Macular holes

Predictive values in macular hole repair

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Optical coherence tomography improves the management of persistent macular holes

Very little information is available about persistent macular holes, and most of the information was provided in the early 1990s. The lack of interest in this group of patients may be related to the increasing primary success rates or because publications about macular hole surgery in the last years have mainly concentrated on technical advances, delamination of the internal limiting membrane (ILM), different staining techniques and possible toxicity of dyes.

Recent literature on macular hole surgery report very high success rates, but regardless of the specific surgical techniques used, not all macular holes are able to be closed after primary surgery. A meta-analysis on 1654 eyes treated using different techniques reported that 87.5% of eyes achieved anatomic success, with 12.5% failing to close.[1] Therefore, persistence of a macular hole after vitrectomy is still one of the major complications of this type of surgery.

When a macular hole remains open, usually the size and diameter of the hole increases markedly, visual acuity drops, and the surgeon is confronted with the question as to whether retreatment is worthwile or not. It is an accepted fact that anatomic and functional success in eyes having failed previous macular hole surgery is lower than after primary surgery, although different studies have demonstrated appreciable results.[2 3] This also implies that the benefit–risk ratio for repeat surgery is lower in persistent macular holes. Certainly, it should be our goal to further refine our surgical technique to allow closure of all holes, but we should not forget to also focus our efforts on the analysis of predictive factors determining not only surgical but also functional success in order to better advise our patients. In this issue of the journal, Hillenkamp *et al* have addressed this problem ***(see page 1445)***.[4]

Previous studies on prognostic factors for primary idiopathic macular hole repair have shown that a smaller macular hole size, better initial visual acuity, shorter duration of the hole and earlier-stage macular holes are associated with better anatomical and visual prognoses. Therefore, our clinical impression suggests that persistent macular holes have a poorer prognosis due to their larger size, poorer initial visual acuity and longer duration of the macular hole. Especially in this group of patients, predictive values would be of major help for an adequate selection of patients.

Hillenkamp *et al* showed that the preoperative configuration of a persistent macular hole visualised by optical coherence tomography (OCT) correlates with anatomical and functional outcome. Little is to be found in the literature, only small patient series exist about the retreatment of persisting macular holes,[2 3] and even less is to be found about predictive values in this selected subgroup of patients. Smiddy *et al*[2] found that preoperative visual acuity better than 20/80 was the only factor associated with a better final visual acuity. They further observed that the interval length between the surgeries did not affect the functional outcome.

Persistent macular holes must be differentiated from reopened macular holes which occurred mainly in the era before ILM removal.[5] Yoshida and Kishi found recurring epiretinal membranes as the main cause of reopening in eyes in which the ILM was not peeled during primary surgery.[6] With ILM peeling, reopening has become extremely rare, indicating that ILM removal prevents reopening of macular holes. It is speculative as to whether ILM peeling is related to prevention of epiretinal traction forces, or to inducing a more extensive and stronger glial response.

There can be a variety of reasons for the failure of primary surgery such as poor patient compliance or traction from a residual or recurrent epiretinal membrane. But, in most cases, there is no obvious cause. In the patient series described by Hillenkamp *et al*, no residual traction was evident after the initial surgery, indicating that ILM peeling prevents further epiretinal membrane formation.[4]

The advent of OCT has allowed us to examine and measure macular pathology objectively and precisely, and meanwhile several studies with quantitative analysis on primary macular holes are available. Tadayoni *et al* found that ILM removal may not be useful in macular holes smaller than 400 µm in diameter.[7] Recent OCT studies have shown that the base and minimum diameters of the hole are strongly predictive of postoperative success or failure in macular hole surgery and that visual results decrease with increasing hole size.[8 9] In a retrospective series of 40 eyes examined with OCT, Ip *et al*[9] found a closure rate of 92% for idiopathic macular holes smaller than 400 µm in diameter vs 56% for larger holes. The smaller the hole, the better the outcome—not really an unexpected finding. Interestingly, the duration of symptoms did not correlate with the diameters measured. These aforementioned studies only highlight the relationship between macular hole size and anatomic closure. Other factors such as initial visual acuity and the duration or stage of the hole may also be considered. However, the size of the hole measured by OCT seems the most suitable parameter to consider, as it is an objective and reproducible measurement and has already been clearly shown to be an important factor predictive of postoperative closure. However, in contrast to primary macular hole surgery, there seems to be no correlation between hole size and outcome in persistent macular holes.

The biomicroscopic impression of enlargement of the macular hole after failed initial surgery is caused either by enlargement of the surrounding detached rim or by atrophy of the hole margins and has to be differentiated because of its different impact on visual prognosis. Enlargement of the hole is observed regardless of whether the ILM was removed or not. Absent vitreous and free access of aqueous may be responsible for enlargement of the surrounding cuff. Transferring OCT correlations in primary hole surgery to treatment recommendations for persistent macular holes, one might advise against further surgery, expecting limited anatomical and functional results. However, Hillenkamp *et al* provide information that retinal thickness at the hole border is an important predictive OCT value, and a thicker border is associated with a better outcome. The mechanism of visual loss for macular holes is therefore probably not only neurosensory loss, but also the effect of a surrounding cuff of subretinal fluid. This explains the improvement of microperimetry function after closure of the macular hole. This is in accordance with the findings of Kusuhura *et al*, who described the ratio of hole height to base diameter of the hole, calculated from OCT transverse images as a prognostic factor for visual outcome. The larger the hole height and the smaller the base diameter, the better the visual outcome.[10]

In previous studies, it has been shown that the success rate of primary macular hole surgery decreases with increasing duration of visual loss and reduced preoperative visual acuity.[11] This opinion is currently changing. A recent study by Stec *et al* reported a visual improvement in most patients having chronic macular holes of more than 1-year duration.[12] A recent study reported that low visual acuity and significant impairment on visual quality of life preoperatively made patients most likely to benefit from macular hole surgery, suggesting that it is sensible to indicate retreatment, even if the visual acuity is low.[13] Consequently, a cuff of subretinal fluid around the hole can be considered strongly predictive of postoperative functional success or failure of macular hole closure; macular hole duration and baseline visual acuity seem to be of less importance.

Sayanagi *et al* have shown in persistent macular holes in highly myopic eyes that reduction of the postoperative macular hole size led to a better postoperative outcome also in patients with retinal detachment.[14] Therefore, it is justified to make every possible effort to achieve this goal. As with previous reports,[15 16] Hillenkamp *et al* found that the anatomical success rate after reoperation of persistent macular holes is lower than after primary surgery, reporting a closure rate of 68%. The present study further shows the heterogeneity and broad variety of surgical approaches used for the retreatment of persistent macular holes. ILM peeling is the most recent change in the procedure for macular hole surgery and is certainly the first therapeutic goal in persistent macular holes. However, it is unclear which treatment strategy is best when the ILM has been already peeled off. Repeat fluid–gas exchange alone can sometimes lead to the closure of macular holes that persist after vitrectomy, but several adjunctive techniques have been suggested to promote glial proliferation and macular hole closure. Earlier, these included photocoagulation applied to the retinal pigment epithelium (RPE) in the hole bed[17 18] or scraping of the RPE.[15 16] Nowadays, most surgeons advocate repeat surgery with more aggressive membrane peeling or the supplemental use of adjuvants such as autologous platelet concentrate. Conventional silicone oil or the use of longer acting gases has been suggested as well. Recently, heavy silicone oil was recommended, since it requires no postoperative positioning and allows a long-term tamponade of the hole.[19]

Observation of a larger number of patients is required to evaluate the potential influence of the retreatment strategy and its impact on the final visual outcome. In the absence of such proof, it is difficult to select the subgroup with a persistent macular hole for which the potential benefit of a reoperation is highest.

Since the persistence of a macular hole is a rare complication, most studies published include only a limited number of patients and lack control groups. As a consequence, no reliable data and no clear guidelines exist. Therefore, the study of Hillenkamp *et al* is valuable despite its retrospective study design because of the fairly large number of patients followed. The study provides us with the useful information that the preoperative appearance of persistent macular holes on OCT scans correlate with visual outcomes. Prognostic features of persistent macular holes are extremely valuable for the selection of patients for whom a potential benefit of retreatment might outweigh the risks and who are most likely to benefit from surgery. Hillenkamp *et al* found out that macular hole size, type of tamponade, macular hole duration prior to the initial surgery or preoperative visual acuity did not correlate significantly with visual or anatomic success.[4] Thus, the indication of retreatment should be based on the presence of a subretinal fluid cuff at the break margin. Because it is difficult to trace the margins of a persistent macular hole after surgery using biomicroscopy, OCT is a helpful tool to precisely measure macular hole size and visualise the detached cuff objectively.

Visual failure despite hole closure, however, remains an important clinical problem. Other factors such as status of the foveal photoreceptors or the retinal pigment epithelium may also influence visual outcome. Using currently available time-domain or Fourier-domain based OCT-systems, the resolution is still not high enough to visualise or predict irreversible photoreceptor damage, loss of neural elements or RPE cells. Thus, OCT cannot yet answer the question why visual loss persists despite anatomical closure. This may be possible with further refinements of OCT technology which may then hopefully enable us to exactly define the prognosis of the individual patient. Further studies should focus on predictive values for primary treatment as well as retreatment, to improve functional outcomes that too often do not replicate the anatomical results.

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