

Adhesive Hydrogel Splint (Patch) To Correct Malacic Trachea (Tracheomalacia)

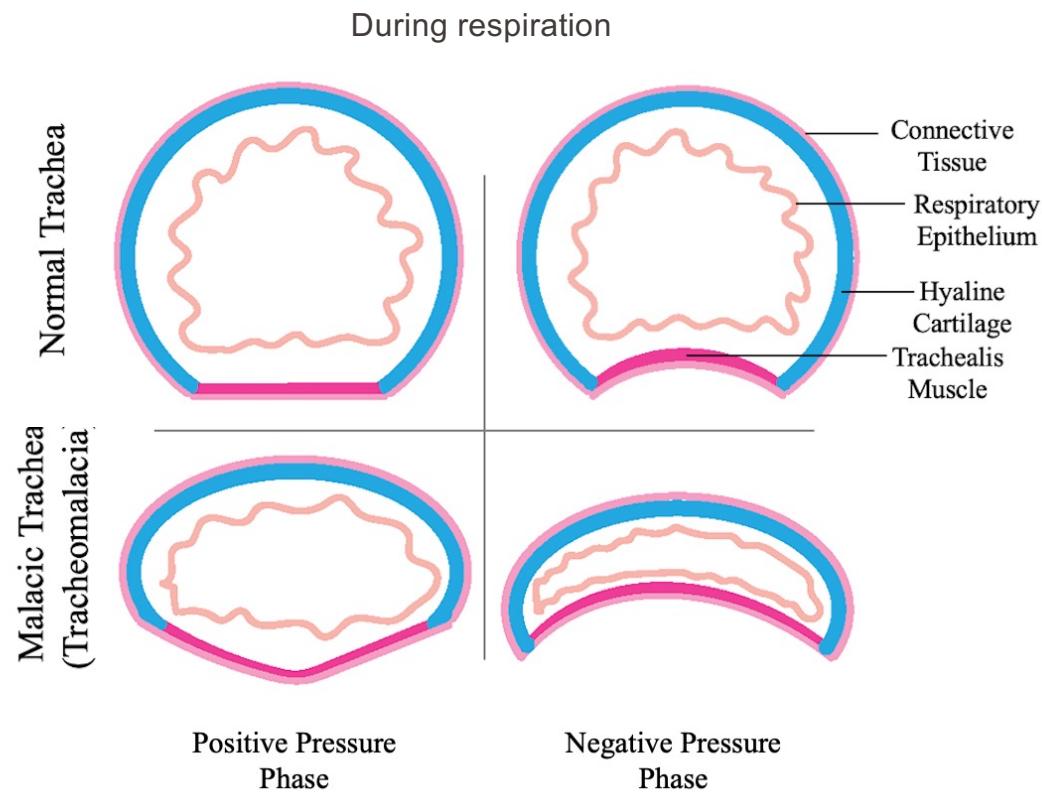


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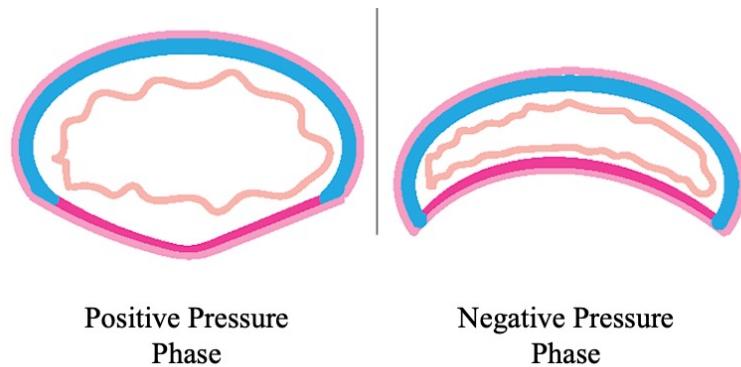
LBO, IBI-STI

Tracheomalacia (TM): A Clinical Problem



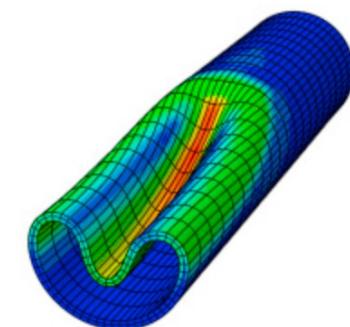
- **Collapse or narrowing of tracheal lumen during respiration**
- **Congenital or acquired**
- **Most commonly affects small children**
- **Incidence of congenital TM: 1:2100**

Why does TM happen: The Cause!



- Weakness of cartilage rings
- Reduced muscle strength (hypotonia)

Engineering Analogy: Collapse in Pipes



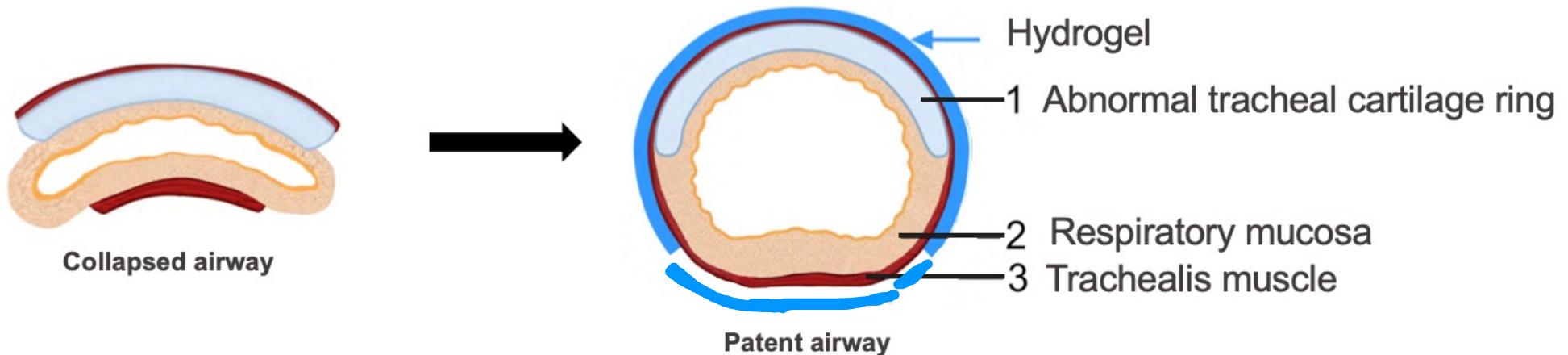
Causes:

- Pipe characteristics
- Material Properties**
- Environmental factors
- Loading conditions

Remedy

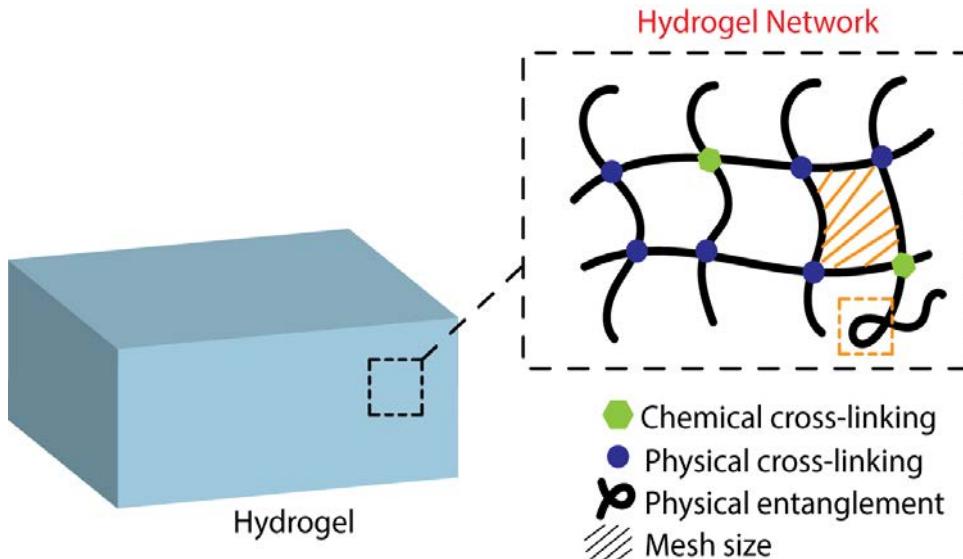
Improve the
mechanical properties

New Approach: adhesive Hydrogel Patch (?)



This is one approach. Not limited.

Why Hydrogel ?

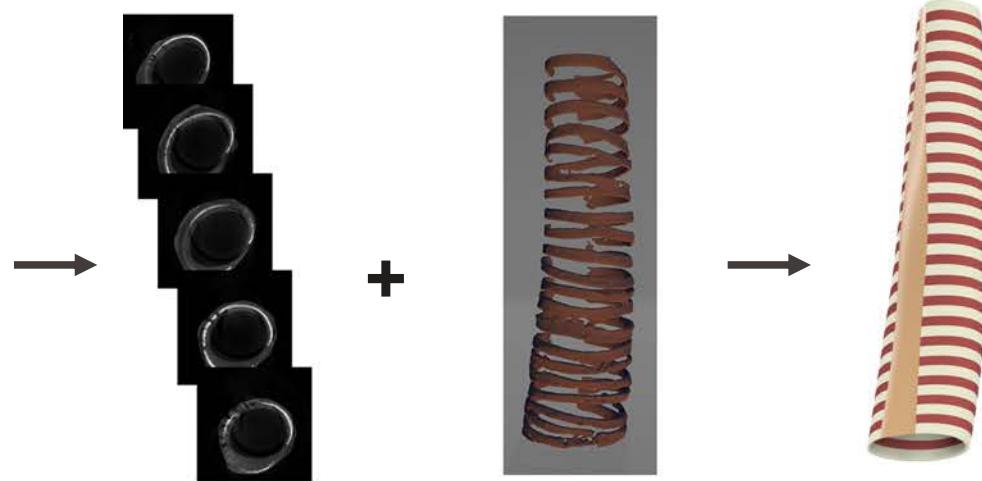
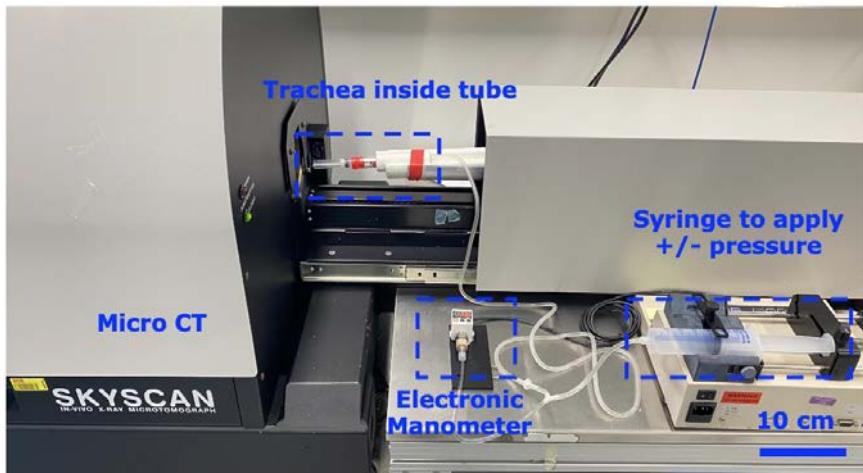


- ❑ Mimics the properties of many tissues.
- ❑ Mostly biocompatible.
- ❑ Allows diffusion of oxygen, nutrients and other molecules, providing potential environment for cells to grow.
- ❑ Can be developed with bioadhesive properties.

Can adhesive hydrogels prevent the airway collapse?, yes, it may!

- ❑ **Viscoelastic Properties:** To allow muscle movement during respiration, and Not to obstruct tissue growth.
- ❑ **Adhesive Properties:** To eliminate invasive suturing, and associate trauma to the surrounding tissues.

Developing a FEM model from a rabbit trachea



CT Scans

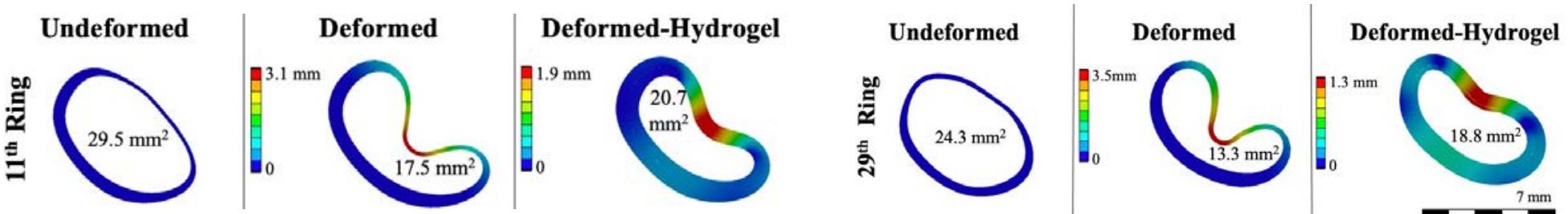
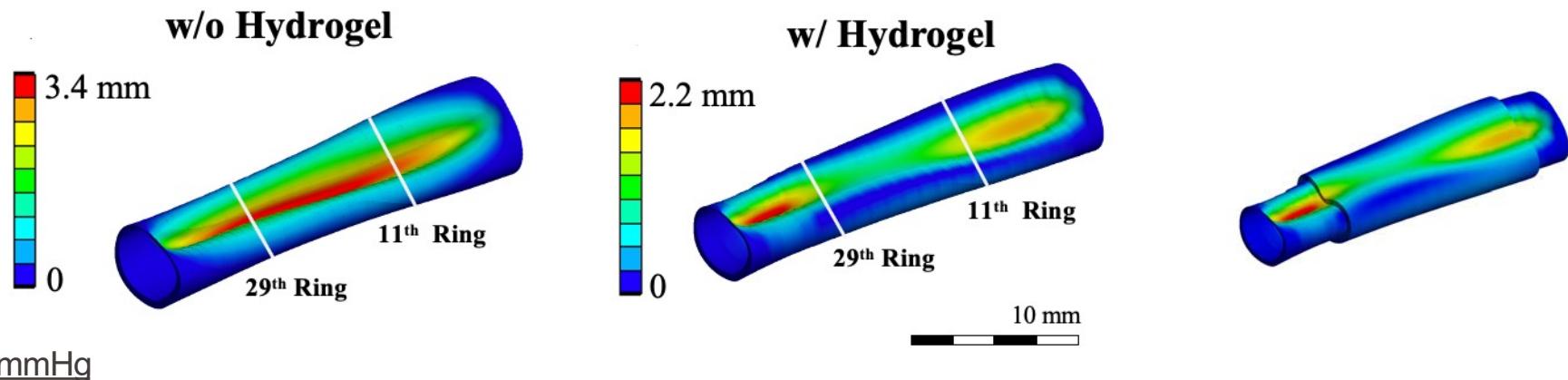
Reconstruction

FEA Model

Collaborator: Prof. N. Stergiopoulos and Mr S. Anagnostopoulos, LHTC, IBI-STI, EPFL.

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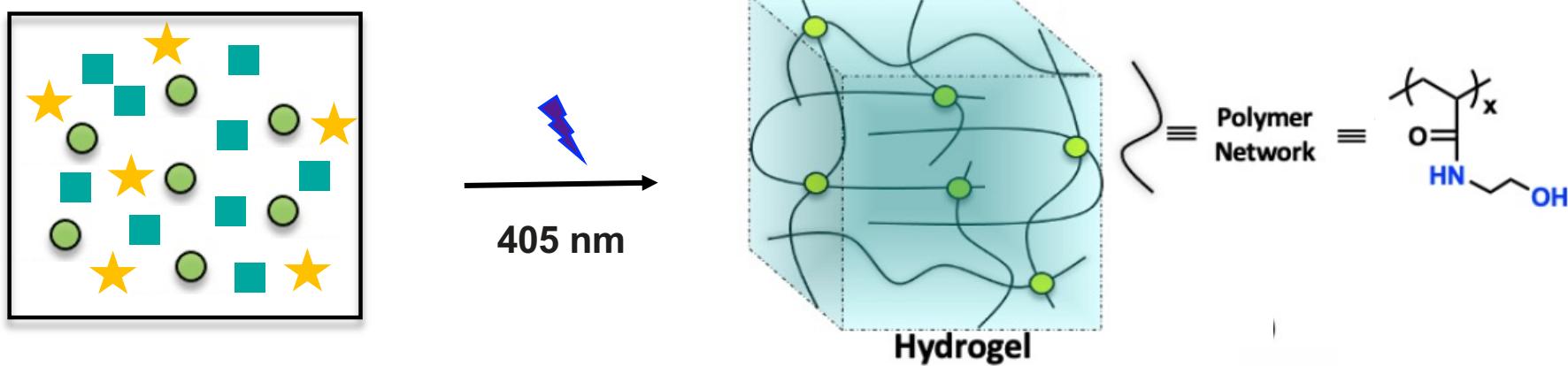
Can Adhesive Hydrogels Prevent the Airway Collapse?



Collaborator: Prof. N. Stergiopoulos and Mr S. Anagnostopoulos, LHTC, IBI-STI, EPFL.

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Development of the Adhesive Hydrogel



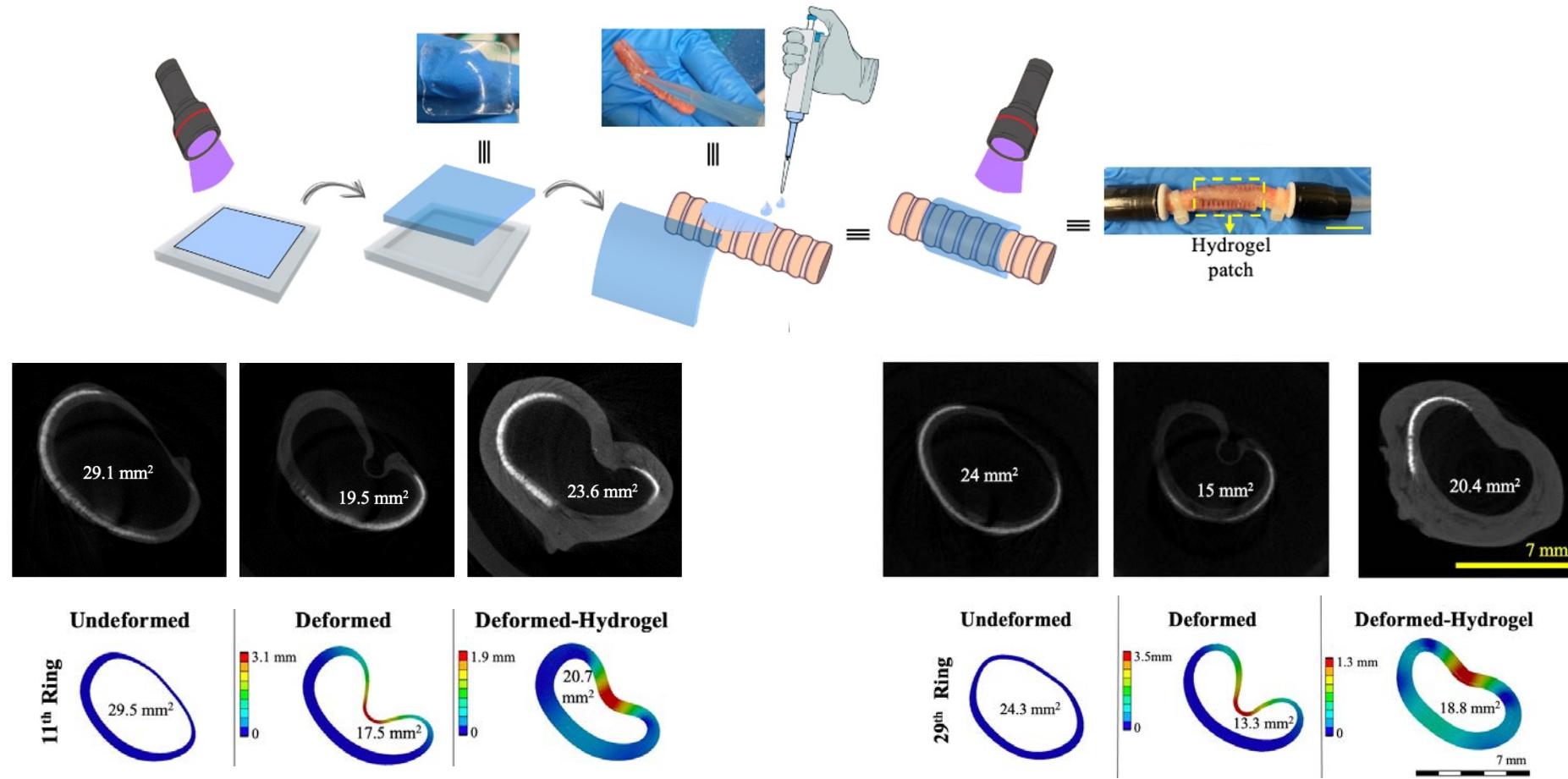
Hydroxyethyl acrylamide (HEAam) monomer

★ Photo initiator (Lithiumphenylphosphinate, LAP)

● PEGDMA, a crosslinker

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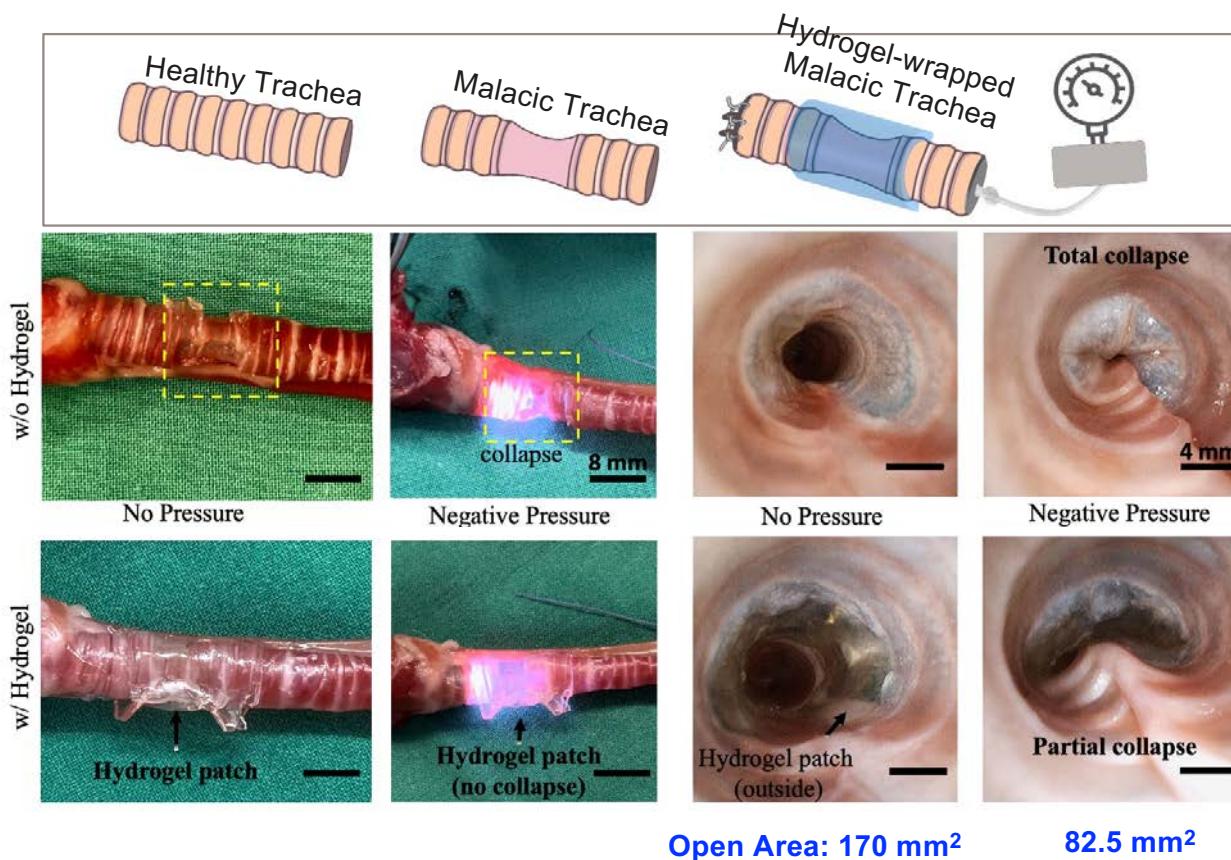
Micro-CT experiments on a mild malacic trachea



Numerical model and CT experiments indicate that collapse can be prevented

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ex-Vivo experiments on the sever-malacic Tracheas



Applied pressure -5 kPa
(physiological pressure)

- ❖ 8-10 tracheal rings were removed, to mimic a severe TM conditions.
- ❖ Total collapse without a hydrogel patch.
- ❖ up to 50% improvement in prevention of airway collapse