Influence of Pt/Ir electrode thickness on magnetic resonance imaging susceptibility artefacts

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Introduction

Magnetic resonance imaging (MRI) is already one of the most important diagnostic tools in medicine and its importance and application is still growing, especially for clinical diagnosis in patients with implants. In active implantable medical devices, metal structures such as electrodes can impair MRI results in the vicinity of the neuronal structures of interest. The size of these imaging artefacts around electrodes play an important role for postoperative electrode localization used for the verification of successful placement. Dimensions of imaging artefacts depend on material, structure, geometry and orientation of the imaged object. Therefore the correlation of imaging artefact size caused by Pt/Ir electrode structures and the thickness of these electrode structures was investigated.

Methods

A 25 µm thick Pt/Ir foil (Goodfellow) was structured with a Rapid10 picosecond-laser (Lumera Laser), resulting in 750 µm in diameter disc shaped electrode-like samples. To realize 6 different sample hights laser ablation across the entire disc surface was applied. Thereafter, the discs were placed on 30 µm thick silicone rubber to serve as substrate for MRI and scanning electron microscopy (SEM) examination. A 9.4 T Bruker BioSpec 94/21 imaging system was used for MRI acquisition.

Results

Laser ablation proved to be a reproducible method for structuring electrode shape and thickness, which was verified using SEM. The MRI examination of the Pt/Ir discs showed a linear correlation between imaging artefact size and Pt/Ir disc thickness.

Conclusion

The imaging artefact size of 750 µm in diameter and 25 µm thick Pt/Ir discs could successfully be reduced by decreasing the sample hight using laser ablation across the entire sample surface. Therefore, postoperative electrode placement verification may get more precise and facilitated by reducing the imaging artefact size with thinner metal layers in implants. Still, more studies on the influence of structure and geometry of electrodes need to be performed.

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