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Original Article

Dermatology Section

Mucoscopic Features of Oral Mucosal Lesions at a Tertiary Care Centre in Central India: A Cross-sectional Study

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ABSTRACT

Introduction: Patients with Oral Mucosal Lesions (OMLs) form a significant number in the daily routine dermatology OPD. Also, many times OMLs pose a diagnostic challenge due to similar-looking morphologies. Every time mucosal biopsy is not feasible for confirmation of diagnosis.

Aim: To study the mucoscopic features of various mucosal lesions affecting the oral cavity.

Materials and Methods: The present cross-sectional study was conducted in the Dermatology outpatient department at Chirayu Medical College and Hospital, Bhopal, Madhya Pradesh, India, from October 2024 to September 2025. A total of 258 patients were enrolled in the study after obtaining approval from the Institutional Ethics Committee. All patients presenting with lesions of the oral mucosa, who were willing to give written informed consent, were included in the study. A detailed history and clinical examination were done, followed by mucoscopic examination. The findings were recorded in a predesigned proforma. The data was then statistically analysed.

Results: A total of 258 patients were enrolled for the study, out of which 149 (57.7%) were males and 109 (42.3%) were females, with a ratio of 1.3:1. The mean age of patients was 33.4±7 years. Inflammatory OMLs 116 (44.9%) was most commonly found, followed by infectious OMLs 56 (21.7%) and premalignant and malignant OMLs 35 (13.5%). Recurrent Aphthous Stomatitis (RAS) 63 (24.4%) was the most common OML studied, followed by Oral Lichen Planus (OLP) 35 (13.5%) and herpes labialis 23 (8.9%). Fordyce spot showed white yellow discrete ovoid structures on mucoscopy and geographic tongue showed atrophic filiform papillae surrounded by whitish yellow irregular serpiginous borders.

Conclusion: According to the findings of the present study mucoscopy helps in aiding the subtle features of various OML and thus assists in diagnosis where mucosal biopsy is not feasible.

Keywords: Dermoscopy, Oral mucosa, Oral ulcers, Premalignant lesions

INTRODUCTION

The OML constitute a common reason for consultation in Dermatology, ENT and Dental Outpatient Departments and encompass a wide spectrum of conditions, including physiological, inflammatory, infectious, pigmentary, premalignant and malignant lesions. Owing to constant exposure to drugs, microorganisms, tobacco-related products, and systemic influences, the oral mucosa frequently manifests pathological changes that may present with overlapping clinical appearances [1]. Many OMLs share similar surface morphologies, colour and distribution, making accurate diagnosis based solely on clinical examination challenging. Early and precise identification of these lesions is clinically important, particularly in premalignant and malignant conditions, as it directly influences management and prognosis of the condition.

Histopathological examination remains the gold standard for definitive diagnosis of many oral mucosal disorders. However, biopsy of oral mucosa is not always feasible due to anatomical constraints, patient discomfort, bleeding tendency, medical co-morbidities, or the need for repeated sampling in multifocal or recurrent lesions. In routine clinical practice, clinicians often rely on a combination of history, clinical morphology, and ancillary investigations to arrive at a provisional diagnosis. This highlights the need for a reliable, non-invasive, bedside diagnostic tool that can aid in the evaluation and differentiation of OMLs while minimising patient discomfort.

Dermoscopy is a non-invasive diagnostic technique that enables visualisation of subsurface structures not appreciable to the naked eye through optical magnification and polarised illumination. When applied to mucosal surfaces, it is referred to as mucoscopy and allows detailed assessment of background colour, vascular morphology, pigmentary patterns, and Structureless Areas (SLA), which often correlate with underlying histopathological changes such as inflammation, epithelial atrophy, keratinisation, fibrosis, or pigment alteration [2]. Compared to routine clinical examination, mucoscopy provides magnified (2-50×) visualisation of microvascular and structural patterns, facilitating assessment of deeper subepidermal components that are not appreciable to the naked eye. By providing this enhanced morphological detail, dermoscopy has been shown to improve diagnostic accuracy by approximately 5-30%, depending on the type of lesion and the examiner's expertise, thereby offering a more objective and reproducible method of lesion assessment [3]. These features enhance diagnostic confidence, assist in distinguishing clinically similar lesions, aid in biopsy site selection, and facilitate documentation and follow-up [3].

Over the past decade, several studies have explored mucoscopic features of individual oral mucosal conditions, including lichen planus, pemphigus vulgaris, leukoplakia, and squamous cell carcinoma [4-7]. Most available literature consists of case reports, small case series, or studies focusing on a limited number of conditions [6-11]. Although these studies have described characteristic mucoscopic patterns, there is considerable variability in terminology and reporting, and comprehensive data encompassing a broad spectrum of OMLs remain scarce. Furthermore, limited studies have evaluated mucoscopy in routine outpatient settings where it may serve as a practical adjunct to clinical examination [3,12].

In the Indian context, oral mucosal disorders are particularly prevalent due to widespread tobacco use, areca nut consumption, infections, and inflammatory conditions [1,13,14]. Despite this high burden, systematic documentation of mucoscopic features of OMLs in Indian patients is limited. There is a clear need for studies that comprehensively evaluate mucoscopic patterns across a wide range of OMLs and correlate these findings with clinical diagnoses. The present study was therefore undertaken to analyse mucoscopic features of various OMLs encountered at a tertiary care centre in Central India, to expand existing knowledge, identifying lesion-specific patterns, and highlighting the role of mucoscopy as a supportive, non-invasive diagnostic tool in routine clinical practice, particularly in situations where biopsy is not feasible or needs to be deferred.

MATERIALS AND METHODS

The present cross-sectional study was conducted in the Department of Dermatology, Venereology and Leprosy at Chirayu Medical College and Hospital, Bhopal, Madhya Pradesh, India, from October 2024 to September 2025, after obtaining approval from the Institutional Ethics Committee (CMCH/IEC/2024/114).

Sample size calculation: Sample size was calculated using the standard formula for estimating a population proportion:

$n=(Z^2 \times p \times (1-p))/d^2$

where:

- n is the required sample size;
- Z is the Z-score corresponding to the desired confidence level (1.96 for 95%);
- p is the estimated prevalence of RAS (20 % [1] or 0.20); and
- d is the margin of error (5% or 0.05).

Substituting the values into the formula:

$n=(1.96)^2 \times 0.20 \times (1-0.20)/(0.05)^2 \approx 245$;

After accounting for a 5% non-response rate, the adjusted sample size was calculated as:

$n_{adjusted}=245/(1-0.05) \approx 245/0.95 \approx 258$.

Inclusion criteria: All patients, irrespective of age and gender, presenting with lesions of the oral mucosa with or without associated cutaneous involvement, who were willing to give written informed consent, were included in the study.

Exclusion criteria: Uncooperative children, active infection around the lesions, severe illness or debilitation, who were unable to open their mouth, had reduced mouth opening, and those who were receiving treatment and lesions were in the resolving phase, were excluded from the study.

Study Procedure

After obtaining written informed consent, all patients with OMLs underwent a detailed history and clinical examination, with emphasis on oral mucosal examination and findings were recorded on a standard predesigned proforma. This was followed by mucoscopic examination using the Dinolite Premier Digital Microscope AM4113ZT with 60X magnification through non-contact dermoscopy using polarised light, and findings were captured using the Dino capture 2.0 software in a Lenovo IdeaPad 310 Laptop. All mucoscopic examinations were performed by a single examiner with prior formal training in dermoscopy and more than five years of experience in routine dermoscopic practice. Relevant laboratory investigations, such as Tzanck smear, Giemsa staining, Gram staining and biopsy for histopathological examination, were carried out as and when required. Photographs were taken with the patient's consent, ensuring that their identity would not be revealed, and confidentiality would be maintained at all levels.

STATISTICAL ANALYSIS

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and was statistically analysed using Statistical Package for Social Sciences (SPSS) version 20.0. The results were tabulated and described in terms of distribution, frequency and mean±SD. Comparisons between variables were conducted using appropriate tests (Chi square) as and when required and p value=0.05 was considered as level of significance.

RESULTS

A total of 258 patients were enrolled for the study, out of which 149 (57.7%) were males and 109 (42.3%) were females, with a ratio of 1.3:1. The mean age of patients was 33.4±7 years. Inflammatory OMLs, 116 (44.9%) were most common, and RAS, 63 (24.4%) was the most common OML studied [Table/Fig-1]. The dermoscopic features of all the lesions have been illustrated in [Table/Fig 2a-e,3a-d,4a-d,5a-d,6a-c].

a) Physiological conditions

1. **Fordyce spots:** Lips {4 (1.5%)} and buccal mucosa {3 (1.1%)} were the sites of involvement. Mucoscopy showed white, yellow, discrete ovoid structures 100% (7/7) with central opacity 42.8% (3/7). These ovoid structures were surrounded by a fine network of linear or branching vessels 57.1% (4/7) [Table/Fig-2a].
2. **Geographic tongue:** All 4 (1.5%) patients had lesions over the dorsum of the tongue. One (0.3%) patient had a history of psoriasis. Mucoscopy showed bald red/erythematous patches surrounded by whitish yellow irregular serpiginous borders representing parakeratosis and inflammation 100% (4/4) [Table/Fig-2b].

b) Pigmentary conditions

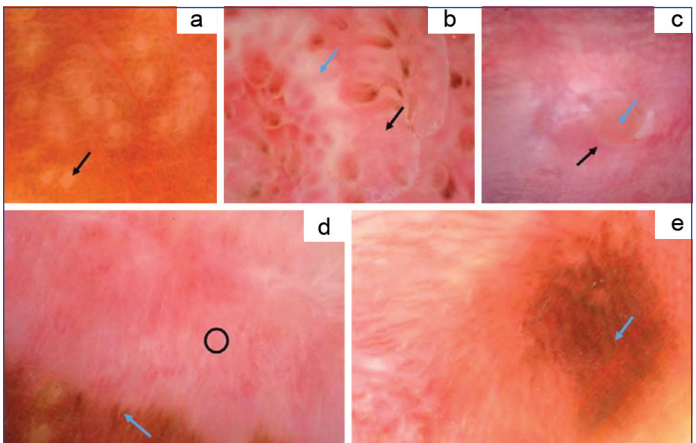
1. **Mucosal vitiligo:** All the patients had lesions over the lips, with 3 (1.16%) patients having lesions that extended towards the oral vestibule. Four (1.55%) patients had isolated lesions of mucosal vitiligo, while 7 (2.71%) patients had lesions as part of lip-tip variety, 6 (2.32%) patients had generalised vitiligo, and 2 (0.7%) patients had segmental vitiligo. Mucoscopy showed white areas due to absent pigment network. Vitiligo was progressive in nature in 42.1% (8/19) patients with scalloped margins, while stable/repigmenting vitiligo was seen in 57.8% (11/19) patients with perilesional pigmentation [Table/Fig-2d].
2. **Lentigenes:** Lesions were present only over lips in 2 (0.7%) patients and over both lips and buccal mucosa in 1 (0.3%) patient. One (0.3%) patient was suffering from Peutz-Jeghers syndrome. Mucoscopy showed uniform and regular brown/black pigmentation in different patterns, like parallel 33.3% (1/3) and dots/globules 66.6% (2/3) [Table/Fig-2e].

c) Inflammatory conditions

1. **Recurrent Aphthous Stomatitis (RAS):** The RAS was the most common OML observed in this study. Minor aphthae 45 (17.4%) were most common, followed by major aphthae 13 (5.03%) and herpetiform aphthae 5 (1.9%). Behcet's Disease was seen in 3 (1.1%) patients. Mucoscopy revealed a central yellow-white SLA 100% (63/63), a surrounding white/greyish zone 63.4% (40/63) and a peripheral rim of red erythematous halo 100% (63/63) [Table/Fig-3a].
2. **Pemphigus vulgaris:** Mucoscopy revealed a structureless red area 100% (13/13), bleeding spots 69.23% (9/13), dirty brown crust 15.38 % (2/13) and a complex network of vessels around the lesions 76.92% (10/13). Intact vesicles looked like different shades of translucent lacunae varying from greyish pink to greyish white in colour 23.07% (3/13) [Table/Fig-3b].
3. **Discoid Lupus Erythematosus (DLE):** Sites of involvement were lips 5 (1.9%), buccal mucosa 4 (1.5%) and palatal mucosa

Oral mucosal lesions		Total	Males	Females
A	**Physiological conditions**	**11 (4.2%)**	**6 (2.3%)**	**5 (1.9%)**
1.	Fordyce Spots	7 (2.7%)	5 (1.9%)	2 (0.7%)
2	Geographic Tongue	4 (1.5%)	1 (0.3%)	3 (1.1%)
B	**Pigmentary conditions**	**22 (8.5%)**	**13 (5.03%)**	**9 (3.4%)**
1	Mucosal vitiligo	19 (7.3%)	11 (4.2%)	8 (3.1%)
2	Lentigenes	3 (1.1%)	2 (0.7%)	1 (0.3%)
C	**Inflammatory conditions**	**116 (44.9%)**	**57 (22.09%)**	**59 (22.8%)**
1	Recurrent Aphthous Stomatitis (RAS)	63 (24.4%)	34 (13.1%)	29 (11.2%)
2	Oral Pemphigus	13 (5.03%)	5 (1.9%)	8 (3.1%)
3	Discoid Lupus Erythematosus (DLE)	5 (1.9%)	3 (1.1%)	2 (0.7%)
4	Oral Lichen Planus (OLP)	35 (13.5%)	15 (5.8%)	20 (7.7%)
D	**Infectious conditions**	**56 (21.7%)**	**32 (12.4%)**	**24 (9.3%)**
1	Herpes labialis	23 (8.9%)	11 (4.2%)	12 (4.6%)
2	Molluscum contagiosum	6 (2.3%)	4 (1.5%)	2 (0.7%)
3	Verruca vulgaris	9 (3.4%)	7 (2.7%)	2 (0.7%)
4	Oral Candidiasis	18 (6.9%)	10 (3.8%)	8 (3.1%)
E	**Vascular conditions**	**3 (1.1%)**	**3 (1.1%)**	**0**
1	Venous lake	1 (0.3%)	1 (0.3%)	0
2	Sublingual varicosities	2 (0.7%)	2 (0.7%)	0
F	**Drug reactions**	**10 (3.8%)**	**7 (2.7%)**	**3 (1.1%)**
1	Fixed Drug Eruptions	7 (2.7%)	5 (1.9%)	2 (0.7%)
2	Steven-Johnson syndrome	3 (1.1%)	2 (0.7%)	1 (0.3%)
G	**Premalignant and Malignant conditions**	**35 (13.5%)**	**28 (10.8%)**	**7 (2.7%)**
1	Oral Submucosal Fibrosis	17 (6.5%)	15 (5.8%)	2 (0.7%)
2	Leukoplakia	13 (5.03%)	9 (3.4%)	4 (1.5%)
3	Squamous cell carcinoma	5 (1.9%)	4 (1.5%)	1 (0.3%)
H	**Miscellaneous**	**5 (1.9%)**	**3 (1.1%)**	**2 (0.7%)**
1	Mucocele	5 (1.9%)	3 (1.1%)	2 (0.7%)
	Total	258 (100%)	149 (57.7%)	109 (42.3%)

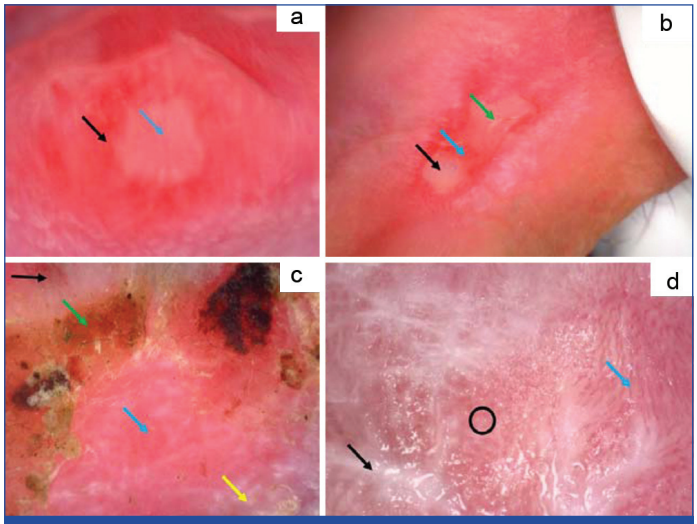
[Table/Fig-1]: The distribution of various OMLs.



[Table/Fig-2]: Dermoscopy: a) Fordyce spot showing white yellow discrete ovoid structures (black arrow); b) Geographic tongue showing atrophic filiform papillae (black arrow) surrounded by whitish yellow irregular serpiginous borders (blue arrow); c) Mucocele showing translucent red to purplish hue (blue arrow) and reticular branching vessels (black arrow); d) Mucosal vitiligo showing white areas due to absent pigment network (black circle) with perilesional pigmentation (stable vitiligo); e) Lentigenes showing uniform and regular brown/black pigmentation in parallel pattern (blue arrow).

2 (0.7%). Mucoscopy showed pink background 100% (5/5) with presence of whitish to yellowish scales 60% (3/5), white SLA 80% (4/5), erosions/bleeding spots 60% (3/5), telangiectasia 100% (5/5), irregular vessels 80% (4/5) and greyish black to brown dots at the periphery 60% (3/5) [Table/Fig-3c].

4. **Oral Lichen Planus (OLP):** The most common sites of involvement were buccal mucosa 25 (9.6%), followed by lip mucosa 10 (3.8%), tongue 5 (1.9%) and gingiva 2 (0.7%). The most common morphological type of OLP observed was reticular 23 (8.9%), followed by erosive 5 (1.9%) and plaque-like 3 (1.1%). Other variants found were atrophic and bullous, with 2 (0.7%) cases each. The most prominent mucoscopic finding was Wickham's Striae. The most common morphological pattern of Wickham's striae was reticular 65.7% (23/35), followed by radial 17.1% (6/35), linear 11.4% (4/35) and leaf venation 5.71% (2/35). Other findings were vascular patterns in the form of dotted 74.2 % (26/35), linear 20% (7/35) and hair pin vessels 5.7% (2/35). Background was red in 51.4% (18/35) patients and violaceous in 48.5% (17/35) patients. Other mucoscopic findings were dots/globules 5.7% (2/35), erosions/ulcerations 14.28% (5/35) and scales 8.57% (3/35) [Table/Fig-3d].

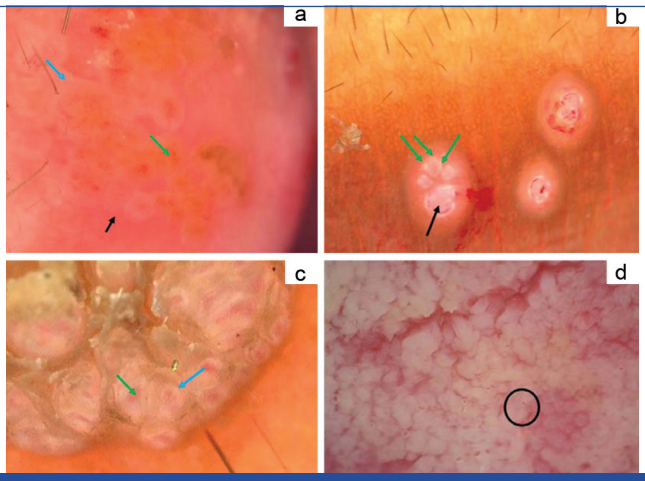


[Table/Fig-3]: Dermoscopy: a) Aphthous ulcer showing central yellow white Structureless Area (SLA) (blue arrow) and a peripheral rim of red erythematous halo (black arrow); b) Pemphigus vulgaris showing structureless red area (blue arrow), intact vesicle (black arrow) and epidermal detachment (green arrow); c) Discoid Lupus Erythematosus (DLE) showing pink background with telangiectasia (blue arrow), whitish to yellowish scales (green arrow), white Structureless Area (SLA) (yellow arrow) and brown dots at the periphery (black arrow); d) Oral Lichen Planus (OLP) showing red background (black circle), Wickham's Striae (radial) (black arrow) and linear blood vessels (blue arrow).

d) Infectious conditions

1. **Herpes labialis:** Most of the patients presented at the early stage (vesicle formation), 15 (5.8%), that showed typical three zones on mucoscopy, namely central area with yellow/brown pigmentation and dots, surrounded by a whitish, often cloudy or polyglobular structure and an outer zone of peripheral erythema [Table/Fig-4a]. Six (2.3%) patients presented at the intermediate stage (ulceration/crusting) with predominantly brownish rims and crust surrounded by greyish white SLA, and 2 (0.7%) patients presented at the late stage (healing) with central brown pigmentation with mild peripheral erythema [Table/Fig-4a].
2. **Molluscum contagiosum:** Predominantly, paediatric age group 4 (1.5%) was affected. On mucoscopy, lesions of MC showed central white to yellow polylobular amorphous structures 66.6% (4/6) or rosettes 33.3% (2/6) encircled by crown vessels 100% (6/6) [Table/Fig-4b].
3. **Verruca vulgaris:** Most of the patients had lesions over the lips 7 (2.7%), while 2 (0.7%) patients had lesions over the buccal mucosa. Mucoscopy showed multiple densely packed papillae, each containing a central red dot 100% (9/9) surrounded by keratotic halo 100% (9/9) [Table/Fig-4c].
4. **Oral candidiasis:** Buccal mucosa 13 (5.03%), tongue 8 (3.1%), palate 5 (1.9%) and post pharyngeal wall 3 (1.16%) were common sites of involvement. Mucoscopy showed white, yellow white or grey, white interrupted SLA 94.4% (17/18), white

projections 83.3% (15/18) and bright red areas with exposed vasculature 77.7% (14/18) [Table/Fig-4d]. Twelve (4.6%) patients had uncontrolled diabetes, 3 (1.16%) had Human Immunodeficiency Virus (HIV)/Acquired Immunodeficiency Syndrome (AIDS), 2 (0.7%) were on chemotherapy, and one (0.3%) patient was on inhaled corticosteroids.



[Table/Fig-4]: Dermoscopy a) Herpes labialis showing central yellow brown pigmentation (green arrow) surrounded by cloudy white polylobular structure (blue arrow) and peripheral rim of erythema (black arrow); b) Molluscum contagiosum showing white amorphous structures forming rosettes (green arrows) surrounded by vasculature (black arrow); c) Verruca vulgaris showing multiple densely packed papillae, each containing a central red dot (green arrow) surrounded by keratotic halo (blue arrow); d) Oral Candidiasis showing white projections over erythematous base (black circle).

e) Vascular conditions

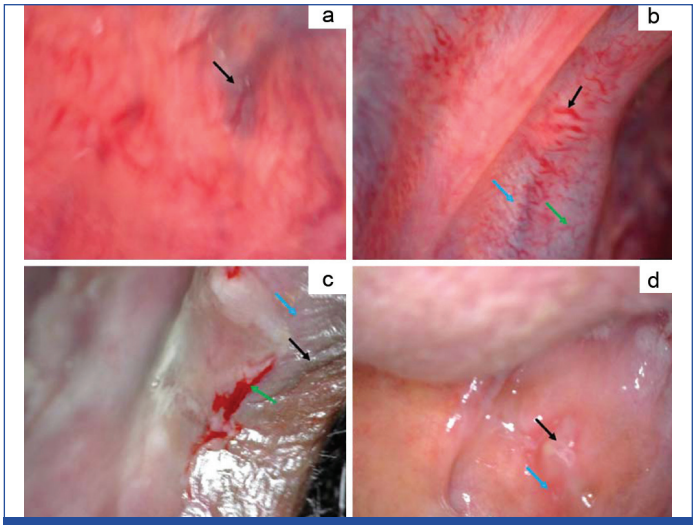
1. **Venous lake:** One (0.3%) male patient had a lesion of Venous Lake over the inner aspect of the lip with mucoscopy showing a structureless blue area and blue globules/clods [Table/Fig-5a].
2. **Sublingual varicosities:** Mucoscopy revealed dark blue/purple (thrombosed) 50% (1/2) or red (non-thrombosed) lacunae (blood filled pools) 100% (2/2) with a bluish white veil 100% (2/2) and surrounding fine vessels 100% (2/2) [Table/Fig-5b].

f) Drug reactions

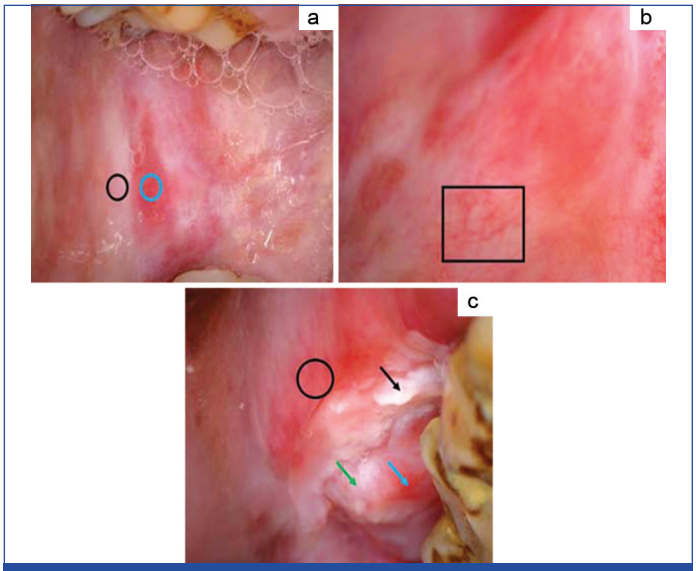
1. **Fixed drug eruption:** Lesions were predominantly present over the lips, extending towards the buccal mucosa. mucoscopy showed pigmentation with blue grey dots 100% (7/7), vascular changes as red dots suggesting inflammation 57.1% (4/7), erosions/epidermal detachment and necrotic borders 42.8% (3/7) [Table/Fig-5c].
2. **Steven-Johnson syndrome:** Mucoscopy of oral mucosa showed epidermal detachment as a wet cigarette paper appearance 100% (3/3), necrotic areas 66.6% (2/3), eroded areas as red SLAs, blood spots and comma-shaped/linear vessels 100% (3/3) [Table/Fig-5d].

g) Premalignant and Malignant Conditions

1. **Oral Submucosal Fibrosis (OSMF):** Mucoscopy revealed fibrotic bands underneath as a chrysalis white SLA 100% (17/17) with telangiectasia and linear vessels 100% (17/17). Atrophic lingual papillae were seen in 64% (11/17) of patients [Table/Fig-6a].
2. **Leukoplakia:** Mucoscopy showed white to pink SLAs 100% (13/13) with intervening pink lines 100% (13/13) and surface corrugations 76.9% (10/13). The periphery of the lesions showed white clods 61.5% (8/13) and dotted vessels 84.6% (11/13) [Table/Fig-6b].
3. **Squamous cell carcinoma:** Sites of involvement were over lips 3 (1.16%) and buccal mucosa 2 (0.7%). Mucoscopy revealed a white SLA 100% (5/5), keratin/scales 60% (3/5), blood spots on keratin 60% (3/5), red SLA 100% (5/5) and polymorphous vascular pattern 80% (4/5) [Table/Fig-6c].



[Table/Fig-5]: Dermoscopy; a) Venous Lake showing structureless blue area and blue globules/clods (black arrow); b) Sublingual varicosities showing red lacunae (black arrow) with a bluish white veil (blue arrow) and surrounding fine vessels (green arrow); c) Fixed Drug Eruptions showing blue grey pigmentation (black arrow) with surrounding erythema (blue arrow) and epidermal detachment (green arrow); d) Steven-Johnson syndrome showing epidermal detachment (black arrow) with red Structureless Area (SLA) (blue arrow).



[Table/Fig-6]: Dermoscopy: a) Oral Submucosal Fibrosis showing chrysalis white Structureless Area (SLA) (black circle) with telangiectasia and linear vessels (blue circle); b) Leukoplakia showing white to pink Structureless Areas (SLA) 100% (13/13) with intervening pink lines 100% (13/13) (Black square); c) Squamous cell carcinoma showing white SLA (green arrow), keratin (black arrow), red SLA (blue arrow) and polymorphous vascular pattern (black circle).

h) Miscellaneous conditions

1. **Mucocele:** Lesions were present over the lower lip mucosa secondary to trauma. Mucoscopy revealed translucent red to purplish hue 100% (5/5) and reticular branching vessels 80% (4/5) with occasional white SLA 20% (1/5) [Table/Fig-2c].

Mucoscopic features of similar looking OMLs have been mentioned in [Table/Fig-7-9]. Similar looking oral macules and papules include fordyce spots, mucosal warts, molluscum contagiosum and mucosal vitiligo. Mucoscopy of Fordyce spots showed central yellow white ovoid structures with central opacity while molluscum showed central yellow white polylobular amorphous structures sometimes forming rosettes. Mucosal warts consists of multiple keratotic halos with central red dots while mucosal vitiligo showed absence of normal pigment network [Table/Fig-7]. Among oral ulcers, aphthous ulcers showed central white SLA with peripheral rim of erythema. Herpes labialis showed central yellow brown pigmentation/crust with surrounding whitish, often cloudy or polyglobular structure representing vesicles. Pemphigus vulgaris showed either intact vesicles or erosions/raw areas in form of red SLA/crust with bleeding spots while Discoid Lupus Erythematosus (DLE) showed

pink background with white SLA/scales, telangiectasia and brown dots. Squamous cell carcinoma showed white structures (white SLA, keratin/scales) and red structures (red structurless area, blood spots) depending upon degree of differentiation along with polymorphous vascular pattern. Fixed drug eruption showed epidermal detachment with pigmentation while Steven Johnson syndrome showed epidermal detachment with red structurelss area and blood spots. Among white lesions, leukoplakia showed white SLA with intervening pink lines. Wickham's striae in lichen planus and white SLAs with white projections in oral candidiasis were predominant features of other white lesions.

Conditions	Fordyce spots	Mucosal warts	Molluscum contagiosum	Mucosal vitiligo
Mucoscopic features	Central white, yellow, discrete ovoid structures	Multiple densely packed papillae with a central red dot and a keratotic halo	Central white to yellow polylobular amorphous structures	Absent pigment network

[Table/Fig-7]: Mucoscopic findings of similar-looking oral macules and papules.

Mucoscopic features	Recurrent aphthous stomatitis	Herpes labialis	Oral pemphigus	Discoid Lupus Erythematosus (DLE)	Squamous cell carcinoma	Fixed drug eruption	Steven-johnson syndrome
White SLA	+	-	-	+	+	-	-
Red SLA	-	-	+	-	+	-	+
Keratin/scales/crust	-	+	+	+	+	-	-
Brown or blue-grey pigmentation/dots	-	+	-	+	-	+	-
Vesicles	-	+	+	-	-	-	-
Epidermal detachment	-	-	+	-	-	+	+
Blood spots	-	-	+	+	+	-	+
Vascular pattern	Peripheral erythema	Peripheral erythema	Complex network of vessels	Irregular vessels, Telangiectasia	Polymorphous vessels	Red dots	Comma-shaped/ Linear vessels

[Table/Fig-8]: Mucoscopic findings of similar-looking oral ulcers.

Mucoscopic features	Leukoplakia	Oral Lichen Planus (OLP)	Oral Candidiasis
Background	White to pink SLAs with intervening pink lines	Red to violaceous background	White, yellow, white, or grey-white interrupted SLA.
Special features	Surface corrugations, white clods	Wickham's striae.	White projections
Vascular pattern	Dotted vessels	Dotted linear 20% (7/35) and hair pin vessels	Bright red areas with exposed vasculature

[Table/Fig-9]: Mucoscopic findings of similar-looking oral white lesions.

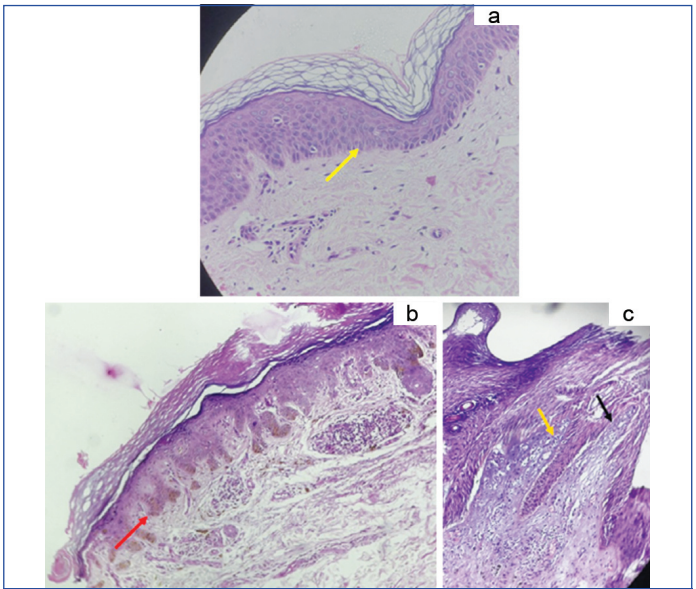
Histopathological features of various OMLs have been shown in [Table/Fig-10,11].

DISCUSSION

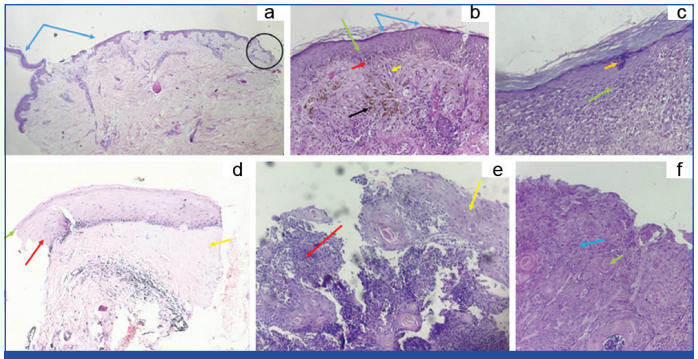
Inflammatory OMLs constituted the most common diagnostic category, with RAS being the most common OML encountered in this study. This was in contrast with that of Rather S et al., and Shreya K et al., where the most common OMLs found were Lichen planus and Pemphigus vulgaris respectively [3,12]. The mean age of all the patients was 33.4±7 years, which was comparable with that of Rather S et al., where the mean age was 34.3 years [3]. Males outnumbered females which were in contrast with that of Rather S et al., where male to female ratio was 1:1.7 [3]. Jain VR et al., had done a study of 369 cases of OMLs where he found papulosquamous disorders as most common encountered category with lichen planus as most common OML followed by squamous cell carcinoma and pemphigus vulgaris with male predominance with 30-50 years as most common age group affected [15]. Such variations may be attributed to regional differences in patient demographics, risk factors, and referral patterns.

In Fordyce spots, yellow-white discrete ovoid structures represent the lobules of sebaceous glands, while central opacity corresponds to gland openings [8,12,16]. This central opacity was seen in 42.8% as compared to 38% in study done by Shreya K et al., [12]. Geographic tongue (benign migratory glossitis) presents with a well demarcated areas of erythema due to atrophy of the filiform papillae surrounded by a serpiginous, white hyperkeratotic border, giving map like appearance that migrates over time [12,17,18].

In mucosal vitiligo, 42.1% patients had lesions progressive in nature with scalloped margins while Shreya K et al., [12] reported scalloped margins in 75% cases. Shreya K et al., also reported satellite macules in 25% cases and trichome pattern in 37.37% cases [12]. Godinez Chaparro JA et al., also described other findings like starburst pattern and comet tail in progressive vitiligo [19]. In lentigenes, parallel pattern was seen in 33.3% and dots/ globules in 66.6% cases while Shreya K et al., reported 20% and 30%, respectively [12]. Shreya K et al., also found reticular lines 10%, fingerprint pattern 30% and other non-specific findings like SLAs 30%, homogenous blue grey areas 20% and prominent 30% and delicate pigment networks 20% [12]. Amirchaghmaghi M et al., also reported feather like pattern 25% as well other than SLA 50% and dots 25% [20].



[Table/Fig-10]: Histopathology: a) Vitiligo showing complete absence of functional melanocytes and melanin in the basal layer of stratified squamous epithelium (yellow arrow) (10X); b) Lentigenes showing increased melanin pigment in the basal layer of epidermis (red arrow) (10X); c) Verruca vulgaris showing papillomatosis (black arrow) with koilocytes (yellow arrow) (10X).



[Table/Fig-11]: Histopathology: a) Pemphigus vulgaris showing suprabasal detachment of epidermis (blue arrow) with intact basal layer showing tombstone appearance (black circle) (4X); b) Discoid Lupus Erythematosus (DLE) showing hyperkeratosis with discontinuous epithelium (blue arrow), acanthosis (green arrow), lichenoid reaction (red arrow), pigment incontinence (black arrow) and dilated vessels (yellow arrow) (10X); c) Lichen planus showing wedge shaped hypergranulosis (yellow arrow) and basal cell degeneration with lichenoid infiltrate (green arrow) (10X); d) Oral Submucosal Fibrosis showing atrophic epidermis (green arrow), juxtaepithelial hyalinisation (red arrow) and dense bundle of collagen fibres in connective tissue (yellow arrow) (10X); e) Leukoplakia showing thickened epidermis with reactive squamous epithelium having dyskeratotic features (yellow arrow) and inflammatory infiltrate in dermis (red arrow) (10X); f) Squamous cell carcinoma showing pleomorphic squamous cells arising from the epidermis and extending into the dermis (blue arrow) with keratin pearls (green arrow) (10X).

Mucoscopy of Aphthous ulcer revealed a central yellow-white SLA that suggests fibrin and necrotic debris. This is surrounded by a white, grey zone and a peripheral rim of erythema that suggests inflammation [12,16]. Rather S et al., also revealed polymorphous blood vessels in the form of dots 100%, linear 79.16%, serpentine 37.5%, lopped 29.16%, and coiled curved vessels 25% predominantly at the periphery [3].

Mucoscopy of Pemphigus vulgaris revealed structureless red areas that represent bright red erosions with surrounding branching vessels. Along with this, Shreya K et al., also mentioned violaceous peripheral streaks in 78.95% cases [12]. A complex network of vessels was seen in 76.92% as compared to 71.93% in study done by Shreya K et al., [12]. Rather S et al., described vascular structures in the form of linear tortuous 100%, serpentine and arborising 100%, dots and comma shaped 85.71% and hairpin vessels 28.57% [3]. Also, he mentioned white SLAs representing healed lichenoid plaques of pemphigus vulgaris. Intact vesicles were seen in 23.07% (3/13) cases as compared to 42.8% (3/7) in study done by Rather S et al., [3]. Narkhede ND et al., described intact lesions as erythematous (vascular) and yellowish (serum) translucent background with regular margins [4].

The most common site of involvement of DLE was over the lips, which was similar to that of Shreya K et al., [12], while Rather S et al., [3] found lesions more commonly over the palatal mucosa. Histopathologically, the mucoscopic findings are due to irregular hyperplasia (white SLA), dilated vessels (telangiectasia), pigment incontinence (brown dots) and inflammation (pink background) [9,12]. Unlike cutaneous DLE, Follicular plugs and perifollicular halos were absent in mucosal DLE.

In OLP, females were more commonly affected than males which were consistent with the findings of Rouai M et al., while Kowe P et al., reported more male patients than females [5,21]. The most common site of involvement was buccal mucosa, which, like Rather S et al., while Rouai M et al., and Kowe P et al., reported lip mucosa as the most common site of involvement [3,5,21]. All the studies reported reticular as the most common variant, followed by erosive [3,5,21]. Wickham's striae were the most prominent finding, with reticular as the most common pattern, which was like Rouai M et al., while Kowe P et al., reported radial as the most common type of pattern of Wickham's striae [5,21]. Histopathologically, Wickham's Striae corresponded to wedge-shaped hypergranulosis. Other than linear, dotted and hairpin vessels like those of Kowe P et al., [21], Rouai M et al., [5] reported peripheral sea anemone-like vessels (37%) as well. Other than background, pigmentation, scaling and erosions, Rouai M et al., [5] reported blunting of lingual papillae in one patient.

In Herpes labialis, the three zones of herpes typically represent melanin retention and necrotic cells in the central area (brown dots) surrounded by white, yellowish cloudy polyglobular structures representing fluid-filled vesicles/bullae with a peripheral rim of erythema representing capillary dilatation and inflammation [22]. Narkhede ND described lesions of viral infections in the early, active and healing stage with a pale yellow translucent SLA in the early stage, a brown amorphous crater surrounded by a structureless grey, white area in the active stage and a brown, grey SLA with brown dots with peripheral erythema in the healing stage [4]. In molluscum contagiosum (MC), the central yellowish white polylobular or clover-like structures (molluscum bodies) represent hyperplastic epidermal lobules containing viral inclusions and crown vessels encircled these central structures [12,22]. Rather S et al., and Kumar Jha A et al., described different mucoscopic patterns of Verruca vulgaris according to the site of inoculation [3,16]. Verruca over rough surface of lower lip, white-coloured papillae with central vessels; lesion over mucosal surface showed pink background, keratotic halos and red dots; lesion over tongue showed pink background with white globules and lack of vascularity [3]. In Candida, White, yellow white or grey, white structureless interrupted areas correspond to the pseudomembrane composed of desquamated epithelial cells, fibrin and fungal hyphae. White projections correspond to swollen or hypertrophied lingual papillae. On removal of pseudomembrane, bright red areas and erosions are seen, suggesting inflammation. Vasculature is seen in red eroded areas [3].

Amirchaghmaghi M et al., described vascular lesions as purple, red or blue lacunas in larger lesions and clods in smaller lesions, which could be accompanied by white fibrous lines [20]. Jha AK reported similar findings in Venous Lake and Lingual varicosities along with a whitish veil at a few places [23].

Mucoscopy of Fixed Drug Eruption (FDE) reveals blue-grey dots to brown, black dots according to the depth of pigmentation in epidermis and dermis. This is due to pigment incontinence and damage at the dermoepidermal junction produced by lymphocyte infiltrate [24]. There may be a peripheral red SLA and red dots denoting inflammation and dilated vessels [12]. Mucoscopy of SJS showed different areas of epidermal detachment, necrotic areas and eroded areas [12,25].

Oral submucosal Fibrosis (OSMF) showed a chrysalis white SLA on mucoscopy, which corresponds to dense hyalinised collagen bands in the lamina propria. White to pink discolouration is due to variable fibrosis and epithelial thickness, and linear dilated vessels are due to vascular remodelling and inflammation [12,13]. Toader MP et al., mentioned characteristic dermoscopic findings of Leukoplakia in the form of a white translucent homogenous appearance resembling a net with sharp edges [26]. Histopathologically, a white to pink SLA corresponds to hyperkeratosis and acanthosis. The surface corrugations are believed to be an indication of underlying dysplasia. The red dot in the periphery denotes inflammation with congested and dilated vessels and lymphocytic infiltrate [6]. Mucoscopy of Squamous Cell Carcinoma (SCC) consists of white structures (white SLA, keratin/scales), red areas (blood spots on keratin, red SLA denoting ulceration) and polymorphous vessels (coiled, hairpin, dotted, linear, irregular). Histopathologically, white structures denote highly keratinised epithelium and red areas correspond to dense vascularity. White circles denoting squamous carcinoma cells invading hair follicles are absent in mucosal SCC. White SLA reflects well differentiation, while predominance of red areas denotes poor differentiation [7].

Mucoscopy of mucocele showed translucent shiny purplish hue (due to stretching of overlying tissue) with reticular branching, hairpin-like or dot vessels (due to vascular congestion) and intervening white SLA (due to hyperplastic epithelium) [11,12]. Ashok S described two more types of Mucocele other than this primary type (Type 1 - retention/extravasated mucocele). Type 2 is due to recurrent trauma

associated with surface hyperkeratosis, and Type 3 is the healing stage, which is red in colour with yellowish areas and hairpin vessels [27]. Selvaraj R et al., and Ayhan E et al., also described similar dermoscopic findings of Mucocele under headings of non-vascular and vascular structures [28,29].

Thus, the present study suggests mucoscopy has an important role in early recognition of subtle structural and vascular alterations in OMLs. With polarised light, it also helps in the visualisation of subepidermal structures. Few mucoscopic peculiar findings like central white to yellow polylobular amorphous structures in molluscum contagiosum 66.6%, Multiple densely packed papillae with central red dot and keratotic halo in verruca vulgaris 100%, Wickham's striae in lichen planus 100%, chrysalis white SLA in oral submucosal fibrosis 100% and white SLA with intervening pink lines in leukoplakia 100% were almost diagnostic for the conditions. It also helps in guiding biopsy site selection and in longitudinal follow-up for monitoring disease progression and treatment response, especially in chronic inflammatory and potentially malignant disorders of the oral cavity like pemphigus vulgaris, DLE, leukoplakia, oral submucosal fibrosis and squamous cell carcinoma.

The mucoscopy can be used as an effective non-invasive diagnostic tool in routine oral mucosal evaluation. While it does not replace histopathological examination, it enhances diagnostic confidence, aids differentiation of clinically similar lesions and supports clinical decision-making, particularly in situations where biopsy is not immediately feasible.

Limitation(s)

The present single-centre, cross-sectional study, which may limit generalisability. Histopathological correlation was not available for all lesions, as biopsy was performed only when clinically indicated, precluding assessment of diagnostic accuracy.

CONCLUSION(S)

In this study involving 258 patients, mucoscopy helped in identifying distinct and reproducible patterns across inflammatory, infectious, pigmentary, premalignant, and malignant conditions, thereby aiding differentiation of clinically similar lesions. It highlights subtle diagnostic features and serves as a useful adjunct in routine clinical practice, particularly when biopsy is not feasible.

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