CLINICAL SCIENCE

A matched study of primary scleral buckle placement during repair of posterior segment open globe injuries

J G Arroyo, E A Postel, T Stone, B W McCuen, K M Egan

Br J Ophthalmol 2003;**87**:75–78

See end of article for authors' affiliations

Correspondence to: Jorge G Arroyo, MD, Department of Ophthalmology, Retina Service, 12th Floor, Massachusetts Eye and Ear Infirmary, 243 Charles Street, Boston, MA 02114, USA; jarroyo@caregroup.harvard.edu

Accepted for publication 25 July 2002

Aims: To compare the visual and anatomical outcomes of patients who underwent primary scleral buckle (SB) placement during posterior segment open globe repair with matched control patients who did not undergo primary SB placement.
Methods: Patients who underwent open globe repair alone or with SB placement at Duke University Eye Center (November 1994–September 1997) and the Massachusetts Eye and Ear Infirmary (July 1993–July 1997) were identified. 19 open globe patients who received primary SB placement were matched with control patients who did not receive a primary SB based on three important prognostic factors: (1) visual grade; (2) zone of injury; and (3) mechanism of injury. The outcomes of interest were: (1) visual outcome; (2) anatomical outcome; (3) subsequent retinal detachment (RD); and (4) number of subsequent surgeries.
Results: Baseline characteristics between the groups were similar. Patients who received primary SB placement had a better final visual grade ($p = 0.02$), logMAR vision ($p = 0.007$), and anatomical grade ($p = 0.01$) compared with control patients. Primary SB patients had an average final vision of 20/270, whereas control patients had an average final vision of hand movement. Primary SB placement also resulted in fewer subsequent RDs (26% versus 53%), but this difference did not reach statistical significance ($p = 0.10$). There were no complications associated with primary SB placement.
Conclusion: Primary SB placement during posterior segment open globe repair may decrease the risk of subsequent RD and improve final visual and anatomical outcome.

Ocular trauma is a common cause of visual impairment in working age patients in the United States. It is estimated that 2.5 million ocular injures occur each year. Since trauma patients are usually young, the cost of ocular trauma to society is related not only to medical treatment, but also to a lifelong loss of productivity.[1]

Open globe injuries that affect the posterior segment of the eye often result in a poor visual and anatomical outcome.[2–5] Retinal detachment (RD) develops in approximately 40–50% of these eyes and is associated with a particularly poor prognosis.[4–7] Retinal detachment following posterior open globe injuries often require multiple surgeries and result in poor vision, if not the eventual loss of the eye.[7–12] Thus, methods that may help prevent the development of RD in patients with posterior segment ocular trauma might improve final visual and anatomical outcome.

A posterior open globe injury often results in vitreous loss and vitreoretinal traction. Retinal breaks due to either vitreoretinal traction or direct trauma to the retina may also occur. Supporting the retina and vitreous base with an encircling scleral buckle (SB) may help reduce vitreoretinal traction and the subsequent development of retinal tears and detachment. Primary SB placement at the time of the posterior segment open globe repair is technically easier than SB placement after initial open globe repair. The rectus muscle insertions are usually already isolated for exploration of the globe and there is no scarring present between the wound and overlying Tenon's capsule and conjunctiva.

In three large retrospective studies,[2–5] prophylactic SB placement at the time of vitrectomy for posterior segment trauma was associated with a lower rate of subsequent RD. Scleral buckle placement within 2 weeks of severe ocular injury appeared to reduce the rate of post-traumatic complications.[13] Finally, the results of primary SB placement at the time of posterior segment open globe repair at Duke University Eye Center (DUEC) has recently been evaluated and published.[6] Subgroup analysis of the patients who received a primary SB at the time of posterior segment open globe repair suggested a trend toward improved visual acuity. However, this study was limited by the few control patients available and possible selection bias inherent in a single institution non-randomised study.

To further examine this hypothesis, we conducted a retrospective matched cohort analysis evaluating outcome after primary SB placement during posterior segment open globe repair. Patients were identified at DUEC and the Massachusetts Eye and Ear Infirmary (MEEI) who had undergone open globe repair alone or with primary SB placement. The open globe injury classification system[14] has been published and identifies important prognostic variable for open globe injuries (Table 1). This classification system categorises open globe patients by: (1) visual grade, (2) zone of injury, (3) mechanism of injury; and (4) presence of an afferent pupillary defect (APD). In this study, patients who had an open globe injury and SB placement were individually matched based on: (1) initial visual grade; (2) mechanism of injury; and (3) zone of injury, to similar control patients who did not receive a SB placement. The results of this retrospective matched cohort study suggest that primary SB placement at the time of posterior segment open globe repair is associated with an improved visual and anatomical outcome.

MATERIALS AND METHODS

Patients who underwent an open globe injury repair alone or with SB placement were identified after searching by diagnosis and surgical codes at the MEEI between July 1993 and July 1997 and DUEC between November 1994 and September 1997. Patients who had a zone 1 injury, no light perception (NLP), less than a 3 month follow up, evidence of a retinal detachment, an intraocular foreign body, endophthalmitis, or

Table 1 Open globe classification system

A Visual grade (visual acuity):
 1 20/20–20/40
 2 20/50–20/100
 3 19/100–5/200
 4 4/200–light perception
 5 No light perception
B Zone of injury (posterior extent of full thickness wound):
 1 Cornea only
 2 5 mm posterior to the limbus
 3 Posterior to zone 2
C Mechanism of open globe injury:
 1 Blunt rupture
 2 Penetrating
 3 Perforating
 4 Intraocular foreign body
 5 Mixed mechanism
D Presence of an afferent pupillary defect:
 1 Yes
 2 No

a vitrectomy at the time of primary open globe repair were excluded from the study. The remaining control patients were categorised according to the open globe injury classification system based on (1) zone of injury (zone 2 or 3); (2) mechanism of injury (blunt rupture, penetrating, and perforating injury only); and (3) visual grade (grade 1–4 only).[14] One of the 19 primary SB patients and all of the control patients came from the MEEI. Primary SB patients were matched to patients with an equivalent zone of injury, visual grade, and mechanism of injury who did not undergo SB placement. When more than one matched control patient was available, one patient was selected at random from the pool of eligible controls.

Surgeons at both institutions had similar amounts of surgical experience and similar surgical approaches (with the exception of primary SB placement at DUEC) towards patients with open globe injuries. At both institutions, open globes or suspected open globes are emergently explored and repaired in the operating room. Corneal/scleral lacerations are primarily closed with non-absorbable suture such as 8-0 or 9-0 nylon. Uveal prolapse is either reposited into the eye or excised. Vitreous at the wound, if present, is carefully excised using a Weck sponge and Wescot scissors. At the conclusion of the case, if necessary, BSS is injected into the anterior chamber or vitreous using a 30 gauge needle to restore normal intraocular pressure. Intravitreal gas or retinopexy is not typically used at the time of the primary open globe repair. Finally, patients receive broad spectrum intravenous antibiotics for at least 48 hours after surgery. DUEC patients with zone 3 open globe injuries usually undergo primary SB placement. These patients have a 3.5–4.0 mm encircling solid silicone exoplant with four scleral fixation sutures in the middle of each oblique quadrant placed after repair of the open globe injury.

Table 3 Unmatched baseline patient characteristics of primary scleral buckle and control patients

	Scleral buckle	Control	p Value
Age	36 (range 10–89)	34 (range 9–82)	0.75
Male	14 (74%)	13 (68%)	1.00
Mean logMAR	2.01	2.09	0.72
APD*	5 (26%)	1 (5%)	0.15

*Eight patients in the SB group and nine patients in the control group could not have an APD assessed.
Continuous variables were analysed using a *t* test. Binary variables were analysed using a Fisher's exact test.

The primary outcomes evaluated in this study were: (1) final visual grade, (2) final anatomical grade, (3) number of subsequent vitreoretinal surgeries, and (4) subsequent postoperative RD. Visual grade was divided into five categories: (1) 20/20–20/40; (2) >20/50–20/100; (3) >20/100–5/200; (4) >5/200-light perception (LP); and (5) no light perception (NLP). Anatomical grade was divided into three categories: (1) IOP $\geqslant$5; (2) IOP <5; and (3) enucleation. The logarithm of the minimal angle of resolution (logMAR) units was calculated by obtaining the logarithm of the reciprocal of the Snellen visual acuity for vision better than or equal to 5/200. In cases where the vision was worse than 5/200 the following conversion was used: counting fingers = 1.6, hand movements = 2.0, LP = 2.5, and NLP = 3.0 logMAR units. These logMAR values were then converted back into Snellen visual acuity to report outcomes. The development of a postoperative RD was noted for each patient. Continuous variables were analysed using a *t* test. Ordinal variables were analysed using a χ^2 trend test. The binary variable was analysed using the Fisher' exact test.

RESULTS

There were 19 patients in both the primary SB group and the control group. The treatment group and the control group were equivalent on the three matching factors: initial visual grade, mechanism of injury, and zone of injury (Table 2). In addition, as shown in Table 3, the groups were similar on other potential prognostic factors including age, sex, and logMAR score. More patients in the primary SB group had a positive APD compared with the control group. The groups differed in baseline vision by less than one Snellen line equivalent (p = 0.72).

The mean follow up for the SB group was 14 months (range 3–48) and for the control group it was 13 months (range 3–55). Time between initial surgery and most recent visual acuity assessment was equivalent in the two groups (p = 0.67). Table 4 shows a comparison of outcome by SB status for number of subsequent surgeries, development of a RD, mean logMAR vision, visual grade, and anatomical grade. Primary SB placement at the time of posterior segment open globe repair was associated with a significantly improved visual and

Table 2 Matched baseline patient characteristics of primary scleral buckle and control patients

	Scleral buckle patients	Control patients
Total number	19	19
Rupture	6	6
Penetrating	8	8
Perforating	5	5
Zone 2	9	9
Zone 3	10	10
Average VA grade	3.68	3.68

Table 4 Final results for primary scleral buckle and control groups

	Scleral buckle	Control	p Values
Mean follow up	14 (range 3–48)	13 (range 3–55)	0.67
Mean No of surgeries	1.3	1.6	0.47
Retinal detachments	5 (26%)	10 (53%)	0.10
Mean logMAR score	1.13	1.99	0.007
Mean visual grade	2.47	3.74	0.02
Mean anatomical grade	1.21	1.89	0.01

Continous variables were analysed using a *t* test. Ordinal variables were analysed using a χ^2 trend test. The binary variable was analysed using the Fisher's exact test.

anatomical outcome (Table 4). Patients undergoing primary SB placement had an average final vision of 20/270 compared with control patients who had an average final vision of hand movements (p = 0.007). In addition, primary SB patients had an average of a 1.3 step improvement in the visual grade (p = 0.02) compared with control patients. Primary SB patients also demonstrated a significant improvement in anatomical grade compared with control patients (p = 0.01). Furthermore, patients undergoing primary SB placement had fewer subsequent vitreoretinal surgeries (p = 0.47) and fewer postoperative RDs (p = 0.10), though these differences did not reach statistical significance. No complications such as scleral buckle infection, endophthalmitis, or buckle extrusion developed in the primary SB placement patients.

DISCUSSION

Posterior segment open globe injuries are associated with a poor visual and anatomical outcome. This retrospective matched cohort study compared patients who received primary SB placement with a matched set of patients who did not receive a SB at the time of posterior segment open globe repair. Our findings suggest that primary SB placement may decrease the incidence of subsequent RD and improve final visual and anatomical outcome.

This study found a statistically significant improvement in visual (visual acuity grade (p = 0.02) and logMAR score (p = 0.007)) and anatomical outcome (p = 0.01) in the SB group compared with the control group. After an average follow up of 13–14 months, patients who received a primary SB at the time of open globe repair had better vision (mean 20/270) than control patients (mean HM). In addition, primary SB patients, on average, had a better anatomical outcome than control patients. Finally, there were no postoperative complications associated with scleral buckle placement.

Patients in the primary SB group had fewer subsequent surgeries and RDs compared with the control group. The lower rate of subsequent RD in the primary SB patients had borderline statistical significance (p = 0.10). Fifty three per cent of the patients in the control group developed a RD after the initial open globe repair, whereas only 26% of the patient in the primary SB group developed a RD. The rate of RD without primary SB placement after posterior open globe injuries is comparable to that reported in the literature (40–57%).[4–6]

Because we matched SB patients with control patients, both groups in this study were identical on the basis of initial visual grade, zone of injury, and mechanism of injury (Table 2). In addition, other unmatched patient characteristics were also similar between the groups, including age and sex (Table 3). However, the SB group had a significantly greater number of patients with a positive APD, compared with the control group, which would bias results away from SB placement. The SB group also had slightly longer average follow up compared with the control group, which again would bias the results against SB placement. Finally, there was a small difference in average initial vision of 0.08 logMAR units between groups that favoured the primary SB group. This difference, although small and not statistically significant (p = 0.72), would bias the results in favour of SB placement.

In three large retrospective studies, prophylactic SB placement at the time of vitrectomy for posterior segment trauma was associated with a lower rate of subsequent RD. Hutton and Fuller studied 194 eyes involved with posterior segment ocular trauma.[5] They found that eyes that received a prophylactic SB at the time of vitrectomy were less likely to develop a subsequent RD (8%), compared with eyes that did not receive a SB (27%). Brinton *et al* in a study of 106 trauma eyes found that patients who received prophylactic SB placement at the time of vitrectomy were less likely to develop a subsequent RD (13%), compared with patients that did not receive prophylactic SB placement (23%).[4] Finally, Miyaka and Ando in a study of 49 trauma eyes also found significantly fewer postoperative RDs in patients receiving prophylactic SB (24%) compared with patients who had not received SB placement at the time of vitrectomy (78%).[8] Another study investigated the optimal timing of vitrectomy in severe ocular trauma and did not find a benefit of prophylactic SB placement at the time of vitrectomy on the risk of subsequent RD.[15] However, since the patients who received primary SB placement had more severe trauma, they were at higher baseline risk of adverse outcomes than controls. Although these studies were retrospective in nature and did not randomly assign patients to SB placement at the time of vitrectomy, they support the concept that prophylactic SB placement at the time of vitrectomy decreases the risk of subsequent RD in trauma patients.

A review of the DUEC experience with primary SB placement at the time of posterior open globe repair has recently been published.[6] In that report, the authors performed subgroup analysis comparing patients who did (group 2) and did not (group 1) receive a primary SB at the time of open globe repair. Although there was a trend toward improved visual acuity in the SB group, no statistical differences were found in the rate of subsequent RD or final visual or anatomical outcome. However, baseline characteristics differed significantly between the groups. Since all the patients came from the same institution, an inherent selection bias existed regarding which patients receive and did not receive a SB. This selection bias may have accounted for some of the baseline differences found between the two groups, with respect to patient age, initial visual acuity, posterior extent of eyewall injury, and mechanism of injury. The authors attempted a matched comparison of patients with similar baseline characteristics, however, numbers of control patients available was limited and results did not reach significance.

In the present study, we attempted to address some of these limitations by comparing posterior segment open globe patients from DUEC with matched patients from the MEEI. Both institutions are academic medical centres that treat ocular trauma patients in a similar manner, except for the routine placement of a SB at the time of open globe injury repair at the DUEC. This study minimised differences between the treatment and control groups through matching, and reduced the selection bias that might be unavoidable in a single institution non-randomised study.

However, the present study has some important limitations. Firstly, this study had relatively few patients; large differences between the groups, in RD for example, did not reach statistical significance. Secondly, the study compared patients in two academic medical centres (DUEC and MEEI) in different geographic locations treated by different surgeons. Although both institutions are resident and fellow training programmes with similar surgical philosophies regarding the repair of traumatised eyes, there may exist inherent differences in either the patient population and/or treatment regimens that may explain our findings. Finally, although patients were matched on three important determinants of final prognosis (vision, zone, and mechanism of injury), there are other predictors of outcome (APD, choroidal detachment, length of laceration, vitreous haemorrhage, and cataract) that were not matched owing to limited patient documentation or numbers of control patients available.

This study suggests that patients who receive a primary SB at the time of posterior segment open globe repair may experience a significantly better final visual and anatomical outcome compared to patients that do not receive a primary SB. In addition, primary SB placement may be associated with fewer subsequent RDs. These results suggest that primary SB placement may improve the overall outcome of patients undergoing posterior segment open globe repair. Given the large number of patients at risk of visual impairment due to ocular trauma, a randomised clinical trial is warranted to more definitively answer this question.

ACKNOWLEDGEMENTS

This work was preformed at Duke University Medical Center and Massachusetts Eye and Ear Infirmary. It was supported in part by a Harvard Medical School Bridge grant and a NIH K23 grant.

None of the authors has any financial interest in the products used in this study.

Authors' affiliations

J G Arroyo, K M Egan, Massachusetts Eye and Ear Infirmary, Brigham and Women's Hospital, Beth Israel Deaconess Medical Center, Harvard Medical School, and Harvard School of Public Health, Boston, MA, USA
E A Postel, T Stone, B W McCuen, Duke University Eye Center, Durham, NC, USA

REFERENCES

1 . Negrel AD, Thylefors B. The global impact of eye injuries (see comments). *Ophthalmic Epidemiol* 1998;**5**:143–69.
2 **Pieramici DJ**, MacCumber MW, Humayun MU, *et al.* Open-globe injury. Update on types of injuries and visual results. *Ophthalmology* 1996;**103**:1798–803.
3 **Fuller DG**, Hutton WL. Prediction of postoperative vision in eyes with severe trauma. *Retina* 1990;**10(Suppl 1)**:S20–34.
4 **Brinton GS**, Aaberg TM, Reeser FH, *et al.* Surgical results in ocular trauma involving the posterior segment. *Am J Ophthalmol* 1982;**93**:271–8.
5 **Hutton WL**, Fuller DG. Factors influencing final visual results in severely injured eyes. *Am J Ophthalmol* 1984;**97**:715–22.
6 **Stone TW**, Siddiqui N, Arroyo JG, *et al.* Primary scleral buckling in open-globe injury involving the posterior segment. *Ophthalmology* 2000;**107**:1923–6.
7 **Matthews GP**, Das A, Brown S. Visual outcome and ocular survival in patients with retinal detachments secondary to open- or closed-globe injuries. *Ophthalmic Surg Lasers* 1998;**1**:48–54.
8 **Miyake Y**, Ando F. Surgical results of vitrectomy in ocular trauma. *Retina* 1983;**3**:265–8.
9 **Ryan SJ**. Guidelines in the management of penetrating ocular trauma with emphasis on the role and timing of pars plana vitrectomy. *Int Ophthalmol* 1979;**1**:105–8.
10 **Brinton GS**, Aaberg TM. Changing aspects of management of ocular trauma (editorial). *Am J Ophthalmol* 1982;**94**:258–60.
11 **Spalding SC**, Sternberg P Jr. Controversies in the management of posterior segment ocular trauma. *Retina* 1990;**10(Suppl 1)**:S76–82.
12 **McCuen BW**, Azen SP, Stern W, *et al.* Vitrectomy with silicone oil or perfluoropropane gas in eyes with severe proliferative vitreoretinopathy. Silicone Study Report 3. *Retina* 1993;**13**:279–84.
13 **Haut J**, Allagui M, Lepvrier N, Morel C. Preventive surgical scleral buckling of retinal detachment after severe ocular injuries. *J Fr Ophtalmol* 1993;**16**:668–72.
14 **Pieramici DJ**, Sternberg P Jr, Aaberg TM Sr, *et al.* A system for classifying mechanical injuries of the eye (globe). The Ocular Trauma Classification Group (see comments). *Am J Ophthalmol* 1997;**123**:820–31.
15 **Hermsen V**. Vitrectomy in severe ocular trauma. *Ophthalmologica* 1984;**189**:86–92.

A matched study of primary scleral buckle placement during repair of posterior segment open globe injuries

J G Arroyo, E A Postel, T Stone, et al.

Br J Ophthalmol 2003 87: 75-78
doi: 10.1136/bjo.87.1.75