Endophthalmitis associated with the Ahmed glaucoma valve implant

A A Al-Torbak, S Al-Shahwan, I Al-Jadaan, A Al-Hommadi, D P Edward

EXTENDED REPORT

Aim: To investigate the rate, risk factors, clinical course, and treatment outcomes of endophthalmitis following glaucoma drainage implant (GDI) surgery.

Methods: A computerised relational database search was conducted to identify all patients who were implanted with Ahmed glaucoma valve (AGV) and developed endophthalmitis following surgery at the King Khaled Eye Specialist Hospital in Riyadh, Saudi Arabia, between 1 January 1994 and 30 November 2003. Only medical records of the patients who developed endophthalmitis were retrospectively reviewed.

Results: 542 eyes of 505 patients who were on active follow up were included in the study. Endophthalmitis developed in nine (1.7%) eyes; the rate was five times higher in children than in adults. Delayed endophthalmitis (developed 6 weeks after surgery) occurred in eight of nine eyes. Conjunctival erosion overlying the AGV tube was present in six of nine eyes. Common organisms isolated in the vitreous included *Haemophilus influenzae* and *Streptococcus* species. Multiple regression analysis revealed that younger age and conjunctival erosion over the tube were significant risk factors associated with endophthalmitis.

Conclusion: Endophthalmitis is a rare complication of GDI surgery that appears to be more common in children. Conjunctival dehiscence over the GDI tube seems to represent a major risk factor for endophthalmitis. Prompt surgical revision of an exposed GDI tube is highly recommended.

Glaucoma drainage implants (GDIs) have become an important method of controlling intraocular pressure (IOP) in patients with refractory glaucoma. Surgery with GDIs is associated with similar operative and post-operative complications that may occur after filtering surgery such as hypotony, hyphaema, cataract, corneal decompensation, and failure to control IOP.1 In addition, several unique complications may develop with GDIs related to the presence of an implanted foreign body such as dioplopia2 and transcorneal tube erosion.3

Although endophthalmitis is a rare complication after GDI surgery, the exact rate is not known.4 Several retrospective studies of GDIs have included a single case or a few cases of endophthalmitis resulting in rates ranging from 0.8% to 6.3%.5–13

We report the rate, clinical course, risk factors, and treatment outcomes of endophthalmitis associated with Ahmed glaucoma valve implant (New World Medical, Rancho Cucamonga, CA, USA) at one institution.

METHODS

This study was reviewed and approved by the institutional review board of the King Khaled Eye Specialist Hospital (KKESH). A computerised relational database search was conducted to identify all patients who were implanted with Ahmed glaucoma valve (AGV), surgery at the King Khaled Eye Specialist Hospital in Riyadh, Saudi Arabia, between 1 January 1994 and 30 November 2003. This group of patients was further screened to identify those who were on active follow up and had no concurrent procedures performed with the AGV implant. Patients who developed AGV related endophthalmitis in this group were included in this study. Only medical records of the patients who developed endophthalmitis were retrospectively reviewed. Patients identified were divided into adult and paediatric groups; those below 18 years of age were considered children as defined by the World Health Organization.

Multiple surgeons performed the AGV implant procedures. In the majority of cases a limbal based conjunctival flap was created between superior and lateral recti muscles. The valve plate was secured 8–10 mm posterior to the limbus using an 8–0 non-absorbable suture. The tube was cut to an appropriate length and inserted into the anterior chamber through a 23 gauge needle track and covered by either donor sclera, dura, or pericardial patch graft. Autologous scleral patch graft was not used in any of the procedures. Patients younger than 6 months with an axial length less than 22 mm received the paediatric model (AGV; model S1). Otherwise the adult model (AGV; model S2) was used. The AGV was the only glaucoma valve implant used at KKESH during the period of the study and other glaucoma drainage implants were not available for comparison.

Based on the chart review, data of patients who developed endophthalmitis following AGV implant surgery were collected and reviewed. This included demographic information, clinical settings, pertinent operative and preoperative data, culture sites, and type of organisms. In addition, treatments and treatment outcomes were also noted. Diagnosis of endophthalmitis was based on clinical findings and ultrasonography.

A multiple regression analysis was performed to determine how the variables of age (above and below 18 years of age) and the presence or absence of conjunctival erosion related to endophthalmitis. Statistical analyses were conducted using GB STAT 10.0 (Dynamic Microsystems, Inc, Silver Spring, MD, USA).

RESULTS

The relational database search identified 102 patients (113 eyes) under age 18 years (paediatric), and 403 patients (429 eyes) over age 18 years (adult) who underwent AGV surgery.
Table 1 Demographics, clinical settings, culture sites, and type of organism

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Glaucoma diagnosis</th>
<th>Mitomycin C use</th>
<th>Implant location</th>
<th>Type of patch graft</th>
<th>Interval (days)</th>
<th>Duration (days)</th>
<th>Presenting visual acuity</th>
<th>Tube erosion</th>
<th>Culture site</th>
<th>Organism(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.8</td>
<td>F</td>
<td>Congenital glaucoma</td>
<td>Yes</td>
<td>IT</td>
<td>Sclera</td>
<td>63</td>
<td>7</td>
<td>NR</td>
<td>No</td>
<td>AC, VIT</td>
<td>Haemophilus influenzae, Streptococcus pneumoniae, Streptococcus agalactiae</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>F</td>
<td>Congenital glaucoma</td>
<td>Yes</td>
<td>ST</td>
<td>Pericardium</td>
<td>30</td>
<td>5</td>
<td>NR</td>
<td>Yes</td>
<td>AC, VIT</td>
<td>Streptococcus pneumoniae</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>F</td>
<td>Congenital glaucoma</td>
<td>Yes</td>
<td>IT</td>
<td>Dura</td>
<td>104</td>
<td>2</td>
<td>NR</td>
<td>Yes</td>
<td>VIT</td>
<td>No growth</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>M</td>
<td>Congenital glaucoma</td>
<td>Yes</td>
<td>ST</td>
<td>Dura</td>
<td>270</td>
<td>5</td>
<td>LP</td>
<td>No</td>
<td>VIT</td>
<td>Streptococcus pneumoniae</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>F</td>
<td>Secondary glaucoma</td>
<td>Yes</td>
<td>ST</td>
<td>Dura</td>
<td>210</td>
<td>2</td>
<td>CF</td>
<td>Yes</td>
<td>AC, VIT</td>
<td>Haemophilus influenzae</td>
</tr>
<tr>
<td>6</td>
<td>43</td>
<td>M</td>
<td>Secondary glaucoma</td>
<td>Yes</td>
<td>SN</td>
<td>Sclera</td>
<td>180</td>
<td>4</td>
<td>CF</td>
<td>Yes</td>
<td>AC, VIT</td>
<td>Streptococcus agalactiae</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>F</td>
<td>Secondary glaucoma</td>
<td>No</td>
<td>ST</td>
<td>Dura</td>
<td>306</td>
<td>2</td>
<td>CF</td>
<td>No</td>
<td>VIT</td>
<td>Streptococcus miltis</td>
</tr>
<tr>
<td>8</td>
<td>78</td>
<td>M</td>
<td>Secondary glaucoma</td>
<td>No</td>
<td>ST</td>
<td>Dura</td>
<td>330</td>
<td>5</td>
<td>Poor LP</td>
<td>Yes</td>
<td>VIT</td>
<td>Pseudomonas aeruginosa</td>
</tr>
</tbody>
</table>

AC, anterior chamber; CF, counting fingers; F, female; HM, hand movements; LP, light perception; IT, inferotemporal; M, male; NR, not recorded since patient was sedated; SN, superonasal; ST, superotemporal; VIT, vitreous.

*Interval between AGV implant surgery and endophthalmitis diagnosis; duration of symptom before diagnosis of endophthalmitis.

The most common previous glaucoma surgery was trabeculectomy with antimetabolite (mitomycin C was used as an adjunct in eight of nine eyes). Three eyes received the Ahmed glaucoma valve implant.

Conjunctival erosion over the tube was noticed in six of nine eyes and four of six eyes had a Siedel positive leak. The site of conjunctival erosion was near the limbus in three of six eyes and four of six eyes had a Siedel positive leak. The site of conjunctival erosion was at the tube plate junction.

Vitrous cultures were positive for the infecting organism(s) in seven of nine eyes and negative in two of nine eyes. Haemophilus influenzae and Streptococcus pneumoniae were isolated from the culture sites in children. In adults, organisms causing ACV related endophthalmitis were isolated from the culture sites in children. In adults, organisms causing ACV related endophthalmitis were isolated from the culture sites in children.

The median duration between onset of symptoms and diagnosis of endophthalmitis was 26 days (range 6-330 days). Delayed onset endophthalmitis (developed more than 3 weeks after initial implant surgery) occurred in eight of nine eyes and was ultimately diagnosed after 10 days. The median interval between ACV implant surgery and diagnosis of endophthalmitis was 260 days (range 63-630 days). Delayed onset endophthalmitis occurred in eight of nine eyes and was ultimately diagnosed after 10 days. The median interval between ACV implant surgery and diagnosis of endophthalmitis was 260 days (range 63-630 days). Delayed onset endophthalmitis occurred in eight of nine eyes and was ultimately diagnosed after 10 days.

The mean age of all patients at the time of endophthalmitis was 28.3 years (range 0.8-78 years); 2.2 years (range 0.8-28.3 years) for the pediatric age group and four (0.9%) in the adult age group. The mean age of patients at the time of endophthalmitis was 28.3 years (range 0.8-78 years); 2.2 years (range 0.8-28.3 years) for the pediatric age group and four (0.9%) in the adult age group.

The mean age of all patients at the time of endophthalmitis was 28.3 years (range 0.8-78 years); 2.2 years (range 0.8-28.3 years) for the pediatric age group and four (0.9%) in the adult age group.

The mean age of all patients at the time of endophthalmitis was 28.3 years (range 0.8-78 years); 2.2 years (range 0.8-28.3 years) for the pediatric age group and four (0.9%) in the adult age group.

The mean age of all patients at the time of endophthalmitis was 28.3 years (range 0.8-78 years); 2.2 years (range 0.8-28.3 years) for the pediatric age group and four (0.9%) in the adult age group.

The mean age of all patients at the time of endophthalmitis was 28.3 years (range 0.8-78 years); 2.2 years (range 0.8-28.3 years) for the pediatric age group and four (0.9%) in the adult age group.

The mean age of all patients at the time of endophthalmitis was 28.3 years (range 0.8-78 years); 2.2 years (range 0.8-28.3 years) for the pediatric age group and four (0.9%) in the adult age group.
Three of nine patients had a final visual acuity outcome of no light perception and six of nine patients attained a final visual acuity of light perception or better. None achieved a final visual acuity of better than 20/200.

**DISCUSSION**

Glaucoma drainage implants (GDIs) have become increasingly useful in surgical management of glaucoma that is refractory to standard filtering surgery. Although intraocular pressure may be successfully controlled, postoperative complications do occur. This large series from a single institution highlights the clinical features, risk factors, and outcomes that have been previously only presented in small case series.

In our series the overall rate of endophthalmitis was 1.7%. We compared this rate with an analysis of endophthalmitis rates following all shunts in the literature. The Krupin Eye Valve Filtering Surgery Study Group reported an endophthalmitis rate of 1.3% following a Krupin valve implant. Recently, Morad et al reported three cases of endophthalmitis following AGV implant surgery in an adult patient. In our series the patient with early endophthalmitis was a child. Moreover, endophthalmitis has also been described after tube repositioning and needling. Such presentations were not seen in our series.

Tube exposure following conjunctival erosion in AGV implant appeared to be a major risk factor for the development of endophthalmitis as shown by regression analysis in our series. Other series have also reported conjunctival tube erosion without risk analysis. Gedde et al reported four cases of endophthalmitis associated with GDIs. In their series all cases were associated with conjunctival erosion overlying the tube. Recently, Morad et al reported three cases of endophthalmitis following AGV. Two of these cases were noted to have tube exposure at the time of presentation. In our series, six of nine eyes were found to have conjunctival erosion over the tube at the time of presentation. The conjunctival erosion was at the limbus in three of six eyes.

### Table 2  Treatment performed and clinical outcomes

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Tap/injection</th>
<th>Intravitreal injections</th>
<th>Implant removed</th>
<th>Sensitivity of organism</th>
<th>Pre-infection</th>
<th>Visual acuity</th>
<th>IOP (mm Hg)</th>
<th>Medications</th>
<th>Follow up (months)</th>
<th>Post-infection</th>
<th>Visual acuity</th>
<th>IOP (mm Hg)</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PPV</td>
<td>V, A</td>
<td>No V</td>
<td>V</td>
<td>HM</td>
<td>14</td>
<td>2</td>
<td>4</td>
<td>NLP</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Top</td>
<td>V, C</td>
<td>Yes V, B</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Top</td>
<td>V, A</td>
<td>Yes V, B</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Top</td>
<td>V, A</td>
<td>Yes V, B</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>PPV</td>
<td>V, C, D</td>
<td>No V, E</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Top</td>
<td>V, A</td>
<td>Yes V, B</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Top</td>
<td>V, A, D</td>
<td>Yes V, P</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>PPV</td>
<td>V, C, D</td>
<td>No V, B</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Primary evisceration</td>
<td>NA</td>
<td>Yes T</td>
<td>FO</td>
<td>FL</td>
<td>18</td>
<td>0</td>
<td>9</td>
<td>NLP</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A, amikacin; AM, ampicillin; B, bacitracin; C, ceftazidime; CE, cefadrox; CF, counting fingers; D, dexamethazone; E, erythromycin; FL, follow light; FO, follow objects; HM, hand movements; LP, light perception; NA, not applicable; NLP, no light perception; P, penicillin; T, tobramycin; V, vancomycin.

### Table 3  Endophthalmitis associated with GDIs reported in various studies

<table>
<thead>
<tr>
<th>Source</th>
<th>Study date</th>
<th>Number of cases</th>
<th>Number of endophthalmitis cases</th>
<th>% of endophthalmitis</th>
<th>Type of implant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Munoz et al</td>
<td>1991</td>
<td>53</td>
<td>1</td>
<td>1.9</td>
<td>Molteno</td>
</tr>
<tr>
<td>Hill et al</td>
<td>1991</td>
<td>70</td>
<td>1</td>
<td>1.4</td>
<td>Molteno</td>
</tr>
<tr>
<td>Chihara et al</td>
<td>1992</td>
<td>16</td>
<td>1</td>
<td>6.3</td>
<td>White pump</td>
</tr>
<tr>
<td>The Krupin Eye Valve Filtering Surgery Study Group</td>
<td>1994</td>
<td>50</td>
<td>2</td>
<td>4</td>
<td>Krupin valve with disc</td>
</tr>
<tr>
<td>Lloyd et al</td>
<td>1994</td>
<td>73</td>
<td>1</td>
<td>1.4</td>
<td>Baerveldt</td>
</tr>
<tr>
<td>Perkins et al</td>
<td>1995</td>
<td>21</td>
<td>1</td>
<td>4.8</td>
<td>Molteno</td>
</tr>
<tr>
<td>Price and Wellemeyer</td>
<td>1995</td>
<td>76</td>
<td>1</td>
<td>1.3</td>
<td>Molteno</td>
</tr>
<tr>
<td>Law et al</td>
<td>1996</td>
<td>38</td>
<td>1</td>
<td>2.6</td>
<td>Molteno</td>
</tr>
<tr>
<td>Nguyen et al</td>
<td>1998</td>
<td>107</td>
<td>1</td>
<td>0.9</td>
<td>Baerveldt</td>
</tr>
<tr>
<td>Diodone et al</td>
<td>2001</td>
<td>35</td>
<td>1</td>
<td>2.6</td>
<td>Ahmed</td>
</tr>
<tr>
<td>Krishna et al</td>
<td>2001</td>
<td>63</td>
<td>2</td>
<td>3.1</td>
<td>Baerveldt</td>
</tr>
<tr>
<td>Taglia et al</td>
<td>2002</td>
<td>27</td>
<td>1</td>
<td>3.7</td>
<td>Molteno</td>
</tr>
<tr>
<td>Morad et al</td>
<td>2003</td>
<td>60</td>
<td>3</td>
<td>5</td>
<td>Ahmed</td>
</tr>
<tr>
<td>Sesh et al</td>
<td>2003</td>
<td>124</td>
<td>1</td>
<td>0.8</td>
<td>Baerveldt</td>
</tr>
<tr>
<td>Tsai et al</td>
<td>2003</td>
<td>70</td>
<td>1</td>
<td>1.4</td>
<td>Baerveldt</td>
</tr>
<tr>
<td>Present study</td>
<td>2004</td>
<td>542</td>
<td>9</td>
<td>1.7</td>
<td>Ahmed</td>
</tr>
</tbody>
</table>

Total 1427 27 1.9
and at other locations in others. It did not appear to be related to the conjunctival incision line which was a few millimetres away from the limbus in the majority of the cases. Reasons for conjunctival erosion over patch grafts and tube are not totally clear and are possibly multifactorial. Most patients had multiple previous conjunctival surgeries with exposure to antimetabolites; in addition seven of nine eyes had received mitomycin C during implant surgery and this may have played a part in the erosion of the conjunctiva. The rate of tube erosion through the conjunctiva can be reduced by covering the anterior portion of the tube by a patch graft. Different tissues have been utilised as a patch graft and these include sclera,29 dura mater,30 fascia lata,31 pericardium,32 and autologous craz.33 Conjunctival erosion overlying the tube in our series occurred despite the use of a dura mater patch graft in five eyes, a donor sclera patch graft in three eyes, and a pericardial patch graft in one eye. The eroded conjunctiva surrounding the tube probably serves as a conduit by which normal flora may pass from the ocular surface into the eye. Given the increased risk of endophthalmitis, we recommend prompt surgical revision in all cases in which there is an exposure to a GDI.

Organisms causing endophthalmitis following GDIs in children are Haemophilus influenzae, Streptococcus pneumonia or both. In our series, cultures revealed Streptococcus pneumonia in two eyes and H influenzae in one eye. Both organisms were cultured from one eye (patient 4). Gedde et al14, and Al-Torbak and Edward15 reported H influenzae caused endophthalmitis following GDIs in two separate paediatric patients. This is not surprising as H influenzae and Streptococcus pneumonia are part of the normal bacterial flora of the conjunctiva and upper respiratory tract, and a common cause of infection in both tissues.14,15 In adults, organisms causing GDI related endophthalmitis include coagulase negative and coagulase positive Staphylococcus species, Streptococcus pneumonia, and Pseudomonas aeruginosa.14,16,26 In our series other Gram positive organisms including Streptococcus agalactiae and Streptococcus mitis were isolated from the vitreous sample in two separate eyes. Pseudomonas aeruginosa was a cause of severe endophthalmitis in one eye that was initially treated by evisceration. It appears that in general, bacterial flora causing GDI related endophthalmitis in Saudi Arabia are similar to those reported in patients from the Western hemisphere.

Recommendations for the removal of the glaucoma shunt device at the time of treatment in an eye with endophthalmitis remain unclear. Gedde and Perkins recommended shunt removal at the time of treatment because of concern the shunt might serve as a reservoir for the infectious organism.4,26 In contrast, others have reported successful outcomes with intravitreal antibiotics without removing the shunt device.23,25 In our series, there appeared to be no difference in final visual acuity relating to whether the implant was or was not removed at the time of treatment. However, it must be noted our sample size is too small to make any definite recommendations.

It is unclear whether pars plana vitrectomy with intravitreal antibiotics injection or vitreous tap with intravitreal antibiotics injection alone is the treatment of choice for GDI related endophthalmitis. Morad et al5 reported three cases of endophthalmitis following AGV implant surgery. All cases were treated with implant removal, vitrectomy and intravitreal antibiotics; two eyes progressed to phthisis. Francis et al21 reported poor outcome with vitreous tap and intravitreal antibiotics injection in a patient who developed endophthalmitis following a Baerveldt drainage implant despite rapid treatment. In our series it appeared that either initial approach to treatment (pars plana vitrectomy with intravitreal antibiotics or intravitreal antibiotic injection alone) did not have a significant impact on the final visual outcome. These findings may have been influenced by the relatively long interval between onset of symptoms and presentation.

In our series the visual outcome is poor. Of note is that most patients had poor visual acuity before the onset of infection because of either advanced glaucoma or corneal opacities.

In conclusion, endophthalmitis is a rare complication following AGV implant surgery and is usually delayed in onset. The rate of endophthalmitis following AGV implant surgery in the paediatric age group was five times higher than in adults. Conjunctival erosions over the AGV tube were present in most cases and seem to represent a major risk factor for endophthalmitis. Prompt surgical revision of such erosions is highly recommended.

Authors’ affiliations
A A Al-Torbak, S Al-Shahwan, I Al-Jadaan, Department of Ophthalmology, King Khaled Eye Specialist Hospital, Riyadh, Saudi Arabia
A Al-Hommadi, Department of Research, King Khaled Eye Specialist Hospital, Riyadh, Saudi Arabia
D P Edward, Department of Ophthalmology, University of Illinois, Chicago, IL, USA

Presented in part as a paper at the annual meeting of the Saudi Ophthalmological Society, 2–5 March 2003, Riyadh, Saudi Arabia.

REFERENCES

---

Video reports

To view the video reports in full visit our website www.bjophthalmol.com and click on the link to the video reports.

- The Nuclear Slide: A novel approach for unleashing the potential of the hydrodissection wave. A Naseri
- Giant pleomorphic adenoma of the lacrimal gland: pre- and post-operative function. A Jain, V I Nehru, U N Saikia, C E E Reddy
- Limbal-sparing lamellar keratoplasty. S L Watson, S Rauz, J Dart
- Bilateral Abducens Neuromyotonia. L H Osina, N Aui-aree, D P Anderson
- Light to dark physiological variation in irido-trabecular angle width. G M Gazzard, P J Foster, D S Friedman, P T Khaw, S K L Seah

Video Suite: Triamcinolone-assisted vitrectomy
- Triamcinolone-assisted removal of the posterior hyaloid to repair retinal detachment due to macular hole in high myopia. A Ueno, H Enaida, Y Hata, T Nakamura, T Hisatomi, K Fujisawa, T Kubota, T Sakamoto, T Ishibashi
- Triamcinolone acetonide-assisted Epiretinal Membrane Peeling. S D M Chen, C K Patel
- A suture technique to manage a case of severe early flap displacement after laser in situ keratomileusis. L Spadea, P Piantaleti, G Bianco
- Reconstruction of the Ocular Surface in LOGIC Syndrome. E Moore, V Kumar, J R Ainsworth, S Shah
- Laser Photocoagulation for Posterior Segment Intraocular Parasites. T Prabriputaloong, S Aswaphureekorn
- Feeder Vessel Treatment with High Speed ICG Angiography. D Stanesco-Segall, G Coscas, F Coscas, G Soubrane
- Endoscopy to aid anterior segment surgery. J E Moore, A Sharm
- Penetrating ocular injury due to a fish hook: Surgical removal. S D M Chen, D Chiu, C K Patel
- Retinal Ganglion Cell Axon Response to Guidance Molecules. S F Oster and D W Sretavan
- Marin-Amat Syndrome. A Jogiya, C Sandy
- Excision of subcutaneous Dirofilariaiasis of the eyelid. D Mallick, T P Ittyerah
- Thixotropy: a novel explanation for the cause of lagophthalmos after peripheral facial nerve palsy. M Aramideh, J H T M Koelman, P P Devriese, F VanderWerf, J D Speelman
- Surgical revision of leaking filtering blebs with an autologous conjunctival graft. K Taherian, A Azaara-Blanco
- Dipetalonema Reconidium in the human eye. T Huynh, J Thean, R Maini
Endophthalmitis associated with the Ahmed glaucoma valve implant

A A Al-Torbak, S Al-Shahwan, I Al-Jadaan, A Al-Hommadi and D P Edward

doi: 10.1136/bjo.2004.049015

Updated information and services can be found at:
http://bjo.bmj.com/content/89/4/454

These include:

References
This article cites 34 articles, 0 of which you can access for free at:
http://bjo.bmj.com/content/89/4/454#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
Angle (1006)
Glaucoma (988)
Intraocular pressure (1002)
Choroid (565)
Eye (globe) (708)
Paediatrics (358)

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/