

ACOUSTICS2008/2194
Using a toroid transducer for thermal ablation by
high-intensity-focused ultrasound increases the coagulated volume

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Here, we report that a new design of High Intensity Focused Ultrasound transducer can significantly enlarge the coagulated volume over short periods of time, and that treatment in the liver can be guided in real-time using an integrated ultrasound imaging probe. Eight ultrasound emitters, divided into 256 elements, were created by sectioning a single toroid piezocomposite transducer. The focal zone was conical in shape and located 70 mm from the transducer; enabling the treatment of deep-seated tumors. A single thermal lesion was created when the eight emitters performed alternative and consecutive 5s ultrasound exposures. This paper presents in vivo evidence that the coagulated volume obtained from a 40 s total exposure in the liver was 7.0 ± 2.5 cm³ (min 1.5 - max 20.0 cm³). All lesions were visible with high contrast on sonograms. The correlation between the diameter of lesions observed on sonograms and during gross examination was 92%. This method also allowed the user to easily enlarge the coagulated volume by juxtaposing single lesions. This approach may have a role in treating unresectable colorectal liver metastases and may also be used in conjunction with resection to extend its limits.