ESRF	**Experiment title:** FEASIBILITY OF IN VIVO SYNCHROTRON RADIATION μCT IN MOUSE	**Experiment number**: Md 50
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Report:

Wild and transgenic mice models being increasingly used, suitable imaging methods have to be developed to follow effects of disease and response to drug on bone micro-architecture. For this purpose, desktop x-ray micro-tomographic systems are already commercially available. However, the quality of the image is crucial to get an accurate quantification due to the very small size of trabeculae in mice (20-30μm). Synchrotron Radiation microtomography (SR μCT) provides quantitative images at spatial resolution up to the micrometer scale, but has only been used in vivo on rats, at Stanford Synchrotron Radiation Laboratory.
In previous work, we demonstrated the capabilities of the SR μCT system developed on beam line ID19 at the ESRF for imaging post-mortem mice bone structures with a spatial resolution of 6μm [1] [2]. The aim of this work was to show the feasibility of SR μCT for assessing bone mineral density and micro-architecture in vivo in mice.

Two strains of mice (C3H/HeJ@Ico and C57BL/6J) were used for the experiment. The experiment was performed using the micro tomographic setup developed on beam line ID19. Imaging was performed using a pixel size of 10μm on the anesthetized animals. A special mouse holder was developed in order to position the animal's femur in the synchrotron beam.
First, tests were performed in order to optimize the imaging conditions (x-ray energy, gap, angular step, and acquisition time) with respect to absorbed dose ranging from 2 and 20 Gy. The dose was measured using a ionization chamber placed on the beam.
A linear correlation was found between the measured signal to noise ratio (SNR) in the images and the dose (R=0,94, n=30) (cf. Figure 1).

Then, six mice of each group were imaged at doses of 7 and 13 Gy corresponding to a total scan time around 5 min. Figure 2 illustrates a radiographic image of the region irradiated, and two reconstructed slices respectively at 7 and 13 Gy. The SNR was respectively found to be 16 (80 dB) and 21 (88 dB).

The comparison between images of the two strains clearly exhibits differences in term of trabecular bone volume and mineralization. Work is in progress to extract quantitative parameters of trabecula and cortical bone envelopes.

There was no apparent damage on the mice. Further tests will be performed to evaluate the effect on bone cells by histological study. Although the dose looked high, the measure performed on a commercialized µCT under similar conditions was similar.

In conclusion, the experiment was successful and proved the availability of SR µCT for longitudinal studies on bone architecture in mice. It provides images with a high SNR and very short scan time as compared to that of most desktop µCT. The radiation dose could be lowered by using more sensitive detectors.

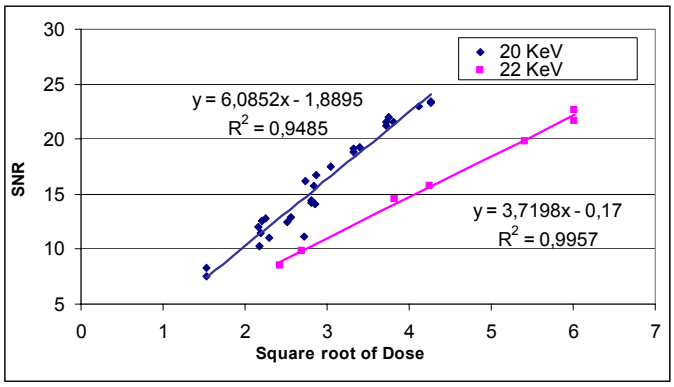

Figure 1 :evolution of SNR with respect to dose

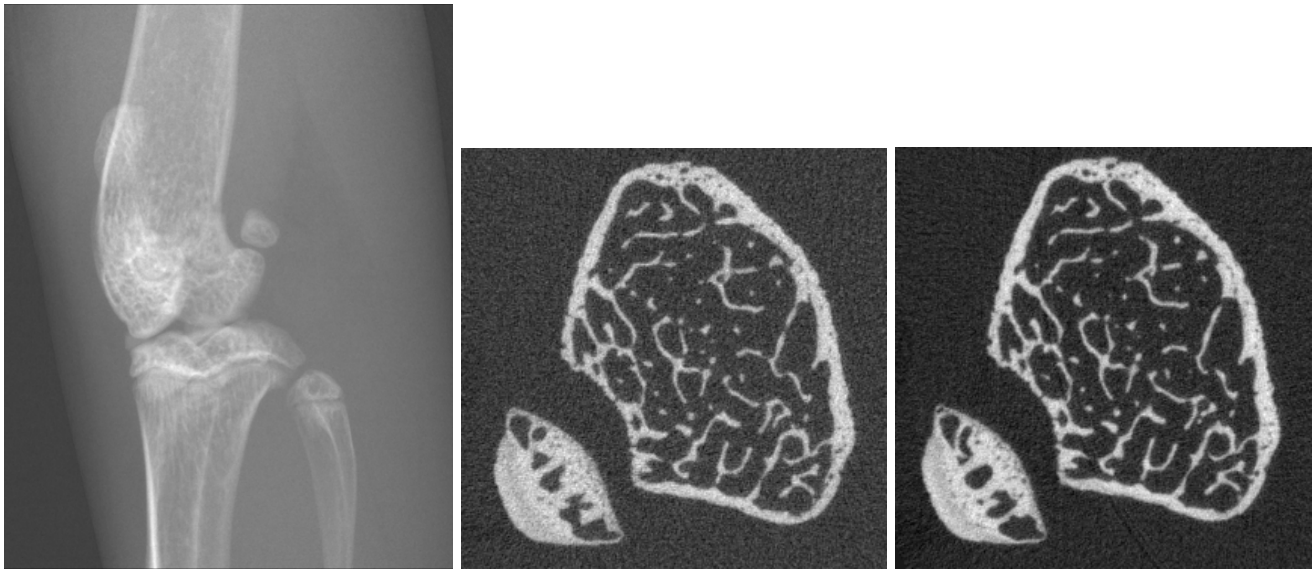

Figure 1 : from left to rigth : a) radiographic image, reconstructed slice at 7 Gy, reconstructed slice at 13 Gy,

References

[1] MARTÍN-BADOSA E., ELMOUTAOUAKKIL A., NUZZO S., AMBLARD D., VICO L., PEYRIN F., A method for the automatic characterization of bone architecture in 3D mice microtomographic images, Computerized Medical Imaging and Graphics, Nov. 2003, vol 27, n°6, pp. 447-458.

[2] MARTÍN-BADOSA E., AMBLARD D., NUZZO S., ELMOUTAOUAKKIL A., VICO L., PEYRIN F., Excised bone structures in mice: imaging at three-dimensional synchrotron radiation micro CT, Radiology, Dec 2003, vol 229, n° 3, pp. 921-928.