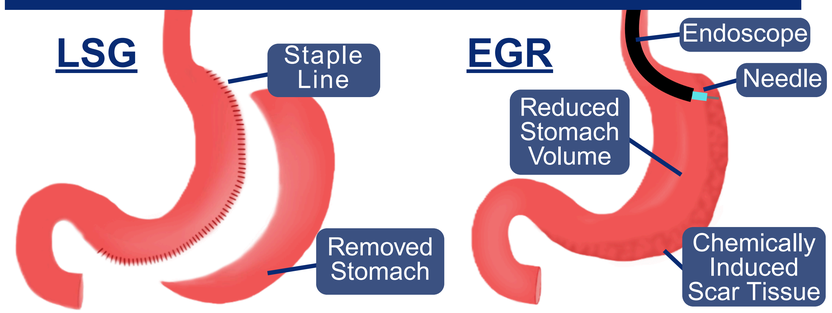
JHUSOM26 Endoscopic Multi-Needle Array for Localized Therapeutic Delivery

Tunde Ayodeji, Cyrus Levy, Eva Loftus, Aidan Montano, Kennedi Woods

Johns Hopkins Whiting School of Engineering

Johns Hopkins School of Medicine

Background



Laparoscopic sleeve gastrectomy (LSG) is an effective obesity treatment, but it is irreversible and invasive. The Johns Hopkins School of Medicine is investigating endoscopic gastric remodeling (EGR) as a less invasive alternative. Current endoscopic injectors typically use a single needle, making large-area submucosal drug delivery slow, inefficient, and difficult to distribute uniformly. This project explores a multi-needle endoscopic device to address these issues.

Requirements

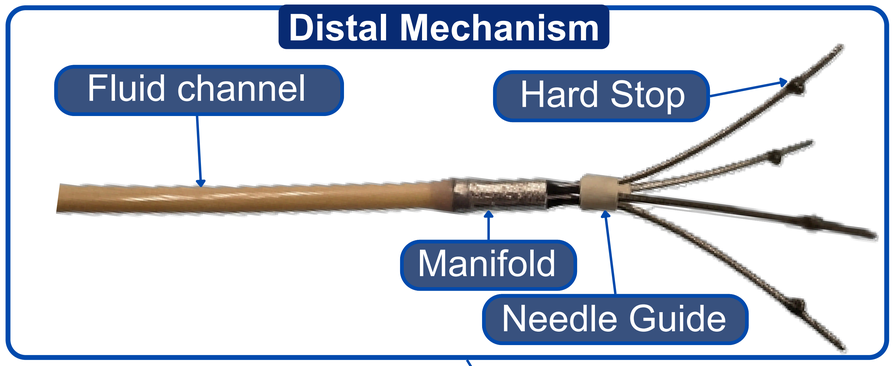
- Deploy through a **2.8 mm endoscope channel** consistently
- Avoid tissue damage during deployment, use, and retraction
- Cover greater area than a single-needle injector
- Consistently deliver **2 mL** total fluid volume
- Penetrate **2-4 mm** into the **submucosa layer**
- Require injection force of **less than 61 N**

Solution

Our endoscopic device features:

- **Four 25 gauge heat-trained nitinol needles** angled at 30° for increased area coverage
- **Individual hard stops** to restrict needle penetration to the submucosa
- **Actuation mechanism** to expand from a compressed profile to a **16 mm x 16 mm** geometry
- **Manifold-based** fluid distribution for symmetric fluid delivery across four needles

System Overview

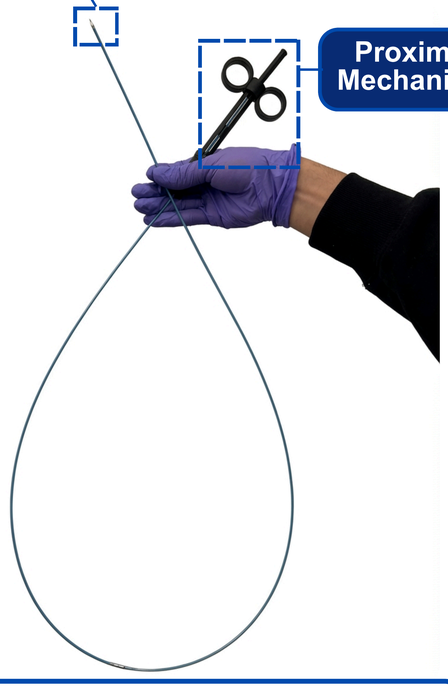


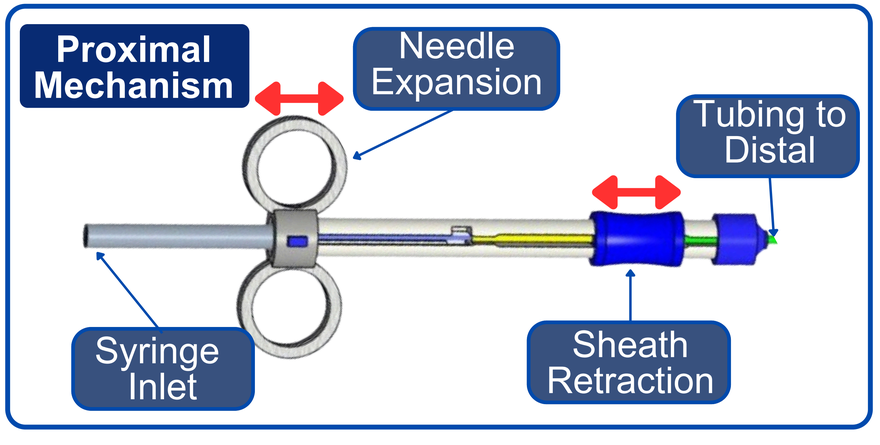
Hard Stop

Mounted on needles to set maximum insertion depth

Nitinol Needles

Heat-trained at 28° to achieve 30° angle





Proximal Subsystem: operator controls sheath retraction, needle expansion, and fluid injection

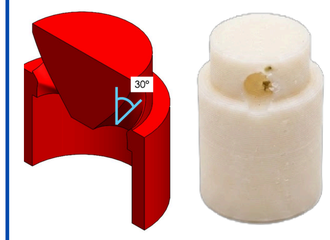
Distal Subsystem: deploys through the endoscope and is injected in the stomach; to actuate, the operator pushes the manifold tubing forward, forcing the needles through the needle guide, expanding the system to full diameter, and allowing for a larger area of injection.

Manifold

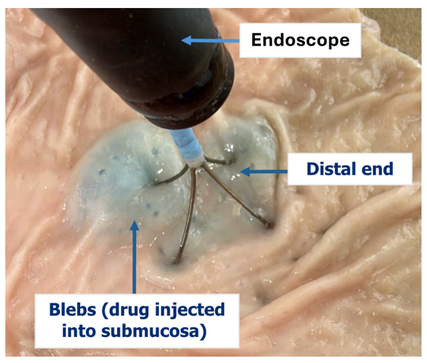
Fluid is distributed from the tubing to all four needles

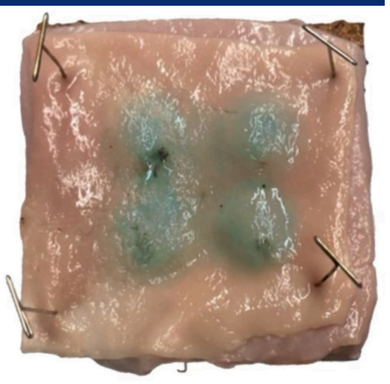
Needle Guide

Pulled back to expand the needles to 30°



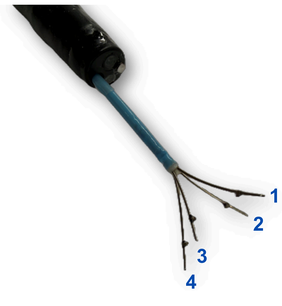
Ex Vivo Testing





Baseline: Single Bleb Area	Multi-Needle Device Bleb Area
5.01 cm²	10.11 cm²

2x increase in bleb area compared to a single injection



Needle #	1	2	3	4
Avg fluid volume (mL)	0.46	0.54	0.64	0.45

16.4% variation from the average drug volume dispensed across needles

Acknowledgements

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