How 3D Printing is changing cardiac care

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What Is 3D Printing?

3D Printing = Rapid Prototyping = Additive Manufacturing
= Building parts layer by layer
Medical 3D Printing History

1970's

- Sir Gofried Hounsfield
  - 1971 First CT Scan
  - 1975 First whole body scan
Medical 3D Printing History

1980’s

• Chuck Hull
  • 1983 Invention of 3D Printing
  • 1986 Commercialization of 3D Printing

Copyright: 3D Systems
Medical 3D Printing History

1990’s

Copyright: 3D Systems

Copyright: Materialise
Medical 3D Printing History

• Printing of anatomical models

1990’s

Before Phidias project
1992

After Phidias project
1995
Medical 3D Printing History

1990’s
- Surgical assist devices
- Anatomical models

1999
Copyright: Materialise

2007

2010
Copyright: Materialise
Medical 3D Printing History

• 2002
  • 99% of hearing aids are 3D printed
  • Optical scan of wax inner ear

Copyright Phonak
Medical 3D Printing History

1990’s
Static anatomy, often ‘bone’

2000’s
‘Moving’ anatomy
Cardiovascular anatomy

2010’s
3D Printing for Cardiovascular research

• CASCADE: Cognitive Autonomous CAtheter operating in Dynamic Environments
  • European project, 36 months

• Consortium:
3D Printing for Cardiovascular research

- CASCADE:Cognitive AutonomouS CAtheter operating in Dynamic Environments
  - European project, 36 months
- Materialise component:
  - Test HeartPrint Flex material for tissue compliance
  - Design and print a test bed for entire catheter pathway
  - *Arterial tissue and calcification*
3D Printing for research

• Material property assessment
  • Young’s modulus
  • Distensibility
• Within range of human arterial tissue

Figure 2: Stress-strain curves of the HeartPrint™ Flex samples obtained during a uniaxial tensile test.

Figure 3: Distensibility of HeartPrint™ Flex samples with different wall thicknesses.
3D Printing for research
3D printing for complex interventions

- Planning pre-procedure using patients anatomy
- Stenting, valve positioning, custom grafts

2010’s
Cardiovascular anatomy
Case Study: Live Case RVOT Stenting

2010’s

‘Moving’ anatomy

Dr. AlJufan, King Faisal Specialist Hospital, Saudi Arabia
Cardiac Cases: Congenital Heart Defect

Born with complex form of congenital heart disease
Cardiac Cases: Congenital Heart Defect

“After the success of this surgery, it’s hard to imagine entering an operating room for another complex case without the aid of a 3D printed model. It’s definitely going to be standard of care in the future and we’re happy to be leading the way.”

Dr. Emile Bacha - Congenital heart surgeon and chief of cardiac surgery at Columbia University Medical Center – NY Presbyterian Hospital
Medical 3D Printing History

2010’s

‘Moving’ anatomy

Devices: Bioresorbable Tracheal Splint
- Polycaprolactone (PCL)

Dr. Hollister, University of Michigan & Dr. Green, C.S. Mott Children’s Hospital, USA
Medical 3D Printing History

2010’s

‘Moving’ anatomy

Devices: Bioresorbable Tracheal Splint
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Copyright: University of Michigan, Mott Children’s Hospital

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Summary

• Combination of CT, Image Processing & 3D Printing unlocking new possibilities in cardiac care
• Strong clinical interest to explore ways 3D Printing can support positive patient outcomes
• Combination of new biocompatible 3D printed materials is opening a new category for med device

Data courtesy of Prof. Johan Bosmans, University Hospital Antwerp
Thank you for your time

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