IMPLEMENTATION OF CONFOCAL ADAPTIVE OPTICAL MICROSCOPY FOR CLINICAL TISSUE ANALYSIS

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The main objective of tumour surgery is to attempt complete resection of tumorous tissue with preservation of normal functional tissue. An incomplete resection with remaining infiltrative growing cells increases the risk of recurrence, leading to a shorter life expectancy. Successful total resection relies on accurate intraoperative definition of tumour boundaries. However, due to intrinsic heterogeneous properties of biological tissues, the resolution, contrast, and imaging depth is compromised such that diagnostic quality imaging is limited to the superficial layers of cells.

Adaptive optics is a technique that can compensate for specimen-induced aberrations by applying an equal but opposite phase pattern, usually to a conjugate pupil plane, using an appropriate dynamic aberration correction device, such as a deformable mirror. The incorporation of aberration correction in confocal surgical microscopes would permit better *in situ* identification of tumour boundaries at a cellular level.

We have developed a compact confocal microscope incorporating adaptive optics using off-the-shelf components. It takes advantage of back-scattered light in the near-infrared region, eliminating the need for fluorescent markers and thus is label-free. A low NA objective lens is identified, allowing for an effective working distance of 2 mm for non-invasive imaging and an ALPAO DM69 deformable mirror is used for aberration correction. Two imaging modes are achieved: one with a narrow central field of view (FOV) and cellular level resolution; and the other with a larger FOV that facilitates the process of finding the region of interest.

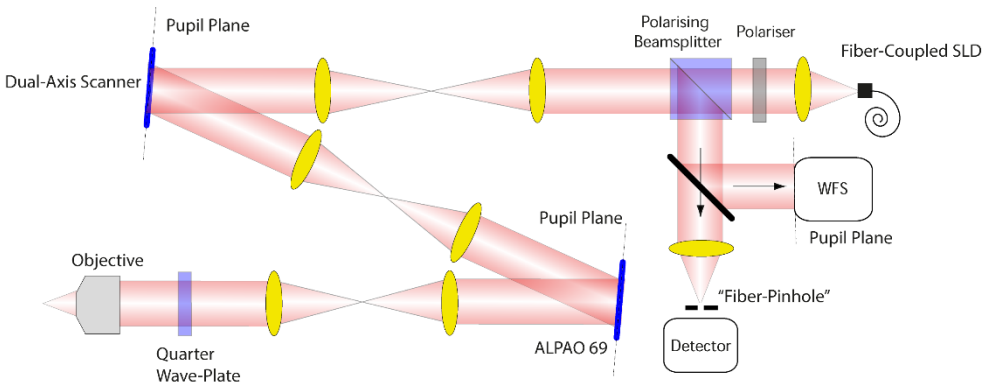

Figure 1. Schematic of compact clinical confocal microscope using adaptive optics.