

TITLE: COMPARATIVE STUDIES OF SPINE SONICATION WITH MR-GUIDED FOCUSED ULTRASOUND ON EX-VIVO MODELS

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Introduction: Facet joint arthritis is a common disease, due to degeneration of facet joints with ageing. It is also a major cause of Back Pain Syndrome. Current treatment options include physiotherapy, steroid injection, Radiofrequency rhizotomy and image-guided radiotherapy. The aim of this study was to demonstrate the treatment of facet joints and main body of spine with MR-guided Focused Ultrasound Surgery (MRgFUS) on ex-vivo models: animal (explanted ox tail) and human (Thiel-embalmed cadaver).

Materials and Methods: The ox tail and the whole Thiel embalmed cadaver were subjected to pre-planning imaging with 1.5T MRI (Signa HDx, GE Healthcare, USA). The facet joints were sonicated with HIFU (CBS ExAblate 2100, InSightec, Israel) under MR-guidance for 8 sec, at various acoustic energies: 165, 210, and 240J. The main body of vertebra was treated for 20 sec at 433J. The MR-based Proton Resonance Frequency shift temperature mapping method was used for thermometry.

Results: In the case of ox tail facet joints, the sonication at 165 J led to increase of temperature up to 54°C, while the treatment at 215 J induced temperatures up to 63°C, and 240 J resulted in temperature increase up to 66°C. Treatment of the spine body at 433 J induced the heating effect around 62°C. Sonication of facet joints in the Thiel-embalmed cadaver at 165 J resulted in heating up to 42°C, whilst the treatment at 215 J and 240 J elevated the temperatures up to 62 and 75°C respectively. Treatment of the spine body at 433 J reached temperature around 62°C.

Discussion: The temperature values achieved during MRgFUS treatment were high enough to ablate and destroy nerves, which are responsible for

transmitting pain signals. The experimental data obtained from both ex-vivo models suggest that, for achieving these temperature levels, the application of acoustic energy higher than 210 J is required.