Evolving trends in primary retinal detachment repair: Microincisional vitrectomy and the role of OCT

by Patrick D. Williams, MD

Despite extensive advances in the management of retinal detachment (RD) over the past 40 years, RD repair continues to further evolve and improve.

As Dr. Patrick Williams notes in this column, the ASRS PAT Survey shows a decline over the past decade in the use of scleral buckles and an increase in vitrectomy to repair primary RDs. U.S. retina specialists have spoken, and the trend is clear: scleral buckle use is on the decline. Reasons include the invasive nature of scleral buckle placement, greater anesthesia requirements compared to vitrectomy, and induced postoperative myopia.

Dr. Williams describes the advances in microincisional vitrectomy and compares this to broader trends toward minimally invasive surgery.

This column provides an up-to-date summary of evolving trends in RD repair. Dr. Williams focuses on microincisional vitrectomy, scleral buckles, pneumatic retinopexy, and the role of emerging OCT technologies. His insights will be educational and thought-provoking for the entire retina community.

Repair of rhegmatogenous retinal detachments is performed with three basic techniques: scleral buckle, vitrectomy, and pneumatic retinopexy. The choice of procedure(s) has evolved with the improvement in techniques and technology. As with the more global surgical concept of minimally invasive surgery, retinal detachment repair has moved toward more efficient and less traumatic surgical interventions.

The modern practice of minimally invasive surgery initially began with cholecystectomy in the mid-1980s. The concepts have been applied to numerous surgical indications with the goals of reducing tissue manipulation and anesthesia. With cholecystectomy and abdominal surgery, the major advance involved the use of trocars to reduce wound size and hasten postoperative recovery. As the concept of minimally invasive surgery became widespread, surgeons of varied specialties adapted the concepts to their own techniques. The evolution of retinal detachment repair highlights the influence of minimal invasiveness concepts on surgical interventions. In a recent editorial, minimally invasive surgery was presented as requiring less expertise. However, newer techniques of retinal detachment repair, including bimanual peeling of membranes, require considerable dexterity and training.

Scleral buckle

Scleral buckling is the oldest form of retinal detachment repair. Modern scleral buckling techniques have not changed in the last 20 years. An encircling or segmental band of silicone is fixed to the sclera with sutures or scleral tunnels to alter contractile vector forces at the vitreoretinal interface of a retinal defect. Commonly, external fluid drainage, cryotherapy, laser retinopexy, and intravitreal gas injections are used as adjuncts. Scleral buckling requires significant manipulation of the extraocular tissue, including dissection of conjunctiva, Tenon’s capsule, and the extraocular muscles, leading to postoperative pain and per-
ocular edema. The intraoperative pain can necessitate general anesthesia. While scleral buckling yields a roughly 80% single-procedure success rate, fish-mouthing of the tear, proliferative vitreoretinopathy (PVR), and posterior breaks can reduce its effectiveness. It remains a common and effective means for repair, especially in younger eyes in which the posterior hyaloid has not detached spontaneously.

Vitrectomy

In the early history of vitrectomy, the procedure was considered an adjunct to scleral buckles for complicated retinal detachment repair. Large scleral wounds, poor fluidics, and iatrogenic retinal breaks were all drawbacks. PVR was considered a risk of vitrectomy, although this likely was more associated with case selection than the procedure itself.

Vitrectomy has evolved considerably from single-port to three-port to small-gauge sutureless surgery. With the decrease in incision size and operative time, vitrectomy has been used for more indications as primary treatment. Air-fluid exchange, expansile gasses such as SF6 and C3F8, posterior retinotomies, and perfluoro-octane make vitrectomy-only retinal detachment repair a possibility. Now debate exists as to whether scleral buckle is a necessary adjunct to vitrectomy-based repair, especially in pseudophakic patients.

With a smaller cutter size, smaller port, and improved fluidics, shaving the vitreous base over mobile retina has become much safer. The major advancements in fluidics have been the increase in cut rate and manipulation of the duty cycle. Over the last 10 tears, the cutter efficiency has improved from 2,500 cuts per minute (cpm) to 5,000 cpm to 7,500 cpm. With the increase in cut rate, the traction on the retina declines significantly, allowing for closer shaves and lower rates of iatrogenic retinal breaks. Duty cycle refers to the time per cut in which the port is open or closed. By reducing the duty cycle (more time per cut with the port closed), retinal traction also declines significantly.

Small-gauge sutureless vitrectomy mimics minimally invasive laparoscopic abdominal surgery, with trocars inserted into small incisions to maintain patent access into the surgical site. Valved cannulas now exist that maintain patency as well as a closed globe with consistent IOP. This advancement prevents complications arising from rapid IOP decline, including choroidal hemorrhage, and prevents loss of intraocular fluids such as balanced salt solution, perfluoro-octane, and silicone oil. Currently, 23-, 25-, and 27-gauge vitrectomy systems exist.

Along with the evolution of vitrectomy toward minimal invasiveness, adjunctive instruments have allowed for the repair of more complicated retinal detachments. Forceps, picks, and scissors can dissect contractile membranes from the retina. Even chandelier lighting has become minimally invasive, with chandelier lights attached to 25-gauge trocars available. As a consequence, bimanual peeling of retinal membranes is much more commonplace.

As technology and techniques have advanced, vitrectomy has become an increasingly popular choice for primary rhegmatogenous repair. The decreased operative times and pain, along with local anesthesia, make retinal detachment repair in ambulatory surgery centers a practical choice. This in turn furthers efficiency in time and cost.

Pneumatic retinopexy

Pneumatic retinopexy has been reported as a stand-alone procedure since the 1980s. It is the least invasive method of retinal detachment repair and requires no surgical facility or systemic anesthesia to perform. An expansile gas is injected through the pars plana, and the tear is treated with either cryotherapy or laser. A tap of aqueous fluid is typically required to maintain appropriate IOP. Its success rate is similar to that of scleral buckle but less than those for vitrectomy or combined buckle-vitrectomy. Traditionally, pneumatic retinopexy is not advised for tears in multiple clock hours, inferior breaks, PVR, and pseudophakic patients. The techniques have not changed considerably since its onset, but debate continues as to its role in the primary repair of retinal detachments. Some have proposed expanding the selection criteria, and a recent report showed similar results in phakic and pseudophakic patients.

In many instances, the decision to perform pneumatic retinopexy or vitrectomy depends on logistic factors such as operating room availability and patient health. In some instances, patients prefer the least invasive approach possible, whereas other patients prefer the higher initial success rate with vitrectomy.

Optical coherence tomography

Predicting visual outcomes in macula-affected retinal detachments has long been a futile venture. Other than in the case of chronic retinal detachments, visual recovery is typically significant but quite variable. However, noninvasive spectral-domain optical coherence tomography (SD-OCT) may provide some prognostic value previously unattainable. While the predictive capability of pre-
operative imaging is still in its infancy, there is evidence that detachment height over 1,000 µm, intraretinal edema, and disruption of the inner segment/outer segment junction (ellipsoid region) portend a poorer visual outcome.\(^{15,16}\)

OCT can also explain visual disturbances after repair such as metamorphopsia due to cystoid macular edema, residual subretinal fluid, or outer retinal folds.\(^{17}\) Intraoperative OCT has mainly been a research tool to date but has yielded information on residual subretinal fluid after injection of perfluoroctane.\(^{18}\)

Adaptive-optics OCT, with its potential for examination of individual cellular morphology and counting macular photoreceptors, could certainly yield qualitative and quantitative data with predictive value. Such information could affect the timing of repair or recommendations to avoid surgical intervention in cases of poor visual potential.

Summary

Retinal detachment repair continues to evolve toward less invasive techniques that can safely, efficiently, and consistently provide optimal outcomes. In fact, 53% of U.S. respondents to the American Society of Retinal Specialists 2013 Preferences and Trends Survey said they would perform a vitrectomy without scleral buckle to treat a retinal detachment with a superior tear, while 25% would perform pneumatic retinopexy, and 21% would use a scleral buckle with or without vitrectomy.\(^{11}\) Compared to in 2005, many more surgeons prefer vitrectomy-only repair, whereas fewer prefer scleral buckle. Interestingly, preferences toward pneumatic retinopexy have slightly declined, which may reflect increased confidence in vitrectomy surgery to repair a detached retina safely and efficiently as an alternative. Even complex detachments can be treated in a minimally invasive fashion with the improvements in instrumentation, trocars, and oil infusion. While trends will likely continue toward minimal invasiveness, some form of scleral buckle, vitrectomy, and pneumatic retinopexy will all persist as treatment options. OCT advancements may allow for individualized discussions of visual prognosis and surgical decision making without the need for any invasive testing.

REFERENCES