MINIMIZED SURGERY FOR RETINAL DETACHMENTS WITH SEGMENTAL BUCKLING AND NONDRAINAGE

An 11-year Follow-up

INGRID KREISSIG, MD, DETLEF ROSE, MD, BETTINA JOST, MD

Abstract: A prospective study was conducted of 107 retinal detachments operated on between August 1979 and January 1980, with a complete follow-up period ranging from 11 years to 11.5 years. Proliferative vitreoretinopathy (PVR) stage C1 or C2 was seen in 16 detachments. Surgery consisted of cryopexy and segmental buckling (limited to the area of breaks) with nondrainage. Of the surgical procedures, 71% were radial buckles, 19% circumferential, and 10% radial combined with circumferential buckles. The primary reattachment rate was 92.6%, and 97% after reoperation. During the long-term follow-up period, redetachment occurred in 12.1% of the eyes: 5.6% were classified as early redetachments (between 2 and 4 months), and 6.5% as late redetachments (between 3 and 7 years). Early redetachment was caused by PVR, and late redetachment by new holes. After reoperation, reattachment occurred in 92.6% of the eyes. The predominant cause of final failure was PVR (3.7%). Only one eye had two reoperations. There was a highly significant ($P < 0.001$) improvement between preoperative visual function (mean 0.32) and postoperative visual function (mean 0.56) in all 99 reattached eyes during the follow-up period (Mann-Whitney U test).
RETINA 12:224–231, 1992

Two principles of surgical approach have evolved in the treatment of rhegmatogenous retinal detachment. First, there is treatment with an encircling element and drainage of subretinal fluid, a method developed by Schepens[1,2] and Arruga[3,4] in the late 1950s, and widely used ever since. Secondly, there is the technique using buckling limited to the area of the break and nondrainage, introduced by Custodis[5] in 1953. Due to serious complications, however, this method has not been widely used. Lincoff, recognizing the value of this technique, modified the procedure in the mid-1960s.[6,7] He developed the tissue inert silicone sponge to replace the somewhat toxic polyviol plombe, and substituted cryosurgery for diathermy. The sufficient strength of this cryosurgical adhesion was verified in animal experiments.[8,9] Thus, by reducing buckling to the area of the break and eliminating drainage of subretinal fluid, a minimization of detachment surgery was made feasible.

In 1970, our Retinal Service switched from extensive circumferential buckling and cerclage with drainage to segmental elastic buckling without drainage.[10] We pursued this in spite of the prevailing opinion that encircling surgery was prophylactic and would prevent a later redetachment. After using segmental sponges without drainage between 1970 and 1977, we reported the clinical results of 1,000 consecutive detachments in 1978.[11] In this series, the retina was reattached after one operation in 83% of the eyes, and after reoperation in 91%. The follow-up period ranged from 4 months to 7.5 years, with an average duration of 32 months.

From the Department of Ophthalmology III (Retina and Vitreous Surgery), University Tübingen, Germany.

Presented in part at the 24th Annual Meeting of The Retina Society, September 12, 1991, Quebec, Canada.

Reprint requests: Ingrid Kreissig, MD, Universitäts-Augenklinik, Schleichstraße 12, D-7400 Tübingen, Germany.

In spite of favorable results with this minimized detachment surgery, the discussion of the necessity of a cerclage continued. We have argued that it may be unnecessary to treat *a priori* an eye with a detachment by a cerclage, with all its possible complications,[12,13] since 1) it is not proved that a later redetachment will occur at all; and 2) it is not known if this additional indentation in an area of unsuspicious retina at the time of surgery would indeed counteract a later redetachment.

In 1979, we began a prospective study with specific inclusion criteria to evaluate the 10-year results of minimized detachment surgery. To provide complete follow-up data on every single patient, however, took us 1.5 years longer, since three patients were temporarily unavailable for follow-up examination. The results of this study of 107 detachment patients, with a complete follow-up period of 11 to 11.5 years, provide the data to answer the open question: is the rate of late redetachment increased in the absence of prophylactic cerclage?

Patients and Methods

We selected 107 cases of retinal detachment treated at the University Eye Clinic Tübingen between August 6, 1979 and January 23, 1980. These patients were selected from 121 consecutive patients with detachments, and according to the protocol 14 were excluded due to perforating injury, giant tear, retinopathy of prematurity, or having had previous surgery elsewhere. The aim of the study was to test the validity of minimized detachment surgery in the treatment of primary rhegmatogenous detachments.

The 107 patients ranged in age from 8 years to 86 years, with a mean age of 56 years. Myopia of 2 diopters to 25 diopters was present in 38 eyes. Myopia was ⩾ 7 diopters in 9 patients, 21 eyes were aphakic (intracapsular cataract extraction), and 1 eye was pseudophakic (Table 1). Sixteen eyes had small amounts of blood in the vitreous, and one eye had a relatively dense vitreous hemorrhage. Proliferative vitreoretinopathy (PVR) was seen in 21 eyes: 5 with stage B PVR and 16 with stage C PVR (12 with C1, 4 with C2). In 61 eyes, the detachment was confined to one to two quadrants and in 46 eyes it was confined to three to four quadrants. Horseshoe tears were present in 91 eyes (85%), round respectively oval-shaped holes in 12 eyes (11%), and an ora disinsertion in 4 eyes (4%). In 64 detachments (60%) there was only 1 break or a group of breaks within one clock hour, and in 43 eyes (40%) there were multiple breaks (2–5) at different clock hours (Table 2).

Table 1. Patient Data (n = 107 Detachments)

Age range (yrs)	8–86
Mean	56
Myopia (diopters)	
⩾2–25	38
⩾7	9
Lens status	
Aphakic	21
Pseudophakic	1
Follow-up period (yrs)	11–11.5
Mean	11.3
Patients lost to follow-up	0

The protocol for follow-up included examinations at 1 week to 2 weeks, 3 months, and 6 months after surgery and then at yearly intervals. All of the 107 patients were examined for a complete follow-up period: if necessary, the patient was traced through various state institutions. Of the patients, 22 (21%) had died between 6 months and 112 months after surgery, and the state of the retina at the time of death was known. Follow-up periods for the remaining 85 patients ranged from 11 years to 11.5 years. For every detachment the operation consisted of a cryopexy treatment to the break and a sponge or balloon applied to buckle the retinal break. The size of the explant was limited to the extent of the break, and a cerclage was not used at all (Figure 1).

Radial plombages were used in 76 eyes (71%): of these, 7 were temporary balloons (at that time the balloon operation was in its first half year) and 69 were radial sponges. Twenty eyes (19%) had circumferential sponges, and 11 eyes (10%) both radial and circumferential sponges (Table 3). Drainage of subretinal fluid was not performed, although in four eyes partial drainage occurred due to an accidental puncture.

Results

The retina was successfully reattached after one operation by the described minimized detachment surgery in 99 (92.6%) of the 107 eyes (Table 4). The retina was partially attached in 4 eyes (3.7%), and remained detached in another 4 eyes (3.7%).

Table 2. Preoperative Characteristics of 107 Detachments

Extent of detachment	
1–2 quadrants	61
3–4 quadrants	46
Shape of retinal break	
Horseshoe	91
Round or oval	12
Ora disinsertion	4
Number of breaks	
One or multiple within one clock hour	64
Multiple	43
Vitreous hemorrhage	17
Proliferative vitreoretinopathy	21
Stage B (5)	
Stage C1 (12)	
Stage C2 (4)	

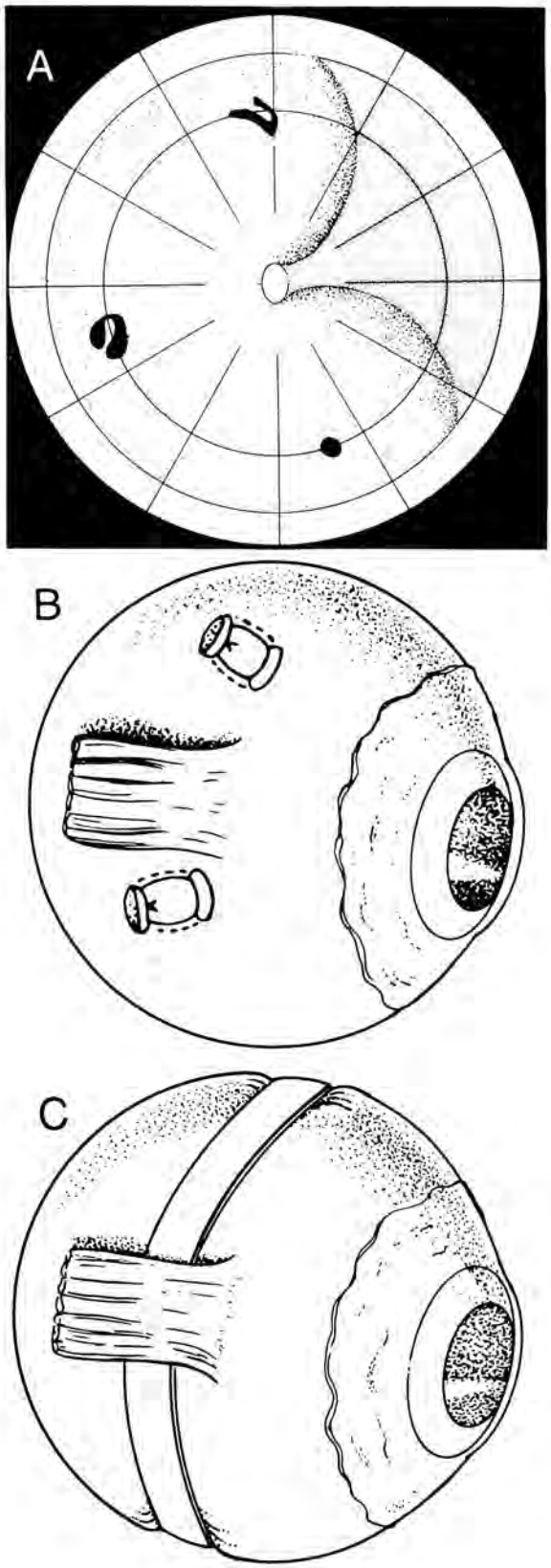

Fig. 1. Principle of minimized detachment surgery by limiting buckling to the area of the break demonstrated in a clinical case. **A.** A 3-quadrant detachment with 3 breaks. **B.** Tamponade of the breaks by separate radial sponges without drainage, but **C.** not by an encircling element.

The reason for primary failure was related to the break needing treatment: in four eyes the tamponade of the break was inadequate, in two eyes another break was present, and in two eyes no break was found. Reoperation was performed in five of the eight primary failures (Table 4): reattachment was achieved in all of them with a second segmental sponge (three eyes) or a balloon (one eye) without drainage, or an intraocular air injection (one eye). Thus, with one reoperation confined to the original break or to a previously undetected break, retinal reattachment was achieved in 104 eyes (97%). Subsequent reoperation was performed in 10 of these eyes during a long-term follow-up period of 11 years to 11.5 years (Table 5).

Early redetachment (between 2 and 4 months after surgery) occurred in 6 eyes (5.6%; Table 6), and was due to progression of preoperative PVR stage C1 in 2 eyes, to postoperatively evolving PVR stage D2 in 2 eyes, and to a new break in 2 eyes, 1 of which involved uncertain localization in a cataractous eye. Four of these six eyes underwent reoperation: three were treated with segmental sponges without drainage, and one eye was reoperated upon elsewhere with vitrectomy and silicone oil injection. The retina was primarily reattached in 3 of these eyes and redetached after 6 weeks in 1 eye. The two reattached eyes were the result of a sponge buckle. Retinal reattachment was present in 100 eyes (93.5%) 2 years after surgery.

Late redetachment (between 3 and 7 years after surgery) occurred in 7 (6.5%) eyes (Table 6). In contrast to early redetachment, late redetachment was due in every case to new retinal breaks. With the exception of one case, the breaks were within one quadrant of a previously treated break. Six of the seven late redetachments were reattached with a second operation: three with a balloon and two with a segmental sponge without drainage. One eye was reoperated upon elsewhere with a cerclage. Final retinal reattachment during the long-term follow-up period was obtained in 99 eyes (92.6%).

During the follow-up period, a total of 15 reoperations

Table 3. Surgical Procedure with Nondrainage (n = 107 Detachments)

Radial plombage	76
Sponge	69
Balloon	7
Circumferential	20
Combination of radial and circumferential	11

Table 4. Primary Anatomical Results of 107 Detachments After Segmental Buckling with Nondrainage and Reoperation*

One operation (n = 107)	
Completely reattached	99 (92.6%)
Partially reattached	4 (3.7%)
Detached	4 (3.7%)
Primary reoperation (n = 5)†	
Completely reattached	5
Total Reattachment	104 (97%)

* Reoperation 2 months or less after primary surgery.
† Two patients declined reoperation because visual acuity was 20/25 in their fellow eye, and another patient with visual acuity of 20/40 was in critical health condition.

(including primary, early, and late) in 14 eyes (13%) were performed for the final result of reattachment in 99 eyes (92.6%). Only 1 of the 107 eyes had 2 reoperations. The reasons for final failure were (Table 7): PVR in four eyes (3.7%), no hole found in three (2.8%), and massive choroidals in one myopic eye of −17 diopters (0.9%).

Complications

After treatment with minimized surgery (sponges, balloon, or with a gas injection in one eye) PVR had developed *de novo* after the primary operation in four eyes (stage C1, C2 and D2 in two eyes): two (stage C1, C2) regressed and two (stage D2) progressed to final failure. In one eye an exposed sponge had to be removed, although the retina remained attached. Buckle removal due to diplopia was not necessary. One highly myopic eye developed massive choroidals and another eye an obvious cataract 8 years after surgery (here the question arises: *post* or *propter?*). One eye with preoperative PVR stage C2 subsequently developed a macular pucker. The one eye that was reoperated upon elsewhere with vitrectomy and silicone oil injection eventually became phthisical and had to be enucleated.

Table 5. Incidence of Redetachment in 104 Reattached Eyes during Follow-up Period of 11 to 11.5 years

	"Early" (n = 6)	"Late" (n = 7)
Result after reoperation		
Reattached	2	6
Redetached early*	1	—
Detached	1	—
No reoperation	2†	1‡

* After 6 weeks.
† One patient declined reoperation due to poor health and another patient because visual acuity was 20/20 in his fellow eye.
‡ One patient declined reoperation due to poor health; he died 6 months later.

Table 6. Long-term Anatomical Results of 104 Reattached Retinas after Segmental Buckling with Nondrainage and Reoperation

	"Early" Redetachment (n = 6)	"Late" Redetachment (n = 7)
Reoperation	4*	6†
Completely reattached	2	6
Total reattachment	100 (93.5%)	99 (92.6%)

* One patient declined reoperation due to poor health and another patient because visual acuity was 20/20 in his fellow eye.
† One patient declined reoperation due to poor health; he died 6 months later.

Throughout the follow-up period all of the eyes were without pain. There was no secondary glaucoma, anisometropia, hypotony, enophthalmus, or cosmetic defect. Amaurosis was not present in any of the cases, including the seven failures. In the 99 patients with retinas reattached, there was a highly significant ($P < 0.001$) improvement of visual function, from a preoperative mean value of 0.32 to a postoperative mean value of 0.56 (Mann-Whitney U test). Additional data on long-term visual function in eyes in this series will be reported separately.

Discussion

After 10 years of experience with the nondrainage procedure,[10,11,14] we operated on 107 detachments with segmental sponges or a balloon without drainage between August 1979 and January 1980 in Tübingen, Germany. It should be noted that aphakia was present in 21 eyes (19.6%) and pseudophakia in only 1 eye (0.9%), a finding that is due to the fact that, at the time of recruitment, a pseudophakic detachment was a rare reason for referral to our practice.

In analyzing the results over a postoperative period of 11 years to 11.5 years, the following facts are of clinical interest. First, the good long-term anatomical results and the low rate of reoperation (13%) after segmental buckling without drainage were achievable only if a most meticulous preoperative search for the retinal breaks was conducted and if a precise localization of the detached break was performed at the operating table. In the more complex detachments, the preoperative search for the breaks often took several hours, and sometimes days.

In 23 of the 104 reattached retinas, a delayed absorp-

Table 7. Reason for Final Failure During Long-term Follow-up (n = 8)

Proliferative vitreoretinopathy	4 (3.7%)
No hole found	3 (2.8%)
Massive choroidals	1 (0.9%)

Table 8. Delayed Absorption of Subretinal Fluid in 104 Reattached Retinas after Segmental Buckling with Nondrainage (n = 23)

3 days–1 month	15
2 months–3 months	6
4 months–6 months	2

tion of subretinal fluid was observed (Table 8). In these cases, the macula was reattached and the patient was asked to sleep with his head elevated so that subretinal fluid was prevented from pooling in the macula overnight and collected instead in the inferior half of the globe. In 5 of the 23 eyes the presence of moderate PVR (stage C1, C2) was the reason for absorption delayed for 1 week to 6 months. In these eyes, the residual fluid was localized beneath traction lines or starfolds (Figure 2); however, its presence did not indicate reoperation or secondary drainage. On the contrary, we found it justifiable to watch these cases and wait for the event of a spontaneous retinal reattachment, since additional surgery in these cases might restimulate PVR already in a dormant state. The residual tractional detachments with starfolds and traction lines finally settled over a month-to year-long period (Figures 2 and 3). This observation has also been reported by others[15–17] and is not considered as a complication requiring reoperation. Subsequently, the starfold formation changed into a dry fold, which in many cases was only visible by biomicroscopy (Figure 2). In 14 of the 16 eyes with PVR stage C before surgery, PVR diminished over a long period of time after minimized detachment surgery with segmental sponges and without drainage. In 4 of the 91 detachments (4.4%) without preoperative PVR stage C, PVR stage C1 or C2 developed *de novo* after the primary operation. In 2 of these eyes PVR finally diminished, and in 2 eyes (2.2%) it progressed to PVR stage D2, resulting in final failure.

In another series of 72 detachments with PVR (50 with stage C1/C2), we found it also worthwhile to first try using segmental sponges without drainage rather than proceeding directly to cerclage and vitrectomy.[18] Reattachment was obtained in 79.5% of the eyes, with an average follow-up period of 26 months (ranging from more than 6 months to 99 months). As one might expect in this cohort of detachments, more than one third of the reattached retinas were characterized by delayed flattening of the tractional component in the postoperative course.

In 2 studies of 157 and 30 PVR detachments with stage C1/C2 PVR that were treated with cerclage and drainage of subretinal fluid, reattachment rates were 82% and 73%, respectively.[19,20] A delayed flattening of the tractional component was not described in these eyes. One might speculate that this was due in part to drainage.

If all of the eyes in which treatment failed within the first 6 months after minimized surgery (i.e., retinas not primarily reattached and retinas that were early redetachments) are added together, the primary reattachment rate is 88% (94 eyes). After reoperation in 8 eyes, or 7.5% (one eye had 2 reoperations), reattachment was achieved in 100 eyes (93.5%), a result that remained stable for 2 years without additional surgery.

A late redetachment occurred only between a well-defined period of time, i.e. between the third to the seventh year after treatment, in 6.5% of eyes. Thus, if an encircling element had been used instead as the primary procedure, it would have counteracted the threat of late redetachment in only 6.5% of eyes treated. In all likelihood it may not have been valid even in those rare cases, since 50% of these late redetachments were reattached by a temporary balloon buckle. It should also be noted that all of the late redetachments were caused by new breaks in the direct area of the break that was buckled in the primary procedure. This alone shows that a primary encircling of the entire globe is not necessary.

In a report of treatment of 95 uncomplicated detachments with cerclage and drainage, missed or new breaks had developed in 13% of the cases during a minimum follow-up period of 6 months.[21] This is in contrast to our findings even during a 2-year follow-up period of missed breaks (4 after the primary operation) or new breaks (2 caused early redetachment) in 5.6% of 107 consecutive complicated and uncomplicated detachments treated by minimized surgery without drainage. These facts also do not support the prophylactic value of a cerclage.

As an alternative to a cerclage, we suggest another simple prophylactic method. Explain to the patient the visual field of his operated eye and ask that he test it regularly, and alert him to the area of the buckles, i.e. to the area where the treated breaks were localized. This is advised because the new breaks of a late redetachment will most likely be localized in this area. All seven patients in our study with late redetachments presented immediately after onset; three of the six eyes we could reoperate on successfully were reattached by a temporary balloon buckle. This postoperative control of the visual field is simple and reliable, and at the same time is a reassuring method of prophylaxis for the patient.

Although it was prospective and consecutive, our study regrettably has no randomized control group treated with cerclage. The only series with an equivalent follow-up period of 10 years is that of Törnquist et al.[22] In their study of 538 detachment patients, cerclage was performed in 43% of the eyes, and reoperation had to be performed in 22.9%, in comparison to the 13% needing reoperation in our series. Törnquist drained subretinal fluid in 80% of the eyes operated on, and reported the occurrence of hemorrhage in 14% of these eyes and choroidals in 8.6%, whereas these findings occurred in only

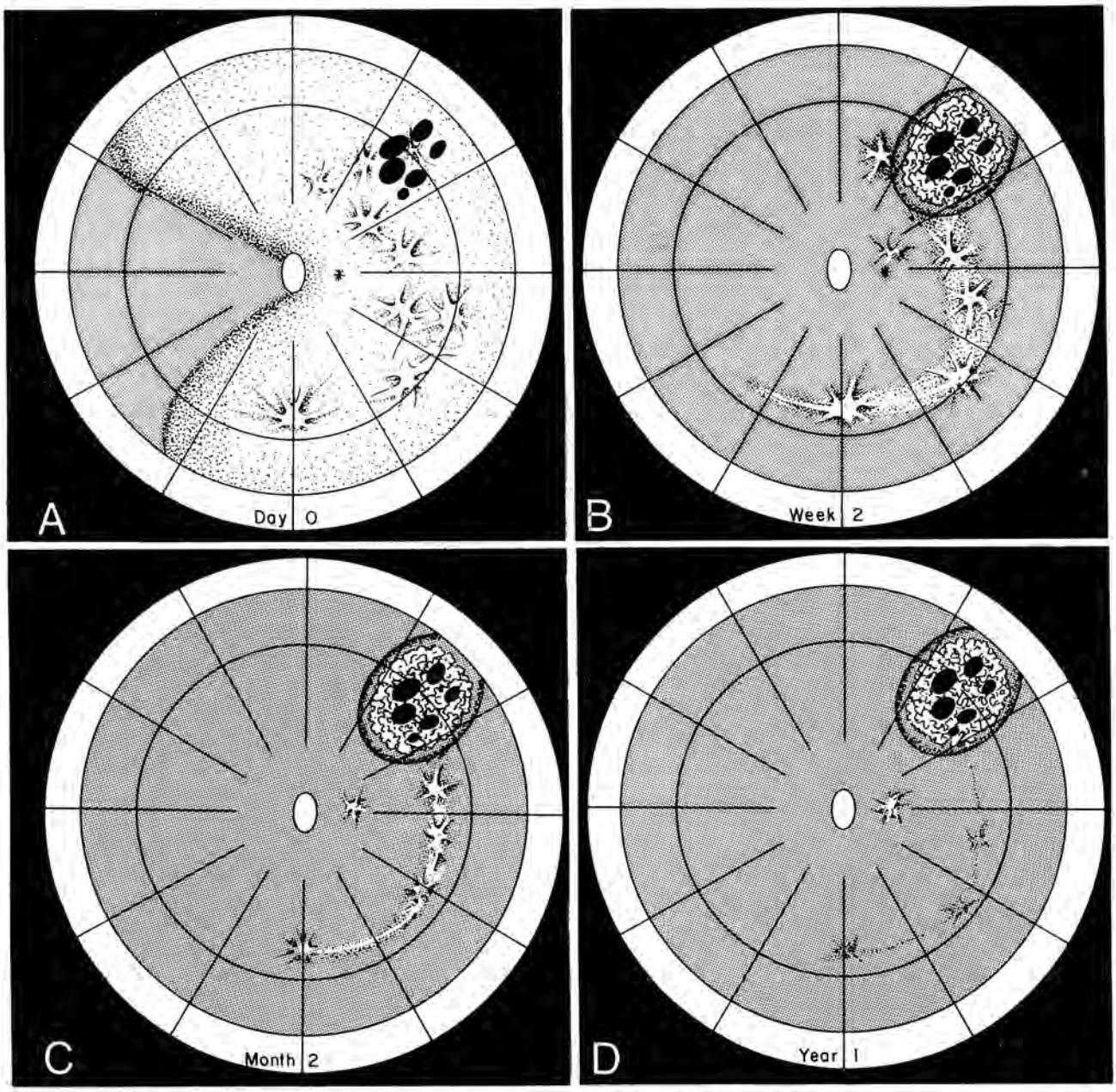

Fig. 3. Delayed absorption with residual fluid after nondrainage operation. **A.** A 3-quadrant detachment with proliferative vitreoretinopathy stage C2 and macular gliosis in the presence of a group of oval-shaped breaks in atrophic retina at 1:30 o'clock in a 67-year-old woman. **B.** After radial buckling, the breaks reattach on the buckle. Two weeks later there is still residual fluid beneath the starfolds. No additional surgery was performed. **C.** After 2 months, residual fluid has disappeared almost completely beneath the starfolds, there is a pucker in the macula, and the remaining retina is reattached. **D.** After 1 year, there is a pucker in the macula, and the visual acuity is 20/400. The starfolds have become dry and have disappeared spontaneously during the subsequent 3 years. Membrane peeling of the pucker (available in 1983, i.e. 4 years after surgery) was declined by the patient, whose visual acuity in the fellow eye was 20/20.

represents a smaller procedure and provides good long-term results. Only 13% of the eyes in our study required reoperation (including those with primary failure and early or late redetachments), and only 1 of the total 107 eyes needed 2 reoperations. At the same time, minimized detachment surgery resulted in a minimum of postoperative complications[11,29,30] during our 11- to 11.5-year follow-up period.

The long-term results of this study support our "less is more" philosophy regarding the treatment of rhegmatogenous retinal detachments. At the same time, minimized surgery improves the postoperative prognosis of the operated eye. Late redetachment after minimized surgery occurred in only seven eyes, all from new breaks. Of the six eyes undergoing reoperation, reattachment was obtained in five eyes with a balloon or another seg-

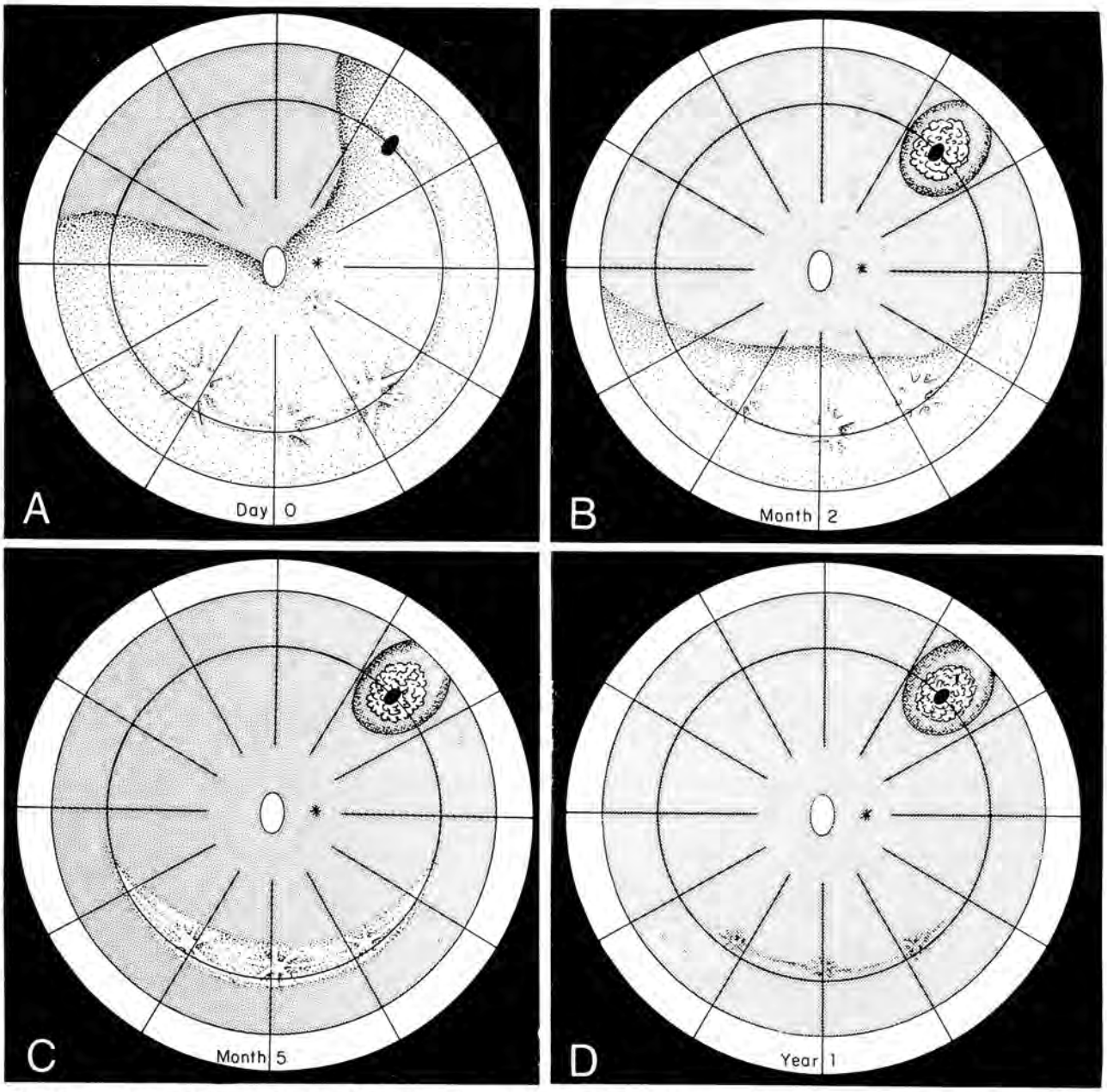

Fig. 2. Delayed absorption with residual fluid after nondrainage operation. **A.** A 3-quadrant detachment with proliferative vitreoretinopathy stage C1 and 1 oval-shaped tear at 1:30 o'clock in a 64-year-old patient. Visual acuity, 20/400. **B.** The break reattaches on the buckle the second day after radial buckling, and subretinal fluid recedes below the area of the macula. The patient was asked to sleep in an upright position. Two months later there was still residual detachment with a concave border and no additional break, but several starfolds. **C.** After 5 months, residual fluid is limited to the area of the traction line and starfolds and the retina is reattached anteriorly and posteriorly. **D.** The detachment (from Fig. A) 1 year after radial buckling without drainage. The retina is now completely reattached, and the starfolds are dry and soon barely visible. Visual acuity, 20/60.

0% and 0.9%, respectively, of the eyes in our series. If one considers studies of detachment surgery with cerclage with a shorter follow-up period of 6 months to 18 months, the rate of reoperation lies between 5.6%[23] and 11% (versus a reoperation rate of 7.5% after minimized detachment surgery within a 30-month follow-up period),[24] and the rate of permanent complications is lower (5.6%). In addition to the serious complications associated with cerclage,[13] recent studies have shown that the constriction of the eye with an encircling band causes chronic ischemia, a diminished amplitude of the ocular pulse, and an obstruction of the choroidal venous outflow.[25–28] All of these factors may jeopardize the long-term prognosis of the operated eye.

Minimized surgery, which limits the buckling to the area of the break, without drainage of subretinal fluid

mental sponge without drainage. The final answer to the question we posed at the beginning of our study would therefore be: The long-term results do not support the prophylactic value of a cerclage in the prevention of late redetachment.

Key words: cerclage, proliferative vitreoretinopathy, radial buckling, segmental buckling, subretinal fluid, delayed absorption, residual fluid, scleral buckle, nondrainage surgery, retinal detachment.

References

1. Schepens CL, Okamura LD, Brockhurst LJ. The sceral buckling procedures: I. surgical techniques and management. Arch Ophthalmol 1957;38:797–811.
2. Schepens CL. Scleral buckling with circling element. Trans Am Acad Ophthalmo Otolaryngol 1964;68:959–979.
3. Arruga H. Modalidades técnicus de las operaciones del desprendimiento de la retina. Arch Soc Oftal Hisp-Amer 1958;18:55–65.
4. Arruga H. Comentarios sobre mil operaciones de "cerclage" en desprendimiento de retina. Arch Soc Oftal Hisp-Amer 1969;29: 996–1007.
5. Custodis E. Bedeutet die Plombenaufnähung auf die Sklera einen Fortschritt in der operativen Behandlung der Netzhautablösung? Deutsche Ophthalmologische Gesellschaft Bericht 1953;58:102–105.
6. Lincoff H, McLean J, Nano H. Cryosurgical treatment of retinal detachments. Trans Am Acad Ophthalmol Otolaryngol 1964;68: 412–432.
7. Lincoff H, Baras J, McLean J. Modifications to the Custodis-procedure for retinal detachment. Arch Ophthalmol 1965;73:160–163.
8. Lincoff H, O'Connor P, Bloch D, et al. The cryosurgical adhesion, Part II. Trans Am Acad Ophthalmol Otolaryngol 1970;74: 98–107.
9. Kreissig I, Lincoff H. Cryosurgery of the retina. Int Ophthalmol Clin 1976;16:63–81.
10. Kreissig I. Kryopexie in der Ablatio-Chirurgie (2. Mitteilung). Klin Monatsbl Augenheilkd 1971;159:737–741.
11. Kreissig I. Der gegenwärtige Stand der Ablatio-Chirurgie ohne Punktion. Klin Monatsbl Augenheilkd 1978;173:140–149.
12. Regan CD, Schepens CL. Erosion of the ocular wall by circling polyethylene tubing: a late complication of scleral buckling. Trans Am Acad Ophthalmol Otolaryngol 1963;67:335–341.
13. Lund OE, Pesch KJ. Early and late complications after encircling eye operations. Deutsche Ophthalmologische Gesellschaft Bericht 1965;67:202–212.
14. Lincoff H, Kreissig I, Goldbaum M. Selection of patients for non-drainage operations. In: Pruett RC, Regan CDC, eds. Retina Congress. New York: Appelton-Century-Crofts, 1974;397–412.
15. Tolentino FI, Schepens CL, Freeman HM. Vitreoretinal disorders: diagnosis and management. Philadelphia: WB Saunders, 1976;483–485.
16. Byer NE. Spontaneous disappearance of early postoperative preretinal retraction. Arch Ophthalmol 1978;90:133–135.
17. De Juan E, Machemer R. Spontaneous reattachment of the retina despite proliferative vitreoretinopathy. Am J Ophthalmol 1984;97: 428–435.
18. Kreissig I, Rose D. Scleral buckling without drainage in treating PVR detachments stage B and C. In: Heimann K, Wiedemann P, eds. Proliferative Vitreoretinopathy. Heidelberg: Kaden, 1989;182–190.
19. Grizzard GW, Hilton GF. Scleral buckling for retinal detachments complicated by periretinal proliferation. Arch Ophthalmol 1982; 100:419–422.
20. Yoshida A, Ho PC, Schepens CL, et al. Severe proliferative vitreoretinopathy and retinal detachment. Ophthalmology 1984;91: 1538–1543.
21. Tornambe PE, Hilton GF, The Retinal Detachment Study Group. Pneumatic retinopexy: a multicenter randomized controlled clinical trial comparing pneumatic retinopexy with scleral buckling. Ophthalmology 1989;96:772–784.
22. Törnquist R, Törnquist P. Retinal detachment: a study of a population-based patient material in Sweden 1971–1981. Acta Ophthalmol 1988;66:630–636.
23. Kreiger AE, Hodgkinson BJ, Frederick AR, Smith TR. The results of retinal detachment surgery. Arch Ophthalmol 1971;86: 385–394.
24. Laatikainen L, Harju H, Tolppanen EM. Post-operative outcome in rhegmatogenous retinal detachment. Acta Ophthalmol 1985;63: 647–655.
25. Lincoff H, Kreissig I, Parver L. Limits of constriction in the treatment of retinal detachment. Arch Ophthalmol 1976;94:1373–1477.
26. Yoshida A, Feke G, Green GJ, et al. Retinal circulatory changes after scleral buckling procedures. Am J Ophthalmol 1983;95:182–191.
27. Dobbie G. Circulatory changes in the eye associated with retinal detachment and its repair. Trans Am Ophthalmol Soc 1980;78: 504–566.
28. Scheider A, Korabjelnikoff E. Bestimmung der arteriovenösen Passagezeit der Aderhaut mit Indozyaningrün. Klin Monatsbl Augenheilkd 1991;199:251–255.
29. Kreissig I. Minimalisierung der Ablatio-Chirurgie. Klin Monatsbl Augenheilkd 1989;195:126–134.
30. Jeanneau E, Aron-Rosa D, Des Jardins L. Étude de l'acuité visuelle à 5 ans de 160 décollements de rétine non draînés. Bull Soc Ophtalmol Fr 1983;3:390–398.