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**Supporting Information**

# 3D Stem Cell Spheroids with Urchin-Like Hydroxyapatite Microparticles Enhance Osteogenesis of Stem Cells

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**Supplementary Figures**

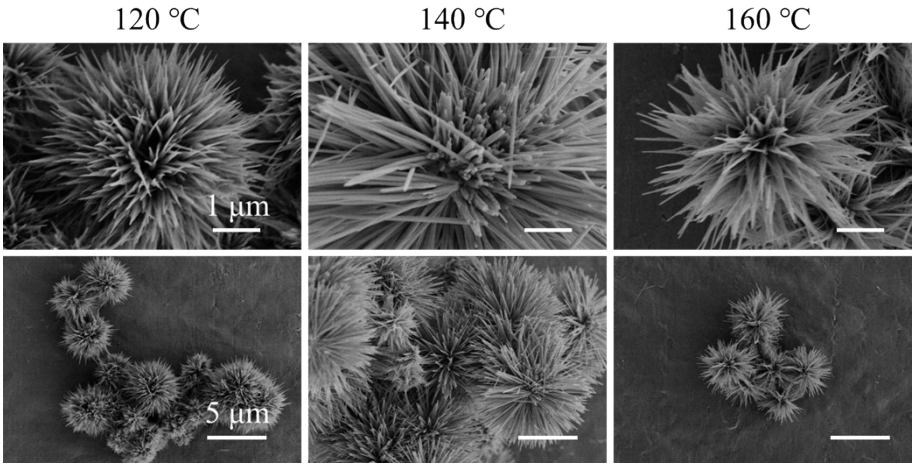


**Fig. S1** Morphologies of uHA under different temperatures.

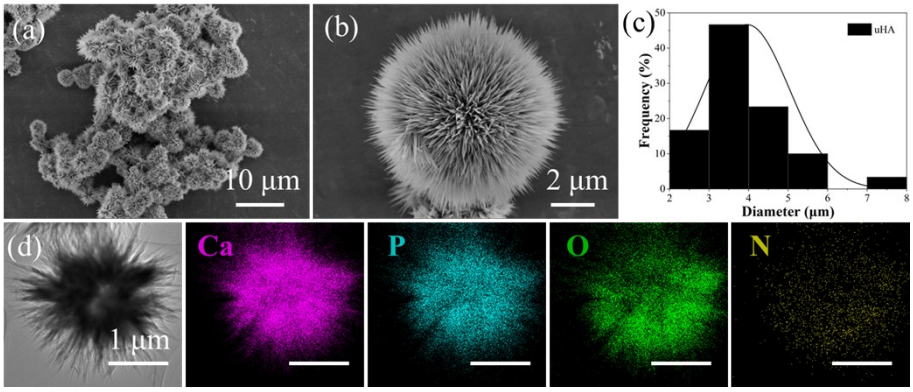


**Fig. S2** (a, b) SEM morphologies of uHA at low magnification topography (a) and high magnification topography (b). (c) The diameter distribution of uHA microparticles (n = 30). (d) TEM and EDS mapping images of uHA.

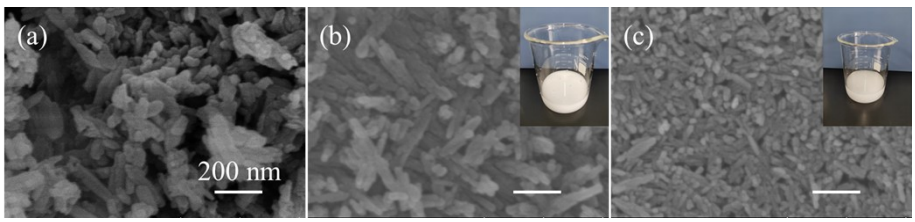


**Fig. S3** Nanorods of commercial HA (a), synthesized HA (b) and amino acid-modified HA without EDTA (c).

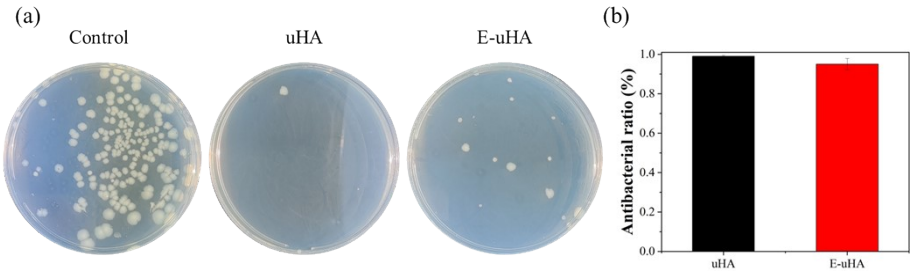


**Fig. S4** (a) Antibacterial properties and (b) corresponding antibacterial ratios of different samples (n=3).

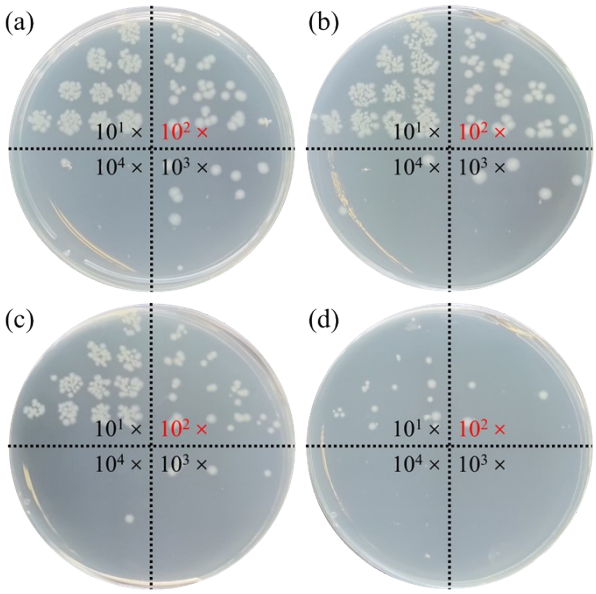


**Fig. S5** Antibacterial evaluation for the tested samples: (a) the untreated sample, (b) commercial HA nanorods, (c) home-synthesized HA nanorods and (d) E-uHA microparticles.

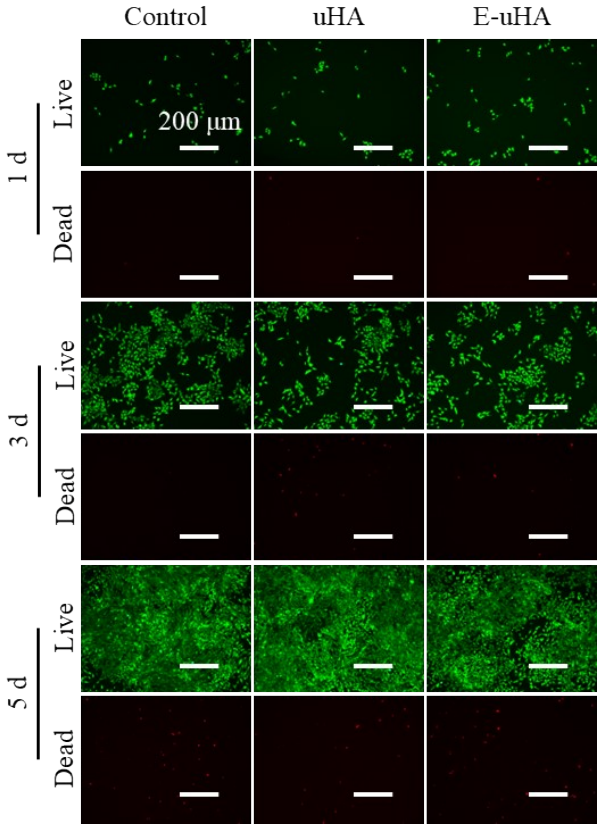


**Fig. S6** Live-dead cell staining of hDPSCs under different culture time with different samples.

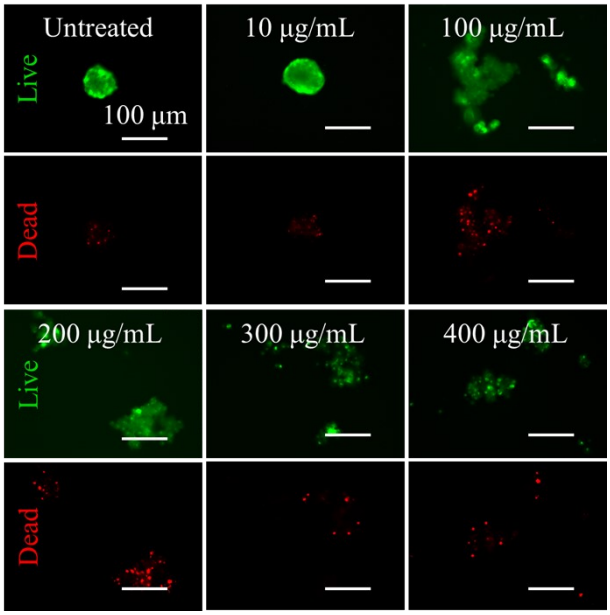


**Fig. S7** Live-dead cell staining of cell spheroids under different concentrations of E-uHA.

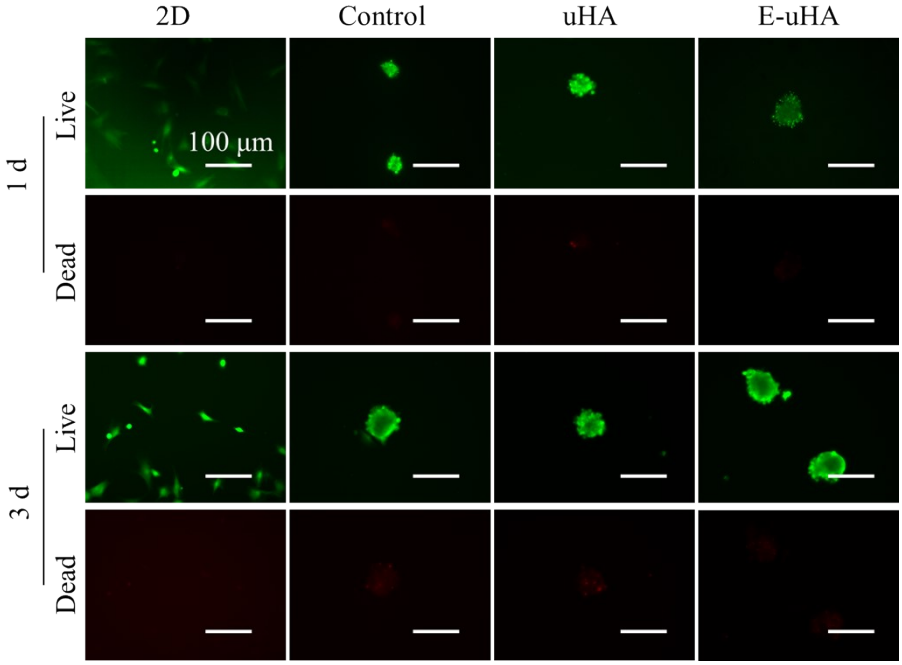


**Fig. S8** Live-dead cell staining of cell spheroids under different samples.

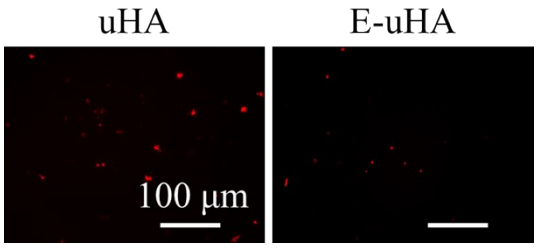


**Fig. S9** Microparticles stained by rhodamine.

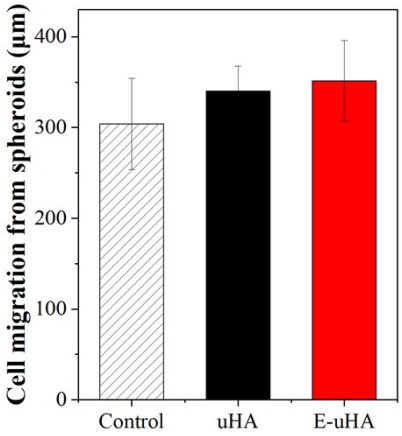


**Fig. S10** Cell migration performance for pristine BMSC spheroids, BMSCs/uHA composite spheroids and BMSCs/E-uHA composite spheroids (n=10).

**Supplementary Tables**

**Table S1** Primers used for qRT-PCR.

| Gene name | Forward primer | Reverse primer |
|---|---|---|
| ALP | aagaagcccttcacagccatc | tggagacgttctcccgttcac |
| RUNX2 | acgaggcaagagtttcactttg | ctttaatagctctgtggtaagtggc |
| BMP-2 | caagagacatgtgaggattagcagg | gcttccgctgtttgtgtttgg |
| Actin | gacgttgacatccgtaaagacc | ctaggagccagggcagtaatct |

**Table S2** Specific surface area and pore size of microparticles after calculation.

| Sample | UHA | UHAE |
|---|---|---|
| $S_{BET}$ ($m^2/g$) | 26.592 | 24.375 ↓ |
| Pore volume ($cm^3/g$) | 0.154 | 0.137 ↓ |
| Pore size (nm) | 4.309 | 3.056 ↓ |

**Table S3** Results of TG analysis of different samples.

| Sample | UHA | UHAE |
|---|---|---|
| First loss (%wt) | 2.905 | 3.104 ↑ |
| Second loss (%wt) | 3.181 | 3.547 ↑ |
| Third loss (%wt) | 0.824 | 0.548 ↓ |

**Table S4** The element content of uHA and E-uHA characterized by XPS analysis.

| Element / (At%) / Sample | Ca | P | O | N | C |
|---|---|---|---|---|---|
| UHA | 16.69 | 12.7 | 52.89 | 1.22 | 16.49 |
| UHAE | 11.31 | 8.72 | 40.21 | 0.51 | 39.25 |