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Preliminary results from an ex-vivo optical coherence tomography of the human prostate after radical prostatectomy

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Introduction: Current imaging modalities and biopsy protocols are insufficiently accurate to support tailored treatment of low- and intermediate risk prostate cancer. Optical coherence tomography (OCT) is a novel technology that provides real time morphological and quantitative information of tissue with unprecedented resolution. We present ex-vivo three-dimensional OCT renderings of prostate tissue using a needle-guided imaging probe**.**

Material & Methods: We performed four to six OCT measurements in 4 prostates, immediately following radical prostatectomy. Two measurements were made in the transitional zone and two to four in the peripheral zone. The images were recorded using a commercially available C7-XR^{tm} Intravascular Imaging System interfaced to a C7 Dragonfly^{TM} 2.7Fr (0.9 mm) Intravascular Imaging Probe (St. Jude Medical, St. Paul, Minnesota, USA) The device uses a pullback system scanning in approximately 5.2 seconds across a trajectory of 520 mm producing a 520 frame dataset. This results in a cylindrical volume of 520 (length) by 10 mm (diameter). The prostates were histopathologically evaluated and compared to the OCT data using 3D reconstruction of the whole mount histopathology. A full 3D OCT dataset is subsequently analysed on the optical attenuation coefficient (μ_{oct}), which is expected to be related to local cellular morphology. We selected 4 prostates in which the OCT images covered both benign and malignant tissue.

Preliminary Results: In the malignant measurements, OCT attenuation coefficient was markedly higher than in benign tissue (Figure 1).

Conclusion & Discussion: OCT is a tool with the potential to detect tumor in prostate tissue. Initial results are promising, however, there are some limitations to this study. The OCT measurement trajectories are perpendicular to the pathology slicing direction. Therefore, only the pathology on the surface of each slice is known. The residual pathology results were interpolated. In-vivo results need to be acquired to evaluate diagnostic accuracy. Finally, benign regions with high scattering structures (false positives), need to be addressed in further studies.

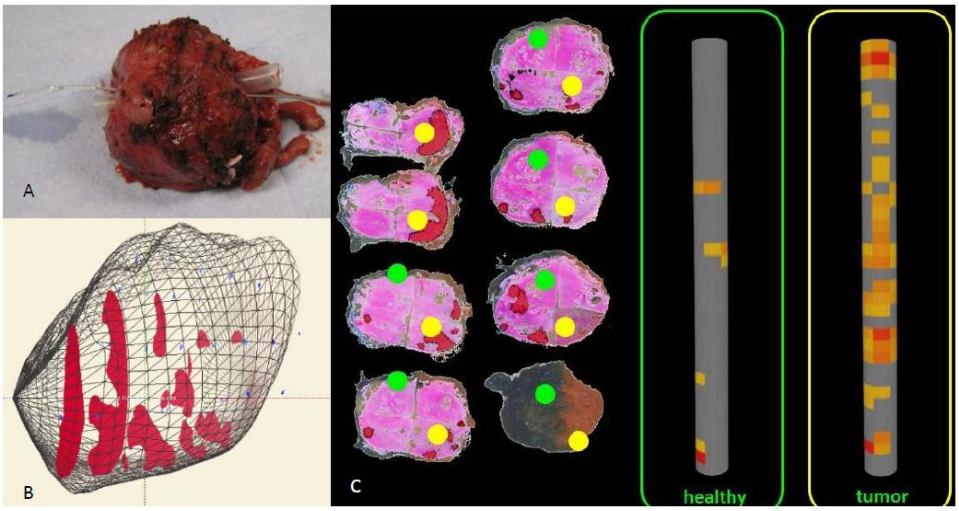

Figure 1: A) OCT measurement in a prostate, directly after radical prostatectomy. B) 3D reconstruction of whole mount histopathology. C) Left, plan of whole mount histopathology of one prostate. The red areas are the sites where the prostate cancer is located. The green and yellow dots are the sites through which OCT measurements have been taken. The green dot (measurement on the left) only travels through benign tissue, whereas the yellow dot (measurement on the right) also travels through malignant tissue. On the right side, the analysis of the OCT measurements are shown in which high attenuation coefficient is correlated to a yellow/red color. It is easily visible that the attenuation coefficient is significantly higher in tumor tissue.