Dermatoglyphics –A Curtain To Periodontal Cachet

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DOI: 10.29322/IJSRP.9.08.2019.p9207
http://dx.doi.org/10.29322/IJSRP.9.08.2019.p9207

Abstract- Periodontal disease compromises a wide range of inflammatory condition that affect supporting structure of teeth. To minimize the progression of periodontal disease early detection is crucial. Traditional periodontal parameters have its own limitation. Hence newer diagnostic methods are under research to overcome the difficulty with conventional methods. Dermatoglypics stands out to be an unexplored field in diagnosing various diseases including periodontal diseases. This review highlights the role of palmar dermatolglypics as an early predictor for periodontal disease.

Index Terms- Dermatoglypics,Periodontitis,Whorls,Loops And Fingerprints

I. INTRODUCTION

Periodontitis is an inflammatory disease affecting the supporting structure of tooth as a result of host microbial interaction. It is multifactorial in origin. Early detection of this disease is pivotal since it allows to minimize the dynamics of progression of disease[1].Traditional periodontal diagnostic parameters used clinically include probing depths, bleeding on probing, clinical attachment levels, plaque index, and radiographs assessing alveolar bone level. However, along with these conventional techniques, newer diagnostic methods are under research to overcome the difficulty of sample collection, patient psychology, fear of dental instrument and ease of predicting disease progression. In Periodontology, Dermatoglypics stands out to be an unexplored field with vast potential in estimating disease progression and treatment prognosis.

Dermatoglypics are the patterns or the skin ridges on the pads of fingers which represent a person's finger prints. Sir Francis Galton in 1892, published his works on fingerprints[2]. He put forth a rule called 'evidence of no change', which states that an individual's ridge patterns remain consistent throughout his/her lifetime. This hypothesis was later coined as 'Dermatoglyphics' by Dr Harold Cummins and Charles Midlo who detailed the concept as the study of definite ridge patterns on the fingers, palms and soles[3]. The term comes from two Greek words (Derma = skin; Glyphe = carve) [3]. It refers to the formation of epidermal skin ridges on volar pads**.** The formation of these ridge patterns occurs in the 6-7th week of the embryonic period and terminates around the 20th week of gestation. [4] It is believed due to external pressure of amniotic fluid on body and internal blood pressure on extremities. During early embryogenesis, the directions of the epidermal ridges which develop on the volar surfaces of soles, palms and ridges are determined. Above the proximal end on the distal metacarpal bone volar pads appear like a mound shaped elevations on each finger. The size and position of these pads are responsible for the shape and formation of the ridge patterns[5].Seven genes are at least thought to be involved in finger ridge formataion[5].The patterns of nervous system, the genes encoding for the layers of skin, the amount of buckling instability and other factors determine an individual's specific unique set of fingerprints.

In dentistry, evaluation of dermatoglyphics has been associated with several disorders like, hereditary gingival fibromatosis, cleft lip/ palate, bruxism, dental caries etc. Genetics has been linked with periodontitis since ancient times. However, the method used to establish the genetic basis of periodontitis are unavailable at most times and are expensive as well.

Dermatoglypics have a strong inheritable genetic connection and can be used as diagnostic tool for oral disease and other disease whose aetiology may be influenced directly or indirectly by genetic inheritance[7] .Numerous studies has pointed out the genetic etiology of periodontal disease -Kornman *et al*. studied genetically determined polymorphism in interleukin-1 (α andβ), tumor necrosis factor-α, CD14 promoter region and shown them to be risk factors for chronic periodontitis.[8]; Another study by Atasu et al also concluded strong correlation between dermatoglypics and Aggressive periodontitis[9].

Every man is unique so does his fingerprints. Dermatoglyphics has come to be recognized as a potent tool in identification of patients with definite group of periodontal disease. The earliest detection of disease is the key for a successful treatment plan. With the advent of newer techniques of diagnosis, this can throw light into the future of treatment modalities

II. PRINCIPLE OF DERMATOGLYPICS

Fingerprint has three important principles [9]:

A): It is an individual characteristic
B): It will remain unchanged during individual's lifetime
C); It have general ridge patterns which help to classify systematically

III. CLASSIFICATION OF FINGERPRINTS

In 1892, as stated by Sir Francis Galton, fingerprints are classified as Arches, Loops, and Whorls. The classic and widely used syllabary is A= arches; Lr = radial loops; Lu= ulnar loops; and W= whorls [9] (Figure 1)

Arches(A): It is the simplest pattern found on fingertips and least frequent pattern, which pass across the finger with slight bow distally. These are parallel ridges that traverse the

pattern area and form a curve that is concave proximally. It makes about five percentage of pattern. They can be either plain arch or tented arch.(Table 1)

ii) Loops(L): It is the most common pattern on the fingertip and accounts for about 70%of population. These involves series of ridges enter the pattern area on one side of the digit, recurve abruptly, and leave the pattern area on the same side. The loop pattern is subdivided into two types: ulnar and radial loops .(Table 2)

Based on size and shape they can be classified as large or small, tailor short, vertically or horizontally oriented, plain loop or double loop. Transitional loops can occasionally resemble whorls or complex patterns.

iii) Whorls: It accounts for 25 to 35% of fingerprints. They make a turn through at least one circuit. Subtypes of whorl patterns include:(Table 3)

IV. DERMATOGLYPHIC LANDMARKS

Dermal ridges configuration has be classified into three major group: Tri –Radius, Core and Radiant (Table 4) [9]
The whorls contain two triradii, while loop possess only one triradius. On the other hand, triradius is absent in arches. Therefore, these patterns may be identified from the occurrence of triradius

V. PALMAR PATTERN CONFIGURATION

To compare dermatoglypics analyses in different individuals, the palm has been classified into severally anatomically designed thenar areas; 1st, 2nd, 3rd, and 4th interdigital areas; and hypothenar area[10]

Ridge counting: Ridges are often counted between triradius and centre or core of the pattern The ridge counts most frequently obtained is between triradii a and b and is referred to as the a–b ridge count. •

atd angle: This angle is formed by lines drawn from the digital triradius (a) to the axial triradius (t) and from this triradius to the digital triradius (d). The more distal the position of “t,” the larger the atd angle. Sometimes, accessory “a” or “d” triradii are present on the palm.

VI. TECHNIQUES FOR RECORDING PATTERNS

Fine quality fingerprints patterns are recorded using different methods as follows[11]

1. **1.Transparent adhesive tape method:** Dry colouring pigments like chalk, ink or graphite are applied on hands. Strips of Scotch® tape is then used to duplicate the hand prints. The prints are recorded by a process called "Lifting". However, recording of the entire hand with accuracy can be a difficult
2. **2.Photographic method:** Polaroid camera is used to capture the magnified image that is formed based on the principles of total internal reflection It is expensive.
3. **3.Numerical method:** This method requires professional expertise in analysing fingerprints. Algorithm of synthesis of images of fingerprints is used to create all possible arrangements of ridges called minutiae. The digital coding of the fingerprint helps in assessment and cataloguing all intricate patterns.
4. **4.Faurot inkless method:** Commercially available patented solution is used to record prints on sensitised paper. Shortcoming is availability.
5. **5.Biometrics method:** This procedure involves scanning of hands and palms with a video camera followed by digitizing the print features which are then subjected to analysis. It is an expensive technique

6.Inkpad method*:* The finger prints are recorded by pressing on the stamp pad turn by turn. The prints are usually smudged and there is loss of clarity.

6.The ink and roller method: This technique was reported by Cummins and Midlo.It utilises printer’s ink, commonly known as duplicating ink. The ink is spread on a sheet with a roller, and fingers and palm are pressed onto the sheet. The ink smeared hands are then transferred on paper. This is an inexpensive and rapid method to register clear, smudge free fingerprints. These prints get dried easily and can be preserved for future use. Also, the ink can be easily removed after the procedure. It is most commonly employed to record fingerprints

VII. ADVANTAGES

- Minimally invasive technique,
- Cost -effective,
- Less discomfort to the patient
- Less chair side time
- Data collected remains unchanged lifelong and only minimum equipment’s are required

VIII. LIMITATIONS

- Technique sensitive: Appropriate quantity of ink should be dispensed to avoid thick and thin prints
- Genetic deformity, Amputations, and Syndromes affect the registration process.

IX. APPLICATIONS OF DERMATOGLYPICS

Dermatoglyphics are of considerable importance in anthropology, criminology, medicine, chromosome abnormalities such as Trisomy 21, Turners syndrome, Klinefelter syndrome, and also plays a significant role in disease affecting the oral cavity.

X. DENTAL CARIES

Dental caries is a global problem. Earlier detection of dental caries will enable earlier preventive measures. Many studies have reported a significant association between dermatoglypics and early stages of dental caries**.** Sharma and Somani[14] reported that dental caries due to abnormality in tooth structures like alterations in the structure of dental enamel, tooth eruption and development may be reflected in dermatoglypics patterns. A high significant difference in loops pattern and

microbial growth between the subject (caries) and control groups was also noticed. Padma et al[15] in their study evaluated the dermatoglyphic variation and caries activity in deaf and mute children and found an increased frequency of whorl pattern in caries group and increased frequency of loops in caries free group. Chinmaya et al[16] reported that central pocket whorl and twinned loops have an association with an increase in dental caries experience.

Malocclusion –

Malalignment of teeth in both the arches showed a significant variation in dermatoglypics patterns. This association between Dermatoglyphics and dental occlusion is due to the fact that the development of dentition and the palate occurs during the same period as the development of dermal patterns. Tikare et al[17] assessed the relationship between fingerprints and malocclusion among a group of 696 high school children aged 12-16 years and it revealed a statistical association between whorl patterns and class 1 and 2 malocclusions. However, Reddy et al[18] concluded that arches were found at a higher frequency percentage in class I and class II div I malocclusions, but no significant increase in whorls was noted in class III malocclusions

Precancerous and cancerous lesion

Dermatoglyphics may be of immense clinical significance to segregate those individuals who are at an increased risk of developing these widespread diseases associated with considerable amount of morbidity and mortality. Venkatesh et al[19] did a study to determine the dermatoglyphic pattern in subjects with leukoplakia and oral squamous cell carcinoma and found that among 30 patients diagnosed with leukoplakia, 30.7% had whorls,6.3% had loop and arch type of finger prints and in oral squamous cell carcinoma patients it was found that 60. 7% had loop, 32.3% had whorl, and 7 % had arch pattern of fingerprint. Gupta and Kharjodkar[20] in their study to analyse the palmar dermatoglyphics in Squamous Cell Carcinoma concluded that an increase in frequency of arch and ulnar loop patterns on fingertips, and decrease in frequency of simple whorl patterns on fingertips, decrease in frequency of palmar accessory triradii on right and left hand. Ganvir and Gajbhiye[21] suggested that predominance of whorl type of fingerprint pattern would serve as a candidate screening marker for susceptibility to oral squamous cell carcinoma and oral submucosa fibrosis. Munishwar et al[22] observed a significant increase in loop pattern among gukta chewers with OSMF when compared to the control group. It was thus concluded that subjects with more number of loop patterns are more prone to develop OSMF as compared to those with other patterns. Punith et al[23] in their study on dermatoglyphics also concluded a significant increase in percentage of whorl pattern in OSMF subjects as compared to control group Hence, dermatoglyphics can be used in this modern era to forecast the future of squamous cell carcinoma and oral submucosis, without much intervention.

Bruxism

Bruxism is the involuntary gnashing, grinding or clenching of teeth. Habitual non-functional forceful contact between occlusal tooth surface can be also studied by using dermatoglypics. Polat et al[24] reported an increase in frequency of whorls and a decrease in frequency of ulnar loops in bruxism patients. There was lower frequency of atd angle, and no significant difference between the total finger ridge counts (TRC) and a-b ridge counts.

Cleft lip and palate

Craniofacial defects such as cleft lip and cleft palate are the most common of all the birth defects. In humans the development of primary palate and lip is completed by 7th week of intrauterine life and secondary palate by 12 th week of intrauterine life. The dermal ridges develop between 6th week of gestation and reach maximum size between 12 and 13 weeks[25]. Mathew[26] in his study on significance of dermatoglyphics in children with oral clefts found an increase in ulnar loop patterns in distal phalanges of ten fingers and an increase in 'atd' angle in oral cleft children. Dziuba[27] observed an increase in frequency of ulnar loops and arches and consequent decrease of whorls.

Dermatoglyphics in Patients with Special Needs

A comparative study done among 100 children (50 healthy,50 mentally challenged) reported an increased frequency of loops and increase palmar crease line were observed among mentally challenged children[28]

Application In Periodontal Disease

Dermatoglyphics serve as an early forecasting tool in periodontal disease, as genetics play a key role in the onset of periodontitis. Numerous qualitative and quantitative methods have shown inheritance of dermatoglyphics to have great resemblance among monozygotic twins and reasonably strong inheritance among siblings and parents. A study performed by Yilmaz et al[29] on 36 early onset periodontitis patients and 20 adult periodontitis patients and 20 periodontally healthy individuals observed that, offspring of chronic periodontitis patients have a high prevalence rate of periodontal breakdown, suggesting a strong familial influence.

Disturbances in the ectodermal layer may manifest itself in both development of skin ridges and the tooth with its periodontium and create a link between dermatoglypics and anomalies of tooth and periodontium. Hence dermatoglypics can be used with other diagnostic methods for early detection of patients with distinct group of periodontal disease. [30]

A Comparative study done by M. Atasu et al[8] among periodontally healthy subjects and patients with periodontitis, observed that patients with juvenile periodontitis, has decreased frequency of twinned and transversal ulnar loops on all fingers, 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 progressing 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 triradii on the palms of the patients with Juvenile Periodontitis(JP), increased frequencies of IV and H loops and triradii on the palms of the patients with RPP and an increased frequency of triradii on the soles of the patients with JP were also found. This is also in accordance to the study conducted by Babitha et al[30]

Soumya et al[31], reported significant increase in the whorl pattern in chronic periodontitis patients. Among the whorl pattern,

central pocket whorl pattern was significantly increased. And the second most common pattern found in the chronic periodontitis patients was the loop pattern. Among the loop pattern, ulnar loop pattern was found to be increased. However, Kranti K at al[33] in their study stated that in spite of ulnar loop pattern being the commonest in both periodontally healthy and periodondally diseased individuals the findings were not significantly coherent. These studies have proved in formulating counselling messages based on dermatoglyphic pattern prevalent among young generation and their possible stimulation to determine the young people's likelihood to develop chronic periodontitis.

XI. CONCULSION:

In Periodontology, Dermatoglypics can be used as a potent bio-indicator for predicting the susceptibility of various diseases like chronic periodontitis due to its genetic nature and wide spread familial tendencies. It also provides a window of hope in establishing more non-invasive techniques and procedures in early diagnosis of periodontal diseases. However, long term studies involving wider range of subjects need to be conducted to help in determining the sensitivity and specificity of the current studies so that dermoglyphics can be also used as a tool for educating and counselling potential patients about their likelihood to develop various periodontal diseases at a later stage in life.

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TABLE 1- Types of Arches

a)Simple or plain arch	Ridges that starts on one side and ridge then slightly cascades upward . A consistency of flow can be observed in this pattern
b)Tented arch	Composed of ridges that starts on one side of finger and flows out to other side in similar pattern.

TABLE 2- Types of Loops

a) Ulnar loop(Lu)	composed of ridges that open on the ulnar side.
b) Radial loop(Lr)	composed of ridges that open on the radial side.

TABLE 3- Different Forms of Whorls

a) Plain/simple/concentric whorl–	Simplest and commonest form of whorl. It composed of ridges that make a turn of one complete circuit which are arranged as a succession of concentric rings or ellipses.
b)Central pocket whorl	a pattern containing a loop within which a smaller whorl is located. These whorl ridge make one complete circuit and may be oval, spiral or any variant of circle They are also classified as ulnar or radial according to the side on which the outer loop opens.
c)Lateral pocket/twinned loop pattern	Pattern composed of interlacing loops
d) Accidentals/complex patterns	These are patterns that match the characteristic of particular whorl subgrouping.

TABLE 4

Tri-radius:	It is formed by the confluence of three ridge systems. Geometric center of triradius is called as tridial point. It forms an angle of 120 degree with another
Core	It is surround by fields of ridges that turn back themselves at 180 degree
Radiant:	They emanate from the tri-radius and enclose the pattern area

FIGURE 1

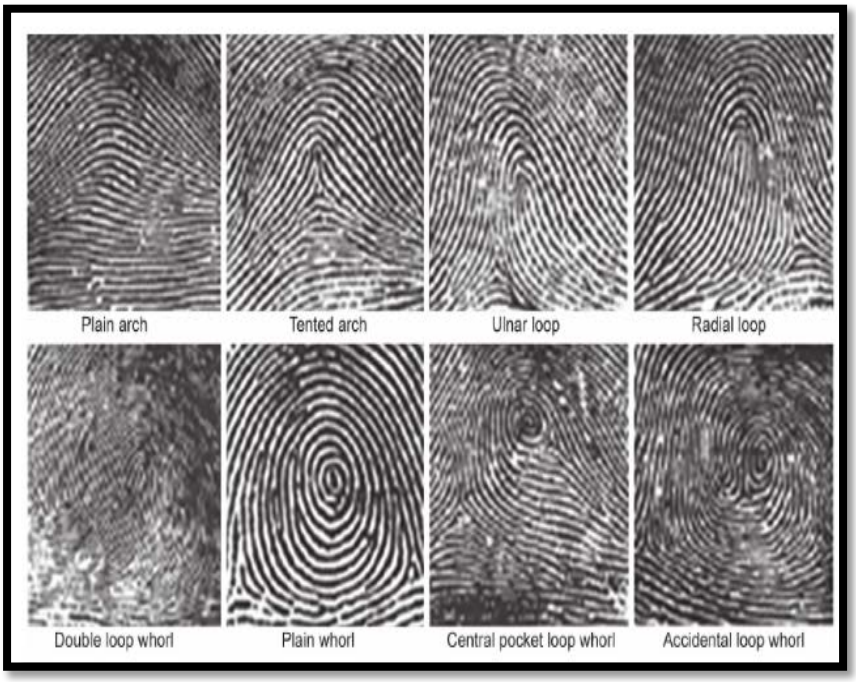

Figure 1: Finger Prints Patterns And Classification-FBI Identification Division-1957