Supporting Information

Title: Soft Robotic Surrogate Lung

Author(s), and Corresponding Author(s): Olivier Ranunkel, Firat Güder*, Hari Arora*,*

Olivier Ranunkel, Dr Firat Güder
Department of Bioengineering, Imperial College London, SW7 2AZ, United Kingdom

Dr Hari Arora
College of Engineering, Swansea University, SA1 8EN, United Kingdom

E-mail: f.guder@imperial.ac.uk
hari.arora@swansea.ac.uk

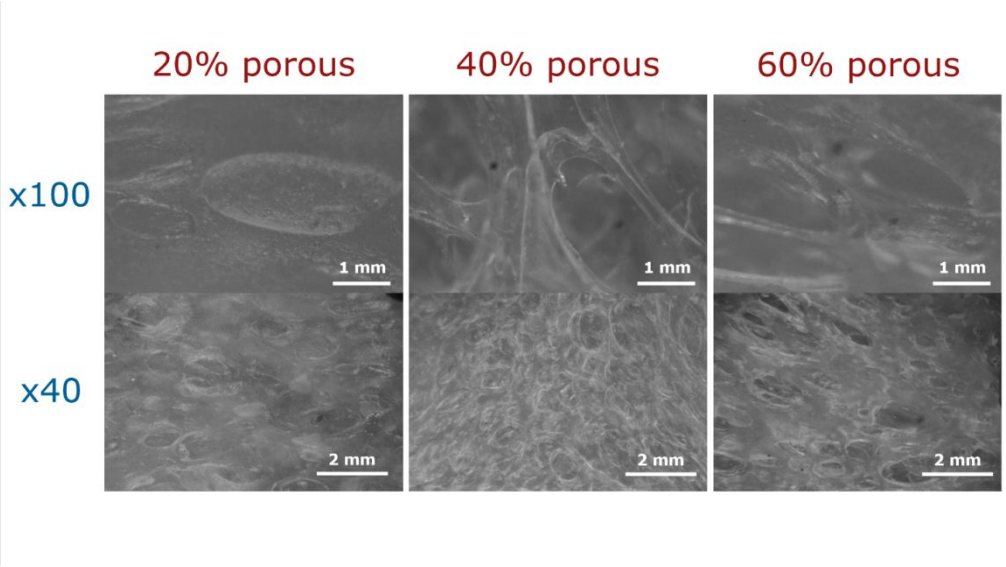

Figure S-1. Microscope images of porous Ecoflex 00-30 at 20%, 40% and 60% porosity. There are round pores into the material with little connectivity (pathway) and the pores become larger with increasing porosity and irregular.

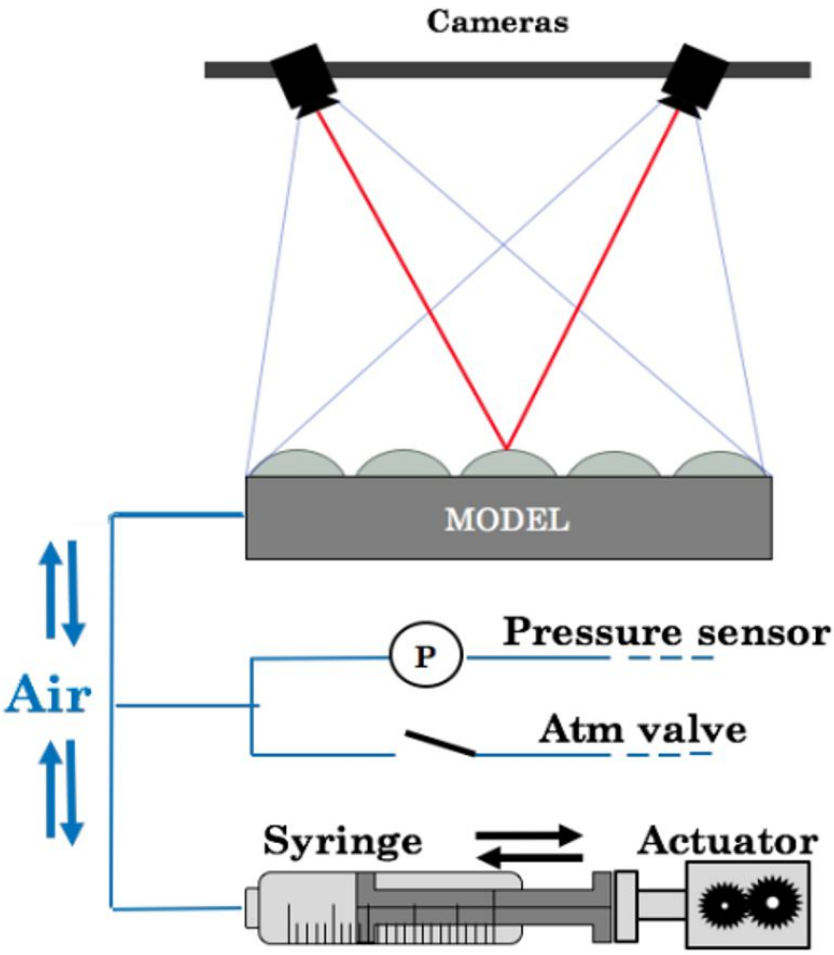

Figure S-2. Set up for Pressure-Volume evaluation (using CiT) and Digital Image Correlation (DIC) tests.

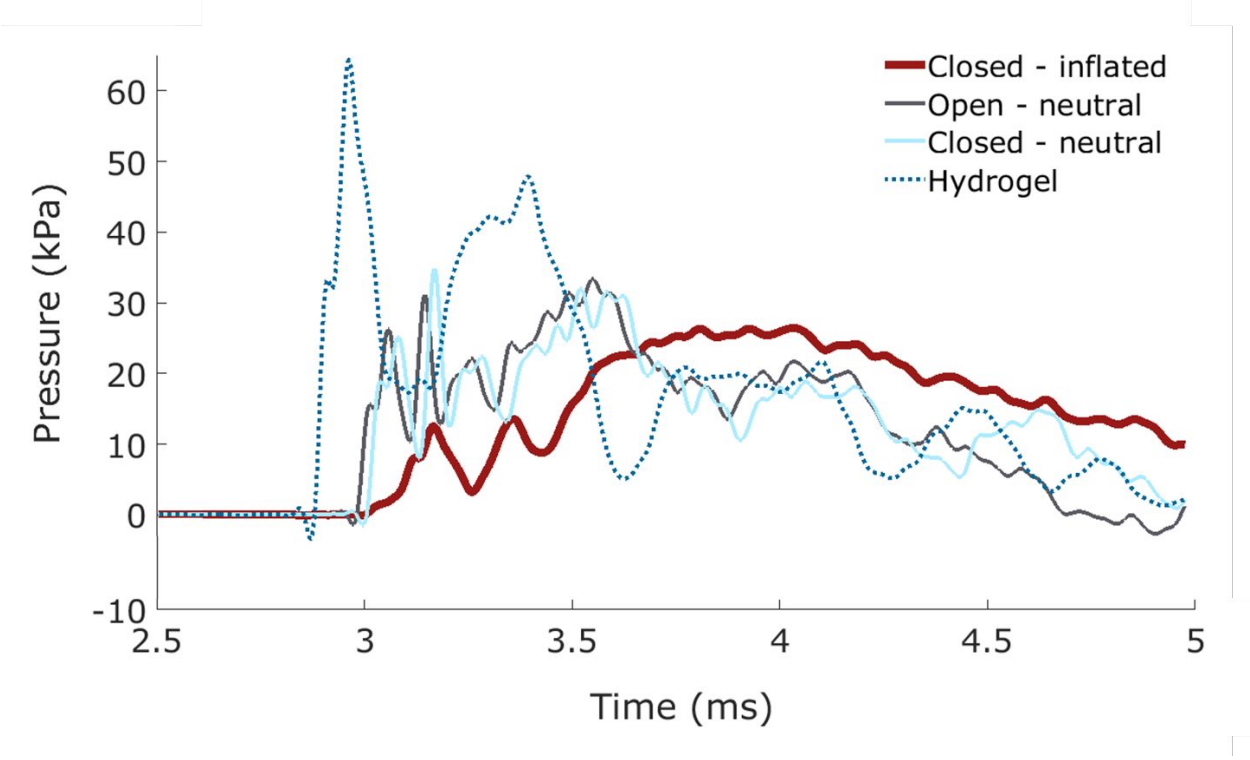

Figure S-3. Pressure data of hydrogel and 3x3 SRSL blasted (82 kPa peak shock overpressure) under various levels of inflation. The hydrogel shows a sharp rise similarly to the open/closed-neutral inflated soft 3x3 SRSL. Open/closed means with respect to atmosphere i.e. open airway to atmosphere or not. When the SRSL is most relaxed or compliant (neutrally/minimally inflated), the shock propagates straight through it and transmits the wave efficiently with minimal resistance. The hydrogel behaves similarly in style to the neutral position, which means that the hydrogel behaves like a collapsed tissue while the SRSL can change response when inflated (like real lungs, strain-stiffening materials).

In this case, the closed – inflated state, the SRSL springs back rapidly. This reaction indicates that inflated lungs are more likely to burst and sustain damage when a blast hits (as seen in **Figure 7b** top right picture), exhibiting the importance of being able to control lung volume, i.e. control model/lung pre-strain. The inflated structure becomes more resistive and shows that it absorbs energy. Therefore, the SRSL like the lungs are more likely to breach an injury or a damage threshold.

The air-filled SRSL produces a versatile set of responses to blast, which is better for lung injury research. The inflation creates more significant resistance to blast waves, which can result in physical failure (with the tuning of material properties), unseen in previous lung surrogates. An SRSL offers the ability to overcome difficulties in replicating the mechanical response of functional lungs and their constituent parts.

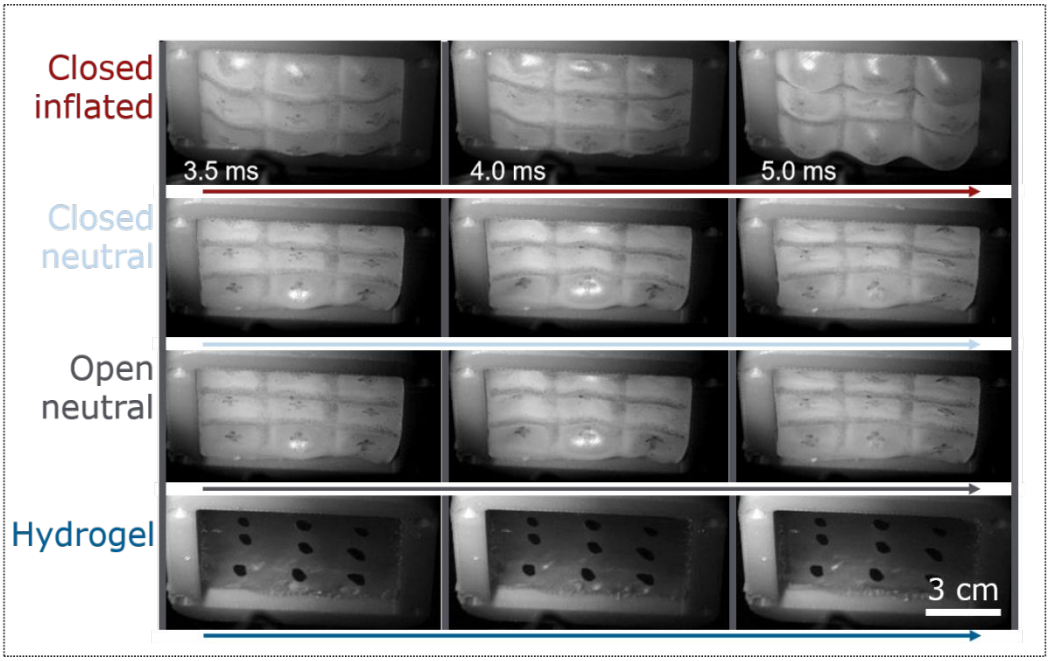

Figure S-4. Extended results from **Figure 7b**. The samples are blasted with 120 kPa of peak shock overpressure. The presence of air in the SRSL exhibits external deformation (rebound) whereas the hydrogel only has small internal deformations/compressions.