A METHOD FOR ACCURATE SPATIAL REGISTRATION OF PET IMAGES AND HISTOPATHOLOGY SLICES


INTRODUCTION
- An accurate alignment of histopathology sections and PET images is important for radiopharmaceutical validation studies.
- We developed a method to align PET and histology images obtained in a routine pathology laboratory setting and assessed its accuracy.
- The method can be applied to non-parallel, non-contiguously cut and non-megablock sized histology slices.

METHODS
- Subjects with head and neck cancer underwent a 64Cu-ATSM PET-CT scan a week before surgery.
- After surgery, sea urchin spines (Figure 1a), which can be identified with CT, optically and histologically, were inserted into the specimen to act as fiducial markers.
- The specimen was fixed and scanned CT ex-vivo. After slicing, blockface images were obtained for visual reference.
- From these thick sectioned slices, a subsection of tissue that included tumour and markers was extracted and embedded in paraffin blocks of size 30x21 millimetre (mm).
- Subsequently microtome sectioning and haematoxylin and eosin staining was performed to acquire thin slides and digitized using a microscope.
- The methodology used to align PET and histology is described in Figure 1b.

RESULTS
- The PET and histology registered to CT ex-vivo are shown in Figure 2.
- The accuracy for registration of in-vivo to ex-vivo CTs was 2.90±0.06mm, and for registration of histology to ex-vivo CT was 1.69±0.70mm.
- The total registration error between PET-Histology for 10 histology samples was 6.39±2.11mm (Table 1).
- The largest error in the PET-Histology registration process is due to the systematic PET-CT registration error.

CONCLUSION
We have developed a semi-automated registration method to align PET and histology images (Figure 2) with a registration accuracy of 6.39mm (Table 1) which is comparable to the PET spatial resolution.

REFERENCES

ACKNOWLEDGEMENTS
We would like to acknowledge King’s College London and UCL Comprehensive Cancer Imaging Centre. Funded by the CRUK and EPSRC in association with the MRC and DoH (England). The authors would like to thank the staff of the head and neck bio bank, the Pathology Department of Guys Hospital and PET Imaging Centre at St. Thomas’ Hospital for their excellent technical support. This research is supported by the National Institute for Health Research (NIHR) Biomedical Research Centre at Guy’s and St Thomas’ NHS Foundation Trust, London, UK and for the Department of Clinical Oncology, Guy’s & St Thomas’ Hospital NHS Trust, London, UK.

CORRESPONDING AUTHOR
Tanuj Puri; tanuj.puri@kcl.ac.uk

TABLE 1: The table shows (from left to right) the registration errors in millimetres for ten histology samples. TRE corresponds to target registration error. L-1-O correspond to leave-one-out. PETin corresponds to postion emission tomographic image obtained in-vivo. CTin corresponds to computed tomography image obtained in-vivo. Ctex corresponds to computed tomography image obtained ex-vivo.