Oral Lumenoscopy: An Adjuvant in Early Screening of Oral Cancer

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ABSTRACT

The World Health Organization has strongly identified prevention and early detection as one of the major objectives in the control of oral cancer worldwide. Population-based mass screening of oral cancer appears to be a promising health promotion strategy with significant increase in survival rate. However, the current protocol comprising conventional visual inspection and palpation of oral soft tissues for the early detection of premalignant or malignant changes appears to be deficient. Neoplastic epithelial cells tend to have an altered nuclear-cytoplasmic ratio. Dehydration with acetic acid highlights this nuclear density and imparts an “acetowhite” appearance to tissue. This phenomenon can be further amplified by replacing conventional lighting with diffuse blue-white chemiluminescent illumination. This article aims to review the usefulness of this screening technology in early detection of oral cancer. The oral lumenoscopy has been proposed to be a method to improve oral screening methods which assist in the identification, evaluation and monitoring of oral mucosal changes. It is a simple, inexpensive and objective method that can provide real-time result for the detection of oral neoplasia which can be used in day to day practice by general dentist.

Keywords: Chemiluminescent illumination, Early screening, Lumenoscopy, Oral cancer, ViziLite plus.

INTRODUCTION

Oral carcinoma may occur in any inaccessible part of the oral cavity, including the posterolateral margin of the tongue and floor of the mouth. Early detection and diagnosis can positively affect life expectancy. Oral cancer is 90% curable when found in its early stages as per literature. Unfortunately, 70% of oral cancers are diagnosed in the late stages which has lead to a five-year survival rate in only 57% of cases. Early detection of potentially malignant oral lesions can improve clinical outcome and quality of life. There is evidence of spread to the regional lymph nodes and metastases during diagnosis in almost 50% of cases. The current protocol which includes conventional visual inspection and palpation of oral soft tissues has many lacunae. In the recent past, adjunctive techniques have emerged with claims of enhancing oral mucosal examinations and facilitating the detection of oral premalignant lesions. Techniques that are promoted to improve early detection include vital staining (toluidine blue), chemiluminescent illumination, tissue fluorescence spectroscopy, oral CDX test, biopsy and tumor marker.

In developing countries, such as India, where there is high prevalence of disease, the focus is to reduce the incidence of oral cancer by diagnosing it at an initial stage. The commonest method of screening for oral cancer is visual inspection. Visual detection of oral cancer at an early stage is difficult, as premalignant and malignant lesions cannot be easily differentiated from benign lesions. Advanced oral cancers present clinical characteristics, such as induration, elevation, bleeding and cervical lymphadenopathy, which are typically absent in early-stage lesions. Diagnosis has traditionally been based on histopathological evaluation of a full-thickness incisonal scalpel biopsy of the lesion. The lumenoscopy has been proposed as a method to improve the current oral screening methods by assisting in the identification, evaluation and monitoring of oral mucosal abnormalities. These supposedly can assist in the detection of early cancerous mucosal changes that can be occult to visual inspection for assessing the biologic potential of clinically abnormal mucosal lesions.

Several studies have been carried out using lumenoscopy as an attempt to demonstrate its efficacy to enhance the identification of mucosal abnormalities. Although no study has demonstrated that the chemiluminescence can help in differentiating dysplasia/carcinoma from benign lesions, but majority of studies have investigated how chemiluminescence enhances subjective clinical evaluation of intraoral lesions, including brightness, sharpness and texture with respect to routine clinical examination. As these parameters are highly subjective, it is not surprising that results have been contradictory, while some authors report that this technique can improve the detection of intraoral abnormalities, others have reported that the overall detection rate was not significantly improved and the chemiluminescent light produced reflections that made visualization even more difficult than with...
incandescent light. Furthermore, majority of studies are limited by methodological flaws, such as lack of histopathological diagnosis or clear objectives. Some studies suggest that chemiluminescence may help identifying occult lesions that cannot be seen with incandescent light but this, however, is not supported by any strong evidence. The reported sensitivity is 100% and the specificity up to 14.2%.

The mechanism of action was based on property of tissue reflectance which has been used for many years as an adjunct in examination of the cervical mucosa for acetowhite premalignant and malignant lesions. Neoplastic epithelial cells tend to have an altered nuclear-cytoplasmic ratio. Dehydration with acetic acid highlights this nuclear density and imparts an acetowhite appearance to tissue. This phenomenon can be further amplified by replacing conventional lighting with diffuse blue-white chemiluminescent illumination (Figs 1A and B).

The lumenoscopy basically comprises a chemiluminescent light source. The light stick contains a peroxyoxalate solution. The capsule is formed by an outer shell of flexible plastic and an inner vial of fragile glass. The outer capsule contains acetylsalicylic acid and the inner vial hydrogen peroxide which react together to produce a bluish-white light with a wave length of 430 to 580 nm which lasts for around 10 minutes. Toluidine blue consists of three swab components: Two swabs of 1% acetic acid rinse, including a post dye decolorizer and one swab with a metachromatic vital tissue dye, toluidine blue which provides the deep blue staining that allows lumenoscopy identified lesions to be seen clearly under normal light. It is used to further evaluate and closely monitor changes in lumenoscopy identified lesions. It has been proposed that living cells will differentially accumulate toluidine blue based on parameters related to metabolic activity. The chemicals are non-toxic and biodegradable. Other components include lumenoscopy retractor, one dosing cup, 30 ml lumenoscopy acetic acid solution, and reproducible patient consent/waiver form with exam documentation map and instructions.

It is a simple procedure which can be done as a chair side investigation. First ask the patient to rinse with 1% acetic acid solution which helps to remove the glycoprotein barrier and may increase the visibility of epithelial cell nuclei, possibly as a result of mild cellular dehydration. Then examination of the oral cavity is done under lumenoscopy (oral lumenoscopy) (Fig. 2). The normal epithelium takes on a blue hue, while the acetowhite lesions appear distinctly white. Lumenoscopy also provides a tolonium chloride solution (toluidine blue), which is intended to aid in the marking of acetowhite lesion for subsequent biopsy once the light source is removed. Lumenoscopy with toluidine blue in oral lesion identification and marking system used as an adjunct to the conventional head, neck and soft tissue examination. Following are the procedure for using oral lumenoscopy system:

- Encourage the patient to read the patient leaflet in the reception area. Give consent form to the patient and ask the patient to sign it
- Conduct the routine examination of oral cavity and record any oral lesion if present in oral cavity

![Figs 1A and B: Without ViziLite plus and with ViziLite plus (Courtesy: www.vizilite.com)](image)

Fig. 2: How lumenoscopy works (Courtesy: www.vizilite.com). Normal cells/tissues absorb the light from ViziLite while abnormal cells/tissues reflect it to be visible as a ‘white patch’. ViziLite penetrates to the basement layer of the 24 layers of epithelial cells enabling detection of stage 1 malignant change.
• Ask the patient to rinse with lumenoscopy prerinse solution (1% acetic acid) for 30 to 60 seconds.
• Bend the flexible outer light stick so that inner brittle vial gets broken (Fig. 3)
• Shake vigorously to mix contents of light stick. Insert light stick into open end of retractor and assemble
• Dim the lights in room or use the eyewear provided by to facilitate the examination
• Re-examine the oral cavity by using lumenoscopy device. The open retractor window should face the tissue being examined (Fig. 4)
• Look for any abnormalities in oral cavity and document it on the mouth map located on the back of the patient consent form. Apply the toluidine blue marking system to lesion visible under lumenoscopy illumination. Swabs should be applied in sequential order. The swab tubes are individually labelled 1, 2 and 3 (Fig. 5)
• Lesions stained with Toluidine blue can be viewed clearly even without the lumenoscopy device. Take an intraoral photograph for inclusion in the patient records, submission to the patient’s insurance company or for referral to specialist12 (Fig. 6).

Fig. 3: Bending of light stick (Courtesy: www.vizilite.com)

The indication of lumenoscopy is that it is used as part of an oral screening for patients with increased risk for oral cancer. Document the clinical appearance and location of the lesion identified during the lumenoscopy examination on the lumenoscopy mouth map and, if possible, one can take the photograph of the lesion. If trauma or inflammation cannot be ruled out, re-evaluation of lesion can be carried out 7 to 14 days. In advanced cases, the lesion should be biopsied or the patient is referred to a specialist for further assessment.

Advantages
• It is an easy to use, noninvasive, chair-side test
• Single use material, can be conveniently disposed, hence eliminate the risk of cross-contamination
• Easily storable
• Highly acceptable to patients and can be used for patient education and motivation
• It uses an easy swab and dye process with disposable elements that are easily restocked
• “Exam map” helps in documenting the clinical appearance of the lesion in follow-up and in case of reference.12

Disadvantages
• Detect only a small percentage of mucosal abnormalities, e.g. potentially malignant disorders
• It cannot discriminate between progressive and the non-progressive counterparts of tumor
• Lumenoscopy alone is not a perfect adjunctive screening tool. With toluidine blue, it can be used as better method of detecting potentially suspicious lesions with a sensitivity of 100% and improving visualization of lesions by 60%
• A strong evidence to support the effectiveness of these adjunctive techniques is still lacking
• The highest reported specificity of lumenoscopy is only 14.2%
• Not economical as the price of the one test costs nearly 1000 rupees.

Fig. 4: Examine the oral cavity using ViziLite plus device (Courtesy: www.vizilite.com)

Fig. 5: Application of the toluidine blue marking system to lesion visible under ViziLite plus illumination (Courtesy: www.vizilite.com)
The commercial preparation of this form of tissue reflectance based examination has been adapted in the oral cavity and is currently marketed under the name ViziLite plus (Zila pharmeceuticals). The price of one lumenoscopy examination ranges around 1000 rupees/unit. The lumenoscopy comprehensive exam tray (Zila Inc, Phoenix, AZ) received US Food and Drug Administration (FDA) approval through the 510(k) process in November 2001. In January 2005, the US Food and Drug Administration cleared the toluidine blue oral lesion marking system as an adjunctive technology for use with the lumenoscopy oral lesion identification system.

CONCLUSION

The World Health Organization has strongly identified prevention and early detection as one of the major objectives in the control of oral cancer worldwide. Prevention and early detection of oral cancer and its preinvasive intraepithelial stages are still largely based on visual examination of the mouth. The adjunctive application of technology to highlight such lesions may increase the diagnostic yield and makes oral screening more comprehensive than ever before. The clinically proven combination of improved visualization and detection of suspicious lesions with lumenoscopy followed by the application of toluidine blue to clinically suspicious lesions provides health professionals with the most effective oral cancer adjunctive screening and diagnostic system available today. Available studies have shown promising results, but strong clear evidence to support their effectiveness is still lacking. Thus to conclude, refined method, like lumenoscopy, can be used to detect the presence and extent of the oral neoplasia which can be the key to effective management of patients with oral cancer.

REFERENCES