

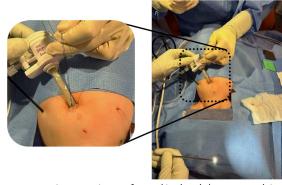
3 mm Mini Laparoscopic Port

Engineering & Applied Science
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Background

- Surgical setup for babies can be challenging and lead to complications or fatalities
- Improving the ability for surgeons to operate with better tools will improve outcomes and reduce newborn fatalities



Laparoscopy: An operation performed in the abdomen or pelvis using small incisions with the aid of a camera

Insufflation: Inflation of the thoracic cavity during an operation to 10-12 psi. Allows surgeons to visualize surgical site via camera

Current Ports



1. Crowding of surgical field

Current large port heads hinder visibility and instrument maneuverability

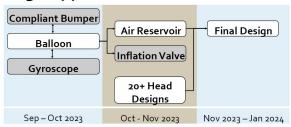
2. Sealing and insufflation

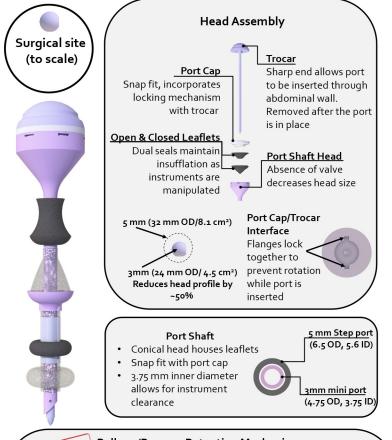
Port must maintain insufflation while accommodating motion of amm instruments

3. Dislodgement of port from cavity Existing designs fail to secure port adequately: surgeons suture ports in place

Goal: Develop a 3mm port with a retention mechanism for use in laparoscopic procedures

Design Approach





Balloon/Bumper Retention Mechanism PATENT PENDING Upper Bumper Forces air out of upper Upper Balloon balloon into lower one via narrow air channels "Reservoir" of air which is pushed into Lower Bumper lower balloon Slides down shaft until flush with skin. further stabilizing port Lower Balloon Balloon holder When inflated. Supports upper balloon prevents port from dislodging from cavity 3. Lower bumper 2. Air is forced 1. Port is inserted stabilizes port, which is from upper to through 3mm lower balloon via ready to accommodate incision

Material Selection



Components fabricated on FormLabs 3B printer

- Material properties similar to FDA-approved resins
- Resins with wide variety of material properties available

Rigid: FormLabs Clear resin

• Trocar, port cap, shaft, balloon holder

Flexible: FormLabs Flexible resin (durometer rating 50A)

Leaflets, bumpers, upper balloon

Soft: Silicone (durometer rating 20A-35A)

Lower balloon

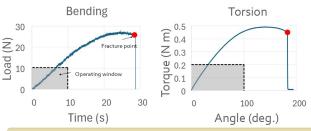
Testing

Chose tests to simulate typical operating conditions on port shaft

- Tension
- Bending
- Torsion

Balloon identified as essential component

- Pressure tested in a pool to simulate loss of insufflation
- All balloons survived pressure testing



Results

1. Crowding of surgical field

Reduced head area profile by roughly 50%.

2. Sealing and insufflation

Leaflets maintain insufflation, while removal of valve further decreases head size

3. Dislodgement of port from cavity

A novel retention mechanism allows for user to apply retention without secondary tooling, reducing port dislodgement.



"It feels familiar"

-Dr. Diaz-Miron

air channels

3mm instruments