Description of skeletal phenotype of mouse strains

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Aims

The study of fracture healing and the effects that can stimulate or delay this process are of common clinical interest. Many animal models were established to study fracture healing under defined conditions aiming to draw conclusion about the healing in humans.
Due to the possibilities of genetic modifications, mouse strains became the optimal model in research of specific regulation levels in the complex field of regenerative medicine and research. Many groups clarified that genetic modification can significantly influence bone morphology and thus changes of bone growth, remodelling and fracture healing are presumed.
Hence it is necessary to describe the skeletal phenotype of mouse strains by precisely analysing the bone morphology before starting further studies.

There are single studies that gave an appropriate concept in description of the phenotype of mouse-strains. We developed an optimized protocol for the description of bone properties in different mice by use of micro-Ct, biomechanical and histo-morphometric parameters.

Method

We observed four different mouse strains (BalbC, BalbCIghb, NodShiLt, Nod-Scid) with immune defects to describe the interaction of the bone physiology with the immune system.
From every strain (ten male animals, 16 weeks old) the humeri, femora and the lumbar spine were dissected. The bones were scanned by micro-Ct, mechanically tested by three-point-bending-test and histologically investigated.
The micro-Ct analysis was performed in a Scyscan1172 (70kV, 120 mA) with a resolution of 8 µm using a 0,5mm Aluminium Filter. We developed a protocol a with region of interest (ROI) of defined size in the femora, humeri and lumbar spine (Fig. 1). We estimated the standardized parameters according to Hildebrand & Ruegesegger 1997 and Odgaard 1997.

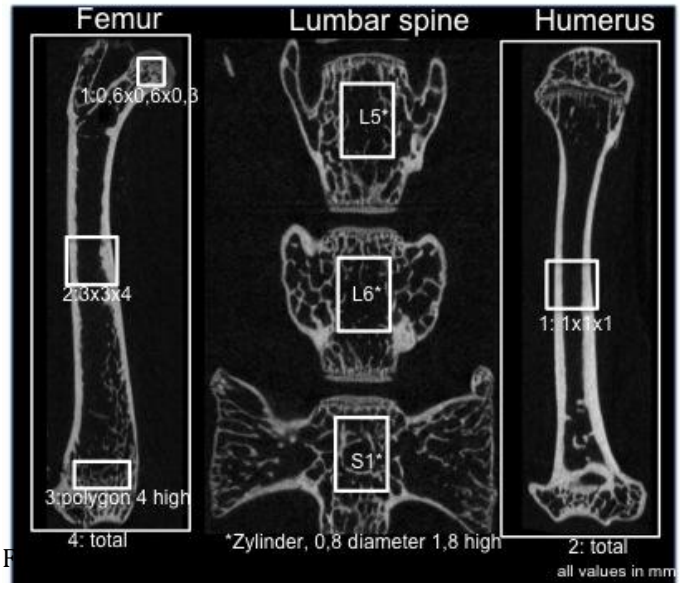

Fig. 1

Results

The analysis of the Ct Scans provided differences between the mouse strains (Fig. 2 and 3). The control group of BalbC mice showed similar results in BV/TV compared to the BalbCIghb mice with deficiencies in the Cytokine IL2 receptor. The NodShiLt strain showed a lower BV/TV ratio in the proximal and distal structures than all the other mice. The Nod-Scid strain, with severe immune-deficiencies had a higher bone mass compared to the Nod-ShiLt mice.

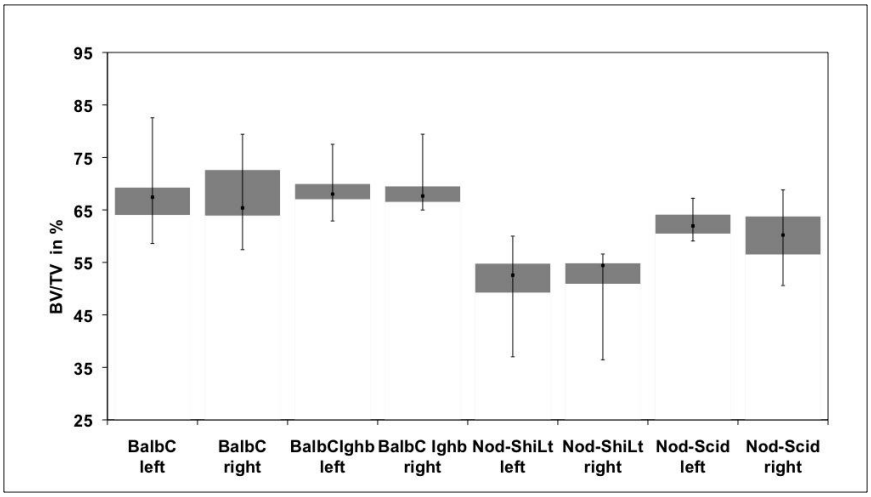

Fig. 2 BV/TV of Femur ROI 1 (Caput femoris) of the mouse strains (left and right Femur), n=10

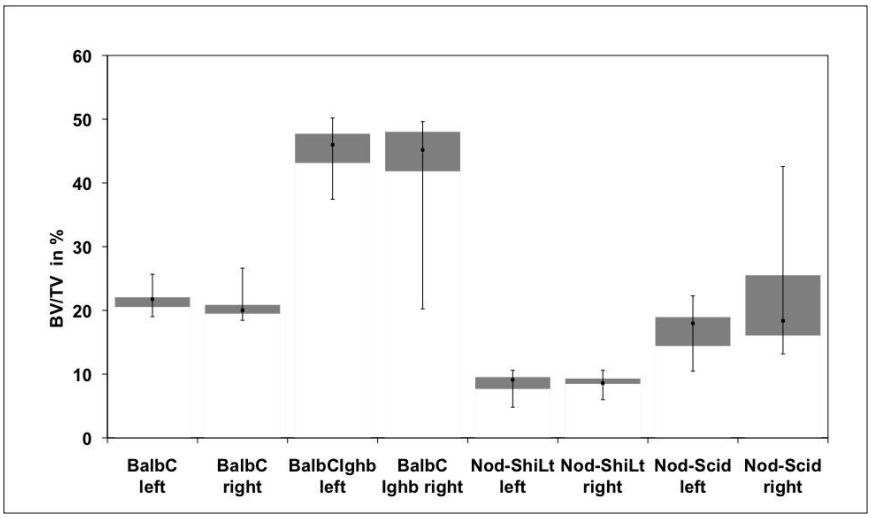

Fig. 3 BV/TV of Femur ROI 3 (distal) of the mouse strains (left and right Femur), n=10

Conclusion

We developed a standardized protocol to describe the skeletal phenotype of mice. With this protocol we are able to describe the murine bone morphology with high precision. This provides important for further studies using these specific genetically modified strains.

References

Hildebrand T, Rugessegger P. A new method for the model-independent assessment of thickness in three-dimensional images. Journal of Microscopy 185 (1): 67-75
Odgaard A. Three dimensional method for quantification of cancellous bone architecture. Bone 20 (4) 1997: 315-328.