3D Printing Techniques for Anatomical Printing

INPUT – DICOM IMAGES
Medical 3D Printing starts with medical scans that result in DICOM images.

SOFTWARE: MATERIALISE MIMICS
DICOM images can be segmented and converted into an accurate virtual 3D anatomical model.

OUTPUT – PRINTABLE FILE FORMAT
STL, VRML, OBJ

3D PRINTING PROCESS
A unique process which allows the creation of a physical 3D model.
Material Extrusion
Fused Deposition Modeling / Fused Filament Fabrication

The 3D model

The thermoplastic modeling filament is heated to a semi-liquid state

The extrusion head ‘draws’ the part and its support one layer at a time

The support is removed

The part is finished

Benefits
- Relatively low total cost of ownership

Considerations
- Printed with supporting structures
- Mechanical post-processing
- Visible layers

Suggested applications
- Device prototyping, orthopedic and CMF anatomical models

Cost: 1

Detail:

Printing duration:

Material: PLA, ABS

Color options: 1 per extruder

materialise.com
**VAT Photopolymerization**

**Stereolithography / Digital Light Processing**

The 3D model

A laser hardens UV curable liquid

The platform is lowered gradually, while the laser selectively hardens the material to form the part and its support

The excess liquid is washed away and the support is removed

The part is finished

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**Benefits**

- Available in desktop format

**Considerations**

- Requires manual removal of lattice supports, chemical cleaning and postcuring
- Discoloration over time

**Suggested applications**

- CMF, orthopedic, and vascular anatomical models

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**Cost:**

- 2

**Detail:**

- Single resin with highlights

**Printing duration:**

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**Material:**

- UV cured polymers

**Color options:**

- Single resin with highlights

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materialise.com
Powdered Bed Fusion
Selective Laser Sintering / Laser Melting / Multi Jet Fusion

The 3D model
A laser binds powder particles together
Successive powder layers are spread on top of each other, while a laser selectively binds particles to form the part and its support
The loose powder is removed
The part is finished

Benefits
- Sterilizable
- No supporting structures
- Highly durable

Considerations
- Creates dust during the cleaning process

Suggested applications
- CMF and orthopedic anatomical models, surgical guides and implants

Cost:
Detail:
Printing duration:
Material:
Color options:
Nylon, Titanium, ...
Single color
The 3D model
Print heads deposit colored, liquid binder onto thin layers of white powder
The binder material fuses and colors the part
A roller spreads a layer of powder, while print heads selectively jet the binder to fuse the subsequent powder layer
The part is cured to maximize strength
The part is finished

Benefits
- Multicolor

Considerations
- Brittle material
- Creates dust during the cleaning process

Suggested applications
- Various anatomical models with custom structures

Cost:
2

Detail:

Printing duration:

Material:
Gypsum

Color options:
Unlimited
Material Jetting
PolyJet / MultiJet Printing

The 3D model
Print heads deposit photopolymer materials and support in ultra-thin layers
Each layer is cured by UV light immediately
The gel-like support material is washed away
The part is ready, without further finishing

Benefits
- Multicolor
- Multi-material incl. flexible polymer

Considerations
- Heavy post-processing
- High total cost of ownership

Suggested applications
- Cardiac and soft tissue anatomical models

Cost: $3
Detail: 
Printing duration: 
Material: UV cured polymers
Color options: Multiple