

**Experiment title:**

Investigation of fetal bone by 3D high resolution computed microtomography

Experiment number:

LS 1243

Beamline:

ID19

Date of experiment:

from: 12/05/99 to: 16/05/99

Date of report:

1 sept 99

Shifts:

15

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Report:

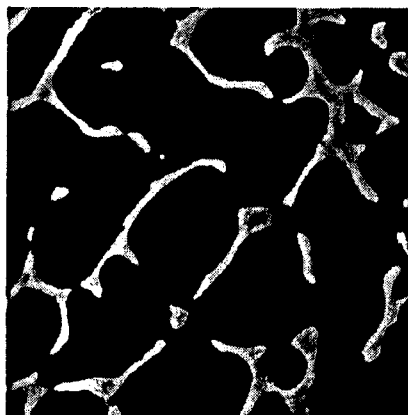
Experiment LS1243 allowed to acquire three dimensional images of various bone data samples. It was allocated as a block allocation for proposals LS-1243, LS-1244, and LS-1245. The 3D synchrotron microtomography system (SR μ CT) developed on beam-line ID 19 was used. The acquisition for one sample consists in recording 900 projection images, which are later used to reconstruct the 3D image. The Frelon camera was used with two configurations of the optics, respectively corresponding to a 10.13 μ m, and 6.7 μ m pixel size. Since a problem appeared on the Frelon camera in the middle of the experiment, it was not possible to acquire images at 2 μ m, as scheduled.

Ten 3D vertebral images from deceased fetus aged from 16 to 24 weeks were acquired. The samples were extracted from the L3 vertebra and embedded in resin. Acquisitions were performed using a 10.13 μ m pixel size at an energy of 20 keV. The images are currently processed to get 3D architecture parameters. The bone volume ratio and the number of trabeculae per unit length are approximately 3 times higher compared to young adult. The external shell appears to be constituted of very thin trabeculae. To analyze it in details we intend to acquire fetal samples using a 2 μ m pixel size in a next experiment.

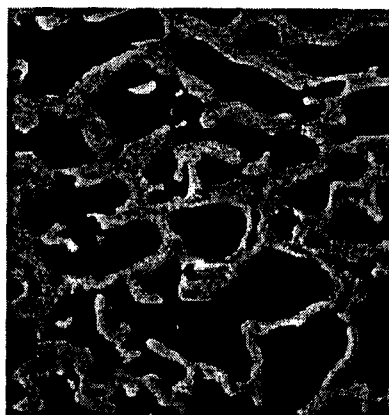
3D images of thirty calcaneus samples were acquired in experiment LS 875 in may 98. The goal of this experiment was to correlate the 3D architecture parameters to ultrasonic and MRI measurements (collaboration LIP, and U2R2M, Paris). It appeared that five images could not be correctly reconstructed because of motion during acquisition. These five samples were re-scanned during this last experiment. Partial results on correlation between ultrasonic and architecture parameters have been presented in three communications (C5, C9, and C10, see attached list).

Experiment LS 875 was done for a study on aging performed in the context of a regional collaboration. The parameters extracted from seven 3D images of calcaneus samples were correlated to histomorphometry parameters and biomechanical trials. To get more robust statistics we acquired during this last experiment, 3D images from ten additional samples. It was not possible to cut these 1cm side cubic samples, because they had to be analyzed by the other groups. Thus a local acquisition was performed : only the core of the sample was imaged. Numerical tests showed that the center of bone samples is correctly reconstructed. Papers on the topic of local reconstruction from ESRF data were presented at two conferences (C6, C8, see attached list).

Ten femoral-neck samples (8mm diameter cylinders) from osteoporotic and cox-arthrosic patients were provided by Orleans Hospital. The 3D architecture of femoral neck have never been reported in literature. The samples of the two groups seem to present interesting differences in architecture and mineralization, as is illustrated in figure 1). A new experiment concerning a systematic study of 20 samples of each group is proposed.



a) cox-arthrosic patient



b) osteoporotic patient

Figure 1 : femoral neck, image size : 512x512; voxel size : 10.13 μm

At last, a test was also performed to study the feasibility of the acquisition of femur samples from two different genetic groups of mice. A specific sample support has been designed. Since mice trabeculae are smallest than human ones, the acquisition was performed at 6.7 μm . The reconstructed images show that this spatial resolution is well adapted. We intend to acquire forty such samples in our next experiment (LS 1393).