ORIGINAL ARTICLE

OPTICAL COHERENCE TOMOGRAPHY PREDICTS VISUAL RECOVERY OF PATIENTS WITH PITUITARY ADENOMA FOLLOWING SURGERY IN DR KARIADI HOSPITAL SEMARANG

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ABSTRACT

Introduction and Objective: *The characteristics, symptoms, and clinical manifestations of pituitary adenoma in Indonesia have not been widely studied. In 26 patients undergoing pituitary surgery at Dr. Kariadi Hospital, we compared visual acuity pre-operative and post-operative from normal and thin optical coherence tomography (OCT) of the retinal nerve fiber layer (RNFL) and ganglion cell layer-internal plexiform layer (GCL-IPL).*

Method: *A retrospective study of the medical record from January 2020 to December 2022 was done. 21 of the 26 patients had surgery by the transsphenoidal route and the rest by craniotomy. All patients had macroadenoma (tumor size >1cm) and were histologically confirmed. Visual acuity before and after surgery was evaluated along with the patient's OCT value.*

Result: *The thinner pre-operative RNFL thickness was associated with worse visual acuity (VA). Patients with normal RNFL had a median VA of 20/200 while those with thin RNFL had to count their fingers (CF). The patients with normal pre-operative RNFL had a significant improvement in median VA after surgery, from 20/200 to 20/32 (p=0.022), whereas the patients with thin RNFL did not improve (CF to CF, p=0.026). The patients with normal pre-operative GCL-IPL had non-significant improvement in median VA after surgery from CF to 20/20 (p=0.505), also the patients with thin GCL-IPL from CF to 20/200 (p=0.151).*

Conclusion: *The visual recovery after pituitary adenoma surgery is likely to be predicted by pre-operative OCT RNFL. Patients with normal RNFL thickness show an increased tendency in visual recovery after surgery.*

Keywords: *Optical coherence tomography, visual acuity, pituitary adenoma*

INTRODUCTION

Adenoma pituitary is the most common benign neuroendocrine neoplasm restricted to the sella which accounts for around 15% of all brain tumors.(1) The most prevalent complaint is vision impairment, which affects 32-70% of patients.(2) There are numerous approaches to establishing a diagnosis of pituitary adenoma, including hormonal function testing and imaging.

The initial medical action is surgery. The postoperative recovery rate reached 90% however visual disturbance may continue in some patients. This prompted some researchers to investigate instruments that potentially predict visual prognosis following surgery.

Tumor recurrence rates ranged from 5-10%, depending on tumor size, tumor stage during surgery, and neurosurgical skill.[2,3] Optical coherence tomography (OCT) can detect retinal nerve fiber layer (RNFL), and ganglion cell layer (GCL) loss in eyes with chiasmal compression. OCT enables quick, non-invasive in vivo cross-sectional imaging of internal tissue microstructure by detecting the echo time delay of back-scattered infrared light with an interferometer and a low-coherence light source.[2]

Such predictors of visual results might be useful for counseling patients about their visual function as well as adjusting treatment strategies regarding surgery. OCT of the RNFL has recently been discovered as having a predictive value in predicting visual outcomes after surgery for chiasmal compression induced by pituitary tumors. The purpose of this study is to assess the correlation between OCT of the RNFL, GCL-IPL, and visual outcome in patients with pituitary adenoma following surgery in Kariadi General Hospital Semarang

METHODS

This study is a retrospective study. Data was taken from the medical record of Kariadi General Hospital Semarang. The medical records was taken from January 2020 to December 2022. Inclusion criteria include all operated patients with pituitary adenoma and histologically confirmed. Deceased patients, lost to follow-up, and incomplete medical records are excluded from this study. The ophthalmic evaluation included visual acuity (VA) tested using Snellen's chart and converted to logMar unit, OCT RNFL, and GCL-IPL pre-operatively by Stratus OCT (Carl Zeiss-Meditec). Furthermore, the ordinal scales of visual acuity for counting fingers (CF), hand movement (HM), light perception (LP), and no light perception (NLP) in patients with poor vision were converted to logMar units. These values are frequently quantified and converted to a numerical form that allows for statistical analysis.[4]

Fundus examination was done using slit lamp biomicroscopy with a +90D/+78D lens, indirect ophthalmoscope with +20D lenses, or direct ophthalmoscope through dilated pupils. Visual acuity before and after surgery was evaluated along with the patient's OCT value.

Twenty-six patients met the inclusion criteria, and 52 eyes were analyzed. Of the 26 surgical procedures, 21 (80,8%) were performed by endoscopic transsphenoid surgery (ETSS) and 5 (19,2%) by craniotomy. Eyes were divided into two groups: thin RNFL thickness was defined as being below the fifth percentile of age-matched normative values (29 eyes, 55.77%),

while normal RNFL thickness was defined as being above the fifth percentile of age-matched normative values (23 eyes, 44.23%).

Analyses were conducted using SPSS statistics. The findings were provided in the form of frequencies, tables, and charts. The Mann-Whitney Test was employed to reveal a significant relationship between visual acuity and outcomes. and OCT parameters.

RESULT

Pituitary adenoma was found in 26 cases. All the patients meet the inclusion criteria during the study period. The ages of the 26 ranged from 20-65 years with mean (SD) = 39,50 ± 11,63. Eleven (42.3%) were females and fifteen (57,7%) were males.

Neuroimaging diagnosis was confirmed by MRI and all the patients were histologically confirmed. Neuroimaging indicated that all 26 individuals had pituitary macroadenoma (tumor size >1cm). Out of the 26 patients who underwent surgery, 21 (80.8%) underwent transsphenoidal surgery and 5 (19.2%) underwent craniotomy.

In the 52 eyes of the 26 patients who underwent transsphenoidal resection and craniotomy, vision improved in 14 (26,93%), decreased in 11 (21,15%), and remained the same in 27 (51,92%). Thirty (57,69%) of the eyes exhibited pre-operative visual acuities ranging from Counting Fingers (CF) to Perception of Light (PL), and 1 eye had visual acuity of NLP.

Table 1. Characteristic between patients pituitary adenoma

	Total
Sex (F:M)	11:15
N	26
Age (years)	39,50 ± 11,63
N (eyes)	52
Operating method	
Transspenoid	21 (80,8%)
Craniotomi	5 (19,2%)
Duration of symptoms (months)	
0-6	
7-12	7 (26,9%)
13-24	3 (11,5%)
>24	3 (11,5%)
	9 (34,6%)
Ocular Symptom	
Visual blur	23 (88,5%)
Ocular pain	4 (15,4%)
Diplopia	2 (7,7%)
Ocular Sign	
Optic atrofi	39 (75%)
Strabismus	1 (3,8%)
Eye movement restriction	2 (3,8%)

Non Ocular Symptom	
Headache	19 (73,1%)
Non Ocular Sign	
Cranial nerve palsies	25 (96,2%)

The author presented demographic characteristics such as age and sex, onset, and condition of the optic disc. The following results are summarized in Table 1. The average age of patients was 39,5 years ± standard deviation (SD) 11,63 (range: 20–65) with males comprising 57,7% and females 42,3%.

The duration of symptoms before presentation in 26 patients with pituitary adenoma is summarized in Table 1. Visual blur (23; 88,5%) and headache (19; 73,1%) were the commonest presenting complaints in pituitary adenoma patients. The commonest neuro-ophthalmic signs were unilateral or bilateral optic atrophy 39 (75%). Cranial nerve palsies occurred in 25 (96,2%) of the patients.

Pre-operative visual acuity (VA) of pituitary adenoma patients was 2,1 while post-operative visual acuity was 1,0. The thinner pre-operative RNFL thickness was associated with worse visual acuity (VA) (Table 2). Patients with normal RNFL had a median VA of 1,0 logMar unit equivalent to 20/200 while those with thin RNFL had to count their fingers (CF). The patients with normal pre-operative RNFL had a significant improvement in median VA after surgery, from 1,0 logMar unit (20/200) to 0,2 logMar unit (20/32) (p=0.022), whereas the patients with thin RNFL did not improve (CF to CF, p=0.026). The patients with normal pre-surgery GCL-IPL had non-significant improvement in median visual acuity (VA) after surgery from CF to 20/20 (p=0.505), also the patients with thin GCL-IPL from CF to 20/200 (p=0.151). The results are summarized in Figure 1.

DISCUSSION

Surgical treatment of pituitary adenomas is the gold standard. The presence of a visual loss is the major reason for surgery, either by transcranial or transsphenoidal. Surgery is thought to be able to remove the tumor pressing on the optic chiasma. It prevents damage to the optic nerve caused by mass compression, allowing eyesight to improve. However, some people still may experience visual loss after surgery. Morphology changes in the optic disc can be seen and monitored objectively by optical examination coherence tomography (OCT). RNFL and GCL-IPL OCT can be used to differentiate optic disc morphology.[5]

Table 2. OCT analysis of people with normal and thin optic nerves and their visual acuity

	Total	Normal RNFL Thickness (eyes)	Thin RNFL (eyes)	P value	Normal GCL-IPL Thickness (eyes)	Thin GCL-IPL (eyes)	P value
RNFL average thickness		98	68				
GCL-IPL average thickness					82,6	64	
VA pre op logMar	2,1	1,19 ± 1,04 (median 1,0)	1,74±0,96 (median 2,1)	0,022*	1,40±0,99 (median 2,1)	1,51 ± 1,04 (median 2,1)	0,505
VA post op logMar	1,0	0,95±1,06 (median 0,2)	1,47±1,08 (median 2,1)	0,026*	0,84±1,15 (median 0,0)	1,28±1,09 (median 1,0)	0,151

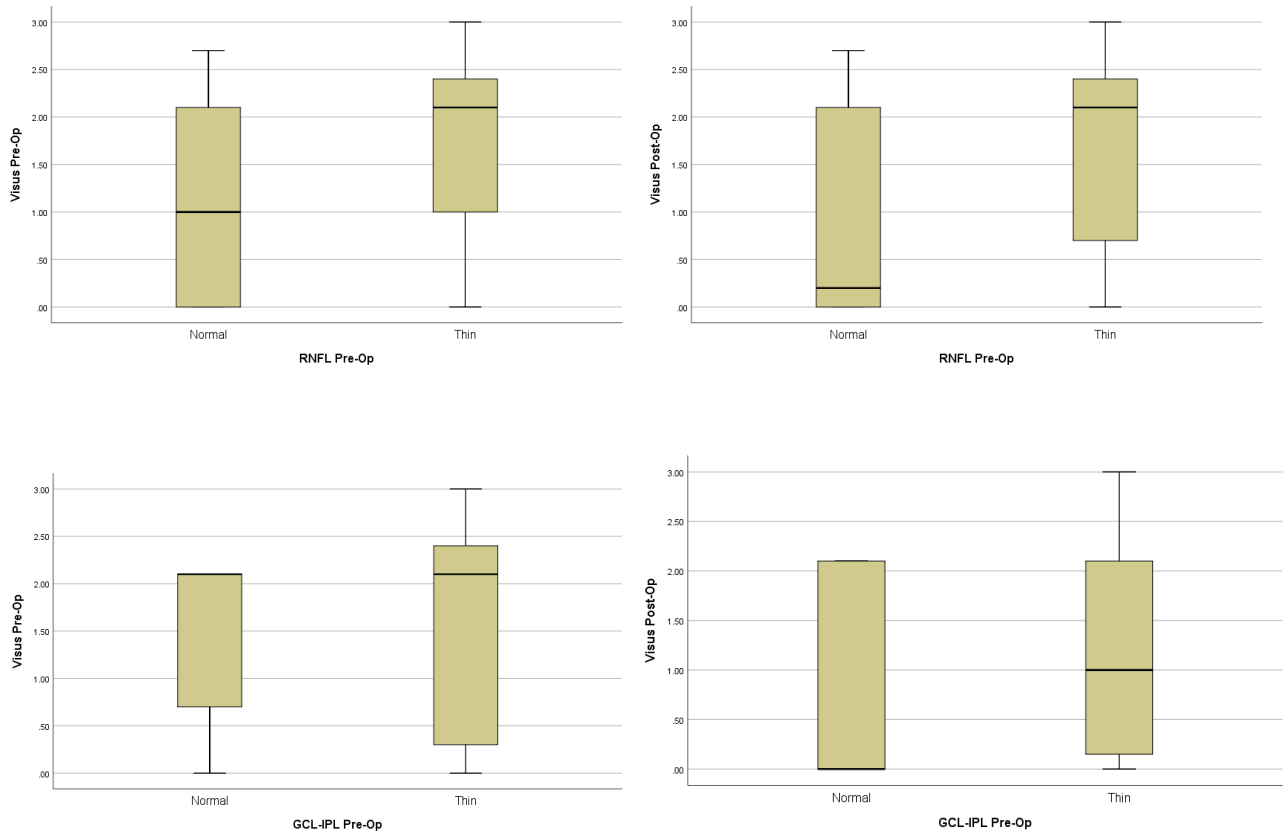

Figure 1. A box plot chart comparing visual acuity based on RNFL and GCL-IPL OCT

There is evidence that RNFL thickness predicts immediate vision recovery after pituitary decompression. The majority of visual recovery happens within the first 6-10 weeks after decompression surgery.(6) VA is often well preserved in patients with pituitary adenomas and is expected to be related to OCT parameters.

In this study, we can see that the thinner pre-operative RNFL thickness was associated with worse visual acuity. Technical innovations in OCT have enabled a detailed examination

of anatomical layers within the retina.[6] OCT revealed retinal thinning in pituitary adenoma patients with impaired eyesight.

Pituitary tumors arising from different cell types most likely are found in the sella turcica.[7] We already know that there is an optic chiasm in the sella. It is hypothesized that recovery of the visual acuity was possible following decompression surgery. We attempt to uncover pre-operative characteristics that could predict visual recovery. Another study conclude that predictive factors for a complete recovery VA were good preoperative visual function, young age, and low craniocaudal tumor size.[8] Danesh et all demonstrated in their study that by 6 weeks after surgery, patients with normal RNFL thickness had considerably larger visual field (VF) improvement, with 77.6% of eyes with normal RNFL compared to 21.7% of those with thin RNFL ($p < 0.001$). Long-term VF improvement was observed in 81.0% of eyes with normal RNFL versus 37.1% of those with narrow RNFL ($p < 0.001$).[2] The result of our study supports this previous study. In our study, patients with normal pre-operative RNFL had a significant improvement in VA after surgery, from 1,0 logMar unit (20/200) to 0,2 logMar unit (20/32) ($p=0.022$), whereas the patients with thin RNFL did not improve (CF to CF, $p=0.026$). This study also provides information on complementing the association with GCL-IPL OCT. Even though the results are not statistically significant, we can see that patients with normal GCL-IPL OCT tend to increase visual acuity better than patients with thin GCL-IPL.

Patients with normal pre-surgery GCL-IPL had non-significant improvement in median VA after surgery from CF to 20/20 ($p=0.505$), also the patients with thin GCL-IPL from CF to 20/200 ($p=0.151$). We can see that there was better VA improvement in patients with normal GCL-IPL than those with thin GCL-IPL although it was not significant. This may be due to several factors that became a limitation of our study, such as the small number of samples. Our study also did not consider and correlate tumor size, duration of disease symptoms, age, time of surgery, visual field defect, and other factors which might influence VA post-operative.

CONCLUSION

The visual recovery after pituitary adenoma surgery is likely to be predicted by pre-operative OCT RNFL. Patients with normal RNFL thickness show an increased tendency in visual recovery after surgery. We can predict the visual recovery of a pituitary adenoma patient after surgery using OCT. It will assist the doctor in educating patients. Further investigation is needed on the factors that potentially influence postoperative VA and their correlation with OCT whether RNFL or GCL-IPL with a larger sample size.

REFERENCES

1. Tagoe NN, Essuman VA, Bankah P, Dakurah T, Hewlett VK, Akpalu J, et al. Visual Outcome of Patients with Pituitary Adenomas Following Surgery and Its Contributory Factors at a Tertiary Hospital in Ghana. Ethiop J Health Sci. 2019;29(1):895–902.
2. Danesh-Meyer H V., Wong A, Papchenko T, Matheos K, Stylli S, Nichols A, et al. Optical coherence tomography predicts visual outcome for pituitary tumors. J Clin Neurosci [Internet]. 2015;22(7):1098–104. Available from: http://dx.doi.org/10.1016/j.jocn.2015.02.001
3. Ummah K, Adi S. View of Management Of Residual Pituitary Adenoma Patient With Manifestation of Acromegaly and Hyperprolactinemia. Curr Intern Med Res Pract Surabaya J. 2021;2(2):49–55.
4. Moussa G, Bassilious K, Mathews N. A novel excel sheet conversion tool from Snellen fraction to LogMAR including 'counting fingers', 'hand movement', 'light perception' and 'no light perception' and focused review of literature of low visual acuity reference values. Acta Ophthalmol. 2021;99(6):e963–5.
5. Kirana NF, Sidik M, Nusanti S. Gambaran Parameter Optical Coherence Tomography Papil dan Hubungannya dengan Fungsi Penglihatan pada Pasien Non_Arteritic Anterior Ischemic Optic Neuropathy di FKUI-RSCM Kirana. Ophthalmol Ina. 2018;44(1):9–16.
6. Yoneoka Y, Hatase T, Watanabe N, Jinguji S, Okada M, Takagi M, et al. Early morphological recovery of the optic chiasm is associated with excellent visual outcome in patients with compressive chiasmal syndrome caused by pituitary tumors. Neurol Res. 2015;37(1):1–8.
7. Asa SL, Mete O, Perry A, Osamura RY. Overview of the 2022 WHO Classification of Pituitary Tumors. Endocr Pathol [Internet]. 2022;33(1):6–26. Available from: https://doi.org/10.1007/s12022-022-09703-7
8. Barzaghi LR, Medone M, Losa M, Bianchi S, Giovanelli M, Mortini P. Prognostic factors of visual field improvement after trans-sphenoidal approach for pituitary macroadenomas: Review of the literature and analysis by quantitative method. Neurosurg Rev. 2012;35(3):369–79.