Functional and Anatomical Outcomes of Minimal Posture Macular Hole Surgery

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Aim: To determine functional and anatomical outcome of macular hole surgery with minimal postoperative posturing for idiopathic macular holes.

Methods: 46 eyes of 45 patients who underwent 20g/23g vitrectomy with dye assisted ILM peeling and gas tamponade were analysed. Patients were instructed to lie prone for 3 days only. OCT was done to determine the type of hole closure and assess photoreceptor recovery. Visual acuity was compared pre- and postoperatively.

Results: Hole closure was achieved in 44 eyes (96%) – Type-1 closure (69.6%), type-2 closure (28.3%). The mean visual acuity was 1.3 LogMAR units preoperatively and improved to 0.6 log mar units postoperatively. 63% eyes with type-1 closure and 67% eyes with type-2 closure showed vision improvement. 18 eyes received combined primary phacovitrectomy and 8 eyes needed early cataract surgery within 3 months post vitrectomy. Recovery of IS/OS (photoreceptor) layer on spectral OCT was complete in 8 eyes (17.4%) and incomplete (focal, diffuse loss) in rest and correlated with visual outcome.

Conclusions: Macular hole surgery with minimal face-down posturing provides satisfactory anatomical and functional results with no significant complications and therefore may be a more acceptable and less cumbersome option especially in those unable to maintain the traditional prolonged post-op posturing.

Introduction
Several studies have shown that pars plana vitrectomy with gas tamponade for idiopathic macular hole results in hole closure and long-term improvement in visual acuity in most eyes. From the inception of this technique by Kelly and Wendell in the early 1990s, face-down positioning has been deemed to be an essential component of the procedure. As surgical techniques have evolved, hole closure rates have risen steadily, with many studies reporting success rates of 90% and above. Internal limiting membrane (ILM) peeling has definitely aided in successful closure of macular holes especially when repair of larger or longstanding defects is undertaken. For many years, there has been debate concerning the optimum duration of face-down posturing following macular hole surgery. Face-down posturing was thought to be essential for hole closure, but recent OCT studies have indicated that a macular hole can close as soon as 1 day after surgery if the tractional forces have been adequately relieved. The speed of hole closure has led some to suggest that face-down posturing is not needed. Most patients find face-down posturing difficult and the prospect of posturing may deter patients from having surgery. Posturing is particularly difficult for older people, obese and those who live alone or have poor mobility. Posturing has also been associated increase the risk of thromboembolism and other neurological problems.

Aim
To determine functional and anatomical outcome of macular hole surgery with minimal postoperative posturing for idiopathic macular holes

Materials and Methods
This was a prospective study of patients who had undergone minimal posture macular hole surgery at Chaithanya Eye Hospital and Research Institute between November 2008 and December 2010. Patients who underwent the standard 2 week post op positioning were not part of this analysis. All stages and sizes of macular hole were included in study. Data collected from the patient charts included patient age and gender, lens status prior to surgery, preoperative visual acuity, other retinal and ocular diseases, stage of macular hole, postoperative visual acuity, hole closure status after surgery, type of hole closure, whether or not cataract surgery was done during vitrectomy or later during follow-up, list of any complications and final follow-up duration in months. All patients underwent a standard 20 g or 23 g three-port pars plana vitrectomy. Patients who had a significant cataract had cataract extraction with IOL implantation before the commencement of vitrectomy. Significant cataract was defined as more than NS2, any PSCC or cortical cataract involving the visual axis. ILM peeling was done in all cases after staining the ILM with brilliant blue dye which was kept in contact for at least 1 minute. Epiretinal membrane (ERM) peeling was performed whenever required. Fluid-air exchange was performed at the end of surgery and intravitreal 15% C3F8 was injected. Postoperatively, patients were instructed to position their head in a face-down position for 3 days only. Following this, they were instructed to avoid the supine position for 10 days and to sleep on their side at night. Patients who completed a minimal period of 3 months were included in the study. Patients who developed any significant cataract in this period which was responsible for the visual deficit underwent cataract surgery SOS. All Snellen visual acuities were converted to logMAR for purposes of...
Results

46 eyes of 45 patients were included in the study. The mean age was 59.7 years (range 51–72). There were 10 males (22.2%) and 35 females (77.8%). 2 eyes (4.4%) had stage 2 holes, 35 eyes (76.1%) had stage 3 macular hole, and 9 eyes (19.6%) had stage 4 macular hole. The mean duration of macular hole evaluated from history was 6.58 mths (range 0.5 to 12 mths).

The mean basal diameter of macular hole was 991.01 microns (range 474 microns to 1360 microns). OCT features included CME and SRF in all eyes (100%), incompletely detached posterior hyaloid in 22 eyes, completely detached posterior hyaloid in 13 eyes and no posterior hyaloid detachment in 11 eyes. At baseline, 33 eyes (71.7%) were phakic, and 13 eyes (28.3%) were pseudophakic. 17 eyes (37%) underwent 20g vitrectomy while 29 eyes (63%) underwent 23g vitrectomy.

The mean follow-up was 6.2 months with a minimum follow-up of 4 months.

Out of the 33 phakic eyes significant cataract was seen in 18 eyes (54.6%) and these eyes underwent a planned phacoemulsification cataract surgery with the vitrectomy procedure. The remainder of the phakic eyes had their lenses intact at the end of surgery. Out of these remaining 15 eyes, 8 eyes developed significant cataract in the early post operative period and needed early cataract surgery with IOL implantation within 3 months of follow up. In these cases cataract surgery was done at 2 months after the absorption of the gas bubble. Thus out of the 33 phakic eyes, 26 eyes (78.8%) underwent cataract extraction.

Closure of the macular hole was acheived in 44 out of 46 eyes (95.7%). Type 1 closure was seen in 32 eyes (69.6%) and type 2 closure was seen in 12 eyes (26.1%) (Fig 1,3). In 2 eyes (4.4%) the macular hole did not close with persistant subretinal fluid. Both these patients were offered resurgery with repelling of ILM under guarded visual prognosis but these patients were unwilling for the resurgery.
Table 1: Photoreceptor recovery after macular hole surgery

<table>
<thead>
<tr>
<th>Status of photoreceptor recovery</th>
<th>No (%)</th>
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<tbody>
<tr>
<td>Complete recovery of IS/OS layer</td>
<td>8 (17.4%)</td>
</tr>
<tr>
<td>Diffuse loss of IS/OS layer</td>
<td>22 (47.8%)</td>
</tr>
<tr>
<td>Focal loss of IS/OS layer</td>
<td>12 (26.1%)</td>
</tr>
<tr>
<td>Could not be determined</td>
<td>4 (8.7%)</td>
</tr>
</tbody>
</table>

Fig 4: Recovery of photoreceptor after macular hole surgery. 
A- Complete recovery of IS/OS layer, B- Focal loss of IS/OS layer, C- Diffuse loss of IS/OS layer

Eyes with normal ISOS and ELM and eyes with focal ISOS loss showed the best improvement in visual acuity. Among the eyes with diffuse loss of IS/OS some eyes especially those where the foveolar photoreceptors recovered demonstrated vision improvement while others had poor visual outcome.

1 patient with a type 1 closed macular hole developed a subtotal retinal detachment at 3 months due to an iatrogenic hole close to the dominant sclerotomy port and needed scleral buckling with repeat gas injection. The closed macular hole in this patient did not open and needed no intervention. The visual acuity in this patient after RD surgery remained at 6/36 which was the baseline vision. No other ocular complication was seen. None of the patients had any systemic problems due to the posturing and all the patients found this modification of posturing less cumbersome.

Discussion

The present study found that minimal posturing after macular hole surgery with brilliant blue stained ILM peeling and C3F8 tamponade achieves 96% hole closure rate. The mean visual acuity improved by 0.7 log MAR units after surgery. 78.8% of phakic eyes had undergone cataract surgery extraction along with scleral buckling with repeat gas injection. The closed macular hole in this patient did not open and needed no intervention. The visual acuity in this patient after RD surgery remained at 6/36 which was the baseline vision. No other ocular complication was seen. None of the patients had any systemic problems due to the posturing and all the patients found this modification of posturing less cumbersome.

Initial postoperative positioning regimens longer than 2 weeks were developed at a time when ILM peeling was not commonly employed. The greater relief of traction obtained with this technique may have diminished the importance of prolonged prone positioning. A recent investigation into the physical mechanism by which gas tamponade effects hole closure has revealed that surface tension rather than buoyancy may be the factor most responsible for flattening the edges of a macular hole. Berger and Brucker convincingly argue this point using Archimedes principle to measure the buoyant pressure exerted by an intraocular gas bubble (0.08 mm Hg for a bubble 1 mm in height). They further note that as long as tangential traction has been relieved with ERM and/or ILM dissection, variation of bubble buoyant pressures is not likely to affect adequate tamponade of macular holes. This would seem to imply that position of the head would not be important as long as the gas bubble is large enough to allow for contact with the hole for a sustained period. This sustained contact is easier to achieve with prolonged prone positioning, but reasonable contact between the hole and the gas bubble could be achieved with strict avoidance of the supine position alone. A larger gas bubble appears necessary for sustained contact to occur in the absence of prone positioning and is facilitated by performing as complete a vitrectomy as possible and taking the time to achieve as complete an air–fluid exchange as possible. In our study, although patients were positioned for 3 days only, with the use of C3F8 gas and avoidance of supine positioning, contact between the bubble and the macular hole would have been present for at least several days.

Another variable which needs closer examination is the role of combined cataract and macular hole surgery. Many
advocates of shortened or eliminated face-down posturing have suggested that in patients who are not posturing, cataract extraction is needed.\textsuperscript{13,14} Cataract surgery is advocated for two reasons. First, it has been proposed that lensectomy may allow more complete vitrectomy and better gas fill. This may allow support of posterior pole, even with the patient sitting upright, and eliminate need for posturing face-down. This theory is supported by the observation of Guillaubey et al\textsuperscript{11} that there was higher success rate in patients face-down. This theory is supported by the observation of Guillaubey et al\textsuperscript{11} that there was higher success rate in patients having a combined macular hole and cataract surgery compared with those having macular hole surgery alone (96.8\% vs 89.8\%). The second reason for combined cataract macular hole surgery is that cataract is the most common complication following macular hole surgery, occurring in up to 64\% of eyes within 1 year\textsuperscript{15}. For the phakic eye, not posturing can lead to an increased rate cataract progression. Tranos et al\textsuperscript{19} found significantly more cataract progression in non-posturing (5/16, 31\%) than posturing group (1/23, 4\%, p 0.009). In our study 8/15 (53.3\%) of phakic eyes that did not undergo cataract surgery primarily developed cataract early in post-op period which could be attributed to the modification in positioning.

Guillaubey et al\textsuperscript{11} found no significant difference in closure rate with or without face-down posturing with surgery for small macular holes. In contrast, for holes >400 microns, the success rate was significantly higher for those that postured face-down (95.1\% vs 79.5\%, p 0.45). This suggests that perhaps macular hole surgery should be tailored to individual patient with small holes being treated differently to larger holes. Previous studies have also shown that closure rate is related to the initial size of the macular hole\textsuperscript{16}. The mean basal hole diameter in this study was 991.01 microns. Though larger this study found 96\% closure rate with ILM peeling and minimal posturing.

Visual outcomes are more difficult to assess than closure rates and are more likely influenced by preoperative differences in initial visual acuity, hole size and duration, follow-up period and concurrent cataract surgery. Dhawahir-Scala et al\textsuperscript{10} and Simcock et al\textsuperscript{11} both had reported that there was no significant difference in patients improving by two or more lines of vision whether posturing for less than 24 h or longer. In our series 65.2\% eyes showed vision improvement. This good visual outcome has to be interpreted keeping in mind the fact that 56.5\% had also undergone cataract surgery along with macular hole surgery. Comparing baseline hole diameter and visual outcome, eyes which had 6/12 or better had smaller holes at baseline (mean 790.33 microns) compared to eyes with 6/18-6/36 vision (mean 902.71 microns) and eyes with 6/60 and worse vision (mean 1280 microns).

It is reported that despite high anatomical closure rates after macular hole surgery, vision remains compromised in 30–40\% of patients\textsuperscript{17,18}. Recent OCT studies suggest that defects in outer retina may explain why vision is compromised despite hole closure. Christensen et al\textsuperscript{19} reported that attenuation and disruption of foveal photoreceptor layer were present in the majority of patients with surgically closed macular holes and seen whether ILM peeling had been performed or not. They found that postoperative photoreceptor layer thickness >33 mm and photoreceptor layer discontinuity with a diameter of <177 mm was associated with an eye having regained reading vision after macular hole surgery. In our study also eyes with normal ISOS and ELM and eyes with focal ISOS loss showed the best improvement in visual acuity. Among the eyes with diffuse loss of IS/OS some eyes especially those where the foveolar photoreceptors recovered demonstrated vision improvement while others had poor visual outcome.

The type of hole closure defined the visual outcome. Kang et al\textsuperscript{12} had defined type 1 and type 2 closure after macular hole surgery and found 61.3\% type 1 closure and 38.7\% type 2 closure in their series. The extent of postoperative visual improvement of type 1 closure group was larger than that of type 2 closure group (p = 0.002). In this study Type 1 closure was seen in 69.6\% eyes and type 2 closure was seen in 26.1\% eyes. 75\% with type 1 closure had vision improvement, compared to 50\% with type 2 closure.

The intravitreal application of brilliant blue dye has been suggested to facilitate macular hole surgery because it has been shown to selectively stain the internal limiting membrane (ILM). Several advantages compared with other dyes such as indocyanine green or trypan blue have been reported. In particular, BB did not show apoptotic death of retinal cells as it was found in laboratory investigations on indocyanine green and trypan blue\textsuperscript{20}.

To conclude Macular hole surgery with minimal face-down posturing provides satisfactory anatomical and functional results with no significant complications and therefore may be a more acceptable and less cumbersome option especially in those unable to maintain the traditional prolonged post-op posturing.

References