Vitreoretinal surgery for macular hole after laser assisted in situ keratomileusis for the correction of myopia

J F Arevalo, F J Rodriguez, J L Rosales-Meneses, A Dessouki, C K Chan, R A Mittra, J M Ruiz-Moreno

METHODS

Institutional ethics committee approval and informed consent were obtained for this study. In addition, the study was performed in accordance with the 1964 Declaration of Helsinki. We reviewed the medical records and obtained follow up information on all consecutive patients in our files with full thickness macular hole after LASIK and who subsequently underwent vitreoretinal surgery to repair the macular hole between March 1996 and March 2003 at seven institutions in Venezuela, Colombia, Spain, and the United States. Preoperative examination including a thorough dilated funduscopy with indirect ophthalmoscopy, and slit lamp biomicroscopy was performed by a retina specialist and/or a refractive surgeon. Patients were female in 60.7% of cases, and underwent surgical correction of myopia ranging from −0.75 to −29.00 dioptres (D) (mean −6.19 D). Patients were followed for a mean of 65 months after LASIK (range 6–84 months). Patients who underwent vitreoretinal surgery to repair the macular hole were included in the study independent of the length of follow up.

Before LASIK, a retina specialist and/or a refractive surgeon performed contact or non-contact biomicroscopic evaluation of the fundus to determine posterior vitreous status. After LASIK, a retina specialist performed contact or non-contact biomicroscopic evaluation of the fundus to determine posterior vitreous status and macular hole characteristics. The presence of a Weiss ring was an important index for diagnosing a posterior vitreous detachment (PVD). The data were collected from the clinical records and/or operative reports. Optical coherence tomography (OCT) was used after LASIK by the retina specialist to confirm the macular hole, and its characteristics. In addition, OCT was used after vitrectomy to confirm the status of the macular hole.

Vitrectomy was used to repair the macular hole in all cases with gas (C3F8 (n = 6) or SF6 (n = 6)), and prone positioning. A mechanical posterior hyaloid detachment was created in those cases with a stage 2 or 3 macular hole. In addition, internal limiting membrane peeling was performed in four of our cases with trypan blue (MembraneBlue, Dorn International bv, Zuidland, Netherlands) or indocyanine green (IC green, Akorn Inc, Decatur, IL, USA) staining.

RESULTS

We found 14 eyes (13 patients) with full thickness macular hole after LASIK. The macular hole formed 1–83 months after LASIK (mean 13 months). In 57.1% of cases it developed ≤6 months after LASIK, and in 28.5% of cases it developed 1 year or more after LASIK. Eleven (84.6%) patients were female. The mean age was 45.5 years old (range 25–65 years). All eyes with myopic macular hole after LASIK were myopic (range −0.50 to −19.75 dioptres (D); mean −8.4 D). Posterior vitreous detachment was not present before and was documented after LASIK in 42.8% of eyes. Most macular hole were unilateral, stage 4 macular hole, had no yellow deposits on the retinal pigment epithelium, had no associated epiretinal membrane, were centric, and had subretinal fluid. The mean diameter of the hole was 385.3 μm (range 200–750 μm). A vitrectomy closed the macular hole on all eyes with an improvement on final best corrected visual acuity (VA) on 13 out of 14 (92.8%) patients.

Abbreviations: IC, indocyanine; LASIK, laser assisted in situ keratomileusis; OCT, optical coherence tomography; PRK, photorefractive keratotomy; PVD, posterior vitreous detachment; VA, visual acuity
to 18 months) after the diagnosis of macular hole. Surgery closed the macular hole on all 14 eyes that underwent surgical management with an improvement on final best corrected visual acuity in 13 out of 14 (92.8%) patients (table 2). The mean follow up after surgery was 17.7 months (3–70 months).

Table 2 outlines detailed characteristics of the macular hole of our case series. The mean diameter of the macular hole was 385.3 μm, and the range was from 200 to 750 μm. A centric macular hole was found in all eyes. The macular hole was unilateral in 12 of 13 patients (although one of those patients had an impending macular hole (stage 1) in the fellow eye). A stage 4 macular hole was found in seven eyes (50%). There was absence of yellow deposits on the retinal pigment epithelium (RPE) of the macular hole in 12 eyes (85.7%). Twelve eyes (85.7%) lacked a surrounding epiretinal membrane (ERM). Twelve eyes (85.7%) had subretinal fluid surrounding the macular hole; four of those eyes (all with –10.00 D of myopia) had extensive subretinal fluid in the posterior fundus (table 1).

A vitrectomy closed the macular hole on all eyes with an improvement on final best corrected visual acuity (VA) on 13 out of 14 (92.8%) patients. Poor VA (20/200 or worse) occurred in four (28.5%) eyes as a result of associated extensive subretinal fluid in the posterior fundus, and cataract. Six (42.8%) eyes out of 14 eyes had a VA outcome of 20/100. Only four (28.5%) eyes out of 14 eyes had a VA outcome of 20/40 (table 2).

### SELECTED CASE REPORT

A 30 year old woman (case 2), with –13.00 D of myopia in the right (RE) and –10.00 D in the left eye (LE), underwent bilateral laser in situ keratomileusis in June 2001. Six months after surgery, she noted the onset of blurred vision involving her LE. Retinal examination revealed a stage 4 macular hole in the LE (fig 1A) associated with a posterior pole retinal.

### Table 1

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Eye</th>
<th>Age (years)</th>
<th>Rx (SE)</th>
<th>Time after LASIK (months)</th>
<th>Stage of MH</th>
<th>Yellow deposits</th>
<th>Location</th>
<th>Cuff of SRF</th>
<th>PVD before LASIK</th>
<th>PVD after LASIK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>L</td>
<td>42</td>
<td>(-) 0.50</td>
<td>8</td>
<td>Stage 1 MH</td>
<td>No</td>
<td>Yes</td>
<td>400</td>
<td>Centric</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>L</td>
<td>30</td>
<td>(-) 10.00</td>
<td>6</td>
<td>OK</td>
<td>No</td>
<td>No</td>
<td>380</td>
<td>Centric</td>
<td>PPRD</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>R</td>
<td>25</td>
<td>(-) 4.50</td>
<td>1</td>
<td>OK</td>
<td>Yes</td>
<td>Yes</td>
<td>400</td>
<td>Centric</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>L</td>
<td>57</td>
<td>(-) 9.00</td>
<td>6</td>
<td>OK</td>
<td>No</td>
<td>No</td>
<td>390</td>
<td>Centric</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>L</td>
<td>34</td>
<td>(-) 9.00</td>
<td>5</td>
<td>OK</td>
<td>No</td>
<td>No</td>
<td>500</td>
<td>Centric</td>
<td>RRD</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>L</td>
<td>48</td>
<td>(-) 8.25</td>
<td>5</td>
<td>Lattice</td>
<td>No</td>
<td>Yes</td>
<td>200</td>
<td>Centric</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>R</td>
<td>54</td>
<td>(-) 3.50</td>
<td>6</td>
<td>Lattice</td>
<td>No</td>
<td>No</td>
<td>200</td>
<td>Centric</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>L</td>
<td>35</td>
<td>(-) 7.75</td>
<td>14</td>
<td>OK</td>
<td>No</td>
<td>No</td>
<td>200</td>
<td>Centric</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>L</td>
<td>52</td>
<td>(-) 14.50</td>
<td>2</td>
<td>OK</td>
<td>No</td>
<td>No</td>
<td>550</td>
<td>Centric</td>
<td>PPRD</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>L</td>
<td>45</td>
<td>(-) 7.75</td>
<td>6</td>
<td>#15</td>
<td>No</td>
<td>No</td>
<td>500</td>
<td>Centric</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>L</td>
<td>45</td>
<td>(-) 8.75</td>
<td>11</td>
<td>#14</td>
<td>No</td>
<td>No</td>
<td>400</td>
<td>Centric</td>
<td>Yes</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>R</td>
<td>52</td>
<td>(-) 7.75</td>
<td>18</td>
<td>VMTS</td>
<td>No</td>
<td>Yes</td>
<td>200</td>
<td>Centric</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>L</td>
<td>53</td>
<td>(-) 6.75</td>
<td>12</td>
<td>OK</td>
<td>Yes</td>
<td>No</td>
<td>325</td>
<td>Centric</td>
<td>No</td>
</tr>
<tr>
<td>14</td>
<td>M</td>
<td>R</td>
<td>65</td>
<td>(-) 19.75</td>
<td>83</td>
<td>OK</td>
<td>No</td>
<td>No</td>
<td>750</td>
<td>Centric</td>
<td>PPRD</td>
</tr>
</tbody>
</table>

MH, macular hole; PPRD, posterior pole retinal detachment; ERM, epiretinal membrane; SRF, subretinal fluid; Rx, refraction; PVD, posterior vitreous detachment; VMTS, vitreomacular traction syndrome; RRD, rhegmatogenous retinal detachment; SE, spherical equivalent; R, right eye; L, left eye.

### Table 2

<table>
<thead>
<tr>
<th>Patient</th>
<th>Treatment</th>
<th>VA w/MH</th>
<th>Final VA</th>
<th>F-U (months)</th>
<th>Excimer laser</th>
<th>Microkeratore</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vit + gas</td>
<td>20/50</td>
<td>20/25</td>
<td>9</td>
<td>Chiron Technolas Keracor 217</td>
<td>Chiron automated corneal shaper</td>
</tr>
<tr>
<td>2</td>
<td>Vit + gas</td>
<td>CF</td>
<td>20/150</td>
<td>4</td>
<td>Nidek EC-5000</td>
<td>Nidek MK-2000</td>
</tr>
<tr>
<td>3</td>
<td>Vit + gas</td>
<td>20/200</td>
<td>20/30</td>
<td>7</td>
<td>Nidek EC-5000</td>
<td>Nidek MK-2000</td>
</tr>
<tr>
<td>4</td>
<td>Vit + gas</td>
<td>20/220</td>
<td>20/80</td>
<td>4</td>
<td>Chiron Technolas Keracor 217</td>
<td>Chiron automated corneal shaper</td>
</tr>
<tr>
<td>5</td>
<td>Vit + gas</td>
<td>CF</td>
<td>20/200</td>
<td>10</td>
<td>Nidek EC-5000</td>
<td>Hansatome</td>
</tr>
<tr>
<td>6</td>
<td>Vit + gas</td>
<td>CF</td>
<td>20/200</td>
<td>12</td>
<td>Nidek EC-5000</td>
<td>Chiron automated corneal shaper</td>
</tr>
<tr>
<td>7</td>
<td>Vit + gas</td>
<td>20/200</td>
<td>20/100</td>
<td>28</td>
<td>Nidek EC-5000</td>
<td>Chiron automated corneal shaper</td>
</tr>
<tr>
<td>8</td>
<td>Vit + gas</td>
<td>CF</td>
<td>20/400</td>
<td>24</td>
<td>Visx 20/20</td>
<td>Visx 20/20</td>
</tr>
<tr>
<td>9</td>
<td>Vit + LAM+ gas</td>
<td>20/80</td>
<td>20/40</td>
<td>24</td>
<td>Visx 20/20</td>
<td>Visx 20/20</td>
</tr>
<tr>
<td>10</td>
<td>Vit + LAM+ gas</td>
<td>20/80</td>
<td>20/25</td>
<td>20</td>
<td>Visx 20/20</td>
<td>Visx 20/20</td>
</tr>
<tr>
<td>11</td>
<td>Vit + Sil Oil</td>
<td>20/80</td>
<td>20/200</td>
<td>11</td>
<td>Nidek EC-5000</td>
<td>Chiron automated corneal shaper</td>
</tr>
<tr>
<td>12</td>
<td>Vit + Sil Oil</td>
<td>20/80</td>
<td>20/200</td>
<td>41</td>
<td>Chiron Technolas Keracor 217</td>
<td>Chiron automated corneal shaper</td>
</tr>
<tr>
<td>13</td>
<td>Vit+LAM+gas</td>
<td>20/100</td>
<td>20/50</td>
<td>3</td>
<td>Visx 20/20</td>
<td>Chiron automated corneal shaper</td>
</tr>
<tr>
<td>14</td>
<td>Vit+ LAM+ Sil Oil</td>
<td>HM</td>
<td>20/200</td>
<td>3</td>
<td>Visx 20/20</td>
<td>Chiron automated corneal shaper</td>
</tr>
</tbody>
</table>

LASIK, laser in situ keratomileusis; MH, macular hole; VA, visual acuity; LP, light perception; CF, counting fingers; HM, hand movements; F-U, follow up after last surgery; w/MH, before macular hole surgery; Vit, vitrectomy; Sil Oil, silicone oil; LAM, internal limiting membrane peeling; Chiron Technolas Keracor 217, Bausch & Lomb Surgical, Inc, San Dimas, CA, USA; Ladar Vision 4000, Alcon Laboratories, Inc, Fort Worth, TX, USA; Nidek EC-5000, Nidek Co, Ltd, Gamagori, Japan; Coherent Schwind Keratom II, Coherent; Santa Clara, CA, USA; VISX 20/20, VISX USA, Inc, Santa Clara, CA, USA; Chiron automated corneal shaper, Bausch & Lomb Surgical, Inc, San Dimas, CA, USA; Carriazo Barraquer, Maria USA, Doylestown, PA, USA; Hansatome, Bausch & Lomb Surgical, Inc, San Dimas, CA, USA; Nidek MK 2000, Nidek Co, Ltd, Gamagori, Japan; Maria one, Maria USA, Doylestown, PA, USA.
Vitreoretinal surgery for macular hole after LASIK

In summary, we present 14 eyes of 13 patients with no presurgical sign of a macular hole, which developed a full thickness macular hole after laser in situ keratomileusis. Our study shows that vitreoretinal surgery can be successful in restoring vision for most myopic eyes with a macular hole after LASIK. Vitreoretinal interface changes may have a role in macular hole formation after LASIK for the correction of myopia. Future prospective investigation involving a large number of myopic eyes with ultrasonic or ocular coherence tomographic studies may be valuable for determining vitreoretinal interface changes before and after LASIK.

Authors’ affiliations
J F Arevalo, Retina and Vitreous Service, Clinica Oftalmologica Centro Caracas, Caracas, Venezuela
F J Rodríguez, Fundacion Oftalmologica Nacional (Fundonal), Bogota, Colombia
J L Rosales-Meneses, Unidad Oftalmologica y de Cirugia Vitreo Retina La Colina, San Cristobal, Venezuela
A Dessouki, Retinal Diagnostic Center, Campbell, CA, USA
C K Chan, Southern California Desert Retina Consultants, Palm Springs, CA, USA

Figure 1 (A) Retinal examination revealed a stage 4 macular hole (arrow) in the left eye associated with a posterior pole retinal detachment, and a best corrected visual acuity (BCVA) of counting fingers. (B) Optical coherence tomography (OCT) image showing features of both foveal retinal detachment and retinoschisis. (C) OCT after vitrectomy reveals a closed macular hole with a BCVA of 20/150.
R A Mittra, Vitreoretinal Surgery, PA Minneapolis, MN, USA
J M Ruiz-Moreno, The Vitreo-Retinal Unit, Instituto Oftalmologico
Alicante and Miguel Hernandez University School of Medicine, Alicante, Spain

Supported in part by the Fundacion Arevalo-Coutinho para la Investigacion en Oftalmologia (FACO), Caracas, Venezuela.

The authors have no proprietary or financial interest in any products or techniques described in this article.

Correspondence to: J Fernando Arevalo, MD, Clinica Oftalmologica
Centro Caracas, Centro Caracas PH-1, Av Panteon, San Bernardino, Caracas 1010, Venezuela; arevalo1@telcel.net.ve

Accepted for publication 1 July 2005

REFERENCES


11th European Forum on Quality Improvement in Health Care

26–28 April 2006, Prague, Czech Republic

For further information please go to: www.quality.bmjpg.com

Book early to benefit from a discounted delegate rate
Vitreoretinal surgery for macular hole after laser assisted in situ keratomileusis for the correction of myopia
J F Arevalo, F J Rodriguez, J L Rosales-Meneses, A Dessouki, C K Chan, R A Mittra and J M Ruiz-Moreno

Br J Ophthalmol 2005 89: 1423-1426
doi: 10.1136/bjo.2005.074542

Updated information and services can be found at:
http://bjo.bmj.com/content/89/11/1423

These include:

References
This article cites 21 articles, 0 of which you can access for free at:
http://bjo.bmj.com/content/89/11/1423#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections
- Retina (1608)
- Ophthalmologic surgical procedures (1223)
- Optic nerve (713)
- Optics and refraction (508)
- Vitreous (147)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/