INTRODUCTION:
Osteonecrosis of the femoral head is a devastating disease in young patients and remains a challenge for clinicians and researchers alike. To increase understanding of the disease and produce effective treatments that preserve a patient’s native hip, an animal model that mimics the disease process in humans, including collapse of the femoral head, is essential. Our goal was to create such a bipedal model by surgically inducing osteonecrosis in the femoral heads of chickens.

METHODS:
A total 24 chickens were used for the study. A lateral approach to the proximal femur was used to access the hip, dislocate the femoral head, and sever the periosteal network of blood vessels. This surgical procedure was approved by the Institutional Animal Care and Use Committee.

At 4, 8, 12, and 20 weeks after surgery, both the left (experimental) and right (control) femoral heads were harvested from 6 chickens for micro-CT and histological analysis (Figure 1).

RESULTS:
H&E stained sections beginning at 4 weeks demonstrated trabecular bone loss, empty osteocyte lacunae, and new appositional bone formation on existing trabeculae. By 20 weeks, subchondral cyst formation and femoral head collapse was observed (Figure 2).

Micro-CT analysis of the operative hips compared to matched controls showed decreased bone volume (18% at 4 weeks, 36% at 8 weeks, 45% at 12 weeks, Figure 3), increased porosity (2.1%, 7.3%, 10.7%), and increased average pore diameter (13%, 18%, 37%).

DISCUSSION:
The results indicate that operative disruption of blood supply to the femoral head produces changes consistent with osteonecrosis, including progression to collapse, as seen in human end-stage disease. A successful osteonecrosis model provides the basis to test new therapies, such as bone graft substitutes including stem cells and growth factors.

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