

Access this article online
Quick Response Code:

Website: www.e-tjo.org
DOI: 10.4103/tjo.tjo_54_21

Optical coherence tomography as a useful adjunct in the early detection of meningioma with optic nerve compression

En-Che Chang¹, Jing-Shan Huang², Yu-Chih Hou,^{1,3,4} Chu-Hsuan Huang¹, I-Hua Wang^{1*}

Abstract:

A 48-year-old woman presented with persistent clouding vision in her lower field in the right eye for 5 months. A small retinal hemorrhage was initially reported. Her visual acuity was 20/30 in the right eye and 20/20 in the left, with normal color vision and pupil response. Fundus examination did not reveal any retinal hemorrhage. Although optical coherence tomography (OCT) showed normal macula and retinal nerve fiber layers in both eyes, asymmetric thinning of the ganglion cell inner plexiform layer was found in the superior macula of the right eye in ganglion cell analysis (GCA). Visual field examination revealed a subtle inferonasal scotoma. Compressive optic neuropathy (CON) was suspected. The visual evoked potential test revealed delayed P100 latency. A tuberculum sellae meningioma was found with right medial optic canal extension. The visual acuity of the right eye returned to 20/25 after decompression surgery. OCT can be used to differentiate between retinopathy and optic neuropathy. GCA can help in the early detection of CON and achieve a good visual outcome after surgery.

Keywords:

Compressive optic neuropathy, ganglion cell analysis, meningioma, optical coherence tomography

Introduction

Although compressive optic neuropathy (CON) is a slow progressive, vision-threatening disease, with proper management, vision in the majority of the eyes can be maintained or improved after decompression surgery.^[1] With advances in technology, optical coherence tomography (OCT), which measures the peripapillary retinal nerve fiber layer (RNFL) and ganglion cell-inner plexiform layer (GCIPL), has become one of the most important tools in neuro-ophthalmic practice. In a recent study, the loss of ganglion cell complex demonstrated by OCT strongly correlated

with the visual field (VF) defects from optic chiasm compressive lesions.^[2] Reports have also shown that GCIPL thinning on the ganglion cell analysis (GCA) could be seen in the setting of normal RNFL measurements or normal VF findings in CON.^[3,4] We present here a case of CON of the right eye due to tuberculum sellae meningioma in a patient with very mild field defects as well as normal pupillary response and color test at initial presentation. The thinning on the GCA was the first sign which led to the diagnosis of visual impairment.

Case Report

A 48-year-old woman presented with 5 months of painless persistent blurred vision of the lower VF in the right eye. She

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Chang EC, Huang JS, Hou YC, Huang CH, Wang IH. Optical coherence tomography as a useful adjunct in the early detection of meningioma with optic nerve compression. Taiwan J Ophthalmol 2022;12:354-9.

¹Department of Ophthalmology, Cathay General Hospital, Taipei, Taiwan, ²Department of Surgery, Cathay General Hospital, Taipei, Taiwan, ³Department of Ophthalmology, College of Medicine, National Taiwan University Hospital, National Taiwan University, Taipei, Taiwan, ⁴Department of Ophthalmology, College of Medicine, Fu Jen Catholic University, New Taipei City, Taiwan

*Address for correspondence:

Dr. I-Hua Wang,
Department of Ophthalmology, Cathay General Hospital, 280, Sec. 4, Renai Road, Taipei, Taiwan.
E-mail: ihua2007@gmail.com

Submission: 10-07-2021
Accepted: 10-11-2021
Published: 10-03-2022

had been to three other eye clinics before her presentation and was informed of having a small retinal hemorrhage in the right eye 3 weeks before this visit [Figure 1]. Her medical history was notable for paroxysmal positional vertigo and hyperthyroidism. She did not have diabetes mellitus or hypertension. Her best-corrected visual acuity (BCVA) was 20/30 in the right eye and 20/20 in the left eye. Intraocular pressure was normal in both eyes. There was no proptosis or lid retraction. The eye movement was normal, and she did not have diplopia. There was no relative afferent pupillary defect (RAPD), and she could recognize all 13 numerical color plates of the Ishihara color test (24 plates edition) in both eyes. The slit-lamp biomicroscopic examination was unremarkable, and fundus examination showed a normal disc appearance without retinal hemorrhage in both eyes [Figure 2a]. Further examination was performed to differentiate between retinopathy and optic neuropathy. OCT (Cirrus OCT, Carl Zeiss, Dublin, CA) demonstrated normal RNFL measurements in both eyes [Figure 2b], but asymmetric GCIPL thickness with thinning at the superior macula in the right eye in the GCA [Figure 2c]. The macular OCT scans showed all retinal layers, including the ellipsoid zone, to be intact in both eyes. The OCT angiography showed no abnormal microvasculature of the retina or choroid in either eye. VF examination (Humphrey Field Analyzer, 24-2; Carl Zeiss, Dublin, CA, USA) revealed a subtle nasal lower defect in the right eye [Figure 2d]. As optic neuropathy was suspected, the visual-evoked potential (VEP) test was performed and demonstrated delayed P100 latency after right eye stimulation. She was referred to a neuro-ophthalmologist 3 weeks after her first visit to our hospital, and her right BCVA deteriorated to 20/100 with color desaturation and trace RAPD. CON was highly suspected, and brain magnetic resonance imaging was performed. A 1.5 cm homogeneous enhancing mass was discovered in the suprasellar region with a dural

tail sign, compressing the right optic nerve [Figure 3]. A tuberculum sellae meningioma with right medial optic canal extension was removed using an extended endoscopic endonasal transsphenoidal approach which was later confirmed by histopathology [Figure 4]. Her visual symptoms resolved, and her right BCVA improved to 20/25 6 weeks postoperatively. The RNFL thickness slightly decreased at the superior pole [Figure 5a], and the GCIPL thinning at the superior macula did not show much difference [Figure 5b], but the VF defect was completely relieved [Figure 5c] 15 months postoperatively.

Discussion

CON is usually caused by an extrinsic lesion, such as optic nerve glioma, pituitary tumor, meningioma, and enlarged muscles in Graves' orbitopathy. Its presentations include reduced visual acuity, dyschromatopsia, RAPD in unilateral cases, with or without an edematous disc, and different patterns of VF defects depending on the location of the compression. Therefore, it is important to differentiate between CON and retinopathy. While patients with CON often describe their visual loss as clouding, darkening, or loss of color perception, those with macular lesions have symptoms such as metamorphopsia, macropsia, or micropsia. A prominent RAPD sign accompanied by visual loss is mostly seen in asymmetric optic neuropathy; but RAPD can also be seen in patients with widespread asymmetric retinal disease. The VF defect pattern can overlap between optic neuropathies and retinopathy. Sometimes, the CON is presented with only dim or foggy vision without obvious optic nerve dysfunction or other similar findings in the early stage, as in our case. In this situation, the patient could be overlooked as having a functional visual disorder and poses a diagnostic dilemma for the doctor in differentiating between the early stage of CON and occult retinopathy. In our case, a delayed P100 waveform on VEP classically implies an optic neuropathy since other entities such as maculopathy, refractive errors, mature cataracts, and lack of co-operation were excluded from the study. The retinal hemorrhage in our case might have been associated with possible vessel stasis in the CON. However, as this has not been reported in the literature, it could be a coincidental finding.

Recently, OCT has been used to objectively evaluate the whole retinal thickness, RNFL and GCIPL thickness toward detecting retinopathy or axonal loss in the optic nerve. Even though both peripapillary RNFL and GCIPL thinning on GCA can be associated with the signs of compressive optic nerve damage, between the



Figure 1: Fundus photography of a retinal hemorrhage in the right eye. A small flame-shaped retinal hemorrhage (white arrow) inferonasal to the macula

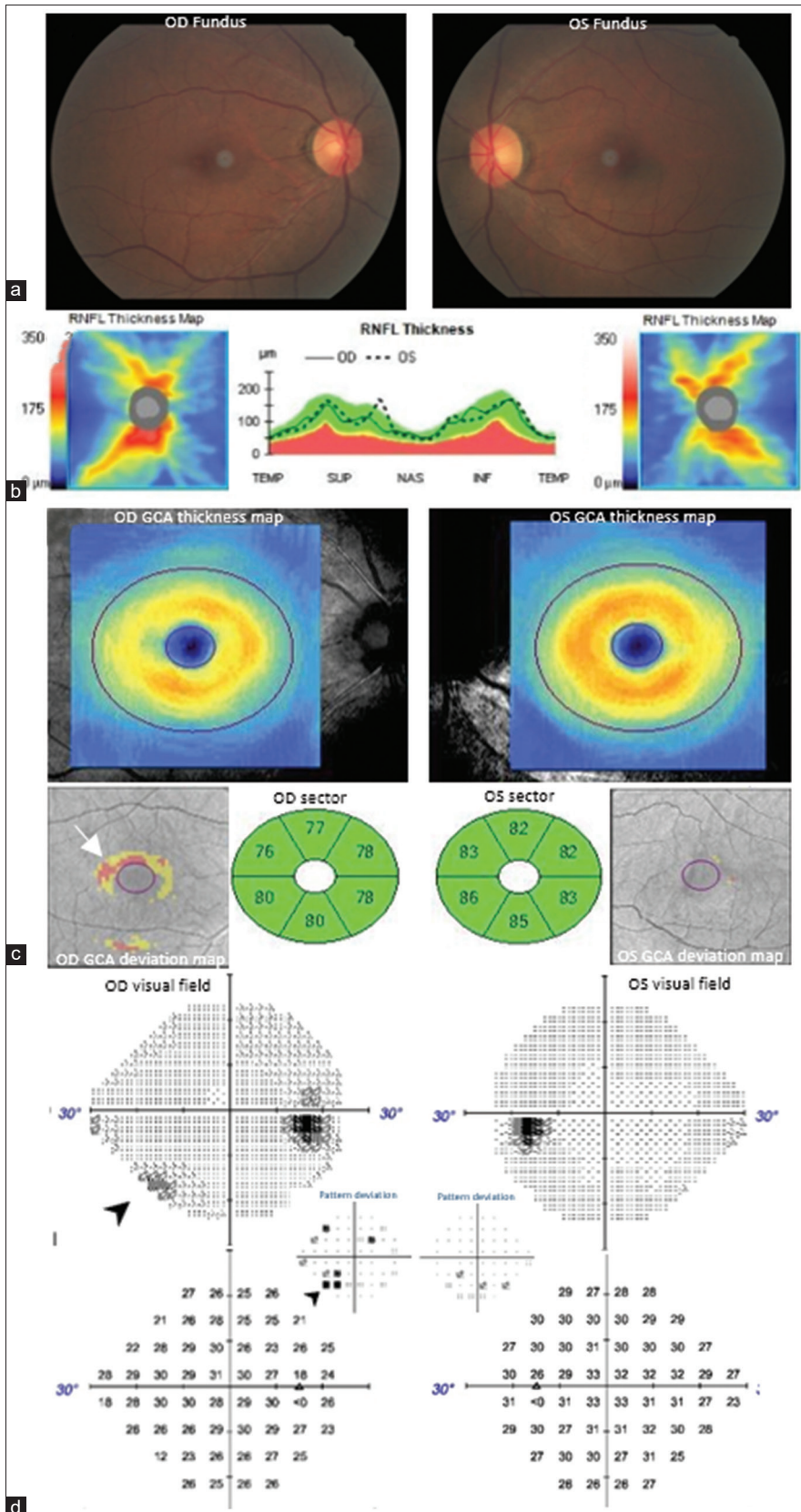


Figure 2: Preoperative fundus photography and the results of optical coherence tomography and visual field. (a) Normal disc appearance and cup-disc ratio seen in both eyes. (b) Normal double hump pattern of circumpapillary in the retinal nerve fiber layer analysis of optical coherence tomography. (c) Asymmetrically decreased ganglion cell thickness at the superior macula (white arrow) in the right eye with normal thickness in the left eye in the deviation map of the ganglion cell analysis of optical coherence tomography. (d) Subtle nasal lower defect (black arrowhead) in the right eye and normal in the left eye in Humphrey 24-2 perimetry

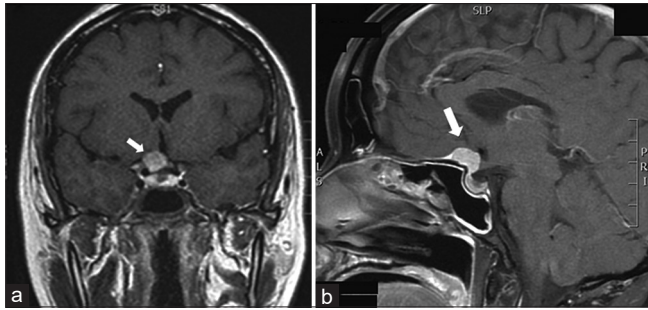


Figure 3: Brain magnetic resonance imaging before surgery. (a) T1-weighted image with contrast brain magnetic resonance imaging revealed a 1.5 cm tumor (white arrow) at the suprasellar region with compression on the right optic nerve in the coronal view. (b) The sagittal view shows the tumor (white arrow) with homogenous enhancement and dural tail sign

two, GCA is more sensitive for CON.^[3,4] Nasal GCIPL thinning occurring before VF change could be a single feature in the early chiasmal compression.^[3] GCIPL thinning has a stronger correlation with the VF loss in CON than RNFL.^[2] OCT helped us make a differential diagnosis in this case. First, although mildly decreased visual acuity in the patient's right eye may have been due to previous retinal hemorrhage, OCT showed normal macular structure, and the thinning of the GCIPL correlated with the consistent visual complaint. This served an early warning for us to not miss a possible CON. Second, asymmetric GCIPL thinning at the superior macula in the right eye, which correlated well with subtle inferonasal VF defects, helped us differentiate the early CON from occult retinopathy. Further VEP and imaging studies confirmed our diagnosis. A previous study has also shown that visual acuity and VF improvement after decompression surgery are correlated with RNFL and GCIPL thickness.^[5] Patients with normal RNFL thickness have more improvement of visual function than those with thin RNFL. Visual acuity and VF usually recover promptly after surgery through the removal of physiological conduction blocks and restoration of signal conduction. Although still controversial, RNFL and GCIPL thickness improvement at 6 months following surgery has been observed.^[5] Although a prolonged retrograde degeneration may progress early after surgery, the delayed restoration of retinal ganglion cells may occur.^[5] However, in the present case, GCIPL thickness did not show improvement after decompression surgery after more than 1 year of follow-up. Delayed RNFL thinning in our patient may be due to the axonal stasis and edema caused by direct compression at an early stage which may contribute to the increased thickness with impaired function and late development of retrograde degeneration.^[6] The sensitivity of VF and OCT examination may be also affected by different perimetric test patterns and scanning protocols.

It needs to be emphasized that one should not use GCA abnormality in isolation as an indicator of ruling in

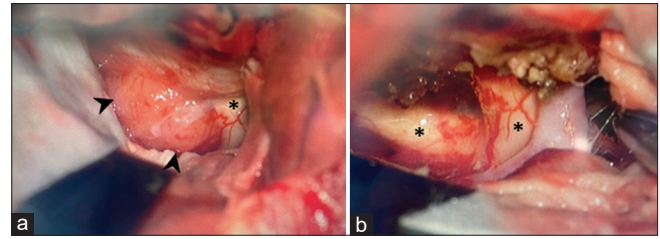


Figure 4: Intraoperative images. (a) The tumor (black arrowhead) compressed the right optic nerve (asterisk). (b) The optic nerve (asterisks) which was exposed after tumor removal

CON without clinical correlation. Measurements of the GCA can have errors and misinterpretations owing to the segmentation failures of the GCIPL complex. The appearance of nonpathological shapes or propeller signs in the thickness or probability map and a GCIPL reading $<40 \mu\text{m}$ are typically indicative of areas of segmentation errors.^[7] Interindividual variation in retinal ganglion cell thickness across the macula can also cause perifoveal thinning. Therefore, an abnormal probability map in the perifoveal location should be scrutinized carefully and correlated with clinical examination and functional tests.^[7] However, when thinning is correlated with other clinical findings, further examinations should be performed without hesitation to determine the underlying etiology.

In conclusion, CON may present with minimal visual symptoms and ocular findings at an early stage. OCT can provide quick, objective evaluation of individual retinal layers and qualification of retinal neural loss in patients with CON. GCIPL thinning can be correlated with VF defects and the location of the CON. GCA is a promising and sensitive tool for the early indication of CON even before VF and RNFL changes. Earlier identification and differentiation of structural changes in the CON lead to timely diagnosis and good visual function recovery following decompression surgery.

Declaration of patient consent

The authors certify that they had obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initial will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest in this paper.

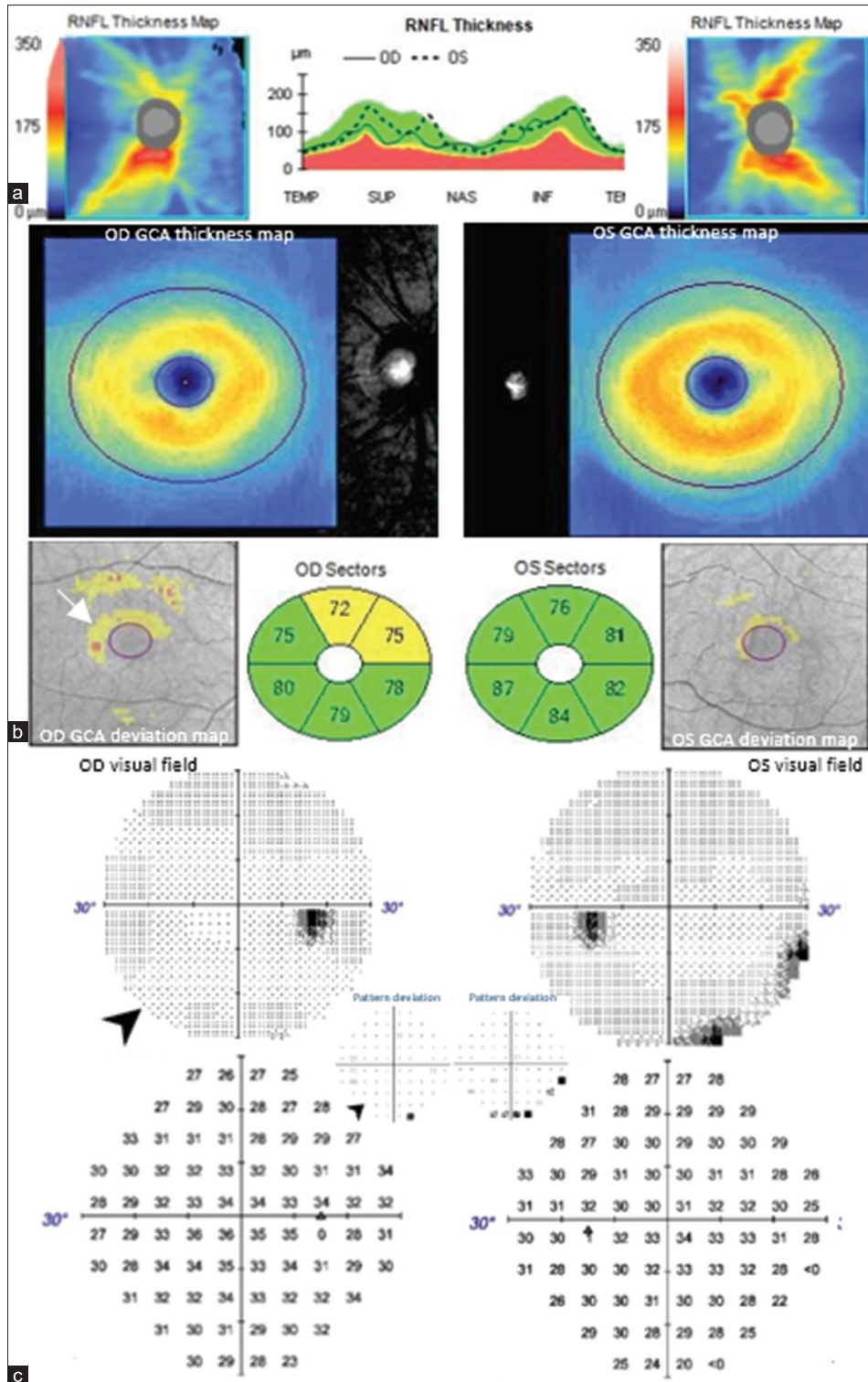


Figure 5: Postoperative optical coherence tomography and visual field at 15-month follow-up. (a) RNFL analysis showed mildly decreased thickness at the superior pole of the circumpapillary RNFL thickness. (b) The GCIPL thinning at the superior macula which did not show much difference (white arrow) after the decompression surgery. (c) Previous visual field defect relieved (black arrowhead) after the decompression surgery. RNFL, peripapillary retinal nerve fiber layer; GCIPL, ganglion cell–inner plexiform layer.

References

1. Sleep TJ, Hodgkins PR, Honeybul S, Neil-Dwyer G, Lang D, Evans B. Visual function following neurosurgical optic nerve decompression for compressive optic neuropathy. *Eye (Lond)* 2003;17:571-8.
2. Tieger MG, Hedges TR 3rd, Ho J, Erlich-Malona NK, Vuong LN, Athappilly GK, *et al*. Ganglion cell complex loss in chiasmal

- compression by brain tumors. *J Neuroophthalmol* 2017;37:7-12.
3. Yum HR, Park SH, Park HY, Shin SY. Macular ganglion cell analysis determined by cirrus HD optical coherence tomography for early detecting chiasmal compression. *PLoS One* 2016;11:e0153064.
 4. Minakaran N, de Carvalho ER, Petzold A, Wong SH. Optical Coherence Tomography (OCT) in neuro-ophthalmology. *Eye (Lond)* 2021;35:17-32.
 5. Moon CH, Hwang SC, Ohn YH, Park TK. The time course of visual field recovery and changes of retinal ganglion cells after optic chiasmal decompression. *Invest Ophthalmol Vis Sci* 2011;52:7966-73.
 6. Laowanapiban P, Chirapapaisan N, Kemahayung S, Srikong M. Variable structure and function relationship of compressive optic neuropathy at the time of diagnosis. *Clin Ophthalmol* 2019;13:1599-608.
 7. Chen JJ, Kardon RH. Avoiding clinical misinterpretation and artifacts of optical coherence tomography analysis of the optic nerve, retinal nerve fiber layer, and ganglion cell layer. *J Neuroophthalmol* 2016;36:417-38.