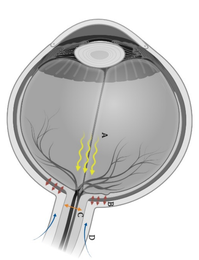
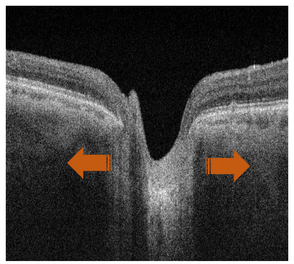
Optic nerve pulsatile deformation in open angle glaucoma after intraocular pressure manipulation measured by OCT

Marissé Masís Solano , Emmanuelle Richer, Santiago Costantino, Mark R Lesk

INTRODUCTION

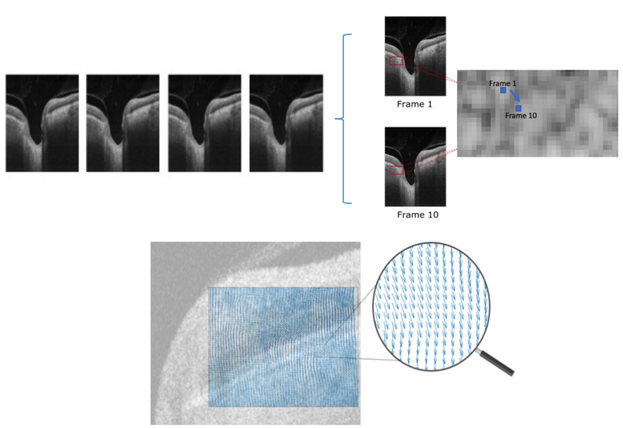
The optic nerve head is a dynamic structure exposed to different mechanical forces. Biomechanical characteristics of the eye are potential biomarkers for glaucoma.





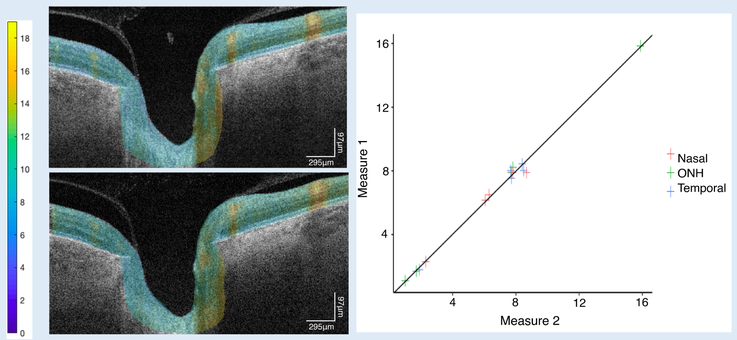
METHODS

Application of a non-invasive technique to quantitatively assess the pulsatile deformation of the optic nerve head (ONH) tissue by combining a high-frequency optical coherence tomography (OCT) imaging with widely available image processing algorithms. Displacement was measured in a cohort of 9 healthy participants and 12 glaucoma subjects before and after IOP lowering treatment (both medical and surgical intervention).

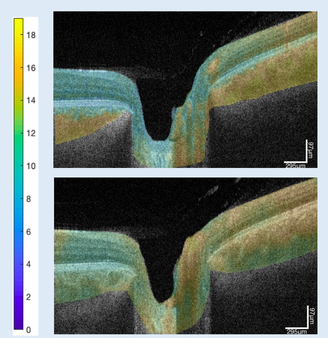


RESULTS

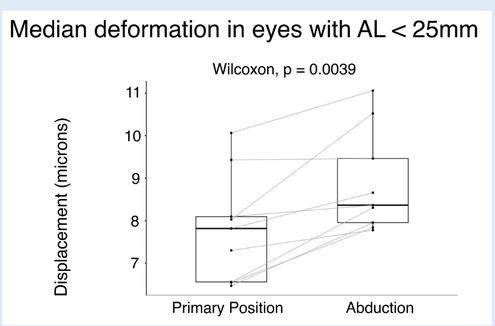
CLINICAL VALIDATION IN NORMAL SUBJECTS



Six eyes of three different healthy individuals were measured in two different time points, pulsatile deformation was calculated in nasal and temporal retina, ONH

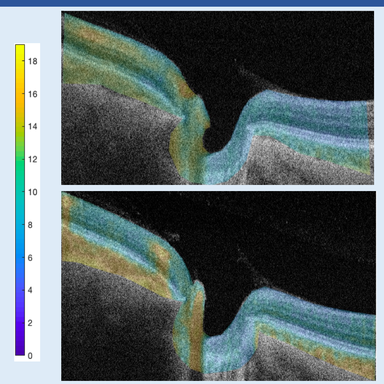


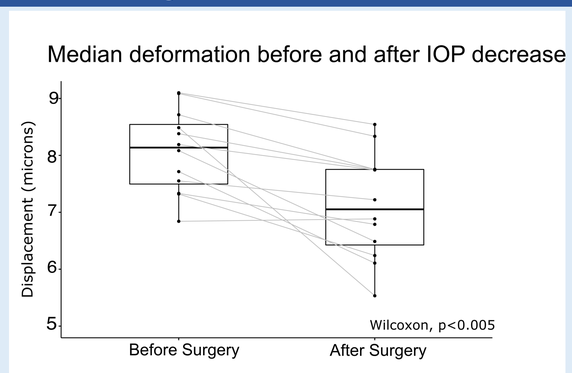
ONH pulsatile deformation maps in different eye gazes. The physiological strain of the optic nerve caused by horizontal eye movements induces a change in the pulsatile deformation of the ONH



PULSATILE DEFORMATION AFTER IOP LOWERING IN GLAUCOMA SUBJECTS

Participants with POAG diagnosis (5 mild and 7 advanced) were imaged before and after intervention. Treatment election was not part of the study design as it was part of the standard medical care. Subjects with moderate glaucoma were treated medically and surgery was performed in advanced cases. Mean age was 68±4years. Mean IOP drop was 5.79mmHg. Before intervention there was a median pulsatile displacement of 6.02±1.2µm compared to a displacement of 4.76±1.4µm after IOP decrease (p<0.005). Therefore, there was a 20% decrease in pulsatile displacement after intervention. Multivariate analysis showed no significant correlation with age, sex, stage disease stage or absolute IOP change for this cohort.





CONCLUSIONS

The computational pipeline demonstrates good reproducibility, and the capacity to accurately map pulsatile deformation of the optic nerve. In a clinical setting, increased median deformation was found in abduction compared to primary position in normal. Additionally, a 20% decrease in optic nerve pulsatile deformation was found after IOP lowering intervention. This could lead to possible biomechanical understanding of the therapeutic response in glaucoma patients

ACKNOWLEDGEMENTS

Research funded by Canadian Institutes of Health Research, the Canadian Space Agency, Fonds de Recherche du Québec Santé,Glaucoma Research Society of Canada, Fonds de Recherche en Ophthalmologie Université de Montréal, Natural Sciences and Engineering Research Council of Canada and IVADO