Figure S1. Measurement of membrane thickness. **A.** Thickness of single layer COL membranes fabricated using 8 mg/ml and 2 mg/ml collagen hydrogel concentrations, as well as COL-MAT membranes at blending ratios of 80:20 and 50:50. B. Thickness of 1-layer, 2-layer, 3-layer and 4-layer stacked COL membranes fabricated using 8 mg/ml collagen hydrogels.

Figure S2. Measurement of average pore size for COL (n = 1099 pores) and COL-ALG (n = 1514 pores) membranes from scanning electron micrographs. *** shows $P < 0.001$ for COL vs. COL-ALG.

Figure S3. Analysis of membrane surface adsorption. **A.** Phase contrast micrographs (top row) and corresponding fluorescence micrographs (bottom row) of untreated COL membranes (COL control) and bare COL membranes treated with 1 mg/ml fluorescein-conjugated bovine serum albumin for 2 hours (COL + FITC-BSA). Additionally, pericyte-seeded COL membranes (COL + cells + FITC-BSA) and Transwell polyester membranes (Transwell + FITC-BSA) were treated with FITC-BSA under the same conditions. Magnification = 100x in all images. **B.** Average fluorescence intensity of FITC-BSA-treated COL (with and without cells) membranes and Transwell inserts. n = at least 13 images per group. * and ** show $P < 0.05$ and $P < 0.01$ compared to Transwell, respectively. The fluorescence intensity of untreated COL membranes at the exposure time utilized was negligible.

Figure S4. An environmental scanning electron micrograph of a hydrated COL-MAT demonstrates a smooth surface texture, indicating transition from a dry fibrous membrane film to a gel-like state upon rehydration as occurs in microdevices prior to cell culture. The feature at the upper left corner of the image is a cut edge of the membrane which appears slightly frayed when the membranes are dry. Scale bar = 40 μm.

Figure S5. Demonstration of membrane stability in extended culture. **A.** A bare COL membrane perfused with cell culture medium for 7 days was stained for type I collagen (green). Scale bar = 200 μm. **B.** A COL membrane was seeded with pericytes and maintained under identical perfusion conditions for 7 days before. Green and blue show type I collagen and cell nuclei, respectively. Scale bar = 200 μm. **C.** The cross-sectional view of the pericyte-seeded COL membrane shows the persistence of structurally stable type I collagen membrane underneath the pericyte cell layer. Similar results were observed when HUVECs were cultured on COL membranes for 14 days (data not shown).

Figure S1.

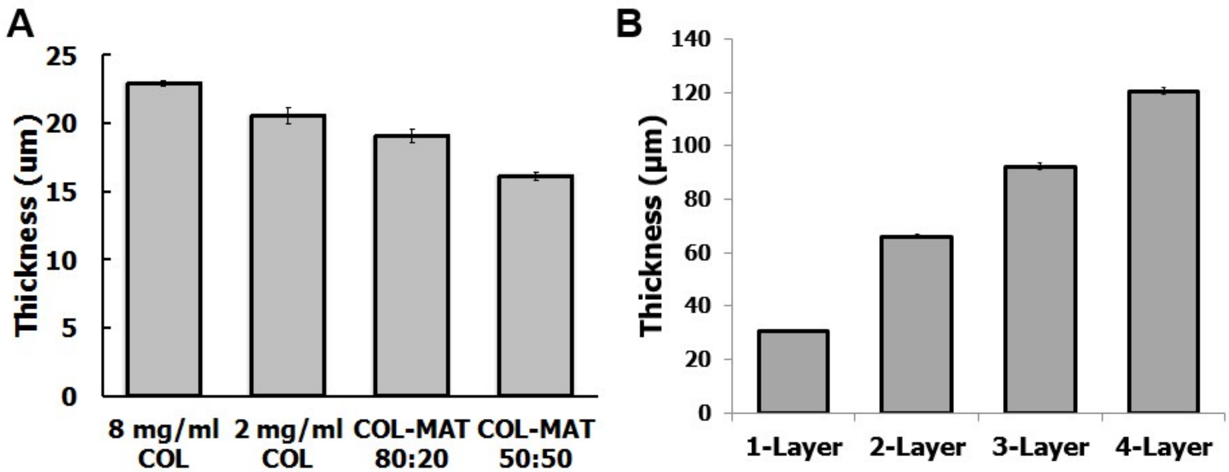
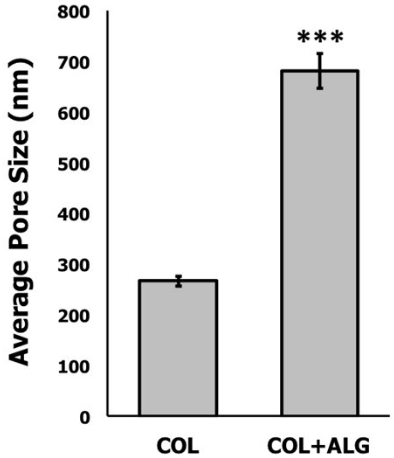

A
Thickness (um)
25
20
15
10
5
0
8 mg/ml COL
2 mg/ml COL
COL-MAT 80:20
COL-MAT 50:50
B
Thickness (μm)
140
120
100
80
60
40
20
0
1-Layer
2-Layer
3-Layer
4-Layer

Figure S2.



800
700
600
500
400
300
200
100
0
Average Pore Size (nm)
***
COL
COL+ALG

Figure S3.

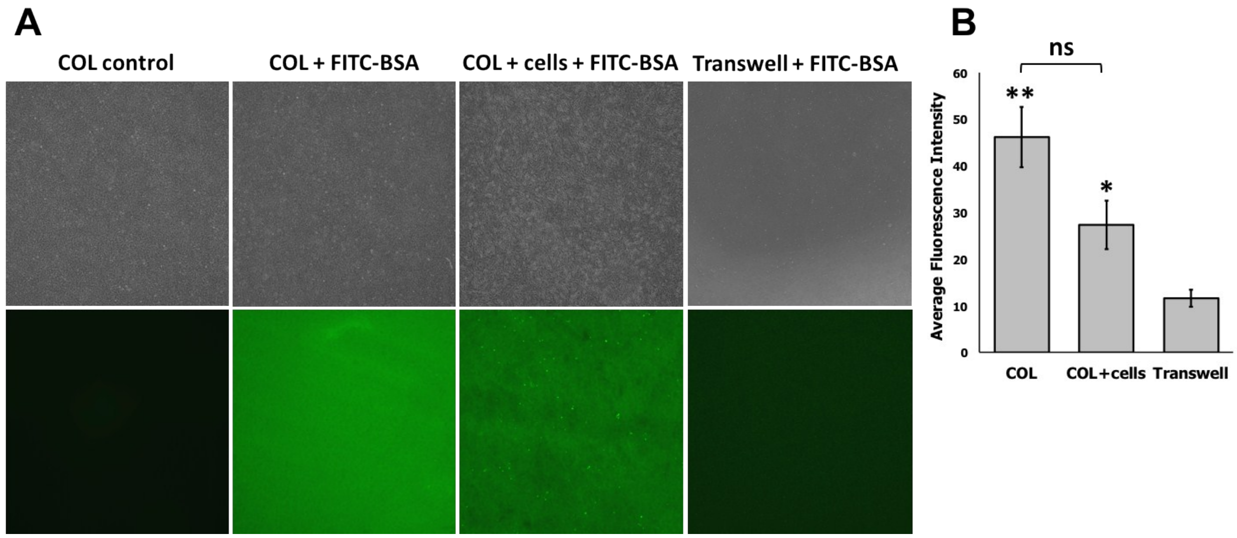

A
COL control
COL + FITC-BSA
COL + cells + FITC-BSA
Transwell + FITC-BSA
B
ns
**
*
Average Fluorescence Intensity
0
10
20
30
40
50
60
COL
COL+cells
Transwell

Figure S4.

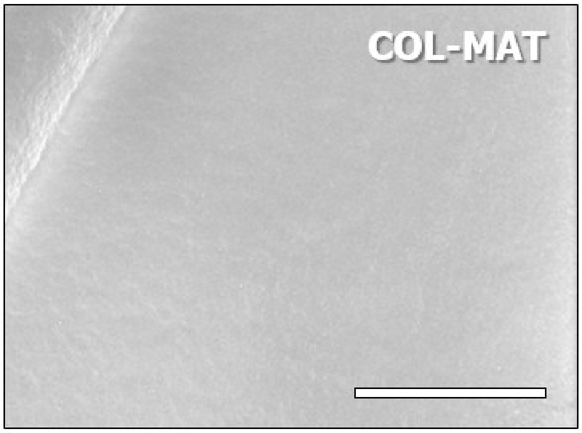
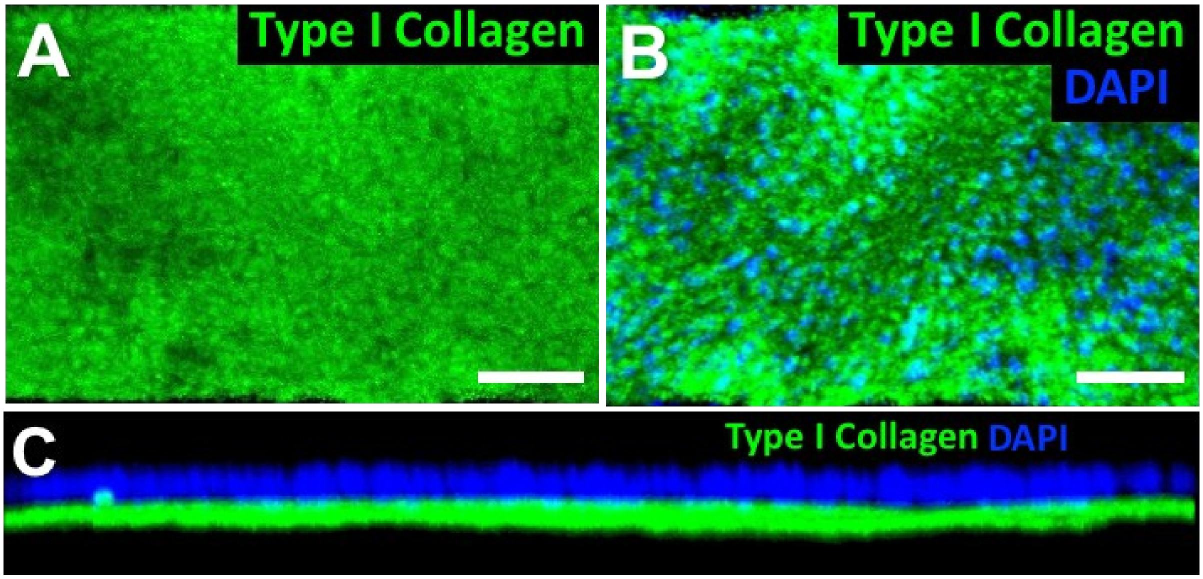


Figure S5.


A
Type I Collagen
B
Type I Collagen
DAPI
C
Type I Collagen DAPI