Predicting Visual Outcome After Treatment of Pituitary Adenomas With Optical Coherence Tomography

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VISUAL OUTCOME AFTER TREATMENT OF PITUITARY adenomas is extremely variable. Visual field (VF) deficit,1–5 patient’s age,1–4 optic disc pallor,1–4,6 duration of symptoms prior to surgery,1,2 endocrine characteristic of the tumor,1,7 and pattern electroretinogram (ERG)8 cannot consistently predict visual outcome. Optical coherence tomography (OCT) may predict visual outcome by measurement of the ganglion cell axons, or retinal nerve fiber layer (RNFL).9–11 In retrospective studies of patients with residual bitemporal hemianopia after treatment of a compressive lesion, OCT disclosed RNFL thinning clock-wise, greater in nasal and temporal quadrants than in superior and inferior quadrants.12–16 A recent prospective study17 showed that among patients with various pituitary lesions, pretreatment RNFL thickness was a good predictor of visual outcome at six weeks of follow-up. Our study aims to confirm the prognostic value of RNFL thickness measured by OCT on VF outcome after treatment of anterior visual pathway compressive lesions. We present the results of a prospective series of patients with pituitary adenomas treated by one surgeon (G.P.) and followed for three months.

Our prospective study aims to confirm the prognostic value of OCT measurement of RNFL thickness on VF outcome after treatment of pituitary adenomas compressing the anterior visual pathway.

METHODS

• SUBJECTS: The study included both patients and a control group. Consecutive patients diagnosed with a pituitary macro-adenoma in our institution were included after informed consent, between June 1, 2006 and March 22, 2007. Inclusion criteria were pituitary adenomas compressing the anterior visual pathways as determined by magnetic resonance imaging (MRI), with or without visual impairment. Exclusion criteria were: 1) any previous treatment for pituitary adenoma and 2) myopia greater than -6 diopters, because the normal range of RNFL measured by OCT has not been established in those eyes. Nineteen patients were included and one patient was excluded because of bilateral high myopia. Thirty-seven eyes were included and one eye was excluded because of unilateral high myopia. Seventeen patients underwent trans-sphenoidal surgery and two patients with macroadenomas received dopamine agonists. Automated visual fields (VF) and OCT (fast-RNFL program) were performed before treatment, and two weeks and three months after treatment.

• RESULTS: Among the eyes with a VF defect before treatment, the odds of complete recovery after three months from the initial VF defect was multiplied by 1.29 for each increase by 1 micron of mean RNFL (odds ratio [OR], 1.29; 95% CI [0.37]). This was independent from age and duration of symptoms, which carried their own prognostic value. Inferior RNFL was a very strong prognostic factor; OR, 6.31 per micron (P = .0000).

• CONCLUSION: RNFL thinning measured by OCT puts the patient at decreased chance of recovery of an initial VF defect three months after treatment in pituitary adenomas compressing the anterior visual pathways. Further studies will establish how useful this tool is for long-term visual outcome. (Am J Ophthalmol 2009;147: 64–70. © 2009 by Elsevier Inc. All rights reserved.)

PurPOSE: To evaluate if optical coherence tomography (OCT), by providing an objective measure of the retinal nerve fiber layer (RNFL) thickness, offers a reliable prediction of visual outcome.

DESIGN: Prospective cohort study.

METHODS: Thirty-seven eyes of 19 consecutive patients from a single hospital suffering from pituitary adenomas compressing the anterior visual pathways were included, and compared with 46 eyes of 23 controls. Exclusion criteria included any previous treatment of pituitary adenoma and high myopia. Seventeen patients underwent trans-sphenoidal surgery and two patients with macroadenomas received dopamine agonists. Automated visual fields (VF) and OCT (fast-RNFL program) were performed before treatment, and two weeks and three months after treatment.

RESULTS: Among the eyes with a VF defect before treatment, the odds of complete recovery after three months from the initial VF defect was multiplied by 1.29 for each increase by 1 micron of mean RNFL (odds ratio [OR], 1.29; 95% CI [0.37]). This was independent from age and duration of symptoms, which carried their own prognostic value. Inferior RNFL was a very strong prognostic factor; OR, 6.31 per micron (P = .0000).

CONCLUSION: RNFL thinning measured by OCT puts the patient at decreased chance of recovery of an initial VF defect three months after treatment in pituitary adenomas compressing the anterior visual pathways. Further studies will establish how useful this tool is for long-term visual outcome.
same surgeon (G.P.). Two patients with prolactin levels $>200$ ng/ml were diagnosed as prolactinomas and treated with dopaminergic agonists. The control group included 23 volunteers from the hospital staff, without any ophthalmological disease.

- **BRAIN IMAGING:** MRI of the pituitary gland was performed before treatment, and three months after treatment. Contact between the tumor and the anterior visual pathways were assessed on pretreatment MRI as an inclusion criteria. Tumor size was evaluated by clips measurements. Compression relief after treatment was evaluated on follow-up MRI three months after surgery or medical treatment.

- **OPHTHALMOLOGIC EVALUATION:** Past medical history and duration of symptoms were recorded for each patient at the first visit. Ophthalmologic evaluation included the following:

  1. Best-corrected visual acuity (BCVA).
  2. Automated VF (Moniteur Ophthalmologique, program STAT 95, which is a 95 point threshold program testing the central 30 degrees). The depth of the deficit was measured by the mean deviation [MD] (normal $\leq$ 1 decibel [dB]). The reliability of the test was judged by the number of fixation losses and attention losses (a false positive index). All VF were reliable.
  3. OCT 3-0 (Carl Zeiss Meditec, Dublin, California, USA), using the fast-RNFL program.
  4. Slit-lamp examination, looking for other causes of visual loss.

### TABLE. Characteristics of 37 Eyes From 19 Consecutive Patients With Pituitary Adenomas Compressing the Anterior Visual Pathways Before Treatment and Three Months Later, and 46 Eyes From 23 Controls

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n = 13)</th>
<th>Group 2 (n = 10)</th>
<th>Group 3 (n = 14)</th>
<th>Group 4 (n = 46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>61.29 (12.6)</td>
<td>50.5 (13.6)</td>
<td>45 (16.7)</td>
<td>41.91 (11.7)</td>
</tr>
<tr>
<td>Symptoms duration (mos)</td>
<td>35.25 (34.31)</td>
<td>6.40 (3.65)</td>
<td>17.14 (25.01)</td>
<td></td>
</tr>
<tr>
<td>Tumor height (mm)</td>
<td>35 (9)(^c)</td>
<td>33 (5)(^d)</td>
<td>22 (5)</td>
<td></td>
</tr>
<tr>
<td>Initial VF defect (dB)</td>
<td>$-12.2$ (6.33)(^a)</td>
<td>$-4.68$ (3.38)(^b)</td>
<td>$-0.27$ (0.15)</td>
<td></td>
</tr>
<tr>
<td>Final VF defect (dB)</td>
<td>$-4.90$ (4.04)</td>
<td>$0.17$ (0.13)</td>
<td>$-0.19$ (0.21)</td>
<td></td>
</tr>
<tr>
<td>Initial VA Snellen 20 feet</td>
<td>20/50 (HM to 20/20)</td>
<td>20/25 (20/50 to 20/20)</td>
<td>20/20 (20/20 to 20/20)</td>
<td>20/20 (20/20 to 20/20)</td>
</tr>
<tr>
<td>Final VA Snellen 20 feet</td>
<td>20/25 (20/63 to 20/20)</td>
<td>20/20 (20/25 to 20/20)</td>
<td>20/20 (20/20 to 20/20)</td>
<td>20/20 (20/20 to 20/20)</td>
</tr>
</tbody>
</table>

$dB = \text{decibel}; \text{HM} = \text{hand motion}; \text{mos} = \text{months}; \text{VA} = \text{visual acuity}; \text{VF} = \text{visual field}; \text{yrs} = \text{years}.$

Groups are defined by the VF outcome three months after treatment (Group 1: Incomplete recovery from the initial VF defect; Group 2: Complete recovery of initial VF defect; Group 3: No VF defect; and Group 4: Control).

Numbers presented represent the mean value; ( ): standard deviation for age, duration of symptoms, and VF defects; range for VAs. $n$ = number of eyes in each group.

\(^{a}\)Difference statistically significant between groups 1 and 2 ($P = .017$) and between groups 1 and 3 ($P = .0003$).

\(^{b}\)Difference statistically significant between groups 2 and 3 ($P = .015$).

\(^{c}\)Difference statistically significant between groups 1 and 3 ($P = .004$).

\(^{d}\)Difference statistically significant between groups 2 and 3 ($P = .03$). No statistically significant difference between groups 1 and 2.

**FIGURE 1.** Comparison of mean retinal nerve fiber layer (RNFL) thickness between groups of eyes defined by visual field (VF) outcome three months after treatment of pituitary tumors compressing the anterior visual pathways (Group 1: Incomplete recovery from the initial VF defect; Group 2: Complete recovery of initial VF defect; Group 3: No VF defect; and Group 4: Control). Mean RNFL thickness was significantly smaller in group 1 compared with the three other groups, whereas there was no statistically significant difference in mean RNFL between groups 2, 3, and 4. * $P < .05$; ** $P \leq .01$; *** $P \leq .001$.

Ophthalmologic evaluations were performed within one month before treatment, two weeks after treatment, and three months after treatment.

Eyes were divided into four groups based on the initial VF defect and its evolution:
1. Group 1: Presence of an initial VF defect, which either incompletely resolved or worsened three months after treatment (only one patient had bilateral worsening of his VF after treatment).

2. Group 2: Presence of an initial VF defect, which completely resolved three months after treatment.

3. Group 3: No VF defect either initially or after treatment.

4. Group 4: Control group.

**STATISTICAL ANALYSIS:** To evaluate the reproducibility of the three RNFL measurements in the same eye, we used the intraeye correlation coefficient, which was calculated as the ratio between the sum of the intereye and interpatient variances and the sum of the intereye, interpatient, and intraeye variances.

To compare the means of RNFL measurements and of the depth of the initial VF defect among the groups, we used a mixed linear regression model. This took into account the dependence of the measures performed on both eyes of the same subject (both eyes from one subject are more likely to have similar RNFL values for example than two eyes from two different subjects). This model also took into account the age of the patients. The differences were tested by a \( t \) test.

The prognostic value of RNFL on the visual outcome three months after treatment was evaluated among the eyes which had an initial VF defect: group 1, in which complete recovery was achieved, and group 2 in which a persistent VF defect persisted after three months. We used a mixed logistic regression model to quantify the RNFL thickness effect on the probability of complete recovery after adjustment for age and duration of symptoms. Odds ratios (OR) were used to express the effect of each prognostic factor. They quantify the evolution of the odds

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**FIGURE 2.** Comparison of RNFL thickness in each of the four quadrants between groups of eyes defined by VF outcome three months after treatment of pituitary tumors compressing the anterior visual pathways (Group 1: Incomplete recovery from the initial VF defect; Group 2: Complete recovery of initial VF defect; Group 3: No VF defect; and Group 4: Control). (Top left) RNFL thickness in the inferior quadrant. Inferior RNFL thickness was significantly smaller in group 1 compared with the three other groups, whereas there was no statistically significant difference in inferior RNFL between groups 2, 3, and 4. (Top right) RNFL thickness in the temporal quadrant. Temporal RNFL thickness was significantly smaller in group 1 compared with groups 3 and 4, and in group 2 compared with groups 3 and 4. No difference was found between groups 1 and 2, and between groups 3 and 4. (Bottom left) RNFL thickness in the nasal quadrant. Nasal RNFL thickness was significantly smaller in group 1 compared with group 4. The differences between the other groups were not statistically significant. (Bottom right) RNFL thickness in the superior quadrant. No difference between any of the groups was found to be statistically significant for RNFL thickness in the superior quadrant. * \( P < .05; ** P \leq .01; *** P \leq .001.\)
of complete recovery at three months (probability of complete recovery over probability of incomplete recovery) when the RNFL thickness increases, for example. The correlation between the RNFL thickness and the initial VF defect was quantified by the Pearson correlation coefficient.

The statistic analysis was performed using the R software, version 6.0 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

- GENERAL CHARACTERISTICS: Gender differed between patients and controls. The patient group consisted of 16 men and three women, the control group of 21 women and two men. Age differed between the four groups (Table), which progressively decreased from group 1 to group 4. However, differences between the groups were not statistically significant. Duration of symptoms averaged 35.25 months in group 1, 6.40 months in group 2, and 17.14 months in group 3 (Table). Tumor height was greater in group 1 compared with group 3 (P = .004), and in group 2 compared with group 3 (P = .03), but no statistically significant difference between groups 1 and 2 was observed (Table). Complete decompression of the anterior visual pathways was seen in all patients on the MRI performed three months after treatment.

- OPHTHALMOLOGIC CHARACTERISTICS: Past Medical History. No patient had glaucoma or use of any medication toxic to the optic nerves. One patient suffered from chronic variant of central serous chorioretinopathy on the right, not involving the macula. Two eyes were amblyopic, and fell into group 1. The initial visual acuities (VA) in both amblyopic eyes had remained lower than in the fellow eye; the initial VF defect was greater in the amblyopic eye in one case and comparable with the VF defect in the fellow eye in the other case.

Visual Function. The initial VF defect adjusted for age (Table) was greater in group 1 than in group 2 (P = .017) or group 3 (P = .0003). The initial VF defect adjusted for age was greater in group 2 than in group 3 (P = .015). In eyes with a pretreatment VF defect complete resolution occurred by three months after treatment in 10 of 23 cases (43%). Initial and final BCVAs are shown in the Table.

Optical Coherence Tomography Parameters. Performing three sequential OCT measurements allowed us to test the reproducibility of the measures and the stability of this parameter over three months. Reproducibility of the measures achieved 97% for mean RNFL and 95%, 89%, 94%, and 95% for the temporal, nasal, inferior, and superior quadrants. Hence, the following analysis took into account the mean for numeric values of RNFL from each test session, and the results from the first examination for RNFL < 5th percentile. The reproducibility seemed to be slightly lower in group 1, and details are shown in Supplemental Table 1 available at AJO.com.

Retinal nerve fiber layer was thinner in group 1 than in the three other groups for mean RNFL (Figure 1); group 1 compared with group 2 (P = .04), group 1 compared with group 3 (P = .009), and group 1 compared with group 4 (P = .003). There was no statistically significant difference between groups 2, 3, and 4. With multivariate analysis, the independent effect of age on RNFL thickness was determined. The RNFL thinned 0.33 microns (P = .02) with each increase of age by one year.

The quadrant analysis (Figure 2) showed that in the inferior quadrant the difference between group 1 and the three other groups was statistically significant; between groups 1 and 2 (P = .0003), between groups 1 and 3 (P = .001), and between groups 1 and 4 (P = .001). The effect of age did not reach significance (P = .06). There was no statistically significant difference between groups 2, 3, and 4. In the temporal quadrant, the differences were statistically significant between groups 1 and 3 (P = .003), and groups 1 and 4 (P = .002), but not between groups 1 and 2 (P = .1846); a significant difference was found between groups 2 and 3 (P = .015), and between groups 2 and 4 (P = .02). In the nasal quadrant the only statistically significant difference was found between groups 1 and 4 (P = .02). In the superior quadrant, no statistically significant difference between the four groups could be found.

The percentage of reduction of RNFL thickness in groups 1, 2, and 3 compared with RNFL thickness in group 4 (control group) is shown in Supplemental Table 2 available at AJO.com. Mean RNFL was reduced by 28% in group 1, 1% in group 2, and 2% in group 3. Among the four quadrants, the greatest reduction of RNFL thickness was observed for the temporal and nasal quadrants: in group 1, temporal RNFL was reduced by 44%, nasal quadrant by 29%, inferior quadrant by 24%, and superior quadrant by 22%. In group 2; temporal RNFL was reduced by 9%, and nasal quadrant by 6%; inferior and superior quadrants were increased by 3% each.

The RNFL thickness and the initial VF defect were strongly negatively correlated, with a correlation coefficient estimated at -0.64 (95 % confidence interval, -1 to -0.37).

- PROGNOSTIC PARAMETERS: Prognostic Value of Retinal Nerve Fiber Layer. Among the eyes with a VF defect before treatment (groups 1 and 2), a greater RNFL thickness increased the probability of complete recovery from the initial VF defect. The odds of complete recovery were multiplied by 1.29 for each increase by 1 micron of the mean RNFL (OR, 1.29; P = .037). This effect was independent of age and duration of symptoms. The odds of complete recovery were multiplied by 0.75 for each in-
crease of age by one year \((P = .019)\), and by 0.85 for each additional month of symptoms duration \((P = .05)\). For an increase by 5 microns of mean RNFL thickness, the OR would be 3.57, for an increase by 10 microns: 12.76. The measurements of RNFL thickness in the inferior quadrant had a very strong prognostic value for VF outcome after three months; the odds of complete recovery were multiplied by 6.31 for each increase of RNFL by 1 micron \((P = .0000)\). In the other three quadrants, the results showed a similar tendency but were not statistically significant (temporal RNFL: OR, 1.13; \(P = .0967\); nasal RNFL: OR, 1.21; \(P = .0999\); superior RNFL: OR, 1.05; \(P = .1675\)).

The criteria “RNFL in the temporal quadrant < 5th percentile” - the percentiles being defined by the OCT software integrated normal values – was strongly associated with a poor visual outcome. The odds of complete recovery were divided by 100 for the eyes that fulfilled this criteria \((P = .04)\).

The prognostic value of the initial VF defect on final VF outcome was assessed in a second multivariate analysis taking into account age and duration of symptoms. The effect of the initial VF defect did not reach significance \((P = .09)\), although a tendency was seen: the odds of complete recovery were divided by five for each increase in the initial VF defect by 1 dB.

**DISCUSSION**

THIS STUDY DEMONSTRATES THE PREDICTIVE VALUE OF OCT on VF outcome three months after treatment of pituitary adenomas compressing the anterior visual pathways. We placed a greater emphasis on the VF defect than on VA. VA reflects the function of a small area of the VF, whereas the quantitative VF defect better reflects the impact of compression onto the anterior visual pathways. In addition, the majority of patients have VF defects with retained acuity.

A variety of prognostic factors have been studied in patients with compressive pituitary adenomas. Age and optic disc pallor were found to be predictive of the visual outcome by some authors but not others.\(^1\)\(^-\)\(^4\)\(^,\)\(^6\) Duration of symptoms prior to surgery has been associated with a poor visual outcome.\(^1\)\(^,\)\(^2\) But this seemed to correlate more to the depth of the preoperative visual deficit in one study\(^1\) and was not statistically significant with multivariate analysis in another study.\(^3\) Whether the adenoma is secreting or non-secreting does not predict visual outcome after surgery.\(^1\)\(^,\)\(^7\) Pattern ERG carried a low prognostic value in one study.\(^8\) The intensity of the preoperative VF deficit was found to be predictive of the visual outcome by some authors but not others.\(^1\)\(^-\)\(^3\) When a Goldmann perimeter was used, the preoperative VF defect had prognostic value in two studies\(^3\)\(^,\)\(^5\) and did not in two others.\(^1\)\(^,\)\(^4\) One study\(^2\) using Humphrey VF showed that temporal superior and temporal inferior VF defects were predictive of the final VF defect. But only the temporal-superior quadrant maintained that prognostic value in a multivariate analysis including age and duration of visual symptoms. The lack of a clear result from these studies makes it difficult to predict the visual outcome in a single patient. VF testing carries the disadvantage of a fairly significant intertest variability, which increases in areas of the VF that have suffered more damage.\(^18\)\(^,\)\(^19\) OCT is a useful tool because it provides an objective and very reproducible measurement of RNFL thickness (89% to 97% in our patients). OCT is also a quick test that requires little cooperation from the patient, making it particularly useful in patients who cannot perform VF testing reliably.

In this study, when a VF defect was present initially (groups 1 and 2), age and duration of symptoms had a statistically significant prognostic value on the VF outcome, independent from RNFL thickness. The initial VF defect did not reach statistical significance as a prognostic factor independent from age and duration of symptoms, although a tendency was observed. Because a strong correlation between the initial VF defect and mean RNFL thickness was found, those two parameters did not behave as independent prognostic factors. The prognostic value of RNFL thinning was statistically significant and independent from the effect of age and duration of symptoms for mean RNFL (OR, 1.29/\(\mu m\)) and also strongly significant for the inferior RNFL (OR, 6.31/\(\mu m\)). It is important to stress that mean RNFL thickness and age were independent prognostic factors since RNFL has been shown to thin with aging, both histologically\(^20\)\(^,\)\(^21\) and on OCT measurements.\(^21\)\(^-\)\(^24\) Although our groups differed in age, the differences were not statistically significant and the use of a multivariate model increased the reliability of our results. Also, the criteria “temporal RNFL < 5th percentile,” easy to use in clinical practice, carried a poor prognostic value on visual outcome three months after treatment (OR, 0.01 for meeting this criteria).

The prognostic value of OCT has been previously assessed by Danesh-Meyer and associates,\(^17\) they studied sixty-three eyes of 35 patients suffering from various pituitary diseases and found that RNFL thickness thinner than the 2.5th percentile determined the likelihood of VF improvement to MD of -3.5 dB or less six weeks after surgery. Among patients with severe VF defect (-10 dB or greater), RNFL thickness was a predictor of VF improvement by 10 dB or more. In this subgroup of eyes, baseline inferior quadrant RNFL thickness accounted for 61% of final MD and independently, baseline MD accounted for 18% of final MD. This study had several confounding factors. Patients were treated with both transsphenoidal surgery and craniotomy. In addition, patients had pituitary tumors and other sellar lesions, such as craniopharyngioma, meningioma, paracrinoid aneurysm, and extrinsic granulomatosis. Brain imaging after treatment was not reviewed, so that the extent of decompression was unknown. RNFL analysis did not take into account the
patient’s age, which contributes to RNFL thinning.\textsuperscript{20,22–24} Finally, the study was short-term with only six weeks of follow-up.

The clock-wise thinning of RNFL in chiasmal injury has been previously described. One pathologic study\textsuperscript{25} after a chiasmal lesion found a loss of 90% of the optic nerve head fibers in the nasal and temporal quadrants, and 50% in the superior and inferior quadrants. In retrospective studies, OCT disclosed similar results,\textsuperscript{12,13} mean RNFL being the most frequently abnormal parameter in eyes with band atrophy, followed by temporal and nasal RNFL.\textsuperscript{15} Given that the ganglion cells for the temporal VF reach the optic disc superiorly, inferiorly, medially, and laterally, whereas the ones for the nasal VF reach the optic disc superiority and inferiorly, the OCT findings match the known anatomy. Thinning of temporal RNFL occurred in group 1 but also in group 2, and reached the greatest percentage of reduction among the four quadrants in groups 1 and 2 (see Supplemental Table 2). Thinning in the inferior quadrant was smaller but only occurred in group 1, and therefore appears to be strongly predictive of the visual outcome after treatment (OR, 6.31 per micron; \textit{P} = .0000). Thinning of inferior RNFL, reflecting an inferolateral chiasmal injury, appears to be a marker of severity of compression from a pituitary adenoma onto the chiasm. Interestingly, the inferior RNFL thickness has also been found to be a strong prognostic factor in Danesh-Meyer and associates\textsuperscript{17} study, even though findings in the other quadrants were not described.

Retinal nerve fiber layer thinning reflects axonal degeneration of optic nerve fibers secondary to compression. In group 3, where no VF defect occurred pre- or posttreatment, RNFL thickness showed no statistically significant difference compared to the control group for mean RNFL and each quadrant. In group 2, RNFL thickness was statistically thinner in the temporal quadrant, despite complete resolution of the VF loss. There are two possible hypotheses. First, ganglion cell redundancy allows a return to a normal VF despite fiber loss, as has been shown in glaucoma.\textsuperscript{26} Second, the VF loss occurs from reversible mechanisms, such as disruption of conduction along the axon and impaired axoplasmic flow and demyelination\textsuperscript{27} before axonal degeneration occurs. These results differ from those of Danesh-Meyer and associates,\textsuperscript{17} who found that 15% of their patients had normal VF tests and RNFL thinner than the 2.5th percentile. Our study excluded highly myopic eyes, unlike that of Danesh-Meyer and associates.\textsuperscript{17} This may contribute to the difference between the two studies, as we have observed abnormal RNFL thickness with normal VFs in a significant number of highly myopic eyes.

In conclusion, RNFL thinning reflects the amount of retinal ganglion cell degeneration caused by compression of the anterior visual pathways by a pituitary adenoma. This permanent damage persists after treatment and is responsible for the long-term visual deficit. It may be evaluated at an early stage of the disease, and in vivo thinning of RNFL measured by OCT puts the patient at decreased chance of recovery of an initial VF defect three months after treatment. OCT has the advantage of being an objective, quantitative, reproducible, noninvasive tool, requiring very little cooperation from the patient. The presence of a VF defect at three months may indicate either a delayed recovery or a nonreversible deficit. Because among the 23 eyes with an initial VF defect, 21 improved and the two remaining eyes with initial worsening finally improved with follow-up greater than three months, we would not recommend to use RNFL thinning to preclude surgical treatment. Additional studies with longer follow-up on a larger population can help evaluate which of the RNFL measurements by OCT has the best prognostic value, and OCT's value as a long-term prognostic tool.

\textbf{REFERENCES}

**SUPPLEMENTAL TABLE 1.** Reproducibility of the Three Consecutive Measurements of Retinal Nerve Fiber Layer Thickness by Optical Coherence Tomography in 37 Eyes From 19 Consecutive Patients Suffering From Pituitary Adenomas Compressing the Anterior Visual Pathways

<table>
<thead>
<tr>
<th></th>
<th>Mean RNFL</th>
<th>Nasal</th>
<th>Temporal</th>
<th>Inferior</th>
<th>Superior</th>
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<tbody>
<tr>
<td>All patients</td>
<td>97%</td>
<td>95%</td>
<td>89%</td>
<td>94%</td>
<td>95%</td>
</tr>
<tr>
<td>Group 1</td>
<td>89%</td>
<td>80%</td>
<td>70%</td>
<td>79%</td>
<td>94%</td>
</tr>
<tr>
<td>Group 2</td>
<td>98%</td>
<td>90%</td>
<td>96%</td>
<td>95%</td>
<td>96%</td>
</tr>
<tr>
<td>Group 3</td>
<td>94%</td>
<td>88%</td>
<td>87%</td>
<td>89%</td>
<td>86%</td>
</tr>
</tbody>
</table>

RNFL = retinal nerve fiber layer.
Groups are defined by the visual field (VF) outcome three months after treatment (Group 1: Incomplete recovery from the initial VF defect; Group 2: Complete recovery of initial VF defect; and Group 3: No VF defect).
### SUPPLEMENTAL TABLE 2. Percentage of Reduction of Retinal Nerve Fiber Layer Thickness Measured by Optical Coherence Tomography in 37 Eyes From 19 Consecutive Patients Suffering From Pituitary Adenomas Compressing the Anterior Visual Pathways

<table>
<thead>
<tr>
<th>Percentage of Reduction</th>
<th>Mean RNFL</th>
<th>Inferior Quadrant&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Temporal Quadrant&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Superior Quadrant</th>
<th>Nasal Quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>28%</td>
<td>24%</td>
<td>44%</td>
<td>22%</td>
<td>29%</td>
</tr>
<tr>
<td>Group 2</td>
<td>1%</td>
<td>−3%</td>
<td>9%</td>
<td>−3%</td>
<td>6%</td>
</tr>
<tr>
<td>Group 3</td>
<td>2%</td>
<td>−1%</td>
<td>1%</td>
<td>−1%</td>
<td>14%</td>
</tr>
</tbody>
</table>

RNFL = retinal nerve fiber layer.

Groups are defined by the visual field (VF) outcome three months after treatment (Group 1: Incomplete recovery from the initial VF defect; Group 2: Complete recovery of initial VF defect; and Group 3: No VF defect).

The differences between the groups were not statistically significant for mean RNFL, nasal RNFL, and superior RNFL.

Negative values indicate that RNFL thickness in the group and quadrant considered were greater than in the control group.

<sup>a</sup>The differences between the groups for the temporal quadrant were statistically significant as follows: between groups 1 and 3: \( P = .015 \); between groups 2 and 3: \( P = .023 \); but between groups 1 and 2: \( P = .33 \).

<sup>b</sup>The differences between the groups for the inferior quadrant were statistically significant as follows: between groups 1 and 2: \( P = .006 \); between groups 1 and 3: \( P = .028 \); but between groups 2 and 3: \( P = .70 \).