Thus, reductions in ONH blood flow detectable by OCT angiography precede detectable visual field damage, suggesting it could be useful in the early detection of glaucoma and the evaluation of glaucoma progression risk.

It should be noted that the amplitude-based method that we have developed is sensitive to motion that is perpendicular (transverse flow) or parallel (axial flow) to the OCT beam. We believe this characteristic of SSADA makes quantitation of microvascular flow independent on beam incidence angle. In addition, we chose to compute amplitude decorrelation rather than amplitude variance (also called speckle variance) [39,40] because decorrelation is less affected by signal strength (i.e., variation due to media scattering, pupil blocking, focusing, polarization mismatch, etc.). This is important because previous techniques such as the laser Doppler flowmetry could not reliably compare flow values between individuals due to the effect of signal strength on the measurements [3,10–12].

Quantitative SSADA has several limitations. First, flow projection artifact from superficial blood vessels to deeper tissue levels prevents us from separately measuring superficial and deep ONH flow. The artifact is caused by the moving shadow cast by flowing blood cells. Decorrelation is caused by both moving reflectors (blood cells) and moving shadows (projected on distal high reflectance tissue). The two type of decorrelation is not distinguished by SSADA – both appear as flow in the 3D angiogram. The artifact is not problematic if our analysis is confined to the 2D maximum projection angiogram. Therefore the study was limited to the use of 2D angiograms that measured superficial and deep vascular beds together. Second, the ONH flow index includes measurements on both local disc circulation and large retinal blood vessels. Thus it is a mixture of both disc and retinal circulation and not a pure measurement of a single vascular bed. However, since glaucoma and optic nerve diseases reduce both circulations, the mixed measurement is clinically useful. Third, OCT angiography cannot distinguish between perfusion reduction caused by tissue loss (a result of glaucoma) and ischemia (a cause of glaucoma). However, the OCT structural images can measure tissue loss. Thus, structural imagery and perfusion measurements could provide complementary information for both clinical assessment and pathophysiological investigation.

5. Summary

We used OCT angiography and the new SSADA algorithm to generate *in vivo* measurements of ONH blood flow. Flow indices and vessel densities in the segmented disc areas and temporal sections were measured in PPG patients and normal control subjects. The reductions of these two flow parameters in the two different areas were statistically significant. Our results showed that OCT angiography was able to detect reduced ONH perfusion in a small group of early glaucoma patients. Further studies are needed to assess the potential of this new technology in glaucoma diagnostic and prognostic evaluation.

Acknowledgments

This work was supported by NIH Grants R01 EY013516, R01-EY11289-26 and AFOSR FA9550-10-1-0551. Financial Interests: Dr. Huang has significant financial interests in Optovue, Inc. and Carl Zeiss Meditec, companies that may have commercial interests in the results of this research and technology. This potential conflict of interest has been reviewed and managed by OHSU. James G. Fujimoto and David Huang receive royalties on an optical coherence tomography patent licensed by the Massachusetts Institute of Technology (MIT) to Carl Zeiss Meditec and Optovue, Inc. Yali Jia, Jason Tokayer, Ou Tan, and David Huang have potential patent interest in the subject of this article. Other authors do not have financial interest in the subject of this article.

#173662 - $15.00USD Received 1 Aug 2012; revised 11 Sep 2012; accepted 15 Oct 2012; published 7 Nov 2012