

# Whole-body vibration with extremely low-amplitude accelerates early-stage bone defect healing with reducing angiogenesis

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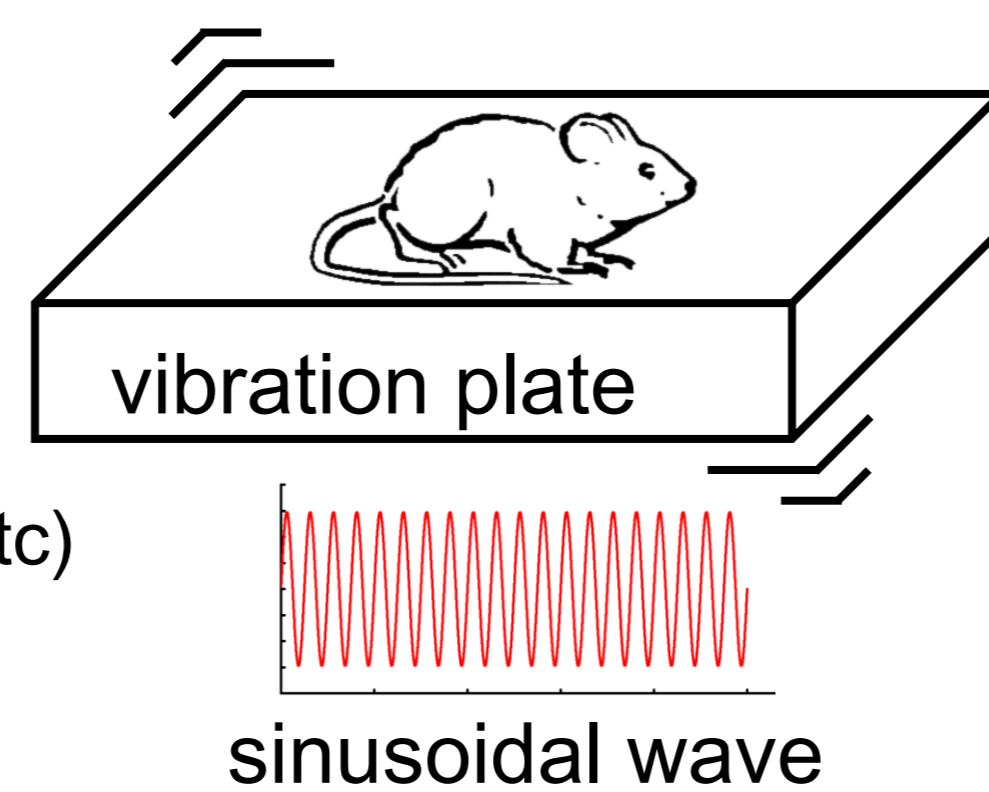
## Introduction

### Whole-body vibration (WBV) during bone healing

- Callus volume
- Mineral deposition
- Material property

(Leung et al: J Orthop Res 2009, Shi et al: Bone 2010, etc)

### Angiogenesis --- a requisite for fracture healing

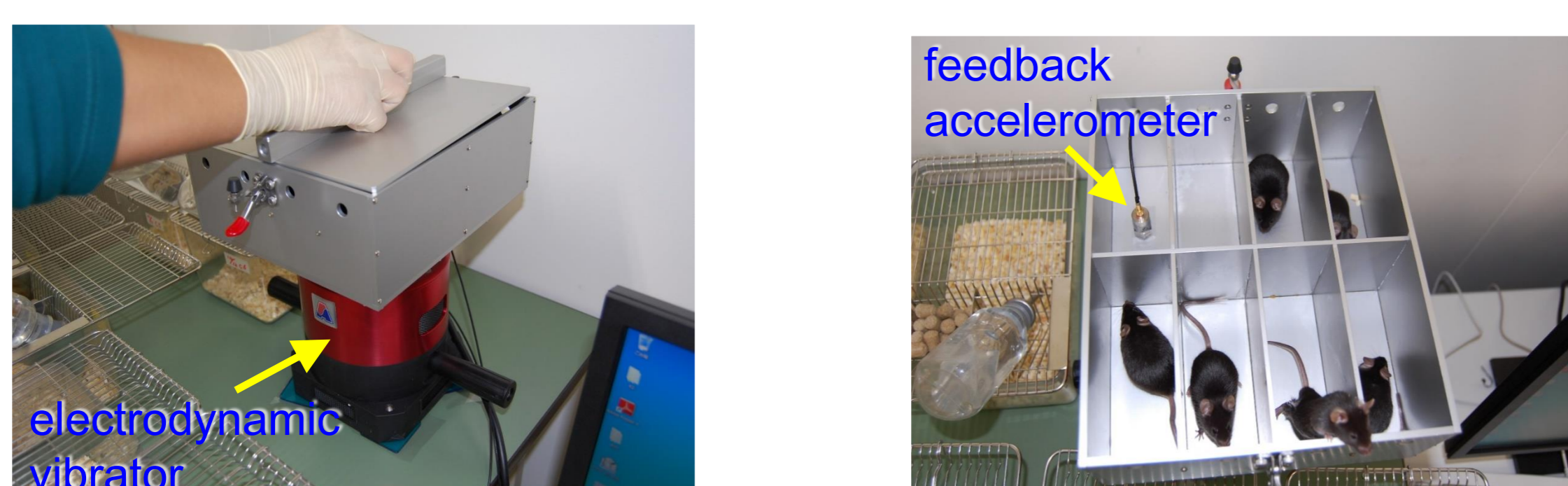


## Aim

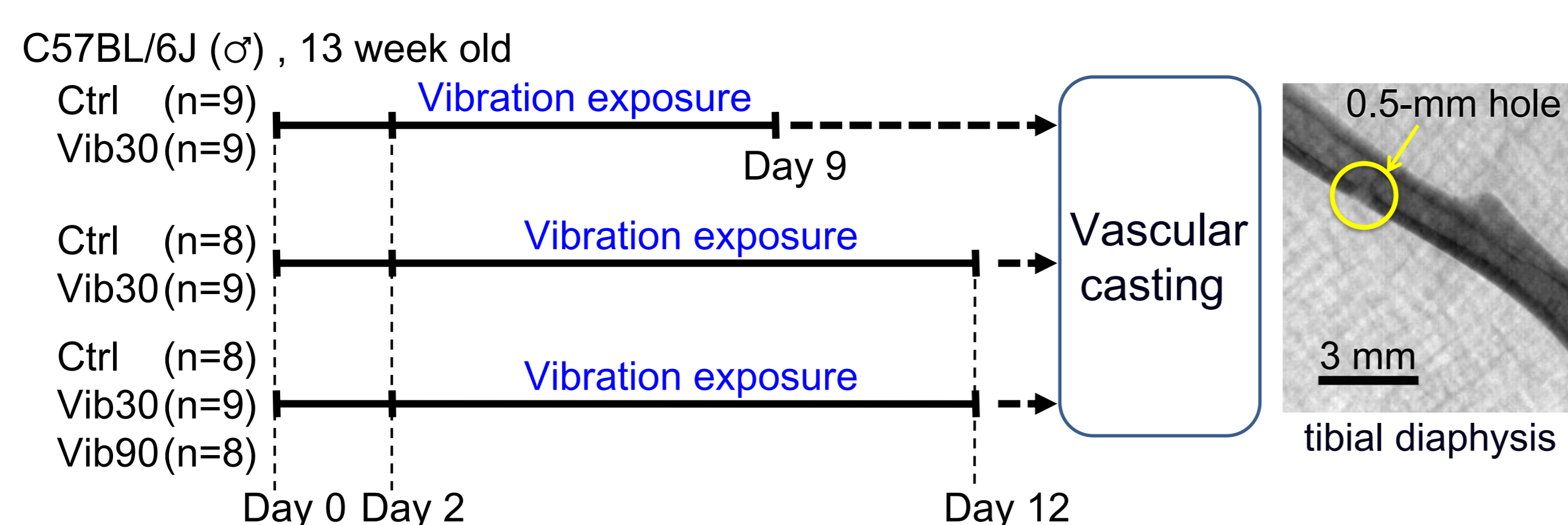
To evaluate the effect of whole-body vibration (WBV) with extremely low-amplitude on early-stage bone defect healing, mainly focusing on the neo-vascular growth.

## Methods

### WBV-load device



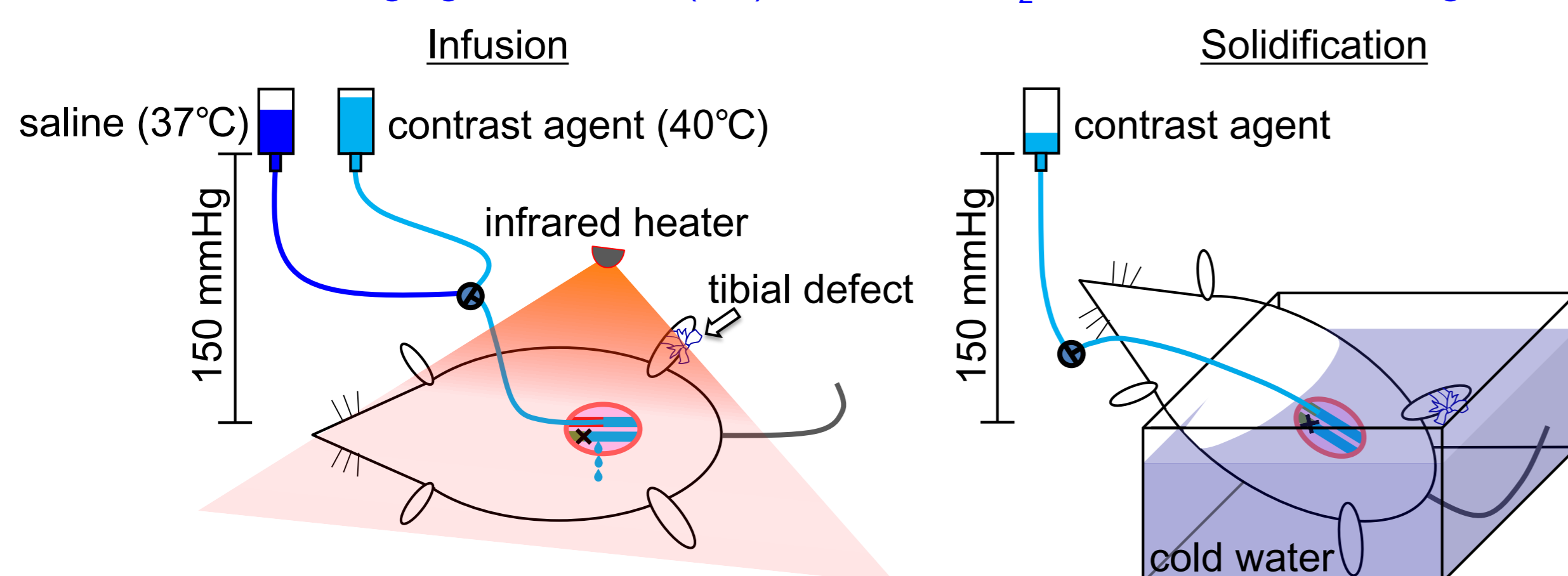
### Animals



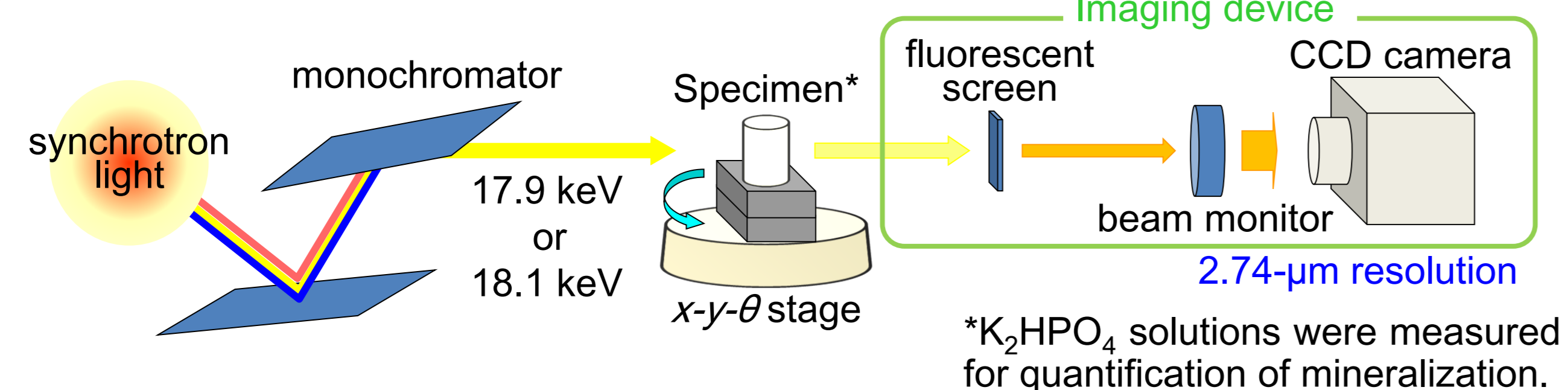
Vib30: 30-Hz, 0.03 g (peak-to-peak) sinusoidal WBV, given daily for 20 min/d  
 Vib90: 90-Hz, 0.03 g (peak-to-peak) sinusoidal WBV, given daily for 20 min/d  
 Ctrl: no vibration (only put in the WBV-load device)

### Vascular casting

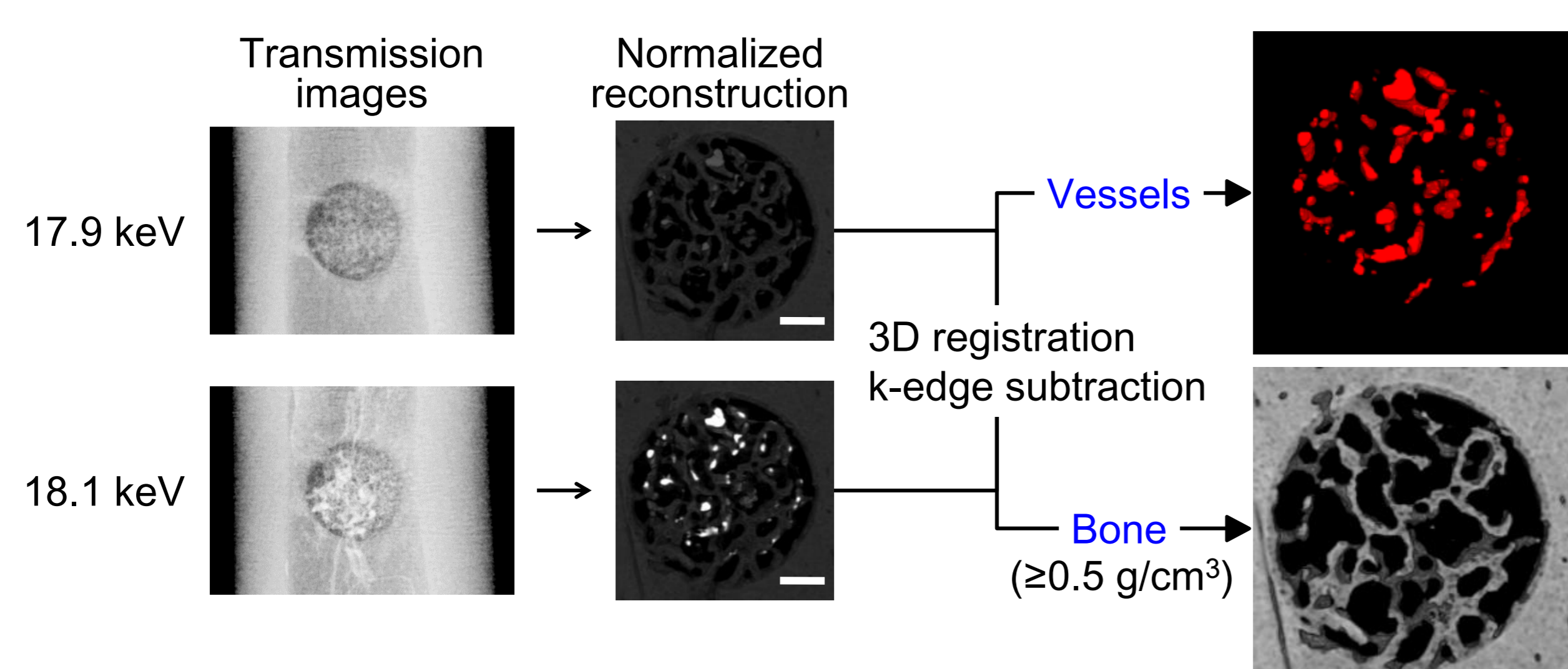
Zirconia casting agent: mixture (1:2) of 9%v/v-ZrO<sub>2</sub> colloid and 1.2%w/v-agarose



### Synchrotron CT



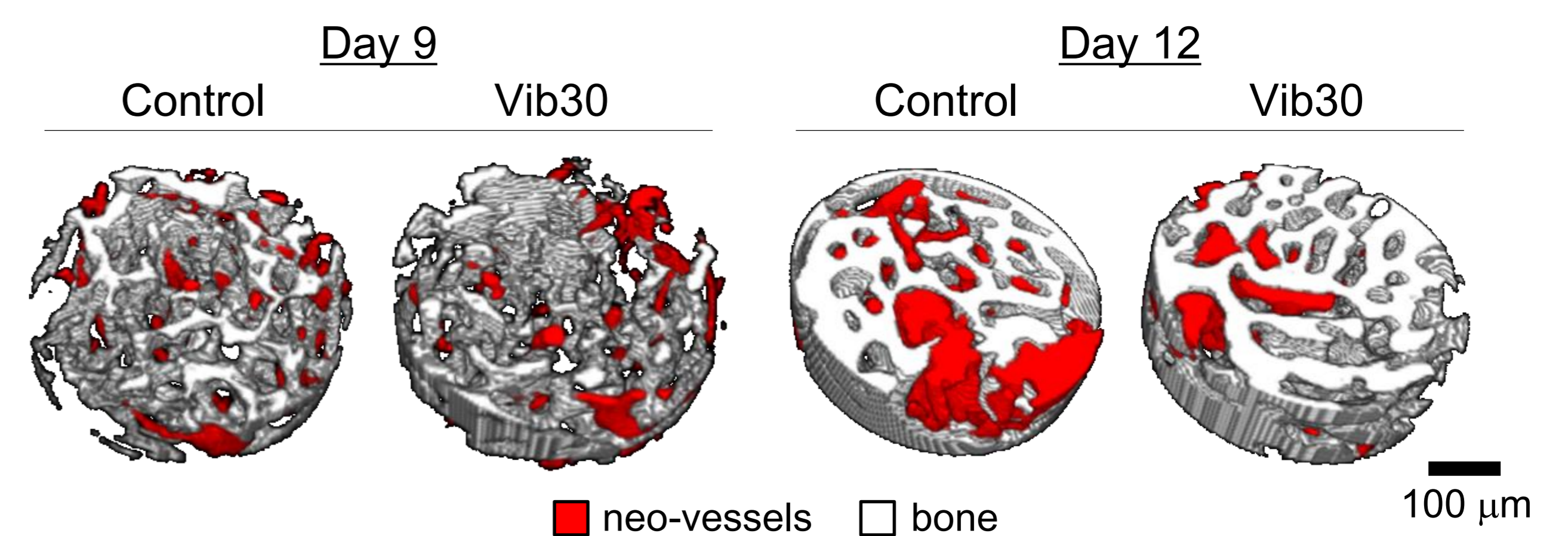
### Image analysis



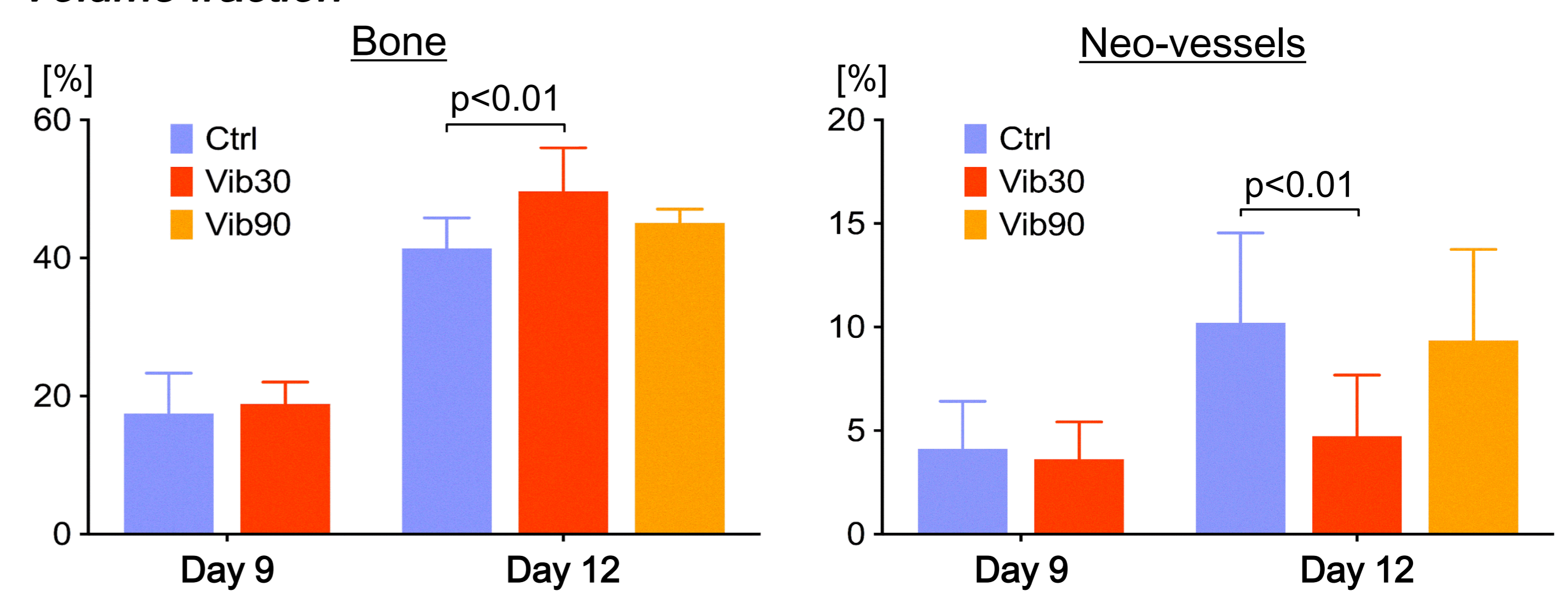
## Results

Differences between age-matched groups were assessed by Kruskal-Wallis test followed by Dunn's multiple comparison test.

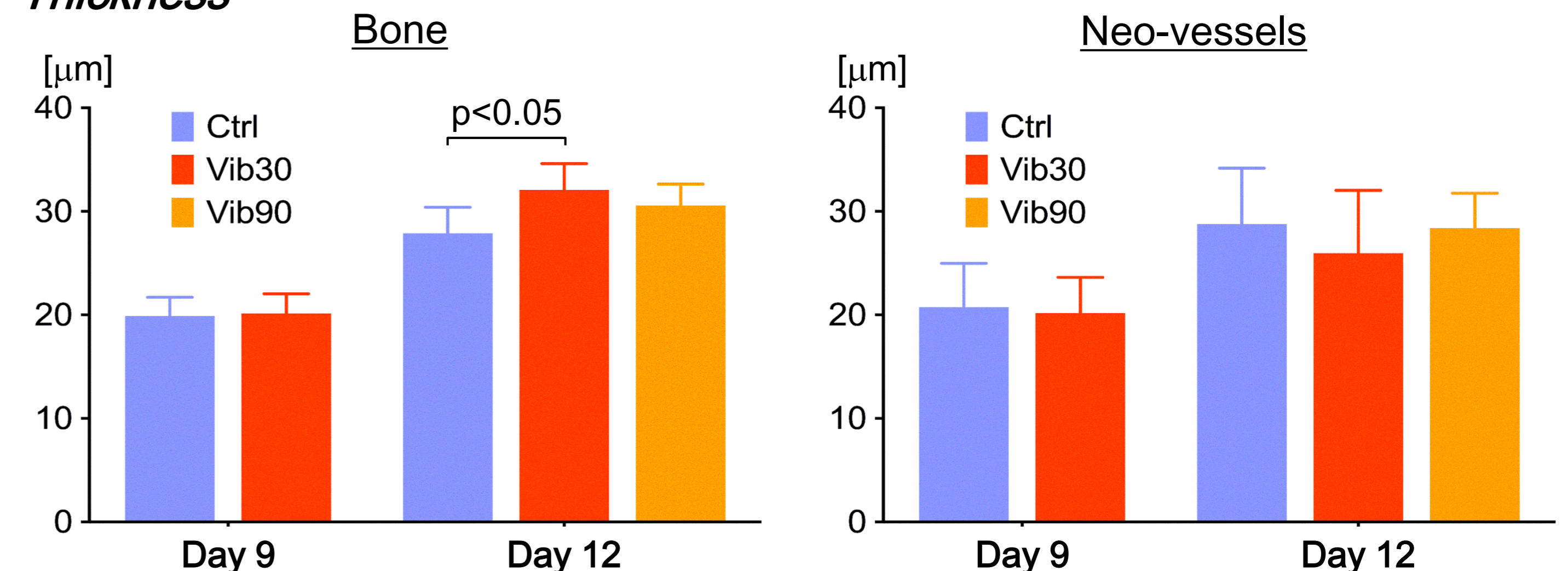
### 3D displays of neovasculture and regenerated bone



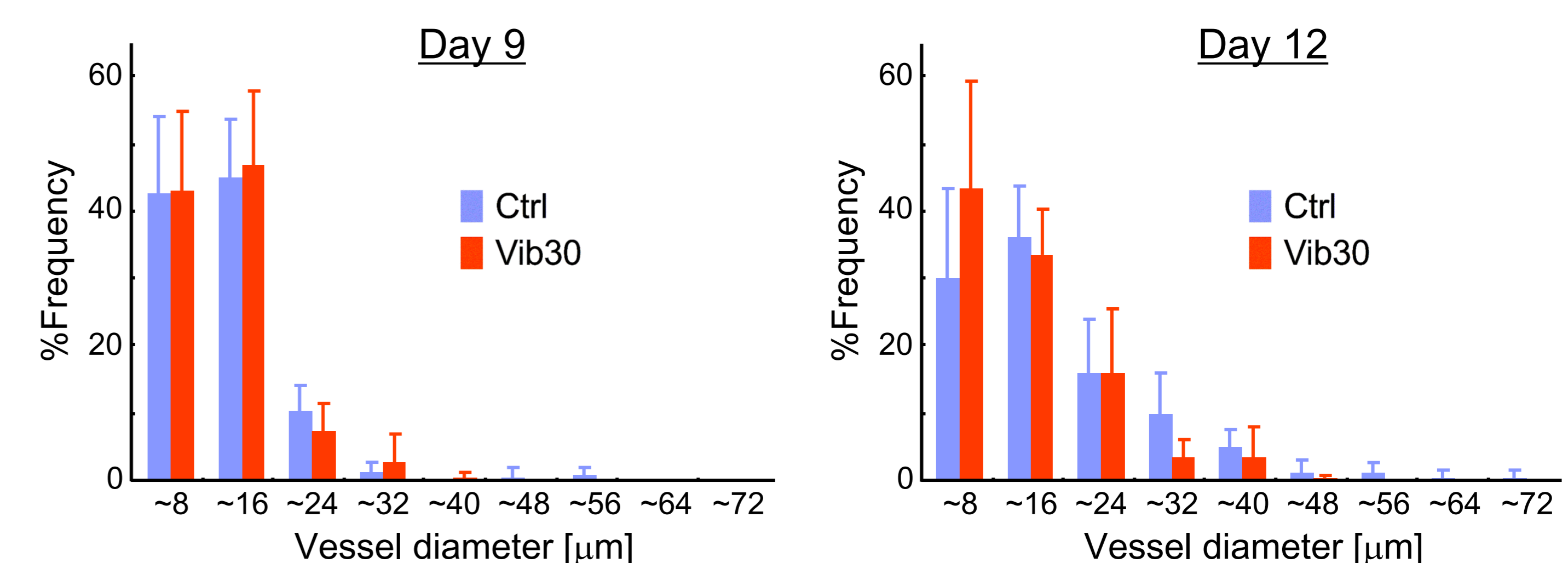
### Volume fraction



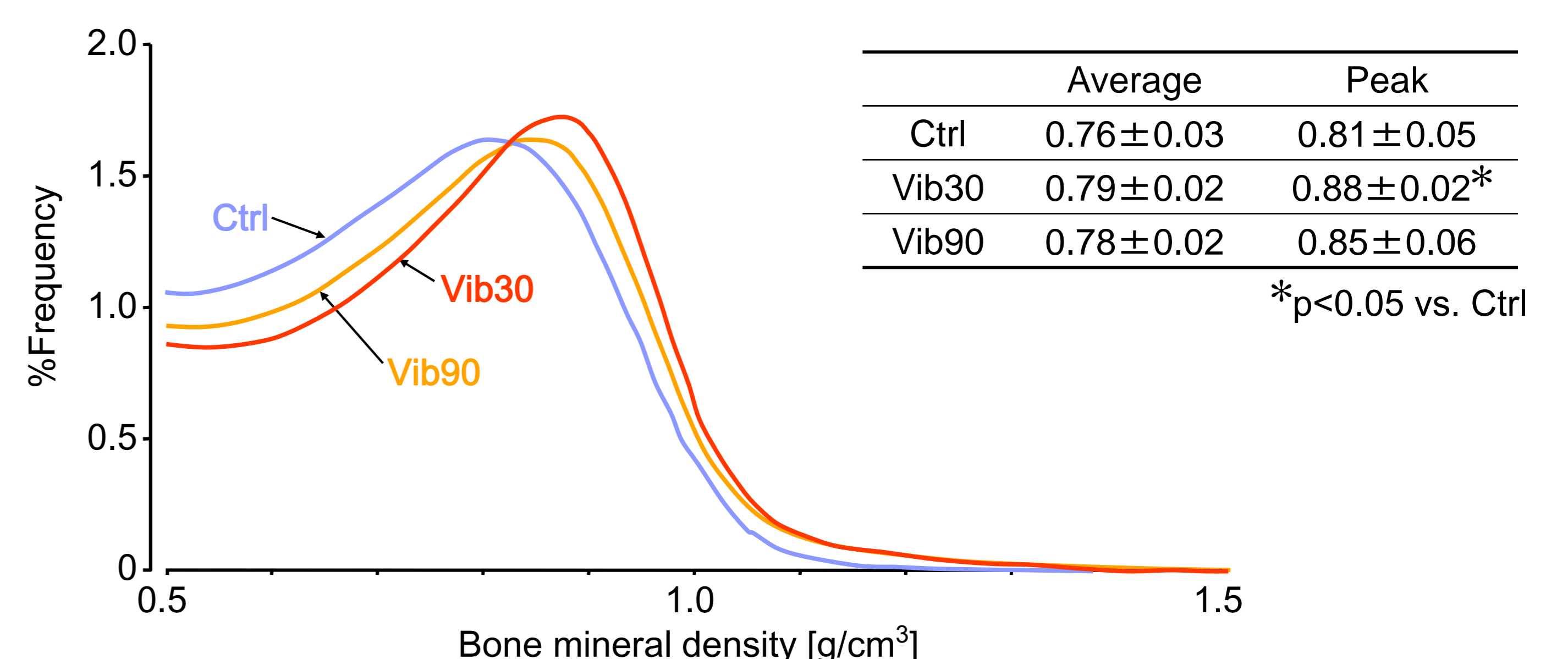
### Thickness



### Vessel segment frequency and length vs. diameter



### Distribution of bone volume vs. density of hydroxyapatite on Day 12



## Conclusions

Extremely low-amplitude WBV facilitates early-stage bone defect repair. Reduced angiogenesis, which would still be suffice to promote osteogenesis, implies that the present WBV leads to preferred differentiation of mesenchymal stem cells into osteoblastic cells instead of differentiating toward an endothelial lineage.

No conflicts of interest are declared by the authors.