

Clinical Application of PCI

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Although synchrotron-based Phase Contrast Imaging (PCI) has generated significant interest, the technique has yet to be implemented in the clinical environment for routine diagnostic or screening imaging. We seek to determine whether available medical equipment, assembled in a geometry optimised for propagation based phase contrast imaging, can produce images which are diagnostically better than images taken with the conventional contact geometry.

The breast is the ideal anatomy to determine whether the PCI technique can clinically implemented. The relatively homogenous electron density of the breast means that conventional X-radiography inherently produces images with limited contrast. PCI, being more sensitive to subtle changes in electron density than conventional absorption imaging, may provide improved diagnostic accuracy.

A micro-focus (100 μm spot size) Molybdenum X-ray source with 0.03 mm Molybdenum filtration was installed at a local hospital. Tissue samples, excised masses and mastectomies, were obtained directly from surgery, compressed in a saline bath and imaged at three geometries. The geometries employed were the conventional mammographic contact arrangement with the sample at 65 cm from the source, the Konica phase contrast geometry and a third, optimized phase contrast geometry. The optimised solution was formulated from a ray-line optics argument that produced a solution which can be applied to any source-detector combination.

Seventy-seven image sets (three images corresponding to each geometry in each set) were comparatively scored employing a seven point scale. Scoring was performed by radiologists expert in mammography, general radiologists, associated clinicians and radiographers on high resolution mammography rated monitors at two separate locations.

Scoring indicated that the optimized and Konica geometries both outperformed conventional mammographic geometry. An unexpected complication within the trial was the effect that the scoring platform and the associated display tools had on some of the scorers. Additionally, the trial resulted in a number of frank discussions about what characteristics of an image rendered it 'better' and that none of the conventional descriptors are adequate.

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