Posterior Segment Trauma: Types of Injuries, Result of Vitreo-retinal Surgery and Prophylactic Broad Encircling Scleral Buckle

Sukhuma Warrasak MD*,
Ataya Euswas MD*, Supawat Hongsakorn MD*

** Department of Ophthalmology, Ramathibodi Hospital, Mahidol University*

Objectives: *To evaluate the result of pars plana vitrectomy (PPV) and prophylactic broad encirling scleral buckle in posterior segment trauma and to define factors that lead to functional failure.*
Design: *Retrospective, noncomparative, interventional case series.*
Intervention: *Prophylactic broad encircling scleral buckle, PPV, SF6/C3F8 or silicone oil implantation if required.*
Results: *Ninety-two patients (94 eyes) with open globe ocular injuries involving posterior segment, were treated between January 1988 and December 2004.The mean age was 33.1 years Common sources of injuries were industrial and automobile accidents. After a follow up period of at least 6 months, 62 of 94 eyes (65.96%) achieved visual acuity of 20/400 or better and 6 eyes (6.38%) lost vision to no light perception. Eyes that had sharp perforating injuries with retained IOFB had better visual outcome than the others. Twenty-three of 38 eyes (60.53 %) that had sharp perforating injuries with retained IOFBs achieved a visual acuity of 20/70 or better. Eyes with traumatic retinal detachment had a reattachment rate of 78.18 % and a functional success rate of 56.36%.The detachment rate in vitrectomized eyes with prophylactic broad encircling scleral buckle was 3.19 %. Main reasons for functional failure (V.A.<20/400) were macular damage, retinal detachment with PVR and optic nerve injury. Endophthalmitis occurred in 6.25%.*
Conclusion: *Sharp perforating ocular injuries have the best visual prognosis among all types of injuries.Pars plana vtrectomy and prophylactic broad encircling scleral buckle, can salvage and prevent subsequent retinal detachment in these severely traumatized eyes.*

Keywords: *Vitreoretina surgery, Posterior segment trauma, Open globe injury, Intraocular foreign body, Prophylactic broad encircling scleral buckle*

J Med Assoc Thai 2005; 88 (12): 1916-30
Full text. e-Journal: *http://www.medassocthai.org/journal*

Ocular injuries involving posterior segment of the eye may lead to severe visual impairment or permanent visual loss[1]. Prognosis for vision in severely traumatized eyes have been improving since the understanding of structural complications and the advancement and refinement of vitreous microsurgical techniques[2-12]. The present study aimed to1) investigate the clinical type of open globe injury which involves posterior segment, 2) to evaluate the outcome of vitreo-retina surgery and compare prognostic factors in consecutive patients who had different types of open globe injury 3) to assess the role of prophylactic broad encircling scleral buckle in the prevention of subsequent retinal detachment and 4) to define factors that lead to functional failure.

Correspondence to : Warrasak S, Department of Ophthalmology, Ramathibodi Hospital, Mahidol University, Rama 6 Rd, Rajthevee, Bangkok 10400, Thailand. Phone: 0-2201-1526, E-mail: sukhuma@csloxinfo.com

Material and Method

At Ramathibodi Hospital, management of ocular trauma cases with posterior segment involvement has been changing since 1988, from conventional approach (retina reattachment surgery without the use of vitreous surgery and external scleral route of magnetic

extraction) to vitreoretinal surgery, pars plana approach of magnetic extraction with intraocular micro-forceps or endomagnet, use of expansile gases (sulfur hexafluoride, SF6 (1988-1993) or perfluoropropane gas, C3F8 (since 1994) and silicone oil implantation. The registered ocular trauma patients had the following information recorded on file: 1) preoperative and postoperative final best corrected Snellen visual acuity 2) type and cause of injury 3) time duration between onset of injury and vitrectomy 4)wound entrance site and most posterior extent of scleral wound 5) lens damage 6) severity of vitreous hemorrhage/opacity 7) type, location, and size of foreign body 8) retinal damage i.e. size and type of retinal break, extent of retinal detachment 9) presence of proliferative vitreoretinopathy (PVR) 10) intraoperative and postoperative complications. The standard treatment and report form for ocular trauma cases included the following: the location of wound entrance site and the most posterior extent of laceration were recorded as being anterior or posterior to ora serrata using the standard distance of nasal ora as 5.73 +/- 0.81 mm. and temporal ora as 6.53 +/- 0.75 mm. from the ora serrata to Schwalbe's line, which constitutes the posterior border of the limbus as the reference location[13]. The foreign body size was measured in millimetres with caliper after removal from the eye. Severity of hemorrhage or opacity was classified into 3 degrees according to its density. Mild if bleeding/opacity was minimally diffused or hemorrhage was localised such that no greater than a quadrant of fundus was obscured, moderate degree if about 2 quadrants of fundus were obscured or disc and some part of the fundus were hardly visualized and severe degree if no part of the fundus could be observed by an indirect ophthalmoscope. The preoperative retinal detachment was recorded as number of quadrants involved with or without macular detachment. Proliferative vitreoretinopathy (PVR) was specified according to standard classification recommended by the Retina Society Terminology Committee in 1983 throughout the study period[14]. Vitreous surgery was performed with the DAISY or MVS XX vitrectomy machines (1988-1993), Millennium, Storz company, St. Louis, Missouri (1994-2002) and Accurus, Alcon, Forthworth, Texas (2002-2004). Foreign bodies were extracted via pars plana approach utilizing intraocular microforceps, external electromagnetic extraction or endomagnet whichever appropriate. Retinal reattachment procedures included exoplant scleral buckling and cyroretinopexy or endolaser photocoagulation. Prophylactic broad encircling scleral buckle was indicated in all eyes that had moderate to severe vitreous hemorrhage despite no associated retinal break. Fluid air exchange and SF6 or C3F8 injection was required when there was a posterior retinal break or retinal break above horizontal meridian. The medical grade silicone oil that had viscosity of 1,300 centistokes (used between 1988-1993) or 5600 centistokes (since 1994) was necessary only when retina was detached or redetached and complicated with PVR grade C3 or worse unresponsive to other means of retina reattachment procedures. Inferior iridectomy at 6 o'clock was performed in all aphakic eyes that required silicone oil to reduce the incidence of keratopathy. Intraoperative chorioretinal adhesion was performed either with a cryoprobe or an endolaser. Postoperative or supplement retinopexy was done with blue green Argon or diode Lasers. In cases of endophthalmitis, culture and sensitivity test were done both from aqueous and vitreous tapping to identify the infective organism.

The authors retrospectively performed a study on all ocular trauma patients The authors managed and excluded those whose follow up periods were less than 6 months. Included in the present study were eyes with blunt and sharp perforating injuries with or without retained intraocular foreign bodies, blunt perforating and blunt nonperforating injuries, double perforating injuries with or without intraocular foreign bodies (IOFBs) managed by non-vitrectomy techniques subsequently referred for vitreo-retina surgery (Fig. 1a-1c). Primary outcome measures were to compare patients who suffered from the same type of injury between those who had functional success versus failure based on final visual outcome. Functional success was defined as final best corrected visual acuity (BCVA) of 20/400 or better and failure was when BCVA was less than 20/400. Data were analysed using the chi-square test or Fisher's exact test when applicable, statistically signicant at $p < 0.05$.

Results

There were 105 patients (107 eyes) who had ocular trauma involving anterior and posterior segment and were managed by the authors between 1988 and 2004. Thirteen patients whose follow up period was less than 6 months were excluded and so a total of 92 patients (94 eyes) were in the present study. Patients' characteristics and clinical data are presented in Table 1. The left eye was more commonly involved than the right: 50 patients had injuries involving the left eye while 34 patients involved the right. Eight patients had bilateral involvement, 4 of them from shot gun injuries and the other four from automobile accidents. Six of

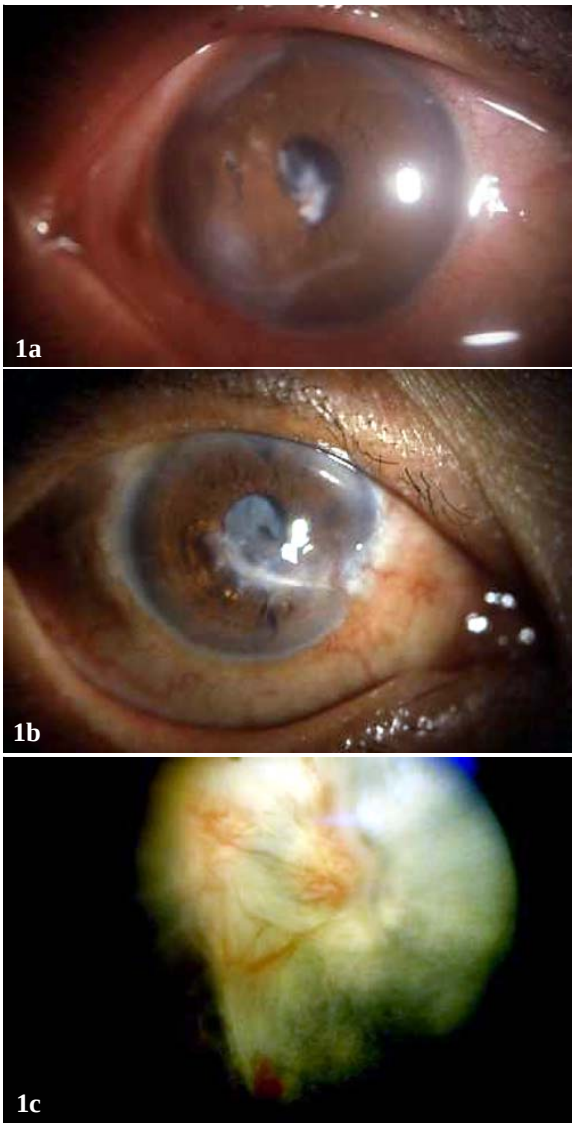

Fig. 1 Demonstrated eyes that had ocular trauma involving both anterior and posterior segments 1a). In sharp perforating injury with IOFB, FB entered through cornea, iris, caused traumatic cataract and retained in the posterior segment of the eye. 1b) This patient had blunt perforating injury secondary to automobile accident. Picture showed healed rupture corneal laceration post repair with leukema adherens and traumatic cataract. 1c) gun shot injury caused retinal detachment with massive PVR

Table 1. Patients' age distribution

Age (Years)	Number of patients (%) N = 92
0-10	2 (17%)
11-20	17 (18.48%)
21-30	32 (34.78%)
31-40	23 (25.00%)
41-50	10 (10.87%)
51-60	6 (6.52%)
61-70	0 (0.00%)
71	2 (2.17%)
Type of injury	**Total = 94 Eyes**
Sharp perforation (with IOFB=34, without IOFB = 5)	39 (41.49%)
Blunt perforation (with IOFB =1, without IOFB=37)	38 (40.42%)
Blunt nonperforation	10 (10.64%)
Double perforation	7 (7.45%)
Duration between injury and vitrectomy (days)	**Total = 94 Eyes**
<1	9 (9.57%)
1-7	18 (19.15%)
8-14	16 (17.02%)
15-30	16 (17.02%)
31-60	17 (18.09%)
>60	18 (19.15%)
Sex	**Total = 92 patients**
Female	6 (6.52%)
Male	86 (93.48%)
Laterality	**Total = 94 Eyes**
Right eye	34
Left eye	50
Bilateral	10
Access to the hospital	**Total = 92 patients**
Primary	9 (9.78%)
Secondary/ Tertiary referral	83 (90.22%)

the 8 patients lost vision to no light perception in one eye and underwent enucleation prior to referral and the authors managed only the fellow eyes. Men had higher rates of injury than women. Eighty-six patients (93.48%) were male and 6 (6.52%) were female. The patients' age ranged from 10-71 years old, a mean of 33.1 years. Injuries occurred most often at the age between 21-40 years (55 of 92 patients or 59.78%). Nine patients (9.78%)

came to this hospital primarily and 83 patients(90.22%) were secondarily or tertiary referred. Of the 94 eyes, nine (9.57%) underwent vitreous surgery within 24 hours, 18(19.15%) from 1 to 7 days, 16 (17.02%) from 8-14 days, 16(17.02%) from 15 to 30 days,17 (18/09%) from 31 to 60 days and 18 (19.15%) after 60 days following the injury. Follow up period varied from 6 to 53 months.

From Table 2, the most common type of injury was sharp perforating injuries (39 of 94 eyes or 41.49%) and blunt perforating injuries which accounted for 38 of 94 eyes (40.42%), blunt nonperforating injuries in 10 eyes (10.64%) and double perforating injuries in 7 eyes (7.45%).

Two most common causes of injuries were industrial and motor vehicle accidents which occurred in 45 eyes (47.87%) and 26 eyes (27.66%), respectively. Domestic accidents occurred in 14 eyes (14.89%), gun shot injury and explosive injury in 9 eyes (9.57%). Industrial accidents caused sharp perforation (32 of 39 cases (82.05%)) and double perforation (6 of 7 cases (85.71%)), whereas 20 of 38 cases (52.63%) of vehicle accidents were blunt perforating type. Gunshot and explosive injuries were both blunt perforating and blunt nonperforating types.

Final visual acuity in each type of injury is presented in Table 3. Of the 94 eyes, 62 (65.96%) achieved visual acuity of 20/400 or better and 40 (42.55%) actually achieved a final VA of 20/70 or better. Twenty-six (27.6%) had minimal vision of counting finger to light perception and 6 (6.38%) lost vision to NLP. Eyes that had sharp perforating injuries had better visual outcome than the others. Of the 39 eyes with sharp perforating injuries, 23 (58.97%) achieved a visual acuity of 20/70 or better whereas 14 of the 38 eyes (36.84%) with blunt perforating injuries, three of the 10 eyes (30%) with blunt nonperforating injury and none of the eyes in double perforating injury achieved this level of visual acuity.

Sharp perforating injury

Sharp perforating injuries were mostly work related in industry and had better visual prognosis than any other type of ocular injuries. Thirty-two (82.05%) of the 39 eyes that had sharp perforating injuries were industrial accidents and twenty-seven (69.23%) of 39 eyes had functional success. Of these, 23 of 39 eyes (58.97%) actually achieved a VA of 20/70 or better. Twelve of 39 eyes (30.77%) had functional failure and one of them lost vision to NLP (Table 3).

Table 2. Distribution of causes of injuries by type of injuries

Cause of injury	Type of injury				Total94
	SP = 39	BP = 38	BNP = 10	DBP = 7	eyes (100%)
Industrial	32	6	1	6	45 (47.87%)
Domestic	3	6	5	0	14 (14.89%)
Vehicle	3	20	2	1	26 (27.66%)
Gun shot injury/Explosion	1	6	2	0	9 (9.57%)

Table 3. Determination of association between type of injury and visual acuity

Type of injury	Success = 62				Failure = 32		
	20/20-20/40	20/50-20/70	20/100-20/400	Total	FC, HM, LP	NLP	Total
SP	16	7	4	27	11	1	12
BP	9	5	11	25	11	2	13
BNP	2	1	3	6	3	1	4
DBP	0	0	4	4	1	2	3
Total	27	13	22	62	26	6	32

SP = Sharp perforating injury
BP = Blunt perforating injury
BNP = Blunt nonperforating injury
DBP = Double perforating injury
FC = Finger counting
HM = Hand motion
LP = Light perception
NLP = No light perception

From Table 4, in 34 eyes that had retained IOFBs, foreign bodies were metallic and magnetic and were localized more often in the retina than in the vitreous (Fig. 2a-2b). Foreign bodies were in the vitreous in 11 eyes (32.35%), and 23 eyes (67.65%) had intraretinal foreign bodies. Fifteen of the 23 eyes had preoperative retinal detachment and two developed retinal detachment following FB removal. In 15 eyes

Table 4. Prognostic factors in eyes with sharp perforating injuries with retained IOFBs final VA ≥ 20/400 and eyes with final VA < 20/400

Factor	Final VA ≥ 20/400 N = 25	Final VA < 20/400 N = 9
1. Preoperative VA		
≥ 20/400	10	2
< 20/400	15	7
2. Wound entrance site		
Cornea	18	4
Sclera	7	5
3. Most posterior extent of wound		
Anterior to ora serrata	22	5
Posterior to ora serrata	3	4
4. Timing of vitrectomy (days)		
≤ 7	10	2
> 7	15	7
5. Lens damage		
Yes	15	5
No	10	4
6. Location of foreign body		
Vitreous	9	2
Retina	16	7
7. FB size (mm)		
1-3	18	5
4-10	7	4
8. Method of FB removal		
Magnet	16	6
Forceps	9	3
9. Vitreous hemorrhage		
Mild	14	5
Moderate - severe	11	4
10. Retinal detachment		
Present	9	5
Absent	16	4
11. Macular damage		
Yes	0	7
No	25	2
12. Endophthalmitis		
Present	3	2
Absent	22	7
13. Presence of PVR		
Yes	3	7
No	22	2

VA = Vvisual acuity
IOFB = Intraocular foreign body

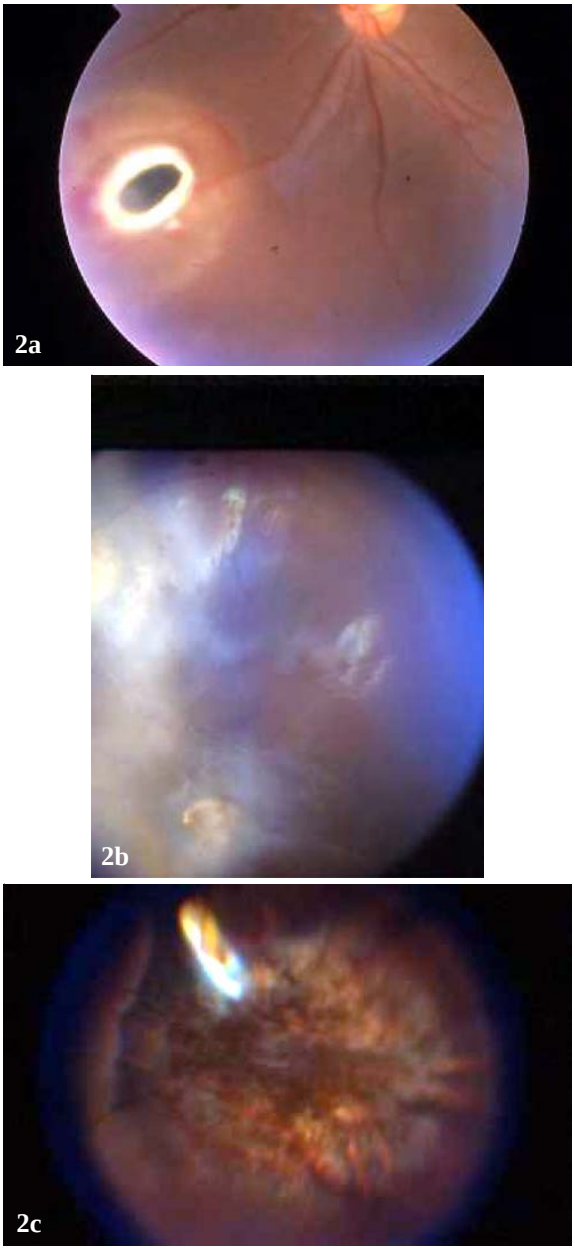

Fig. 2 Location of FB inside the eye more often in the retina than in the vitreous. Fig. 2a) showed reaction in the eye within 24 hours after injury 2b) became partly encapsulated 2c) totally encapsulated. This is one reason why sometimes external electromagnet failed to remove these IOFBs in prolonged duration of retention

that had preoperative retinal detachment, 8 had PVR. Timing of vitrectomy varied from within 24 hours to 7 months. When comparing eyes that had functional success versus failure, the authors found no statistically significant difference in terms of preoperative visual acuity, wound entrance site, lens damage, foreign body size, method of FB removal, severity of vitreous hemorrhage, presence of retinal detachment and endophthalmitis when the two groups were compared. Factors that had significant effect on visual outcome were extent of the wound posterior to ora serrata ($p = 0.039$), macula damage ($p = 0.022$) and the presence of PVR ($p = 0.001$).

Four of the five patients who were diagnosed as traumatic endophthalmitis had vitreous surgery performed within 6 hours to 8 days of the injuries and three of them attained visual acuity of 20/200 or better. The authors found 5 cases or 14.7% of 34 cases with retained IOFBs with evidence of infectious endophthalmitis (Fig. 3a-3d) and 4 of them (80%) resulted in culture positive, namely Bacillus subtilis, Staphylococcus coagulase negative, Acinetobacter, and Pseudomonas aeruginosa organisms. Combination of systemic, intravitreal antibiotics and vitrectomy resulted in a final VA of 20/200 or better. For patients who resulted in negative culture received systemic and topical but not intravitreal antibiotics before referral.

In 5 siderotic eyes, IOFBs were retained in the eyes for 15, 4, 7, 13 and 2 months respectively. The size of foreign bodies were found to be smaller than 3 mm and located at the posterior polar region of the eye or at the periphery of the fundus. Due to prolonged retention and well encapsulation of foreign bodies, intraocular microforceps was used to remove foreign bodies. Three of these 5 eyes attained a visual acuity of 20/70 or better while the other two eyes had recurrent retinal

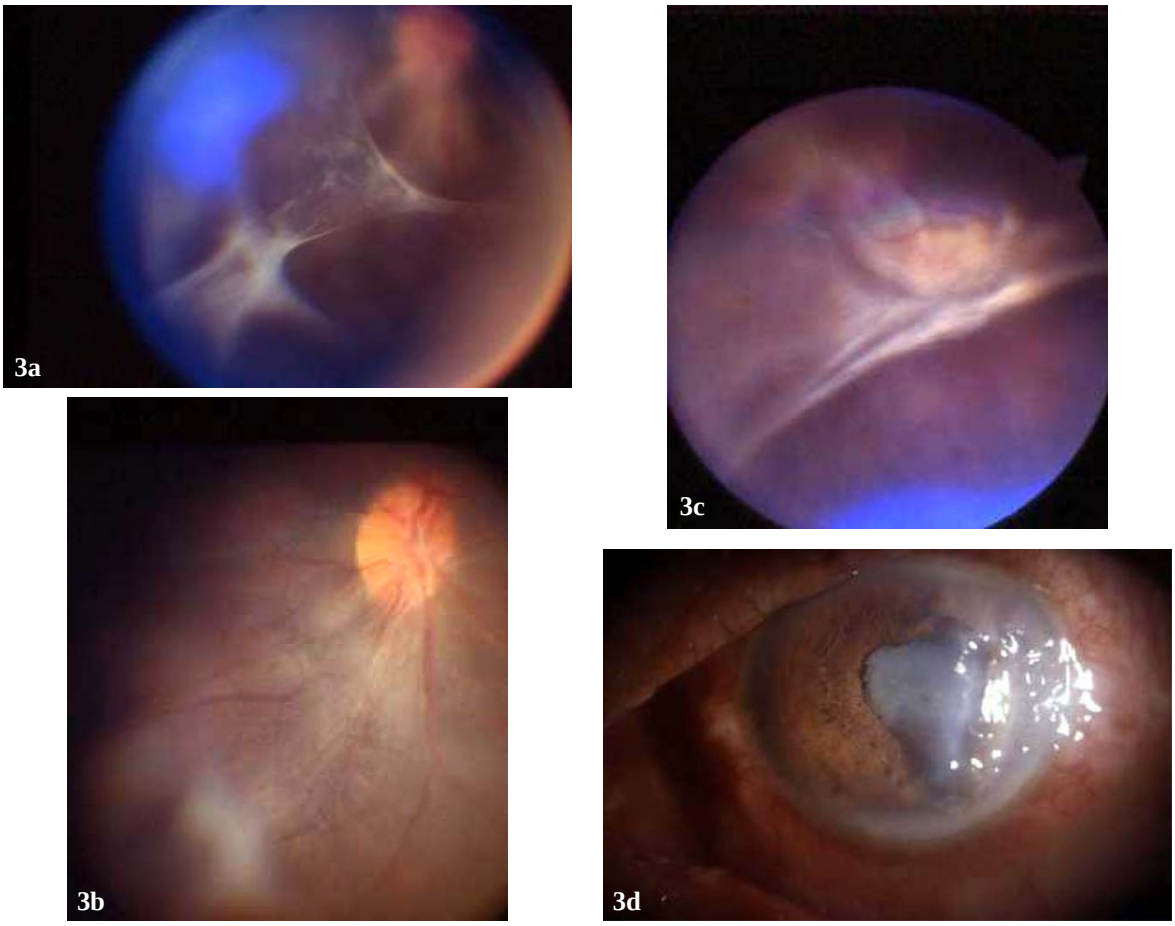

Fig. 3 3a-3c: Eye infected with Bacillus subtilis. This eye can be salvaged but final VA was poor due to large area of macular nonperfusion. 3d) An eye infected with Acinetobactor

detachment. There were two eyes that developed subretinal neovascular membrane (SRNVM) at FB site near macula at two years and one year following FB removal. Visual acvity deteriorated from subretinal bleeding but both finally attained a visual acuity of 20/70 (Fig. 4a-4c).

Blunt Perforating Injury

From Table 2, automobile accidents were the most frequent cause of blunt perforating injury. Of the 38 eyes that had blunt perforating injuries, 20 were accidents related to vehicles, 6 were industrial accidents, 6 were domestic accidents, 6 were gun shot injuries/ explosive injuries (Tables 2). From Table 3, 14 of the 38 eyes (36.84%) in blunt perforating injury had final acuity of 20/70 or better, 11 (28.94%) had visual acuity of 20/100-20/400, 11 (28.94%) had counting finger to light perception and two (5.26%) lost vision to NLP. The only eye that had retained IOFB was a patient who had an automobile accident and had retained a piece of windshield at the inferior retina in her left eye. The foreign body was first removed from the eye with diamond coated intraocular microforceps. Due to its large size (5 x 6 x 7 mm) and rectangular shape, the foreign body was successfully removed with toothed forceps under air via limbal incision and the retina was then repaired. Postoperatively the patient had irregular astigmatism but was corrected with aphakic hard contact lens and finally attained visual acuity of 20/30.

Of the 13 eyes that had functional failure, 10 had automobile accidents and 3 had shotgun injuries. Eight of the 10 eyes that had automobile accidents, had preoperative visual acuity of less than 20/400, had moderate to severe vitreous hemorrhage and retinal detachment with PVR. Five of the 8 eyes required silicone oil implantation. From Table 5, when comparing eyes that had functional success versus those who had functional failure it was found that there were no statistically significant difference in any prognostic factors.

Blunt non-perforating and double perforating injuries

Blunt non-perforating and double perforating injuries are two types of injuries that appeared to have poor final outcome. Of the 10 eyes that had blunt non-perforating injury, 3 (30%) had final VA of 20/70 or better, 3 (30%) had 20/100-20/400, 3 (30%) had counting finger and one (10%) lost vision to NLP. In 7 eyes of double perforating injury, 4 (57.14%) had final visual acuity of 20/100-20/400, one (14.28%) had hand motion and the other two (28.57%) ended up with NLP. There was one case of double perforating injury who had transorbital perforating trauma to the frontal lobe following a car accident. The injuries involved laceration of the lid, perforation of the cornea, rupture of the lens and perforation through the roof of the orbit by broken windshields which were eventually retained in the orbit and in the frontal lobe. The retina was then

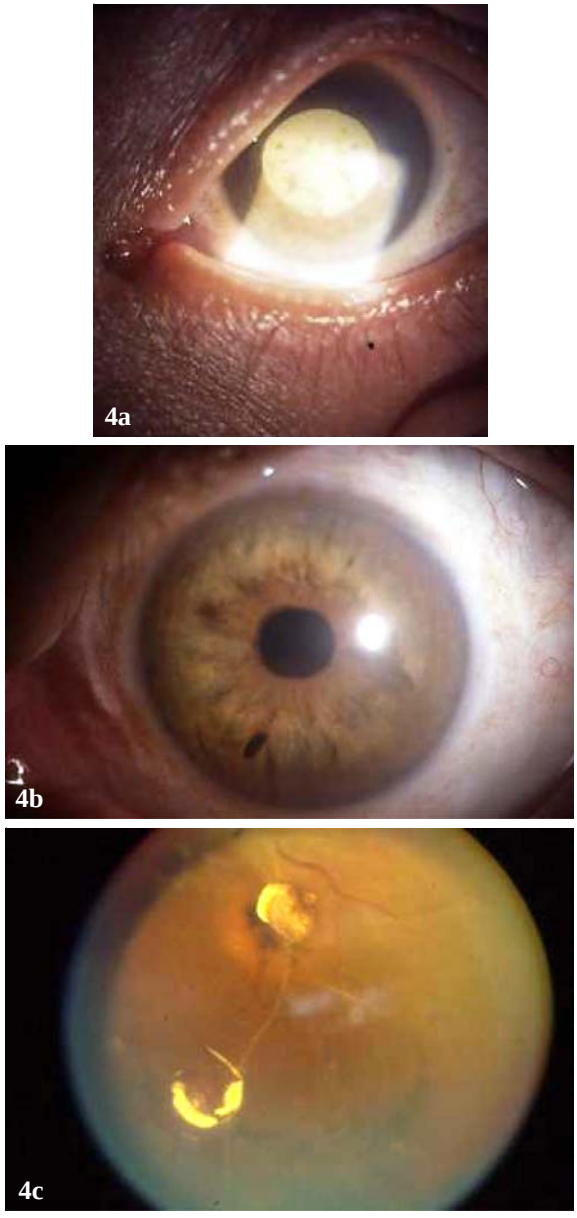

Fig. 4 4a-4c: Siderotic eyes 4a) siderosis lentis 4b) Typical iris discoloration and inferior iridotomy secondary to perforation from foreign body entering the eye 4c) Note fundus change in this siderotic eye where IOFB was retained in the eye for 15 months

Table 5. Possible prognostic factors for poor visual outcome in eyes that had blunt perforating injuries

Factor Functional status	Functional success N = 25	Functional failure N = 13
1. Preoperative visual acuity		
≥ 20/400	5	0
< 20/400	20	13
2. Site of initial laceration		
Cornea	15	5
Corneosclera/ sclera	10	8
3. Most posterior extent of scleral wound		
Anterior to ora serrata	19	9
Posterior to ora serrata	6	4
4. Timing of Vitrectomy (days)		
≤ 7	5	1
> 7	20	12
5. Lens damage		
Yes	22	10
No	3	3
6. Vitreous hemorrhage		
Mild	10	5
Moderate-severe	15	8
7. Preoperative retinal detachment with PVR		
Yes	18	8
No	7	5
8. Presence of retinal detachment with PVR		
Yes	7	8
No	18	5

PVR= Proliferative vitreoretinopathy

repaired with vitreo-retinal techniques, fluid gas exchange and postoperative laser retinopexy. Postoperatively, the retina had minimal localized subretinal fibrosis inferior to the macula. The patient developed aphakic bullous keratopathy which required penetrating keratoplasty at 6 months following the injury and his final best corrected visual acuity at 34 months was 20/400.The retained piece of inactive windshield was left without removal and the patient has not had any neurological complications.

Retinal detachment in posterior segment injuries

Table 6 summarizes 55 eyes that had retinal detachment associated with posterior segment injuries. Of these, 52 had preoperative retinal detachment and 31 (59.61%) were complicated with PVR. There were three eyes that developed retinal detachment postoperatively. So the detachment rate in prophylactic encircled- buckling eyes was 3 in 94 eyes or 3.2%. Eleven of the 31 eyes that had preoperative retinal detachment with PVR required silicone oil implantation. The overall reattachment rate or anatomical success rate was 43/55 (58.18%%) and functional success rate was 31/55 (56.36%). Table 7 reports the visual results and complications in 11 silicone filled eyes. Three of the 11 eyes had functional success. Postoperative complications included secondary glaucoma in 2 eyes, keratopathy in 3 eyes, progressive cataract in one eye and membrane proliferation under silicone oil in 3 eyes and recurrent inferior retinal detachment in one eye.

Reasons for functional failure in all types of injuries

From table 8, a total of 32 (34.04%) of 94 eyes ended up with functional failure. Of these, 10 (31.25%) resulted from macular damage, 10 (31.25%) from RD with PVR, 6 (18.75%) from optic nerve injury, 3 (9.38%) from endophthalmitis, 2 (6.25%) from bullous keratopathy, and 1 (3.12%) from secondary glaucoma. A total of 6 eyes (6.38%) lost vision to no light peception. Fig. 6a-6f show the reasons for failure in some patients.

Table 6. Anatomical success and functional success in eyes that had retinal detachment

	SP (N = 17)	BP (N = 27)	BNP (N = 6)	DBP (N = 5)	Total (N = 55)
Preop RD	15 (PVR = 8)	26 (PVR = 15)	6 (PVR = 5)	5 (PVR = 3)	52 (PVR = 31)
Postop RD in previously attached retina	2 (PVR = 2)	1 (PVR = 1)	0	0	3 (PVR = 3)
Anatomical success	14	18	6	5	43 (78.18%)
Functional success	8	15	5	3	31 (56.36%)

Table 7. Visual results and complications in silicone-oil-filled eyes

#	VA		Indications	Results and complications
	Preop	Postop		
1.	LP	FC	Postoperative RD/PVR following IOFB removal	SACG
2.	20/70	5/200	Pos operative RD/PVR	Keratopathy
3.	HM	20/400	RD/PVR in retained metallic IOFB	Partial attached retina, inferior RD
4.	HM	20/200	Automobile accident, total RD/PVR, vitreous incarcerated and traction at scleral wound	Secondary cataract
5.	HM	FC	Automobile accident, GRT/PVR	Membrane proliferation under silicone oil implant
6.	HM	LP	Automobile accident, total RD/PVR	Incarcerated retina at corneal wound, not possible to reattach
7.	HM	HM	Automobile accident, total RD/PVR	Partially attached retina with membrane
8.	HM	FC	Automobile accident, total RD/PVR	Proliferation under silicone oil
9.	FC	NLP	Domestic accident, total RD/PVR	Keratopathy
10.	HM	20/400	Automobile accident, GRT/PVR	Keratopathy
11.	PJ	CF3'	Automobile accident, postop RRD with massive PVR with retained IOFBs (wind shields)	SACG due to emulsified silicone oil

VA = Visual acuity
FC = Finger counting
LP = Light perception
FB = Foreign body
GRT = Giant retinal tear
SACG = Secondary angle closure glaucoma
HM = Hand motion
PJ = Projection of light
NLP = No light perception
RD = Retinal detachment
PVR = Proliferative vitreoretinopathy

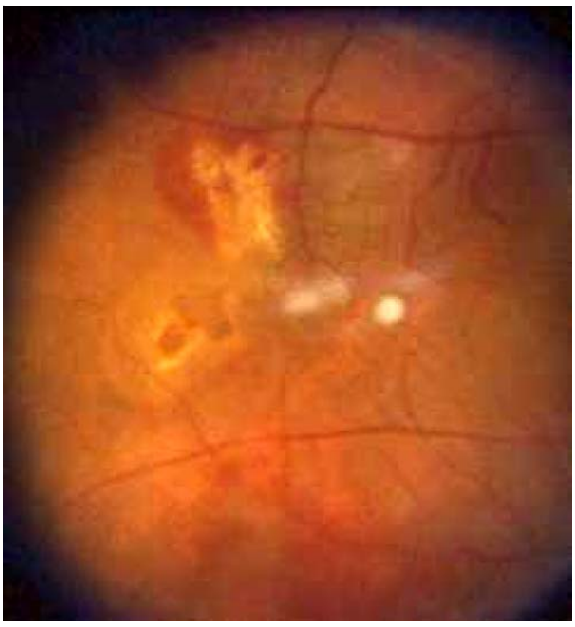

Fig. 5 Subretinal neovascular membrane developed two years after injury at previous site of IOFB

Discussion

Results of conventional management between 1982-1984 after a mean follow period of 18.2 months revealed a final VA of 20/200 or better was achieved in 16 eyes (44.4%) of 36 patients with retained IOFBs and causes of functional failure were retinal detachment with advanced PVR (11 of 26 eyes or 42.3%) and endophthalmitis (13.9%)[15]. Since 1988, the authors have recorded ocular trauma patients who had open globe injury with posterior segment involvement to combat several factors that limit meaningful comparisons due to retrospective nature.A prospective study evaluating the role of vitreo-retinal surgery, intraocular microforceps, and electromagnet in the management of perforating injury with retained metallic IOFBs (1988-1993)showed a high success rate of functional success (BCVA=20/400 or better) in 80.8%of the patients who had a follow-up period of at least 6 months and 65.4% actually achieved VA of 20/70 or better[16].

The present study analyzed a tertiary referral hospital-based ocular trauma patients with open globe injury of all types over a 16 year period (1988-2004) by one anterior segment and one vitreo-retinal surgeon at a single institution. However, the timing of vitreous

Table 8. Reason for failure, type & cause of injury in eyes that had functional failure

Reason of failure	Type of injury				
	SP N = 12	BP N = 13	BNP N = 4	DBP N = 3	Total N = 32
Macular damage					10
macular scar	IOFB (1)	-	Industrial (1)	-	
large macular hole	IOFB (1)	-	-	-	
macular pucker	-	Automobile accident (5)	Explosive (1)	-	
macular ischemia	IOFB (1)	-		-	
Optic nerve injury	-	Motorcycle (1) Shotgun (2)	Domestic (1)	IOFB (2)	6
RD with massive PVR	IOFB (6)	Automobile accident (2) Domestic (1) Explosion (1)	-	-	10
Endophthalmitis	IOFB (2)	-	-	Industrial (1)	3
Keratopathy (ABK)	IOFB (1)	-	Domestic (1)		2
Secondary glaucoma	-	Automobile accident (1)	-	-	1

ABK = Aphakic bullous keratopathy

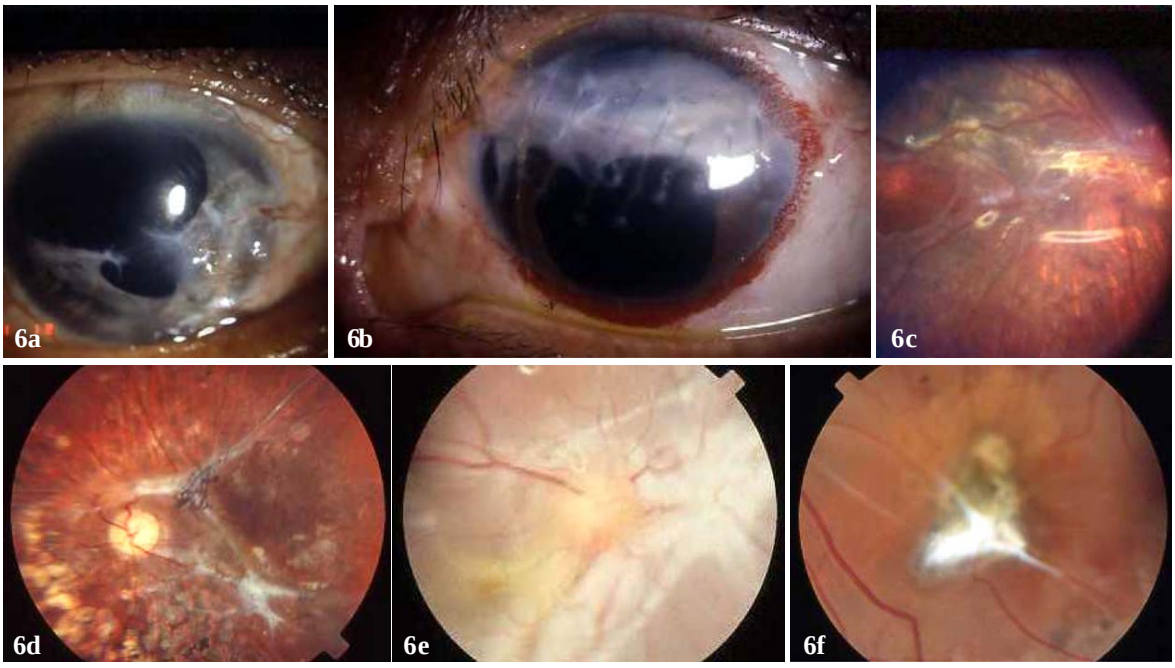

Fig. 6 6a-6e: Reasons for failure 6a-6b) Keratopathy due to corneal scar 6c) large macular hole after large IOFB was removed 6d) significant scar formation within the vicinity of macula 6e) fixed fold and macular pucker 6f) fibrous scar developed after FB removal and when located near macula can cause striae and distortion

surgery is an important factor that the authors cannot manipulate because of referral pattern and patients were referred to us from weeks to several months following injury. In a large cohort of patients from a major trauma center, Sastry documented that 65% of adult major trauma victims with ocular injury were involved in a motor vehicle related mechanism[17]. The present study showed that the two most common injuries were work-related in industry and automobile accidents. We found that preoperative visual acuity, lens damage, degree of vitreous hemorrhage, timing of vitrectomy before 7 days and foreign body size did not appear to have a significant difference on the final outcome when magnetic foreign bodies entered the eyes through the cornea or sclera anterior to ora serrata which is a safe zone and when vitreous surgery with the use of intraocular microforceps and/or endomagnet aided in successful removal of encapsulated foreign body. Three prognostic factors for poor outcome were the extent of the wound posterior to the ora serrata, macula damage and the presence of RD with PVR.

The present study revealed an overall success rate of 65.96% with the best visual outcome of 20/70 in 58.97% of consecutive cases of complicated IOFBs. Conway and Michels reported a successful result with vision of 20/400 or better in 12 of 13 consecutive cases with complicated IOFBs[9]. Brinton et al reported a functional success rate of 63% using both vitrectomy and nonvitrectomy method[18]. Ryan and Allen reported a similar result of 61% in 33 eyes with complicated IOFBs[19]. Coleman et al reported an overall improvement of visual acuity of one line or better in 61% of 35 eyes with retained IOFBs using magnetic extraction in combination with pars plana vitrectomy[20]. Whether external versus internal approach is better depends on the size of IOFBs and extent of injuries. In a large series of 158 patients analyzed transscleral magnetic extraction versus pars plana approach found the latter approach to be a management of choice and that final visual acuity did not depend on the interval between injury and IOFB removal[21]. Another series of 70 eyes reported a significant improvement of visual outcome despite varying surgical techniques and encouraged a viable treatment of external electromagnet use in selected case of retained metallic IOFB[22]. Jonas and Budde pointed out that removing retained IOFBs within the first 24 hours after the injury may reduce the risks of infectious endophthalmitis and proliferative vitreoretinopathy[23]. Regarding prognostic factors, Greven et al found that presenting visual acuity was the strongest predictor of final outcome, other factors included the mechanism of injury, presence of relative afferent papillary defect (RAPD), and vitreous hemorrhage[24].

Prolonged retention of metallic foreign bodies in the eye resulted in siderosis bulbi. Studies have shown a widespread degeneration of lens epithelium, iris stromal cells and iris pigment epithelium by the deposition of ferritin in the cytoplasm especially in the form of siderosomes and that there is a relationship between degree of cell degeneration and number of intracellular siderosomes in lens epithelium of siderotic eyes[25-27]. The authors successfully removed retained metallic IOFBs in 5 siderotic eyes that had prolonged duration of retention for months to years and observed progressive clearing of the iron deposits in these eyes following removal of FBs. Schocket et al reported progressive clearing of the retinal iron deposits in siderotic eye following removal of a foreign body[28]. Other series of managing 14 cases of ocular siderosis have shown a successful removal in 12 of 14 eyes using electromagnet,or intraocular FB forceps and 11 eyes had postoperative VA ranging from 20/15 to 20/40[29].

Infectious endophthalmitis following penetrating eye injuries is a potentially catastrophic complication due to the underlying eye trauma and the frequency of more virulent organisms such as Bacillus species. Risk factors for infection include 1) retained intraocular foreign body, 2) a rural injury setting, 3) delay in primary wound closure, and 4) disruption of the crystalline lens. Although endophthalmitis is difficult to distinguish from traumatic changes, recognition of early clinical signs of endophthalmitis, such as hypopyon, vitritis, or retinal periphlebitis, is important and early treatment is recommended[30]. Incidence of infectious endophthalmitis after penetrating injury with retained foreign body was reported varied from 2.5% to 13.3%. Rowsey and et al also obtained their high culture positive incidence with vitreous aspiration[31]. Bacillus species is commonly found in post traumatic and is rarely cultured in postsurgical endophthalmitis. The clinical course is very devastating and progresses within 24 hours. Most eyes infected with this organism ended up with irreversible visual loss requiring evisceration or enucleation[22,32-35]. Schemmer and Driebe have reported a case of traumatic Bacillus cereus endophthalmitis who recovered a useful vision of 20/60[36]. Eyes infected with Staphylococcus organism had better final visual acuities than those with Bacillus organism[37,38]. Gram negative bacteria were the causative organisms in traumatic endophthalmitis in 7 to 20% and the overall prognosis with gram negative

organisms is generally poor[32]. Thompson et al advocated removal of intraocular foreign body within 24 hours of injury to reduce the risk of infectious endophthalmitis and in his report culture negative endophthalmitis had better vision than culture positive[39]. Prophylactic antibiotics especially intravitreal administration may lessen the severity or even prevent endophthalmitis. Alfaro et al proved the efficacy of prophylactic intravenous cefazolin in preventing the development of post traumatic endophthalmitis in a rabbit model[40].

The development of subretinal neovascular membrane in eyes that foreign bodies had been removed in the posterior pole of the retina followed with laser retinopexy suggested that foreign bodies located in this area may not need laser treatment since spontaneous retinopexy can occur and that laser photocoagulation applied to an area of chorioretinal inflammation can cause an intense burn[41]. Ambler and Meyers reported five cases of retained metallic foreign bodies in the posterior retina without retinopexy and obtained good visual result[42].

Meredith and Gordon found that retinal detachment with or without PVR occurred in blunt perforating injury more often than in sharp perforating trauma[12]. The authors found the same thing. The authors advocated broad buckle from anterior retina to about equatorial region in all eyes that have moderate to severe vitreous hemorrhage to support peripheral retinal tears that may be precluded by poor visualization and to support vitreous base against late contraction and traction due to vitreous incaceration at laceration sites. The authors have found a beneficial effect of prophylactic encircling buckle in preventing subsequent retinal detachment. The present series found an overall prevalence of 3.12% detachment rate in vitrectomized eyes with prophylactic buckle. Other studies, also retrospective in nature and did not randomly assign patients to SB placement at the time of vitrectomy, support the concept that prophylactic SB placement at the time of vitrectomy decreases the risk of subsequent RD in trauma patients[43,44]. Brinton et al found a 23% detachment rate in eyes not receiving prophylactic buckles as opposed to a 13% rate in prophylactically buckled eyes[18]. Miyake and Ando reported a 24% detachment rate in prophylactic eye versus a 78% detachment rate among non-buckled eyes[45]. Hutton and Fuller found a 27% detachment rate without scleral buckle versus an 8% rate in prophylactic eyes[46]. Ahmadieh reported final acuity of 20/200 or better was achieved in 41.3% of 29 eyes that had prophylactic buckle and 68.4% of 168 eyes which prophylactic scleral buckling was used[47].

The two most important factors determining the potential for return of useful vision in the presented patients that had severely injured eyes is the magnitude of damage incurred by the macula or optic nerve at the time of injury and the presence of PVR. When PVR was in advanced stages vitrectomy and sulfur hexafluoride (SF6) injection may not satisfactorily reattach the retina, silicone oil was used as adjunctive therapy to aid in reattachment status. The silicone study [48] confirmed the superiority of silicone oil over SF6. Our patients with retinal detachment had an overall reattachment rate of 78.18% and functional success of 56.36% while those that had PVR and underwent silicone oil implantation had reattachment rate of 63.64%. Other investigators reported total reattachment caused by trauma in silicone oil filled eyes in 52 to 62%[49]. Postoperative silicone oil complications were secondary glaucoma, secondary cataract, keratopathy and progressive PVR under silicone oil.

Experimental and clinical studies suggested that among all types of injuries double perforating injuries had the worst prognosis[50-52]. The authors' only case of transorbital perforating injury to the frontal lobe had final visual recovery of 20/400. Three cases of the same injury with excellent vision were reported and were suspected of the possibility of intracranial injury[53]. Bilateral shotgun injuries also has poor visual prognosis. Limiting factors to good visual recovery was due to direct injury of optic nerve or macular, intraocular scarring and fibrosis with secondary retinal detachment or severe ocular disorganization[54,55]. One debatable subject in the study of perforating injury with posterior segment involvement evaluating vitrectomy role is the optimal time for vitreous surgery. Several vitreo-retinal surgeons preferred within two weeks after initial trauma. Coleman preferred early surgery in less than 72 hours based on the concept to reduce inflamation by early removal of any inciting agents[11]. Ryan and Allen believed the optimum time for vitrectomy is four to ten days after the original injury[19]. Hutton and Fuller[46] in the retrospective study of 194 eyes treated by pars plana vitrectomy for severe injury with posterior segment involvement found no statistical significant difference in the groups operated on in less than 72 hours and those in other categories. Winthrop et al [56] examined and reported histological findings in 34 eyes that had severe penetrating trauma and found 32 out of the 34 eyes had retinal detachment and they concluded that vitrectomy should not be

delayed beyond the second week of injury by which time massive cellular ingrowth may already be under way. The ideal timing of vitrectomy in ocular trauma is still controversial but early vitrectomy is crucial in the presence of associated retinal detachment and/or endophthalmitis. In the authors' circumstances, there is selection bias as tertiary referral centre and the timing of vitrectomy is a variable factor that cannot be controlled. However an overall functional success rate of 65.96% among all types of injuries was achieved despite the fact that 29% had vitreous surgery within 7 days and nearly 55% of the cases had vitreous surgery after 14 days of injury.

In conclusion, vitreous surgery, prophylactic broad encircling scleral buckle, and adjunctive therapies such as long expansile gases and silicone oil implantation are beneficial to salvage severely traumatized eyes. It is advisable that general ophthalmologists perform initial repair of the globe, provide prophylactic antibiotics and refer the patient timely though the national coverage policy. Primary enucleation may be deferred unless initial injury was so extensive and associated with very poor prognosis.The results were presented and described by frequency tables with number and percentage.

References

1. Percival SP. Late complications from posterior segment intra-ocular foreign bodies with particular reference to retinal detachment. Br J Ophthalmol 1972; 56: 462-8.
2. Coles WH, Haik GM. Vitrectomy in intraocular trauma. Its rationale and its indications and limitations. Arch Ophthalmol 1972; 87: 621-8.
3. Hutton WL, Snyder WB, Vaiser A. Vitrectomy in treatment of ocular perforating injuries. Am J Ophthalmol 1976; 81: 733-9.
4. Cleary PE, Ryan SJ. Experimental posterior penetrating eye injuries in the rabbit I. Method of production and natural history. Br J Ophthalmol 1979; 63: 306-11.
5. Topping TM, Abrams GW, Machemer R. Experimental double-perforating injury of the posterior segment in rabbit eyes; the natural history of intraocular proliferation. Arch Ophthalmol 1979; 97: 735-42.
6. Gregor Z, Ryan SJ. Complete and core vitrectomies in the treatment of experimental posterior penetrating eye injury in the rhesus monkey. Arch Ophthalmol 1983; 101: 446-50.
7. Hsu HT, Ryan SJ. Experimental retinal detachment in the rabbit. Penetrating ocular injury with retinal laceration. Retina 1986; 6: 66-9.
8. Benson WE, Machemer R. Severe perforating injuries treated with pars plana vitrectomy. Am J Ophthalmol 1976; 81: 728-32.
9. Conway BP, Michels RG. Vitrectomy techniques in the management of selected penetrating ocular injuries. Ophthalmology 1978; 85: 560-83.
10. Michels RG. Vitrectomy methods in penetrating ocular trauma. Ophthalmology 1980; 87: 629-45.
11. Coleman DJ. Early vitrectomy in the management of the severely traumatized eye. Am J Ophthalmol 1982; 93: 543-51.
12. Meredith TA, Gordon PA. Pars plana vitrectomy for severe penetrating injury with posterior segment involvement. Am J Ophthalmol 1987; 103: 549-54.
13. Strattsma BR, Foos RY, Feman SS. Degenerative diseases of the peripheral retina. In: Duane TD, editor. Clinical ophthalmology. Vol. 3. Philadelphia: Harper & Row; 1986: 1-29.
14. The Retina Society Terminology Committee. The classification of retinal detachment with proliferative vitreoretinopathy. Ophthalmology 1983; 90: 121-5.
15. Warrasak S. Results of conventional management of penetrating ocular injury due to retained metallic intraocular foreign bodies with posterior segment involvement. Ramathibodi Med J 1994; 17: 35-41.
16. Warrasak S, Euswas A, Na Chiengmai B, Sansupo B. Vitreo-retinal surgery in sharp perforating ocular injuries with retained metallic intraocular foreign bodies (1988-1993). Asia Pacific J Ophthalmol 1995; 7: 10-6.
17. Sastry SM, Paul BK, Bain L, Champion HR. Ocular trauma among major trauma victims in a regional trauma center. J Trauma 1993; 34: 223-6.
18. Brinton GS, Aaberg TM, Reeser FH, Topping TM, Abrams GW. Surgical results in ocular trauma involving the posterior segment. Am J Ophthalmol 1982; 93: 271-8.
19. Ryan SJ, Alien AW. Pars plana vitrectomy in ocular trauma. Am J Ophthalmol 1979; 88: 83-91.
20. Coleman DJ, Lucas BC, Rondeau M, Chang S. Management of intraocular foreign bodies. Ophthalmology 1987; 94: 1647-53.
21. Karel I, Diblik P. Management of posterior segment foreign bodies and long-term results. Eur J Ophthalmol 1995; 5: 113-8.
22. Chow DR, Garretson BR, Kuczynski B, Williams

GA, Margherio R, Cox MS, et al. External versus internal approach to the removal of metallic intraocular foreign bodies. Retina 2000; 20: 364-9.
23. Jonas JB, Budde WM. Early versus late removal of retained intraocular foreign bodies. Retina 1999; 19: 193-7.
24. GrevenCM, Engelbrecht NE, Slusher MM, Nagy SS. Intraocular foreign bodies: management, prognostic factors and visual outcomes. Ophthalmology 2000; 107: 608-12.
25. Tawara A. Transformation and cytotoxicity of iron in siderosis bulbi. Invest Ophthalmol Vis Sci 1986; 27: 226-36.
26. Talamo JH, Topping TM, Maumenee AE, Green WR. Ultrastructural studies of cornea, iris and lens in a case of siderosis bulbi. Ophthalmology 1985; 92: 1675-80.
27. Hope-Ross M, Mahon GJ, Johnston PB. Ocular siderosis. Eye 1993; 7: 419-25.
28. Schocket SS, Lakhanpal V, Varma SD. Siderosis from a retained intraocular stone. Retina 1981; 1: 201-7.
29. Sneed SR, Weingeist TA. Management of siderosis bulbi due to a retained iron- containing intraocular foreign body. Ophthalmology 1990; 97: 375-9.
30. Reynolds DS, Flynn HW Jr. Endophthalmitis after penetrating ocular trauma. Curr Opin Ophthalmol 1997; 8: 32-8.
31. Rowsey JJ, Newsom DL, Sexton DJ, Harms WK. Endophthalmitis: current approaches. Ophthalmology 1982; 89: 1055-65.
32. Parrish CM, O'Day DM. Traumatic endophthalmitis. Int Ophthalmol Clin 1987; 27: 112-9.
33. Brinton GS, Topping TM, Hyndiuk RA, Aaberg TM, Reeser FH, Abrams GW. Posttraumatic endophthalmitis. Arch Ophthalmol 1984; 102: 547-50.
34. Puliafito CA, Baker AS, Haaf J, Foster CS. Infectious endophthalmitis. Review of 36 cases. Ophthalmology 1982; 89: 921-9.
35. Bohigian GM, Olk RJ. Factors associated with a poor visual result in endophthalmitis. Am J Ophthalmol 1986; 101: 332-41.
36. Schemmer GB, Driebe WT Jr. Posttraumatic Bacillus cereus endophthalmitis. Arch Ophthalmol 1987; 105: 342-4.
37. Behrens-Baumann W, Praetorius G. Intraocular foreign bodies. 297 consecutive cases. Ophthalmologica 1989; 198: 84-8.
38. Mieler WF, Ellis MK, Williams DF, Han DP. Retained intraocular foreign bodies and endophthalmitis. Ophthalmology 1990; 97: 1532-8.
39. Thompson JT, Parver LM, Enger CL, Miecer WF, Liggett PE. Infectious endophthalmitis after penetrating injuries with retained intraocular foreign bodies. Ophthalmology 1993; 100: 1468-74.
40. Alfaro DV, Runyan T, Kirkman E, Tran VT, Liggett PE. Intravenous cefazolin in penetrating eye injuries.Treatment of experimental posttraumatic endophthalmitis. Retina 1993; 13: 331-4.
41. L'Esperance FA Jr. Ophthalmic lasers. Vol. II. St. Louis: CV Mosby; 1989: 987.
42. Ambler JS, Meyers SM. Management of intraretinal metallic foreign bodies without retinopexy in the absence of retinal detachment. Ophthalmology 1991; 98: 391-4.
43. Stone TW, Siddiqui N, Arroyo JG, McCuen BW II, Postel EA. Primary scleral buckling in open-globe injury involving the posterior segment. Ophthalmology 2000; 107: 1923-6.
44. Arroyo JG, Postel EA, Stone T, McCuen BW, Egan KM. A matched study of primary scleral buckle placement during repair of posterior segment open globe injuries. Br J Ophthalmol 2003; 87: 75-8.
45. Miyake Y, Ando F. Surgical results of vitrectomy in ocular trauma. Retina 1983; 3: 265-8
46. Hutton WL, Fuller DG. Factors influencing final visual results in severely injured eyes. Am J Ophthalmol 1984; 97: 715-22.
47. Ahmadieh H, Soheilian M, Sajjadi H, Azarmina M, Abrishami M. Vitrectomy in ocular trauma. factors influencing final visual outcome. Retina 1993; 13: 107-13.
48. Silicone Study Group. Vitrectomy with silicone oil or sulfur hexafluoride gas in eyes with severe proliferative vitreoretinopathy: results of a randomized clinical trial. Silicone Study Report 1. Arch Ophthalmol 1992; 110: 770-9.
49. Skorpik C, Menapace R, Gnad H, Parousis P. Silicone oil implantation in penetrating ocular injuries complicated by PVR. Result from 1982 to 1986. Retina 1989; 9: 8-14.
50. Abrams GW, Topping TM, Machemer R. Vitrectomy for injury: the effect on intraocular proliferation following perforation of the posterior segment of the rabbit eye. Arch Ophthalmol 1979; 97: 743-8.
51. De Juan E Jr, Sternberg P Jr, Michels RG, Auer C. Evaluation of vitrectomy in penetrating ocular trauma. A case-control study. Arch Ophthalmol 1984; 102: 1160-3.
52. Ramsay RC, Cantrill HL, Knobloch WH. Vitrectomy for double penetrating ocular injuries. Am J Ophthalmol 1985; 100: 586-9.

53. Sebag J, Shillito J, Robb R. Transorbital penetrating injuries to the frontal lobe. Ophthalmic Surg 1986; 17: 631-4.
54. Morris RE, Witherspoon CD, Feist RM, Byme JB Jr, Ottemiller DB. Bilateral ocular shotgun injury. Am J Ophthalmol 1987; 103: 695-700.
55. Sternberg P Jr, de Juan E Jr, Green WR, Hirst LW, Sommer A. Ocular BB injuries. Ophthalmology 1984; 91: 1269-77.
56. Winthrop SR, Cleary PE, Minckler DS, Ryan SJ. Penetrating eye injuries: a histopathological review. Br J Ophthalmol 1980; 64: 809-17.

อุบัติเหตุทางตา: การรักษาโดยการผ่าตัดน้ำวุ้นตา และการป้องกันจอรับภาพหลุดลอก โดยการใช้สายรัดลูกตาโดยรอบ

สุขุมา วรศักดิ์, อัทยา อยู่สวัสดิ์, ศุภวัฒน์ หงษ์สาคร

วัตถุประสงค์:
1. เพื่อศึกษาผลการผ่าตัดรักษาตาที่ได้รับอุบัติเหตุทางตาชนิดต่าง ๆ ที่มีแผลเปิดและมีความรุนแรงทั้งส่วนหน้าและส่วนหลังของตาโดยได้รับการผ่าตัดจอประสาทตาและน้ำวุ้นตาหรือใช้สายรัดลูกตาโดยรอบ
2. เพื่อประเมินว่าการใช้สายรัดลูกตาโดยรอบจะช่วยลดอุบัติการณ์จอประสาทตาหลุดลอกได้ดีเพียงไร
3. ศึกษาปัจจัยที่ทำให้ตาที่ได้รับอุบัติเหตุสูญเสียการมองเห็น
วัสดุและวิธีการ: *ศึกษาข้อมูลย้อนหลัง ผู้ป่วยที่ได้รับอุบัติเหตุทางตาชนิดต่าง ๆ ระหว่างปี พ.ศ. 2531 - พ.ศ. 2547 โดยดูจากบันทึกเวชระเบียนผู้ป่วยดังกล่าวที่มีการติดตามผลการรักษาเป็นเวลานาน 6 เดือนขึ้นไป*
ผลการศึกษา: *ผู้ป่วยที่ได้รับอุบัติเหตุทางตาทุกชนิดที่มีแผลเปิดและมีผลกระทบต่อส่วนหลังของลูกตา และได้รับการผ่าตัดจอประสาทตาและน้ำวุ้นตา มีจำนวน 92 คน (94 ตา) ระหว่างปี พ.ศ. 2531 - พ.ศ. 2547 อายุผู้ป่วยตั้งแต่ 10-70 ปี อายุเฉลี่ย 33.1ปี ติดตามผลการรักษา ตั้งแต่ 6 เดือนขึ้นไป พบว่าอุบัติเหตุส่วนใหญ่เกิดในโรงงานอุตสาหกรรมและอุบัติเหตุบนท้องถนน ผู้ป่วยที่ได้รับอุบัติเหตุทางตาทุกชนิดที่มีระดับการมองเห็น 20/400 หรือดีกว่ามีจำนวน 62 ตา หรือ ร้อยละ 65.96 และมีผู้ป่วยสูญเสียการมองเห็น จำนวน 6 ตา หรือ ร้อยละ 6.39 การติดเชื้ออักเสบเป็นหนองของลูกตาพบได้ร้อยละ 6.25 ตาที่ได้รับอุบัติเหตุจากของมีคมแทงทะลุ โดยมีเศษโลหะฝังค้างในตา มีโอกาสมองเห็นดีกว่าผู้ป่วยที่ได้รับอุบัติเหตุจากสาเหตุอื่น จากจำนวนได้รับอุบัติเหตุ ดังกล่าว 38 ตา พบว่ามีผู้สามารถมองเห็นในระดับ 20/70 หรือ ดีกว่า คิดเป็นร้อยละ 60.53 ผู้ป่วยที่จอประสาทตาหลุด ลอกก่อนได้รับการรักษามี จำนวน 52 ตา และหลังให้การรักษาอัตราการติดกลับของจอประสาทตาพบร้อยละ 78.18 โดยที่สามารถมองเห็นได้ที่ระดับ 20/400 หรือ ดีกว่า คิดเป็นร้อยละ 56.36 จำนวนตาที่ไม่มีจอประสาทตาหลุดลอก มาก่อนแต่ได้ป้องกันโดยสายรัดรอบลูกตา พบว่าเกิดจอประสาทตาหลุดลอกหลังทำผ่าตัดครั้งแรก มีจำนวน3ตา คิดเป็นร้อยละ 3.19 สาเหตุหลักของการมองเห็นได้ที่ระดับต่ำกว่า 20/400 คือ การที่จุดรับภาพถูกทำลาย การเกิดจอประสาทตาหลุดลอกโดยมีพังผืดร่วมด้วย การเกิดอันตรายต่อประสาทสมองคู่ที่สองและการที่ขั้วประสาท ตาได้รับความกระทบกระเทือน*
สรุป: *การผ่าตัดน้ำวุ้นตาและใช้สายรัดลูกตาโดยรอบเป็นวิธีการรักษาตาที่ได้รับอุบัติเหตุที่ได้ผลดี โดยเฉพาะในตาที่มีจอประสาทตาหลุดลอก หรือเพื่อป้องกันการหลุดลอกของจอประสาทตาในเวลาต่อมาได้*