



JOHNS HOPKINS
MEDICINE



MAGFIT
DYNAMIC
DYNAMIC URINARY INCONTINENCE SLING

MagFit Dynamic

Dynamic Urinary Incontinence Sling

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JOHNS HOPKINS

WHITING SCHOOL
of ENGINEERING

Introduction

In the United States,

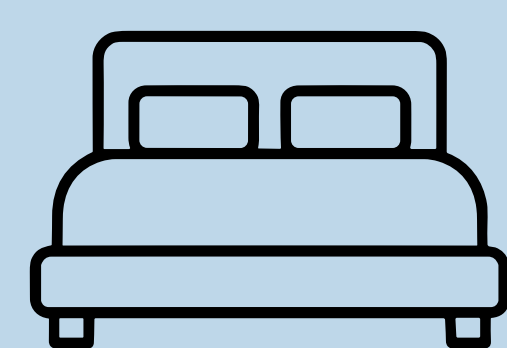
24-45%

of women older than 30 are experiencing stress urinary incontinence.

Urinary incontinence is the involuntary leakage of urine due to loss of bladder control. The most common type is **stress urinary incontinence (SUI)**.

SUI occurs during physical activities that increase abdominal pressure, such as coughing, sneezing, laughing, or exercising.

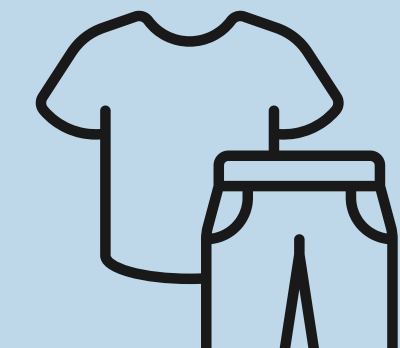
Why It Matters



Disrupted Sleep at Night



Skin Irritation from Pads



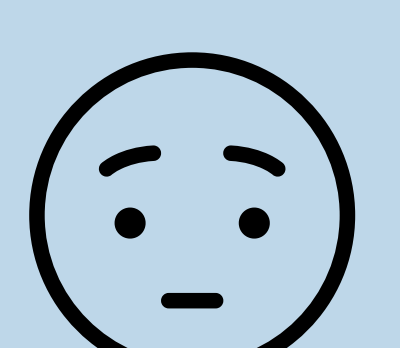
Frequent Changing



Leakage with Daily Activities



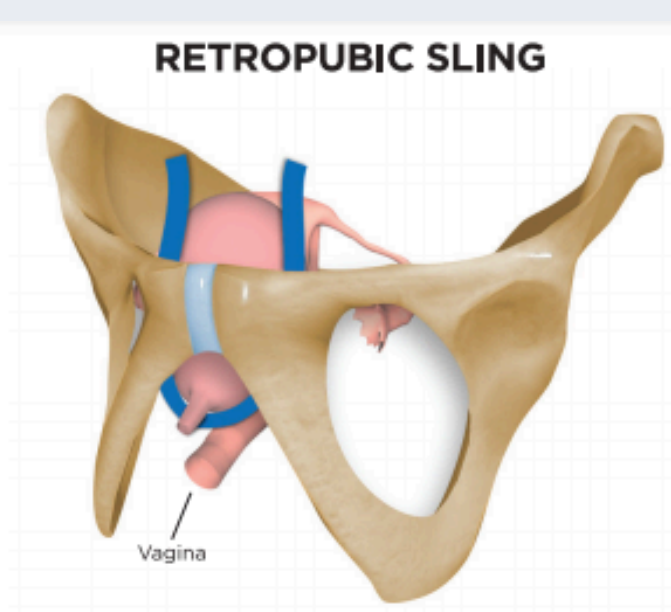
Limits Daily Planning



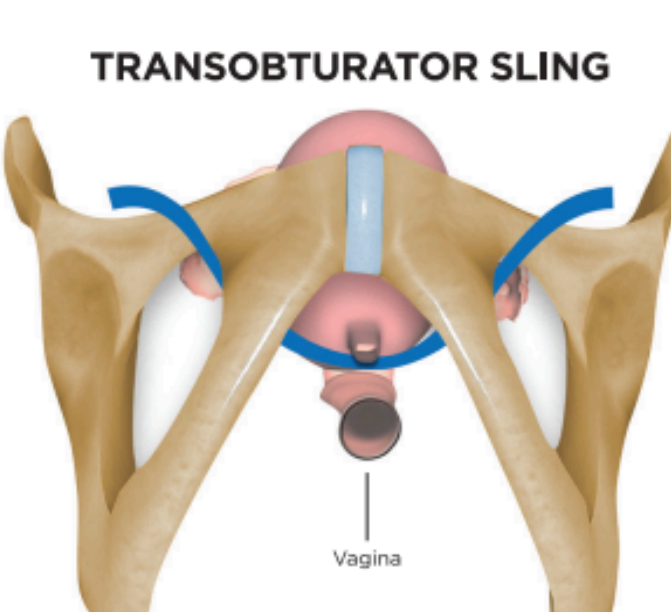
Loss of Confidence in Public

Limitations of the Current Solutions

Current SUI treatments lack adaptability and introduce long-term risks.



RETOPUBIC SLING
The placement of the retropubic sling is like a U



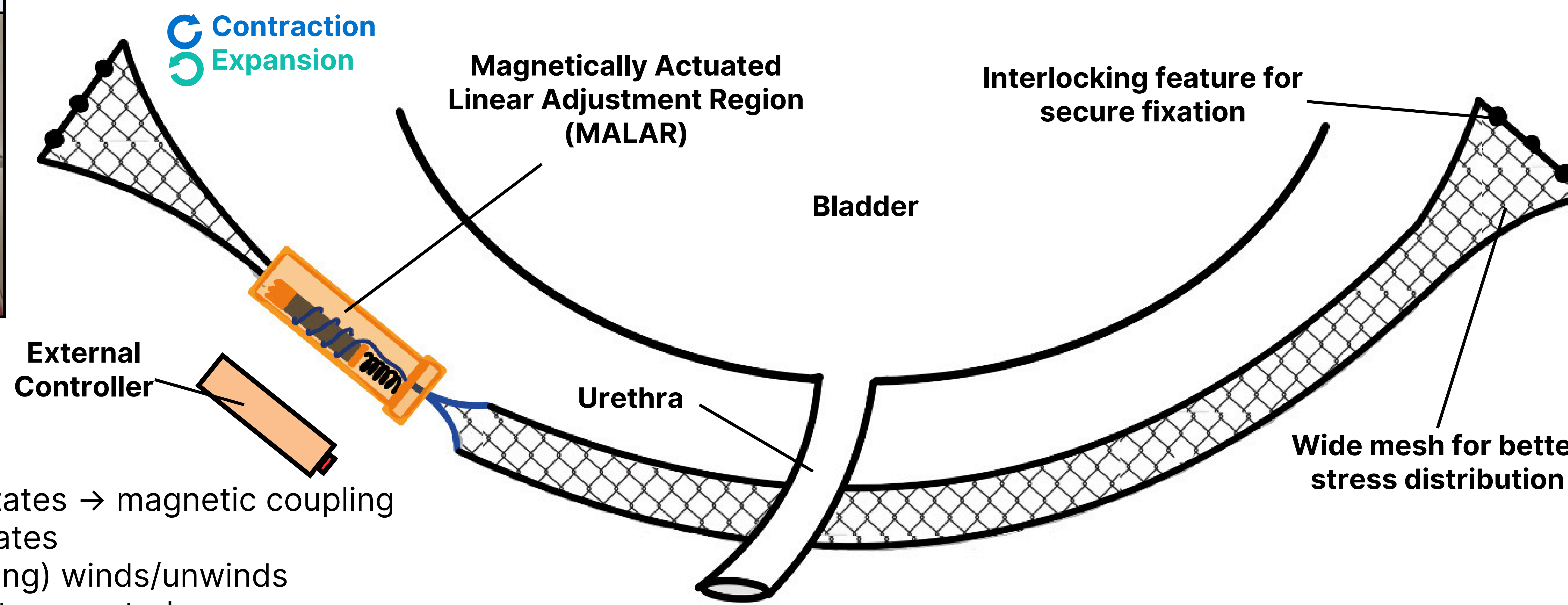
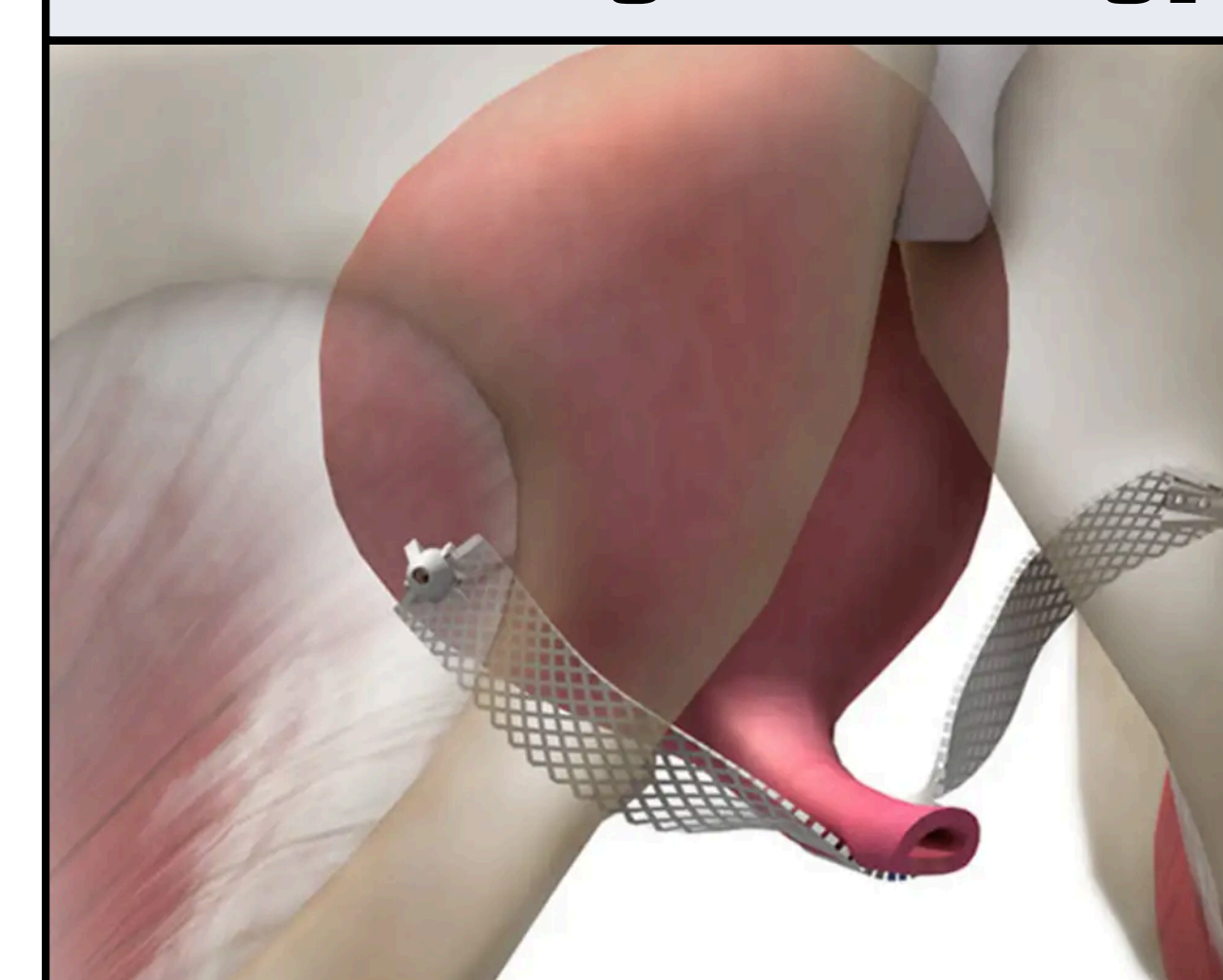
TRANSOBURATOR SLING
The placement of the transoburator is a "smile"

- **Fixed sling tension/support**
→ sling is not adjustable post-surgery
- **Patient variability**
→ different patients require different sling tensions, leading to inconsistent outcomes across anatomy
- **Overcompression of the sling on the urethra risk**
→ urinary retention complications
- **Under-support of sling risk**
→ persistent leakage

Key Need: Postoperative Adjustability

Our Solution Concept

Current Sling Technology



MALAR Actuation

1. External magnet rotates → magnetic coupling
2. Internal magnet rotates
3. Attached mesh (string) winds/unwinds
4. Linear displacement generated

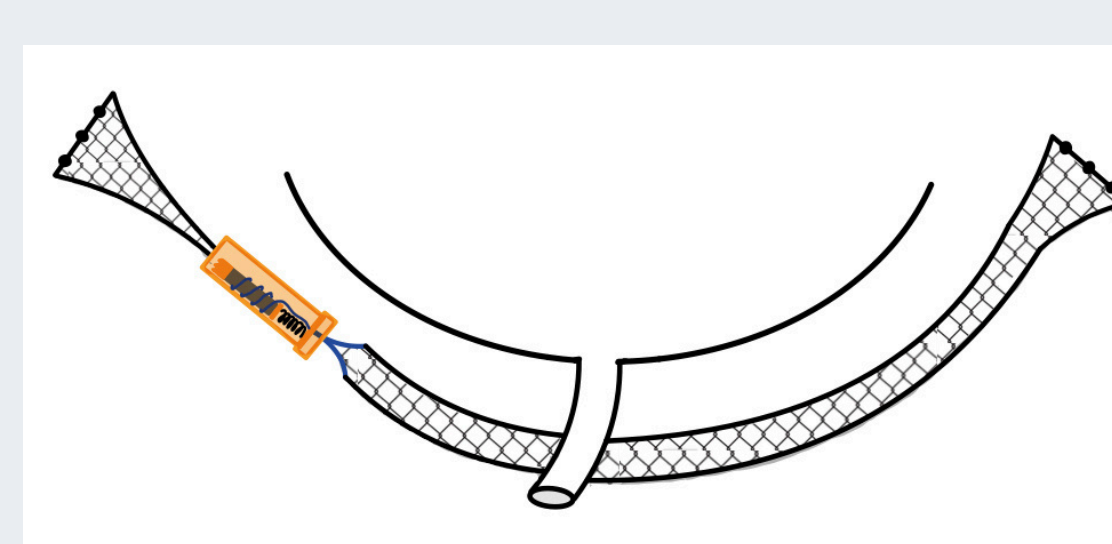
Patient Workflow

Implantation



Patient undergoes minimally invasive MAGSLING implantation by a urologist.

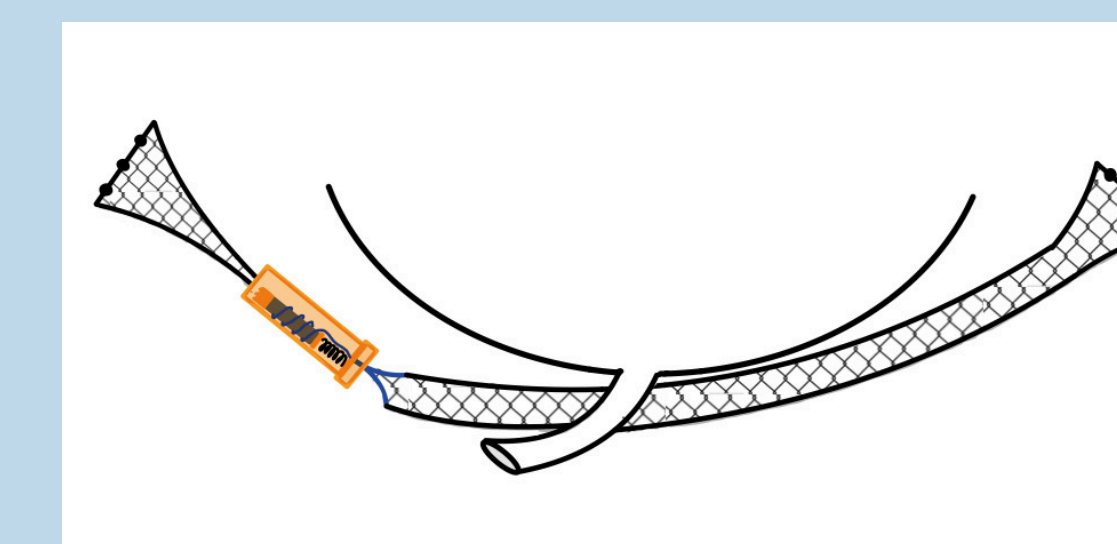
Normal Voiding



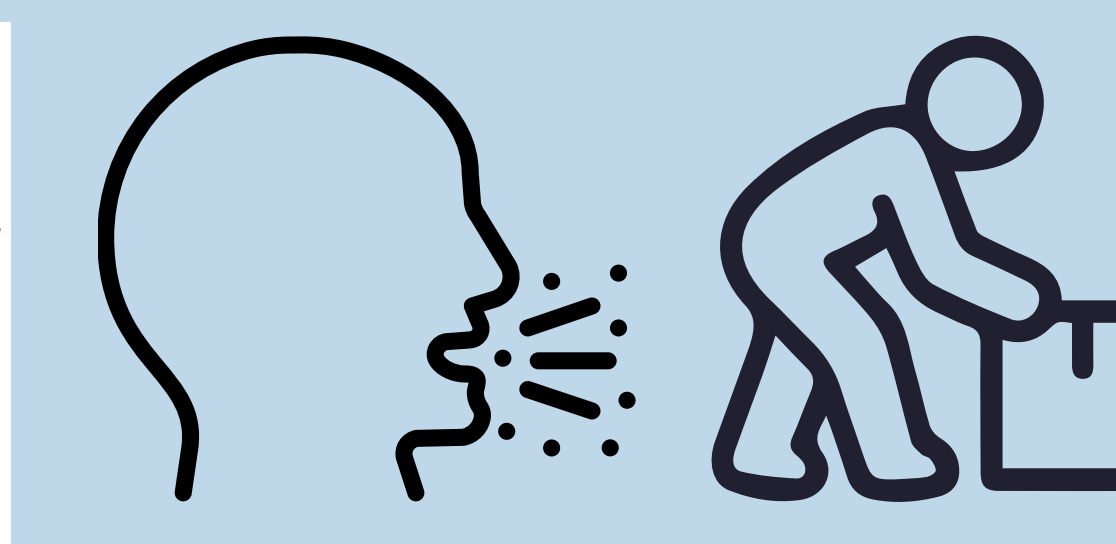
To void the bladder, the controller is used to temporarily relax the sling, allowing urine flow.



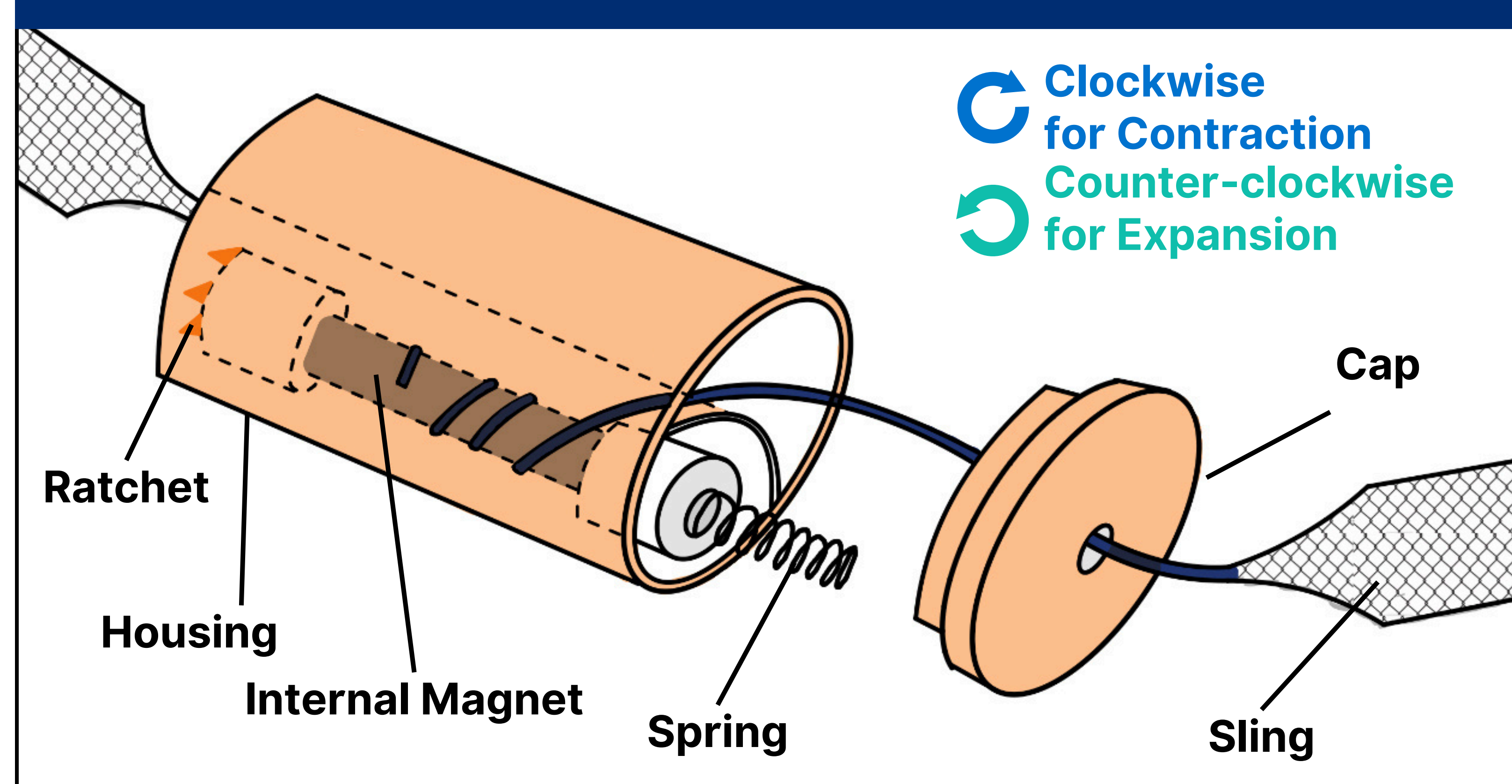
Stress Event Preparation



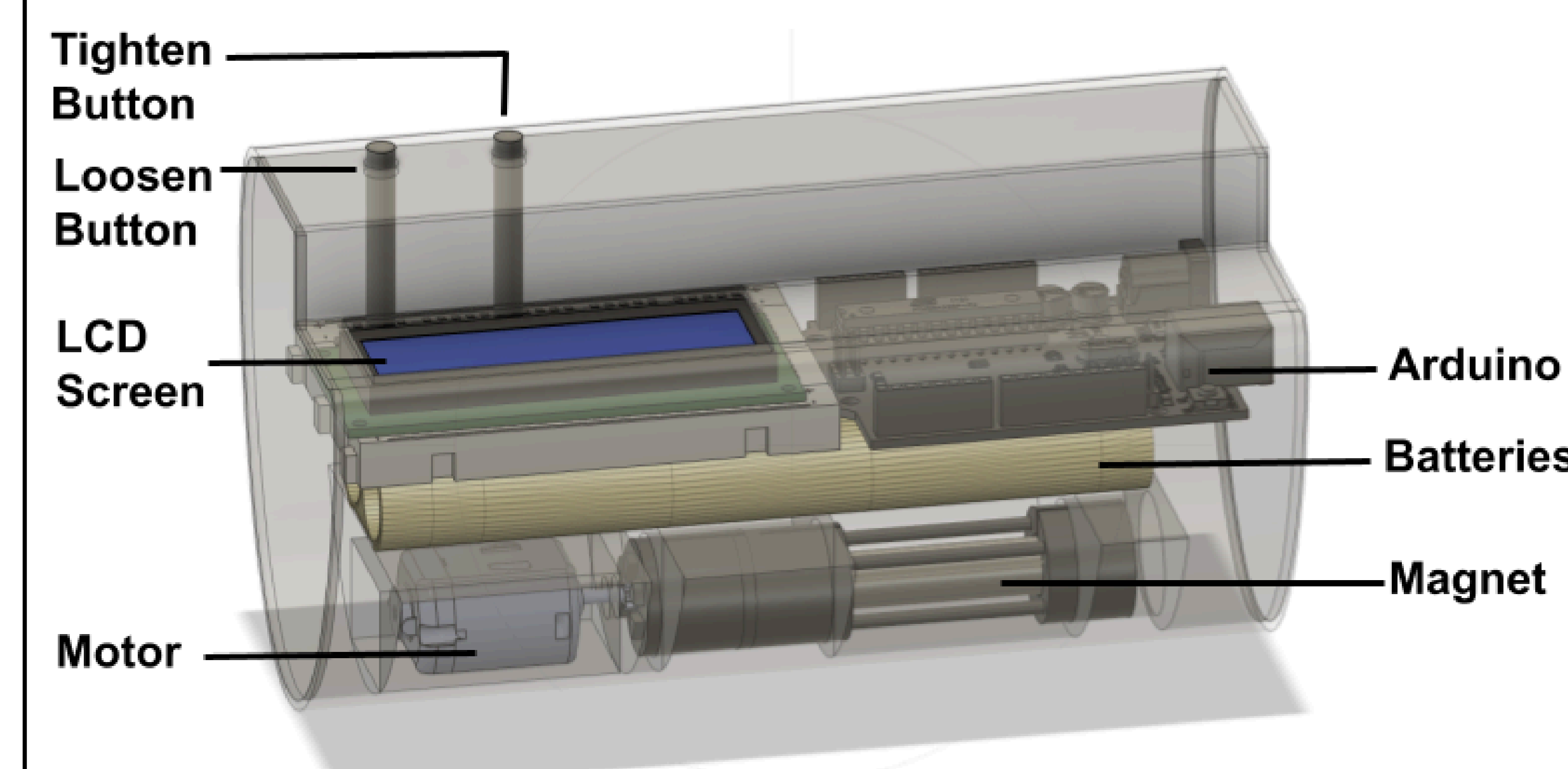
During activities (e.g., coughing, exercise), the controller tightens the sling to prevent leakage.



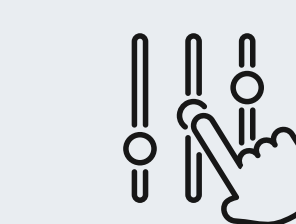
Linear Adjustment Region Mechanism



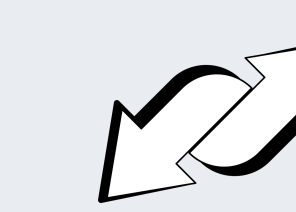
External Controller



Key Design Features



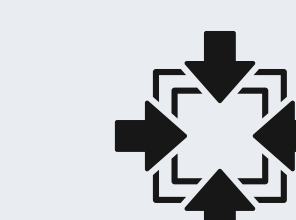
Post-operative adjustability



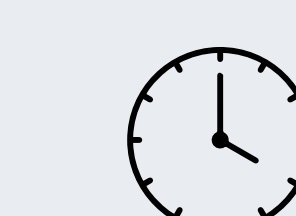
On-demand, reversible support



Non-invasive magnetic actuation



Compact, implantable design



Durability

Performance Characterization

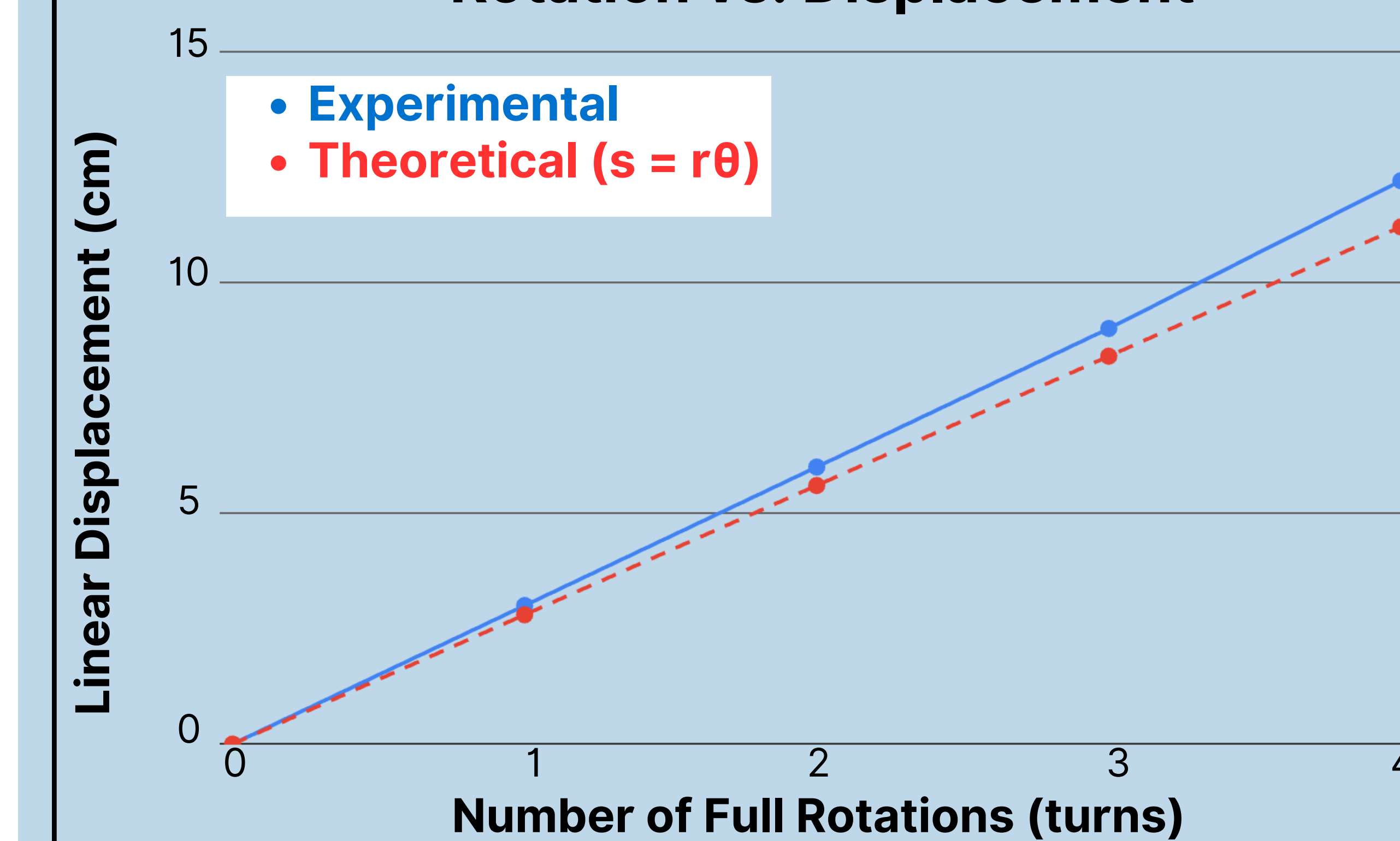
Rotation-displacement relationship validated

- Magnet diameter: 9 mm
- Experimental: ~3.0 cm/turn
- Theoretical: 2.83 cm/turn
- Error: ~5.7 %

Scaled down to implantable magnets (Diameter < 5 mm)

- If the magnet diameter = 3 mm → 0.94 cm/turn
- If the magnet diameter = 4 mm → 1.26 cm/turn

Rotation vs. Displacement



Future Work

- Optimize miniaturization for implantation
- Evaluate long-term durability and biocompatibility
- Assess MRI-compatibility and safety

References

1. Bakar, J.L. & Badreldin, A.M. (2023). Stress urinary incontinence.
2. International Urogynecological Association (n.d.). Mid-urethral sling procedures.
3. Boston Scientific (n.d.). Patient stories on incontinence.
4. Medpage Today (2022). Mini-Sling Matches Midurethral Sling for Urinary Incontinence in Women.
5. Oregon Urology Alliance. Female Mid-Urethral Sling