# Magnetic Micro-Robots for Medical Application

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## Objective & Research Question:

The primary objective of this research is to design, construct, and evaluate magnetic micro-robots capable of conducting tissue resection within the human GI tract

## Background:

- Robotic surgery and rehabilitation have become prevalent in medical centers today.
- Magnetic robots can assist physicians in performing intricate procedures such as surgery and drug delivery in hard-to-access areas of the human body.
- This research has the potential to mitigate surgical risks, enhance precision, and carry out surgical procedures that are challenging for surgeons.

## Methods:

- Performing experiments to characterize forces between magnets.
- Utilizing COMSOL Multiphysics software for conducting simulations of magnet interactions.
- Utilizing SolidWorks to design a gastrointestinal (GI) tract container. Setting the stage for the use of full-size internal and external magnets in in vitro experiments
- Using a laser cutter to fabricate a precise container cover. The design is specifically targeted to prevent any potential odor leakage.

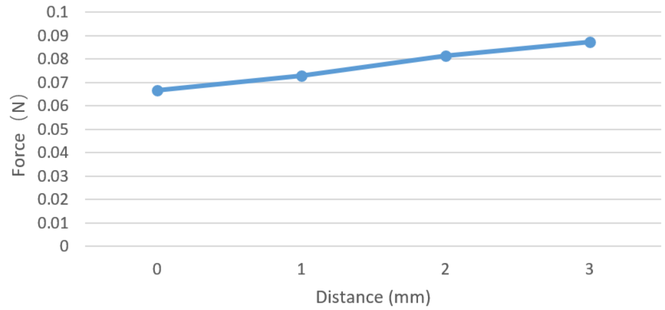


Figure 1. Magnetic force vs. distance of the internal and external magnets.

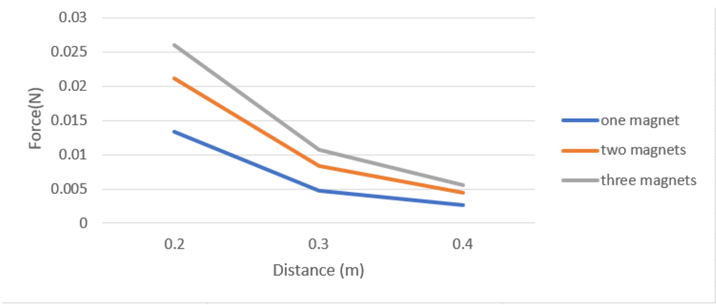


Figure 2. Magnetic force vs. distance for different number of internal magnets.

Figure 3. GI tract container

## Results

- When the number of internal magnets remains constant, the force required decreases as the distance between the internal magnet and the external magnet extends (Fig. 1).
- The magnetic force increases proportionally with increasing the number of internal magnets placed at the same distance (Fig. 2).
- The seal is not quite tight for the container (Fig. 3). During experiments, we observed air leaks.

## Conclusion and Future Work

- The preliminary experiments and simulations suggest that the magnetic force generated by the external magnet is sufficient to control the internal magnet and perform tissue resection.
- We had issues maintaining the inflation of the colon throughout the experiment.
- Future plan is to persist with our research, shifting focus to experiments with the stomach in both ex-vivo and live animal experiments. .

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