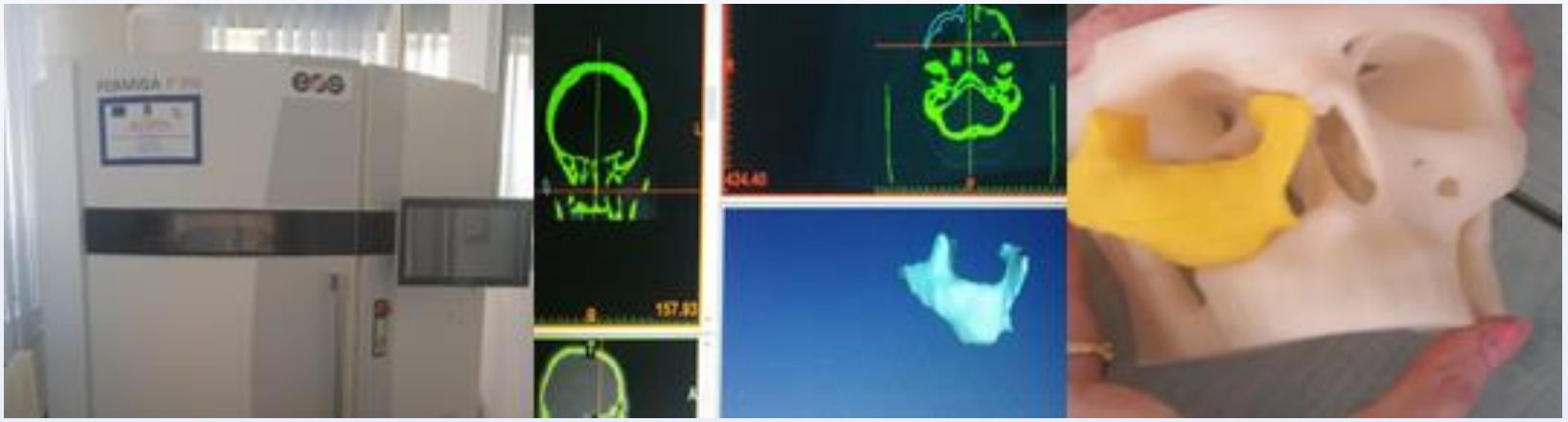

Implementation of additive manufacturing technology for patient specific implants – selective laser sintering of plastic biocompatibility powder

Workshop *Additive Manufacturing: industry necessities and research solutions*

„This work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI – UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0224/ctr. number 77PCCDI/2018 - DigiTech, within PNCDI III”

Agenda

- INCDMTM- Rapid Prototyping Laboratory: an overview
- Research on additive manufacturing technology for hard tissue implants: past and current
- Research on additive manufacturing technology for patient specific implants: past and current
- Future of additive manufacturing in medical field

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Partners

Faculty of Machine Building
www.utcluj.ro

The research team of the Rapid Prototyping Laboratory inside the National Institute of Research and Development in Mechatronics and Measurement Technique

National Research and Development Institute for Gas Turbines COMOTI
www.comoti.ro

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BIOMECHATRONIC AND RAPID PROTOTYPING LABORATORY

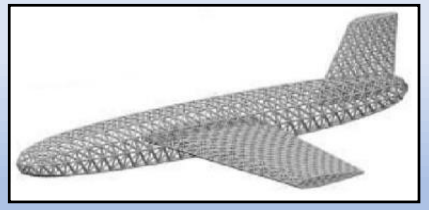
Mechatronic, biomedical and robotics department

Purpose

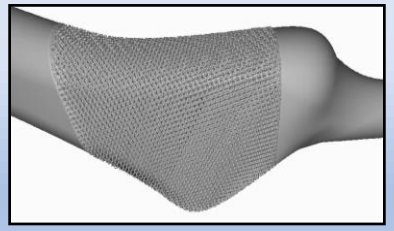
To increase the competitiveness of Romanian companies in: Medical, Aerospace and Automotive fields through implementing innovative technologies

Technical fields

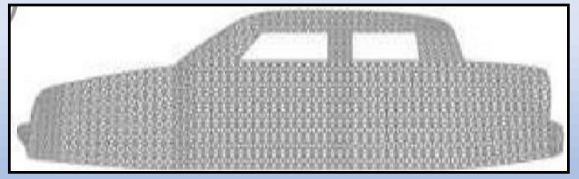
Aerospace



Mechatronics, Robotics and Biomedical Engineering



Automotive engineering



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Capacities and competencies

SLS EOSINT M270 Dual-Mode with metal powder

SLS Formiga P110 with plastic powder

12 engineers and technician

SLS Shining E-Plus-3D with metal powder

SLA Stratasys with resin

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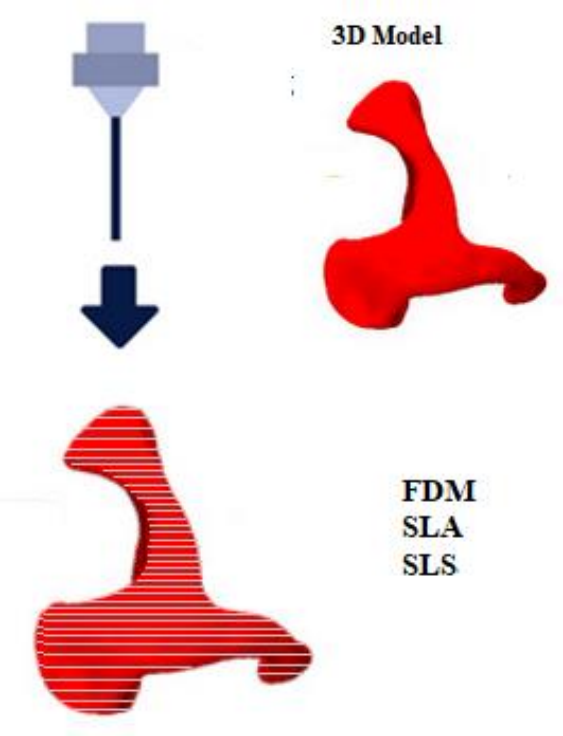
Additive technology. The process



Model preparation

- Position
- Slicing
- Exposure parameters

Machine preparation

- Powder
- Preheat

Fabrication

- Deposition of powder
- Laser explosion
- Repositioning the platform

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Rapid prototyping in the medical field. Advantages

Pre-surgical planning

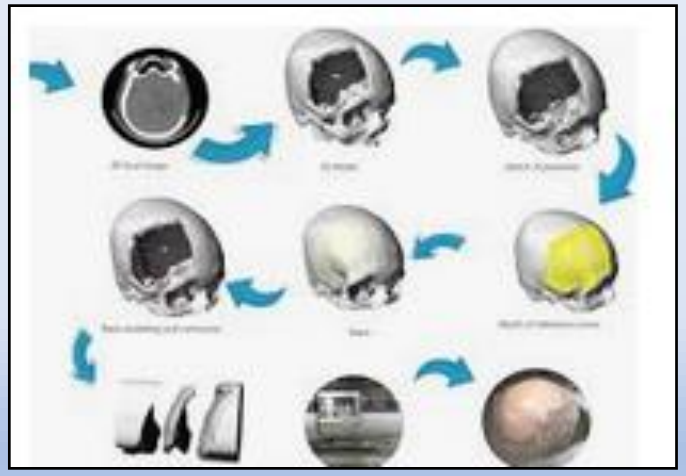
Custom implant manufacture

Powerful patient presentation tool

Medical student/ resident education

3D Surface Scanning

Custom Prosthesis Design



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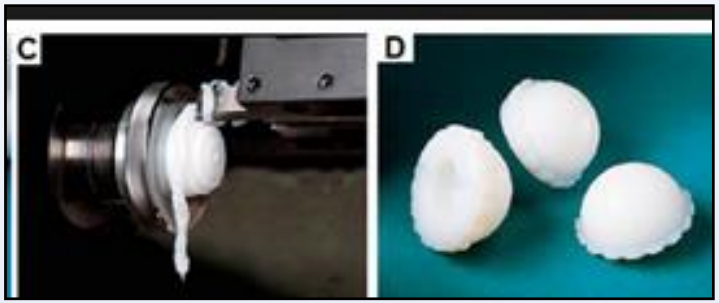
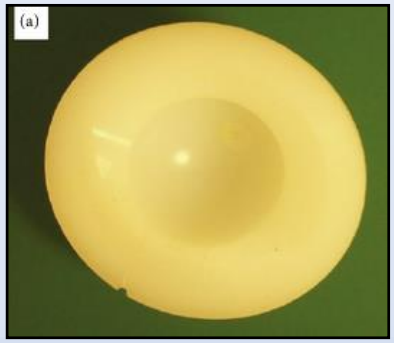
Implants Manufacturing: PAST



Lathe

Dip molding and coating



CNC milling

CNC milling

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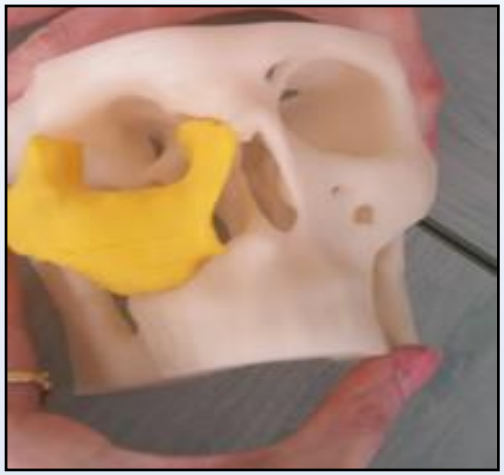
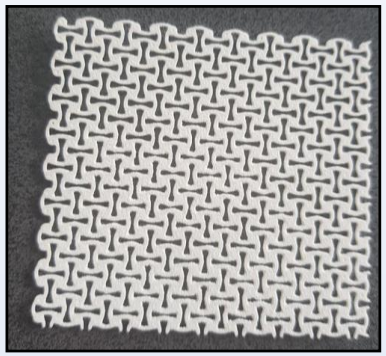
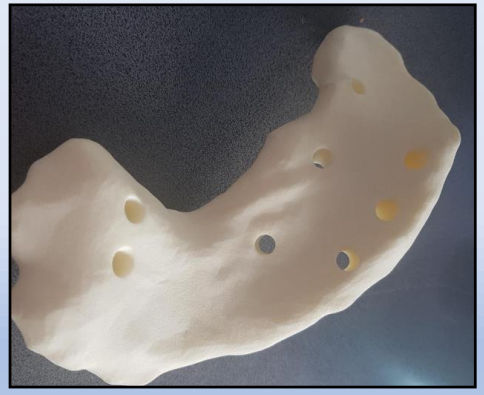
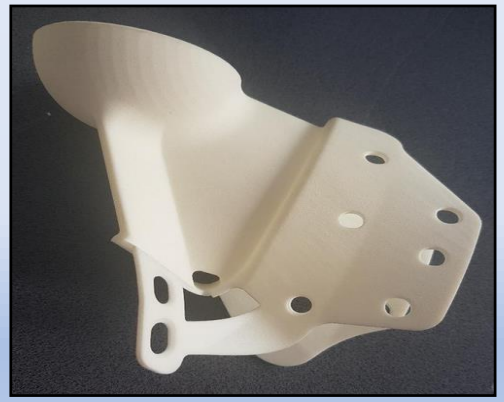
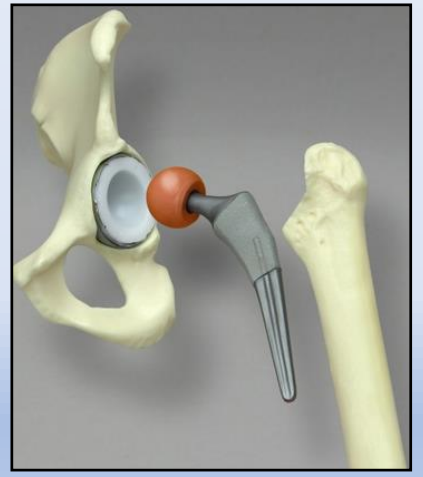
Implants Manufacturing: CURRENT











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Process

Patient → CT/MRI Scan → Image acquisition → DICOM

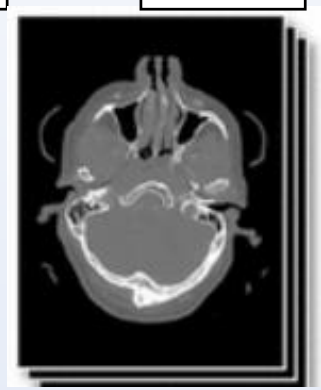
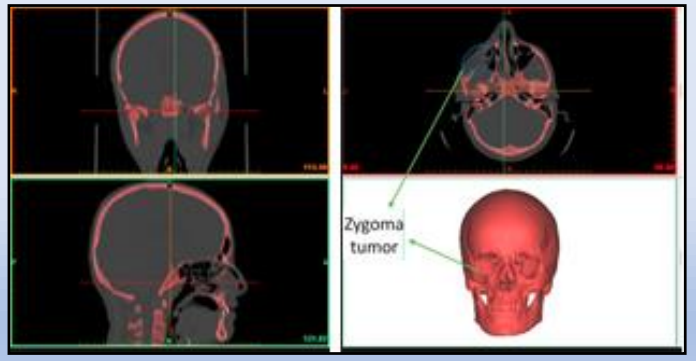


Image converting

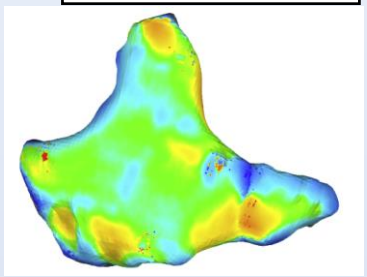
Image processing

Medical modeling software

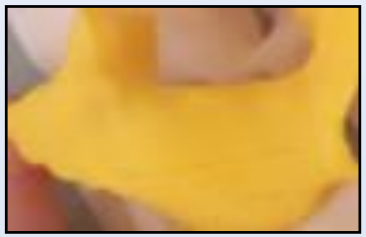


STL

FEM analysis



Additive manufacturing



Post processing & sterilization

Surgery

Follow up

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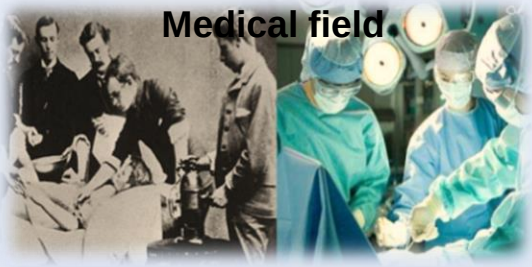
Biocompatible materials used in additive processing for the medical field

Metals:
Titanium Ti6Al4V
Stainless steel
Shape memory alloys Ni-Ti
Noble materials (gold)

Polymers:
PTFE-polytetrafluoroethtlene
PMMA- polymethyl metracrylate
PE -polyethilene



Ceramics
Hydroxyapatite
Zirconia
Tricalcium phosphate
Alumine

Others
Hydrogels
Human cells

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Medical additive manufacturing: Software

Materialise: Mimics, 3-Matic;

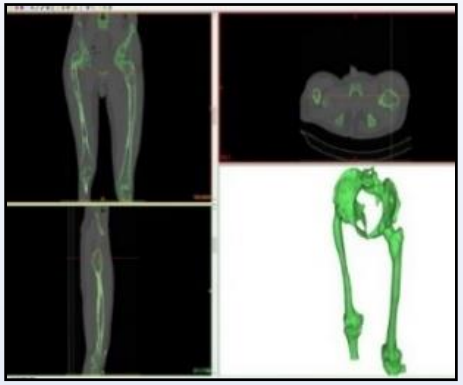
3D Systems: RapidForm, Geomatic Studio

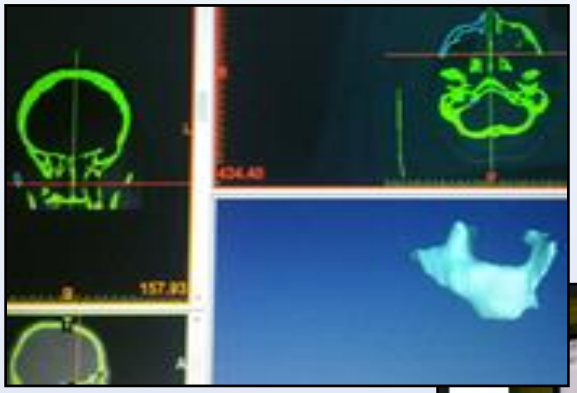
Visage Imaging: Amira

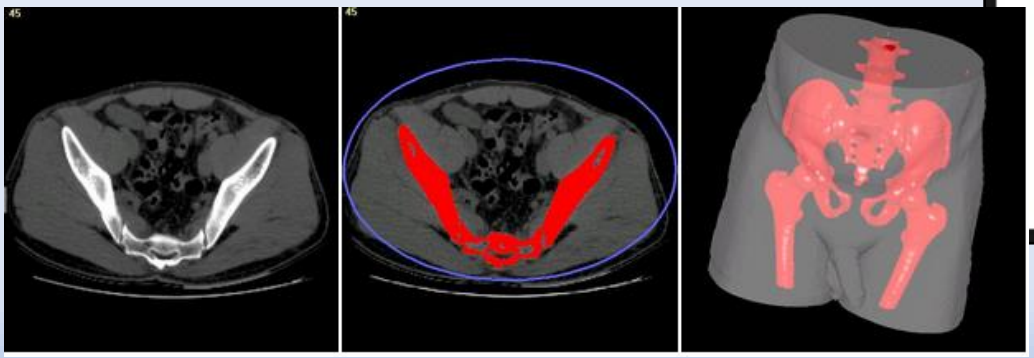
Open Source: Osirix

Able Medical Software: 3D Doctor

Marcam: AutoFab







Creating a 3D mesh model from an original CT image using 3D Doctor and Mimics

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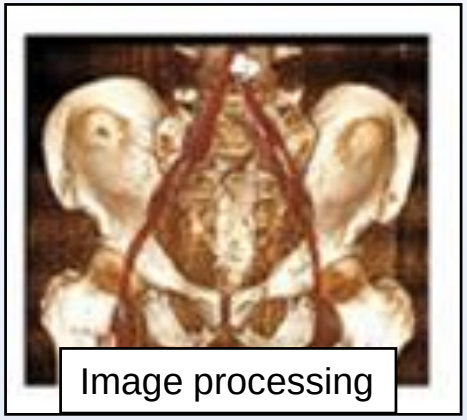
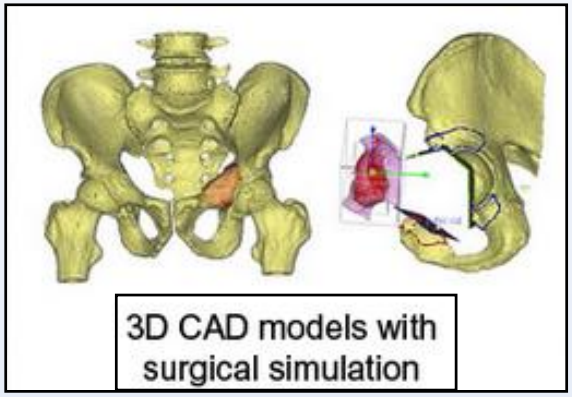
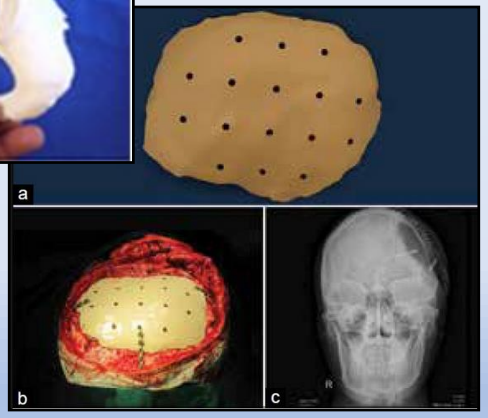
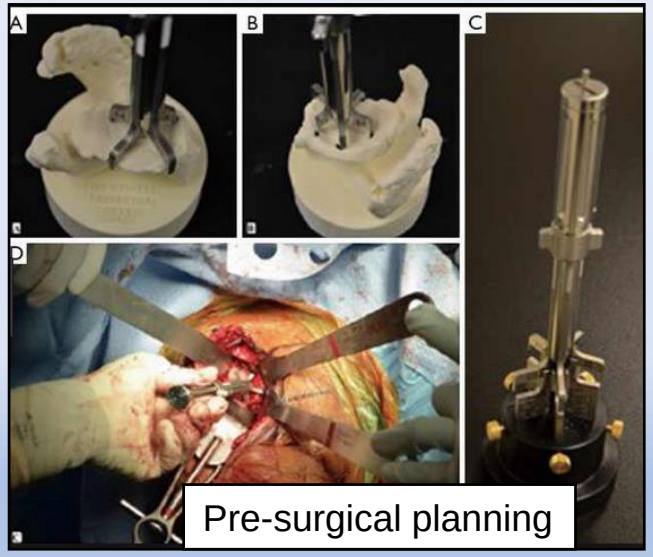
Manufacture of patient-specific implants: benefits









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Pre-surgical planning. Application

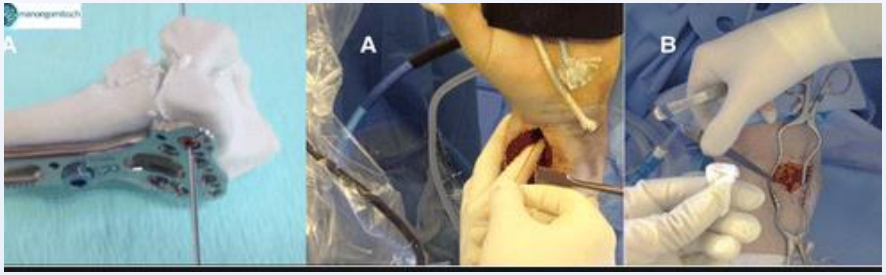
Implant pre-conturing

Screw trajectory

Screw selection/ location

Instrument selection

Technique rehearsal



Significantly reduces O.R. time

Lowers cost

Reduces O.R. team fatigue

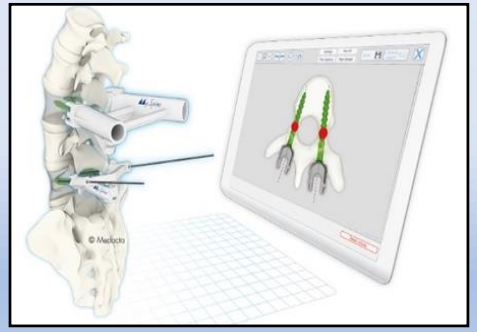
Enhances patient outcomes

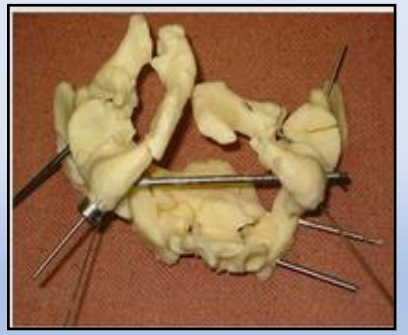
Reduces re-do procedures

Minimizes size of incisions

Speeds recovery times

Improves anatomical alignments





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Towards newly designed implants

Pacient → Image acquisition → Image processing → STL → 3D Modelling-CAD&FEA

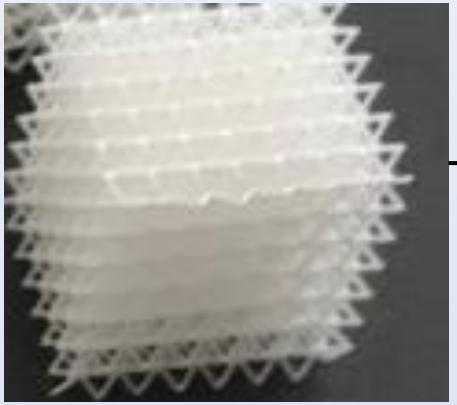
CT Scan data

DICOM

Medical modeling software

Custom fit and lattice structures integration

zygomatic bone implant



3d cellular lattice structures

lattice structure integrated with the implant

Implant manufacturing → Post-processing → Sterilization → Surgery

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Thank you!