

# Quantum GX3 system: assessing osseointegration using micro CT.

## Overview

- Micro CT is a powerful imaging tool for assessing osseointegration, enabling high resolution, three dimensional visualization and quantification of peri implant bone architecture, organization, and mineralization.
- Reliable assessment of osseointegration can be achieved while minimizing imaging related impact by selecting systems such as the Quantum™ GX3 system, which features a large area flat panel detector and optimized geometry to deliver fast, low dose scans with high image quality around metal implants.

## Introduction

Animal models are a fundamental component of preclinical research in orthopedics and biomaterials science. Their skeletal biology, regenerative capacity, and genetic tractability make them well-suited for studying bone healing and the biological response to implanted medical devices. When combined with high resolution micro computed tomography (micro CT), these models provide a valuable platform for evaluating osseointegration, bone remodeling, and implant performance *in vivo* and *ex vivo*.

The Quantum GX3 micro CT system is well-suited for bone implant research. Its micro focus X ray source and variable-geometry design provide high resolution imaging for small bones, while offering a field of view (FOV) large enough to accommodate full body rats and rabbits, and *ex vivo* samples from larger animals.



In addition, the large area CMOS detector of the Quantum GX3 system enables rapid image acquisition at low radiation dose, supporting longitudinal *in vivo* studies of bone healing and osseointegration while preserving animal welfare and maintaining high image quality.

Non destructive 3D imaging of mineralized tissues with the Quantum GX3 micro-CT system provides anatomical, structural, and densitometric information at micron level resolution, enabling detailed characterization of peri implant bone.

Researchers can quantify:

- Bone volume and thickness
- Structural integrity
- Cortical remodeling
- Formation of new mineralized tissue at the interface

This enables detection of subtle differences in implant performance or healing response that are not visible with histology alone.

Through segmentation and ROI analysis, the Quantum GX3 system can determine:

- Bone-implant contact
- Bone-implant distance
- Peri implant bone volume
- Bone ingrowth into porous or lattice structures

These metrics are important for evaluating how well an implant integrates with host tissue and how local tissue responds to different surface treatments, materials, or loading conditions.

A key advantage of the Quantum GX3 system is its ability to perform serial *in vivo* scans of small and medium-size animals with low radiation dose. This reduces inter animal variability and allows continuous monitoring of:

- Early inflammatory and remodeling stages
- Progression of mineralization
- Implant stability over time

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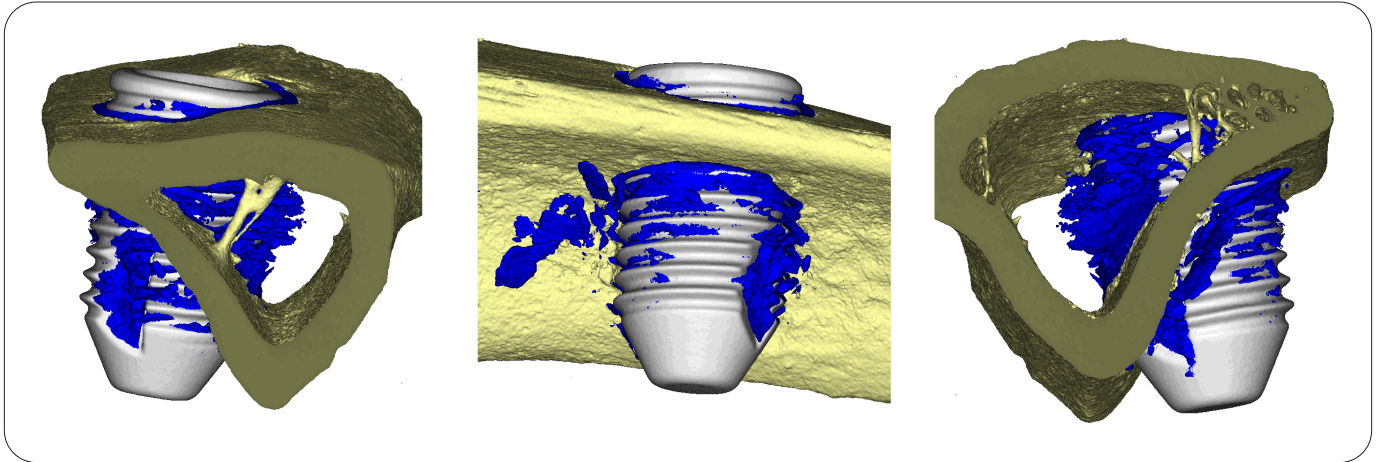
Longitudinal imaging with the Quantum GX3 system provides a dynamic view of healing, improving experimental power while minimizing animal usage.

The combination of Quantum GX3 high resolution imaging and quantitative software tools supports standardized measurements that can be consistently reproduced across studies and laboratories. This is valuable for biomaterials evaluation, regulatory submissions, and translational research.

## Conclusion

The Quantum GX3 micro CT system enhances orthopedic and biomaterial studies by delivering high resolution, quantitative, and low radiation dose longitudinal *in vivo* assessment of bone formation and implant integration.

Together, these capabilities support a robust preclinical framework for the development of new orthopedic devices, implant surface technologies, and regenerative therapies.



The figures above depict a mouse tibia with a metal screw ( $\varnothing = 2$  mm). The bone at the implant interface (peri-implant bone) is shown in Blue. Image courtesy of Dr. Joni Augusto Cirelli, DDS, MSc, PhD, Department of Diagnosis and Surgery, Sao Paulo State University (UNESP), School of Dentistry at Araraquara, Brazil.

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