RISK FACTORS FOR SCLERAL BUCKLE REMOVAL: A MATCHED, CASE-CONTROL STUDY

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ABSTRACT

Purpose: To identify preoperative, perioperative, and postoperative risk factors for scleral buckle (SB) removal.

Methods: A retrospective, consecutive, matched, case-control study. Cases included all patients undergoing SB removal between 1988 and 2007 at a single academic center. Case patients were matched against 4 randomly selected control patients who underwent SB implantation during the same year as the case patients. Odds ratios (ORs) were calculated for each factor investigated.

Results: Forty cases of SB removal and 148 matched control cases were identified. Three cases of SB removal were omitted from analysis because of incomplete records. Factors associated with SB removal for any reason, according to univariate analysis, included concurrent globe-penetrating injury at the time of SB placement (OR, 24; 95% confidence interval [CI], 2.9-200), concurrent pars plana vitrectomy (PPV) (OR, 17.3; CI, 4.9-61), diabetes mellitus (DM) (OR, 7.3; CI, 1.8-30), prior long-term topical ocular therapy (OR, 4.3; CI, 1.7-11), and subsequent ocular procedures (OR, 3.4; CI, 1.5-7.5). Factors independently associated with SB removal according to multivariate analysis included concurrent globe-penetrating injury (OR, 27.3; CI, 1.7-426), concurrent PPV (OR, 11.3; CI, 2.9-45), DM (OR, 8.9; CI, 1.3-58), and subsequent ocular procedures (OR, 3.9; CI, 1.4-11). Factors that did not alter SB removal risk included patient age; sex; and type, size, or location of buckling elements used.

Conclusions: Awareness of these risk factors may be valuable for the surgical planning of retinal detachment repair in patients at higher risk for subsequent SB removal and for risk stratification subsequent to SB implantation.

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INTRODUCTION

Scleral buckle (SB) placement remains a common procedure in the management of rhegmatogenous retinal detachment (RD). Rarely, SBs can be associated with complications and require removal in 1% to 24% of cases.[1-9] Reported indications for SB removal are numerous and include SB exposure, SB extrusion, migration of SB elements,[4-15] intrusion of SB,[13,16-20] infection,[2,6-8,10,13] chronic pain, inflammation, foreign body sensation,[3,6,7,9,13,14,21] strabismus and diplopia,[6-9,10,11,14,21] recurrent subconjunctival hemorrhage,[3] macular distortion,[3] impingement of the optic nerve,[3] swelling of buckle elements,[11,21] granuloma,[10,11] sudden loss of vision,[14] and cutaneous extrusion.[22] Removal of buckling elements is a significant event, as it can result in scleral perforation,[11,14] endophthalmitis,[14,23] and recurrent RD in 0% to 34% of cases.[1-3,6-8,10,11,13,14,24,25] Although prior studies have investigated complications of SB removal,[2-5,8-11] we are not aware of any recent large case-control study on risk factors for SB removal.

In this report, we attempt to identify preoperative, perioperative, and postoperative factors associated with SB removal using a large retrospective, matched case-control study. Factors analyzed included age, sex, the presence of systemic conditions such as diabetes mellitus (DM) or rheumatologic diseases, the location of the SB sleeve, type and size of buckling elements used, prior ocular therapies, and prior or subsequent ocular surgeries.

METHODS

A retrospective, matched, case-control study of all patients undergoing SB removal at the Medical College of Wisconsin between 1988 and 2007 was performed. Institutional Review Board (IRB) approval was obtained; informed consent was waived by the IRB. Cases were identified using hospital billing records and surgical logs of 4 surgeons (T.B.C., D.P.H., J.E.K., W.J.W.). Possible control patients were likewise identified from hospital billing records and surgical logs of the same surgeons. The control cohort was generated by randomly identifying patients who underwent SB placement in the same year using random number lists. As an example, consider a case that underwent SB removal in 2003 but whose SB was originally implanted in 1994. This case would therefore be matched with 4 cases undergoing SB placement in 1994. Because of the relatively low incidence of SB removal, a 4:1 ratio of controls to cases was used to increase the statistical power of the analysis.

All cases were reviewed for the following: patient age at time of SB removal; sex; involved eye; ocular comorbidities, including prior or interim ocular diagnoses and procedures; prior use of topical ophthalmic medications for greater than 30 days (other than that used for brief periods after routine ophthalmic surgery); medical comorbidities, including DM and rheumatologic diagnoses; presence and type of concurrent trauma at the time of initial RD repair; date of SB placement; concurrent procedures performed at time of SB placement; the material and type of SB; the number and type of sutures used to secure the SB elements; the primary reason for SB removal, including presence of signs of infection and exoplant exposure; clinical course following SB implantation, including subsequent ocular procedures; the date of last follow-up; and anatomic status of the retina at that visit. Data for control patients obviously did not include information for a SB removal procedure. Prior long-term use of topical ophthalmic medication was analyzed in 2 ways. The first included prior medications used in the operated eye for greater than 30 days for any reason, and the second included prior medications used in the operated eye for greater than 30 days for purposes other than routine postoperative care; artificial tears were not included in either group. Attempts were made to contact control patients at their last known residence to confirm that they had not undergone SB removal elsewhere.

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The data were compiled in Microsoft Excel (Microsoft Corporation, Redmond, Washington) and subsequently imported into SPSS version 14.0 (SPSS Inc, Chicago, Illinois). Analysis of data was performed in a matched fashion using the Cox regression function of SPSS to create conditional logistic regression models.[26] Outcomes used in the logistic regression analysis included SB removal for any reason, SB removal for exposure, and SB removal for a preoperative diagnosis of SB infection. Both univariate and multivariate models were constructed. The odds ratios (ORs) for potential risk factors were calculated and are reported with 95% confidence intervals (CIs). Forest plots of ORs were constructed using GraphPad Prism version 5 (GraphPad Software, San Diego, California).

RESULTS

Forty cases of SB removal were identified. Three were omitted from analysis because of incomplete medical documentation. The characteristics of the remaining 37 cases are summarized in Table 1. The primary indications for SB removal were exposure without clinical infection (n = 16, 43%), clinical infection without exposure (n = 6, 16%), clinical infection with exposure (n = 6, 16%), chronic irritation (n = 5, 14%), migration without exposure (n = 2, 5%), glaucoma requiring shunt placement (n = 1, 3%), and inhibition of the growth of the eye (n = 1, 3%). The diagnosis of "clinical infection" was made by the evaluating physician on the basis of symptoms and clinical examination. The characteristics of the 148 controls are also summarized in Table 1. Twenty-eight control patients were successfully contacted and confirmed to be controls (28 of 148, 19%).

TABLE 1. CHARACTERISTICS OF PATIENTS UNDERGOING SCLERAL BUCKLE (SB) REMOVAL AND CONTROLS

FACTOR	GROUP UNDERGOING SB REMOVAL (n = 37)			CONTROL GROUP (n = 148)		
	MEAN	RANGE	SD	MEAN	RANGE	SD
Age at SB implantation	48.8 yr	3 mo-84 yr	23.1 yr	55.1 yr	3 mo-93 yr	19.1 yr
Age at SB removal	53.3 yr	8 mo-90 yr	21.2 yr	N/A	N/A	N/A
Time from implantation to removal	54.7 mo	2.5-202 mo	58.4 mo	N/A	N/A	N/A
Operative eye	18 right 19 left			74 right 74 left		
Sex	14 women 23 men			58 women 90 men		

N/A, not applicable.

Patients with any previous long-term use of topical medication, including routine postoperative care for prior ocular procedures, included 11 cases and 14 controls. Patients with prior long-term topical medication use for other than routine postoperative care included 6 cases and 10 controls. In the latter case, medications included Lotemax, Alphagan, Tobradex, Zaditor, Opcon-A, Trusopt, Xalatan, Restasis, Timoptic, Travatan, Betimol, Blephamide, and Flarex for conditions such as glaucoma, allergic conjunctivitis, recurrent episcleritis, recurrent infections, dry eye, and blepharitis.

SCLERAL BUCKLE REMOVAL FOR ANY REASON

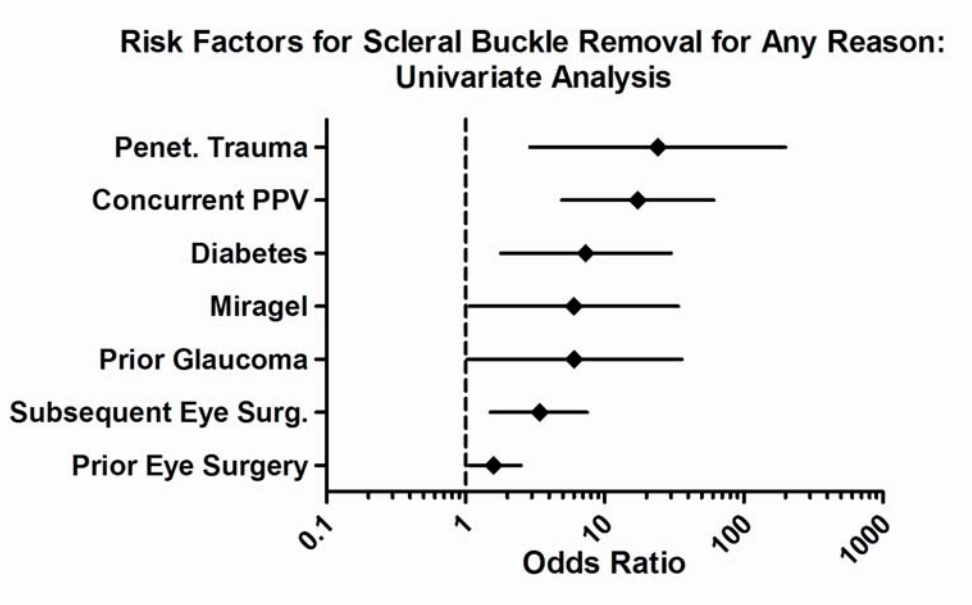
By univariate analysis, statistically significant risk factors of SB removal for any reason included DM, prior long-term topical ocular therapy, prior diagnosis of glaucoma, prior ocular surgery, traumatic etiology of initial RD—especially penetrating or perforating trauma—concurrent pars plana vitrectomy (PPV), use of Miragel implants, and subsequent ocular procedures, including cataract extraction. Relative magnitudes of effect for these factors are displayed on a single forest plot for visual comparability in the Figure. Additional factors not found to be statistically significant are listed in Table 2. By multivariate analysis, factors independently associated with SB removal included concurrent globe-penetrating injury at the time of initial RD, DM, subsequent ocular procedures, and concurrent PPV (Table 3).

SCLERAL BUCKLE REMOVAL FOR EXPOSURE

By univariate analysis, factors significantly associated with SB removal for exposure included DM, prior long-term topical ocular therapy, prior cataract extraction, traumatic cause of initial RD, concurrent PPV, and subsequent ocular procedures (Table 2). By multivariate analysis, factors independently associated with SB removal included prior long-term topical ocular therapy, DM, concurrent globe-penetrating injury at time of initial RD, and concurrent PPV (Table 4). The composition and extent of buckling elements in this group of patient are detailed in Table 5.

SCLERAL BUCKLE REMOVAL FOR INFECTION

By univariate analysis, factors significantly associated with SB removal for infection included concurrent PPV and subsequent cataract extraction (Table 2), both of which remained independent predictors by multivariate analysis (Table 6).



FIGURE

Univariate forest plot of risk factors for scleral buckle removal showing odds ratios and associated 95% confidence intervals for risk factors that were statistically significant by univariate analysis. PPV, pars plana vitrectomy.

TABLE 2. RISK FACTORS FOR SCLERAL BUCKLE REMOVAL FOR ANY REASON: UNIVARIATE ANALYSIS

	REMOVAL FOR ANY REASON (37 Cases, 148 Controls)		REMOVAL FOR EXPOSURE (22 Cases, 88 Controls)		REMOVAL FOR INFECTION (12 Cases, 48 Controls)	
FACTOR	**OR***	**95% CI**	**OR***	**95% CI**	**OR***	**95% CI**
Age at implantation (per each additional year)	0.99	0.97-1.003	1.00	0.98-1.03	1.0	0.97-1.03
Rheumatologic disease	4.0	0.6-28	8.0	0.73-88	ND†	
Diabetes mellitus	7.3	1.8-30	8.0	1.47-44	ND†	
Prior diagnosis of glaucoma	6.0	1.03-36	4.0	0.25-64	ND†	
Prior long-term topical ocular therapy	4.3	1.7-11.0	6.2	1.8-21.3	3.3	0.79-13.8
Prior long-term topical ocular therapy excluding routine postoperative medications	2.8	0.92-8.64	2.0	0.42-9.8	1.0	0.07-13.7
Any prior ocular surgery	1.6	1.06-2.5	1.9	0.96-3.6	0.45	0.09-2.3
Prior cataract extraction, any time	1.8	0.81-3.9	2.9	1.07-7.6	0.28	0.03-2.4
Prior cataract extraction, before 1992	0.73	0.20-2.64	1.0	0.21-4.7	0.04	0.00-101
Prior cataract extraction, after 1995	2.57	0.67-9.8	7.0	1.25-39.0	2.45	0.14-43
Any traumatic etiology of detachment	11	2.8-40	20.0	2.3-171	2.7	0.45-16
Blunt trauma	4.0	0.56-28	4.0	0.25-64	2.0	0.18-22
Perforating or penetrating trauma	24	2.9-200	ND†		4.0	0.25-64
Scleral buckle elements						
Silicone sponge	0.78	0.22-2.8	1.5	0.39-6.0	1.6	0.28-8.9
Tire	0.59	0.25-1.4	0.72	0.23-2.24	0.53	0.91-3.1
Temporal location of sleeve	1.8	0.55-5.6	2.3	0.50-10.4	0.49	0.046-5.2
Miragel	6.0	1.06-34	1.4	0.12-16.4	ND†	
Concurrent vitrectomy	17.3	4.9-61	16	3.4-75	10	1.9-52
Any subsequent ocular procedure	3.4	1.5-7.5	3.3	1.2-9.1	3.6	0.90-14
Subsequent cataract extraction	3.6	1.04-13	5.0	0.82-31.0	12	1.25-115

CI, confidence interval; ND, no data; OR, odds ratio.

*****Reference group for determination of ORs is always the group without the listed factor. For example, the OR of patients with diabetes mellitus of 7.3 for removal for any reason means that patients with diabetes are 7.3 times as likely as patients without diabetes to have undergone scleral buckle removal.

†The conditional logistic regression procedure did not converge, and thus no model was constructed for this factor and outcome.

TABLE 3. RISK FACTORS FOR SCLERAL BUCKLE REMOVAL FOR ANY REASON: MULTIVARIATE ANALYSIS

FACTOR	ODDS RATIO	95% CONFIDENCE INTERVAL
Diabetes mellitus	8.9	1.3 - 58
Perforating or penetrating traumatic etiology	27.3	1.7 - 426
Concurrent vitrectomy	11.3	2.9 - 45
Any subsequent ocular procedure	3.9	1.4 - 11

TABLE 4. RISK FACTORS FOR SCLERAL BUCKLE REMOVAL FOR EXPOSURE: MULTIVARIATE ANALYSIS

FACTOR	ODDS RATIO	95% CONFIDENCE INTERVAL
Prior long-term topical ocular therapy	3.5	1.1 - 11.2
Diabetes mellitus	4.7	1.02 - 21.2
Perforating or penetrating traumatic etiology	9.8	1.6 - 61.0
Concurrent vitrectomy	4.9	1.4 - 16.7

TABLE 5: SCLERAL BUCKLE COMPOSITION FOR CASES OF EXPOSURE AND THEIR MATCHED CONTROLS

	CASES (n = 22)	CONTROLS (n = 88)
Encircling band alone	7	35
Encircling band with tire	9	40
Encircling band with sponge element	2	7
Miragel composition	1	3
Details unknown	3	3

TABLE 6: RISK FACTORS FOR SCLERAL BUCKLE REMOVAL FOR INFECTION: MULTIVARIATE ANALYSIS

FACTOR	ODDS RATIO	95% CONFIDENCE INTERVAL
Subsequent cataract extraction	38.9	2.3 - 656
Concurrent vitrectomy	23.7	2.64 - 213

TRAUMATIC DETACHMENTS

The significant association of SB removal for RDs due to traumatic causes merits further details. Of 37 case patients, 8 had a history of trauma at the time of the initial RD, which prompted SB placement. Six of these were penetrating injuries: one from a screwdriver; one from a beer bottle; one scleral laceration from a blow of the fist and glass causing scleral laceration 3 mm posterior to the limbus, extending 11 mm posteriorly; one from needle perforation of the sclera at the time of cataract extraction; one from a dog bite injury causing corneoscleral laceration; and one from pliers striking the unprotected eye, causing scleral laceration just posterior to the inferonasal limbus with injury to the iris, ciliary body, and lens, vitreous hemorrhage, and a macular puncture. The other 2 traumatic causes were blunt injuries, one of which was a closed fist and the other a motor vehicle accident.

Of 148 control patients, 3 had a history of trauma at the time of initial RD: one was a perforating injury of projectile glass fragments causing a 3.5-mm full-thickness scleral laceration and associated laceration of the medial rectus muscle, and the other two were blunt trauma by blows with closed fists.

Pain was present in 24 of 36 patients (67%) undergoing removal for any reason (excluding 1 patient who was 6 months old at the time of buckle removal), and 11 of 22 patients (50%) undergoing SB removal for exposure.

DISCUSSION

This study attempts to identify preoperative, perioperative, and postoperative risk factors for SB removal following placement for RD. Although prior reports in this area include case series studies,[11] retrospective studies,[2-4,8-10] and prospective cohort studies of patients undergoing SB implantation with subsequent SB removal,[5] we are not aware of any recent large case-control studies on this topic. The only large case-control study in the literature is from Ulrich and Burton,[2] 34 years ago, in which they studied 878 eyes that underwent SB implantation, 37 of which underwent subsequent SB removal for infection.[2] Our report was designed as a matched, retrospective case-control study using a 4:1 control-to-case ratio to maximize the ability to identify risk factors for SB removal. The data were analyzed with the end points of removal for exposure and infection, as well as removal for any reason.

Similar to Ulrich and Burton's case-control study from 1974,[2] our study confirmed subsequent ocular procedure as a risk factor for SB removal. Interestingly, we further identified subsequent cataract extraction surgery as a risk factor for SB removal due to SB infection (Tables 2 and 6). The mechanism by which subsequent ocular surgery or cataract extraction places an eye at risk for SB removal is unclear, but it may involve inflammation and microtrauma damaging the conjunctiva and jeopardizing the integrity of the ocular surface. To our knowledge, increased risk of SB removal following cataract surgery has not been reported in the literature. Specifically, no cases of SB removal were described in recent reports of extracapsular cataract extraction following SB for RD.[27-30] However, this is not surprising given the relatively low frequency of SB removal and the fact that SB removal may have occurred outside the follow-up interval.

This study was unable to differentiate the risk of SB infection due to extracapsular cataract extraction without phacoemulsification as compared to cataract extraction with clear-cornea phacoemulsification, since many eyes underwent cataract surgery outside of our facility and information on surgical technique was limited. The vast majority of eyes that underwent cataract extraction after SB placement had the cataract surgery after 1996, which would have likely been within the era of clear-cornea phacoemulsification. However, it may be incorrect to assume that clear-cornea phacoemulsification is associated with less risk of SB removal due to exposed SB elements. When we considered patients who underwent cataract extraction *prior to* SB placement, we found an excessive risk for patients having undergone cataract extraction after 1996 (OR, 7.0; 95% CI, 1.25-38.8) compared to patients undergoing cataract extraction prior to 1992 (OR, 1.0; 95% CI, 0.21-4.71). Considering that clear-cornea phacoemulsification was likely performed after 1995 and not before 1992, it would seem that clear-cornea phacoemulsification is a risk factor, even though the conjunctiva is not typically grossly traumatized. This analysis may be biased by a closer proximity of cataract extraction to SB placement in the post-1996 group, however.

In this study, several other risk factors for SB removal were identified that have not been previously described in the literature, including concurrent globe trauma at the time of RD, prior long-term topical ocular drop therapy, DM, concurrent PPV, prior ocular surgery, and history of glaucoma. While the mechanisms of action for these factors are also unclear, it is interesting that all can influence the integrity of the ocular surface. The association of SB removal with trauma and penetrating injury at the time of SB placement raises the possibility of bacterial contamination. The microbiologic spectrum of organisms identified from the explanted buckles in this study will be discussed in a separate manuscript. The association of DM with SB removal is not surprising, since these patients frequently demonstrate altered wound healing and reduced resistance to infection.

Concurrent PPV is one factor that was clearly associated with all 3 outcomes in this study (SB removal for any reason, SB exposure, and SB infection) using both univariate and multivariate analysis (Tables 2, 3, 4, and 6). Although concurrent PPV has not been formally described as a risk factor for SB removal previously, the possibility for this association was raised in a prior study.[8] In 2006, Brown and colleagues[8] observed that in a series of 840 patients undergoing RD repair (380 patient with SB alone, 460 patients with SB and concurrent PPV), all 6 patients who required SB removal underwent concurrent PPV at the time of their SB placement. It remains unclear whether concurrent PPV increases the risk for SB removal through a mechanism similar to that for other ocular surgeries as described above or through a different pathophysiologic mechanism. We recognize that concurrent PPV at the time of SB placement increases the surgical time and produces greater manipulation of the sclera and conjunctiva. Possible confounding factors include more severe eye injury at the time of RD or a more complex RD requiring perfluorocarbon liquid or silicone oil.

The only risk factor for SB removal regarding type of SB implant in this study was Miragel composition (OR, 6.0; 95% CI, 1.06-34). This finding is not surprising given reports of frequent SB complications and SB removal with Miragel implants.[11] In this study, we did not identify an increased risk for SB removal with the use of larger SB elements, with the use of silicone sponge implants, or following the placement of the SB sleeve in the temporal quadrant for connecting the SB ends, as suggested in prior studies.[3,10] We cannot clearly explain why this study did not reaffirm these previously identified risk factors but question whether it may be due to differences in surgical technique. This series did not have any patients receiving intrascleral implants.

Weaknesses of this study include its retrospective nature, the involvement of only one surgical center, and the remote possibility that some patients in the control group underwent SB removal at another facility. Measures to limit this last factor involved calling all control patients to confirm that they had not undergone SB removal. While all those responding were confirmed to still possess their SB, unfortunately only 19% of patients (28 of 148) responded. This low response rate likely relates to the long period of elapsed time since SB implantation for most patients. In this study, measures to limit the bias from the retrospective nature included matching cases

to controls that underwent SB implantation during the same year, studying only cases with sufficient medical documentation available, and developing a factor list and analysis methodology a priori. We do not believe a selection bias for advanced cases of SB infection or SB exposure requiring SB removal was present, since all cases of SB infection or SB exposure are invariably treated with SB removal at our institution. This study was not designed to investigate the outcomes of SB removal.

In conclusion, this investigation suggests that DM, prior long-term topical ocular therapy, traumatic cause of RD (especially concurrent globe-penetrating trauma at time of initial RD), concurrent PPV, and subsequent ocular procedures, including cataract extraction, increase the risk of subsequent SB removal. We hope that this information will enable clinicans to further reduce the incidence of SB removal. In particular, the information from this study may be valuable for surgical planning of RD repair in patients at high risk for subsequent SB removal, especially in those patients sustaining RD from traumatic causes. It is also helpful for stratifying patients according to nonmodifiable risk factors, such as DM, prior long-term topical ocular therapy, and a traumatic cause of RD, toward more frequent follow-up visits and more aggressive education on symptoms and signs of SB exposure or infection.

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Conformity with Author Information: The Medical College of Wisconsin Institutional Review Board approved this investigation (informed consent was waived by the IRB); this study was HIPAA compliant.

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PEER DISCUSSION

DR. C. P. WILKINSON: Extruding, eroding, infected scleral buckles are well-known complications of retinal reattachment surgery. In this study, the authors attempted to identify risk factors for buckle removal. They studied 37 cases in which silicone elements were removed, although the total number of scleral buckling cases performed over this 19-year period is not stated. The average post-op time of buckle removal was over 4 ½ years, with a huge standard deviation.

In the text, several reasons for removal are stated and include exposure without infection in 43%; infection with or without exposure in 32%; and irritation in 14%. However, when the statistical methodologies were applied, three modified designations were employed, including removal for "any reason"; for "exposure"; and for "infection".

Trauma, concurrent vitrectomy, subsequent surgery, diabetes, and chronic drop usage were demonstrated to be risk factors for buckle removal in both univariate and multivariate analyses. However, the multivariate analyses were not completely consistent. Only concurrent vitrectomy had odds ratios that were statistically significant in all 3 categories of reasons for removal. And there were striking differences in the mean odds ratios, especially with regard to subsequent surgery.

Statistics indeed can be a lot like bikinis in revealing certain things but obscuring others, and there may be some important information in this report that remains concealed.

The 4:1 matching of controls might be questioned if a gigantic number of patients had buckling procedures performed during the 19-year period. In addition, raw numbers of patients in several of these categories are missing. In particular, the numbers of patients undergoing subsequent cataract surgery and vitreous surgery for trauma are not stated.

Data collected in regard to buckling included the use of sponge or tire, temporal location of the silicone sleeve, and the use of Miragel. But many important variables were not studied, including the extent and location of the buckle, its size, and the types of peritomies that were performed. These are important variables that have previously been linked to threat of extrusion.[1,2] For instance, most would agree that an anterior full-thickness segmental sponge is much more likely to extrude and/or become infected than an encircling silicone band located at the equator.

I will conclude by asking 4 questions:

- During the 19 years in which data were collected, how many buckling procedures did this group perform?
- Secondly, how many eyes in the study and control groups had subsequent cataract surgery?
- Third, over what range of time following cataract surgery were buckles removed?
- Finally, How do you determine if an exposed buckle is infected or not?

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DR. WILLIAM H. JARRETT, II: I have no conflict of interest of any kind. I echo Pat Wilkinson's comments about the frequency of this occurrence. What percentage of total cases of scleral buckle procedures required removal of these elements? No mention was made whether or not recurrent detachments occurred when the elements were removed. That is certainly a consideration which should be in there. I was taught that what became infected was not the silicone, but the sutures that were holding it to the sclera. It was important to remove every suture inserted at the time of surgery. Rarely would we see intrusion of an encircling silicone band through the choroids and into the vitreous cavity, and neither was that finding mentioned. Finally, I cannot resist telling you that my beloved partner and good friend Billy Hagler used to say that in our early years, we would probably put these things in eyes and spend our later years taking them out. Thank you.

DR.RICHARD P. MILLS: No relevant conflicts. I noticed that among your possibilities for extrusion, inadequate conjunctival closure was not mentioned. Glaucoma surgeons harbor the belief that retina surgeons show insufficient care in closing the conjunctiva.

DR.VINOD LAKHANPAL: No conflict of interest. In terms of the last comment, I remember that in the earlier part of my training, we used to close the conjunctiva and Tenon's capsule after scleral buckling surgery in two separate layers. Ron Michaels told me that this was not a good idea because you produced adhesive syndromes and double vision in these patients, so I started closing only the conjunctival incision. My question relates to the 12 infections that you reported. What types of implants were removed from these infected eyes? Were they sponge or solid silicone materials? In my experience, and I perhaps I have had an isolated experience, I have observed a higher incidence of removal of infected sponges than solid silicone materials. Knowing the type of encircling material that was used for buckling in these infected eyes would help us to know a little more about the condition. I would also like to know if some of the removed buckles were small localized exoplants. There was a trend to use small radial sponges to reattach the retina for the treatment a single solitary tear, and those are the eyes that I used to have the highest rate of recurrent detachment. Of course, now with more buckling elements, we have stopped using that procedure. I would appreciate if you can comment on that.

DR. DOUGLAS J. COVERT: Thank you everyone for your comments regarding this paper. I will start with Dr. Wilkinson's comments. The huge standard deviation that he commented on, regarding the time of scleral buckle removal, is actually one of the interesting findings of the study. It implies that there is not a single point in time after which you reduce your risk, or eliminate your risk, for having your buckle removed. The outcome variables were operationalized to removal for any reason, removal for exposure, and removal for infection, because we believe these two represent the most clinically useful diagnosis in practice. Moreover, they comprise the majority of the reasons for buckle removal and allow statistically significant results to potentially be discovered. Considering other outcomes would decrease the study population dramatically. In the subtype analysis, subsequent ocular surgery is the risk factor that contained bias. He mentioned that he was concerned about the changes in the absolute numbers for subsequent ocular surgery and that may be related to the follow-up bias that I mentioned. Fortunately that is the only risk factor that is susceptible to follow-up bias. Regarding the bikini comment, we designed the study to assess all potential risk factors that could be accurately and reliably determined from a retrospective chart review. As I mentioned, but did not stress, all patients underwent 360º circumferential buckling and the use of accessory elements varied. Factors we could not reliably determine from the chart review were not considered, such as the anterior or posterior location of the buckling elements and the type of conjunctival closure. We would relate the fact that the conjunctival peritomies were completely circumferential, 360º, for the inclusion of the 360º band. We did investigate the width and thickness of the buckling elements, and the use of silicone sponge elements, tires, and accessory elements, but none of them were determined to statistically influence the risk of buckle removal for any of the outcomes.

To answer Dr. Wilkinson's specific questions, the study was not designed to assess the incidence of scleral buckle removal, and knowing this number would not impact the validity of our findings. Even if there were a very large number of scleral buckles being placed, then that would underscore the importance of having a smaller retrospective study, rather than the entire prospective study. I will note; however, the faculty coauthors performed 1,560 scleral buckle procedures at our facility during this time period. Four study patients and five control patients underwent subsequent cataract extraction, and the time of cataract surgery range from four months to five years after buckle removal. The preoperative diagnosis of infection was based on clinical signs and symptoms, including pain, discharge, redness, and edema. The diagnosis was obtained from the chart, by looking for that specific wording. Culture results were not used to determine the preoperative clinical diagnosis of infection.

Regarding Dr. Jarrett's comments, the frequency of occurrence was not the primary reason for proceeding with the study. Other studies have examined that finding, but our incidence of scleral buckle removal is consistent with prior reports. Determining the recurrent reattachment rate was also not the primary reason for doing the study. I will note that 1 of 37 did undergo re-detachment after the buckle had been removed. That patient had PVR at the time it was decided to remove the buckle.

Regarding the suture comment, the number of sutures that had been removed was assessed and was not determined to be a risk factor for scleral buckle removal. During the removal of the encircling elements, all sutures were removed. No mention in the operative notes or clinical records indicated that any of the buckles had eroded into the vitreous cavity.

Regarding Dr. Mills' comments about conjunctival wound closure, I will be careful with the conjunctiva in the future.

Dr. Lakhanpal mentioned that the type of material, sponge versus solid silicone, was an important consideration in prior studies; however, in this study that was not the case. The raw data for all these factors are presented in the paper. No segmental or localized implants were removed. Thank you for your attention and comments.