Appendix

A. Validation of DVC method

The DVC algorithm baseline displacements and strains error were estimated from the following artificial cases (performed on a baseline volume of healthy subjects) – (1) 20-micron rigid body translation along a positive x-direction, (2) a 2-degree clockwise rotation about the center of the ONH, (3) 4% tension, (4) 4% compression along the x-direction, (5) radial expansion from the geometric center of the LC with a mean effective strain of approximately 4%, (6) 3% compression along the z-direction, (7) a combination of case 5 and 6 and (8) case 6 with an addition of gaussian noise (mean 0 and standard deviation of 5%). We also estimated the baseline error due to variation in subject's body position and motion between each scan by comparing repeated baselines (N = 3) scans from a single subject. We quantify the errors in terms of the following parameters: displacement magnitudes in the X, Y and Z direction and effective strains.

For case (1), the average error in displacements were 0.086 $\pm$ 0.10 micron in the x-direction, 0.028 $\pm$ 0.27 micron in the y-direction, 0.035 $\pm$ 0.33 micron in the z-direction and the average error in effective strain value was 0.0024 $\pm$ 0.001%. For case (2), the average error in displacements were 0.024 $\pm$ 0.66 micron in the x-direction, 0.033 $\pm$ 0.43 micron in the y-direction, 0.017 $\pm$ 0.068 micron in the z-direction and the average error in effective strain value was 0.0070 $\pm$ 0.005%. For case (3), the average error in displacements were 0.26 $\pm$ 0.65 micron in the x-direction, 0.002 $\pm$ 0.016 micron in the y-direction, 0.015 $\pm$ 0.19 micron in the z-direction and the average error in effective strain value was 0.0003 $\pm$ 0.002%. For case (4), the average error in displacements were 0.36 $\pm$ 0.71 micron in the x-direction, 0.031 $\pm$ 0.019 micron in the y-direction, 0.011 $\pm$ 0.22 micron in the z-direction and the average errors in effective

strain value was 0.0025 ± 0.002%. %. For case (5), the average error in displacements were 0.44 ± 0.76 micron in the x-direction, 0.042 ± 0.033 micron in the y-direction, 0.018 ± 0.31 micron in the z-direction and the average errors in effective strain value was 0.0065 ± 0.003%. %. For case (6), the average error in displacements were 0.015 ± 0.22 micron in the x-direction, 0.011 ± 0.018 micron in the y-direction, 0.033± 0.35 micron in the z-direction and the average errors in effective strain value was 0.007 ± 0.003%. %. For case (7), the average error in displacements were 0.51 ± 0.31 micron in the x-direction, 0.032 ± 0.018 micron in the y-direction, 0.035± 0.35 micron in the z-direction and the average errors in effective strain value was 0.0074 ± 0.003%. For case (8), the average error in displacements were 0.65 ± 0.37 micron in the x-direction, 0.035 ± 0.022 micron in the y-direction, 0.038± 0.37 micron in the z-direction and the average errors in effective strain value was 0.0077 ± 0.003%.

Overall, for the artificial deformation cases, the maximum error in displacements along the X, Y and Z direction was less than 5% of the voxel resolution. The maximum error in effective strain was 0.5%.

We validated the accuracy of our DVC method on 12 healthy eyes (repeated baseline, adduction and abduction scans) and 5 HTG eyes (repeated baseline scans). we found that for repeated baseline scans on 17 eyes, the average effective strain error was 1.00 ± 0.05%. We found that for repeated adduction scans on 12 eyes, the average effective strain error was 1.04 ± 0.08%. We found that for repeated abduction scans on 12 eyes, the average effective strain error was 1.00 ± 0.07%.

We further validated the accuracy of our DVC method on 16 highly myopic eyes and found that the average effective strain error was 1.1 ± 0.08%, with a maximum error of 1.3% in an eye. The strain errors (under repeated scans without loads) in

highly myopic eyes were comparable to those observed in healthy eyes (1.00 ± 0.05% with a maximum error of 1.1%)

B. Sectoral strains of ONH tissues

We quantified the average strains of all ONH tissues across different sectors of the ONH and reported these findings in figure A1.

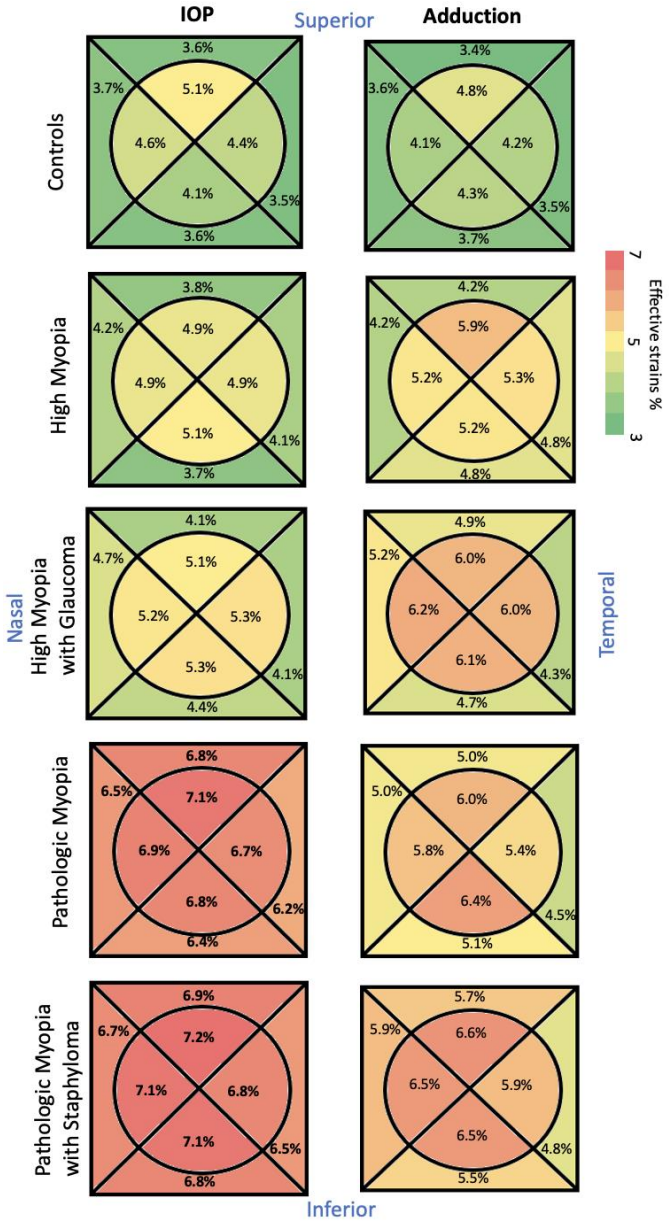

Figure A1. Average strains by sector of each subject group under IOP elevation and adduction. The area within the circle (defined as BMO best-fit circle) was the central region and the area outside the circle was defined as peripheral region. The superior-inferior and nasal-temporal quadrants were defined using 2 orthogonal lines that intersect at the center of the BMO.

We found that the average effective strains (under IOP elevation and adduction) were significantly higher in the central region (5.7 ± 1.0%) than the peripheral region (4.8 ± 1.1%) across all subjects ($p < 0.05$). Under adduction, average effective strains in the nasal region (5.2 ± 1.0%) were observed to be significantly higher ($p < 0.05$) than those in the temporal region (4.7 ± 0.8%).