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CLINICAL EVALUATION OF ORAL CAVITY STATUS IN PATIENTS WITH KERATINIZATION DISORDERS

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ABSTRACT — Pathological processes associated with disturbed keratinization and risks of cancer tend to become more common and affect younger people. However, the currently available diagnostic methods are not always reliable, which explains the need to further study this. The aim of the study was to improve the efficiency of early diagnosis of keratoses of the oral cavity under autofluorescence spectroscopy incorporated into the proposed screening algorithm. The examination methods involved clinical, luminescent, analytical, statistical evaluation. The study allowed obtaining optical images through autofluorescence stomatoscopy in patients with keratinization disorders, identifying their color range within affected and healthy tissues, as well as confirming their reliability employing the Color Spatioplotter ver 2.46 software. The tested autofluorescent stomatoscopy method featured sufficient sensitivity (98%) against relative specificity (75%), with prediction of a positive outcome (100%).

KEYWORDS — keratoses, autofluorescence spectroscopy, optical images.

INTRODUCTION

Pathological processes associated with keratinization disorders occur in 13.5±1.67% of all patients affected with diseases of oral mucosa (OM) [2, 6, 8, 9, 12]. According to the WHO data, OM leukoplakia ranks first (80%) among keratoses. Besides, it tends to affect a growing number of people, and is diagnosed most often in middle aged male adults. Per 100% of leukoplakia cases, OM issues account for 5.6% of precancerous conditions and 4.8% of early cancer, these being patients with verrucous and erosive-ulcerative leukoplakias, where the precancerous condition can transform into invasive squamous cell carcinoma [10, 14, 17, 21, 23]. Epidemiological studies show that oral lichen planus (OLP) accounts for 30–35% of all oral mucosa diseases, affecting 0.1–2% of the population, more often in women aged 40 to 65 [18, 20]. The hyperkeratotic form of OLP also belongs to facultative precancerous diseases [11, 22].

The etiology of these diseases has not been investigated fully yet [15]. These conditions display no notable pain syndrome in the early stages. In this very period patients have a low motivation for undergoing dental treatment, which, in turn, contributes to the disease progression as well as adds to the risk of developing malignancy [19]. However, currently there are no universal methods for early diagnosis of these pathologies at the clinical examination and the screening techniques have not been commonly applied yet [3, 5, 24–29]. Therefore, search for tools that would help detect the first symptoms of pathological processes at the preclinical stage is a feasible task [1, 4, 7, 13, 16]. In this study we attempted to objectivize the capabilities of autofluorescence stomatoscopy as a method, which could be universally applied for early diagnosis and screening.

MATERIALS AND METHODS

To achieve the goal stated above, a clinical study was carried out involving 162 patients of both sexes aged 20 to 50 diagnosed with keratoses (OLP — 83; leukoplakia — 29), who, depending on the clinical status of the oral cavity, were divided into two groups:

Group 1 — patients with healthy oral cavity mucosa (control group) — 50 persons.

Group 2 — patients with oral cavity mucosa diseases — 112 persons.

The study implied a comprehensive dental examination of patients with OM issues, identifying increased risk areas, and evaluating the diagnostic capacity of autofluorescence stomatoscopy.

The patients underwent clinical examination subject to the following algorithm:

1. Interrogation: complaints; duration of the process; previously prescribed treatment and its result; bad habits; general somatic status.

2. Visual examination in natural and artificial light.

3. Manual examination of the lymph nodes, salivary glands, OM lesion foci — all done to identify the density, to detect infiltrate, as well as to assess the degree of the pain and its boundaries.

4. Instrumental research and index evaluation:

4.1. Oral hygiene index OHI-S (Greene J. C., Vermillion J. R., 1964);

4.2. Papillary-marginal-alveolar index (PMA);

4.3. Dentoalveolar sulcus bleeding evaluation by H. P. Miihlemann, S. Son (1971);

4.4. Community periodontal index of treatment needs index (CPITN);

4.5. K. Kojima et al. index (1985) to evaluate the degree of the tongue plaque;

4.6. Permanent teeth caries intensity index DMF.

5. The oral cavity mucosa was studied using an autofluorescent somatoscope (Manufacturer: OOO Polironik, Russia). The diode wavelength of the device employed was 400 nm, which is within the blue light spectrum that stays in the OM surface layers at a depth of 4–19 mm. The data was introduced in a dental medical record card developed specifically at the Department of Dentistry (Fig. 1).

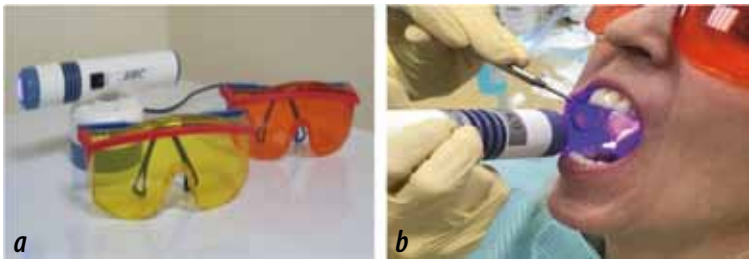

Fig. 1. *AFS: a — AFS kit; b — oral mucosa examination*

Table 1. *Index-based evaluation of oral cavity hygiene, M±m*

Investigated indices	First group	Second group
OHI-S (J.C. Green, J.R. Vermillion, 1964), (p=0,0212)	0,9±0,3	3,6±0,55
PMA (Schour, Massler, 1948) modified by Parma (C. Parma, 1960), (p=0,0392)	11±0,55	28±0,5
Groove Bleeding Index (SBI Muhlemann and Son, 1971) modified by Cowell (1975), (p=0,0412)	0,2±0,15	1,3±0,65
CPITN (WHO index), (p=0,0421)	1,3±0,09	2,9±0,12
KPU index - component "Carious teeth" (p=0,0021) - component «Filled teeth» (p=0,0354) - component «Extracted teeth» (p=0,0034)	10,5±1,5 1,9±0,2 7,3±1 1,3±0,3	14,5±2,3 4,3±0,55 6,3±0,2 3,9±1,55
Index K. Kojima	Distribution of index 0 and 1 (34 and 16 patients)	Index distribution 1-4 (41,48,52,59 patients)

Topography and coding of the OM lesion elements were performed using the Roed-Petersen and Renstrup topogram-scheme modified by O. S. Gileva et al., 2008.

6. The obtained optical images were investigated using the Color Spatioplotter ver 2.46 software in order to obtain and analyze the color code of the selected OM segment, using the LAB format, the results to be further introduced in the data bank.

RESULTS

The analysis of the complaints reported by the patients, as well as their further ranking, allowed identifying the most common ones, including a feeling of discomfort and roughness on the oral cavity mucosa (14.8%); burning sensation on the oral mucosa and tongue (7.4%), with another 10.5% of patients reporting a combined manifestation of symptoms. The timing of their occurrence and the fact the respective patients were seeking dental care much later point at a low motivation activity among the patients. Of all those patients, only 7% had turned for help to dentists previously.

Identification of exogenous and endogenous risk factors allows placing patients in outpatient observation groups at the stage of dental rehabilitation. There was a correlation detected between smoking and the occurrence of hyperkeratosis in 85.2% of cases.

On average, the age of oral cavity mucosa diseases was 1.6±1.1 months. 13% of the patients were observed to have an increase in the lymph nodes falling within the submandibular and chin groups.

The dental status in the control group differed significantly from that in the study group. Patients of Group 2, for instance, while featuring a high intensity of the carious process (14.5±2.3), the D and M elements dominance (4.3±0.55 and 3.9±1.55) ($p<0.01$), poor oral hygiene (3.6±0.55) and severe periodontal diseases, also revealed a tendency to growing hyperkeratosis.

The dental patient map we created specifically based on the modified topogram-scheme by O. S. Gileva (Roed-Petersen and Renstrup, modification by O. S. Gileva et al., 2008) enabled to detect the most common localization zones for hyperkeratoses. Leukoplakia, for instance, is typically located at the region buccal mucosa (29 patients / 41.43%), on the tongue lateral surface (17 patients

/ 24.29%), at the upper and lower jaws transitional fold (15 patients / 21.43%), and at the mandible alveolar process mucosa (9 patients / 12.85%).

Oral cavity mucosa OLP was diagnosed in 83 patients, while in 31 patients the lesion elements were observed in the retromolar area (37.39%); in 33 patients pathological changes were observed on the buccal mucosa (39.76%), in 12 (14.45%) — in the transitional fold, with another 7 patients (8.4%) having the said issues on the lower jaw alveolar process.

The oral cavity mucosa examination was performed with the autofluorescent somatoscope. Pathological processes of different nature feature different optical images, since the affected areas, even at the preclinical stage, reveal zones of dimmed fluorescence whose intensity depends on the nature of the pathology. The para- and hyperkeratosis foci act as lightening agents, which have clear boundaries.

To enhance the diagnostic reliability of this method, all the obtained optical images were processed with the standardized Color Spatioplotter ver 2.46 software with the lesion color code identified (the average value detected in 12 measurement areas, based on the patient's 5 photos).

All the studies implied identifying the color code boundaries. A healthy oral cavity mucosa, for instance, is pale pink with its average values at L=63, a=54, b=39, x=130, y=191, which corresponds to pink shades within the coordinate system. Analyzing the results obtained from patients with OM keratosis allows saying that the x values increase, while y values decrease (corresponding to the light pink spectrum).

DISCUSSION

The study outcomes serve proof to the high efficiency of the AFS-diagnostics (98% sensitivity and 75% specificity of the method).

Examining the groups of patients with healthy oral cavity mucosa and those with keratoses provided the evidence for exploiting fluorescence, which adds to the potential and diagnostic capacity of this system. Fluorescent stomatoscopy involving an AFS device allowed differentiating the pathological process at the preclinical stage, as well as to identify its true boundaries.

The study has helped identify the clinical effectiveness of using the AFS screening system developed nationally; detect OM pathological processes in the preclinical stage; evaluate the system while defining the diagnostic reliability parameters.

The AFS device used for oral cavity mucosa diagnostic purposes revealed a different spectrum of its luminescence both in case of the oral mucosa normal status and with pathological changes, which is of high diagnostic importance in terms of their differentiation.

Besides, notable is that the fluorescence stomatoscopy can be described as a method, which features non-invasiveness, a possibility to obtain diagnostic results directly at the time of the study, high accuracy and data reliability, as well as economic affordability, which could be observed through this current study.

CONCLUSION

Fluorescence stomatoscopy is an advanced technology with a high degree of sensitivity, specificity and diagnostic accuracy. Decoding the optical images using the Color Spatioplotter 2.46 software helps reduce diagnostic errors, perform early diagnosis of oral cancers and differentiate the exact boundaries of the lesion, which is crucial for further treatment.

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Table 2. *AFS diagnostic capacity evaluation*

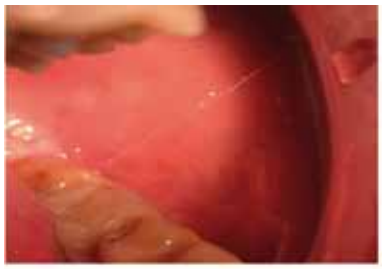
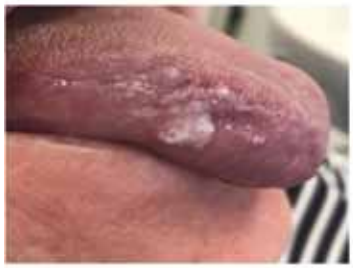
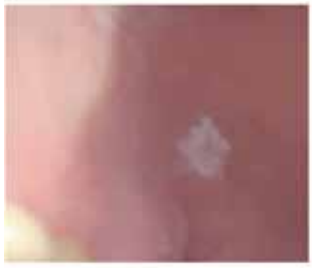
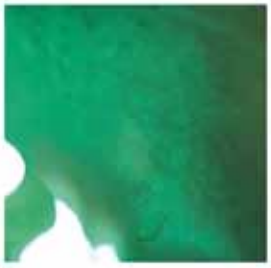
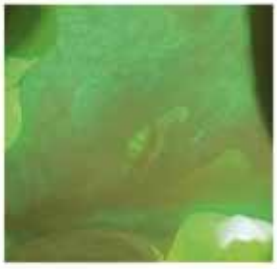
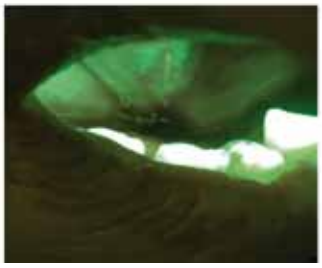
Glow	Artificial lighting	Autofluorescence
The glow of a healthy oral mucosa is registered as different shades of green light		
The foci of hyperkeratosis are determined when glowing in the form of white foci		
A focus of hyperkeratosis on the mucous membrane of the hard palate (Tuppainer's leukoplakia)		
A focus of hyperkeratosis on the buccal mucosa		
Cancer of the mucous membrane of the floor of the oral cavity is recorded as a focus of fluorescence quenching with a black and burgundy tint		

Table 3. *Color code identification in Color Spatioplotter 2.46 software*

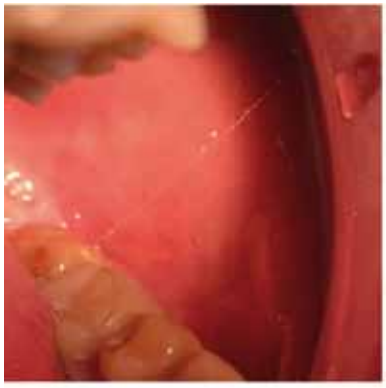
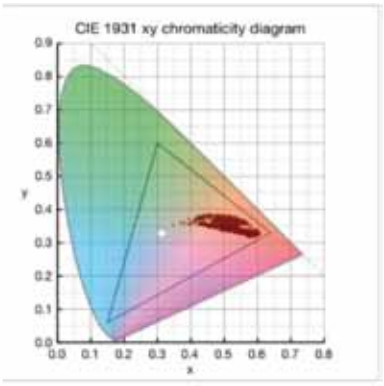
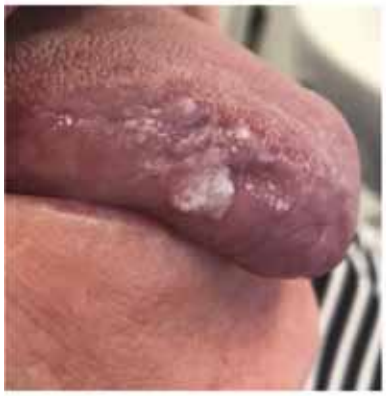
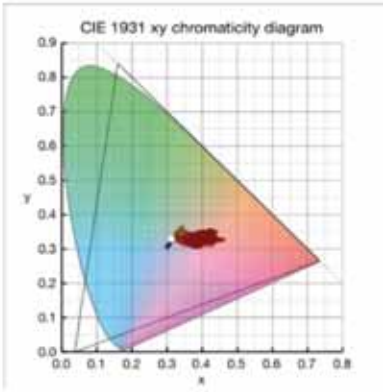
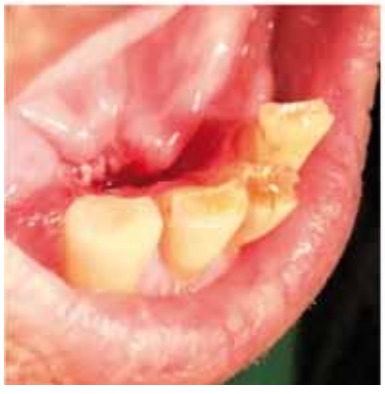
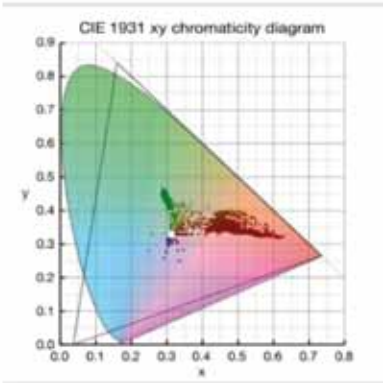
Artificial lighting	Photo in LAB format	Color code
		Healthy oral mucosa L = 63 A = 54 B = 39 X = 130, y = 191
		Site of hyperkeratosis L = 78 A = 21 B = -3 X = 194, y = 268
		Oral floor cancer L = 83 A = 135 B = 8 X = 101, y = 393

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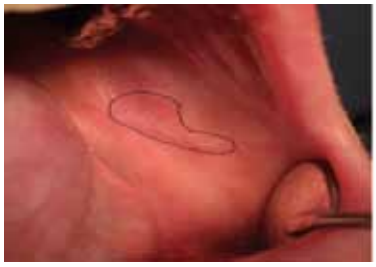
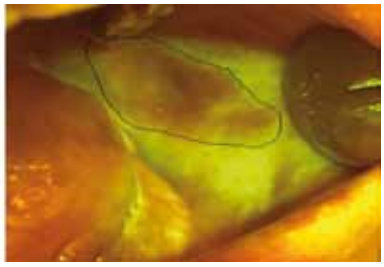
Table 4. *Identifying lesion true boundaries not visible at examination*

Artificial lighting	Autofluorescence
	

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