Abstract No. Jure0416

Visualization of Joint Ligaments – A Preliminary Approach with Diffraction Enhanced Imaging

S. Jureczek (U of Saskatchewan, Canada) and Z. Zhong (NSLS)

Beamline(s): X15A

Introduction: Conventionally, soft tissue can not be imaged with radiography in undisruptive anatomical structures. Clinically, non-invasive approaches are useful to diagnose abnormalities of internal soft tissue. Particular in joints, ligaments and capsules are of interest in various medical fields. This preliminary project was designed to investigate the possibilities of detecting joint ligaments with Diffraction Enhanced Images in combination with synchrotron based x-rays.

Methods and Materials: One half of a mice head (left side) at the age of 6 months have been exposed in an undisruptive, fully intact anatomical context (skin removed), to photons with a selected monochromatic energy level of 40 keV. In addition, a complete joint of a mouse leg (left, anterior) was exposed also intact (without skin). The equipment was set up for DEI as described by Mollenhauer et al. [1]. Images were taken each at peak, midrange of the ascending and descending “rocking curve” [2] of the analyzer crystal (Si 3,3,3). Conventional x-rays have been taken prior to the studies of the specimen for comparison. The image detector plate was a phosphate plated one and had a maximum resolution of 50 µm.

Results: Images taken display clearly a difference in details of bony structures of the skull and leg bones of the specimen. Ligament attachments and structures can be visualized with larger ligament as seen in the leg joint of the mouse. However, ligaments of the temporo-mandibular joint region of the skull which are in the mouse assumed to be small could not be discriminated. The ligament capsule from the mandibular condyle to the temporal bone was visible on the images of all specimen taken with the DEI set-up.

Conclusions: The concept of DEI utilizing diffraction and refraction rather than absorption of x-ray radiation improves discrimination of details of anatomical substructures in intact contexts. Since DEI is a new technique, specifics of applicable tissues as well as clinical limitations (e.g. minimal size) are not well understood, in particular, for ligaments with complex 3-D anatomical structures and textures under investigation. Subsequently, technical details and possible limiting factors, e.g. detector resolution, could not be applied and adapted specifically.

Acknowledgments: Supported in part by Saskatchewan Synchrotron Institute (SSI), Canada, University of Saskatchewan, College of Dentistry, Canada, and Brookhaven National Laboratory, Upton, U.S.A.

References:

[1] Mollenhauer, J, Aurich ME, Zhong Z et al, “Diffraction enhanced x-ray imaging of articular cartilage” Osteoarthritis and Cartilage (2002) 10, 163-171

[2] Zachariasen, WH., “Theory of x-ray Diffraction in Crystals” New York, John Wiley & Sons, 1945