Nonlinear Optical Imaging of the Microenvironment of Breast Cancer

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Stromal reorganization and specifically the extracellular matrix (ECM) has been associated with the progression of breast cancer. Changes in collagen alignment in the ECM, has been shown to be a potential biomarker for breast cancer invasion and progression. Nonlinear optical techniques including Second Harmonic Generation (SHG) and Multiphoton Laser Scanning Microscopy (MPLSM), have been a powerful tool in studying disease progression and ECM reorganization. These imaging modalities are not only compatible with genetically tagged fluorescence markers and intrinsic signatures such as that from collagen but can also detect these changes non-invasively with cellular scale resolution deep within intact tissue. Together MPLSM and SHG are powerful non-invasive methods to study cancer cell and collagen architecture interaction. Recently we have implemented the use of a Mammary Imaging Window (MIW) that is surgically implanted on the developing tumor in our breast cancer mouse model. This technique along with other imaging modalities like Fluorescence Lifetime Imaging Microscopy (FLIM), which can track changes in cellular metabolism, greatly increases our ability to understand cellular interactions as they relate to the progression of disease. We will discuss the optical and computational tools we are developing to study these microenvironment based processes in breast cancer invasion and progression.