A review of techniques employed in 1100 cases of retinal detachment

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SUMMARY To produce a flat retina after an operation demands an unrestricted view of the retina during the operation, and to achieve such a view most retinal surgeons would unhesitatingly recommend the binocular indirect ophthalmoscope and scleral depression. Once the retina and all its breaks are clearly in view, the keynote of the ensuing surgery should be simplicity and safety. The former requires that the intended operation should be the least complicated available and, should the surgical intention be frustrated, that each step should blend with the next in orderly progression, the surgeon exhausting the possibilities of one step before moving on to the next and being able to recognise when the possibilities are exhausted. The latter requires experience in deciding which is in fact the least complicated operation. In general the cavity of the globe should not be entered unless the eye stands to lose more than it gains by remaining inviolate. Paracentesis, fluid release, and intravitreal air all have their place, and to avoid them gains us nothing if the retina remains detached.

As the years go by surgical convictions change their patterns, and indeed much of their substance, before the awkward questions of tactless assistants and the bewildering face of failure. This review traces how my own techniques and convictions have been shaped by the differing fortunes of those 1100 patients with retinal detachments who have come my way. They have presented as new cases from Edinburgh and the Lothians and as a blend of new and relapsed cases from elsewhere. The acceptance of patients has in no way been subordinate to a parade of surgical triumph, and the only contraindication to operation has been the impending collapse of the globe or the absence of light perception.

When surgeons attempt to operate, they must believe that their attempt is going to have some chance of success. The will to persevere undaunted develops after seeing the most appalling retinæa stay flat when all reason declares that they should not. Surgical confidence is impossible to measure, but as it strengthens time is not wasted on gestures that experience has proved profitless in the past. I have tried to develop an approach of related progressions, exhausting the possibilities of a simple manoeuvre before justifying the advance to one that is less simple.

Binocular indirect ophthalmoscope

The pivot of my faith is the binocular indirect ophthalmoscope—an instrument whose alleged qualities I regarded at first with some scepticism, and whose apparent complexity I anticipated with some trepidation. There are other ways of looking at the retina, but none can match the wide flexible stereoscopic view that penetrates all errors of refraction and all but the most opaque media.

Unfortunately there is no device quite like it for inducing at the start a sensation of helpless incompetence, which makes many people appreciate its difficulties more than its qualities. The secret is to master each of its elements in practice separately before attempting to use them in earnest all together. This involves learning first how to hold a static image, then to hold that image as the patient’s eye moves, to know exactly where it was and where it has gone to. Thereafter the same facility should be developed when the examiner moves and the patient does not. Finally scleral depression completes the quartet of skills, and on this last depends the confident application of the cryoprobe during surgery.
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The limited illumination of the monocular indirect ophthalmoscope and the limited field of the direct ophthalmoscope gave rise to a series of surgical guidelines carried out in unconfirmed speculation rather than observed certainty. Their influence lingers. For example, every surgical tray contains callipers to chart in millimetres the position of the ora serrata, a retinal break, a fluid release site, or the position of a buckle—as though millimetres from the limbus confer precision when the huge diversity of ocular size might suggest that they do not. The unambiguous view of where we are with the binocular indirect ophthalmoscope eliminates the need for rules of thumb to guess where we ought to be.

Because most of the visible retinal tears were red, it was assumed that all tears and breaks were red. This can only be so if the underlying choroid is also red, which frequently it is not. More often it requires indentation to expose a retinal perforation—invisible face on, but unmistakable as a sharp-edged slit when viewed in profile. And, more subtle still, the clue to the presence of a break may be found in the vitreous, as a round fragment of floating retina or as a tuft like a goat's beard wisping on the hump of a scleral depressor (Fig. 1). And to see all these different features, a +20D aspheric lens is possibly the most popular. However, in the early stages of learning the instrument a +30D lens may shorten the initial period of disillusion.

Retinal surgery began for me with Dr James Graham Dobbie, of North Western University, Chicago, with whom I worked in 1968–9. His basic approach at that time, developed from his own training in Boston, consisted of limbal peritomy, monitored cryopexy to the exact area of the tear, subretinal fluid release when necessary, and local buckling with Silastic sponges—radial for equatorial tears, circumferential for those more anterior. His principle then was that the tear had to be stretched dry on the buckle before the patient left the theatre.

Increased prominence of the posterior edge of the vitreous base behind the ora serrata in aphakic eyes was taken to signify potential danger of preretinal retraction. For this reason such eyes were encircled as a routine with a silicone band (no. 40 in the catalogue of the Medical Instruments Research Association, Boston) on the assumption that, if a little traction threatened the retina, a little more traction in the opposite direction from a band on the equator would place the retina at the safer end of the traction force.

In exceptional cases of exceptional rigidity half-thickness diathermy was used to produce a more powerful adhesion, and an implant was buried in an area of scleral dissection. Air injection through the pars plana into the vitreous was reserved for retinae with giant tears.

My first attempt to flatten a retina with scleral dissection and a buried implant was not successful. The pathologist's remorseless description of my surgical ineptitude persuaded me not to attempt to bury another implant.

As sponge explant buckling seemed to stress my technique in another way, it struck me that if intravitreal air were effective for giant tears it might be equally effective for all tears. It was dramatically so, flattening retinae where my sponges had not, and persuading me to use it when I might perhaps have escaped with something more simple still.

Simple or complicated, retinal surgery, however, starts in the dark room, but there is not always a direct relationship between surgical success and the amount of time spent there. The operation can of course be planned in advance from the state of the retina, the state of the vitreous, and the position, number, and quality of retinal tears. The final procedure, however, can be only what the eye permits in the theatre, and slavish adherence to one technique may well be more a triumph of theory than of practice. The extent of a detachment is also significant, not that total separation makes surgery any more difficult, but from the hints that partial flattening prior to operation might give about the desire of the remainder of the retina to flatten as well.

If the macula is intact, then of course bed rest should keep it so until surgery is possible. But bed rest can only be of value otherwise to flatten a freely mobile retina. When the retina is criss-crossed with star folds and the breaks immobile with rolled edges, then bed rest will do nothing to unfold the stars or unroll the edges.

Operation

A limbal peritomy allows easy access at first and at subsequent procedures—and we all have subsequent procedures. Silk sutures (4/0) looped under the rectus

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Fig. 1 All breaks are not red.

"Goat's beard" on hump of scleral depressor

A tear lies at its root
muscles permit exposure of any relevant part of the sclera. At a reoperation only that part that requires manipulation need be dissected free. Dissection around 360° of the globe when only 90° are required lengthens the reoperation and the postoperative morbidity. I have never found it necessary in any of my cases to detach an extraocular muscle. This embarrasses the anterior ciliary blood supply, while encirclement embarrasses the posterior ciliary supply, and together they may be more than the eye can tolerate.

Information acquired in the dark room can now be refined under anaesthesia. Secondary breaks can be found easily by rolling a moist cotton tipped applicator around the contour line on which the major break lies. At the same time the state of the sclera can be estimated, and the amount of pressure required to produce pulsation of the central retinal artery can help us to determine in advance what surgical manoeuvre is possible and what has to be discarded. The same search is neither so fast nor so easy with a cryoprobe, the shape of which prevents the tip from rolling around the eye ball.

**Cryopexy**

There can be little disagreement now that cryopexy is the most effective and most simple way of applying an inflammatory insult to the chorioretinal bed. There is equally no disagreement that each application has to be monitored. The appearance of the ice ball varies with the thickness of the sclera, the time shortening with later applications. All applications must be continuous and only where necessary. Occasionally the pressure of multiple applications brings the tear nearer to its expected resting place. When this happens, first notions of the planned operation may be discarded, again in favour of something simpler.

Occasionally deep fluid prevents the accurate placement of the cryoprobe, in which case fluid release would be safer than overfreezing, and the volume of the globe may be restored with an air bubble into the vitreous; aphakic eyes are excepted for fear of multiple obscuring bubbles in the anterior chamber. In my experience cryopexy has been the most common associate of choroidal bleeding, a mishap that appears to be more likely when the probe is detached from the eye before it has had time to defrost.

It is at this point that opinions diverge about what to do next. Cryopexy produces the necessary impetus for glial proliferation, but that alone will not make the tear watertight unless the layers are persuaded to stay together while the scar is forming—and after it has formed. To the first end the retina may be floated upwards from within on an air bubble, or the sclera may be buckled from without. To the second end some element must be introduced to limit the potential danger of retinal shrinkage. To achieve both ends with variations on one theme is the essence of the art.

**Air in the vitreous**

The mechanics of this procedure are effective and simple. It is the ideal way to place the edges of ragged, large, and irregular tears against the treated chorio-retinal bed. These edges follow the contours of the eye and as such are more likely to stick in that position than when draped over the unnatural summit of a high buckle. In reoperations it vastly reduces the complexity of buckling a sclera that may well have been buckled beyond its limits.

There are several popular misconceptions about the use of air. The first is that it obscures the retina. This is not true. Except when multiple bubbles 'frog spawn' through the anterior chamber of an aphakic eye, and not always then, a single bubble can always be produced by the single movement of the plunger of a dry syringe with a dry needle. Indeed it is sometimes easier to see through this bubble than through the natural vitreous.

A second misconception is that air does not last long enough to seal a retinal break. Again this is not true. Twelve hours may be long enough, but clearly a large tear needs a large bubble and may not always get one.

A further misconception, perhaps perpetuated by myself, concerns the release of subretinal fluid. With my earlier method it was always assumed that this was indicated, but it has become increasingly evident that such an assumption is not always correct. The eye may be soft to begin with and further softened by carbonic anhydrase inhibitors prior to surgery. Further useful reduction of intraocular pressure may be obtained with a paracentesis. If a further reduction still is required, some aqueous may be tapped from the same paracentesis opening by depressing its posterior lip outside the globe. Paracentesis is arguably safer than attempting drainage of small amounts of fluid from remote areas.

Air does have the disadvantage, however, of converting what might be an extraocular procedure into an intraocular one, with the potential danger of intraocular inflammation. But in 700 cases treated with air there have been only 3 episodes of vitreal turbidity. All occurred in eyes suffering from some vitreal disturbance to begin with, and one of these ended with a shrunken retina. If air seems to be the method of choice, this choice should not be rejected on the grounds of such a minimal risk.

The first basic change in my technique was to...
realise that air could be injected without the prior release of subretinal fluid. The second was to realise that air was not necessarily the best method every time. A detachment is only as deep as that part of the retina bearing the tear. For example, aphakic tears are often found in shallow areas of a deep detachment, tethered on one side by the ora serrata, and there they may be buckled with no disturbance to the cavity of the eye or to the central retinal artery.

The third concerned the substitution of air for vitreous. In posterior polar detachments, where subretinal fluid release was dangerous or impossible, the evacuation of fluid vitreous along a Graefe blade through the pars plana was possibly a safer recourse, though one now acceptably refined by the development of instruments to make a formal excision of vitreal material.

Despite these unfortunate misconceptions, injection of air into the vitreous is gaining favour in many places, not least the Bascom Palmer Institute in Miami. This is perhaps as it should be, because its merits and demerits have had much longer to be considered than have many techniques since it was first described in detail by Rosengren before the second world war.

**Release of subretinal fluid**

There has been an intense and fairly sterile controversy around the perils of this manoeuvre. It has a disproportionate reputation for danger, which may be traced to the days when ill-placed drainage holes were cut in the comforting shade of suspect guidelines. Fluid release certainly used to have complications, but many of these now linger on in reputation only. However, they linger sufficiently to induce caution for reasons that may be no longer relevant. The exciting prospects of internal drainage make them even more irrelevant.

The former rules commended a site near the rectus muscle to avoid vortex veins. Now vortex veins do tend to leave the sclera half way between the rectus muscles, but the vortex ampullae remain within the eye, and on a meridian not infrequently where the old rules said they were not. Their position can be taken as a landmark for the equator.

The rules went on to emphasise that fluid should not be released beside a retinal tear, and there was some additional dispute about whether this should be before or behind the buckle. Clearly the place to release fluid is where there is fluid, and secondly where the choroid is relatively avascular. Since one of the alleged dangers is perforation of the retina, it has become my custom to place the sclerotomy exactly over where the retina is perforated anyway—over the retinal tear. Tight closure of the sclerotomy afterwards will guarantee that surface tension will keep the air in the vitreous where it was intended to be in the first place. If the edges of the sclerotomy fail to contact each other, the air may bubble through both the break and the sclera and will fail totally as an instrument of floatation.

Rather than divide retinal surgeons into those who release fluid and those who do not, it is possibly better to recognise that if fluid has to be released it should be released, and that if release can be avoided it should be avoided, but not if avoidance places the eye in greater danger. It would seem to me that the absolute reasons for fluid release might be as follows.

1. The part of the retina bearing the tear is too widely separated from the chorioretinal bed to allow accurate placement of cryopexy or of a local buckle, because it may be impossible to know exactly where the tear is going to settle.

2. Any long-standing detachment, particularly dialyses, especially in the young, is invariably separated from the chorioretinal bed by extremely thick subretinal fluid. My attempts to buckle such a tear without the prior release of fluid always resulted in all the layers advancing in procession into the eye ahead of the buckle, with a thick layer of subretinal fluid defiantly in between.

3. A rigid retina that clearly will not settle must be forced to do so with a high buckle, made possible only with a soft eye, itself often possible only in the circumstances with subretinal fluid release.

It is simpler to prepare tension sutures prior to fluid release. The attempt to run a needle through the sclera of a soft eye may well add further tears to the original problem.

Not all the fluid has to go. The aim of release is to make certain manipulations possible, not merely to make the retina look nice on the table. It is more comforting, and indeed more informative afterwards, to watch the fluid disappear than to wait for its return.

**Encircling silicone band**

This part of the operation is simple, though not perhaps wholly understood. It reduces the diameter of the globe across the equator, and hence slackens any traction forces in the same plane. It also reduces the ocular volume, displacing vitreous forwards and backwards. This displacement may possibly plug open tears and it may well reduce traction forces in planes other than that across the equator.

Used in this way, the band, pulled up deep to the rectus insertions, will achieve an acceptable tension when pushed back and stitched on to the equator of the globe. If the retina is extremely rigid, the band may be shortened further before or after it has been
stitched into place. The Watzke sheath permits this, a tantalum clip or a stitch does not (Fig. 2).

At this point the band is still just a simple encirclement or, as it is sometimes called, a cerclage. But it should be remembered that it is still not an operation in its own right, for it has done nothing yet to seal any retinal breaks and is not a substitute for finding them.

If a break is not to be sealed with an air bubble, it requires to be sealed with a buckle. This buckle may sometimes be part of the band which may have been placed deliberately to catch retinal breaks on its anterior slope. Should the buckle, however, require to be higher because of a large or rigid tear, then the Watzke sheath may be tension sutured in the appropriate position. If more height still is required, then a segment of guttered explant (no. 20 band in the MIRA catalogue) may be added deep to the encircling band, and again tension sutured in position. And if all this is not enough a fragment of Silastic sponge or a cut remnant of the no. 40 band may be slipped between the guttered explant and the eye (Fig. 3).

All these previous manipulations have been devised so that they might be advanced step by step forwards without the need to make any steps backwards. Should the scleral stitches cut out or appear suspect, the attempt can be abandoned and exchanged for an air bubble.

My belief in this encirclement, now a routine, has deepened into a conviction of its value, not because of scientifically controlled trials but because it has proved to be demonstrably safe. Although it may not be absolutely necessary in all cases, it is impossible to know in which cases it is going to be absolutely unnecessary. It might be conceded that an anaesthetic for a second operation carries more hazard than a possibly superfluous band at a first operation.

The band has to be secured in each quadrant with a holding stitch. If tension stitches have been used, to rely on them alone for security is to rely on expedients that cannot be guaranteed secure. Security is attainable for the anterior limb at least of a tension suture if some fibres of a rectus insertion, if available, can be caught in its track. The minimal risk of diplopia afterwards is possibly preferable to a slack buckle.

A band correctly placed lengthens the globe and induces myopia but it does not occlude the long ciliary vessels. Only 3 of my 1100 bands have had to be removed because of deep ocular pain, but none of these eyes displayed any of the classic signs of anterior segment ischaemia in the form of hypotony, anterior uveitis, or optic atrophy.

The distinction between encirclement and buckling must be emphasised again. Encirclement alone is not an operation in itself. It is only part of an operation. The tear is sealed with a buckle or by an air bubble. Encirclement may prevent it from unsealing afterwards.

The traditional anxiety that a circumferential buckle on the equator increases the risk of radial folds is certainly true, but only if the band is so tight that the retina is thrown up into these folds; and indeed such a
band may well cause other problems which may make the presence or absence of a flat retina irrelevant.

If each step can be carried out without the release of subretinal fluid, then of course release should be avoided. The limiting factor is the patency of the central retinal artery, and this may be kept safe with carbonic anhydrase inhibitors or repeated taps of a single paracentesis opening.

Large and multiple tears, and large volumes of subretinal fluid, raising the tear from the chorio-retinal bed, make the release of subretinal fluid necessary. If such tears can subsequently be caught on a buckle, this should be the next step forwards. Should this not be possible, it is an easy matter to dispense with the buckle and inject an air bubble with no steps retraced.

**Sutures**

I have found the most inert suture material to be 5/0 PTFE coated polyester. This slides easily through the sclera and the knots hold well. If the colour is other than white, at reoperations it does give a valuable clue to the position of explants, which always blend invisibly into the sclera unless the eye is 'rejecting' them.

A half circle spatulate needle allows suturing well behind the equator, and reduces the danger of perforation of the retina. The technique of inserting the needle that I have found to be the safest has been to pick up the required depth with the tip of the needle, then to advance it through the sclera with the back surface of the needle leading and the tip pointing away from the retina. The motion is not unlike that of the prow of a yacht rising and dipping in a gentle swell (Fig. 4).

Finally the conjunctiva can be secured with a single cat-gut stitch at the temporal side, and, if the conjunctival edge is left 2 mm or so from the limbus, then by the next morning it will be in perfect position. Anything closer to the limbus at the end of the operation will have obscured the cornea the following day.

**Radial sponge buckles**

I have generally tried to avoid these because they make an asymmetric distortion of the globe, and in my experience Silastic sponges have tended more than solid silicone explants to present beneath, and indeed through, the conjunctiva. Their bulk makes anterior positioning obvious beneath the conjunctiva, and if beneath a muscle they may be more obvious with the resultant diplopia. I must stress that this is a personal view. Silastic sponges have been used very successfully by many surgeons without the problems that I have found, and of course they are obligatory for all large equatorial tears in the lower quadrants.

The broad encircling Silastic expant which I described briefly in 1970 to buckle from the equator to the ora must be dismissed as a folly of youth. What retina remained behind the buckle certainly flattened, but the general crude inelegance of the procedure had little else to recommend it.

**Postoperative care: double padding**

There is no concrete evidence that the eye movements are reduced behind double pads, and indeed patients have told me that they keep moving their eyes in order to catch chinks of light around the sides.

Extreme immobility after an operation might be considered bad rather than good. In my experience, if subretinal fluid has not been released and the retina is apparently slow to settle on the buckle, then mobilising the patient may hasten the desired development. But common sense must be the guide, and clearly the benefits of gravity and bed rest in sealing a lower tear must be balanced against the possible benefits of early mobilisation. Prolonged bed
rest, so much advised formerly, depends on another lingering belief whose value is not borne out in practice now. If a procedure cannot survive simple mobilisation, it will not survive much else.

Local corticosteroids and mydriatics are the only standard medication used during the first 4 days of inpatient care and in the subsequent 2 weeks leading to the first outpatient appointment.

I have found it useful also to measure the intraocular pressure, which can sometimes be found raised in the early postoperative period. But in none of my patients has this remained permanently so unless there was some pre-existing tendency to a raised pressure at the outset.

As my surgical method has evolved, I have tried to eliminate needless steps, rather like a golfer rolling 3 shots into 2. While scleral landmarks of intraocular features have to be located during every procedure, they can be marked with something that is going to be used anyway instead of with some extra apparatus or with some evanescent dye. A fluid release site, which must be scrupulously located, can be easily relocated if a half-thickness sclerotomy is cut to begin with. It can then be deepened when the moment for fluid release arrives. A retinal tear can be indicated by a stitch—not over it, but beside it—as one limb of a tension suture that will be used to tie the buckle. And any doubts about the position of a tear can be dispelled by those petechial haemorrhages that spread over the area of frozen sclera.

My early complicated method of marking the sclera with a converted dental instrument, triumphantly described some years ago, has been now quietly discarded in favour of the Gass locator, which can be modified from an ordinary scleral depressor. As an offshoot of the same economy the theatre lights are no longer extinguished during every fundal check, simply because it is not necessary. This was not the product of thought, but the impatience of a new theatre nurse who could not understand why any surgeon would want to operate in the dark.

The aim of all retinal surgery is to replace a flat and functioning retina at a first attempt. What is flat is perhaps self-evident. What is functioning is the restoration of vision, both central and field, to a level that is compatible with the presenting visual state. Central vision may not come up to expectations, but restoration of visual field is of enormous consequence.

We all have failures, and the only real cause of failure in my series has been retinal shrinkage, almost invariably in eyes that were disturbed from the outset by vitreal haemorrhage, posterior uveitis, multiple or vigorous procedures, and vitreoretinal rigidity. With the increasing development of vitreoretinal surgery it is to be hoped that even these will join the ranks of successes in the future.

All surgeons have their own pet beliefs that do not always stand up to the scrutiny of reason. This paper describes the evolution of my beliefs, most of which I hope are based on reason rather than conviction. It in no way implies that the techniques favoured by others are wrong. They are merely different. Although all the techniques may not be acceptable to everyone, it is to be hoped that the description of their development might help others in the future who might be starting out to develop their own surgical method.

Artur Rubinstein once said that he had fed off Chopin’s blood all his life. At a humbler level I would like to acknowledge my debt to all those researchers, thinkers and innovators, nurses, and patients who have made this paper possible.
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