

Quantitative characterization of pre-neoplastic progression using single cell computed tomography and 3D karyometry

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Cell CT instrument overview

The cell CT instrument consists of an inverted microscope (IX71, Olympus, San Diego, CA) fitted with a mechanical assembly to transport and rotate stained cells (Figure 1). The core component of the mechanical assembly is a cartridge that houses a glass microcapillary with an inner diameter of 50 μm superglued in a syringe needle orifice. The capillary passes through an oil-filled coverslip sandwich, forming an imaging chamber between the condenser and a high-magnification microscope objective. The cartridge incorporates a distal waste reservoir to collect the extruded cell-gel suspension after imaging. The imaging chamber in the middle of the cartridge is positioned directly above the microscope objective lens. A 100x, 1.3 NA, oil immersion objective lens (UPlanFluor, Olympus) and a 1400 \times 1100 pixel, color CCD camera (Prosilica 1650C, Burnaby, BC) are used to acquire projection images. The needle is coupled into a syringe barrel through a Teflon gasket, allowing needle rotation. The syringe contains cells embedded in a thixotropic carrier gel whose flow is controlled by the actuation of a plunger driven by a stepper-motor. The microcapillary is rotated by a gear on the syringe needle. The immersion oil, the coverslip sandwich, an optical oil filling the sandwich around the capillary, the capillary glass and the cell transport gel are all refractive index matched at about 1.5 to minimize spatial distortions in the projections.

Figure 1: Cell CT schematic

