

3d (bio)printing in healthcare & regulatory affairs vision

Dr. Christophe Marquette, Dr. Edwin-Joffrey Courtial & Dr. Célia Halimi

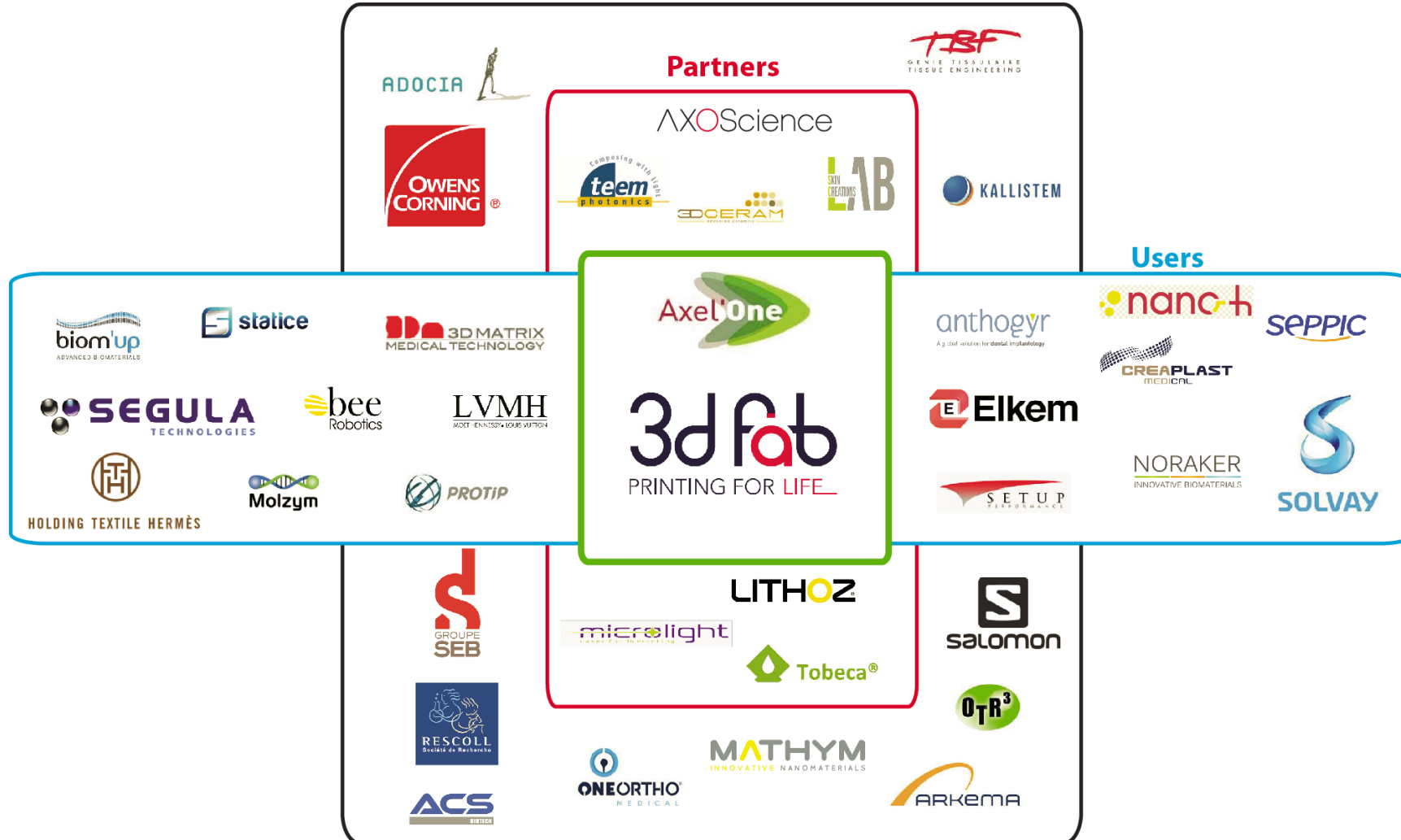
Institute of Chemistry and Molecular and Supramolecular Biochemistry Team Enzyme Engineering, Biomimetic Membranes and Supramolecular Assemblies, CNRS 5246 ICBMS, University of Lyon 1, Villeurbanne, France.

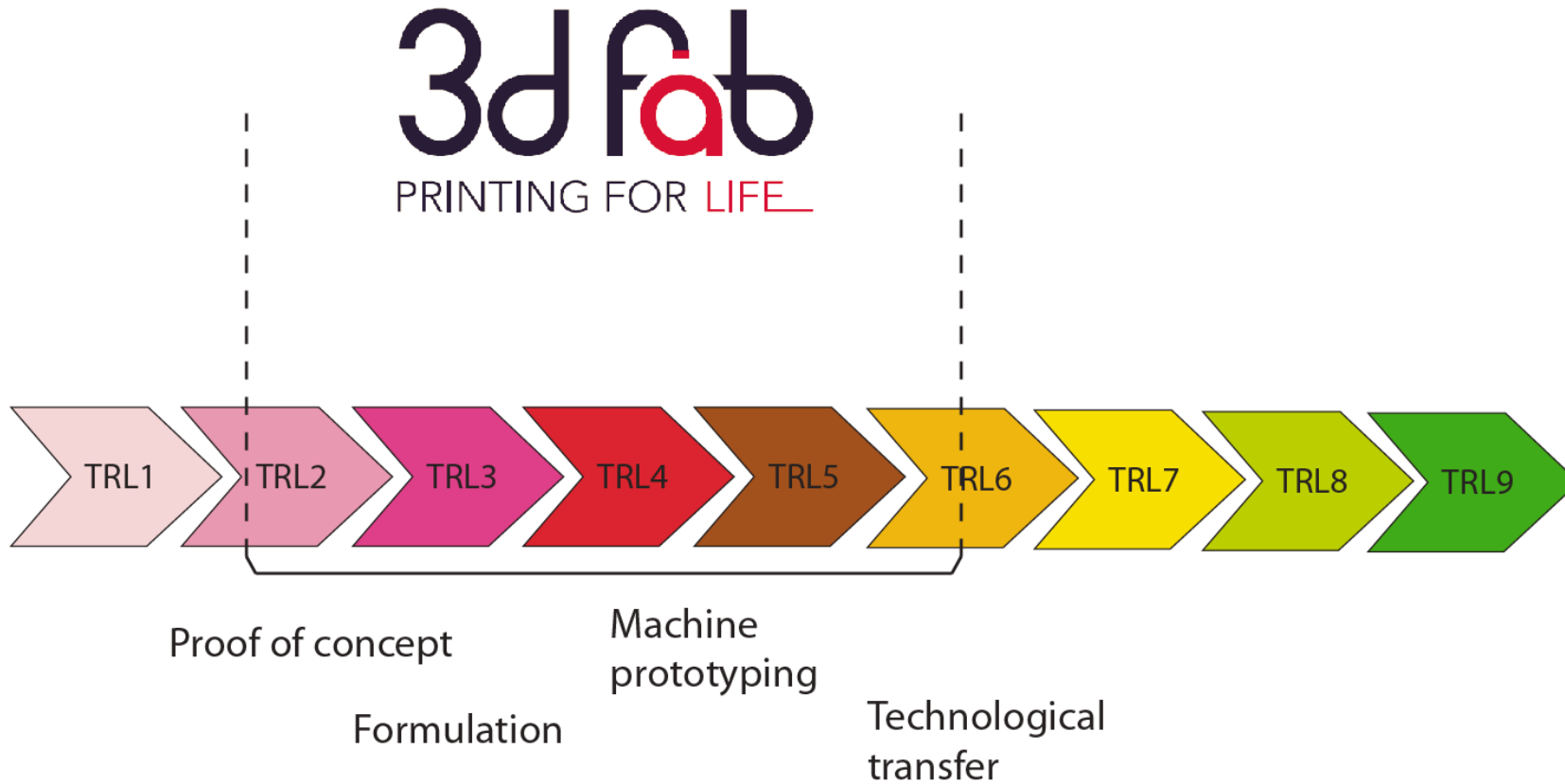


3d.FAB presentation



Contacts







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Coordinator

Quality Manager – ISO 13485

Rheology / Mechanic / extruder design

Bioreactors

4D: biomolecules printing

Material sciences & chemistry

4D: biomolecules printing

Bioprinting

Tissue bioprinting (soft tissues)

Tissue bioprinting (bones)

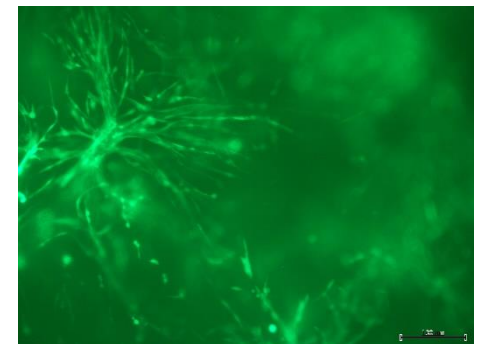
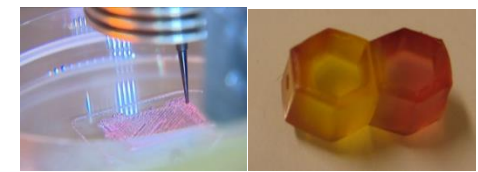
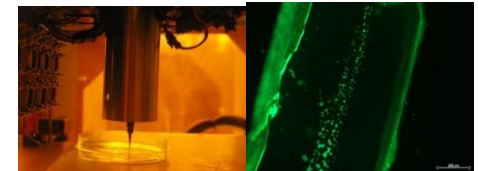
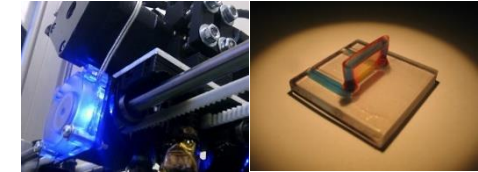
3d (bio)printing – Environment control

Photo initiators/photopolymers

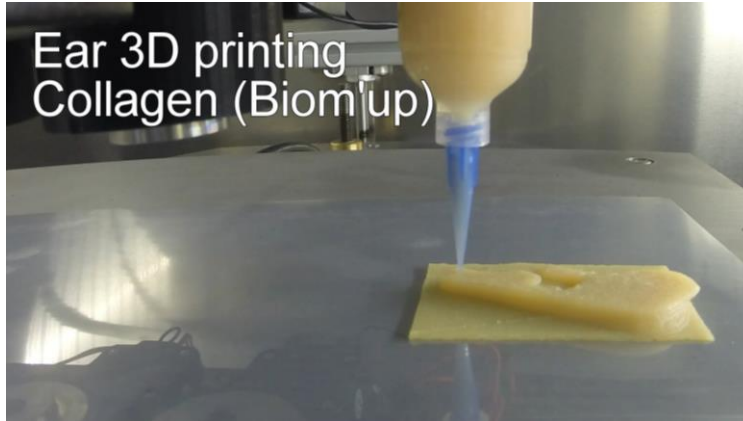
2-photons Polymerisation

Ceramic and biocompatibility

Ceramic printing

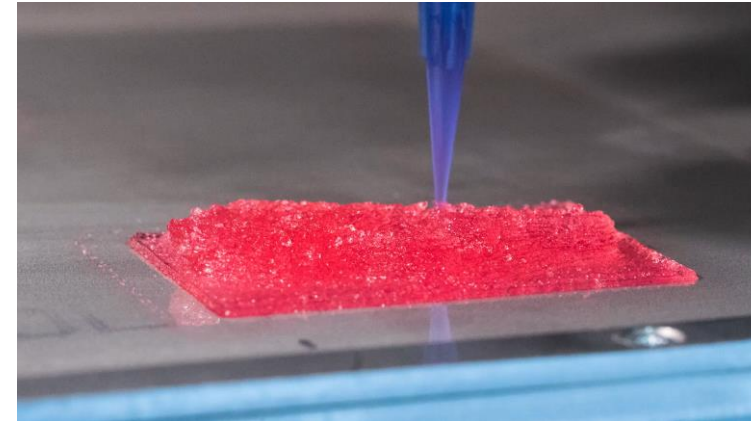


Introduction of 3d printing

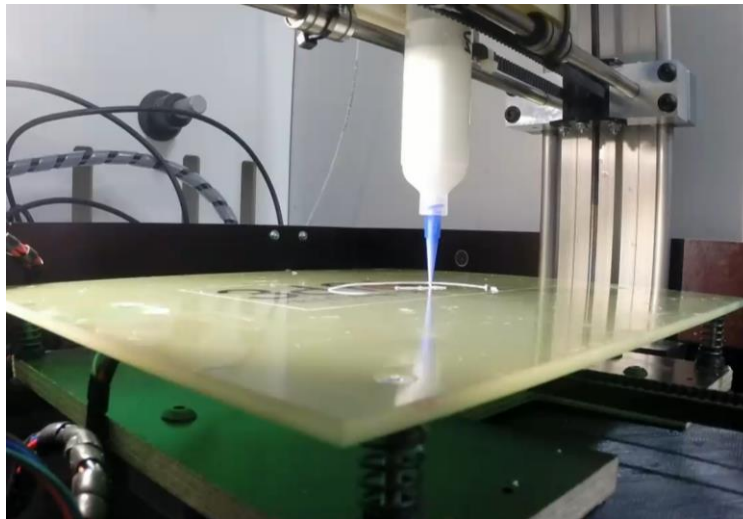


Ear 3D printing
Collagen (Biomfup)

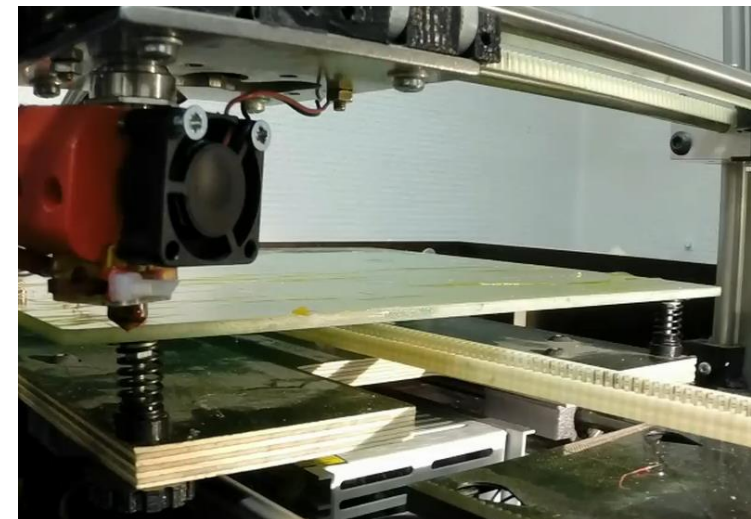
Collagen



Biogel



Silicone

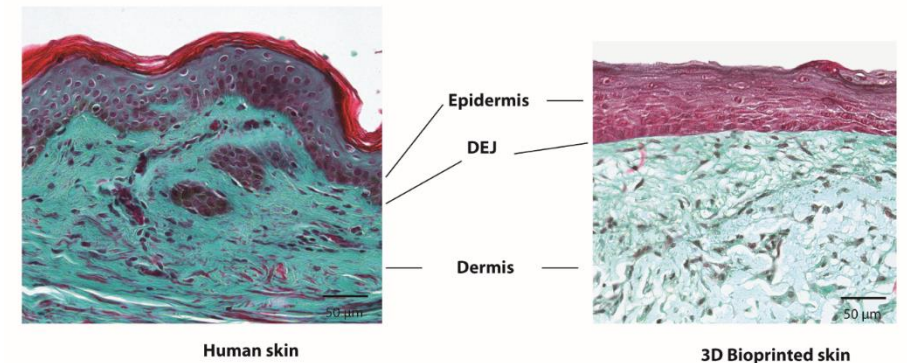
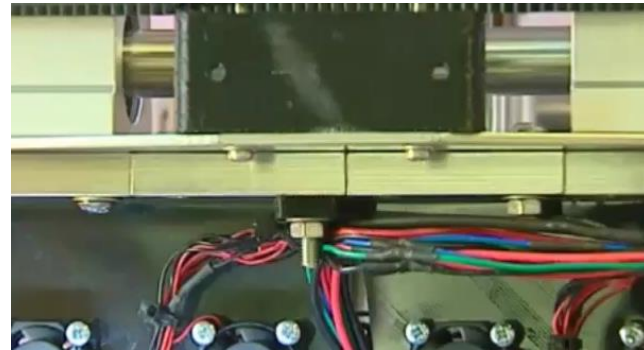
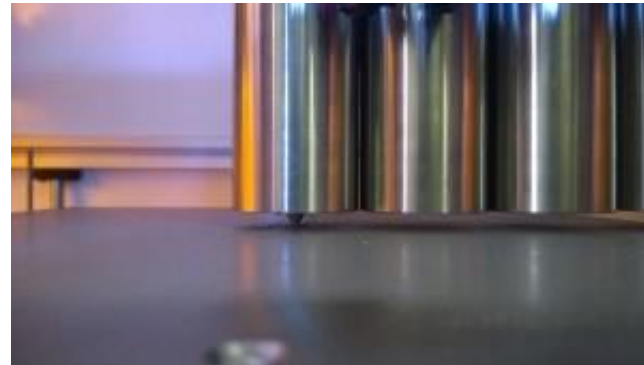


Thermoplastic

Available technologies & Medical application

Bioprinting

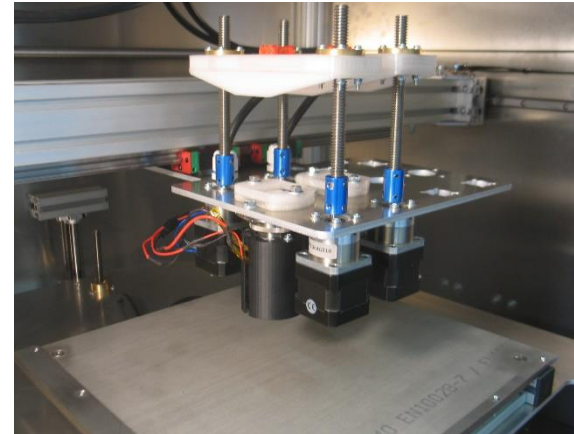
Skin Bioprinter



Marquette Christophe, Lea, Thepot Amelie. Procédé De Fabrication De Substituts Cutanés Par Dépôt Additif. Patent N° 15 63461 (30/12/2015).

Bioprinting

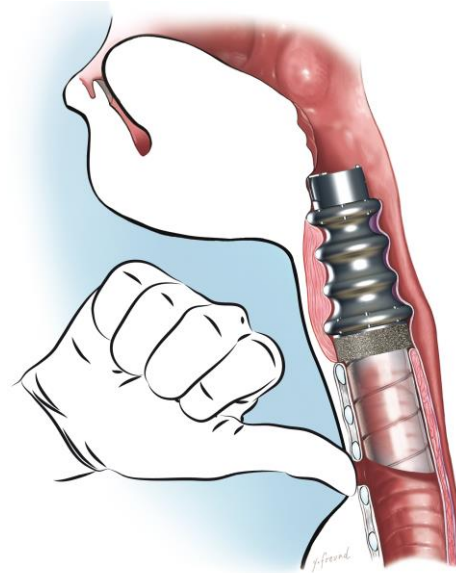
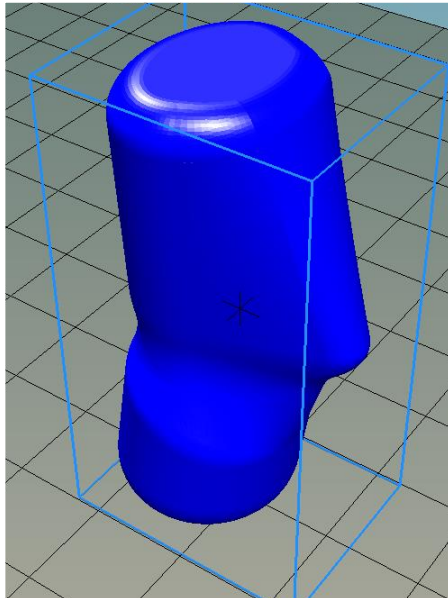
R&D Bioprinter



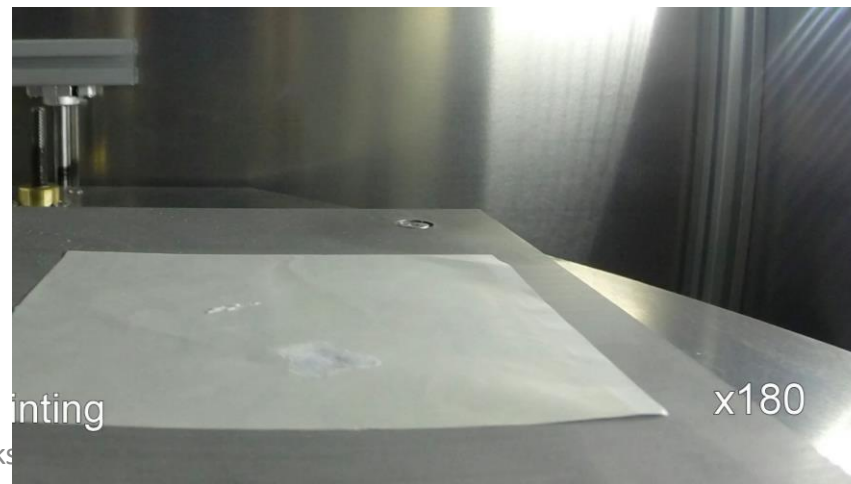
- 4 thermostated heads
- Full enclosure temperature control
- Building platform cooling down to 4°C
- UV decontamination
- Full stainless steel structure for P2 lab

Silicone printing

Prosthesis printing for airways

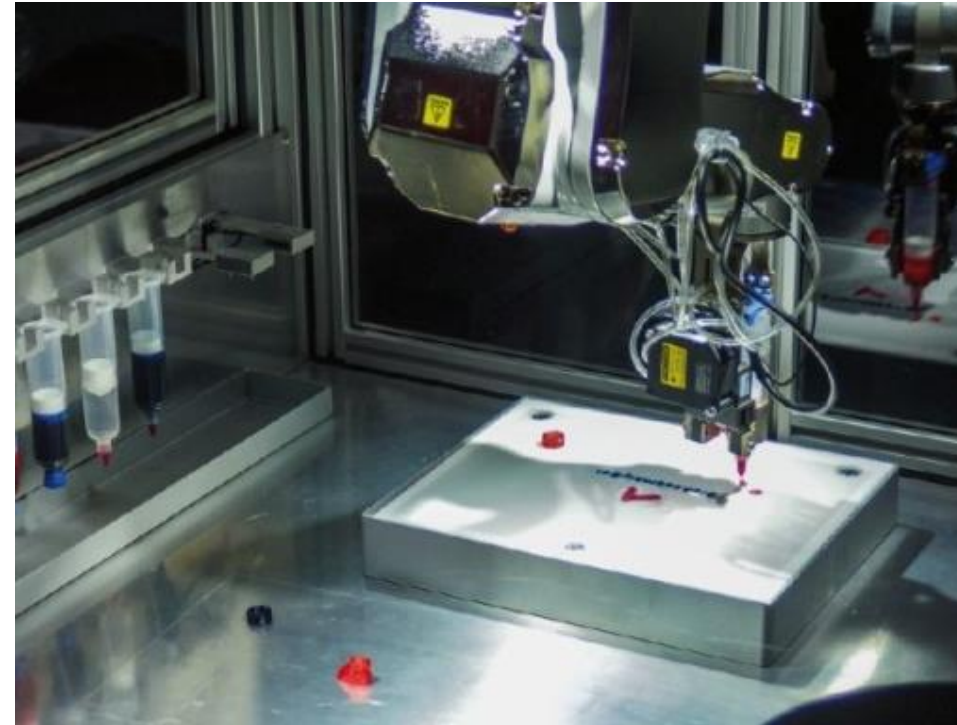


Printing highly complex implants



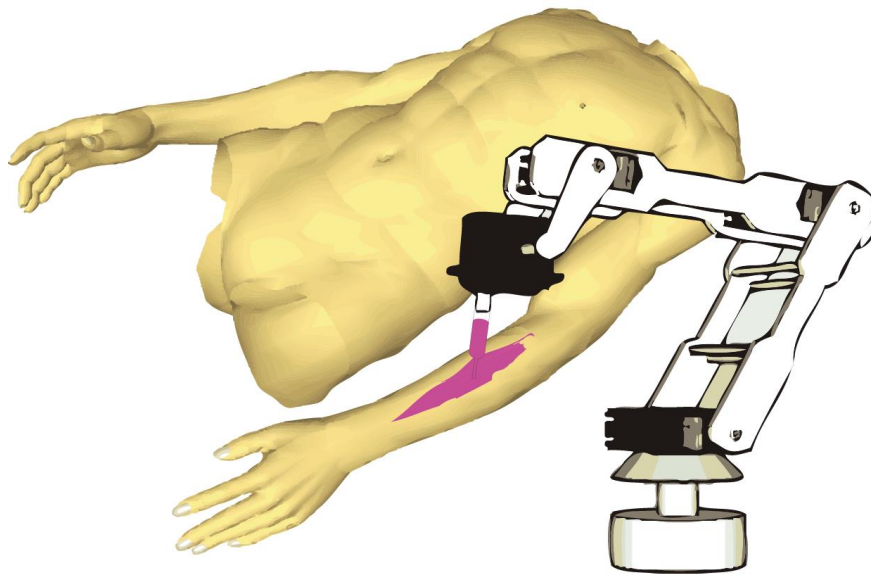
Bioprinting

Surgery theatre bioprinter



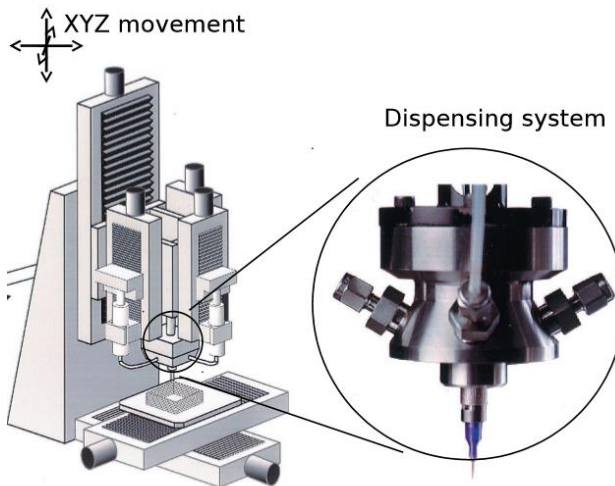
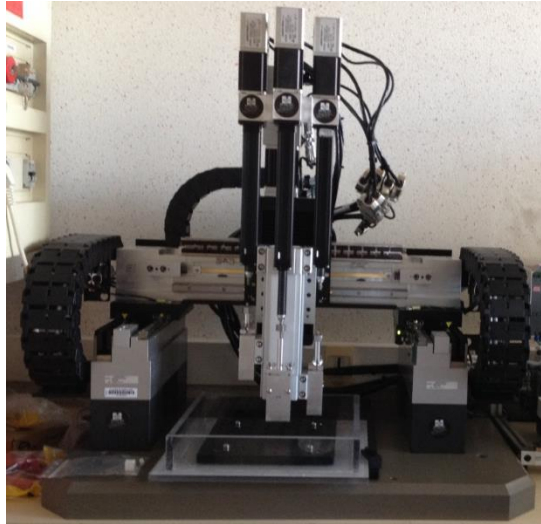
In vivo 3D bioprinting

in vivo bioprinting

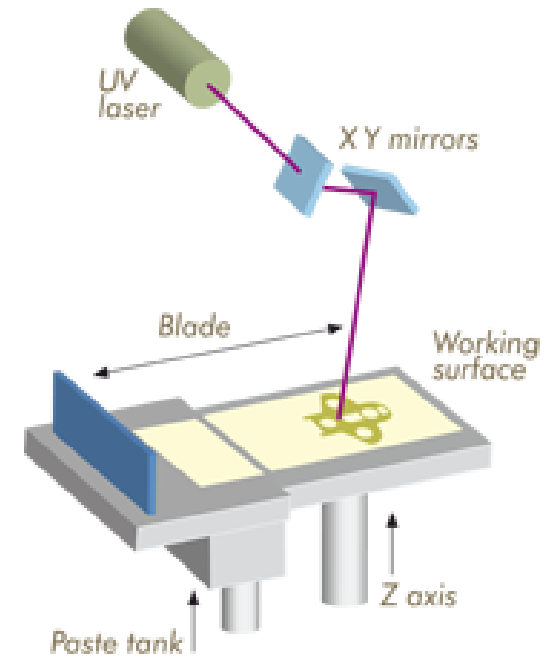
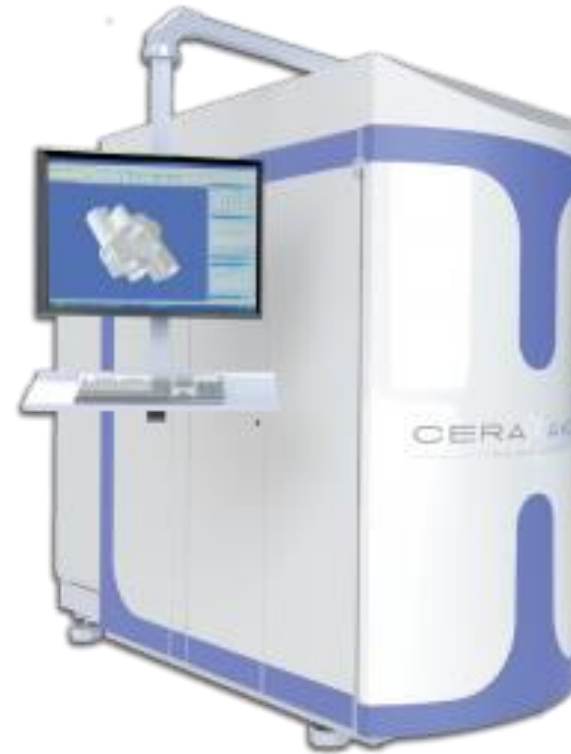


Ceramic printing

Robocasting

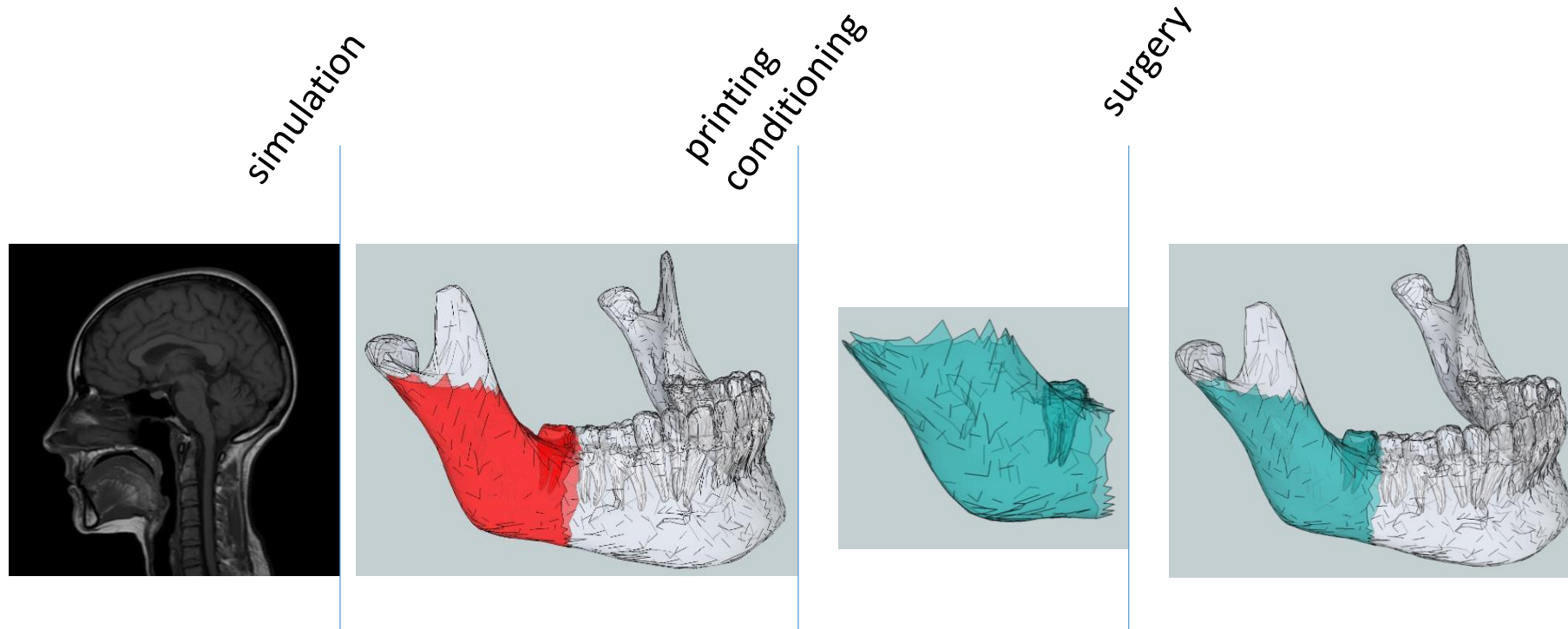


Stereo lithography



Bone printing

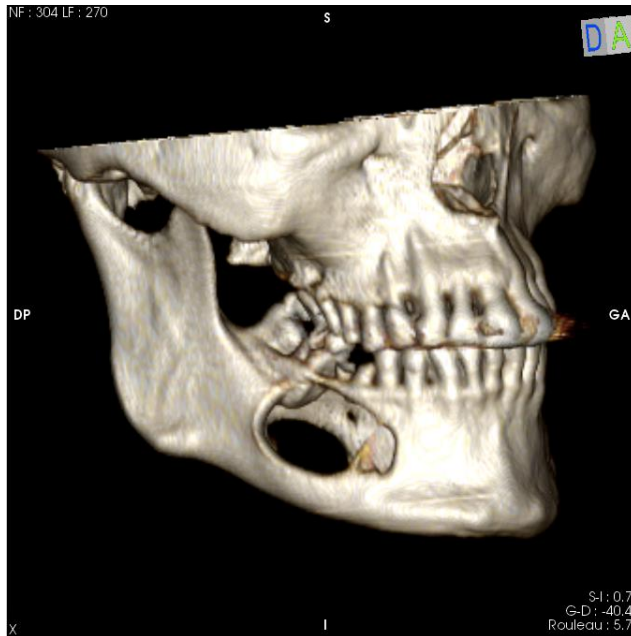
Grafts and implants for maxillofacial reconstruction



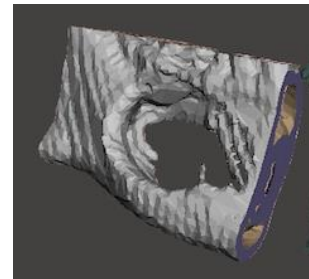
Bone printing (ceramic printing approach)

Grafts and implants for maxillofacial reconstruction

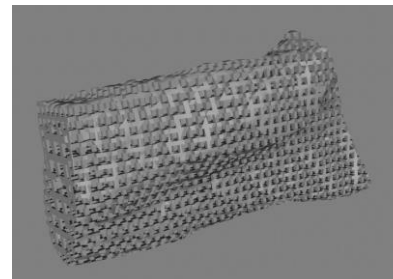
Printing ceramic and seeding with living cells from
spongy bone (Iliac crete)



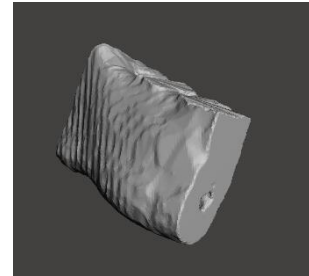
Removed defect



Printed construct



Potential construct



Cellularized construct

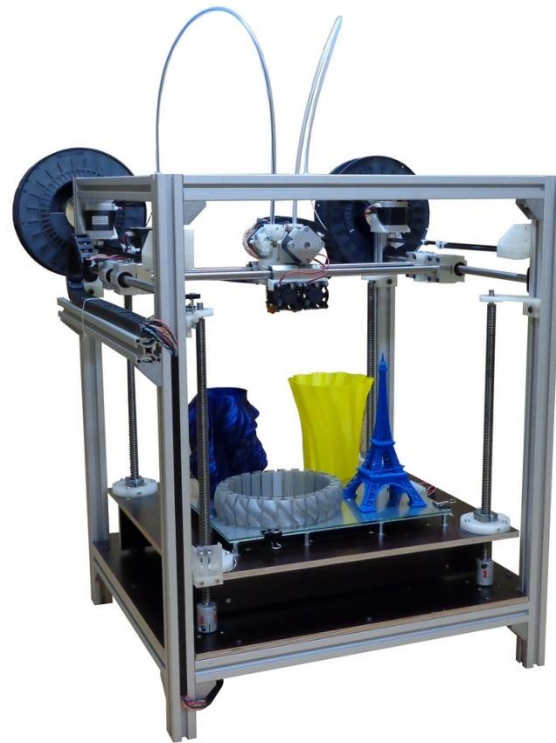


Plastic prototyping

Ink Jet



Fused deposition



Hôpitaux de Lyon



VISIBLE PATIENT

Biomolecules printing (4D)

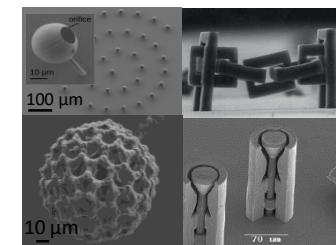
Digital Light processing



Ultra-high resolution Stereo-lithography



4D printing tools
diagnostic devices



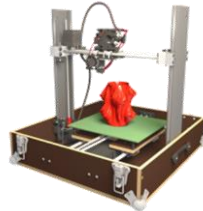
Extra-cellular-matrix
building
Sub-micron resolution
printing

Fast Ceramic Production



3D Ceram®

Extrusion FDM
(Fused Deposition Modeling)



Tobeca®

Inkjet



Polyjet
Stratasys

Stereolithography
Photo-polymerization

DLS
(Digital Light Processing)



B9 Creator

2-photons absorption
sub-micron laser
writing



Microlight®

Bio-extrusion

3 axes



Tobeca®

6 axes



BioassemblyBot

Hardened materials

- Ceramics

- PolyLactic Acid (PLA)
- Acrylonitrile Butadiene Styrene (ABS)
- PolyCarbonate (PC)
- Polyvinyl alcohol (PVA)

- Photopolymer (acrylate)

- Polymer-ceramic material
- Biocompatible materials

- Hydrogels
- Mineral gels

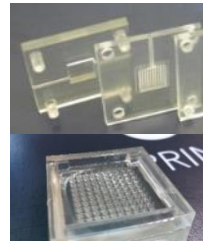
Soft materials



Ceramic printing
Scaffolds
Surrogates,
bone substitutes



Plastic
prototyping



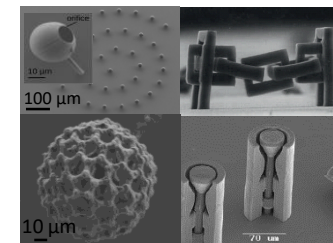
Functional devices



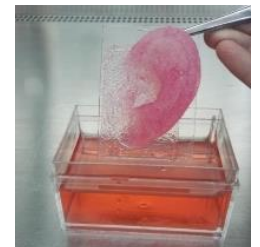
Medical training for
pediatric surgeon



4D printing tools
diagnostic devices



Extra-cellular-matrix
building
Sub-micron resolution
printing



Tissue
engineering,
Surrogates

Regulatory affairs for medical devices or drug manufactured by 3d printing

- Fabrication at the manufacturing company or in hospital (in the operating room)

Manufacturing company fabrication

- ✓ Easier to control all process
- ✓ Easier to determine responsibility
- × Longer than fabrication in hospital

Hospital fabrication

- ✓ Reduce the risk of contamination
- ✓ Reduce the time of fabrication (all steps are directly realized in the operating room)
- × More constrained for manufacturer (provision of service for maintenance printer, furniture of 3d model, harder to control)

Where manufacture? It depends on manufacturer development and affairs regulatory strategy

3D.FAB :

- Only academic platform dedicated on 3d printing, 3d bioprinting and 4d printing
- Skills : (Bio)Material science, 3d printing process (Ceramic and Polymers), Tissue engineering
- P2 laboratory for all activities in bioprinting

Need **robotic** development for medical applications including end-users (surgeon)

Strategy regulatory affairs for 3d printing in healthcare is complex and must be integrated in R&D project

3d fab
PRINTING FOR LIFE



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