Case Report / Приказ болесника

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Prognostic value of optical coherence tomography in chronic chiasmal compression

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SUMMARY
Introduction Sellar and parasellar region lesions, such as pituitary adenoma often lead to the compression of the optic chiasm. Consequentially, visual field (VF) defects and loss of visual acuity (VA), is a common complaint in these patients. The aim of this study is to evaluate if optical coherence tomography (OCT), measuring retinal nerve fibre layer (RNFL) and ganglion cell complex thickness (GCC), offers a reliable prediction of visual outcome in patients with chronic chiasmal compression from a pituitary macroadenoma.

Case outline We present a case of chronic chiasmal compression from a pituitary macroadenoma with an initial binocular visual field defect and low values of OCT parameters binocularly. The average value of RNFL on the right eye pre/postoperatively was 48/79 μm, while on the left eye it was 56/63 μm. The average value of GCC pre/postoperatively was 47/46 microns on the right and 45/46 microns on the left eye. Six weeks after surgical optochiasmal decompression macular GCC on both eyes and RNFL on the left eye remained largely unchanged, while RNFL of the right eye exhibits increases in thickness, as the postoperative consequence of the removal of conduction block. Neither visual field, nor visual acuity shows postoperative improvement.

Conclusion Irreversible damage of GCC and RNFL by longstanding compression results in poor visual outcome after surgery. Ganglion cell layer of the macula is a more accurate and reliable indicator of postoperative visual outcome.

Keywords: optical coherence tomography; macular ganglion cell layer; peripapillary retinal nerve fiber layer; visual outcome; suprasellar mass

INTRODUCTION

Compressive optical neuropathies are among the most important anterior optical pathways diseases that can lead to severe impairment of visual function. Compressive optic
neuropathy (CON) is a group of diseases that are caused by mechanical comperssion of retinal ganglion cell (RGC) axons of the optic nerve. Chiasmal lesions may be caused by pituitary adenoma, craniopharyngioma, meningioma, cysts, and aneurysm.

Surgical removal of the lesions is an important aspect of clinical management. One of the primary indications for surgical management of chiasmal compression is progressive loss of visual function. Surgical treatment enables decompression of optochiasmatic complex, prevents further visual function deterioration, and enables visual acuity improvement at the same time. Visual recovery after surgical treatment of chiasmal compression occurs in stages with the removal of the conduction block, followed by secondary remyelination and restoration of axoplasmic flow over months to years [1].

Pituitary adenoma, is the most common anterior optical pathways diseases. As a consequence, visual impairment, including visual field (VF) defects and loss of visual acuity (VA), is a common complaint [2, 3].

Several predictors for the improvement of visual function after decompression of the anterior visual pathway have been studied, including duration of symptoms, age, preoperative visual acuity, tumor size, optic disc pallor, funduscopic appearance of the retinal nerve fiber layer were evaluated in the past, with conflicting results [3–6].

With the development of optical coherence tomography (OCT), more objective measurements of optic nerve damage and more objective prediction of visual outcome after treatment of pituitary adenomas have become available [7–19].

The aim of this study is to evaluate if optical coherence tomography (OCT) offers a reliable prediction of visual outcome in a case report of chronic chiasmal compression from a pituitary macroadenoma. We used objective parameters were the thickness of the retinal nerve fiber layer (RNFL) and the thickness of ganglion cell complex (GCC).
CASE REPORT

A 65-year-old woman presented with an eight month history of malaise, weakness, frontal headaches, and blurred vision in both of her eyes. Complete neuro-ophthalmic examination, including the visual acuity test (Snellen charts), color vision test, visual field analysis (Humphrey Field Analyzer (Carl Zeiss Meditec, Inc. Dublin, CA, USA) Full field 120 point suprathreshold test, ocular motility test, dilated stereoscopic fundus examination and OCT measurements of retinal nerve fiber layer (RNFL) and the macular ganglion cell-inner plexiform layer (GCIPL) thickness, was done.

OCT imaging was conducted after pupil dilation (administration of 1% Tropicamide eye drops), using the Cirrus OCT (OCT-3, OCT software version 6.0; Carl Zeiss Meditec Inc. Dublin, CA, USA). RNFL Optic Disc Cube 200×200 and Macular Cube 512×128 scan protocols were used. The ganglion cell analysis algorithm was used to determine macular GCIPL thickness within 14.13 mm² elliptical annulus area centred on the fovea. Six sectoral (superior, superonasal, inferonasal, inferior, inferotemporal, and superotemporal) GCIPL thickness values were used for analysis. The Cirrus SD-OCT algorithm calculates the peripapillary RNFL thickness at each point on the circle of 3.14 mm² centered on the optic disc. Four-quadrant (superior, nasal, inferior, and temporal) RNFL thicknesses were used for analysis.

The patient had normal ocular position and motility with pupils of equal sizes. Dilated fundus examination revealed atrophic optic nerve head in the right eye and subatrophic optic nerve head in the left eye.

On examination, her visual acuity (Snellen) was 0.03 in the right eye and 0.6 in the left eye, and there was a mild right relative afferent pupillary defect and red desaturation in the right eye.

Visual field testing demonstrated preservation of the central 30 degrees in the nasal half of the left visual field and total visual field loss in the right eye.

Due to the concern of a chiasmal lesion, MRI of the endocranium was performed and revealed a pituitary macroadenoma measuring $28 \times 37 \times 36$ mm. The tumour extended supra,
para i infrasellary and throughout both cavernous sinuses, with pronounced compressive effect on prechiasmal part of both optic nerves and chiasma itself. (Figure 1)

Additionally, there were multiple endocrinological disorders observed, including dropout of thyroid, adrenocorticotropic, somatotropic and gonadotropic function. Pathohistologic examination confirmed the case of gonadotropic adenoma, a neuroendocrine hypophyseal tumour.

Neurosurgical treatment involved subtotal tumor resection.

Optical coherence tomography (OCT) showed pronounced thinning of RNFL (Table 1, Figure 1) and macular GCC binocularly (Table 2, Figure 4)

Nuclear magnetic resonance examination six weeks after surgical treatment revealed a larger residual lesion in the right sellar region and within the right cavernous sinus, with minimal growth of the tumor inside left cavernous sinus. Visual acuity also stayed unchanged. OCT parameters - macular ganglion cell complex on both eyes and RNFL thickness of left eye remained largely decreased, as on initial presentation, while RNFL showed signs of improvement as the consequence of postoperative removal of conduction block (Figure 3 and 5). The visual field defect was unchanged binocularly (Figures 6 and 7).

All procedures performed in this report were in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Written consent to analyze and publish all shown material was obtained from the patient and the approval for the study was given by Ethics Committee of the Eye Clinic, Clinical Centre of Vojvodina.

**DISCUSSION**

Tumors of sellar, suprasellara and parasellar region, which compose 30% of all intracranial tumors according to multiple authors, are a complex neurosurgical problem even today. This is mainly the consequence of their close anatomical relations with the vital
structures of this region – a.carotis interna and her branches, hypothalamus, infundibulum and pituitary gland, with optic nerves and their chiasma.

Individual variations of chiasmal position and the inclination of its oblique plain, determine the duration of “quiet stage” of the growth of pituitary adenoma needed for the deterioration of visual function. The gradual, slow progression of visual function decline, headaches, a mild endocrine disorder result in the late physician involvement, with already enlarged tumors of uncertain prognosis for visual recovery.

In recent years it has been established that patients who have objectively measurable RNFL loss and loss of retinal ganglion cell complex (GCC) at the time of surgery for chiasmal compressive lesions are less likely to have recovery of VA or VF after surgery [9–16]. Thinner preoperative RNFL and macular GCC thickness was found to be associated with worse visual acuity (VA) and VF after surgery. This also supports the notion that preserved OCT RNFL and macular GCC thickness confers a good visual outcome.

In this case, chronic chiasmal compression caused not only conduction block, but also a significant atrophy of retinal ganglion cells that was confirmed with OCT parameters that remained mostly decreased.

Although our study’s follow up period was only 8 weeks, the results proved to be comparable with the findings of Danesh-Meyer et al. [11 abstract], that showed in the series of 40 cases with chiasmatic compressive lesions, with OCT and visual field analysis, that pre and post decompression treatment in patients with thin RNFL did not demonstrate significant improvement in VA and visual field. Min Sun et al. [5] Jing Zhang et al. [15], as well as Jonathan [16] found with preoperative and postoperative RNFL thickness analysis that eyes with visual defects but normal preoperative RNFL thickness showed a significantly greater improvement in postoperative visual function than those with thin preoperative RNFL thickness. Similarly, Jacob et al. [6] demonstrated that circumpapillary RNFL thinning measured by OCT decreased the patient's chances of recovery of initial visual field defect 3 months after treatment.

Some researchers also explored the predictive value of RNFL thicknesses in different quadrants [2, 6, 15, 17, 20]. Chiasmal compression is well-known to cause more thinning of
the nasal and temporal sectors of peripapillary retinal nerve fiber layer (RNFL) thickness, [2, 17] and predominantly nasal hemiretina thinning of macular GCC [20], something we weren’t able to confirm in our patient due to extreme thinning of RNFL and GCL in all sectors.

While a majority of the research have focused on measuring the peripapillary retinal nerve fiber layer (pRNFL) [6, 12, 15], recent data suggest the ganglion cell layer–inner plexiform layer (GCL-IPL) of the macula may be a more accurate and reliable biomarker of vision [7, 8, 10, 17, 18]. GCC thinning, according to numerous authors, remained relatively unchanged before and after decompression [17–20], found in our patient, as well. Consequently, patients with GCC loss before decompression had decreased chances of recovery of postoperative VF [17–20], the fact we can agree based on the postoperative visual field in our patient.

RNFL and GCC thickness measured by OCT have been identified as useful prognostic indicators in the preoperative assessment of chiasmal compression and became an important aspect of the pre-treatment evaluation of pituitary tumors. OCT analysis may be an objective method to diagnose and follow patients with chiasmal lesions.

In the patient involved in our study, chronic chiasmal compression led to pronounced axonal damage, manifested in significant RNFL and GCC thinning and poor postoperative recovery of visual function. Ganglion cell layer of the macula proved to be a more accurate and reliable indicator of postoperative visual outcome.

**Conflict of interest:** None declared.
REFERENCES


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**Figure 1.** Nuclear magnetic resonance scan of the endocranium with optochiasmal compression
Figure 2. Preoperative retinal nerve fiber layer (RTNL) thickness
**Figure 3.** Postoperative (retinal nerve fiber layer) RNFL thickness
**Figure 4.** Preoperative ganglion cell complex thickness
Figure 5. Postoperative ganglion cell complex thickness
Figure 6. Full-field 120-point perimetry test of the left eye preoperatively
**Figure 7.** Full-field 120-point perimetry test of the left eye postoperatively
**Table 1.** Thickness of the retinal nerve fiber layer [µm]

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### Table 2. Thickness of the macular ganglion cell layer [µm]

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