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

Bianca Hoffmann<sup>1,2,3</sup>, Carl-Magnus Svensson<sup>2</sup>, Maria Straßburger<sup>4</sup>, Björn Gebser<sup>1</sup>, Ingo Irmler<sup>5</sup>, Thomas Kamradt<sup>5</sup>, Hans Peter Saluz<sup>1,3</sup> and Marc Thilo Figge<sup>2,3</sup>



# Background

### Rheumatoid Arthritis (RA)

- one of the most common autoimmune diseases
- leads to joint swelling, bone erosion,



Results		
	∞ – arthri	tic art
PET imaging results: • increased uptake of [ <sup>18</sup> F in arthritic animals	=]-fluoride	



#### 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



Methods

Prepare volumes of interest (VOIs)
 extract parts of image stack

- distribution 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





#### that contain the hind paws



- <u>3. Calculate local roughness [3]</u>
  for each facet normal
  - average angle between facet normals



## triangulated surface mesh

• marching cubes algorithm [2]

2. Reconstruct surface



- 4. Calculate global roughness [3]
  - composite histogram
  - sum of frequencies of angles above threshold



- variation of roughness radius r reveals differences between outer and inner cortical bone surface
- at outer surface roughness appears on a smaller spatial scale with a turnover to larger spatial scales at day 35

# 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







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

#### endosteal sites of the cortical bone



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<sup>1</sup> Cell and Molecular Biology, Hans Knöll Institute, Jena, Germany

- <sup>2</sup> Applied Systems Biology, Hans Knöll Institute, Jena, Germany
- <sup>3</sup> Friedrich Schiller University, Jena, Germany
- <sup>4</sup> Molecular and Applied Microbiology, Hans Knöll Institute, Jena, Germany
- <sup>5</sup> Institute of Immunology, Jena, Germany

### Contact: bianca.hoffmann@leibniz-hki.de

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