Challenges of co-culturing osteogenic and endothelial cells within collagen/hydroxyapatite scaffolds – which hurdles have to be overcome?

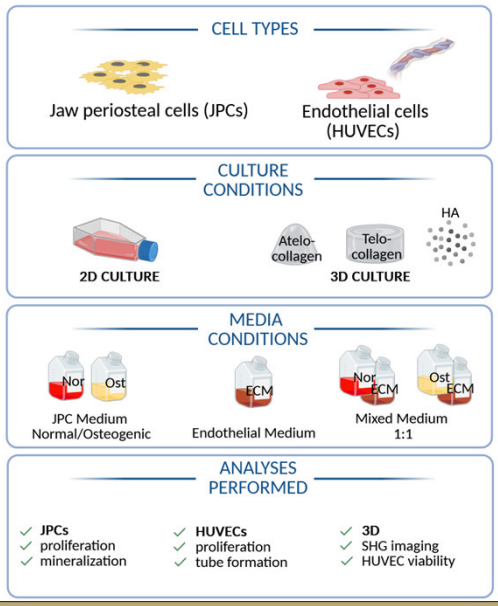
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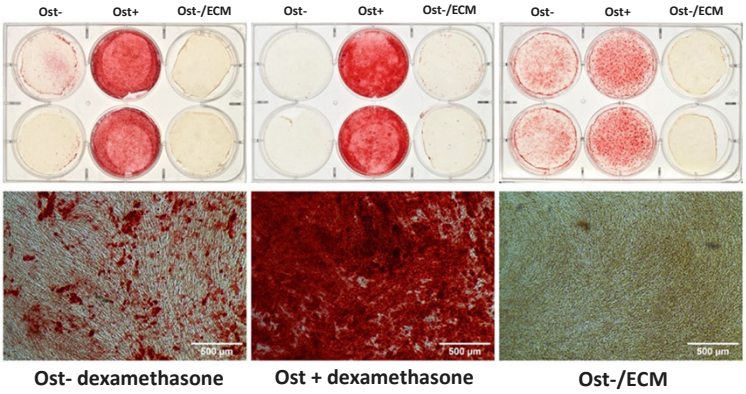
Aim of the project and experimental procedure

Establishment of common culture conditions for jaw periosteal and endothelial cells to develop vascularized bone constructs. JPC media (normal/osteogenic), ECM medium and mixed media were used to evaluate cell functionalities.



RESULTS

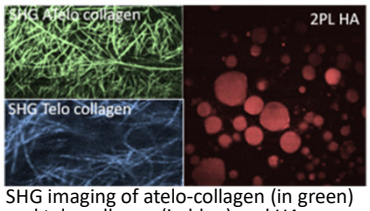
JPC Mineralization in 2D



JPC mineralization was strongest under osteogenic conditions with dexamethasone, weaker without it, and absent in mixed media with or without dexamethasone.

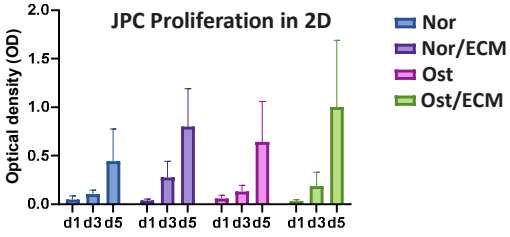
RESULTS

SHG Imaging of Scaffolds

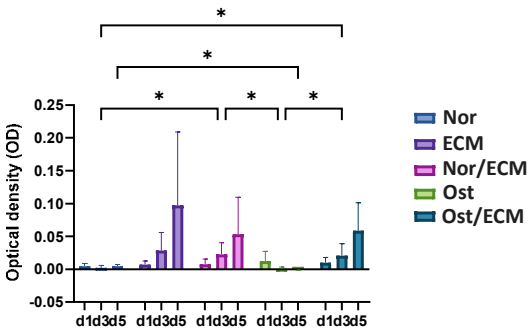


SHG imaging of atelo-collagen (in green) and telo-collagen (in blue) and HA particles in red

JPC Proliferation in 2D

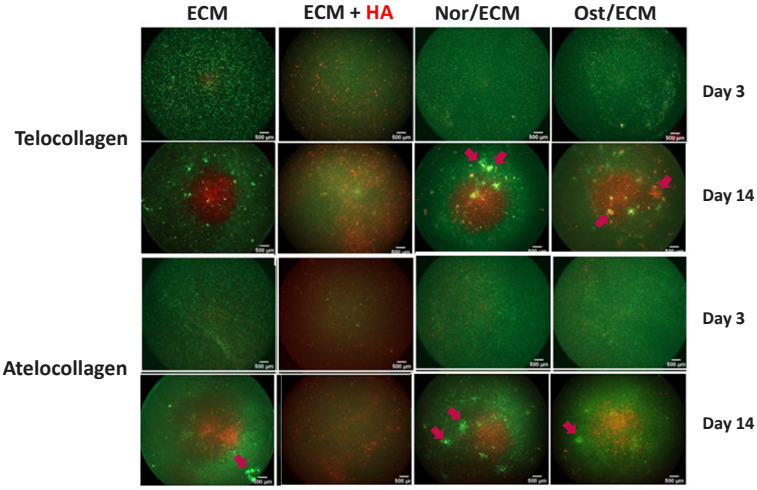


HUVEC Proliferation in 2D



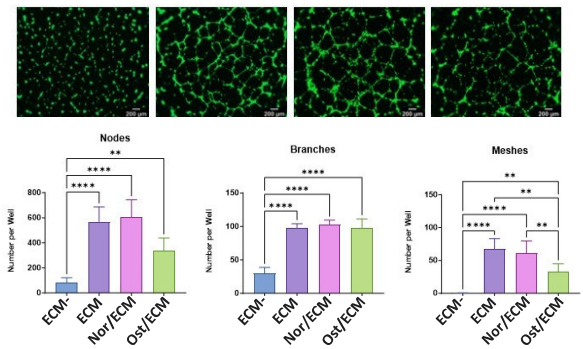
JPCs and HUVECs proliferate very good under mixed media conditions.

HUVEC Vitality in 3D



HUVEC formed mainly under mixed media conditions sprout-like structures.

HUVEC Tube Formation



HUVEC formed tubes mainly under Nor/ECM but not under Ost/ECM mixed media conditions.

Conclusion

- ❖HUVEC proliferation in 2D was supported by mixed media and unaffected by phosphate.
- ❖However, in 3D, osteogenic phosphate levels strongly impaired endothelial functionality: tube formation was diminished, and despite initial sprouting, extensive HUVEC death occurred after 14 days under osteogenic conditions.
- ❖We conclude that osteogenic and angiogenic culture conditions are incompatible within the same scaffold. Spatial separation of endothelial cells within collagen/HA composites is required to prevent phosphate exposure, which is detrimental to endothelial function.