

## Review Article

### **Dermatoglyphics, the Hidden Potential in Dentistry- A Review**

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#### **ABSTRACT:**

Dermatoglyphics signifies to the formation of biologically formed ridges on specific body parts namely palms, fingers, soles and toes which is a consequence of continuous friction occurring in these certain areas. Such body parts do not have hair growth resulting in improved contact while preventing slippage. Dermatoglyphics study provides one to analyse a person's potentiality, personality and preferences because of the uniqueness of a person's finger prints. This uniqueness is because of the reason that Dermatoglyphics is the reflection of DNA and therefore cannot change. Finger prints of both the hands are never similar and they do not increase in size except in cases of major trauma. Over the decade of scientific research, these features of hand has come to be taken in consideration as an important tool in the diagnosis of psychological, genetic and various other medical conditions. Epidermal ridge outlines form early in fetal growth and they continue to remain constant through the entire life and hence they could be very helpful to point out towards gene or chromosomal abnormalities. Thus, the dermatoglyphic patterns can be utilized effectively to study the genetic basis of various diseases, as it is a non invasive, inexpensive and effective tool for screening and foretell the probability of occurrence of various diseases. Therefore, present review aims to discuss different pattern of fingerprints and briefly symbolizes the importance of fingerprints in prediction of oral diseases.

**Keywords:** Fingerprints, Epidermal ridge patterns, Dermatoglyphics.

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#### **INTRODUCTION**

Human skin, the largest and delicate organ of the human body can perform many vital functions in life. The soles of the feet and the palms of the hands are covered with two totally distinct classifications of marks. The most conspicuous are the creases or folds of the skin which are of great interest to the followers of palmistry.<sup>1</sup> Cummins in 1926 introduced the term 'dermatoglyphics'. The word 'dermatoglyphics' is a derivative of two Greek words i.e. *derma*, skin and *glyphe*, carve. It refers to epidermal skin ridge formations which appear on the fingers, palms of the hands and soles of the feet.<sup>2</sup> The dermal pattern once formed remains constant throughout life. Dermatoglyphics is viewed as the opening window of congenital anomalies and is a very sensitive pointer of intrauterine anomalies. It is observed that subjects with chromosomal abnormalities had unusual ridge formations. The ridges are influenced by blood vessel-nerve pairs at the border between the dermis and

epidermis during prenatal development and various other factors, such as insufficient oxygen supply, unusual distribution of sweat glands, and alterations of epithelial growths could influence the ridge patterns.<sup>3,4</sup>

The development of dermatoglyphic patterns begins with the appearance of fetal pads in the 6th week of gestation and reaches maximum size between 12th and 13th weeks and ends with the appearance of finished patterns on the surface of the skin in 24th week of gestation.<sup>5</sup> From this stage onward, they are unaffected by the environment, and this signifies their unique role, as an ideal distinguisher for individual identification and the study of populations, as well as detection of defects due to intra-uterine irregularities in the early weeks of pregnancy. The ridges formed are of two types namely primary and secondary ridges. There is an increment in the number of ridges from the adjoining ones and primary ridge formation is responsible for the dermatoglyphics pattern. Secondary ridges are reformed into sebaceous

glands and are found at the tip of primary ridges at regular intervals. Ridges are the areas which decompose in the last after a person dies.<sup>6</sup>

Finger print configurations are determined by multiple genes and the study of finger prints reveal vital genetic and medical information about an individual. Dermatoglyphics studies have been carried out on leukemia, breast cancer, pulmonary tuberculosis etc. Dermatoglyphics in dentistry is becoming a reliable tool for preliminary investigations of oral pathosis with suspected genetic baseline. Significant number of dermatoglyphic researches have been carried out in conditions like Down's syndrome, dental caries, oral clefts, submucous fibrosis. The present review aims to discuss various pattern of fingerprints and briefly mentions the importance of fingerprints in prediction of oral diseases.

**History**

The initial explanation of epidermal contours was circulated at the end of the 17th century, but the study of finger patterns and their use for personal identification was begun by Francis Galton in 1892. The scientific study of papillary ridges of the hands and feet is marked as the beginning with the work of Joannes Evangelista Purkinje in 1823. William Herschel (1858) was the first to experiment with fingerprints in India.<sup>7,8</sup>

Sir Edward Henry (1893) published the book "The classification and uses of fingerprints," commencing a modern era of fingerprint identification.<sup>9</sup>

In Germany, Dr. Alexander Rodewald in 2001 diagnosed a large number of congenital abnormalities with 90% accuracy from the features of the hands alone. Dr. Stowens in 2003, Chief of Pathology at St Luke's Hospital in New York, proves claims to detect schizophrenia and Leukemia with 90% accuracy from the patterns on the hands alone.<sup>10</sup>

**Types of fingerprints**

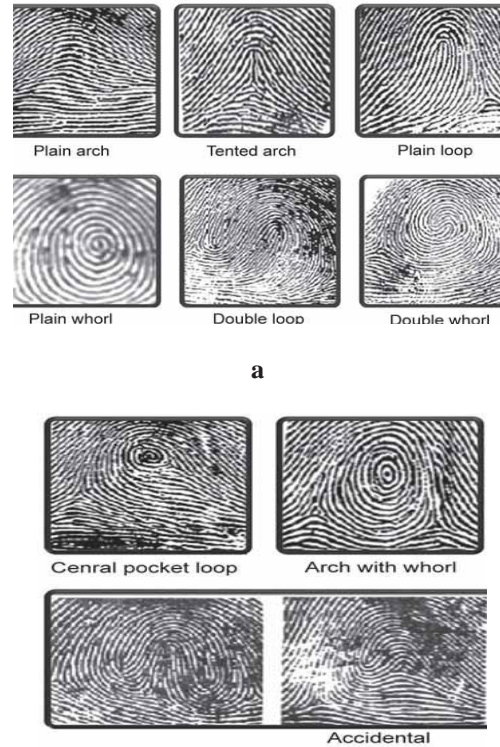
In 1892, Sir Francis Galton published his highly persuasive and prominent book, 'Finger Prints' in which he discussed his classification system based on the number of tri radii. Galton's fingerprint system included three major patterns of finger print types (Figure 1):

I) **Arch:** It is the simplest pattern found on finger tips. It is formed sequentially of more or less parallel ridges, which traverse the pattern area and make a curve that is concave proximally. Arches have no tri radii. Tri-radius is formed by the confluence of three ridge systems at an angle of approximately 120° with one another. Arch pattern is further classified into plain and tented arch.<sup>11</sup>

II) **Loop:** It is the most common pattern on the finger tip. 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. Loops have one tri radius, and are further classified into Ulnar and Radial loop.

III) **Whorl:** It is the type of ridge configuration with two or more tri radii. One tri radius is on radial side 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. The 'whorl' is characterised by a pattern of concentric circles, or a spiral shape - some of the ridges make a turn through at least. This pattern is further segregated into plain whorl; Central pocket loop; Double loop and Accidental whorl.<sup>12</sup>



**Figure 1: Classification of finger pattern**

**Methods of Printing<sup>13, 14</sup>**

The methods used for palm printing is economical and swift.

**Ink method-** One of the most extensively used method. The mandatory equipment consists of printer's ink, a roller, a glass or metal inking slab, a sponge rubber, and good quality paper preferably with a slightly glazed surface.

**Faurot inkless method-** Commercially available patented solution and specially treated sensitized paper is used in this method.

**Transparent adhesive tape method-** In this technique, the print is generated by smearing a dry coloring pigment to the skin and lifting it off with the transparent adhesive tape. The coloring agent may be anything ranging from colored chalk to dust, India ink, standard ink, carbon paper, graphite stick or powdered graphite, common oil pastel crayon, etc. Advantage is prints are clear and not smudged and can be preserved for an indefinite period of time.

**Photographic method-** It is based on the principles of total internal reflection which occurs when an object is pressed against a prism. The magnified image is photographed by a polaroid camera.

**Special methods-** It allows the study of the correlation between the epidermal patterns and the underlying bone structures (radiodermatography), research of sweat pores (hygrophotography) or the study of the spatial shape of the ridged skin areas, for example in primates (plastic mold method).

**Numerical method-** Algorithm of synthesis of images of fingerprints is used and minutiae are created. The model allows looking at digital coding of a fingerprint and also enables mathematical cataloging of minutiae and types of patterns.

### **Dermatoglyphics and oral diseases**

Dermatoglyphics has attracted a lot of attention in the arena of dentistry and has been used to unveil oral diseases such as dental caries, oral cancer, bruxism, malocclusion, various anomalies of teeth, cleft palate, cleft lip, periodontal disease and it also includes dental fluorosis, and also in unveiling truth with forensic odontology.

1. **Down's syndrome:** A marked increase of the ulnar loops on the fingertips is virtually a constant feature of the dermatoglyphics in Down's syndrome.<sup>15</sup>

2. **Cleft lip and cleft palate:** Increased radial and ulnar loops were observed in Cleft lip and palate patients.<sup>16</sup> Maheshwari N et al conducted a study to observe and compare the differences in the dermatoglyphic patterns between cleft lip/palate (CL/P) and normal healthy children and concluded that any deviation in dermatoglyphics features indicates a genetic etiology.<sup>17</sup>

3. **Dental caries:** A Sharma, R Somani (2009) found highly significant difference in loops between the subject (Caries) and control groups, and also increased whorl pattern, total finger ridge count was higher, higher frequency of arches and radial loop in interdigital areas were found.<sup>18</sup>

4. **Cancer studies:** One of the study has found significantly fewer 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 of head and neck cases.<sup>19</sup>

Menser MA, Pervis-Smith SG have reported an increase of arches and a decrease of ulnar loops in the fingertips of a group of patients with an acute blast cell leukemia.<sup>20</sup>

Kumar S et al determined the fingerprint patterns in gutkha chewers with oral submucous fibrosis (OSMF) and in healthy controls without gutkha chewing habit and OSMF and established a marked diminishing of tented arches, ulnar and radial loops, and an increase of simple whorls in OSMF subjects in comparison with normal individuals.<sup>21</sup>

5. **Periodontal disease:** Atasu M et al evaluated dermatoglyphic findings in patients with periodontal diseases and reported that dermatoglyphics could be used together with the other investigative approaches such as clinical and radiological investigations and in the categorizing of the patients from distinct groups of periodontal diseases.<sup>22</sup> Atasu and Akyuz (2005) observed a decreased frequency of twinned and transversal ulnar

loops in fingers of the patients with juvenile periodontitis, a decrease in double loops on all fingers and an increased frequency of radial loops on the right second digits of the patients with rapidly progressing periodontitis.<sup>23</sup>

**6. Forensic odontology:** In a comparative study among 100 children (50-healthy, 50-mentally challenged) an increased incidence of loops and transverse palmar crease line amongst the cerebrally challenged children patients were observed.<sup>24</sup>

### **Advantages**

The major advantages of dermatoglyphics are that scanning or recording is cost effective, rapid and can be done in the clinics without hospitalization and without causing any trauma. It also requires minimum equipment and data collected can be preserved for lifelong.

**Limitations of dermatoglyphics:** It is nearly impossible for the dermatoglyphics patterns to be diagnostically handy if the patient has gross disfigurements of limbs. Care must be taken while recording the prints to rub in the ink material in substantial and enough amounts. A very thin or thick application results in improper prints.

### **CONCLUSION**

The dermatoglyphics are important in forensic sciences due to their important feature that fingerprints are unchanged in due course even after death. Different patterns of fingerprints represent various pathologies. As the dermatoglyphics are genetically driven characteristics, any deviation from normal in dermatoglyphic features indicates a genetic difference between the control and study group population. Though dermatoglyphics is considered an inexact science, it has moved from obscurity to acceptability as a diagnostic tool. Extensive research in this field is required in order to determine the validity.

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