

# Combined [<sup>18</sup>F]-Fluoride Imaging in Experimental Arthritis

B. Hoffmann, C.-M. Svensson, M. Straßburger, B. Gebser,  
I. Irmler, T. Kamradt, H.P. Saluz and M. T. Figge

01/09/2016

**Background**

- Rheumatoid Arthritis (RA)
  - one of the most common autoimmune diseases
  - leads to joint swelling, bone erosion, loss of joint function
- Experimental Arthritis
  - used to study RA and arthritic processes
  - glucose-6-phosphate isomerase(G6PI) induced [1]
- Longitudinal, *in vivo* Imaging
  - combined positron emission tomography/computed tomography

**Results**

- PET imaging results:
  - increased uptake of [<sup>18</sup>F]-fluoride in arthritic animals
  - location of the tracer is visualized by PET/CT image fusion
  - accumulates predominantly in metatarsophalangeal and tarsocrural joint regions
- CT imaging results:
  - arthritic animals show increased bone roughness in hind paws
  - already at day 10 roughness is significantly increased
  - roughness is declining in late remitting phase of experimental arthritis

**Methods**

1. Prepare volumes of interest (VOIs)
  - extract parts of image stack that contain the hind paws
2. Reconstruct surface
  - marching cubes algorithm [2]
  - triangulated surface mesh
3. Calculate local roughness [3]
  - for each facet normal
  - average angle between facet normals
4. Calculate global roughness [3]
  - composite histogram
  - sum of frequencies of angles above threshold

**PET image analysis**

- manually place regions of interest around paws
- calculate standard uptake value (SUV)

**Conclusion**

- combined PET/CT imaging allows longitudinal, *in vivo* studies
- [<sup>18</sup>F]-fluoride is well suited to quantify pathological bone metabolism
- fully automated CT image analysis pipeline for roughness evaluation
- very sensitive to early anatomical changes of the bones
- revealed different dynamics of bone erosion at periosteal and endosteal sites of the cortical bone

1 Cell and Molecular Biology, Hans Knoll Institute, Jena, Germany  
2 Applied Microbiology, Hans Knoll Institute, Jena, Germany  
3 Friedrich Schiller University, Jena, Germany  
4 Molecular and Applied Microbiology, Hans Knoll Institute, Jena, Germany  
5 Institute of Immunology, Jena, Germany

[1] Schubert et al., (2004) Hemopoiesis with Glucose-6 Phosphate Isomerase induces T-cell Differentiation. Peripheral T-lymphocytes in Genetically Modified Mice. *J. Immunol.* 172(7): 4503-4509.  
[2] Lorensen and Cline, (1987) Marching Cubes: A High resolution 3D surface construction algorithm.  
[3] Silva et al., (2006) Application of surface roughness analysis on micro-computed tomographic images of bone erosion: examples using a rodent model of rheumatoid arthritis. *Mol Imaging* 5(4): 475-84.

Contact: bianca.hoffmann@leibniz-hki.de