Supplementary Information

Labeling Human Mesenchymal Stem Cells with Gold Nanocages for *in vitro* and *in vivo* Tracking by Two-Photon Microscopy and Photoacoustic Microscopy

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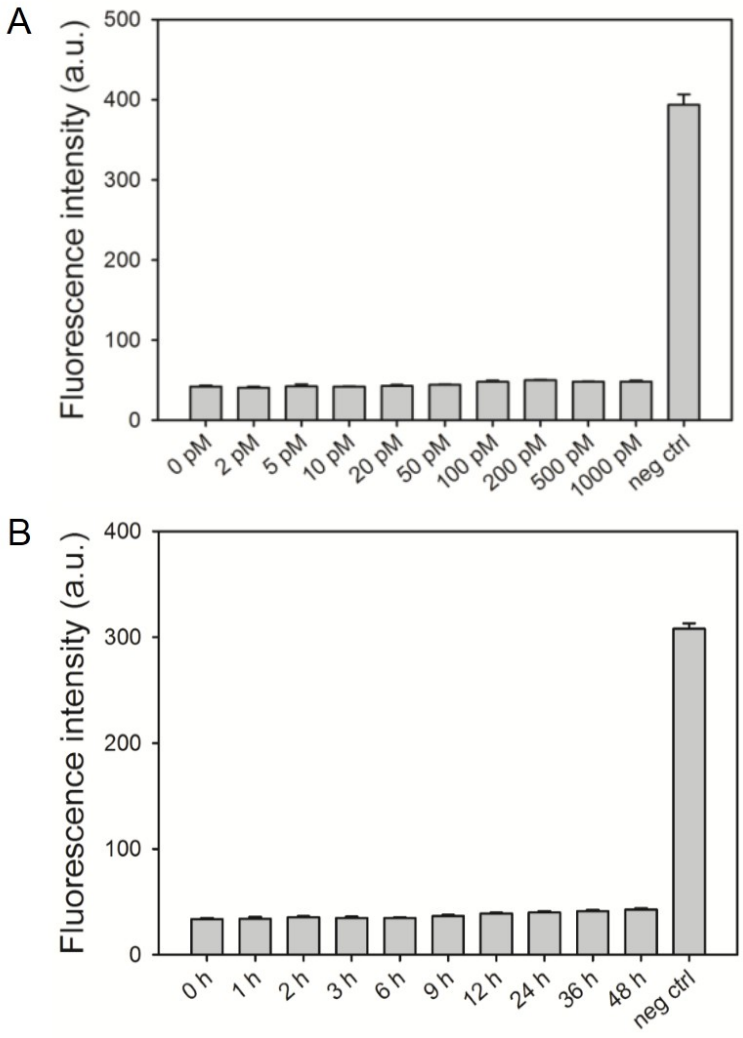

Figure S1. Plots showing membrane integrity of hMSCs incubated with AuNCs at various concentrations and for different periods of time, as quantified by the release of glucose-6-phosphate dehydrogenase (G6PD) from the cells into the surrounding medium.

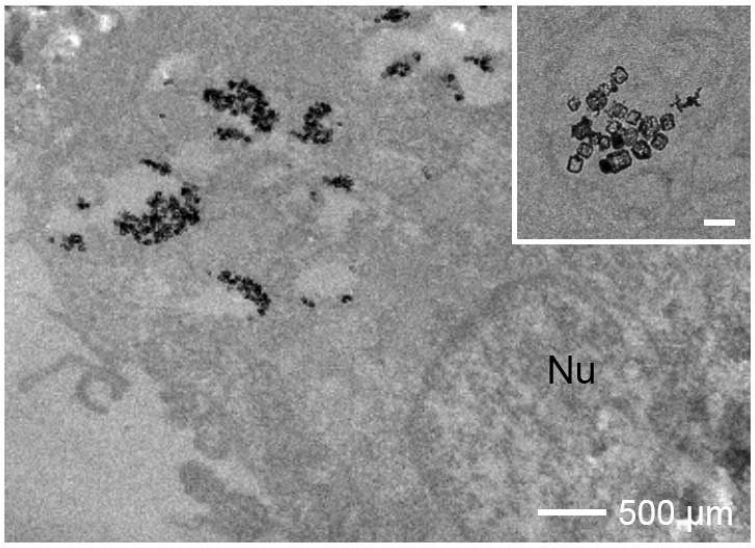

Figure S2. TEM image showing the typical distribution of AuNCs in an hMSC. 'Nu' refers to the nucleus of the cell. The inset is a magnified image showing the morphology of AuNCs in the cell; scale bar: 100 nm.

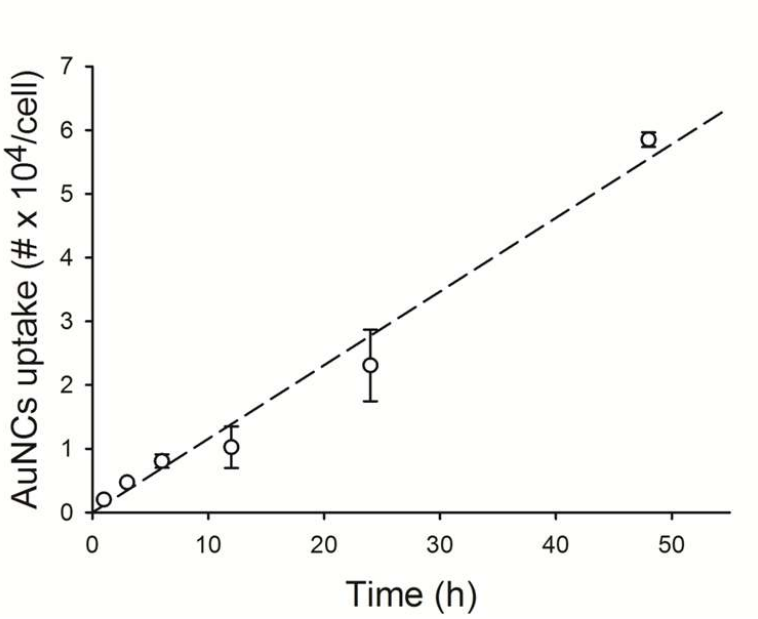

Figure S3. Quantification of the uptake of AuNCs by hMSCs *versus* the incubation time by ICP-MS. The concentration of AuNCs was 25 pM.

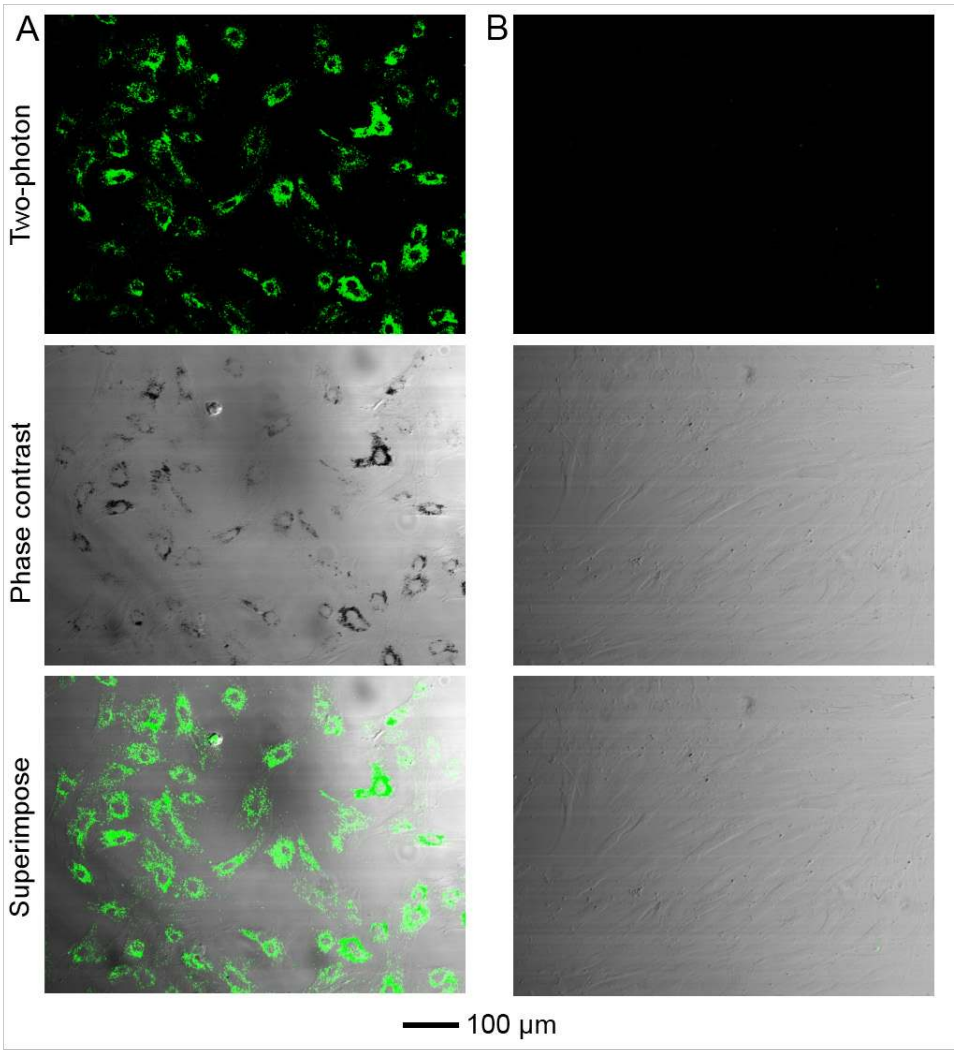

Figure S4. (A) Two-photon and phase contrast images of samples after the hMSCs pre-labeled with AuNCs had been cultured in a proliferation medium for 28 days. (B) Two-photon and phase contrast images of the hMSCs cultured in the medium collected from the cultures of cells pre-labeled with AuNCs. Note that the laser power was increased to 5% (c.f. **Figure 3C** where the laser power was 2%) when imaging these cells for better observation due to the decreased amount of AuNCs in the cells after 28 days of culture.

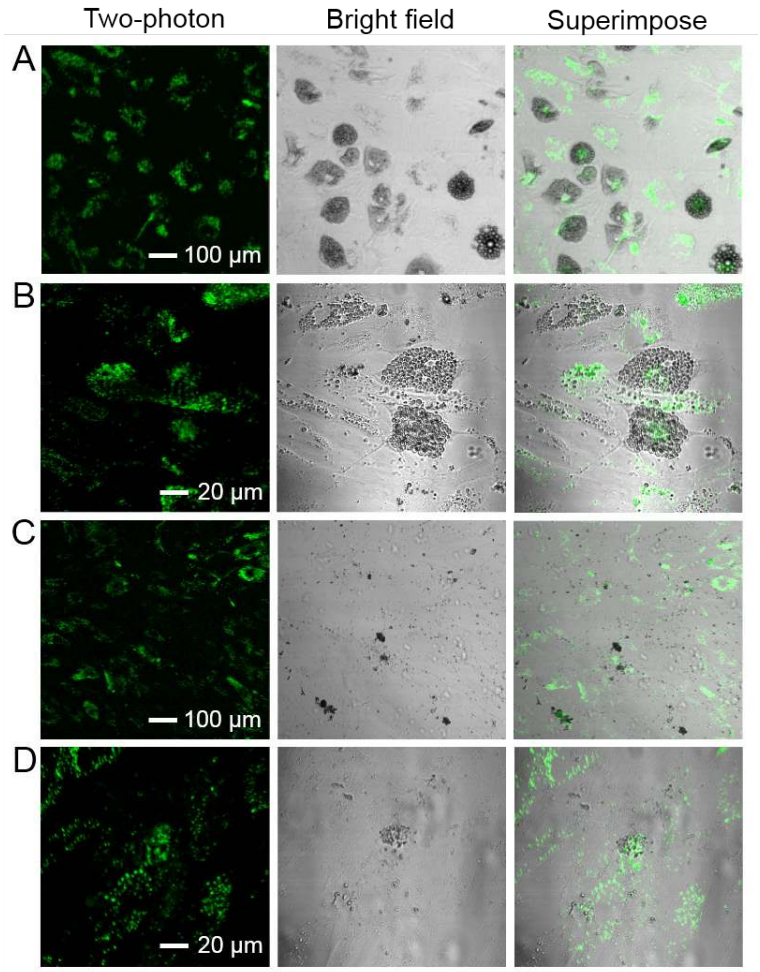

Figure S5. Two-photon and phase contrast micrographs showing AuNCs-labeled hMSCs after induction for (A, B) adipogenesis and (C, D) osteogenesis for 28 days.

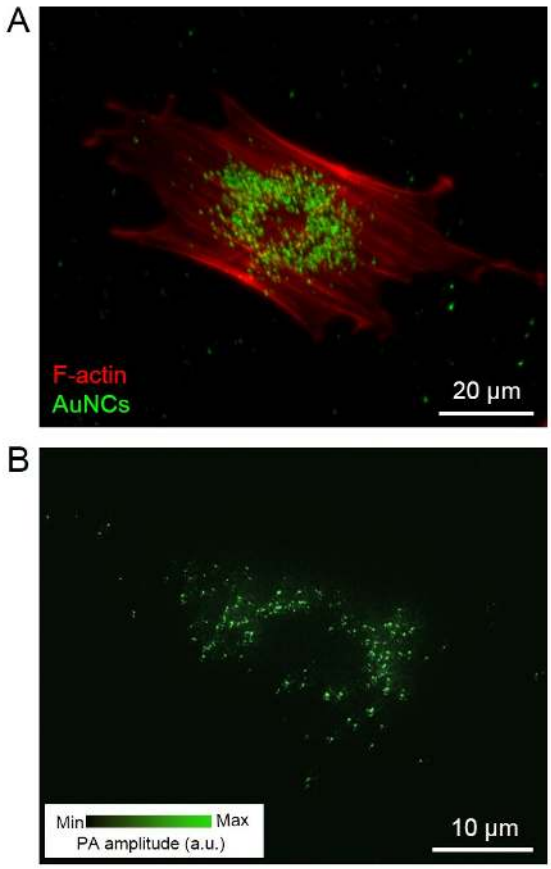

Figure S6. (A) Two-photon image showing an hMSC labeled with AuNCs, where f-actin was stained in red by rhodamine-phalloidin. (B) A high-resolution photoacoustic (PA) image showing an hMSC labeled with AuNCs.

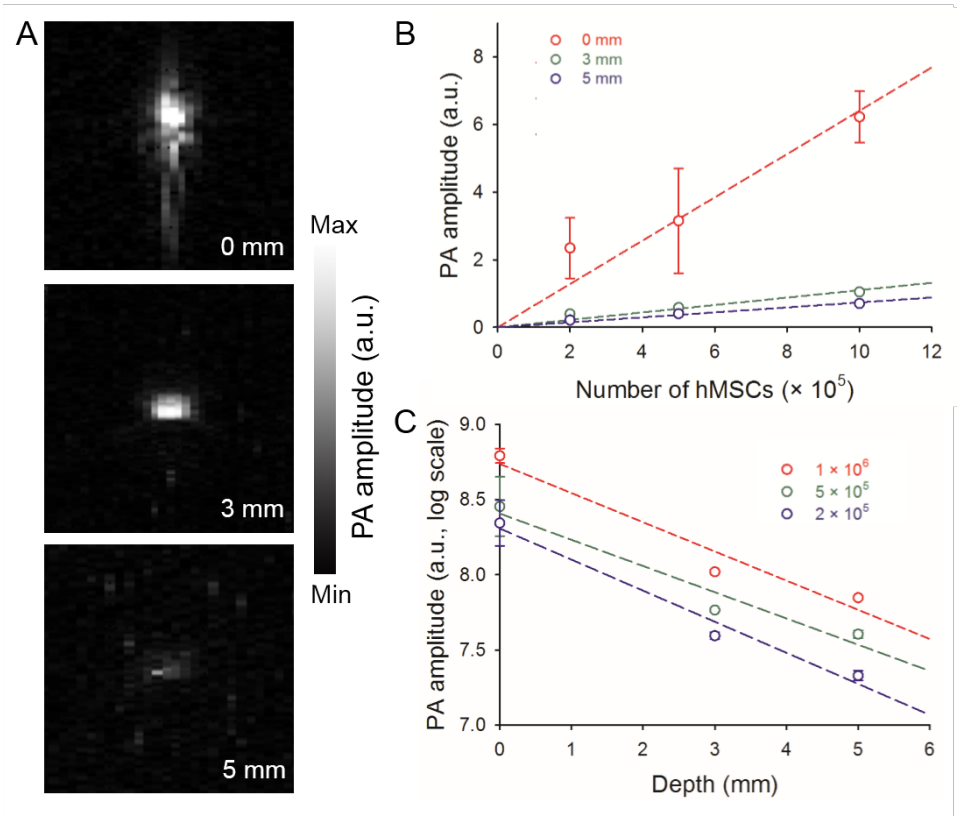

Figure S7. (A) Photoacoustic (PA) images of hMSCs labeled with AuNCs (1×10^6) embedded in chicken tissues at different depths. (B) A plot showing the relationship between the PA amplitude and the number of hMSCs labeled with AuNCs, at different depths. (C) A plot showing the relationship between the PA amplitude and the depth, at different numbers of hMSCs labeled with AuNCs.

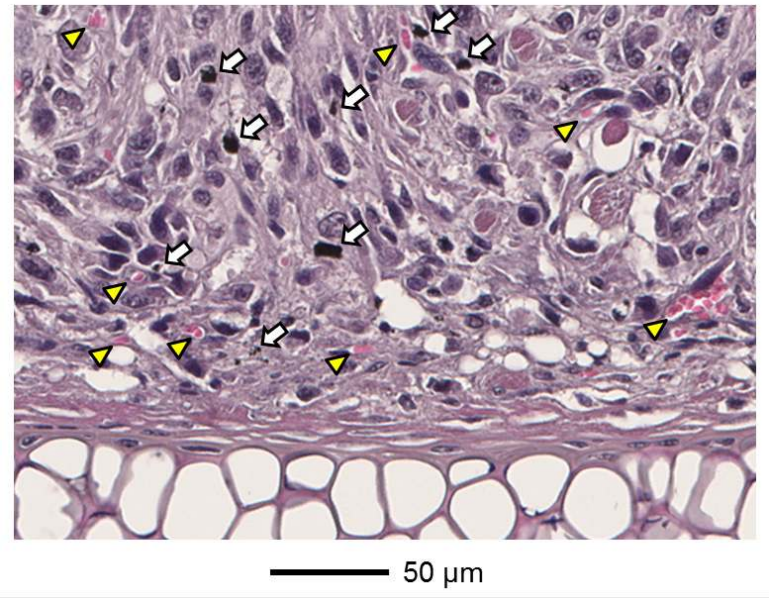

Figure S8. An optical micrograph showing a hematoxylin and eosin stained tumor section, where the blood vessels are indicated by yellow arrowheads and AuNCs-carrying hMSCs by white arrows.