Association of Angle Width With Progression of Normal-Tension Glaucoma
A Minimum 7-Year Follow-up Study

Ahnul Ha, MD; Young Kook Kim, MD; Jin Wook Jeoung, PhD; Dong Myung Kim, PhD; Ki Ho Park, MD, PhD

IMPORTANCE  Glaucoma has been dichotomically classified as open or closed angle, and accordingly, distinct therapies have been administered. In this study, the issue of narrow-angle normal-tension glaucoma (NTG), which may be an intermediate-stage or hybrid-stage disease entity, was addressed.

OBJECTIVE  To determine whether anterior chamber (AC) angle width plays any role in NTG progression.

DESIGN, SETTING, AND PARTICIPANTS  Retrospective analysis of prospectively collected data at Seoul National University Hospital between January 2004 and December 2009. Fifty-two eyes of narrow-angle NTG and 52 wide-angle NTG eyes matched for age, untreated intraocular pressure, and mean deviation of visual field. Nonindentation gonioscopy was used to grade AC angles: narrow angle was defined as a partially invisible (invisible in ≥90° and <180°) pigmented posterior trabecular meshwork, and wide angle was defined as a fully visible pigmented posterior trabecular meshwork. Data were analyzed in September 2017.

MAIN OUTCOMES AND MEASURES  Optic disc/retinal nerve fiber layer defect and visual field progression.

RESULTS  Of the narrow-angle NTG cohort, the mean (SD) age was 49.5 (9.1) years and 15 individuals (28.8%) were women; of the wide-angle NTG cohort, the mean (SD) age was 48.7 (9.5) years and 19 (36.5%) were women. All participants were Korean. Over the course of the mean (SD) 7.6 (0.4)-year follow-up period, 25 of 52 narrow-angle eyes (48.1%) and 13 of 52 wide-angle eyes (25.0%) showed structural progression (odds ratio [OR], 2.78; 95% CI, 1.21-6.37; P = .02). Meanwhile, 21 of 52 narrow-angle eyes (40.3%) and 9 of 52 wide-angle eyes (17.3%) showed functional progression (OR, 3.24; 95% CI, 1.31-8.00; P = .009). The cumulative probability of both structural and functional progression was significantly greater in the narrow-angle than in the wide-angle group (mean [SD] 5-year survival rates, 0.56 [0.07] vs 0.83 [0.05]; P = .006 and 0.60 [0.07] vs 0.87 [0.05]; P = .007, respectively). The baseline diurnal intraocular pressure’s SD was approximately 1.38-times greater in the narrow-angle than in the wide-angle group (mean [SD] 5-year survival rates, 0.56 [0.07] vs 0.83 [0.05]; P = .006 and 0.60 [0.07] vs 0.87 [0.05]; P = .007, respectively). The baseline diurnal intraocular pressure’s SD was approximately 1.38-times greater in the narrow-angle than in the wide-angle group (mean [SD] 5-year survival rates, 0.56 [0.07] vs 0.83 [0.05]; P = .006 and 0.60 [0.07] vs 0.87 [0.05]; P = .007, respectively).

CONCLUSIONS AND RELEVANCE  Narrow-angle NTG showed a greater probability of disease progression than did wide-angle NTG. Further studies determining whether augmented or differentiated treatment strategies would be beneficial for patients with narrow-angle NTG are warranted.

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Open-angle glaucoma that is within a statistically normal baseline intraocular pressure (IOP) range is known as normal-tension glaucoma (NTG). East Asian individuals have shown a higher susceptibility to NTG. In the Japanese Tajimi and Korean Namil studies, for example, 92% and 77% of the respective primary open-angle glaucoma cohorts showed a baseline IOP of 21 mm Hg or less. Although the typical IOP in patients with NTG is considered to be within the normal range, adequate lowering of IOP remains the keystone of NTG treatment.

It is proposed that large IOP fluctuation (diurnal and follow-up variation) is significantly associated with NTG progression. However, the exact mechanism of such fluctuation, or the answer to the question of why some patients show lesser and others greater fluctuation, is not yet known. In the case of angle-closure glaucoma, it is understood that IOP fluctuations are related to anterior chamber (AC) angle status: in patients with primary angle-closure glaucoma and primary angle-closure compared with patients diagnosed as primary angle-closure suspects and normal control individuals, diurnal IOP fluctuation is significantly higher; moreover, there is a statistically significant association between higher IOP fluctuation and the extent of peripheral anterior synechiae.

Patients with NTG can be further classified into subgroups: with a wide AC angle and with a relatively narrow AC angle. Further, patients with NTG with a narrow AC angle relative to those with a wide angle can share some features with primary angle closure or primary angle-closure glaucoma. On this basis, we hypothesized that patients with a narrower AC angle width are susceptible to a higher IOP and/or greater IOP fluctuation and, as such, eventually present faster disease progression rates.

In this longitudinal, minimum 7-year follow-up study, we compared the disease progression between patients with narrow-angle and wide-angle NTG. Our results can serve as a starting point for differentiation of treatment strategies by subclassification of patients with NTG according to AC angle width.

### Methods

This study was approved by the Seoul National University Hospital institutional review board and faithfully adhered to the tenets of the Declaration of Helsinki. All of the participants provided written informed consent.

### Study Participants

Patients with NTG who had first been examined between January 2004 and December 2009 and included in the NTG cohort of an ongoing prospective study at Seoul National University Hospital’s Glaucoma Clinic were considered as study participants. Patients followed-up for a minimum of 7 years at 6-month intervals were consecutively included in this study after a retrospective medical record review in September 2017. All underwent a complete ophthalmic examination: visual acuity assessment, refraction, slitlamp biomicroscopy, gonioscopy, Goldmann application tonometry (Haag-Streit), and dilated-funduscopic examination. Additionally, they were subjected to the following: central corneal thickness measurement (Orbscan 73 II, Bausch & Lomb Surgical), digital color stereo disc photography (SDP), red-free retinal nerve fiber layer (RNFL) photography, and Humphrey VF central 30-2 threshold tests (Humphrey Instruments Inc). Central corneal thickness was measured on the same day that the diurnal IOP measurement was taken.

The participants’ NTG diagnosis was based on the following criteria: (1) typical glaucomatous optic neuropathy with corresponding VF loss; (2) open AC angles (>180° visible pigmented posterior trabecular meshwork on nonindentation gonioscopy in primary position); (3) normal untreated IOP level (≤21 mm Hg). Glaucomatous optic neuropathy diagnoses were determined based on certain characteristic optic disc and/or RNFL changes as visible on either stereo disc photography or red-free RNFL images (ie, the presence of diffuse or localized rim thinning, rim notching, and an RNFL defect). Glaucomatous VF defect diagnoses, meanwhile, were made based on the following criteria: glaucoma hemifield outside normal limits results for 2 or more consecutive VF tests or 2 or more consecutive VF tests indicating at least 3 contiguous P less than .05 test points (1 or more of which was <.01) for the same hemifield on a pattern deviation plot (note that these tests, to be considered valid, required a fixation loss rate ≤20% as well as false-positive and false-negative error rates ≤25%).

Patients were excluded from the study for 1 or more of the following reasons: best-corrected visual acuity less than 20/40; a history of laser treatments including trabeculoplasty, iridoplasty, and iridotomy; any posterior pole lesions or optic neuropathy other than glaucoma that could possibly affect the VF examination during the entire follow-up period; intraocular surgery (including cataract surgery) during the follow-up period; history or current use of topical or systemic medications possibly affecting the angle structure or pupillary reflex; presence of evidence of previous angle-closure attack (eg, peripheral anterior synechiae, glaukomflecken, sector iris atrophy, posterior synechiae, or irregular pupil). Patients also were excluded if they had any history of (1) recurrent acute ocular or periorcular pain, (2) nausea or vomiting associated with visual symptoms, or (3) intermittent blurred vision with haloes. If both eyes were qualified according to the inclusion criteria, 1 eye was randomly selected for further analysis.
Measurement of IOP
Goldmann applanation tonometry was used to measure IOP at the baseline (prior to initiation of topical medication) and at every follow-up visit thereafter. For the baseline IOP, the mean of the diurnal IOP measurements taken at 8:30 AM, 10:00 AM, 11:30 AM, 1:00 PM, 2:30 PM, and 4:00 PM was used. Subsequently, all of the patients were administered glaucoma treatment aiming to reduce their baseline IOP by 20% or more. Diurnal IOP variation was determined by calculating the standard deviation (SD) of the 6 IOPs, and the follow-up IOP fluctuation was defined as the SD of the IOPs measured throughout the follow-up period.

Evaluation of AC Angle
All patients underwent an AC angle evaluation by Zeiss 4-mirror gonioscopy (Carl Zeiss) in the primary gaze position with 0.5% proparacaine (Alcaine) for topical anesthesia under the dim-light condition (0.5 cd/m²). The examiner ensured that the pupil was not exposed to direct light, thereby avoiding miosis. If narrowing or a partially closed angle was observed, the cause, whether apposition or peripheral anterior synechiae, was determined by indentation gonioscopy. For angle grading by clock hour, the modified Shaffer classification system was determined posteriortrabecularmeshworkconfirmedbygonioscopyinprimaryposition,(2)evidenceofglaucomatousopticneuropathylateranextrodiscphotography/RNFLphotographs. They then determined, based on the initial photograph, the presence or absence of structural progression. Optic disc progression was judged according to the extent of neuroretinal rim thinning. Retinal nerve fiber layer progression was defined as widening or deepening of an existing RNFL defect or a newly apparent defect. If cases of disagreement among the 3 examiners on structural progression, consensus was reached by further discussion.

Assessment of Functional Progression
In the assessment of functional glaucoma progression, the first 1 to 2 VF results were excluded to minimize learning effects, and any unreliable results (fixation loss rate >20% or false-positive and/or false-negative error rates >25%) also were excluded. Event-based analysis using the HFA with guided progression analysis software was used to determine VF progression, and only likely progression was considered to be VF progression. To ensure the absence of any artificial results, a glaucoma specialist (Y.K.K.) reviewed all of the patients’ VF results. The VF-defect progression rate was evaluated with reference to the HFA’s mean deviation (MD) slope. To calculate the MD slope in each eye, a linear regression analysis against time was performed; slopes of less than .05 probability value were included in the final analysis.

Classification of NTG According to AC Angle Width
The participants’ eyes were classified into 2 groups according to the AC angle width as follows (Table 1):

Wide-angle NTG: (1) fully visible (in 360°) pigmented posterior trabecular meshwork on nonindentation gonioscopy in primary position, (2) evidence of glaucomatous optic neuropathy with corresponding VF defect, and (3) normal baseline IOP (≤21 mm Hg).

Narrow-angle NTG: (1) partially invisible (≥90° and <180°) pigmented posterior trabecular meshwork confirmed by gonioscopy in primary position, (2) evidence of glaucomatous optic neuropathy with corresponding VF defect, and (3) normal baseline IOP (≤21 mm Hg).

Assessment of Structural Progression
Three experienced graders (A.H., Y.K.K., and K.H.P.) masked to the patients’ clinical and VF information reviewed the stereo disc photography/RNFL photographs. They then determined, based on the initial photograph, the presence or absence of structural progression. Optic disc progression was judged according to the extent of neuroretinal rim thinning. Retinal nerve fiber layer progression was defined as widening or deepening of an existing RNFL defect or a newly apparent defect. If cases of disagreement among the 3 examiners on structural progression, consensus was reached by further discussion.

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Statistical Analysis
For the patient matching, a 1:1 case-control matching analysis based on propensity scores was used, and the match tolerance value within each matched pair was 0.001. Age, baseline IOP, and baseline MD of VF were included as the matching parameters. The normally distributed data were compared by independent t test. The categorical data were analyzed by χ² test or Fisher exact test. The intergroup cumulative risk ratios of structural and functional progression were compared by Kaplan-Meier survival analysis and log rank test. The initial progression detection was regarded as the end point in the survival analysis. The end of follow-up was deemed to be the point at which patients without progression were censored. The statistical analysis was performed using the SPSS statistical package, version 22.0 (IBM). A 2-sided P value less than .05 was considered to be statistically significant.

Results
Among the initially included 68 narrow-angle NTG eyes, 3 were excluded from further analysis owing to combined retinal diseases diagnosed during the course of the follow-up. Thirteen eyes that had undergone intraocular surgery (11 eyes, uncomplicated cataract surgery; 2 eyes, combined vitrectomy) also were excluded. Finally, a total of 52 eyes were included in the narrow-angle NTG group. For comparative analysis, wide-
angle NTG eyes 1:1 matched for age, baseline IOP, and baseline MD of VF were consecutively included in the wide-angle NTG group. The final 52 matched eyes were found within the wide-angle NTG pool, including 134 eyes that met the inclusion criteria, and the standardized mean difference value after matching by propensity score was 0.007.

Demographic and Clinical Characteristics of Patients With Narrow-Angle and Wide-Angle NTG

The demographics and clinical characteristics of the patients with narrow-angle and wide-angle NTG are summarized in Table 2. No significant differences in baseline and systemic factors were found between the groups, but the mean (SD) number of glaucoma medications during the follow-up was significantly greater in the narrow-angle group (2.0 [0.6] vs 1.4 [0.3]; P < .001). There was no eye with patchy trabecular meshwork pigmentation in either the wide-angle or narrow-angle NTG group. None of the narrow-angle NTG eyes were treated by laser or with miotics during the follow-up period, and detailed information on the types of glaucoma medication is provided in the eResults and eTable in the Supplement.

IOP-Associated Factors in Patients With Narrow-Angle and Wide-Angle NTG

Table 3 compares the IOP-related parameters between the narrow-angle and wide-angle groups. In the narrow-angle group, the SD of baseline diurnal IOP was significantly (1.38 times) greater (1.8 [0.6] mm Hg vs 1.3 [0.3] mm Hg; mean difference, 0.52; 95% CI,
Table 3. Comparison of Intraocular Pressure Between Patients With Narrow-Angle and Wide-Angle Normal-Tension Glaucoma

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>P Value</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Narrow Angle (n = 52)</td>
<td>Wide Angle (n = 52)</td>
</tr>
<tr>
<td>Baseline IOP, mm Hg</td>
<td>16.9 (1.6)</td>
<td>16.4 (1.7)</td>
</tr>
<tr>
<td>Diurnal variation, mean (SD) [range], mm Hg</td>
<td>1.8 (0.6) [0.5-2.5]</td>
<td>1.3 (0.3) [0.6-1.8]</td>
</tr>
<tr>
<td>IOP with medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up IOP, mm Hg</td>
<td>13.0 (1.5)</td>
<td>12.5 (1.6)</td>
</tr>
<tr>
<td>Reduction in IOP, %</td>
<td>23.1 (9.0)</td>
<td>23.9 (9.4)</td>
</tr>
<tr>
<td>Peak follow-up IOP, mm Hg</td>
<td>16.2 (2.6)</td>
<td>15.4 (2.4)</td>
</tr>
<tr>
<td>Eyes achieved 20% mean IOP reduction, No. (%)</td>
<td>41 (78.8)</td>
<td>48.6 (84.6)</td>
</tr>
<tr>
<td>Percentage of follow-up visits with &lt;20% IOP reduction</td>
<td>24.2 (11.1)</td>
<td>19.5 (11.8)</td>
</tr>
<tr>
<td>Follow-up IOP, mean (SD) [range], mm Hg</td>
<td>2.1 (0.5) [0.8-2.6]</td>
<td>1.2 (0.3) [0.7-2.0]</td>
</tr>
</tbody>
</table>

Abbreviation: IOP, intraocular pressure.

Comparison of Glaucoma Progression Between Narrow-Angle and Wide-Angle NTG

During the mean (SD) 7.6 (0.4)-year (range, 7.0-8.6 years) follow-up period, 25 of 52 narrow-angle eyes (48.1%; 95% CI, 0.344-0.615) and 13 of 52 wide-angle eyes (25.0%; 95% CI, 0.132-0.367; P = .02) showed structural progression. The mean (SD) 5-year survival rate for structural progression was significantly lower in the narrow-angle group than in the wide-angle group: 0.56 (0.07) vs 0.83 (0.05) (P = .006; Figure, A).

Functional progression was shown in 21 of 52 narrow-angle eyes (40.3%; 95% CI, 0.268-0.533) and 9 of 52 wide-angle eyes (17.3%; 95% CI, 0.070-0.275; P = .009). As for functional progression, the 5-year survival rates were 0.87 (0.05) and 0.60 (0.07) in the wide-angle and narrow-angle NTG groups, respectively (P = .007; Figure, B).

The numbers of eyes that showed either structural or functional progression were 26 of 52 narrow-angle eyes (50%; 95% CI, 0.364-0.635) and 15 of 52 wide-angle eyes (28.8%; 95% CI, 0.165-0.411; P = .03). As for either structural or functional progression, the mean (SD) 5-year survival rates were 0.54 (0.07) and 0.83 (0.05) in the narrow-angle and wide-angle NTG groups, respectively, narrow-angle NTG showing a significantly greater probability of progression (P = .01; Figure, C).

The overall mean rates of standard automated perimetry MD change among the patients with NTG were −0.54 (0.68) and −0.23 (0.44) dB/y in the narrow-angle and wide-angle groups, respectively (P = .006; eFigure in the Supplement). The factors associated with progression are presented as Table 4 and eResults in the Supplement.

Discussion

Glaucoma has been dichotomically classified as open or closed angle. Accordingly, distinct therapies have been administered. Treatment of open-angle glaucoma has focused mainly on IOP lowering, whereas for treatment of closed-angle glaucoma, widening of AC angle width has been considered an important additional approach. Through this study, we addressed the issue of narrow-angle NTG, which may be an intermediate or hybrid-stage disease entity.

In this study, narrow-angle NTG eyes showed greater probability and faster rates of both optic disc/RNFL and VF progression than did wide-angle NTG eyes over the course of the mean 7.6 years of follow-up. Interestingly, in the narrow-angle NTG group, the IOP variations (eg, fluctuations in both diurnal IOP and follow-up IOP) also were far greater.

A positive association between the degree of IOP variation and the probability of glaucomatous progression in NTG eyes is already well established. Patients with NTG relative to control individuals have shown a significantly greater degree of short-term IOP fluctuation during waking hours. Kim et al found that in patients with NTG, long-term IOP variation, as adjusted for diurnal fluctuation, is significantly associated with glaucoma progression. Takeo et al demonstrated that in NTG, faster-VF-progression eyes tend to show greater long-term IOP variation. In this study, the extent of both diurnal IOP variation and follow-up IOP fluctuation were significantly greater in the narrow-angle group. Therefore, we may deduce that IOP fluctuation might have played a role, at least in part, in the narrow-angle group's much higher probability and faster rates of disease progression.

In diseases associated with abnormal AC angle width, the angle width is directly associated with extent of IOP fluctuation: the narrower the angle, the greater the IOP fluctuation. It is known that even in eyes with a normal open AC angle, various external factors, such as changes in body and/or head position, can affect changes of IOP. Both normal eyes and patients with primary open-angle glaucoma seated in a completely dark room for an hour, for example, showed an apparent IOP rise. Kim et al reported that asymmetrical IOP elevation in the lateral decubitus position is significantly associated with asymmetric VF loss in patients with NTG. It is suspected that if the AC angle is relatively narrow, even in open-angle eyes, IOP fluctuation will be greater within the daily conditions that cause IOP change.

In our study, the narrow-angle NTG eyes showed normal axial length and a slightly more myopic spherical equivalent,
Figure. Kaplan-Meier Curves Depicting Nonprogression Probability in Patients With Normal-Tension Glaucoma (NTG) According to Angle

A, Patients with structural progression (greater cumulative progression probability than did those with a wide AC angle). The patients with NTG with a narrow anterior chamber (AC) angle showed a greater cumulative progression probability than did those with a wide AC angle. A, Patients with structural progression ($P = .006$). B, Patients with functional progression ($P = .007$). C, Patients with either structural or functional progression ($P = .01$).

Although the difference between the 2 groups did not reach statistical significance. Two explanations can be considered as underlying factors for this. First, a more anteriorly positioned lens might result in myopic shift in narrow-angle NTG eyes. Because the relative lens position has been regarded as an important determinant in anterior angle width, a slightly anterior-located lens could cause both angle narrowing and myopic shift. Additionally, changes in refractive index owing to cataract progression might be another factor influencing refraction.

Because angle structure can change over time (eg, a normal angle can become occludable with age), one could argue that narrow-angle NTG might represent a very early stage of angle-closure disease. Among the 52 narrow-angle NTG eyes, 21 that showed more frequent occurrence of increased IOP and definite VF progression were suspected, based on such clinical courses, of angle narrowing. In those 21 eyes, follow-up gonioscopic examination was performed at least 3 or more years after the initial examination; however, none had progressed or changed to a closed angle consistent with the primary angle-closure suspect definition. In this regard, narrow-angle NTG possibly should be considered a distinct disease entity from primary angle closure or primary angle-closure glaucoma.

Limitations

First, not all patients underwent follow-up AC angle evaluation; thus, we were unable to perform the sequential angle-structural comparison in all patients. Although the follow-up examination was performed on patients with suspected angle narrowing, it remains possible that the angle narrowing had progressed even in patients with a stable disease course. Also, after a longer period, narrow-angle NTG might further progress to meet the angle-closure criteria. Second, all of the gonioscopic examinations were acquired under constant lighting conditions; as such, we could not assess dynamic iris-feature changes that might contribute to AC angle width under various circumstances. Third, several other important anterior-segment features, including AC depth, iris configuration, and lens vault, were not evaluated. There were no initial anterior-segment optical coherence tomography results for most of the patients who had started their glaucoma treatment more than 7 years previously. The degree of cataract progression and related lens vault change can contribute to angle narrowing. Thus, more quantitative evaluation of lens position by an imaging modality, such as anterior-segment optical coherence tomography, is essential. Fourth, our results might not be directly applicable to higher-baseline IOP primary open-angle glaucoma; therefore, further studies investigating the association of narrow angle with disease progression in those patients are warranted. Finally, in this study, all of the patients were East Asian (Korean), and the mean age was relatively younger compared with previous studies, possibly owing to the exclusion of eyes that had undergone cataract surgery. Also, the patients included in this study showed a slight male predominance. Anterior chamber parameters and angle-closure disease prevalences reflect racial/ethnic, age, and sex differences. Thus, these points should be considered when interpreting our results.
Angle NTG during the mean 7.6-year follow-up of the study warrants.

**Table 4. Univariate and Multivariate Hazard Ratios and 95% Confidence Intervals of Significant Risk Factors for Each of Structural and/or Functional Deterioration in Patients With Normal-Tension Glaucoma**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Structural Hazard Ratio (95% CI)</th>
<th>P Value</th>
<th>Functional Hazard Ratio (95% CI)</th>
<th>P Value</th>
<th>Structural or Functional Hazard Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optic disc hemorrhage</td>
<td>2.501 (1.145-4.652)</td>
<td>.02</td>
<td>3.352 (1.490-5.740)</td>
<td>.003</td>
<td>2.246 (1.037-4.868)</td>
<td>.04</td>
</tr>
<tr>
<td>Percentage reduction in IOP</td>
<td>0.832 (0.731-0.947)</td>
<td>.005</td>
<td>0.785 (0.675-0.914)</td>
<td>.002</td>
<td>0.836 (0.737-0.947)</td>
<td>.005</td>
</tr>
<tr>
<td>Diurnal IOP variation</td>
<td>1.887 (1.110-3.207)</td>
<td>.02</td>
<td>1.934 (1.075-3.478)</td>
<td>.03</td>
<td>1.683 (1.005-2.818)</td>
<td>.05</td>
</tr>
<tr>
<td>Follow-up IOP fluctuation</td>
<td>1.824 (1.095-3.038)</td>
<td>.01</td>
<td>2.061 (1.154-3.678)</td>
<td>.01</td>
<td>1.727 (1.059-2.816)</td>
<td>.03</td>
</tr>
<tr>
<td>Narrow AC angle width</td>
<td>2.459 (1.257-4.812)</td>
<td>.007</td>
<td>2.876 (1.316-4.285)</td>
<td>.008</td>
<td>2.266 (1.198-4.287)</td>
<td>.01</td>
</tr>
</tbody>
</table>

**Conclusions**

Anterior chamber angle width played a role in the progression of NTG. Narrow-angle NTG showed much greater probability and faster rates of disease progression than did wide-angle NTG during the mean 7.6-year follow-up of the study period. The vulnerability to glaucoma progression in narrow-angle NTG eyes might be associated, at least in part, with greater IOP fluctuation. Further studies determining whether narrow-angle NTG has a distinctly different natural disease course from that of wide-angle NTG or primary angle closure or primary angle-closure glaucoma, and whether an augmented or differentiated treatment strategies would be beneficial for patients with narrow-angle NTG, are warranted.

**REFERENCES**

15. Fukuchi T, Yoshino T, Sawada H, et al. The relationship between the mean deviation slope and follow-up intraocular pressure in open-angle...


