Innovative bioabsorbable filaments for 3D printing: use cases in tissue engineering applications

Julien PAYEN, PhD – CEO Lattice Medical



With the support of:

LATTICE MEDICAL

- Incorporated late 2017
- Last funding round 43m€ Series B October 2025
- 28 FTE
- Surrounded by international KOL in plastic surgery and oncology surgery

Our Partners:

COUSIN SURGERY

DASSAULT SYSTEMES

ROUGEGORGE LINGERIE

CHU LILLE

Université de Lille

Inserm

Mission

Develop innovative medical devices to repair soft tissue defects induced by cancerous treatment



Breast Cancer & Reconstruction

1 in 8 women

Will suffer from breast cancer in the world

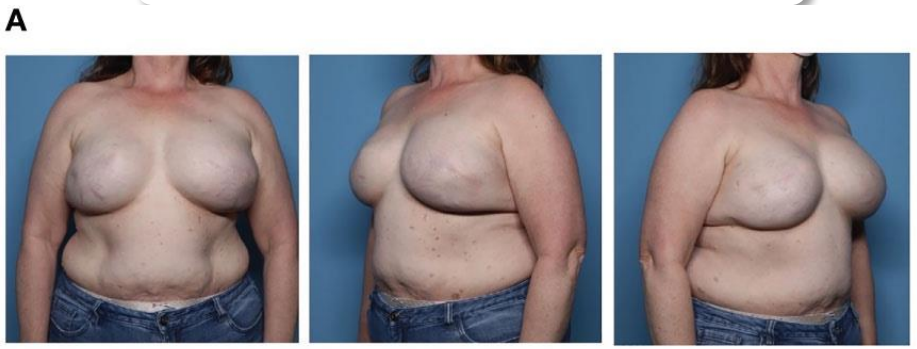
650 000

Mastectomies every year in Europe and USA

Only 30% of women

Have a reconstruction

Breast Implants

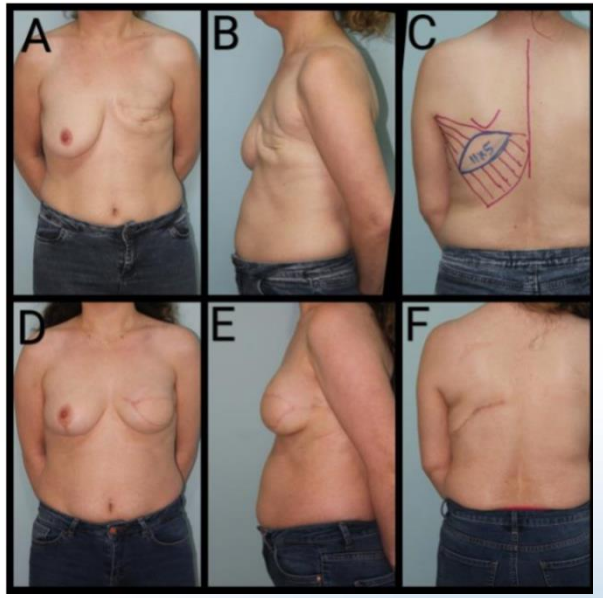


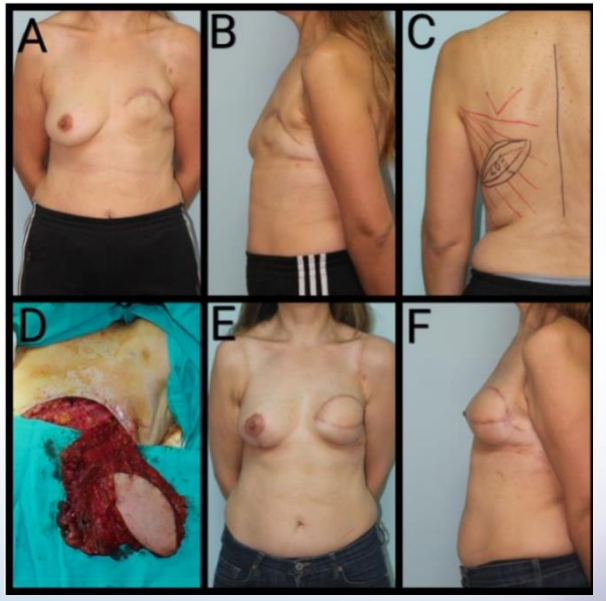




- 30% risk of collapse before 5 years
- 20% risk of capsular fibrosis

Autologous (Flaps)





- Surgical complexity (4 hours)
- Donor site impact
- Less availability for donor sites with low BMI

1 in 8 women

Will suffer from breast cancer in the world

650 000

Mastectomies every year in Europe and USA

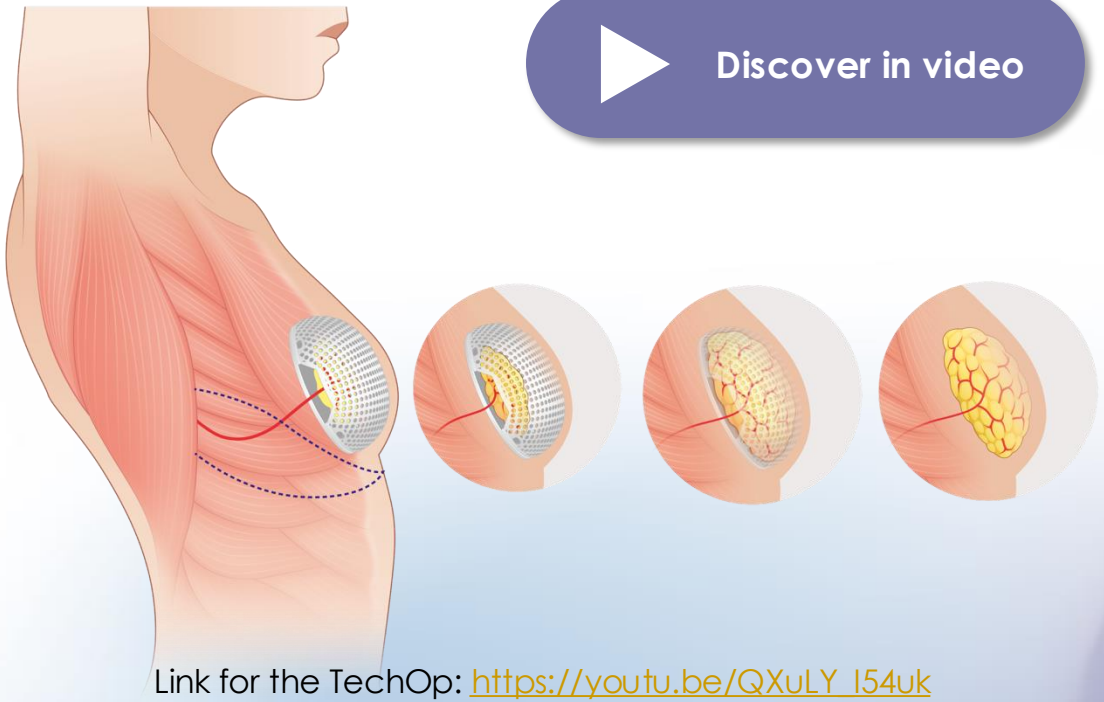
$10 Bn/year

Cost in US

The MATTISSE Bio-prosthesis

A Revolution in Breast Reconstruction

- **Regeneration** of autologous adipose tissue **restoring breast volume**
- **Degradable** implant leading to **natural feeling** of the breast
- **A 1-hour surgery instead of 4 hours** in standard autologous flaps



Discover in video

Link for the TechOp: https://youtu.be/QXuLY_I54uk

LAUREATE

PRIX GALIEN USA 2023

European INNOVATION Council

i-Lab i-Nov

LA FRENCH TECH 2030

MEDTECH INNOVATOR ACCELERATOR

PUBLICATIONS

SCIENTIFIC REPORTS

polymers

Plastic and Reconstructive Surgery

Evaluation of tissue reconstitution with a vascularised fat flap in a resorbable prosthesis in the minipig (validation study)

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Soft Tissue Reconstruction

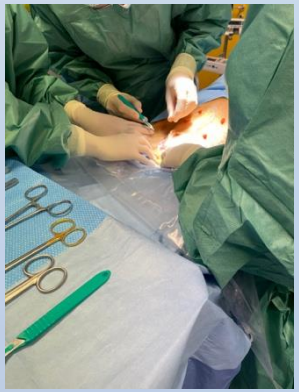
Evaluation of flap growth kinetics, inflammation, vascularization and mechanical behavior of the TEC

Arrival at the animal facility → **Acclimatation (at least 7 days)** → **Implantation** → **Post-surgical follows-up** → **IRM and blood sampling (1, 2, 3, 6, 9, 12, 15, 18, 21 months)** → **Sacrifice at : 3 months 6 months 12 months 21 months** → **Histological and blood analysis**

Number of animals: 10
Species and strain: Minipig *(Sus scrofa)*
Age/weight at arrival: 2 years [70; 80] kg

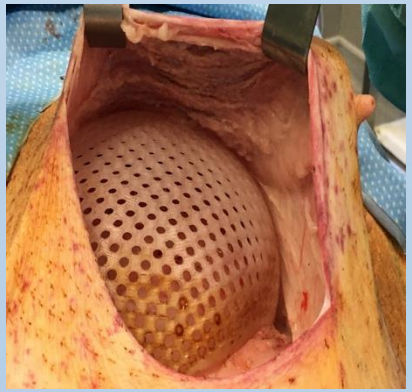

Installation and anaesthesia


Detersion and surgical drawings


Skin incision


Fat flap dissection


MATTISSE implantation


Implanted MATTISSE

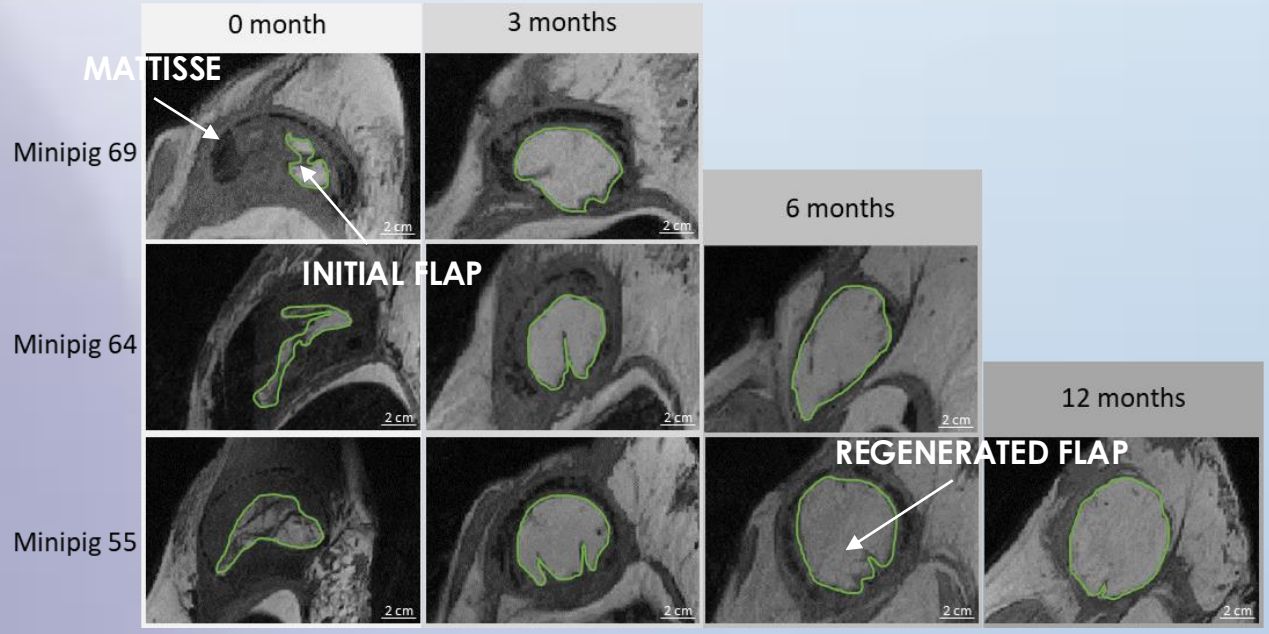

Wound closure

Fat Flap restores volume inside MATTISSE in 6 months

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Soft Tissue Reconstruction

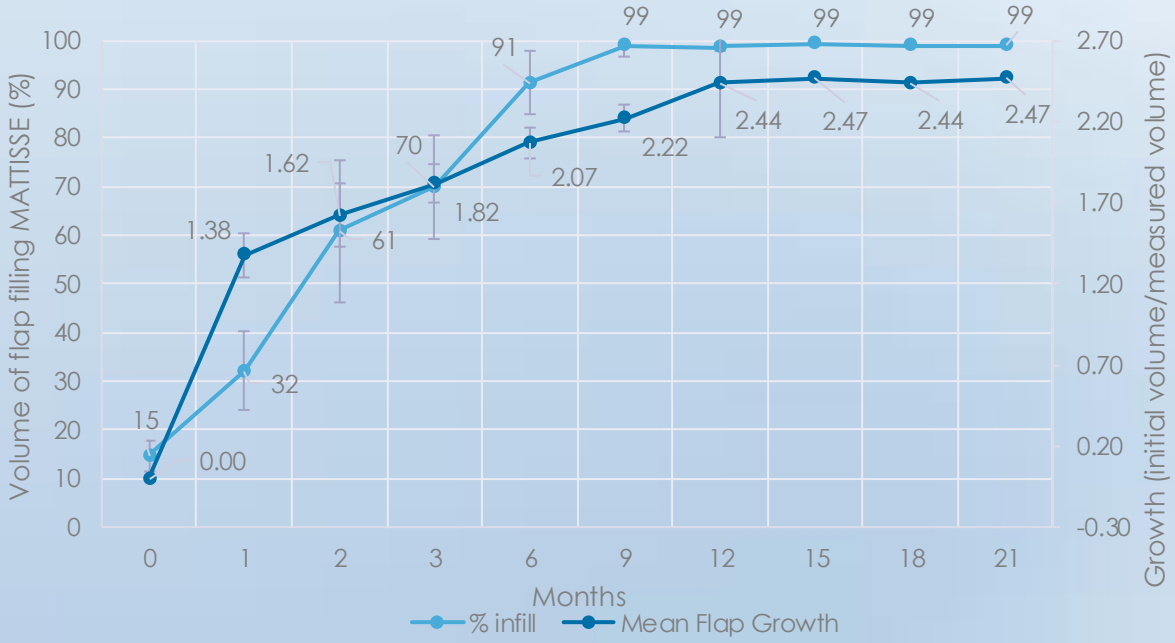
MRI verification of fat flap growth

10 minipigs implanted with MATTISSE implant



- 90 days after the surgery, the flap has grown and occupies most of the available volume
- After resorption, a good quality and stability other time of fat flap tissue is observed

After 6 months, tissue expended by 100%



- The initial tissue size is doubled after 3 months
- 2-month filling volume of MATTISSE is 61% - 6-month filled volume of MATTISSE is 91%
- Mean evolution of animal weight after 1 year: +7%

Minipigs study shows high performance, good reproducibility and long term volume stability after 21 months review

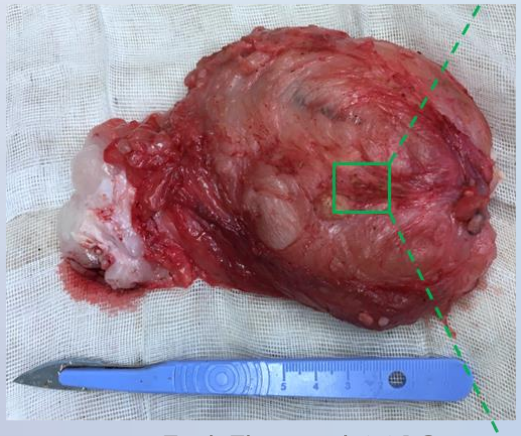
Strong tissue viability is obtained thanks to excellent vascularization

LATTICE MEDICAL
Soft Tissue Reconstruction

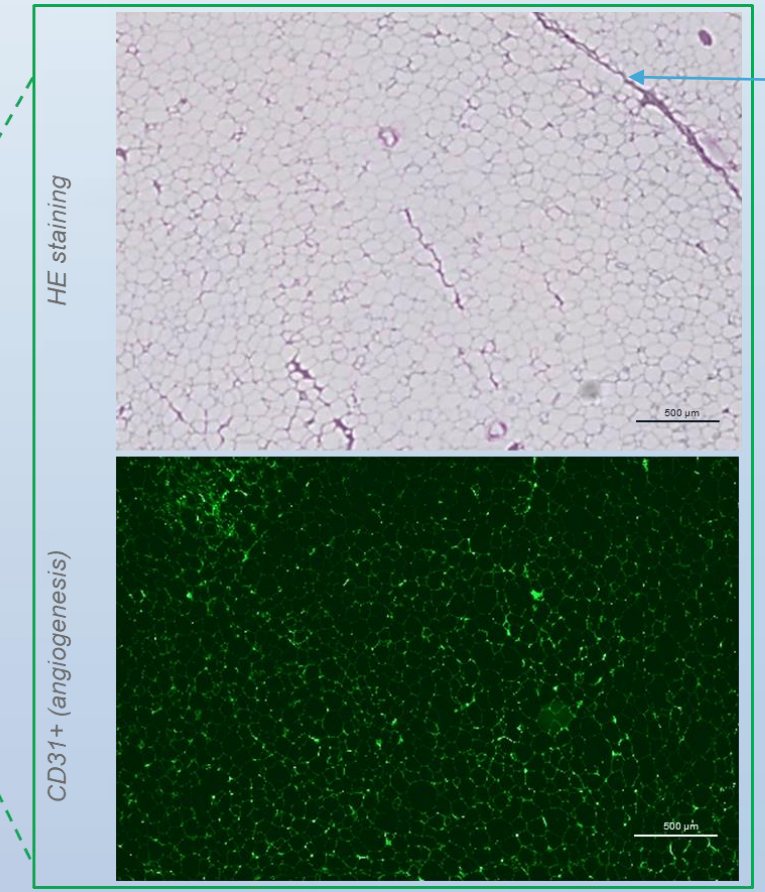
Histology demonstrates high level of vascularization, and limited fibrosis



Fat Flap at M0



Fat Flap at M12



Newly formed vessels

Both Haematoxylin / Eosin staining and CD-31 immunofluorescence

Confirm high vascular density

CD31: platelet endothelial cell adhesion molecule-1, PECAM-1

Newly grown tissue are highly vascularized, indicating long term viability

Scientific Reports ***volume 10****, Article number: 11779 (2020)*

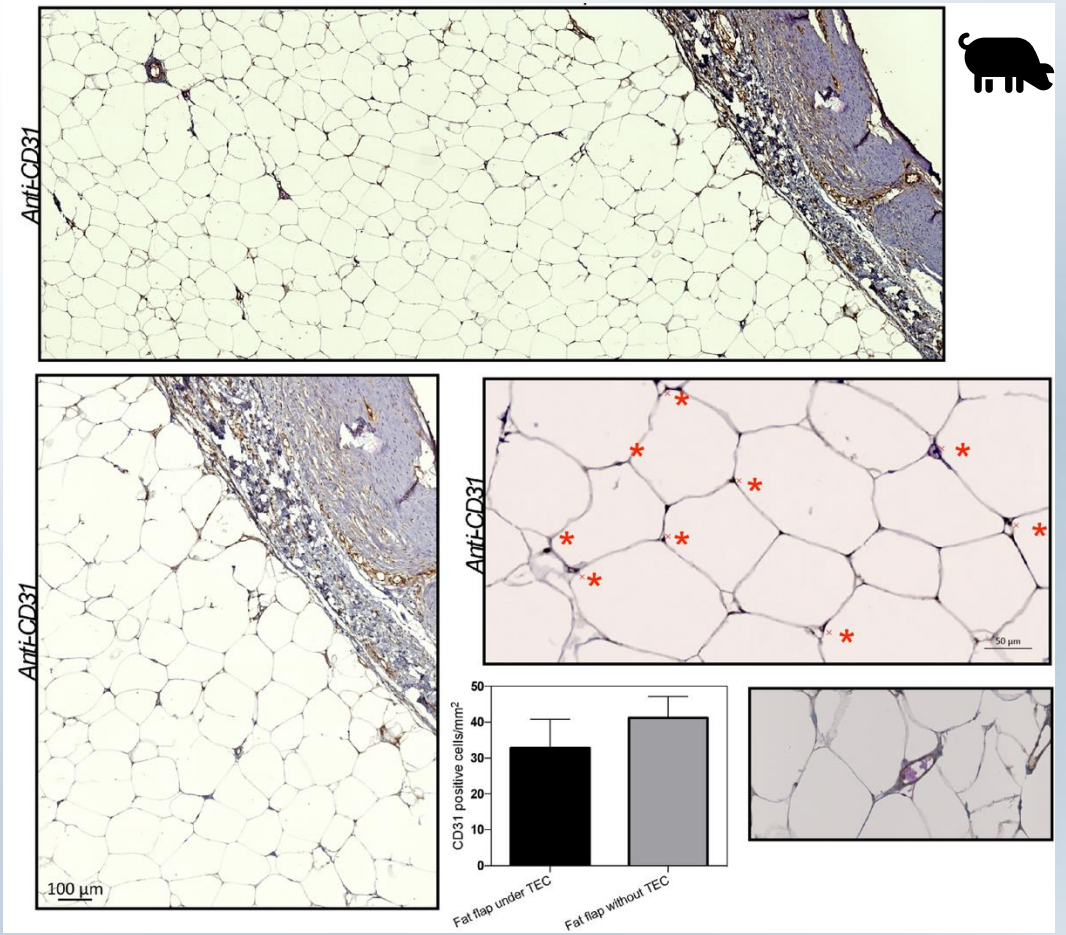
MATTISSE promotes angiogenesis

LATTICE MEDICAL
Soft Tissue Reconstruction

CD31 immunohistochemistry confirms the evidence of angiogenesis

Blood vessels network is identified at the junction between edge of fat flap and connective tissues

MATTISSE porosity is generating the blood vessels



Representative photographs of healthy, well-vascularized, adipose tissue with CD31⁺ capillaries within the bioresorbable TEC. Note also the well-vascularized connective tissue above fat tissue. Blood vessel walls are stained dark brown (red stars), and lumens with some containing red blood cells are visible at higher magnification. Comparison of the number of CD31⁺ cells per mm^2 of fat flap within the bioresorbable TEC and without the TEC. Results are expressed as means ± SD.

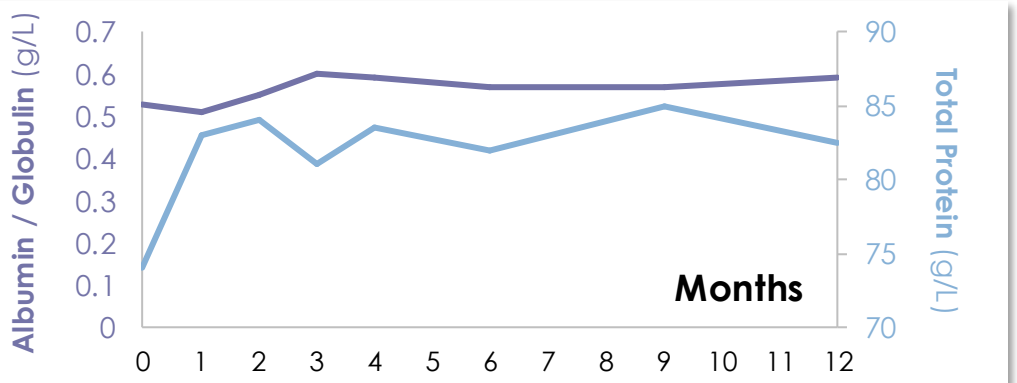
Histology confirms the viability and stability of newly regenerated adipose tissue

Scientific Reports ***volume 10****, Article number: 11779 (2020)*

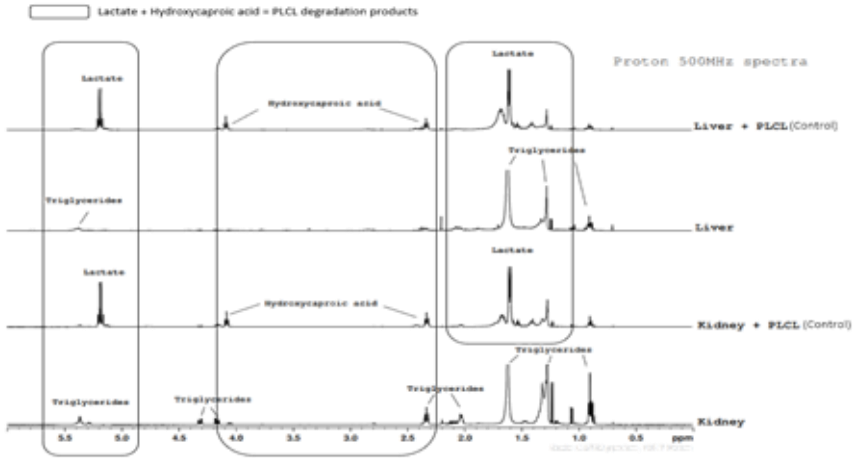
Positive physiological response established by pre-clinical tests

Biocompatibility

Stable levels of serum protein & albumin/globulin over 12 months

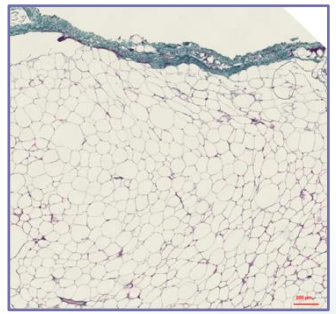


Kidney and liver free from degradation products after 12 months

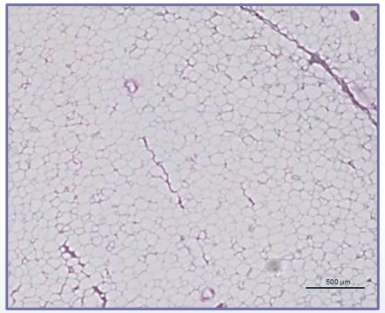


Tissue regeneration

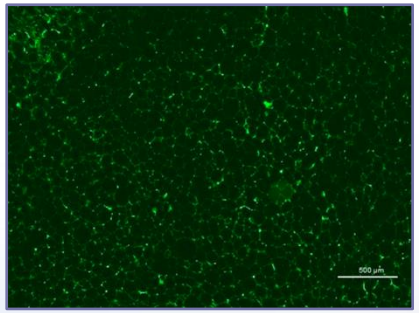
Histological analysis reveals strong tissue integration



Low peripheral connective tissue after 12 months



HE staining shows newly formed vessels



CD31 staining confirms high vascular density

- ✓ Adipose tissue is **mature** and **viable**, and is supported by strong **angiogenesis**
- ✓ **No systemic inflammatory** response detected
- ✓ Biopolymers are **well eliminated** by the body

Plastic and Reconstructive Surgery - Global Open 10(12):p e4720. December 2022.

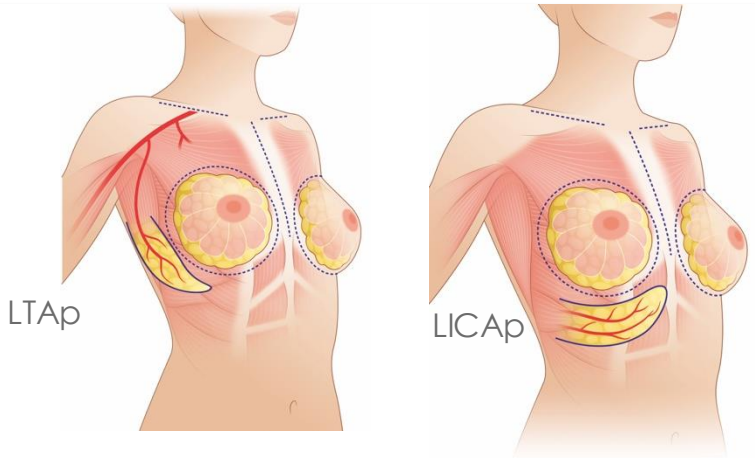
TIDE STUDY: FIH for MATTISSE in Breast Reconstruction

Study Design

→ MATTISSE™ entered **clinical trials** Q4 2023 in France and Q3 2024 in Spain.

- ✓ First enrollment phase of **10 patients** in breast reconstruction done with a follow-up of 3 years
- ✓ Inclusion criteria:
  - ✓ **Single-stage** reconstruction
  - ✓ **Two-stage** reconstruction after expander
  - ✓ **Prophylactic** unilateral
  - ✓ **Autologous conversion** from silicon implants
- ✓ Exclusion criteria of radiotherapy treatment

Study Objectives



Available flaps for the study

1. **Safety Objective**: Rate of patients with major complications related to MATTISSE at 6 months post-op **not significantly > 10%**
2. **Performance Target:** Tissue regeneration **> 50%** at 6 months after breast reconstruction with MATTISSE® implant

Lattice Medical development platform for innovative medical devices dedicated to plastic and reconstructive surgery

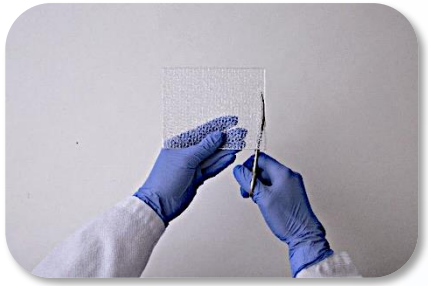
Reconstructive surgery



MATTISSE

Breast surgeries (reconstruction & aesthetics)

CLINICAL PHASE



RODIN

Hypodermia reconstruction after deep wound damage

PRE-CLINICAL PHASE

Contract Dev & Manufacturing



Contract development and manufacturing of implant and raw material

COMMERCIALY AVAILABLE

https://wwww.lattice-services.com

LATTICE SERVICES

Medical 3D Printing

Lattice Services medical grade filaments for 3D printing

Resorbable & implantable filaments



PLGA filament

Poly (lactic-co-glycolic) copolymer



PLGA / HA filament

Poly (lactic-co-glycolic) copolymer filled with 10% hydroxyapatite



PDO filament

Polydioxanone



PCL filament

Polycaprolactone



PCL / HA filament

Polycaprolactone with 30% hydroxyapatite



PLCL filament

Poly (lactic-co-caprolactone) copolymer

Skin contact filaments



PC filament

Polycarbonate



PETG filament

Polyethylene glycol



ABS filament

Acrylonitrile Butadiene Styrene



TPE filament

Thermoplastic elastomer

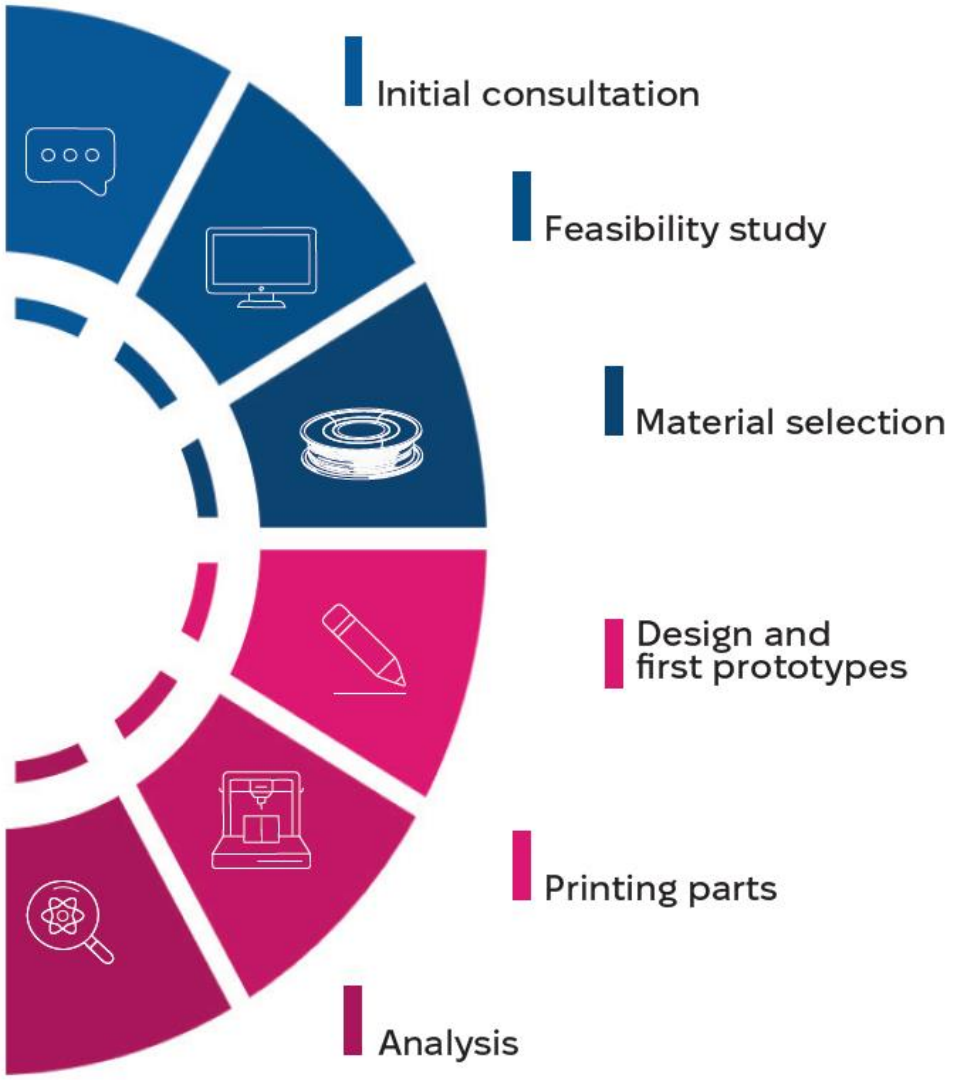


PLA filament

Polylactic Acid

They trust us:

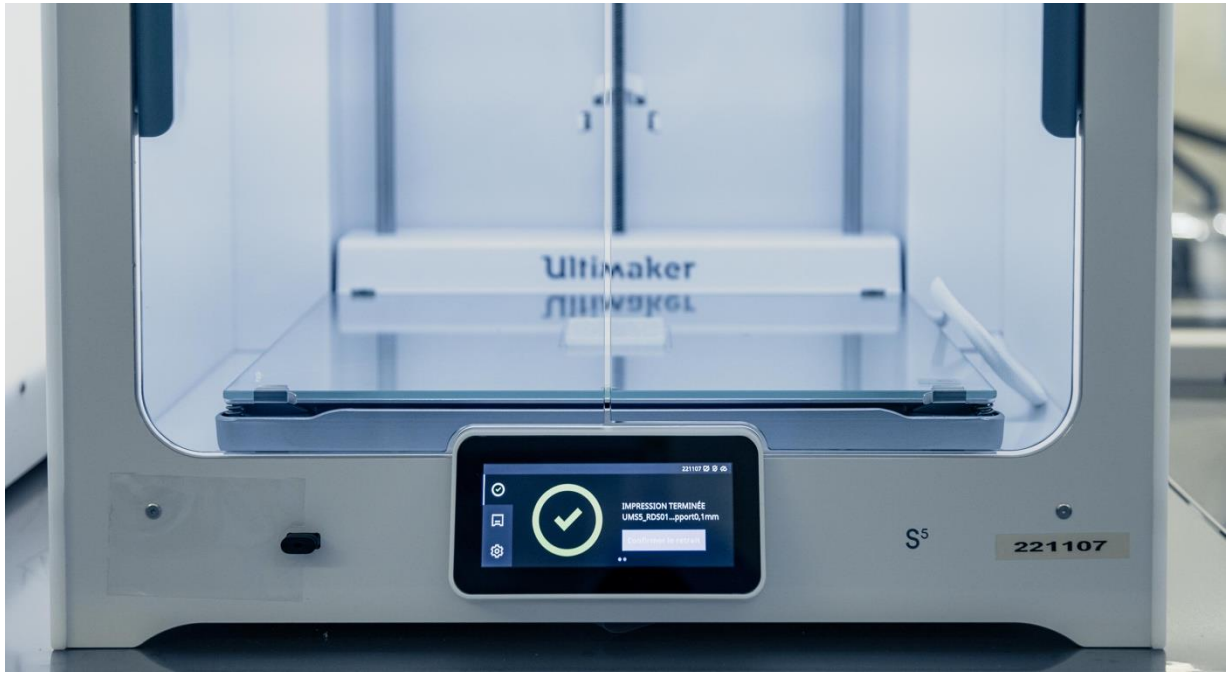
Co-development of your medical devices

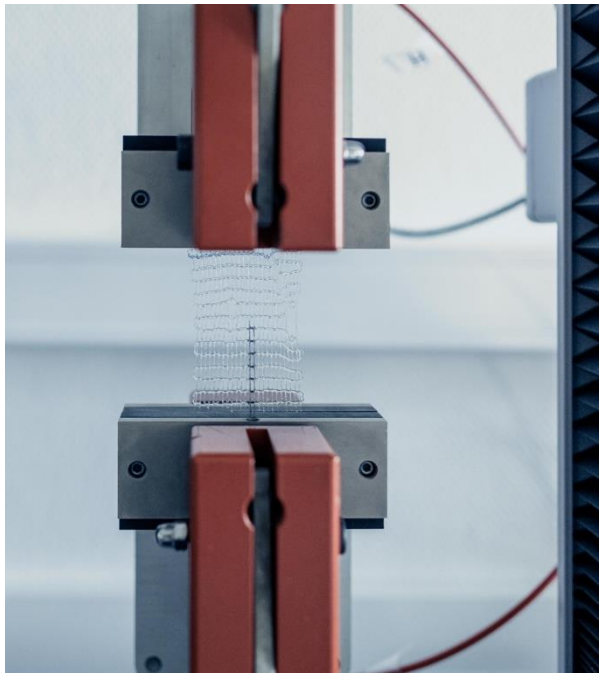


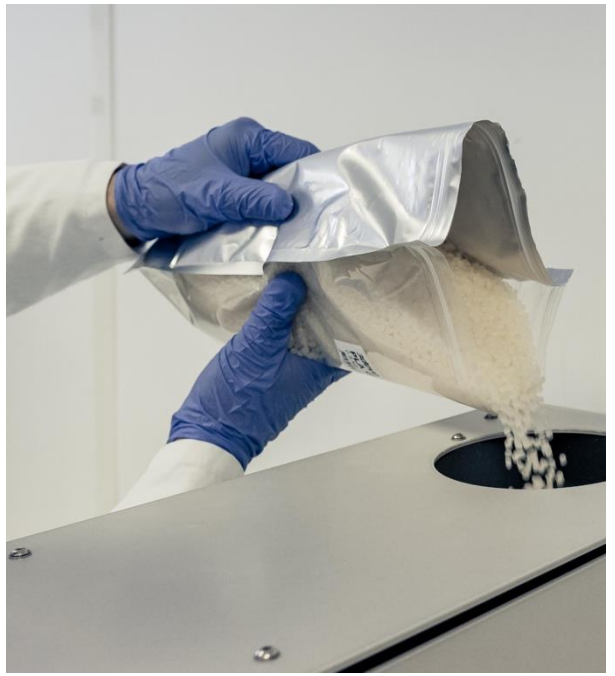
From initial design to production, we're with you every step of the way, transforming your ideas into working prototypes, right through to pre-production. With complete mastery of implantable materials and state-of-the-art technology, we offer you a personalized service that meets the highest standards of quality and performance.

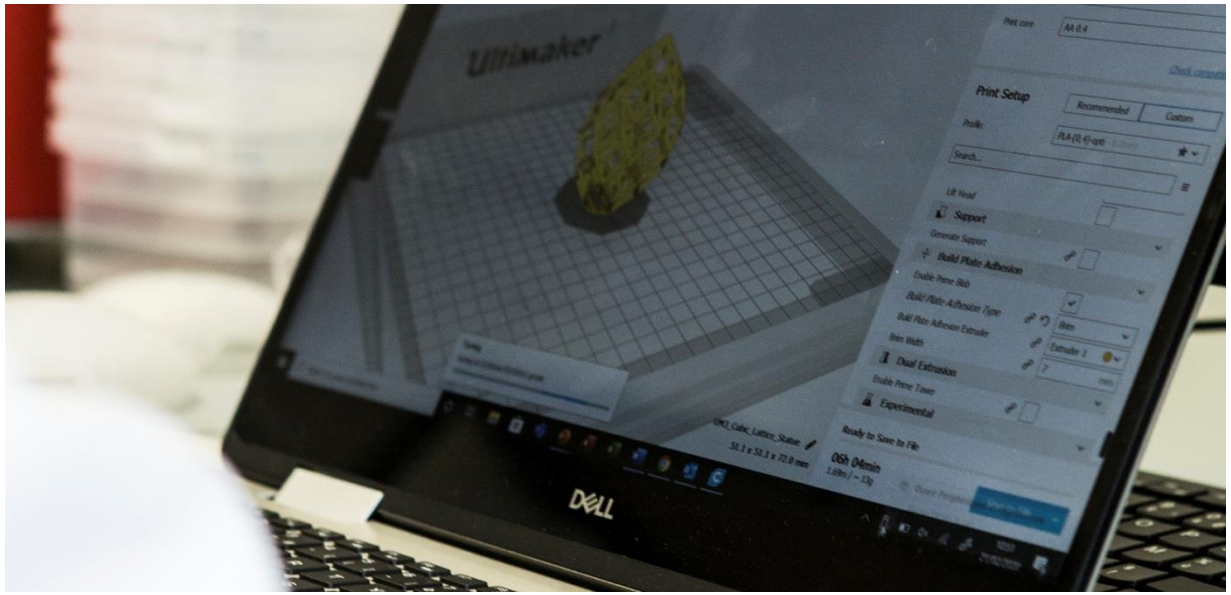
We can support you throughout the development of your medical device (MD), or only in a specific phase.
This starts with a confidential initial consultation, followed by a feasibility study to assess technical viability and draw up a quotation. We then advise you on the choice of materials, including our certified medical-grade filaments. We develop and prototype your designs, print your parts with the appropriate 3D technologies, then analyze their mechanical, thermal and biological properties in our laboratories to ensure compliance with regulatory requirements.

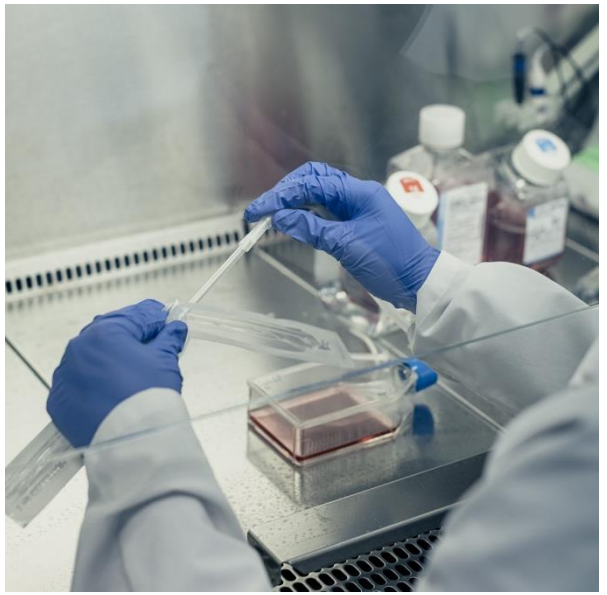
We have a unique know-how in biomaterials, 3D printing and tissue engineering for tissue engineering solutions













Polymers **2021**, *13*(4), 572; https://doi.org/10.3390/polym13040572

Lattice Services

Ohio State University

PLCL

Biodegradable, radiopaque mesh for monitoring tumor cavities in breast tissue

Researchers at Ohio State University are developing an innovative solution to improve follow-up care after breast-conserving surgery.

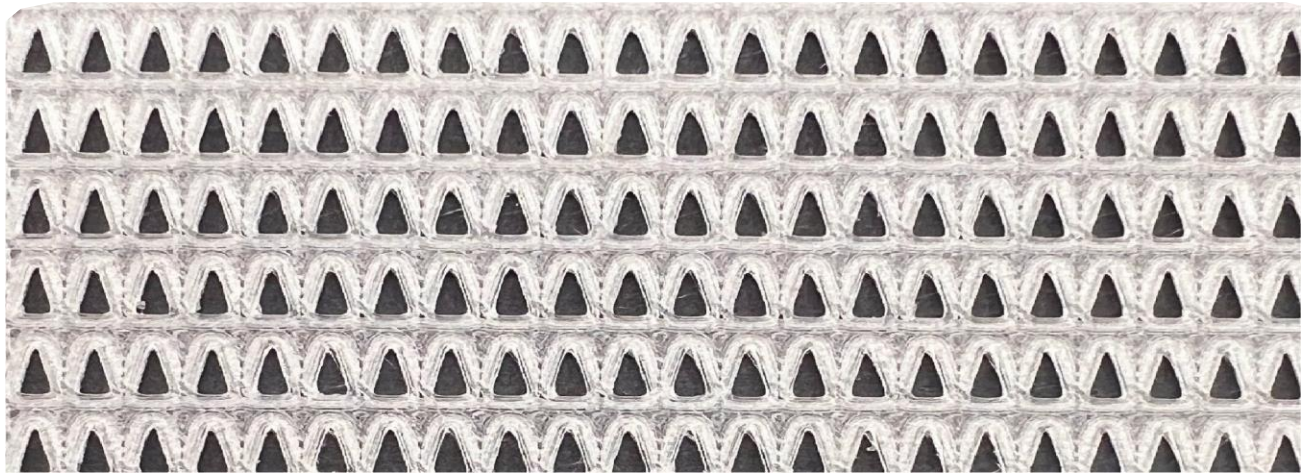
After a tumor is removed, it is essential to accurately locate the residual cavity in order to effectively target radiation therapy. Current solutions, such as metal clips, can move, deform, or remain permanently in the body, which can complicate treatment and patient comfort.

To overcome these limitations, researchers are working on the development of a marker made of PLCL (poly(lactide-co-caprolactone)), a biodegradable and biocompatible polymer. Thanks to the flexibility of this material, the marker adapts perfectly to the shape of the cavity, and its mechanical strength allows it to maintain its structure for the time necessary to guide the radiotherapy. The PLCL then degrades naturally, avoiding any additional intervention.

“

This filament has been incredible to work with. There have been zero issues with regards to printing in part due to how spot on the recommended settings have been.

Adrian Bakhtar, Mechanical Engineering at The Ohio State University



Lattice Services

The University of Manchester

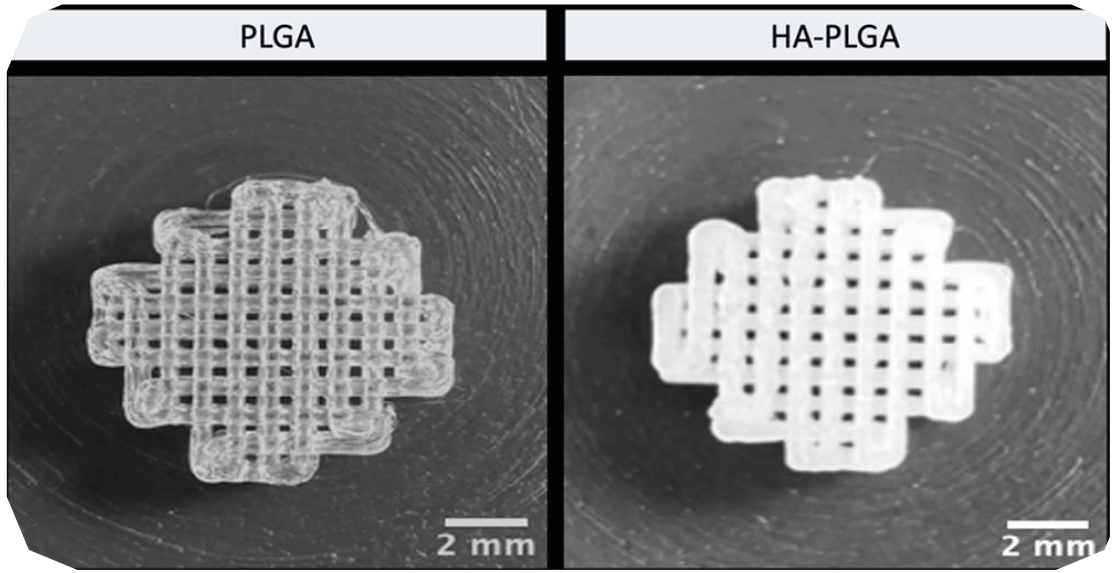
PLGA & PLGA HA

in vitro bone model using 3d-printed PLGA and PLGA HA scaffolds

The project led by the research team at The University of Manchester represents a major advance in the modeling of bone tissue in vitro. Using 3D printing, the researchers have succeeded in creating “laboratory bones,” biocompatible and biodegradable scaffolds capable of hosting stem cells and reproducing natural bone structure. Among other things, this offers an alternative to animal testing for studying tissue and cell behavior.

To build these structures, they relied on a polymer well known in tissue engineering: PLGA, used as a base matrix for its rigidity, biodegradability, and biocompatibility.
As part of this partnership, we provided them with our GLYCOLACTISSE 85/15 material, a medical-grade PLGA copolymer that is perfectly suited to FDM printers and widely used for bone regeneration applications.

To go further and improve the biomimetic properties of scaffolds, we have also developed a customized PLGA enriched with hydroxyapatite, which is now part of our product range.
This version combines the resorbable and structural properties of PLGA with hydroxyapatite, a mineral naturally present in bone that improves bone compatibility and allows us to approximate the actual mineral composition of the tissue.



Pioneer Neurotech

PDO

Manufacture of a nerve guide from resorbable materials

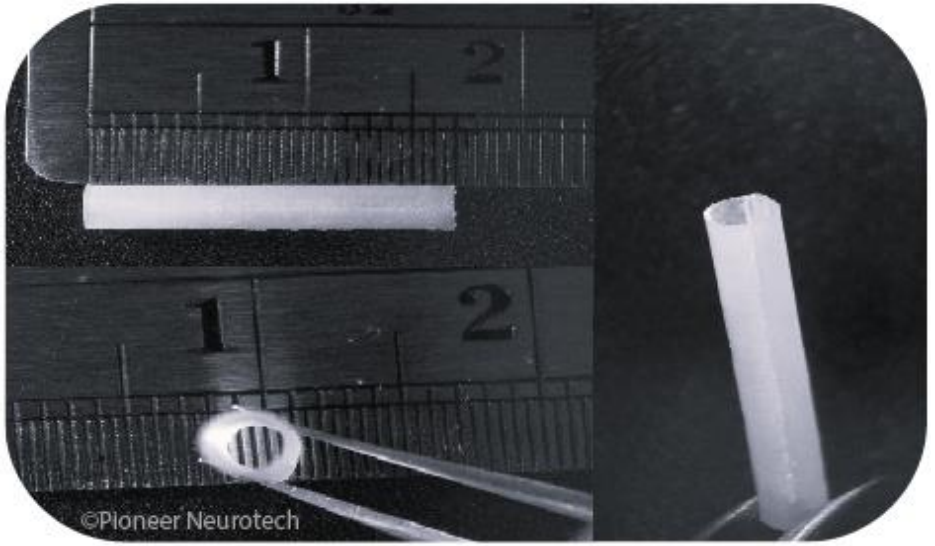
As part of its research into a multi-material nerve guide, Pioneer Neurotech turned to Lattice Services to manufacture the device's outer casing. The materials initially sourced presented significant constraints, both regulatory and technical.

By using our PDO filament, it was possible to implement a reproducible manufacturing process based on a biodegradable and biocompatible material that had already been validated.
In addition, fused filament fabrication (FFF) offers unique flexibility, allowing Pioneer Neurotech to quickly incorporate design adjustments, promoting agile iteration between the development phase and experimental testing.

This collaboration perfectly illustrates how advanced manufacturing technologies can accelerate innovation in the field of implantable medical devices.

PDO filament is allowing us to work with consistent fabrication processes using proven biodegradable and biocompatible materials. Most importantly, fused filament fabrication (FFF) makes incorporating certain design alterations in our application feasible and fast.

Kenneth NGUYEN, Chief engineer



Fundacion Idonial

PCL

Dimɛd, the network of excellence in the field of next-generation personalized invasive medical devices

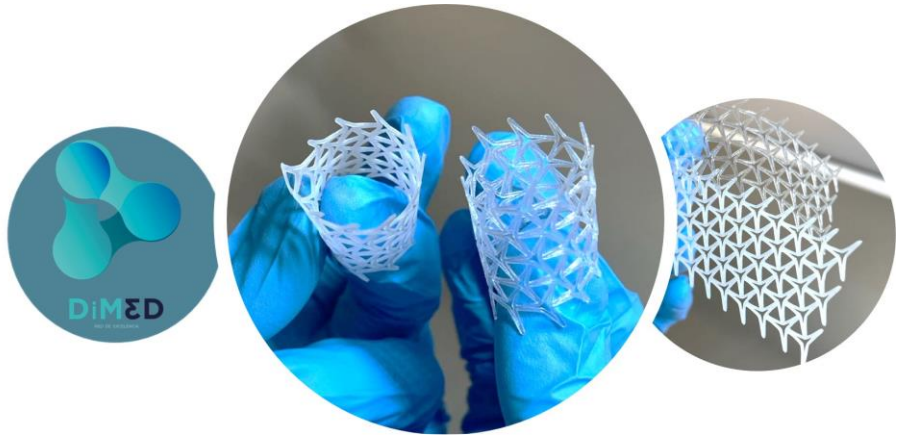
DiMɛD project, led by the IDONIAL technology center in collaboration with several European centers of reference, aims to revolutionize personalized medicine by developing customized invasive medical devices using additive manufacturing technologies, particularly bioprinting.

The design of devices adapted to each patient's anatomy and physiology offers undeniable advantages over standard products: it improves surgical precision, functionality, aesthetics, and stress distribution. It also reduces the need for post-operative care and the associated costs, thus directly contributing to patients' quality of life.

To meet this growing demand for customization, DiMɛD relies on cutting-edge technologies, combining additive manufacturing, medical image analysis, and digital simulation of processes and products. The initiative aims to strengthen the capabilities of participating centers, generate cutting-edge expertise, and foster collaboration with strategic players in the healthcare sector, both public and private, in order to transform innovative concepts into concrete, customized solutions for patients.

The tested PCL filaments (PCL100 and PLCL) have enabled us to create scaffolds with varying mechanical properties tailored to the project's needs. These high-quality filaments feature a homogeneous composition and consistent diameter, allowing for easy and reliable printing without added complications.

Helena HERRADA MANCHÓN, R&D technician



LATTICE MEDICAL

Life after cancer exists, we are shaping it !

https://www.lattice-medical.com/
https://lattice-services.com/

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