

STA 2016
JAN 6-9TH
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3D PRINTING IN PEDIATRIC ANESTHESIA
EXPERIENCES - CHALLENGES - OPPORTUNITIES

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SickKids 

DISCLOSURES
AN ANESTHESIOLOGIST AND ANESTHESIOLOGIST IN TRAINING

NO CONFLICTS OF INTEREST TO DECLARE

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OBJECTIVES
AN ANESTHESIOLOGIST AND ANESTHESIOLOGIST IN TRAINING

- 01. A Case
- 02. Background on 3D Printing and History
- 03. 3D printing in Anesthesia/Medicine
- 04. Our 3D Printing Experience - look and printing
- 05. Lessons and Summary



OBJECTIVES



01. A CASE
POTENTIAL FOR 3D IMAGING AND PRINTING

A CASE STORY

40827032X 41

Prophylactic tracheal and bronchial intubation without intubation 1-2 attempts. The patient had a poorly developed trachea and advanced tube past the vocal cords.

Intraoperative findings:

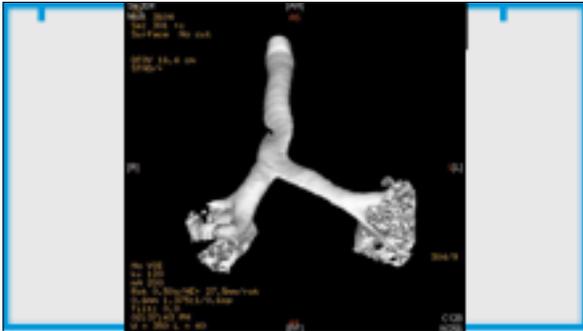
Failed intubation of the end with denervation and increased airway pressures.

Tracheostomy and fiberoptic intubation performed.

Seen in PEG with tube advanced past the obstructive area.

PEX
Monitor with STT in situ.







A CASE STORY

40827032X 41
40827032X 41 SECOND STAGE (PROXIMAL)

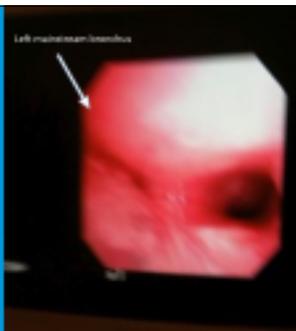
STT repositioned distal to the tracheal narrowing using PEX.

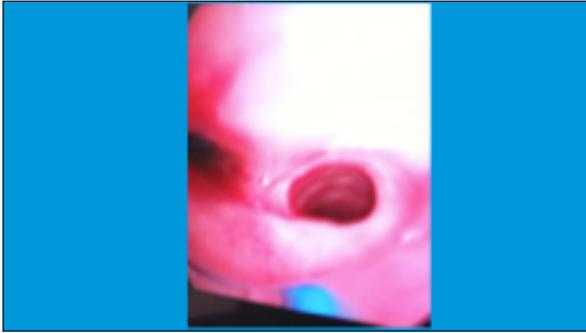
Positive humid gases:
Spontaneous breathing resumed/flow increased with no air entry bilaterally.

Tracheal patient support:
T-tube intubation
T-tube adjustment

Positive humid gases:
Flow pressures increased and/or air entry to the left lung.
Performed a proximal bronchoscopy.

Positive humid gases:
Endotracheal tube











History of 3D Printing

Five often-cited examples of technology and human manufacturing milestones:



1984-86

Charles Hull
Invented the process for creating and printing the first "liquid slushprint"



2000

Human Kidney
First human kidney created through 3D printing



1999

First 3D printer
The way to an additional fourth dimension was made possible by the first fully ready 3D printer



2006

Laser Sintering Machines
The first laser sintering machines printed multiple industrial parts



1999

Printing Human Organs
First application of 3D printing technology to create a human kidney

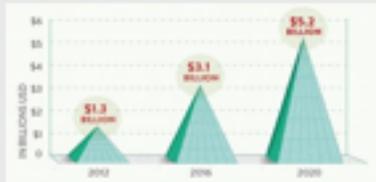


2009

2009
First fully ready 3D printer printed the first human kidney using 3D printing

Projected Growth of 3D Printing

It is predicted that the 3D printing industry will triple in size in the next 4 years!



(Source: <http://www.3dprinting.com/news/industry-growth-2012-2016>)

Concept Modelling



Functional Prototyping



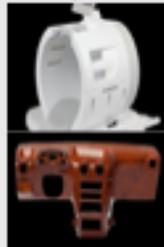
Manufacturing



End Use Parts



Finishing



Potential Uses of 3D Printing in Pediatric Anesthesia

MEDICAL DEVICES



- implants
- prosthetics
- braces
- guides and templates
 - craniocly
 - medical clauds
 - CMI
- Risks
 - anyone can print a medical device
 - counterfeit devices
 - defective devices
 - toxic materials
- harm to patient

Potential Uses of 3D Printing in Pediatric Anesthesia

BIOPRINTING



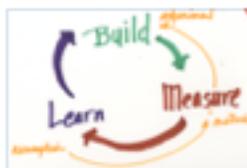
- a subcategory of 3D printing
- may have different regulations
- different policy may apply



04. OUR 3D PRINTING EXPERIENCE

LUCK AND MISTAKES

Pragmatic approach



Focus

Airway

Education

Medical Device/Tool

Build a library of 3D difficult congenital airways
- Croonian's, Pierre Robin Sequence, Goldenhar, Treacher Collins
Toolbox for surgical airway

Airway Anatomy
Caudal Space

Laryngoscopes

Our Space



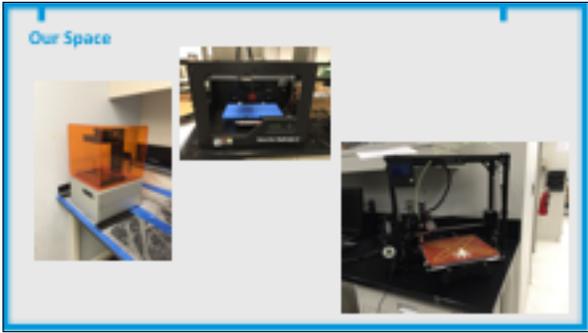
Our Space

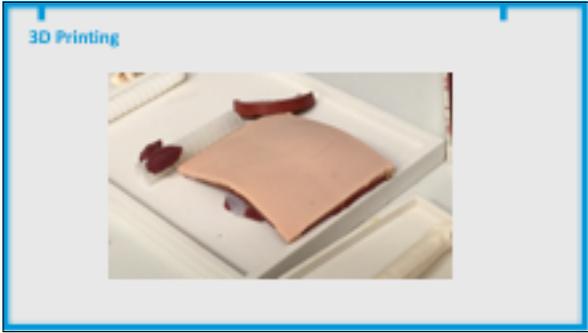


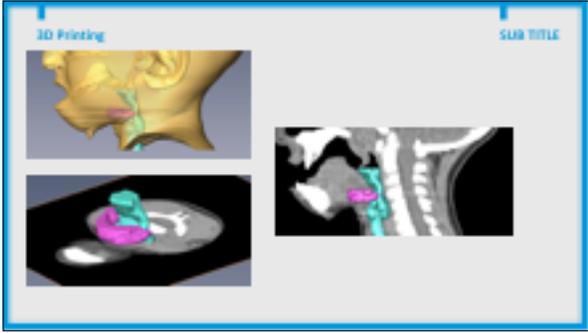
Our Space

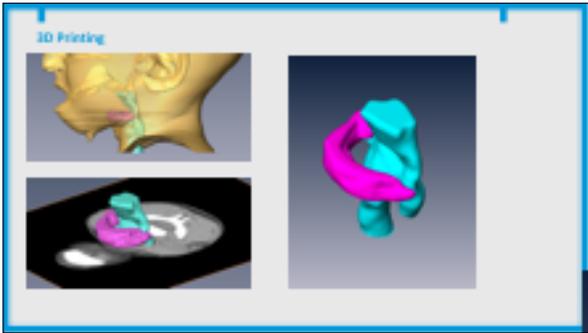


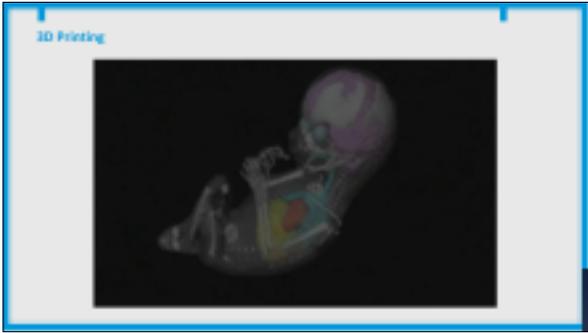




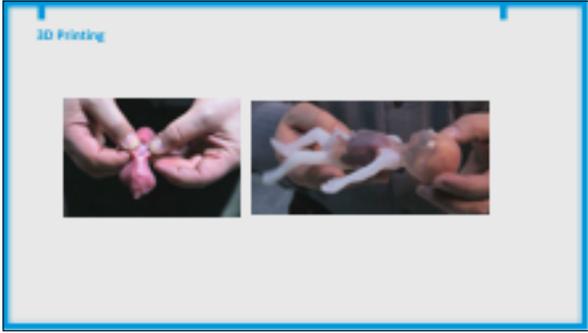












Lessons

Identification of appropriate CT Scans

- Retrospective evaluations limiting useable CTs
- Inadequate C-Spine levels included in the CT Scan
- Low dose CT Scans used for children limiting the voxel resolution.

Cost of Software

- Opensource software is of varied quality
- Licensed software is expensive and requires key licences
- Identifying patients with enough time to get consent for use of images can be challenging

Image processing

- ill defined borders seen between cartilaginous structures and soft tissues (i.e. thyroid cartilage and epiglottis compared with surrounding muscle and fat) likely due to low dose scanning

Lessons

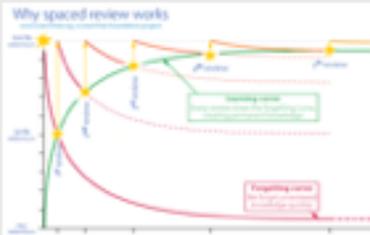
Materials

- Modulus of elasticity
- behaviour with a finite element analysis of the baseline airway used for segmentation
- (deformability) of applying force on the airway in 3 dimension

Standards

- Nomenclature for anaesthesia

Measure and assess



SUMMARY

in 3D printing in medicine

01. A Case
02. Background on 3D Printing and History
03. 3D printing in Anesthesia/Medicine
04. Our 3D Printing Experience - look and enjoy!
05. Lessons and Summary



OBJECTIVES

Acknowledgements to team

 Stephanie Pollock	 Matthew Lu
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THANK YOU
