

In an effort to deliver biologically meaningful thermal doses in the treatment of superficial tumors, two approaches have been pursued: (i) to improve heating systems, and (ii) to deliver external beam radiation fractions during hyperthermia treatments, that is, to administer simultaneous thermoradiotherapy. Both of these approaches required novel device developments. In 1994, a new device, the scanning ultrasound reflector linear array system (SURLAS), was introduced and its feasibility established (Med Phys 21:993-994, US2.2). Here, numerical and experimental results are presented that demonstrate the potential for three-dimensional power deposition control of a prototype device with two, parallel opposed, linear ultrasonic arrays operating at different frequencies, and a double-sided scanning reflector (called the dual array system or DAS). It will be shown that lateral power conformability is possible by properly controlling the power to each element of the arrays in conjunction with the motion of the scanning reflector. It will also be shown that penetration depth can be varied dynamically by adjusting the power of one array relative to the other, that is, by frequency mixing. Parametric numerical results were generated from three-dimensional acoustic and biothermal models. Experimental data were obtained from in vitro studies where a fixed-perfused canine kidney model was heated. The data shows that the DAS can controlled power deposition patterns in three dimensions, and thus, it represents a significant advance towards delivering meaningful thermoradiotherapy doses to superficial tumors such as chest-wall recurrences. (Support: NIH grant R29-CA63121).