

## REVIEW ARTICLE

## Colposcopy: The Rising Star in Oral Diagnosis

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## ABSTRACT

Premalignant Lesions and oral cancers undoubtedly have an upward trend all over the globe. The mortality of oral cancer patients can be decreased if timely detections and treatments are implemented at the stage of infancy. Thus the diagnosis of these lesions cannot be completely left on just clinical findings. Therefore histopathological examination is considered as the gold standard in diagnosing oral lesions.

For this, suitable biopsy site is of high importance. This research presents a review of the colposcope, its oral application and its importance in timely diagnosis of the lesions. Thus the direct oral microscopy or Colposcopy aides and directs the clinician in identifying more representative locations for biopsy as compared to mere clinical examination. The other contributing factors for the usage of colposcopy are its ease of utility, accuracy of usage, flexibility in its usage, and most important it's a non-invasive technique.

**Keywords:** Colposcopy, Vascular Patterns, Lugol's Iodine, Toluidine Blue, Dysplasia

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## INTRODUCTION

Globally, Oral Cancer is ranked as the 06<sup>th</sup> most common cancer with the incidence highest in India. The mortality of oral cancer patients can be decreased if timely detections and treatments are implemented at

the stage of infancy.<sup>1</sup>

Carcinoma of buccal mucosa, has an increased incidence, attributed to the quid habit in Indian population and being preceded with numerous pre-malignant lesions and conditions the most common being leukoplakia and pouch keratosis. Though, biopsy with histopathological examination is still considered to be the gold standard in the diagnosis of oral cancer and pre-cancerous lesions and conditions, the selection of the site for biopsy is the most important criteria to arrive at a correct diagnosis. But, as biopsy site is a subjective choice, it is possible that biopsy specimens are taken from unrepresentative sites of the lesion or, before the morphologic changes could be detected in it.<sup>1</sup> Some of the many conventional techniques developed to identify early carcinoma are toluidine blue vital staining, acetic acid staining, exfoliative cytology, brush biopsy, auto fluorescence, chemiluminescence etc.<sup>2</sup>

## WHY COLPOSCOPY

- 1) Toluidine blue vital staining has been advocated as a simple, inexpensive and sensitive chairside test but it has shown the risk of affinity of the stain with DNA. It gives false positive staining as high as 30%, the risk of which is attributed to enhanced staining of ulcerations and filiform papillae of the tongue.
- 2) Exfoliative cytology has a false-negative rate of approximately 30%.
- 3) Other techniques such as autofluorescence, oral brush biopsy, acetic acid staining, Chemiluminescence etc are however not accurate to establish a final diagnosis.<sup>3</sup>

Hence, there is a pressing need for a non-invasive, more accurate diagnostic tool. This is fulfilled by colposcopy to a great extent.

## HISTORY

**"COLPOSCOPY"** The word is derived from the Ancient Greek word kolpos means "hollow, womb, vagina" and skopos means "look at". This procedure was developed in 1925 by a German physician Hans Hinselmann. He reported the construction of the first

colposcope. This was then used in detection of cervical tumour. The magnification initially was however only around 7.5 times. It was only in the year 2000, Goran Gynther used colposcope for oral lesions.<sup>4</sup>

### Advantages of colposcopy

- 1) High resolution,
- 2) Good magnification,
- 3) Good illumination,
- 4) Data can be stored for future use if it is connected to a storage device.
- 5) Detects lesions at an early stage,
- 6) Painless, non-invasive, with an accuracy of 80-90%.
- 7) Prevents multiple biopsies in patients thus adding to their convenience and comfort level.

### Disadvantages of colposcopy

- 1) The results can vary due to subjective variance.
- 2) Complexity and Cost of the procedure,

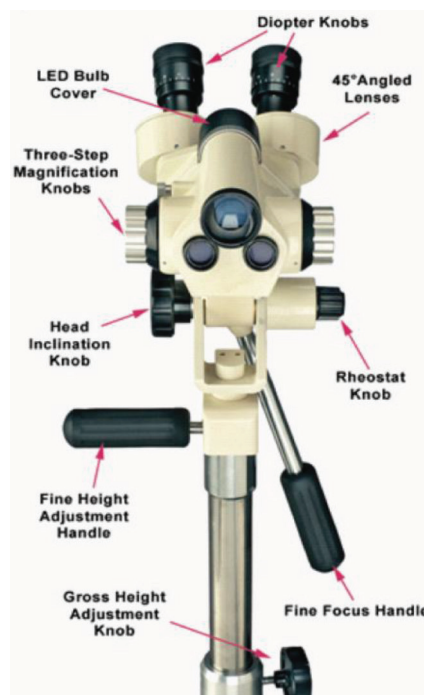
## COLPOSCOPE

A colposcope is a stereoscopic binocular field microscope which provides 3-dimensional image of tissue surfaces examined. It is connected to a video monitor that can magnify the area of interest 4-40 times its normal size. It has a long focal length of about 200mm which provides optimal working distance. There is a powerful halogen lamp for illumination connected to a system of lenses via a fiberoptic cable. A digital colposcope helps in live viewing and computerized manipulation of colposcopic image when required (Fig-1)<sup>5</sup> Different aspects of the tissue surface are brought to light by numerous light filters.

The use of a green or blue filter improves the examination of vascular changes and colour tone. The unfiltered white or yellow light diminishes the contrast between the terminal vessels and the surrounding tissue. The green filter removes red light thereby enhancing the vascular details by making blood vessels appear dark.<sup>3</sup>

### Mechanism of action

The image in colposcopy is due to the reciprocal relationship between the epithelium and the underlying connective tissue stroma wherein the epithelium acts as a filter through which both the incident and the reflected light pass. The redness is due to its rich vascularity. This intensity represents the ratio of reflected and absorbed light and it is related to the thickness of the epithelium, the optical density, the vascularity and the nature of the underlying stroma.<sup>4</sup>



**Figure-1:** Depicting the parts of a Colposcope

## STAINING PROCEDURE

Acetic acid and iodine solutions (Lugol's or Schiller's) can also be applied to the surface epithelium to improve visualization of abnormal areas.

### Acetic acid

- 4% acetic acid is applied to the mucosa using cotton swabs for about 30 s.
- Application of acetic acid causes reversible coagulation / precipitation of cellular proteins and causes swelling of abnormal squamous epithelial cells.
- If the epithelium contains a lot of cellular proteins, acetic acid coagulates these proteins, which may obliterate the colour of the stroma.
- The normal squamous epithelium appears pink. It is the dysplastic cells which are most affected.
- The resulting acetowhitening is seen distinctly as compared with the normal pinkish colour of the surrounding normal squamous epithelium.<sup>7</sup>
- Acetowhite areas correlate with higher nuclear density.

### Lugol Solution

If after acetic acid application no lesions are visible, Lugol's solution or Schiller's solution is used for further examination of abnormalities. The principle is based on glycogen content of the cytoplasm and the reaction is known as the iodine– starch reaction, visualized by a colour change. As there is enhanced glycolysis

in cancer cells, they do not promote the iodine–starch reaction. Hence there is no color change in dysplastic epithelium. Whereas due to high glycogen content of normal epithelial cells, brown color can be noticed.

## TUMOUR PROGRESSION AND VASCULAR CHANGES

Biopsy sites in oral mucosa can be selected based on the vascularity changes seen in the colposcopy images. Studies conducted by Dhakal et al., Pazouki et al., it was concluded that there was a close relationship between vascularity and tumour progression in oral mucosa.<sup>8</sup>

The normal squamous epithelium of the oral mucosa demonstrates as fine, regular vessels. This normal vascularity can be altered in various inflammatory, benign, and malignant lesions and conditions.<sup>9</sup> Based on the vascular and tissue changes seen in colposcopic images, Niekerk in 1998 differentiated low grade from high grade lesions (Table 1)

The capillary changes are very different from the usual neo-vascularization taking place during repair and regeneration processes. These changes are before the tumor growth along with the pattern of tumour angiogenesis. There is an implication of various molecules such as vascular endothelial growth factor, basic fibroblast growth factor, and transforming growth factor alpha at the cell level. Direct optical visualization of these patterns would be beneficial in the quick diagnosis of the underlying pathology and also help in identifying the site of biopsy.<sup>1,10</sup>

Colposcopic findings suggesting invasion are: vascular pattern, inter-capillary distance, surface pattern, colour tone and opacity as well as the clarity of demarcation of the mucosal lesions.<sup>1,6</sup>

### Blood Vascular Pattern

The parameters for selection of the site of biopsy are as under:

#### Normal

In the normal mucosa, two basic types of capillary networks can be seen with the colposcopy procedure - Network capillaries and Hairpin capillaries (Fig-2,3).<sup>3</sup>

#### Abnormal

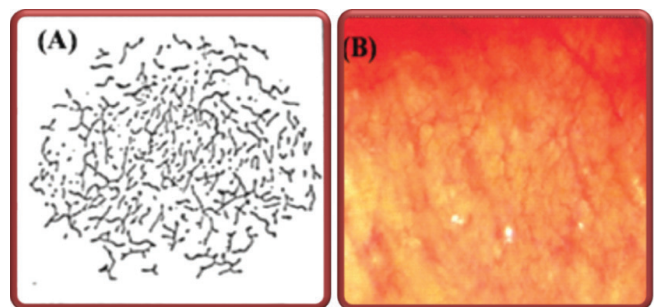
It has three different types of capillary networks.

##### 1) Punctuation pattern

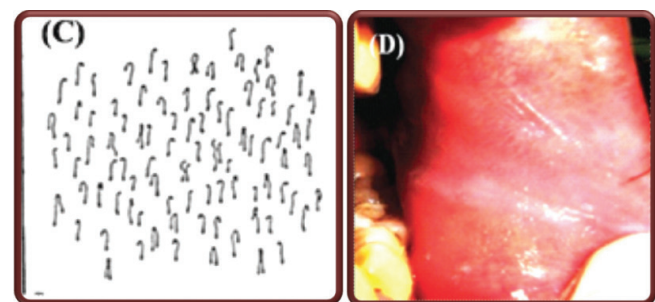
It is a common pattern.

Marked by dilated, often twisted, irregular, hairpin-type

| Low grade  | High Grade   |
|--|--|
| <b>Acetowhite epithelium:</b> shiny or snow white, semitransparent                           | <b>Acetowhite epithelium:</b> dull, oyster white color                                 |
| <b>Surface:</b> flat   | <b>Surface:</b> irregular contour, microexophytic                                      |
| <b>Demarcation:</b> diffuse, irregular, flocculated, feathered. Internal demarcation absent  | <b>Demarcation:</b> sharp, straight line. Internal demarcation present                 |
| <b>Vessels:</b> fine, regular shape, uniform caliber, normal arborization, changing calibers | <b>Vessels:</b> Coarse, dilated, increased ICD, Bizarre, Comas, corkscrews sharp bends |
| <b>Iodine:</b> uniform mahogany brown  | <b>Iodine:</b> mustard yellow, yellow or iodine -ve                                    |



**Figure-2:** Network capillaries, (A) Illustration of Network capillaries in colposcopic view, (B) Network capillaries in normal buccal mucosa.



**Figure-3:** Hairpin capillaries, (A) Illustration of Hairpin capillaries in colposcopic view, (B) Hairpin capillaries in normal buccal mucosa.

vessels.

The collection of dots appearing from the ends are known as punctuation are nothing but the same dilated capillaries terminating on the surface (Fig-4).<sup>1</sup>

##### 2) Mosaic pattern

It is the pattern of vessels in dysplasia.

They are the terminal capillaries.

Roughly circular or polygonal blocks of acetowhite epithelium crowded together. These vessels form a basket around the blocks of abnormal epithelium (Fig-5).<sup>3</sup>

##### 3) Atypical pattern

As the name suggests, whenever the pattern is undesirable, we call it as a “Atypical” pattern. The vessels are



irregular in size and shape and are coarse. Such formation indicates neoplasia. They may be looped, branched, or reticular. Some more characteristics are their sharp turns, dilations, and luminal narrowing (Fig-6).<sup>3</sup>

### VASCULAR CHANGES INDICATING DEGREE OF DYSPLASIA

- 1) Fine punctuation and mosaicism by narrow low-grade lesions → essels and uniform intercapillary distances
- 2) A coarse pattern resulting from a wider and high grade abnormalities → more variable vessel diameter and spacing
- 3) The mosaic tiles with central punctuation → carcinoma in situ.
- 4) Fracturing of previously intact mosaic and → squamous micro invasion or cancer punctuate patterns with the production of predominantly thread like vessels.

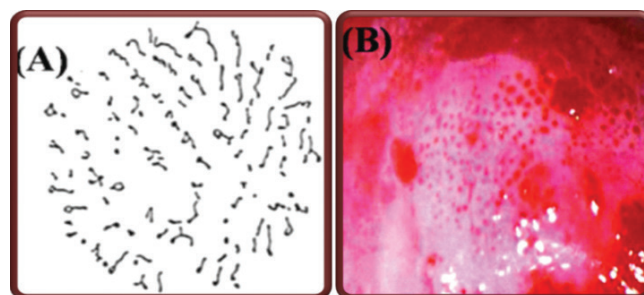
With the neoplastic growth, the demand of oxygen and nutrition rises. Thus angiogenesis occurs due to tumour and local tissue production of VEGF, PDGF, EGF, and other cytokines. This further results in the proliferation of blood vessels and neovascularization. The surface epithelium may be lost in these areas leading to irregular surface contour and friability.<sup>11</sup> Common to all these vascular patterns is irregular vessel dilatation and intercapillary distances greater than the normal distance of 50-200  $\mu\text{m}$ . With the increasing degree of dysplasia, the distance increases so much that the maximum distances may exceed 700  $\mu\text{m}$ .

### DISCUSSION

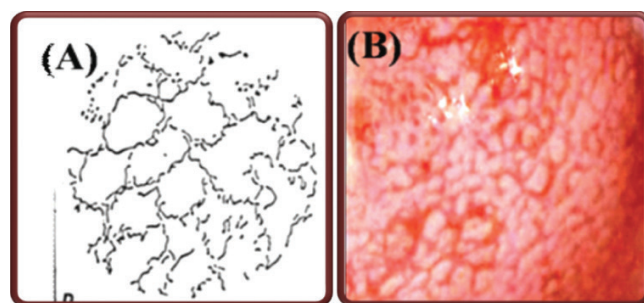
In the year 2000, a research conducted by GoranGnyther portrayed 29 out of 35 of their patients with various premalignant lesions and suspected malignancy showed changes in the vascular picture on microscopy. Authors have concluded that direct oral microscopy of mucosal lesions seem to offer advantage in selecting more representative sites for biopsy.<sup>12</sup>

In 2013, Abhishek et al conducted a study to assess the role of oral colposcopy for biopsy site selection in cases of carcinoma of buccal mucosa. The biopsy samples taken from the clinical presentation of cases showed a sensitivity of 0.7826 (78%) and specificity of 0.5714 (57%). Biopsy samples of colposcopically directed biopsy specimens had a sensitivity of 0.6842 (68%) with a specificity of 0.5455 (54%).<sup>13</sup>

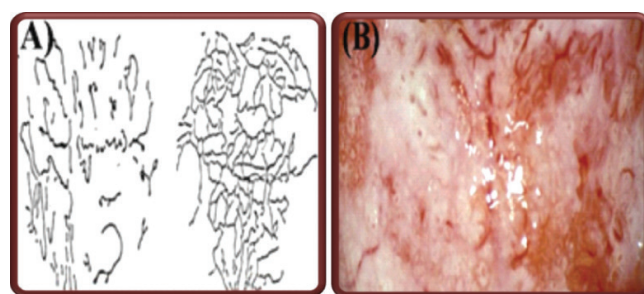
S. Ahmed and Nayyer AS performed a study for clinically diagnosed cases of carcinoma buccal mucosa. It concluded that colposcopy was found more significant



**Figure-4:** (A) Illustration of Punctate capillaries in colposcopic view, (B) Punctate capillaries in leukoplakia.



**Figure-5:** (A) Illustration of Mosaic capillaries in colposcopic view, (B) Mosaic capillaries in leukoplakia pointing towards high grade dysplasia.



**Figure-6:** (A) Illustration of Atypical capillaries in colposcopic view, (B) Atypical capillaries in leukoplakia suggestive of epithelial dysplasia and ongoing malignant transformation.

in the selection of biopsy site for leukoplakia patients while clinical criterion was found to be more appropriate for carcinoma buccal mucosa cases.<sup>14</sup>

### FUTURE SCOPE

1. Colposcopy could be further used to compare effects of different treatment modalities, ( radiation and chemotherapy) on the junction between the tumour and normal tissue.
2. Patient follow up studies to identify signs of progression for any mucosal lesions can be further done by colposcopy.
3. For improving the patient care with early diagnosis, colposcopy can be incorporated in our routine practice.

## CONCLUSION

In conclusion, Oral Colposcopy is a promising tool in the hands of the oral physician for an objective identification of the most representative site for biopsy. However future studies need to be carried out to evaluate the efficacy and accuracy in detecting oral lesions with varying degrees of dysplasia, in comparison with other diagnostic methods.

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