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Retinal Structural Integrity and Visual Field Function in Patients with Mild Traumatic Brain Injury (mTBI)

Toan M. Trinh & Suresh Viswanathan

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14. ABSTRACT The visual system is vulnerable to traumatic brain injury. Optical coherence tomography (OCT) is an objective, non-invasive imaging technology to capture and evaluate ocular structures with precision and high resolution. Also, standard automated perimetry (SAP) is widely used to screen and manage afferent disorders, including optic nerve conditions. The purpose of this study was to evaluate optic nerve, macular thickness, and visual field functions in patients with chronic mild traumatic brain injury (mTBI). The peripapillary retinal nerve fiber layer (pRNFL) and macular thickness were measured using the HRA-SPECTRALIS from Heidelberg Engineering. Standard automated perimetry was assessed using the Humphrey Field Analyzer from Carl Zeiss Meditec with Swedish Interactive Threshold Algorithm (SITA). The study found a reduction in the global pRNFL and visual field sensitivity and their deviation from age-expected values in patients with chronic mTBI compared to age-matched, healthy controls suggest that OCT and SAP can be utilized to assist in monitoring neurodegeneration and functional deficits after mTBI. Alterations in the axoplasmic flow in the prelaminar and post-laminar optic nerve may lead to thinning of the peripapillary RNFL. The reduction in the RNFL thickness could be a structural biomarker of the neurodegeneration after mTBI.					
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Retinal Structural Integrity and Visual Field Function in Patients with Mild Traumatic Brain Injury (mTBI)

Toan M. Trinh, OD, PhD, FAAO^{1,2} Suresh Viswanathan, PhD²

¹U.S. Army Aeromedical Research Laboratory, Fort Novosel, AL
²State University of New York College of Optometry, New York, NY



Background

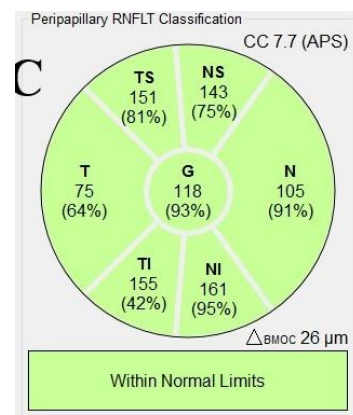
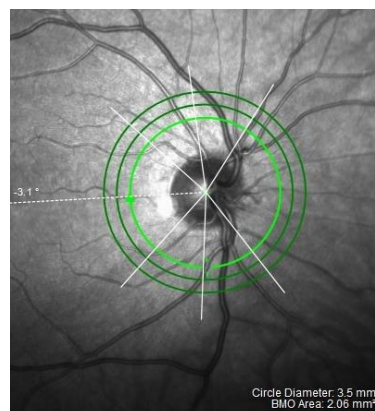
The visual system is vulnerable to traumatic brain injury. Optical coherence tomography (OCT) is an objective, non-invasive imaging technology to capture and evaluate ocular structures with precision and high resolution. Also, standard automated perimetry (SAP) is widely used to screen and manage afferent disorders, including optic nerve conditions.

The purpose of this study was to evaluate optic nerve, macular thickness, and visual field functions in patients with chronic mild traumatic brain injury (mTBI).

Methods

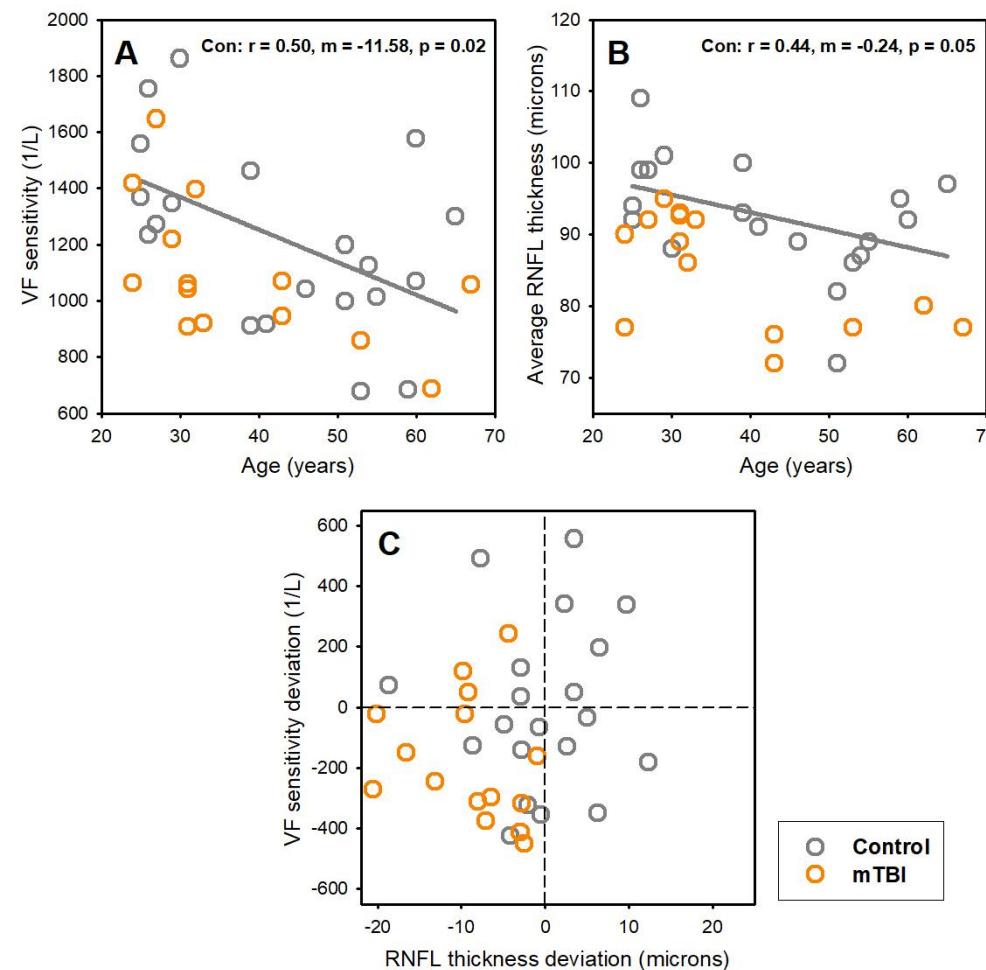
The peripapillary retinal nerve fiber layer (pRNFL) and macular thickness were measured on the dominant eye for 15 mTBI subjects (ages 40.13 ± 15.99 years) and 20 controls (ages 43.05 ± 13.12 years) using the HRA-SPECTRALIS from Heidelberg Engineering. Standard automated perimetry was assessed using the Humphrey Field Analyzer from Carl Zeiss Meditec with Swedish Interactive Threshold Algorithm (SITA) Standard 24-2 and 10-2 for the same eye.

The OCT and visual field measurements were extracted for each mTBI and control subject. Student t-tests were used to compare the parameters between control and mTBI groups. Type I error $\alpha = 0.05$ was used for statistical significance and a Holm-Bonferroni correction was applied to adjust for multiple comparisons.



Results

- Global pRNFL and temporal-superior (TS) sector were thinner in mTBI subjects at 3.5 millimeter (mm), 4.1 mm, and 4.7 mm circle diameter around the optic nerve compared to controls.
- No significant macular thinning was observed in the subjects with mTBI compared to visually normal controls.
- Visual field (VF) sensitivity (1/Lambert or 1/L) of the mTBI subjects was on average lower than the normal values expected for their age by 174.0 ± 207.0 units and the RNFL thickness was reduced on average by 9.0 ± 6.0 microns relative to age-expected values.



Results Continued

- Mean visual field sensitivity (**A**) and average RNFL thickness for 4.1 mm diameter ring (**B**) as a function of age. The linear regressions fit to the data had slopes that were significantly different from zero.
- The deviation of the VF sensitivity from age-expected values plotted as a function of the deviation of the RNFL thickness from age-expected values for the mTBI and control subjects (**C**). The vertical and horizontal dashed lines indicate the zero difference between actual and age-expected values of RNFL thickness and VF sensitivity.
- 12/15 (80%) mTBI subjects demonstrated reduction in both measures relative to age-expected values and the remaining 3 (20%) demonstrated RNFL thickness below and VF sensitivity above age-expected values.

Discussion

- Reduction in the global pRNFL and visual field sensitivity and their deviation from age-expected values in patients with chronic mTBI compared to age-matched, healthy controls suggest that OCT and SAP can be utilized to assist in monitoring neurodegeneration and functional deficits after mTBI.
- Alterations in the axoplasmic flow in the prelaminar and post-laminar optic nerve may lead to thinning of the peripapillary RNFL.
- The reduction in the RNFL thickness could be a structural biomarker of the neurodegeneration after mTBI.

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