AbstractID: 9507 Title: Closed-loop guidance of laser induced thermal therapy using MRI

Purpose: A closed-loop MR-guided laser induced thermal therapy (LITT) system has been developed and validated in large animals, obtained 510(k) clearance and undergone initial safety studies in humans. In this work we outline the capabilities and potential applications of the system, recent advances and current challenges in MR temperature imaging for guidance of these procedures, initial results in human subjects and current work in integrating the system with an interventional MR suite. **Methods & Materials:** All imaging has been performed on 1.5T MRI scanners. Temperature was measured in real-time using MR thermography based on the proton resonance frequency shift and used to control a high-power 980-nm diode actively-cooled laser for interstitial LITT. An MR compatible targeting template, similar to that used for brachytherapy delivery, was developed and used to investigate the feasibility of performing MR-guided LITT in prostate using a canine model. Treatments in spine used a canine sarcoma model. Intracranial treatment in a canine model were performed to test the safety of the equipment and evaluate the lesions over time prior to commencing treatment of intracranial metastasis in patients. MR-guided LITT using MRTI feedback was also performed in patients with liver metastases. The system was integrated into a multi-modality interventional suite featuring a large bore 1.5T magnet and floor mounted fluoroscopy unit for image guided procedures. **Results:** Actively-cooled laser applicators facilitate much more rapid therapy delivery than previous laser technology allowing 2-cm treatments to be completed in <90 seconds in many cases. MR temperature imaging provided valuable feedback during therapy allowing a more aggressive therapy delivery. Procedures were well tolerated in both animal and human subjects. **Conclusion:** MRI-guided LITT is feasible and safe. MR temperature imaging provides a means to either qualitatively monitor the therapy or apply quantitative dosimetry which can accurately predict the region of ablation.