

***Infrared Imaging in Breast Cancer: Automated Tissue Component Recognition and Spectral Characterization of Breast Cancer Cells as well as Tumor Microenvironment***

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Current evaluation of histological sections of breast cancer samples remains unsatisfactory. The search for new predictive and prognostic factors is ongoing. Infrared spectroscopy and its potential to probe tissues and cells at the molecular level without requirement for contrast agents could be an attractive tool for clinical and diagnostic analysis of breast cancer. In this study, we report the successful application of FTIR (Fourier transform infrared) imaging for breast tissue component characterization. We show that specific FTIR spectral signatures can be assigned to the major tissue components of breast tumor samples.

Breast cancer formalin-fixed paraffin-embedded samples (FFPE) from 50 patients were provided from the tumor tissue bank of the Jules Bordet Institut (Brussels, Belgium). Eleven additional FFPE breast cancer samples were considered for the independent validation of the tissue component classifier. To refine our description of the immune and stromal responses, seven lymph nodes and three tonsils as well as seven scars from mastectomy biopsied tissue samples, one cutaneous scar and four biopsies chosen for their extracellular matrix characteristic of scar remodelling were analyzed. Tissue Microarray (TMA) including four Grade I and eight Grade III invasive breast carcinomas was built.

We demonstrate that a tissue component classifier can be built based on a spectral database of well-annotated tissues and successfully validated on independent breast samples. We also demonstrate that spectral features can reveal subtle differences within a tissue component, capturing for instance lymphocytic and stromal activation. By investigating in parallel lymph nodes, tonsils and wound healing tissues, we prove the uniqueness of the signature of both lymphocytic infiltrate and tumor microenvironment in breast disease context. Finally, we demonstrate that the biochemical information reflected in the epithelial spectra might be clinically relevant for grading purpose, suggesting a potential to improve breast cancer management in the future.