

Table S1. List of Abbreviations used in the manuscript.

Abbreviation	Full Term
ACAN	Aggrecan Gene
ADSC / ADSCs	Adipose-Derived Stem Cells
AFM	Atomic Force Microscopy
AI	Artificial Intelligence
AlgMA	Alginate Methacryloyl
AMCh	Amnion-Derived Collagen Hydrogel
AMPK	AMP-Activated Protein Kinase
APC	Adenomatous Polyposis Coli
BdECM	Bone-Derived Extracellular Matrix
BMP-12	Bone Morphogenetic Protein 12
BMSCs	Bone Marrow Mesenchymal Stem Cells
BNC	Bio-Nanocellulose
CAD	Computer-Aided Design
CaO ₂	Calcium Peroxide
CK1	Casein Kinase 1
CNCs	Cellulose Nanocrystals
COL2A1	Type II Collagen Gene
Col II MA	Type II Collagen Methacryloyl
dECM	Decellularized Extracellular Matrix
DLP	Digital Light Processing
DMOG	Dimethyloxalylglycine
ECM	Extracellular Matrix
FAK	Focal Adhesion Kinase
FC	Fish Collagen
FGF19	Fibroblast Growth Factor 19
FLSs	Fibroblast-Like Synoviocytes
FMS	Fentanyl-Loaded PLGA Microspheres
GAGs	Glycosaminoglycans
GeIMA	Gelatin Methacryloyl
GO	Graphene Oxide
GSK-3 β	Glycogen Synthase Kinase 3 Beta
HA	Hyaluronic Acid
HAMA	Methacrylated Hyaluronic Acid
HAp / nHAp	Hydroxyapatite / Nano-Hydroxyapatite
hiPSCs / iPSC	Human Induced Pluripotent Stem Cells
HMs	Hydrogel Microspheres
IDD	Intervertebral Disc Degeneration
IL-4 / IL-17	Interleukin-4 / Interleukin-17
iNOS	Inducible Nitric Oxide Synthase
Jag1-OMVs	Jagged1-Functionalized Osteocyte Membrane Vesicles

Lam-pGelMA	Laminin-Modified Porous GelMA Microspheres
LATS1/2	Large Tumor Suppressor Kinase 1/2
LINC	Linker of Nucleoskeleton and Cytoskeleton
LRP5/6	Low-Density Lipoprotein Receptor-Related Protein 5/6
M1 / M2	Pro-inflammatory M1 Macrophages / Pro-regenerative M2 Phenotype
MAPK	Mitogen-Activated Protein Kinase
MBA	N,N'-Methylene Bisacrylamide
MML	Matrix Metalloproteinase
MLSs	Macrophage-Like Synoviocytes
MPS	Micro-Physiological Systems
MRI	Magnetic Resonance Imaging
MST1/2	Mammalian Sterile 20-Like Kinase 1/2
NFAT	Nuclear Factor of Activated T-Cells
NGF	Nerve Growth Factor
NMJ	Neuromuscular Junction
NPC	Nuclear Pore Complex
NSC / NSCs	Neural Stem Cells
OA	Osteoarthritis
OoC	Organ-on-a-Chip
ONOO ⁻	Peroxynitrite
P53	Tumor Protein P53
PAX7 ⁺ / Pax7	Paired Box 7
PCM	Pericellular Matrix
PDA	Polydopamine
PDGF-BB	Platelet-Derived Growth Factor-BB
PEG	Poly(ethylene glycol)
PEGDA	Poly(ethylene glycol) Diacrylate
PI3K/Akt	Phosphoinositide 3-Kinase/Protein Kinase B
PLGA	Poly(lactide-co-glycolide)
PNI	Peripheral Nerve Injury
PVA	Poly(vinyl alcohol)
RAPA@Lipo@H Ms	Rapamycin-Loaded Liposomes encapsulated in Hydrogel Microspheres
RGD	Arginine-Glycine-Aspartic Acid
ROS	Reactive Oxygen Species
S-GAGs	Sulfated Glycosaminoglycans
SCI	Spinal Cord Injury
SF	Silk Fibroin
SHAMA	Sulfated Hyaluronic Acid
SIS	Small Intestinal Submucosa
SMSCs	Synovium-Derived Mesenchymal Stem Cells
TCF/LEF	T-Cell Factor/Lymphoid Enhancer-Binding Factor

TEAD / Tead4	TEA Domain Family Member 4
TGF- β 1 / TGF- β 3	Transforming Growth Factor-Beta 1 / Beta 3
TH17	T Helper 17 Cells
TRPV / TRPV4	Transient Receptor Potential Vanilloid / Vanilloid 4
UV	Ultraviolet
Van	Vancomycin
YAP/TAZ	Yes-Associated Protein / Transcriptional Coactivator with PDZ-Binding Motif
μ CGPs	Micro-Combinatorial Hydrogel Particles