

Background

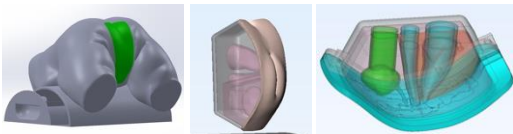
Anorectal malformations (ARM): rare congenital anomalies requiring complex technical repair. Average number of ARM repairs performed:

- American pediatric surgery trainees: 15.5 over 2 years
- Recertifying American pediatric surgeons: 2.2 annually

Aim: develop a high-fidelity ARM surgical model that allows for simulation of the operative steps of the reconstruction

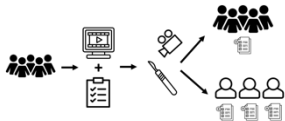
High-Fidelity ARM Simulator Design

- Designed using digital modeling software packages
- Fabricated using a combination of 3D-printing, hand-sculpting, and multi-stage silicone injection molding techniques



Validation Methods

- Cross-sectional observational study at international surgical meeting



- Participants performed posterior sagittal anorectoplasty (PSARP) on the model
 - Completed questionnaire on model's realism and didactic value
- Each session recorded and independently assessed by 3 experienced pediatric colorectal surgeons (raters) using:
 - Standardized general skills (OSATS) assessment
 - PSARP step-specific assessment

PSARP Steps on Simulator



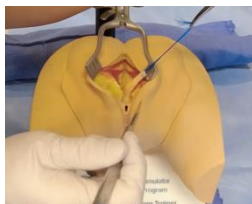
Evaluation of vagina and fistula



Midline incision



Define posterior and lateral planes around fistula



Separate anterior rectal wall from posterior vaginal wall



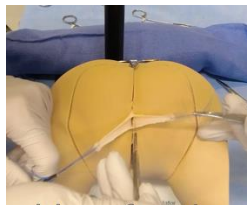
Gain rectal length



Perineal body repair



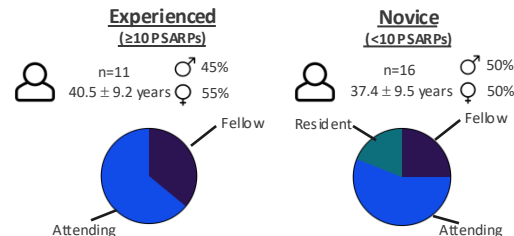
Tacking of posterior rectal wall



Anoplasty and closure of posterior sagittal wound



Validation Results



Face Validity

- Rated >4/5 on 6 measures assessing realism of the simulator ($p < 0.001$)
- Rated >4/5 on 8 measures assessing simulation of the PSARP ($p < 0.01$)

Content Validity

- Experienced participants endorsed simulator as a realistic simulation and as a valuable tool for training and maintenance of skills ($p < 0.0001$)

Discriminant Validity

- OSATS Evaluation
 - Significant differences between experienced and novice participants in respect for tissue instrument handling, flow of operation, and knowledge of specific steps
 - Cumulative OSATS: experienced 16.6 ± 2.9 vs. novice 12.0 ± 4.5 ($p = 0.008^{**}$)
- PSARP Steps Evaluation
 - Significant differences between experienced and novice participants in all steps
 - Cumulative score: experienced 26.2 ± 3.9 vs. novice 20.1 ± 5.8 ($p = 0.006^{**}$)

Conclusion

High-fidelity synthetic anatomic models offer the opportunity to learn and practice the steps of rare and complex surgical procedures. Future research will focus on validating this simulator's ability to replicate a PSARP and assess its potential role in training, assessment, and maintenance of skills.