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DERMATOGLYPHIC FINGERPRINT PATTERNS IN PATIENTS WITH ORAL SQUAMOUS CELL CARCINOMA: AN INSTITUTIONAL OBSERVATIONAL STUDY

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ABSTRACT:
Background: Oral squamous cell carcinoma (OSCC) is a major malignancy of the oral cavity. Its development is multifactorial, with environmental exposures and host-related factors contributing to disease susceptibility. Dermatoglyphic patterns are established during fetal development and remain relatively stable throughout life, making them potential phenotypic markers for investigating disease associations.
Aim: To assess the distribution of dermatoglyphic fingerprint patterns among patients with histopathologically confirmed OSCC and to explore their potential association with the disease.
Methods: An institutional observational study was conducted over 9 months, from October 2024 to June 2025, in the Departments of Oral and Maxillofacial Surgery and Oral Pathology. Sixty-one patients with histopathologically confirmed OSCC were included. Fingerprints were recorded from all ten digits using the conventional ink-and-paper method and classified according to the Galton-Henry system as complex whorl (CW), central pocket loop (CPL), double loop (DL), radial loop (RL), ulnar loop (UL), and tented arch (TA). The reported analysis comprised 292 valid fingerprint observations from selected thumb, middle, and little finger positions of both hands. Frequencies and percentages were calculated, and the chi-square test was used for analysis.
Results: Of the 61 participants, 46 (75.4%) were male and 15 (24.6%) were female. The reported median age was 46.8 years. Among the 292 analysed fingerprint observations, UL was the most frequent pattern (156; 53.42%), followed by CW (63; 21.58%), RL (39; 13.36%), TA (20; 6.85%), CPL (9; 3.08%), and DL (5; 1.71%). Double-loop patterns were not observed in the little-finger positions of either hand. The reported chi-square analysis for this finding was not statistically significant ($p > 0.05$).
Conclusion: Ulnar loop was the predominant dermatoglyphic pattern in the studied OSCC population. The findings provide a descriptive assessment of fingerprint-pattern distribution but do not establish any specific dermatoglyphic pattern as a diagnostic or predictive marker of OSCC. Larger controlled and multicentric studies are required to determine whether reproducible associations exist between dermatoglyphic characteristics and OSCC.

KEYWORDS: Dermatoglyphics; Fingerprints; Oral squamous cell carcinoma; Ulnar loop; Whorl; Phenotypic marker.

INTRODUCTION

Oral squamous cell carcinoma (OSCC) is the most common malignant neoplasm of the oral cavity and represents an important global health burden. Its development is multifactorial, involving environmental exposures, behavioural factors, host susceptibility, and genetic and molecular alterations. Tobacco use, areca-nut exposure, and alcohol consumption are among the major established risk factors, particularly in South Asian populations. [1,2]

India carries a substantial burden of oral cancer, and tobacco-related exposure remains an important preventable contributor. Regional evidence from Odisha has highlighted continuing challenges in tobacco control and their implications for oral cancer prevention. [3] Carcinoma of the buccal mucosa is also an important manifestation of oral malignancy, with tobacco and areca-nut exposure being particularly relevant in the Indian context. [4]

Although established environmental risk factors contribute substantially to OSCC, individuals with apparently similar exposures may have different disease outcomes. This has led to increasing interest in host-related characteristics that may reflect differences in susceptibility. Dermatoglyphics is the study of epidermal ridge patterns of the fingers, palms, toes, and soles. These patterns develop during fetal life and remain relatively stable after their formation, making them useful phenotypic characteristics for investigating developmental and disease associations. [5,6]

Dermatoglyphic patterns are influenced by genetic and intrauterine developmental factors. The formation of dermal ridges occurs during a specific period of fetal development, and the resulting patterns are generally maintained throughout life. [5–7] Dermatoglyphic analysis has consequently been investigated in various congenital, chromosomal, and systemic conditions as a potential marker of altered developmental processes. [8]

Table 1. Demographic Characteristics of the Study Participants

Characteristic	Value
Total participants	61
Male, n (%)	46 (75.4)
Female, n (%)	15 (24.6)
Median age (years)	46.8

The possible relationship between dermatoglyphic characteristics and oral malignancy has been explored in previous studies. Jatti et al. investigated dermatoglyphic patterns in individuals with precancerous and cancerous lesions of the oral cavity and reported differences among the studied groups. [9] Dodia et al. subsequently examined fingerprint patterns in individuals with oral potentially malignant disorders and oral cancer and reported associations between selected fingerprint patterns and disease categories. [10] Tonkaboni et al. also investigated fingerprint patterns in patients with OSCC and reported differences in the distribution of major fingerprint patterns between their study groups, while emphasizing that dermatoglyphics should not replace established diagnostic procedures. [11] Earlier work by Venkatesh et al. examined palmar dermatoglyphics among patients with oral leukoplakia and OSCC and reported differences in dermatoglyphic characteristics between affected and control groups. [12]

Table 2. Frequency and Percentage Distribution of Dermatoglyphic Fingerprint Patterns

S. No.	Fingerprint pattern	Frequency (n)	Percentage (%)
1	Ulnar loop (UL)	156	53.42
2	Complex whorl (CW)	63	21.58
3	Radial loop (RL)	39	13.36
4	Tented arch (TA)	20	6.85
5	Central pocket loop (CPL)	9	3.08
6	Double loop (DL)	5	1.71
	Total	292	100.00

Despite these observations, available evidence remains heterogeneous because of differences in study populations, sample sizes, control groups, anatomical sites, fingerprint classification systems, and methods of analysis. Furthermore, an association between a dermatoglyphic characteristic and a disease does not demonstrate that the fingerprint pattern directly causes the disease or represents a specific cancer-associated genetic alteration.

The present study was therefore undertaken to assess the distribution of dermatoglyphic fingerprint patterns among patients with histopathologically confirmed OSCC and to explore their potential association with the disease. The study evaluated six fingerprint-pattern categories—complex whorl, central pocket loop, double loop, radial loop, ulnar loop, and tented arch—among selected finger positions of both hands.

Aim and Objectives

Aim

To assess the distribution of dermatoglyphic fingerprint patterns among patients with histopathologically confirmed oral squamous cell carcinoma (OSCC) and to explore their potential association with OSCC.

Objectives

1. To record and classify the dermatoglyphic fingerprint patterns among patients diagnosed with OSCC.
2. To determine the frequency and percentage distribution of the identified fingerprint patterns.
3. To evaluate the distribution of fingerprint patterns across the selected finger positions of the right and left hands.
4. To assess whether the distribution of individual fingerprint patterns differs significantly among the selected finger positions.
5. To explore the potential utility of dermatoglyphic fingerprint patterns as a supplementary phenotypic marker in patients with OSCC.

MATERIALS AND METHODS

Study Design: An institutional observational study was conducted to evaluate the distribution of dermatoglyphic fingerprint patterns among patients with histopathologically confirmed oral squamous cell carcinoma (OSCC).

Study Setting and Study Period: The study was conducted in the Department of Oral and Maxillofacial Surgery and Department of Oral Pathology, Hi-Tech Dental College and Hospital, Bhubaneswar, over a period of 9 months from October 2024 to June 2025.
Study Participants and Sample: A total of 65 patients were initially assessed. Of these, 61 patients were considered for the final study analysis based on the corrected study dataset.
All included participants had a histopathologically confirmed diagnosis of OSCC.

Inclusion Criteria
Participants were included if they:
- Had OSCC confirmed by biopsy;
- Were aged 18 years or older; and
- Were willing to provide informed consent

Exclusion Criteria
Participants were excluded if they had:
- Dermatological diseases affecting the fingers;
- Deformed or mutilated fingers that could interfere with fingerprint recording; or
- A history of systemic genetic syndromes

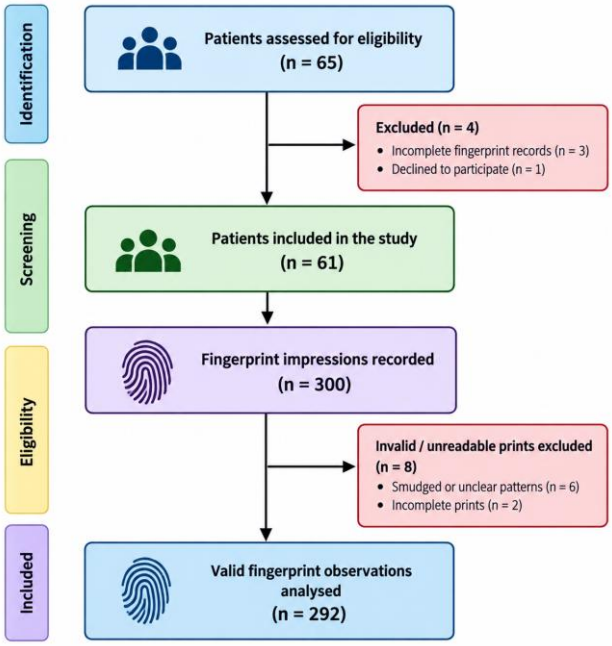
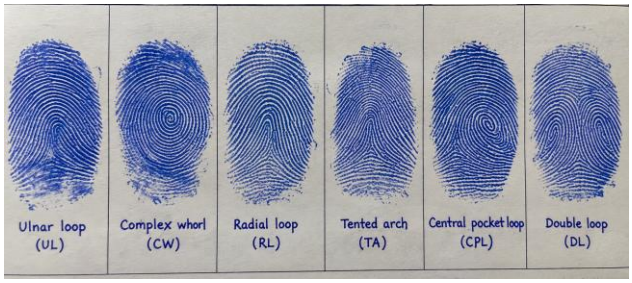


Figure 4. PRISMA-Style Flow Diagram of Study Participants and Fingerprint Analysis

Legend: Figure 4 illustrates the participant selection and fingerprint-analysis pathway, from initial assessment of 65 patients to inclusion of 61 patients and analysis of the available valid fingerprint observations (n = 292).

Method of Fingerprint Data Collection
Fingerprint patterns were recorded using the conventional ink-and-paper method on A4-size paper. Fingerprints from all ten fingers were recorded for each participant.
The recorded fingerprints were classified according to standard Galton-Henry classification into six pattern categories:
1. Complex whorl (CW)
2. Central pocket loop (CPL)
3. Double loop (DL)
4. Radial loop (RL)
5. Ulnar loop (UL)
6. Tented arch (TA)

Types of Dermatoglyphic Fingerprint Patterns



Legend: Figure 5 presents representative blue-ink fingerprint impressions illustrating the six dermatoglyphic pattern categories recorded in the study: ulnar loop (UL), complex whorl (CW), radial loop (RL), tented arch (TA), central pocket loop (CPL), and double loop (DL).

Finger Positions Included in the Analysis

Although fingerprints were recorded from all ten digits, the reported statistical analysis evaluated the thumb, middle, and little fingers of both hands, representing six digit positions. The dataset reported 292 fingerprint observations for these positions.

Statistical Analysis

The frequency and percentage distribution of the six fingerprint-pattern categories were calculated. A chi-square (χ^2) test of independence was used to assess the relationship between fingerprint-pattern type and finger position. Statistical analysis was performed using Microsoft Excel, with analysis validated using IBM SPSS Statistics version 26.0. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Written informed consent was obtained from the participants for use of their fingerprints and relevant clinical information for research and publication. Participant confidentiality was maintained, and identifying information was not intended to be disclosed.

RESULTS

Study Population

A total of 65 patients were initially assessed during the study period. Following evaluation of the available study records, 61 patients were included in the final analysis.

Among the 61 participants, 46 (75.4%) were male and 15 (24.6%) were female. The reported median age of the study population was 46.8 years.

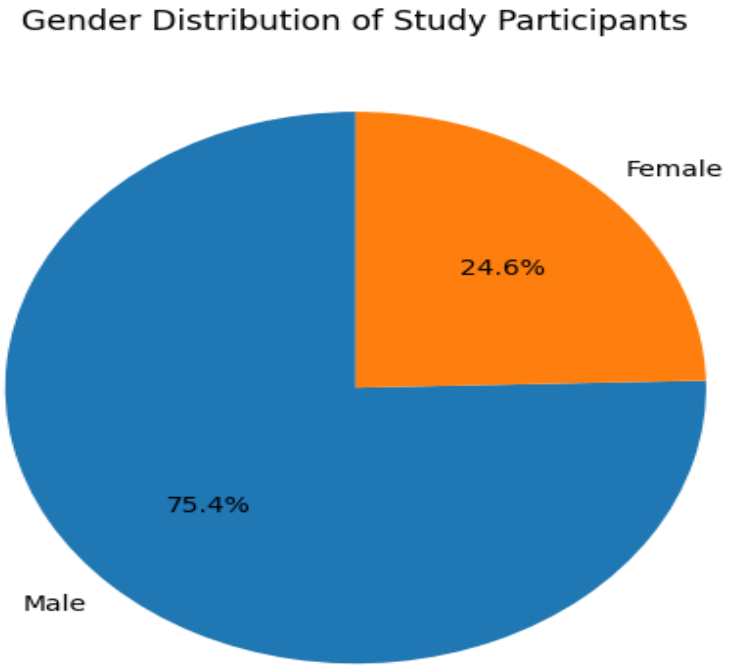


Figure 1. Gender Distribution of the Study Participants

Legend: Figure 1 shows the gender distribution among the 61 study participants, comprising 46 males (75.4%) and 15 females (24.6%).

Distribution of Dermatoglyphic Fingerprint Patterns

A total of 292 fingerprint observations from the selected thumb, middle, and little finger positions of both hands were analysed.

The frequency distribution was as follows:

Fingerprint pattern	Frequency (n)	Percentage (%)
Ulnar loop (UL)	156	53.42
Complex whorl (CW)	63	21.58
Radial loop (RL)	39	13.36
Tented arch (TA)	20	6.85
Central pocket loop (CPL)	9	3.08
Double loop (DL)	5	1.71
Total	292	100.00

The ulnar loop was the most frequently observed pattern, comprising 156 (53.42%) observations. Complex whorl was the second most frequent pattern, with 63 (21.58%), followed by radial loop with 39 (13.36%). Tented arch, central pocket loop, and double loop accounted for 20 (6.85%), 9 (3.08%), and 5 (1.71%), respectively.

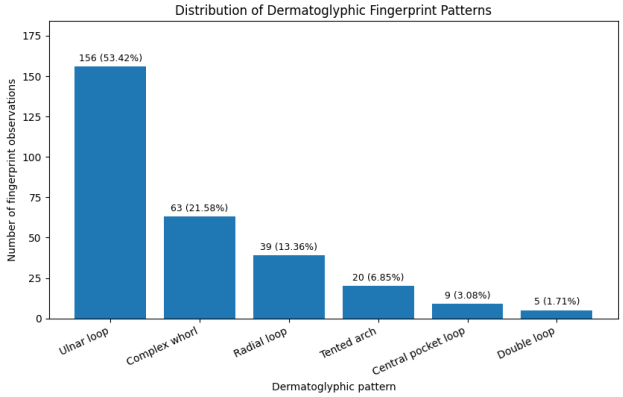


Figure 2. Distribution of Dermatoglyphic Fingerprint Patterns

Legend: Figure 2 shows the distribution of the six dermatoglyphic fingerprint patterns among the 292 analysed fingerprint observations. Ulnar loop was the most frequent pattern (156; 53.42%), followed by complex whorl (63; 21.58%), radial loop (39; 13.36%), tented arch (20; 6.85%), central pocket loop (9; 3.08%), and double loop (5; 1.71%).

Distribution of Double-Loop Patterns

The double-loop pattern was reported to be absent in the little fingers of both the right and left hands, despite being present in the thumb and middle-finger positions. The reported expected frequency of double-loop patterns in the little fingers was approximately 1.66, whereas no occurrences were observed.

The reported chi-square value was 1.66, with $p > 0.05$, indicating that the observed difference was not statistically significant. Accordingly, the absence of double-loop patterns in the little fingers is reported as a descriptive observation and should not be interpreted as evidence of a statistically significant association with OSCC.

Table 3. Distribution of Double-Loop Pattern in Little-Finger Positions

Parameter	Value
Expected frequency	1.66
Observed frequency	0
χ^2 value	1.66
p-value	>0.05
Statistical significance	Not significant

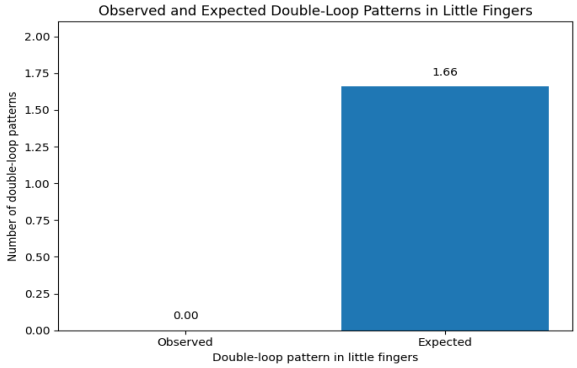


Figure 3. Observed and Expected Double-Loop Patterns in Little Fingers

Legend: Figure 3 compares the observed and expected frequency of double-loop patterns in the little fingers. No double-loop pattern was observed, whereas the expected frequency was 1.66. The difference was not statistically significant ($\chi^2 = 1.66$; $p > 0.05$).

Summary of Findings

The principal finding was the predominance of the ulnar-loop pattern, followed by complex whorl and radial loop. The remaining dermatoglyphic patterns occurred at lower frequencies. The reported absence of double-loop patterns in the little fingers was not statistically significant.

Discussion

The present study evaluated the distribution of dermatoglyphic fingerprint patterns among patients with histopathologically confirmed oral squamous cell carcinoma (OSCC). Among the 292 fingerprint observations analysed, the ulnar loop (UL) was the predominant pattern, accounting for 53.42% of observations, followed by complex whorl (21.58%) and radial loop (13.36%). The remaining patterns—tented arch, central pocket loop, and double loop—were observed less frequently.

Dermatoglyphic patterns are established during fetal development and are influenced by genetic and intrauterine developmental factors. Once formed, the fundamental ridge configuration remains relatively stable throughout life. [5–8] This biological stability has provided the rationale for investigating dermatoglyphic characteristics as potential phenotypic markers in various diseases. However, the presence of a particular fingerprint pattern should not be interpreted as evidence of a specific genetic mutation or a direct causal mechanism for OSCC.

The predominance of the ulnar-loop pattern observed in the present study should primarily be regarded as a descriptive finding. Because the present study included only patients with confirmed OSCC and did not include a healthy control group, it cannot determine whether ulnar loops occur more frequently in patients with OSCC than in the general population. Differences in dermatoglyphic frequencies may also occur because of population characteristics, genetic background, sex distribution, geographical variation, sample size, and differences in recording or classification methods.

The relationship between dermatoglyphics and oral disease has been investigated previously. Jatti et al. evaluated dermatoglyphic characteristics in patients with precancerous and cancerous lesions of the oral cavity and reported differences between the studied groups. [9] These observations suggested that dermatoglyphic analysis could be explored as a potential supplementary approach in oral disease research. However, such findings require confirmation in appropriately designed comparative studies.

Dodia et al. subsequently investigated fingerprint patterns among individuals with oral potentially malignant disorders and oral cancer and reported associations between selected fingerprint patterns and disease categories. [10] The findings of that study, together with those of the present investigation, support continued research into dermatoglyphic characteristics in oral oncology. Nevertheless, differences in study populations and methodology make direct comparison of pattern frequencies inappropriate without standardized protocols and comparable control groups.

Tonkaboni et al. specifically investigated the relationship between fingerprint patterns and OSCC and reported a statistically significant difference in the distribution of major fingerprint-pattern categories between their study groups. [11] Their findings provide additional support for investigating dermatoglyphics in relation to OSCC. Importantly, however, dermatoglyphic analysis cannot substitute for clinical examination, biopsy, and histopathological diagnosis. This distinction is particularly relevant to the present study because all participants had already been diagnosed with OSCC histopathologically.

Venkatesh et al. also evaluated palmar dermatoglyphic characteristics among patients with oral leukoplakia and OSCC and reported differences between affected individuals and controls. [12] Collectively, these studies indicate that dermatoglyphic characteristics may warrant further investigation as developmental phenotypic variables associated with oral potentially malignant and malignant conditions. However, the heterogeneity of the available literature prevents the identification of a consistent OSCC-specific fingerprint profile.

In the present study, the complex whorl was the second most frequent pattern, accounting for 21.58% of the analysed observations. Although whorl patterns have been examined in previous dermatoglyphic studies of oral disease, the current case-only design does not permit an inference that the observed frequency is characteristic of OSCC. Similarly, the relatively lower frequencies of tented arch, central pocket loop, and double loop should be interpreted descriptively rather than as evidence of disease-specific associations.

The double-loop pattern represented 1.71% of the analysed observations and was reported to be absent from the little-finger positions of both hands. The expected frequency was approximately 1.66, while the reported chi-square value was 1.66 with $p > 0.05$. Therefore, the absence of the double-loop pattern in these positions was not statistically significant and should not be described as evidence of an OSCC-associated developmental abnormality.

The developmental basis of dermatoglyphics provides biological interest to these observations, but it does not establish causality. Genetic and environmental influences acting during fetal development can affect ridge formation, and dermatoglyphic characteristics may consequently reflect aspects of early development. [5–8] However, extrapolating from this developmental stability to specific molecular mechanisms of carcinogenesis would require independent genetic or molecular evidence, which was not obtained in the present study.

From a clinical perspective, fingerprint recording is non-invasive and relatively simple. Nevertheless, the present findings do not establish sufficient diagnostic performance to support the use of dermatoglyphics as an independent screening or diagnostic method for OSCC. Its possible role should therefore be considered supplementary and investigational, pending validation through larger controlled studies.

The study has several limitations. The sample was relatively small and derived from a single institution, limiting generalizability. More importantly, the study did not include a healthy control group, preventing direct assessment of whether the observed fingerprint distribution differs significantly from that of individuals without OSCC. In addition, although fingerprints were recorded from all ten digits, the reported statistical analysis included only the thumb, middle, and little fingers of both hands and comprised 292 observations. The study also did not provide sufficient data to assess associations according to tumour site, clinical stage, histopathological grade, or individual tobacco and areca-nut exposure.

Future studies should therefore include larger, multicentric and appropriately matched control populations, standardized fingerprint acquisition and classification, and predefined statistical methods. Analysis according to tumour site, stage, histopathological characteristics, and established behavioural risk factors may further clarify whether any reproducible dermatoglyphic association exists.

Overall, the present study demonstrates a predominance of the ulnar-loop pattern among the analysed fingerprint observations in patients with OSCC, but it does not establish a specific dermatoglyphic signature for the disease. The findings should consequently be interpreted as preliminary descriptive evidence supporting further investigation rather than as proof that dermatoglyphic patterns are diagnostic, predictive, or causal markers of OSCC.

CONCLUSION

The present institutional observational study demonstrated that the ulnar loop was the most frequently observed dermatoglyphic fingerprint pattern, accounting for 53.42% of the 292 analysed fingerprint observations among patients with histopathologically confirmed oral squamous cell carcinoma.

Although dermatoglyphic analysis provides a simple and non-invasive method for recording stable epidermal ridge patterns, the present study does not establish any specific fingerprint pattern as a diagnostic, predictive, or causal marker of OSCC. The reported absence of double-loop patterns in the little fingers was a descriptive finding and did not reach statistical significance ($p > 0.05$).

The findings should therefore be interpreted cautiously, particularly because of the relatively small sample size, single-institution design, and absence of a healthy control group. Larger, multicentric, controlled studies with standardized fingerprint recording and appropriate statistical analysis are required to determine whether reproducible associations exist between dermatoglyphic patterns and OSCC susceptibility or clinical characteristics.

Ethical Approval

The study was conducted in accordance with the ethical principles applicable to research involving human participants. Institutional Ethics Committee approval was obtained on 16 September 2024, prior to commencement of participant recruitment and data collection in October 2024.

Informed Consent

Written informed consent was obtained from all participants before their inclusion in the study. Participants consented to the use of their fingerprints and relevant clinical information for research and publication purposes. Confidentiality of participant information was maintained.

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Conflict of Interest: The authors declare no conflicts of interest.

Author Contributions

1. Prof. Dr. Sandeep Kumar Samal: Conceptualization, study supervision, clinical coordination, and critical review of the manuscript.
2. Prof. Dr. Aparna Gupta: Histopathological evaluation, pathological interpretation, and critical review of the manuscript.
3. Dr. Ashutosh Panda (Corresponding Author): Study coordination, clinical data collection, fingerprint recording, literature review, manuscript preparation, correspondence with the journal, and final manuscript approval.
4. Dr. Kohinoor Acharya: Data collection, dermatoglyphic assessment, literature review, manuscript preparation, and critical revision.
5. Asso. Prof. Dr. Prateek Tripathy: Patient evaluation, clinical data collection, interpretation of findings, and manuscript review.
6. Asso. Prof. Dr. Saswati Sidarth: Histopathological assessment, data interpretation, and manuscript review.

All authors reviewed and approved the final manuscript and agreed to be accountable for all aspects of the work.

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REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209–249.
2. Subash A, Bylapudi B, Thakur S, Rao VUS. Oral cancer in India, a growing problem: Is limiting the exposure to avoidable risk factors the only way to reduce the disease burden? Oral Oncol. 2022;127:105768.
3. Patnaik S, Acharya K, Mishra S, Behera L. Challenges and outcomes of tobacco control laws on oral cancer in Odisha. J Prev Med Holist Health. 2025;11(2):87–94. doi:10.18231/j.jpmhh.12460.1763363037.
4. Nayak SC, Barik RK, Acharya L, Acharya K, Mishra A. Carcinoma of the buccal mucosa: A comprehensive clinical review. J Orofac Health Sci. 2025;12(4):196–204. doi:10.18231/j.johs.13569.1765970993.
5. Mulvihill JJ, Smith DW. The genesis of dermatoglyphics. J Pediatr. 1969;75(4):579–589. doi:10.1016/S0022-3476(69)80453-1.
6. Okajima M. Development of dermal ridges in the fetus. J Med Genet. 1975;12(3):243–250. doi:10.1136/jmg.12.3.243.
7. Lacroix B, Wolff-Quenot MJ, Haffen K. Early human hand morphology: An estimation of fetal age. Early Hum Dev. 1984;9(2):127–136. doi:10.1016/0378-3782(84)90093-8.
8. Smith GF, Schindeler J, Shear C. Dermatoglyphic analysis in medicine. Finger, palm and sole prints as indicators of chromosomal or congenital abnormalities. J Fla Med Assoc. 1969;56(12):912–918.
9. Jatti D, Bhoomareddy Kantraj YD, Nagaraju R. Role of dermatoglyphics as an indicator of precancerous and cancerous lesions of the oral cavity. Contemp Clin Dent. 2013;4(4):448–453. doi:10.4103/0976-237X.123039.
10. Dodia VS, Odedra SP, Shah KH, Monpara PC, Vyas PM, Pillai JP. The association of fingerprint patterns with oral potentially malignant disorders and oral cancer: A dermatoglyphic study. J Oral Maxillofac Pathol. 2022;26(3):420–425. doi:10.4103/jomfp.jomfp_261_21.
11. Tonkaboni A, Etemadian M, Manifar S, Shirkhoda M, Gharehdaghi J, Kharazi Fard MJ. Investigating the relationship between fingerprint pattern and development of oral squamous cell carcinoma. J Dent (Shiraz). 2022;23(2):144–150. doi:10.30476/DENTJODS.2021.87173.1240.
12. Venkatesh E, Bagewadi A, Keluskar V, Shetti A. Palmar dermatoglyphics in oral leukoplakia and oral squamous cell carcinoma patients. J Indian Acad Oral Med Radiol. 2008;20(3):94–98. doi:10.4103/0972-1363.52774.