Published in final edited form as:

Ophthalmol Plast Reconstr Surg. 2017 ; 33(1): 61–64. doi:10.1097/IOP.0000000000000652.

Compliance with Protective Lens Wear in Anophthalmic Patients

Michael G. Neimkin, MD^{1,2} and Philip L. Custer, MD, FACS¹

¹Washington University in Saint Louis, Department of Ophthalmology and Visual Sciences

²Ophthalmic Plastic and Cosmetic Surgery Inc. Des Peres, Missouri

Abstract

Purpose—To evaluate the frequency of protective lens wear by anophthalmic patients and identify factors that influence compliance.

Methods—An IRB approved descriptive retrospective chart review of patients undergoing surgery with the senior author (PLC) with an anophthalmic orbit and one remaining sighted eye. Results were tabulated and analyzed using age, indication for procedure, duration of visual symptoms, safety glasses wear, number of post-operative visits, and evidence of new trauma to the remaining eye. All patients underwent counseling on the importance of protective lens wear preoperatively and each subsequent visit.

Results—Etiologies for loss of the eye in the 132 study patients included trauma (33.3%), blind painful eye (33.3%), congenital disorders (14.4%), adult-onset malignancy (14.4%), and retinoblastoma (4.5%). At the final visit, protective lenses were worn in the following patterns: full-time (55.3%), frequently (11.4%), occasional (6%), and never (28.8%). The regular use of protective eyewear at last visit was more common in patients wearing glasses at presentation (79.7%), than in those who did not (32.9%) ($p < 0.001$). Increased number of office encounters correlated with more frequent use of protective eyewear ($p < 0.01$). Patient age ($p = 0.95$), indication for surgery ($p = 0.97$), and duration of visual loss ($p = 0.85$) were not predictive of safety glasses wear. 3 patients had evidence of subsequent ocular trauma to the remaining eye, with 2 having resultant decrease in acuity; none of these 3 patients wore safety glasses full-time.

Conclusions—A significant number of anophthalmic patients were not wearing protective lenses at presentation. Overall compliance was poor; but repeated education on the importance of safety glasses appears to improve compliance. Educating referring providers and primary care physicians about the importance of early and repeated counseling is vital to increasing compliance.

Corresponding Author: Michael G. Neimkin M.D., 12990 Manchester Road, Suite 102., Saint Louis, MO. 63131, (205) 222 2611
mgneimkin@gmail.com.

Relevant Financial Disclosures

Michael Neimkin MD- None

Phil Custer- None

Financial Disclosures:

Michael G Neimkin MD: none

Philip L. Custer MD, FACS: Equity Stock Ownership: Pfizer, Johnson and Johnson (unrelated to manuscript)

Introduction

The frequency, debilitating nature, and impact of eye injuries are well reported in the literature. According to the World Health Organization (WHO), over 55 million eye injuries occur annually. From these, 1.6 million people worldwide are bilaterally blind and 19 million more are either monocular or have low vision; including an estimated 700,000 in the United States (U.S.) alone.^{1,2} The American Academy of Ophthalmology (AAO) has reported over one million eye injuries occur in the U.S. yearly, more than 90% of which are preventable with proper safety precautions, which include full-time use of protective safety lenses.³

Fortunately, monocular patients experience a recalibration of the spatial process system that helps adaptation and ability to function with one working eye.⁴ This allows these individuals to adapt well with function and quality of life that rivals their binocular counterparts.⁵ However, the reduction of visual field and loss of depth perception increases the risk of a future traumatic injury compared to individuals with normal binocular acuity.⁶ Further injury to the remaining sighted eye severely reduces quality of life and ability to function^{6,7}; thus making the use of protective lensed paramount in monocular individuals.

While many studies have investigated the nature of ocular trauma and behavioral alteration to reduce its incidence⁷, there are no published studies examining compliance with and factors that influence monocular precautions. We sought to investigate factors that led to anophthalmos (and thus monocular status), frequency of compliance with monocular safety precautions, factors that affected compliance, and the effectiveness of frequent educational counseling for anophthalmic patients.

Methods

An IRB approved, a single-center, retrospective chart search was conducted of the senior author's (PLC) previous surgical procedures for patients who underwent either: enucleation, evisceration, exenteration, or anophthalmic socket. All patients included were either: anophthalmic at the time of presentation, or underwent an eye removal procedure. Other inclusion criteria consisted of: greater than hand motion (HM) vision in the remaining sighted eye, more than 1 year of follow-up from initial presentation, last follow-up appointment after January 1, 2013, and documentation of protective lens status.

One hundred thirty two (132) patients were included in the study. Information recorded include: age, indication for procedure, history of trauma, duration of visual symptoms, prescription glasses wear at presentation, safety glasses wear at presentation and last office visit, number of post-operative visits, and evidence of new trauma to the remaining eye. All patients were counseled on the benefits of protective lens wear at the initial and each follow-up visit, and asked about the frequency of protective lens wear. Patients not wearing protective lenses were asked the reason for not wearing.

The initial counseling session given to each patient on presentation included:

1. A description of impact-resistant frames and polycarbonate shatter-resistant lenses. All patients were advised to ensure their lenses are polycarbonate, or to return to their primary eye provider for a new prescription if unsure.
2. The necessity of full time protective lens wear, even at home.
3. The increased risk of injury to the sighted eye due to decreased stereopsis, depth perception and visual field.
4. The need to ensure the entire eye was covered.
5. Counseling that contact lenses are not protective against eye trauma and carry increased risk of ocular infection. Contact lens wearers were advised to consider wearing prescription polycarbonate safety glasses in lieu of contacts, or prescription-free safety glasses.
6. Any additional injury to the remaining eye might result in severe loss of function and impairment of quality of life.
7. A free pair of prescription-free polycarbonate safety glasses was dispensed to each patient.

Each patient was subsequently asked about their protective lens wear, and counseled on the criteria above each follow-up visit. Lens wear was classified as full-time (>90% of waking hours), frequently (65%–89% of waking hours), occasionally (10%–64% of waking hours), or never (<10% of waking hours).

Age was separated into 3 categories for analysis: 0–25 years old at initial presentation, 26–50 years old, and greater than 51 years old. Duration of visual loss was defined as: (1) the amount of time since eye removal in patients anophthalmic at presentation, or (2) the amount of time vision in the eye needing removal was poor, in patients referred for eye removal. This was classified as either acute (<6 months), or chronic (>6 months). P values were calculated with the Fisher exact two-tail test for 2 group comparison; and the Freeman-Halton test for multi-group contingency analysis⁸.

An online google.com search was performed from St. Louis, Missouri (Area Code 63108) in May 2015 for “online glasses retailers”. The first 10 results were then explored to identify the default lens for eyeglass purchases, and any additional fee for protective polycarbonate lenses. Only retailers that provided the option to purchase the lenses online are included.

Results

132 patients were included in the study. The benefits of protective eyewear and eye safety were typically discussed preoperatively and during each subsequent visit. Etiologies for loss of the eye included: trauma n=44 (33.3%), blind painful eye from non-traumatic causes n=44 (33.3%), congenital and pediatric disorders n=19 (14.4%), adult-onset malignancy n=19 (14.4%), and retinoblastoma n=6 (4.5%). We performed the following procedures: enucleation (n=96, 72.7%), evisceration (n=4 3.0%), exenteration (n=5, 3.8%), and socket

reconstruction (n=27, 20.5%). All patients had at least HM vision in the remaining sighted eye.

At presentation to our service, 47.1% (49/104) of the patients with chronic visual loss in the eye to be removed or anophthalmic socket (>6 months) were wearing prescription glasses, compared to 35.7% (10/28) of those with more acute disease ($p=0.19$). However, duration of visual loss did not correlate with increased use of protective lens wear ($p=0.84$, Table 1).

The study group had an average of 7.4 office encounters (range: 2–36). At the final visit, protective lenses were worn in the following patterns: full-time (55.3%), frequently (11.4%), occasional (4.5%), and never (28.8%). The regular use of protective eyewear at last visit was more common in patients wearing glasses at presentation (79.7%), than in those who did not (35.6%) ($p<0.001$).

Overall, increased number of office encounters correlated with more frequent use of protective eyewear ($p<0.01$): 20% of patients with 2–3 post-operative visits, 64.8% with 4–7 visits, 61.5% with 7–10, 57.1% with 11–15, and 83.3% with >15 visits (table 2). Comparing patients who did and did not wear glasses at presentation further corroborated this. Patients who converted from no pre-operative glasses to regular safety wear averaged more than a full office visit/counseling session more (Table 3).

Reasons for not wearing safety glasses included: good uncorrected vision (17%), aesthetics (26%), convenience (13%), and lack of concern (43%).

Patient age ($p=0.95$), indication for surgery ($p=0.97$), and duration of visual loss ($p=0.84$) were not predictive of safety glasses wear (tables 1, 3, 4 and 5). Gender did not have a statistically significant impact on protective lens wear (table 6).

Of the patients who wore glasses at presentation but did not wear protective lenses regularly post-operatively, 10/12 (83.3%) still wore glasses but denied purchasing polycarbonate safety lenses.

Post-operatively, 3 patients had evidence of subsequent ocular trauma to the remaining eye, with 2 having resultant decrease of >2 lines in Snellen acuity; none of these 3 patients wore safety glasses full-time.

50% (5/10) of the online retailers identified by the google.com search included polycarbonate lenses as the default lens. The other 50% (5/10) included CR-39 plastic lenses as the default; with additional charge for polycarbonate lenses. The additional charge averaged \$21.60 (range \$9.00–\$59.00, table 7).

Discussion

The emotional, economic and functional consequences after traumatic ocular injury are widely reported.^{1,2,5,9–14} In binocular patients that experience a loss of acuity in one eye, the visual pathway's plasticity allows recalibration of the spatial processing system, which promotes adaptation to monocular functioning. Furthermore, the up-recruitment of cross-modal systems enhance function.⁴ This allows monocular patients to have comparable

physical and mental health scores to binocular patients, despite some limitation in visual function.⁵

Despite safety recommendations, eye injuries remain a leading cause of monocular blindness.¹⁵ Since the passage of the Occupational Safety and Health Act (OSHA) in 1970, protective lens wear is required in work circumstances that present a reasonable chance of ocular injury. Protective lenses are required to be provided by the employer, while it is the employees' responsibility to wear the lenses.^{15,16} However, the rate of noncompliance is significant and frequency of eye injuries is striking. In 1999, almost 280,000 work-related eye injuries were treated in U.S. emergency departments.¹⁷ There were 27,450 eye injuries reported in 2006 that required 2 or more days off from work.¹⁵ Noncompliance with safety recommendations is a prevailing theme amongst these work related injuries. A UK study revealed protected lens wear was not worn in 80% of ocular injuries amongst fireman.¹⁸ OSHA estimates 90% of eye injuries in the US are preventable by proper use of protective eyewear.¹⁶

While the statistics regarding work-related injuries are most readily available, it is important to recognize there are many other dangerous activities with high rates of ocular trauma. The pediatric population has a high rate of ocular injuries that has been reported with an annual incidence of 15.2/100,000 necessitating hospital treatments.¹⁹ Sports, projectiles such as fireworks, and airbags are amongst the most common in this population, with an estimated 90% preventability if proper safety glasses are worn.²⁰

The serious and debilitating nature of eye injuries cannot be emphasized enough. A recent Thai study reported 57% of all work-related eye injuries result in an open globe, resulting in an average best corrected visual acuity (BCVA) of 1.2 +/- 1.0 logMAR (20/320). 67% of these patients reported a lack of education of the importance of safety glasses.¹¹ Ocular trauma without a ruptured globe also has significant impact on visual function and can result in significant visual field defects despite a good measured BCVA.¹⁰ These injuries result in a significant economic burden to society and have a grave impact to the injured. OSHA estimates that occupational eye injuries have a \$300,000,000 annual cost in lost production, medical expenses and compensation.²¹ Patients with blindness or visual impairment have lower incomes, poorer overall health status, and higher overall average medical expenses.²²

As half of the US population wears prescription glasses²³, emphasizing the importance of filling their prescription with protective lenses is vital. Previous studies have demonstrated the protective benefit of polycarbonate frames far exceed other plastic and glass options.²⁴ Our patients who wear prescription lenses pre-operatively are almost three times more likely to wear protective eyewear regularly post-operatively. Logically, as there is no inherent change or learned behavior required, higher compliance among this group is not surprising. However, patients must be educated to ensure their prescription is filled with polycarbonate lenses. Of our patients who wore glasses preoperatively but did not regularly wear safety glasses post-operatively: 1/12 (8.3%) only wore readers preoperatively with 20/20 uncorrected distance vision and 10/12 (83.3%) of patients who wore glasses preoperatively but did not wear protective lenses post-operatively continued to wear glasses but did not purchase protective lenses. Thus, it is possible several of these patients actually were

wearing polycarbonate lenses, but were unaware of the default lens during their purchase. In our search, 50% of online retailers defaulted to non-polycarbonate lenses and required an additional fee for polycarbonate lenses. It can be reasonably assumed that patients are more likely to order the default lenses, without proper education.

Early initiation of counseling and initiating of protective behavior increases compliance, and is of vital importance to public health. A previous study by Drack et al. showed children <3 at the time of their initial safety lens prescription had higher compliance those at an older age. Their pediatric population also had an almost 50% rate of serious accidents that safety lenses protected the good eye.²⁵ This is in line with prior studies that have shown the ability to modulate behavior and increase the use of protective lens wear with education in patients who have sustained prior eye trauma.⁹

Our study shows a correlation between the amount of counseling sessions and the frequency of regular protective lens wear (tables 2 and 3). Amongst both patients who wore and did not wear glasses preoperatively, an increased number of office visits was found amongst patients who wore safety glasses regularly post-operatively. Our office practice of education involves recommending full time lens wear, even at home. This is important as previous studies have demonstrated that many ocular injuries occur in the home setting, which the patients may not recognize as a dangerous setting,²⁶ particularly in the monocular setting which has an inherent increased risk of trauma.

Recent literature has showed current counseling practices on the benefit of protective have significant shortcomings, as over half of the patients studied did not recall prior education before their oculoplastics clinic referral.²⁷ Although our patient population did show increased compliance after multiple in-depth counseling sessions, there were a significant number of patients who were non-compliant with our recommendations. Of our noncompliant patients, 69% attributed failure to wear full-time protective lenses as aesthetic or lack of concern; which demonstrates a patient population that may be non-responsive to counseling. However, counseling is a vital aspect of monocular patient care, as a significant percentage do increase compliance with protective lens wear after multiple counseling sessions. Therefore, it is imperative that the importance of protective eyewear counseling is emphasized to primary care physicians, optometrists, and ophthalmologists of all subspecialties. A 1992 Icelandic study showed an eye removal incidence of 1.2/100,000 persons (0.000012%).²⁸ As the prevalence of amblyopia is estimated between 2–5%²⁹; even without adding all other causes of vision loss, it can be concluded the overwhelming majority of monocular patients will not be evaluated by an oculoplastic surgeon. Therefore, a team-based approach with all providers emphasizing the importance of safety lenses is paramount to increasing compliance.

Our study is not without limitations. As a retrospective study, we are unable to verify the exact counseling each patient received. However, all patients were counseled by either the senior author (PLC), or his ASOPRS-accredited fellow to ensure standards and quality of counseling. We understand there is also an element of selection bias as all patients in our study are anophthalmic, and many have endured traumatic injuries and diagnoses that necessitate frequent office visits. Finally, interview bias cannot be neglected, as patients are

more likely to report higher than actual compliance to the physicians conducting the interview.³⁰

Acknowledgments

NIH Funding: Washington University Ophthalmology & Visual Sciences NIH/NEI Core Grant #P30EY002687

References

1. Guly CM, Guly HR, Bouamra O, et al. Ocular injuries in patients with major trauma. *Emergency Medicine Journal : EMJ*. 2006; 23(12):915–917. [PubMed: 17130597]
2. Negrel AD, Thylefors B. The global impact of eye injuries. *Ophthalmic Epidemiol*. 1998; 5(3):143–169. [PubMed: 9805347]
3. <http://development.aao.org/eyecare/treatment/eye-safety.cfm>. Retrieved on April 25, 2015.
4. Nys J, Scheyltjens I, Arckens L. Visual system plasticity in mammals: the story of monocular enucleation-induced vision loss. *Frontiers in Systems Neuroscience*. 2015; 9
5. Kondo T, Tillman WT, Schwartz TL, et al. Health-related quality of life after surgical removal of an eye. *Ophthalm Plast Reconstr Surg*. 2013; 29(1):51–56.
6. Tammila V, Tarkkanen A. Incidence of loss of vision in the healthy eye in amblyopia. *Br J Ophthalmol*. 1981; 65(8):575–577. [PubMed: 7295619]
7. Shah A, Blackhall K, Ker K, et al. Educational interventions for the prevention of eye injuries. *Cochrane Database Syst Rev*. 2009; (4):CD006527. [PubMed: 19821372]
8. FREEMAN GH, HALTON JH. NOTE ON AN EXACT TREATMENT OF CONTINGENCY, GOODNESS OF FIT AND OTHER PROBLEMS OF SIGNIFICANCE. *Biometrika*. 1951; 38(1–2):141–149. [PubMed: 14848119]
9. Blackburn JL, Levitan EB, MacLennan PA, et al. Changes in eye protection behavior following an occupational eye injury. *Workplace Health Saf*. 2012; 60(9):393–400. [PubMed: 22909223]
10. Blanch RJ, Good PA, Shah P, et al. Visual outcomes after blunt ocular trauma. *Ophthalmology*. 2013; 120(8):1588–1591. [PubMed: 23618228]
11. Chaikitmongkol V, Leeungurasatien T, Sengupta S. Work-Related Eye Injuries: Important Occupational Health Problem in Northern Thailand. *Asia Pac J Ophthalmol (Phila)*. 2015; 4(3):155–160. [PubMed: 26065502]
12. Park SJ, Park KH, Heo JW, et al. Visual and anatomic outcomes of golf ball-related ocular injuries. *Eye (Lond)*. 2014; 28(3):312–317. [PubMed: 24384962]
13. Pizzarello LD. EYE SAFETY AND THE ECONOMIC IMPACT OF EYE INJURIES DURING THE LAST CENTURY IN THE UNITED STATES. *Ophthalmology Clinics*. 12(3):297–301.
14. Schein OD, Hibberd PL, Shingleton BJ, et al. The spectrum and burden of ocular injury. *Ophthalmology*. 1988; 95(3):300–305. [PubMed: 3173996]
15. Blackburn J, Levitan EB, MacLennan PA, et al. A case-crossover study of risk factors for occupational eye injuries. *J Occup Environ Med*. 2012; 54(1):42–47. [PubMed: 22227872]
16. Lipscomb HJ. Effectiveness of interventions to prevent work-related eye injuries. *Am J Prev Med*. 2000; 18(4 Suppl):27–32. [PubMed: 10793278]
17. Xiang H, Stallones L, Chen G, et al. Work-related eye injuries treated in hospital emergency departments in the US. *American Journal of Industrial Medicine*. 2005; 48(1):57–62. [PubMed: 15940717]
18. Owen CG, Margrain TH, Woodward EG. Aetiology and prevalence of eye injuries within the United Kingdom fire service. *Eye (Lond)*. 1995; 9(Pt 6 Suppl):54–58. [PubMed: 8729022]
19. Strahlman E, Elman M, Daub E, et al. Causes of pediatric eye injuries. A population-based study. *Arch Ophthalmol*. 1990; 108(4):603–606. [PubMed: 2322164]
20. Abbott J, Shah P. The epidemiology and etiology of pediatric ocular trauma. *Survey of ophthalmology*. 2013; 58(5):476–485. [PubMed: 23969021]
21. [Accessed 08/22/2015] 2015. <https://www.osha.gov/SLTC/eyefaceprotection/>

22. Frick KD, Gower EW, Kempen JH, et al. EConomic impact of visual impairment and blindness in the united states. *Archives of Ophthalmology*. 2007; 125(4):544–550. [PubMed: 17420375]
23. Keeney AH, Fintelmann E, Estlow B. Refractive correction and associated factors in spectacle glass injury. *Arch Ophthalmol*. 1972; 88(1):2–8. [PubMed: 5049452]
24. Vinger PF, Parver L, Alfaro DV 3rd, et al. Shatter resistance of spectacle lenses. *JAMA*. 1997; 277(2):142–144. [PubMed: 8990340]
25. Drack A, Kutschke PJ, Stair S, et al. Compliance with safety glasses wear in monocular children. *J Pediatr Ophthalmol Strabismus*. 1993; 30(4):249–252. [PubMed: 8410576]
26. Bhogal G, Tomlins PJ, Murray PI. Penetrating ocular injuries in the home. *Journal of Public Health*. 2007; 29(1):72–74. [PubMed: 17090631]
27. Boss JD, Shah CT, Elner VM, et al. Assessment of Office-Based Practice Patterns on Protective Eyewear Counseling for Patients With Monocular Vision. *Ophthalmic Plastic & Reconstructive Surgery*. 2015; 31(5):361–363. [PubMed: 25393903]
28. Sigurdsson H, Thórisdóttir S, Björnsson JK. Enucleation and evisceration in Iceland 1964–1992. Study in a defined population. *Acta Ophthalmologica Scandinavica*. 1998; 76(1):103–107. [PubMed: 9541445]
29. Friedman DS, Repka MX, Katz J, et al. Prevalence of Amblyopia and Strabismus in White and African-American Children Aged 6 through 71 Months: The Baltimore Pediatric Eye Disease Study. *Ophthalmology*. 2009; 116(11):2128–2134. e2121–2122. [PubMed: 19762084]
30. Grootendorst PV, Feeny DH, Furlong W. Does it matter whom and how you ask? inter- and intra-rater agreement in the Ontario Health Survey. *Journal of clinical epidemiology*. 1997; 50(2):127–135. [PubMed: 9120505]

Table 1

Incidence of Protective Lens Wear By Duration of Visual Loss (p=0.84)

Duration of Visual Loss	Acute (<6 months)	Chronic (>6 months)	Total
Regularly Wears Protective Lenses	18	55	73
Does not Regularly Wear	13	46	59
Total	31	101	132
% Wearing Protective Lenses Regularly	58.10%	54.50%	55.30%

Table 2

Incidence of Protective Lens Wear by Number of Visits (p<0.01))

Number of Visits	<3	4-6	7-10	11-15	>15
Regularly Wears Protective Lenses	5	35	16	12	5
Does not Regularly Wear	20	19	10	9	1
Total	25	54	26	21	6
% Wearing Protective Lenses Regularly	20%	64.80%	61.50%	57.10%	83.30%

Table 3Protective Lens Wear by Preoperative Glasses Wear ($p<0.01$)

	Wore Glasses Preoperatively	Did Not Wear Preoperative Glasses
Regularly Wears Protective Lenses	47	26
<i>Average Number of Visits</i>	7.84	7.85
Does not Regularly Wear	12	47
<i>Average Number of Visits</i>	7.35	6.46
Total	59	73
% Wearing Protective Lenses Regularly	79.70%	35.60%

Table 4

Protective Lens Wear by Age (p=0.95)

Age	Age <25	Age 25–50	Age >51
Regularly Wears Protective Lenses	10	24	39
Does not Regularly Wear	8	18	33
Total	18	42	72
% Wearing Protective Lenses Regularly	55.60%	57.10%	54.20%

Table 5

Incidence of Protective Lens Wear by Indication for Surgery (p=0.32).

Indication for Surgery	Trauma	Adult Onset Cancer	Pediatric Conditions	Blind, Painful Eye
Regularly Wears Protective Lenses	25	7	16	25
Does not Regularly Wear	19	12	9	19
Total	44	19	25	44
% Wearing Protective Lenses Regularly	56.80%	36.90%	64.00%	56.80%

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 6

Incidence of Protective Lens Wear by Sex (p=0.86)

Sex	Male	Female
Regularly Wears Protective Lenses	39	33
Does not Regularly Wear	31	29
% Wearing Protective Lenses Regularly	55.70%	53.30%

The first 10 results for “online glasses retailer” from google.com in May 2015. The default lens and additional fee for polycarbonate, if applicable.

Table 7

Online Retailer	Default Frame	Polycarbonate Fee
Warbyparker.com	Polycarbonate	N/A
framesdirect.com	Polycarbonate	N/A
39dollarglasses.com	Polycarbonate	N/A
zennioptical.com	CR-39 Plastic	\$9.00
Coastal.com	Polycarbonate	N/A
glasses.com	CR-39 Plastic	\$20.00
glassesusa.com	CR-39 Plastic	\$59.00
eyeglassesdirect.com	CR-39 Plastic	\$10.00
classicspecs.com	Polycarbonate	N/A
marveloptics.com	CR-39 Plastic	\$10.00