RNFL thinning in patients after traumatic brain injury

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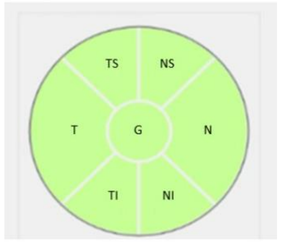
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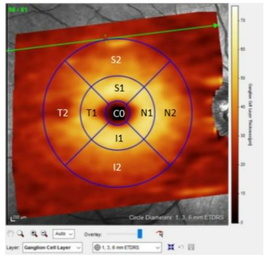
Introduction: In traumatic brain injury (TBI), Optical Coherence Tomography (OCT) has shown retinal changes as early as 1-2 weeks when compared to optic disc pallor changes occurring as early as 6 weeks.

Aims and Methods: To investigate TBI-related retinal changes and their association to TBI severity using DoD classification and CT head findings using CT Marshall scoring system .
Retrospective, observational, and longitudinal study involving TBI patients referred to a trauma centre in Birmingham. Macula ganglion cell layer(GCL) and cirumpapillary retinal fibre layer(RNFL) thickness changes were assessed on serial OCT. RNFL changes were subcategorised as single-sectoral, multi-sectoral thinning, TON or thickening.

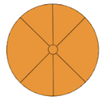




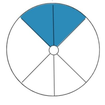
Representative
RNFL OCT image



Representative GCL
OCT image



TON



Multi-sectoral RNFL
thinning



Multi-sectoral RNFL
thinning



Single sectoral RNFL
thinning

Results:

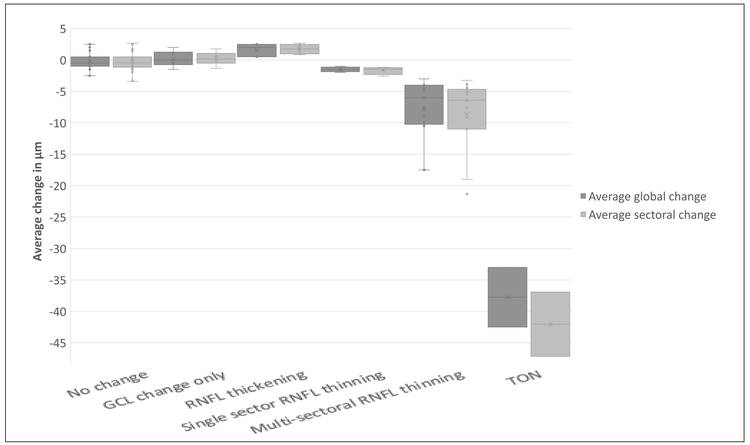
Patients demographics.

Age	Mean: 31 years Median: 27 years Range 16-82 years
Sex	Male: 109 (81%) Female: 26 (19%)
Initial LogMAR VA LogMAR (Snellen)	Median: RE -0.1 (20/16) LE -0.04 (20/20)
Follow up LogMAR VA LogMAR (Snellen)	Median: RE -0.04 (20/20) LE -0.06 (20/16)
Mechanism of injury	Sport: 76 (56%) RTC: 20 (15%) Assault: 16 (12%) Fall: 23 (17%)
Multiple TBI in lifetime	29/135 (21%)
TBI severity	Mild: 81 (60%) Moderate: 36 (26.7%) Severe: 18 (13.3%)
Mean time to initial OCT after TBI for patients with follow up OCT assessments (S.D.)	Mean: 50.91 days (80.74)
Follow up OCT	Total: 62/135 (45.93%)
Mean time to follow up OCT after TBI (S.D.)	Mean: 157.34 days (152.43)
CT head	Total: 60/135 (44.44%)
Marshall classification score	I: 10 (7%) II: 35 (26%) III: 6 (4%) IV: 0 V: 9 (7%) VI: 0

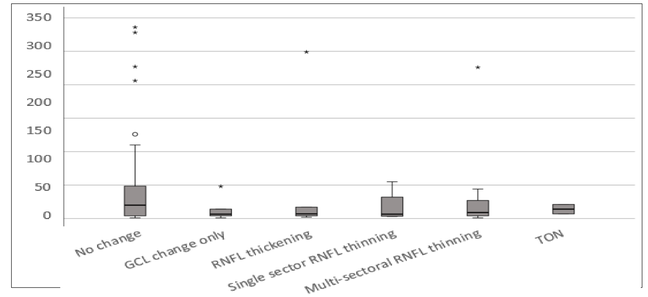
Time to OCT and RNFL changes, in association to TBI severity.

Severity	Timing of initial assessment	Change in RNFL thickness (µm/month)	Standard error (µm)
Mild	<42 days	0.16482	0.278301
	>42 days	-0.21598	0.406547
Moderate	<42 days	-1.21248	0.700237
	>42 days	1.105344	0.577719
Severe	<42 days	-2.21418	1.501425
	>42 days	-1.84681	1.068723

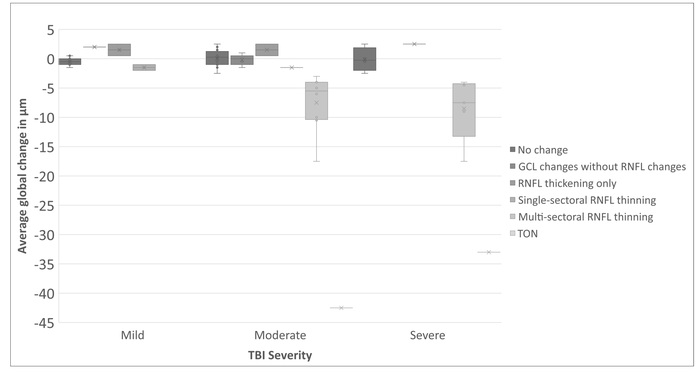
Average global retinal nerve fibre layer (RNFL) thickness changes on follow-up



Time to first OCT in days.



Association between average global RNFL thickness changes and traumatic brain injury (TBI) severity



Summary of RNFL changes in patients with follow up. (n=62)

OCT Category	Number of patients (%)	Patients with GCL changes (thinning or thickening) (%)	TBI Severity (Marshall Score)				TBI Severity(DoD classification)		
			I	II	≥III	No CT	Mild	Moderate	Severe
TON	2 (3.2)	2(100)	0	2	0	0	0	1	1
Single sector RNFL thinning	4 (6.5)	2 (50)	1	1	0	2	3	1	0
Multi-sector RNFL thinning	13(21)	7 (53.8)	0	9	4	0	0	8	5
RNFL thickening only	6 (9.7)	1 (16)	1	2	1	2	3	2	1
GCL changes without RNFL changes	6 (9.7)	6 (100)	2	3	0	1	1	5	0
No changes	31 (50)	0 (0)	2	9	5	15	15	12	4

Conclusion:

This study shows detectable OCT circumpapillary RNFL changes in 40.32% of patients with TBI. There is strong association between RNFL findings post TBI and the TBI severity, and CT brain imaging findings, suggesting OCT changes can be used as oculomic imaging biomarker for TBI severity even in subclinical RNFL changes, p=0.001 for all.
Significant RNFL loss occurs in TBI patients seen 42-150 days post injury after injury, with lesser thinning even after 150 days.
There was no association between macular GCL changes and TBI severity or CT brain findings with p=2.09 and p=0.118 respectively.