Skin equivalent through bioprinting

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The Lyon Biochip group:
- We have an open source and application driven approach.
- We aim at filling the gap between technology and application using additive technology.

The 3d.FAB platform: the only French platform dedicated to academic and private innovation through 3D printing, in the field of health.

The printed dermis project = made dermis via bioprinting
A. Platform
Platform presentation

**3D FAB = 3D Fabric of Advanced Biology**

Platform is specialized in biology/material interaction.

2 areas of expertise:
- Biochemistry for diagnostic.
- Biology for regenerative medicine.

Available technology

Biochemistry, especially diagnosis
Hardened materials for rapid prototyping of diagnostic devices with multicomponent possibilities.

Regenerative medicine
Soft materials for biology: the future of medicine, via bio-extrusion and photopolymerization with a large range of hydrogel-like polymers.

TOBECA®
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B9 Creator
B. Bioprinting process
Bio-extrusion process

Biomaterials mix + Cells → Bio-ink

Bioprinter: Loading Bio-ink into a syringe

Print → Final object

Cell maturation step

Patent number: 1563461
Bio-ink

The special bio-ink formulation has three purposes:
- maintaining an appropriate gel rheology during the extrusion process,
- enabling the consolidation of the printed object during the post-processing step
- allowing the adequate development of the 3D cell network leading to a correct organisation and function of the maturate tissue.
Bioprinter
Examples
Maturation step

Allows cell proliferation and synthesis of Extra-Cellular Matrix

In this step, we need to control:
- Degradation rate of the hydrogel which is replaced by neosynthetised ECM
- Addition of growth factor
C. Results of bioprinting dermis
Macroscopic appearance
Printed dermis morphology D12

Harris' hematoxylin–phloxin–saffron (HPS) staining:

x20 x10

Control without cells
x20
Vimentin staining allows to see cytoskeleton in green and nucleus in blue.
Printed dermis morphology D30

Keratinocytes seeding at D5

Keratinocytes seeding at D12
Harris' hematoxylin–phloxin–saffron (HPS) staining:

Masson’s Trichrome staining:
Epidermis marker: Fluorescent microscopy observation

Human skin

Skin equivalent

Printed skin

Epidermal differentiation and dermal marker profile of bio-printed SEs in comparison to NHS from healthy donor. Scale bar: 50 µm.
Dermal Marker

**Elastine**

**Vimentin**

**Fibrilin**

**Collagen I**

**Collagen V**

**Human skin**

**Skin equivalent**

**Printed skin**
Conclusion

What can we do:
- Skin printing
- Cartilage printing too

Next step: printed skin for burned people
Thanks for your attention

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