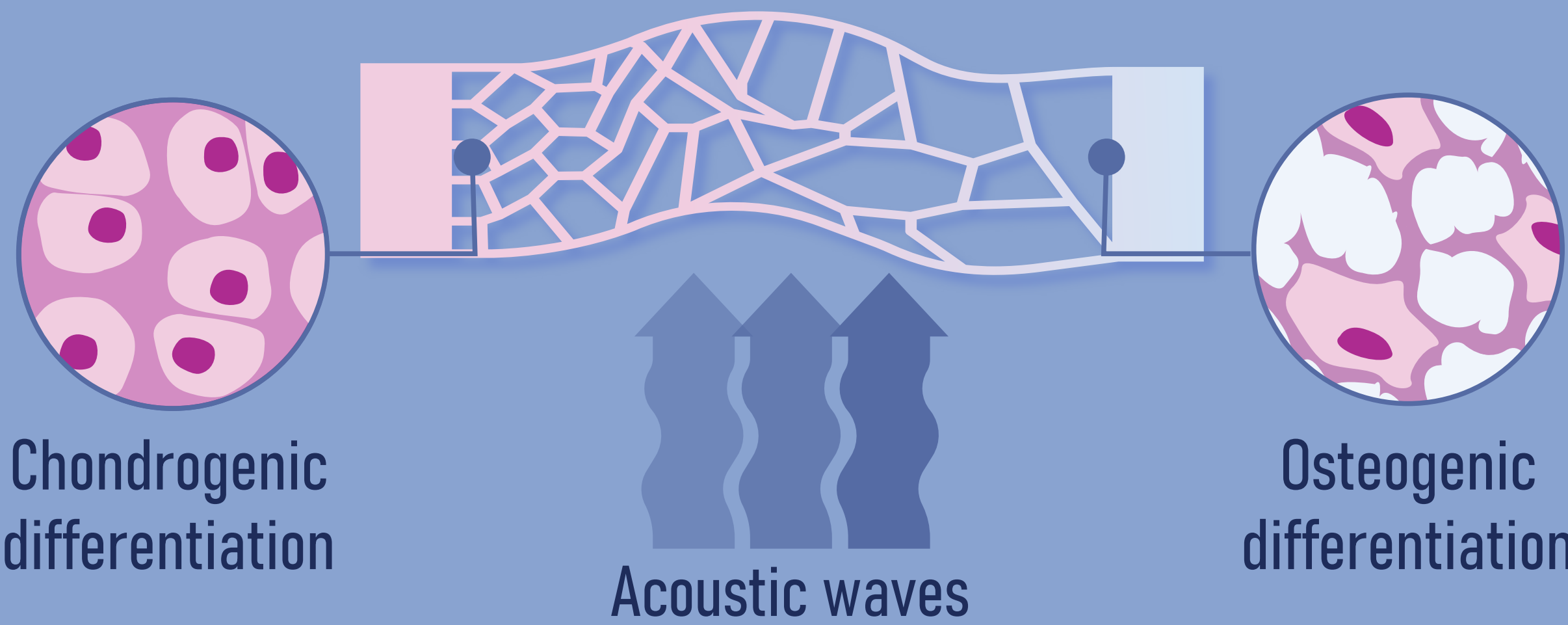


In vitro evaluation of osteogenic and chondrogenic stem cell differentiation in acoustically responsive 3D scaffolds

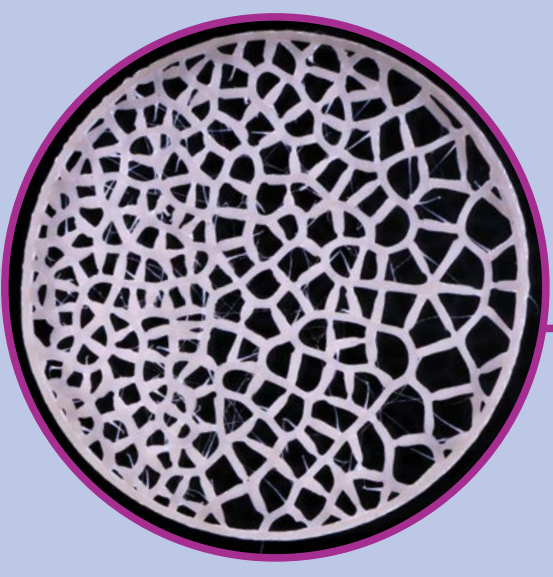
Aleksandra Predeina, Ebrahim Yarali, Carlos Mota, Lorenzo Moroni
MERLN Institute for Technology-Inspired Regenerative Medicine, Maastricht, Netherlands
Supported by the Netherlands Organization for Scientific Research, Applied and Engineering Sciences (NWO-AES, Grant #21756)

Aim of the project:

- Develop acoustically responsive 3D scaffolds capable of interacting with externally applied ultrasound stimulation;
- Investigate the influence of scaffold microarchitecture, particularly pore geometry and pore size, on cellular behavior and on the interaction of acoustic waves within the scaffold;
- Evaluate the synergistic effects of scaffold architecture and ultrasound stimulation on directing osteogenic and chondrogenic differentiation of stem cells.

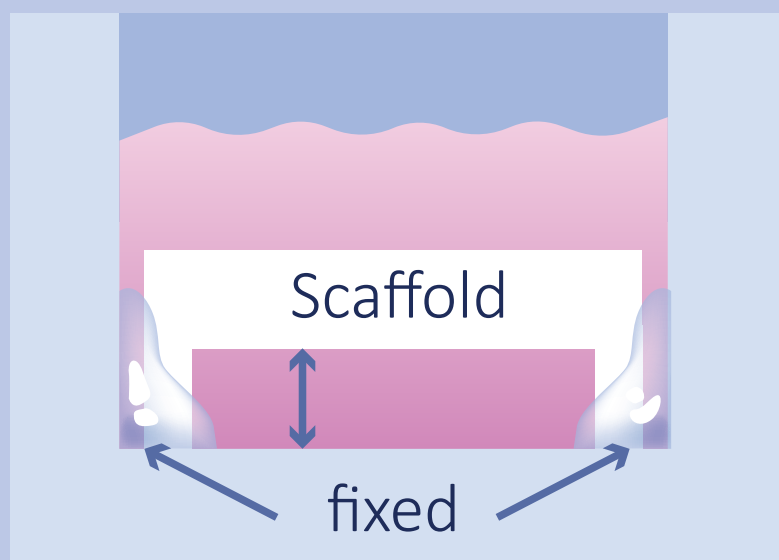
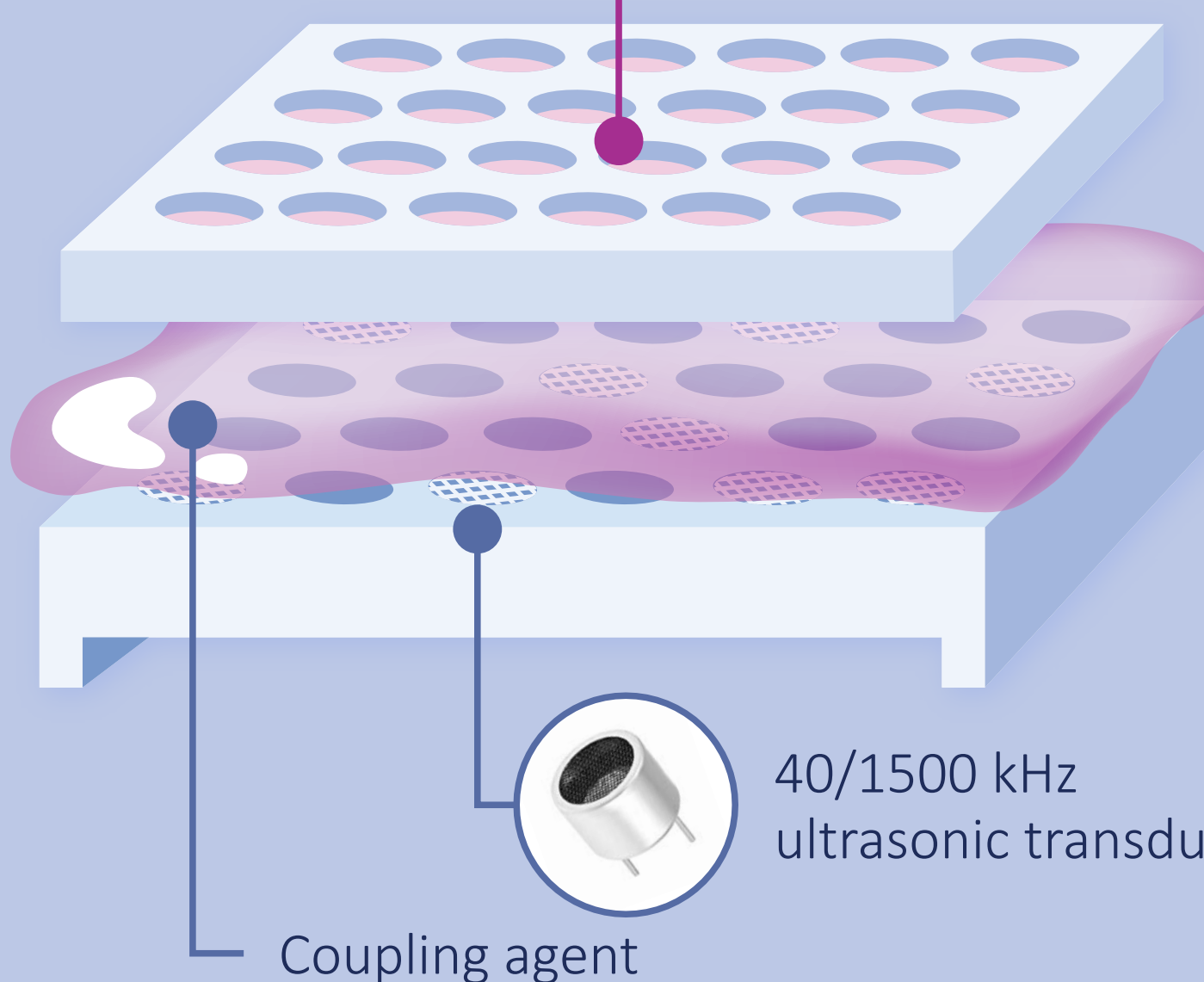


Acoustic stimulation:

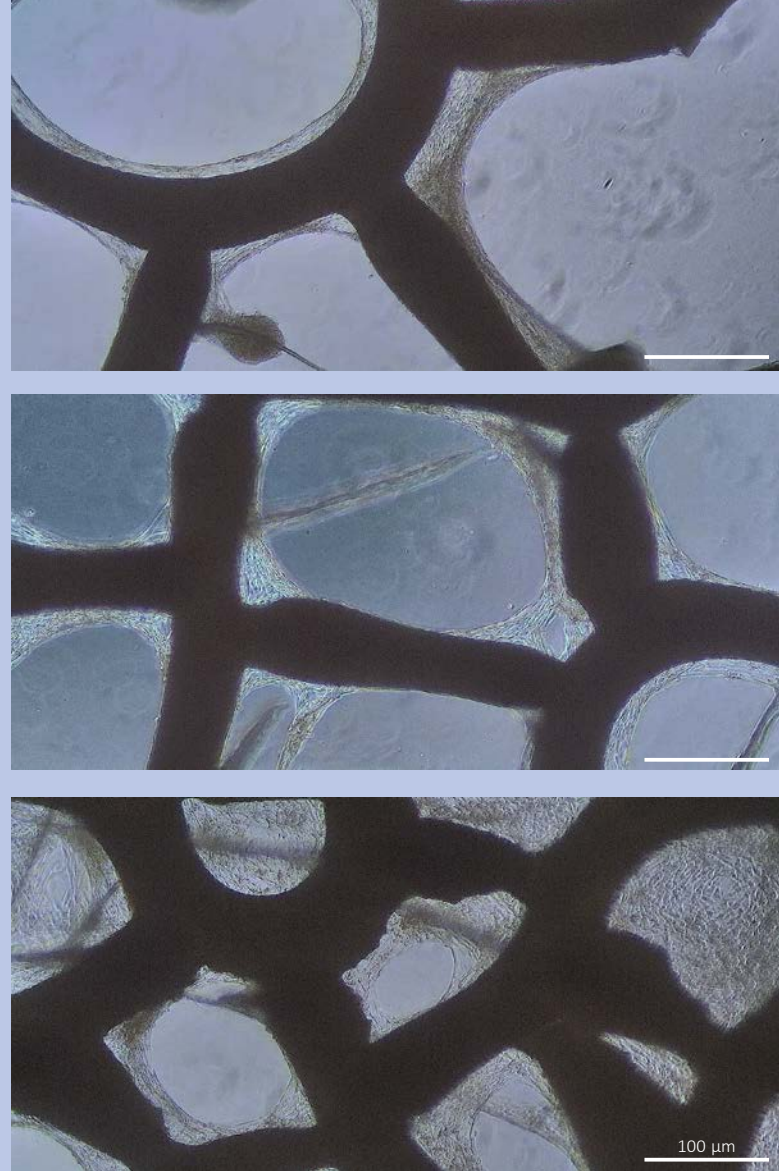


PA300PEOT55PBT45

S pore, d	501 μm
M pore, d	746 μm
L pore, d	1197 μm
Filament	230 μm

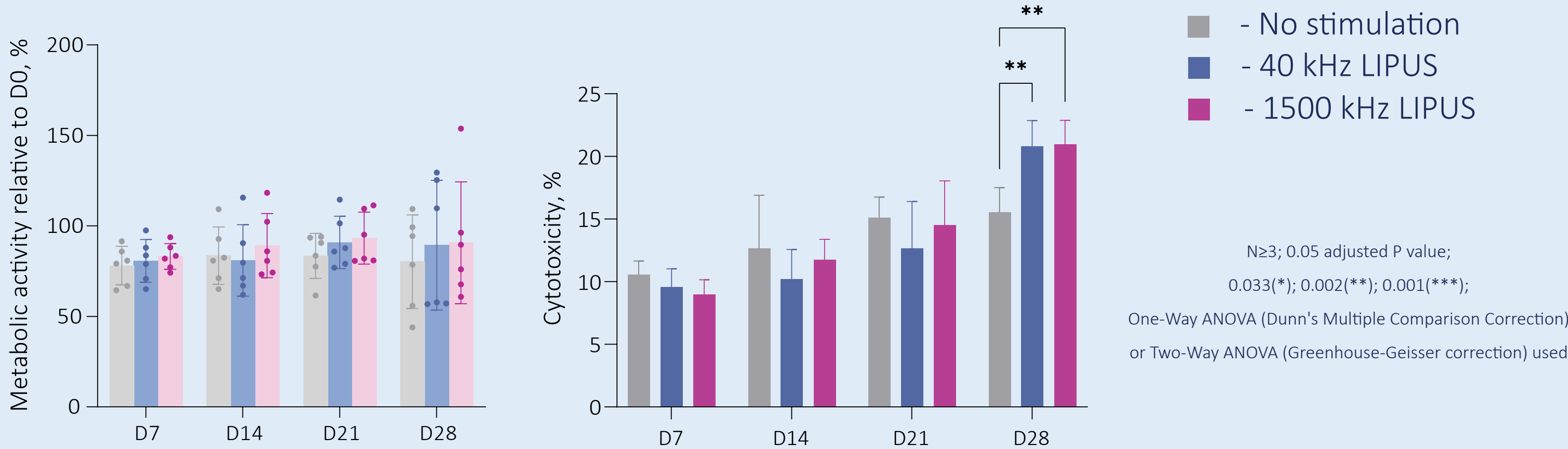


Seeded with hMSC (P5)

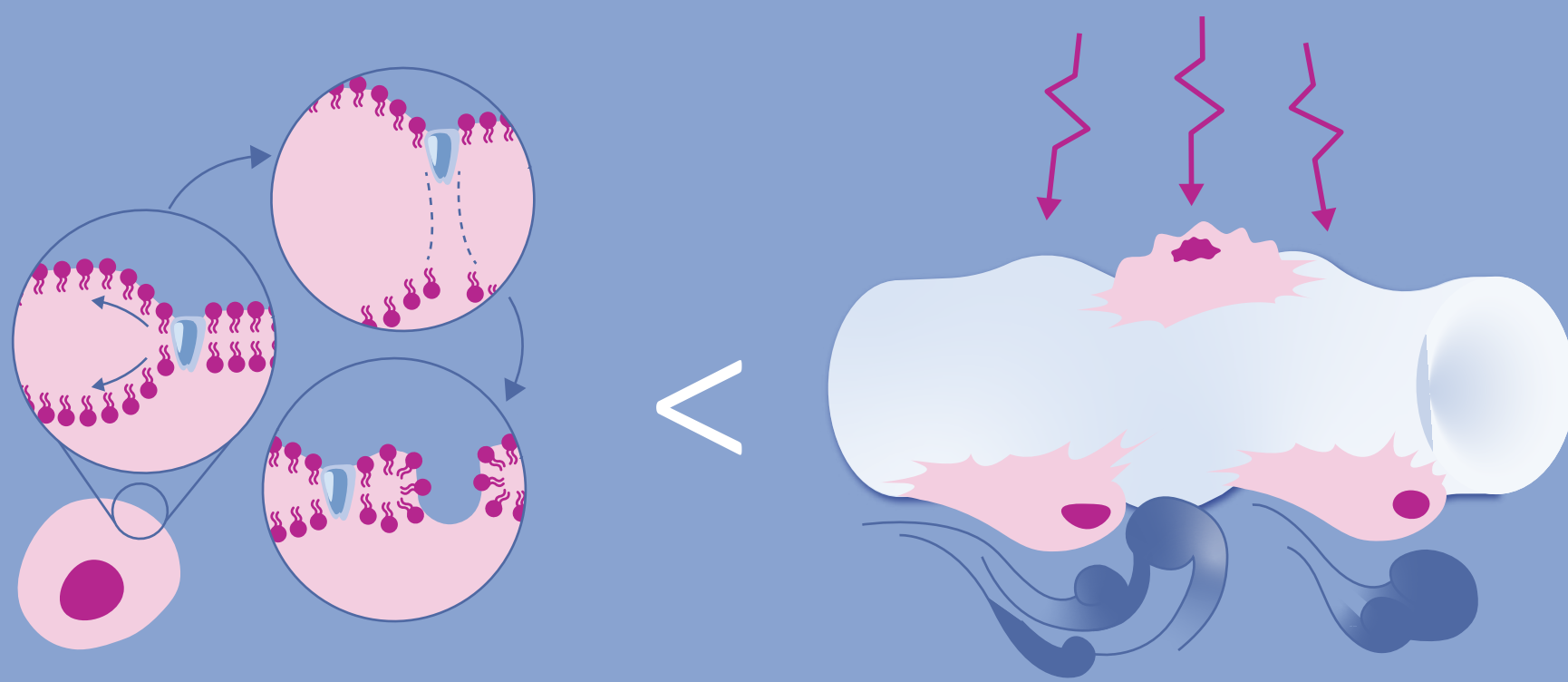


Results:

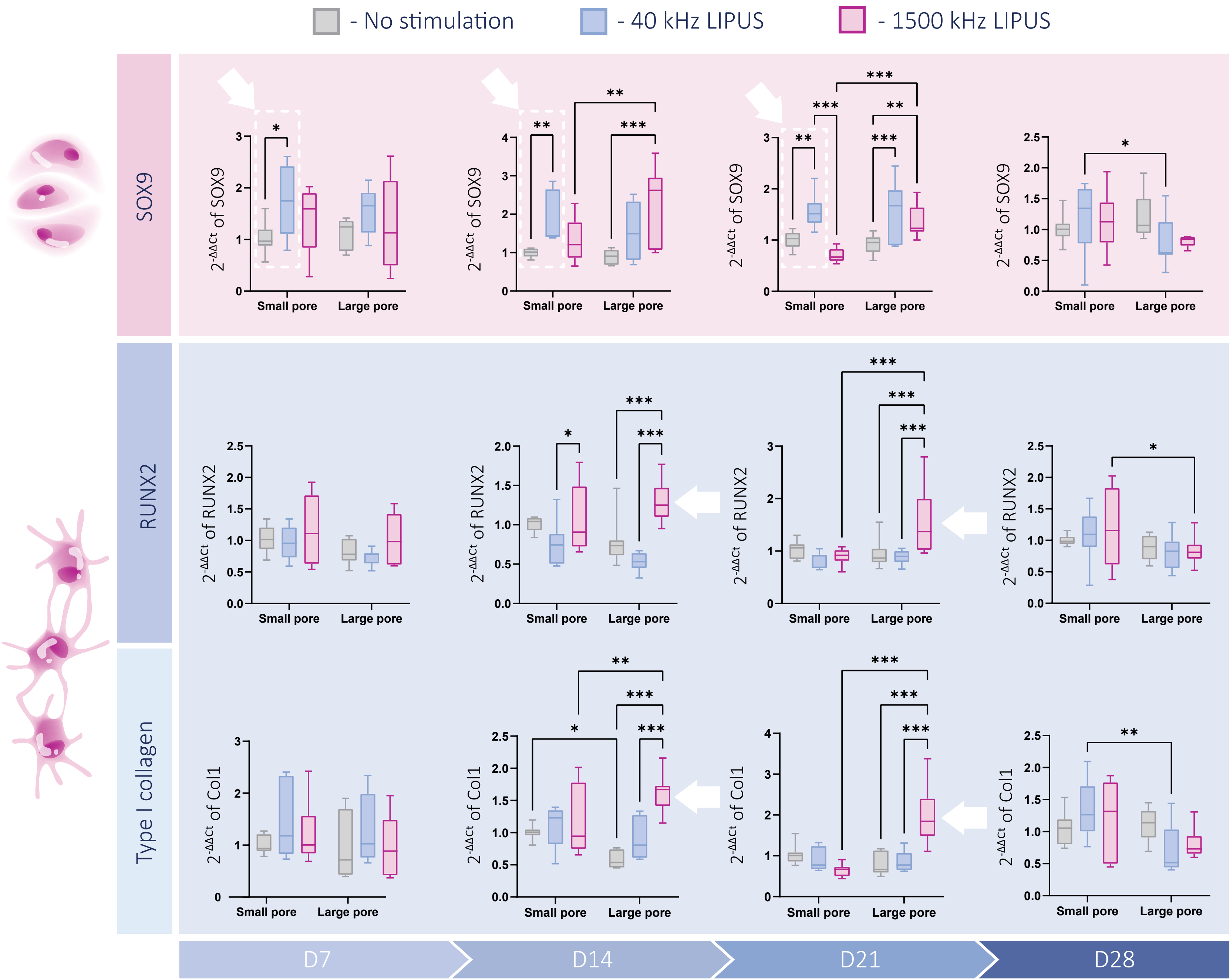
Metabolic activity and cytotoxicity in scaffold cultures:



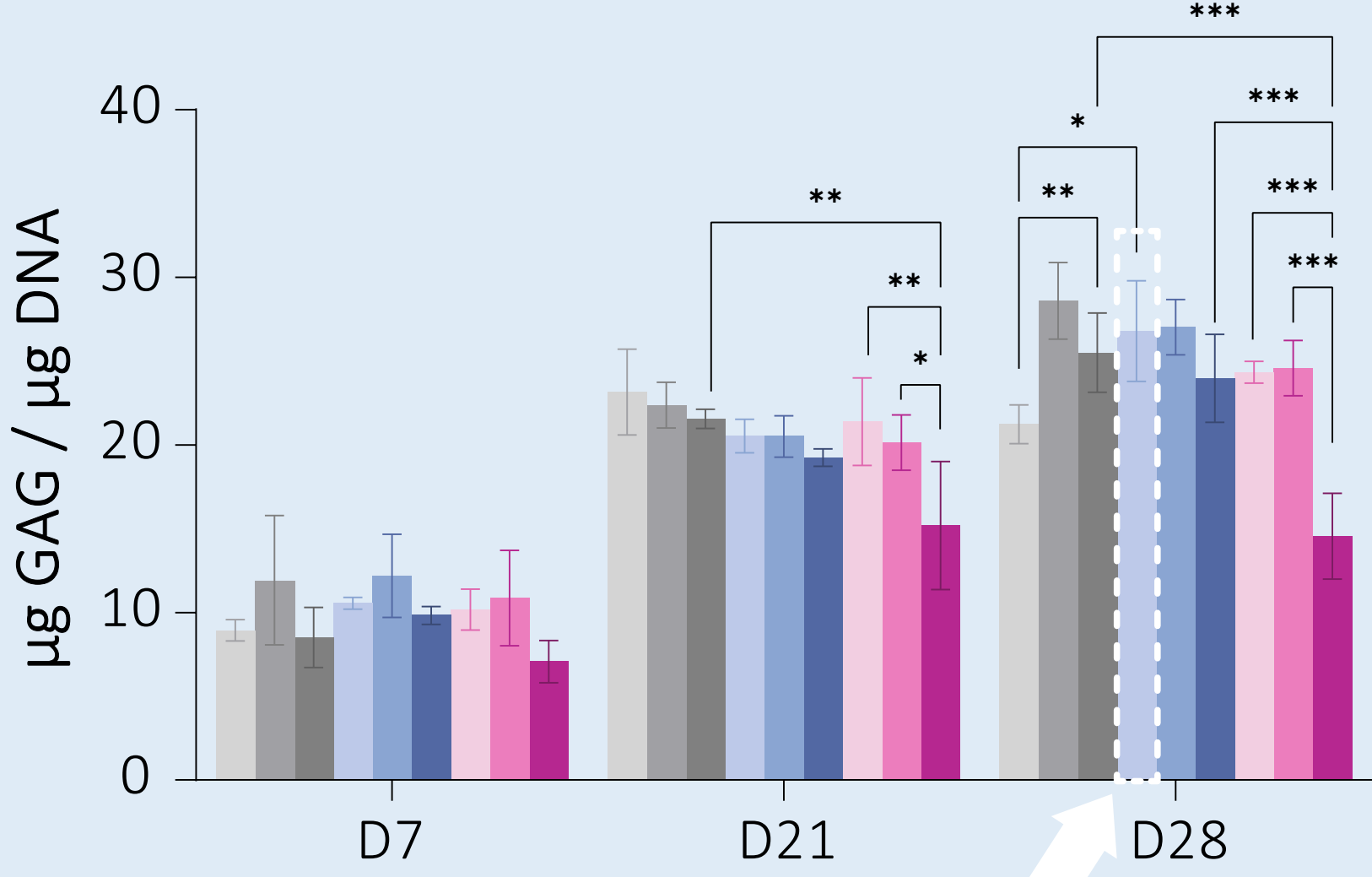
To minimize the effects from increased medium components uptake through sonoporation, and isolate the mechanical stimulation of LIPUS, proliferation medium was used.



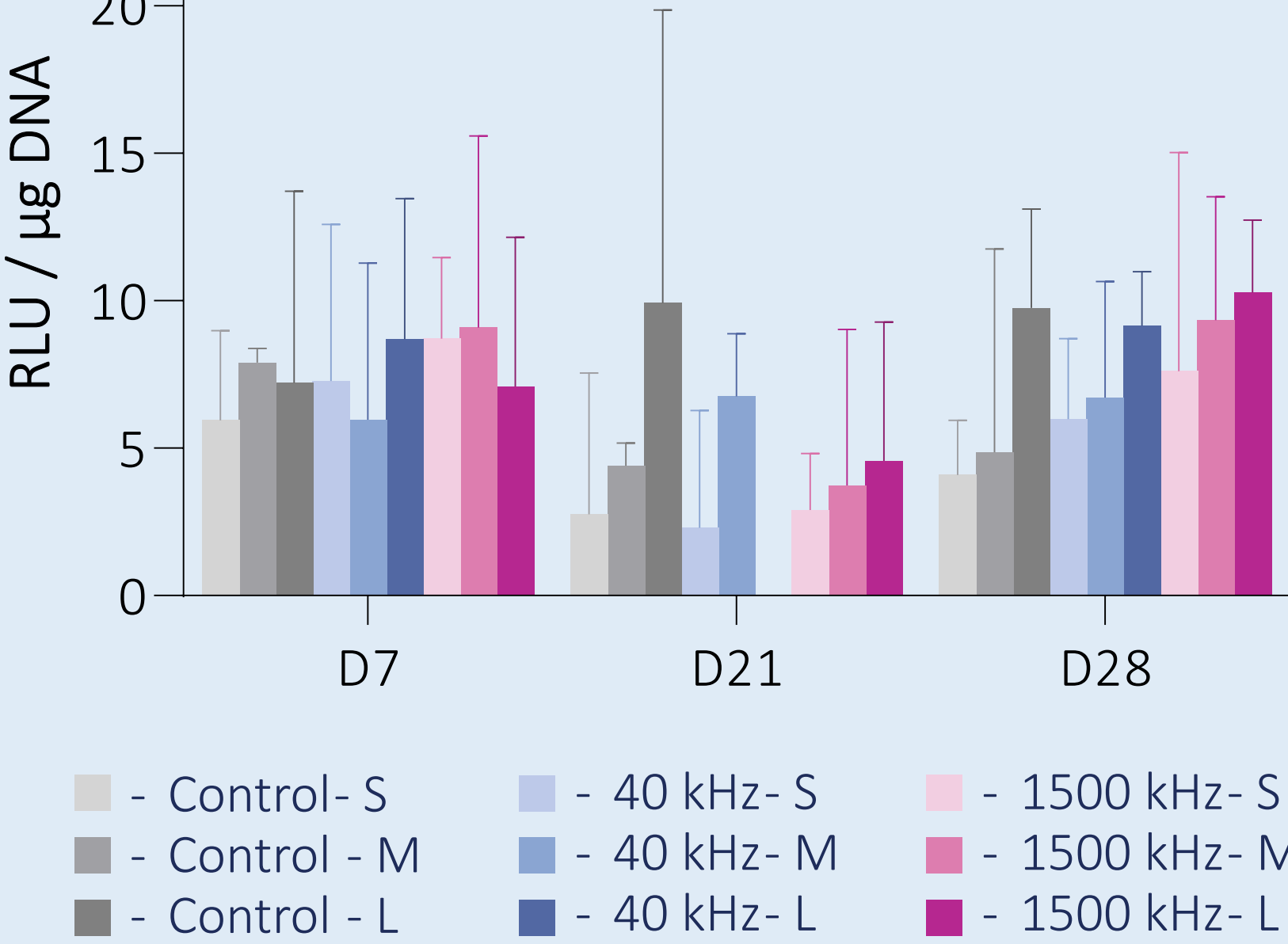
Pore size and stimulation type effect on osteochondral differentiation:



Glycosaminoglycans (GAGs) evaluation in scaffold cultures



Alkaline Phosphatase (ALP) evaluation in scaffold cultures

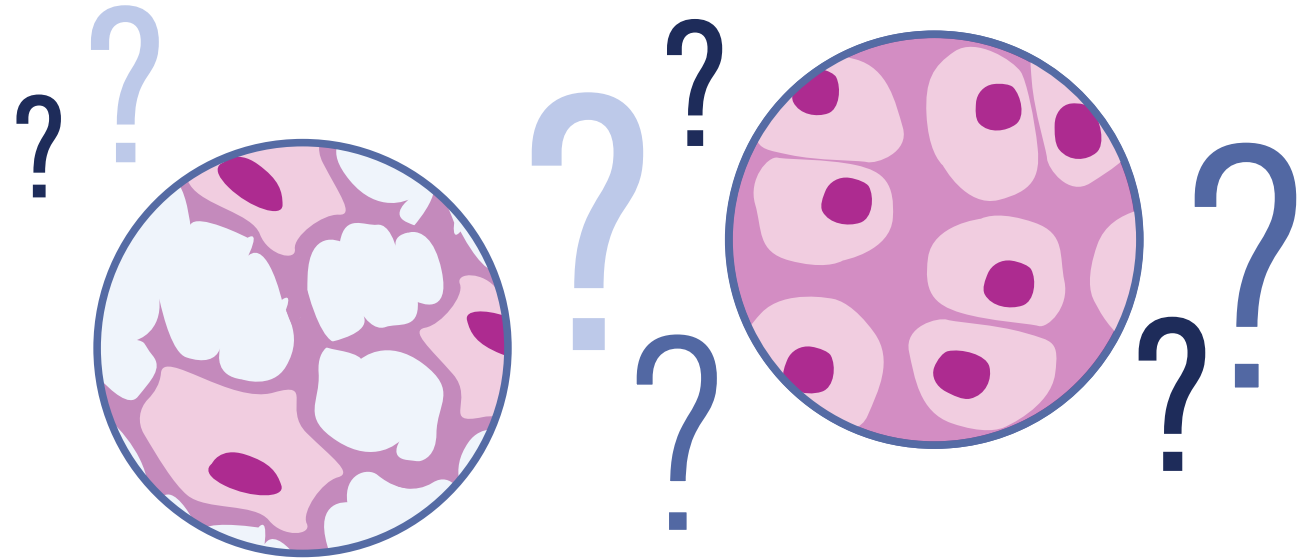
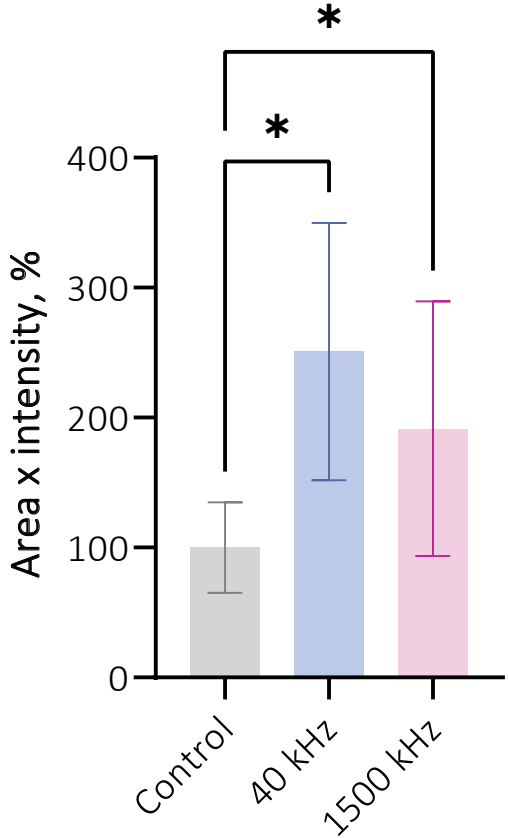


Outlook and perspectives:

Focus on mechanisms underlying cellular response:

Proliferation/metabolism:

Opening of PIEZO1, PIEZO2, TRPV1, and KCNK2 (TREK-1) channels causing an **influx of intracellular Ca²⁺**
Activation of voltage-gated Ca²⁺ channels



Proliferation/Differentiation:

Integrins and focal adhesions
Mitogen-activated protein kinase (MAPK/ERK) + Akt pathways
RhoA/ROCK/Myosin II Pathway
Wnt/ β -catenin Pathway
Low-level ROS and Inflammation

