Methods:
injury. to identify the changes to subchondral bone that occur early after joint use a newly developed non-invasive mouse model of knee joint injury bone occur early after a joint injury. The purpose of this study was to hypothesis is that substantial changes to the cartilage and subchondral bone occur early after a joint injury. The purpose of this study was to use a newly developed non-invasive mouse model of knee joint injury to identify the changes to subchondral bone that occur early after joint injury.

Methods: Mouse joint injuries were induced in anesthetized mice using a custom tibial compression jig mounted in a Bose Enduratec instrument. Mouse tibiae were loaded to 10–12 N at a rate of 1 mm/sec, causing anterior translation of the tibia relative to the distal femur and injuring the soft tissues of the knee (Figure 1). Mice were euthanized at 1, 3, 7, 14, 28, and 56 days after knee injury, and compared to uninjured control mice (n = 6 per group). Injured and uninjured knees were imaged using micro-computed tomography (SCANCO µCT35), and the volume of the trabecular bone analyzed at several locations including the femoral epiphysis.

Results: Joints were consistently injured at approximately 10–12 N, with very little variation in the force required for injury. All mice survived the joint injury well, with no apparent change in activity levels or obvious signs of discomfort. Analysis of the trabecular bone volume at the femoral epiphysis and proximal tibial epiphysis showed a rapid and unexpectedly large loss of trabecular bone after injury, which was readily detectable at day 3 and reached a maximum loss of >40% BV/TV (bone volume/total volume) at day 7. This was followed by a period of partial recovery of bone volume. A more mild but still significant loss of trabecular bone volume was observed in the uninjured contralateral limbs, which indicates a systemic response to the injury (Figure 2). There was very little variation in the extent of injury between mice of the same group, indicating these observations are highly reproducible.

Conclusions: The immediate and significant loss of trabecular bone volume following a relatively mild non-invasive joint injury is a novel observation. Since OA is initiated at the molecular and cellular level shortly after injury occurs, the optimal timeframe for therapeutic intervention may also be shortly after the joint injury. A more thorough characterization of the early changes in an injured joint will enable the future design of more accurate OA biomarkers and more effective therapeutic intervention strategies.