

Factors Associated With 3-Month Visual Outcomes in Patients With Pituitary Tumors: The Impact of Functional Status and Transsphenoidal Surgery

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Research Article

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Abstract

Purpose

To evaluate 3-month ophthalmologic outcomes after management of pituitary adenomas and identify clinical, radiological, surgical, and optical coherence tomography (OCT)-based predictors of visual-field recovery, with emphasis on functional status, transsphenoidal surgery (TSA), and a novel visual field-OCT discordance index (VFODI).

Methods

Seventy-five patients with pituitary adenoma/pituitary neuroendocrine tumor were retrospectively evaluated. Functional status, tumor size, optic chiasmal compression, TSA status, baseline visual-field mean deviation (MD), best-corrected visual acuity (BCVA), and OCT parameters were analyzed. VFODI was defined as the standardized residual reflecting visual-field loss disproportionate to that predicted by age and temporal retinal nerve fiber layer thickness. The primary outcome was the 3-month change in visual-field MD, assessed using multivariable linear regression.

Results

The mean age was 65.0 ± 12.1 years, and 45 patients (60.0%) were male; 40 (53.3%) had nonfunctioning and 35 (46.7%) had functioning tumors, and 37 (49.3%) underwent TSA. Visual-field MD improved from -6.02 ± 3.26 dB to -2.98 ± 2.17 dB at 3 months ($P < 0.001$), with greater improvement in TSA than non-TSA patients (4.41 ± 2.64 vs 1.72 ± 1.34 dB, $P < 0.001$). TSA ($P < 0.001$), younger age ($P = 0.003$), and higher VFODI ($P < 0.001$) were independent predictors of greater improvement, whereas functional status was not.

Conclusions

Visual function improved substantially within 3 months after pituitary tumor management. TSA was independently associated with greater early visual-field recovery, whereas functional status was not. Higher VFODI, reflecting a functional deficit disproportionate to structural damage, was strongly associated with recovery and may represent a novel biomarker of reversible chiasmal dysfunction.

Introduction

Pituitary neuroendocrine tumors (PitNETs) are sellar tumors with heterogeneous endocrine and mass-related manifestations. When a tumor extends into the suprasellar space, compression of the optic chiasm or adjacent optic nerves can produce visual-field defects, decreased visual acuity, dyschromatopsia, and optic atrophy. Although bitemporal visual-field loss is considered the classic

ophthalmologic manifestation, the pattern and severity of visual dysfunction vary according to the anatomy and duration of compression. Visual impairment is particularly important in clinically nonfunctioning tumors, which may remain clinically silent until they become sufficiently large to produce mass effects.[1–4]

Visual function often improves after decompression of the anterior visual pathway, particularly following transsphenoidal surgery (TSA), but the degree and time course of recovery are variable. Previous studies and meta-analyses have identified baseline visual-field impairment, age, symptom duration, tumor size, and the severity of optic chiasmal compression as potential determinants of postoperative visual recovery.[4–7] Recovery is often most prominent within the first several postoperative months, making a 3-month assessment a clinically meaningful early outcome point.[5, 8]

Optical coherence tomography (OCT) provides structural biomarkers of compressive optic neuropathy. Peripapillary retinal nerve fiber layer (RNFL) and macular ganglion cell-inner plexiform layer (GCIPL) thickness reflect retinal ganglion cell and axonal integrity, and preserved preoperative retinal structure has been associated with a greater potential for visual recovery after decompression.[6, 9, 10] However, structural and functional injury are not always concordant. Some patients demonstrate marked visual-field dysfunction despite relatively preserved retinal structure, potentially reflecting conduction block or early reversible axonal dysfunction rather than established retinal ganglion cell loss. Quantifying this structure-function discordance may therefore provide complementary prognostic information beyond visual-field or OCT measurements considered separately.

The clinical functional status of a pituitary tumor may also influence ophthalmologic presentation and subsequent course. Functioning tumors may be detected earlier because of hormone-related symptoms, whereas clinically nonfunctioning tumors are frequently diagnosed after enlargement produces visual or other mass-related manifestations. Treatment strategies also differ according to functional status; prolactinomas may show substantial tumor shrinkage with dopamine agonist therapy, whereas other tumors causing clinically significant optic pathway compression commonly require surgical decompression.[1, 11] Therefore, functional status and treatment modality should be considered alongside anatomical severity and baseline optic nerve integrity when evaluating visual prognosis.

The purpose of this study was to evaluate the ophthalmologic clinical course of patients with pituitary tumors over a 3-month period and to identify factors associated with early visual outcome. We specifically investigated whether functional status and TSA were associated with visual recovery after adjustment for baseline visual-field impairment, tumor size, and optic chiasmal compression. In addition, we explored a novel visual field-OCT discordance index (VFODI), designed to quantify visual-field loss that was disproportionate to structural retinal damage, as a potential marker of reversible visual dysfunction.

Methods

This retrospective observational cohort study included patients diagnosed with pituitary adenoma or pituitary neuroendocrine tumor (PitNET) who underwent ophthalmologic evaluation at Korea University Ansan Hospital between 2020 and 2025. Patients were eligible if they had a radiologically confirmed pituitary tumor, sufficient endocrinological evaluation to determine tumor functional status, available baseline sellar magnetic resonance imaging (MRI), and ophthalmologic examinations performed at baseline and approximately 3 months after initial treatment or observation. Patients were excluded if they had ocular or neurological disorders that could independently affect visual acuity, visual-field measurements, or OCT parameters, including glaucoma, clinically significant retinal disease, optic neuropathy unrelated to the pituitary tumor, severe media opacity, or other intracranial lesions involving the visual pathway. Patients with insufficient endocrinological, radiological, or ophthalmologic data were also excluded. The study protocol was reviewed and approved by the Institutional Review Board of Korea University Ansan Hospital (IRB No. AS20260846) and was conducted in accordance with the tenets of the Declaration of Helsinki. The requirement for informed consent was waived because of the retrospective nature of the study, subject to the final IRB determination.

Pituitary tumors were classified according to their clinical functional status. A functioning PitNET was defined as a tumor associated with a clinically and biochemically established hormone hypersecretion syndrome, including prolactinoma, growth hormone-secreting PitNET associated with acromegaly, adrenocorticotrophic hormone-secreting PitNET associated with Cushing disease, thyroid-stimulating hormone-secreting PitNET, and other clinically functioning plurihormonal tumors. A clinically nonfunctioning PitNET was defined as a tumor without clinical and biochemical evidence of a hormone hypersecretion syndrome, regardless of hormone or transcription-factor expression on pathological immunohistochemical examination. Hyperprolactinemia considered secondary to pituitary stalk compression was not regarded as evidence of a functioning tumor. The diagnosis of prolactinoma was based on the overall clinical and endocrinological assessment, including serum prolactin level, tumor size, clinical manifestations, and response to dopamine agonist treatment when available.[1, 11]

Demographic and clinical information was obtained from the electronic medical records. Age at diagnosis, sex, duration of visual symptoms, functional status, presence of pituitary apoplexy, and treatment modality were recorded. TSA was specifically evaluated as a binary study variable. Patients who underwent TSA during the observation period were categorized as the TSA group, whereas patients managed medically, observed without surgery, or treated with other non-TSA strategies were categorized as the non-TSA group. Comprehensive ophthalmologic assessment included best-corrected visual acuity (BCVA), pupillary findings, ocular alignment and motility, funduscopy findings, automated visual-field testing, and OCT. BCVA was converted to logarithm of the minimum angle of resolution values. Automated perimetry was performed using Humphrey Field Analyzer 3 (model 830; Carl Zeiss Meditec, Dublin, CA, USA) with the 24 – 2 strategy, and mean deviation (MD), pattern standard deviation, and visual field index were recorded when available. OCT was performed using Cirrus HD-OCT (Carl Zeiss Meditec, Dublin, CA, USA), and average and sectoral peripapillary RNFL and macular GCIPL measurements were recorded. Pre-treatment sellar MRI was reviewed for maximum tumor diameter, suprasellar extension, optic chiasmal contact or compression, cavernous sinus invasion, Knosp grade

when available, pituitary apoplexy, and cystic or hemorrhagic components. Macroadenoma was defined as a tumor with a maximum diameter of at least 10 mm. Optic chiasmal involvement was graded from 0 to 3, with grade 0 indicating no contact, grade 1 contact without definite deformation, grade 2 definite compression or displacement, and grade 3 severe compression with marked deformation of the optic chiasm or adjacent optic nerves.

To explore whether disproportionate functional impairment relative to structural retinal damage predicted reversibility, a visual field-OCT discordance index (VFODI) was derived. Baseline visual-field loss was expressed as the negative of MD so that larger values represented greater functional impairment. A linear regression model was used to estimate expected visual-field loss from temporal RNFL thickness and age, and the standardized residual from this model was defined as VFODI. A positive VFODI therefore indicated more severe visual-field loss than would be expected from the patient's age and temporal RNFL thickness, whereas a negative value indicated structural retinal damage that was relatively advanced for the measured functional deficit. VFODI was analyzed as a continuous standardized variable, with each one-unit increase corresponding to one standard deviation of discordance.

The examination performed closest to 3 months was used as the primary follow-up examination, with an acceptable interval of approximately 2 to 4 months. The primary outcome was the change in visual-field MD between baseline and the 3-month examination, calculated as the 3-month MD minus baseline MD, such that a positive value indicated improvement. Secondary outcomes included changes in BCVA, visual field index, characteristic chiasmal visual-field defects, temporal RNFL thickness, and GCIPL thickness. For categorical analyses, visual-field improvement was defined as an improvement in MD of at least 2 dB or definite clinical improvement or normalization of a pre-existing chiasmal visual-field defect.

Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range according to distribution, and categorical variables were expressed as numbers and percentages. Normality was assessed using the Shapiro-Wilk test. Baseline characteristics were compared using independent-samples t tests or Mann-Whitney U tests for continuous variables and chi-square or Fisher exact tests for categorical variables. Baseline and 3-month ophthalmologic measurements were compared using paired t tests or Wilcoxon signed-rank tests as appropriate. Univariable linear regression was initially used to assess candidate factors associated with the 3-month change in MD. Given the sample size, the primary multivariable model was restricted to clinically important covariates, including baseline MD, optic chiasmal compression grade, maximum tumor diameter, functional status, TSA status, and age. VFODI was then added in an exploratory multivariable model to determine whether structure-function discordance provided additional prognostic information. Binary logistic regression was used for the secondary categorical endpoint of visual-field improvement. All statistical analyses were performed using SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA), and a two-sided P value < 0.05 was considered statistically significant. Formal multicollinearity diagnostics (eg, variance

inflation factors) and a pre-planned sensitivity analysis isolating the contribution of VFODI from that of baseline MD were not performed in the primary analysis; this is addressed as a limitation below.

Results

A total of 75 patients were included. The mean age was 65.0 ± 12.1 years (range, 16–84), and 45 patients (60.0%) were male. Forty patients (53.3%) had clinically nonfunctioning tumors and 35 (46.7%) had functioning tumors. The mean maximum tumor diameter was 26.6 ± 7.3 mm, and the mean optic chiasmal compression grade was 1.61 ± 1.00 . The baseline visual-field MD was -6.02 ± 3.26 dB. Compared with functioning tumors, clinically nonfunctioning tumors were larger (28.4 ± 7.5 vs 24.5 ± 6.6 mm, $P = 0.019$) and had greater chiasmal compression (mean grade, 1.85 vs 1.34; $P = 0.028$). Baseline characteristics according to functional status are summarized in Table 1.

Table 1
Baseline characteristics according to clinical functional status

Characteristic	Overall (n = 75)	Nonfunctioning (n = 40)	Functioning (n = 35)	P value
Age, years	65.0 ± 12.1	65.0 ± 12.6	65.0 ± 11.5	0.995
Male sex, n (%)	45 (60.0)	21 (52.5)	24 (68.6)	0.238
Tumor maximum diameter, mm	26.6 ± 7.3	28.4 ± 7.5	24.5 ± 6.6	0.019
Chiasmal compression grade	1.6 ± 1.0	1.9 ± 0.9	1.3 ± 1.0	0.028
Symptom duration, months	5.0 (3.3–7.2)	5.2 (3.5–6.6)	4.9 (2.8–7.2)	0.610
Temporal RNFL, μm	65.7 ± 7.4	64.6 ± 6.3	66.9 ± 8.4	0.185
GCIPL, μm	69.9 ± 6.5	68.5 ± 6.0	71.5 ± 6.8	0.047
Baseline visual-field MD, dB	-6.0 ± 3.3	-6.4 ± 3.1	-5.5 ± 3.4	0.237
Baseline BCVA, logMAR	0.2 ± 0.1	0.2 ± 0.1	0.1 ± 0.1	0.585
TSA performed, n (%)	37 (49.3)	26 (65.0)	11 (31.4)	0.008
Pituitary apoplexy, n (%)	10 (13.3)	6 (15.0)	4 (11.4)	0.742
<i>Data are presented as mean $\pm$ standard deviation, median (interquartile range), or number (%). BCVA, best-corrected visual acuity; GCIPL, ganglion cell–inner plexiform layer; MD, mean deviation; RNFL, retinal nerve fiber layer; TSA, transsphenoidal surgery.</i>				

TSA was performed in 37 patients (49.3%). Patients undergoing TSA had larger tumors (30.0 ± 6.8 vs 23.2 ± 6.3 mm, $P < 0.001$), greater chiasmal compression (2.00 ± 0.91 vs 1.24 ± 0.94 , $P < 0.001$), and worse baseline visual-field MD (-7.16 ± 3.12 vs -4.92 ± 3.04 dB, $P = 0.002$) than patients managed without

TSA. Baseline OCT parameters were also thinner in the TSA group, including temporal RNFL and GCIPL thickness (Supplementary Table S1).

Mean visual-field MD improved from -6.02 ± 3.26 dB at baseline to -2.98 ± 2.17 dB at 3 months, corresponding to a mean improvement of 3.04 ± 2.48 dB ($P < 0.001$). Forty-one patients (54.7%) demonstrated an improvement of at least 2 dB. BCVA improved from 0.15 ± 0.09 to 0.11 ± 0.08 logMAR ($P < 0.001$). In contrast, temporal RNFL thickness decreased from 65.7 ± 7.4 to 64.2 ± 7.4 μm ($P < 0.001$), indicating that structural thinning could continue despite functional improvement (Table 2).

Table 2
Changes in ophthalmologic outcomes over 3 months

Outcome	Baseline	3 months	Change	P value
Visual-field MD, dB	-6.02 ± 3.26	-2.98 ± 2.17	3.05 ± 2.48	< 0.001
BCVA, logMAR	0.15 ± 0.09	0.11 ± 0.08	-0.04 ± 0.05	< 0.001
Temporal RNFL, μm	65.7 ± 7.4	64.2 ± 7.4	-1.5 ± 1.7	< 0.001
<i>Data are presented as mean $\pm$ standard deviation. BCVA, best-corrected visual acuity; MD, mean deviation; RNFL, retinal nerve fiber layer.</i>				

The mean improvement in MD was greater in the TSA group than in the non-TSA group (4.41 ± 2.64 vs 1.72 ± 1.34 dB, $P < 0.001$), and improvement of at least 2 dB occurred in 27 of 37 patients (73.0%) compared with 14 of 38 (36.8%) in the non-TSA group ($P = 0.004$). The distribution of MD change according to TSA status is shown in Fig. 2.

In univariable analyses, larger tumor size, greater chiasmal compression, worse baseline MD, TSA, thinner temporal RNFL, thinner GCIPL, and higher VFODI were associated with greater improvement in MD. In the prespecified multivariable model without VFODI, worse baseline MD ($B = -0.44$, 95% CI -0.63 to -0.26 ; $P < 0.001$) and TSA ($B = 1.78$, 95% CI 0.97 to 2.59 ; $P < 0.001$) were independently associated with greater 3-month MD improvement. Functional status was not independently associated with the outcome ($P = 0.163$).

When VFODI was added to the multivariable model, higher VFODI was strongly associated with greater recovery ($B = 1.38$ dB per 1-SD increase, 95% CI 0.99 to 1.78 ; $P < 0.001$). TSA remained independently associated with greater improvement ($B = 1.82$, 95% CI 1.20 to 2.45 ; $P < 0.001$), whereas older age was associated with less recovery ($B = -0.04$ dB per year, 95% CI -0.06 to -0.01 ; $P = 0.003$). The exploratory model explained 81.2% of the variance in 3-month MD change. Functional status, tumor size, and baseline MD were no longer independently significant after VFODI was introduced. The relationship between VFODI and MD improvement is shown in Fig. 1, and the multivariable effect estimates are summarized in Table 3 (Supplementary Fig. S1).

Table 3

Univariable and multivariable linear regression for 3-month change in visual-field mean deviation

Predictor	Univariable B (95% CI)	P value	Multivariable B (95% CI)	P value
Baseline MD, per 1 dB	-0.57 (-0.69 to -0.45)	< 0.001	-0.05 (-0.23 to 0.13)	0.581
Chiasm compression grade	1.61 (1.17 to 2.05)	< 0.001	0.65 (-0.02 to 1.32)	0.058
Tumor size, per 1 mm	0.21 (0.15 to 0.27)	< 0.001	-0.03 (-0.11 to 0.04)	0.355
Functioning tumor	-0.56 (-1.70 to 0.59)	0.335	0.41 (-0.16 to 0.98)	0.153
TSA performed	2.69 (1.73 to 3.65)	< 0.001	1.82 (1.20 to 2.45)	< 0.001
Age, per 1 year	-0.03 (-0.08 to 0.02)	0.190	-0.04 (-0.06 to -0.01)	0.003
VFODI, per 1 SD	1.93 (1.57 to 2.29)	< 0.001	1.38 (0.99 to 1.78)	< 0.001
<i>B, unstandardized regression coefficient; CI, confidence interval; MD, mean deviation; VFODI, visual field–OCT discordance index.</i>				

Discussion

This study evaluated the early ophthalmologic course of patients with pituitary tumors and identified several factors associated with visual-field recovery at 3 months. The principal findings were that visual-field MD and BCVA improved substantially during the first 3 months, patients who underwent TSA experienced greater visual-field recovery despite having more severe baseline disease, and clinical functional status was not independently associated with recovery after adjustment for anatomical and ophthalmologic severity. In addition, a newly derived visual field–OCT discordance index (VFODI) showed a strong association with visual-field improvement and added explanatory value to the multivariable model.

The magnitude and timing of recovery observed in this cohort are consistent with previous reports showing that decompression of the anterior visual pathway frequently leads to meaningful visual improvement. Kerrison et al. described a rapid early phase followed by a slower period of recovery during approximately the first 1 to 4 months after pituitary tumor resection.[8] A systematic review by Pelsma et al. likewise found improvement in visual-field defects in the large majority of patients with nonfunctioning pituitary adenomas and chiasmal compression.[4] These findings support the use of an approximately 3-month examination as a clinically relevant endpoint for early functional recovery.

TSA was independently associated with greater improvement in visual-field MD even after adjustment for baseline MD, tumor size, and chiasmal compression. This finding should be interpreted in the context of treatment selection. Patients undergoing TSA had larger tumors, more severe chiasmal compression, and worse baseline visual fields, indicating clear confounding by indication. Nevertheless, persistence of the association after multivariable adjustment is compatible with a direct benefit of mechanical

decompression when optic pathway compression is clinically significant. Previous observational studies have similarly reported substantial improvement in visual function after transsphenoidal decompression. [3, 4] The present findings should not be interpreted as evidence that TSA is superior to medical treatment in all pituitary tumor subtypes, particularly prolactinomas, for which dopamine agonist therapy is often the preferred initial treatment.[11]

Functional status itself was not an independent predictor of 3-month visual recovery. Clinically nonfunctioning tumors were larger and produced greater chiasmal compression at baseline, which is consistent with the tendency of these tumors to remain undetected until mass effects develop. Once baseline severity, anatomy, and treatment were incorporated into the model, however, endocrine functional status did not explain additional variation in visual recovery. This suggests that from an ophthalmologic prognostic perspective, the degree and reversibility of neural injury may be more important than hormone secretion status itself.

An important finding was the association between VFODI and subsequent visual-field recovery. Previous studies have established that preserved RNFL or GCIPL thickness is associated with better postoperative visual outcomes.[6, 9, 10] However, OCT thickness and visual-field MD represent different aspects of compressive optic neuropathy: OCT reflects structural axonal and ganglion-cell integrity, whereas perimetry reflects current visual function. VFODI was designed to capture the discordance between these domains. A high value indicated that visual-field loss was more severe than expected given the degree of structural retinal thinning and the patient's age. One possible interpretation is that such patients have a larger component of potentially reversible conduction dysfunction, ischemia, or mechanical block at the chiasm, whereas patients with visual loss proportionate to severe retinal thinning may have a larger component of irreversible retrograde axonal degeneration. This concept is biologically compatible with prior evidence showing that preserved RNFL predicts recovery after decompression, but the combined discordance metric may provide information that either measurement alone does not capture.[6, 9]

The observation that temporal RNFL thickness decreased slightly during the 3-month period despite significant improvement in visual-field MD further supports a temporal dissociation between functional and structural responses. After relief of compression, neural conduction can improve rapidly, whereas retrograde degeneration initiated before treatment may continue for a period and become detectable on OCT despite functional recovery. Similar structure-function dissociation has been described in compressive optic neuropathy and reinforces the need to interpret postoperative OCT changes together with visual-field findings rather than assuming that short-term retinal thinning necessarily represents clinical deterioration.[2, 6]

Older age was associated with less visual-field recovery in the exploratory model. This is consistent with a meta-analysis identifying age, baseline visual-field defect, symptom duration, and preoperative pRNFL thickness as major predictors of postoperative visual recovery.[7] More recent work incorporating both age and stratified pRNFL/GCIPL thickness has also suggested that the probability of complete recovery

declines with increasing age, even when retinal structure is relatively preserved.[10] Reduced neural plasticity, age-related axonal vulnerability, and reduced capacity for recovery after chronic compression may contribute to this relationship.

The proposed VFODI may have practical value because it can be calculated from routinely available visual-field and OCT measurements without additional imaging or specialized testing. If validated, a patient with severe visual-field loss but relatively preserved temporal RNFL for age might be counseled that the functional deficit could contain a substantial reversible component. Conversely, concordant severe visual-field loss and marked OCT thinning could identify patients at higher risk for incomplete recovery even after technically successful decompression. VFODI should therefore be considered an exploratory prognostic construct rather than a replacement for baseline MD, OCT, MRI findings, or clinical judgment.

This study has several limitations. Its retrospective design may have introduced selection bias, and treatment allocation was not randomized. The number of patients was modest, limiting the number of covariates and interaction terms that could be included in multivariable models. No a priori sample-size calculation was performed, and the ratio of candidate predictors to the sample size raises the possibility of model overfitting, particularly for the exploratory model incorporating VFODI, which explained an unusually high proportion of outcome variance (81.2%); internal validation methods such as bootstrap resampling or split-sample analysis were not applied and are needed before this estimate can be considered stable. The population included both functioning and nonfunctioning tumors and multiple treatment strategies, which increases clinical heterogeneity; in particular, the non-TSA group itself was heterogeneous, including patients treated with dopamine agonists, other medical therapy, or observation alone, and outcomes were not analyzed separately by these subcategories, which may obscure differential recovery patterns within this comparator group. Symptom duration may be imprecisely documented in retrospective records, and visual-field reliability can vary among patients; standard automated perimetry is in addition subject to test-retest variability and a learning effect on repeated testing, so part of the observed 3-month improvement in MD may reflect increased test reliability rather than genuine neuro-ophthalmologic recovery.

A methodological limitation specific to VFODI also deserves emphasis. VFODI was derived and tested within the same cohort and therefore requires prospective validation in an independent dataset before clinical use. Because VFODI was calculated from a regression of baseline visual-field loss on temporal RNFL thickness and age, and the primary outcome was itself defined as the change from that same baseline MD, part of the strong association observed between VFODI and 3-month improvement may reflect mathematical coupling or regression to the mean rather than a purely biological reversible-dysfunction effect. This potential artifact cannot be excluded by the present design and should be explicitly tested in future studies, for example by deriving VFODI in an independent baseline dataset, by modeling follow-up MD directly rather than its change score, or by comparing models with and without baseline MD included alongside VFODI to determine how much of its apparent effect is attributable to this shared term. Future studies should determine whether VFODI improves discrimination or calibration

beyond established predictors such as baseline MD, age, RNFL/GCIPL thickness, tumor size, and quantitative chiasmal deformation.

In conclusion, visual function improved substantially within 3 months in patients with pituitary tumors. TSA was associated with greater early visual-field recovery after adjustment for baseline severity, whereas clinical functional status was not an independent prognostic factor. A higher visual field-OCT discordance index was strongly associated with greater recovery and may represent a novel marker of reversible chiasmal dysfunction. External validation and prospective assessment are needed to determine its clinical utility.

Declarations

Funding

[No funding was received for conducting this study. / 研究 수행에 대한 자금을 지원받지 않았습니다.]

Competing interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics approval

This retrospective study was reviewed and approved by the Institutional Review Board of Korea University Ansan Hospital (IRB No. AS20260846) and was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Consent to participate

The requirement for informed consent was waived by the Institutional Review Board of Korea University Ansan Hospital because of the retrospective nature of the study.

Consent for publication

Not applicable — no identifying images or individual patient data are included.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by YJL and SGH. The first draft of the manuscript was written by YJL and all

authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Figures

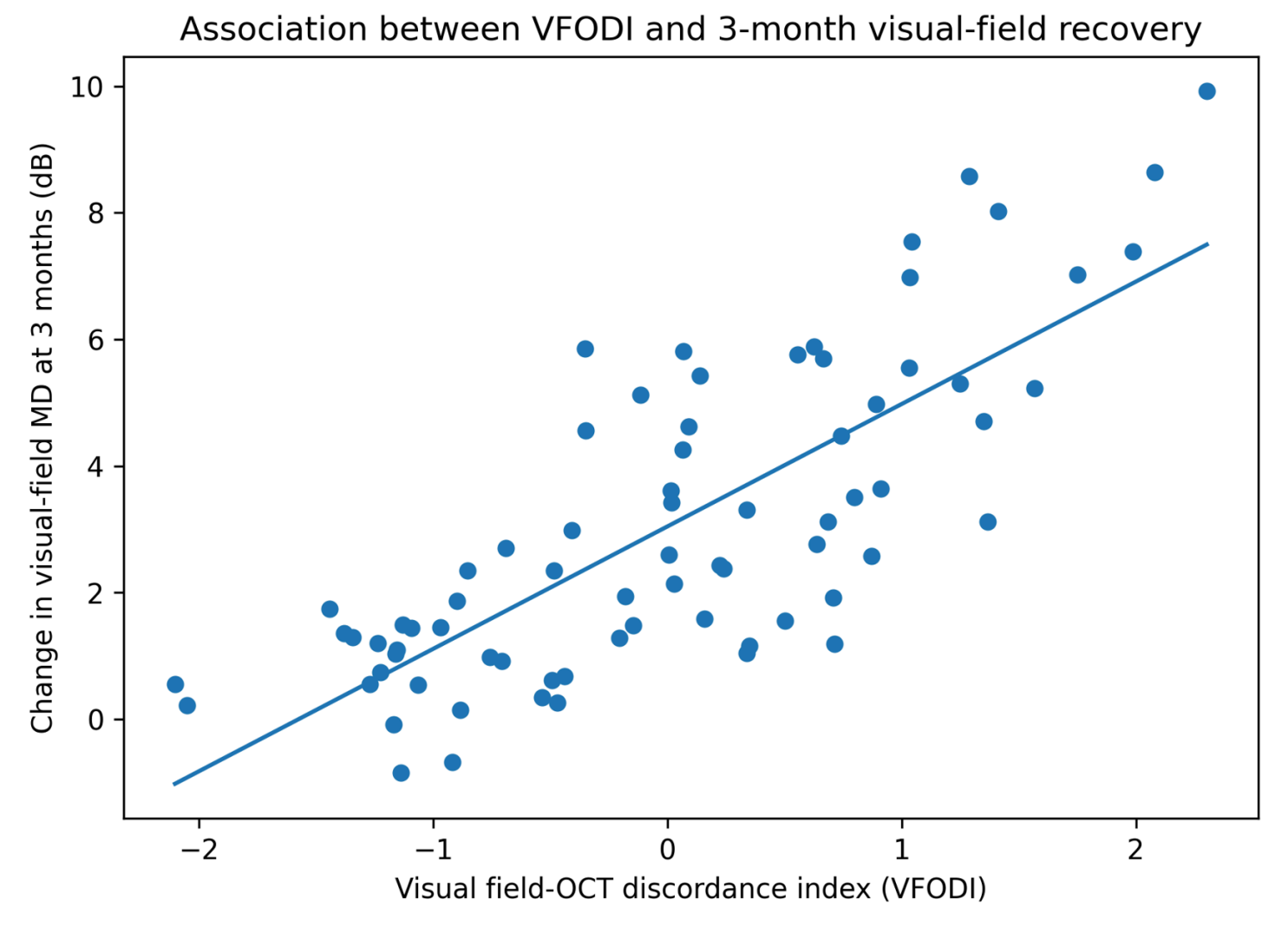


Figure 1

Association between the visual field-OCT discordance index (VFODI) and the 3-month change in visual-field mean deviation (MD). Higher VFODI values indicate visual-field loss that is more severe than expected from age and temporal RNFL thickness.

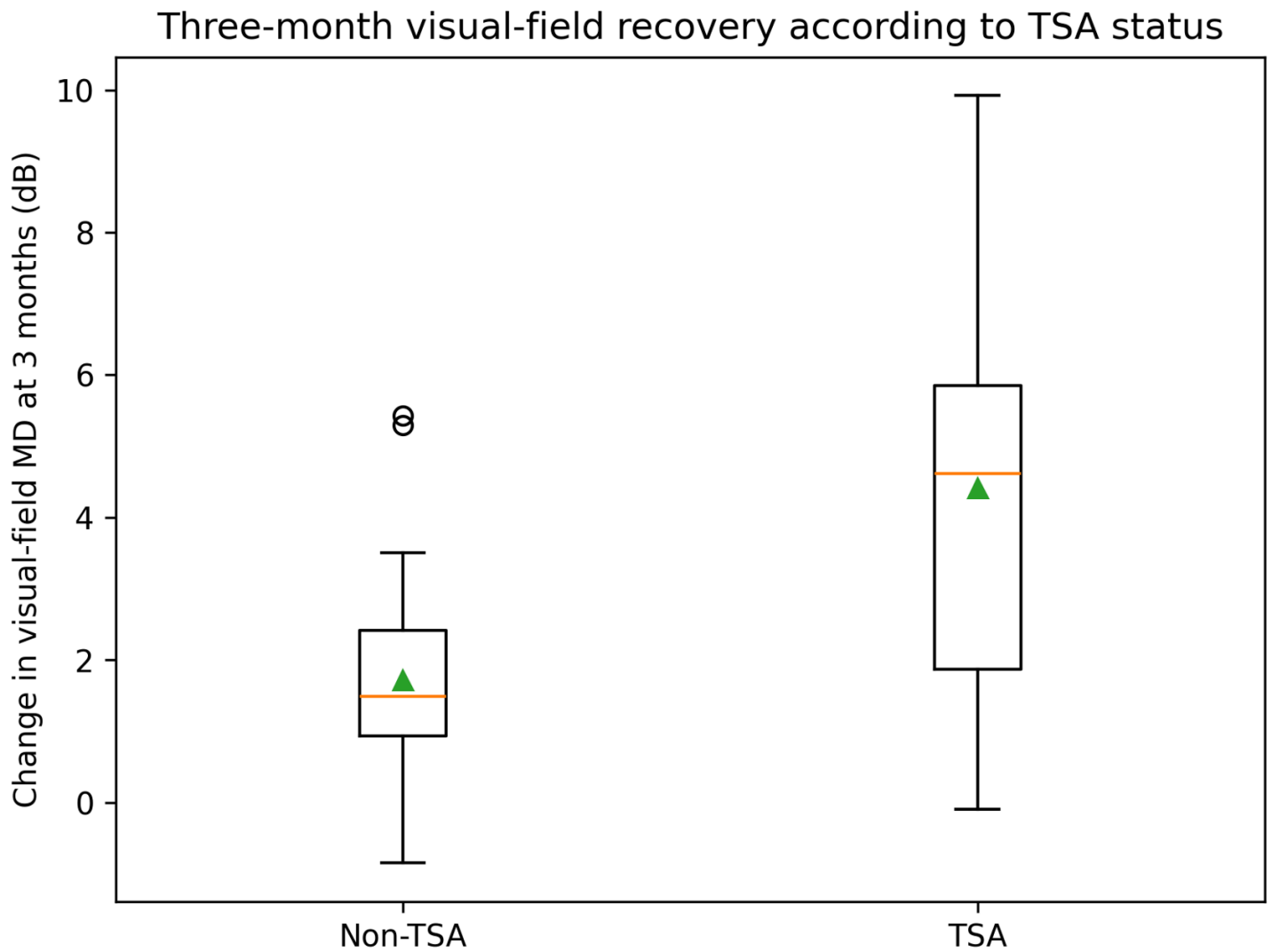


Figure 2

Change in visual-field mean deviation (MD) at 3 months according to transsphenoidal approach surgery (TSA) status.

Supplementary Files

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