DEVELOPMENT OF A COST-EFFECTIVE LAPAROSCOPIC CAMERA NAVIGATION TRAINER FOR SURGICAL TRAINEES

J Wang, E Madha, J Flanary, K Stransky, R Mateo

BACKGROUND

Camera navigation is critical skill for medical students and surgical trainees in laparoscopic surgery, yet no dedicated trainer exists. Current trainers have significant flaws:

1. **Fixed cameras** prevent navigation training.
2. **High costs** make commercial trainers inaccessible.
3. Existing models **lack horizon and angle control.**

This project develops a cost-effective trainer to improve navigation skills.

METHODS

Board-certified general surgeons, residents, and medical students provided feedback throughout development.

Design Priorities: Fidelity (realistic handling), cost (<$100), and accessibility (compatible with various trainers).

Core Components:

- Borescope with rotating lens attachment to simulate laparoscopic camera operation.
- Beam-steering mechanism allowing independent control of camera horizon and direction of view.
- 360-degree rotation with an angled degree field of view.

FIGURES

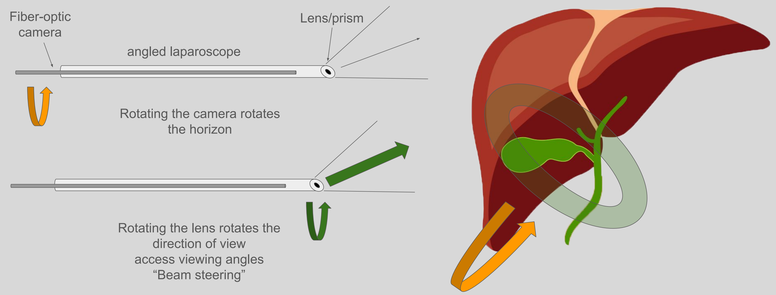


Figure 1: Challenges in developing a laparoscopic camera

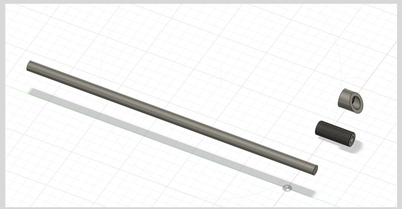


Figure 2: 3D modelling and design of lap camera trainer

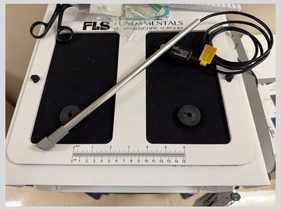


Figure 3: Assembly of lap camera trainer

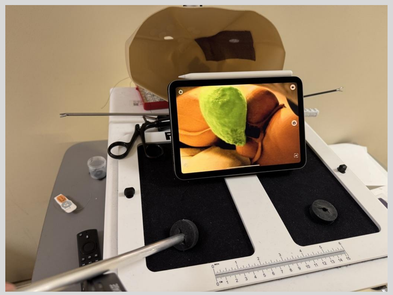
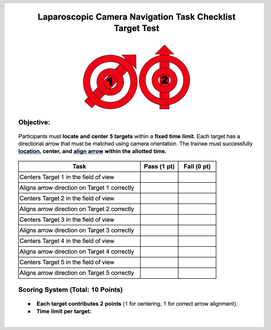


Figure 4: Trainer in action viewing a 3D printed liver and gallbladder



Laparoscopic Camera Navigation Task Checklist
Target Test

Objective:

Participants must **locate and center 5 targets** within a **fixed time limit**. Each target has a directional arrow that must be matched using camera orientation. The trainee must successfully **location, center, and align arrow within the allotted time.**

Task	Pass (1 pt)	Fail (0 pt)
Centers Target 1 in the field of view		
Aligns arrow direction on Target 1 correctly		
Centers Target 2 in the field of view		
Aligns arrow direction on Target 2 correctly		
Centers Target 3 in the field of view		
Aligns arrow direction on Target 3 correctly		
Centers Target 4 in the field of view		
Aligns arrow direction on Target 4 correctly		
Centers Target 5 in the field of view		
Aligns arrow direction on Target 5 correctly		

Scoring System (Total: 10 Points)

- **Each target contributes 2 points** (1 for centering, 1 for correct arrow alignment).
- **Time limit per target:**

Figure 5: Task Checklist

RESULTS

- **Fidelity:** Horizon and angle control, correct dimensions
- **Cost:** <$100
- **Accessibility:** deployable in commercial and homemade/custom trainers
- **Portability:** wireless via tablet/phone

FUTURE DIRECTIONS

- **Validation:** Compare results between trainee skill level and existing laparoscopic equipment
- **Curriculum design:** Camera navigation curricula for cholecystectomies and appendectomies
- **Integration:** Incorporate into medical student curricula at USUHS

CONCLUSIONS

- The trainer effectively addresses key barriers: **cost, fidelity, and accessibility**.
- Ongoing validation and refinement will enhance its integration into surgical training

REFERENCES

References

Lap Camera Trainer STL file

Disclaimer: The views expressed in this presentation are those of the authors and do not reflect the official policy of the Department of Army/Navy/Air Force, Department of Defense, or the U.S. Government