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Indentation Microsurgery: Internal Searching for Retinal Breaks

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Summary
Breaks responsible for rhegmatogenous retinal detachments in 78 eyes could not be seen preoperatively owing to opacities in the media, previous buckling or other causes. Deep kinetic indentation of the sclera combined with endoillumination enabled retinal breaks to be identified during closed microsurgery in 95% of these eyes, and retinal reattachment was eventually achieved in 85%.

Gonin stated the principles of repair of rhegmatogenous retinal detachment, *viz* identification of the retinal breaks and their effective closure.[1] However, difficulties may arise in locating retinal breaks owing to opacities in the media (including problems of pupil dilatation), or the position and/or size of the breaks. These factors are inter-related; for example, large retinal breaks can generally be seen by ophthalmoscopy despite considerable obscuration in the media, while small breaks may prove impossible to locate even if the media are perfectly clear.[2] Lincoff and Geiser[3] have shown that the distribution of subretinal fluid (SRF) can be a useful predictor of the position of retinal breaks, but "speculative" buckling procedures based on these guidelines in eyes with unidentified breaks are of only limited value,[2,4] especially in cases of failed previous retinal surgery, total or subtotal detachment or major obscuration of fundus details. Alternatively, a closed microsurgical technique can be employed in order to remove any media opacities and thus to permit identification of the breaks.[2,5] By this means, elements of vitreoretinal traction can also be managed and space created for intravitreal injection of gases (or silicone oil) for postoperative internal break tamponade.

Wong, Billington and Chignell reported encouraging results of both 'speculative' conventional retinal surgery and an 'internal' vitrectomy approach for eyes in which retinal breaks could not be seen before surgery.[2] However, breaks were discovered in only 18 of the 47 vitrectomy patients. We describe an indentation microsurgery technique which, in our hands, has greatly increased the chances of identifying retinal breaks (especially those located near the ora serrata), and we report the outcome of such surgery in 78 eyes.

Material and Methods

We reviewed a consecutive series of patients who underwent pars plana vitrectomy for rhegmatogenous retinal detachment between January 1985 and October 1987 in whom the principal reason for undertaking vitrectomy was to permit identification of the responsible retinal breaks. We excluded from consideration eyes with combined traction and rhegmatogenous retinal detachment associated with trauma or vasoproliferative retinopathies (including diabetic retinopathy), together with eyes with proliferative vitreoretinopathy (PVR) in which the main reason for recourse to vitrectomy was removal of tractional membranes rather than identi-

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fication of breaks. Seventy-eight eyes of 78 patients were included in this series; the patients ages ranged from nine to 88 years (mean 51 years). Of these, 40 eyes were phakic in the visual axis, 27 were aphakic, nine were pseudophakic and two had dislocated lenses. Axial myopia of more than −6.0 dioptres (or its aphakic equivalent) was present in 28 (36%) of eyes. Scleral buckling or encircling procedures had previously been undertaken (unsuccessfully) in 48 eyes (62%) on up to five occasions (mean 1.6 failed procedures in this 'secondary' group). The retina was totally detached in 35 eyes, subtotally detached in 24 eyes (i.e. less than one quadrant attached), or less extensively detached in 19 eyes; in 63 eyes the macula was detached. Tangential traction from epiretinal membrane contraction (PVR grade B or C1) was evident in 13/78 eyes (17 per cent).

Problems of Fundus Visualisation

In 71 out of the 78 eyes (constituting category A), the retina was identified as being detached by ophthalmoscopy but no retinal breaks were seen preoperatively or, if a break *was* seen (17 eyes), it was not thought to be primarily or solely the cause of the detachment by virtue of its site in relation to the configuration of the detachment. In the remaining seven out of 78 eyes (category B), neither retinal breaks nor the retinal detachment could be seen ophthalmoscopically, and the diagnosis of mobile retinal detachment was made by B-scan ultrasonography.

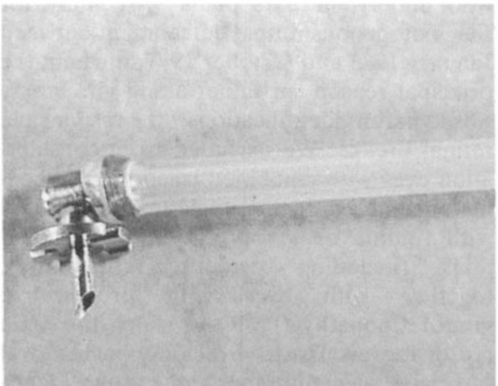

Fig. 1. *Right-angled infusion cannula for internal searching.*

The following were the reasons for resorting to an internal search, either singly or in combination, in the 78 eyes in this series: *opacity of the media* (56 eyes), including vitreous haemorrhage (12 eyes), vitreous pigment and debris (30 eyes), lens remnants (12 eyes), cataract (10 eyes) or corneal opacities (3 eyes), *pupillary miosis or distortion* (20 eyes), *deep previous scleral indentation* (12 eyes), and *highly bullous retinal and/or choroidal detachment* (7 eyes).

Preliminaries to Internal Searching

Patients were carefully positioned for surgery so that all quadrants of the fundus were accessible for internal searching: in essence, the head was secured so that the coronal plane of the eye was horizontal but with a slight tilt nasally to improve access to the nasal periphery. Subconjunctival mydricaine was given routinely to ensure maximal pupillary dilatation throughout the procedure.

Vitrectomy was performed using 20-gauge instrumentation and a standard 3-port system. The infusion cannula was generally placed opposite the lower border of the lateral rectus insertion to facilitate temporal rotation of the globe; a modified infusion cannula (Fig. 1) was sometimes employed either inferotemporally or inferonasally, and on rare occasions a lateral canthotomy was necessary. The active entry sites for endoillumination and vitrectomy were made opposite the upper borders of the horizontal recti in order to maximise the angular range of internal inspection and surgery. Scleral indentation facilitated removal of the basal vitreous gel following posterior vitrectomy, and vitrectomy was combined with other surgery to improve viewing of the posterior segment in 23 eyes (lens extraction in two eyes; lensectomy in nine eyes and anterior segment revision in 12 eyes).

Internal Searching Posteriorly

The post-equatorial retina was inspected using endoillumination, and suction was applied by means of a flute needle or linear aspirator to any areas suspected of harbouring retinal breaks. Transretinal flow of SRF enabled any full-thickness discontinuity to be confirmed.

Internal Searching Peripherally

One of the two superior entry ports was plugged and, with the height of the infusion bottle lowered, 180° of peripheral retina was examined by endoillumination combined with surgeon-controlled deep kinetic scleral indentation (Fig. 2). By 'changing hands' i.e. by plugging the other active port and replacing the endoilluminator within the globe through the other entry site, internal searching was repeated throughout the remaining ocular circumference.

Retinal Reattachment Surgery

SRF was drained internally in 40 eyes (via a retinal break in 33 eyes or via a deliberate retinotomy in seven eyes) and externally in seven eyes; both internal and external drainage of SRF was performed in one eye. In the remaining 30 eyes, fluid was not drained from the subretinal compartment.

Air or an SF6: air mixture was exchanged for vitreal fluid in 70 eyes to allow postoperative internal tamponade of breaks. In one eye, no tamponade was used owing to peroperative choroidal haemorrhage. Silicone oil was injected into the remaining seven eyes for the following reasons: two eyes with retinal breaks at the edge of the optic disc; three eyes with macular holes and adjacent epiretinal membranes; one eye with retinal incarceration into a surgical entry site requiring extensive retinectomy; and one eye with breaks in grossly atrophic retina and with a very thin sclera from multiple previous surgical procedures.

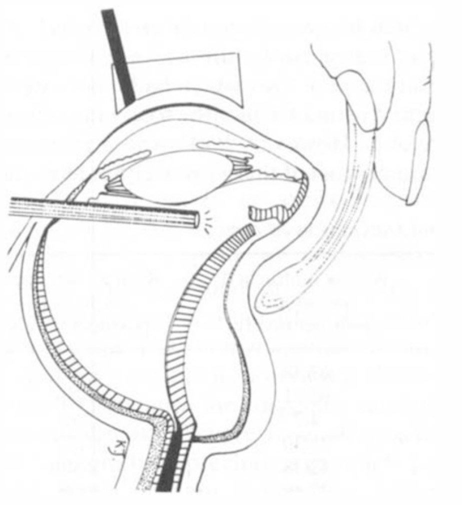

Fig. 2. *Drawing of internal searching using endoillumination and surgeon-controlled deep scleral indentation.*

Retinal breaks were treated by transscleral cryotherapy in 49 eyes, by endolaser photocoagulation in 23 eyes, and by both modalities in five eyes. No retinopexy was carried out in one eye owing to peroperative choroidal haemorrhage.

Except for one primary procedure for a localised retinal detachment owing to a single small break, all eyes had a scleral buckle and/or encircling band over the vitreous base region at the completion of surgery. Equatorial breaks were supported by a break-ora occlusive buckle.[6] In the four eyes in which no retinal breaks were discovered, an encircling band was placed at the posterior border of the vitreous base together with tyre explants over particularly suspicious areas of the retinal periphery.

Postoperative Positioning

For four or more days postoperatively, patients adopted a face-down or other appropriate posture in order to maintain the arc of contact of the tamponade agent against the site of the retinal break. In eyes in which subretinal fluid was not drained at surgery, patients were alternately postured immediately postoperatively in the right or left semiprone positions at hourly intervals in order to prevent redundancy folding of the retina posterior to the buckle.

Results

I. *Break Identification*

In 74 out of 78 eyes (95%), breaks were discovered peroperatively which were felt to be responsible for the retinal detachment. This included additional breaks in all 17 eyes in which, although a break was seen preoperatively, it was not thought to be primarily responsible for the detachment.

In 15 eyes the break was post-equatorial and in 52 eyes pre-equatorial; in seven eyes both pre- and post-equatorial breaks were seen. In the remaining four eyes, no retinal break could be identified peroperatively. Of the posterior breaks, five were macular holes and three were breaks at the edge of the optic disc, while seven of the 22 eyes with post-equatorial breaks were highly myopic.

The number of breaks identified in each eye was 1–8 (mean 1.9), and there was a substantial preponderance of peripheral breaks in the superior hemisphere. There was no difference in the success of break discovery comparing categories A and B, or comparing primary and secondary procedures (Table I).

In the 48 eyes with previous scleral buckling or encirclement, the newly-discovered breaks were located *anterior* to the buckle in nine eyes, *posterior* to the buckle in 20 eyes, *to the side* of the buckle in four eyes, *on* the buckle in two eyes and with *no relation* to a segmental buckle in the remaining eyes.

II. *Peroperative Complications*

Significant peroperative complications arose in seven of the 78 procedures: lens touch occurred in two eyes, subretinal infusion in one eye, retinal incarceration in an entry site in one eye and choroidal haemorrhage in three eyes.

III. *Retinal Reattachment at One Month Postoperatively*

Sixty-seven out of 78 eyes (86%) had a completely reattached retina at one month following surgery. Within this period, however, three eyes had required further retinal reattachment surgery. The anatomical success of surgery was similar whether the internal search was a primary or secondary procedure (Table I) but three of the failures were category B patients. All eyes in which SRF was not drained peroperatively were successfully reattached justifying this type of procedure in selected cases.

IV. *Retinal Reattachment at Six Months Postoperatively*

Sixteen of the patients with a successful anatomical outcome at one month postoperatively were lost to further follow-up because they returned home overseas. Of the 62 eyes which were re-examined at six months (or which were known to be failures), 53 eyes (85%) had complete retinal reattachment (Table I). Among these 53 eyes, however, ten had required further retinal reattachment surgery in the interim (the retina remaining attached for a period of six months from the last surgical intervention). Thus 43 out of 62 eyes (70%) which were reviewed at six months had an attached retina and had required no further vitreoretinal surgery after the internal search. Surgery was especially definitive in the 40 secondary procedures in which the retina remained attached throughout the six postoperative months in 32 eyes (80%).

Of the seven eyes with peroperative complications, five were successfully reattached at six months (the two failures having suffered choroidal haemorrhage peroperatively). The precise reason for failure was not always evident in the nine eyes which had a persistently detached retina six months following internal searching. However, PVR was a prominent feature of most of these eyes, either as a cause

Table I. *Break discovery and retinal reattachment after internal searching in 78 eyes*

	Break seen peroperatively	Retina reattached one month postoperatively	Retina reattached six months postoperatively
Overall	74/78	67/78	53/62
Category A	67/71	63/71	48/56
Category B	7/7	4/7	5/6
Primary procedure	28/30	25/30	17/22
Secondary procedure	46/48	42/48	36/40
SRF drained		37/48	30/38
SRF not drained		30/30	23/24
Break seen peroperatively		64/74	52/59
Break not seen peroperatively		3/4	1/3

or consequence of failure, and no further surgery was advised.

Discussion

A single small break can cause a total detachment of the retina while the retina will withstand the tangential tractional effects of widespread epiretinal membranes without significant elevation provided no breaks are created or re-opened. It follows that the methodology of internal searching for breaks ranks at least equal in importance to sophisticated membrane dissection techniques in closed microsurgery for rhegmatogenous detachment. Posterior breaks are readily identified by standard methods of endo-illumination combined with aspiration; the *schlieren* of relatively dense SRF entering a pre-retinal compartment filled with infusion fluid confirms the full-thickness retinal discontinuity. However, the majority of retinal breaks are located peripherally, especially at the posterior border of the vitreous base, and special techniques are required for visualisation of this area during vitrectomy. Prismatic fundus-viewing lenses can be helpful for this purpose (and indeed the 3-mirror contact lens is employed in some European centres even for conventional retinal reattachment procedures). Alternatively, some surgeons temporarily plug the sclerotomies after vitrectomy and view the ocular interior with the indirect ophthalmoscope (Michels, personal communication). We prefer the technique described here whereby reflex-free endoillumination is combined with surgeon-controlled deep kinetic scleral indentation thus enabling the whole circumference of the peripheral retina to be viewed up to and including the ora serrata even in phakic eyes. Breaks can be seen directly or the operculum viewed in profile; small breaks are often best seen on the slope rather than the summit of indentation. The zoom magnification and binocular viewing of the operating microscope serve to maximise the surgeon's capability to identify breaks. Where residual opacities in the vitreous base preclude a complete peripheral search, further indentation vitrectomy with the suction-cutter and coaxial microscope illumination can be used and, if necessary, the flap of any tear can be amputated or the break otherwise enlarged to permit internal drainage of SRF. Approximation of the pigment epithelium to the retina by deep indentation also permits endolaser photocoagulation of the retina adjacent to the break as an alternative to transcleral cryopexy.

Although the actual number of retinal breaks in the eyes in this series is unknown, a break or multiple breaks were successfully identified in 95% of the procedures. However, internal searching is not without its dangers. Lens damage, retinal incarceration in entry sites and subretinal infusion are risks inherent in any closed microsurgical approach to a bullous retinal detachment while choroidal haemorrhage is an ever-present concern in highly myopic or inflammed eyes. Furthermore, the possible introduction of new vitreoretinal tractional problems owing to either vitreous incarceration in entry sites[6] or continuing hypocellular gel contraction in the vitreous base (anterior loop traction)[7] underscores the need for indentation vitrectomy of basal gel and consideration of encirclement in these cases. Nevertheless, the newly-discovered breaks can be closed *precisely* (by focal scleral buckling and/or retinal coagulation) and the associated retinal detachment treated *definitively*. We therefore commend the internal search for eyes with unseen retinal breaks, especially those which have previously undergone failed retinal reattachment surgery.

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