



Research & Innovation
Transforming European
Healthcare

2023 11 16

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Regenerative Approaches for Joints and Heart



State Research Institute Centre for Innovative Medicine
Department of Regenerative Medicine



In collaboration with hospitals - human donor/patient tissues and cells

Articular cartilage,
Meniscus,
Synovium



Heart



Lungs



Bone marrow
Uterine/Menstrual blood



- ✓ Tissue engineering
- ✓ Novel therapies and drug toxicity
- ✓ Live cell and tissue Biobank
- ✓ Organ-on chip, biosensors, disease biomarkers



1. Joint diseases

Pathologies:
Osteoarthritis
Rheumatoid arthritis
Intravertebral disc degeneration



Type 1:
inflammation
and edema



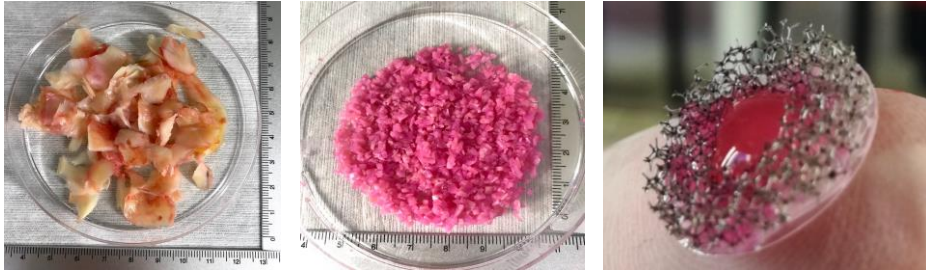
Type 2:
fatty
infiltration



Type 3:
sclerotic change
and endplate

Recapitulation of natural tissue 3D microenvironment in vitro

Human patient cell culture models and tissue engineering

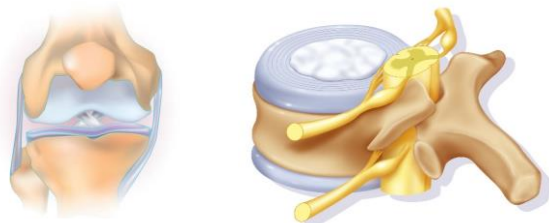


- Tissue explants, cocultures, engineering
- Ion channels (Ca^{2+}) VOCC
- Secretome, exosomes, proteomics

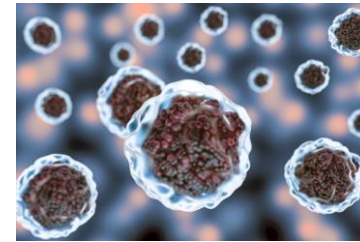
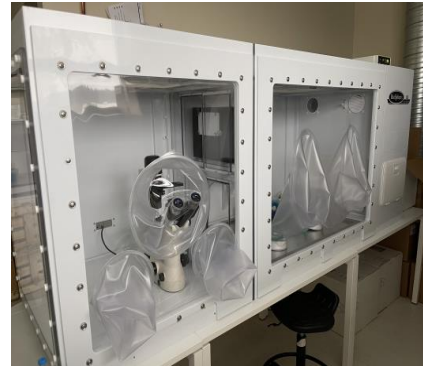
✓ Horizon Europe project TWINFLAG

2023-2025

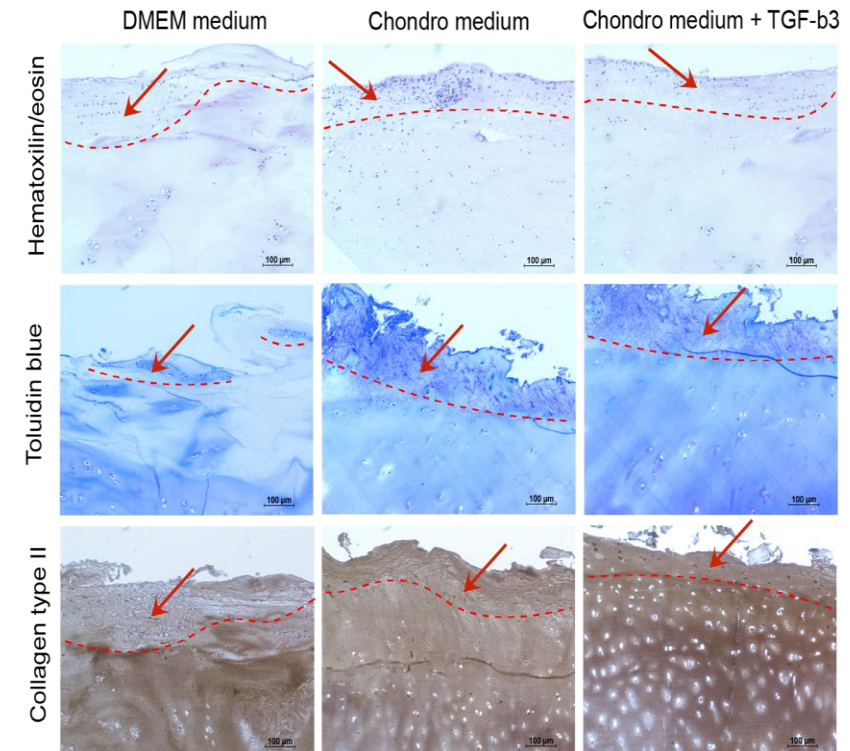
➤ Physioxia and Hypoxia



O_2 2-9 % 1-5 %

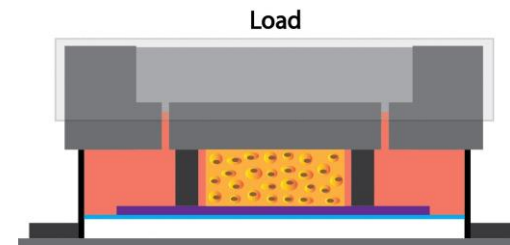
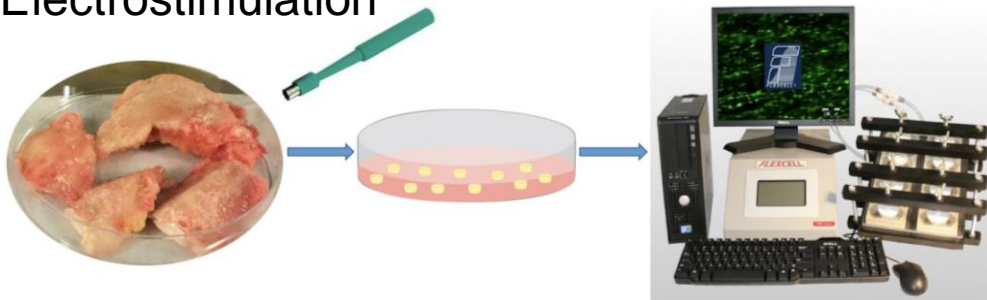


Biointegration of MSC loaded hydrogel into cartilage:



➤ Mechanical load for 3D cultures using Flexcell FX5000 system.

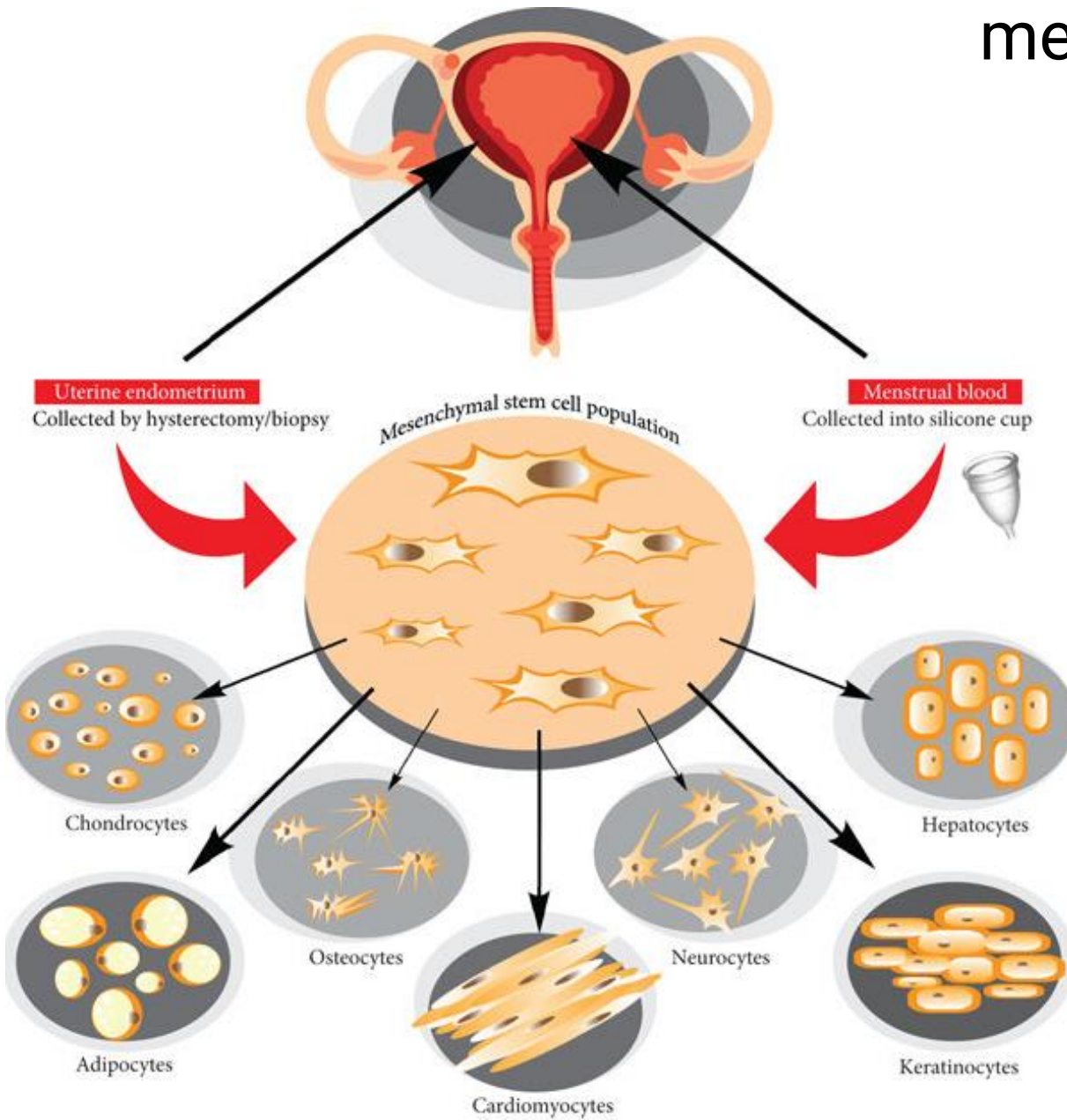
➤ Electrostimulation



Menstrual blood mesenchymal stem cells



➤ Dr. Ilona Uzieliene



Hindawi
Stem Cells International
Volume 2018, Article ID 5748126, 10 pages
<https://doi.org/10.1155/2018/5748126>

Review Article

The Potential of Menstrual Blood-Derived Mesenchymal Stem Cells for Cartilage Repair and Regeneration: Novel Aspects

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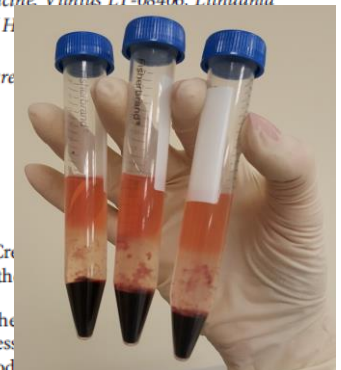
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Menstrual blood is a unique body fluid that contains mesenchymal stem cells (MSCs). The attention due to their exceptional advantages including easy access and frequently accessible source, as well as their self-renewal and differentiation potential, has led to their use in complex ethical and surgical interventions, as compared to other tissues. Menstrual blood-derived MSCs have been shown to possess similar stem cell properties and even have a greater proliferation and differentiation potential as compared to bone marrow-derived MSCs.





Pathologies:
cardiomyopathies,
arrhythmias,
channelopathies

2. Heart

Development of novel therapeutics,
drug cardiotoxicity testing

ElectroMechanoActive Polymer-based Scaffolds for Heart-on-Chip, H2020: EMAPS 2021-2025

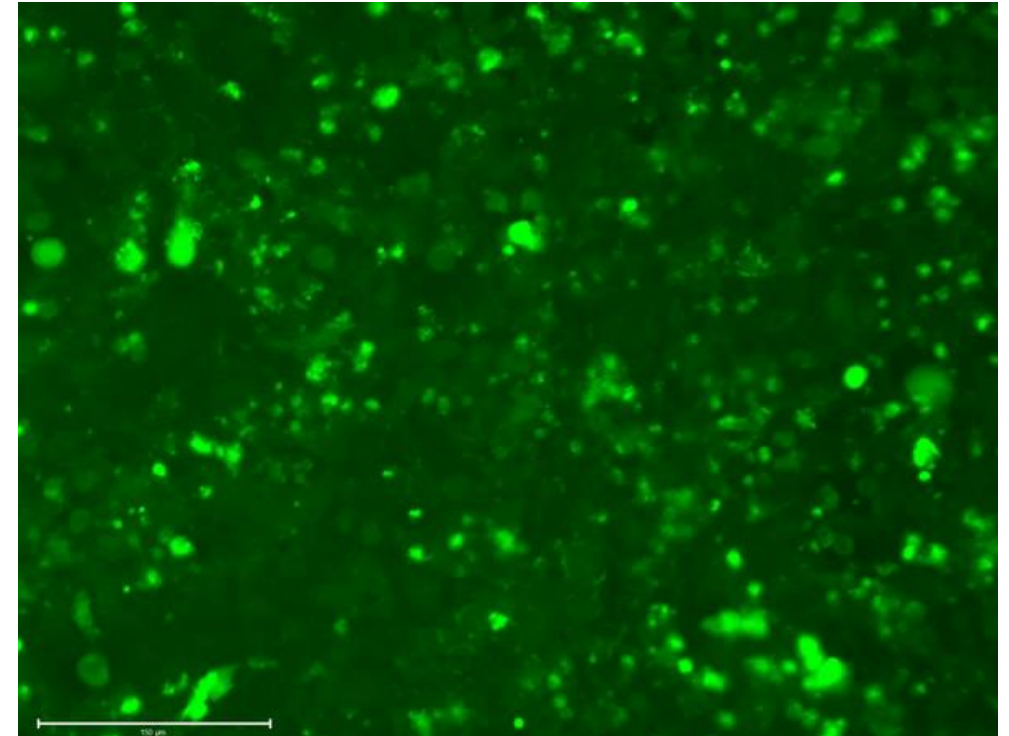


Development of platform for maturation of cardiac microtissues biomimetic 3D microenvironment stimuli :

- Electrical,
- Mechanical,
- Biochemical
- Physioxia

Role of IMC:

- ✓ evaluation of human iPSC-derived cardiomyocyte maturation on the scaffolds
- ✓ Ion channels (Ca²⁺) VOCC
- ✓ heart disease modeling
- ✓ responses to drugs



EMAPS

Advancing the Understanding and Treatment of Heart Diseases



Department of Regenerative Medicine

- Cell cultures; Physioxia/Hypoxia-inducing chamber for environmental change analysis (Biospherix x3).
- Microscopic imaging using light, epifluorescence (EVOS M7000), holomonitor etc.
- Analysis of cell surface/cytoplasmic markers, microparticles, using cell sorting with the FACS Aria II/magnetic activated cell sorting (MACS).
- Platforms for mechanical and electrostimulation of cells and tissue explants.
- Seahorse for analysis of metabolism
- Histology and immunohistochemistry.
- Cytoflex LX flow cytometer for Microvesicle/Exosome analysis



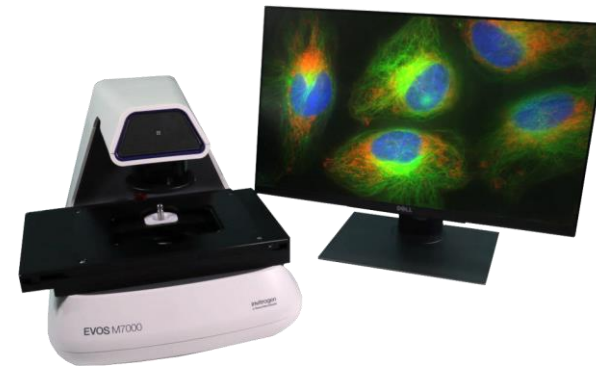
Luminex 200 system



PCR Quantstudio 1



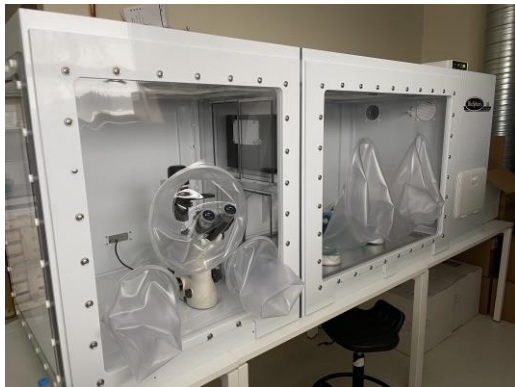
Magnetic-activated cell sorting (MACS)



Fluorescent microscope EVOS M7000



Electrical stimulation of cells



Hypoxia chamber Biospherix x3



Spectrophotometer Spectramax i3



Flow cytometer FACS Aria II



Holomonitor for live cell imaging



Mechanical compression on 3D cultures. Flexcell fx5000



Thank you!



Cooperation opportunities ?