertip Pattern Configurations

Galton (1892)[3] divided the ridge patterns on the distal phalanges of the fingertips into three groups**:**

1. Arches
2. Loops
3. Whorls

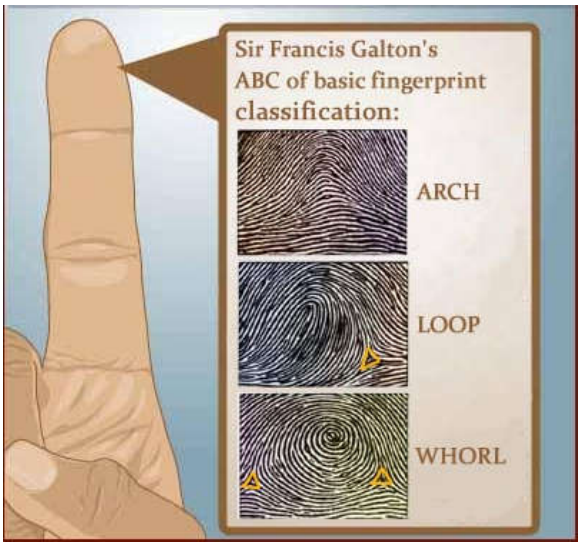

Figure 1 Fingertip Pattern Configurations

Although numerous sub classifications have been subsequently offered, this simple classification is still recognized and used by majority of investigators today.[4]

Arches

It is the simplest pattern found on fingertips. It is formed by succession of more or less parallel ridges, which traverse the pattern area and form a curve that is concave proximally. Sometimes, the curve is gentle; at other times it swings more sharply so that it may also be designated as a low or high arch respectively.[4,5]

The arch pattern is subdivided into two types.

Simple arch or plain arch (A) composed of ridges that cross the fingertip from one side to the other without recurving.

Tented arch (T or A^1) composed of ridges that meet at a point so that their smooth sweep is interrupted. The point of confluence is called a triradius, because ridges usually radiate from this point in three different directions. In the tented arch, the triradius is located near the midline axis of the distal phalaynx. The distal radiant of the triradius usually points vertically toward the apex of the fingertip. Ridges passing over this radiant are abruptly elevated and form a tent like pattern and are designated as 'tented arch'.[4]

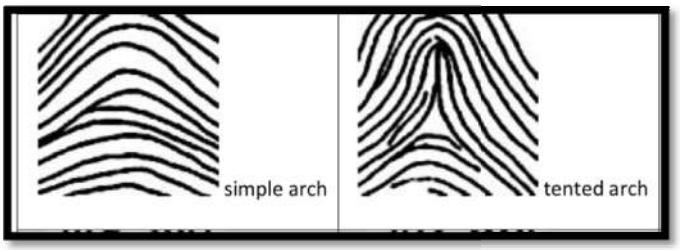

Figure 2 Arch Pattern

Loops

It is the most common pattern on the fingertip. 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. If the ridge opens on the ulnar side, resulting loop is termed as ulnar loop(U,Lu) If the ridge opens toward the radial margin, it is called a radial loop. (R,Lr) A loop has a single triradius or confluence point of ridges. The triradius is usually located laterally on the fingertip and always on the side where the loop isclosed. Loops may vary considerably in shape and size. They may be large or small, tall or short, vertically or horizontally oriented. Occasionally, 'Transitional' loops can be found which resemble whorls or complex patterns.[4]

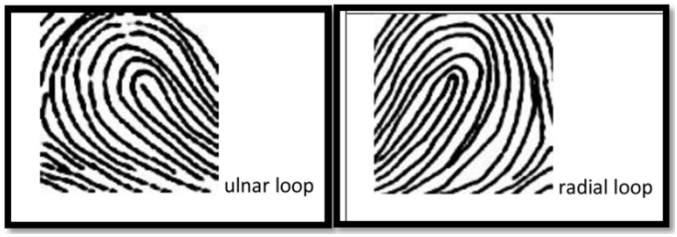

Figure 3 Loop Pattern

Whorls

It is any ridge configuration with two or more triradii. One triradius is on the radial and the other on the ulnar side of the pattern**.** Henry (1937), limited the designation of the term 'Whorl' to those configurations having ridges that actually encircle a core. He named more complex patterns as "Composites.". The ridges in a simple whorl are commonly arranged as a succession of concentric rings or ellipses. Such patterns are described as concentric whorls (W^c). Another configuration spirals around the core in either a clockwise or a counterclockwise direction. This pattern is called a spiral whorl (W^s). Sometimes, both circles and ellipses or circles and spirals are present in the same pattern. The size of the whorl can vary considerably, and is determined by means of a ridge count. A central pocket whorl (W^{cp}) is 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. The significance of separating these two varieties of loop whorls for medical diagnosis remains unproved. Therefore, they are ordinarily grouped together as a double loop. Another type is composed of interlocking loops, which may form either a lateral pocket (W^{LP}) twin or twinned loop (W^t) pattern. Each has two triradii and the two types of whorls are morphologically similar. Complex patterns, which cannot be classified as one of the above patterns, are called accidental (A)/(W^{acc}). They represent a combination of two or more configurations such as a loop and a whorl, triple loops and other unusual formations.[4]

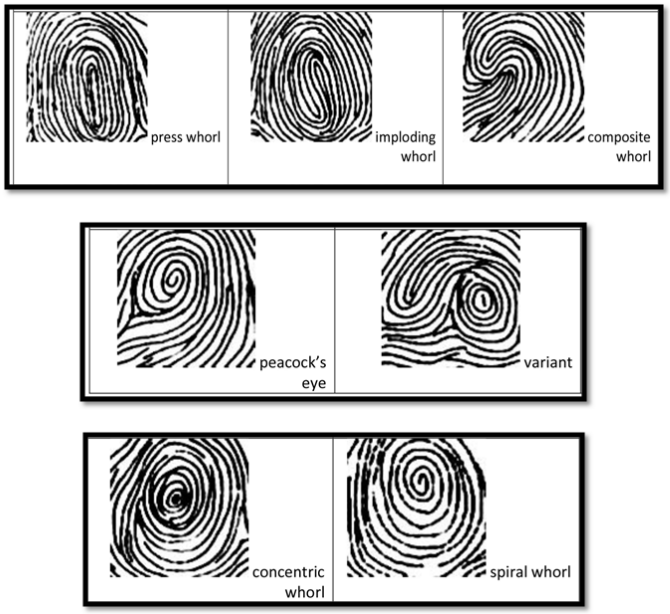

Figure 4 Whorl Patterns

Dermatoglyphic Landmarks

The three basic Dermatoglyphic landmarks found on the fingertip patterns are

1. Triradii
2. Cores
3. Radiant.

Triradius

It is formed by the confluence of three ridge systems. The geometric center of the triradius is designated as a triradial point. It is the meeting point of three ridges that form angles of approximately 120^0 with one another. The triradial point forms one terminus of the line along which ridges are counted. Sometimes, large patterns are extralimital. These are commonly observed in the hypothenar areas of the palms and the hallucal areas of soles.[4]

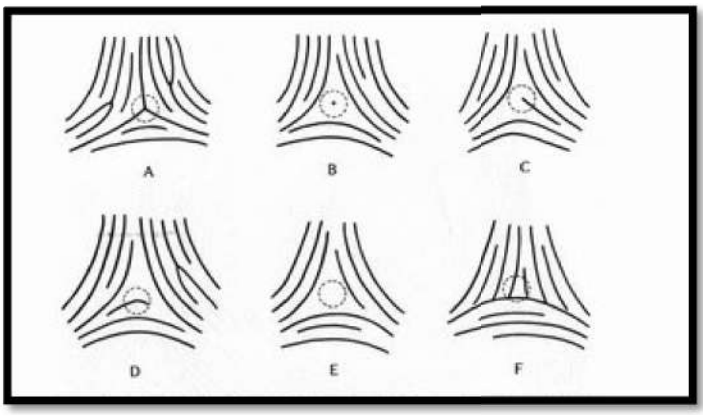

Figure 5 Different Typpes of Ridge Arrangement In The Area of A Triradius

Core

It is in the approximate center of the pattern. The core may be of different shapes.

1. In a loop pattern, the core is usually represented by a straight, rod like ridge or a series of two or more such parallel ridges, over which other recurving ridges pass. If a straight ridge is absent in the center of the loop, the innermost recurving ride is designated as a core.
2. In a whorl, the core can appear as a dot or a short ridge (either straight or bent) or it can be shaped as a circle or an ellipse in the center of the pattern.[4]

Figure 6 Core Arrangement

Radiants

These are the ridges that emanate from the triradius and enclose the pattern area. These ridges constitute the 'skeletal' framework of the pattern area.[4]

Palmar Pattern Configuration

In order to carry out dermatoglyphic analyses that can be compared in different individuals, the palm has been divided into several anatomically designed areas. It includes thenar area, four interdigital areas and hypothenar area.[5]

Thenar and first interdigital areas: (Th / I1)

There is no pattern in the Th / I1 area, but the ridges follow a mild curve around the base of the thumb. Sometimes, the simple flow is disturbed by an area of abruptly disarranged ridges, which are oriented at an angle to the general direction of other ridges in the area. They do not form a true pattern. Hence, this configuration is called a vestige.[5]

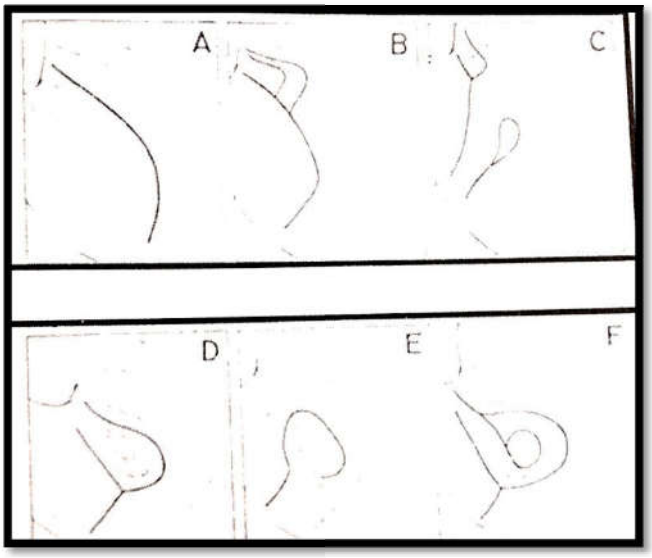

Figure 7 Thenar / First Interdigital Area Pattern

A. Open field / open field B. Open field / vestige C. Loop / Loop
D. Loop / Open Field E. Vestige / Open Field F. Whorl / Open Field

Second, third and fourth interdigital areas

These areas are found in the distal palm in the region of the heads of the metacarpal bones. Each interdigital area is bordered laterally by digital triradii. Digital triradii are labeled a,b,c and d. The second interdigital area (I2) lies between triradii a & b, the third interdigital area (I3) between triradii b & c, and the fourth interdigital area (I4) between triradii c & d. If a digital triradius is absent, the midpoint of the base of the corresponding digit can be used to separate the interdigital areas.Configurations encountered in the interdigital regions are loops, whorls, vestiges and open fields.[5]

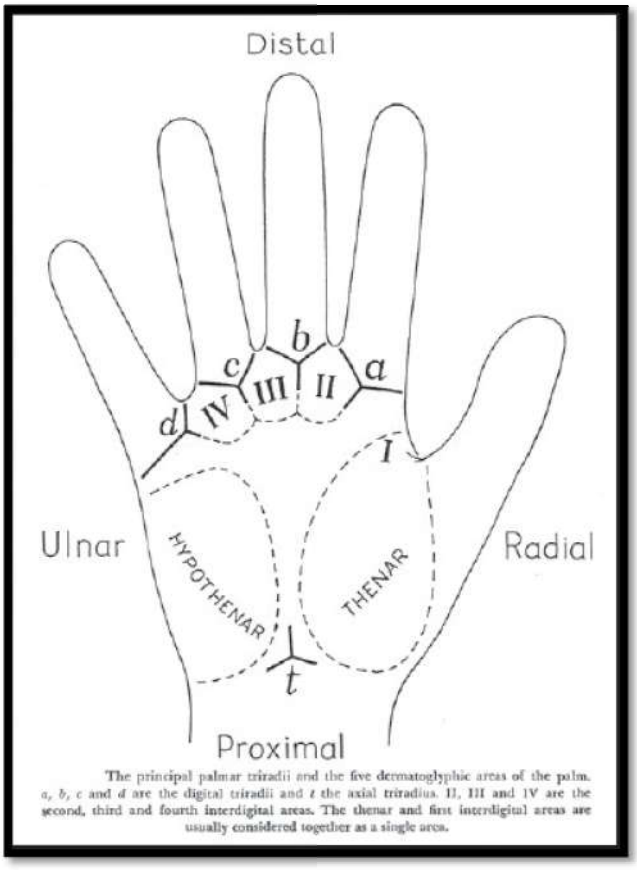

Figure 8 Interdigital areas

Hypothenar area

True patterns are commonly present in the hypothenar area *(*Hy). The patterns are whorls, loops, and tented arches. Simple arches, open fields, vestiges and ridge multiplications also occur. The triradius or triradii close to the palmar axis are termed axial triradii (t) symbols t, t' and t" are used to designate the position of these triradii in the proximal – distal direction on the palm.[5]

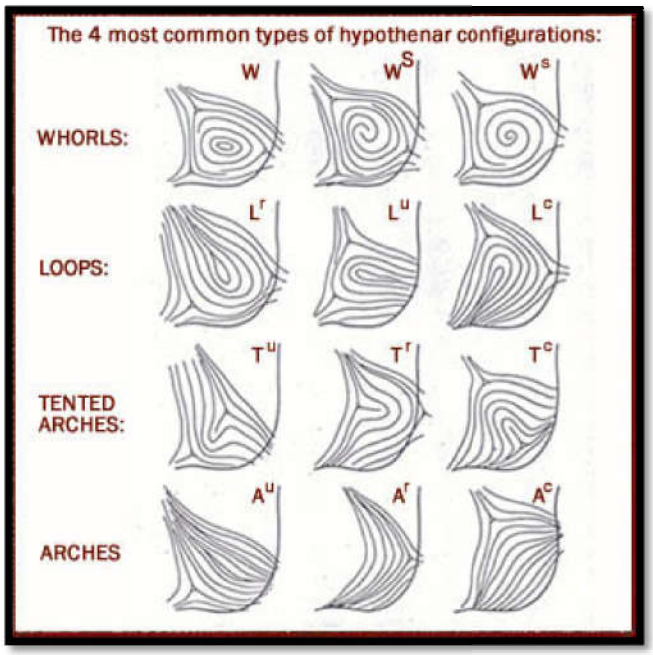

Figure 9 Hypothenar Area Configurations

STUDIES IN DERMATOGLYPHICS

Dermatoglyphics in cleft lip and cleft palate

EgleZarakauskaite *et al*., (2004), in their case control study, suggested that there are some significant dermatoglyphic peculiarities in persons with cleft lip and/or cleft palate (CLP) in comparison with control group.[6]

- The patterns on thenar eminence in hands of those with CLP were six times rarer than in controls ($p<0.05$)
- There was a significant difference ($p<0.05$) between the control group and persons with CLP by count of all triradii (controls-98%, CLP-87.3%)
- The main line A ended more often in fields 5' and 5" in persons with CLP incomparison with their parents.
- There were significantly more arches, double loops and ulnar loops in personswith CLP than in control dermatograms.

Scott NM *et al*., (2005) studied dermatoglyphic prints from individuals with non-syndromic CL/P (n=460) and their unaffected relatives (n=254) from the Philippines and China. The significant associations between particular pattern types and CL/P were not the same in both populations. Increased radial and ulnar loops were observed in CL/P patients.[4]

Mathew L *et al*., (2005)studied dermatoglyphic patterns of 100 children between age of 5-15 years with no difference between sexes of which 50 consisted of the study group (non-syndromic children with CL/P) and remaining 50 consisted of control group (healthy children without any anomalies). It was observed that oral cleft individuals had an increased frequency of ulnar loops as the ridge configuration as compared to control group.[4]

Balgir R S *et al*., (2006) studied dermatoglyphic characteristics of 69 cases of CL/P and 28 isolated CP cases. They were evaluated for finger patterns, digital patterns, inter-digital patterns, types of C- and D-line. It showed variations in patients and controls. Wider 'atd' angle (more than 30°) and dermatoglyphic asymmetry were noted in the patient groups. There was also a significant increase in the ulnar loop and arch patterns among the CP patients.[4]

RunjhunSubhanandSaxena *et al*., (2013) studied 294 subjects (48 cleft subjects and 50 healthy controls with both their parents) and found increased frequency of loops and arches and low mean total ridge count in cleft subjects. Increased frequency of loops and arches with decreased frequency of whorls, mean total ridge count, and atd angle of right hand was found in parents of cleft group as compared with the parents of the controls.[4]

Dermatoglyphics and dental caries

MetinAtasu *et al*., (1992) studied dermatoglyphic configurations in caries-free students and the students with extensive caries and found there was significant difference in dermatoglyphic patterns in these two groups as caries free students had more ulnar loops on the fingertips and the students with extensive caries had more whorls on the finger tips.[4]

A Sharma *et al*., (2009) studied to determine if there is any significant correlation between salivary bacteria interactions, dermatoglyphics, and dental caries. In this study, a total of 90 subjects were evaluated and found that the subject group had positive correlation with loops and Streptococcus mutans growth likened to control group that had negative correlation with both.[7]

Dermatoglyphics and potentially malignant disorders and oral carcinomas

ElluruVenkatesh (2006) carried out a study to determine whether specific dermatoglyphic patterns exist which help in predicting the occurrence of oral squamous cell carcinoma and oral leukoplakia. This study comprised of 30 subjects with oral squamous cell carcinoma, 30 subjects with oral leukoplakia and 30 individuals with habits and no lesions as controls. Arches and loops were more frequent in cases than in controls, whereas whorls were more frequent in the control group ($p<0.01$). Loops were at higher frequency in the inter-digital areas in cases than in control ($p<0.05$) and the distribution of hypothenar and thenar pattern was statistically insignificant. Similarly there was no correlation between atd angle, ab count, total finger ridge count and oral leukoplakia and oral squamous cell carcinoma. However this study concluded that dermatoglyphic patterns may have a role in identifying individuals either with or at risk for developing oral leukoplakia and oral squamous cell carcinoma.[8]

A prospective study was carried out by Tamgire DW *et al*., (2013) to collect the dermatoglyphic prints of the gutkha chewers with and without Oral Submucous Fibrosis (OSMF). Study consisted of 200 subjects divided into two groups. Group A consisted of 100 gutkha chewers without OSMF and group B consisted of gutkha chewers with OSMF. The results showed a highly significant decrease in simple whorl pattern

with increase in composite whorl pattern on left little finger in Group B as compared with Group A, decrease in composite whorl pattern of right index finger in Group B when compared with Group A, increase in simple whorl pattern on right thumb in Group B when compared with Group A, increase in composite whorl pattern on left thumb in Group B as compared with Group A and decrease in radial loop on left index finger in Group B when compared with Group A.[7]

Dermatoglyphics and bruxism

With the aim to examine the dermatoglyphic patterns of finger and palm, 38 bruxism patients, 18 being female were studied by Polat MH *et al*., (2012). Bruxism patients demonstrated an increase in frequency of whorls, I loops, and t tri-radii. There was decrease in frequency of ulnar loops, atd angle, IV, H and t" tri-radii than the controls. Furthermore, the main line A ended more frequently in sector 5' in bruxism patients when compared with controls. There was no significant difference between the total finger ridge counts and a-b ridge counts the subjects with bruxism and that of the controls. This study summarized that when combined with other clinical features in bruxism, dermatoglyphics can serve to strengthen a diagnostic impression.[7]

Dermatoglyphics and malocclusion

Reddy S *et al*.,(1997) conducted a study using dermatoglyphics to predict and compare Class I, Class II, div. 1, div.2 and Class III malocclusions. A total of 96 subjects were divided into 3 malocclusion groups, i.e. Class I (control group), Class II, div.1, div.2 and Class III (experimental group) in the ages of 12-14 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 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.[9]

Another study was conducted by Tikare S *et al*.,(2010) to assess the relationship between fingerprints and malocclusion among a group of high school children. A total of 696 high school children aged 12-16 years were randomly selected. The authors found a statistical association between whorl patterns and classes I and II malocclusion ($p<0.05$). However, no overall statistical association was observed between fingerprint patterns and malocclusion ($p>0.05$).[7]

Dermatoglyphics and periodontal diseases

Atasu M *et al*. (2005) conducted a study with the aim of finding a finger-tip pattern type that would identify the patients with periodontal diseases (PD's). When the finger-tip patterns of the patients were compared with those of Periodontally Healthy (PH) individuals, the decreased frequencies of twinned and transversal ulnar loops on all fingers of the patients with Juvenile Periodontitis (JP), a 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), and the increased frequencies of concentric whorls and transversal ulnar loops on all fingers of the patients with Adult Periodontitis (AP), an increased frequency of the tri-radii on the palms and soles of the patients with JP were found. 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 the identifying of the patients from distinct groups of PD's.[10]

CONCLUSION

A question, asked today is **"**Is dermatoglyphics enough"? Some see dermatoglyphics, stagnating, as a field and unable to generate new thought-provoking hypothesis, because of the lack of development of new technologies and methodologies. Others, see dermatoglyphics truly, as a science in transition with the ability to formulate new thinking, develop new methods and able to utilize new technological advances in order to answer many of the remaining questions and challenges and to pose new ones.

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