



**NATIONAL RESEARCH AND
DEVELOPMENT INSTITUTE FOR
MECHATRONICS AND
MEASUREMENT TECHNIQUE**

Rapid Prototyping Laboratory - Research team to accelerate the implementation of additive processing technology in the patient-specific implants manufacturing

PARTNERS:



Technical University of
Cluj-Napoca Faculty of
Machine Building

www.utcluj.ro



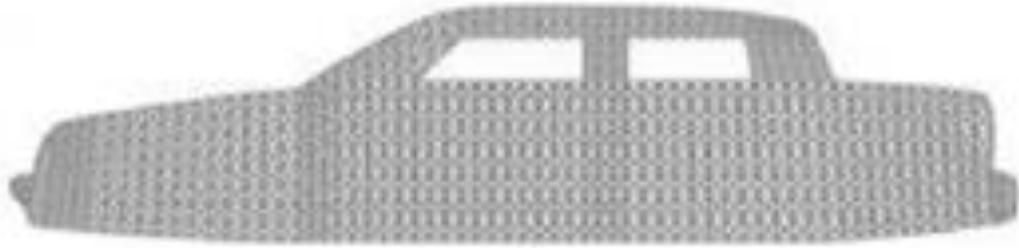
NATIONAL RESEARCH
AND DEVELOPMENT
INSTITUTE FOR
MECHATRONICS AND
MEASUREMENT
TECHNIQUE

<https://incdmtm.ro/>



Romanian Research and
Development Institute for Gas
Turbine

www.comoti.ro/



OUR TECHNOLOGICAL FIELDS

MISSION:

Increasing the competitiveness of Romanian companies in the fields of:
Auto, Medical and Aerospace by implementing innovative technologies



IMPLEMENTATION OF ADDITIVE MANUFACTURING TECHNOLOGY FOR PATIENT SPECIFIC IMPLANTS - SELECTIVE LASER SINTERING OF BIOCOMPATIBLE METALIC POWDERS

CONTENTS:

Rapid Prototyping Laboratory: an overview

Research on additional processing of hard tissue implants: past and present

Research on additional processing of patient-specific implants: present and future

Future of additive processing in the field of implants



MECATRONIC, BIOMEDICAL AND ROBOTICS DEPARTMENT



Medical applications



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

INCDMTM capacities and competencies



Word leader: 12 engineers and technicians

**SLS-METALIC POWDERS
EOSINT M270 Dual-Mode**



**SLS-PLASTIC POWDERS
Formiga P110**



**SLS-METALIC POWDERS
SHINING E-PLUS-3D**



**SLA-Resin curing 3D printer
Stratasys Objet30 Pro**

Implant manufacturing: past

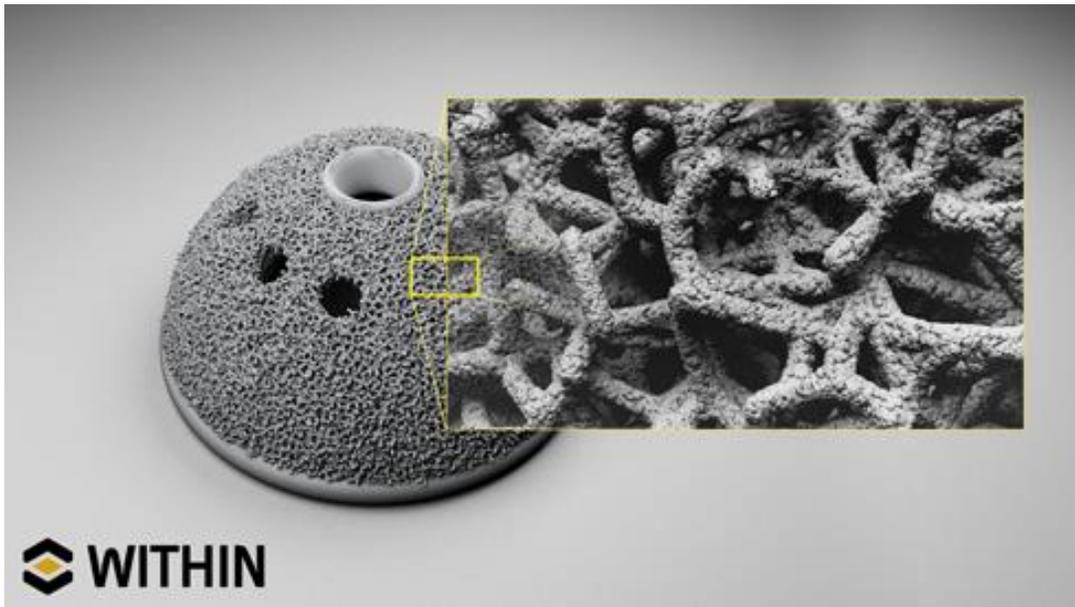
Case Study

Manufacture of standard hip and knee joint components



Implant manufacturing: current

Preoperative manufacturing of implants



Subtractive vs. additive technologies



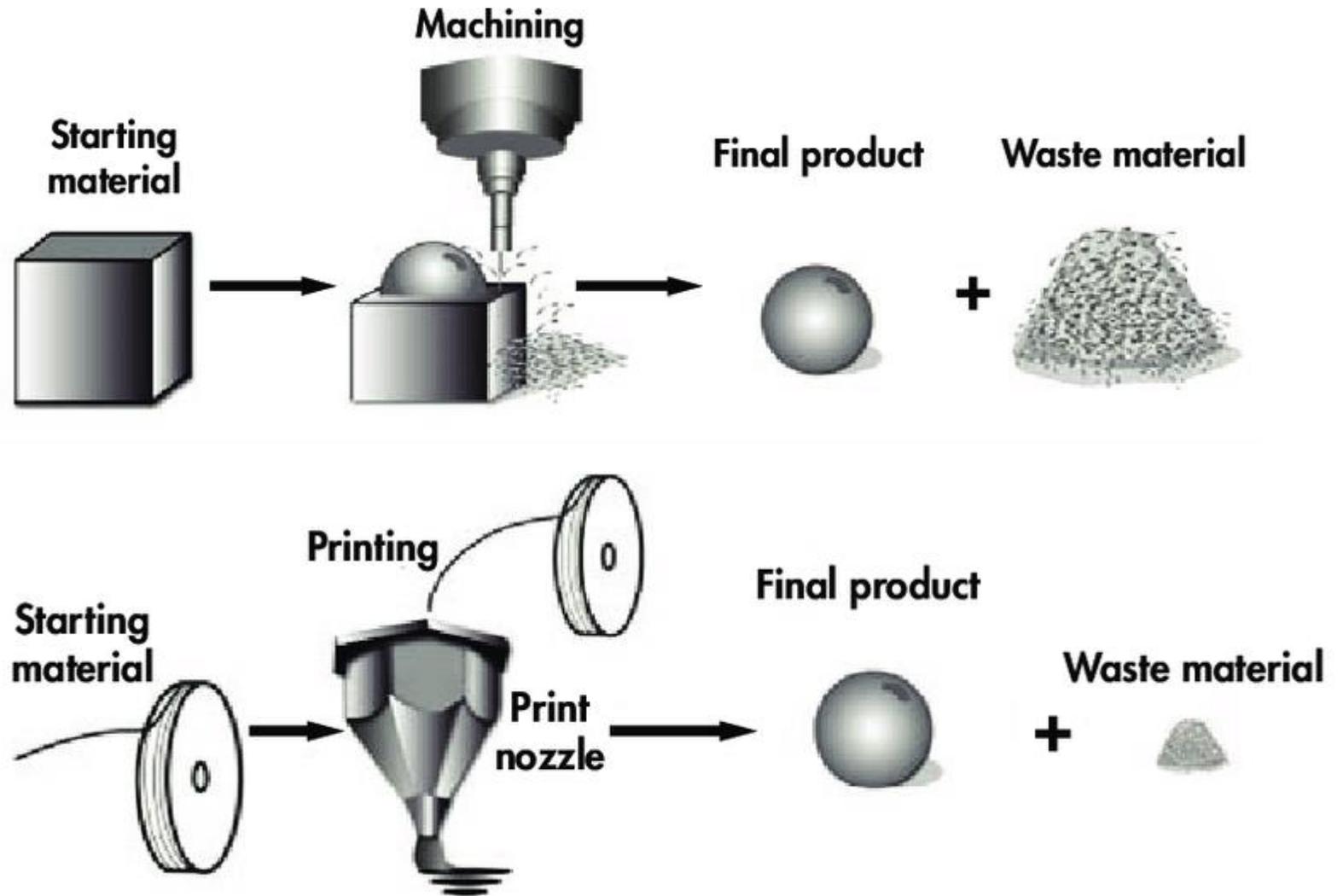
Milling
Turning
Grinding
Water-jet cutting
Sawing

Subtractive machining removes material by physical or chemical processing



Wire extrusion
Powder-bed
Deposition

Additive manufacturing adds layers of material



Biocompatible materials used in the additive processing for the medical field

Metals:

Titanium Ti6Al4V
Cobalt-chromium
Stainless steel
Shape memory alloys Ni-Ti
Noble materials (gold)

Polymers:

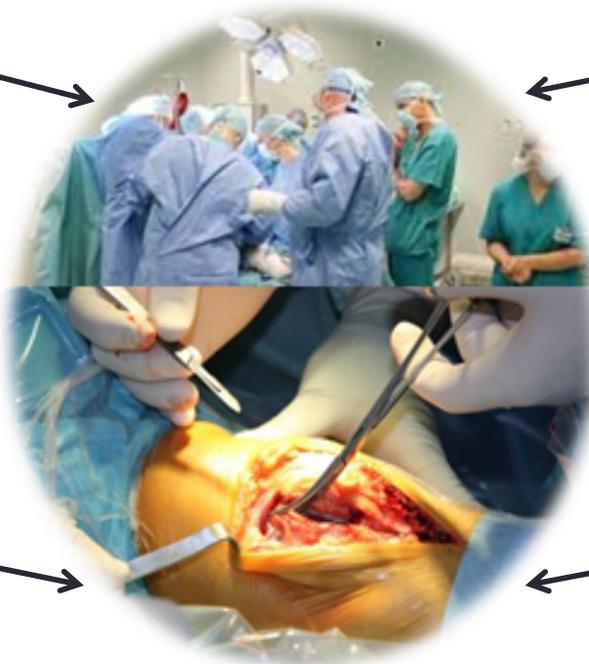
PTFE-
polytetrafluoroethylene
PMMA- polymethyl
methacrylate
PE -polyethylene

Ceramics:

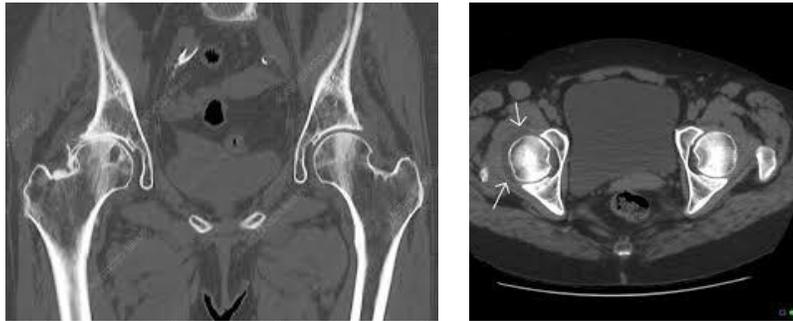
Hydroxyapatite
Zirconia
Tricalcium phosphate
Alumine

Others:

Hydrogels
Human cells



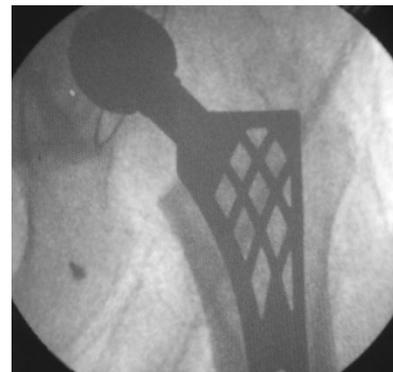
Manufacture of patient-specific implants



Evolution of medical imaging technology gives easy access to the 3D world!

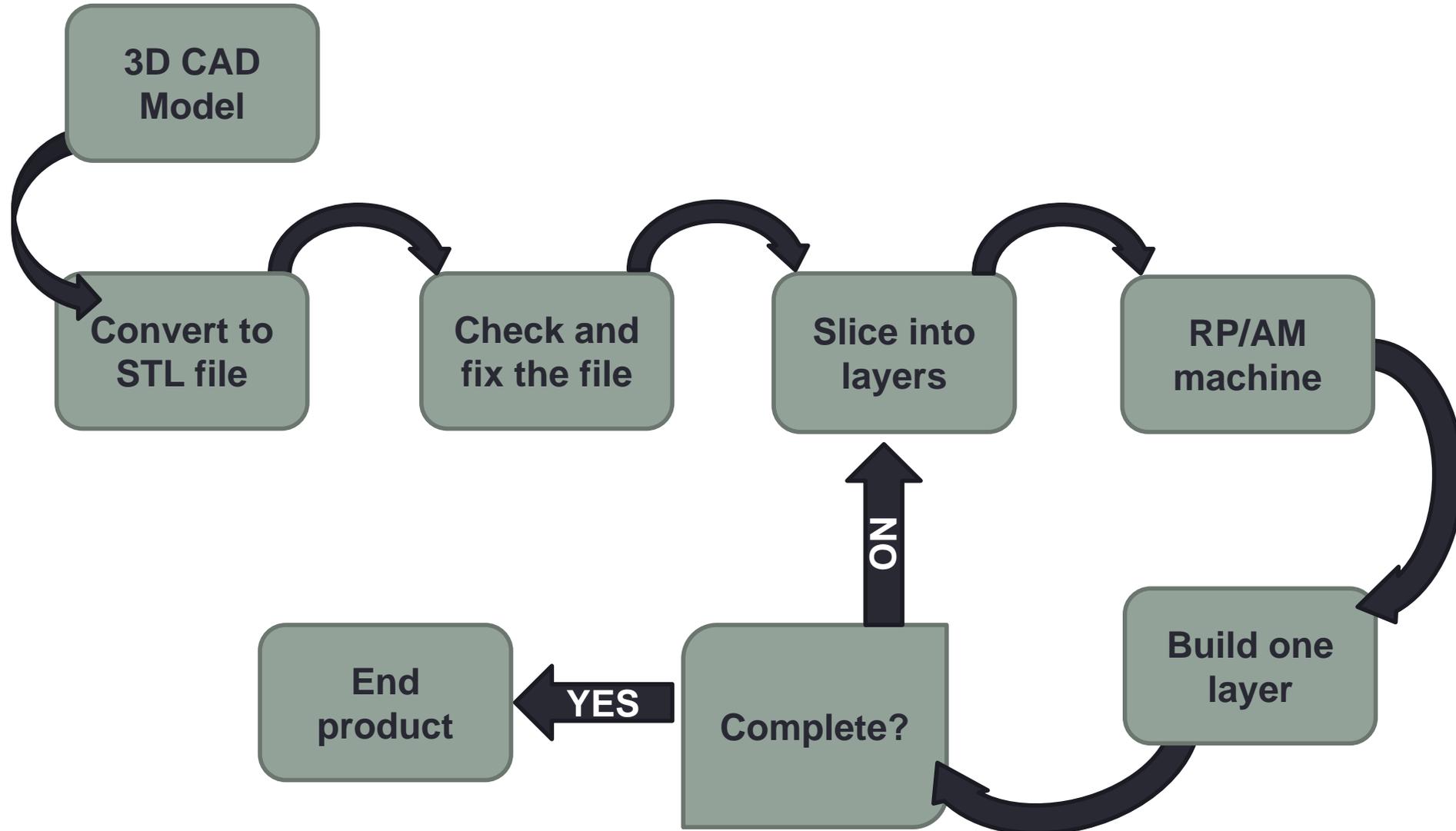


Are specific implants necessary?
Every human is different!



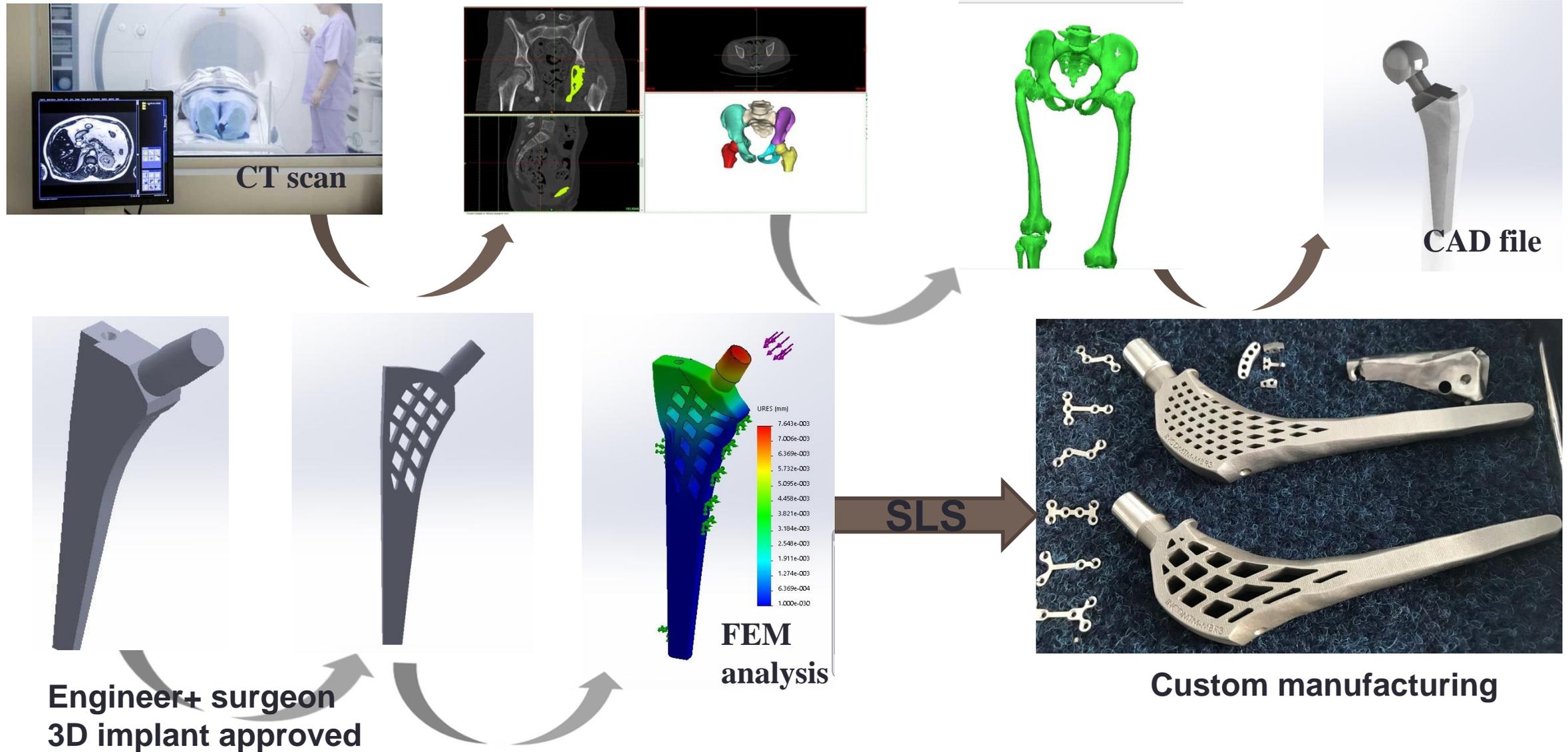
Need of flexibility, complex structures and fast response for surgery

Rapid Prototyping and Additive Manufacturing process

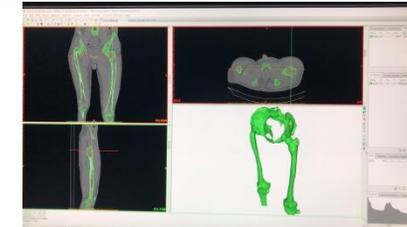
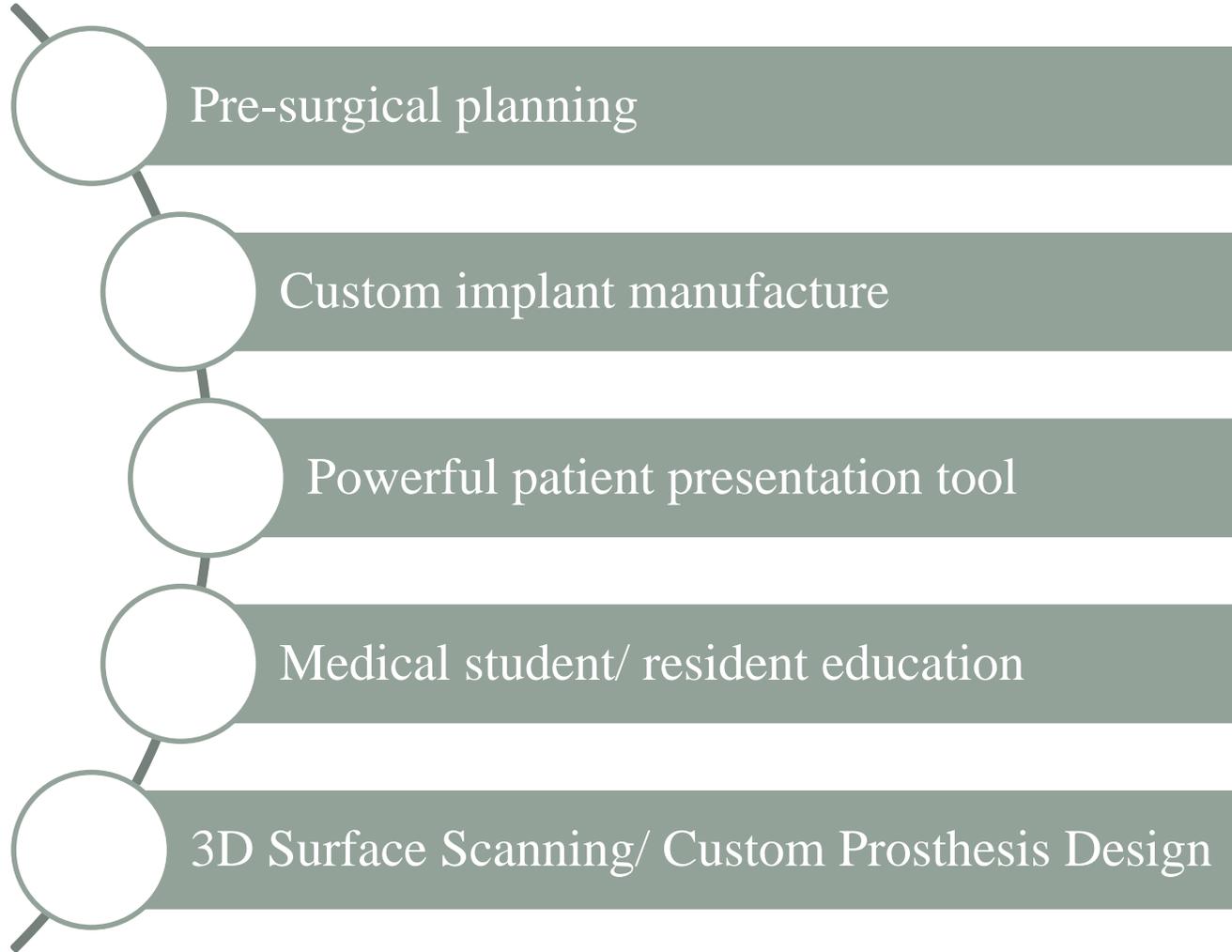


The utility of Additive Manufacturing technologies in the medical field

Manufacture of patient-specific implants



Leading application:



Pre-surgical planning

Implant pre-conturing

Screw trajectory

Screw selection/ location

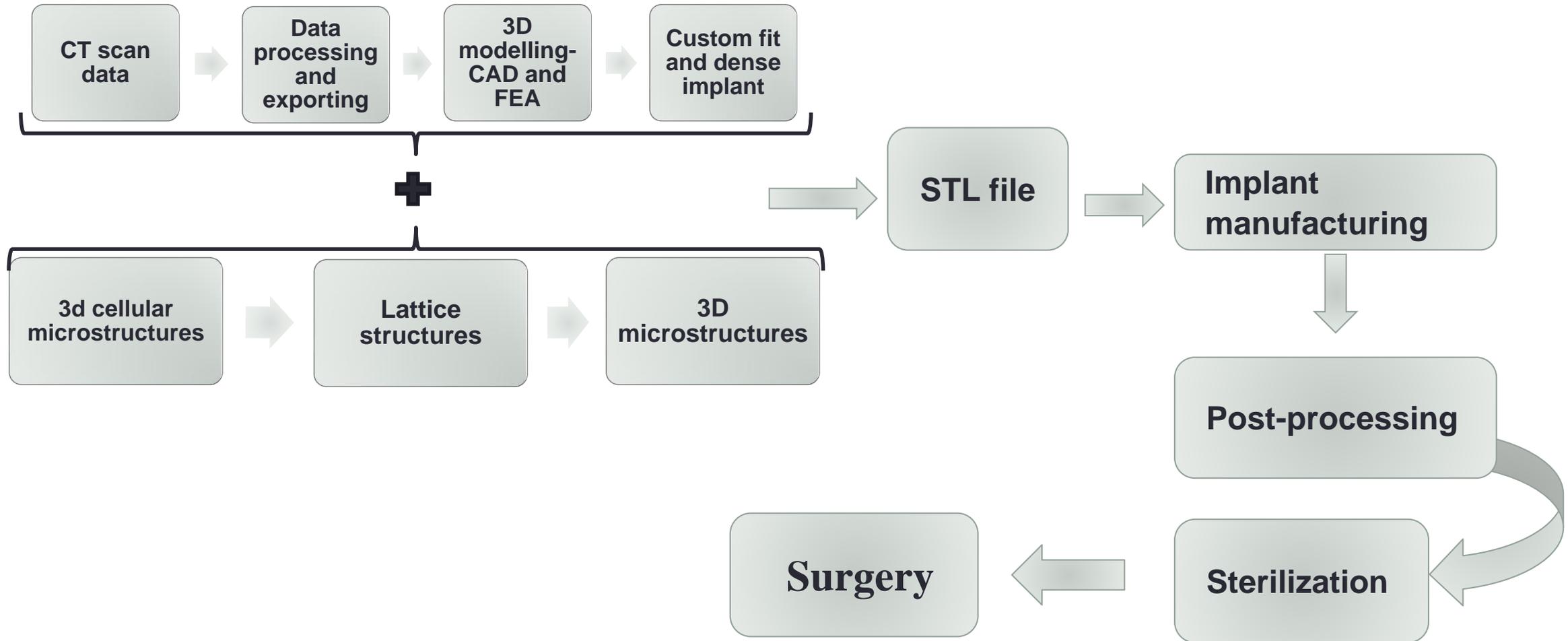
Instrument selection

Technique rehearsal

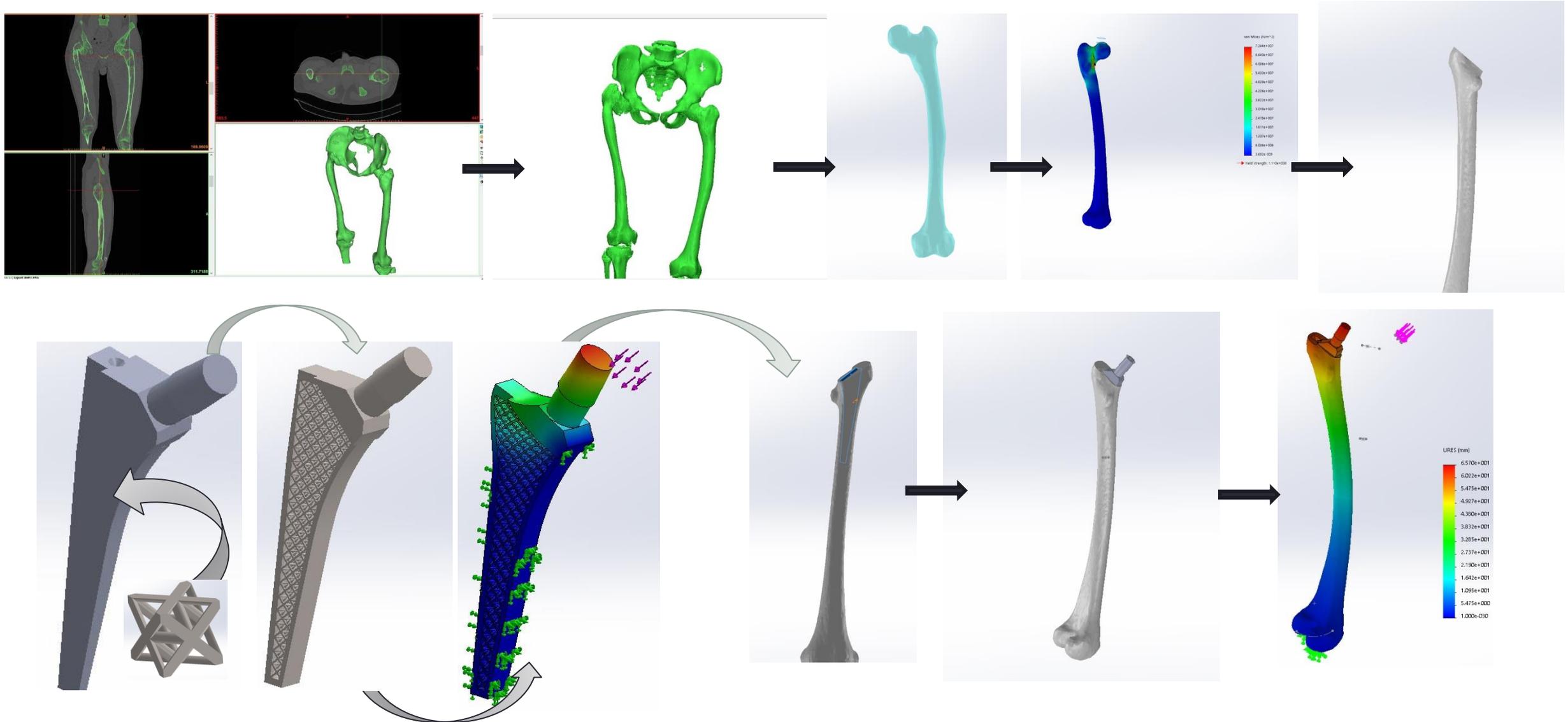
Advantages of pre-surgical planning

- **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**

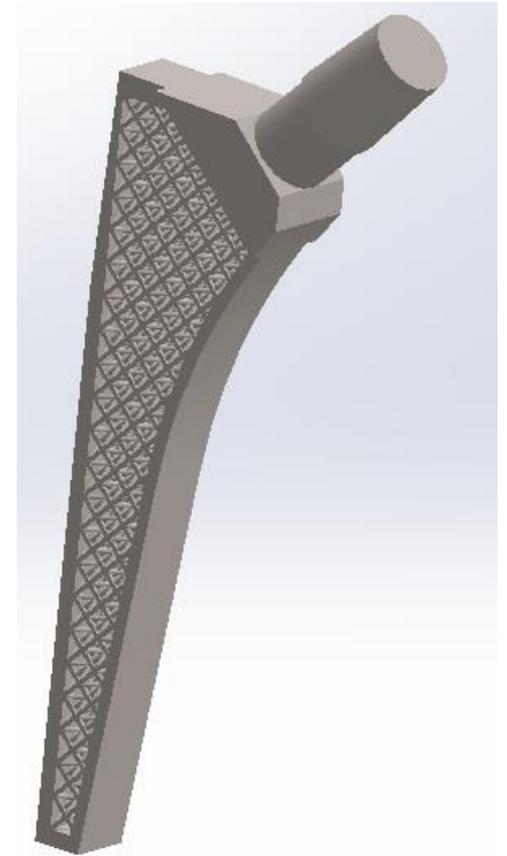
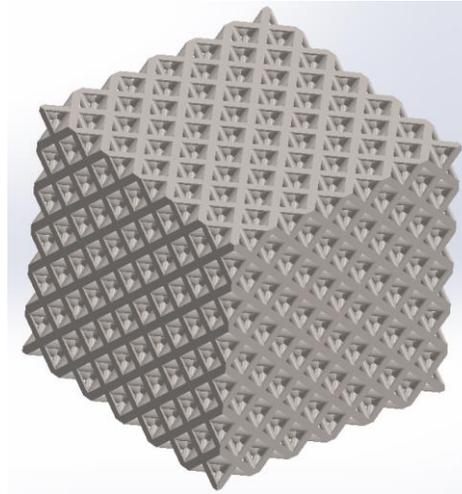
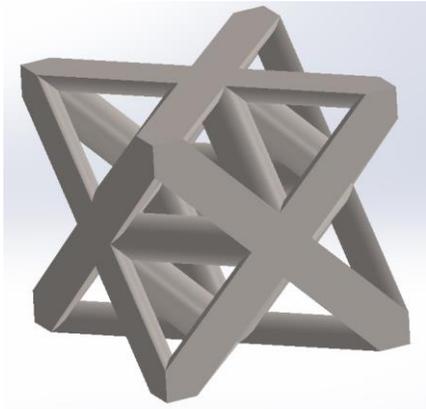
Towards newly designed implants



Case study: Future of additive processing in the field of implants



Lattice structures



BENEFITS:

- Consume less material while still distributing the necessary strength
- Used to create rough surfaces, to stimulate bone ingrowth (osseointegration)
- Are an emerging solution to weight, energy and advanced manufacturing time reduction
- To mimic bone properties in order to avoid stress-shielding
- To achieve excellent performance and multi functionality while reducing weight
- Suitable for cell attachment and growth on implants

References:

<https://www.eos.info/en>

<https://3dexter.com/additive-manufacturing-vs-subtractive-manufacturing/>

<https://www.machinetools.net.tw/machining-center/taiwan-cnc-machine-centers.htm>

https://www.researchgate.net/figure/Subtractive-and-Additive-Manufacturing-Subtractive-manufacturing_fig1_319098991

<https://www.shutterstock.com/video/search/ischium>

<http://industrynewsfocus.us/18967/hip-replacement-implant-market-research-report-major-players?investment-to-boost-the-growth-expeditiously/>

THANK YOU!