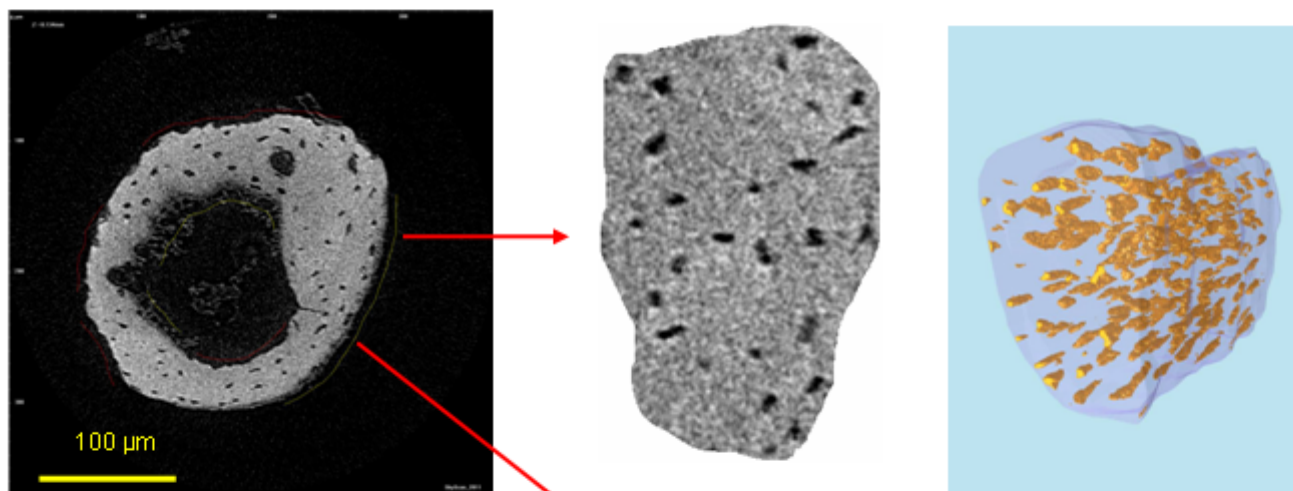


# Quantitative assessment of osteocyte 3d distribution and formation and resorption surfaces in the mouse fibula from nano-CT non-destructive imaging.

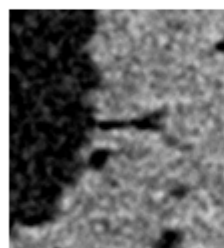
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**Introduction.** A novel range of histomorphometric indices can be measured non-destructively in the mouse fibula from nano-CT imaging, with submicron resolution. **Method.** A section of the fibula of a 6 week old mouse was scanned in the Skyscan 2011 nano-CT scanner, using an x-ray source spot size of 300 nm and a pixel size of 290 nm. The applied source voltage was 25 kV, the tomographic rotation 180 degrees, the rotation step 0.8 degrees and the scan duration 35 minutes. A section of fibula 100  $\mu\text{m}$  long was analysed. **Results.** Histomorphometric indices were measured using Skyscan CT-analyser software. The whole fibular cross-section was analysed except for a small peripheral segment containing a blood vessel. Osteocyte size and spatial distribution were measured on the basis of enclosed small cavities in the fibula. Resorption surfaces were visible as scalloped surfaces, and formation sites as fuzzy boundaries with an adherent soft tissue (low density) layer (figure 1). The parameters thus measured are listed in table 1. **Conclusion.** A lateral remodelling drift was visible in the fibula cross-section as angular separation of the resorption and formation sites on the endosteal and periosteal surfaces. This imaging technique offers an insight into bone ultrastructural quality, and possibly biomechanical competence, from a non-destructive nano-CT scan.



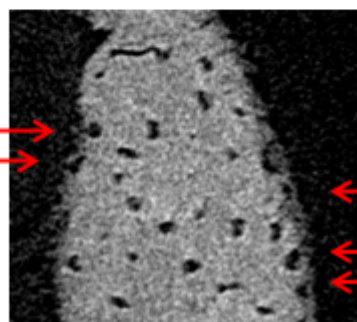
**Figure 1.** Mouse fibula (diameter about 230  $\mu\text{m}$ , pixel size 290 nm) Osteocytes and submicron cracks are visible. Resorbing surfaces (red lines) and forming surfaces (yellow line) can be identified. Remodelling drift is evident from left to right.



Bone microcracks, above and left

**Table 1.** Histomorphometric parameters of the juvenile mouse fibula measured by nano-CT imaging.

Parameter	Unit	Value
Bone area	$\mu\text{m}^2$	21353.065
Endosteal perimeter	$\mu\text{m}$	478.602
Periosteal perimeter	$\mu\text{m}$	764.934
Endosteal formation surface	$\mu\text{m}$	252.557
Endosteal percent formation surface	%	52.770
Endosteal resorption surface	$\mu\text{m}$	115.852
Endosteal percent resorption surface	%	24.206
Periosteal formation surface	$\mu\text{m}$	219.034
Periosteal percent formation surface	%	28.634
Periosteal resorption surface	$\mu\text{m}$	299.274
Periosteal percent resorption surface	%	39.124
Osteocyte lacuna diameter	$\mu\text{m}$	2.506
Osteocyte lacuna separation	$\mu\text{m}$	17.513
Osteocyte lacuna number	$\mu\text{m}^{-1}$	0.00779
Osteocyte lacuna percent volume	%	1.957
Osteocyte lacuna anisotropy		2.602



Osteocytes undergoing burial at the site of bone formation (arrows)