Pigmented skin lesions assessment with optical coherence tomography

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Introduction

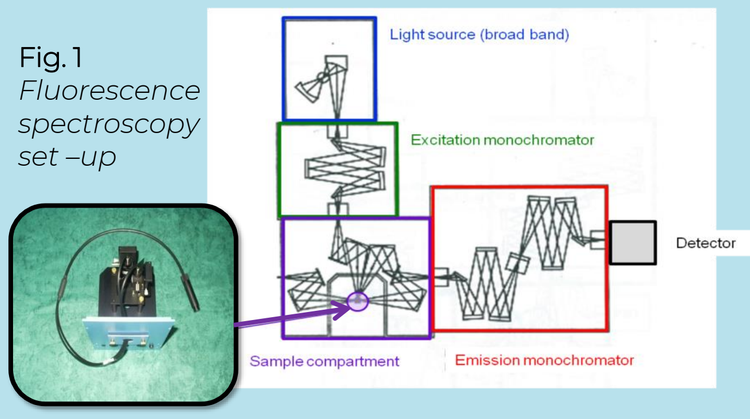
Skin cancer is one of the most severe disease worldwide. Newly registered cases of non - melanoma skin cancer (BCC,SCC, etc.) and malignant melanoma are increasing every year. Early detection of all cutaneous neoplasia is a challenge due to their resemblance to each other. This is essential for adequate treatment, which can achieve high survival rates. Several optical techniques are applied in recent years to early diagnosis of skin lesions in real time and without necessity of biopsy. Most of them provide only information about biochemical and morphological changes in the tissue, but no insight on an important for successful therapy parameter – the thickness of the lesion.

Spectroscopy modalities based on the detection of fluorescence signal are some of the most promising in the field of biphotonic. One of these modalities is fluorescent excitation – emission matrix (EEM) spectroscopy. An EEM is a 3- dimensional scan, which provide complete quantitative analysis of biological samples without need of adding fluorescent markers. On the other hand, Optical coherence tomography (OCT) is novel non – invasive method, which works on the principle of Michelson interferometry. It allows 2 or 3 – dimensional cross – sectional as well as en - face sectional images in real time of the microstructural morphology of biological tissue. Therefore, the technique enable visualization of changes that occur in the lesions and interpretation of cutaneous anatomy.

Methods and Materials

FluoroLog 3 (HORIBA Jobin Yvon, France) and F-3000 fiber-optic module

Fig. 1 *Fluorescence spectroscopy set –up*



The fluorescence of the samples was evaluated through EEM excitation of 280-440 nm and detection of 300-800 nm.

The OCT imaging is performed with Telesto TEL221 OCT (Thorlabs); 1300 nm FWHM > 100nm; Sensitivity 28kHz; RI = 1.4

Fig. 2 *Ex vivo tissue sample scheme*

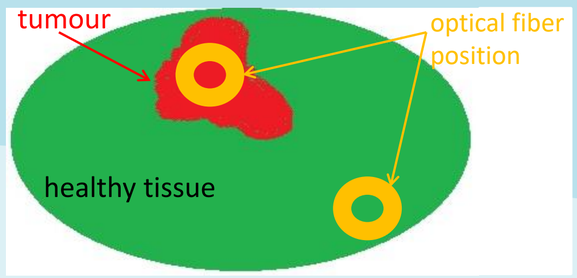
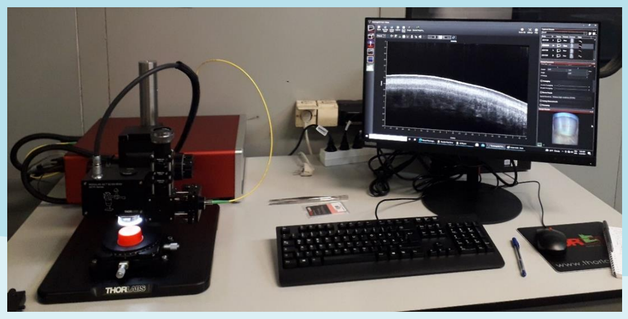


Fig. 3 *The OCT set – up*



Results

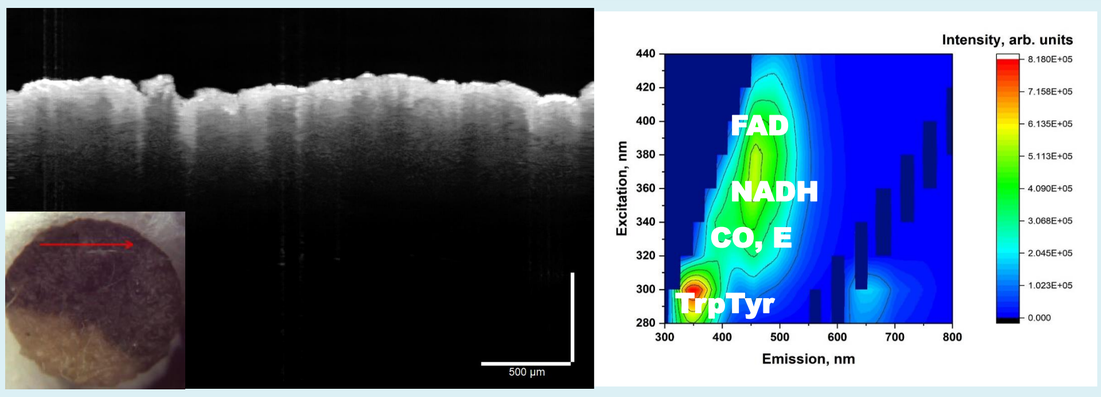


Fig. 4 *OCT images and EEM of Dysplastic melanocyte nevus.*

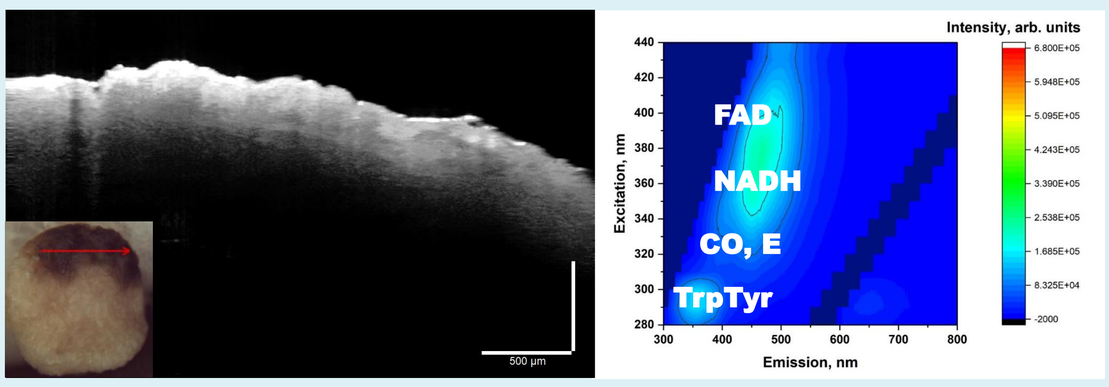


Fig. 5 *OCT images and EEM of Sample 27 Malignant melanoma*

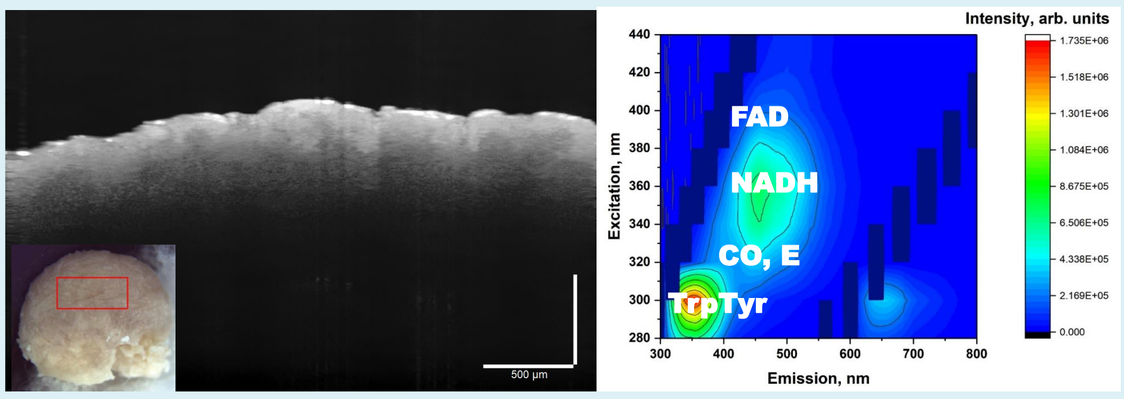


Fig. 6 *OCT images and EEM of Sample 9 Basal cell carcinoma.*

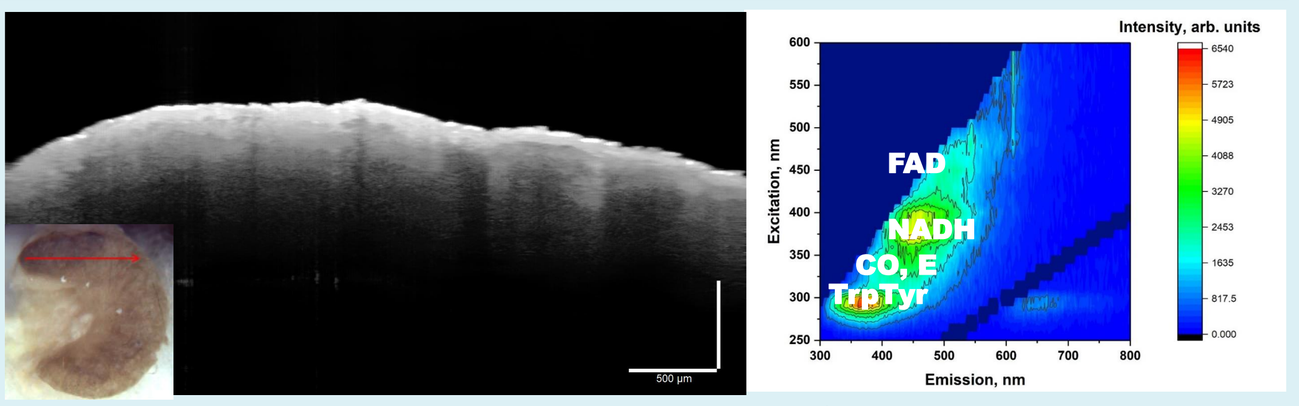


Fig. 7 *OCT images and EEM of Basal cell carcinoma/ Squamous cell carcinoma.*

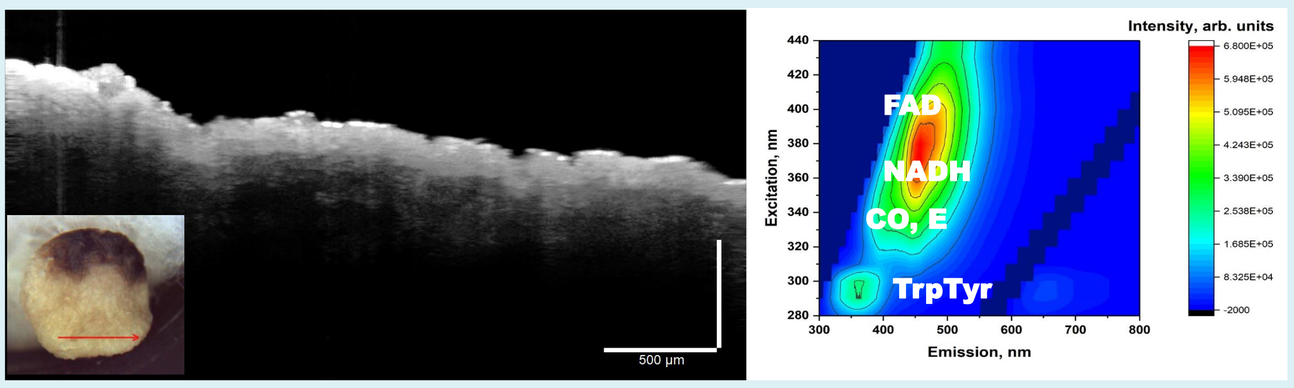


Fig. 8 *OCT images and EEM of healthy part of Malignant melanoma*

Endogenous fluorophore	Tryptophan Tyrosine	Collagen Elastin	NADH	FAD	Porphyrins
Excitation maximum [nm]	280 - 300	320 - 360	340 - 380	450 - 500	400 - 450
Emission maximum [nm]	320 - 400	400, 460 - 500	450 - 500	450 - 530	630 - 690

Discussion and Conclusions

OCT images demonstrate abnormal thickening, infiltration of superficial into deeper skin layers and roughness in correlation with lesion development. Further analysis of OCT images through image processing algorithms could provide quantification parameters for differentiation between cancerous and healthy skin.

Although fluorescence spectroscopy provides quantitative information about collagen presence in the investigated tissue samples, it gives no further enlightenment on the alterations in the tissue architecture. OCT provides the opportunity for visual non-invasive assessment and direct translation of standard histology diagnostic peculiarities for lesion identification. On the other hand, fluorescence spectroscopy gives more information about biochemical and metabolic alterations in the tissue. Both techniques have the potential to be combined in a noninvasive novel diagnostic modality for skin cancer diagnosis.

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