External drainage of subretinal fluid during scleral buckling procedures is considered by many ophthalmologists to be a rather dangerous and uncontrolled process owing to the potential for complications such as retinal incarceration, subretinal hemorrhage, and loss of vitreous. Typically, drainage is monitored externally, with only intermittent use of indirect ophthalmoscopy to assess drainage progression and retinal flattening. We present a variant technique that entails continuous, rather than intermittent, monitoring of subretinal fluid drainage via indirect ophthalmoscopy. Using this technique, we report a series with a 2.0% incidence of subretinal hemorrhage and no retinal incarceration or loss of vitreous. Continuous monitoring of drainage with indirect ophthalmoscopy results in a safer and more controlled drainage process by allowing for immediate detection and correction of impending drainage complications.
complications.13 External indicators of drainage complications include premature cessation of SRF drainage, indicating possible retinal incarceration, or bleeding from the drainage site, indicating possible choroidal, subretinal, or vitreous hemorrhage. With external monitoring, an evolving drainage complication may worsen prior to being discovered, a situation that would not occur during continuous internal monitoring of drainage with IO. Descriptions of SRF drainage using the Charles technique,13 which uses a needle and syringe, do indeed emphasize continuous IO monitoring; however, to our knowledge, continuous monitoring has not been emphasized as an integral component of the suture needle drainage technique.18 The advantages of suture needle drainage over the Charles technique include a reduced risk for retinal incarceration as the needle is withdrawn from the eye as soon as drainage begins and before the retina flattens, as well as the ability to increase eye pressure to either promote drainage or cause tamponade should bleeding be detected.

We describe a variant technique of suture needle drainage of SRF that emphasizes continuous IO monitoring of the entire process of drainage until the retina is flat or nearly so. Continuous IO monitoring allows the surgeon to identify imminent complications and manage them before they jeopardize anatomic or visual outcomes. In addition to limiting drainage complications, continuous IO monitoring enables near-complete drainage of SRF, with theoretically better anatomic and visual outcomes. Studies have shown that the persistence of SRF postoperatively does delay the recovery of VA.20,21 Near-complete drainage of SRF prior to application of cryotherapy in macula-off cases also decreases the risk for submacular pigment dispersion. In addition, SRF drainage permits a larger gas tamponade, decreasing the need for restrictive patient positioning, which makes outpatient surgery more feasible. We contend that continuous monitoring of SRF drainage with IO provides a safer, more effective, and more controlled means of reducing complications during SB procedures, while also facilitating near-complete drainage of SRF.

### METHODS

We conducted a retrospective, single-surgeon, chart review of consecutive patients who underwent SB with SRF drainage from February 7, 2008, through December 28, 2010, and reviewed anatomic and visual outcomes, as well as postoperative complications. A total of 57 patients underwent primary SB, of whom had drainage of SRF with continuous IO monitoring. All failures of primary retinal reattachment with SB were successfully treated with a single reoperation via PPV. Visual acuity was recorded preoperatively and postoperatively using a Snellen chart. The VAs were converted to logMAR values for averaging and statistical analysis using the t test function in Microsoft Excel, and then converted back to the nearest whole-number Snellen values for data reporting.

The average age of the patients was 53 years (range, 18-73 years), with 57% being male. Of the 49 patients who underwent drainage, 47 were phakic and 29 had macula-on RDs. Both acute and chronic RDs were represented in the patient population. Thirty-seven of the 49 patients had an acute RD following posterior vitreous detachment. Of the acute RD population, the average age was 60 years (range, 42-73 years) and 39% were male. Twelve of 49 patients had chronic RD associated with lattice degeneration. Of the chronic RD group, the male to female ratio was equal, and the average age was 33 years (range, 18-45 years).

The technique of continuous monitoring of SRF drainage is performed as follows. After localization of all retinal tears, cryopexy is applied to all retinal tears, except in cases of macula-off detachments, in which cryopexy is applied after drainage. An encircling band (type 41 or type 287 wide groove) is placed and sutures to support, if indicated, either a radial sponge (type 506) or segmental sponge (type 506) are placed. A drainage site is chosen adjacent to one of the rectus muscles. A radial incision is made through the sclera to the level of the choroid with preplacement of a 4-0 nylon suture across the incision for future closure. An assistant uses a 4-0 silk suture to pull the encircling band aside; meanwhile, the surgeon performs a single-pass puncture of the choroid with a 6-0 tapered-tip silk suture needle. As soon as drainage is established, the surgeon uses IO to observe the entire process of SRF drainage internally and monitor for complications. A cotton-tipped applicator (CTA) is used as a scleral depressor.

During the course of drainage, if liquid vitreous is observed to be passing through the tear, the CTA is rotated with pressure over the tear externally, while verifying via IO that the tear has been closed internally. This generally stops or substantially lessens drainage of liquid vitreous. If subretinal bleeding is noted, this can be arrested via external tamponade using the CTA over the drain site. It is useful to observe the fluttering of the retina during the process of drainage, as this indicates unimpeded drainage. The absence of retinal fluttering or the presence of retinal dimpling can indicate imminent retinal incarceration as the retina tends to dimple as it nears the chorioretinal drainage site. If dimpling of the retina toward the drainage site is observed, the drainage site is massaged with the CTA in a rolling fashion, which will release the dimpled retina, preventing incarceration. Flattening of the retina against the RPE is observed as the last of the SRF drains (video, http://www.jamaophth.com).

### RESULTS

In the macula-on and macula-off groups who underwent drainage, there was a 2.0% rate (1 of 49) of premature SRF drainage with a suture pass, and a 2.0% rate (1 of 49) of subretinal hemorrhage, which was small but submacular (Table 1). There were no

<table>
<thead>
<tr>
<th>No. (%)</th>
<th>Drainage During Suture Pass</th>
<th>Hemorrhage</th>
<th>Retinal Incarceration</th>
<th>Loss of Vitreous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage complications (n = 49)</td>
<td>1 (2.0)</td>
<td>1 (2.0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

### Table 1. Incidence of Complications During Drainage of SRF

Abbreviation: SRF, subretinal fluid.
Table 2. Reoperations Required With PPV After Persistent RD

<table>
<thead>
<tr>
<th>Drainage</th>
<th>Macula-on (n = 29)</th>
<th>Macula-on (n = 8)</th>
<th>Macula-off (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reoperations with PPV, No. (%)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>1 (3.4)</td>
<td>2 (25.0)</td>
<td>4 (20.0)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: PPV, pars plana vitrectomy; RD, retinal detachments.

Table 3. Comparison of Preoperative and Postoperative Visual Outcomes in Macula-on and Macula-off RDs With or Without Drainage of SRF During Scleral Buckling Procedures

<table>
<thead>
<tr>
<th>Type of Retinal Detachment</th>
<th>Drainage</th>
<th>Average Preoperative Vision</th>
<th>Average Postoperative Vision</th>
<th>P Value for Change in Snellen VA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Snellen VA</td>
<td>Counting Fingers</td>
<td>Hand Motion</td>
</tr>
<tr>
<td>Macula-on (n = 29)</td>
<td>Yes</td>
<td>20/27</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Macula-on (n = 8)</td>
<td>No</td>
<td>20/30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Macula-off (n = 20)</td>
<td>Yes</td>
<td>20/158</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Abbreviations: RD, retinal detachment; SRF, subretinal fluid; VA, visual acuity.

complications related to loss of vitreous or retinal incarceration. The reoperation rates for the macula-on detachment with drainage group was 3.4% (1 of 29), 25.0% (2 of 8) for the macula-on without drainage group, and 20.0% (4 of 20) for the macula-off group with drainage (Table 2). The single-operation success rate of retinal reattachment in patients who underwent SB with SRF drainage was 90% (44 of 49). Of the 5 cases requiring reoperation with PPV, 2 cases involved inferior tears that failed to close, 2 cases were complicated by early proliferative vitreoretinopathy, and 1 case was associated with the occurrence of a new retinal tear 6 weeks postoperatively.

In macula-on detachments that underwent drainage, VA was maintained at an average of 20/27, with no significant difference noted between preoperative and postoperative VAs (Table 3). In this group, 1 patient's VA decreased from 20/20 to counting fingers after the initial SB procedure, but the patient was lost to follow-up. In macula-on detachments that did not undergo drainage, no significant difference was noted between preoperative and postoperative VAs (Table 3). In the macula-off detachment group with drainage, the VA significantly improved from an average of 20/158 preoperatively to 20/58 postoperatively (P < .005; Table 3). Also in this group, 4 patients could count fingers and 2 were hand motion preoperatively, but they attained an average postoperative VA of 20/45.

**COMMENT**

The initial success rate of retinal reattachment was 90% (44 of 49), which is comparable with, and higher than, many published ranges.1,7,12 The complication rates we attained using a variant technique involving continuous IO monitoring were lower than other published studies using similar surgery needle drainage techniques without continuous monitoring.18,19 While we reported a 2.0% rate of hemorrhage with no incidence of retinal incarceration or loss of vitreous, Aylward et al19 reported a 28.3% rate of total hemorrhage with a 2.2% rate of retinal incarceration. Likewise, Raymond et al18 reported a 13.8% rate of overall hemorrhage. Wilkinson and Bradford12 used a similar technique with a cold diathermy pin instead of a surgery needle and reported a 3.1% incidence of small subretinal hemorrhage, 2.2% incidence (12 of 556) of retinal incarceration, and a 0.4% incidence (2 of 556) of loss of vitreous.

Using the Charles drainage technique,11 Burton et al11 reported a 22.2% incidence (10 of 45) of hemorrhage with no retinal incarcerations, whereas Jaffe et al16 reported a 4.3% incidence (8 of 187) of small subretinal hemorrhage with no retinal incarcerations. Direct comparison of these studies is limited by differences in patient populations, case numbers, exclusion criteria, surgeon experience, and definitions of complications, but it is reasonable to postulate that the drastic differences in the incidences of hemorrhage, for instance, may be related to slight differences in surgical techniques, such as the choice of choroidal puncture instrument, and the amount of emphasis placed on the importance of using IO to internally monitor complications.

The incidence and morbidity of complications associated with drainage of SRF during SB procedures can be reduced by using IO to continuously monitor drainage of SRF. Internal IO monitoring allows imminent complications to be detected before significant damage occurs, whereas with external or intermittent internal monitoring, complications such as hemorrhage, retinal incarceration, and loss of vitreous may become much more advanced before detection. The major advantage of continuous IO monitoring of drainage is that it permits the surgeon more control over the drainage process, which was considered previously to be a rather uncontrolled, and thus dangerous, process. Scleral buckling remains a safe and effective lens-sparing means of repairing RDs. The technique of continuous IO monitoring of SRF drain-
Age can reduce the rate of complications that have deterred many ophthalmologists and patients away from SB for retinal reattachment.

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