

NEST: Needle Stabilizer

Student Team

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Course Mentors

30.123: Healthcare Product Design
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Background

Patients typically undergo a biopsy for cancer diagnosis and staging. Multiple needle manipulations are performed during biopsies to reach the target lesion as the needle translates and changes trajectory when inserted in superficial tissues. This results in prolonged procedure times, increasing the risk of haemorrhage.

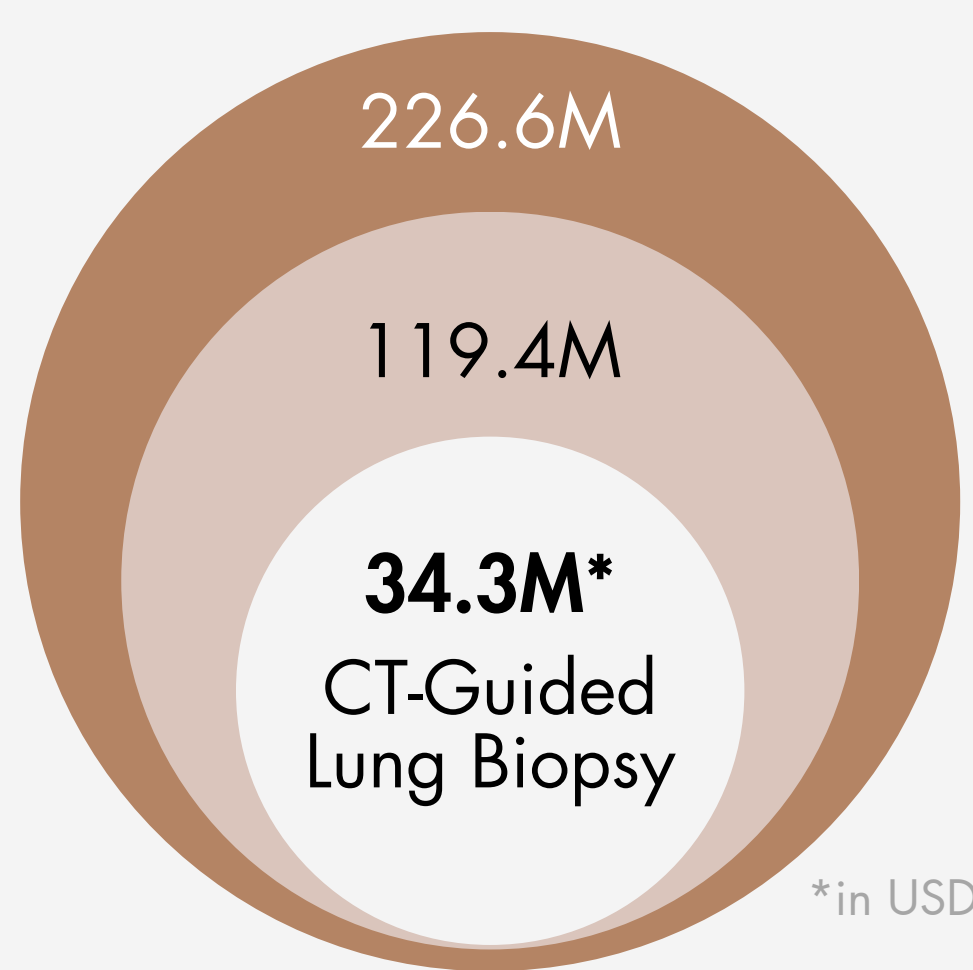
Problem Statement

There is a need to design a needle stabilization device that enables secure needle insertion, ensuring stability throughout minimally invasive image-guided procedures even when the needle is released from the hand.



NEST is a **minimally invasive, freehand steerable** needle stabilization device that helps doctors achieve **precise needle positioning** during needle-based biopsy procedures.

Market Value and Impact

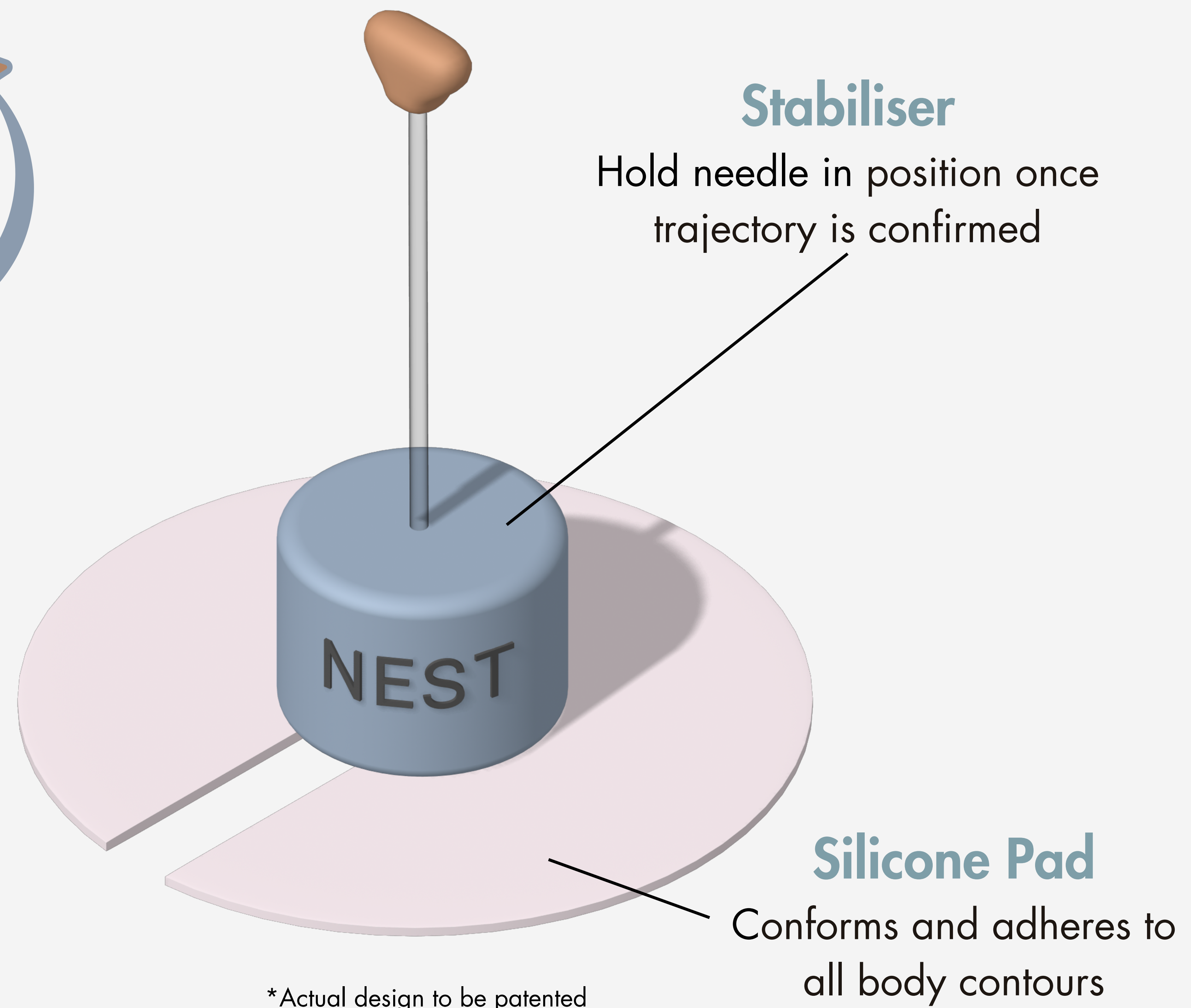


Miss Rate / Insufficient Sample:

Lung	10%
Bone	3.42%
Soft Tissue	2.4%
Renal	13%

The precision provided by NeST has the potential to improve the efficacy of needle biopsy procedures and reduce the number of repeated procedures.

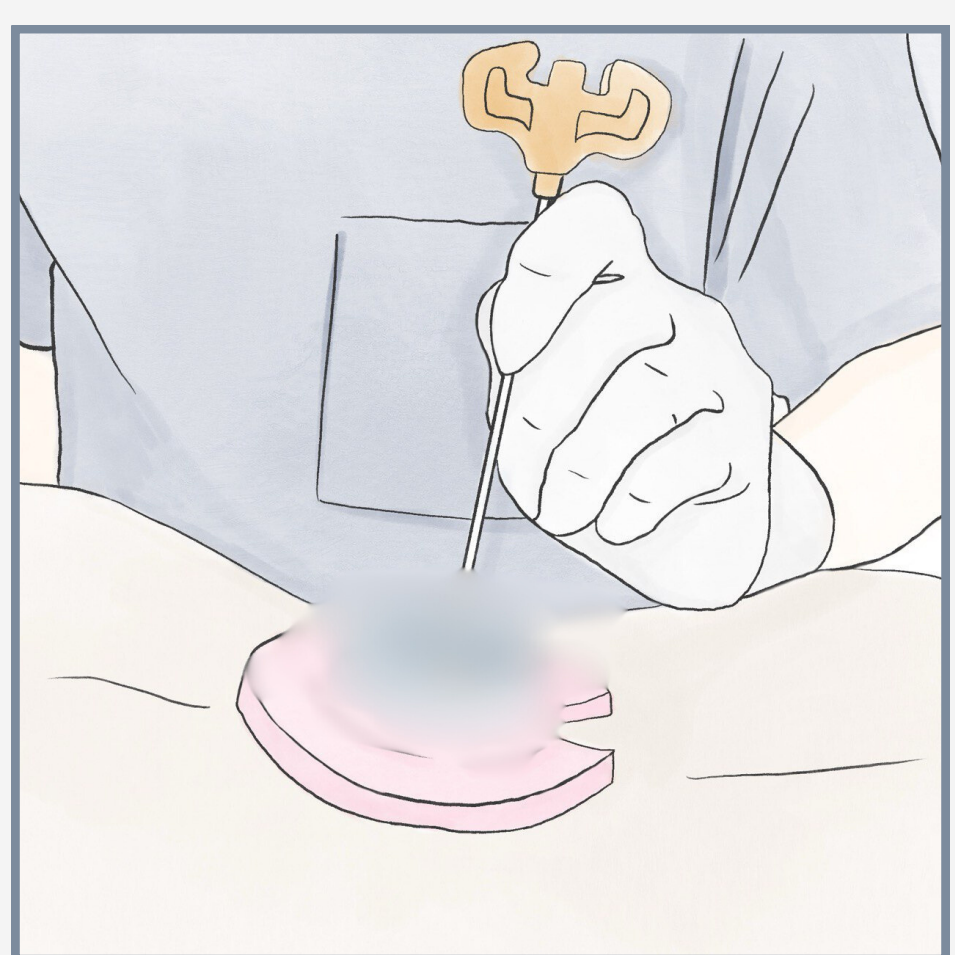
171K CT-Guided Lung Biopsy/year (US)
 Miss Rate: 10%
 Avg Cost of Lung Biopsy: US\$2000



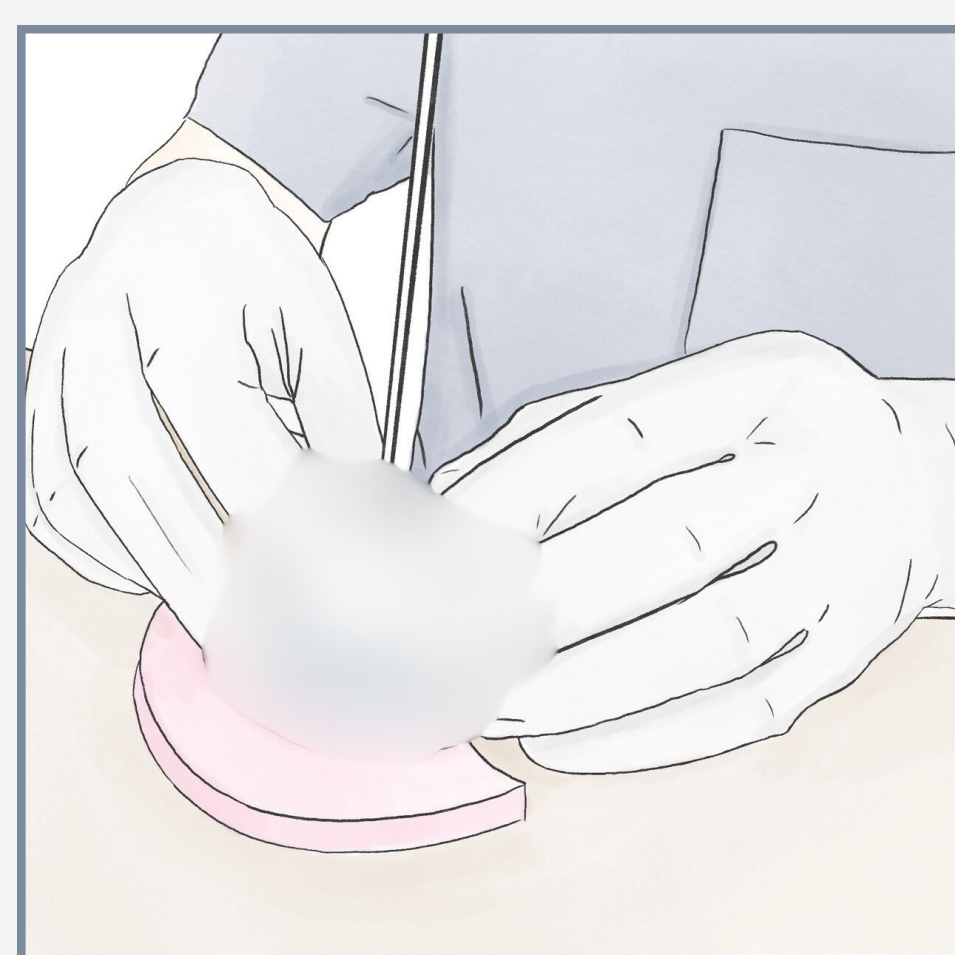
Key Aspects & Novelty

- Freehand Steering
- Fuss-free Assembly
- Mid-procedure Implementation
- Stability on all Body Curvatures

How to Use



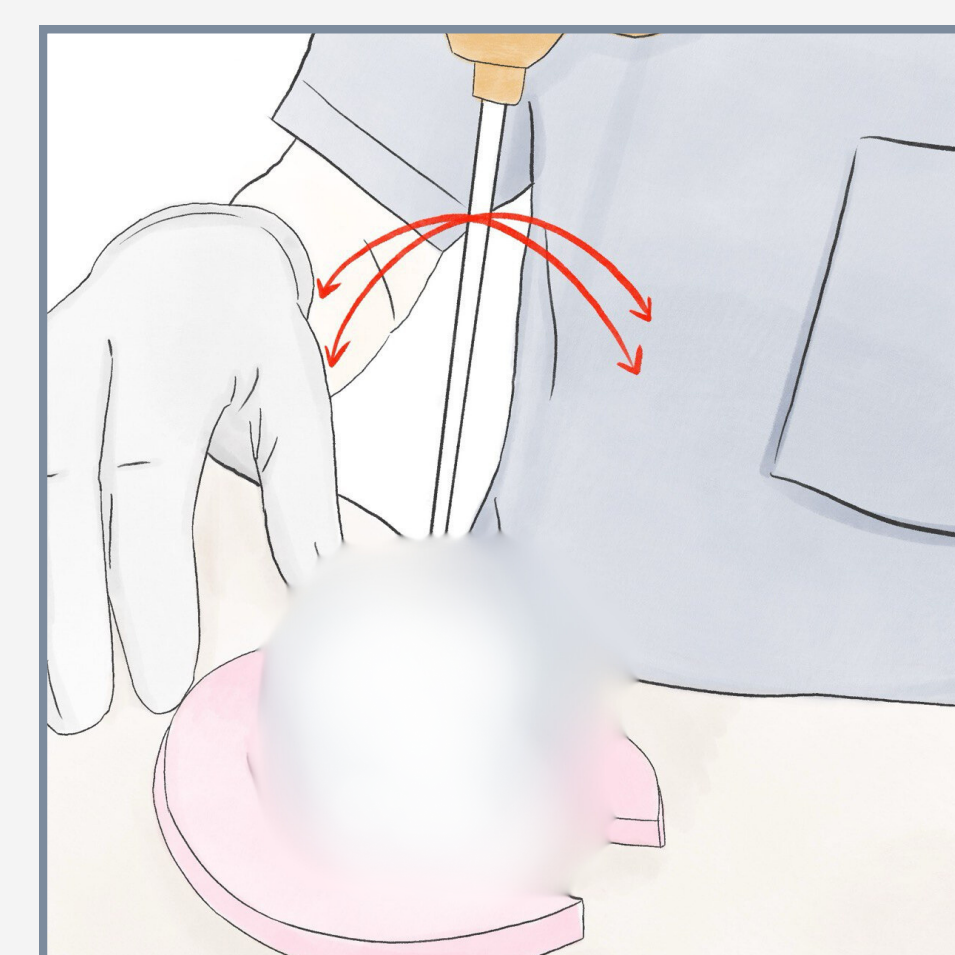
CT-Safe



Easy to Assemble
 <1 min



One-handed Operation

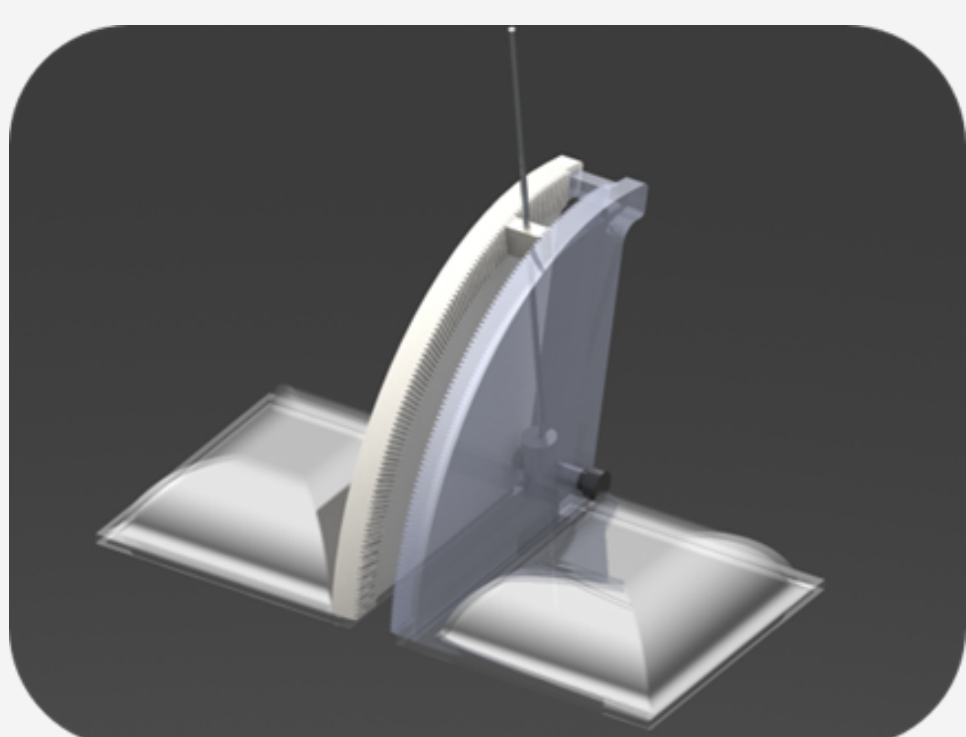


Freehand Adjustment



Needle is stable & in place

Design Iterations

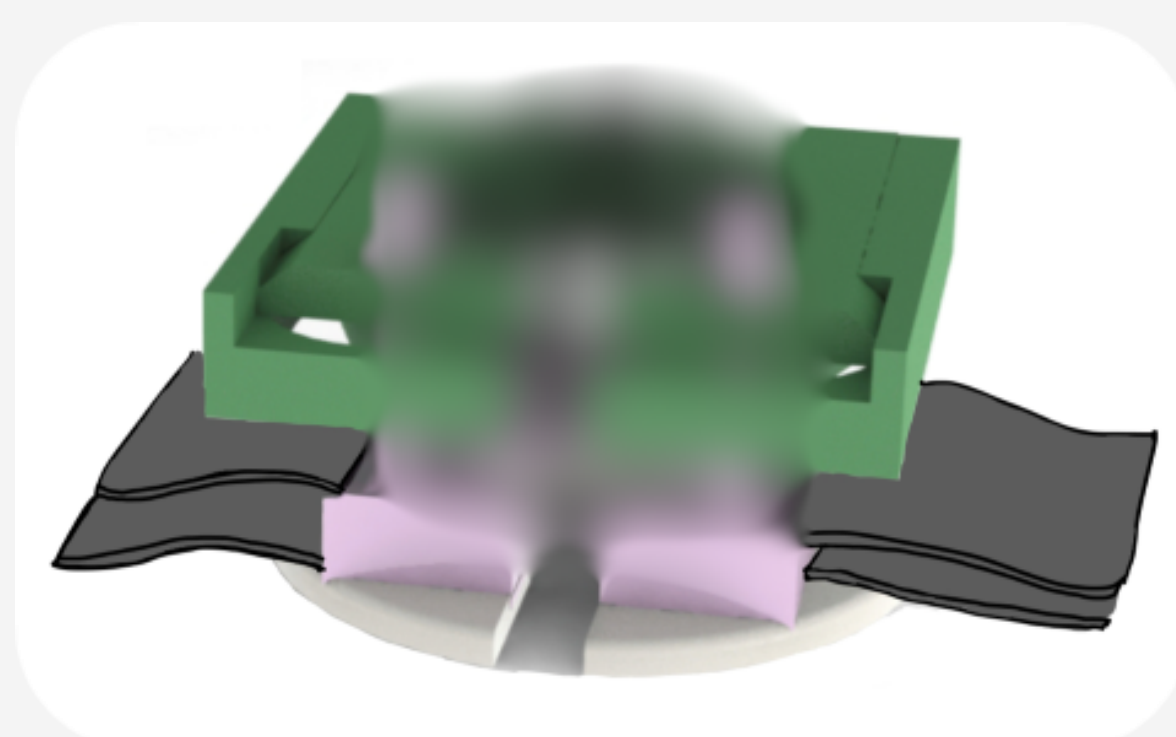


Features:

- Suction for skin adhesion
- 3 Degrees-of-Freedom (DOF)
- Stabilises needle for fine-tuning

Limitations:

- Does not allow free-hand steering
- Limited DOF
- Does not allow disassembly mid-procedure



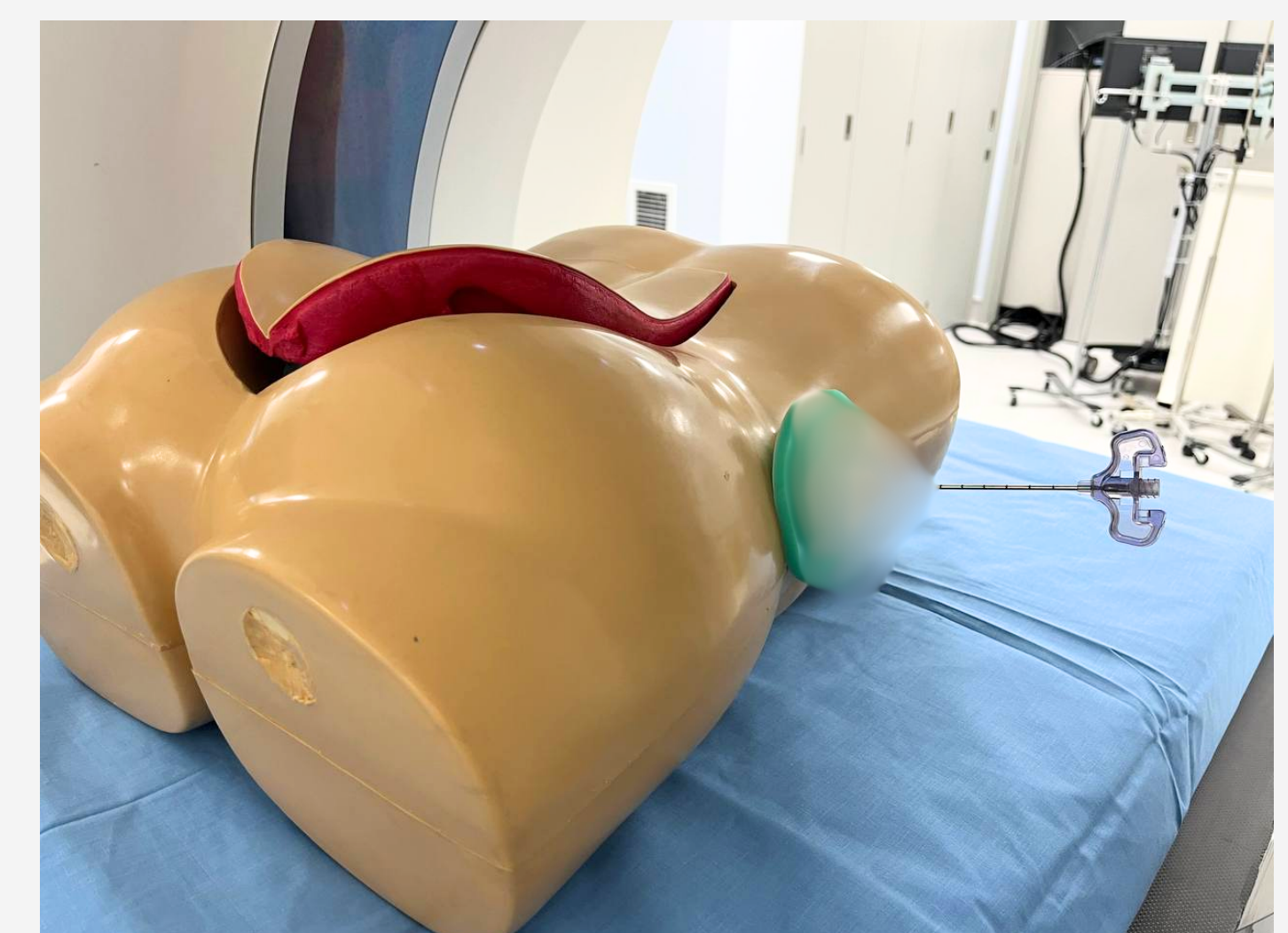
Features:

- Velcro straps for additional stability
- 4 Degrees-of-Freedom (DOF)
- Mid-procedure implementation

Limitations:

- Asymmetrical design hinders ease of use
- Velcro straps lack sterility
- Complex assembly procedure

Validation Testing



*"The **rotational symmetry** makes it easy for me to use it, without having to decide which way the device needs to be oriented. In addition, the fact that I'm not limited to either two or three degrees of freedom, whereas I have **four**."*

Feedback from Dr. Chong Le Roy, CGH