ORIGINAL ARTICLE

Dermatoglyphic patterns in subjects with potentially malignant disorders and oral carcinoma

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Abstract

Background: The study of the epidermal ridges and the patterns formed by them is dermatoglyphics. The influence of genetic or environmental factors on early development is often reflected by the altered dermatoglyphics. Hence, this study is conducted to determine the dermatoglyphic dependence of potentially malignant disorders and oral carcinoma and hence that preventive measures can be instituted to high-risk groups and prevents the occurrence of disease.

Materials and Methods: Fingerprints were collected using ink method from 70 patients that includes 30 subjects with potentially malignant disorders, 10 subjects with oral cancer and 30 healthy controls. Data were subjected to statistical analysis (Student’s paired t-test).

Results: Mean number of loops and the mean number of total ridge count were found to be higher in case of subjects with potentially malignant disorders and oral carcinoma when compared with controls. Arches were seen predominantly in patients with oral cancer. Right ATD angle was lower in subjects without deleterious habit and potentially malignant disorders. These findings were highly significant statistically.

Conclusion: We, therefore, recommend dermatoglyphics to identify individuals who are more prone to develop potentially malignant disorders and oral squamous cell carcinoma. We suggest the use of the same as an education tool for genetic counseling.

Keywords
Dermatoglyphics, oral carcinoma, potentially malignant disorders, ridge count

Introduction

Dermatoglyphic is defined as the study of epidermal ridges and their patterns. The term is coined by the anatomist Cummins (1926). The word dermatoglyph means “a skin carving.” Dermatoglyphics comprises the varied and intricate patterns present on the surface of the skin in man and other mammals.¹ These configurations are unmistakable and are readily classifiable marks that can be used to distinguish one individual from another. Dermal ridge patterns are formed embryologically between the 10th and 17th weeks of life; hence, the dermatoglyphic traits may reflect prenatal developmental stability. Most importantly they remain constant from before birth until death unaffected by any constitutional or environmental disturbances during the remaining gestative period.²

Literature shows many dermatoglyphic studies conducted in genetically inherited diseases such as Down’s syndrome, leukemia, schizophrenia, diabetes, hypertension, epilepsy and cleft lip and cleft palate.³⁴

"Potentially malignant disorders,” conveys that not all lesions and conditions may transform to cancer, some may have an increased potential for malignant transformation. These disorders of the oral mucosa are also indicators of risk of likely future malignancies elsewhere in the oral mucosa and not only site specific predictors.⁵

Various epidemiological and experimental evidence indicates a causal relationship between tobacco or betel nut habit and few potentially malignant disorders like leukoplakia and oral submucous fibrosis (OSMF), only fraction of people exposed to these agents develop oral leukoplakia and OSMF. Genetically determined differences among this individual would explain the susceptibility.⁵⁶

Similarly, other potentially malignant disorders like lichen planus, discoid lupus erythematosus, palatal lesions in reverse smokers, actinic keratosis, sideropenic dysphagia, chronic hyperplastic candidiasis shows individual variability, which might explain the genetic predisposition of the disorders.
Dermatoglyphic study in potentially malignant disorder and oral carcinoma

This study was conducted to study dermatoglyphic patterns in individuals with potentially malignant disorders and oral cancer and hence that the variations in the patterns can be assessed to determine the usefulness of dermatoglyphics in studying the genetic etiology. It can be used as an educational tool for genetic counseling. Preventive measures can be instituted in these susceptible individuals to prevent the occurrence of potentially malignant disorders.

**Materials and Methods**

**Source of data**

Subjects were selected from the Department of Oral Medicine and Radiology.

**Method of collection of data**

In this study, 70 individuals were selected. Study consisted of three groups. Patients were divided into following groups:

- **Group I**: 30 patients with or without deleterious habit but no lesions:
  - Group Ia: 15 patients with deleterious habit but no lesions
  - Group Ib: 15 patients without deleterious habit but no lesions.
- **Group II**: 30 patients with potentially malignant disorders that includes:
  - Group IIa: 20 subjects with deleterious habit and potentially malignant disorders
  - Group IIb: 10 subjects without deleterious habit and potentially malignant disorders.
- **Group III**: 10 patients with deleterious habit and oral squamous cell carcinoma (OSCC).

An informed consent was obtained from the subjects. A detailed case history with thorough clinical examination had been done, and findings were recorded in a prepared case history proforma. The cases of potentially malignant disorders and OSCC were diagnosed on the basis of their clinical features and their association with supporting etiological factors.

Dermatoglyphic patterns were collected using ink method with the black duplicating ink. Fingerprint patterns of the study subjects were recorded by applying duplicating ink on the distal phalanges of all the 10 fingers and the fingerprint patterns using rolling impression technique on a non-blotting A4 size blank white recording paper. Data were collected to analyze for various dermatoglyphic patterns.

Comparison of dermatoglyphic data was done between the following groups:
- Group I and Group II
- Group I and Group III
- Group IIa and Group IIb
- Group II and Group III

The obtained data were calculated and subjected to relevant statistical analysis (Student’s paired t-test).

**Results**

The present study was undertaken to compare the dermatoglyphic patterns in subjects of potentially malignant disorders and OSCC, designed as cross-sectional study.

The study shows distribution of various finger patterns in Group I, Group II and Group III. Among Group I, 41.00% have loops, 58.66% have whorls, and 0.37% has arches. Among Group II, 65.33% have loops, 34.00% have whorls, and 0.67% has arches. Among Group III, 60.00% have loops, 32.00% have whorls, and 8.00% have arches.

**Palm and Finger Prints**

**Comparison of dermatoglyphic patterns between Group I and Group II (Table 1)**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group I</th>
<th>Group II</th>
<th>Z calculated</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loops</td>
<td>4.10±2.94</td>
<td>6.53±2.86</td>
<td>−3.248</td>
<td>0.001*</td>
</tr>
<tr>
<td>Whorls</td>
<td>5.86±2.96</td>
<td>3.40±2.81</td>
<td>3.305</td>
<td>0.001*</td>
</tr>
<tr>
<td>Arches</td>
<td>0.03±0.18</td>
<td>0.06±0.25</td>
<td>−0.584</td>
<td>0.559</td>
</tr>
<tr>
<td>Total ridge count</td>
<td>152.03±26.67</td>
<td>128.33±24.80</td>
<td>3.565</td>
<td>0.000*</td>
</tr>
<tr>
<td>ATD angle - right</td>
<td>39.82±4.86</td>
<td>40.40±4.51</td>
<td>1.929</td>
<td>0.054*</td>
</tr>
<tr>
<td>ATD angle - left</td>
<td>37.53±4.29</td>
<td>37.97±4.94</td>
<td>1.994</td>
<td>0.046*</td>
</tr>
</tbody>
</table>

*Statistically significant. SD: Standard deviation
ATD angle of right hand was found to be statistically significant between the groups \((P \leq 0.05)\).

**Comparison of dermatoglyphic patterns between Group I and Group III [Table 2]**

**Finger ridge patterns**

- **Loops:** The mean number of loops was found to be higher in Group III compared with that of Group I. This difference was found to be statistically significant \((P < 0.05)\).

- **Whorls:** The mean number of loops was found to be lower in Group III compared with that of Group I. This difference was found to be statistically significant \((P < 0.001)\).

- **Arches:** No statistically significant difference was observed between Group I and Group III \((P > 0.05)\).

**Total ridge count**

The mean total ridge count in Group III was found to be lower when compared to Group I. This difference between the groups was statistically significant \((P < 0.001)\).

**ATD angle**

The mean ATD angle of left hand in Group III was found to be lower with that of Group I and this difference of ATD angle of left hand was found to be statistically significant \((P < 0.05)\).

The mean ATD angle of the right hand was almost same in both the groups. No statistically significant difference was observed \((P > 0.05)\).

**Table 2:** Comparison of dermatoglyphic patterns between Group I and Group III

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean±SD</th>
<th>Z calculated</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>Group III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loops</td>
<td>4.10±2.94</td>
<td>-2.096</td>
<td>0.036*</td>
</tr>
<tr>
<td>Whorls</td>
<td>5.86±2.96</td>
<td>2.828</td>
<td>0.005*</td>
</tr>
<tr>
<td>Arches</td>
<td>0.03±0.18</td>
<td>-1.494</td>
<td>0.135</td>
</tr>
<tr>
<td>Total ridge count</td>
<td>152.03±26.67</td>
<td>3.648</td>
<td>0.000*</td>
</tr>
<tr>
<td>ATD angle - right</td>
<td>39.82±4.86</td>
<td>-0.213</td>
<td>0.832</td>
</tr>
<tr>
<td>ATD angle - left</td>
<td>37.53±4.29</td>
<td>2.887</td>
<td>0.004*</td>
</tr>
</tbody>
</table>

*Statistically significant. SD: Standard deviation

**Comparison of dermatoglyphic patterns between Group IIa and Group IIb [Table 3]**

- **Loops:** The mean number of loops was found to be higher in Group IIb compared to that of Group IIa. No statistically significant difference was observed \((P > 0.05)\).

- **Whorls:** The mean number of loops was found to be lower in Group IIb compared to that of Group IIa. No statistically significant difference was observed \((P > 0.05)\).

- **Arches:** No statistically significant difference was observed between Group IIa and Group IIb \((P > 0.05)\).

**Total ridge count**

The mean total ridge count in Group IIb was found to be lower when compared to Group IIa. No statistically significant difference was observed \((P > 0.05)\).

**ATD angle**

The mean ATD angle of the right hand in Group IIb was found to be lower with that Group IIa. The differences were found to be statistically significant \((p < 0.05)\).

**Table 3:** Comparison of dermatoglyphic patterns between Group IIa and Group IIb

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean±SD</th>
<th>Z calculated</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group IIa</td>
<td>Group IIb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loops</td>
<td>6.05±3.186</td>
<td>-1.575</td>
<td>0.115</td>
</tr>
<tr>
<td>Whorls</td>
<td>3.85±3.133</td>
<td>1.481</td>
<td>0.138</td>
</tr>
<tr>
<td>Arches</td>
<td>0.1±0.307</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Total ridge count</td>
<td>133.4±24.392</td>
<td>1.647</td>
<td>0.099</td>
</tr>
<tr>
<td>ATD angle - right</td>
<td>38.47±4.396</td>
<td>1.89</td>
<td>0.05*</td>
</tr>
<tr>
<td>ATD angle - left</td>
<td>38.35±4.377</td>
<td>0.532</td>
<td>0.594</td>
</tr>
</tbody>
</table>

*Statistically significant, NA: Not applicable, SD: Standard deviation

**Comparison of dermatoglyphic patterns between Group II and Group III [Table 4]**

**Finger ridge patterns**

- **Loops:** No statistically significant difference was observed \((P > 0.05)\).

- **Whorls:** No statistically significant difference was observed \((P > 0.05)\).

- **Arches:** The mean number of arches is higher in Group III than Group II. This difference was found to be statistically significant \((P < 0.001)\).

**Total ridge count**

The mean total ridge count in Group III was found to be lower when compared to Group II. No statistically significant difference was observed \((P > 0.05)\).

**ATD angle**

The mean ATD angle of the right hand in Group III was found to be lower with that Group II. The difference was found to be statistically significant \((p < 0.05)\).

**Table 4:** Comparison of dermatoglyphic patterns between Group II and Group III

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean±SD</th>
<th>Z calculated</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>Group III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loops</td>
<td>6.53±2.86</td>
<td>0.593</td>
<td>0.55</td>
</tr>
<tr>
<td>Whorls</td>
<td>3.40±2.81</td>
<td>0.215</td>
<td>0.82</td>
</tr>
<tr>
<td>Arches</td>
<td>0.06±0.25</td>
<td>-6.09</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Total ridge count</td>
<td>128.33±24.80</td>
<td>0.645</td>
<td>0.51</td>
</tr>
<tr>
<td>ATD angle - right</td>
<td>40.40±4.51</td>
<td>-1.23</td>
<td>0.21</td>
</tr>
<tr>
<td>ATD angle - left</td>
<td>37.97±4.94</td>
<td>0.656</td>
<td>0.51</td>
</tr>
</tbody>
</table>

*Statistically significant. SD: Standard deviation
ATD angle
The mean ATD angle of right and left hand in Group III were found to be equal with that Group II. No statistically significant difference was observed (P > 0.05).

Discussion
Fingerprints, palm and foot prints, altogether more properly termed dermatoglyphics, occupy ever-increasing attention in medical practice. Each individual’s ridge configurations are unique, remain unchanged from womb to tomb and have been utilized as means of personal identification. Widespread interest in epidermal ridges developed only in last several decades as many patients with chromosomal aberrations had unusual ridge formations.

In a recent past, a number of investigators have focused their attention in finding out an association of morphological and genetical characters with a number of pathological conditions. Developmental instability is reflected and reliably measured by fluctuating asymmetry. Fluctuating asymmetry is an indicator of genetic and environmental stress. Fluctuating asymmetry can be assessed by variations in ridge patterns, ridge counts and ATD angle. Inspection of skin ridges, therefore, seemed simple, promising, noninvasive and inexpensive means for determining particular chromosomal defect in patients.

With this background, the present study was undertaken to analyze and evaluate variations in the dermatoglyphic patterns in subjects with potentially malignant disorders and OSCC. The purpose of the study was to determine the usefulness of dermatoglyphics in studying the genetic etiology of potentially malignant disorders and OSCC. It was also attempted to study the usefulness of the dermatoglyphic data for genetic counseling. It is proposed that many genes that take part in the control of finger and palmar dermatoglyphic development can also give an indication to the development of potentially malignant disorders and oral cancer.

In the present study, sample consisted of three groups with Group I (30 subjects with or without deleterious habits and no lesion), Group II (30 subjects with or without deleterious habit and potentially malignant disorders) and Group III (10 subjects with deleterious habit and oral cancer). Finger and palm prints of all 70 subjects were recorded using the ink method on recording paper. The observed data was subjected to statistical analysis (Student’s paired t-test).

In the present study, Group I (subjects with no lesions) was compared with Group II (subjects with potentially malignant disorders). It was found that the mean number of loops and left ATD angle were higher and total ridge count was lower in Group II. This is in agreement with various studies that showed predominant presence of loops in patients with oral leukoplakia.

Group I (subjects with no lesions) were compared with Group III (subjects with OSCC) in the present study. It was found that the mean number of loops was higher and total ridge count and left ATD angle were found lower in Group III.

This is in agreement with various studies that showed predominant presence of loops in patients with other carcinomas. One study showed an increased proportion of ulnar loops in cancer patients. Another study has suggested a decreased ridge count in patients with cancer. However on examining dermatoglyphics in different cancers, one study found more whorls to be present and in studying high-risk kindred also found more whorls. In yet another study of 201 Turkish cancer patients in general, there was an increase in whorls and a decrease in radial loops.

The difference in the frequency of the patterns of potentially malignant disorders and oral cancer subjects reflect the underlying developmental instability, though indirectly.

In the present study, Group IIa (subjects with deleterious habit and potentially malignant disorders) were compared to Group IIb (subjects without deleterious habit and potentially malignant disorders). We found that right ATD angle was lower in Group IIa. This suggests a strong genetic predisposition.

Several genes which take part in the control of finger and palmar dermatoglyphic development, can also give an indication to the development of premalignancy and malignancy.

This showed that even the habits like tobacco and alcohol are risk factor for patients of oral leukoplakia, OSMF and OSCC, substantial evidence suggested that the interaction between exposure to exogenous carcinogens and inherent genetic susceptibility also plays significant role in carcinogenesis. Environmental exposures lead to genetic damage which accumulates more quickly in individuals with genetic susceptibility to DNA damage than in those without such instability but with similar exposure.

In the present study, Group II (subjects with potentially malignant disorders) and Group III (subjects with OSCC) were compared. It was found that the mean number of arches were higher in Group III than in Group II.

This finding is consistent with a study by Hakan et al., which also showed increased frequency of arches in oral tumors. This may suggest that individuals with potentially malignant disorders and having increased number of arches may be at high risk for malignant transformation.

Our study revealed variations in dermatoglyphic patterns which could be considered as genetic markers for detecting those who are predisposed to develop potentially malignant disorders and oral cancer. We suggest that the fingerprints can be recorded with the inkless biometric method which captures a better print with no deterioration over a period. Further studies with the use of a larger sample size are suggested.

Conclusion
The present study on dermatoglyphics in patients with potentially malignant disorders and OSCC showed significant changes. Mean number of loops were higher, and the mean number of
total ridge count were lower in case of subjects with potentially malignant disorders and OSCC when compared with controls. Arches were seen predominantly in patients with OSCC. Right ATD angle was lower in subjects without deleterious habit and potentially malignant disorders when compared with subjects with habit and potentially malignant disorders. We, therefore, recommend dermatoglyphics to identify individuals who are more prone to develop potentially malignant disorders and OSCC. We suggest the use of the same as an education tool for genetic counseling. Preventive measures can also be instituted in susceptible individuals to prevent the occurrence of potentially malignant disorders and OSCC.

References
