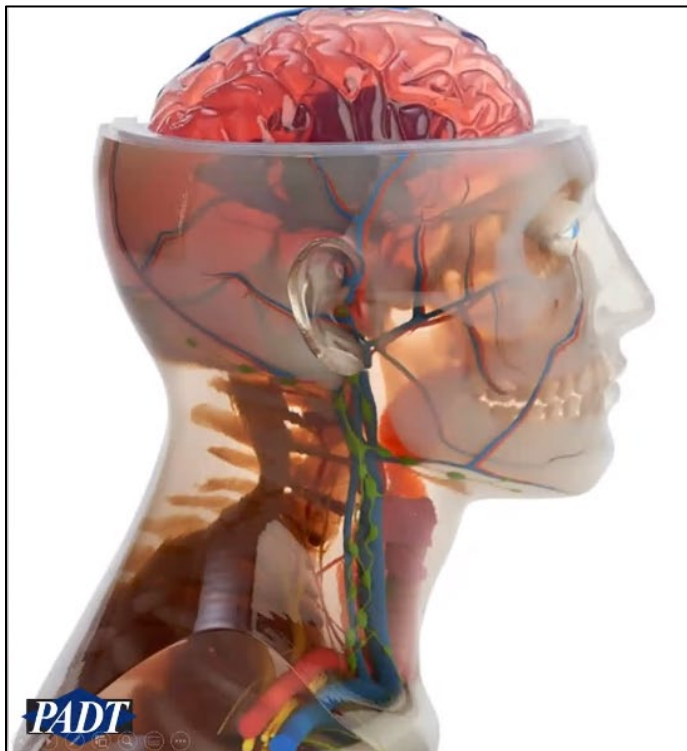


Recent Breakthroughs Advances in 3D Printing in Healthcare

What is New

What you need to know



Agenda

Introductions

Background

Prototyping for R&D

Tools for Better Outcomes

▶ Customized Replacement Parts

On the Horizon

About Eric Miller

- ◆ Co-Founder and Principal of PADT
- ◆ BS Mechanical Engineering, UC Berkeley, 1986
- ◆ Responsibilities
 - ◆ Simulation and Product Development Consulting
 - ◆ Marketing, IT, HR, Administration, Facilities
- ◆ Speaking - Writing
- ◆ Involved in Startups
 - ◆ Angel investor, screening, mentoring, speaking
- ◆ Chair of Arizona Technology Council BoD



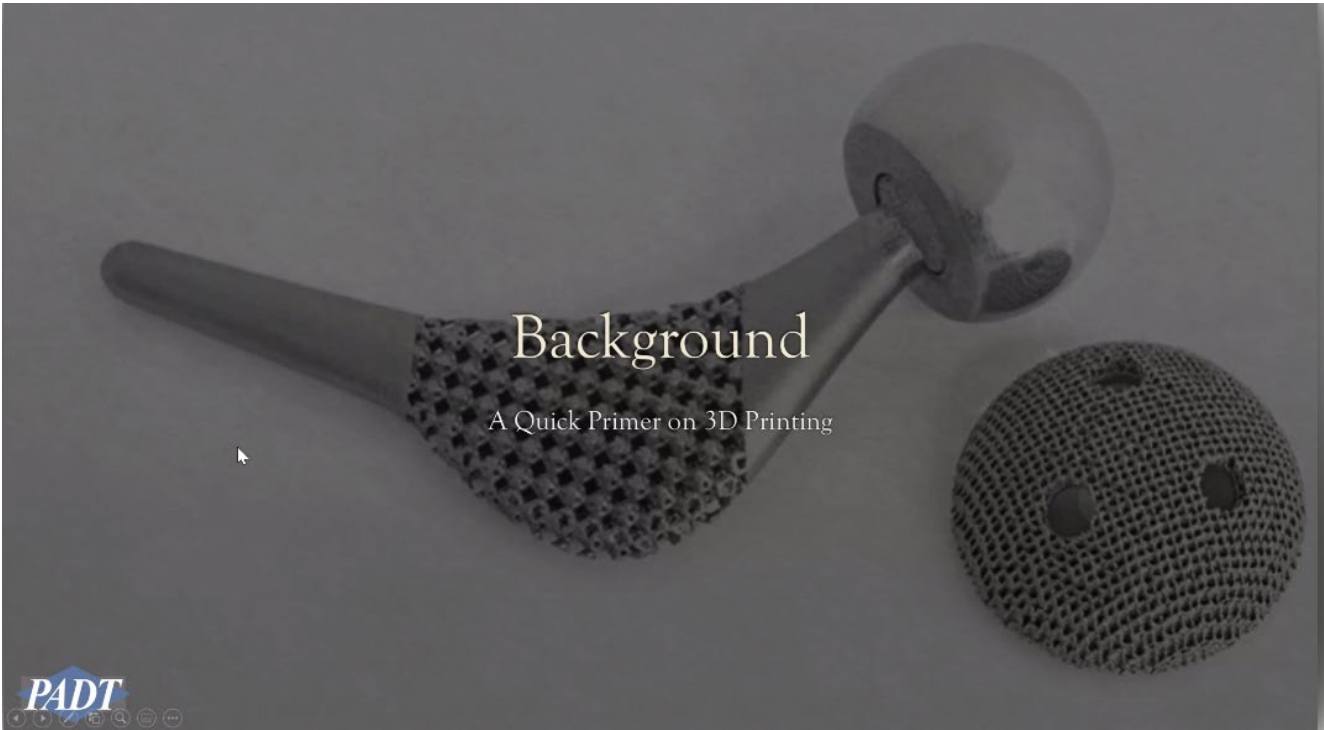
About PADT

- ◆ Founded in 1994 by four Turbomachinery Engineers
- ◆ Based in Tempe, AZ
 - ◆ Offices in California, Colorado, New Mexico, Utah, and Texas
- ◆ 85'ish Employees



We Make Innovation Work





Background

A Quick Primer on 3D Printing



Additive Manufacturing

Additive manufacturing is the industry-accepted term (ASTM F2792) for all manufacturing processes that make physical objects by adding material, as opposed to subtractive manufacturing where material is removed. It is a subset of free form fabrication.

Abbreviated as AM.



Three Applications



PROTOTYPING



TOOLING



END USE



Rapid Prototyping

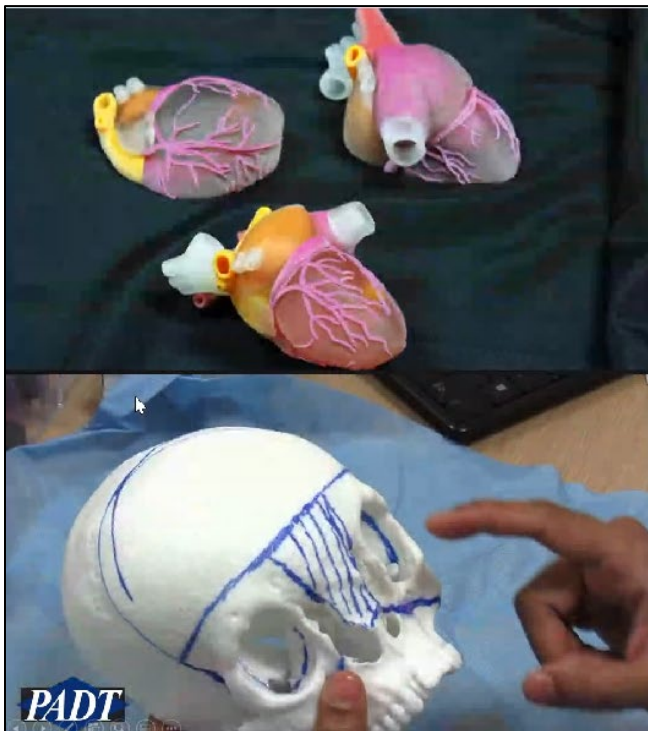
- ◇ Not unique to Healthcare
- ◇ Quick Iterations
 - ◇ Fast turnaround
 - ◇ Inhouse
- ◇ Fit
- ◇ Form
- ◇ Function



Could show you more...

- ◇ PADT currently has three Medical Design Projects
 - ◇ 5+ in the last 12 months
- ◇ All use Additive Manufacturing to Speed the Design and Improve Performance
- ◇ Over a dozen Medical Device Customers for Stratasys Systems In-House

PADT



PADT

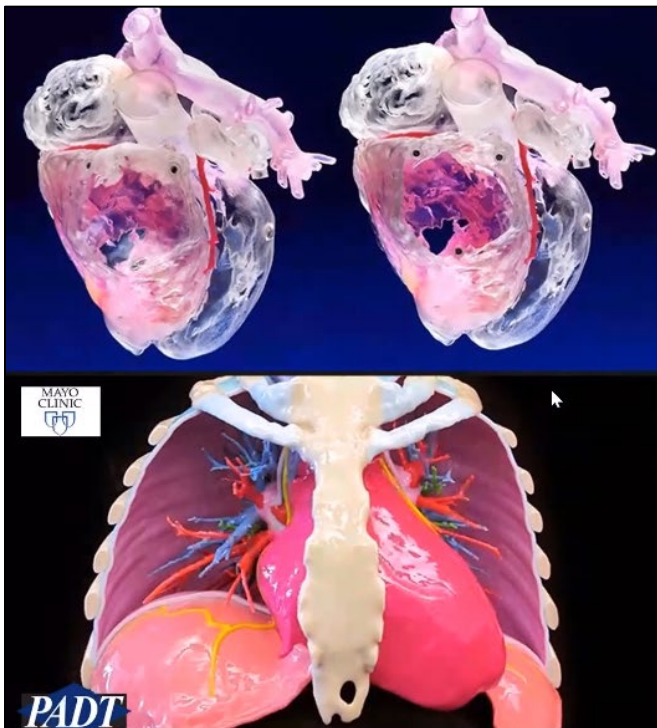
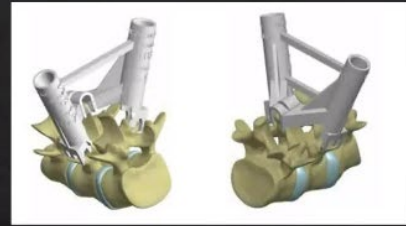
Preparation

- ◇ Surgery is a hands-on thing
 - ◇ 2D Images - OK
 - ◇ 3D Images - Good
 - ◇ 3D Visualization - Better
 - ◇ 3D Model - Outstanding
- ◇ Student Training
- ◇ Visualization and Planning
- ◇ Enabled by CT Scanning
- ◇ Major step forward
 - ◇ Multi-material printing
 - ◇ Clear + Color + Flexible

Jigs and Fixtures

- ◇ Surgeon = Carpenter + Tailor
 - ◇ Only two hands
- ◇ Need Jigs
 - ◇ Align
- ◇ Need Fixtures
 - ◇ Hold things in place
 - ◇ Protect tissue
 - ◇ Keep things out of the way
- ◇ Custom
 - ◇ Fits the patient
 - ◇ What each doctor wants

PADT

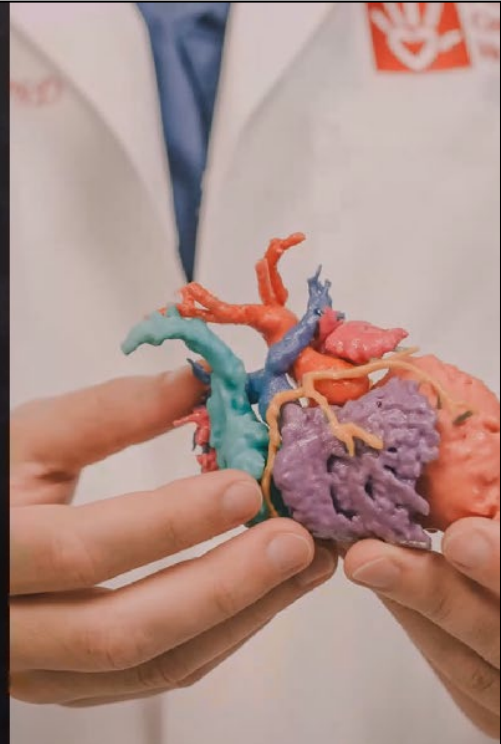


Mayo Clinic

- ◇ Early Adopters
 - ◇ Across system
 - ◇ Active in the community
 - ◇ 61 papers on PubMed.gov
 - ◇ Training Classes and Seminars
- ◇ PADT has assisted with
 - ◇ Drill Guides
 - ◇ Radiology Head Stabilizers
 - ◇ Pre-Surgical Planning
 - ◇ Much more

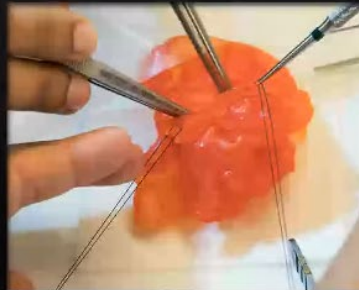
Phoenix Children's Hospital

- ◆ Surgical Planning and Family Consultation
- ◆ Collaboration with ASU Image Processing Applications Laboratory
- ◆ Over 260 hearts for surgical planning
- ◆ "You don't know what you will find till you hold it in your hand."



Stratasys J750 Digital Anatomy 3D Printer

- ◆ 3 Material Types
 - ◆ GelMatrix - support
 - ◆ TissueMatrix - soft tissue
 - ◆ BoneMatrix - bone
- ◆ Vary color and stiffness



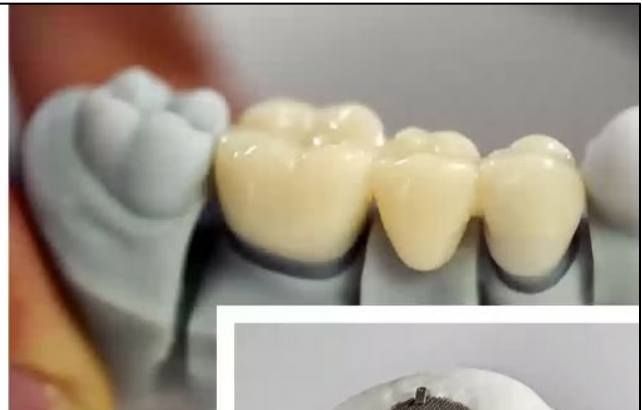
Orthotics

- ◇ External Structural Support or Protection
- ◇ Custom
- ◇ Lightweight
- ◇ Variable Stiffness
- ◇ Onsite or “lab” creation
- ◇ Two important factors
 - ◇ Materials
 - ◇ Scanning



Biocompatible Implants

- ◇ Repair and Replacement
- ◇ Massive growth in dental
- ◇ Hearing aids
- ◇ Often Metal
- ◇ Standard sizes or Custom
- ◇ Joints are most common
- ◇ Custom “plates”
- ◇ Mesh



ADDI+VE IMPLANTS

Additive Implants

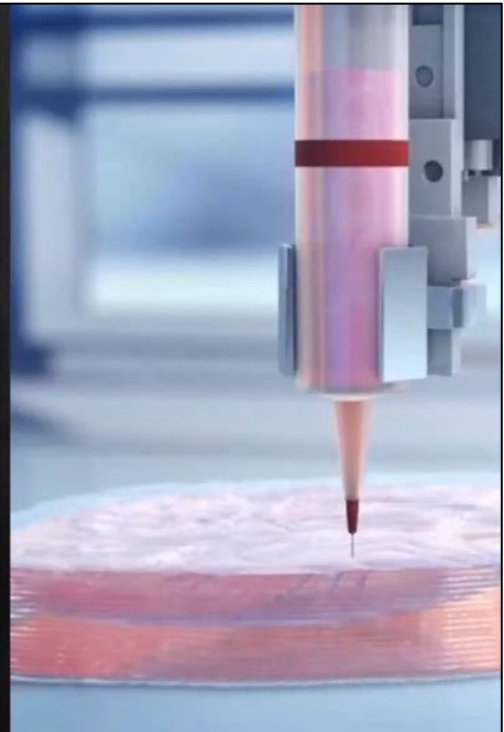
- ◆ Cervical Spacers
- ◆ Used variable lattice structure to provide flexibility where needed
- ◆ Startup, doing well
- ◆ Phoenix



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Biological

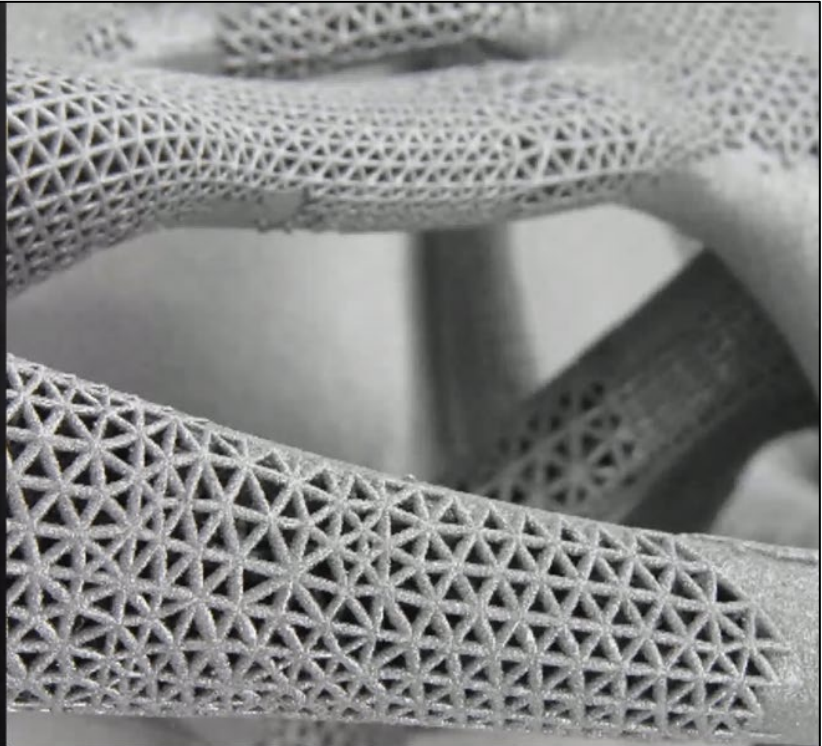
- ◆ Multifunction devices
- ◆ 3D Print structure – scaffold
 - ◆ Gel or rigid
- ◆ Deposit cells and growth factors
 - ◆ “Bioink”
 - ◆ Robotic Syringe
- ◆ Cells grow and gel is absorbed
- ◆ Major area of research
 - ◆ Success with skin and cartilage
 - ◆ Resent success with multi-organ printing
 - ◆ Pancreas and vascular system



PADT

Barriers

- ◇ Non for Prototyping
- ◇ No Reimbursement
- ◇ Cost
- ◇ Layered process
- ◇ Post-processing
- ◇ Effort to go from Medical Image to computer model



So Much to Come

- ◇ Removes Limitations
- ◇ Encourages Innovation
- ◇ Personalized Medicine



We Make Innovation Work



Thank You

www.padtinc.com
eric.miller@padtinc.com