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Re: Compliance of hydrogel vascular models

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Samples: Hydrogel tubes
Equipment: Pressurization system

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1. Summary

The similarity in water of hydrogels to human tissue makes these materials likely candidates for testing models for cardiovascular devices and instrumentation. To test their applicability arterial models, we fabricated tubes of varying wall thicknesses from one of our custom hydrogel formulations, and measured the compliance of the tube as a function of internal pressure, selecting pressure ranges similar to systolic and diastolic pressures. Hydrogel samples with wall thicknesses between 25 to 3.6 mm showed compliance values between 5-7% over a pressure range of 80 to 160 mm Hg.

2. Samples

A custom formulated hydrogel was cast into tubes with wall thicknesses between 2.5 to 11 mm. The internal diameter was 5 mm for all samples. The samples were equilibrated in water for 2 weeks prior to testing. Two samples per wall thickness were tested.

3. Experimental

A custom pressure system was fabricated to generate a steady hydrostatic pressure inside a uniform tubing composed of the hydrogel. The hydrogel tube was immersed in water during the testing at room temperature. Digital images taken of the hydrogels were used to measure the outside diameter at 3 locations on each sample as a function of internal pressure. A pressure range of 0.5 to 5.0 psi was used.

4. Results

The %compliance/100 mm Hg was computed according ISO 7198, with the exception that the outer diameter of the vascular analog was used instead of the inner diameter.

% compliance = (D_p1 - D_p2) * 10^4 / (D_p1 (p_2 - p_1))

where D_p1 = the outer diameter at pressure p1
D_p2 = the outer diameter at pressure p2
p_1,2 is the internal pressure in units of mm Hg.

Compliance calculations were made between pressures of 80 and 160 mm Hg.

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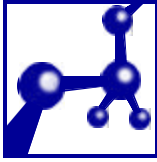


Figure 1: Hydrogel expansion at an internal pressure of 78 mm Hg. Vertical lines indicate the diameter measurement locations. 78 mm Hg.

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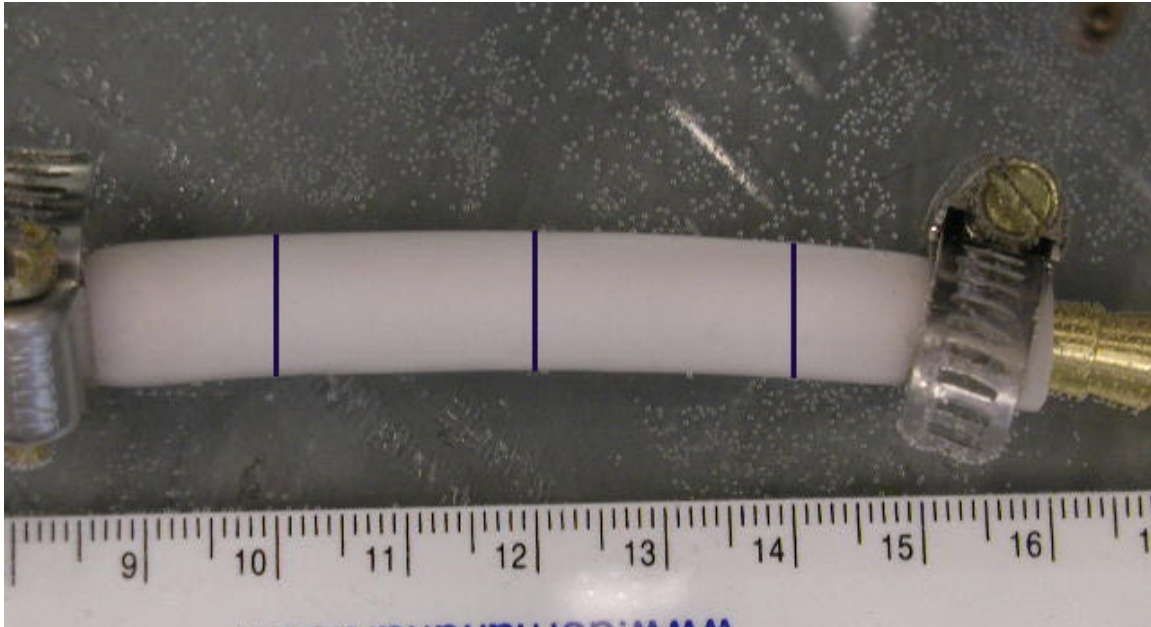
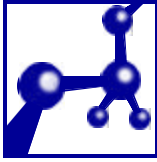
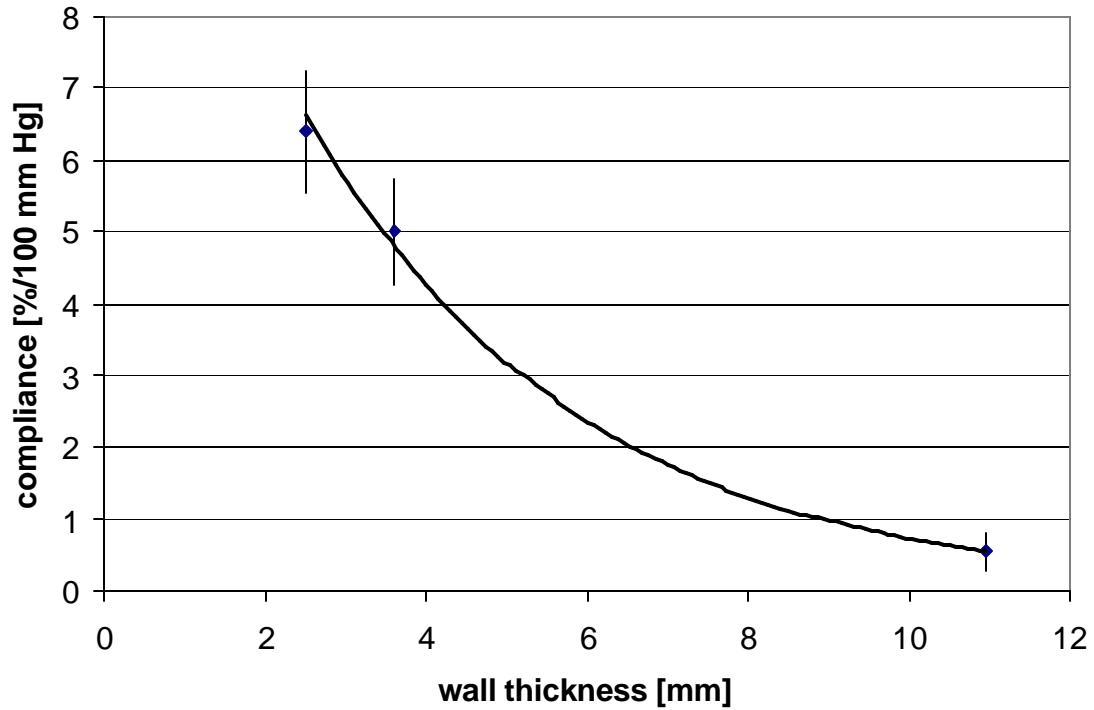


Figure 2: Hydrogel expansion at an internal pressure of 155 mm Hg. Vertical lines indicate the diameter measurement locations. Compliance measurements based on OD: 6.9, 6.9, 5.4% (6.4 ± 0.9 %)



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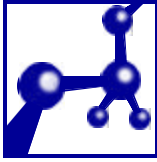


Figure 3: Compliance vs. wall thickness for hydrogel formulation. The compliance was calculated between 80 and 160 mm Hg at room temperature based on the outer diameter of the sample.

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