Purpose: Theoretically, idiopathic macular holes develop because of tangential vitreous traction on the fovea. The purpose of this study was to demonstrate ultrasonographically the vitreomacular relationships in a series of 44 consecutive patients with macular holes and to correlate the ultrasonographic findings with the clinical and intraoperative findings of these patients. Methods: I examined 47 eyes with a macular holes by using contact lens biomicroscopy and clinically staged the macular hole and the status of the vitreous. A kinetic B-scan ultrasonographic examination of the vitreomacular relationships was performed in each study eye and in the fellow eye by using a contact method, with topical anesthesia. Results: The clinical stage of macular hole in 47 eyes of 44 patients included eight holes in stage 1, five in stage 2, 22 in stage 3, and 12 in stage 4. The vitreous was attached to the macular region by ultrasound interpretation in seven of eight stage 1 holes, two of five stage 2 holes, 21 of 22 stage 3 holes, and zero of 12 stage 4 holes. The correlation between the clinical status of the vitreous and the ultrasonographic findings was high (94%). The status of the vitreous by ultrasound was confirmed intraoperatively in all 14 patients undergoing subsequent surgery. Conclusions: Ultrasonographic examination of the vitreomacular relationships provides an accurate assessment of vitreomacular attachment or detachment. The ultrasonographic findings in these 47 eyes with macular holes support the vitreomacular traction theory of macular holes.

Imaging of Epiretinal Membranes in Macular Holes by Scanning Laser Ophthalmoscopy. J. Akiba, S. Ishiko, T. Hikichi, H. Ogasawara, N. Yanagiya, A. Yoshida. *American Journal of Ophthalmology 1996;121(20:177–180).*

Purpose: Because recognition and removal of an epiretinal membrane are important in macular hole surgery, we used the scanning laser ophthalmoscope preoperatively to study epiretinal membranes in patients with idiopathic macular holes. Methods: We studied 67 eyes (60 consecutive patients) with idiopathic macular holes. We evaluated the thickness and the extent of the epiretinal membrane by using a scanning laser ophthalmoscope. We then compared the fundus images obtained with the scanning laser ophthalmoscope with red-free monochromatic fundus photographs. Results: Confocal imaging of the fundus with either argon blue (488 nm) or argon green (514 nm) laser illumination clearly showed the epiretinal membranes. In all eyes, we observed lesions ranging from a patchy glinting light reflex to a dense epiretinal membrane. A well-demarcated dense epiretinal membrane around the macular hole was observed in seven (44%) of 16 eyes with stage 2 macular holes and in 12 (40%) of 30 eyes with stage 3 holes, but in only two (10%) of 21 eyes with stage 4 holes. The prevalence of the dense epiretinal membrane in stage 2 or 3 holes was significantly higher than in stage 4 holes ($P = .025$ and .024, respectively). Conclusions: Fundus imaging using the scanning laser ophthalmoscope with argon laser illumination is useful preoperatively to evaluate epiretinal membranes in eyes with idiopathic macular holes.

Optical Coherence Tomography of Macular Holes. M.R. Hee, C.A. Puliafito, C. Wong, J.S. Duker, E. Reichel, J.S. Schuman, E.A. Swanson, J.G. Fujimoto. *Ophthalmology 1995;102(5):748–756.*

Purpose: To assess the potential of a new diagnostic technique called optical coherence tomography (OCT) for diagnosing and monitoring macular holes. This technique is a novel noninvasive, noncontact imaging modality that produces high longitudinal resolution (10-micron) cross-sectional tomographs of ocular tissue. Methods: Optical coherence tomography is analogous to ultrasound except that optical rather than acoustic reflectivity is measured. Cross-sectional tomographs of the retina profiling optical reflectivity in a thin, optical slice of tissue are obtained with a longitudinal resolution of 10 microns. Optical coherence tomography was used to examine 49 patients with the clinical diagnosis of idiopathic full-thickness macular hole, impending macular hole, epimacular membrane with macular pseudohole, or partial-thickness hole. The resulting OCTs were correlated with contact lens and slit-lamp biomicroscopy, fundus photography, and fluorescein angiography. Results: The cross-sectional view produced by OCT was effective in distinguishing full-thickness macular holes from partial-thickness holes, macular pseudoholes, and cysts. Optical coherence tomography was successful in staging macular holes and provided a quantitative measure of hole diameter and the amount of surrounding macular edema. Optical coherence tomography also was used to evaluate the vitreoretinal interface in patients' fellow eyes and was able to detect small separations of the posterior hyaloid from the retina. Conclusion: Optical coherence tomography appears potentially useful as a new, noninvasive, diagnostic

technique for visualizing and quantitatively characterizing macular holes and assessing fellow eyes of patients with a macular hole. The tomographic information provided by OCT eventually may lead to a better understanding of the pathogenesis of macular hole formation.

Posterior Segment Complications After Vitrectomy for Macular Hole. S.S. Park, D.M. Marcus, J.S. Duker, R.D. Pesavento, T.M. Topping, A.R. Frederick, Jr., D.J. D'Amico. *Ophthalmology 1995;102(5):775–781.*

Purpose: The purpose of this study is to assess the rate of posterior segment complications after vitreous surgery for macular holes and to evaluate the effect of such complications on final visual outcome. Methods: The authors reviewed retrospectively all cases of vitreous surgery for macular holes performed between June 1990 and October 1993. Among 98 patients with a follow-up period of 3 months or more, all patients with posterior segment complications during the postoperative course were identified. The rate of complications was compared with that seen after vitreous surgery for macular pucker performed by the same surgeons. Results: Posterior segment complications were noted in 23 (23%) of 98 patients. These included peripheral retinal breaks (3%), rhegmatogenous retinal detachment from a peripheral retinal break (14%), enlargement of the hole (2%), late reopening of the hole (2%), retinal pigment epithelium loss under the hole (1%), photic toxicity (1%), and endophthalmitis (1%). In 40% of these eyes, the final visual acuity was two lines or more below preoperative visual acuity. When compared with the macular pucker group, the rate of posterior segment complications, in particular the rate of peripheral retinal tears and detachments, was significantly higher ($P <$ or $= 0.05$). Conclusions: The authors conclude that visually significant posterior segment complications may occur after vitrectomy for macular hole, and the rate of these complications appears to be higher than expected.

Progression of Nuclear Sclerosis and Long-term Visual Results of Vitrectomy with Transforming Growth Factor Beta-2 for Macular Holes. J.T. Thompson, B.M. Glaser, R.N. Sjaarda, R.P. Murphy. *American Journal of Ophthalmology 1995;119(1):48–54.*

Purpose: We studied the progression of cataracts and visual acuity up to 36 months after vitrectomy and instillation of transforming growth factor beta-2 for treatment of full-thickness macular holes. Methods: Sixty-four eyes with idiopathic and two with traumatic macular holes in this prospective consecutive series were divided into the following two groups: 56 phakic eyes were treated with 70, 330, or 1,330 ng of transforming growth factor beta-2 to study the progression of cataracts, and 31 phakic or pseudophakic eyes were treated with 1,330 ng of transforming growth factor beta-2 to study the long-term visual acuity after macular hole surgery. Results: Eyes in the cataract progression study had a mean preoperative nuclear sclerosis grade of 0.4, which increased to 2.4 on final lens examination at a mean of 12.4 months postoperatively. The amount of nuclear sclerosis increased progressively with duration of the follow-up period, and 16 (76%) of 21 eyes observed for 24 months or more required cataract extraction. The mean preoperative posterior subcapsular cataract grade was 0.0 and increased only slightly to 0.25 on final lens examination. All eyes had initial successful closure of the macular hole, but the macular hole reopened in two eyes (between 6 and 12 months and at 19 months) for an overall success rate of 29 (93.5%) of 31 eyes at a mean of 19.5 months. The visual acuity increased two or more Snellen lines in 29 (93.5%) of 31 eyes. The final visual acuity was 20/40 or better in 23 (74%) of 31 eyes, and the visual improvement was stable in eyes observed for 3 years. Conclusions: Nuclear sclerotic cataracts progress substantially after macular hole surgery with a long-acting intraocular gas tamponade. The visual acuity often decreases 12 or more months after vitrectomy because of cataract progression, but the visual results of vitrectomy and transforming growth factor beta-2 for macular holes are excellent when the cataracts are removed.

Increased Intraocular Pressure After Macular Hole Surgery. J.T. Thompson, R.N. Sjaarda, B.M. Glaser, R.P. Murphy. *American Journal of Ophthalmology 1996;121(6):615–622.*

Purpose: To determine the incidence and timing of increased intraocular pressure in eyes with an idiopathic macular hole treated with bovine transforming growth factor-beta 2 (TGF-beta 2) with different intraocular gas concentrations, recombinant TGF-beta 2, or placebo. Methods: Intraocular pressure was measured preoperatively and 2 days, 2 weeks, 6 weeks, and 3 months postoperatively in