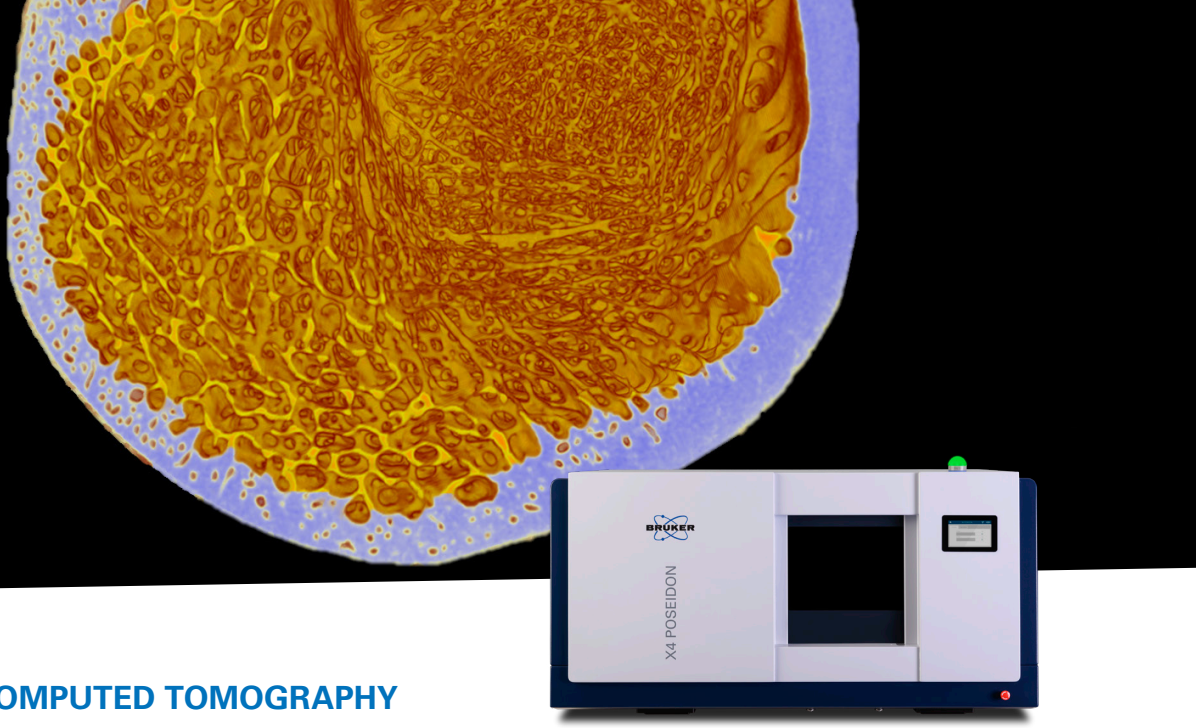

X-RAY MICROCOMPUTED TOMOGRAPHY

X4 POSEIDON – Sheep proximal femur

Innovation with Integrity

MicroCT is a powerful tool for evaluating the intricate microarchitecture of bones, offering high-resolution imaging and quantitative analysis of trabecular and cortical bone structures.

In joint models, microCT provides detailed insights into bone microstructure, porosity, and the transitions between cortical bone, subchondral bone, and the growth plate. Trabecular bone analysis focuses on parameters such as trabecular thickness, number, and separation, which reflect the bone's mechanical integrity and adaptability to mechanical stress. Cortical bone, in contrast, is analyzed for porosity, thickness, and density. Cortical porosity is a critical determinant of bone strength and is closely associated with fracture risk, particularly in aging or disease conditions.

Subchondral bone, located beneath the articular cartilage, is integral to joint function and load distribution. MicroCT imaging enables precise visualization of subchondral plate thickness and porosity, which are key indicators of degenerative diseases such as osteoarthritis. The growth plate, essential for bone elongation and development, can also be studied using microCT to investigate ossification patterns and structural maturation.

In mature human joints, however, the growth plate, or epiphyseal plate, is absent due to its closure after puberty during skeletal maturation. This contrasts with animal models, such as sheep, where the growth plate is still present and serves as a model for studying bone development. This application provides a robust framework for understanding bone health and pathology, contributing significantly to orthopedic and biomedical research.

Scan parameters

- Detector: 7 MP flat panel
- Voxel size: 22 µm
- Source settings: 90 keV, 13.5 W
- Filter: 1 mm Al + 0.1 mm Cu
- Rotation step: 0.16° over 360°
- Scan time: 42 minutes

Cover Image: Sheep proximal femur imaged at 22 µm voxel size in the X4 POSEIDON microCT

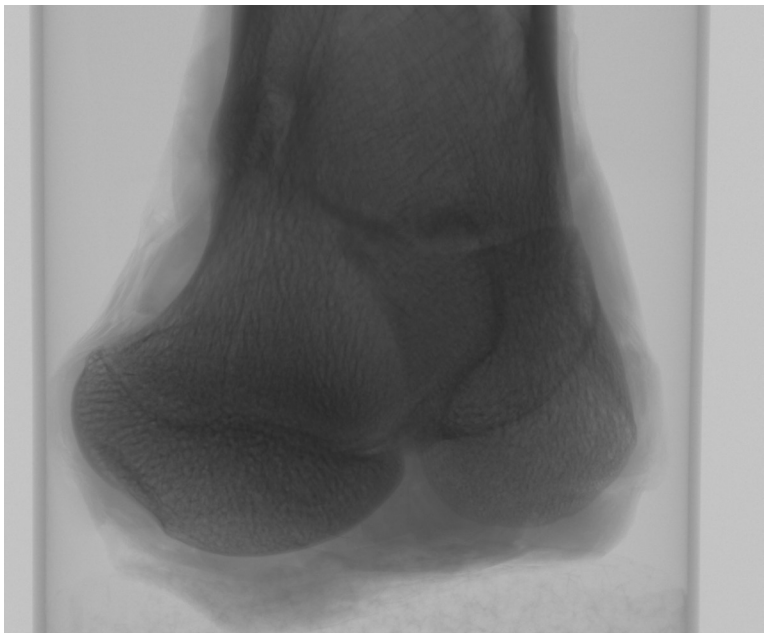

Figure 1: Projection image of a sheep proximal femur, single field of view with 22µm isotrophic pixel size

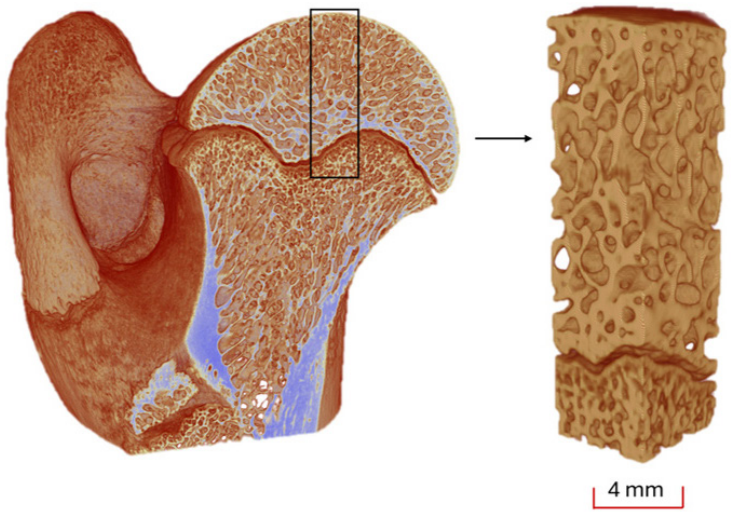

Figure 3: 3D volume rendering of a sheep proximal femur, 22 µm isotrophic voxel size, allowing segmentation of cortical and trabecular bone

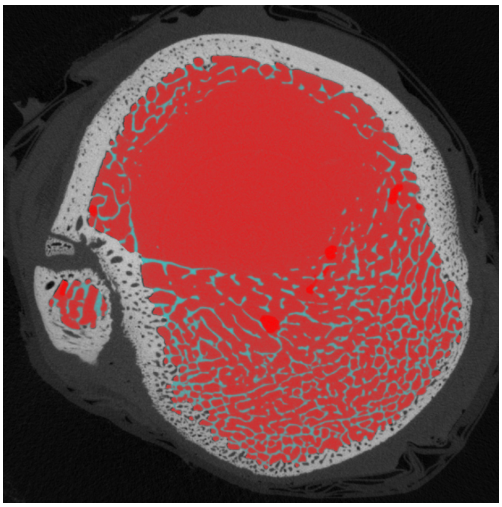

Figure 2: Segmentation of trabecular bone from the surrounding cortical bone in a reconstructed image of a sheep proximal femur, 22 µm isotrophic voxel size

The X4 POSEIDON microCT system, equipped with flat-panel detector, enables microstructural analysis of the entire sheep proximal femur. Scanning is accomplished in a relatively short duration of approximately 42 minutes, making it suitable for high-throughput studies.

The system achieves clear resolution of cortical bone, trabecular bone and the growth plate as illustrated in figures 1 and 2, allowing for quantitative assessment of key parameters, including trabecular micro-architecture (e.g., thickness, separation, and number), cortical porosity, and the morphological characteristics of the growth plate, all within a single scan. This capability enables the study of bone development, structural adaptation, and the effects of mechanical loading or therapeutic interventions.

The Bruker 3DxSUITE software package includes all tools needed for image processing and analysis, and allows creating realistic 3D models through volume and surface rendering algorithms (Figure 3).

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