

EFFICIENCY OF FLUORESCENCE IMAGING IN LOCALISATION OF ORAL LESION AT RISK OF MALIGNANCY

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ABSTRACT

Aim of the study The aim of this study is to evaluate the efficacy of autofluorescence in localisation of oral mucosal lesions at risk of malignancy. **Material and methods** 72 patients with oral lesions were examined using conventional light and the Oral ID device, complementing the conventional light examination. **Results** The concordance between the conventional light (CL) examination method and the examination method using the device based on the fluorescence of the oral mucosa was 88.9% with a Kappa coefficient of 0.755 for the tongue localization, 84.7% with a Kappa coefficient with the value 0.627 for the cheek localization, 97.3% with a Kappa coefficient with the value 0.911 for the oral floor localization, 100% with a Kappa coefficient with the value 1 for the palate and alveolar ridge localization, 97.2% with a coefficient Kappa with a value of 0.819 for the lower lip location, 98.6% with a Kappa coefficient with the value of 0.793 for the upper lip location. The average concordance between the two examination techniques is 95.24% with a Kappa coefficient with an average value equal to 0.84. **Conclusions** The concordance between the two examination methods was good for all the sites considered in this study. The use of the visualization method based on fluorescence of the oral mucosa improved the detection of oral lesion with locations difficult to examine under conventional light.

Key words: oral lesion, malignity, fluorescence imaging

INTRODUCTION

The rate of oral cancer mortality in the last decades is high, despite the many advances in the development of cancer therapeutic techniques, the 5-year survival rate being about 50%. [1] Improving the quality of life after treatment and reducing mortality from oral cancer are dependent on early detection and treatment. Oral mucosa screening serves to detect both the onset lesions of oral cancer and premalignant lesions or those with potential for malignancy at an early stage. [2]

Autofluorescence can improve the ability to distinguish normal mucosa from neoplastic tissue due to the emission of fluorescence signal into tissues at different wavelengths, without additional fluorescent agents. [3]

The most relevant endogenous fluorophores for optical screening and diagnosis of precancer and cancer are those

that excite in the spectrum from visible purple / blue (400-450 nm) to UV-A (315-400 nm) and have properties that have been spectroscopically correlated with disease progression rate. [4]

Lane [5] attributes the loss of autofluorescence signal in images of precancerous and cancerous oral lesions, primarily to degradation of the collagen matrix and increased hemoglobin absorption, and secondarily to epithelial factors, such as increased epithelial dispersion.

The aim of this study is to evaluate the efficacy of autofluorescence in localisation of oral mucosal lesions at risk of malignancy.

MATERIAL AND METHODS

To perform this study, 72 patients who presented for specialized consultation between January 1, 2016 - December 31, 2020 in the Department of Oral and Maxillofacial Surgery within the Emergency County Clinical Hospital “Sf. Ap. Andrei” from Constanța and in the Department of Oral Pathology in the Faculty of Dental Medicine of Constanța, were enrolled in the study group. The inclusion criteria were related to the presence of untreated oral lesions, with potential for malignancy, premalignant or malignant. Patients under the age of 18 were excluded.

The patients were examined using conventional light and by complementing the use of conventional light with the Oral ID device that uses fluorescent light technology with blue light (425-469 nm wavelength), which allows the doctors to identify early stages of oral cancer, precancerous lesions as well as abnormal lesions. The study was approved by the Research Ethics Commission of "Ovidius" University of Constanța.

The concordance between the two examination methods was studied for the following sites: tongue, cheek, oral floor, palate, alveolar ridge, lower lip and upper lip.

Table 1. Crosstabulation test results for the “oral lesion” and “site” variables

		SITE								Total
		tongue	cheek	oral floor	palate	alveolar ridge	lower lip	upper lip	multiple	
ulcer	Count	4	2	1	0	1	1	1	0	10
	% of Total	5.6%	2.8%	1.4%	0.0%	1.4%	1.4%	1.4%	0.0%	13.9%
penetrant ulcer	Count	1	2	2	0	1	3	0	0	9
	% of Total	1.4%	2.8%	2.8%	0.0%	1.4%	4.2%	0.0%	0.0%	12.5%
exophytic ulcer	Count	3	1	1	1	3	1	0	1	11
	% of Total	4.2%	1.4%	1.4%	1.4%	4.2%	1.4%	0.0%	1.4%	15.3%
papilloma	Count	3	2	0	2	1	0	0	0	8
	% of Total	4.2%	2.8%	0.0%	2.8%	1.4%	0.0%	0.0%	0.0%	11.1%
malignant tumor	Count	3	2	4	0	1	0	1	1	12
	% of Total	4.2%	2.8%	5.6%	0.0%	1.4%	0.0%	1.4%	1.4%	16.7%
oral hyperplastic candidosis	Count	0	0	0	0	0	0	0	3	3
	% of Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%
gingival fibromatosis	Count	0	0	0	1	1	0	0	1	3
	% of Total	0.0%	0.0%	0.0%	1.4%	1.4%	0.0%	0.0%	1.4%	4.2%
leukoplakia	Count	1	6	0	0	0	1	0	3	11
	% of Total	1.4%	8.3%	0.0%	0.0%	0.0%	1.4%	0.0%	4.2%	15.3%
oral lichen planus	Count	0	1	0	1	0	0	0	3	5
	% of Total	0.0%	1.4%	0.0%	1.4%	0.0%	0.0%	0.0%	4.2%	6.9%
Total	Count	15	16	8	5	8	6	2	12	72
	% of Total	20.8%	22.2%	11.1%	6.9%	11.1%	8.3%	2.8%	16.7%	100.0%

RESULTS AND DISCUSSIONS

In table 1 is represented the distribution of oral lesions type by site. 16,7% of oral lesion have multiple sites.

Of the 26 lesions identified by conventional light inspection on the tongue, 5 lesions were not detected by using the OralId

device, however, the use of this device allowed the identification of 3 lesions that were not visible at conventional light inspection (table 2). Of the 23 lesions identified by conventional light inspection on the cheek, 8 lesions were not detected by using the OralId device, however, the use of

this device allowed the identification of 3 light inspection (table 3).
 lesions that were not visible on conventional

Table 2. Crosstabulation test results to determine the concordance between the two examination methods in the identification of tongue lesions

			Tongue Oid		Total
			yes	no	
Tongue CL	yes	Count	21	5	26
		% of Total	29.2%	6.9%	36.1%
	no	Count	3	43	46
		% of Total	4.2%	59.7%	63.9%
Total		Count	24	48	72
		% of Total	33.3%	66.7%	100.0%

Table 3. Crosstabulation test results to determine the concordance between the two examination methods in the identification of cheek lesions

			Cheek Oid		Total
			yes	no	
Cheek CL	yes	Count	15	8	23
		% of Total	20.8%	11.1%	31.9%
	no	Count	3	46	49
		% of Total	4.2%	63.9%	68.1%
Total		Count	18	54	72
		% of Total	25.0%	75.0%	100.0%

Table 4. Crosstabulation test results to determine the concordance between the two examination methods in the identification of oral floor lesions

			Oral floor Oid		Total
			yes	no	
Oral floor CL	yes	Count	13	0	13
		% of Total	18.1%	0.0%	18.1%
	no	Count	2	57	59
		% of Total	2.8%	79.2%	81.9%
Total		Count	15	57	72
		% of Total	20.8%	79.2%	100.0%

Table 5. Crosstabulation test results to determine the concordance between the two examination methods in the identification of palate lesions

			Palate Oid		Total
			yes	no	
Palate CL	yes	Count	6	0	6
		% of Total	8.3%	0.0%	8.3%
	no	Count	0	66	66
		% of Total	0.0%	91.7%	91.7%
Total		Count	6	66	72
		% of Total	8.3%	91.7%	100.0%

All 13 lesions identified by conventional light inspection on the oral floor were also

detected using the OralID device. The use of the OralID device allowed the identification

of 2 lesions that were not visible on inspection under conventional light (table 4). 6 lesions were detected on the palate, both after the inspection under the conventional light from the dental unit, and after the examination with the OralID device (table 5). Following the inspection under conventional light from the dental unit, 8 lesions were detected on the alveolar ridge. The same lesions were detected after examination with

the OralID device (table 6). On the lower lip, 2 of the 7 lesions identified by inspection under conventional light, were not detected using the OralID device (table 7). On the upper lip, 3 lesions were detected by examination under conventional light from the dental unit, and by using the OralID device, only 2 lesions were detected (table 8).

Table 6. Crosstabulation test results to determine the concordance between the two examination methods in the identification of alveolar ridge lesions

			Alveolar ridge Oid		Total
			yes	no	
Alveolar ridge CL	yes	Count	8	0	8
		% of Total	11.1%	0.0%	11.1%
	no	Count	0	64	64
		% of Total	0.0%	88.9%	88.9%
Total		Count	8	64	72
		% of Total	11.1%	88.9%	100.0%

Table 7. Crosstabulation test results to determine the concordance between the two examination methods in the identification of lower lip lesions

			Lower lip Oid		Total
			yes	no	
Lower lip CL	yes	Count	5	2	7
		% of Total	6.9%	2.8%	9.7%
	no	Count	0	65	65
		% of Total	0.0%	90.3%	90.3%
Total		Count	5	67	72
		% of Total	6.9%	93.1%	100.0%

Table 8. Crosstabulation test results to determine the concordance between the two examination methods in the identification of upper lip lesions

			Upper lip Oid		Total
			yes	no	
Upper lip CL	yes	Count	2	1	3
		% of Total	2.8%	1.4%	4.2%
	no	Count	0	69	69
		% of Total	0.0%	95.8%	95.8%
Total		Count	2	70	72
		% of Total	2.8%	97.2%	100.0%

The evaluation of the effectiveness of light-based optical imaging techniques in oral

cancer screening is appreciated differently in the literature. Regarding the use of screening

techniques based on oral fluorescence, some studies have demonstrated superior results to the screening technique by conventional examination in terms of sensitivity and specificity, significantly improving the detection rate of lesions at risk of malignancy / malignancy. [6]

Other studies, however, have brought to attention a number of similar results between the two techniques. [7] A number of authors have obtained inferior results to conventional technique. [8]

Poor specificity can be explained by the

autofluorescence mechanism. specifically, tumor angiogenesis can lead to increased submucosal blood volume. The absorption of collagen and elastin-induced autofluorescent light in the tissue may appear dark. Therefore, a variety of traumatic and inflammatory conditions that increase the content of submucosal hemoglobin may reduce the specificity of autofluorescence. For this reason, several benign morphological changes may induces optical tissue changes that affect autofluorescence findings. [9-11]

Table 9. Kappa concordance test results between the two examination methods in the identification of tongue lesions

	Value	Asymptotic Standardized Error	Approximate T	Approximate Significance
Measure of Agreement Kappa	0.755	.081	6.419	(p) 0.000
N of Valid Cases	72			

Table 10. Kappa concordance test results between the two examination methods in the identification of cheek lesions

	Value	Asymptotic Standardized Error	Approximate T	Approximate Significance
Measure of Agreement Kappa	0.627	.101	5.399	.000
N of Valid Cases	72			

Table 11. Kappa concordance test results between the two examination methods in the identification of oral floor lesions

	Value	Asymptotic Standardized Error	Approximate T	Approximate Significance
Measure of Agreement Kappa	0.911	.062	7.764	.000
N of Valid Cases	72			

Table 12. Kappa concordance test results between the two examination methods in the identification of palate lesions

	Value	Asymptotic Standardized Error	Approximate T	Approximate Significance
Measure of Agreement Kappa	1.000	.000	8.485	.000
N of Valid Cases	72			

Table 13. Kappa concordance test results between the two examination methods in the identification of alveolar ridge lesions

	Value	Asymptotic Standardized Error	Approximate T	Approximate Significance
Measure of Agreement Kappa	1.000	.000	8.485	.000
N of Valid Cases	72			

Table 14. Kappa concordance test results between the two examination methods in the identification of lower lip lesions

	Value	Asymptotic Standardized Error	Approximate T	Approximate Significance
Measure of Agreement Kappa	0.819	.124	7.064	.000
N of Valid Cases	72			

Table 15. Kappa concordance test results between the two examination methods in the identification of upper lip lesions

	Value	Asymptotic Standardized Error	Approximate T	Approximate Significance
Measure of Agreement Kappa	0.793	.201	6.879	.000
N of Valid Cases	72			

In this study, the concordance between the conventional light examination method and the examination method using the device based on the fluorescence of the oral mucosa was:

- 88.9% with a Kappa coefficient of 0.755 for the tongue localization (table 9);
- 84.7% with a Kappa coefficient with the value 0.627 for the cheek localization (table 10);
- 97.3% with a Kappa coefficient with the value 0.911 for the oral floor localization (table 11);
- 100% with a Kappa coefficient with the value 1 for the palate and alveolar ridge localization (table 12 and table 13);
- 97.2% with a coefficient Kappa with a value of 0.819 for the lower lip location (table 14);
- 98.6% with a Kappa coefficient with the value of 0.793 for the upper lip location (table 15).

The average concordance between the two examination techniques is 95.24% with

a Kappa coefficient with an average value equal to 0.84.

The literature cites concordance values of 60.7% [12] or 96.1% with a Kappa coefficient equal to 0.88 [13], but regarding the establishment of the indication to perform the biopsy following the use of the two examination methods.

CONCLUSIONS

The concordance between the conventional light examination method and the examination method using the device based on the fluorescence of oral mucosa was good for all the sites considered in this study. Using the visualization method based on fluorescence of oral mucosa improved the detection of oral lesion with locations that are difficult to examine under conventional light.

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