Dermatoglyphics in Oral and Systemic Diseases

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ABSTRACT

Background: Dermatoglyphics refers to the study of epidermal ridge patterns of fingers, palms and soles of hand and feet. Fingerprint develops completely at 24th week of embryonic life. Once formed, they are permanent and unalterable throughout the life, not affected by environmental factors. As dermatoglyphic patterns are assumed to be associated with genetic factors, the idea of using it as supportive evidence in the diagnosis of hereditary disorders becomes a reality, although the exact mechanism of inheritance is still unknown. Serious medical and dental diseases like cancer, diabetes, heart diseases and hypertension, dental caries, periodontitis, and malocclusion had also been studied for early prediction. So, hypothetically some association between particular dermatoglyphics pattern of these patients are expected, that aids the clinician to initiate early preventive measures. Hence, the present paper reviews the brief knowledge on dermatoglyphics.

Keywords: Dermatoglyphics, Embryonic, Environmental, Epidermal ridge, Fingerprints, Genetic, Hereditary, Inheritance, Knowledge.

INTRODUCTION

The word dermatoglyphics is derived from two Greek words derma and glyphae, derma means skin and glyphae means carvings. Dermatoglyphics refers to the scientific study of epidermal ridge patterns found on the volar pads of fingers, palms and soles of hand and feet. The volar pads are elevation at the distal metacarpal bone of each finger. The epidermal ridges are formed due to continuous friction occurring in the above areas. The primary ridge forms the dermatoglyphics pattern. Secondary ridges are modified into sebaceous glands and are found above primary ridges. The epidermal ridges of the hand and feet were first studied by Joannes E Purkinje in 1823. William Hershel in 1858, first introduced fingerprints in India for personal identification. Sir Francis Galton in 1892, published the first book on fingerprints. Cummins and Midlo in 1926 were the first to coin the term dermatoglyphics. Sir Harold Cummins is acknowledged as father of dermatoglyphics. Fingerprints begin to form at the 6th week of the embryonic life and develops completely at 24th week except the dimensions related to the growth of the body. Once formed, the fingerprints are permanent and unalterable throughout the life except in cases of serious injuries, in which the dermis of hands and feet changes. Not even the monozygotic twins have the same fingerprints. Fingerprints of both hands of same individual are not identical.

Over the past 150 years, dermatoglyphics has been a useful tool in field of anthropology, biology, medicine, genetics, evolution, crime detection, twin diagnosis and racial variation and personal identification. Serious medical diseases, like cancer, diabetes, heart diseases and hypertension had been studied for early prediction by dermatoglyphics. Dermatoglyphics was first studied in cancer field in 1977. This science has also been utilized in diagnosis of many congenital abnormalities, schizophrenia and leukemia. Dermatoglyphics can aid the clinician to early detect health problems in individuals and enables them to initiate early preventive and protective health measures.

ADVANTAGES

The main advantages of the dermatoglyphics are as follows:

- Finger and palm prints scanning or recording can be done rapidly with ease.
- Economical method.
- Noninvasive method without causing any trauma to the patient.
- No hospitalization is required.
- Minimum equipments are needed.
- Data collected can be preserved for longer duration for future references.
- Give better details in children, as they have fine fingerprint prints.

TYPES OF FINGERPRINTS

Plastic impressions: Prints are formed in soft material, like butter, soap, etc.
Visible prints: Prints are formed when fingers are covered in blood, dirt, oil, paint. Latent prints: Prints are not visible to the human eye until chemical is applied.

Methods of Recording Dermatoglyphics

The various methods for recording fingerprint pattern are the following:

Ink method: This is the most widely used method. The equipment includes printer’s ink, a roller, a glass slab, a sponge rubber, and glazy paper. This method is not suitable for uncooperative children and those with very fine ridges. The prints obtained are of poor quality, which do not allow accurate counting of ridges.8

Inkless method: This method was described by Walker. The equipment includes commercially available patented solution and paper. It is not popular currently. The method is good for hands or feet prints with well-demarcated patterns.9

Transparent adhesive tape method: The dry colored pigment, like colored chalk, dust, India ink, standard ink, carbon paper, and powdered graphite is applied to the skin and transparent adhesive tape is used to lift of the prints clearly. This method is inexpensive, rapid and easy to use with all types of patients.8

Photographic method: The principle of total internal reflection is used. When an object is pressed against a prism, the magnified image is photographed by a Polaroid camera. It is an expensive method.7

Special methods: These methods are not widely used. The study of the correlation between the epidermal patterns and the underlying bone structures (radiodermatography), study of sweat pores (hygrophotography), can be done.7

Integrated automated fingerprint identification system: This method scans the fingerprints into a computer database, which transforms it into digital image. Then the unknown prints are identified with several possible matches. This method does not make final verification of print identity, finds closest correlation to the search prints.8

Ultraviolet imaging system: This method do not use any chemical or powder. When ultraviolet light strikes the fingerprint, light is reflected back to the viewer showing the print from its background surface.7

Chemical methods for latent prints visualization:

- Iodine fuming: Suspect material, when kept in closed container with iodine crystals and get heated, vapor reacts with latent print to make it visible. Iodine prints are not permanent.
- Superglue fuming: Superglue when applied on nonporous surfaces of object and get heated after applying sodium hydroxide, produces toxic fumes of cyanide. When fumes and object packed in container for 6 hours, produces white latent print.7

DERMATOGLYPHIC LANDMARKS

The dermatoglyphic landmarks found on fingertips are the following:

Triradius: It is formed by the joining of three ridges that makes angles of 120° with one another.1 The center of the triradius is known as a triradial point. They are commonly located in the hypothenar areas of the palms.10

Core: It is the center of the pattern. It may be circular or elliptical shape in the center of the pattern.10

Radiant (delta): A place where two lines run side by side and then diverge with a significant recurving line which passes in front to form a triangle known as delta. They move from the triradius and enclose the pattern area (Fig. 1).1

The dermatoglyphic landmarks found on palms are the following:

Thenar area: The area which lies anatomically closer to the thumb side on the palm (Fig. 2).
First, second, third and fourth interdigital area: The area which lies in between the interdigital regions of thumb, index finger, middle finger, ring finger and little finger are known as interdigital area.

Hypothenar area: The area which lies anatomically closer to the little finger side on the palm.

[Diagrams showing core and delta on finger and dermatoglyphics landmark on palm]
Triradii point a, b, c, d, t: The center point present at the base of index finger, at the base of middle finger, at the base of ring finger, at the base of little finger are known as triradii point a, b, c, d and center point present near wrist is known as triradii point t.11

DERMATOGLYPHICS QUALITATIVE ANALYSIS

Patterns of Finger Ridge

The finger ridge patterns are of three types: arches, loops, and whorls (Figs 3A to D).

Arches: It is the simplest type of pattern. It has no delta. It is formed when one or more epidermal ridges enter from one side of the pattern area and exit from other side forming a arch like curve at the center. The curve of arch may be low or high. The arch pattern is further of two types:

- Simple or plain arch is formed by the ridges that cross the fingertip from one side to the other with little recurving at the center.
- Tented arch is formed by the ridges that cross the fingertip from one side to the other with a tent like elevation at the center.

Loops: It is the most common type of pattern. It consists of core and one delta. It is formed when one or more epidermal ridges enter the pattern area from one side, recurves and exit from the same side. The loop pattern is further of two types:

- Ulnar loop is formed by the ridges that enter the pattern area, recurves and exit from the little finger side.
- Radial loop is formed by the ridges that enter the pattern area, recurves and exit from the thumb side.

Sometimes, transitional loops is formed which is similar to complex whorl patterns.

Whorls: It consists of core and two deltas. The whorl patterns are further of four types (Figs 4A to C):

- Plain/simple/concentric whorl is formed by the loop that surrounds the core in concentric rings pattern and touches or cross the line joining the two deltas.
- Double Loop whorl is formed by two loops and two deltas.
- Central pocket whorl is formed by a small loop, which do not cross the line joining the two deltas.
- Accidentals/complex pattern is formed differently from the above whorl pattern.1,12

DERMATOGLYPHICS QUANTITATIVE ANALYSIS

Many dermatoglyphic characteristics can be described quantitatively (Fig. 5):

Ridge counting: The number of ridges counted from core to the delta is known as ridge count. Total finger ridge count: The total number of ridges is counted from core to delta in all the 10 fingers of an individual is known as total finger ridge count.
Measuring the distances:

**ab palmar distance**: A straight line is drawn and measured between triradii point a and b.

**bc palmar distance**: A straight line is drawn and measured between triradii point b and c.

**cd palmar distance**: A straight line is drawn and measured between triradii point c and d.

**ad palmar distance**: A straight line is drawn and measured between triradii point a and d.

Measuring the angles between specified points:

**atd angle**: Triradii point a, t and d is joined with a scale to form a triangle, and atd angle is calculated by protractor.

**adt angle**: Triradii point a, t and d is joined with a scale to form a triangle and adt angle is calculated by a protractor.

**dat angle**: Triradii point a, t and d is joined with a scale to form a triangle and dat angle is calculated by a protractor.

**USE OF DERMATOGLYPHICS IN DENTISTRY**

The uses of dermatoglyphics in dentistry are as follows:

**Dermatoglyphics in cleft lip and palate**: Zarakauskaite E et al in 2004 found significant increase in arches, double loops and ulnar loops in cleft lip and palate patients than in control. Scott NM et al in 2005 found increased radial and ulnar loops in cases. Mathew L et al in 2005 found increased frequency of ulnar loops in cases. Balgir RS et al in 2006 found wider atd angle of more than 30° in cases. Increased ulnar loop and arch patterns among the cleft palate patients were also found. Saxena RS et al in 2013 found increased loops and arch pattern and low mean total ridge count in cleft patients.1

**Dermatoglyphics in dental caries**: Their patterns showed increased whorls, higher total finger ridge count and higher interdigital radial and ulnar loops.3 Padma et al in 2011 evaluated the dermatoglyphic patterns of deaf and mute children and found that caries group had increased whorl pattern while caries free had increased loop pattern. Sharma A et al in 2009 found significant difference in loops between the caries and caries free group.5

**Dermatoglyphics in periodontal diseases**: Atasu M et al in 2005 found decreased frequency of ulnar loops on all fingers and increased frequency of t triradii on the palms of the patients with juvenile periodontitis, 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, and the increased whors and ulnar loops pattern on all fingers of the patients with adult periodontitis.2

**Dermatoglyphics in potentially malignant disorders and oral carcinomas**: Tamgire DW et al in 2013 studied the dermatoglyphic prints of gutkha chewers with and without oral submucous fibrosis (OSMF). He found that there was decrease simple whorl and increase composite whorl pattern on left little finger, decrease composite whorl on right index finger, increase simple whorl on right thumb, increase composite whorl on left thumb, and decrease radial loop on left index finger in gutkha chewers with OSMF. Elluru Venkatesh in 2006 studied the dermatoglyphic patterns of oral squamous cell carcinoma, oral leukoplakia and individuals with habits and no lesions as controls. Arches and loops were increased in cases than in controls that had more whorl pattern. Loops were increased in the interdigital areas in cases than in control. adt angle, ab count and total finger ridge count had no relation among the cases.1

**Dermatoglyphics in bruxism**: Polat MH et al in 2012, found increased whorls pattern and t triradii and decreased ulnar loops and atd angle than the controls. Total finger ridge counts and a-b ridge counts were almost similar in both study and control group.1
Dermatoglyphics in malocclusion: Reddy S et al in 1997 found that class II, div\(^1\) and div\(^2\) patients had increased arches, ulnar loops and decreased whorls pattern, while class III patient had increased arches, radial loops and decreased ulnar loops pattern taking class I as control group. Tikare S et al in 2010 found correlation between whorl patterns in classes I and II malocclusion.\(^3\)

Dermatoglyphics in Kanner’s syndrome: These patients have increased frequency of arches in fourth and fifth fingers of right hand and first finger of left hand, and decreased frequency of arches, radial loops and ‘atd’ angle in both hands.\(^4\)

Dermatoglyphics in Down’s syndrome: Their pattern showed increased frequency of creases, bilateral radial loops on digits of ring and little finger and increased ulnar loops.\(^4\)

Dermatoglyphics in hypoparathyroidism: Their pattern showed increased arch.\(^4\)

Dermatoglyphics in Rubinstein Taybi syndrome: Their pattern showed four or more bilateral arch pattern.\(^4\)

Dermatoglyphics in obsessive compulsive disorder: Balgir RS et al in 2001 studied patients with obsessive compulsive disorder and found significant increase in the ulnar loop with a ridge count of 2 to 3 on the forefinger, and a proximal crease on the palm of the patients than in the control.\(^4\)

Dermatoglyphics in genodermatosis: Kuklin VT in 2001 studied the dermatoglyphic patterns and found dermatoses patients had suppressed loop pattern than the control. Blackwell D in 2002 found significant increased in the ulnar loop pattern in dairers diseases. Cusumano D in 2003 studied the dermatoglyphic patterns of atopic dermatitis and found significant higher whorl pattern in the atopic group than in control.\(^4\)

Dermatoglyphics study in Schizophrenia: Their dermatoglyphic pattern showed increased number of arches and loops and less whorls.\(^3\)

Dermatoglyphics in cancer studies: A study showed decreased radial loop patterns on the first, second, third and fourth digits of the left hand, and the second digit of the right hand in squamous cell carcinoma. In another study, it was found that male’s right hand had increased radial loops while female’s left hand had an increased atd angle in acute myelogenous leukemia. Menser MA et al found increased arches and decreased ulnar loops in acute blast cell leukemia.\(^10\)

Dermatoglyphics to identify different blood groups: The dermatoglyphic patterns in different blood groups were studied and it was found that, whorls pattern was predominantly associated with in B blood group, while loop pattern was most commonly found in candidates with O blood group. Arch pattern was predominantly associated with AB blood group. RH negative blood group had more arches than RH positive blood group.\(^14\)

Dermatoglyphics and hypertension: A study showed that total finger ridge count of more than 1000 with increase whorl pattern (100% in first right digit of males) are found in patients with essential hypertension. Another study showed that hypertensive male and female had increased whorls and total finger ridge count and decreased ulnar loops and ‘atd’ angle in both hands.\(^15\)

Dermatoglyphics in myocardial infarction: Jalali F et al in 2002 studied the dermatoglyphic patterns of myocardial infarction patient and found 7.2% arch, 46.8% loop, and 46% whorl type pattern. In control, they were 3.7, 50.7 and 45.5% respectively. Arch pattern was significantly increased in left thumb, left forefinger and left ring finger in the patients.\(^4\) Another study showed that the patients showed increased whorl pattern, decreased mean total finger ridge count, increased a-b, c-d ridge counts and decreased b-c ridge count. Mean atd angle was wider in the MI patients than that of the controls.\(^16\)

Dermatoglyphics in diabetes mellitus: In diabetic patients frequency of whorls was significantly increased, while frequency of ulnar loops was significantly decreased in cases as compared to controls. Arches, radial loops and Atd angle showed no significant difference. A-b ridge count is significantly decreased in diabetics. C line type also showed significant difference in cases and controls.\(^17\)

Use of dermatoglyphics to identify left handed uniqueness: Left handers have more dominant control of left hand over right hand. The hand which lies closer to the mouth of fetus, determines the handedness. Leucine rich repeat transmembrane neuronal gene on chromosome 2p12 determines the handedness. Schizophrenia disease more likely to occur in left handers. Left handers dermatoglyphics pattern show increased loop, tented arch and plain whorl pattern and decreased simple arch, central pocket and double loop whorl when compared to right handers.\(^3\)

CONCLUSION

The dermatoglyphics plays an important role in forensic sciences as epidermal ridge patterns of hands and feet are last to decompose after death. Different ridge patterns are found in different diseases. By studying these patterns, one can evaluate the significant changes representing the diseases. Dentists may use dermatoglyphics for the early diagnosis and prevention of the diseases by observing the various ridge patterns of an individual. In future, it may serve as an early indicator to predict the future health of an individual.

REFERENCES