Ophthalmoscopic Appearance of the Normal Optic Nerve Head in Rhesus Monkeys

Jost B. Jonas¹ and Sohan Singh Hayreh²

PURPOSE. To evaluate the ophthalmoscopic appearance of the normal optic disc, parapapillary region, and retinal nerve fiber layer in rhesus monkeys.

METHODS. Color stereo fundus photographs of 17 normal eyes of 17 rhesus monkeys aged between 13 and 23 years were morphometrically evaluated.

RESULTS. The neuroretinal rim was significantly (P < 0.008) broadest in the inferior disc region followed by the superior disc region, the nasal region, and the temporal region. Retinal nerve fiber layer visibility was significantly highest in the inferior temporal fundus region followed by the superior temporal fundus region, the superior nasal fundus region, and the inferior nasal fundus region. It decreased significantly (P < 0.001) with increasing age. The retinal arterioles were significantly (P < 0.01) wider in the inferior temporal and superior temporal fundus regions than in the superior nasal and inferior nasal fundus regions. The alpha zone of parapapillary atrophy (14/17 or 82.4%) occurred significantly (P < 0.001) more often than the beta zone (2/17 or 11.8%). In 15 eyes (88.2%), the foveola was located inferior to a horizontal line drawn through the center of the optic disc. Neuroretinal rim shape and area and size of alpha and beta zones of parapapillary atrophy were independent of age.

CONCLUSIONS. As in humans, in normal rhesus monkeys the neuroretinal rim has a typical physiologic configuration that spatially correlates with the retinal arteriole diameter, retinal nerve fiber layer visibility, and position of the foveola inferior to the center of the optic disc. Neuroretinal rim shape is independent of age. Retinal nerve fiber layer visibility decreases significantly with increasing age. These findings may be useful for the early detection and differentiation of experimental optic nerve damage in rhesus monkeys. (Invest Ophthalmol Vis Sci. 2000;41:2978–2983)

Optic nerve fibers originating from the retina, with an area of approximately 1204 ± 184 mm² in humans,¹ are densely packed in the optic nerve head, covering an area of approximately 2.69 ± 0.70 mm².² This suggests that minor localized defects may be detectable in the retinal nerve fiber layer before changes are seen in the optic disc; as has been demonstrated in studies in patients with glaucoma.³ It also shows the high clinical importance of the examination of both the optic disc and the retinal nerve fiber layer in the detection of optic nerve diseases.³,⁴ The optic disc and the retinal nerve fiber layer in optic nerve diseases can be studied in humans as well as in monkeys.⁵ In any type of research, however, to evaluate the validity and reliability of pathologic findings in a disease process, it is essential to know the normal findings, to avoid interpreting normal as abnormal. This also raises the issue of the validity of findings of the optic nerve head in monkeys for understanding the human disease process—i.e., do the pathologic changes seen in the optic disc in rhesus monkeys represent the changes seen in the optic disc in humans?

In view of these considerations, the present study had a twofold objective: to evaluate the normal appearance and parameters of the optic disc, parapapillary region, and retinal nerve fiber layer in normal rhesus monkeys eyes, which should enable early detection and follow-up of experimentally induced changes in the optic nerve in monkeys, and to compare the findings in rhesus monkeys with those in humans.

MATERIALS AND METHODS

The study included 17 eyes of 17 rhesus monkeys (Macaca mulatta) with a mean age of 16.94 ± 2.7 (SD) years (range, 13–23 years). All 17 eyes were normal; none had been used in any other experiment or study, undergone any surgical procedure, or received any medical treatment. All eyes were examined under ketamine anesthesia (8–10 mg/kg body weight). Intraocular pressure measurements performed by Goldmann applanation tonometry were in the normal range. Color stereo diapositive images of the fundus were taken in all monkeys included in the study. The study design complied with the National Institutes of Health and the University of Iowa Institutional Guidelines for the Care and Use of Laboratory Animals and the ARVO Statement for the Use of Animals in Ophthalmic and Vision Research.

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Supported by Grant EY-1576 from the National Institutes of Health; in part by unrestricted grants from Research to Prevent Blindness; and by grant SFB 539 from Deutsche Forschungsgemeinschaft.

SSH is a Research to Prevent Blindness Senior Scientific Investigator.

Supported in part by unrestricted grants from Research to Prevent Blindness; and by grant SFB 539 from Deutsche Forschungsgemeinschaft.

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The morphometric analysis of the fundus photographs that had been taken at the University of Iowa was performed in Erlangen (Germany). After viewing the pairs of diapositive images stereoscopically, one of the two disc slides of each eye was projected in a scale of 1 to 15. The outlines of the optic cup, optic disc, peripapillary scleral ring, alpha and beta zones of parapapillary atrophy, and the retinal arterioles at the optic disc border in the inferior temporal, superior temporal, superior nasal, and inferior nasal regions were plotted on paper and morphometrically analyzed. The optic cup was defined on the basis of contour and not of pallor. The border of the optic disc was identical with the inner side of the peripapillary scleral ring. The neuroretinal rim width was measured in the inferior, superior, nasal, and temporal disc regions. The parapapillary atrophy was differentiated into a peripheral alpha zone with irregular pigmentation and a central beta zone with visible Bruch's membrane and visible large choroidal vessels (Figs. 1, 2). The parapapillary region was divided into four sectors. The temporal horizontal sector covered 64°. The inferior temporal and the superior temporal sectors were right-angled, and their middle lines were tilted 13° temporal to vertical optic disc axis. The nasal sector covered the remaining area of 116°. The method has been described in detail elsewhere. Because the magnification of the optic disc photographs varied according to the period of the study and the fundus camera used, and because keratometric readings and refractometry had not been performed for all monkeys included in the study, the optic disc measurements were expressed in relative size units.

The visibility of the retinal nerve fiber layer was evaluated in a second step. The fundus was divided into eight sectors:
inferior temporal, temporal horizontal, superior temporal, super-
ior, superior nasal, nasal horizontal, inferior nasal, and in-
ferior. In each sector, the visibility of the retinal nerve fiber
bundles was estimated using subjective grading ranging from 0
(no fiber bundles detectable) to 8 (abundant nerve fiber bun-
dles visible). Theoretically, the maximal score for all eight
sectors together was 64. The retinal nerve fiber layer was
assessed without knowledge of the morphometric optic disc
data, by a technique that has been described elsewhere in
detail. Because of the photographic quality, the retinal nerve
fiber layer visibility could not be evaluated on the photograph
of 1 of the 17 monkeys.

To determine the reproducibility of the semiquantitative
assessment of the retinal nerve fiber layer visibility, each of 10
photographs of 10 randomly selected eyes was re-evaluated
twice. The coefficient of variation, calculated as the ratio of
the mean of the SD divided by the mean of the mean values,
was 0.13 for the reassessment of the visibility of the retinal
nerve fiber layer. When the study on reproducibility was per-
formed, the photographs were mixed with photographs of
monkeys showing optic nerve atrophy in eyes with experiment-
ally elevated intraocular pressure and photographs of mon-
keys with nonglaucomatous optic nerve damage.

For statistical analysis of the data, Wilcoxon’s signed rank
test was used in the evaluation of differences between fundus
regions. Pearson’s correlation coefficient was calculated for the
evaluation of the relationship between visibility of the retinal
nerve fiber layer and age.

RESULTS

Neuroretinal Rim

The neuroretinal rim was significantly \( P = 0.008 \) broader in
the inferior disc region than in the superior disc region and
became successively significantly narrower in superior disc
region \( P = 0.007 \), the nasal disc region \( P < 0.001 \), and the
temporal disc region (Table 1). Consequently, the ratio of
inferior-to-temporal rim width was significantly \( P = 0.03 \)
higher than the ratio of superior-to-temporal rim width (Table
1). The inferior-to-temporal neuroretinal rim width ratio was
significantly \( P = 0.043 \) and negatively correlated with the
quotient of horizontal-to-vertical disc diameter. The more hor-
izontally the optic disc was configured, the higher the rim
width ratio (equation for the regression line: inferior-to-tempo-
ral rim width ratio = \( -7.77 \) [ratio of horizontal-to-vertical disc
diameter] + 8.47). The superior-to-temporal rim width ratio
also increased with decreasing horizontal-to-vertical disc di-
ameter ratio. The correlation, however, did not reach statistical
significance \( P = 0.20 \). Both rim width ratios were independent
of neuroretinal rim area and age \( P = 0.41 \) and \( P = 0.06 \);
\( P = 0.91 \) and \( P = 0.35 \), respectively.

The rim-to-disc area ratio was, on average, 0.678 ± 0.084,
with a minimum of 0.50 and a maximum of 0.80 (Table 1). It
was statistically independent of age \( P = 0.71 \); correlation
coefficient \( R = 0.10 \). Correspondingly, if the differences in
measured optic disc area between monkeys of different age
were corrected, the neuroretinal rim area was statistically
independent of age \( P = 0.70 \); correlation coefficient \( R = 0.09 \).

Cup-to-Disc Ratios

In agreement with the shape of the neuroretinal rim, the
horizontal cup-to-disc diameter ratio was significantly \( P <
0.001 \) higher than the vertical cup-to-disc diameter ratio (Ta-
ble 1). Correspondingly, the quotient of the horizontal cup-to-
disc ratio divided by the vertical cup-to-disc ratio was higher
than 1.0 (Table 1). The cup-to-disc diameter ratios and the
quotient of both ratios were independent of age \( P > 0.20 \).

Parapapillary Atrophy

An alpha zone of parapapillary atrophy was present in 14
(82.4%) of the 17 eyes. It was significantly \( P = 0.039 \) larger in
the temporal horizontal parapapillary region than in the infe-
rior temporal region, where it was significantly \( P = 0.009 \)
larger than in the superior temporal region, where it was
significantly \( P = 0.035 \) larger than in the nasal region (Table
1). The beta zone of parapapillary atrophy was present in 2
(11.8%) of the 17 eyes. The number of eyes with a beta zone
was too small for a statistical analysis of regional differences in
the extent of beta zone.

In a comparison of alpha zone with beta zone in each of
the four sectors, the alpha zone was significantly larger than
the beta zone in the temporal horizontal \( P = 0.002 \), the infe-
rior temporal \( P = 0.003 \), and the superior temporal \( P = 0.008 \)
regions. In the nasal region, the difference was not
significant \( P = 0.180 \); Table 1). The alpha zone occurred
significantly \( P < 0.001 \) more often than the beta zone (Table
1). The sizes of the alpha and beta zones of parapapillary
atrophy area were independent of age \( P > 0.05 \).

Retinal Vessels

The retinal arterioles were significantly \( P < 0.01 \) wider in the
inferior and superior temporal fundus regions than in the
superior and inferior nasal fundus regions (Table 1). The infe-
rior temporal arteriole did not differ significantly \( P = 0.46 \) in
diameter from the superior temporal arteriole, and the superior
nasal arteriole did not vary significantly \( P = 0.19 \) in diameter
from the inferior nasal arteriole.

Retinal Nerve Fiber Layer

Visibility of the retinal nerve fiber layer was significantly \( P =
0.035 \) higher in the inferior temporal fundus region than in the
superior temporal fundus region, where it was significantly
\( P < 0.001 \) higher than in the superior and inferior nasal
fundus regions (Table 1). In the two latter fundus regions,
which did not differ significantly in visibility of the retinal
nerve fiber layer \( P = 0.80 \), retinal nerve fiber layer visibility
was significantly higher \( P < 0.01 \) than in the temporal hori-
zontal fundus, the superior fundus, and the inferior fundus
regions. The visibility was lowest in the nasal fundus region
(Table 1). Retinal nerve fiber layer visibility decreased signifi-
cantly \( P < 0.001 \) with increasing age (Fig. 3).

In 15 (88.2%) of the 17 eyes, the foveola was located
inferior to a horizontal line drawn through the center of the
optic disc. In two (11.8%) eyes, the foveola was located at the
same height as the center of the optic disc. In view of the
relatively small number of eyes examined, the latter two eyes
did not vary significantly from the other 15 eyes in the regional
distribution of the visibility of the retinal nerve fiber layer.

Optic Disc Shape

The shape of the optic disc was quantified by calculating the
vertical-to-horizontal disc diameter ratio, the minimal-to-maxi-
mal disc diameter ratio, the difference of maximal disc diame-
Table 1. Optic Nerve Head Measurements in Normal Rhesus Monkeys

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuroretinal rim area (relative mm²)</td>
<td>0.048 ± 0.0112</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Inferior temporal disc sector</td>
<td>0.160 ± 0.0400</td>
</tr>
<tr>
<td>Superior temporal disc sector</td>
<td>0.140 ± 0.0300</td>
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<tr>
<td>Nasal disc sector</td>
<td>0.154 ± 0.0344</td>
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<tr>
<td>Temporal horizontal disc sector</td>
<td>0.045 ± 0.0136</td>
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<tr>
<td>Neuroretinal rim width (relative mm)</td>
<td>0.30 ± 0.09</td>
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<tr>
<td>Inferior disc region</td>
<td>0.24 ± 0.05</td>
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<tr>
<td>Superior disc region</td>
<td>0.20 ± 0.05</td>
</tr>
<tr>
<td>Nasal disc region</td>
<td>0.13 ± 0.13</td>
</tr>
<tr>
<td>Temporal disc region</td>
<td>0.13 ± 0.13</td>
</tr>
<tr>
<td>Rim width ratios</td>
<td></td>
</tr>
<tr>
<td>Inferior to temporal</td>
<td>2.70 ± 1.14</td>
</tr>
<tr>
<td>Inferior to superior</td>
<td>1.27 ± 0.36</td>
</tr>
<tr>
<td>Superior to nasal</td>
<td>1.52 ± 0.45</td>
</tr>
<tr>
<td>Superior to temporal</td>
<td>2.30 ± 1.18</td>
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<tr>
<td>Superior to nasal</td>
<td>1.22 ± 0.29</td>
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<tr>
<td>Temporal to nasal</td>
<td>0.61 ± 0.21</td>
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<tr>
<td>Rim to disc area ratio</td>
<td>0.678 ± 0.084</td>
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<tr>
<td>Cup to disc diameter ratio</td>
<td>0.627 ± 0.060</td>
</tr>
<tr>
<td>Horizontal</td>
<td></td>
</tr>
<tr>
<td>Vertical</td>
<td>0.502 ± 0.077</td>
</tr>
<tr>
<td>Horizontal to vertical</td>
<td>1.26 ± 0.12</td>
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<tr>
<td>Parapapillary atrophy</td>
<td></td>
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<tr>
<td>Alpha zone, area (relative mm²)</td>
<td>0.134 ± 0.099</td>
</tr>
<tr>
<td>Total</td>
<td></td>
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<tr>
<td>Inferior temporal sector</td>
<td>0.040 ± 0.032</td>
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<tr>
<td>Superior temporal sector</td>
<td>0.026 ± 0.020</td>
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<tr>
<td>Nasal sector</td>
<td>0.011 ± 0.032</td>
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<tr>
<td>Temporal horizontal sector</td>
<td>0.098 ± 0.042</td>
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<tr>
<td>Beta zone, area (relative mm²)</td>
<td>0.013 ± 0.035</td>
</tr>
<tr>
<td>Total</td>
<td></td>
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<tr>
<td>Inferior temporal sector</td>
<td>0.004 ± 0.010</td>
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<tr>
<td>Superior temporal sector</td>
<td>0.003 ± 0.010</td>
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<tr>
<td>Nasal sector</td>
<td>0.003 ± 0.010</td>
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<tr>
<td>Temporal horizontal sector</td>
<td>0.006 ± 0.016</td>
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<td>Beta zone, frequency (%)</td>
<td>82.4</td>
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<td>Total</td>
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<tr>
<td>Inferior temporal sector</td>
<td>76.5</td>
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<tr>
<td>Superior temporal sector</td>
<td>82.4</td>
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<tr>
<td>Nasal sector</td>
<td>11.8</td>
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<tr>
<td>Temporal horizontal sector</td>
<td>76.5</td>
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<tr>
<td>Retinal vessel diameter (relative mm)</td>
<td>0.055 ± 0.0080</td>
</tr>
<tr>
<td>Arterioles</td>
<td></td>
</tr>
<tr>
<td>Inferior temporal</td>
<td>0.053 ± 0.0100</td>
</tr>
<tr>
<td>Superior temporal</td>
<td>0.038 ± 0.0110</td>
</tr>
<tr>
<td>Nasal</td>
<td>0.042 ± 0.012</td>
</tr>
<tr>
<td>Visibility of the retinal</td>
<td>38.23 ± 4.93</td>
</tr>
<tr>
<td>Nerve fiber layer (relative units)</td>
<td></td>
</tr>
<tr>
<td>Inferior temporal sector</td>
<td>7.35 ± 0.61</td>
</tr>
<tr>
<td>Superior temporal sector</td>
<td>6.88 ± 0.70</td>
</tr>
<tr>
<td>Superior nasal sector</td>
<td>5.00 ± 1.27</td>
</tr>
<tr>
<td>Inferior nasal sector</td>
<td>4.94 ± 1.14</td>
</tr>
<tr>
<td>Temporal horizontal sector</td>
<td>3.82 ± 1.01</td>
</tr>
<tr>
<td>Superior sector</td>
<td>3.53 ± 0.51</td>
</tr>
<tr>
<td>Nasal</td>
<td>3.25 ± 1.20</td>
</tr>
<tr>
<td>Inferior sector</td>
<td>3.65 ± 0.49</td>
</tr>
<tr>
<td>Optic disc shape (diameter ratio)</td>
<td>1.39 ± 0.09</td>
</tr>
<tr>
<td>Vertical to horizontal disc diameter</td>
<td>1.40 ± 0.09</td>
</tr>
<tr>
<td>Maximum/minimum disc diameter</td>
<td>1.007 ± 0.009</td>
</tr>
<tr>
<td>Minimum horizontal disc diameter</td>
<td>0.003 ± 0.003</td>
</tr>
</tbody>
</table>

Data are expressed as means ± SD.

* See the Methods section for a description of quantification.

**Figure 3.** Correlation between visibility of the retinal nerve fiber layer and age in 16 normal rhesus monkeys. Equation of the regression line: visibility score of retinal nerve fiber layer = −0.93 × (age in years) + 53.98; Pearson’s correlation coefficient R = −0.52; P = 0.032.

**Discussion**

The neuroretinal rim represents the quantity of optic nerve fibers in the optic nerve head, and it is one of the main targets in the quantitative and qualitative evaluation of the optic nerve. In the rhesus monkeys examined in the present study, the neuroretinal rim had a characteristic configuration. It was broadest in the inferior disc region, and narrower in the superior disc region, than the nasal disc sector. It was smallest in the temporal horizontal disc sector (Table 1). This agrees with previous studies in normal human eyes in which, as in the rhesus monkey eyes in the present study, the shape and width of the neuroretinal rim followed the ISNT rule (i.e., width of the inferior part > the superior region > the nasal region > the temporal region).

As a consequence of the configuration of the neuroretinal rim with the rim being broader inferiorly than superiorly, the inferior-to-temporal rim width ratio was significantly higher than the superior-to-temporal rim width ratio (Table 1). Both rim width ratios depended on the shape of the optic disc: the
more horizontally elongated the optic disc, the lower the rim width ratios. A similar finding has been reported in normal human eyes.⁹ In horizontally oval optic discs in humans, the retinal nerve fiber bundles in the inferior and superior disc regions have a longer part of the disc circumference to enter the optic nerve head than they have in vertically oval optic discs. This leads to a narrower neuroretinal rim in the inferior and superior disc regions and, consequently, to a lower inferior-to-temporal rim width ratio and a lower superior-to-temporal rim width ratio in horizontally elongated optic nerve heads than in vertically shaped optic discs. This finding may have diagnostic importance, because the neuroretinal rim width ratios can be taken as quantitative measures of the neuroretinal rim shape in the early detection of glaucomatous optic nerve damage.⁹

Size and shape of the neuroretinal rim were independent of age, in agreement with findings in human eyes in which neuroretinal rim size and shape do not change with age.³ The findings contrast with the decrease in the visibility of the retinal nerve fiber layer and in optic nerve fiber count with increasing age in monkeys (Fig. 3) as well as in humans.¹⁰⁻¹² The discrepancy may be explained by the fact that in eyes with a nonglaucomatous reason for optic nerve fiber loss, such as central retinal artery occlusion,¹³ nonarteritic anterior ischemic optic neuropathy,¹⁴ and age, the neuroretinal rim does not decrease in shape and size despite the loss of nerve fibers.

An alpha zone of parapapillary atrophy was present in almost all eyes (in 14 of 17 eyes examined). A beta zone was found in 2 (11.8%) of the 17 eyes. Both zones were largest in the temporal horizontal sector and smallest in the nasal region. Similar data have been reported in normal human eyes.⁶ As in the human eyes, both zones were independent of age.⁶,¹⁵ The findings suggest that the alpha zone of parapapillary atrophy, but not the beta zone, is a physiologic element in the normal appearance of the optic nerve head. It suggests that, in rhesus monkeys as well as in humans with suspected glaucoma,¹⁶ the presence of a beta zone is a qualitative hint for glaucomatous optic nerve damage.

The retinal arterioles were significantly wider in the inferior and superior temporal vascular arcs than in the superior and inferior nasal fundus regions. Similar findings have been reported for normal human eyes.⁷ This goes along with the regional distribution of the visibility of the retinal nerve fiber layer, which was significantly more detectable in the inferior temporal fundus region followed by the superior temporal fundus region, the superior nasal region, and the inferior nasal region (Table 1). As in humans, this suggests an anatomic relationship between the caliber of the retinal arterioles and the amount of retinal nerve fibers. In humans, a similar relationship has been demonstrated in eyes with optic nerve damage, in which the reduction in the visibility of the retinal nerve fiber layer was correlated in space and extent with a decrease in the diameter of the retinal arterioles.¹⁷,¹⁸ The regional distribution of visibility of the retinal nerve fiber layer, which has already been studied using Fourier ellipsometry measurements,¹⁹ in correlation with the regional variation in the diameter of the retinal arterioles and the width of the neuroretinal rim, may be explained by the location of the foveola inferior to a horizontal line drawn through the center of the optic disc. As in humans,¹⁰ more retinal ganglion cells, and thus more retinal nerve fibers, may be located inferior to this line compared with the region superior to the horizontal line, requiring more supply by the retinal arterioles and leading to a broader neuroretinal rim in the inferior disc region than in the superior disc region.

The regional variability in the retinal nerve fiber layer visibility may be important for the early detection of glaucomatous optic nerve damage. In monkeys,²⁰ as well as in humans, nerve fiber layer loss in early glaucoma takes place predominantly in the inferior temporal region, followed by the superior temporal region and can lead to a change in the sequence of sectors concerning the best visibility of the retinal nerve fiber layer.

In the monkey eyes in the present study, the visibility of the retinal nerve fiber layer decreased significantly with increasing age (Fig. 3). Assuming a mostly linear relationship, the average loss per year of monkey life was 0.93/53.98 or 1.72%. Taking into account the difference in the normal life expectancy of monkeys versus humans, a comparable figure of 0.45% of annual loss in the retinal nerve fiber layer visibility has been reported in humans.¹⁰ In parallel, the optic nerve fiber count decreases by approximately 0.3% in humans per year of age.¹² This shows that in monkeys, as in humans,¹⁰,²² age has to be taken into account in the assessment of the retinal nerve fiber layer visibility. If the retinal nerve fiber layer visibility is the same in a young monkey as in an old monkey (and if no other reasons such as an opacity in the optic media or a different pigmentation of the background of the eye can be held responsible), the young monkey may have optic nerve damage, whereas the old monkey may have a normal optic nerve for his age.

The shape of the optic disc was more vertically elongated in the monkeys of the present study compared with the optic disc of humans.³ This was indicated by a relatively high vertical-to-horizontal disc diameter ratio in the monkey eyes compared with human eyes (Table 1). The difference in the shape of the optic disc may influence the shape of the neuroretinal rim because the inferior-to-temporal rim width ratio and the superior-to-temporal rim width ratio depend on the shape of the optic disc.

There are limitations in the present study. The findings concerning the location of the fovea in relation to the optic disc may have been influenced by changes in the setup of the monkeys in front of the camera—i.e., it could have been caused by head torsion. When the photographs were taken, however, the emphasis was on the orientation of the fundus camera in relation to the head of the monkey. Furthermore, the effects of an oblique angle of photography of the optic nerve head may have partially canceled each other if the torsion of the image was randomly distributed. In humans, the location of the fovea beneath a horizontal line drawn through the center of the optic disc has already been demonstrated.¹⁰ For the statistical analysis of the correlation between retinal nerve fiber layer visibility and age (Fig. 3), the values of the old monkeys were important. A look at the scattergram (Fig. 3) shows that the possibility cannot be excluded that, besides a linear relationship, a curvilinear relationship may exist with almost no changes occurring up to the monkey age of 18 years and then a relatively steep loss occurring beyond this age. Further studies on a larger number of monkeys may reveal whether, as has already been reported in humans, in monkeys the relationship between retinal nerve fiber layer visibility and age is also mostly linear.
In conclusion, the appearance of the normal optic nerve head in healthy rhesus monkeys markedly resembles the morphology of the normal optic nerve head in human subjects, so that findings of studies on the optic nerve head in rhesus monkeys may be applicable in humans. Knowledge of the normal appearance of the optic nerve head and retinal nerve fiber layer may be useful for the detection of early changes in the morphology of the optic nerve due to a pathologic loss of optic nerve fibers.

References