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Optical attenuation coefficient measurement of hemangioma vascular lesion in labial mucosa by Optical Coherence Tomography

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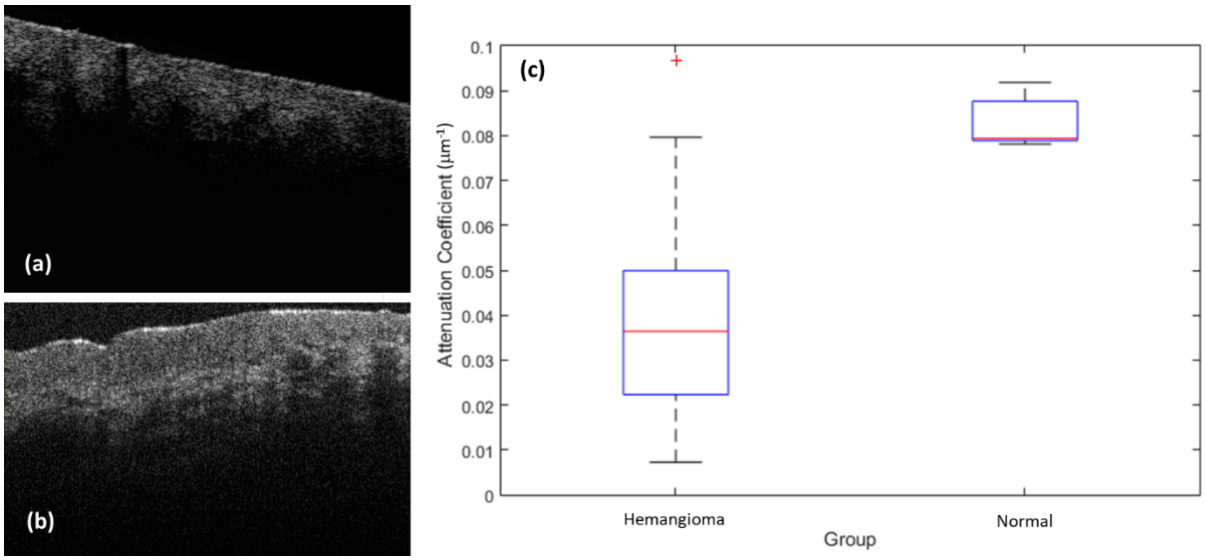
Background, Motivation and Objective. Hemangioma is a common childhood benign tumor affecting 10% of children worldwide. In most cases it spontaneously involute, although complications caused by tissue deformities. Diagnose it can help to differentiate lesion and normal tissue guiding an appropriated treatment or invasive intervention if required. The excisional biopsy is the gold standard diagnosis, but in most cases it is prohibitive due to bleeding. Other noninvasive techniques, such as computer tomography (CT) scan, magnetic resonance imaging (MRI) and ultrasound (US), are recommended in those cases. However, CT and MRI are expensive techniques for daily clinical application. USs are limited to evaluate hemangioma vascular lesions on the tissue near the skin surface due to the depth and lower resolution of the technique. A non-invasive alternative is the Optical Coherence Tomography (OCT) technique. OCT provides a cross-section image of superficial tissues with higher resolution (~5μm). Blood vessels density of vascular lesions on skin has been characterized by OCT, although it was not possible to observe vessels in all images due to its dimension. An alternative approach is to measure the optical attenuation coefficient (OAC) of the tissue by OCT. Normal and lesioned tissues presents different OAC and many cases affect the mucosa tissue. However, none or little information about the hemangioma OAC is presented on literature. So, the aim of this work was to measure the mucosa optical attenuation coefficient of normal mucosa and hemangioma vascular lesion tissue affecting the mucosa, to allow its differentiation for diagnosis and future treatment.

Methods. All images were acquired after the study been approved by the Ethics Committee of IMIP (protocol no. 728.993). Using a swept source OCT system (OCS1300SS; Thorlabs GmBH), at 1325 nm of central wavelength and 100 nm of bandwidth, it was collected image of labial mucosa region of 25 lesions and 5 normal patients. A home-developed software was implemented using Matlab (MathWorks) environment was used to automatically measure the OAC. This software opens each image, find the external edge of the mucosa, align each A-scan (column of the image) by the tissue edge and perform the average A-scan. This average process is important to minimize the influence of noise on the model fit. To measure the OAC (μ) of each image, the average A-scan is used to fit Beer's law model ($I_{OCT}(z) = I_0 e^{-2\mu z}$), were z is the depth position on tissue.

Results. Figure 1 presents a typical OCT image of a normal mucosa tissue (a) and of hemangioma lesion tissue (b). It is not possible, or it is not ease, to visually identify differences on this two tissue images, evidencing the importance of measure objective parameters. Figure 1c presents the boxplot for the OAC values for the hemangioma and normal groups. It is possible to identify that hemangioma group has a more spread distribution compared to the normal group. The mean OAC value and standard error for the hemangioma group was 0.040(5) μm^{-1} and for the normal group was 0.083(3) μm^{-1}, these values are statistically different (p-value < 0.001).

Figure 1: OCT image of (a) normal mucosa tissue and (b) hemangioma tissue lesion. (c) Boxplot of optical attenuation coefficient for hemangioma and normal groups.



Discussion and Conclusions. It was possible to measure the optical attenuation coefficient of hemangioma and normal labial mucosa as 0.040(5) μm^{-1} and 0.083(3) μm^{-1}, respectively. The measured OAC values were statistically different (p-value < 0.001) allowing its use to differentiate normal from lesion tissue and making it a good candidate to monitor treatments or surgical interventions.

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