Purpose:To investigate the impact of ultrasound wave reflections from distal surfaces on aimed treatment center shifts and dose distributions during MR-guided-FUS (focused ultrasound) to provide important information for treatment planning. Methods: An integrated Philips Sonalleve system on a 1.5T was used for this study. FUS waves reflected from four different reflectors (air, acrylic (modeling bone), rubber, and a gel pad) after propagation through a thermal phantom and an ex vivo tissue phantom were investigated. FUS was aimed at positions 1 cm, 2 cm and 4 cm below the distal interface surface. Volumetric sonications were 20 seconds, at 50 watts for all cases. Proton resonance frequency shift imaging was used to measure temperature during and after FUS. Target location shifts toward the distal interface are reported, along with the maximum temperature at both the center of the treatment area and at the interface. Results: Surface heating was greatest at the acrylic-thermal phantom interface. The greatest shifts from planned treatment position were beneath acrylic and rubber interfaces at an aimed depth of 2cm in the thermal phantom. Shifts in position observed in the tissue phantom were less extreme. Conclusions: In both the thermal and tissue phantoms, the gel pad interface causes the least increase in temperature at the surface, and minimal displacement from the target. For translational research utilizing animal cancer models, this work demonstrates the benefit of placing a gel pad on the distal surface of small volumes to reduce the shift that would occur if that surface was left open to the air. Future work will compare experimental data with simulations and investigate the effect of reflections from distal surfaces using in vivo animal studies.

Funding Support, Disclosures, and Conflict of Interest:

This work was supported by grants from the Focused Ultrasound Surgery Foundation and Philips Healthcare.