Photoacoustic imaging – a new diagnostic tool for skin cancer

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Background and aims
Skin cancer is one of the most common cancers globally, with malignant melanoma being the deadliest form. To decrease the risk of non-radicality during surgery, while preserving healthy tissue, several non-invasive imaging techniques have been developed for preoperative imaging in skin. However, these methods are limited by their imaging depth, or lack functional and molecular imaging capabilities. Photoacoustic (PA) imaging combines laser light and ultrasound to provide high-resolution 3D images at a depth of several centimeters. However, only a few studies have explored PA imaging for skin cancer diagnostics, and these were limited in both sample sizes and spectral information. The aim of this thesis is to develop PA imaging into a preoperative diagnostic tool for skin cancer, by using tumor specific spectral signals.

Method and results
In the first study (1), we scanned 33 human cutaneous squamous cell carcinomas (cSCCs) ex vivo using PA imaging. Our results show a unique spectral absorption signal for cSCCs and demonstrate how the signal can be used for three-dimensional visualization of tumor cell distribution and overall lesion architecture.

In the second study (2), we scanned 52 human cutaneous melanomas and nevi ex vivo using PA imaging, and developed a new method for spectral analysis that could more accurately differentiate between tumor tissue and healthy tissue. We then used the results to measure tumor dimensions and compared these to histological measurements. Our results show a strong correlation between PA measured tumor width and thickness compared to histopathological measurements.

Conclusion
The results from the first (1) and second study (2) show that PA imaging can be used for three-dimensional visualization of human cSCCs and melanomas ex vivo. The method for spectral analysis that was developed in the second study can be used in future in vivo studies of PA imaging as a preoperative diagnostic tool for skin cancer.

Significance
The development of PA imaging into a diagnostic tool is important for future complete and precise surgical excision of skin cancer, reducing the risk of non-radicality or excessive scarring.