

Supplemental Legends

Supplemental Figure 1. MagMP can be incorporated within human mesenchymal stem cell spheroids. Magnetic MPs, seeded in a 1:10 ratio, were incorporated within human mesenchymal stem cell spheroids using forced aggregation within microwells. Dark regions, consistent with those observed in ESC aggregates, were observed in all spheroids (A-C) indicating the presence of magMPs. Scale bars 50 μ m (a), 100 μ m (b) and 200 μ m (c).

Supplemental Video 1. Spheroids form with magMPs in microwells. Time lapse microscopy indicated that cell movement during spheroid formation corresponded with displacement of the magMPs. Spheroids formed over 10-12 hours and were removed from the wells after 24 hours of culture.

Supplemental Video 2. Magnetic manipulation of spheroids in suspension. Under static culture conditions, entire fields of individual spheroids could be agglomerated, translated and rotated based upon the relative location, direction and manner in which external magnetic fields were applied.

Supplemental Video 3. Paramagnetic elements incorporated within the culture can manipulate single spheroids. In the absence of an external magnetic field, a spheroid remained free-floating in the center of the configuration, but as soon as one of the iron rods was magnetized, the spheroid was immediately attracted by the magnetic field to the end of that particular rod. The rod was then demagnetized and the next rod was magnetized to move the spheroid.

Supplemental Video 4. Spheroids in contact merge into one spheroid over 15 hours. Individual spheroids, pre-labeled with CellTracker™ Red or Green, were magnetically guided within close proximity of each other and monitored with time-lapse microscopy. After the first hour, the spheroids began to merge and by 15 hours of culture, the spheroids had merged into one continuous spheroid. The red and green fluorescence remained localized to the position of the original spheroids.