VELSCOPE- A RECENT EXAMINATION TOOL IN DENTISTRY

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ABSTRACT:

Oral cancer is a global health disease that has a major impact on an individual's health, psychology and lifestyle. It is the 6th most common cancer in the world and has a high prevalence worldwide, and is found more in men than women. It is attributed to a myriad of causes which especially include tobacco smoking, alcohol consumption and chewing betel quid. Survival rates of oral cancer are very poor despite advances in therapeutic interventions. Detecting oral cancer at an early stage is believed to be the most effective means of reducing death rates. Thus arises the need for an important diagnostic tool which is able to detect pre-malignant and malignant lesions at an early stage. Treatment helps only for about 5 years after which recurrences are seen. The only way to reduce recurrences is early diagnosis. VELscope, also known as Visually-Enhanced Lesion scope, serves this purpose. It is an important diagnostic tool that uses an auto-fluorescence based imaging system to detect lesions and allows enhanced visibility of the premalignant and malignant lesions. It emits a harmless, non-invasive blue coloured LED fibre optic light that shines in the patient's mouth. The fluorescent light is absorbed by normal tissues whereas neoplastic lesions lose fluorescence and become dark. This helps in quick and non-invasive diagnosis.

Keywords: Oral cancer; VELscope; autofluorescence; premalignant lesions; malignancies; diagnosis; sensitivity; specificity.

ACRONYMS:
COE: Conventional oral examination
FVL: Fluorescence visualisation loss
OSCC: Oral squamous cell carcinoma
PMD: Potentially malignant disorder
PPV: positive predictive value
VELscope: Visually- Enhanced Lesion scope

DEFINITIONS:
Sensitivity: The probability that a patient with PMD/OSCC will give a positive result when measured against the gold standard of scalpel biopsy.

Specificity: The probability that a patient who does not have a PMD/OSCC will give a negative finding.

Positive predictive value: Probability that a patient with a positive test result actually has a PMD/OSCC**.**

Negative predictive value: Probability that a patient with a negative test result does not have a PMD/OSCC [1].

INTRODUCTION:

Oral cancer is one of the major threats to public health globally [2]. It is considered as a global health disease that affects an individual's health, psychology, lifestyle resulting in loading the whole family with its effect [3]. Oropharyngeal cancer is the 6th most common cancer in the world [4,5][6]. It accounts for up to half of all malignancies in India and other Asian countries. This prevalence is influenced by carcinogens and non-specific lifestyle factors including adverse oral habits of tobacco smoking, alcohol consumption and chewing betel quid and smokeless tobacco [7,8] [9]. Thus it is important to maintain good oral hygiene practices for optimum oral health [10] [11]. In addition to these causes, human papillomavirus (HPV) plays an important role in the aetiology of epithelial cancer of the oropharynx and tonsils, wherein more than 10% of these cancers have HPV DNA integrated into their genome [12]. Oral squamous cell carcinoma (OSCC) can occur even without the habit of tobacco smoking and chewing. It could be attributed to occupational hazards like exposure to actinic rays may predispose to the development of carcinoma of lip and exposure to UV rays may develop a potentially malignant disorder called actinic cheilosis [13]

Hard and soft tissue anomalies and malignancies are frequently encountered in dental practice [14]. Survival rates with oral cancer are very poor, accounting for approximately 50% overall and have not improved in recent decades despite advances in therapeutic interventions [15] [16]. Detecting oral cancer at an early stage is believed to be the most effective means of reducing morbidity and death rates of the disease [17]. The mortality rate of oral cancer is 40%. Treatment could help only for 5 years; after which recurrences are seen in about 40-50% cases. Further complications like oral mucositis and pericoronitis[18] and orofacial pain [19](possibly due to trigeminal neuralgia) also occur while undergoing treatment [20]. Early detection has decreased this value to 10-20% [21]. Malignant oral lesions are those lesions that exhibit changes in shape or colour on clinical or histological appearance [22]. Oral squamous cell carcinoma is the most prevalent oral malignancy [23]. About 35% of all the malignant lesions can be detected at an early stage. But a majority of these lesions are difficult to detect since they start at the basal cell layer which is not visible to the naked eye [3]. These kinds of changes may be detected by using the standard surgical biopsy [21]. But a biopsy can cause trauma to the patient [24]. So it is important to have a non-invasive technique to detect such lesions, especially in their early stages [25], such as using fluorescent light in case of VELscope; which also allows enhanced visibility of the premalignant and malignant lesions [26].

Various techniques have been employed to detect the early mucosal changes, which include Vital staining procedures (using dyes), cytopathological examination (using markers), exfoliative biopsy, brush biopsy and light-based techniques namely chemiluminescence and autofluorescence imaging, examples of which include VELscope and oral ID [27,28]. Autofluorescence technique is based on the principle that naturally occurring fluorescent chemical compounds called fluorophores are located in the mucosa and submucosa. These show fluorescence upon treatment with radiation at a wavelength of 375-440 nm. Detection of lesions at an early stage is difficult by visual examination of the oral cavity, which is made possible by the phenomenon of autofluorescence. Through autofluorescence, the tissues can absorb and re-emit specific light wavelengths, detectable through spectrophotometric devices like VELscope. It has been designated as a visual diagnostic aid for the detection of malignant lesions and the lesions that have the potential to turn into malignancies [29]. Autofluorescence can help in detection of transformational changes in tissues and thus makes the screening or diagnosis of oral cancer easy and possible [30]. Thus autofluorescence based imaging e.g. the use of VELscope is designated as an adjunctive tool for early detection of cancerous lesions [24] [30]

VELSCOPE:

Visually- Enhanced lesion scope (VELscope) was first introduced by Lane et. al. [31]. It is a simple, wireless, non-invasive device developed by LED Medical Diagnostics in association with scientists of the British Columbia Agency (BCCA) [32]. It consists of an LED fibre optic light source that emits blue light of wavelength 400-460 nm, that shines inside the patient's mouth [25]. Normal oral mucosa absorbs and re-emits a green fluorescence whereas abnormal mucosa appears dark [25][33]. Oral mucosal lesions which have an increased potential of transformation into malignant lesions are termed as Oral Potentially Malignant disorders (OPMD) [34] [35]. Examples of such include pemphigoids which have a high risk of malignancy [36]. These are regarded as the early tissue changes that develop due to chewing or smoking tobacco or other adverse oral habits [37].

Neoplastic tissues tend to lose fluorescence which is also called Fluorescent Visualisation Loss (FVL) because of which a dark appearance is observed [33].

VELscope is a visualisation- enhancement adjunct currently marketed to assist the clinician in accessing potentially dysplastic or malignant mucosal lesions in the oral cavity [38]. The light that is emitted illuminates the epithelium and penetrates the epithelial tissue through the basal cell layer where a majority of malignant lesions begin [39,40]. The tool contains a digital camera inside, which is capable of photographing tissues (26). VELscope offers non-invasive, painless, a quick diagnosis which does not require drugs and the visit barely takes 10 minutes [25]. It is divided into two phases; a manual examination carried out by palpating the tissues and a visual investigation by illuminating the tissues using the light emitted by the VELscope. It is also designated by the WHO as an efficient tool for diagnosis and prevention of oral cancer [41].

[26]. Advanced training curriculum could be developed in Oral Medicine to improve clinical competency [42].

SENSITIVITY AND SPECIFICITY:

The efficacy of a diagnostic instrument is based on its accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV). Various studies have been conducted to determine whether VELscope serves as an adjunct tool in cancer screening and diagnosis.

Hanken et.al. examined 120 patients with suspicious oral lesions and found that VELscope has a higher sensitivity (22%) and lower specificity (8.4%). It was also found that VELscope diagnosis is more promising than Conventional oral examination in detecting precursor oral malignant lesions.

Koch, et.al. in his study showed a higher sensitivity (97%) and specificity (95.8%) of VELscope to diagnose oral squamous cell carcinoma [43]. The positive predictive value (PPV) was 41% and the negative predictive value (NPV) was 75-80% [44].

Rana et.al. in his study showed that using the VELscope leads to higher sensitivity(100% vs 17%), but lower specificity (74% vs 97%) as compared to conventional oral examination (COE). The major lack of the study was a large number of false-positive test results [45].

Babiuch, et.al. found in his study that autofluorescence was not highly specific for dysplasias and cancers, as FVL was observed in 87.5% of benign oral lesions, leading to low specificity of 12.5%. But this device was unable to discriminate between high risk from low-risk lesions [46].

EFFICACY OF VELscope EXAMINATION:

The present study reveals that the use of VELscope serves as an important diagnostic tool in the detection of oral pre-malignant and malignant lesions. The benefits of VELscope usage outweigh the disadvantages. VELscope is a simple, non-invasive, important diagnostic tool which enhances the visibility of the

mucosal lesions by differentiating the normal and defective mucosa which in turn facilitates appropriate management of oral cancer due to early detection. But the efficacy and usage over conventional methods are questionable.

A study done by Mc Namara et.al., concluded that COE is more efficient in routine screening of OPMD than autofluorescence examination with VELscope. They believed that careful, systematic visual and tactile examination of the entire oral cavity on a regular basis remains the gold standard for early detection of OPMD [47].

Awan KH, et.al. concluded that the device was unable to discriminate high-risk from low-risk lesions [48].
Ganga RS, et.al. , Chaitanya N, et.al. and Yamamoto N, et.al. stated that VELscope examination alone cannot provide a definitive diagnosis to the presence of dysplastic tissue changes [39] [49] [27]
Marzouki HZ, et.al. stated that VELscope may add sensitivity to clinical examination and serve as a useful adjunct in high-risk patients [50].
Cicciù M, et.al. concluded that VELscope represents an excellent diagnostic tool to make the diagnosis of lesions of the oral mucosa. Unfortunately, it does not have the capacity to differentiate between a benign or malignant or simple acute inflammation [41].
Giudice A, et.al. added that VELSCOPE is useful in guiding bone resection margins in patients with Medication-Related Osteonecrosis of the Jaw (MRONJ) [51]. This condition is regarded as a 'dentist's nightmare' [52]
Cânjău SI, et.al. concluded that direct visual fluorescence evaluation (DFE) allows for a simple and cost-effective margin determination, in order to perform the detection and screening of oral precancerous and early cancerous disorders. It was found that VELscope could not fully replace histopathology. Nonetheless, the study demonstrated its usefulness in clinical examination, monitoring oral lesions and guiding biopsy [53].
Awan KH, et.al. concluded that VELscope can detect OPMD, but its ability to distinguish between precancerous or cancerous lesions from benign lesions is questionable [6].
Thus, VELscope serves as a diagnostic aid in the detection of abnormal mucosal lesions at early stages, with the only disadvantage of not providing a differential diagnosis regarding the type of lesion. This puts forward the need to interpret the results with caution.

CONCLUSION:

From the results obtained from previous studies and the present review, VELscope represents an excellent tool to diagnose any kind of lesion other than normal mucosa. Unfortunately, this instrument does not help in the differentiation of the type of lesion, be it high or low risk, premalignant or malignant, benign or malignant or acute inflammation. However, it has been proved to be an excellent tool to guide surgical procedures. The gold standard for the diagnosis will always be a biopsy unless any new diagnostic tool is found more effective than the former.

AUTHOR CONTRIBUTION:

Neha N has contributed for the execution of the work, data collection and drafting of the manuscript. Dr. Jayalakshmi Somasundaram has contributed to the concept and design of the study, validation of the data collection, revision and proof-reading of the review.

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CONFLICT OF INTEREST:

No potential conflict of interest relevant to this article was reported.

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