**Supporting Information**

**Supplementary Methods**

*Transduction of MSCs in the presence of CAR Receptor Booster*

For CAR Receptor Booster transductions, $3 \times 10^4$ MSCs were plated in 24-well plates and cultured overnight and subsequently treated with 2.5 µL CAR Receptor Booster (Clontech, Cat: 631470) in 4 µg/mL polybrene containing MSC growth media for 2 h. The CAR Receptor Booster-containing media was then removed and cells transduced with adeno-GFP vector at 0, 1, 10, or 50 multiplicity of infection (MOI) for 2 h. Transduction efficacy was assessed 2 days post-transduction by analyzing GFP fluorescence with an Olympus microscope (Tokyo, Japan). The percentage of GFP-positive area to the total cell area was determined in 4 images (200× magnification) per well using ImageJ (National Institutes of Health, USA). MSCs transduced in the absence of CAR Receptor Booster served as controls.
Supplementary Figure S1. Enhanced adeno-GFP transduction efficiency in MSCs by CAR Receptor Booster. Human MSCs were transduced with GFP-expressing adenovirus at 0, 1, 10, and 50 MOI in the presence and absence of CAR Receptor Booster for 2 h. Cells were imaged using Olympus fluorescence microscope two days later. (A) Photomicrographs show GFP expression in respective fields of various cultures containing similar numbers of MSCs. Scale bar = 50 µm. (B) The ratio of GFP-positive to total cell area was assessed from 4 random fields per culture at 200× magnification from two independent experiments as determined by ImageJ.
Supplementary Figure S2. Chondrogenic and adipogenic differentiation of adeno-GFP transduced MSCs. MSCs transduced at 50 MOI were differentiated into chondrocytes (A, B) and adipocytes (C, D). Chondrocyte differentiation at 4 weeks showed similar sized cartilage tissue mass in both MSCs and adeno-GFP transduced MSCs (MSCs/Ad-GFPs) (A). Alcian blue staining confirmed glycosaminoglycan deposition by chondrocytes, nuclear red staining was used to stain the nucleus (B). Adipogenic differentiation was visualized by fluorescence and light microscopy at day 12. Merged images of adipocyte differentiation showed no GFP-positive cells carrying lipid droplets. GFP-negative cells were readily differentiated into adipocytes with lipid droplets (C). Very few oil red O- and GFP-positive cells (arrow) were detected in adipogenic differentiation media (D). Scale bars = 50 μm.