Surgery for full-thickness macular holes with short-duration prone posturing: results of a pilot study

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Abstract

Purpose **To see whether surgical success and complication rates in surgery for full-thickness macular holes (FTMH) followed by 5 days prone posturing are comparable to those obtained with longer posturing regimes recorded in the literature.**

Methods **A pilot study was carried out of pars plana vitrectomy, autologous platelet adjunct and 16% C_2F_6 tamponade followed by 5 days prone posturing in 38 eyes of 34 patients with idiopathic FTMH. A follow-up postal questionnaire was used to assess patients' perception of posturing and outcome.**

Results **Fifty-three per cent of eyes gained 2 or more lines of Snellen acuity. Twenty-four per cent of patients with symptom duration of 12 months or less (29 patients) achieved a visual acuity of 6/12. Fifty-eight per cent of patients achieved N8 or better near vision. The only significant predictor of post-operative Snellen acuity was the stage of the hole (p = 0.02). Eighty-six per cent of questionnaire respondents felt that surgery had improved their quality of life. Eighty-seven per cent of all patients reported a reduction in, or elimination of, metamorphopsia. Fifty-four per cent of patients described posturing for 5 days as difficult or very difficult. Five patients admitted to posturing for less than 12 h a day, but all stated that they had postured for the full 5 days. Cataract was the commonest complication observed in this series (42% of patients have had or been listed for cataract surgery).**

Conclusions **Five days of prone posturing following vitrectomy for FTMH with autologous plaletet concentrate and C_2F_6 tamponade afforded success and complication rates comparable to those in published studies with longer posturing times.**

Key words Macular hole, Platelets, Posturing, Tamponade, Vitrectomy

Whilst the use of adjuncts and inner limiting membrane peeling in surgery for full-thickness macular holes (FTMH) remain controversial,[1] all workers agree that adequate intraocular gas (rarely silicone oil[2]) tamponade is essential to the success of any attempt at surgical closure. Although never proven in a controlled trial, prone posturing is generally considered essential to the success of the technique. It is this undertaking, rather than the prospect of intraocular surgery itself, which constitutes the biggest obstacle to surgery in the minds of most patients. Furthermore many surgeons feel that patients unable to unwilling to accept the rigors of face-down posturing will have too poor a chance of an acceptable outcome to risk the potential complications of surgery. With the sole exception of a pilot study of surgery for FTMH without posturing,[3] regimens for prone posturing in the literature range from 7 to 14,[4–14] 14 to 21[1,15,16] and occasionally up to 28[17,18] days. We present the results of a pilot study in which we employed a regimen of 5 days posturing to see whether acceptable results could be obtained with a shorter period of prone posturing.

Materials and methods

Permission to perform a pilot study of pars plana vitrectomy with autologous platelet concentrate adjunct[9] for stage 2, 3 and 4 idiopathic FTMH was sought and obtained from the local ethics committee.

Patient selection

From 1 December 1996 surgery was offered to all patients who wished it after full discussion of potential complications, likely chance of desired improvement in vision, and willingness and ability to posture for 5 days. Patients with a duration of symptoms greater than 24 months were not excluded. Counselling by nursing staff was offered to all patients pre-operatively and from a physiotherapist in a few cases where deemed appropriate. Latterly, when these

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became available, supportive stands were loaned to patients. All patients were given a copy of a booklet produced by Storz Ophthalmics.[19]

Diagnostic procedures

Unaided and best corrected Snellen acuity were recorded with the patient wearing their own spectacles. Near vision with normal near prescription was recorded using the Keeler text. Amsler grid (black on white) testing was performed with separate recording of metamorphopsia and scotoma boundaries. Visual fields were assessed pre- and post-operatively with the Humphrey (24-II Fastpac) automated perimeter because it has been shown that the characteristic post-operative temporal field defects extend to within 20°–30° from fixation.[20] Fundus examination was performed with slit-lamp biomicroscope and Volk 90 D and 78 D lenses, and with corneal contact lens when appropriate. Staging of the macular holes was according to the system outlined by Gass.[21,22] Binocular indirect ophthalmoscopic examination of the retinal periphery was performed. The Watzke-Allen test was applied.[23] Intravenous fluorescein angiography and digital red free imaging were performed using the Rodenstock 101 scanning laser ophthalmoscope. Colour fundus photography was performed with the Canon CF-60UV using Ectachrome 100 ASA film.

Surgical methods

All surgery was performed by a single surgeon (P.S.B.). Anaesthesia was general or local, according to patient preference unless there were contraindications to general anaesthesia. Local anaesthesia involved a peribulbar block with single-site (inferotemporal) technique using 10 ml of lignocaine and marcaine. Two patients were pseudophakic at the time of surgery and 2 further patients had cataract extraction (anterior segment phacoemulsification via scleral tunnel) and intraocular lens insertion at the time of pars plana vitrectomy. A standard three-port pars plana approach was used. In stage 2 and 3 holes, detachment of the posterior hyaloid was achieved with high suction using the vitrector over the disc and vitrectomy completed with Machemer lenses without excessive clearing of peripheral gel. In stage 4 holes posterior vitreous detachment was confirmed using a silicone-tipped needle.

After air exchange the retina was allowed to dry for 2 min with removal of fluid from the centre of the FTMH with active aspiration using a soft-tipped aspiration cannula prior to application of platelet concentrate. The platelet concentrate was prepared by a two-stage centrifugation process. One hour prior to administration of anaesthesia 16 ml of venous blood was drawn into a syringe containing 4 ml of citrate phosphate glucose anticoagulant (CGPA). The blood sample was centrifuged at 800 r.p.m. for 15 min and the red-cell-free, platelet-rich plasma decanted, mixed with 0.5 ml CPGA and centrifuged at 3000 r.p.m. for a further 10 min. The supernatant was discarded and the platelet concentrate suspended in 0.6 ml of isotonic saline. 0.1 ml of this sterile, autologous platelet concentrate was applied via the flute needle directly to the macular hole. Gas exchange was performed with 16% C_2F_6. The patient was postured supine for 12 h and then turned face-down to posture for 5 days continuously.

Post-operative assessment

Review was undertaken on the first post-operative day, at 2 weeks, 2 months, 6 months and 1 year. Any additional interval consultations (self-referrals or discussion of cataract surgery) were recorded. Acuity was recorded after full refraction was possible and after cataract surgery where this was undertaken. Closure of the hole was defined clinically on the basis of the biomicroscopic appearance. This was supplemented by the post-operative angiographic record looking for disappearance of central hyperfluorescence. A central defect on the angiogram with or without flattening of the elevated fluid cuff was defined as an open hole.

Questionnaire administration

A postal questionnaire was administered at the conclusion of the study. Patients were allowed to remain anonymous if they wished and were encouraged to be honest. A mixture of Likert, visual analogue scale and closed questions were used to obtain information regarding: (1) difficulty of posturing, (2) the number of days and consecutive hours the patient postured, (3) the patient's perception of the adequacy and accuracy of pre-operative counselling regarding the posturing and, finally, (4) whether they would go through the same experience again for the same improvement in vision.

Results

Case mix

Surgery was performed on 38 eyes of 34 patients. There were four stage 2, 28 stage 3 and four stage 4 holes. Two patients were repeat operations following failed surgery without platelets prior to the present study. Twenty-six patients were female (76%) and 8 male (24%). The average age of the group as a whole was 69.4 years (standard deviation (SD) ± 5 years). The mean duration of symptoms at the time of surgery was 7 months (SD ± 2 months) in stage 2 holes, 12 months (SD ± 12 months) in stage 3 holes and 24 months (SD ± 23 months) in stage 4 holes. The average follow-up time from surgery was 12 months (range 3–22 months), with 68% of patients having completed 6 month review and 40% 12 month review at the time of data analysis. One patient died but none were lost to follow-up.

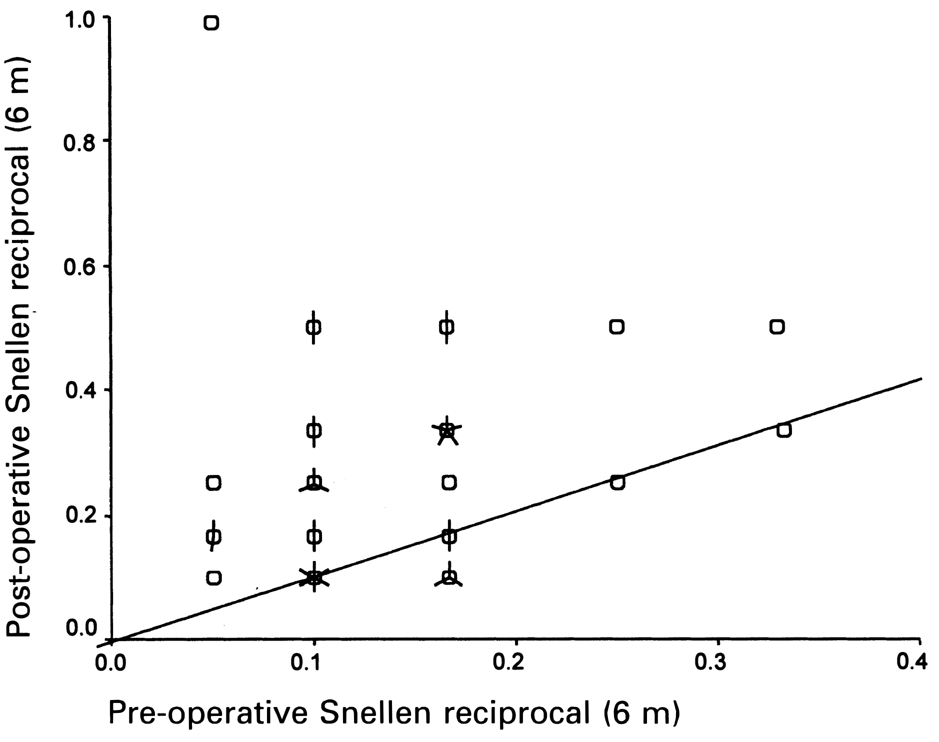

Fig. 1. *Vision displayed as the Snellen reciprocal, with the line of no improvement shown. Points above the line represent improved vision. Bars on points represent the number of cases when more than 1 patient had identical pre- and post-operative vision. n=* 37 (1 deceased).

Surgical outcome and visual improvement

Thirty-five holes were closed by surgery indicating a 92% primary closure rate. Of the three unclosed holes, two had flattening of the elevated retinal cuff with a persistent defect although the size of the defect was obviously reduced in one. In one patient the hole failed to close and the cuff of fluid remained elevated. One late failure was observed; a hole documented as closed at 2 month review was noted to be open at 6 month review.[24] Overall closure rate was 89%.

The improvement in best corrected distance acuity is shown in Fig. 1. Post-operative vision was recorded after cataract surgery where appropriate. In total 7 patients (18%) achieved 6/12 and 20 patients (53%) gained 2 or more Snellen lines of acuity. Nine eyes (24%) had chronic macular holes (symptoms greater than 2 years). None of these achieved 6/12. Overall 24% of patients with symptom duration 12 months or less achieved 6/12. Results for improvement in near vision, recorded with appropriate reading addition at the patient-preferred distance, demonstrated that 15 patients (40%) achieved N5, 18 patients (47%) achieved N6 or better and 22 patients (58%) achieved N8 or better. One patient had worse near vision after surgery (N12 pre-operative, N24 post-operative). Metamorphopsia was graded at post-operative review on a simple 4-point ordinal scale as worse, unchanged, better or resolved. Eighty-seven per cent of patients reported a reduction in or complete resolution of metamorphopsia, although eradication of metamorphopsia occurred in only 9 patients (24%). Three patients were neither better nor worse and 1 patient reported worsening of metamorphopsia despite improvement of vision from 6/60, N12 to 6/36, N8.

Attempting to determine predictors of final visual outcome, Spearman correlation coefficients were calculated for best corrected pre-operative Snellen acuity, duration and stage of the hole, and Mann–Whitney *U* (Wilcoxon) significance calculated for phakic status as a binary variable. The only factor achieving significance at the 5% level was the stage of the hole (p = 0.008). To test this relationship further, stepwise linear regression was performed for the same independent variables with age added as a further potential confounder. The significance of hole stage was weakened but preserved (p = 0.02), indicating that this is an independent predictor of visual outcome. Analysis was performed using the Statistical Package for the Social Sciences (SPSS). Significances quoted are two-tailed.

Complications

Cataract was the commonest complication observed in this series.[25] Two patients were pseudophakic at diagnosis of FTMH. Of the remainder, 2 had sufficient cataract to warrant cataract extraction at the time of vitrectomy. Overall 45% of patients had some degree of nuclear sclerosis pre-operatively. Eight patients have had, and a further 6 are listed for, cataract surgery (total 42%, 1 patient deceased). Mean time to listing for cataract surgery was 8 months (SD ± 3 months) compared with 11 months (SD ± 5 months) average follow-up in the group not listed. No cases of retinal detachment or endophthalmitis occurred. We did not observe any holes re-open after cataract extraction.[26]

A reduction of 1 line of Snellen acuity compared with the pre-operative level occurred in 3 patients (8%). No patients had reduction greater than 1 line.

Platelet concentrate has been used as a model for proliferative vitreoretinopathy in the rabbit eye.[27] We observed 2 patients with fine epiretinal membranes. Neither showed evidence of progression (follow-up 13 and 16 months) and both described less distortion than pre-operatively; however, metamorphopsia was not eliminated.

Pre-operative field testing was not possible in 8 patients and therefore these patients did not undergo post-operative testing. We observed definite post-operative field defects in 4 patients and an equivocal superonasal quadrant defect in one further patient (16% of those tested). Only 1 patient's field defect (superotemporal quadrant) was symptomatic (3%).

Questionnaire results

Twenty-eight out of a possible 33 (1 patient deceased) questionnaires were returned representing an 85% response rate. No patients chose to remain anonymous. There was little difference between Likert and analogue scores for difficulty of posturing. Twenty-one per cent of patients found posturing very difficult and 32% found it difficult (total 54%). Out of these two combined categories, 40% felt at some point that discomfort was so severe they were tempted to give up, although none admitted to stopping. Five patients admitted to posturing for less than 12 h a day, but all stated that they postured for the full 5 days. Only 2 patients (7%) found posturing easy. The majority of patients (86%) felt in retrospect that they had been adequately prepared for surgery and had realistic expectations of the difficulties of posturing. Overall 50% stated that their quality of life had been greatly improved by surgery, a further 36% that it had improved somewhat, and 14% stated that there had been no improvement. The majority (86%) of patients stated that they would go through the same experience again for the same improvement in vision (i.e. that surgery had been worthwhile).

Discussion

In less than a decade since the first reported series,[4] success in terms of anatomical closure in surgery for FTMH has steadily improved with increasing experience,[6] patient selection[28] and, in some cases, the use of adjuncts.[15,29,30] Most series now report closure rates of around or better than 80%. In general, improvement in vision can be correlated with duration of symptoms,[31,32] however, the functional results in any individual case can be difficult to predict with certainty. In stage 3 and 4 holes the Vitrectomy of Treatment of Macular Hole study group trial[12] found the only significant predictor of outcome to be maximum hole diameter, with a division point of 520 μm. This accords with our own results, which demonstrated that the stage of the hole was the only significant predictor of final visual outcome.

Whilst clinico-pathological correlates that exist demonstrate close approximation of morphologically normal photoreceptors with Müller cell processes closing the remaining small gap,[33–35] it has been elegantly demonstrated that some 'pseudo' opercula do in fact contain photoreceptor/retinal elements, thus limiting final visual recovery despite apparently successful closure.[36] Since the nature of the opercula cannot be known in any individual case this will introduce an element of unpredictability.

These variables may not significantly alter anatomical closure rates.[31,37] but are likely to affect visual outcome. Because the variability introduced by these factors cannot be fully controlled for, an adequately powered randomised control trial of duration of posturing and surgical outcome would require large numbers of patients.

Most workers have therefore used posturing times based on extrapolation from useful tamponade times, depending on gaseous agent, in other forms of retinal surgery. Two multicentre studies of surgery for FTMH of less than 12 months duration, compared closure rates with air followed by 3 days posturing in the first study[38] and 10% C_3F_8 followed by 1 week of posturing in the second study[18] with 16% C_3F_8 followed by 3–4 weeks of prone positioning. In both studies the increase in closure rate, from 53% and 63% respectively to between 94–97%, was highly significant ($p = 0.001$). To date only one study has addressed the issue of the absolute necessity of prone posturing.[3] A primary closure rate of 79% was achieved using 15% C_3F_8 in 33 eyes without posturing despite the fact that 21% of these holes had been present for more than 1 year. In our own series 34% of eyes had a symptom duration of 12 months or more, yet the overall closure rate was 89%. Comparing these results with the multicentre studies described above which excluded chronic macular holes, it would appear that altering the gaseous agent or its concentration alone may account for much of the improvement observed.

Review of the literature demonstrates considerable variation in posturing, gaseous agent used, use of adjunct and outcome. With the sole exception of the pilot study by Tornambe *et al.*[3] of surgery without prone posturing, 5 days is the shortest period of prone posturing employed. The variation in functional results reported is extremely wide. It has been shown in randomised controlled trials that inadequate masking of investigators leads to an average overestimate of effect size of 41%.[39] Masking of observers in studies of surgical outcome is comparatively difficult and it must be assumed that this explains some of the observed variability. Finally we are aware of only one study which compared outcome in the treatment group with the natural history of untreated stage 3 and 4 FTMH.[12]

In our study 53% of eyes gained two or more lines of Snellen acuity and 58% of patients achieved N8 or better near vision. Fifty per cent felt that surgery had significantly improved their quality of life and 87% reported a reduction in, or elimination of, metamorphopsia. These rates are comparable to those attained with longer posturing. Complication rates in this series are also comparable with other studies. A reduction of distance vision by 1 or more Snellen or ETDRS lines occurred in 34% (20 eyes) of the stage 3 and 4 eyes in the Vitrectomy for Treatment of Macular Hole study group trial,[12] although other groups have noted lower rates, which may be explained by the better prognosis of stage 2 holes.[8] We found reduced post-operative vision of 1 Snellen line in 8%. All were stage 3 holes and 1 remained open. Visual field defects following surgery have been well characterised in surgery for FTMH.[40] Asymptomatic field loss has been described in up to 23%[41] of cases, and symptomatic loss occurs in around 5%.[42] We observed field loss in 16%, and symptomatic loss in 3% (1 patient). It has been suggested that excessive drying rather than traumatic disinsertion of the posterior hyaloid at the disc rim may be responsible for the development of these defects.[43] On this basis the relatively short duration of retinal drying employed in this study might have been expected to be associated with a lower observed rate of field defects; however, the numbers in the present study were too small to enable any conclusion to be drawn concerning this problem. The rate of development of, and surgery for, nuclear sclerotic cataract in our experience matches most published series allowing for the relatively short follow-up period in our study.

This study has several limitations. The number of eyes in this study is relatively small, post-surgical follow up was less than 1 year in 18 eyes (47%), there is no control group with longer duration of posturing and, in common with most studies in this area, the researchers recording hole closure and acuity were not masked. Nevertheless in this series 5 days prone posturing following vitrectomy for FTMH with autologous platelet concentrate and C_2F_6 tamponade, afforded success and complication rates comparable to published studies with longer posturing times.

Fifty-four per cent of patients described posturing for 5 days as difficult or very difficult. The majority stated that neck, shoulder and back pain constituted the major source of discomfort. Most were adequately prepared for surgery and posturing and considered the experience worthwhile provided the visual improvement was satisfactory. This would appear to indicate that this undertaking is a considerable one for the patient and should not be longer than absolutely necessary.

The acceptable closure rates obtained in this study suggest that the reparative process may be further advanced in the few days following surgery than has previously been assumed. Nevertheless it seems unlikely that healing is completed within 5 days. The flotation force of the C_2F_6 bubble remaining after 5 days is presumably sufficient to continue to provide reduced but adequate tamponade to the macula without posturing. The 5 day posturing regime we employed was not chosen empirically. Would even shorter posturing still yield acceptable results? A randomised trial of short, intermediate and long duration posturing with identical gaseous agent and surgical technique would answer this question definitively. Such a study would need to be very large to possess adequate power to deal with a potentially negative outcome (surgical success is independent of posturing duration). A further lesson from this study, which has been confirmed elsewhere,[12] is the improved prognosis of smaller holes. In order to translate into benefit to this population, awareness of this issue is required amongst all those who see these patients in a primary (optometric) or secondary setting prior to referral to the regional vitreoretinal service. If anxiety about committing the patients we refer to an inevitably long and taxing period of posturing is also somewhat allayed, perhaps more patients will be able to benefit from this form of surgery.

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