Three-dimensional X-ray Microtomography of zebrafish larvae

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The zebrafish embryo (ZFE) is a well-suited model system to study medically relevant pharmacokinetics and toxicity of nanomaterials, because it shows many parallels to humans and is ethically easy to handle. Hard X rays have a wavelength three orders of magnitude smaller than visible light and allow for label-free tomographic imaging in a non-destructive manner. A recent study elucidates the performance of synchrotron radiation-based micro computed tomography in the visualization of zebrafish embryos and the localization of injected superparamagnetic iron oxide nanoparticles (SPIONs) [1]. Here, the biodistribution of nanoparticles was assessed with isotropic micrometer resolution and without the need for staining, providing the full anatomical context. The accessibility of synchrotron radiation facilities, however, is restricted. Therefore, we have employed the rather simple table-top instrument SkyScan1275 (Bruker, Kontich, Belgium) to perform three-dimensional X-ray microscopy of zebrafish embryos in ethanol and paraffin with an acceleration voltage of 15 kV. Similar to tomography studies of paraffin-embedded brain [2,3], the absorption mode yields enough contrast to identify many anatomical microstructures.

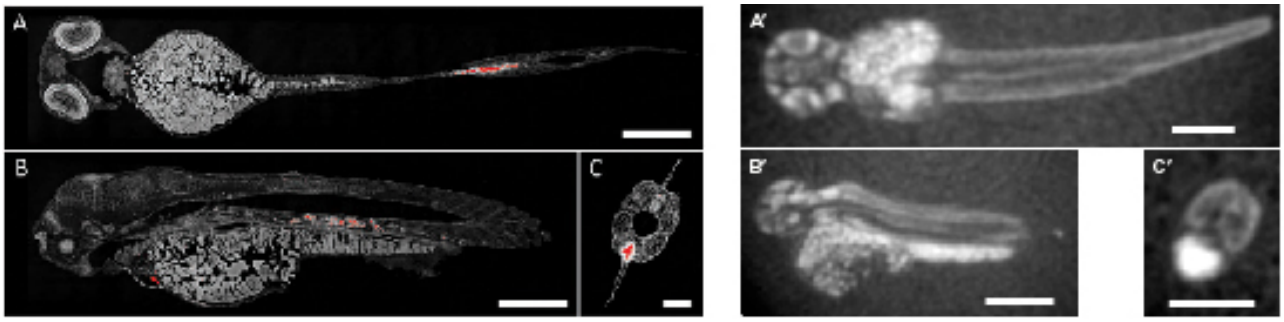

Figure 1: Axial (A/A'), sagittal (B/B') and coronal (C/C') slices through the ZFE with SRµCT (TOMCAT X02DA beamline, *left*) compared to lab-based µCT (SkyScan 1275, Bruker, *right*). The red-colored dots elucidate the localization of injected SPIONs. So far, they had only been identified with SRµCT in absorption and phase contrast modes. More detailed lab-based studies should enable their visualization. The scale bar corresponds to 300 µm (*left*)/ 200 µm *(right*).

Currently, we are investigating the sensitivity limits of both the laboratory- and synchrotron radiation-based approaches for detecting nanoparticle aggregations. The success of this study will enable us to perform expedient series of experiments on the pharmacokinetics and tissue distribution of medically relevant nanomaterials.

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