ESRF	**Experiment title:** 3D CMT imaging of os calcis samples micro-architecture	**Experiment number:** LS 725
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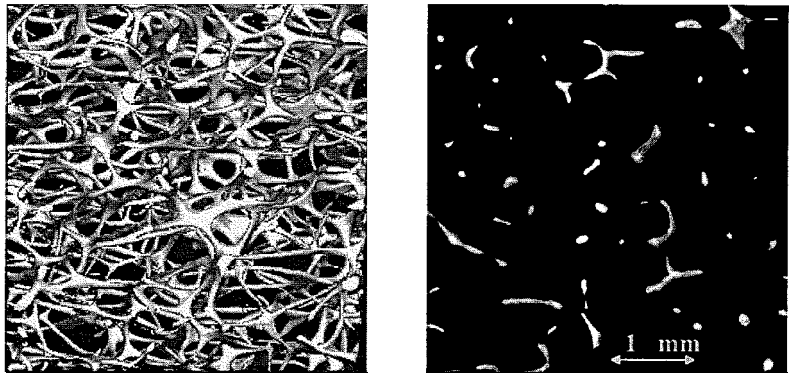
Report:

Bone microarchitecture is recognized to play a major role in the biomechanical properties of bone. The investigation of bone micro-architecture requires three-dimensional (3D) high resolution imaging, not available in clinical routine at present. Conventional investigation tools include absorptiometry, x-ray radiography and histomorphometry. Ultrasounds have recently appeared as an attractive technique since it is a non invasive method. However none of these techniques gives access to the 3D structure.

The purpose of this work was to perform 3D synchrotron microtomography (SR CMT) on os calcis which is the anatomical site for ultrasound measurements. The samples were selected in the context of a research program supported by «Région Rhône-Alpes», (CRT n°H098730000) and leaded by Professor Meunier, in Lyon. This program started two years ago and allowed to collect human vertebra and os calcis bone samples from 22 autopsied subjects aged 57 to 95.

In this experiment, seven different os calcis bones were used. On each bone, two small adjacent cylindrical samples (diameter around 1 cm) were extracted. The first one was used for biomechanical trials (compression tests). The second one was embedded in methylmetacrylate, analyzed by histomorphometry, and prepared for SR CMT. For imaging, the samples were first tailored to a 5mmx5mmx1cm zone. The Synchrotron Radiation Computed MicroTomography experiment was installed on ID 19. The optics were fixed so that the pixel size on the acquired images was 10.13 micrometers. The energy was set to 20 keV. For each sample, 900 projection images were acquired.

As an example, Figure la) represents a 3D display of a (512)3 reconstructed Region of Interest in an os calcis sample. Figure lb) shows a 2D slice of the 3D image. The images present a good contrast and a high signal to noise ratio. The 3D network appears quite dense and made of trabeculae thinner than in vertebrae.



a) 3D display b) 2D reconstructed slice

Figure 1 : Os calcis sample; image size (512)3; voxel size : 10.13 μm

Due to the total data set recorded during our different experiments (LS-725, LS-875, LS-876, LS-877) all the images have not yet been reconstructed and processed. The perspective are as following. After reconstruction, the 3D images will be analyzed to get 3D quantitative architecture parameters. The same images will be studied by the LMSO (laboratoire de Mecanique des solides, INSA, Lyon), in order to get experimental and simulated biomechanical parameters (Young modulus from finite elements methods). The simulated and experimental mechanical parameters will then be correlated both to 3D architecture parameters extracted from 3D SR CMT images, and to the conventional 2D histological architecture parameters.

This should allow to test the relevance of 2D and 3D architecture parameters with respect to the biomechanical properties of bone.