Visual and Anatomical Outcomes of Vitreous Surgery for Large Macular Holes

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Abstract:

Purpose: To report the visual and anatomical results of surgery for large macular holes.

Methods: Retrospective interventional case series of 33 consecutive patients with macular hole of more than 1000 microns on Optical Coherence Tomography (OCT) who underwent vitrectomy with internal limiting membrane (ILM) peeling and intravitreal gas tamponade between January 2006 to December 2007 were included in the study. All patients had undergone preoperative OCT measurements; repeat OCT was done every 3 months thereafter. Outcome measures were visual acuity and anatomical closure.

Results: 33 eyes of 33 patients with a mean age of 62.96 years were included. Mean preoperative base diameter was 1259 microns (1006 - 1809 microns). Mean follow-up was 9.12 months (2 months - 25 months). Mean post op BCVA was 1.02 logMAR units, which had improved to 0.87 logMAR units postoperatively with a mean improvement of 0.15 logMAR units (p 0.017). Best corrected visual acuity improved or stabilized in 27 of 33 eyes (81.8 %) Anatomic closure using OCT was seen in 23 of 33 eyes (69.7 %).

Conclusion: In large macular holes vitrectomy with ILM peeling appears to be a beneficial treatment.

Introduction

The first clinical description of a macular hole was published by Henry Noyes in 1871. Since then our understanding of development and pathogenesis of macular holes has improved. However, it took more than 100 years, until Kelly and Wendell reported the first successful closure of a series of macular holes by pars plana vitrectomy and induction of posterior vitreous detachment in 1991. Several authors have reported significantly higher rates of anatomical closure and visual rehabilitation in many of these cases. The postoperative success rate varies between 86 % and 95 % with improvement in visual acuity in a large percentage of cases.

Recent attempts to use imaging techniques such as confocal scanning laser tomograph and the scanning laser ophthalmoscope to predict success suggest a correlation between the macular hole size and visual recovery. This study used optical coherence tomography (OCT) to measure the preoperative macular hole size and correlated this with the postoperative rate of anatomical closure.
OCT is a recently introduced diagnostic tool for high resolution, cross sectional imaging of the posterior and anterior segment of the eye with an axial resolution of 10 μm and a transverse resolution of 30 μm. OCT has been of immense use in understanding the pathogenesis and staging of macular holes, prognostication and grading of the surgical outcomes as well.

There has always been a controversy on the maximum size of hole which can be operated. In our study we report the anatomical and functional outcomes following surgery for large macular holes with a minimum diameter of 1000 microns.

**Materials and Methods**

A retrospective review between January 2006 to December 2007 of all eyes with an idiopathic macular hole that were examined preoperatively and postoperatively by OCT at our hospital was performed. Only eyes diagnosed as having idiopathic macular holes more than 1000 microns were included in this study. Patients with previous and or coexisting diseases such as intraocular inflammation, ocular trauma and retinal detachment, and patients who were not fit to maintain postoperative prone positioning due to systemic diseases and patients diagnosed to have macular holes due to secondary causes like post trauma etc were excluded from the study.

Patients underwent a complete ophthalmic examination including complete medical and ophthalmic history, best corrected Snellen visual acuity, Amsler grid testing, intraocular pressure measurement, slit lamp biomicroscopy, indirect ophthalmoscopy and OCT. Each patient was examined with OCT through a dilated pupil and macular holes were measured. Largest base diameter was taken for calculation of macular hole size. Informed consent was obtained prior to surgical intervention in all patients. All surgical procedures were done by a single surgeon between January 2006 and April 2008. Surgery consisted of standard three-port pars plana vitrectomy, peeling of the internal limiting membrane with subsequent intraocular gas tamponade using 13 % perfluoropropane (C₃F₈) gas. Internal limiting membrane was identified by staining using vital stains like Trypan blue (Retiblue) or Brilliant peel or IntraVitreal Triamcinolone during surgery. After surgery patients were asked to maintain a prone position for 14 days. Patients were examined on day 1, day 10, 1 month, 2 months and 6 months. Postoperative OCT was performed at 2 months following surgery.

Anatomical success was clinically defined as apposition of macular hole edges and absence of sub-retinal fluid cuff. Anatomical success determined by OCT was restoration of full or partial thickness retinal reflection over the retinal pigment epithelium and choriocapillary reflections. The primary outcome of the study was anatomical closure of macular hole. On the basis of postoperative OCT findings closure of macular hole was classified into two groups; type 1 and type 2 closures. Type 1 closure indicated that the macular hole is closed without foveal defect of the neurosensory retina as a U-type (Normal foveal contour); Type 2 closure indicated macular hole is closed with foveal defect of the neurosensory retina. Those holes where there was neurosensory retinal defect and the lips of the hole were elevated were defined as open macular holes, and considered as anatomical failure.

For statistical purposes best corrected visual acuity was which was recorded in Snellen’s was converted to logMAR. Statistical analysis was done using SPSS statistical software over 11.0.

**Results**

This was a retrospective interventional case series. All patients who had a macular hole of more than 1000 microns and who met the study criteria were included. 33 eyes of 33 patients who were eligible were included in the study. There were 24 women and 9 men, with a median age of 63.33 years (Range 50 – 77 years). Left eye was involved in 21 eyes while right eye was involved in 12 eyes. (Demographic data of study is shown in table 1).

Preoperative macular hole diameter ranged from 1006 μm to 1809 μm with a mean of 1259 μm. On OCT 16 holes were diagnosed as stage 3 holes while 17 holes were classified as stage 4. The mean length of visual symptoms ranged from 6 months to 36 months. Follow up ranged from 2 months to 25 months with a mean follow up of 9.12 months.

Preoperative visual acuity ranged from 3/60 (1.3 LogMAR) to 6/18 (0.5 LogMAR) with a mean of
Mean postoperative best corrected visual acuity has improved to 0.87 logMAR units with a mean change of 0.15 logMAR units (p = 0.017). Best corrected visual acuity had improved or stabilized in 27 of 33 eyes (81.8 %).

Anatomical closure of macular hole was achieved in 23 of the 33 eyes (69.69 %) with single surgery. Type 1 closure was seen in 19 of the 23 eyes (82.60 %). Optical coherence tomographic analysis of macular holes with type 1 closure showed regular pattern of photoreceptor layer in 7 of 19 eyes and irregular pattern in 12 of 19 eyes. (Postoperative OCT feature are depicted in table 2).

10 patients had progression of cataract following macular hole surgery. 4 of these patients who had significant cataract affecting visual acuity underwent cataract surgery subsequently. There were no complications during the surgical procedure.

**Discussion**

Surgical treatment of idiopathic macular holes has given vitreo-retinal surgeons and patients an option for visual recovery for this once untreatable condition. Although the surgical results have improved over the years, controversy still exists as regards to the exact surgical timing and also case selection.

Timing of surgical intervention, depending on idiopathic macular hole staging, size and duration has shown correlation in success rate and visual recovery. Preoperative staging has been traditionally based on the classification system proposed by Gass, judging macular hole diameter on clinical and photographic evaluation using the peri papillary vein (125 μm in diameter) as reference. Moreover, conditions such as epiretinal membrane, lamellar macular hole, cystoid macular edema and macular degeneration can be misdiagnosed as macular hole on biomicroscopy. OCT helps to differentiate these conditions and also assess macular hole diameter correctly. The use of OCT may allow better quantification of macular hole diameter, as OCT measurements are reproducible with a transverse resolution of 30 μm.

The most favourable explanation for the development of macular hole is traction caused by focal shrinkage of the perifoveolar vitreous. Also glial cells and newly formed collagen may play an important part in macular hole formation by exerting tangential traction. The diameter of the hole therefore may depend mainly on traction forces and not on the duration of the macular hole.

Ultrich et al have shown that preoperative measurement of macular hole size can be used as a prognostic factor for assessing anatomical success rate. We also calculated the hole formation factor originally created by Puliafito. He considered the ratio between the overlying dimension and the hole base diameter to be of greater influence on the anatomical success rate than the base diameter alone. Puliafito found an 80 % anatomical success rate in eyes with HFF greater than 0.9 and an anatomical success rate of less than 25 % in eyes with HFF under 0.5. However in our study 30 eyes out of 33 had a HFF of less than 0.9, the 3 eyes which had a HFF of more than 0.9 closed postoperatively. Results in our study cannot be correlated to Puliafitos assumption of HFF as a predictor for macular hole closure in view of the less number of holes with HFF more than 0.9.

The closure rate following surgery in our study of 69.69 % correlated to data reported in literature but the significance of our study was that it had the largest ever reported series of eyes with macular holes of more than 1000 microns. In our study there was an improvement of best corrected visual acuity from a
mean of 1.02 logMAR to a postoperative best corrected visual acuity of 0.87 logMAR with a mean change of 0.15 logMAR which was statistically significant (p = 0.017). Best corrected visual acuity had also improved or stabilized in 27 of 33 eyes (81.8%).

Based on ophthalmoscopy or biomicroscopic examinations, the anatomical status of the macula after macular hole surgery was classified by Tornabe et al into three types. They suggested that flat and closed outcomes have a better visual prognosis than flat and open outcomes. Imai et al categorized the successfully repaired macular hole into three patterns with OCT: U-type (normal foveal contour), V-type (steep foveal contour), and W-type (foveal defect of neurosensory retina). The authors reported that postoperative visual acuity was well correlated with these patterns (U>V>W). The visual results obtained from the two types in our study were also similar. Because the borderline between the U and V pattern in the aforementioned study was sometimes unclear, and because the ophthalmoscopic appearance of postoperative macular hole status could be easily matched with one of the two types of closure in our study, our classification system seems more clinically relevant.

Complications of vitreous surgery for idiopathic macular hole include retinal breaks, visual field defects, cataract formation and late reopening of the macular hole. Late reopening of macular holes has been reported in 5% to 9.5% of eyes in the previous studies. Other than cataract formation which was subsequently treated we did not encounter any complications intraoperatively or postoperatively.

**Conclusion**

In the present study we describe the anatomical and functional outcomes of surgery for large macular holes with a minimum base diameter of 1000 microns. Our study shows that even in patients with large macular holes of greater than 1000 microns surgery has resulted in anatomical closure in 69.69% eyes with a statistically significant improvement in best corrected visual acuity with stabilization or improvement of BCVA in up to 81.8% eyes. To the best of our knowledge our study is the largest case series of large macular holes ever presented.

**Reference**

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