Introduction

Rhegmatogenous retinal detachment (RRD) although rare, it is a serious ophthalmic condition that can lead to significant loss of vision or blindness without timely and appropriate management. It has been nearly a century (1918) since Jules Gonin demonstrated the importance of localizing and sealing retinal breaks, a procedure termed ignipuncture. Scleral buckling techniques, introduced by Custodis and refined by Schepens and later Robert Machemer’s pars plana vitrectomy, revolutionized repair of RRDs. Pneumatic retinopexy introduced in the mid 1980s allowed treatment of retinal detachments as an outpatient procedure in selected retinal detachments. Above techniques either alone or in combination has resulted in surgical success rates close to 90%.

For most surgeons, choice of surgical procedure for primary retinal detachment will depend on the individual clinical situation combined with each surgeon’s experience; bias and comfort level with a particular procedure. Recent advances in surgical instrumentation, wide angle visualization, and the use of various intra-operative tamponade agents have made vitrectomy procedures safer and preferred treatment by the surgeons. There is less exposure to scleral buckling for vitreo-retinal surgeons in training and younger surgeons may ultimately prefer vitrectomy as a first choice for repair of retinal detachments. Scleral buckling however still has relevance to this day, but without a randomized clinical trial comparing the 3 modalities, and in various clinical scenarios, definitive answer as to which procedure is superior will be impossible.

Basic Rationale of repair of RRD

The regardless of the procedure chosen, the surgery aims to identify and close all the retinal breaks with minimum iatrogenic damage. Break closure in retinal detachment would involve two steps. First, is to bring the edges of the retinal break into contact with the underlying RPE which is achieved either by bringing the eye wall closer to the detached retina (a scleral buckle) or by pushing the detached retina toward the RPE (intraocular tamponade with a gas/PFCL(expand) bubble). The second step would be to create a strong chorio-retinal adhesion around the breaks; this may be accomplished with cryotherapy, laser photocoagulation or diathermy.

This review will try to find answers to some of the common situations in retinal detachment treatment

Asymptomatic retinal detachment

Management of asymptomatic retinal detachments usually identified on routine clinical examination range from conservative observation to prophylactic surgery. Vrabec et al, Byer et al 5 and Cohen et al 6 suggest a conservative management. These authors recommend that asymptomatic RRDs in selected cases may be safely observed for many years with routine examinations and appropriate patient education on symptoms of retinal detachment. Vrabec et al demonstrated, demarcation laser photocoagulation of shallow, macula-sparing, RRD without associated PVR to be a reasonable alternative to surgical repair. However, in a case series by Greven et al 7, asymptomatic RRD patients undergoing scleral buckle had good anatomic and functional results. They advocate that surgical management should be considered for asymptomatic RRD

Scleral Buckling:

Scleral buckles usually are made of solid silicone and silicone sponges. They can either be used as explants or as implants. Explants are the most commonly done procedure where the buckle is sutured to the sclera while in the implant technique they are placed in the bed of the dissected sclera. Scleral explant procedure was initially described by Custodis 2 which Lincoff later modified 8 while the implant method was popularised by Schepens 9. Both the above techniques have the following steps in common

- conjunctival peritomy and tenotomy
- Isolation of the recti muscles.
- Localisation of breaks with IDO
- Retinopexy with Cryotherapy /diathermy
- Suture placement / scleral bed dissection and placement of buckle is then performed.
- Subretinal fluid drainage is done based on surgeon preference and case based need.
- Break buckle relation and adjustment of buckle height,
- Careful monitoring of central retinal artery perfusion is done (AC Paracentesis done if required)
- Finalisation of buckle and encirclage
- Closure of the conjunctiva

Contentious issues in Scleral buckling.
a) Cryotherapy vs laser photocoagulation
In a randomised clinical trial by Lira et al 39 in eighty six patients with uncomplicated retinal detachment, both techniques of retinopexy were shown to have satisfactory anatomical and functional success. Laserpexy offered faster visual acuity recuperation with fewer postoperative complications but required a second intervention and was costlier than cryotherapy. They opined that laserpexy to be a successful alternative to cryopexy in creating chorioretinal adhesion for scleral buckle surgery

b) Need for drainage of subretinal fluid?
Drainage of subretinal fluid is one of the debatable issues in scleral buckling. As this step is almost a blind procedure it is not free from potential complications that include choroidal hemorrhage, retinal incarceration and intraocular infection. Drainage in scleral buckling surgery is usually done in bullous detachments to visualise the breaks, to make space to allow a large scleral indent without significant increase in intraocular pressure. Hilton et al.10 compared drainage vs. non drainage in a randomised controlled trial of 120 consecutive patients undergoing scleral buckling procedures. He found no significant difference in the primary success rate (87% in the drainage group v 82% in the non-drainage group), final flattening rate (97% in both groups) or visual acuity outcome between the two groups. Decision on whether to drain subretinal fluid was assigned at random preoperatively and all surgeries were done by a single surgeon. It can be concluded that drainage of subretinal fluid is not an absolute necessity and is indicated only in specific situations.

c) Which is the best method of drainage?
Various methods of drainage have been described:
1) Scleral cut-down and choroidal puncture with diathermy,
2) Scleral cut-down and the choroidal puncture by argon laser via an indirect ophthalmoscope or endoprobe.
3) Needle drain where the sclera and choroid are punctured in one stab with a 3 mm suture needle
4) Needle drainage with 26/27 g needle

Three trials have prospectively compared needle and laser drainage. Ibanez et al. 11 in a randomised study of 175 patients comparing laser drainage choroidotomy using an endoprobe, or needle drainage found no significant difference in the complication rate between the two groups (13% v 16%). However, Das and Jalali 12 reported an increased complication rate in the needle drainage group (4/25) than in the laser group however no statistical analysis was provided. Randomised prospective, controlled trial comparing suture needle drainage with argon laser drainage by Aylward et al 13 Argon laser drainage was associated with a lower rate of clinically significant subretinal haemorrhage (4-3% v 28-3.%, respectively) and a higher rate (98%) of adequate drainage, compared with suture needle drainage (85%), even though larger sclerostomy created by the argon laser drain was larger it was not associated with any increase in the rate of retinal incarceration. Azad et al 14 compared modified needle drainage with conventional drainage of subretinal fluid (SRF) as described by Schepens in surgery for primary rhegmatogenous retinal detachment. They found the Conventional Drainage group had, more serious SRF drainage complications and opined modified needle drainage is a safe and effective procedure for SRF drainage

Sub-retinal haemorrhage is the dreaded complication and is problematic if it tracks back under the macula. Most retina specialists practice favours the expediency of a needle drain when the macula is attached and the submacular space is closed, while the safer laser drain is preferred when the macula is off. In case of total retinal detachments undergoing buckling, drainage on the nasal side would reduce chances of sub-retinal bleed tracking under the macula in the event of such a complication.

Pneumatic retinopexy
Pneumatic retinopexy has the major advantage of being an outpatient procedure. The technique was recommended in the management of RD caused by a single break, no larger than one clock hour and located within the superior eight hours of the ocular fundus, or by a group of small retinal breaks within one clock hour, in the absence of grade C or D PVR and uncontrolled glaucoma. Some selected cases with multiple retinal breaks located more than 30° apart can also treated with this technique.

Perfluoropropane (C3F8) and sulfur hexafluoride (SF6) are the most commonly used gases for pneumatic retinopexy. It involves cryopexy of retinal breaks if possible, followed by injection of an intravitreal gas bubble and postoperative positioning to allow the gas bubble to act as a tamponade for the retinal break. If cryopexy is not performed, laser photocoagulation is applied to the retinal breaks after they have been flattened with intraocular gas. Complications: Complications of pneumatic retinopexy in the treatment include
- New retinal break formation in 4–26% of cases,
- development of new retinal detachment in 15–24% of cases,
- delayed subretinal fluid absorption in 4–21%,
- chronic macular detachment in 4.1%,
- PVR in 3–24%, macular pucker in 2–9%,
- subretinal gas in about 2%, and
- endophalmitis in 1% of cases.

Other rare complications include supra-choroidal gas, extension of the retinal detachment, macular hole formation, and entrapment of gas in the pre-vitreous space anterior chamber 15

In a comprehensive review by Clement et al 16 the updated
average surgical outcomes for the 4,138 eyes in the 21-year period revealed a single-operation successes (74.4%), final operation successes (96.1%), new retinal breaks (11.7%), and proliferative vitreoretinopathy (5.2%). Pneumatic retinopexy is an effective procedure. Since the success rate is only marginally less than scleral buckling, it is a viable alternative and is of great use in patients unfit for surgery.

Contentious issues in Pneumatic retinopexy

a) Is scleral buckling/vitrectomy better than pneumatic retinopexy?

The evidence

PR Vs Scleral Buckling

Several controlled trials have evaluated the results. The Retinal Detachment Study Group conducted a multi-centre trial and compared pneumatic retinopexy with scleral buckling. They reported results at six months, 17, and at 2 years; 18 there was no significant difference in either first time (82% v 73%) or final (98% v 99%) reattachment rate for scleral buckling and pneumatic retinopexy, respectively. Pneumatic retinopexy group had better visual outcomes. Mulverhill et al.19 in small randomised study of 20 consecutive patients, who met inclusion criteria, to be treated either by scleral buckling or pneumatic retinopexy. Retinal flattening was achieved in one operation in 90% of the pneumatic retinopexies and 100% of the scleral buckles. Visual outcome was comparable between the two groups. However, in a meta-analysis of pneumatic retinopexy compared to primary scleral buckling procedures, scleral buckling was found to have a higher primary success rate than pneumatic retinopexy.20

PR vs. Vitrectomy

Pneumatic retinopexy, was found to have a comparable success rate to vitrectomy with cryotherapy and gas in a prospective randomised controlled trial of 120 cases in 1987.21 However it is not desirable to extrapolate this study findings to present day as the technique of vitrectomy was still evolving at that time.

Is pseudophakia a relative contraindication for Pneumatic retinopexy?

Multiple clinical studies have demonstrated the lower success rate of pneumatic retinopexy in repairing pseudophakic detachments compared with phakic ones, with a range of success from 45% to 80%. 22 This has led Tornambe to recommend 360° peripheral laser at the time of pneumatic retinopexy in pseudophakic detachments, placing several laser rows posterior to the vitreous base. This lower success rate might be due to the higher difficulty in detecting pseudophakic breaks. 17,18 The retinal detachment study group found that most aphakic and pseudophakic eyes that initially failed to pneumatic retinopexy ultimately reattached with fairly good vision, hence recommended the use of pneumatic retinopexy independently to whether the eye was phakic or aphantic/pseudophakic. 17,18 However for many clinicians, pseudophakia still remains a relative contraindication to pneumatic retinopexy.

Primary pars plana vitrectomy (with or without scleral buckling)

Vitrectomy is usually indicated in patients with PVR greater than grade C1, giant retinal tears, posterior breaks, multiple breaks at multiple levels, in patients of iridofundal coloboma with RD.

Over the past decade, more and more surgeons have been advocating pars plana vitrectomy for the primary management of retinal detachments probably due to the vitreoretinal training patterns and better technology in vitrectomy machinery and wide angle visualization.

Technique involves a 3-port pars plana vitrectomy with removal of the juxta basal vitreous. During this process, retinal breaks are identified, freed of vitreous traction and marked. Internal subretinal fluid drainage is then performed by one of 3 techniques: either through the causative anterior breaks using perfluorocarbon liquids or through one of the causative anterior breaks using a cannulated extrusion during fluid–air exchange or through a posteriorly created retinotomy during fluid–air exchange. The breaks are then treated with endolaser, either through perfluorocarbon liquids or under air. Some surgeons will only treat the identified retinal breaks, whereas some other will perform 360° peripheral laser, placing several rows posterior to the vitreous base. The air is finally exchanged for a long-acting gas/silicone oil. The patient has to maintain position postoperatively. One of the major advantages of vitrectomy over scleral buckling is the greater ability of visualizing retinal breaks with the combined use of wide-angle viewing systems and scleral depression. Retinal break detection is also possible with the help of perfluorocarbon liquids and the Schlieren phenomenon. Many retinal breaks undetectable by ophthalmoscopic examination can thus be found during pars plana vitrectomy. The risks of hemorrhage and retinal incarceration associated with external subretinal fluid drainage are not encountered with endodrainage during vitrectomy.

Other significant advantages of vitrectomy over scleral buckling include the

• absence of refractive shift,
• clearance of vitreous hemorrhage/vitreous floaters,
• less postoperative pain,
• lower risk of postoperative diplopia, and
• Lowered risk of infection.

Removal of the vitreous potentially present in the anterior segment and around the intraocular lens might also be beneficial for postoperative visual recovery.

Disadvantages of pars plana vitrectomy over scleral buckling
include a more
• the requirement for postoperative positioning, and
  the inability to engage in air travel when gas is used for
  intraocular tamponade
• costly surgery, especially if perfluorocarbon liquids are
  used,
• the risk of postoperative intraocular lens displacement,
  • Complications:
  ✿ Intraoperative complications include iatrogenic breaks,
    optic capture, and retinal haemorrhage.
  ✿ Postoperative complications include cellophane
    maculopathy, cystoid macular edema, PVR. Some have also
    suggested that compartmentalization of fluid against the
    retinal surface might potentially increase the risk of epiretinal
    membrane formation.

Factors Determining Anatomical and Functional Success
Several factors appear to have an influence in the anatomical
and functional recovery after vitreoretinal surgery in PRD.
1. Higher reattachment rates have been achieved in cases
   in which the macula was attached pre-operatively. Similarly,
   patients with less extensive RDs appear to have better
   anatomical outcomes after vitreoretinal surgery.
2. The presence of PVR at presentation appears to be one
   of the most important factors determining the anatomical
   outcome in PRD, with higher redetachment rates in those
   cases in which PVR is present.
3. Poor presenting vision and longer duration of symptoms
   before presentation,
   the presence of preoperative choroidal detachment, vitreous
   hemorrhage, large retinal breaks (> 1 clock hour), or breaks
   located posterior to the equator and
4. The occurrence of intra-operative hemorrhage appear to
   also be variables predictive of poor anatomical success. (23)
5. The length of history of the RD (time between the
   occurrence of RD and the surgical repair) appears to have a
   major influence in the functional results obtained after
   surgery. The shorter the history of visual loss, the better the
   visual recovery following surgery.
6. Girard 24, 25 found that the presence of anterior chamber
   reaction and preoperative PVR of grade B or greater were
   also associated with a poor visual outcome following surgery.

As per the results of the SPR (Sclera buckling vs Primary
Vitrectomy in Retinal Detachment) study, 26 a prospective
randomized clinical trial comparing scleral buckling
surgery (SB) and primary pars plana vitrectomy (PPV)
in rhegmatogenous retinal detachments of medium
complexity, primary vitrectomy combined with scleral
buckling surgery is recommended for the treatment of
rhegmatogenous retinal detachment in pseudophakic and
aphakic patients. It should be noted that these results do
not apply to localized detachments with a single break and
patients with proliferative vitreoretinopathy (PVR) grade B or
higher and giant tears were excluded from the study.

Contentious issues in Vitrectomy
1. Optimal intraocular tamponade agent in the surgical
   management of PVR

   The Silicone Study group analysed the efficacy and
   complications of intraocular gas and silicone oil tamponade
   in patients with severe PVR and reported its results in a series
   of publications.27–37 Silicone oil and C3F8 gas were similar
   in visual acuity and anatomical outcomes. No difference was
   found in keratopathy rates and persistent hypotony was
   more common in C3F8 treated eyes (P < 0.05).

2. Need for scleral buckle / encircling band with vitrectomy

   In a prospective, nonrandomized, comparative study in
   pseudophakic patients Stangos et al 40 did not find any
   additional benefit of encircling band.

3. 20g vs 23g vs 25g

   In a comparison of 20- and 25-gauge vitrectomy for primary
   repair of rhegmatogenous retinal detachment Kobayashi
   et al 38 reported good anatomic and functional results with
   25-gauge vitrectomy and the outcomes were comparable
   with 20-gauge vitrectomy. Similarly in a comparative study
   Lewis et al 41 found 20-, 23-, and 25-gauge instruments
to be equally effective for primary repair of pseudophakic
rhegmatogenous retinal detachment.

Conclusions:
Rhegmatogenous retinal detachment (RRD) can have multiple
anatomic presentations. An individualized approach to repair
of RRD is necessary for optimal results than following a single
stereotyped procedure. Scleral buckling can be a valuable
component for repair of retinal detachments as it supports
both the existing tears and the vitreous base. However, the
use of scleral buckling has decreased in recent years due
to the success of vitrectomy alone and the avoidance of
complications associated with scleral buckle that include
buckle erosion and strabismus.

Based on available evidence the following the principles in
management of rhegmatogenous RDs
• Phakic RRD is best treated by scleral buckling alone,(figure
  1 a-d) unless other problems, such as proliferative
vitreoretinopathy(figure 2) opaque media, (figure 3 a,b)
  blood in the vitreous, , or GRT(figure4 a,b,c) (figure posterior
  tear, necessitate vitrectomy as well.
• Pseudophakic RRD is treated with vitrectomy combined
  with/without scleral buckling.
• Pneumatic retinopexy is reserved for only very simple
RRDs.

Some Common representative situations and management
options are described in the table below.
Figure 1c, d: Inferior RD in a patient with High myopia managed successfully with scleral buckling.

Figure 2: RD with posterior PVR.

Figure 3a: RD with significant vitreous haze managed with vitrectomy+silicone oil.

Figure 3b: RD with significant vitreous haze.

Figure 4a: Giant retinal detachment.

Figure 4b: GRT with rolled flap and bare choroid.

Figure 4c: GRT managed with vitrectomy with silicone oil.
<table>
<thead>
<tr>
<th>Clinical situation</th>
<th>Pneumatic retinopexy</th>
<th>Scleral buckling</th>
<th>Primary vitrectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior Quadrantic detachment with one peripheral break.</td>
<td>First choice excellent candidate for PR, in the absence of contraindications</td>
<td>First choice segmental scleral buckle placed radially, if the tear lies under a vertically acting muscle, a segmental circumferential buckle of solid silicone may be preferable</td>
<td>Second choice Can be considered as first choice if there is significant traction on the edges of the breaks especially in pseudophakics</td>
</tr>
<tr>
<td>Total detachment with one break.</td>
<td>Can be considered as First choice if the tear is in the upper eight clock-hours &amp; patient positioning possible</td>
<td>First choice with /without drainage Especially if the break is the lower 4 clock hours Encircling band may be needed in the presence of other retinal lesions/traction/early PVR</td>
<td>Second choice Can be considered as first choice if there is significant traction on the edges of the breaks especially in pseudophakics</td>
</tr>
<tr>
<td>Detachment with multiple breaks at same distance from ora</td>
<td>Usually not an option unless all open breaks are within a 1-2 clock-hours</td>
<td>Can be considered as First choice usually with drainage Encircling band recommended</td>
<td>Can be considered as first choice especially in pseudophakics</td>
</tr>
<tr>
<td>Detachment with multiple breaks at different distances from ora.</td>
<td>Usually not an option</td>
<td>Broad buckle grooved silicone implant is employed</td>
<td>First choice</td>
</tr>
<tr>
<td>“Aphakic detachment” with multiple small ora breaks.</td>
<td>Usually not an option</td>
<td>Buckling with encircling band Can be considered as First choice</td>
<td>First choice Encircling band &amp; A 360-degree peripheral laser photocoagulation is often applied.</td>
</tr>
<tr>
<td>Macula off Detachment with peripheral break and pseudomacular hole</td>
<td>As per situation 2,3,4</td>
<td>As per situation 2,3,4</td>
<td>As per situation 2,3,4</td>
</tr>
<tr>
<td>Macula off Detachment with peripheral break and macular hole</td>
<td>Can be considered but second surgery may be required for macular hole</td>
<td>Challenging surgery, good results reported by some surgeons implant may be sutured to the sclera of the posterior pole.</td>
<td>First choice ILM peeling can be considered May require Heavy silicone oil for tamponade</td>
</tr>
<tr>
<td>Detachment due to macular break generally seen in association with high myopia</td>
<td>Can be considered</td>
<td>First choice</td>
<td></td>
</tr>
<tr>
<td>Detachment with retinal dialysis.</td>
<td>First choice: drainage optional</td>
<td>First choice with or without a low, encircling scleral buckle PFCL needed to flatten retina</td>
<td></td>
</tr>
<tr>
<td>Detachment with giant break.(more than 3 clock hours)</td>
<td>Not an option</td>
<td>Usually not considered</td>
<td></td>
</tr>
<tr>
<td>Detachment with no apparent break. Rule out secondary retinal detachment</td>
<td>Not considered</td>
<td>Contiguous cryotherapy is applied in one or two rows starting just posterior to the ora in all detached quadrants.</td>
<td>Can be considered as first choice as breaks can be identified with use of PFCL that causes the subretinal fluid to exit the subretinal space via the break(s). Staining the subretinal fluid with Trypan blue can also be tried for better visualisation</td>
</tr>
</tbody>
</table>
References:

29. The Silicone Study Group. Vitrectomy with silicone oil

Dr Raju has completed his postgraduate training in ophthalmology and vitreo-retina residency at the prestigious All India Institute for Medical Sciences. He has published several scientific papers in international peer reviewed journals and presented papers, videos and posters in various international and national conferences. He has previously worked as associate editor of the DOS times (Delhi Ophthalmic Society) and is currently the chief editor of Chakshu, Journal of the Karnataka ophthalmic society.