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The potential of synchrotron-based cryo-X-ray phase contrast imaging of myocardial biopsies

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Cardiomyopathies are serious heart muscle (myocardial) abnormalities which can lead to life-threatening complications such as heart failure, cardiac arrest, and sudden death. Myocardial biopsies obtained from surgical septal myectomies are essential for confirming diagnosis of cardiomyopathies. Owing to the recent advancements of synchrotron radiation-based X-ray phase contrast imaging (XPCI), detailed histological information of myocardial microstructure can be achieved *ex vivo* and non-destructively. However, synchrotron-based cryogenic (cryo-) XPCI of biological samples, which has not yet been perfected, is a technique of interest due to its ability to preserve biological samples. This is because this technique requires minimal tissue processing and therefore maintains DNA and RNA integrity which are paramount for downstream genomics and proteomics applications. In order to establish optimal conditions for imaging, cryopreserved myocardial biopsies from mouse models [Brn3b (Pou4f2) knockout and wild-type mice] were used to mimic the clinical myectomy biopsies for imaging with cryo-XPCI at the Swiss Light Source TOMCAT X02DA beamline. To test the effects of the beam on the samples post-scanning, DNA and RNA were extracted from the samples for integrity assessment. This data was then used to design a novel protocol for clinicians performing surgical septal myectomies from cardiomyopathy patients to minimise sample degradation and maximise the potential use of these precious biopsies for synchrotron-based cryo-XPCI for future genomics and transcriptomics analyses. Overall, this pilot study demonstrated the potential of synchrotron-based cryo-XPCI of myocardial biopsies from pre-clinical animal models and invaluable human myectomies.

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