The Link between Fingerprints, Genetics & Chronic Periodontitis: a Dermatoglyphic Study

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Received Date: 10-04-2019; Accepted Date: 10-15-2019; Published Date: 10-18-2019

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Abstract

Background: Several methods have been employed for diagnosing inflammatory conditions including biomarkers, enzymes and various other clinical parameters. Dermatoglyphics is one such field which has gained entry in Forensic Medicine, Forensic Odontology and in General Medicine for diagnosing chronic inflammatory conditions. Periodontitis is a chronic inflammatory condition associated with destruction of periodontal tissues. This study aimed to assess the relationship between the fingerprint patterns and chronic periodontitis

Methods: A total of 60 patients, belonging to both healthy and chronic periodontitis subjects were assessed by a commercially available fingerprint scanner. All the fingerprint images were assessed for the fingerprint pattern and the ridge count manually. The results were tabulated as percentage frequency distribution for the type of fingerprint pattern. The ridge count is shown as mean ± SD. Unpaired t test was applied to test for statistical significance.

Results: The frequency distribution showed equal percentage of Radial Loop type of fingerprint pattern in subjects of both Health and Chronic Periodontitis. Statistical analysis showed Plain Whorl type of fingerprint pattern more significant in subjects having Chronic Periodontitis

Conclusion: It was concluded that there might be a relationship between type of fingerprint pattern to the chances of a person having Chronic Periodontitis.

Keywords

Chronic Periodontitis; Dermatoglyphics; Fingerprint pattern; Genetics; Inflammation.


Introduction

Periodontitis is characterized by microbially-associated; host mediated chronic inflammation that results in loss of periodontal attachment [1]. The pathophysiology not only lies in the molecular pathways but also in the genetic and environmental factors which alter the susceptibility of an individual in acquiring Chronic Periodontitis [2]. So, the key to prevent the loss of the periodontal ligament fibres and the alveolar bone is the early diagnosis of the chronic inflammation which helps to mediate the host response, thus reducing or even preventing the destruction of periodontal structures.

The branch of science which studies the patterns of skin (dermal) ridges present on the fingers, toes and the soles of humans is called as Dermatoglyphics (“Derma” and “Glyphe” which mean skin and carving). The term ‘Dermatoglyphics’ was given by Harold Cummins and Midlo in 1926 who is acknowledged as the father of Dermatoglyphics [3]. It is one such field of Medicine which has already being substantially used in the stream of Forensic Medicine & Forensic Odontology for dealing medico-legal cases [4-5]. Broadly, fingerprint patterns are classified as arches, loops & whorls basing on which the studies are performed. Every individual has a unique fingerprint pattern and even the monozygotic twins also have unique fingerprint which makes dermatoglyphics as a strong feature for diagnosing any condition. In the recent past, Dermatoglyphics is slowly gaining importance in the diagnosis of several syndromes and other chronic inflammatory conditions of systemic origin as well. Dermatoglyphics has been linked to certain chromosomal anomalies such as the Patau’s syndrome (trisomy 13–15), Edwards’ syndrome (Chromosome 18), Down’s syndrome (Chromosome 21) and the sex chromosomes Turner’s syndrome (total or partial missing Chromosome X) and Kleinfelter’s syndrome (Chromosome 47, XXY) and deletion of the short arm of chromosome 5 in Cri du Chat syndrome [6]. Differences in fingerprint patterns have also been noticed to be associated to conditions such as Leukaemia, Early Onset Diabetes Mellitus, Alopecia Areata, Atopic Dermatitis, Rubella Embryopathy and Chronic Intestinal Pseudo Obstruction [7,8,9,10,11,12]. These findings suggest that environmental factors during the time of pregnancy might have played a role which led to variations in the type of fingerprints and those in turn could be linked to various syndromes or chronic inflammatory conditions. A study of the type of fingerprint patterns and blood pressure showed that whorl type of fingerprint pattern are markers of disturbed foetal development during pregnancy. Using this background, we hypothesised that the development of different types of fingerprints in an individual might be linked to the chances of the same individual having chronic periodontitis.

The null hypothesis was “Variations in type of fingerprints in an individual is not linked to the occurrence of Chronic Periodontitis.” So, to disprove our null hypothesis, the study aimed to find the relation between the type of fingerprint pattern and fingerprint ridge count to the subjects of Health and Chronic Periodontitis.


DOI: https://doi.org/10.37191/Mapsci-2582-3736-1(1)-016
Material & Methods

The study was designed as a cross sectional and an observational study which was carried out in the outpatient department of Periodontology & Implantology. The age group of the subjects that were included into the study ranged between 21 to 55 years of age. After obtaining ethical clearance from the Institutional Review Board, 60 patients were recruited into the study as subjects who are healthy (Group A) and subjects having chronic periodontitis (Group B). A subject was healthy if there was no bleeding on probing, no probing pocket depths, no gingival recession and no clinical attachment loss. Chronic Periodontitis was defined as an individual having Clinical Attachment Loss of ≥ 5 mm in more than 30% of their teeth [13]. The inclusion criteria were patients having chronic periodontitis and healthy individuals, subjects not having any long term systemic illness or conditions (pregnancy, breast feeding, mental disability, diabetes, hypertension etc..) and no use of drugs that would alter overall periodontal health. The exclusion criteria were set as subjects having Chronic Periodontitis due to any environmental factors, deleterious or pernicious habits such as smoking, tobacco chewing, mouth breathing, tongue thrusting etc; previous history of hospitalizations or surgeries in the past 6 months; history of oral prophylaxis or any other periodontal treatment in the last 6 months; missing digit or any abnormality leading to difficulty in recording a fingerprint.

Study design- All the patients were explained about the need and procedure of study, after which the fingerprints of all the 10 fingers were recorded using a commercially available fingerprint scanner as shown in Figure 1. The fingerprints were obtained on the computer screen with the help of the associated software which came with the same device. Later, all the images were saved as JPEG image formats which were observed for the type of fingerprint pattern and ridge count using a Microsoft Office software.

**Figure 1:** Recording of fingerprints with fingerprint scanner.

Fingerprint Patterns: A total of 600 fingerprints were obtained from both the groups and were observed with reference to the right hand based on the fingerprint pattern classification criteria given by Sir Richard Henry [14]. (Figure 2, 3).
Core is the central portion of the fingerprint pattern around which the epidermal ridges encircle.

Delta is a point on the periphery of the fingerprint which forms an imaginary triangular area due to meeting of the terminating epidermal ridges.

A. Arches: It is the simplest type of pattern having no delta. It is formed when the epidermal ridges enter from one side of the pattern area and exits from the other side forming an elevation at the centre. The arch pattern is further of two types based upon the elevation as:

i. Plain (Figure 2a): With little elevation at the centre

ii. Tented (Figure 2b): With a tent like elevation at the centre

B. Loops: It is the most common type of pattern, consisting of core and one delta. It is formed when one or more epidermal ridges enters the pattern area from one side, recures, and exits from the same side. The loop pattern is further of two types:

i. Radial (Figure 2c): The pattern area recures and exit from the thumb side

ii. Ulnar (Figure 2d): The pattern area recures and exit from the little finger side

C. Whorl: It consists of core and two deltas. The whorl pattern is further divided into four types:

i. Plain (Figure 2e): It is formed by the loop that surrounds the core in concentric rings pattern and touches or cross the line joining the two deltas

ii. Central pocket (Figure 2f): It is formed by a small loop, which does not cross the line joining the two deltas

iii. Double loop (Figure 2g): It consists of two loops and two deltas separately

iv. Composite whorls (Figure 2h): It is a complex pattern consisting of two deltas, with the epidermal ridges encircling a core.

Total Finger Ridge Count: It indicates the pattern size. A straight line is drawn connecting the delta to the point of core (Figure- 3). The number of epidermal ridges between the delta and core was counted numerically. The ridges containing the point of core and delta were both excluded from the count.

The distribution of type of fingerprints were tabulated as percentage frequency graph while the size of the fingerprint i.e. the fingerprint ridge count was expressed as mean ± SD values. Unpaired t test was performed using SPSS software, version 20 to check for the statistical significance between the type of fingerprint pattern to subjects having Chronic Periodontitis. The p value less than or equal to 0.05 was considered as statistically significant.
Results

The study included 37 male and 23 female subjects of health & Chronic Periodontitis. In Group- A (Graph 1), the percentage frequency analysis showed a tendency towards Radial Loops & Plain Whorl. In Group- B (Graph 2), the tendency of percentage frequency distribution was also towards Radial Loops & Plain Whorl, but the statistical differences existed upon inter group comparisons. The entire data for healthy & chronic Periodontitis subjects did not record for Complex Whorl type of fingerprint pattern while the Double Whorl type of fingerprint pattern was not recorded in subjects having Chronic Periodontitis.
Graph 1: Graphical representation of fingerprint patterns in healthy subjects

Graph 2: Graphical representation of fingerprint patterns in chronic periodontitis subjects

On comparing the various types of fingerprint patterns between both the groups, the Plain Arch & Plain Whorl type of Fingerprint pattern was statistically associated with subjects having Chronic Periodontitis (Table 1).

Table 1: Percentage frequency of types of fingerprints in healthy patients.

<table>
<thead>
<tr>
<th>Type of fingerprint</th>
<th>Healthy (group a)</th>
<th>Periodontitis (group b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain Arch</td>
<td>3</td>
<td>13* (p value&lt; 0.05)</td>
</tr>
<tr>
<td>Tented Arch</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Radial Loop</td>
<td>46</td>
<td>43</td>
</tr>
<tr>
<td>Ulnar Loop</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Plain Whorl</td>
<td>15</td>
<td>21* (p value&lt; 0.05)</td>
</tr>
<tr>
<td>Central Pocket</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>Double Whorl</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Complex Whorl</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* denotes significance
The mean ridge count for Group- A, 311.1±51.6 was less than the ridge count of Group B, 280.33 ±48.43 (Table 2 & Graph 3) The study results did not show any statistically significant relationship to any of the groups that were included in the study.

Table 2: Finger ridge count in healthy and periodontitis patients

<table>
<thead>
<tr>
<th></th>
<th>Healthy</th>
<th>Periodontitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>311.1</td>
<td>280.3</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>51.663</td>
<td>48.433</td>
</tr>
</tbody>
</table>

Graph 3: Graphical representation of fingerprint ridge count.

Discussion

Dermatoglyphics, off late has gained importance in the field of Medicine for the diagnosis of several inflammatory conditions [8]. The advantage in use of dermatoglyphics for early diagnosis lies in the ease of use with which it can be recorded, easy to store the recorded data, and relatively easy interpretation of data and cost effectiveness as it does not require large equipment or laboratory investigations. The basis of Dermatoglyphics were laid down by Joannes E Purkinje way back in the year 1823. The use of fingerprints as a personal identification code in India was first introduced by William Hershel in the year 1858 [3].

Our study was aimed to find the relationship between type of fingerprint pattern and ridge count to the occurrence of Chronic Periodontitis. For this observation 600 fingerprint patterns were recorded from a total of 60 patients and were analysed. The study showed that both Healthy and Chronic Periodontitis subjects showed increase in tendency towards Radial Loop and Plain Whorl type of fingerprint patterns. Upon statistical analysis it showed that only Plain Whorl type of fingerprint patterns were significantly seen in subjects having Chronic
Periodontitis. Although not statistically significant, the mean fingerprint ridge count increased in subjects of Chronic Periodontitis.

The probable relation between type of fingerprint pattern and Chronic Periodontitis may lie in the development of fingerprints and tooth germ during embryogenesis. Fingerprints are one of the earliest features to develop inside the womb. The development of fingerprints takes place during 4th to 7th week of intra uterine life [15]. Early on during foetal development, stem cell tissues condense to form structures called Volar Pads develop underneath the skin of each finger [16]. The angle and size of the Volar Pad determines the main pattern of fingerprint. On top of the Volar Pads, during about 10th week of intra uterine life, embryonic skin has several layers of cells such as the dermis, basal layer and epidermis all growing at different rates [17]. As the dermal layer grows, the middle layer i.e. basal layer starts to buccal which forms ridges on the epidermis [18]. The ridges first form parallel to the three main areas of stress on the growing finger i.e. (i) near the fingernail, (ii) near the crease of the first joint and (iii) on top of the Volar Pads. As the ridge lines grow, they sometimes run into one another resulting in either a block or a split which is determined by the growth of nerves and capillaries underneath the skin, fluid pressure changes in the womb and the direction in which the finger is oriented relative to gravity [17,15]. Disturbances during the development in the form of trauma or environmental changes affects the development of these fingerprints [19]. The same factors i.e trauma and environmental changes occurring during pregnancy may have detrimental effects in the development of tooth germ. So, the changes that are detected in the form of variations in fingerprint patterns could give us some insight into the occurrence of Chronic Periodontitis in an individual.

According to our knowledge, very few studies have been performed to assess the relationship between fingerprints and Chronic Periodontitis. A parallel study was conducted by Yilmaz et al., which included 35 Juvenile periodontitis patients and 20 adult periodontitis patients[20]. He concluded that the offspring of the patient affected with Juvenile periodontitis showed increased periodontal breakdown than the counterpart suggesting a strong genetic inheritance of periodontal disease. The study conducted by Atasu et al.,2005 has showed increase in tendency towards Plain Whorl & Ulnar Loop type of fingerprint pattern associated with Periodontitis. Recent studies conducted by Vineeth Garg et al., 2017 [21], Surekha Rathod et al., 2018(Rathod, Maske, Kolte, & Wanikar, 2018) and Gargi Chaterjee at al., 2017 ([22] showed Central Pocket, Arches and whorls to be associated with Periodontitis respectively.

The mean ridge count, although did not show statistical significance showed increase in number in subjects having Chronic Periodontitis. The reason may be due to the lesser sample size which can be considered as one of the limitations of the study.

Limitations of the study include non-classification of Periodontitis group into mild, moderate and severe subgroups and lack of maternal history for any trauma during pregnancy. The fact that the formation of fingerprints is not a random process and governed by certain factors and that they can be used to link other systemic conditions adds on weightage to the research. Features such as unaltered ridge count, unique fingerprint pattern and its unaltered nature...
from birth to death indicate that fingerprints are one of the features of development that can be substantially used for understanding the link between fingerprint pattern and Chronic Periodontitis. This study might pave way for further cutting-edge research where multicentred studies with larger sample size can be conducted to arrive at a definitive conclusion for the possible link between fingerprint pattern and Chronic Periodontitis. Aggressive Periodontitis is a genetically linked chronic inflammatory disease of periodontium in which the subject is ruled out of any systemic illness. So, studies conducted at observing the variations of fingerprint patterns may alter the treatment approach and help reducing or even preventing the loss of periodontal tissues.

**Conclusion**

Within the limitations of the study, it can be concluded that dermatoglyphics is linked to chronic inflammatory disease. The Plain Whorl type of fingerprint patterns and an increase in fingerprint ridge count might be associated with Chronic Periodontitis, the early diagnosis of which can be used to formulate an even appropriate treatment plan.

**References**

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