Evaluating the Relation Between Palmar Dermatoglyphics with Submucous Fibrosis and Squamous Cell Carcinoma of the Oral Cavity

G Vinothini¹, Ramasamy Sarvathikari², Sakthivel Sambasivam³, J Venkatesh⁴, John Hearty Deepak⁵, J Nandhini⁶

¹Senior Lecturer, Department of Oral Medicine and Radiology, Vinayaga Missions Dental College & Hospital, Puducherry, India, ²Professor, Department of Oral Medicine and Radiology, Rajas Dental College and Hospital, Thirunelveli, Tamil Nadu, India, ³Lecturer, Department of Oral Medicine and Radiology, Rajas Dental College and Hospital, Thirunelveli, Tamil Nadu, India, ⁴Reader, Department of Oral Medicine and Radiology, Rajas Dental College and Hospital, Thirunelveli, Tamil Nadu, India, ⁵Senior Lecturer, Oral Medicine and Radiology, Rajas Dental College and Hospital, Thirunelveli, Tamil Nadu, India, ⁶Post-graduate Student, Department of Oral Medicine and Radiology, Rajas Dental College and Hospital, Thirunelveli, Tamil Nadu, India

ABSTRACT

Background and Objectives: Dermatoglyphics are the dermal ridge configuration on the digits, palms, and soles. These ridge patterns are formed fully by the 16th week of gestation and remain constant throughout the life. They are not only genetically determined but also influenced by the environmental factors that occur before the 16th week. Although exposure to tobacco is known to cause oral submucous fibrosis (OSMF) and oral squamous cell carcinoma (OSCC), only a portion of the exposed individuals develop these lesions which suggest genetic susceptibility to carcinogenesis. Several studies have proved the association between dermatoglyphics and the malignancies. Hence, this study was undertaken to determine whether specific dermatoglyphic patterns exist which would help in predicting the occurrence of OSMF and OSCC.

Materials and Methods: The cross-sectional study comprised 15 individuals with OSMF, 15 individuals with OSCC and 15 individuals with no habits and lesions as controls. Finger and palm prints from all three groups using ink method were collected and evaluated both qualitatively and quantitatively using Cummins, Mildo and Penrose method and Chi-square test, SPSS software 10.01 version.

Results: Loops were frequent in cases than in controls whereas whorls were often present in the control group (P < 0.05). Loops were more common in the interdigital areas in cases than in control (P < 0.05). However, the distribution of hypothenar and thenar patterns were statistically insignificant. Similarly, there was no correlation between atd angle, ab count, total finger ridge count in OSMF, and OSCC.

Conclusion: The present study concluded that dermatoglyphic patterns might help with early identification of individuals either with or at risk of developing OSMF and OSCC. Hence, the beforehand identification of high-risk group helps in implementation of early primary and secondary preventive measures to prevent the occurrence of these lesions.

Keywords: Dermatoglyphics, Malignant, Oral squamous cell carcinoma, Oral submucous fibrosis, Premalignant condition

Corresponding Author: Dr. J Nandhini, Department of Oral Medicine and Radiology, Rajah Muthiah Dental College & Hospital, Annamalai University, Chidambaram, Tamil Nadu, India. E-mail: dr.nandhinior@gmail.com

INTRODUCTION

Oral cancer is one among the fatal health problems faced by the humans today, ranking sixth overall in the world, it represents the leading cause of death.¹ In India, because of cultural, ethnic, geographic factors, and the popularity of addictive habits such as usage of various tobacco and tobacco-related concoctions, and alcohol,
the frequency of oral cancer is high thus ranking the highest incidence among men and third among women. The increased occurrence of oral cancer and pre-cancer in Southeast Asia due to betel quid chewing habit has been clearly demonstrated.2 The oral submucosal fibrosis (OSMF) is a premalignant condition and a disease due to chronic, insidious change in fibroelasticity characterized by generalized submucosal fibrosis and subsequently leads to restricted mouth opening, restriction in food consumption, difficulty in maintaining oral health, as well as impaired ability to speak. In Indian subcontinent alone, the frequency of OSMF has rapidly increased from 2.5 lakhs in 1980 to 2 million cases in 19933 and 5 million cases (0.5%) in 2002.4 The reason for this rapid increase is believed to be the increased copper content of processed areca nut exponentially marketed by the pan industry5 and also the growth of this habit among young people.4 The malignant transformation rate is 7-19%.6 Despite advances in surgery, radiotherapy, and chemotherapy, the 5-year survival rate of oral squamous cell carcinoma (OSCC) patients remains approximately 50% due to the lack of early detection and treatment.7 This necessitates the betimes detection of these lesions to a promising improvement in the survival and morbidity rates of these patients. However, not all individuals exposed to the etiological factors develop carcinoma or OSMF. Host susceptibility must, therefore, play a role, and genetic instability is of fundamental importance in the pathogenesis of oral cancer.8

The soles and palms of all primates bear a ridged skin, the relatively new branch of science dealing with the skin ridge system is known as dermatoglyphics (derma-skin; glyphos-carvings) a Greek word coined by Cummins and Midlo in 1926.9 Dr. Harold Cummins, in 1936 examined several children with trisomy 21 (Down’s syndrome) and found consistent dermatoglyphic changes that were absent among controls and is considered as a window of congenital abnormalities and also a sensitive indicator of intrauterine anomalies.10 This discovery helped to move the emerging science of dermatoglyphics from a place of obscurity to being acceptable as a diagnostic tool for medical personnel. The current state of medical dermatoglyphics is such that the diagnosis of some illness can be done with dermatoglyphic analysis alone and currently, several dermatoglyphic studies claim a high degree of accuracy in their prognostic ability from these ridges.11 It is suggested that, those genes influence the dermatoglyphic pattern can also indicate the risk of premalignancy and malignancy;12 hence, identifying high-risk people for oral cancer and pre-cancer could be of great value to decrease its incidence.

As there is increasing mortality and morbidity due to oral malignancy and high incidence of OSMF in India, this study was undertaken to analyze the dermatoglyphic patterns in these diseases as the association between dermatoglyphics and cancer is a known fact. In this study, an attempt was made to find out the association of OSCC, OSMF with dermatoglyphic traits. This would give a unique and cost-effective approach that would certainly help more in screening and identifying the persons who are at risk.

Aim and Objectives

Aim
The aim of the study was to analyze the correlation of the palmar dermatoglyphic pattern in patients with OSMF and OSCC.

Objectives
The objective was to study the dermatoglyphic patterns in OSMF, OSCC patients, and healthy individuals, then to compare and contrast the pattern between them.

MATERIALS AND METHODS

This cross-sectional descriptive study had been conducted on the individuals who visited Department of Oral Medicine, Diagnosis, and Radiology, Rajah Muthiah Dental College and Hospital, Annamalai University, Chidambaram during March 2014 to October 2014.

Sample Characteristics

Based on the availability of patients 45 individuals with the age range between 25 and 70 years were included in the study. Those with mixed dietary habit, in and around the same locality (Chidambaram) were chosen as study individuals. These individuals were divided into three groups, each comprising 15 individuals.

Patients who were newly, clinically, and histopathologically proven cases of all grades of OSMF were taken as Group I, OSCC as Group II. Healthy controls with matched age, sex, socioeconomic status, without tobacco habits, and oral lesions were taken as Group III.

Exclusion Criteria

Patients with chromosomal disorders, congenital or acquired deformities of palm and fingers, scar or wound on the palm and fingers, mentally and physically challenged, already under treatment for OSMF, and OSCC had been excluded from the study.

Data Collection

A detailed case history was taken with emphasis on their habits and recorded on standard pro forma. Ethical clearance was obtained according with
in institution protocol. All the individuals selected for the study had been explained in detail about the condition affecting the oral cavity and the procedure they were subjected to, and a formal informed written consent had been taken. Incisional biopsy followed by hematoxylin and eosin histopathological study was done on all the OSMF and OSCC patients and were confirmed.

**Obtaining Dermatoglyphic Prints**

Dermatoglyphic prints were obtained from all the 45 individuals. To enhance the quality of dermatoglyphic prints, the individuals were advised to wash their hands with soap and water followed by natural drying. Then, ink (Camel™ ink pad) was uniformly spread over the palm and fingers. Prints of fingertips were taken first followed by that of the palm, on paper (Royal built 70 GSM) kept over the table. After obtaining satisfactory prints, the individuals were instructed to wash their hands with soap and water (Figures 1-5).

**Dermatoglyphic Pattern Analysis**

The fingerprints were analyzed qualitatively for arches (A), loops (L), and whorls (W); on fingertips, hypothenar area, and interdigital areas such as I₁, I₂, I₃, and I₄. Analyzed quantitatively for ab ridge count, finger ridge count, total finger ridge count (TFRC), and ad angle.

The above-mentioned analysis was done using; magnifying lens, ruler, protractor, microtip stick pen, pencil, and divider (Figure 1).
Arches as simple or tented, loops as radial or ulnar, and
whorls as simple or double loop were recorded. All
10 digits of an individual were considered to find the
frequency of fingerprint pattern; similarly, both right and
left palms were studied for hypothenar and I1, I2, and I3,
interdigital areas. Ridge counting was done from the
triradii to the core, starting from first digit (little finger)
of the right hand to the fifth digit (thumb) of the same hand
and similar procedure followed on the left hand. The count
begins on the ridge lying immediate following the first
blank space after the triradii. The core forming ridge was
not counted. If more than one ridge counts were present,
the ridge with largest number was considered. TFRC was
derived by adding all the ridge counts on ten fingers, ab
ridge count was done between triradii a and b over the
palm in the same manner as that used for ridge counting
done on the digits. atd angle was recorded by drawing lines
from the digital triradii “a” to the triradii “t” and from this
to the distal triradii “d,” in case of more than one atd angle
the widest was counted (Figure 6).

Statistical Analysis
Separate tables were prepared for individual
dermatoglyphic parameters and results obtained were
tested for statistical significance (P value) for both
qualitative and quantitative analysis by Cummins, Mildo
and Penrose method and Chi-square test. The statistical
package SPSS 10.01 version was used to perform the
above analyses.

RESULTS
Table 1 indicates OSMF and OSCC were most commonly
seen in males than in females with a ratio of 2:1 and they
fall in the age group of more than 46 years (>50%).

Patients with OSMF and OSCC had increased frequency
of loops when compared with controls who had whorls
as the frequent pattern, which was statistically significant
at P < 0.001 (Table 2).

In all the three groups, the commonly observed
hypothener pattern was ulnar arch type in both palms
which was statistically insignificant at P > 0.05 (Table 3).

On analyzing, the I1/thenar pattern in both palms on all
three study groups, there were no predominant pattern
presents. The result was statistically insignificant at
P > 0.05 (Table 4).

While anatomizing the frequency of I2, I3, and I4 pattern,
there was an increased frequency of loops in controls
as compared to patients with OSMF and OSCC with a
significant P = 0.03 (Table 5).

Table 6 shows no significant difference in TFRC of the
digits.

Table 7 shows no significant difference in ab ridge count
on both palms.

Table 8 shows no significant difference in atd angle on
both palms.

Table 1: Demographic data

<table>
<thead>
<tr>
<th>Groups</th>
<th>Age in years – N (%)</th>
<th>Gender N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25-35</td>
<td>36-45</td>
</tr>
<tr>
<td>Group I (N=15)</td>
<td>13.33 (2)</td>
<td>33.33 (5)</td>
</tr>
<tr>
<td>Group II (N=15)</td>
<td>6.68 (1)</td>
<td>26.66 (4)</td>
</tr>
<tr>
<td>Group III (N=15)</td>
<td>0.00 (0)</td>
<td>60.00 (9)</td>
</tr>
</tbody>
</table>

Table 2: Qualitative analysis: Frequency of fingerprint pattern among study groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N (%)</th>
<th>χ²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arches</td>
<td>Loops</td>
<td>Whorls</td>
</tr>
<tr>
<td>Group I (N=15)</td>
<td>9 (6)</td>
<td>95 (63.3)</td>
<td>46 (30.7)</td>
</tr>
<tr>
<td>Group II (N=15)</td>
<td>10 (6.7)</td>
<td>91 (60.7)</td>
<td>49 (32.6)</td>
</tr>
<tr>
<td>Group III (N=15)</td>
<td>3 (2)</td>
<td>45 (30)</td>
<td>102 (68)</td>
</tr>
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</table>

Table 3: Qualitative analysis: Frequency of hypothenar pattern among study groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N (%)</th>
<th>χ²</th>
<th>P</th>
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<tbody>
<tr>
<td></td>
<td>Right palm</td>
<td>Left palm</td>
<td></td>
</tr>
<tr>
<td>Group I (N=15)</td>
<td>14 (93.3)</td>
<td>13 (86.7)</td>
<td></td>
</tr>
<tr>
<td>Group II (N=15)</td>
<td>12 (80)</td>
<td>10 (66.7)</td>
<td></td>
</tr>
<tr>
<td>Group III (N=15)</td>
<td>11 (73.3)</td>
<td>14 (93.3)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Qualitative analysis: Frequency of thenar/I1 pattern among study groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N (%)</th>
<th>χ²</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Right palm</td>
<td>Left palm</td>
<td></td>
</tr>
<tr>
<td>Group I (N=15)</td>
<td>9 (60)</td>
<td>12 (80)</td>
<td></td>
</tr>
<tr>
<td>Group II (N=15)</td>
<td>11 (73.3)</td>
<td>13 (86.7)</td>
<td></td>
</tr>
<tr>
<td>Group III (N=15)</td>
<td>12 (80)</td>
<td>10 (66.7)</td>
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DISCUSSION

OSCC, the sixth most common malignancy and a major cause of cancer morbidity and mortality worldwide, is mostly due to the addictive habits, cultural, ethnic, and geographic factors. OSMF is a premalignant condition, and areca nut exposure is the major determinant of OSMF. However, it has also been reported in people with no habit of areca nut chewing.\textsuperscript{13} Since only a fraction of exposed persons develop cancer, an intrinsic susceptibility of an individual to environmental genotoxic exposures was also been suggested as playing a role in carcinogenesis.\textsuperscript{14} It has been widely recognized that both genetic and environmental factors play a significant role in cancer initiation. Aberrations in cellular functions play a role in the etiology of cancer, among that DNA repair is imperative in maintaining genomic integrity and protecting against cancer. Within the general population, there may exist varying degrees of DNA maintenance and repair capability.\textsuperscript{15}

Following the environmental exposures, the genetic damage accumulation was more quick in individuals with genetic susceptibility to DNA damage than in those were not susceptible but with a similar exposure. Consequently, the one with genetic instability might be at a greater risk for developing these lesions.\textsuperscript{16}

The dermal ridge configurations have attracted the attention of layman for millennia. During the past century, the fact that the uniqueness of each ridge confirmations had been utilized as a personal identification by law enforcement officials. Widespread medical interest in epidermal ridges developed after the observation of correlation between the chromosomal aberrations and unusual ridge patterns. Hence, the study of dermal ridges provides a simple, inexpensive means of information about the chromosomal defect in a given patient.\textsuperscript{17} Unusual ridge configurations have been also observed in patients with single gene disorders and in whom the genetic basis of the disease is unclear.\textsuperscript{18}

The dermal ridge patterns are strongly but not exclusively governed by heredity (>80%). Studies on qualitative and quantitative methods have shown great resemblance among monozygotic and dizygotic twins reasonably supports the inheritance among siblings and parents.\textsuperscript{19}

A great diversity in the types and combinations of patterns found on the fingers, palms, and soles suggests the formation of dermal ridges was determined by many genes spread over many chromosomes.\textsuperscript{17}

With an ever-growing population, it becomes imperative that methods be developed to identify individuals either at risk for or already having a given illness in the most cost-efficient manner without sacrificing quality of care. Dermatoglyphics is such an effective method having a unique and cost-effective approach to identifying such individuals.\textsuperscript{20}

In the present study we observed the following: The demographic findings showed high prevalence of OSMF and OSCC in males than females with a ratio of 2:1, and more common in the age group above 46 years (>50%), in accordance with the study by Warnakulasuriya. This might be due to easy accessibility of information about the chromosomal defect in a given patient. The dermal ridge configurations have been utilized as a personal identification by law enforcement officials. Widespread medical interest in epidermal ridges developed after the observation of correlation between the chromosomal aberrations and unusual ridge patterns. Consequently, the one with genetic instability might be at a greater risk for developing these lesions.\textsuperscript{16}

On observing the fingertips, there was increased frequency of loops in patients with OSMF and OSCC as compared to controls who have whorls as the frequent pattern. Gupta et al., Venkatesh et al., and David and Sinha stated in their study; there was a significant increase of loops in cases which is consistent with our study. However, in other studies done by Jatti et al. and Hakan et al., these authors have observed an increased arch pattern in cases which were inconsistent with our results. On the contrary, a study done by Ganvir and

<table>
<thead>
<tr>
<th>Groups</th>
<th>N (%)</th>
<th>χ²</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Right palm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I (N=15)</td>
<td>15 (16.7)</td>
<td>13 (14.4)</td>
<td>6.516</td>
</tr>
<tr>
<td>Group II (N=15)</td>
<td>14 (15.6)</td>
<td>10 (11.1)</td>
<td></td>
</tr>
<tr>
<td>Group III (N=15)</td>
<td>16 (17.8)</td>
<td>12 (13.3)</td>
<td></td>
</tr>
<tr>
<td>Left palm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Quantitative analysis: TFRC

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean±SD</th>
<th>χ²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (N=15)</td>
<td>153.0±14.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group II (N=15)</td>
<td>154.7±13.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group III (N=15)</td>
<td>153.8±13.6</td>
<td>0.73</td>
<td>0.930</td>
</tr>
</tbody>
</table>

Table 7: Quantitative analysis: ab count

<table>
<thead>
<tr>
<th>ab count</th>
<th>Mean±SD</th>
<th>F value</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right palm</td>
<td>37.4±4</td>
<td>37.4±4</td>
<td>37.4±3.9</td>
</tr>
<tr>
<td>Left palm</td>
<td>35.4±6.4</td>
<td>35.6±6.5</td>
<td>35.5±6.3</td>
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Table 8: Quantitative analysis: atd angle

<table>
<thead>
<tr>
<th>atd angle</th>
<th>Mean±SD</th>
<th>F value</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right palm</td>
<td>37.8±4</td>
<td>37.5±4</td>
<td>37.7±3.9</td>
</tr>
<tr>
<td>Left palm</td>
<td>35.1±5.5</td>
<td>34.8±5.4</td>
<td>34.9±4.4</td>
</tr>
</tbody>
</table>

SD: Standard deviation, TFRC: Total finger ridge count
Gajbhiye\textsuperscript{26} found an increased frequency of whorls in cases. Hypothenar pattern, when compared among all three groups was the ulnar arch type which revealed no significant differences. Our findings were consistent with Venkatesh et al.\textsuperscript{20} study results. However, in Gupta et al.\textsuperscript{22} and Ganvir and Gajbhiye\textsuperscript{26} studies there was no significant difference in hypothenar area pattern among study groups. Thenar/\textsubscript{I\textsubscript{1}} area pattern, when compared among all three groups revealed no significant differences. Our findings were in accordance with some studies done by Gupta et al.,\textsuperscript{22} Venkatesh et al.\textsuperscript{20} and Ganvir and Gajbhiye.\textsuperscript{26} However, a study was done by Veena et al.\textsuperscript{27} and Kulkarni\textsuperscript{28} showed an increase in frequency in thenar/\textsubscript{I\textsubscript{1}} area in patients with OSMF.

In our study, loops were most common in controls than in cases in \textsubscript{I\textsubscript{1}}, \textsubscript{I\textsubscript{2}} and \textsubscript{I\textsubscript{3}} areas as compared to the patients with OSMF and OSCC. Our finding was consistent with the studies by Venkatesh et al.\textsuperscript{20} Veena et al.\textsuperscript{27} in her study proved that there was increase in pattern frequency in \textsubscript{I\textsubscript{1}} area in OSMF patients. On the other hand, a study was done by and Hakan et al.\textsuperscript{29} observed that there was a reduced frequency of patterns in the 4\textsuperscript{th} interdigital area in OSCC patients. Other studies by Gupta et al.\textsuperscript{22} and Ganvir and Gajbhiye\textsuperscript{26} reported that there was no significant difference among the study groups.

In our study, no significant difference was observed in the mean TFRC between the three study groups. Our findings were consistent with the study done by Venkatesh et al.\textsuperscript{20} However, a study by Jatti et al.,\textsuperscript{24} showed an increase in mean TFRC, whereas in Gupta et al.\textsuperscript{22} David and Sinha and Tamgire et al.\textsuperscript{29} observed a decrease in mean TFRC.

There was no significant difference in the mean ab count between the three groups was observed in our study. Our findings were consistent with studies by Gupta et al. and Venkatesh et al.\textsuperscript{20}

In our study, there was no significant difference in atd angles among the study groups. This was in accordance with the studies of Venkatesh et al.\textsuperscript{20} and Jatti et al.,\textsuperscript{24} but there was an increase in David and Priscilla\textsuperscript{23} study. On the contrary, few studies done by Gupta et al.,\textsuperscript{22} Veena et al.,\textsuperscript{27} Tamgire et al.,\textsuperscript{29} and Kulkarni\textsuperscript{28} found a decrease in atd angle in the study group.

The limitation of the study is the smaller-sample size because of lesser availability of OSMF and OSCC patients. Future studies including other potentially malignant disorders will substantiate the reliability of dermatoglyphics.

**CONCLUSION**

The relevance of dermatoglyphics in the primary diagnosis of the disease appears dubious. However, its role in the identification of people with a genetic predisposition to diseases (OSMF and OSCC) is promising and may contribute to prevention strategies in developing countries with huge populations and finite health budgets. Further multicentric studies must be done with a larger sample size with age, sex, religion, and race-matched controls to universalize the dermatoglyphic markers of OSMF and OSCC which will be a powerful screening tool for the genetically susceptible individuals.

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Correlation b/w Palmar Dermatoglyphics and Precancerous/Cancerous Lesion


Source of Support: Nil, Conflict of Interest: None declared.