Iridolenticular Contact Decreases Following Laser Iridotomy for Pigment Dispersion Syndrome

Peter J. Breingan, MD; Kohji Esaki, MD; Hiroshi Ishikawa, MD; Jeffrey M. Liebmann, MD; David S. Greenfield, MD; Robert Ritch, MD

Objective: To evaluate changes in anterior segment anatomy after laser iridotomy for pigment dispersion syndrome.

Methods: Ultrasound biomicroscopy was performed on 7 eyes of 7 untreated patients with reverse pupillary block and pigment dispersion syndrome. A radially oriented image with the probe perpendicular to the eye in the superior meridian was obtained before and at least 1 week after laser iridotomy in each eye. We assessed changes in angle recess area and iris-lens contact distance.

Results: Mean ± SD patient age was 31.3 ± 5.7 years and mean±SD refractive error was −5.0 ± 3.9 diopters. Angle recess area (mean±SD, 0.78 ± 0.28 vs 0.35 ± 0.11 mm²; P=0.001, paired t test) and iris-lens contact distance (2.05 ± 0.28 vs 0.79 ± 0.13 mm; P=0.001) decreased following iridotomy. Central anterior chamber depth did not change.

Conclusion: Flattening of the iris following laser iridotomy for pigment dispersion syndrome causes a decrease in iris-lens contact and angle width while lens position remains constant.

Arch Ophthalmol. 1999;117:325-328

A PERIPHERAL iris concavity facilitates iridozonular contact and pigment liberation in pigment dispersion syndrome and pigmentary glaucoma. In reverse pupillary block, this concavity is due to greater aqueous humor volume or pressure in the anterior chamber relative to the posterior chamber, which pushes the iris posteriorly. How and why reverse pupillary block develops, however, remains poorly elucidated. It is believed analogous to relative (forward) pupillary block, which leads to angle-closure glaucoma. Like pupillary block, is relieved by laser iridotomy, which produces a planar iris configuration in both disorders. In relative pupillary block, the loss of iris convexity after iridotomy is accompanied by increased iris-lens contact, as the central iris falls backward with the elimination of the aqueous pressure in the posterior chamber. If the reverse pupillary block in pigment dispersion syndrome is analogous to this, then iris-lens contact should increase and the central iris should move anteriorly with the elimination of the aqueous pressure gradient from the anterior to the posterior chamber. To test this hypothesis, we used ultrasound biomicroscopy to evaluate the effect of laser iridotomy on angle width and irido-lenticular contact distance in eyes with pigment dispersion syndrome.

Seven eyes of 7 patients (5 men, 2 women) were enrolled (Table 1). Mean patient age was 31.3 ± 5.7 years (range, 23-37 years). All patients were white. There were 5 left eyes and 2 right eyes. The mean spherical equivalent refractive error was −5.0 ± 3.9 diopters (range, plano to −10.75 diopters). Mean axial length was 26.1 ± 2.1 mm (range, 24.1-29.0 mm). Before iridotomy, all irides had a concave configuration between the iris root and the point of iris-lens contact. After iridotomy, all irides assumed a planar configuration from the insertion at the ciliary face to the peripheral contact with the anterior lens capsule (Figure 2).

Mean angle recess area decreased from 0.78 ± 0.28 mm² before laser iridotomy to 0.35 ± 0.11 mm² after laser iridotomy (P=0.001) (Table 2). Iris-lens contact distance decreased from 2.05 ± 0.28 mm to 0.79 ± 0.13 mm after laser iridotomy (P<0.001). There was no significant change in central anterior chamber depth before (3.4 ± 0.2 mm) vs after (3.3 ± 0.2 mm) iridotomy.

This article is also available on our Web site: www.ama-assn.org/ophth.
**Subjects and Methods**

All patients with pigment dispersion syndrome who had undergone ultrasound biomicroscopic imaging at the New York Eye and Ear Infirmary, New York, both before and after laser iridotomy were included. All patients had had elevated intraocular pressure with or without glaucomatous damage. The use of topical medications other than cholinergic agonists was not grounds for exclusion. Informed consent was obtained from all patients using forms approved by the institutional review board of the New York Eye and Ear Infirmary. Argon laser iridotomy was performed within 1 clock hour of the 12-o’clock meridian in the peripheral iris. The size of the aperture attained was approximately 100 µm in diameter.

Ultrasound biomicroscopy (Humphrey Systems Inc, San Leandro, Calif) was performed using a 50-MHz transducer with tissue penetration of 4 to 5 mm. All scanning was done with the patient in the supine position, while room illumination, fixation, and accommodation were held constant by having the patient fixate with the fellow eye on a ceiling target. A radially oriented image in the superior meridian was obtained before and at least 1 week after laser iridotomy. Anterior chamber depth was obtained by A-scan ultrasonography (Auto Ref-Keratometer RK2; Canon, Tokyo, Japan). Recorded data included age, sex, race, refractive error, axial length, and central anterior chamber depth.

Captured image files were exported as PCX-formatted data via floppy disks into a personal computer. Images were analyzed using a software program of our own design running on Microsoft Windows95 (Microsoft Corp, Seattle, Wash). The position of the scleral spur was defined as the innermost point of a line separating ciliary muscle and scleral fibers and localized on the ultrasound biomicroscopic image by the observer. Angle recess area was defined as the triangular area bordered by the iris pigment epithelium from the pupillary border centrally to the point at which the iris can be discerned to separate from the anterior lens capsule. Anterior chamber depth was also measured along a single A-scan line that penetrated the center of the cornea and the pupil. These 2 variables were measured using a caliper provided in the ultrasound biomicroscopic software.

Postoperative changes in anterior segment anatomy were evaluated statistically using the paired t test. All values are given as mean±SD.

---

**Table 1. Patient Data**

<table>
<thead>
<tr>
<th>Patient No./Age, y/Sex</th>
<th>Eye</th>
<th>Axial Length, mm</th>
<th>Refractive Error, D†</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/23/M</td>
<td>Left</td>
<td>26.2</td>
<td>−1.25</td>
</tr>
<tr>
<td>2/36/M</td>
<td>Left</td>
<td>NA</td>
<td>−8.00</td>
</tr>
<tr>
<td>3/33/M</td>
<td>Right</td>
<td>NA</td>
<td>Plano</td>
</tr>
<tr>
<td>4/37/M</td>
<td>Left</td>
<td>26.0</td>
<td>−5.00</td>
</tr>
<tr>
<td>5/29/F</td>
<td>Right</td>
<td>29.0</td>
<td>−10.75</td>
</tr>
<tr>
<td>6/25/F</td>
<td>Left</td>
<td>25.2</td>
<td>−7.25</td>
</tr>
<tr>
<td>7/36/M</td>
<td>Left</td>
<td>24.1</td>
<td>−3.00</td>
</tr>
</tbody>
</table>

*All patients were white. D indicates diopters; NA, not applicable.†Spherical equivalent.

---

**Comment**

Pigment dispersion syndrome is an autosomal dominant disorder in which iridozonular friction resulting in disruption of the posterior pigment epithelium of the iris is facilitated by a concave iris configuration, which is accentuated by accommodation and reversed by inhibition of blinking, miotic therapy, or laser iridotomy. The epithelial disruption, the dispersion of pigment within the anterior chamber, and pigment deposition on anterior segment structures results in the classic triad of midperipheral, slitlike, radially oriented transillumination defects, Krukenberg spindle, and dense trabecular pigmentation. The iris concavity is believed to result from reverse pupillary block due to increased aqueous pressure or volume in the anterior chamber relative to the posterior chamber. We have hypothesized that blinking results in transfer of a bolus of aqueous humor into the anterior chamber and that subsequent equilibration between the 2 chambers is prevented by an increased iridolenticular contact distance, which might possibly result from a disproportion in the size of the iris relative to that of the anterior segment. Alternatively, the reverse pupillary block itself might flatten the iris against the lens surface.

©1999 American Medical Association. All rights reserved.
Eyes with forward pupillary block have a smaller than normal anterior segment; relative pupillary block typically occurring in hyperopic eyes, which have a shorter than average axial length; a more shallow anterior chamber; a thicker lens; a more anterior lens position; and a smaller radius of corneal curvature.\(^{13-17}\) Eyes with pigment dispersion syndrome are usually myopic and have a greater than normal anterior chamber depth and volume.\(^{18}\) Eyes with forward pupillary block have a convex iris configuration and decreased iridolenticular contact. After iridotomy, the angle width increases, iris configuration becomes planar or even concave, and iridolenticular contact increases (Figure 3).\(^{3}\) If reverse pupillary block is analogous to forward pupillary block, the angle width should decrease, the iris configuration should become planar, and iridolenticular contact should decrease, which is what we have found. In both disorders, iridotomy creates a communication between the anterior and posterior chambers, equalizing pressures across the iris (which can be analogized to an impermeable membrane between 2 solutions) leading to a planar configuration and decreased iridolenticular contact. We found no significant effect of iridotomy on central anterior chamber depth, similar to what has been reported in forward pupillary block.\(^{10}\)

Although our knowledge as to why relative pupillary block develops in pigment dispersion syndrome is incomplete, all evidence supports the concept that a “flap valve” effect allows aqueous to move in a forward direction only. Whether the increased iridolenticular apposition is due to an abnormality of iris size or iris rigidity remains to be elucidated. The development of software to measure iris volume under varying circumstances should facilitate further understanding.

Accepted for publication November 17, 1998.

This study was supported in part by the New York Glaucoma Research Institute, the Department of Ophthalmology.

Table 2. Anterior Chamber Anatomy Before and After Laser Iridotomy\(^{*}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before Laser Iridotomy</th>
<th>After Laser Iridotomy</th>
<th>% Change</th>
<th>(P) Paired t Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC depth, mm</td>
<td>3.4 ± 0.2</td>
<td>3.3 ± 0.2</td>
<td>1.2 ± 2.4</td>
<td>.4</td>
</tr>
<tr>
<td>ARA, mm²</td>
<td>0.78 ± 0.28</td>
<td>0.35 ± 0.11</td>
<td>53.0 ± 10.0</td>
<td>.001</td>
</tr>
<tr>
<td>Anterior chamber angle, degrees</td>
<td>58.4 ± 9.5</td>
<td>42.9 ± 10.7</td>
<td>27.4 ± 9.9</td>
<td>.0001</td>
</tr>
<tr>
<td>Angle opening distance, mm</td>
<td>1.1 ± 0.3</td>
<td>0.5 ± 0.2</td>
<td>50.0 ± 8.4</td>
<td>.00017</td>
</tr>
<tr>
<td>Iris-lens contact distance, mm</td>
<td>2.05 ± 0.28</td>
<td>0.79 ± 0.13</td>
<td>61.7 ± 6.4</td>
<td>&lt;.000</td>
</tr>
</tbody>
</table>

* Data are presented as mean ± SD unless otherwise indicated. AC indicates anterior chamber; ARA, angle recess area.

Figure 2. Left, Iris configuration before laser iridotomy. The iris has a concave configuration. There is a long region of iris-lens contact (white arrow). Black arrow indicates scleral spur. Right, After laser iridotomy and elimination of reverse pupillary block. Arrow indicates laser iridotomy; ARA indicates angle recess area.

Figure 3. Composite ultrasound biomicroscopy of an eye with forward (relative) pupillary block angle-closure. Top, Before iridotomy. Bottom, After iridotomy.
Research Fund of the New York Eye and Ear Infirmary (Dr Esaki), and The David Warfield Fellowship Program in Ophthalmology of the New York Community Trust and the New York Academy of Medicine (Dr Ishikawa), New York, NY.

Presented in part at the annual meeting of the Association for Research in Vision and Ophthalmology, Fort Lauderdale, Fla, May 12, 1998.

Reprints: Robert Ritch, MD, Glaucoma Service, Department of Ophthalmology, New York Eye and Ear Infirmary, 310 E 14th St, New York, NY 10003 (e-mail: ritch@inx.net).

REFERENCES