

## MR Imaging of the Human Biliary Tree Using a Flexible Catheter-Mounted Radio-Frequency Detector Microcoil

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**Problem:** Cancer of the bile duct (cholangiocarcinoma) is increasing in frequency worldwide.<sup>[1]</sup> Despite advances in Computed Tomography (CT) and Magnetic Resonance (MR) technology, the correct classification of biliary strictures as benign or malignant remains difficult.<sup>[2]</sup> This diagnostic uncertainty is particularly troubling as patients with benign biliary diseases, such as primary sclerosing cholangitis, are at high risk of bile duct cancer. Even the gold standard investigation, Endoscopic Retrograde Cholangiopancreatography (ERCP) with brush cytology, has a low sensitivity for neoplasm detection.<sup>[3]</sup> Also, ERCP provides no imaging data beyond the lumen of the bile duct. Standard MR imaging systems utilise a detector radio-coil that remains external to the patient under investigation. A MR system in which the detection radio-coil is more closely apposed to the tissue of interest should improve the resolution of the images obtained. Our group has developed such a coil, designed so that it might be passed into the biliary tree via an endoscope to improve resolution and tissue conspicuity. Previous *in vitro* testing has demonstrated sub-millimetre resolution imaging of animal tissue with this device.<sup>[4]</sup>

**Aim:** To confirm the utility of a prototype receiver microcoil in obtaining MR images of a human liver resection specimen and compare this to imaging data collected contemporaneously with the MR body coil.

**Method:** An extended left hemihepatectomy specimen was studied. Images were acquired using a 1.5T GE Signa™ scanner, initially using the main body coil for excitation and detection. Each scan was then repeated with the same parameters, but with the body coil used for excitation only and the prototype microcoil used for detection. The microcoil is a 60mm long 2-turn thin film device, tuned and matched at 63.8 MHz and is attached to an 8F biliary catheter. Overall, the probe is 2.7mm in diameter and is fully MR compatible (figure 1). In Scan 1, the microcoil was positioned on the surface of the specimen, parallel to the gallbladder and cystic duct (figure 2). In Scan 2, the microcoil was positioned deep into left main hepatic duct. In both studies the specimen was located at the magnet isocentre with the microcoil parallel to the magnet bore. Axial images were obtained with a T2-weighted FRFSE sequence with TR = 33 ms, TE = 15 ms.

**Results:** High-resolution images were obtained using both the body coil and the catheter-mounted microcoil. Images were obtained with the microcoil applied to the surface of the liver and inserted deep into a duct. As expected, the microcoil images had a field of view of 15mm radius around its full 60mm length. Structures such as the cystic duct, gall bladder (figure 3) and adjacent ducts (figure 4) could be seen clearly. The signal-to-noise ratio and image resolution were substantially better in the images obtained with the microcoil than those obtained with the body receiver coil (SNR 260 vs 30).

**Conclusion:** The MR probe developed by our group can produce high quality images of *ex vivo* human liver tissue. These images demonstrate interpretable anatomical detail with sub-millimetre resolution and are superior to those obtained using a standard body coil. Work to improve the images obtained, collect MR spectroscopy data and translate into a clinical study of this device is ongoing. This catheter-mounted microcoil has the potential to enhance clinical imaging, as well as a number of exciting research applications.

### References:

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