

AN OLD TECHNIQUE MADE NEW: SCLERAL BUCKLING

Why this approach remains integral to surgical success
in the current era of vitreoretinal surgery.

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Although advances in the field of vitreoretinal surgery have significantly enhanced our understanding of rhegmatogenous retinal detachment (RRD), the core schema of RRD repair remains fundamentally unchanged: find, close, and seal the breaks.

Pars plana vitrectomy (PPV) and scleral buckling (SB) are the most frequently performed treatment options in the management of RD, with both conferring high rates of surgical success and postoperative visual improvement. While there exists general agreement on the approach for certain RDs, such as vitrectomy for eyes with significant media opacity, there is a lack of consensus on the preferred treatment for many cases of primary noncomplex RD.

Currently, there is a growing trend away from SB and toward PPV. Because the advent of wide-angle viewing systems, 3D heads-up display, and smaller-gauge instrumentation have enhanced the efficiency and safety of PPV, SB is becoming a forgotten art. This shift affects both new and experienced vitreoretinal surgeons alike, as SB is performed in less than 20% of RD repairs today.¹

BUCKLE MECHANICS

Although PPV has become the dominant focus of modern vitreoretinal surgery, SB is not an obsolete surgical option. Rather, surgeons should recognize SB as a cornerstone in the framework of RD repair. To appreciate SB's value in the modern surgeon's toolkit, surgeons must have a robust understanding of the relationship between

the pathophysiology of RRD and the biomechanics of SB, as well as the surgical implications on the eye and the outcomes data.

SB alters the forces leading to RD while concurrently augmenting forces that promote reattachment of the retina. RD is caused by a combination of vitreous traction and vitreous liquefaction, with ocular saccades enabling fluid passage into and propagation within the subretinal space. SB causes indentation of the eye wall to directly decrease the magnitude of this vitreous traction and indirectly change the direction of its exerted force. Encircling bands further compel the eye into a prolate geometric shape with a vitreous base that is reduced in diameter, thereby diminishing transvitreal traction.

AT A GLANCE

- Scleral buckling alters the forces leading to retinal detachment while concurrently augmenting forces that promote reattachment of the retina.
- Maintaining familiarity with scleral buckling is essential to maximize success for each patient.
- The authors prefer an encircling band for its multifaceted advantages: diffusely reducing transvitreal traction, addressing pathology in multiple quadrants, and maintaining adequate buckle height.

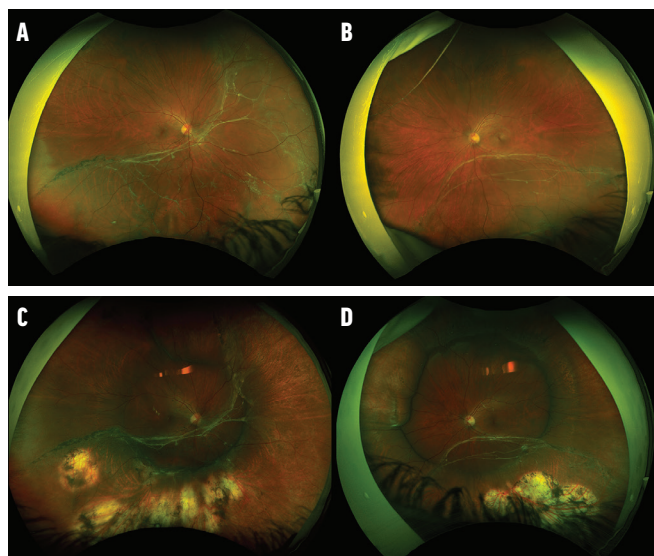
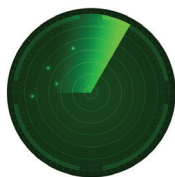


Figure. Preoperative widefield fundus photographs of the eyes of a 31-year-old woman with high myopia document RDs in the right (A) and left (B) eye with associated lattice degeneration and demarcation lines. One year after primary SB surgery, the retina is attached in the right (C) and left (D) eye.

The remarkable degree to which SB relieves vitreoretinal traction is demonstrated in investigations showing that the addition of retinopexy does not result in better rates of reattachment compared with SB alone.^{2,3}

The induced indentation beneath the break displaces the existing subretinal fluid, allowing reapposition of the retina to the underlying retinal pigment epithelium. Often, this leads to displacement of the liquified vitreous with more solidified gel that closes the break. In eyes with a detached retina and fibrocellular membrane formation, contraction of this tissue generates posteriorly directed radial forces that can create new retinal breaks and contribute to the expansion of existing breaks. SB changes the eyewall's contour from naturally concave to iatrogenically convex, redirecting these radial forces outward along the buckle. This enables relaxation and flattening of a foreshortened retina without the need for membrane peeling and retinectomy, often obviating the need for PPV entirely with proper case selection.

SUPPORTING DATA

The clinical efficacy of SB is substantiated by both landmark studies and more recent investigations. The Scleral Buckling Versus Primary Vitrectomy in Rhegmatogenous Retinal Detachment Study (SPR) was the first large prospective randomized clinical trial comparing the outcomes of SB and PPV in the management of noncomplex RD.⁴ Analysis showed comparable BCVA with SB in eyes that were phakic but a higher primary anatomic success rate with PPV in pseudophakic eyes. However, the study protocol permitted supplemental SB at the time of PPV based on surgeon discretion; ancillary analysis of the

data showed that primary anatomic success was improved with PPV/SB compared with PPV alone in these pseudophakic eyes.⁴

Thus, the declining popularity of SB since the SPR study is not based on outcomes data. Instead, it is largely attributed to surgeons becoming increasingly acclimated to advanced retinal imaging and evolving vitrectomy technologies, while growing less familiar with careful ophthalmoscopy, detailed retinal drawings, and the nuances of SB.

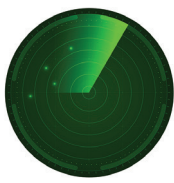
This notion is bolstered by current research that substantiates the excellent visual and anatomic outcomes achieved by surgeons who continue to prefer and remain experienced in the art of SB. In a meta-analysis of 41 studies, Dhoot et al reported comparable rates of primary surgical success (> 85%) and final surgical success (> 95%) for both SB and PPV but significantly improved postoperative visual acuity with SB.⁵ Znaor et al conducted a Cochrane analysis of PPV and SB performed in clinical trials across North America, Asia, and Europe and similarly reported no significant differences in primary or final surgical success between the operations.⁶ Most recently, Kowano et al performed a propensity score-matched analysis of 882 phakic eyes with noncomplex macula-on RRD, and advanced analytics demonstrated that the proportion of surgical failure is significantly higher with PPV versus SB (risk difference 0.10, $P = .01$).⁷

The Primary Retinal Detachment Outcomes Study (PROS) included approximately 3,000 patients with noncomplex RD managed across six institutions with academic surgeons experienced in performing and teaching both SB and PPV.⁸ The first PROS report noted that single-surgery success was greatest for the SB group, and eyes treated with SB (91.2%) and PPV/SB (90.2%) had higher rates of primary success compared with PPV alone (84.2%).⁹

Akin to the SPR study, subsequent PROS reports stratified eyes by lens status and reported similar outcomes with SB, PPV, and PPV/SB. In phakic eyes, primary surgical success was significantly higher with SB (91.7%) and PPV/SB (91.2%) compared with PPV alone (83.1%).¹⁰ Furthermore, postoperative vision in eyes with macula-splitting RD was significantly better in the SB group even when controlling for cataract progression ($P < .001$). All pseudophakic eyes in PROS underwent PPV, and eyes managed using supplemental SB demonstrated significantly better single-surgery success for both macula-on RD (PPV/SB, 100%; PPV, 88%) and macula-off RD (PPV/SB, 89%; PPV, 81%). Notably, single-surgery success for PPV/SB was also significantly higher compared with PPV (96% vs 82%) in eyes with inferior RD.¹¹

MAKE IT YOUR OWN

SB is an intricate and dynamic operation that empowers each surgeon to develop a unique approach in the OR.



ALTHOUGH PPV HAS BECOME THE DOMINANT FOCUS OF MODERN VITREORETINAL SURGERY, SB IS NOT AN OBSOLETE SURGICAL OPTION. RATHER, SURGEONS SHOULD RECOGNIZE SB AS A CORNERSTONE IN THE FRAMEWORK OF RD REPAIR.

Nearly every surgical step is customizable. Common variants of SB include the creation of lamellar scleral flaps or scleral sutures; choice of radial element, segmental exoplane, or encircling band; consideration for draining subretinal fluid; and the use of intraocular tamponade. More recently, the use of noncontact viewing systems with chandelier endoillumination has gained increasing popularity. Many surgeons advocate that this setup provides enhanced magnification and localization of peripheral pathology, enables safer completion of retinopexy and drainage, and allows for improved instruction of trainees. Recent comparative investigations have shown that anatomic success and postoperative outcomes are comparable among these different surgical techniques.¹²⁻¹⁴

OUR APPROACH

Our personal approach is to perform primary SB in phakic eyes (particularly in younger patients with an attached hyaloid), when pathology is in multiple quadrants, and when there is likely to be densely adherent vitreous (eg, high myopes with lattice degeneration [Figure]). We also use SB in eyes with a known history of trauma, retinal dialysis, or retinoschisis, in patients who are monocular, and in those with significant asymptomatic RD.

We further advocate supplementing PPV with SB in eyes that are at high risk for recurrent detachment (ie, eyes that have failed previous RD repair, have inferior pathology or existing proliferative vitreoretinopathy, and eyes with a history of inherited vitreoretinopathy, giant retinal tear, or RD in the fellow eye). We prefer to use an encircling band for its multifaceted advantages of diffusely reducing transvitreal traction, addressing pathology in multiple quadrants, and maintaining adequate buckle height throughout prolonged follow-up.

The use of sutures minimizes trauma to the sclera, especially in cases with existing ectasia, staphylomatous change, or large myopic eyes with thin tissue. Drainage is considered on a case-by-case basis and is generally reserved for eyes with large RDs that will remain reasonably bullous after finalizing the buckle position, extensive inferior subretinal fluid, and chronic fluid that presumably requires prolonged time to resolve spontaneously.

DON'T FORGET THE BUCKLE

In the current era of vitreoretinal surgery, maintaining familiarity with the practice of SB is essential to tailoring RD repair surgery and maximizing success for each patient. Among the myriad ways to perform SB, surgeons should employ the techniques they are most experienced with to consistently yield optimal outcomes. ■

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