

The Evolution of Design: A Novel Thoracoscopic Diaphragmatic Hernia Repair Simulator

Lauren M Davis, Ellen K Hawkinson, Katherine A
Barsness, MD

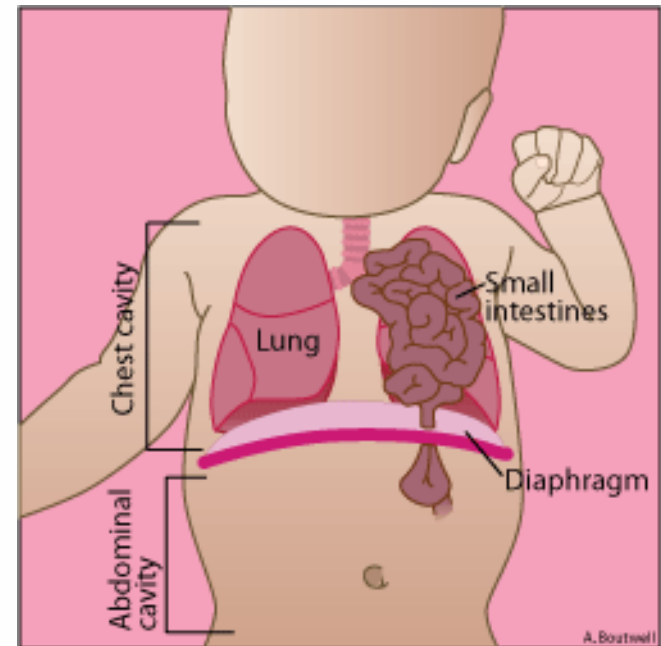


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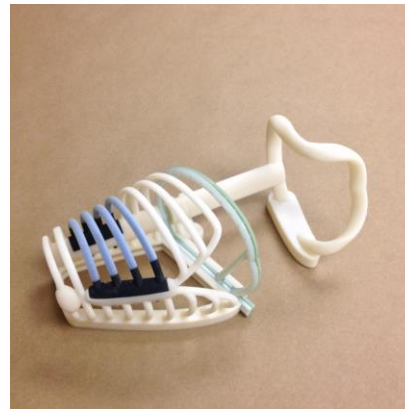
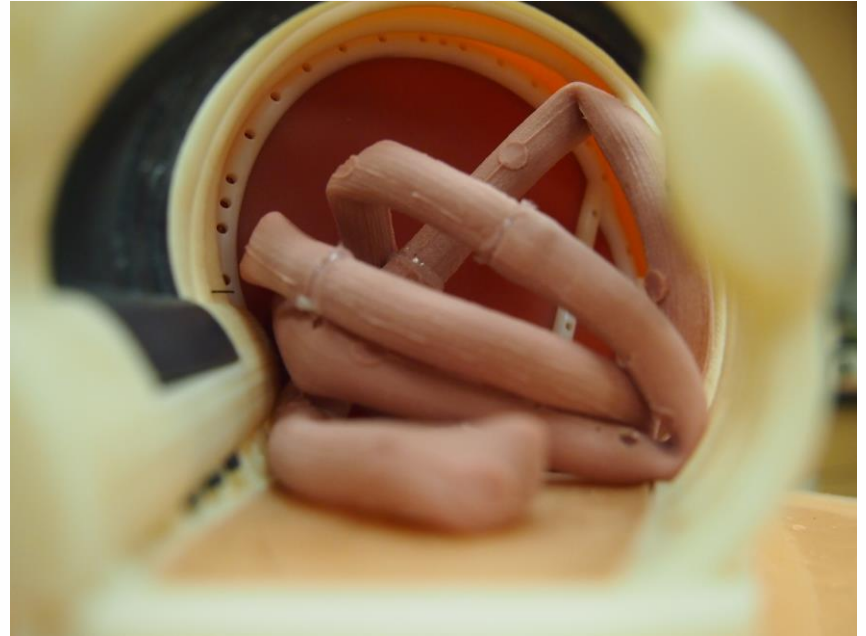
FEINBERG
SCHOOL OF MEDICINE

Background

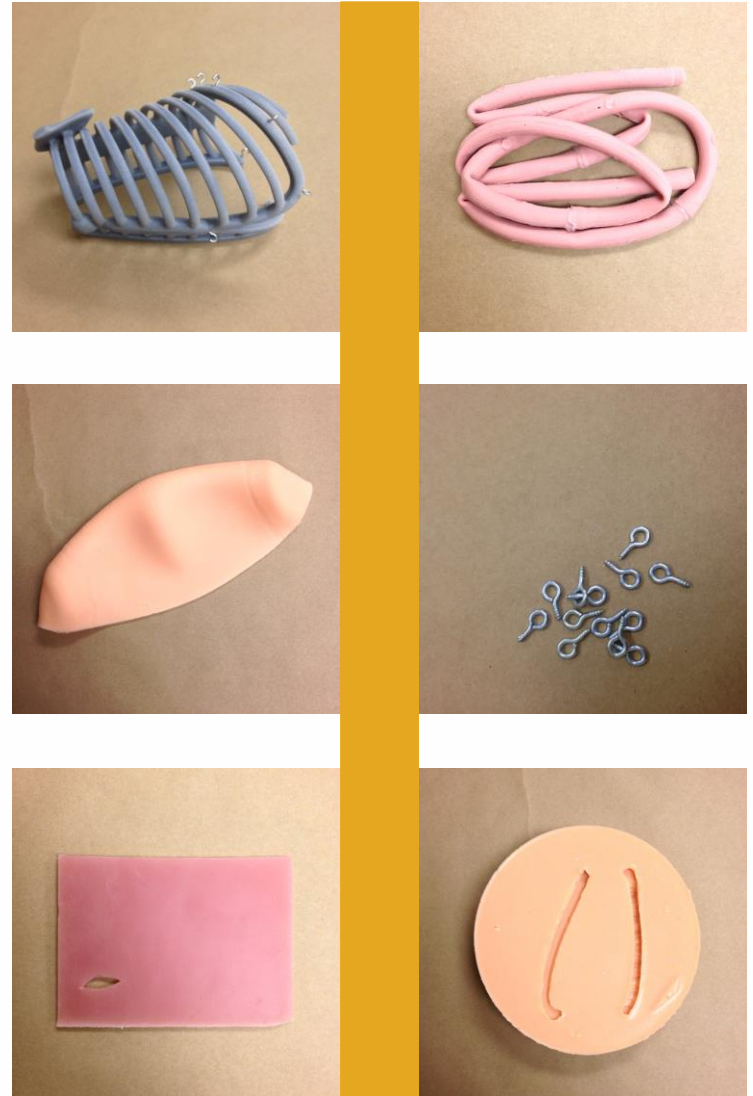
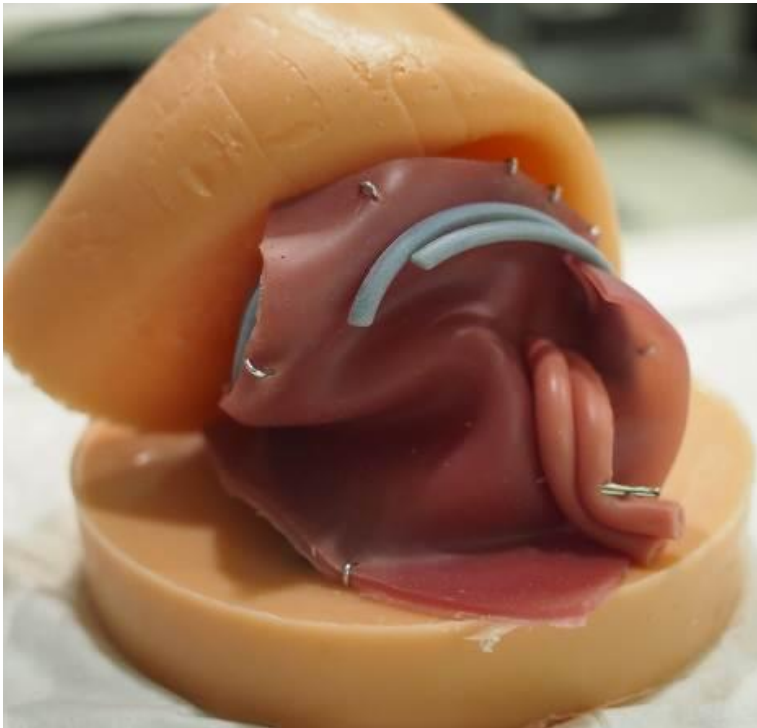
- Diaphragmatic Hernia (DH)
 - 1 out of 3000 live births
 - Technically challenging repair
- Few opportunities to train
 - inherent learning curve
- Simulator provides an opportunity for deliberate practice and mastery learning



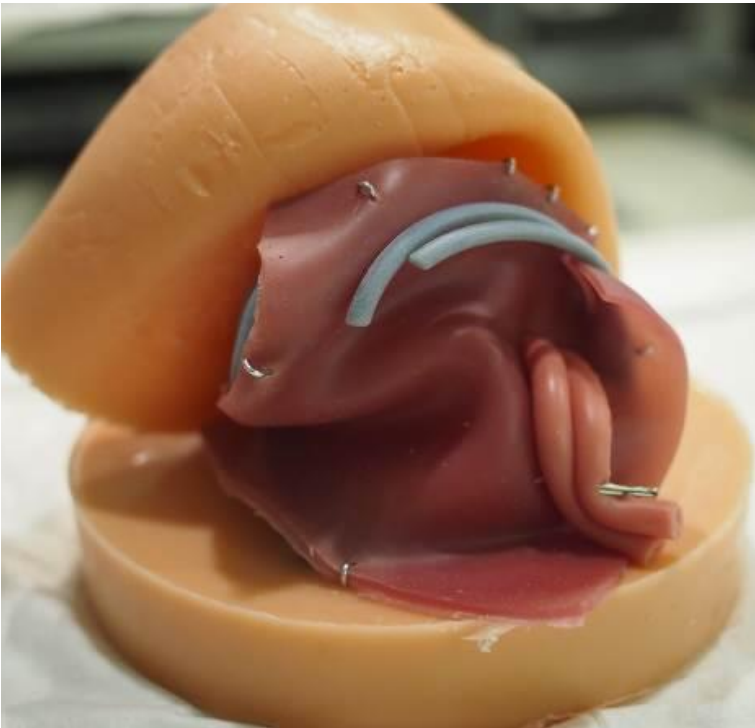
- 3D printing
 - Ribs
 - Molds for organs
- Silicone modeling
 - Organs
 - Base
 - Skin



LOW FIDELITY



Failures



Brittle ribs:
broke with
pressure from
tools



Embedded
nylon caused
tension and
fraying



Difficult to
secure tissue
to replicate
location of
defect

HIGH FIDELITY



Failures



Brittle ribs:
broke with
pressure from
tools

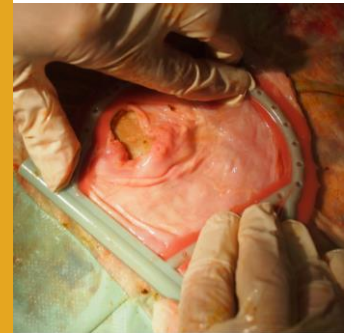
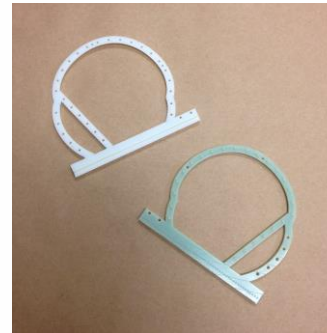
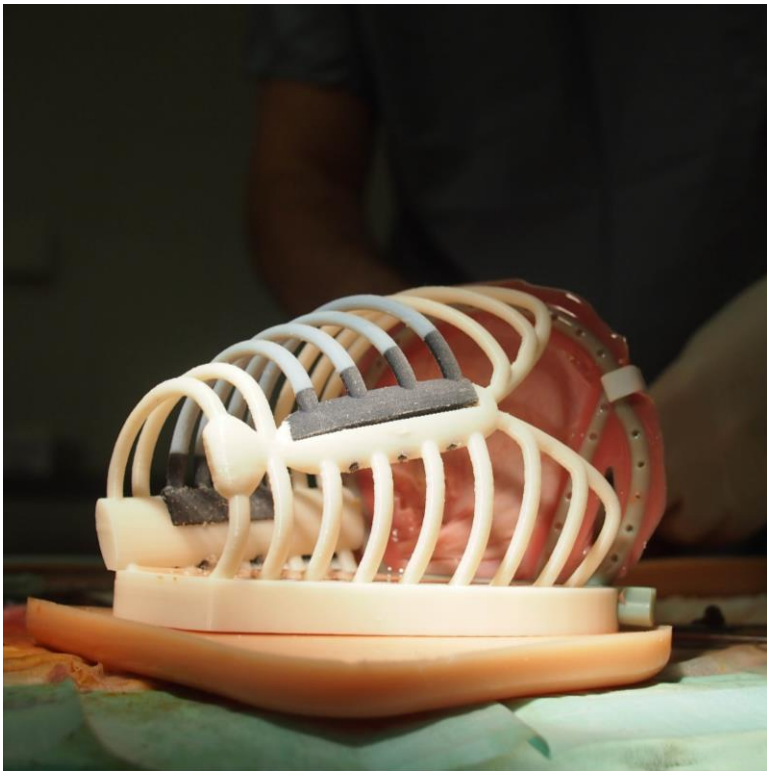


Difficult to
secure tissue
to replicate
location of
defect



Eye hooks
caused the
tissue to fray

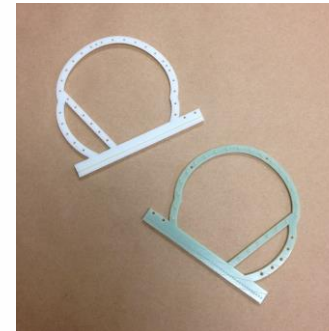
HIGH FIDELITY



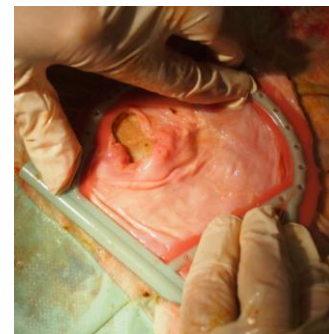
Failures



Rib cartridge was too soft: could not palpate

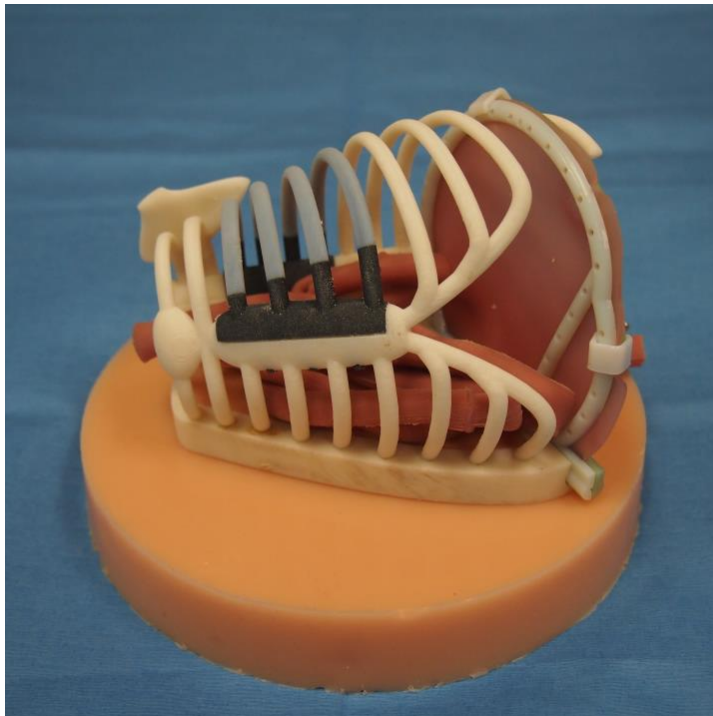


Glass filled nylon was not durable: teeth broke off cartridge



Cartridge sprung open: used binder clip to keep closed

MIDDLE FIDELITY



Cost break down

Prototype	Rib Cage	Rib 3-6	Stabilizer	Silicone Skin/Base	Silicone Tissue	Bovine Tissue	TOTAL
1	\$200.00	NA	NA	\$16.32	\$2.04	NA	\$218.36
2	\$200.00	NA	NA	\$16.32	NA	\$85.00	\$301.32
3	\$60.00	\$60.00	\$35.00	\$16.32	NA	\$85.00	\$221.32
4	\$60.00	\$60.00	\$35.00	\$16.32	\$2.04	NA	\$173.36

Cost break down

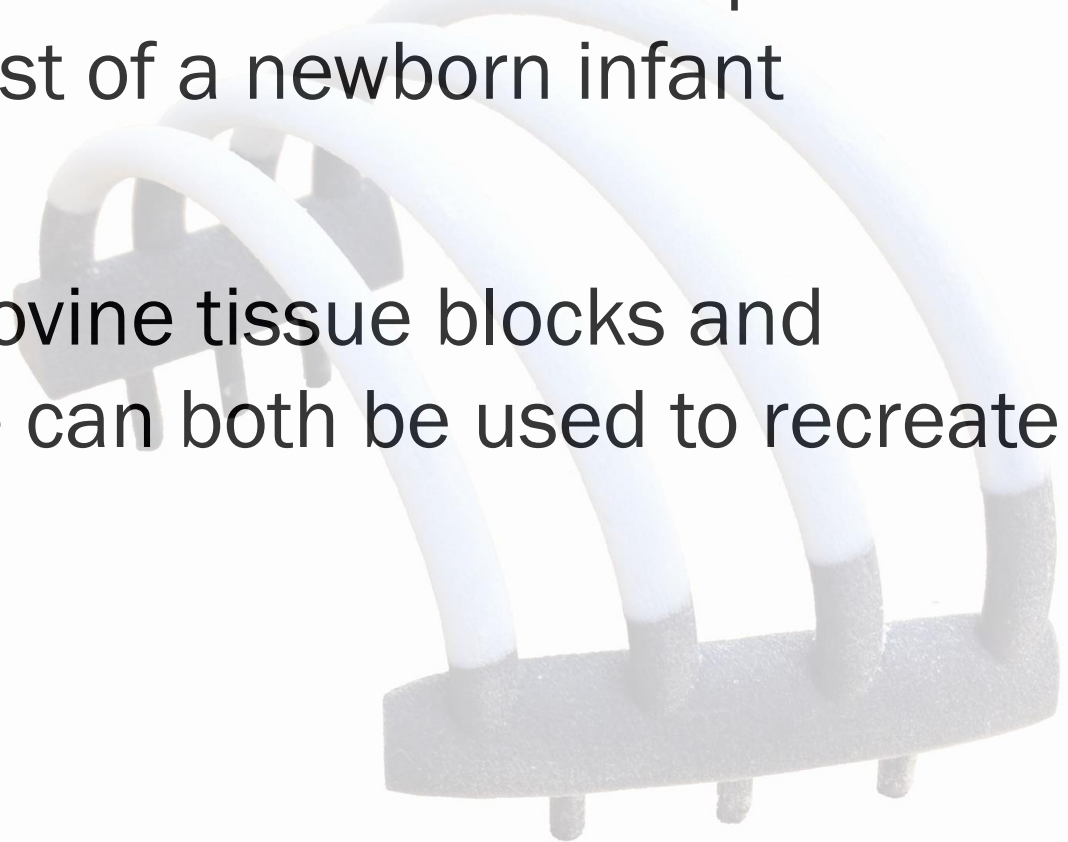
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- Favorable responses from pediatric surgical trainees
- Simulator demonstrated evidence of content validity
- Suitable model for training CDH repair



Conclusion

- Low-cost, reusable CDH repair trainer can accurately simulate the confined space inside the chest of a newborn infant
- Ex-vivo fetal bovine tissue blocks and silicone tissue can both be used to recreate CDH anatomy.



- Continue to collect validation data
- Additional features:
 - Sensors
 - Smart materials



References

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2. Davis LM; Rooney DM; Barsness KA. Design and Development of a Novel Thoracoscopic Trachoesophageal Fistula Repair Simulator. *Stud Health Technol Inform.* **184** (2013) 114-6.
3. Barsness KA; LM; Rooney DM; Davis LM. Collaboration in simulation: The development and initial validation of a novel thoracoscopic neonatal simulator. *J Pediatr Surg.* **48** (2013) 1232-9.
4. Barsness KA; LM; Rooney DM; Davis LM. The Development and Evaluation of a Novel Thoracoscopic Diaphragmatic Hernia Repair Simulator. *J Laparoendosc Adv Surg Tech A.* **23** (2013) 714-8.
5. Solidworks Corp. (2011). Solidworks [computer software]. Massachusetts: Concord.

Questions/Comments?

Thank you!